1. Call to Order

2. Approval of the October 3, 2023 Senate Minutes (Action)

3. Report of the Chair

4. Special Order
   Amy Karlsson
   Chair, Academic Procedures & Standards Committee
   Revision to to the Final Exam Provision in the University of Maryland Policy on the Conduct of Undergraduate Courses and Student Grievance Procedure (Senate Document #21-22-11) (Information)

5. PCC Proposal to Establish a Master of Science in Data Science (Senate Document #23-24-11) (Action)

6. PCC Proposal to Establish a Master of Science in Bioinformatics and Computational Biology (Senate Document #23-24-12) (Action)

7. PCC Proposal to Establish a Master of Science in Applied Machine Learning (Senate Document #23-24-13) (Action)

8. Revisions to the School of Public Policy (PLCY) Plan of Organization (Senate Document #19-20-24) (Action)

9. New Business

10. Adjournment

CALL TO ORDER

Chair Jarzynski called the meeting to order at 3:17 p.m.

APPROVAL OF THE MINUTES, SEPTEMBER 6, 2023 MEETING

Chair Jarzynski asked if there were any corrections to the minutes of the September 6, 2023, meeting; hearing none, he declared the minutes approved as distributed.

REPORT OF THE CHAIR

Board of Regents' Staff Awards
Chair Jarzynski announced that the Staff Affairs Committee would begin accepting nominations shortly for this year's Board of Regents' (BOR) Staff Awards. Chair Jarzynski reminded Senators that BOR Staff Awards are the highest System-wide recognition of the exceptional work done by staff members across the University System of Maryland (USM). Chair Jarzynski explained guidelines and eligibility requirements to nominate staff members. Chair Jarzynski stated that nomination packets are due to the Staff Affairs Committee by Friday, November 10 and that detailed instructions can be found on the Senate website.

Volunteers for the Nominations Committee
Chair Jarzynski stated that outgoing Senators had received an email about volunteering for the Senate Nominations Committee.

Chair Jarzynski stated that every year, the Nominations Committee solicits nominations for the Senate Chair-Elect and membership on the Executive Committee, the Committee on Committees, and other University-wide committees and councils. Chair Jarzynski stated that the Senate relies on the good judgment of the members of the Nominations Committee to present candidates that reflect the quality and diversity of the campus community. Chair Jarzynski noted that the committee would meet between January and April.

Chair Jarzynski explained that those who are interested in serving on the committee should look for an email with a link to a Google form, and complete the form as soon as possible. Chair Jarzynski added that those interested may contact the Senate Office Staff for additional information or assistance. Chair Jarzynski stated that the Senate will vote on the Nominations Committee membership in December.

Senator Constituency Communication
Chair Jarzynski reminded Senators of the Senator-Constituency email communication program that was launched at the last Senate Meeting. A number of Senators had participated in sending Senate Meeting Overview templates, and Chair Jarzynski encouraged all Senators to share those meeting overviews with their constituency groups following each Senate meeting.

New Senate Onboarding Video
Chair Jarzynski explained that Senate Leadership has created a new informational and promotional video about Shared Governance for the campus community. The video had recently been finalized and was shown.

SPECIAL ORDER OF THE DAY

Darryll J. Pines
President of the University of Maryland
2023 State of the Campus Address

Chair Jarzynski invited President Pines to give the 2023 State of the Campus Address.

President Pines began by acknowledging Senate leadership and the senior leadership, Vice Presidents and Deans, in the room. He thanked them for their services to the University.

President Pines continued by showcasing the rankings for College Park as told from US News and World Report. The following rankings were highlighted by President Pines;

> #19 Top Public Universities
> #46 Overall National Universities
> #19 Best Public College for Veterans
> #8 Living-Learning Communities
> #58 Overall Most Innovative

President Pines detailed the upward trend the University has seen, rising from #64 in Overall National Universities to #46 in a decade. He emphasized that these rankings are thanks to everyone at the University.

President Pines further explained that the US News ranking is just one measure of success, and a variety of other measures make University of Maryland, College Park a world class institution. He highlighted the following measures;

> #1 Best Colleges for LGBTQ+ students
> #7 in Maryland on Forbes' list of America's Best Employers by State
> #14 US public institutions for patents awarded
> #16 among public four-year institutions
> and number one among that list of public four-year institutions for best six-year graduation rate for Pell Grant students.

President Pines then congratulated Maryland on the rise in research. As the flagship institution for the state of Maryland, President Pines announced that UMD had a record-breaking research year in Fiscal Year 2023: with $834 million granted in research awards. Additionally, the President highlighted the rare accomplishment of a 23% increase, more than $157 million, between Fiscal Year 2022 and 2023, which has not been recorded in decades. Vice President for Research, Greg Ball, was congratulated and thanked for his role in leading both research awards and expenditures in a positive direction.

President Pines also spoke about the nationally and internationally recognized faculty: highlighting varied achievements in journalism, business, health, education and anthropology.
President Pines also highlighted a drone called the Gambit which was developed by a group of students during a worldwide challenge put forth by NIST. This is the second consecutive year that a University of Maryland team has won the Grand Prize, and $150,000, in the international competition.

President Pines described the excellent foundation University of Maryland has built. One of the frontiers President Pines highlighted is Artificial Intelligence (AI).

President Pines described AI as a tool, a new technology, and an advancement in teaching and learning. President Pines showed a chart which displayed the rapid improvement of the past few years in AI's language and image recognition capabilities. The global investment in AI has also been exponentially increasing, and President Pines challenged all to pay greater attention to this area.

President Pines then announced a Presidential Commission on AI. Going forward, the commission would answer: how can the campus be a national model for leveraging the incredible potential of machine learning and artificial intelligence? The two co-chairs were announced: Mr. Axel Persaud, Assistant Vice President of Enterprise Engineering in the Department of Information Technology, and Professor Jen Goldbeck in the College of Information Studies. This commission will examine AI in all areas of campus, and President Pines will continue to provide progress updates.

Another emerging technology discussed was Quantum Computing. The University, and the surrounding professional and private institutions in the area, are leaders in quantum science, computing, information science, sensors, and technology. The breakthroughs in medical treatment, cybersecurity, and environmental stewardship are promising.

The national quantum lab, or QLab, had its grand opening in College Park. With a $20 million investment, and in partnership with IonQ- a startup that emerged out of the physics faculty research, the QLab is a user facility that opens opportunities for experts around the world to use the resources. President Pines highlighted that among the many revolutionary practices that are possible, the leaders on campus are focused on a potential Quantum "ion trap" internet, the first of its kind.

An additional update President Pines provided was on the DoGood Institute, which expanded last spring. Thanks to that expansion, several new programs can progress; The DoGood Campus Fund, (with grants between $5,000 and $50,000) the DoGood Campus Strategic Leadership Council, and the DoGood Innovator Awards.

President Pines then introduced XFoundry, a new initiative launching from the Idea Factory, that promotes technology innovation and advancements through collaborations with every academic discipline on campus. Featuring a guided curriculum with annual targeted competitions, students enrolled in XFoundry's academic program experience will have 4 stages of incredible exploration. President Pines outlined the stages as follows;
1. XPLORE: an interactive, campuswide event where members of the community vote on the topic for that cohort's challenge.
2. XPERIMENT: a two-course sequence on entrepreneurship where students form teams and pitch ideas.
3. XCELERATE: a final competition, where students work with mentors and advisors to build their solutions functionality, but also their pitching, market viability, and financial planning.
4. XECUTE: A winner is chosen among the teams and along with the prize, given $250,000-$2 million investment.

President Pines also spoke about the Next Now event series that the President and the President's leadership team have been attending.

President Pines also shared the forum hosted with Reginald Dwayne Betts, an alum from the Department of English. Reginald Dwayne Betts is a poet, a lawyer, and a MacArthur Genius fellow that was incarcerated at the age of 16. During the forum, Betts discussed using that experience to tap into vision and insight, and the reality that University of Maryland was the first institution to identify promise and potential in his future.

President Pines concluded the state of the campus and Chair Jarzynski opened the floor to questions.

Senator Sharp, exempt staff, VPA asked President Pines a question about staff development.

President Pines shared development and investment in people within the strategic plan is a priority, exemplified through the large Cost of Living Adjustment (COLA) packages and merits over the past years.

Chair Jarzynski thanked President Pines.

PCC PROPOSAL TO RENAME THE DEPARTMENT OF "AFRICAN AMERICAN STUDIES" TO "AFRICAN AMERICAN AND AFRICANA STUDIES" (SENATE DOCUMENT #23-24-06)

Chair Jarzynski invited Wendy Stickle, Chair of the Programs, Curricula & Courses Committee, to present the following PCC items. She began by presenting the related proposals and provided background information.

Chair Jarzynski thanked Stickle and opened the floor to discussion of the proposal. Hearing none, he asked for unanimous consent for PCC proposals #23-24-06, #23-24-07, and #23-24-08 to be voted on as a group due to their similarities. There were no objections.

PCC proposals #23-24-06, #23-24-07, and #23-24-08 were voted on as a group. The result was 100 in favor, 3 opposed, and 3 abstentions. **The proposals passed.**

PCC PROPOSAL TO RENAME THE UPPER DIVISION CERTIFICATE IN "AFRICAN AMERICAN STUDIES" TO "AFRICAN AMERICAN AND AFRICANA STUDIES" (SENATE DOCUMENT #23-24-07)

PCC proposals #23-24-06, #23-24-07, and #23-24-08 were voted on as a group. The result was 100 in favor, 3 opposed, and 3 abstentions. **The proposals passed.**

PCC PROPOSAL TO RENAME THE BACHELOR OF ARTS IN "AFRICAN AMERICAN STUDIES" TO "AFRICAN AMERICAN STUDIES AND AFRICANA STUDIES" (SENATE DOCUMENT #23-24-08)

PCC proposals #23-24-06, #23-24-07, and #23-24-08 were voted on as a group. The result was 100 in favor, 3 opposed, and 3 abstentions. **The proposals passed**.

Jack Blanchard
Associate Provost for Enterprise Resource Planning
Elevate Update

Chair Jarzynski welcomed Jack Blanchard, Associate Provost for Enterprise Resource Planning.

Blanchard began by providing a background to the Elevate program. The Elevate program is aiming to update the University's obsolete enterprise system. These are the computing systems that sustain financial systems, human resources, and student information systems.

The current systems can no longer meet the complex needs of a flagship university. Elevate will provide a more efficient and effective system, and to more accurately collect, report and analyze data, as well as ensure the security and privacy of those data. Finally, the new system can be easily maintained and updated on a regular basis.

Blanchard introduced the Elevate leadership team including sponsor, executive steering committee. This group meets on a weekly basis and is always reviewing the progress of the program and addressing issues and escalating any problems up to the sponsors for further input and guidance.

Blanchard reminded the Senate that The Elevate program incorporates University of Maryland College Park, as well as Eastern Shore, and the Center for Environmental Science. The solution that has been adopted is called Workday. Workday is a cloud-based solution, an integrated platform that includes HR, finance, and ultimately, student systems.

Blanchard also presented the timeline for Workday implementation. Finance and Human Capital management (HCM) started in January 2021. The original launch date for Workday was November, 2023. The student system's original launch date was 2024. Both were multiyear implementations, to allow for adjustments and flexibility within the University.

The status report for Workday, currently, is that the November 15 live launch has been postponed. This was announced to the University on September 19, and Blanchard detailed the reasons behind that adjusted schedule, as well as provided an estimated new timeline.

Factors for the new scheduled launch of Workday systems include; a high priority on payroll accuracy and reliability that could not be assured on the original timeline, a priority with testing and a need to ensure issues that were being identified were corrected before opening to the University.

On September 18, sponsors and leadership, considering all the factors that were available, ultimately made the decision to postpone the November launch, out of an abundance of caution to ensure that we can resolve the issues within payroll.

The new timeline ensures that Workday will not go live before summer of 2024.

Blanchard explained the implications of this change. Planned freezes originally upcoming for November go live have all been lifted. Those systems will not be impacted this academic year. Training deadlines for Workday among University employees have been extended, and new deadlines will be announced once details on the launch date are confirmed.

Blanchard emphasized that the training individuals have already completed is not wasted. Those training courses remain available. A Workday practice tenant allows staff to go in practice and familiarize themselves with Workday.

Chair Jarzynski opened the floor for questions.

Senator Hajiaghayi, TTK faculty, CMNS asked if there was any specificity that could be provided for the new cost and the new launch dates.

Blanchard responded that the launch dates will be forthcoming based on new fiscal timelines, testing, and administrative deadlines. The budget has been approved by the Board of Public Works and will be available to individuals if they contact the Enterprise Resource Planning team.

Dean Infantino, CMNS, noted that within the last model of Workday training, there were some errors in the courses individuals needed to complete, to ensure their training compliance. These courses were specific to an individual's role on campus, but if that role changed, the trainings would not update accordingly. Blanchard responded they are continuing to work on methods to ensure the trainings are specific and accurate to the employees' role on campus.

NEW BUSINESS

There was no new business.

ADJOURNMENT

The meeting was adjourned at 4:24 p.m.

Revision to the Final Exam Provision in the UMD Policy on the Conduct of Undergraduate Courses and Student Grievance Procedure

PRESENTED BY Amy Karlsson, Chair

REVIEW DATE Senate Executive Committee: October 20, 2023

I am writing on behalf of the Senate Academic Procedures & Standards Committee to be permitted to make a special presentation at the November 1, 2023 Senate meeting on the Revision to the Final Exam Provision in the UMD Policy on the Conduct of Undergraduate Courses and Student Grievance Procedure (V-1.00[A]). The purpose of the presentation will be to provide the committee's considerations to revise the policy and receive feedback from the Senate before making a final report and recommendations.

Based on the Senate's decision to return the committee's report for further review and the limited scope of feedback provided at the Senate meeting prior to that decision, the committee would like to consider additional feedback from the Senate. To obtain this feedback, I respectfully request that I be permitted the opportunity to make a 20-minute presentation at the November 1, 2023 Senate meeting.

A preliminary presentation at the November meeting would allow the committee to incorporate the Senate feedback in developing its final report and recommendations.

PCC Proposal to Establish a Master of Science in Data Science

PRESENTED BY	Wendy Stickle, Chair, Senate Programs, Curricula, and Courses Committee
REVIEW DATES	SEC – October 20, 2023 | SENATE – November 1, 2023
VOTING METHOD	In a single vote
RELEVANT POLICY/DOCUMENT	
NECESSARY APPROVALS	Senate, President, USM Board of Regents, and the Maryland Higher Education Commission

ISSUE

The College of Computer, Mathematical, and Natural Sciences proposes to establish a Master of Science in Data Science. This program exists currently as an iteration of the Master of Professional Studies (MPS) program. The 30-credit MPS program (titled Data Science and Analytics) has been in operation since the Winter 2019-2020 term. Master of Professional Studies programs were first approved in 2005, when the University System of Maryland Board of Regents and Maryland Higher Education Commission approved an expedited review process for master's and graduate certificate programs that respond quickly to the changing market needs of working professionals. Once a new iteration of the MPS is approved through campus PCC review, it only needs approval by the USM Chancellor to become official.

A limitation of offering this program as an MPS iteration is that all Professional Studies programs must use the same generic Federal Classification of Instructional Programs (CIP) code, rather than a CIP code that accurately describes the program content. Those who search for academic programs by using the CIP codes related to Data Science will not find this program. Moreover, some CIP codes are designated as "STEM" eligible by the US Department of Homeland Security, and international students with F1 visas who graduate from STEM designated programs may continue to work in the United States for two years longer than students in non-STEM designated programs. The generic CIP code for Professional Studies programs does not qualify as STEM-designated, even if the academic content of the Professional Studies program is STEM-related, as is the case with this program.

Consequently, the college proposes to transition the current program from a Master of Professional Studies program to a stand-alone Master of Science program in order for the program to be classified more accurately. The 30-credit curriculum will remain the same.

The Master of Science in Data Science will provide students with an education in the theory and practice of data science including mathematical and statistical foundations, computational approaches, and communication considerations. In addition to the fundamentals of data science, the program covers data science-relevant probability and statistics, algorithms, big data systems, machine learning, data mining, and analysis of networks. The program consists of 10 required 3-credit courses. The program is a non-thesis program and will have both an in-person and distance

education version. Students who finish the program successfully will be able to design, conduct, and interpret data analysis tasks. Students will be able to communicate data analysis findings and will be able to apply methods and tools of statistics, machine learning, and computer science to data studies.

The proposal was approved by the Graduate School PCC committee on September 27, 2023, and the Senate Programs, Curricula, and Courses committee on October 6, 2023.

RECOMMENDATION(S)

The Senate Committee on Programs, Curricula, and Courses recommends that the Senate approve this new academic program.

COMMITTEE WORK

The committee considered this proposal at its meeting on October 6, 2023. Michael Cummings, Amy Chester, and John Fourkas, from the College of Computer, Mathematical, and Natural Sciences, presented the proposal and answered questions from the committee. The committee unanimously approved the proposal.

ALTERNATIVES

The Senate could decline to approve this new academic program.

RISKS

If the Senate declines to approve this new degree program, the university will lose an opportunity to apply a more accurate Federal CIP code to an existing program thereby making the program more marketable.

FINANCIAL IMPLICATIONS

There are no significant financial implications with this proposal as the program already exists as a self-supported Master of Professional Studies program.

912: DATA SCIENCE

In Workflow

1. CMNS PCC Chair (jpresson@umd.edu; fourkas@umd.edu)
2. CMNS Dean (rinfanti@umd.edu)
3. Academic Affairs Curriculum Manager (mcolson@umd.edu)
4. Graduate School Curriculum Manager (jfarman@umd.edu)
5. Graduate PCC Chair (jfarman@umd.edu)
6. Dean of the Graduate School (jfarman@umd.edu; sroth1@umd.edu)
7. Senate PCC Chair (mcolson@umd.edu; wstickle@umd.edu)
8. University Senate Chair (mcolson@umd.edu)
9. President (mcolson@umd.edu)
10. Board of Regents (mcolson@umd.edu)
11. MHEC (mcolson@umd.edu)
12. Provost Office (mcolson@umd.edu)
13. Graduate Catalog Manager (bhernand@umd.edu; fantsao@umd.edu)

Approval Path

1. Thu, 27 Apr 2023 21:52:25 GMT
   John Fourkas (fourkas): Approved for CMNS PCC Chair
2. Fri, 28 Apr 2023 17:35:03 GMT
   Robert Infantino (rinfanti): Approved for CMNS Dean
3. Wed, 06 Sep 2023 18:16:55 GMT
   Michael Colson (mcolson): Approved for Academic Affairs Curriculum Manager
4. Fri, 29 Sep 2023 20:03:14 GMT
   Jason Farman (jfarman): Approved for Graduate School Curriculum Manager
5. Fri, 29 Sep 2023 20:08:41 GMT
   Jason Farman (jfarman): Approved for Graduate PCC Chair
6. Wed, 04 Oct 2023 20:48:08 GMT
   Stephen Roth (sroth1): Approved for Dean of the Graduate School
7. Sat, 07 Oct 2023 17:29:43 GMT
   Wendy Stickle (wstickle): Approved for Senate PCC Chair

New Program Proposal

Date Submitted: Wed, 26 Apr 2023 19:13:16 GMT

Viewing: 912 : Data Science
Last edit: Mon, 31 Jul 2023 21:08:50 GMT

Changes proposed by: Michael Cummings (mcummin1)

Program Name

Data Science

Program Status

Proposed

Effective Term

Spring 2024

Catalog Year

2023-2024

Program Level

Graduate Program

Program Type

Master's

Delivery Method

On Campus

Departments

Department
Computer, Mathematical, and Natural Sciences

Colleges

College
Computer, Mathematical, and Natural Sciences

Degree(s) Awarded

Degree Awarded
Master of Science

Proposal Contact

Michael Cummings, Amy Chester

Proposal Summary

The University of Maryland Science Academy is pleased to submit this proposal for an MS in Data Science. The MPS in Data Science and Analytics has been a very successful program since launching in 2019 and this proposal is to convert that program to an MS in Data Science. CIP Code: 30.7001 Data Science, General

(PCC Log Number 23006)

Program and Catalog Information

Provide the catalog description of the proposed program. As part of the description, please indicate any areas of concentration or specializations that will be offered.

The Master of Science in Data Science provides students education in the theory and practice of data science including mathematical and statistical foundations, computational approaches, and communication considerations. In addition to the fundamentals of data science the program covers data science-relevant probability and statistics, algorithms, big data systems, machine learning, data mining, and analysis of networks. The program consists of 30-credit course work. It is a non-thesis program.

Catalog Program Requirements:

Course	Title	Credits
DATA601	Probability and Statistics	3
DATA602	Principles of Data Science	3
DATA603	Principles of Machine Learning	3
DATA604	Data Representation and Modeling	3
DATA605	Big Data Systems	3
DATA606	Algorithms for Data Science	3
DATA607	Communication in Data Science and Analytics	3
DATA612	Deep Learning	3
DATA641	Natural Language Processing	3
DATA698	Research Methods and Study Design	3
Total Credits		**30**

Sample plan. Provide a term by term sample plan that shows how a hypothetical student would progress through the program to completion. It should be clear the length of time it will take for a typical student to graduate. For undergraduate programs, this should be the four-year plan.

Full time

Term 1:
DATA601 Principles of Data Science
DATA602 Probability and Statistics
DATA603 Principles of Machine Learning

Term 2:
DATA604 Data Representation and Modeling
DATA605 Big Data Systems
DATA641 Natural Language Processing

Term 3:
DATA606 Algorithms for Data Science
DATA698 Research Methods in Data Science

Term 4:
DATA607 Communication in Data Science and Analytics
DATA650 Cloud Computing

Part Time

Term 1:
DATA601 Principles of Data Science
DATA602 Probability and Statistics

Term 2:
DATA603 Principles of Machine Learning
DATA604 Data Representation and Modeling

Term 3:
DATA606 Algorithms for Data Science
DATA698 Research Methods in Data Science

Term 4:
DATA607 Communication in Data Science and Analytics
DATA650 Cloud Computing

Term 5:
DATA605 Big Data Systems
DATA641 Natural Language Processing

List the intended student learning outcomes. In an attachment, provide the plan for assessing these outcomes.

Learning Outcomes
Design, conduct and interpret data analysis tasks
Communicate data analysis tasks and findings
Apply methods and tools of statistics, machine learning, computer science, to data studies

New Program Information

Mission and Purpose

Describe the program and explain how it fits the institutional mission statement and planning priorities.

This proposal is to transition the current MPS in Data Science and Analytics program to an MS in Data Science. The MPS in Data Science and Analytics launched in Winter 2019 and has seen great success and high demand. For the Fall 2023 semester, the program has over 450 completed applications as of 31 March 2023. The program had 75 registered majors during Fall 2022, a 23% increase from the prior year.

The new MS in Data Science will be directly aligned with the mission of the University, which states, in part the following.

"As a land-grant institution, the University shares its research, educational, cultural, and technological strengths with the Maryland citizenry and other constituencies. Its collaborations with State, federal, private and non-profit partners promote economic development and improve quality of life."

The last few years have seen the emergence and rapid growth of professional education in the sciences, in particular in Data Science and other fields linked to computer science. The explosion of data and computing power has placed Data Science at the forefront of a much broader wave of new research areas requiring professional training including Machine Learning and Immersive Media. Data Science is a fundamental area and provides a basis for a range of new knowledge and skills that can be broadly applied. The University of Maryland is the best place in the region for professionals to gain these skills. U.S. News & World Report ranks UMD the highest in the region for computer science and applied mathematics.

This program will offer students the opportunity to engage in foundational technical course work in data science and analytics. The program will focus on five thematic competencies for the art and science of the new field of data science and analytics: Statistics, Machine Learning, Computing, Communication, and Professional Practice. The program will consist of 30-credit course work in the following thematic areas.
1. Statistics — Statistics here are the standard statistics subsumed by general linear models (e.g., linear regression, ANOVA, t-tests, f-tests, and multivariate extensions); discrimination, classification, ordination (e.g., PCA, MDS), linear discriminant analysis, factor analysis, and related methods; permutation and randomization methods; Bayesian estimation.

2. Machine learning — Machine learning here represents methods that are not subsumed by general linear models or other traditional distributional model-based statistics. Includes such things as: support vector machines; artificial neural networks and their derivatives and extensions; decision tree induction; random forests; other ensemble methods; affinity analysis; association rule learning; deep learning.

3. Computing — Computing here are those topics that are traditionally taught in computer science programs though restricted here to only include those core elements most necessary for professional practice in data science and analytics. Included here: programming using scripting/interpretative languages (e.g., shell, Python).

4. Communication — Communication here comprises methods and practice of communicating data science and analytics concepts, methods and results in written, verbal, and electronic media.

5. Research/professional practice — Research/professional practice here means actual design, execution, and communication of a data science and analytics project.

Program Characteristics

What are the educational objectives of the program?

When students graduate from the program, they should be able to design, conduct, interpret and communicate data analysis tasks and studies using methods and tools of statistics, machine learning, computer science, and communications.

Describe any selective admissions policy or special criteria for students interested in this program.

Admission is for the fall semester only. Applicants must meet the following minimum admission criteria as established by the Graduate School:

Applicants must have earned a four-year baccalaureate degree from a regionally accredited U.S. institution, or an equivalent degree from a non-U.S. institution.
Applicants must have earned a 3.0 GPA (on a 4.0 scale) in all prior undergraduate and graduate coursework.
Applicants must provide an official copy of a transcript for all of their post-secondary work.
International applicants must fulfill all requirements relating to international academic credentials, evidence of English proficiency, financial certification, and visa documentation.
In addition, applicants must submit the following:

Required items:
Statement of purpose.
Curriculum vitae/resume.
Evidence (e.g., transcripts) of quantitative abilities by taking two courses in calculus, linear algebra and/or statistics.
Evidence (e.g., transcripts, certificates) of computer programming proficiency in one or more interpreted or compiled languages.

Optional items:
Two letters of recommendation.
Graduate Record Examination (GRE) scores.

Summarize the factors that were considered in developing the proposed curriculum (such as recommendations of advisory or other groups, articulated workforce needs, standards set by disciplinary associations or specialized-accrediting groups, etc.).

The factors that were considered in developing the proposed curriculum derive largely from our professional experiences working in areas related to data science, careful study of other data science curricula at other institutions, and educational/training needs articulated by major employers.

Select the academic calendar type for this program (calendar types with dates can be found on the Academic Calendar page)

Traditional Semester

For Master's degree programs, describe the thesis requirement and/or the non-thesis requirement.

non-thesis

Identify specific actions and strategies that will be utilized to recruit and retain a diverse student body.

The primary recruitment activities will be via the CMNS Science Academy. The Science Academy uses a diverse, targeted approach when recruiting students. This digital strategy focuses on UMD alumni, current UMD graduating seniors, and working professionals in the DMV area. The admissions review process reviews for not only academic readiness but also diversity in experiences, industries, backgrounds, and career aspirations to recruit a diverse student body.

To attract a diverse student population, we will engage in the following activities:
• Representing the program in educational fairs, conferences and events, e.g. the National Leadership Conference of the National Society of Black Engineers, GEM Grad Labs.
• Advertising the program to the National Society of Black Engineers (NSBE), the Society of Women Engineers (SWE), and the Association for Women in Computing (AWC).
• Direct mailing and email campaigns to domestic and international colleges
• Outreach to UMD Campus organizations and clubs
• Holding online (virtual) open houses, information sessions and career panels

• Outreach to US Military to attract veterans
• Social media and online advertising
• Establishing graduate scholarships to provide financial aid to underrepresented minority applicants

Once enrolled, the Science Academy staff, and faculty are committed to creating and fostering a supportive environment for all students to thrive. We regularly share resources and opportunities for counseling, support, and funding. All students are expected to complete and honor the TerrapinSTRONG orientation and initiatives. Students are encouraged to take part in Grad School programs that address diversity and inclusion in higher education, build communities of support and success, and create meaningful dialogue among graduate students. Such programs include"Cultivating Community Conversations" and the "Annual Office of Graduate Diversity and Inclusions Spring Speaker Services." Faculty that are involved in the Science Academy represent many departments, have a diversity of appointments (both tenure track, professional track, and adjunct) exposing students to many future career paths. The Science Academy and faculty provide student advising, academic support, and career guidance to students to retain all students and support timely graduation.

Our student retention efforts will consist of:
• Holding "Women in Engineering, Computing and STEM" seminars to addresses the obstacles faced by women in today's technical workplace and guide our women students to maneuver through the internship and job application process
• Requiring students to attend mandatory advising sessions with the program adviser to ensure that the students' study plans are in line with their interests and career goals, and that the students make satisfactory progress toward meeting the degree requirements
• Implementing an early warning system that detects students struggling with core courses and alerts the academic advisor, who meets with the students and designs a study plan to get them back on track

Relationship to Other Units or Institutions

If a required or recommended course is o#ered by another department, discuss how the additional students will not unduly burden that department's faculty and resources. Discuss any other potential impacts on another department, such as academic content that may significantly overlap with existing programs. Use space below for any comments. Otherwise, attach supporting correspondence.

Three of the courses are co-listed versions of courses in common with the programs in Bioinformatics and Computational Biology, and Machine Learning: BIOI/DATA/MSML601, Probability and Statistics; BIOI/DATA/MSML602, Principles of Data Science; and BIOI/DATA/MSML603, Principles of Machine Learning. These three courses are foundational to modern quantitative and computational-based science, and thus are common to the existing programs and the proposed program. All the remaining core courses will be new to the program, and some electives may be accepted from other programs. All programs are managed by the Science Academy.

Accreditation and Licensure. Will the program need to be accredited? If so, indicate the accrediting agency. Also, indicate if students will expect to be licensed or certified in order to engage in or be successful in the program's target occupation.

No accreditation or licensure is required for the program.

Describe any cooperative arrangements with other institutions or organizations that will be important for the success of this program.

n/a

Faculty and Organization

Who will provide academic direction and oversight for the program? In an attachment, please indicate the faculty involved in the program. Include their titles, credentials, and courses they may teach for the program.

The CMNS Science Academy will work closely with the department chairs of Computer Science, Mathematics, and Electrical and Computer Engineering for shared academic oversight. The Dean of the College will assign a faculty director to the program who will provide academic and advising oversight to incoming and admitted students. Professor Michael Cummings has been serving in this role for the MPS in Data Science and Analytics since 2019. In addition, the faculty director is responsible for instructor selections and appointments and works collaboratively with the Science Academy and OES when appropriate. A full list of faculty to be involved in the program is attached.

Indicate who will provide the administrative coordination for the program

The Science Academy in the College of Computer, Mathematics and Natural Science will provide administrative coordination for the program, in collaboration with the Office of Extended Studies. The Office of Extended Studies provides program development support (budget development and projections, in house marketing research, preparation of PCC document), program management (UMD policies and procedures compliance, program website, data requests), student and program services (admission support, scheduling, registration, billing and payment, graduation, appeals), and financial management (faculty contracts, payment processing, course charge processor, net revenue distribution).

Resource Needs and Sources

Each new program is required to have a library assessment prepared by the University Libraries in order to determine any new library resources that may be required. This assessment must be done by the University Libraries. Add as an attachment.

see attached.

Discuss the adequacy of physical facilities, infrastructure and instructional equipment.

No additional physical facilities, infrastructure and instructional equipment is required for this program. Existing facilities (e.g., classrooms) and resources (e.g., instructional equipment) will be used, and these are demonstrably adequate for the proposed program. It is anticipated that most of the instruction will be in the evenings, as befitting the target student population of working adults. Thus, the use of classrooms will be outside the hours used for instruction by most other programs.

Discuss the instructional resources (faculty, staff, and teaching assistants) that will be needed to cover new courses or needed additional sections of existing courses to be taught. Indicate the source of resources for covering these costs.

For each course an instructor will be needed. The Director of the Science Academy, Faculty Director, and participating department chairs will recruit instructors and work closely with the faculty in the development of teaching materials. Costs for instructors and teaching assistants/graders (as needed for larger enrollment) will be covered from program revenue. In addition, any costs for development of teaching materials will be handled through the new CMNS Science Academy covered by program revenue.

In addition, the Science Academy works with the departments/units developing courses on instructor selections and appointments.

Discuss the administrative and advising resources that will be needed for the program. Indicate the source of resources for covering these costs.

The CMNS Science Academy will provide the academic and advising oversight to incoming and admitted students. Revenue generated from the program will be used to support administrative and advising resources including a Program Manager. No state resources will be used to support the program

Use the Maryland Higher Education Commission (MHEC) commission financial tables to describe the program's financial plan for the next five years. See help bubble for financial table template. Use space below for any additional comments on program funding.

The financial plan is attached. The program will generate sufficient revenue to be self sustained.

Implications for the State (Additional Information Required by MHEC and the Board of Regents)

Explain how there is a compelling regional or statewide need for the program. Argument for need may be based on the need for the advancement of knowledge and/or societal needs, including the need for "expanding educational opportunities and choices for minority and educationally disadvantaged students at institutions of higher education." Also, explain how need is consistent with the Maryland State Plan for Postsecondary Education.

See support document attachment, Market Analysis, for a full analysis of the market as of March 2023. Our research indicates a much faster than average growth in computer and information research scientist positions nationally in the next 10 years. As more jobs become available in this area, it is our responsibility to respond to this need by preparing the workforce. Our graduates will complete the program with the skills and knowledge to fill the open positions in the market. Our program directly aligns with the Maryland State Plan for Postsecondary Education and the principles of public education in the State of Maryland. This program in the Science Academy increases access to higher education (specifically graduate level education) and increases the diversity of graduate students

Present data and analysis projecting market demand and the availability of openings in a job market to be served by the new program. Possible sources of information include industry or disciplinary studies on job market, the USBLS Occupational Outlook Handbook, or Maryland state Occupational and Industry Projections over the next five years. Also, provide information on the existing supply of graduates in similar programs in the state (use MHEC's Office of Research and Policy Analysis webpage for Annual Reports on Enrollment by Program) and discuss how future demand for graduates will exceed the existing supply. As part of this analysis, indicate the anticipated number of students your program will graduate per year at steady state.

See support document attachment, Market Analysis, for a full analysis of the market as of March 2023. Our research indicates a much faster than average growth in computer and information research scientist positions in the field nationally (21%) in the next 10 years. Growth in the state of Maryland is projected at 7%. Lastly, following the enrollment trends at other Maryland programs, our successful MPS enrollments, coupled with the projected job growth in this area, the program anticipates enrollment greater than 40 students per year. These positions are found across the federal government, software publishers, professional and technical services, hospitals, higher education, and other employment locations.

Identify similar programs in the state. Discuss any di#erences between the proposed program and existing programs. Explain how your program will not result in an unreasonable duplication of an existing program (you can base this argument on program di#erences or market demand for graduates). The MHEC website can be used to find academic programs operating in the state: http://mhec.maryland.gov/institutions_training/pages/HEPrograms.aspx

Other similar programs in the State of Maryland are research focused degrees. Our program will be differentiated and attractive to the professional learner in its applied nature. While other programs in the state do exist, most are either research focused and or only available in an online or blended space. The UMD program will be available both in person and online with an applied and experiential approach.

Discuss the possible impact on Historically Black Institutions (HBIs) in the state. Will the program affect any existing programs at Maryland HBIs? Will the program impact the uniqueness or identity of a Maryland HBI?

We do not foresee any negative impacts on the uniqueness or identity of any Maryland HBIs. Rather, we see our program complementary in several ways. First, most HBIs in the state do not have related degree programs, and thus our program provides HBI students more opportunities for an

advanced degree in an area not presently offered at their current institution. Second, there is distinct differentiation between the somewhat related programs at Maryland HBIs. The Applied Computer Science MS program at the University of Maryland, Eastern Shore (UMES) and the Advanced Computing MS program at Morgan State University, although listed in our market research document, are fundamentally different in subject matter coverage from the Data Science MS covered by this proposal. The UMES and Morgan State programs are more broadly computer science-focused (sans theoretical aspects of the field). These degree programs are geared toward students who would be employed in various areas of computer science. Our degree program is geared toward data-informed or data-driven employment opportunities and emphasizes the interdisciplinary nature of data science

Supporting Documents

Attachments

DATA_Market_Research_MS_2-10-23.xlsx
MS in Data Science Budget.xlsx
Library Assessment.docx
Faculty List Template- DS.docx
Appendix 2 Summary of Learning Outcome Assessments 7-31-2023.pdf

Key: 912

Program Name = Data Analytics, MS

Institution	Website	Delivery Method	Degree Name & Type (MPS, MA, MS, MPH, etc.)	# of Credits	Tuition (course or credit)		Target Population	Prior Education/ Pre-Requisites	
					Resident	Non-Resident			

Big Ten Institutions

Institution	Website	Delivery Method	Degree Name & Type	# of Credits	Resident	Non-Resident	Target Population	Prior Education/ Pre-Requisites	
University of Illinois Urbana-Champaign	https://cs.illinois.edu/academics/graduate/professional-mcs/online-master-computer-science-data-science	Online	Data Science, MCS (Master of Computer Science)	32 credits (8 4-credit courses)	$670/credit		Students interested in the art of extracting new knowledge and finding meaningful information in a massive sea of data	Applicants should hold a 4-year bachelor's degree. Students with a bachelor's degree in a field other than CS are encouraged to apply, but to succeed in graduate-level CS courses, they must have prerequisite coursework or commensurate experience in object-oriented programming, data structures, algorithms, linear algebra, and statistics/probability. Applicants without this can strengthen their application for admission by passing the optional Data Structures Proficiency Exam.	Students receive lectures through Coursera's massive open online course (MOOC) platform, but are advised and assessed by Illinois faculty and teaching assistants on the more rigorous set of assignments, projects, and exams required for university degree credit. GRE and letter of recommendations are not required to apply.
Indiana University Bloomington	https://datascience.indiana.edu/programs/ms-data-science-online/index.html	Online and F2F	Data Science, MS	30 credits	$485.00/credit	$797.50/credit	*Online Program: Designed to provide convenience and flexibility to midcareer professionals. *Residential Program Applied Data Science Track: This track is ideal for students with a background in the humanities, social sciences, or any other non-STEM field, as well as for students uninterested in a math-oriented course load *Residential Program Computational and Analytical Track: Designed for students who have a strong STEM background and are ready to advance their career as data specialists.	Applicant must hold a U.S. bachelor's degree from a regionally accredited institution or foreign equivalent. Online Program: Before applying to this program, you should have a basic understanding of the programming languages Python and R, in addition to math and probability. *Residential Program Computational and Analytical Track: GRE score (quantitative) of 160 or higher, A grade of B or higher in college calculus I and II, A grade of B or higher in a college-level algorithms or data structure course, A grade of B or higher in two college-level programming courses.	If you don't have a STEM background, consider taking Data Science Essentials: a self-paced package of online coursework that can help you prepare for the successful completion of the M.S. in Data Science degree.
University of Iowa	https://grad.admissions.uiowa.edu/academics/data-science-ms	F2F	Data Science, MS	30 credits	$1,002/credit	$2,625/credit	The Master of Science program in data science aims to train the next generation of data scientists with the analytical and technical skills to explore, formulate, and solve complex data-driven problems in science, industry, business, and government.	Applicant must have Three Letters of Recommendation; unofficial or official transcripts sent to admissions	
University of Michigan Ann Arbor	https://lsa.umich.edu/stats/masters_students/mastersprograms/data-science-masters-program.html	F2F	Data Science, MS	30 credits	$1,790/credit	$3,247/credit	Full-time students interested in the confluence of (1) Computer and Information Sciences (2) Statistical Sciences, and (3) Domain Expertise.	Applicant must hold a U.S. bachelor's degree from a regionally accredited institution or foreign equivalent. While a Data Science undergraduate major is not required, it is expected that applicants will have at least the following background before they join: 2 semesters of college calculus, 1 semester of linear or matrix algebra, 1 introduction to computing course	
Michigan State University	https://stt.natsci.msu.edu/graduate-programs/prospective-students/ms-in-data-science.aspx	F2F	Data Science, MS	30 credits	$812/credit		The MSDS prepares professional students for the demands of tomorrow's workplace in data-driven decision making. Data science is an emerging interdisciplinary field whose purpose is the extraction of actionable insights from data. It employs theories and techniques from the core areas of statistics, computational mathematics, computer science, and information science. Our MSDS provides high-quality training in state-of-the-art data analysis and computational methods. We include coverage of the principles...	Required application materials include a 2-page letter of motivation (combined personal statement and academic statement, please do not submit two separate letters); a detailed CV/resume including all relevant industrial experience if applicable; full official transcripts from undergraduate and/or graduate institutions, sent by the granting institutions (unofficial copies can be uploaded by the applicant); a minimum of three letters of recommendation sent directly by the recommenders (not attached to the application);if the mother tongue of the candidate is not English, or the candidate is not a...	
University of Minnesota Twin Cities	https://datascience.umn.edu/masters	F2F	Data Science, MS	31 credits	$1,128/credit	$1,412/credit	Students who want a strong foundation in the science of Big Data and its analysis by gathering in a single program the knowledge, expertise, and educational assets in data collection and management, data analytics, scalable data-driven pattern discovery, and the fundamental concepts behind these methods.	A four-year bachelor's degree from an accredited college or university in computer science, math, statistics, engineering, natural sciences, or a related field. A minimum GPA of 3.5 (or the equivalent in other grading scales) in undergraduate coursework is normally expected to be considered for admission. Mathematics: Calculus (2 semesters), Multivariable Calculus (1 semester), Linear Algebra (1 semester), Statistics (1 semester), Computer Programing (2 semesters), Experience with mathematical software environments such as Matlab, R or the equivalent is a definite plus, but not a total substitute for experience with a general-purpose programming language. A class on advanced data structures is also a plus.	
University of Nebraska-Lincoln	https://graduate.unl.edu/academics/programs/COMP-MS	F2F	Computer Science, MS	30 credits	$472/credit	$1,285/credit	The School of Computing offers opportunities for students to develop teaching skills in support of undergraduate instruction and to enhance research skills in support of the department's active research programs. The goal is to build a foundation for future scientific discovery, engineering innovation, and scholarly and professional achievement.	Applicant must submit an Application for Admission with $50 non-refundable application fee. One set of transcripts; Curriculum vitae Three letters of recommendation; GRE is not required; Statement of purpose, including research interests, objectives, and potential SoC faculty names	
Northwestern University	https://sps.northwestern.edu/masters/data-science/	Online	Data Science, MS 4 Specializations: Analytics and Modeling, Artificial Intelligence, Data Engineering, or Analytics Management	36 credits	$4,550/course		Students interested in learning how to utilize relational and document database systems and analytics software built upon open-source systems such as R, Python, and TensorFlow.	Applicant must hold a U.S. bachelor's degree from a regionally accredited institution or foreign equivalent.	
Northwestern University	https://sps.northwestern.edu/masters/data-science/	F2F	Accelerated Data Science, MS	12 Courses	$14,715/per quarter		Students are encouraged to find and arrange part-time internships or roles with area organizations. nternational and domestic students are encouraged to apply for the accelerated option. Admitted international students are eligible to apply for and receive a student visa.	Applicant must hold a U.S. bachelor's degree from a regionally accredited institution or foreign equivalent.	
Penn State Great Valley	https://greatvalley.psu.edu/academics/masters-degrees/data-analytics	F2F	Data Analytics, MS	30 credits	$1,160/credit	$1,877/credit	Students typically are fresh out of undergraduate studies. Through its emphasis on research, this program is designed to prepare you for entry into doctoral programs in data analytics. The curriculum has five required courses and three electives. You'll take a research methods class and must...	Applicant must hold a U.S. bachelor's degree from a regionally accredited institution or foreign equivalent.	
Penn State Great Valley	https://greatvalley.psu.edu/academics/masters-degrees/data-analytics	F2F	Data Analytics, MPS	31 credits	$1,160/credit	$1,877/credit	Intended for professionals looking to acquire analytical skills relevant to the workplace, the curriculum consists of six required courses and three electives. The program culminates in a capstone course that builds upon the theories, technology, and skills learned in previous coursework.	Applicant must hold a U.S. bachelor's degree from a regionally accredited institution or foreign equivalent.	
Purdue University	https://www.stat.purdue.edu/academic_programs/graduate/gradDSfinance.html	F2F	Data Science in Finance Residential Program, MS	33 credits	$ 347.85/credit	$ 948.30/credit	The goal of the program is to equip students with the tools necessary to pursue a career in a quantitative financial field. The 2-year course work provides students with comprehensive and practical knowledge of the mathematical, statistical, and computational skills. The following courses are...	Included in this application you must submit the following: Short answer items, each with less than 200 words (The Statement of Purpose on the application package is not required.); GRE scores (optional; Diversity Essay: required for U.S. applicants only; English proficiency scores: required for all non-native English speakers; Recommendation letters are required to be submitted	
Rutgers University New Brunswick	https://sas.rutgers.edu/m-s-in-data-science	F2F	Data Science, MS- Statistics Track Data Science, MS- Computer Science Track	Statistics Track- 30 credits CS Track- 36 credits	$1,034/credit	$1,758/credit	The Statistics track directs its focus towards the data analysis aspects of the Data Science field, whereas the Computer Science (CS) track concentrates more on its computer science aspects.	Applicant must hold a U.S. bachelor's degree from a regionally accredited institution or foreign equivalent. Prerequisites: Multivariate Calculus, Linear Algebra, Introduction to Probability, Theory of Statistics, Two courses in statistical computing or computer science, including advanced programming	

Institution	URL	Format	Program	Credits	Cost/credit	Cost/credit	Description	Requirements
University of Wisconsin–Madison	https://guide.wisc.edu/graduate/statistics/statistics-ms/statistics-data-science-ms/#text	F2F	Statistics: Data Science, MS	30 credits	$1,014/credit	Nonresident: $2,125/credit Minnesota: $1607/credit	The MS Statistics: Data Science program is intended for three types of students: *VISP students: Students from the Visiting International Student Program (Stat VISP or Math VISP). They may request transfer of up to 15 credits from their VISP coursework. *Workforce students: Students coming with 5 or more years in the workforce who have worked extensively with data and are seeking a well-rounded training. *General students: Students who have BS degrees or expected to obtain BS degrees prior to the first semester as MS Statistics: Data Science students.	Applicant must hold a U.S. bachelor's degree from a regionally accredited institution or foreign equivalent. Students admitted to the MS Statistics: Data Science program are expected to have: Calculus and Analytic Geometry 1, Calculus and Analytic Geometry 2, Calculus--Functions of Several Variables, The Theory of Single Variable Calculus (or another advanced analysis course), The Theory of Single Variable Calculus (or another advanced analysis course), R for Statistics I, R for Statistics II, Introduction to Probability and Mathematical Statistics I, Introduction to Probability and Mathematical Statistics II.

State of Maryland System Institutions: Overseen by MHEC (http://mhec.maryland.gov/publications/Pages/research/index.aspx)

Institution	URL	Format	Program	Credits	Cost/credit	Cost/credit	Description	Requirements
Bowie State University	https://www.bowiestate.edu/academics/colleges/college-of-arts-and-sciences/departments/computer-science/graduate/masters-degree/	F2F	Computer Science, MS- Data Science Specialization	36 credits	$439/credit	$723/credit	Students interested in focusing on core competencies in machine learning, data mining, data visualization, and cloud computing.	Applicants must hold a bachelor's degree from a regionally accredited institution and have a cumulative grade point average of 2.5 or better (on a 4.0-point scale). In addition, the following prerequisites are required: Calculus of One Variable (i.e. Calculus I and II), One additional mathematics course beyond Calculus, (e.g. Linear Algebra, Differential Equations, Abstract Algebra, Advanced Calculus, Discrete Structures, Probability and Statistics), COSC 503 - Software Design and Development (or equivalent)
Capitol Technology University	https://www.captechu.edu/degrees-and-programs/masters-degrees/technical-mba-business-analytics	Online	Technical Master of Business Administration in Business Analytics	36-39 credits	$630/credit		The program provides the essential knowledge to enter into the industry in a role managing data assets of budgets, employment, marketing and other data science duties, all of which are essential to the success of a profitable business.	No Information Given
Hood College	https://www.hood.edu/graduate/academics/programs/computer-science-ms	33 credits	Computer Science, MS	33 credits	$1073/credit		This program is ideal for individuals who want to acquire or update their skills in cutting-edge computer science technologies – and tackle the challenges inherent in capturing, storing, sharing, transferring and analyzing data.	For students applying to the computer science program, please submit the following to the Graduate School: One copy of official transcripts from each institution of higher education attended. A résumé of work experience. Applicants to the graduate program in computer science are expected to have a strong background in computer science and mathematics. Four foundation courses introduce students to algorithms and programming, computer organization and design, advanced data structures and discrete mathematics. Students holding a baccalaureate degree in computer science will normally be exempted from all foundation courses. Other students may...
Frostburg State University	https://www.frostburg.edu/academics/majorminors/graduate/ms-applied-computer-science/index.php	F2F or Online	Computer Science, MS- Database concentration	30 credits	$456/credit	$588/credit	This program prepares students for exciting career opportunities with the government, in network security, web development and a host of other rewarding fields. Unlike theory-based graduate programs, the FSU applied computer science master's degree is highly experiential.	Students without Computer Science degree or background may be required to take up to two foundation courses as part of their program of study before entering the degree program courses.
Johns Hopkins University	https://ep.jhu.edu/programs-and-courses/programs/data-science/	Online or Hybrid	Data Science, MS	30 credits	$4,920 per course *Per-course tuition is $5,872., but with dean support from the Whiting School of Engineering, students receive a decreased out-of-pocket cost.		This program is designed to prepare graduates to succeed in specialized jobs involving everything from the data pipeline and storage, to statistical analysis and eliciting the story the data tells	Applicants must hold a bachelor's degree from a regionally accredited institution. Prior education must include the following prerequisites: (1) three semesters or five quarters of calculus, which includes multivariate calculus; (2) one semester/term of advanced math (discrete mathematics is strongly preferred but linear algebra and differential equations will be accepted); (3) one semester/term of Java or Python (C++ will be accepted but the student must be at least also somewhat knowledgeable in Java or Python); and (4) one semester/term of Data Structures. Linear Algebra or Differential Equations will be accepted in lieu of Discrete Mathematics. A grade of B− or better must have been earned in each of the prerequisite courses.
Loyola University Maryland	https://www.loyola.edu/academics/data-science/graduate	Online	Data Science, MS	31-34 credits	$925/credit		The master's program provides the skills you need to become a data scientist. As part of the program, Loyola's strong commitment to social justice encourages students to engage with nonprofits.	Applicants must hold a bachelor's degree from a regionally accredited institution. A student is expected to have had a college-level introductory statistics course. A mathematics boot camp prior to the start of the program may be required for students without sufficient mathematics background as determined by the program directors.
McDaniel College	https://www.mcdaniel.edu/node/2380	Online or Hybrid	Data Analytics, MS	30 credits	$675/credit		You'll notice right from the start that the Professional Master of Science in Data Analytics at McDaniel College is uniquely designed to prepare you for professional success. Every course in the curriculum integrates skills and knowledge that prepares the student to think more critically and through a more peripherally focused lens. This requirement highlights not only our...	Applicants must hold a bachelor's degree from a regionally accredited institution with a minimum GPA of 2.75. Prior education must include the following prerequisites: One course in Statistics (required), One course in Calculus (recommended).
Morgan State University	https://www.morgan.edu/advanced-computing-ms/ms_advancedcomputing	Online or F2F	Advanced Computing, MS	30 credits	$455/credit	$894/credit	This new program is designed for students who have recently completed a bachelor's degree program in Computer Science or a related field and wish to enhance their career, explore research opportunities in Computer Science, and apply their acquired skills in multi-disciplinary teams or for specific focus. The program also meets the needs of students who are already in the workforce and wish to update or improve their knowledge of current computer science.	Applicants must hold a bachelor's degree from a regionally accredited institution with a focus in Computer science or a related field.
Notre Dame of Maryland University	https://www.ndm.edu/grad-prof-studies/academics/programs/analytics	Online	Analytics, MS	36 credits	$580/credit		More professionals are needed to manage the architecture of knowledge from traditional- and online-based resources. The online Master of Science in Analytics helps you become an asset in your current role or prepare for the jobs of tomorrow, with a curriculum focused on multidisciplinary competencies in knowledge management technologies, qualitative processes and economic principles of change risk management.	Applicants must hold a bachelor's degree from a regionally accredited institution.
Towson	https://www.towson.edu/fcsm/departments/computerinfosci/grad/computersci/	F2F	Computer Science, MS Data Science Track	33 credits	$642/credit	$1,158/credit	The master's in computer science provides a comprehensive curriculum with a solid scientific and technical foundation for pursuing either doctoral work or advanced positions in business, industry and government. Graduates find high-profile jobs as software developers, web developers, computer security analysts and e-commerce analysts.	Baccalaureate degree in computer science from a regionally accredited college or university**, or a baccalaureate degree from a regionally accredited college or university** in any other field and completion of one to three preparatory courses from among MATH 263, COSC 501* and COSC 502*. An undergraduate GPA of 3.00 for full admission, or 2.75 for conditional admission, is required.
University of Maryland, Baltimore County	https://professionalprograms.umbc.edu/data-sciencehttps://professionalprograms.umbc.edu/data-science/masters-of-professional-studies-data-science/	F2F	Data Science, MPS	30 credits	$850/credit	$1,352	UMBC's Master of Professional Studies (MPS) in Data Science program prepares students from a wide range of disciplinary backgrounds for careers in data science. In the core courses, students will get a fundamental understanding of data science through classes that highlight machine learning, data analysis and data management. The core courses will also introduce students to ethical and legal implications surrounding data science.	Applicant must have an undergraduate degree in any subject; Students must have prior coursework to include college-level math, statistics, and programming. Students who do not have prior coursework or industrial experience should take online courses in statistics, linear algebra, and programming. Minimum undergraduate GPA of 3.0 on a 4.0 scale.

University of Maryland, Eastern Shore	https://wwwcp.umes.edu/cset/	F2F	Applied Computer Science, MS	30 credits	$346/credit $641/credit	No Information Given	Admission requirements include a bachelor's degree in a technology related field, such as Engineering Technology, Computer Science, Information Technology, Software or Computer Engineering, Networking, Information Security, or related disciplines. Applications from prospective students with bachelor's degrees in non-technical fields may be considered for admission. All applicants must show a strong record of academic achievement, as indicated by official transcript(s), three letters of recommendation, and a statement of purpose.
UMGC UMD Global Campus	umgc.edu/academic-programs/masters-degrees/data-analytics.cfm	Online	Data Analytics, MS	36 credits	$694/credit	This program is designed to help prepare you for work in the high-demand field of data science and analysis in a public- or private-sector organization. Potential career fields include data mining, machine learning, and predictive modeling for large data sets.	Applicants must hold a bachelor's degree from a regionally accredited institution. We recommend a background in software programming and statistics. If you do not have demonstrated experience or prior coursework in programming, you may be required to complete additional coursework.

Colleges & Universities in the Washington DC - Baltimore MD area

University	Link	Format	Program	Credits	Cost		Description	Requirements
American University	https://www.american.edu/programs/grad/data-science/	F2F or Online	Data Science, MS	30 credits	$1,866/credit		American University's MS in Data Science prepares students to acquire, process, analyze, and present complex data.	The program is open to all students with a bachelor's degree from an accredited institution that have a cumulative grade point average of at least a 3.00 (on a 4.00 scale). Students without sufficient mathematical background as determined by the program directors may be required to complete a mathematical boot camp prior to starting the program.
Catholic University of America	https://engineering.catholic.edu/academics/graduate/data-analytics/masters/index.html	F2F or Online	Data Analytics, MS	30 credits	$1,250/credit		The curricula for the graduate certificate and master's degree were developed with guidance from lead industry partner Booz Allen Hamilton and is designed to meet the workforce needs of businesses, government agencies, and non-profit organizations. The program is intended for those with	Applicants must hold a bachelor's degree from a regionally accredited institution.
Columbia University	https://www.datascience.columbia.edu/master-of-science-in-data-science	F2F	Data Science, MS	30 credits	$2,178/credit		Individuals looking to strengthen their career prospects or make a career change by developing in-depth expertise in data science.	Requires: Undergraduate degree, prior quantitative coursework (calculus, linear algebra, etc.), Prior introductory computer programming coursework
George Mason	https://www.gmu.edu/program/data-analytics-engineering-ms	F2F or Online	Data Analytics Engineering, MS	30 credits	$679.46/credit	$1,474/credit	Designed to provide students with an understanding of the technologies and methodologies necessary for data-driven decision-making. It is aimed at students who wish to become data scientists and analysts in finance, marketing, operations, business/government intelligence and other information intensive groups generating and consuming large amounts of data.	Applicants must have completed a baccalaureate degree from a regionally accredited program with an earned GPA of 3.00 or better in their 60 highest-level credits. Applicants are expected to have completed a degree in engineering, business, computer science, statistics, mathematics, or information technology, with demonstrated foundational competence in calculus, statistics, and computer programming.
Georgetown University	https://analytics.georgetown.edu/about/	F2F	Data Science and Analytics, MS	30 credits	$2,358/credit		The Data Science and Analytics program provides students with a rigorous training in computational, mathematical, and statistical methods to prepare them for careers in data science and analytics.	This program is appropriate for students who have recently completed degrees with significant mathematical or statistical emphasis, as well as for mid-career professionals who seek professional advancement or a shift in career track.
George Washington University	https://www.programs.gwu.edu/data-analytics	F2F	Data Analytics, MS	30 credits	$2,035/credit		Designed to address the growing demand for professionals skilled in big data and data analytics.	Bachelor's degree with a GPA of at least 3.0 on a 4.0 scale for the last 60 hours of coursework; two courses in mathematics beyond pre-calculus; one year of science with laboratory; courses in computer science using a structured language, discrete structures, data structures, and computer architecture.
Howard University	https://programs.howard.edu/applied-data-science-analytics-ms	Online	Applied Data Science & Analytics, MS	30 credits	$1,481/credit		Howard Graduate School's fully online interdisciplinary M.S. in Applied Data Science and Analytics program prepares data-driven leaders to generate, analyze, interpret, and present complex data in compelling ways that drive solutions to real-world problems. Whether you are interested in	Applicant must have an Online GradCAS application; Statement of purpose/ Statement of academic interest (500-1,000 words); GRE scores not required; Official transcripts sent to GradCAS; 3 letters of recommendation; Bachelor's degree from an accredited college or university Resume or Curriculum Vitae; Autobiographical statement (500-750 words)
James Madison University	https://www.jmu.edu/grad/programs/snapshots/computer-science-info-security.shtml	Online	Computer Science, Information Security Concentration, MS	30 credits	$1,065		This concentration is offered in a remote, electronic distance-learning format that, while satisfying all requirements for the Master of Science program, is especially appropriate for people with professional interests in information security. Further information can be obtained from the program website at	No Information Given
Radford University	https://www.radford.edu/content/csat/home/daim.html	F2F	Data and Information Management	30 credits	$748/credit	$923/credit	As the volume of information continues to explode, so does the need for IT professionals who can maximize the value of information assets while getting the right data to the right people at the right time.	The Master's in Data and Information program requires a solid foundation in computer science. Students entering the program must have a strong academic background covering the topics in: Introduction to Databases, Principles of Computer Science III, Procedural Analysis and Design, Business Calculus, Calculus and Analytic Geometry I.
University of Virginia	https://onlinedatasciencemasters.virginia.edu/	F2F or Online	Data Science, MS	32 credits	$1,377/credit		The new online Master of Science in Data Science (MSDS) from the University of Virginia School of Data Science expands the accessibility of our cutting-edge curriculum beyond Charlottesville.A part-time master's in data science designed for working professionals	Applicants to the Master of Science in Data Science (MSDS) program must earn an undergraduate degree prior to the start of the summer term in which the program starts. A specific undergraduate major or program of study is not required. Students must complete each of the following prerequisites: Single variable calculus, Linear algebra or matrix algebra, Introductory statistics, Introductory programming.
Virginia Tech	http://analytics.cs.vt.edu/edu-daas.php	Blended	Data Analysis and Applied Statistics, MA	33 credits	$806.75/credit	$1,626/credit	Students seeking admission to the M.A. DAAS degree are those wishing to expand their statistical knowledge beyond the material presented in graduate service courses, tackling more specialized topics, whether they are taught statistical methodology by the Department of Statistics or by other programs/departments on campus.	The Department of Statistics and the DAAS program encourage applications from students in fields other than mathematics and statistics to apply. However, successful applicants will have taken Calculus I and II, and a basic Statistics class as an undergraduate and have done well in those courses. In addition, applicants should be able to demonstrate some experience in computer programing, either in a classroom or professional setting.

Other Major Institutions Offering Similar Programs

University	Link	Format	Program	Credits	Cost		Description	Requirements
University of Virginia	https://dsi.virginia.edu/degrees/msds-degree	F2F	Data Science, MS	32 credits	$705/credit	$1,125/credit	Students looking to expand their knowledge and skills in the data science field.	Completed pre-requisite courses in single variable calculus, linear algebra or matrix algebra, introductory statistics, and introductory programming.
Drexel University	https://drexel.edu/cci/academics/graduate-programs/ms-in-data-science/	Online or F2F	Data Science, MS	45 credits	$1,396/credit		Designed for students with or without a bachelor's degree in Data Science. Students looking to gain data analytics knowledge to enhance their current role or seeking a career change.	A four-year bachelor's degree from a regionally accredited institution. Those without a prior degree or sufficient work experience in Computer Science, Software Engineering, or Math (plus programming) may have to take additional prerequisites before pursuing advanced computer science courses.

OES In-House Market Research: Projected Enrollment Information				
Program Name = Data Science, MS				
Occupation	# of Jobs in the Field	Where Professionals are Employed	Professional Salary Information	Projected Job Growth
Information from U.S. Bureau of Labor Statistics' Occupational Outlook Handbook				
Computer and Information Research Scientists	33,500 (2021)	31% - Federal government, excluding postal service 20% - Computer systems design and related services 16% - Research and development in the physical, engineering, and life sciences 6% - Software publishers 5% - Colleges, universities, and professional schools; state, local and private	$131,490 per year (2021) $63.22 per hour (2021)	21% (Much faster than average) 2021-2031
Information from State of Maryland's Occupational and Industry Projections				
Computer and Information Research Scientists	2,873 (2021)	**Top 12** - Computer systems design and related services; - Management and technical consulting services; - Architectural and engineering services; - Scientific research and development services; - Colleges and universities; - Management of companies and enterprises; - Commercial equip. merchant wholesalers; - Wired telecommunications carriers; - Other financial investment activities; - Elementary and secondary schools; - Insurance carriers; - Data processing, hosting and related services;	Annual Mean Wage: $123,324 Annual 10th Percentile: $87,880 Annual 75th Percentile: $142,438	2018-2028 Increase by 7%

							OES In-House Market Research: Projected Enrollment Information						
							Five-Year Enrollment Trends						
Year	Bowie State University	Capitol Technology University	Frostburg State University	Hood College	Johns Hopkins University	Loyola University Maryland	McDaniel College	Morgan State University	Notre Dame of Maryland University	Towson	University of Maryland, Baltimore County	University of Maryland, Eastern Shore	UMGC UMD Global Campus
	Computer Science, MS-Data Science Specialization	Technical Master of Business Administration in Business Analytics	Computer Science, MS-Database concentration	Computer Science	Data Science, MS	Data Science, MS	Data Analytics, MS	Advanced Computing, MS	Analytics, MS	Computer Science, MS Data Science Track	Computer Science, MS	Applied Computer Science	Data Analytics, MS
2017	32	0	40	53	97	23	0	0	9	135	128	10	1998
2018	31	3	47	36	179	29	0	0	5	136	132	12	2048
2019	30	5	70	33	249	34	0	0	6	130	155	9	1993
2020	25	3	58	33	347	44	22	2	4	143	101	7	2106
2021	36	3	49	34	456	35	68	10	5	105	178	7	2126
							Projected						

							Five-Year Degree Recaps						
Year	Bowie State University	Capitol Technology University	Frostburg State University	Hood College	Johns Hopkins University	Loyola University Maryland	McDaniel College	Morgan State University	Notre Dame of Maryland University	Towson	University of Maryland, Baltimore County	University of Maryland, Eastern Shore	UMGC UMD Global Campus
	Computer Science, MS-Data Science Specialization	Technical Master of Business Administration in Business Analytics	Computer Science, MS-Database concentration	Computer Science	Data Science, MS	Data Science, MS	Data Analytics, MS	Advanced Computing, MS	Analytics, MS	Computer Science, MS Data Science Track	Computer Science, MS	Applied Computer Science	Data Analytics, MS
2018	12	0	27	28	0	0	0	0	1	40	34	4	137
2019	12	0	11	13	5	0	0	0	4	32	62	4	115
2020	15	1	20	8	28	3	0	0	3	36	61	5	92
2021	6	1	26	10	37	3	0	0	4	45	70	4	83
2022	8	2	24	11	89	9	2	2	0	33	36	1	113

The learning outcomes for the program will be assessed using a combination of formative and summative assessments during and at the completion of each semester. Each course in the program will have homework assignments, practice sets, and other assessments that will be graded with feedback to help assess the student's learning. Midterms and final exams or projects will be cumulative assessments to determine if and to what level the student mastered the learning outcomes for each course.

The assessments will be appropriate to the nature of the course content and the course learning objectives. Both individual assessments and group assessments will be required in the program. This type of variation best mimics the work and industry expectations. The assessments of the program will mirror work products in the industry and prepare students for jobs in industry. For example, many of the elective courses include final projects, presentations and assignments where students have to work with real data sets. Students will be expected to process the data, and perform tasks and make recommendations that are expected of an entry level data scientist/AI engineer.

Lastly, students will also be challenged to complete reflective assessments to apply knowledge and skills in their future professional work. This work will assist students in the job search process and enable them to identify, apply to, and earn positions in this field. The assessments will all follow best practices for adult and professional students. As the student progresses through the curriculum and satisfies learning objectives, they will align with and accomplish the program-level learning outcomes.

MS in Data Science					
Five-Year Program Budget					
Tuition Revenue	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
A. Total enrolled students	9	19	20	21	23
First year enrollment	9	10	10	11	12
Second year enrollment		9	10	10	11
B. Total # of 3-credit Courses (by enrollment year)	8	10	10	10	10
# of courses offered for students in year one of the program	8	8	8	8	8
# of courses offered for students in year two of the program		2	2	2	2
C. Per Course Rate	$4,000	$4,120	$4,244	$4,371	$4,502
Total Tuition Revenue	$288,000	$403,760	$424,360	$472,058	$531,240
Direct Expenses	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
A. Instructor Salaries and Fringe	$134,927	$173,936	$179,154	$184,529	$190,065
1. Subtotal: Instructor salaries	$103,870	$133,900	$137,917	$142,055	$146,316
Average 3-credit course salary	$13,000	$13,390	$13,792	$14,205	$14,632
Program specific courses (100% FTE)	7	7	7	7	7
Shared courses (33% FTE)	3	3	3	3	3
2. Fringe Benefits: 29.9%	$31,057	$40,036	$41,237	$42,474	$43,749
Total Direct Expenses	$134,927	$173,936	$179,154	$184,529	$190,065
Total Annual Tuition Revenue	$288,000	$403,760	$424,360	$472,058	$531,240
Total Annual Direct Expenses	$134,927	$173,936	$179,154	$184,529	$190,065
Total Annual OES Administrative Fee	$28,800	$40,376	$42,436	$47,206	$53,124
Annual Distributable Revenue	$124,273	$189,448	$202,770	$240,323	$288,051

Indirect Expenses					
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Administrative Salaries and Fringe	$53,692	$55,303	$56,962	$58,671	$60,431
1. Administrative Salaries	$39,596	$40,784	$42,007	$43,268	$44,566
Director (20% FTE)	$25,846	$26,621	$27,420	$28,243	$29,090
Faculty Director Stipend	$15,000	$15,450	$15,914	$16,391	$16,883
Program Manager (33% FTE)	$13,750	$14,163	$14,587	$15,025	$15,476
2. Fringe Benefits: 35.6%	$14,096	$14,519	$14,955	$15,403	15,865
Hourly Wages	$38,736	$51,648	$52,552	$53,474	$54,414
1. Hourly Wages	$36,000	$48,000	$48,840	$49,697	$50,571
Graders for program specific courses ($6K per course)	30,000	42,000	42,840	43,697	44,571
Graders for shared courses ($2K per course)	6,000	6,000	6,000	6,000	6,000
2. Hourly Wages Benefits: 7.6%	$2,736	$3,648	$3,712	$3,777	$3,843
Marketing	$2,500	$2,575	$2,652	$2,732	$2,814
1. Marketing	2,500	2,575	2,652	2,732	2,814
Equipment	$1,500	$1,545	$1,591	$1,639	$1,688
1. Equipment	1,500	1,545	1,591	1,639	1,688
Travel & Recruitment	$1,500	$1,545	$1,591	$1,639	$1,688
1. Travel & Recruitment	$1,500	$1,545	$1,591	$1,639	$1,688
Total Indirect Expenses	$97,928	$112,616	$115,349	$118,155	$121,035

Net Revenue	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
OES Distribution to CMNS	$124,273	$189,448	$202,770	$240,323	$288,051
Indirect Expenses	$97,928	$112,616	$115,349	$118,155	$121,035
Balance	**$26,345**	**$76,832**	**$87,421**	**$122,169**	**$167,016**

DATE: April 25, 2019
TO: Matthew M. Nessan, Associate Director, Programs; Office of Extended Studies
FROM: On behalf of the University of Maryland Libraries:
Nevenka Zdravkovska, Head, STEM Library
Maggie Saponaro, Head of Collection Development
Daniel Mack, Associate Dean, Collection Strategies & Services

RE: Master of Professional Studies in Data Science and Analytics - Library Collection

Assessment

The University of Maryland Libraries are providing this assessment in response to a proposal by the Science Academy of the College of Computer, Mathematical, and Natural Sciences (CMNS) to create a Master of Professional Studies (MPS) in Data Science and Analytics. This program asked that we at the University of Maryland Libraries assess our collection resources to determine how well the Libraries support the curriculum of this proposed MPS in Data Science and Analytics.

Serial Publications
The University of Maryland Libraries currently subscribe to a large number of scholarly journals, with almost all in online format that focus on various specialties within Computer Science applications, including Data Science, Big Data, Analytics, and Machine Learning. The Libraries subscribe to several of high ranked journals that are listed in Journal Citation Reports* under the categories: Mathematics, Interdisciplinary Applications or Computer Science, Interdisciplinary Applications. Among the journals relevant to data science and analytics are the following journals, all available online:
- Computational Statistics and Data Analysis
- EPJ Data Science
- Statistical Analysis and Data Mining
- International Journal of Data Science and Analytics [new journal]
- Journal of Machine Learning Research
- Machine Learning

Also, the Libraries have subscription to IEEE and ACM publications, which are numerous and can be accessed through the relevant databases, as discussed below.
Due the interdisciplinary research and instruction inherent in data science and analytics, there may be highly-ranked core journals to which the Libraries do not currently subscribe. However, articles in journals that we do not own likely will be available through Interlibrary Loan/Document Delivery.

Databases
The Libraries' Database Finder (http://www.lib.umd.edu/dbfinder) resource offers online access to databases that provide indexing and access to scholarly journal articles and other information sources. Many of these databases cover subject areas that would be relevant to this proposed program, especially since due to the interdisciplinary applications of data

science and analytics. Databases that would most be useful in the field of machine learning are
- IEEE Xplore
- ACM Digital Library
- ScienceDirect

In many and likely in most cases, these indexes offer full text copies of the relevant journal articles. In those instances that the journal articles are available only in print format, the Libraries can make copies
available to graduate students through either the Libraries' Scan & Deliver Program (http://www.lib.umd.edu/access/scan-deliver) or via Interlibrary Loan (more details given below).

Monographs
The Libraries regularly acquire scholarly monographs in data science and analytics and allied subject disciplines. Monographs not already part of the collection can usually be added upon request. The Libraries has also acquired many eBooks and eBook collections, like:
- Springer eBooks in Computer Science and Springer eBooks (2005-2011)
- SIAM eBooks
- SPIE eBooks
- Synthesis Digital Library (Morgan & Claypool)
- IEEE/Wiley eBooks

A search of the University of Maryland Libraries' WorldCat UMD catalog was conducted, using a variety of relevant subject terms. This investigation yielded sizable lists of citations of books that we own related to data science and analytics. In addition, we own hundreds of monographs published within the last five years, insuring the program has access to relevant and recent holdings. Additionally, the Libraries' membership in the Big Ten Academic Alliance (BTAA) increases these holdings. As with our own materials, graduate students can request that chapters be copied from these BTAA books if the books are not available electronically.

Scan & Deliver and Interlibrary Loan
These services offer online delivery of bibliographic materials that otherwise would not be available online. As a result, remote users who take online courses may find these services to be helpful. Scan & Deliver and Interlibrary Loan are available free of charge.
The Scan & Deliver service scans and delivers journal articles and book chapters within three business days of the request--provided that the items are available in print on the UM Libraries' shelves or in microform. In the event that the requested article or chapter is not available on campus, Scan & Deliver will automatically refer the request to Interlibrary Loan (ILL). Interlibrary Loan is a service that enables borrowers to obtain online articles and book chapters from materials not held in the University System of Maryland.

Additional Materials and Resources
In addition to serials, monographs, and databases available through the University Libraries, students in

the proposed program will have access to a wide range of media, datasets, software, and technology.

- Library Media Services (http://www.lib.umd.edu/lms) houses media in a variety of formats that can be utilized both on-site and via ELMS course media.
- GIS Datasets are available through the GIS Data Repository (https://www.lib.umd.edu/gis/data-and-resources).
- Statistical consulting and additional research support are available through the Research Commons (http://www.lib.umd.edu/rc), and technology support and services are available through the Terrapin Learning Commons (http://www.lib.umd.edu/tlc).

Additionally, although not likely to be highly used by this program, UMD does have a number of microform collections, which may be of use for interdisciplinary research. Finally, the STEM Library is a Patent and Trademark Resource Center and provides patent and trademark research consultation. The subject specialist librarian for Computer Science is Nevenka Zdravkovska (Nevenka@umd.edu) and will also serve as an important resource to programs such as the one proposed.

Other Research Collections
Because of the University's unique physical location near Washington D.C., Baltimore and Annapolis, University of Maryland students and faculty have access to some of the finest libraries, archives and research centers in the country vitally important for researchers in this discipline. These include the Library of Congress, the National Archives, the Smithsonian, and more available for research use.

Conclusion
With our substantial journals holdings and index databases, as well as additional support services and resources, the University of Maryland Libraries have the resources to support teaching and learning in data science and analysis. These materials are supplemented by a strong monograph collection and additional holdings through the Big Ten Academic Alliance. Additionally, the Libraries Scan & Deliver and Interlibrary Loan services make materials that otherwise would not be available online, accessible to remote users. As a result, our assessment is that the University of Maryland Libraries are able to meet the curricular and research needs of the proposed MPS in Data Science and Analysis to be offered from the College of Computer, Mathematical, and Natural Sciences (CMNS).

*Journal Citation Reports is a tool for evaluating scholarly journals. It computes these evaluations from the relative number of citations compiled in the Science Citation Index and Social Sciences Citation Index database tools.

Faculty Information- Data Science

The following faculty members are projected to teach in the program. All faculty are full-time unless otherwise indicated.

Name	Highest Degree Earned, Program, and Institution	UMD Title (indicate if part-time)	Courses
Babak Azimi-Sadjadi	Ph.D., ECE, UMD	Visiting Lecturer	DATA/MSML 603: Principles of Machine Learning
Sandra Cerrai	Ph.D., Mathematics, Scuola Normale Superiore of Pisa	Prof & Assoc Chair	DATA/MSML 601: Probability and Statistics
Michael Cummings	Ph.D., Organismic and Evolutionary Biology, Harvard University	Professor	DATA698: Research Methods and Study Design
Wojtek Czaja	Ph.D. Washington University, St. Louis	Professor	DATA 604: Data Representation and Modeling
Mohammad Taghi Hajiaghayi	Ph.D., Computer Science, MIT	Professor	DATA/MSML 602: Principles of Data Science
Leonid Koralov	Ph.D., Mathematics, SUNY at Stony Brook	Prof & Assoc Chair	DATA/MSML 601: Probability and Statistics
Alejandra Mercado	Ph.D., ECE, UMD	Associate Director	DATA/MSML 603: Principles of Machine Learning
Abdirisak Mohamed	Ph.D. Mathematics, Karlsruhe institute of Technology	Lecturer	DATA 606: Algorithms for Data Structures
Vincent Paul Lyzinski	Ph.D. in Applied Mathematics and Statistics, Johns Hopkins University	Associate Professor	DATA607: Communication in Data Science and Analytics
Arefeh A Nasri	Ph.D., Transportation Engineering, UMD	Visiting Lecturer	DATA/MSML 602: Principles of Data Science
Zoltan Safar	Ph.D., ECE, UMD	Director	DATA/MSML650: Cloud Computing
Giacinto Saggese	Ph.D. ECE, University of Illinois Urbana-Champaign	Lecturer	DATA 605: Big Data Systems
Shabnam Tafreshi	Ph.D., Computer Science, George Washing University	Asst Research Scientist, ARLIS	MSML641- Natural Language Processing
Jerry Wu	Ph.D., RF MEMS, George Washington University	Lecturer	MSML642: Robotics

PCC Proposal to Establish a Master of Science in Bioinformatics and Computational Biology

PRESENTED BY	Wendy Stickle, Chair, Senate Programs, Curricula, and Courses Committee
REVIEW DATES	SEC – October 20, 2023	SENATE – November 1, 2023
VOTING METHOD	In a single vote
RELEVANT POLICY/DOCUMENT	
NECESSARY APPROVALS	Senate, President, USM Board of Regents, and the Maryland Higher Education Commission

ISSUE

The College of Computer, Mathematical, and Natural Sciences proposes to establish a Master of Science in Bioinformatics and Computational Biology. This program exists currently as an iteration of the Master of Professional Studies (MPS) program. The 30-credit MPS program was approved in 2022 and the first group of incoming students began in Fall 2023. Master of Professional Studies programs were first approved in 2005, when the University System of Maryland Board of Regents and Maryland Higher Education Commission approved an expedited review process for master's and graduate certificate programs that respond quickly to the changing market needs of working professionals. Once a new iteration of the MPS is approved through campus PCC review, it only needs approval by the USM Chancellor to become official.

A limitation of offering this program as an MPS iteration is that all Professional Studies programs must use the same generic Federal Classification of Instructional Programs (CIP) code, rather than a CIP code that accurately describes the program content. Those who search for academic programs by using the CIP codes related to Bioinformatics or Computational Biology will not find this program. Moreover, some CIP codes are designated as "STEM" eligible by the US Department of Homeland Security, and international students with F1 visas who graduate from STEM designated programs may continue to work in the United States for two years longer than students in non-STEM designated programs. The generic CIP code for Professional Studies programs does not qualify as STEM-designated, even if the academic content of the Professional Studies program is STEM-related, as is the case with this program.

Consequently, the college proposes to transition the current program from a Master of Professional Studies program to a stand-alone Master of Science program in order to be classified more accurately. The 30-credit curriculum will remain the same.

The Master of Science in Bioinformatics and Computational Biology will provide students with an education in the theory and practice of the major current areas in the field including biological problem contexts, mathematical and statistical foundations, computational approaches, communication, and ethical, privacy and legal considerations. In addition to the fundamentals of bioinformatics and computational biology, the program covers relevant probability and statistics,

data structures and algorithms, and machine learning. The program consists of nine required 3-credit courses and one 3-credit elective requirement. The program is a non-thesis program and will have both an in-person and distance education version. Graduates of the program will be able to explain multiple problem-solving methods in bioinformatics and computational biology and apply these methods to problems in biology and biomedical research. Students will be able to interpret and infer results of bioinformatics and computational biology analyses to different audiences and communicate results with considerations of ethical, privacy, and legal issues.

The proposal was approved by the Graduate School PCC committee on September 27, 2023, and the Senate Programs, Curricula, and Courses committee on October 6, 2023.

RECOMMENDATION(S)

The Senate Committee on Programs, Curricula, and Courses recommends that the Senate approve this new academic program.

COMMITTEE WORK

The committee considered this proposal at its meeting on October 6, 2023. Michael Cummings, Amy Chester, and John Fourkas, from the College of Computer, Mathematical, and Natural Sciences, presented the proposal and answered questions from the committee. The committee unanimously approved the proposal.

ALTERNATIVES

The Senate could decline to approve this new academic program.

RISKS

If the Senate declines to approve this new degree program, the university will lose an opportunity to apply a more accurate Federal CIP code to an existing program thereby making the program more marketable.

FINANCIAL IMPLICATIONS

There are no significant financial implications with this proposal as the program already exists as a self-supported Master of Professional Studies program.

925: BIOINFORMATICS AND COMPUTATIONAL BIOLOGY

In Workflow

1. CMNS PCC Chair (jpresson@umd.edu; fourkas@umd.edu)
2. CMNS Dean (rinfanti@umd.edu)
3. Academic Affairs Curriculum Manager (mcolson@umd.edu)
4. Graduate School Curriculum Manager (jfarman@umd.edu)
5. Graduate PCC Chair (jfarman@umd.edu)
6. Dean of the Graduate School (jfarman@umd.edu; sroth1@umd.edu)
7. Senate PCC Chair (mcolson@umd.edu; wstickle@umd.edu)
8. University Senate Chair (mcolson@umd.edu)
9. President (mcolson@umd.edu)
10. Board of Regents (mcolson@umd.edu)
11. MHEC (mcolson@umd.edu)
12. Provost Office (mcolson@umd.edu)
13. Graduate Catalog Manager (bhernand@umd.edu; fantsao@umd.edu)

Approval Path

1. Thu, 27 Apr 2023 21:52:46 GMT
   John Fourkas (fourkas): Approved for CMNS PCC Chair
2. Fri, 28 Apr 2023 17:34:12 GMT
   Robert Infantino (rinfanti): Approved for CMNS Dean
3. Wed, 06 Sep 2023 18:17:26 GMT
   Michael Colson (mcolson): Approved for Academic Affairs Curriculum Manager
4. Fri, 29 Sep 2023 20:03:48 GMT
   Jason Farman (jfarman): Approved for Graduate School Curriculum Manager
5. Fri, 29 Sep 2023 20:08:50 GMT
   Jason Farman (jfarman): Approved for Graduate PCC Chair
6. Wed, 04 Oct 2023 20:48:16 GMT
   Stephen Roth (sroth1): Approved for Dean of the Graduate School
7. Sat, 07 Oct 2023 17:30:30 GMT
   Wendy Stickle (wstickle): Approved for Senate PCC Chair

New Program Proposal

Date Submitted: Thu, 27 Apr 2023 19:45:55 GMT

Viewing: 925 : Bioinformatics and Computational Biology
Last edit: Mon, 31 Jul 2023 21:24:10 GMT

Changes proposed by: Michael Cummings (mcummin1)

Program Name

Bioinformatics and Computational Biology

Program Status

Proposed

Effective Term

Spring 2024

Catalog Year

2023-2024

Program Level

Graduate Program

Program Type

Master's

Delivery Method

On Campus

Departments

Department
Computer, Mathematical, and Natural Sciences

Colleges

College
Computer, Mathematical, and Natural Sciences

Degree(s) Awarded

Degree Awarded
Master of Science

Proposal Contact

Michael Cummings, Amy Chester

Proposal Summary

This proposal is to convert the existing MPS in Bioinformatics and Computational Biology to an MS in Bioinformatics and Computational Biology. Proposed CIP code: 26.1199 Biomathematics, Bioinformatics, and Computational Biology, Other

(PCC Log Number 23008)

Program and Catalog Information

Provide the catalog description of the proposed program. As part of the description, please indicate any areas of concentration or specializations that will be offered.

The Master of Science in Bioinformatics and Computational Biology provides education in the theory and practice of the major current areas in the field including biological problem contexts, mathematical and statistical foundations, computational approaches, communication, and ethical, privacy and legal considerations. In addition to the fundamentals of bioinformatics and computational biology, the program covers relevant probability and statistics, data structures and algorithms, and machine learning. The program consists of 30-credit course work and is a non-thesis MS program.

Catalog Program Requirements:

Course	Title	Credits
Core Requirements		
BIOI601	Probability and Statistics	3
BIOI602	Principles of Data Science	3
BIOI603	Principles of Machine Learning	3
BIOI604	Course BIOI604 Not Found (Principles of Molecular Biology, Genetics, and Genomics)	3
BIOI605	Course BIOI605 Not Found (Data Sources and Data Management in Bioinformatics)	3
BIOI606	Course BIOI606 Not Found (Sequence and Alignment)	3
BIOI607	Course BIOI607 Not Found (Data Structures and Algorithms for Bioinformatics)	3
BIOI610	Course BIOI610 Not Found (Genome Annotation)	3
BIOI611	Course BIOI611 Not Found (Analysis of Gene Expression Data)	3
Elective Requirement (choose one of the following):		**3**
BIOI621	Course BIOI621 Not Found (Genome Assembly and Annotation)	
BIOI622	Course BIOI622 Not Found (Metagenomics Data Analysis)	
BIOI699	Course BIOI699 Not Found (Capstone Research)	
Total Credits		**30**

Sample plan. Provide a term by term sample plan that shows how a hypothetical student would progress through the program to completion. It should be clear the length of time it will take for a typical student to graduate. For undergraduate programs, this should be the four-year plan.

SAMPLE PLAN OF STUDY (PART-TIME, TWO 3-CREDIT COURSES PER SEMESTER)

UPDATED JULY 2023

Semester 1 (fall)

- BIOI601 Probability & Statistics (Core)
- BIOI604 Principles of Molecular Biology, Genetics, and Genomics (Core)

Semester 2 (spring)

- BIOI605 Data Sources and Data Management in Bioinformatics (Core)
- BIOI606 Sequence Alignment (Core)

Semester 3 (summer)

- BIOI610 Genome Annotation (Core)

Semester 4(fall)

- BIOI602 Principles of Data Science (Core)
- BIOI611 Analysis of Gene Expression Data (Core)

Semester 5 (spring)

- BIOI603 Principles of Machine Learning (Core)
- BIOI607 Data Structures and Algorithms for Bioinformatics (Core)

Semester 6 (summer)- no classes

Semester 7 (fall)

- BIOI621 Genome Assembly and Annotation (Elective)

Full Time
Semester 1(Fall)

- BIOI601 Probability & Statistics (Core)
- BIOI602 Principles of Data Science (Core)
- BIOI604 Principles of Molecular Biology, Genetics, and Genomics (Core)

Semester 2(Spring)

- BIOI605 Data Sources and Data Management in Bioinformatics (Core)
- BIOI606 Sequence Alignment (Core)
- BIOI607 Data Structures and Algorithms for Bioinformatics(Core)

Semester 3(summer)

- BIOI610 Genome Annotation (Core)

Semester 4(Fall)

- BIOI603 Principles of Machine Learning (Core)
- BIOI611 Analysis of Gene Expression Data (Core)
- BIOI621 Genome Assembly and Annotation (Elective)

List the intended student learning outcomes. In an attachment, provide the plan for assessing these outcomes.

Learning Outcomes
Explain multiple problem-solving methods in bioinformatics and computational biology.
Apply bioinformatics and computational biology methods to problems in biology and biomedical research.
Interpret and infer results of bioinformatics and computational biology analyses to different audiences.
Communicate results of analyses with considerations of ethical, privacy and legal issues

New Program Information

Mission and Purpose

Describe the program and explain how it fits the institutional mission statement and planning priorities.

Bioinformatics and computational biology are critical areas at the nexus of life sciences, computer science, and data science. Maryland is among the top locations in the nation for biomedical research, the home of the National Institutes of Health, and home to numerous pharmaceutical and biotechnology companies. There is a tremendous need for graduate-level training at the local, national, and international levels. The program will serve a student population mostly consisting of experienced professionals that fall in the categories of "Career Advancers" who work in a related discipline,

and "Career Crossers" working in an unrelated discipline. Professionals in these categories place priority on flexible delivery, professional development, and interdisciplinary pathways.

This proposed self-supported graduate program allows the University of Maryland to serve additional students above and beyond the resources provided by the state while fulfilling demonstrated higher education and workforce needs. This program aligns with the missions of the University of Maryland; College of Computer, Mathematical, and Natural Sciences; and the Science Academy within the College.

Program Characteristics

What are the educational objectives of the program?

Students from this program should be able to identify, choose, describe, explain, and apply bioinformatics and computational biology methods to problems in biology and biomedical research, and to interpret, infer, and communicate results of bioinformatics and computational biology analyses to different audiences, with consideration of ethical, privacy and legal issues.

Our curriculum design philosophy is that ethical, privacy and legal considerations are integrated throughout the program, with specific topical coverage relevant to other material being taught. For example, the Health Insurance Portability and Accountability Act (HIPAA) and other privacy concerns are covered in courses dealing with analyses of personal identifying information, or analyses of data where identification might be inferred (e.g., some DNA data). Whereas ethical considerations related to samples (e.g., tissue) and informed consent are covered in courses related to data collection and subsequent analyses. Thus, these and related topics are reinforced in a context-specific manner throughout the curriculum.

Describe any selective admissions policy or special criteria for students interested in this program.

Applicants must have earned a four-year baccalaureate degree from a regionally accredited U.S. institution, or an equivalent degree from a non-U.S. institution.

Applicants must have earned a 3.0 GPA (on a 4.0 scale) in all prior undergraduate and graduate coursework.

Applicants must provide an official copy of a transcript for all post-secondary work.

International applicants must fulfill all requirements relating to international academic credentials, evidence of English proficiency, financial certification, and visa documentation.

Personal statement including such elements as relevant experience. The admissions criteria will include education or work experience in biological/biomedical sciences, mathematics, statistics, and computer science deemed sufficient for success in the program. These criteria, apart from those related to biological/biomedical sciences, are like those for the MS programs in Data Science, and Machine Learning. Students also can submit an optional essay during the admissions process to explain any deficient areas or to share additional context to their previous academic performances. This will ensure all applicants have a chance to be considered and share how/why they are prepared for academic success in the program.

Summarize the factors that were considered in developing the proposed curriculum (such as recommendations of advisory or other groups, articulated workforce needs, standards set by disciplinary associations or specialized-accrediting groups, etc.).

The motivation for the program is based on the perceived need for the training the program is designed to provide. The faculty within the Center for Bioinformatics and Computational Biology are very frequently contacted about available positions, the qualifications for which would be provided by the program. These perceived needs comport with the market analysis (attached), and success of similar programs in the state, region, and country more broadly. There is a shortage of qualified professionals in bioinformatics and computational biology. Maryland is home to over 2000 life science businesses, and the DMV region has the third largest concentration of biotech and bio-pharmaceuticals companies in the country.

The proposed curriculum was developed through extensive discussions with the faculty in the Center for Bioinformatics and Computational Biology, each of whom has domain science expertise in different areas of the field and extensive collaborative research experience including with non-academic partners. Furthermore, many of our PhD students have been placed in various academic, government and industry settings and we are familiar with the training relevant for those positions.

Select the academic calendar type for this program (calendar types with dates can be found on the Academic Calendar page)

Traditional Semester

For Master's degree programs, describe the thesis requirement and/or the non-thesis requirement.

master's non-thesis

Identify specific actions and strategies that will be utilized to recruit and retain a diverse student body.

The primary recruitment activities will be via the CMNS Science Academy. The Science Academy uses a diverse, targeted approach when recruiting students. This digital strategy focuses on UMD alumni, current UMD graduating seniors, and working professionals in the DMV area. The admissions review process reviews for not only academic readiness but also diversity in experiences, industries, backgrounds, and career aspirations to recruit a diverse student body.

To attract a diverse student population, we will engage in the following activities:
• Representing the program in educational fairs, conferences and events, e.g. the National Leadership Conference of the National Society of Black Engineers, GEM Grad Labs.

• Advertising the program to the National Society of Black Engineers (NSBE), the Society of Women Engineers (SWE), and the Association for Women in Computing (AWC).
• Direct mailing and email campaigns to domestic and international colleges
• Outreach to UMD Campus organizations and clubs
• Holding online (virtual) open houses, information sessions and career panels
• Outreach to US Military to attract veterans
• Social media and online advertising
• Establishing graduate scholarships to provide financial aid to underrepresented minority applicants

Once enrolled, the Science Academy staff, and faculty are committed to creating and fostering a supportive environment for all students to thrive. We regularly share resources and opportunities for counseling, support, and funding. All students are expected to complete and honor the TerrapinSTRONG orientation and initiatives. Students are encouraged to take part in Grad School programs that address diversity and inclusion in higher education, build communities of support and success, and create meaningful dialogue among graduate students. Such programs include"Cultivating Community Conversations" and the "Annual Office of Graduate Diversity and Inclusions Spring Speaker Services." Faculty that are involved in the Science Academy represent many departments, have a diversity of appointments (both tenure track, professional track, and adjunct) exposing students to many future career paths. The Science Academy and faculty provide student advising, academic support, and career guidance to students to retain all students and support timely graduation.

Our student retention efforts will consist of:
• Holding "Women in Engineering, Computing and STEM" seminars to addresses the obstacles faced by women in today's technical workplace and guide our women students to maneuver through the internship and job application process
• Requiring students to attend mandatory advising sessions with the program adviser to ensure that the students' study plans are in line with their interests and career goals, and that the students make satisfactory progress toward meeting the degree requirements
• Implementing an early warning system that detects students struggling with core courses and alerts the academic advisor, who meets with the students and designs a study plan to get them back on track

Relationship to Other Units or Institutions

If a required or recommended course is o#ered by another department, discuss how the additional students will not unduly burden that department's faculty and resources. Discuss any other potential impacts on another department, such as academic content that may significantly overlap with existing programs. Use space below for any comments. Otherwise, attach supporting correspondence.

None of the courses in the program are currently offered by any department, nor do existing courses target the intended student population. Apart from the three courses shared with current programs with the CMNS Science Academy, all courses for the program will be new, and thus should not burden department faculty and resources. Instructors for the program courses will be a combination of tenure-track or professional-track faculty teaching on overload, and adjuncts. There is no substantial programmatic overlap with any existing program, and no existing program targets the specific student population for which this program and degree are designed.

Three of the proposed courses are to be co-listed versions of courses in common with the MS programs in Data Science, and Machine Learning: BIOI/DATA/MSML 601, Probability and Statistics; BIOI/DATA/MSML 602, Principles of Data Science; and BIOI/DATA/MSML 603, Principles of Machine Learning. These three courses are foundational to modern quantitative and computational-based science, and thus are common to the existing programs and the proposed program. All the remaining core courses will be new to the program, and some electives may be accepted from other programs. All programs are managed by the Science Academy.

Accreditation and Licensure. Will the program need to be accredited? If so, indicate the accrediting agency. Also, indicate if students will expect to be licensed or certified in order to engage in or be successful in the program's target occupation.

No accreditation or licensure is required for the program.

Describe any cooperative arrangements with other institutions or organizations that will be important for the success of this program.

No formal cooperative arrangements with other institutions or organizations are important for the success of the proposed program.

Faculty and Organization

Who will provide academic direction and oversight for the program? In an attachment, please indicate the faculty involved in the program. Include their titles, credentials, and courses they may teach for the program.

The Oversight Committee will be composed of the following individuals: Graduate Director, Professor Michael P. Cummings (approved by Dean and departmental chair); Professor Najib El-Sayed (approved by departmental chair); and Amy Chester, Director of the Science Academy, CMNS. Academic coordination of the program will be the responsibility of the Director, Master of Professional Studies Program in Bioinformatics and Computational Biology.

Indicate who will provide the administrative coordination for the program

The Science Academy in the College of Computer, Mathematics and Natural Science will provide administrative coordination for the program, in collaboration with the Office of Extended Studies. The Office of Extended Studies provides program development support (budget development and

projections, in house marketing research, preparation of PCC document), program management (UMD policies and procedures compliance, program website, data requests), student and program services (admission support, scheduling,
registration, billing and payment, graduation, appeals), and financial management (faculty contracts, payment processing, course charge processor, net revenue distribution).

Resource Needs and Sources

Each new program is required to have a library assessment prepared by the University Libraries in order to determine any new library resources that may be required. This assessment must be done by the University Libraries. Add as an attachment.

The library assessment is attached

Discuss the adequacy of physical facilities, infrastructure and instructional equipment.

No additional physical facilities, infrastructure and instructional equipment is required for this program. Existing facilities (e.g., classrooms) and resources (e.g., instructional equipment) will be used, and these are demonstrably adequate for the proposed program. It is anticipated that most of the instruction will be in the evenings, as befitting the target student population of working adults. Thus, the use of classrooms will be outside the hours used for instruction by most other programs.

Discuss the instructional resources (faculty, staff, and teaching assistants) that will be needed to cover new courses or needed additional sections of existing courses to be taught. Indicate the source of resources for covering these costs.

Instructional resources for the program will comprise current tenure track faculty, professional track faculty, and adjunct instructors, as is the case with the Graduate programs in Data Science and Analytics, and Machine Learning. These instructional personnel will come from the Center for Bioinformatics and Computational Biology, departments listed elsewhere in this proposal, and outside the university (e.g., National Institutes of Health, industry). The funding source of covering instructional costs will come from tuition both from the program and the Science Academy if needed. No state resources will be used to support the program.

Discuss the administrative and advising resources that will be needed for the program. Indicate the source of resources for covering these costs.

The CMNS Science Academy will provide the academic and advising oversight to incoming and admitted students. Revenue generated from the program will be used to support administrative and advising resources including a Program Manager. No state resources will be used to support the program

Use the Maryland Higher Education Commission (MHEC) commission financial tables to describe the program's financial plan for the next five years. See help bubble for financial table template. Use space below for any additional comments on program funding.

The Office of Extended Studies (OES) has prepared a five-year financial projection, which is attached.

Implications for the State (Additional Information Required by MHEC and the Board of Regents)

Explain how there is a compelling regional or statewide need for the program. Argument for need may be based on the need for the advancement of knowledge and/or societal needs, including the need for "expanding educational opportunities and choices for minority and educationally disadvantaged students at institutions of higher education." Also, explain how need is consistent with the Maryland State Plan for Postsecondary Education.

See support document attachment, Market Analysis, for a full analysis of the market as of March 2023. Our research indicates a faster than average growth in bioinformatic scientist positions in the field with Maryland is the second highest employment level and the second highest top paying state for Bioinformatics Scientists. Other similar programs in the State of Maryland are all MS degrees. Our program will be differentiated and attractive to the professional learner in its applied nature. Lastly, following the enrollment trends at other Maryland programs, coupled with the projected job growth in this area, the program anticipates enrollment greater than 10 students per year, recovering costs no later than 2 years of operation.

Present data and analysis projecting market demand and the availability of openings in a job market to be served by the new program. Possible sources of information include industry or disciplinary studies on job market, the USBLS Occupational Outlook Handbook, or Maryland state Occupational and Industry Projections over the next five years. Also, provide information on the existing supply of graduates in similar programs in the state (use MHEC's Office of Research and Policy Analysis webpage for Annual Reports on Enrollment by Program) and discuss how future demand for graduates will exceed the existing supply. As part of this analysis, indicate the anticipated number of students your program will graduate per year at steady state.

US Bureau of Labor Statistics indicate a much faster than average growth in health information technologists and mathematicians/statisticians occupations, 17% and 31% respectively. These positions are found across the federal government, professional and technical services, hospitals, higher education, and other employment locations.

Identify similar programs in the state. Discuss any di#erences between the proposed program and existing programs. Explain how your program will not result in an unreasonable duplication of an existing program (you can base this argument on program di#erences or market demand for graduates). The MHEC website can be used to find academic programs operating in the state: http://mhec.maryland.gov/institutions_training/pages/HEPrograms.aspx

While other programs in the state do exist, most are either clinical focused and or only available in an online or blended space. The UMD program will be available both in person and online with an applied and experiential approach.

Discuss the possible impact on Historically Black Institutions (HBIs) in the state. Will the program affect any existing programs at Maryland HBIs? Will the program impact the uniqueness or identity of a Maryland HBI?

Our research indicated that Morgan State has a small MS program in Bioinformatics. The UMD program would complement the Morgan State program and provide an opportunity to strengthen the offerings in the state rather than competing. The State of Maryland is seeing tremendous growth in this area and our offering will expand opportunities for state and regional professionals.

Morgan State University MS in Bioinformatics is a 5-course plus thesis degree program, whereas the UMD program is a 10-course program. The UMD program is further distinguished by having a much broader topical coverage within bioinformatics and computational biology, and provides a stronger and broader foundation in data science, machine learning, data structures, and other areas, which are increasingly important in the field.

Supporting Documents

Attachments

Bioinformatics_Market_Research_2023 (1).xlsx
MS in Bioinformatics and Computational Biology Budget.xlsx
LIbrary_Collection_Assessment_Computational_Biology.docx
Faculty List Template- Bioinformatics.docx
Appendix 2 Summary of Learning Outcome Assessments 7-31-2023.pdf
Appendix 6 Bioinformatics Course Descriptions.pdf

Key: 925

	OES In-House Market Research: Other Institution Comparison								
	Program Name = Bioinformatics, M.S.								
Institution	**Website**	**Delivery Method**	**Degree Name & Type (MPS, MA, MS, MPH, etc.)**	**# of Credits**	**Program Duration**	**Tuition (course or credit)**		**Target Population**	**Prior Education/ Pre-Requisites**
						Resident	**Non-Resident**		
Big Ten Institutions									
University of Illinois Urbana-Champaign	https://ischool.illinois.edu/degrees-programs/ms-bioinformatics	F2F	Bioinformatics, M.S.- Information Sciences Concentration	36	Program can be completed in 1 year	$14,578/year	$26,990/year	Students seeking a promising career in managing information produced in a range of biomedicine settings and in creating health care systems that connect the available data and analytics to improve medicine and public health.	Bachelor's degree with at least 3.0 GPA in last two years of coursework. If an applicant's GPA is below a 3.0, then GRE test scores are required. Applicants are required to have strong backgrounds in information science, including undergraduate computing and mathematics- CS Data Structures, CS- Intro Programming, Math-Matrix Theory, and Math-Intro Statistics
Indiana University Bloomington	https://cs.indiana.edu/programs/ms-bioinformatics.html	F2F	Bioinformatics, M.S.	30	Program can be completed in 2 years	$10,630/year	$30,704/year	Designed for students interested in learning how to model, analyze, and manage massive amounts of biological data.	M.S. in Bioinformatics students are expected—but not required—to have at least introductory knowledge of both biology and informatics, including: 1. Approximately 6 credit hours of undergraduate coursework in biology, covering molecular biology, genetics, and evolution, 2. Approximately 6 credit hours of undergraduate coursework in computer science or informatics, covering programming, discrete structures, and data structures If you haven't completed these prerequisites, you will be required to take one or two appropriate 500-level background classes.
University of Iowa	https://informatics.grad.uiowa.edu/programs/bioinformatics-and-computational-biology	F2F	Bioinformatics, MS	31		$605/credit		This program provides competency in fundamental biological sciences as well as computing, math, and statistics that are essential in pursuing a career, academic or otherwise, that depends on bioinformatics and/or computational analyses of biological information.	Applicants are expected to have 6 hours of undergraduate work in computer science and/or informatics and 6 hours in biology (covering genetics, molecular biology and evolution). Work experience may be considered as meeting some of these prerequisite requirements, as determined by the UI Academic Affairs Committee.
University of Michigan Ann Arbor	https://medicine.umich.edu/dept/dcmb/education/degrees/masters-program	F2F	Bioinformatics, M.S.	30	The majority of full-time students can complete the degree in 1 ½ years	$2,033/credit	$3,473/credit	prepares students for a wide range of consulting and applied research positions in industry, government, and academia. The Master's degree also offers outstanding training for students who may be interested in pursuing a Ph.D. but feel that they are not quite prepared (for example, when returning to academics after a period in the work force).	Some academic background in at least two of the following areas or strong academic background in one – molecular biology, biochemistry, mathematics, statistics, computer science – are highly considered. Proven interest in bioinformatics by taking classes, attending workshops or conferences, or working on research projects that are related to biological data analysis is also highly considered.
	https://medicine.umich.edu/dept/dcmb/education/degrees/accelerated-masters-program	F2F	Bioinformatics, Accelerated Master's Program	30	Students complete B.A and M.S in five years	$2,033/credit	$3,473/credit	The Accelerated Master's Degree Program is an excellent way for UM undergraduates to acquire applicable knowledge and skills in bioinformatics as they complete their studies, plus explore overlapping interests. Students start taking Bioinformatics graduate-level courses while in their senior year of UM undergraduate study.	Students must submit an online application(link is external) in their junior year of undergraduate study (or approximately 18 months before finishing requirements). Undergraduate majors in Biology, MCDB (formerly CMB), LSI, Math, or CSE are encouraged. Other majors are allowed, if their home department permits and all other criteria can be met.
Michigan State University	https://cmse.msu.edu/academics/bioinformatics-program/	F2F	Bioinformatics Program- Not a degree program	N/A	N/A	$938/credit	$1,758/credit	The bioinformatics modules are a set of introductory courses that help life science students learn basic skills in computation and bioinformatics. These modules are 1 graduate credit, one month long, and flipped classroom (students watch video lectures online for homework and then come to class to solve problems and ask questions).	Postdocs, staff, visiting scholars, faculty, and other MSU-affiliates who are not students can audit these modules for a fee. Undergraduates at the junior/senior level who wish to take the modules should also contact the Coordinator to discuss their eligibility.
University of Minnesota Twin Cities	https://r.umn.edu/academics-research/graduate/bicb/degree-programs/masters	F2F	Bioinformatics and Computational Biology, M.S.	30		$1,539/credit	$2,381/credit	The graduate program trains graduate students in the development and applications of computational methods and to work in interdisciplinary teams of life scientists and computational scientists. The program offers industrial and clinical internships and training in business leadership, technology management, and ethics to prepare students for the workplace.	The program expects incoming graduate students to have a strong background in the quantitative sciences and varied backgrounds in the life/health sciences. Including: Calc1, Intro Programming, Intro Bio, Multivariable calc, algorithms and data structures statistics, biochemistry, and health sciences.
University of Nebraska Lincoln	https://cse.unl.edu/ms-computer-science-bioinformatics-specialization	F2F	Computer Science M.S.-Bioinformatics Specialization	Thesis- 30 Non-Thesis- 36		$472/credit	$1,285/credit	To prepare graduate students for advanced professional practice as bioinformaticians or to prepare graduate students for doctoral studies in bioinformatics. Offers a thesis and non-thesis option.	Applicants must have a Bachelor of Science degree in Bioinformatics or a Bachelor of Science degree in Computer Science and a minor in Biology, or a Bachelor of Science degree in Biology (or Master of Science in a related field, e.g. Agronomy) and a minor in Computer Science. However, students with background in only one of the two areas will also be considered for provisional admission if they have a good academic record.
Northwestern University	https://sps.northwestern.edu/masters/health-informatics/	Online	Health Informatics, M.S.	36	1 Year	$4,883/course		MHI students prepare for emerging opportunities and roles across the healthcare enterprise in classes taught by thought leaders in the informatics field. Graduates leave the program ready to leverage technology tools and data for more efficient, patient-centered healthcare delivery and improved population health, and apply essential skills such as organizational change leadership and project management.	The program expects incoming graduate students to have a strong background in the quantitative sciences
Ohio State University	https://medicine.osu.edu/departments/biomedical-informatics/education/masters-degrees-in-infomatics	F2F	Biomedical Informatics, M.S.	48	2 Years	$ 30,124/year (Within Medical College)	$55,048/year (Within Medical College)	Our degree programs are designed to cultivate biomedical informatics expertise in public health and clinical practitioners and researchers. Intended for students whose interests are academically oriented rather than directed toward professional practice.	Undergraduate GPA of 3.0 or higher on a 4.0 scale.
Purdue University	https://polytechnic.purdue.edu/degrees/ms-computer-and-information-technology	F2F	Computer Science and Information Technology- Bioinformatics and Healthcare computing Specialization	33		$ 4,859/semester	$ 9,401/semester	When you pursue your advanced degree in computer and information technology, your studies and research will represent the intersection of new technologies, enterprise-scale computing, and solving the challenges of society and industry. You will be at the forefront of emerging areas such as information security, healthcare infrastructure, computing application, and data management.	A relevant, earned baccalaureate degree in computer science, information technology, computer engineering, information systems, informatics, or other computer-related field of study. Minimally, students should have earned 15-18 credit hours of computational coursework.

University	Link	Format	Program	Credits		Cost		Description	Requirements
Rutgers University New Brunswick	https://shp.rutgers.edu/health-informatics/master-of-science-health-informatics/	Online	Health Informatics, M.S.	36		$950/credit		The Masters in Health Informatics degree program is specifically designed to provide an in-depth knowledge of the appropriate systems, software and analytical techniques for use in Hospitals, Pharmaceutical Organizations, Health Insurance Companies and such. The program curriculum provides ample knowledge and practice of the use of state of the art analytical techniques and	Bachelor's degree or higher with a minimum GPA of 3.0. Complete application form online and select either Piscataway (Off Campus) option for On Campus MS HI Program or Online (Distance) for MS HI Online Program. Since the On Campus classes are held during daytime hours nearly all of our students who are working professionals choose the MS HI Online Program. Three letters of recommendation from individuals who can assess your professional ability and potential for successful
University of Wisconsin–Madison	https://guide.wisc.edu/graduate/biostatistics-medical-informatics/biomedical-data-science-ms/	F2F	Biomedical Data Science, MS	31		$811/credit	$1,644/credit	The current explosion of biomedical data provides an awesome opportunity to improve understanding of the mechanisms of disease and ultimately to improve human health care. However, fully harnessing the power of high-dimensional, heterogeneous data requires a new blend of skills including programming, data management, data analysis, and machine learning.	Potential students include both those with bachelor's degrees in an area of data-science (e.g., computer science, statistics), as well as health professionals and clinicians (e.g., M.D.'s, Pharm.D.'s, R.N.'s). It is expected that admitted candidates will have demonstrated an aptitude for computer science and math, fundamental programming skills, knowledge of data structures and algorithms, and at least two semesters of college calculus. We will however consider candidates who have a wide

Institution	Link	Format	Program	Credits	Time to Complete	Tuition (in-state)	Tuition (out-of-state)	Description	Admission Requirements
Hood College	https://www.hood.edu/graduate/academics/programs/bioinformatics-ms	F2F	Bioinformatics, M.S.	33	Program can be completed in 2 years	$610/credit		The program meets the growing demand for desk- and bench-based science professionals to demonstrate expertise in the experimental design, data handling and data analysis of biology studies that examine genes—genomics, proteins—proteomics, and metabolites—metabolomics.	B.A. or B.S. in a life science or computer science field with a GPA of 2.75 or higher OR Bioinformatics certificate from Hood OR M.A. or M.S in a biology-related or computer science-related field with a 3.0 or better.
Johns Hopkins University	https://advanced.jhu.edu/academics/graduate/ms-bioinformatics/	F2F or Online	Bioinformatics, M.S.	33	Program can be completed in 16-24 months	Location: Baltimore, MD Requirements: 11 courses Time to Complete		Designed for students interested in combining studies in data and computer sciences with biological science areas, including molecular biology, biochemistry, personalized medicine, and genomic sequencing. The MS in Bioinformatics degree also serves as a foundation for medical school, law school, or advanced study in public health.	Bachelor's degree from an accredited college or university in the biological sciences or in engineering. Programs require a minimum GPA of 3.0 on a 4.0 scale. Two semesters of Organic Chemistry, one semester of biochemistry, Intro to Programming, Data Structures, one course in Statistics, Calculus.
Morgan State University	https://catalog.morgan.edu/preview_program.php?catoid=25&poid=5677	F2F	Bioinformatics, M.S.	30 (recently reduced from 36)		$464/credit	$912/credit	Designed to train such professionals with an educational background that blends biology with computer science. This program provides students with a strong foundation in computer programming, biostatistics, computer visualization, biostatistics, computational biology, computational mathematics, and database management.	a bachelor's degree from a regionally accredited college or university, preferably in bioinformatics, computer science, mathematics, statistics, or science (biology, chemistry, physics).
Mount Saint Mary's University	https://msmary.edu/academics/graduate-school/master-science-biotechnology-management.html	Blended	Biotechnology and Management, M.S.	36	Program can be completed in 1-2 years (8-week sessions)	$694/credit		The MSB program is designed for working adults in biotechnology or related industries.	
UMB UMD, Baltimore	https://graduate.umaryland.edu/clinicalinformatics/	F2F	Clinical Informatics, MS	34	2 Years	$746/credit	$972	Our curriculum focuses on biomedical data, clinical processes, and computational systems, which students will apply to the practice of medicine, in order to enhance health outcomes, improve patient care and strengthen the clinician-patient relationship. Coursework will also address leadership, professionalism, ethics, governance, bias, equity, and social determinants of health	Physicians, nurses, pharmacists, scientists, and researchers trained in informatics will be uniquely equipped to direct optimal implementation of health information technology for clinical care delivery and continuous quality improvement. The MS in Clinical Informatics is designed for professionals who are committed to improving our national health agenda.
UMGC UMD University Global Campus	https://www.umgc.edu/academic-programs/masters-degrees/biotechnology/bioinformatics.cfm	Online	Biotechnology, M.S.- Bioinformatics Specialization	36		$514/credit	$659 /credit	Prepares students to become qualified bioinformatics professional for public- or private-sector organizations.	Undergraduate coursework in molecular biology, programming, and statistics is required for admission.

Colleges & Universities in the Washington DC - Baltimore MD area

University	Link	Format	Program	Credits	Duration	Cost		Description	Requirements
American University	https://www.american.edu/cas/biology/biotechnology/	F2F or Online	Biotechnology, M.S.- Bioinformatics Track	30	Program can be completed in 16 months	$1,866/credit		Designed to transform your understanding of science and prepare you to be a leader in the biotechnology industry.	Appropriate undergraduate science courses or significant practical background
Catholic University of America	https://biology.catholic.edu/academics/graduate/ms-biotechnology/why-cua/index.html	F2F	Biotechnology, M.S.	30	18 month accelerated option or 24 months regular option	$2,075/credit		Designed for students interested in scientific research at biotechnology companies, federal agencies, and research institutions	Applicants must have completed a bachelor's degree in biology or a related field.
George Mason	https://masononline.gmu.edu/programs/bioinformatics-and-computational-biology-ms/	Online	Bioinformatics and Computational Biology, M.S.	31		$793/credit	1,681/credit	This program addresses growing national and regional demand for trained computational biologists. Graduates are qualified to pursue careers that require knowledge and applications of current bioinformatics methods and the ability to develop and use new bioinformatics software.	Ideal candidates for this program have a background or interest in biological or computer sciences.
Georgetown University	https://bioinformatics.georgetown.edu/	F2F	Bioinformatics, M.S.	30	Program can be completed in 2-3 semesters	$2,360/credit		Graduates from the program will have gained knowledge and experience in both Biochemistry, Molecular Biology, and Bioinformatics, making them great candidates for job positions in the D.C. biotechnology hub. Graduates often pursue a career in industry, government, and academia, or pursue another advanced degree (MS, PhD, MD).	A regionally or nationally accredited bachelor's degree.
George Washington University	https://smhs.gwu.edu/biochemistry-molecular-medicine/educational-programs	F2F	Bioinformatics and Molecular Biochemistry, M.S.	30	Accelerated 1 year program or regular 2 year program	$1,315/credit		Designed for students interested in medical genomics, proteomics, analytical bioinformatics, Big Data statistics, system biology, pharmaceutical oncology, algorithm development, Next-Generation sequencing, data analysis and annotation. After graduating, students work as bioinformatitians in academia or industry, or pursue PhD programs at GW or at other leading institutions.	Applicants should have a bachelor's degree with a strong background in biology, chemistry and mathematics. Required courses for admission include General Biology (1 year), General Chemistry (1 year), Organic Chemistry (1 year) and College Physics (1 year).
Liberty University	https://www.liberty.edu/online/business/masters/health-informatics/	Online	Health Informatics, M.S.	42	Program can be completed in 2 years	$565/credit		Online health informatics programs train people to combine the two fields of healthcare and information technology to organize, manage and secure health information. People in this field use various classification systems to code and categorize patient information for insurance reimbursement purposes and to maintain patients' medical and treatment histories.	A regionally or nationally accredited bachelor's degree with a 3.0 or above GPA is required for admission in good standing

Other Major Institutions Offering Similar Programs

University	Link	Format	Program	Credits	Duration	Cost		Description	Requirements
Arizona State University	https://chs.asu.edu/programs/biomedical-informatics-ms	F2F	Bioinformatics, M.S.	32	Program can be completed in 2 years	$1,144/credit	$1,563/credit	Students looking to advance their knowledge in order to become professionals in the field.	Applicants are eligible to apply to the program if they have earned a bachelor's or master's degree in biology, computer science, engineering, nursing or statistics from a regionally accredited institution. Applicants who have earned degrees in other unrelated fields must have basic competencies in college-level calculus (similar to MAT 270), general biology (similar to BIO 188) or physiology, statistics (similar to STP 226) and basic computer programming (similar to CSE 100 or CSE 110).
Columbia University	cs.columbia.edu/education/ms/computationalbiology/	F2F	Computer Science, M.S.-Computational Biology Track	30		$2,196/credit		The Computational Biology Track is intended for students who wish to develop working knowledge of computational techniques and their applications to biomedical research.	Applicants should have a bachelor's degree with a strong background in biology, chemistry and mathematics.
Harvard University	https://www.hsph.harvard.edu/sm-computational-biology/	F2F	Computational Biology and Quantitative Genetics, M.S.	80	Program can be completed in 18 to 24 months	$65,460/year		The SM in Computational Biology and Quantitative Genetics is intended as a terminal professional degree which will enable you to launch your career in bioinformatics.	An undergraduate degree in mathematical sciences or allied fields (e.g. biology, psychology, economics). Calculus through partial differentiation and multivariable integration, One semester of linear algebra or matrix methods, Either a two-semester sequence in probability and statistics or a two-semester sequence in applied statistics, At least one semester of training in biology, with some familiarity with molecular biology and genetics.
Stanford University	https://online.stanford.edu/programs/biomedical-informatics-ms-degree?certificateId=1240186&method=load	Blended	Biomedical Informatics, M.S.	45	Program can be completed in 2-5 years	$1,400/credit		Our mission is to train future research leaders to design and implement novel quantitative and computational methods that solve challenging problems across the entire spectrum of biology and medicine. The program is flexible, and attracts applicants with training in biology, research and clinical medicine, computer science, data science and analytics, statistics, and engineering.	Applicants should have a bachelor's degree with a strong background in biology, chemistry and mathematics.
University of Delaware	https://bioinformatics.udel.edu/Education/bicb-ms/	F2F	Bioinformatics and Computational Biology, M.S.	31		$979/credit		The thesis-based MS degree prepares students for advanced research.	A regionally or nationally accredited bachelor's degree.
Virginia Commonwealth University	https://bulletin.vcu.edu/graduate/vcu-life-sciences/center-study-biological-complexity/bioinformatics-ms/	F2F	Bioinformatics, M.S. (Or Bioinformatics, MPS [Non-thesis])	34		$524/credit	$1,132/credit	Students enter the program from a variety of academic backgrounds (biology, chemistry, computer science, mathematics/statistics, etc.) assisted by flexible "bridge curricula" designed to help them meet program prerequisites. Students will have an effective exposure to the biotech industry and other career options and to real-life applications of their learning.	A graduate student admitted to a program or concentration requiring a final research project, work of art, thesis or dissertation, must qualify for continuing master's or doctoral status according to the degree candidacy requirements of the student's graduate program. Admission to degree candidacy, if applicable, is a formal statement by the graduate student's faculty regarding the student's academic achievements and the student's readiness to proceed to the final research phase of the degree program.
Boston University	https://www.bu.edu/bioinformat	F2F	Bioinformatics, M.S.	32	Program can be	$61,050/year		Our MS program, the first of its kind, was founded in 1999 and	Application Requirements: Transcripts; Three recommendations; Personal statement;
Northeastern University	https://www.northeastern.edu/graduate/program/master-of-science-in-bioinformatics-online-14245/	Online	Bioinformatics, M.S.	32	Program can be completed in 2 to 3 years	$55,400/year		Combining challenging academics in biology, computer science, and information technology with real-world experience, the program helps students integrate the knowledge, skills, experience, and confidence they need to achieve their goals and make a difference in our world. The Master of Science in Bioinformatics is structured to provide students with the skills and knowledge to develop, evaluate, and deploy bioinformatics and computational biology applications. The program is designed to prepare students for employment in the	Requirements Online application; Application fee; Transcripts from all institutions attended; Personal statement; Resumé; 2 letters of recommendation; GPA 3.0 + GRE not required; English language proficiency:

OES In-House Market Research: Projected Enrollment Information				
Program Name = Bioinformatics, M.S.				
Occupation	**# of Jobs in the Field**	**Where Professionals are Employed**	**Professional Salary Information**	**Projected Job Growth**
Information from U.S. Bureau of Labor Statistics' Occupational Outlook Handbook				
Bioengineers and Biomedical Engineers	17,900	Research and development in the physical, engineering, and life sciences 28% Medical Equipment and supplies manufacturing 14% Healthcare and social assistance 8% Navigational, measuring, electromedical, and control instruments manufacturing 7% Colleges, universities, and professional schools; state, local and private 5%	$97,410 per year $46.83 per hour	Job Outlook 2021-31: 10% (Faster than average)
Health Information Technologists and Medical Registrars	39,900	Hospitals; state, local, and private 46% Offices of physicians 11% Professional, scientific, and technical services 7% Management of companies and enterprises 6% Administrative and support services 6%	$55,560 per year $26.71 per hour	Job Outlook 2021-31: 17% (Much faster than average)
Mathematicians and Statisticians	36,100	Federal government 62% Professional, scientific, and technical services 13% Colleges, universities, and professional schools; state, local and private 13%	$96,280 per year $46.29 per hour	Job Outlook 2021-31: 31% (Much faster than average)
Information from State of Maryland's Occupational and Industry Projections				
Bioinformatics Scientists (Biological Scientists, All Other)	4,620	Federal Executive Branch Scientific Research and Development Services Colleges, Univerisities, and Professional Schools Management, Scientific, and Technical Consulting Services Pharmaceutical and Medicine Manufacturing	Mean Annual Wage: $107,849 **Maryland is the second highest top paying state for this occupation.	**Maryland has the second highest employment level in this occupation in the United States. (Only CA is higher). **Maryland has the highest concentration of jobs in this occupation in the United States.
Bioinformatics Technicians (Statistical Assistants)	3,520	Scientific Research and Development Services Colleges, Univerisities, and Professional Schools Federal Executive Branch Pharmaceutical and Medicine Manufacturing General Medical and Surgical Hospitals	Mean Annual Wage: $50,570 **Maryland is the second highest top paying state for this occupation.	**Maryland has the fifth highest employment level in this occupation in the United States. (Only CA is higher). **Maryland has the third highest concentration of jobs in this occupation in the United States.

Five-Year Enrollment Trends						
Year	**Hood College**	**Johns Hopkins University**	**Morgan State University**	**Mount Saint Mary's University**	**UMB**	**UMGC**
	Bioinformatics, M.S.	**Bioinformatics, M.S.**	**Bioinformatics, M.S.**	**Biotechnology and Management**	**Clinical Informatics, MS**	**Biotechnology, M.S.-Bioinformatics Specialization**
	Approved in 2016	*Approved in 2003*	*Approved in 2002*	*Approved in 2012*	*Approved 2021*	*Approved in 2007*
2016	5	141	5	23	Approved 2021	395
2017	15	169	3	10		446
2018	24	174	3	14		498
2019	32	173	6	13		543
2020	28	183	9	17		597
2021	25	207	11	29		598
Five-Year Degree Recaps						
Year	**Hood College**	**Johns Hopkins University**	**Morgan State University**	**Mount Saint Mary's University**	**UMGC**	**UMGC**
	Bioinformatics, M.S.	**Bioinformatics, M.S.**	**Bioinformatics, M.S.**	**Biotechnology and Management**	**Clinical Informatics, MS**	**Biotechnology, M.S.-Bioinformatics Specialization**
	Approved in 2016	*Approved in 2003*	*Approved in 2002*	*Approved in 2012*	*Approved 2021*	*Approved in 2007*
2017		36	1	9	Approved 2021	92
2018	1	32	3	15		91
2019	3	39	1	5		113
2020	10	51	0	6		137
2021	5	43	5	8		130
2022	7	59	3	6		154

The learning outcomes for the program will be assessed using a combination of formative and summative assessments during and at the completion of each semester. Each course in the program will have homework assignments, practice sets, and other assessments that will be graded with feedback to help assess the student's learning. Midterms and final exams or projects will be cumulative assessments to determine if and to what level the student mastered the learning outcomes for each course.

The assessments will be appropriate to the nature of the course content and the course learning objectives. Both individual assessments and group assessments will be required in the program. This type of variation best mimics the work and industry expectations. The assessments of the program will mirror work products in the industry and prepare students for jobs in industry. For example, many of the elective courses include final projects, presentations and assignments where students have to work with real data sets. Students will be expected to process the data, and perform tasks and make recommendations that are expected of an entry level data scientist/AI engineer.

Lastly, students will also be challenged to complete reflective assessments to apply knowledge and skills in their future professional work. This work will assist students in the job search process and enable them to identify, apply to, and earn positions in this field. The assessments will all follow best practices for adult and professional students. As the student progresses through the curriculum and satisfies learning objectives, they will align with and accomplish the program-level learning outcomes.

MS in Bioinformatics and Computational Biology					
Five-Year Program Budget					
Tuition Revenue	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
A. Total enrolled students	9	19	20	21	23
First year enrollment	9	10	10	11	12
Second year enrollment		9	10	10	11
B. Total # of 3-credit Courses (by enrollment year)	8	10	10	10	10
# of courses offered for students in year one of the program	8	8	8	8	8
# of courses offered for students in year two of the program		2	2	2	2
C. Per Course Rate	$4,000	$4,120	$4,244	$4,371	$4,502
Total Tuition Revenue	$288,000	$403,760	$424,360	$472,058	$531,240
Direct Expenses	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
A. Instructor Salaries and Fringe	$134,927	$173,936	$179,154	$184,529	$190,065
1. Subtotal: Instructor salaries	$103,870	$133,900	$137,917	$142,055	$146,316
Average 3-credit course salary	$13,000	$13,390	$13,792	$14,205	$14,632
Program specific courses (100% FTE)	7	7	7	7	7
Shared courses (33% FTE)	3	3	3	3	3
2. Fringe Benefits: 29.9%	$31,057	$40,036	$41,237	$42,474	$43,749
Total Direct Expenses	$134,927	$173,936	$179,154	$184,529	$190,065
Total Annual Tuition Revenue	$288,000	$403,760	$424,360	$472,058	$531,240
Total Annual Direct Expenses	$134,927	$173,936	$179,154	$184,529	$190,065
Total Annual OES Administrative Fee	$28,800	$40,376	$42,436	$47,206	$53,124
Annual Distributable Revenue	$124,273	$189,448	$202,770	$240,323	$288,051

Indirect Expenses					
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Administrative Salaries and Fringe	$53,692	$55,303	$56,962	$58,671	$60,431
1. Administrative Salaries	$39,596	$40,784	$42,007	$43,268	$44,566
Director (20% FTE)	$25,846	$26,621	$27,420	$28,243	$29,090
Faculty Director Stipend	$15,000	$15,450	$15,914	$16,391	$16,883
Program Manager (33% FTE)	$13,750	$14,163	$14,587	$15,025	$15,476
2. Fringe Benefits: 35.6%	$14,096	$14,519	$14,955	$15,403	15,865
Hourly Wages	$38,736	$51,648	$52,552	$53,474	$54,414
1. Hourly Wages	$36,000	$48,000	$48,840	$49,697	$50,571
Graders for program specific courses ($6K per course)	30,000	42,000	42,840	43,697	44,571
Graders for shared courses ($2K per course)	6,000	6,000	6,000	6,000	6,000
2. Hourly Wages Benefits: 7.6%	$2,736	$3,648	$3,712	$3,777	$3,843
Marketing	$2,500	$2,575	$2,652	$2,732	$2,814
1. Marketing	2,500	2,575	2,652	2,732	2,814
Equipment	$1,500	$1,545	$1,591	$1,639	$1,688
1. Equipment	1,500	1,545	1,591	1,639	1,688
Travel & Recruitment	$1,500	$1,545	$1,591	$1,639	$1,688
1. Travel & Recruitment	$1,500	$1,545	$1,591	$1,639	$1,688
Total Indirect Expenses	$97,928	$112,616	$115,349	$118,155	$121,035

Net Revenue	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
OES Distribution to CMNS	$124,273	$189,448	$202,770	$240,323	$288,051
Indirect Expenses	$97,928	$112,616	$115,349	$118,155	$121,035
Balance	**$26,345**	**$76,832**	**$87,421**	**$122,169**	**$167,016**

DATE: 08/11/2021

TO: Michael P. Cummings, PhD

     Professor, Department of Biology, and Institute for Advanced Computer Studies

     Director, Center for Bioinformatics and Computational Biology

     Director, Master of Professional Studies Program in Data Science and Analytics

FROM: On behalf of the University of Maryland Libraries:

     Jodi Coalter, Life Sciences & Outreach Librarian

     Maggie Saponaro, Director of Collection Development Strategies

     Daniel Mack, Associate Dean, Collection Strategies & Services

RE: Library Collection Assessment

We are providing this assessment in response to a proposal by the College of Computer, Mathematical, and Natural Sciences to create Master's in Bioinformatics and Computational Biology program. The Bioinformatics and Computational Biology program asked that we at the University of Maryland Libraries assess our collection resources to determine how well the Libraries support the curriculum of this proposed program.

Serial Publications

University of Maryland Libraries currently subscribe to a large number of scholarly journals—almost all in online format—that focus on bioinformatics, computational biology, and biology.

The Libraries subscribe to most of the top ranked journals that are listed in the computational biology category in the Science Edition of *Journal Citation Reports.** These journals include the following, all of which are available online:

- *PLoS Computational Biology*
- *Journal of Computational Biology*
- *Computational Biology and Chemistry*
- *Biomedical Engineering and Computational Biology*
- *IEEE/ACM Transactions on Computational Biology and Bioinformatics*

One highly-ranked core journal to which the Libraries does not currently subscribe is *Journal of Bioinformatics and Computational Biology,* published by World Scientific Publishing Co. PTE LTD. However, articles in journals that we do not own will likely be available through Interlibrary Loan/Document Delivery.

*Note: *Journal Citation Reports* is a tool for evaluating scholarly journals. It computes these evaluations from the relative number of citations compiled in the *Science Citation Index* and *Social Sciences Citation Index* database tools.

Databases

The Libraries' *Database Finder* (http://www.lib.umd.edu/dbfinder) resource offers online access to databases that provide indexing and access to scholarly journal articles and other information sources. Many of these databases cover subject areas that would be relevant to this proposed program. Databases that would be useful in the field of bioinformatics and computational biology are *Web of Science, PLoS Biology, SciFinder, PubMed, IEEE Xplore, BioOne, Biosis Previews*, and *ACM Digital Library*. Some of the other subject databases that would be relevant to this curriculum include *SpringerLink, Springer eBooks in Computer Science, Lecture Notes in Computer Science*, and *Science Direct.*

In many-and likely in most-cases, these indexes offer full text copies of the relevant journal articles. In those instances in which the journal articles are available only in print format, the Libraries can make copies available to students through the Libraries' Interlibrary Loan service (https://www.lib.umd.edu/access/ill-article-request). (Note: see below.)

Monographs

The Libraries regularly acquire scholarly monographs in computational biology and allied subject disciplines. Monographs not already part of the collection can usually be added upon request.

Even though most library research for this course/program likely will rely upon online journal articles, students may wish to supplement this research with monographs. Fortunately, more and more monographs are available as e-books. Even in instances when the books are only available in print, students will be able to request specific chapters for online delivery through the Interlibrary Loan program (https://www.lib.umd.edu/access/ill-article-request). (Note: see below).

A search of the University of Maryland Libraries' WorldCat UMD catalog was conducted, using a variety of relevant subject terms. This investigation yielded sizable lists of citations of books that we own. Terms searched included "computational biology" (949 results), "bioinformatics" (2,389 results), and "metagenomics" (132 results). A further search revealed that the Libraries' membership in the Big Ten Academic Alliance (BTAA) dramatically increases these holdings and citations (1,996 results for "computational biology", 5,553 results for "bioinformatics", and 442 results for "metagenomics"). As with our own materials, students can request that chapters be copied from these BTAA books if the books are not available electronically.

Interlibrary Loan Services

Interlibrary Loan services (https://www.lib.umd.edu/access/ill) provide online delivery of bibliographic materials that otherwise would not be available online. As a result, remote users who take online courses may find these services to be helpful. Interlibrary Loan services are available free of charge.

The article/chapter request service scans and delivers journal articles and book chapters within three business days of the request--provided that the items are available in print on the UM Libraries' shelves or in microform. In the event that the requested article or chapter is not available on campus, the request will be automatically forwarded to the Interlibrary Loan service (ILL). Interlibrary Loan is a service

that enables borrowers to obtain online articles and book chapters from materials not held in the University System of Maryland.

Additional Materials and Resources

In addition to serials, monographs and databases available through the University Libraries, students in the proposed program will have access to a wide range of media, datasets, software, and technology. Media in a variety of formats that can be utilized both on-site and via ELMS course media is available at McKeldin Library. GIS Datasets are available through the GIS Data Repository (https://www.lib.umd.edu/gis/data-and-resources) while statistical consulting and additional research support is available through the Research Commons (http://www.lib.umd.edu/rc) and technology support and services are available through the Terrapin Learning Commons (http://www.lib.umd.edu/tlc).

The subject specialist librarian/s for the discipline/s, including Jodi Coalter (Life Sciences & Outreach Librarian, jcoalter@umd.edu), Svetla Baykoucheva (Chemistry and Life Sciences Librarian, and liaison to Cell Biology and Molecular Genetics, sbaykouc@umd.edu), and Nevenka Zdravkovska (Head of the STEM Library and liaison to computer science and mathematics, nevenka@umd.edu) also serve as an important resource to programs such as the one proposed. Through departmental partnerships, subject specialists actively develop innovative services and materials that support the University's evolving academic programs and changing research interests. Subject specialists provide one-on-one research assistance online, in-person, or via the phone. They also provide information literacy instruction and can provide answers to questions regarding publishing, copyright and preserving digital works.

Other Research Collections

Because of the University's unique physical location near Washington D.C., Baltimore and Annapolis, University of Maryland students and faculty have access to some of the finest libraries, archives and research centers in the country vitally important for researchers in bioinformatics and computational biology. These include the Library of Congress, the National Archives, National Library of Medicine, National Agricultural Library, and the Smithsonian, to name a few.

Conclusion

With our substantial journals holdings and index databases, as well as additional support services and resources, the University of Maryland Libraries have resources to support teaching and learning in bioinformatics and computational biology. These materials are supplemented by a strong monograph collection. Additionally, the Libraries Scan & Deliver and Interlibrary Loan services make materials that otherwise would not be available online, accessible to remote users in online courses. As a result, our assessment is that the University of Maryland Libraries are able to meet the curricular and research needs of the proposed Master's in Bioinformatics and Computational Biology program.

Faculty Information- Bioinformatics and Computational Biology

The following faculty members are projected to teach in the program. All faculty are full-time unless otherwise indicated.

Name	Highest Degree Earned, Program, and Institution	UMD Title (indicate if part-time)	Courses
Stephen Altschul	Ph.D., Mathematics, MIT	Adjunct Professor	BIOI606 Sequence Alignment
Babak Azimi-Sadjadi	Ph.D., ECE, UMD	Visiting Lecturer	DATA/MSML/BIOI 603: Principles of Machine Learning
Sandra Cerrai	Ph.D., Mathematics, Scuola Normale Superiore of Pisa	Prof & Assoc Chair	DATA/MSML/BIOI 601: Probability and Statistics
Michael Cummings	Ph.D., Organismic and Evolutionary Biology, Harvard University	Professor	BIOI605: Data Sources and Data Management in Bioinformatics
Najib M. El-Sayed	Ph.D., Molecular Parasitology, Yale	Professor	BIOI604: Principles of Molecular Biology, Genetics, and Genomics BIOI610: Genome Annotation
Mohammad Taghi Hajiaghayi	Ph.D., Computer Science, MIT	Professor	DATA/MSML/BIOI 602: Principles of Data Science
Brantley Hall	Ph.D. Genomics, Bioinformatics, and Computational Biology, Virginia Tech	Assistant Professor	BIOI622 Metagenomics Data Analysis
Leonid Koralov	Ph.D., Mathematics, SUNY at Stony Brook	Prof & Assoc Chair	DATA/MSML/BIOI 601: Probability and Statistics
Alejandra Mercado	Ph.D., ECE, UMD	Associate Director	DATA/MSML/BIOI 603: Principles of Machine Learning
Arefeh A Nasri	Ph.D., Transportation Engineering, UMD	Visiting Lecturer	DATA/MSML/BIOI 602: Principles of Data Science

Rob Patro	Ph.D., Computer Science, UMD	Associate Professor	BIOI607 Data Structures and Algorithms for Bioinformatics BIOI611 Analysis of Gene Expression Data
Mihai Pop	Ph.D., Computer Science, Johns Hopkins University	Professor	BIOI621 Genome Assembly and Annotation

Course Descriptions

BIOI601 Probability and Statistics (core), co-listed with DATA601 and MSML601
An introduction to the fundamental concepts of probability theory and statistics. The course covers the basic probabilistic concepts such as probability space, random variables and vectors, expectation, covariance, correlation, probability distribution functions, etc. Important classes of discrete and continuous random variables, their inter-relation, and relevance to applications are discussed. Conditional probabilities, the Bayes formula, and properties of jointly distributed random variables are covered. Limit theorems, which investigate the behavior of a sum of random variables, are discussed. The main concepts of random processes are then introduced. The latter part of the course concerns the basic problems of mathematical statistics of point and interval estimation and hypothesis testing.

BIOI602 Principles of Data Science (core), co-listed with DATA602 and MSML602
An introduction to the data science pipeline, i.e., the end-to-end process of going from unstructured, messy data to knowledge and actionable insights. Provides a broad overview of what data science means and systems and tools commonly used for data science and illustrates the principles of data science through several case studies.

BIOI603 Principles of Machine Learning (core), co-listed with DATA603 and MSML603
A broad introduction to machine learning and statistical pattern recognition. Topics include the following. Supervised learning: Bayes decision theory; discriminant functions; maximum likelihood estimation; nearest neighbor rule; linear discriminant analysis; support vector machines; neural networks; deep learning networks. Unsupervised learning: clustering; dimensionality reduction; principal component analysis; auto-encoders. The course will also discuss recent applications of machine learning, such as computer vision, data mining, autonomous navigation, and speech recognition.

BIO604 Principles of Molecular Biology, Genetics and Genomics (core)
Provides a review of basic concepts in molecular biology, genetics, and genomics. Topics include the following: prokaryotic and eukaryotic genome structure and organization (including 3D architecture); Mendelian genetics, recombination, linkage and linkage disequilibrium, genome-wide association studies; review of genome projects, comparative genomics, genome variation, single nucleotide polymorphisms and genotyping; gene expression and the transcriptome, transcriptional regulation, gene regulatory networks; translation and translational regulation; proteomics approaches; integrative genomics.

BIOI605 Data Sources and Data Management in Bioinformatics (core)
An introduction to the different types of data generated for bioinformatics analyses and data management principles required for scientific rigor and reproducibility. Data sources include, but are not limited to, sequencing data, 'omics data (e.g., proteomics, metabolomics, lipidomics), imaging data, and clinical data. Data organization will cover topics such as management and curation of metadata, downloading data from and submitting data to public repositories, and using databases versus spreadsheets and tables.

BIOI606 Sequence Alignment (core)
In-depth coverage of biological sequence alignment including the following: definitions, algorithms, and statistics for local, global, pairwise, and multiple alignments; scoring schemes; BLAST, BLAST variants, and similar programs; motif finding; and related topics.

BIOI607 Data Structures and Algorithms for Bioinformatics (core)
An introduction to the fundamental data structures and algorithms underlying many parts of Bioinformatics. Standard data structures for efficient indexing and sequence search will be covered, including the suffix array and the FM-index, as will alignment-free methods for sequence comparison. This course will also introduce the fundamental algorithms in computational phylogenomics and biological network analysis. Finally, bioinformatics

oriented applications of classic unsupervised learning algorithms (e.g., clustering and dimensionality reduction) and database techniques (e.g., sorting, selection, joining) will be examined. The focus will be both on formal understanding of computational efficiency as well as the practical applications of these concepts.

BIOI610 Genome Annotation (core)
An introduction to approaches for the structural and functional annotation of genome content. Topics covered include the following: ab initio gene/coding sequence discovery; signals and signal sensors (including regulatory sequences); non-protein coding genes and other structural features of genome sequences; similarity searches (orthologs, paralogs, xenologs); clustering of genes by sequence similarity; clusters of orthologous genes; phylogenetic classification of genes; gene ontologies, gene set enrichment analyses; next generation sequencing functional assays; integrated genomics circuits; and annotation databases.

BIOI611 Analysis of Gene Expression Data (core); prerequisite: BIOI604
This course focuses on the analysis of transcriptomics data, and specifically on the analysis of gene and transcript level expression. Material covered includes transcript and gene expression estimation from RNA-seq data (short and long-read), basic experimental design and statistical methods for differential expression analysis, discovery of novel transcripts via reference-guided and de novo assembly, and the analysis of single-cell gene expression data (e.g., single-cell expression quantification, dimensionality reduction, clustering, pseudotime analysis).

BIOI621 Genome Assembly and Annotation (elective); prerequisite: BIOI604
An introduction to the algorithms and tools used to reconstruct genome sequences from shotgun sequencing data and to annotate the resulting sequence. The first part of the course will cover the theoretical underpinnings of core assembly paradigms and discuss the practical use of these paradigms in the context of current sequencing technologies. Also discussed will be approaches for scaffolding the reconstructed sequences along chromosomes using mate-pair and other types of information such as mapping data. An important focus of the course will be on approaches for validating the output of sequence assemblers, also discussing the impact assembly errors can have on downstream analyses such as genome annotation and comparative analyses. The second part of the course will discuss approaches for interpreting sequence annotations in the context of a reconstructed genome, focusing on genome browsers and other visualization and analytical tools and approaches for analyzing and interpreting gene synteny information. A particular focus will be on the impact of repetitive sequences on the quality of genome assemblies and ability to effectively analyze gene synteny and to conduct comparative genomic analyses.

BIOI622 Metagenomics Data Analysis (elective); prerequisite: BIOI604
An introduction to metagenomics, the study of sequence data derived from environmental samples without the cultivation of individual organisms. The course will provide an overview of the entire process of obtaining and analyzing metagenomic data including sample collection, DNA isolation strategies, sequencing strategies, and initial data processing. Additionally, taxonomic analysis, the determination of the identity of organisms within a metagenomic sample and the analysis of whole metagenome shotgun sequencing with metagenomic assembly and functional annotation will be discussed. Diversity metrics used to summarize the ecological structure of microbial communities in terms of richness or distance as well as the visualization of these metrics will be discussed. Finally, methods to identify features that differ between microbial communities will be reviewed.

BIO699 Capstone Research (elective)
The course provides an opportunity for a more in-depth research experience focusing on an original research project. Expected learning outcomes include that the student should be able to: design and conduct a bioinformatics or computational biology project; place the research in the context of biological problems; develop a written report and other deliverables if applicable.

PCC Proposal to Establish a Master of Science in Applied Machine Learning

PRESENTED BY	Wendy Stickle, Chair, Senate Programs, Curricula, and Courses Committee
REVIEW DATES	SEC – October 20, 2023 | SENATE – November 1, 2023
VOTING METHOD	In a single vote
RELEVANT POLICY/DOCUMENT	
NECESSARY APPROVALS	Senate, President, USM Board of Regents, and the Maryland Higher Education Commission

ISSUE

The College of Computer, Mathematical, and Natural Sciences proposes to establish a Master of Science in Applied Machine Learning. This program exists currently as an iteration of the Master of Professional Studies (MPS) program. The 30-credit MPS program (titled Machine Learning) has been in operation since the Winter 2019-2020 term. Master of Professional Studies programs were first approved in 2005, when the University System of Maryland Board of Regents and Maryland Higher Education Commission approved an expedited review process for master's and graduate certificate programs that respond quickly to the changing market needs of working professionals. Once a new iteration of the MPS is approved through campus PCC review, it only needs approval by the USM Chancellor to become official.

A limitation of offering this program as an MPS iteration is that all Professional Studies programs must use the same generic Federal Classification of Instructional Programs (CIP) code rather than a CIP code that accurately describes the program content. Those who search for academic programs by using the CIP codes related to Machine Learning will not find this program. Moreover, some CIP codes are designated as "STEM" eligible by the US Department of Homeland Security, and international students with F1 visas who graduate from STEM designated programs may continue to work in the United States for two years longer than students in non-STEM designated programs. The generic CIP code for Professional Studies programs does not qualify as STEM-designated, even if the academic content of the Professional Studies program is STEM-related, as is the case with this program.

Consequently, the college proposes to transition the current program from a Master of Professional Studies program to a stand-alone Master of Science program in order for the program to be classified more accurately. The 30-credit curriculum will remain the same.

The Master of Science in Applied Machine Learning will provide students with the opportunity to engage in cutting edge technical course work in machine learning and develop their problem-solving skills in the art and science of processing and extracting information from data with special emphasis on large amounts of data (Big Data). Students will build solid foundations in mathematics, statistics and computer programming, and explore advanced topics in machine learning such as deep learning, optimization, big data analysis, and signal/image understanding. The program

consists of 18 credits of required courses and 12 credits of electives. This program is a non-thesis program and will have both an in-person and distance education version. Graduates of the program will be able to understand the fundamental concepts of machine learning and explain applied mathematics and statistics necessary for the thorough understanding of machine learning algorithms and methods. Students will be able to implement problem-solving and analytical skills necessary to succeed in industry, including scripting and programming, and will be familiar with state-of-the-art machine learning tools and high-performance computing platforms. Students will be able to work in teams to solve problems and demonstrate written and oral communication skills appropriate to engineering professionals.

The proposal was approved by the Graduate School PCC committee on September 27, 2023, and the Senate Programs, Curricula, and Courses committee on October 6, 2023.

RECOMMENDATION(S)

The Senate Committee on Programs, Curricula, and Courses recommends that the Senate approve this new academic program.

COMMITTEE WORK

The committee considered this proposal at its meeting on October 6, 2023. Amol Deshpande, Amy Chester, and John Fourkas, from the College of Computer, Mathematical, and Natural Sciences, presented the proposal and answered questions from the committee. The committee unanimously approved the proposal.

ALTERNATIVES

The Senate could decline to approve this new academic program.

RISKS

If the Senate declines to approve this new degree program, the university will lose an opportunity to apply a more accurate Federal CIP code to an existing program thereby making the program more marketable.

FINANCIAL IMPLICATIONS

There are no significant financial implications with this proposal as the program already exists as a self-supported Master of Professional Studies program.

922: APPLIED MACHINE LEARNING

In Workflow

1. CMNS PCC Chair (jpresson@umd.edu; fourkas@umd.edu)
2. CMNS Dean (rinfanti@umd.edu)
3. Academic Affairs Curriculum Manager (mcolson@umd.edu)
4. Graduate School Curriculum Manager (jfarman@umd.edu)
5. Graduate PCC Chair (jfarman@umd.edu)
6. Dean of the Graduate School (jfarman@umd.edu; sroth1@umd.edu)
7. Senate PCC Chair (mcolson@umd.edu; wstickle@umd.edu)
8. University Senate Chair (mcolson@umd.edu)
9. President (mcolson@umd.edu)
10. Board of Regents (mcolson@umd.edu)
11. MHEC (mcolson@umd.edu)
12. Provost Office (mcolson@umd.edu)
13. Graduate Catalog Manager (bhernand@umd.edu; fantsao@umd.edu)

Approval Path

1. Thu, 01 Jun 2023 22:36:12 GMT
   John Fourkas (fourkas): Approved for CMNS PCC Chair
2. Tue, 06 Jun 2023 16:22:47 GMT
   Robert Infantino (rinfanti): Approved for CMNS Dean
3. Wed, 06 Sep 2023 18:17:56 GMT
   Michael Colson (mcolson): Approved for Academic Affairs Curriculum Manager
4. Fri, 29 Sep 2023 20:04:15 GMT
   Jason Farman (jfarman): Approved for Graduate School Curriculum Manager
5. Fri, 29 Sep 2023 20:08:44 GMT
   Jason Farman (jfarman): Approved for Graduate PCC Chair
6. Wed, 04 Oct 2023 20:48:32 GMT
   Stephen Roth (sroth1): Approved for Dean of the Graduate School
7. Sat, 07 Oct 2023 17:31:39 GMT
   Wendy Stickle (wstickle): Approved for Senate PCC Chair

New Program Proposal

Date Submitted: Mon, 29 May 2023 22:37:14 GMT

Viewing: 922 : Applied Machine Learning
Last edit: Tue, 10 Oct 2023 20:36:12 GMT

Changes proposed by: Sennur Ulukus (ulukus)

Program Name

Applied Machine Learning

Program Status

Proposed

Effective Term

Spring 2024

Catalog Year

2023-2024

Program Level

Graduate Program

Program Type

Master's

Delivery Method

On Campus

Departments

Department
Computer, Mathematical, and Natural Sciences

Colleges

College
Computer, Mathematical, and Natural Sciences

Degree(s) Awarded

Degree Awarded
Master of Science

Proposal Contact

Sennur Ulukus, Amol Deshpande, Amy Chester

Proposal Summary

Proposal to convert the MPS in Machine Learning to the MS in Applied Machine Learning with CIP code: 30.7101 (Data Analytics, General)

(PCC Log Number 23010)

Program and Catalog Information

Provide the catalog description of the proposed program. As part of the description, please indicate any areas of concentration or specializations that will be offered.

The Master of Science in Applied Machine Learning offers students the opportunity to engage in cutting edge technical course work in machine learning and develop their problem solving skills in the art and science of processing and extracting information from data with special emphasis on large amounts of data (Big Data). During their coursework, students will build solid foundations in mathematics, statistics and computer programming, and explore advanced topics in machine learning such as deep learning, optimization, big data analysis and signal/image understanding. The program consists of 30-credit course work and is a non-thesis MS program.

Catalog Program Requirements:

Course	Title	Credits
Core Requirements		
MSML601	Probability and Statistics	3
MSML602	Principles of Data Science	3
MSML603	Principles of Machine Learning	3
MSML604	Introduction to Optimization	3
MSML605	Computing Systems for Machine Learning	3
MSML606	Algorithms and Data Structures for Machine Learning	3
Elective Requirement (choose four of the following):		**12**
MSML612	Deep Learning	
MSML640	Course MSML640 Not Found (Computer Vision)	
MSML641	Natural Language Processing	
MSML642	Course MSML642 Not Found (Robotics)	
MSML650	Cloud Computing (Cloud Computing)	
MSML651	Course MSML651 Not Found (Big Data Analytics)	
Total Credits		**30**

Sample plan. Provide a term by term sample plan that shows how a hypothetical student would progress through the program to completion. It should be clear the length of time it will take for a typical student to graduate. For undergraduate programs, this should be the four-year plan.

First Year

Semester 1	Credits	Semester 2	Credits	Semester 3	Credits
MSML601	3	MSML604	3	MSML606	3
MSML602	3	MSML605	3	MSML612	3
MSML603	3	MSML641	3		
	9		9		6

Second Year

Semester 1	Credits
MSML640	3
MSML650	3
	6

Total Credits 30

Part Time

First Year

Semester 1	Credits	Semester 2	Credits	Semester 3	Credits
MSML601	3	MSML604	3	MSML606	3
MSML603	3	MSML605	3	MSML612	3
	6		6		6

Second Year

Semester 1	Credits	Semester 2	Credits
MSML602	3	MSML641	3
MSML640 (Computer Vision)	3	MSML650 (Cloud Computing)	3
	6		6

Total Credits 30

List the intended student learning outcomes. In an attachment, provide the plan for assessing these outcomes.

Learning Outcomes
Students will be able to understand the fundamental concepts of machine learning.
Students will be able to explain applied mathematics and statistics necessary for the thorough understanding of machine learning algorithms and methods.
Students will be able to implement problem-solving and analytical skills necessary to succeed in industry, including scripting and programming, and will be familiar with state-of-the-art machine learning tools and high-performance computing platforms.
Students will be able to demonstrate written and oral communication skills appropriate to engineering professionals.
Students will be able to work in teams to solve problems.

New Program Information

Mission and Purpose

Describe the program and explain how it fits the institutional mission statement and planning priorities.

The Computer Science (CS) and the Electrical and Computer Engineering (ECE) Departments at the University of Maryland, College Park propose launching a new Master of Science in Applied Machine Learning. This program will offer students the opportunity to engage in cutting-edge technical course work in machine learning and develop their problem solving skills in the art and science of processing and extracting information from data. During their coursework, students will build solid foundations in mathematics, statistics and computer programming, and explore advanced topics in machine learning such as deep learning, optimization, big data analysis and signal/image understanding. Students will also learn about applications of machine learning to computer vision, natural language processing, robotics, data science and other areas. The program will consist of 30-credit course work.

Artificial Intelligence (AI) has been an important aspect of Maryland's Computer Science department since the department's creation. Historically, and continuing at present, UMD has had strong groups in computer vision, natural language processing, and game theory. During the last several years, a strong presence has also emerged in two more areas, machine learning and robotics, in part due to intense faculty recruiting efforts supported by the campus administration.

The ECE Department offers one of the strongest and most highly-ranked programs in the nation in electrical and computer engineering. The ECE Department covers a wide spectrum of teaching and research activities in the areas of communications and networking, information and signal

processing, control, robotics and dynamical systems, computer engineering and electric, electronic and electromagnetic materials, devices and systems.

This document proposes the establishment of a new Master Science in Applied Machine Learning. This new degree program focuses on offering advanced education in the field of machine learning and aims to provide the skills and knowledge necessary to become a successful technologist in our information-based society. Its rigorous technical curriculum has been designed to prepare students for a career as an information engineer, data scientist, or data mining engineer. It will teach the methods and the techniques of creating models and algorithms that learn from, and make decisions or predictions based on data. The graduates of this program will be able to apply the learned tools and techniques to a wide variety of real world problems in areas such as marketing, finance, medicine, telecommunications, biology, security, engineering, social networking and information technology. Examples of such applications include the way email programs self-learn to distinguish spam from legitimate email, or how intrusion detection systems learn to differentiate between legitimate computer network traffic and malicious cyber-attacks, or how medical detection devices learn to distinguish healthy tissue and flag potentially dangerous tissue, or self-learning to detect stealth attacks in a smart grid; the number of applications of automated data-driven learning is growing at an ever increasing rate.

The MS in Applied Machine Learning program will contribute to the University of Maryland's vision in multiple ways. First, it will provide world-class graduate education and produce graduates who will become competent professionals in this new and constantly growing field. Their contributions and innovations will shape the future of our increasingly data-driven and information-driven society, and they will become well-trained leaders to meet the State of Maryland's future workforce needs. Second, this program will be a science, technology, engineering and mathematics (STEM) program, and it will enhance the University's STEM-related offerings and increase the number of students graduating with advanced STEM degrees. In addition, the program will be committed to creating an ethnically, culturally, and racially diverse community. This will be accomplished through diverse enrollment practices, through strategies for recruitment and retention of our faculty and staff, as well as implementing initiatives to build a greater sense of community among the students and alumni.

Program Characteristics

What are the educational objectives of the program?

The objective of the program is to provide highly technical, industry- and application-oriented education in the field of machine learning. The focus will be on teaching and training that provide our students with a solid understanding of the principles as well as the practical skill set to be able to start and maintain a successful career in industry after graduation. Furthermore, the course contents will also be of interest to professionals working in federal research labs and government organizations. While going through this program, the students will build a solid foundation in mathematics, statistics and programming, and these fundamental skills will form the core of their education. Then, while studying various electives, they will learn different methods and approaches to solve problems in machine learning and related technical fields concerned with automated data-driven learning, decision-making, and prediction.

Taking an industry-oriented approach, one of the program's goals is to teach the students how to use state-of-the-art tools and provide opportunities for hands-on experimentation and project-based learning.

Describe any selective admissions policy or special criteria for students interested in this program.

Any student applying for admission to a graduate program at the University of Maryland must meet the following minimum admission criteria as established by the Graduate School.
- Applicants must have earned a four-year baccalaureate degree from a regionally accredited U.S. institution, or an equivalent degree from a non-U.S. institution.
- Applicants must have earned a 3.0 GPA (on a 4.0 scale) in all prior undergraduate and graduate coursework.
- Applicants must provide an official copy of a transcript for all of their post-secondary work.

General Requirements:
- Statement of Purpose
- Transcript(s)
- TOEFL/IELTS/PTE (international graduate students)

Program-Specific Requirements:
- Graduate Record Examination (GRE) (optional)
- CV/Resume
- Description of research/work experience
- Prior coursework establishing quantitative ability (including calculus II, linear algebra, statistics, etc.)
- Proficiency in programming languages, demonstrated either through prior programming coursework or substantial software development experience

Summarize the factors that were considered in developing the proposed curriculum (such as recommendations of advisory or other groups, articulated workforce needs, standards set by disciplinary associations or specialized-accrediting groups, etc.).

The MS in Applied Machine Learning is based on the existing MPS in Machine Learning at UMD. The curriculum was inspired by similar, already existing programs at the Carnegie Mellon University, New York University, and Columbia University. Detailed descriptions of these programs and lists their most important characteristics are in the appendix. An ML Advisory Committee was formed from CS and ECE faculty members and the ENTS program staff, and the proposal was put together based on the suggestions and recommendations of the committee. The members of the Machine Learning Advisory Committee were: Prof. David Jacobs, Prof. Jordan Lee Boyd-Graber, Prof. Soheil Feizi, Prof. Dinesh Manocha, Prof. Sennur Ulukus, Prof. Rama Chellappa, Prof. Behtash Babadi, and Dr. Zoltan Safar.

Select the academic calendar type for this program (calendar types with dates can be found on the Academic Calendar page)

Traditional Semester

For Master's degree programs, describe the thesis requirement and/or the non-thesis requirement.

master's non-thesis

Identify specific actions and strategies that will be utilized to recruit and retain a diverse student body.

The primary recruitment activities will be via the CMNS Science Academy. The Science Academy uses a diverse, targeted approach when recruiting students. This digital strategy focuses on UMD alumni, current UMD graduating seniors, and working professionals in the DMV area. The admissions review process reviews for not only academic readiness but also diversity in experiences, industries, backgrounds, and career aspirations to recruit a diverse student body.

To attract a diverse student population, we will engage in the following activities:
• Representing the program in educational fairs, conferences and events, e.g. the National Leadership Conference of the National Society of Black Engineers, GEM Grad Labs.
• Advertising the program to the National Society of Black Engineers (NSBE), the Society of Women Engineers (SWE), and the Association for Women in Computing (AWC).
• Direct mailing and email campaigns to domestic and international colleges
• Outreach to UMD Campus organizations and clubs
• Holding online (virtual) open houses, information sessions and career panels
• Outreach to US Military to attract veterans
• Social media and online advertising
• Establishing graduate scholarships to provide financial aid to underrepresented minority applicants

Once enrolled, the Science Academy staff, and faculty are committed to creating and fostering a supportive environment for all students to thrive. We regularly share resources and opportunities for counseling, support, and funding. All students are expected to complete and honor the TerrapinSTRONG orientation and initiatives. Students are encouraged to take part in Grad School programs that address diversity and inclusion in higher education, build communities of support and success, and create meaningful dialogue among graduate students. Such programs include"Cultivating Community Conversations" and the "Annual Office of Graduate Diversity and Inclusions Spring Speaker Services." Faculty that are involved in the Science Academy represent many departments, have a diversity of appointments (both tenure track, professional track, and adjunct) exposing students to many future career paths. The Science Academy and faculty provide student advising, academic support, and career guidance to students to retain all students and support timely graduation.

Our student retention efforts will consist of:
• Holding "Women in Engineering, Computing and STEM" seminars to addresses the obstacles faced by women in today's technical workplace and guide our women students to maneuver through the internship and job application process
• Requiring students to attend mandatory advising sessions with the program adviser to ensure that the students' study plans are in line with their interests and career goals, and that the students make satisfactory progress toward meeting the degree requirements
• Implementing an early warning system that detects students struggling with core courses and alerts the academic advisor, who meets with the students and designs a study plan to get them back on track

Relationship to Other Units or Institutions

If a required or recommended course is o#ered by another department, discuss how the additional students will not unduly burden that department's faculty and resources. Discuss any other potential impacts on another department, such as academic content that may significantly overlap with existing programs. Use space below for any comments. Otherwise, attach supporting correspondence.

Three of the proposed courses are to be co-listed versions of courses in common with the MPS programs in Data Science and Analytics, and Machine Learning: BIOI/DATA/MSML601, Probability and Statistics; BIOI/DATA/MSML602, Principles of Data Science; and BIOI/DATA/MSML603, Principles of Machine Learning. These three courses are foundational to modern quantitative and computational-based science, and thus are common to the existing programs and the proposed program. All the remaining core courses will be new to the program, and some electives may be accepted from other programs. All programs are managed by the Science Academy.

Accreditation and Licensure. Will the program need to be accredited? If so, indicate the accrediting agency. Also, indicate if students will expect to be licensed or certified in order to engage in or be successful in the program's target occupation.

No accreditation or licensure is required for the program.

Describe any cooperative arrangements with other institutions or organizations that will be important for the success of this program.

n/a

Faculty and Organization

Who will provide academic direction and oversight for the program? In an attachment, please indicate the faculty involved in the program. Include their titles, credentials, and courses they may teach for the program.

The CMNS Science Academy will work with the CS and ECE department chairs for oversight. Each department will also assign a faculty director each who will provide the academic and advising oversight to incoming and admitted students. In addition, the academic co-directors are responsible for all instructor selections and appointments and work with. Science Academy and OES will also have oversight.

Full list of faculty expected to participate in the program is available in one of the attached documents.

Indicate who will provide the administrative coordination for the program

The Science Academy in the College of Computer, Mathematics and Natural Science will provide administrative coordination for the program, in collaboration with the Office of Extended Studies. The Office of Extended Studies provides program development support (budget development and projections, in house marketing research, preparation of PCC document), program management (UMD policies and procedures compliance, program website, data requests), student and program services (admission support, scheduling, registration, billing and payment, graduation, appeals), and financial management (faculty contracts, payment processing, course charge processor, net revenue distribution),

Resource Needs and Sources

Each new program is required to have a library assessment prepared by the University Libraries in order to determine any new library resources that may be required. This assessment must be done by the University Libraries. Add as an attachment.

full assessment is attached.

Discuss the adequacy of physical facilities, infrastructure and instructional equipment.

No additional physical facilities, infrastructure and instructional equipment is required for this program. Existing facilities (e.g., classrooms) and resources (e.g., instructional equipment) will be used, and these are demonstrably adequate for the proposed program. It is anticipated that most of the instruction will be in the evenings, as befitting the target student population of working adults. Thus, the use of classrooms will be outside the hours used for instruction by most programs.

Discuss the instructional resources (faculty, staff, and teaching assistants) that will be needed to cover new courses or needed additional sections of existing courses to be taught. Indicate the source of resources for covering these costs.

Instructional resources for the program will comprise current tenure track faculty, professional track faculty, and adjunct instructors. These instructional personnel will come from the Computer Science Department and the Electrical and Computer Engineering Department, outside the university (e.g., National Institutes of Health, ARLIS, industry). The funding source of covering instructional costs will come from tuition both from the program and the Science Academy if needed. No state resources will be used to support the program.

Discuss the administrative and advising resources that will be needed for the program. Indicate the source of resources for covering these costs.

The CMNS Science Academy will provide the academic and advising oversight to incoming and admitted students. Revenue generated from the program will be used to support administrative and advising resources including a Program Manager. No state resources will be used to support the program.

Use the Maryland Higher Education Commission (MHEC) commission financial tables to describe the program's financial plan for the next five years. See help bubble for financial table template. Use space below for any additional comments on program funding.

Based on the attached proposed budget the program projects to bring in revenue during the first year and to cover all start up costs. This program will not use any state funds and will be revenue generating. All expenses will be paid for by the tuition revenue for this program. See attached document.

Implications for the State (Additional Information Required by MHEC and the Board of Regents)

Explain how there is a compelling regional or statewide need for the program. Argument for need may be based on the need for the advancement of knowledge and/or societal needs, including the need for "expanding educational opportunities and choices for minority and educationally disadvantaged students at institutions of higher education." Also, explain how need is consistent with the Maryland State Plan for Postsecondary Education.

See support document attachment, Market Analysis, for a full analysis of the market as of March 2023. Our research indicates a much faster than average growth in computer and information research scientist positions nationally in the next 10 years. As more jobs become available in this area, it is our responsibility to respond to this need by preparing the workforce. Our graduates will complete the program with the skills and knowledge to fill the open positions in the market. Our program directly aligns with the Maryland State Plan for Postsecondary Education and the principles of public education in the State of Maryland. This program in the Science Academy increases access to higher education (specifically graduate level education) and increases the diversity of graduate students. Lastly, the program is an example of creativity and collaboration- a true partnership across departments and colleges on campus.

Present data and analysis projecting market demand and the availability of openings in a job market to be served by the new program. Possible sources of information include industry or disciplinary studies on job market, the USBLS Occupational Outlook Handbook, or Maryland state Occupational and Industry Projections over the next five years. Also, provide information on the existing supply of graduates in similar programs in the state (use MHEC's Office of Research and Policy Analysis webpage for Annual Reports on Enrollment by Program) and discuss how future demand for graduates will exceed the existing supply. As part of this analysis, indicate the anticipated number of students your program will graduate per year at steady state.

See attached for a full analysis of the market as of March 2023. Our research indicates a much faster than average growth, 21%, in computer and information research scientist positions in the field nationally in the next 10 years. Our program will be attractive to the professional learner because of its applied and experiential nature. Lastly, following the enrollment trends at other Maryland programs, our successful enrollments in other related programs, coupled with the projected job growth in this area, the program anticipates enrollment greater than 20 students per year.

Identify similar programs in the state. Discuss any di#erences between the proposed program and existing programs. Explain how your program will not result in an unreasonable duplication of an existing program (you can base this argument on program di#erences or market demand for graduates). The MHEC website can be used to find academic programs operating in the state: http://mhec.maryland.gov/institutions_training/pages/HEPrograms.aspx

While there are programs in the State that cover similar content areas, this will be the only program focused specifically on Machine Learning. Other state programs are in computing and systems engineering and are heavily focused on research. Other programs are offered online only whereas our program is offered both in-person and online.

Discuss the possible impact on Historically Black Institutions (HBIs) in the state. Will the program affect any existing programs at Maryland HBIs? Will the program impact the uniqueness or identity of a Maryland HBI?

We do not foresee any negative impacts on the uniqueness or identity of any Maryland HBIs. Rather, we see our program complementary in several ways. First, most HBIs in the state do not have related degree programs, and thus our program provides HBI students more opportunities for an advanced degree in an area not presently offered at their current institution. Second, there is distinct differentiation between the somewhat related programs at Maryland HBIs. The Computer Science MS program at Bowie State and the Advanced Computing MS program at Morgan State University, although listed in our market research document, are fundamentally different in subject matter coverage from the Applied Machine Learning MS covered by this proposal. The Bowie State and Morgan State programs are more broadly computer science-focused (sans theoretical aspects of the field). These degree programs are geared toward students who would be employed in various areas of computer science. Our degree program is geared toward data-informed or data-driven employment opportunities and emphasizes the interdisciplinary nature of machine learning.

Supporting Documents

Attachments

Faculty List Template- ML.docx
MachineLearningBenchmark2_23.xlsx
MS in Applied Machine Learning.xlsx
Library Assessment.pdf
Appendix 2 Summary of Learning Outcome Assessments 7-31-2023.pdf
Appendix 6 Course Descriptions.pdf

Key: 922

Faculty Information- Applied Machine Learning

The following faculty members are projected to teach in the program. All faculty are full-time unless otherwise indicated.

Name	Highest Degree Earned, Program, and Institution	UMD Title (indicate if part-time)	Courses
Babak Azimi-Sadjadi	Ph.D., ECE, UMD	Visiting Lecturer	DATA/MSML 603: Principles of Machine Learning
Sandra Cerrai	Ph.D., Mathematics, Scuola Normale Superiore of Pisa	Prof & Assoc Chair	DATA/MSML 601: Probability and Statistics
Manoj Franklin	Ph.D., Computer Science, University of Wisconsin- Madison	Associate Professor	MSML 605: Computing Systems for Machine Learning
Mohammad Taghi Hajiaghayi	Ph.D., Computer Science, MIT	Professor	DATA/MSML 602: Principles of Data Science
Leonid Koralov	Ph.D., Mathematics, SUNY at Stony Brook	Prof & Assoc Chair	DATA/MSML 601: Probability and Statistics
Yuntao Liu	Ph.D., ECE, UMD	Asst Research Scientist	MSML604: Introduction to Optimization
Alejandra Mercado	Ph.D., ECE, UMD	Associate Director	DATA/MSML 603: Principles of Machine Learning
Arefeh A Nasri	Ph.D., Transportation Engineering, UMD	Visiting Lecturer	DATA/MSML 602: Principles of Data Science
Paul Rodrigues	Ph.D., Linguistics, Indiana University Bloomington	Visiting Assoc Res Scientist, ARLIS	MSML:651: Big Data Analytics
Zoltan Safar	Ph.D., ECE, UMD	Director	DATA/MSML650: Cloud Computing
Shabnam Tafreshi	Ph.D., Computer Science, George Washington University	Asst Research Scientist, ARLIS	MSML641- Natural Language Processing
Jerry Wu	Ph.D., RF MEMS, George Washington University	Lecturer	MSML642: Robotics

					OES In-House Market Research: Other Institution Comparison			
					Program Name = Machine Learning, MS			
Institution	**Website**	**Delivery Method**	**Degree Name & Type (MPS, MA, MS, MPH, etc.)**	**# of Credits**	**Tuition (course or credit)**		**Target Population**	**Prior Education/ Pre-Requisites**
					Resident	**Non-Resident**		
Big Ten Institutions								
Northwestern University	https://www.mccormick.northwestern.edu/artificial-intelligence/	F2F	Artificial Intelligence, MS	Five-quarter sequence	$20,314/quarter (students pay for 4 quarters of tuition)		The program targets ambitious students who seek to become architects of intelligent systems as well as developers.	Bachelors degree in Computer Science or a related field.
University of Michigan	https://masters.engin.umich.edu/degree/robotics-ms/	F2F	Robatics, MS	30 credits	$1,926/credit	$3,286/credit	Our students come to the field with a variety of backgrounds, particularly in mechanical engineering, electrical engineering, and computer science. They learn to work in teams to accomplish the many tasks necessary to build and operate an autonomous system, including mechanical design, electronics, programming and integrating all the parts. Students graduate the program as independent researchers and engineers, and many will go on to become leaders in robotics research in academia, industry and government.	An engineering background is recommended but not required for the Robotics Program, although we have found that the lack of an engineering background puts students at a disadvantage as they begin their graduate studies. In general, our Admissions Committee is most interested in undergraduate and graduate academic performance, research experience, letters of recommendation (with particular attention to letters coming from faculty in relevant fields) and the academic statement of purpose.
Penn State University Park	https://www.worldcampus.psu.edu/degrees-and-certificates/penn-state-online-artificial-intelligence-masters-degree/overview	Online	Artificial Intelligence, MS	33 credits	$1,046/credit		This online program is designed to provide technical education that empowers graduates to drive the design, development, and deployment of AI and ML products and services across a broad array of applications. Professionals working in the field of AI are responsible for identifying and acquiring relevant data sets, developing scalable algorithms based on state-of-the-art AI/ML (including deep learning), natural language processing, reinforcement learning, and computer vision. Their work also includes applying findings to smart consumer devices, medical imaging diagnostics, autonomous vehicles, and weapons systems.	For admission to the Graduate School, an applicant must hold either (1) a baccalaureate degree from a regionally accredited U.S. institution or (2) a tertiary (postsecondary) degree that is deemed comparable to a four-year bachelor's degree from a regionally accredited U.S. institution. This degree must be from an officially recognized degree-granting institution in the country in which it operates.\n\nStudents should hold a bachelor's degree in computer science, engineering, or mathematics to be considered for admission to the program. Students from other disciplines will be considered based on prior course work (including the entrance requirements for mathematics and programming) and standardized test scores. Students should have earned at least a 3.00 junior/senior GPA (on a 4.00 scale) in their baccalaureate program.\nEntrance to Major\n\nMathematics entrance requirement\nApplicants must complete Calculus I equivalent to Penn State's MATH 140 and 1 semester of probability or statistics.\n\nProgramming entrance requirement\nApplicants must complete two introductory-level programming courses where both courses used the same language. If an applicant believes his/her work experience satisfies the background, he/she should include a recommendation letter from a technical colleague describing the applicant's coding contributions at work.
Rutgers University New Brunswick	https://www.cs.rutgers.edu/graduate/ms-program-in-computer-science/#section32	F2F	Computer Science, MS-Machine Learning Track	36 credits	$779/credit	$1,325/credit	Students who:\n*Hold professional positions in the development and design of computer systems and software applications\n*Teach computer science\n*Interested in future study and research at the doctorate level.	The department requires that applicants to the M.S. program have completed an undergraduate program in Computer Science, or taken the following prerequisite courses for the undergraduate degree: calculus, linear algebra, finite mathematics, probability/combinatorics, numerical analysis, high level languages, data structures, computer architecture, assembly language, algorithm design and analysis, programming languages and compilers, operating systems, distributed systems, information systems, networks.
University of Wisconsin–Madison	https://www.wisc.edu/	F2F or Online	Electrical Engineering: Machine Learning & Signal Processing, MS	30 credits	$1,200/credit		Designed for students looking for a jump start on a career in data science with a passion for quantitative thinking, practical problem-solving, and computer programming. The Electrical Engineering MLS master's degree is an accelerated program intended to prepare students to excel in the data science workforce in just one year.	All applicants must: Have a Bachelor of Science in electrical or computer engineering from an accredited institution, however bachelor's degrees in other fields of engineering, computer science, mathematics, statistics or a related discipline will be considered. Have a minimum undergraduate GPA of 3.0 on the last 60 credits of degree. Submit GRE test scores using code 1846 (optional).\nSubmit evidence of English language proficiency, if applicable. The required proficiency scores are: TOEFL IBT 92, PBT 580; or IELTS 7.0. Application materials required: Online application; Resume/CV; Statement of purpose; Transcripts; Three letters of recommendation
State of Maryland System Institutions: Overseen by MHEC (http://mhec.maryland.gov/publications/Pages/research/index.aspx)								
Bowie State University	https://www.bowiestate.edu/academics/colleges/college-of-arts-and-sciences/departments/computer-science/graduate/masters-degree/	F2F	Computer Science, MS- Artificial Intelligence/Machine Learning Specialization	36 credits	$439/credit	$723/credit	Students interested in knowledge representation and logical reasoning, robotics, machine learning, probabilistic modeling and inference, natural language processing, cognition, and applications.	Bachelors degree from an accredited institution and completion of specific mathematics (Calc I and Calc 2 and one course beyond Calc) and computer science (Software Design and Development)

Institution	Link	Format	Program	Credits	Cost (in-state)	Cost (out-of-state)	Description	Admission Requirements
Capitol Technology University	https://www.captechu.edu/degrees-and-programs/masters-degrees/systems-engineering-mres	Online	Systems Engineering, MS	30 credits	$630/credit		The M.Res. in Systems Engineering program is structured for those with experience, or established professionals, in the Engineering field with an appropriate degree. During the program, students will conduct original research in an approved area of Systems Engineering.	Not Noted
University of Maryland, Baltimore County	https://umbc.edu/admissions/graduate/graduate-degree-programs/#engineering-IT	F2F	Human-Centered Computing, MS	30 credits	$679/credit	$1,166/credit	The program has two tracks: a Practitioner Track for those who wish to become user experience, information architecture, or usability professionals and a Research Track for those who are interested in pursuing a Master's Thesis and possibly apply to a PhD program. Graduates from our program have moved on to be UX directors in both government and industrial positions, and graduates from the research track have joined top HCC PhD research programs.	Most accepted students meet the following minimum criteria: Applicants must include a Goal Statement summarizing their interests and experience in the field of Human-Centered Computing (Recommend 1-2 pages) Applicants must submit three letters of recommendation. We recommend these be from individuals who know the applicant professionally and can speak about their past professional accomplishments and potential as a graduate student. The majority of successful applicants have an undergraduate GPA well above 3.2 (on a 4.0 scale). All applicants are expected to read, speak, write, and understand the English language fluently. Those whose native language is not English are required to take the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS), unless they have earned a post-secondary degree from an accredited university in the United States. Admitted applicants must have a combined TOEFL score of 550 (written), 213 (computer based) or 80 (iBT-Internet based), a score above 6.5 with the IELTS (International English Language Testing System), or a score of 105 and above through DuoLingo. The code for UMBC is 5835 While not required for consideration to the MS program, we encourage interested applicants to include a resume (or CV), any samples of high-quality past work, and/or a UX portfolio or link to one. If online UX courses have been taken (e.g. through CourseEra), we encourage applicants to upload certificates of completion. GRE scores are not required for the MS degree program. When entering in contact details for referees, use institutional or corporate email addresses. References provided to us should be completed on headed notepaper and signed by the referee.
Morgan State University	https://www.morgan.edu/advanced-computing-ms/ms_advancedcomputing	F2F or Online	Advanced Computing - Artificial Intelligence Area, MS	30	$464/credit	$912/credit	This new program is designed for students who have recently completed a bachelor's degree program in Computer Science or a related field and wish to enhance their career, explore research opportunities in Computer Science, and apply their acquired skills in multi-disciplinary teams or for specific focus. The program also meets the needs of students who are already in the workforce and wish to update or improve their knowledge of current computer science.	Only students with an undergraduate cumulative grade-point average of 3.0 will be considered for admission. Students with an undergraduate cumulative GPA of between 2.5 and 2.99 may be considered for conditional admission. Post-bachelor's undergraduate credits will not be used to enhance G.P.A. requirements for admission to graduate study. For admission to graduate study an applicant must: Have earned a bachelor's degree from a regionally accredited college or university. The undergraduate record must be of such quality as to promise successful achievement at the graduate level.
Johns Hopkins University	https://ep.jhu.edu/programs/artificial-intelligence/masters-degree-requirements/	Online	Artificial Intelligence, MS	10 Courses	$4,920/course		With the expertise of the Johns Hopkins Applied Physics Lab, we've developed one of the nation's first online artificial intelligence master programs to prepare engineers like you to take full advantage of opportunities in this field. The highly advanced curriculum is designed to deeply explore AI areas, including computer robotics, natural language processing, image processing, and more.	You must meet the general admission requirements that pertain to all master's degree candidates. Prior education must include the following prerequisites such as: (1) three semesters or five quarters of calculus, which includes multivariate calculus; 625.108 – Calculus I 625.109 – Calculus II 625.250 – Multivariable Calculus and Complex Analysis (2) one semester of Linear Algebra 625.252 – Linear Algebra and Its Applications (3) one semester of Probability and Statistics 625.240 – Introduction to Probability and Statistics (4) one semester/term of Java or Python. 605.201 – Introduction to Programming Using Java OR 605.206 – Introduction to Python (5) one semester/term of advanced programming such as Data Structures. 605.202 – Data Structures If prior education does not include the prerequisites listed above, you may still be admitted under provisional status followed by full admission once you have completed the missing prerequisites. Missing prerequisites may be completed with Johns Hopkins Engineering (all prerequisites are available) or at another regionally accredited institution. When reviewing an application, your academic and professional background will be considered. If you are an international student, you may have additional admission requirements.

Institution	Link	Format	Program	Credits	Tuition		Description	Admission Requirements
Catholic University of America	https://engineering.catholic.edu/eecs/graduate-programs/index.html	F2F	Computer Science, MS- Robotics and Artificial Intelligence Concentration	30 credits	$1,910/credit		The program focuses on teaching how to enhance automation in motion planning and provide assistance in human-machine cooperative tasks in complex domains such as robotic-assisted surgery, robot manipulation, mobile robotics, and air-traffic control.	Students seeking admission to a graduate program in the School of Engineering must have received a bachelors degree in engineering, science, mathematics, or a related field from an accredited institution
Columbia University- Video Network	https://cvn.columbia.edu/program/columbia-university-computer-science-masters-degree-machine-learning-masters-science	Online	Computer Science, MS- Machine Learning Track	30 credits	$2,362/credit		The Machine Learning Track is intended for students who wish to develop their knowledge of machine learning techniques and applications. Machine learning is a rapidly expanding field with many applications in diverse areas such as bioinformatics, fraud detection, intelligent systems, perception, finance, information retrieval, and other areas.	Have a bachelor's degree from a regionally accredited U.S. institution with a 3.3 GPA. Most candidates have completed an undergraduate degree in computer science. Applicants with degrees in other disciplines and a record of excellence are encouraged to apply; these applicants are required to have completed at least six prerequisites: 4 computer science courses covering the foundations of the field and 2 math courses.
George Mason	https://cs.gmu.edu/current-students/ms-students/ms-in-computer-science/machine-learning-concentration/	F2F	Computer Science, MS- Machine Learning Concentration	30 credits	$679/credit	$1,474/credit	Designed for students interested in research and professional practice in computer science and related technologies.	Have a bachelor's degree from a regionally accredited U.S. institution.
Virginia Tech	https://www.vt.edu/innovationcampus/masters-degrees/meng-cpe.html	F2F	Computer Engineering, MEng - Machine Learning and Applications Track	30 credits	$16,060/year (no credit breakdown available)	$31,298/year (no credit breakdown available)	The master of engineering in computer engineering offers graduate students a strong academic foundation in core technological areas with a culminating project-based learning experience, preparing students to begin or to advance their professional careers.	We are looking for applicants with a strong math background. Ideally applicants will have completed up to Calculus III, but some completion of Calculus is needed. Complete applications include Transcript, Strong GPA (minimum 3.0 cumulative), No GRE required, 2-3 Letters of recommendation
Howard University	https://gs.howard.edu/computer-science-mcs	F2F	Computer Science, MCS- Algorithms and Machine Learning Specialization	33 credits	$35,556/year (no credit breakdown available)		Designed for students with interest in a comprehensive knowledge of contemporary computer science through training that combines both theory and practice.	Have a bachelor's degree from a regionally accredited U.S. institution with a 3.0 GPA.

Institution	Link	Format	Program	Credits	Tuition		Description	Admission Requirements
Carnegie Mellon University	https://www.ml.cmu.edu/academics/primary-ms.html	F2F	Machine Learning, MS	30 credits	$27,250/semester		Students who have good analytic skills and a strong aptitude for mathematics, statistics, and programming.	Incoming students must have a strong background in computer science, including a solid understanding of complexity theory and good programming skills, as well as a good background in mathematics. First-year courses assume at least one year of college-level probability and statistics, as well as matrix algebra and multivariate calculus.
Drexel University	https://drexel.edu/cci/academics/graduate-programs/ms-in-artificial-intelligence-machine-learning/	F2F or Online	Artificial Intelligence and Machine Learning, MS	45 credits	$1,342/credit		Students interested in exploring the artificial intelligence and machine learning field's fundamental mathematics to develop related tools and apply AI and ML to various real-world problems.	A four-year bachelor's degree or Master's degree from a regionally accredited institution with a 3.0 GPA in Computer Science, Software Engineering or related STEM degree plus work experience equal to Drexel CS Post-Baccalaureate certificate. Those without the above will have to complete the Post-Baccalaureate Certificate in Computer Science program (with grade B or better in each course) prior to admission to the AI masters degree.
Duke University	https://ece.duke.edu/masters/degrees/ms	F2F	Electrical & Computer Engineering- Data Analytics & Machine Learning Concentration	30 credits	Master's students are required to enroll in and pay tuition for at least three semesters of full-time study ($30,110). After that, they will be charged at an estimated rate of $3,478 per credit.		Specialized preparation for industry, research careers or doctoral study	Have a bachelor's degree from a regionally accredited U.S. institution with a 3.0 GPA.

OES In-House Market Research: Projected Enrollment Information				
Program Name = Machine Learning, MS				
Occupation	**# of Jobs in the Field**	**Where Professionals are Employed**	**Professional Salary Information**	**Projected Job Growth**
Information from U.S. Bureau of Labor Statistics' Occupational Outlook Handbook (https://www.bls.gov/ooh/)				
Computer and Information Research Scientists	33,500 (2021)	31% - Federal government, excluding postal service 20% - Computer systems design and related services 16% - Research and development in the physical, engineering, and life sciences 6% - Software publishers 5% - Colleges, universities, and professional schools; state, local and private	$131,490 (2021)	2021-2031 Projected to grow 21% (much faster than average)
Information from State of Maryland's Occupational and Industry Projections (http://www.dllr.state.md.us/lmi/iandoproj/)				
Computer and Information Research Scientists	2,873 (2021)	**Top 12** - Computer systems design and related services; - Management and technical consulting services; - Architectural and engineering services; - Scientific research and development services; - Colleges and universities; - Management of companies and enterprises; - Commercial equip. merchant wholesalers; - Wired telecommunications carriers; - Other financial investment activities; - Elementary and secondary schools; - Insurance carriers; - Data processing, hosting and related services;	Annual Mean Wage: $123,324 Annual 10th Percentile: $87,880 Annual 75th Percentile: $142,438	2018-2028 Increase by 7%

Five-Year Enrollment Trends					
Year	**Bowie State University**	**Capitol Technology University**	**University of Maryland, Baltimore County**	**Morgan State University**	**Johns Hopkins University**
	Computer Science, MS- Artifical Intelligence/Machine Learning Specialization	**Systems Engineering, MS**	**Human-Centered Computing, MS**	**Advanced Computing - Artificial Intelligience Area, MS**	**Artificial Intelligence, MS**
2017	32	Starting Spring 2023	35	0	0
2018	31		37	0	0
2019	30		37	0	0
2020	25		30	2	60
2021	36		44	10	191
Five-Year Degree Recaps					
Year	**Bowie State University**	**Capitol Technology University**	**University of Maryland, Baltimore County**	**Morgan State University**	**Johns Hopkins University**
	Computer Science, MS- Artifical Intelligence/Machine Learning Specialization	**Systems Engineering, MS**	**Human-Centered Computing, MS**	**Advanced Computing - Artificial Intelligience Area, MS**	**Artificial Intelligence, MS**
2018	12	Starting Spring 2023	16	0	0
2019	12		14	0	0
2020	15		21	0	0
2021	6		14	0	0
2022	8		21	2	4

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http://mhec.maryland.gov/publications/Pages/research/index.aspx

Enrollment Trends: Go to "Enrollment Reports" then "Trends in Fall Enrollment by Program"
Degree Recaps: Go to "Student Outcomes" then "Trends in Degrees and Certificates by Program"

The learning outcomes for the program will be assessed using a combination of formative and summative assessments during and at the completion of each semester. Each course in the program will have homework assignments, practice sets, and other assessments that will be graded with feedback to help assess the student's learning. Midterms and final exams or projects will be cumulative assessments to determine if and to what level the student mastered the learning outcomes for each course.

The assessments will be appropriate to the nature of the course content and the course learning objectives. Both individual assessments and group assessments will be required in the program. This type of variation best mimics the work and industry expectations. The assessments of the program will mirror work products in the industry and prepare students for jobs in industry. For example, many of the elective courses include final projects, presentations and assignments where students have to work with real data sets. Students will be expected to process the data, and perform tasks and make recommendations that are expected of an entry level data scientist/AI engineer.

Lastly, students will also be challenged to complete reflective assessments to apply knowledge and skills in their future professional work. This work will assist students in the job search process and enable them to identify, apply to, and earn positions in this field. The assessments will all follow best practices for adult and professional students. As the student progresses through the curriculum and satisfies learning objectives, they will align with and accomplish the program-level learning outcomes.

MS in Applied Machine Learning					
Five-Year Program Budget					
Tuition Revenue	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
A. Total enrolled students	9	19	20	21	23
First year enrollment	9	10	10	11	12
Second year enrollment		9	10	10	11
B. Total # of 3-credit Courses (by enrollment year)	8	10	10	10	10
# of courses offered for students in year one of the program	8	8	8	8	8
# of courses offered for students in year two of the program		2	2	2	2
C. Per Course Rate	$4,000	$4,120	$4,244	$4,371	$4,502
Total Tuition Revenue	$288,000	$403,760	$424,360	$472,058	$531,240
Direct Expenses	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
A. Instructor Salaries and Fringe	$134,927	$173,936	$179,154	$184,529	$190,065
1. Subtotal: Instructor salaries	$103,870	$133,900	$137,917	$142,055	$146,316
Average 3-credit course salary	$13,000	$13,390	$13,792	$14,205	$14,632
Program specific courses (100% FTE)	7	7	7	7	7
Shared courses (33% FTE)	3	3	3	3	3
2. Fringe Benefits: 29.9%	$31,057	$40,036	$41,237	$42,474	$43,749
Total Direct Expenses	$134,927	$173,936	$179,154	$184,529	$190,065
Total Annual Tuition Revenue	$288,000	$403,760	$424,360	$472,058	$531,240
Total Annual Direct Expenses	$134,927	$173,936	$179,154	$184,529	$190,065
Total Annual OES Administrative Fee	$28,800	$40,376	$42,436	$47,206	$53,124
Annual Distributable Revenue	$124,273	$189,448	$202,770	$240,323	$288,051

Indirect Expenses					
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Administrative Salaries and Fringe	$53,692	$55,303	$56,962	$58,671	$60,431
1. Administrative Salaries	$39,596	$40,784	$42,007	$43,268	$44,566
Director (20% FTE)	$25,846	$26,621	$27,420	$28,243	$29,090
Faculty Director Stipend	$15,000	$15,450	$15,914	$16,391	$16,883
Program Manager (33% FTE)	$13,750	$14,163	$14,587	$15,025	$15,476
2. Fringe Benefits: 35.6%	$14,096	$14,519	$14,955	$15,403	15,865
Hourly Wages	$38,736	$51,648	$52,552	$53,474	$54,414
1. Hourly Wages	$36,000	$48,000	$48,840	$49,697	$50,571
Graders for program specific courses ($6K per course)	30,000	42,000	42,840	43,697	44,571
Graders for shared courses ($2K per course)	6,000	6,000	6,000	6,000	6,000
2. Hourly Wages Benefits: 7.6%	$2,736	$3,648	$3,712	$3,777	$3,843
Marketing	$2,500	$2,575	$2,652	$2,732	$2,814
1. Marketing	2,500	2,575	2,652	2,732	2,814
Equipment	$1,500	$1,545	$1,591	$1,639	$1,688
1. Equipment	1,500	1,545	1,591	1,639	1,688
Travel & Recruitment	$1,500	$1,545	$1,591	$1,639	$1,688
1. Travel & Recruitment	$1,500	$1,545	$1,591	$1,639	$1,688
Total Indirect Expenses	$97,928	$112,616	$115,349	$118,155	$121,035

Net Revenue	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
OES Distribution to CMNS	$124,273	$189,448	$202,770	$240,323	$288,051
Indirect Expenses	$97,928	$112,616	$115,349	$118,155	$121,035
Balance	**$26,345**	**$76,832**	**$87,421**	**$122,169**	**$167,016**

DATE:　　　　February 21, 2019

TO:　　　　　Matthew M. Nessan

　　　　　　　Associate Director, Programs; Office of Extended Studies

FROM:　　　　On behalf of the University of Maryland Libraries:

　　　　　　　Nevenka Zdravkovska, Head, STEM Library

　　　　　　　Maggie Saponaro, Director of Collection Development Strategies

　　　　　　　Daniel Mack, Associate Dean, Collection Strategies & Services

RE:　　　　　Master of Professional Studies in Machine Learning - Library Collection Assessment

We are providing this assessment in response to a proposal by the Computer Science Department (CMNS) and Electrical and Computer Engineering Department (A. James Clark School of Engineering) to create a Master of Professional Studies (MPS) in Machine Learning. This program asked that we at the University of Maryland Libraries assess our collection resources to determine how well the Libraries support the curriculum of this proposed MPS in Machine Learning.

Serial Publications

The University of Maryland Libraries currently subscribe to a large number of scholarly journals, with almost all in online format that focus on various specialties within Electrical and Computer Engineering, including Machine Learning.

The Libraries subscribe to several of the top ranked journals that are listed in the Computer Science, Artificial Intelligence category (which includes machine learning journals) in *Journal Citation Reports.** These journals include the following, all of which are available online:

- *International Journal of Machine Learning and Cybernetics*
- *Journal of Machine Learning Research*
- *Machine Learning*

Also, the Libraries have subscription to IEEE and ACM publications, which are numerous and can be accessed through the relevant databases, as discussed below.

Due the interdisciplinary research and instruction inherent in machine learning, there may be highly-ranked core journals to which the Libraries do not currently subscribe. However, articles in journals that we do not own likely will be available through Interlibrary Loan/Document Delivery.

*_Journal Citation Reports_ is a tool for evaluating scholarly journals. It computes these evaluations from the relative number of citations compiled in the _Science Citation Index_ and _Social Sciences Citation Index_ database tools.

Databases

The Libraries' _Database Finder_ (http://www.lib.umd.edu/dbfinder) resource offers online access to databases that provide indexing and access to scholarly journal articles and other information sources. Many of these databases cover subject areas that would be relevant to this proposed program, especially since due to the interdisciplinary applications of machine learning. Databases that would most be useful in the field of machine learning are

- IEEE Xplore
- ACM Digital Library
- Knovel
- ScienceDirect

In many and likely in most cases, these indexes offer full text copies of the relevant journal articles. In those instances that the journal articles are available only in print format, the Libraries can make copies available to graduate students through either the Libraries' Scan & Deliver Program (http://www.lib.umd.edu/access/scan-deliver) or via Interlibrary Loan (more details given below).

Monographs

The Libraries regularly acquire scholarly monographs in machine learning and allied subject disciplines. Monographs not already part of the collection can usually be added upon request. The Libraries has also acquired many eBooks and eBook collections, like:

- Springer eBooks in Computer Science and Springer eBooks (2005-2011)
- SIAM eBooks
- SPIE eBooks
- Synthesis Digital Library (Morgan & Claypool)
- IEEE/Wiley eBooks

A search of the University of Maryland Libraries' WorldCat UMD catalog was conducted, using a variety of relevant subject terms. This investigation yielded sizable lists of citations of books that we own over 700 monographs related to machine learning, including hundreds in areas relevant to proposed courses. In addition, we own dozens of monographs published within the last five to ten years, insuring the program has access to relevant and recent holdings.

A further search revealed that the Libraries' membership in the Big Ten Academic Alliance (BTAA) dramatically increases these holdings and citations with 694 results for "machine learning" and 221 results

for "deep learning." As with our own materials, graduate students can request that chapters be copied from these BTAA books if the books are not available electronically.

Scan & Deliver and Interlibrary Loan

These services offer online delivery of bibliographic materials that otherwise would not be available online. As a result, remote users who take online courses may find these services to be helpful. Scan & Deliver and Interlibrary Loan are available free of charge.

The Scan & Deliver service scans and delivers journal articles and book chapters within three business days of the request--provided that the items are available in print on the UM Libraries' shelves or in microform. In the event that the requested article or chapter is not available on campus, Scan & Deliver will automatically refer the request to Interlibrary Loan (ILL). Interlibrary Loan is a service that enables borrowers to obtain online articles and book chapters from materials not held in the University System of Maryland.

Additional Materials and Resources

In addition to serials, monographs, and databases available through the University Libraries, students in the proposed program will have access to a wide range of media, datasets, software, and technology. Library Media Services (http://www.lib.umd.edu/lms) houses media in a variety of formats that can be utilized both on-site and via ELMS course media. GIS Datasets are available through the GIS Data Repository (https://www.lib.umd.edu/gis/data-and-resources). Statistical consulting and additional research support are available through the Research Commons (http://www.lib.umd.edu/rc), and technology support and services are available through the Terrapin Learning Commons (http://www.lib.umd.edu/tlc).

Additionally, although not likely to be highly used by this program, UMD does have a number of microform collections, which may be of use for interdisciplinary research. Finally, the STEM Library is a Patent and Trademark Resource Center and provides patent and trademark research consultation.

The subject specialist librarian for Computer Science is Nevenka Zdravkovska (Nevenka@umd.edu) and will also serve as an important resource to programs such as the one proposed.

Other Research Collections

Because of the University's unique physical location near Washington D.C., Baltimore and Annapolis, University of Maryland students and faculty have access to some of the finest libraries, archives and research centers in the country vitally important for researchers in this discipline. These include the Library of Congress, the National Archives, the Smithsonian, and more available for research use.

Conclusion

With our substantial journals holdings and index databases, as well as additional support services and resources, the University of Maryland Libraries have the resources to support teaching and learning in machine learning. These materials are supplemented by a strong monograph collection and additional holdings through the Big Ten Academic Alliance. Additionally, the Libraries Scan & Deliver and Interlibrary Loan services make materials that otherwise would not be available online, accessible to remote users. As a result, our assessment is that the University of Maryland Libraries are able to meet the curricular and research needs of the proposed MPS in Machine Learning to be offered from the Computer Science and Electrical and Computer Engineering departments.

Course Descriptions

MSML601 Probability and Statistics (3 Credits)
Provides a solid understanding of the fundamental concepts of probability theory and statistics. The course covers the basic probabilistic concepts such as probability space, random variables and vectors, expectation, covariance, correlation, probability distribution functions, etc. Important classes of discrete and continuous random variables, their inter-relation, and relevance to applications are discussed. Conditional probabilities, the Bayes formula, and properties of jointly distributed random variables are covered. Limit theorems, which investigate the behavior of a sum of a large number of random variables, are discussed. The main concepts random processes are then introduced. The latter part of the course concerns the basic problems of mathematical statistics, in particular, point and interval estimation and hypothesis testing.
Prerequisite: Undergraduate courses in calculus and basic linear algebra. Cross-listed with: DATA601, BIOI601.
Credit Only Granted for: BIOI601, DATA601 or MSML601.

MSML602 Principles of Data Science (3 Credits)
An introduction to the data science pipeline, i.e., the end-to-end process of going from unstructured, messy data to knowledge and actionable insights. Provides a broad overview of what data science means and systems and tools commonly used for data science, and illustrates the principles of data science through several case studies.
Restriction: Must be in one of the following programs: (Data Science Post-Baccalaureate Certificate, Master of Professional Studies in Data Science and Analytics, or Master of Professional Studies in Machine Learning). Cross-listed with: DATA602, BIOI602.
Credit Only Granted for: BIOI602, DATA602, MSML602 or CMSC641.
Formerly: CMSC641.

MSML603 Principles of Machine Learning (3 Credits)
A broad introduction to machine learning and statistical pattern recognition. Topics include: Supervised learning: Bayes decision theory, discriminant functions, maximum likelihood estimation, nearest neighbor rule, linear discriminant analysis, support vector machines, neural networks, deep learning networks. Unsupervised learning: clustering, dimensionality reduction, PCA, auto-encoders. The course will also discuss recent applications of machine learning, such as computer vision, data mining, autonomous navigation, and speech recognition.
Restriction: Must be in one of the following programs: (Data Science Post-Baccalaureate Certificate, Master of Professional Studies in Data Science and Analytics, or Master of Professional Studies in Machine Learning). Cross-listed with: DATA603, BIOI603, MSQC603.
Credit Only Granted for: BIOI603, DATA603, MSML603, MSQC603 or CMSC643.
Formerly: CMSC643.

MSML604 Introduction to Optimization (3 Credits)
Focuses on recognizing, solving, and analyzing optimization problems. Linear algebra overview: vector spaces and matrices, linear transformations, matrix algebra, projections, similarity transformations, norms, eigen-decomposition and SVD. Convex sets, convex functions, duality theory and optimality conditions. Unconstrained optimization: 1D search, steepest descent, Newton's method, conjugate gradient method, DFP and BFGS methods, stochastic gradient descent. Constrained optimization: projected gradient methods, linear programming, quadratic programming, penalty functions, and

interior-point methods. Global search methods: simulated annealing, genetic algorithms, particle swarm optimization.
Prerequisite: Undergraduate courses in calculus and basic linear algebra.
Recommended: DATA601.

MSML605 Computing Systems for Machine Learning (3 Credits)
Programming, software and hardware design and implementation issues of computing systems for machine learning. Topics in the programming/software domain will include: basic Python program structure, variables and assignment, built-in data types, flow control, functions and modules; basic I/O, and file operations. Classes, object-oriented programming and exceptions. Regular expressions, database access, network programming and sockets. Introduction to the Numpy, Scipy and Matplotlib libraries. Topics in the hardware domain include computer architecture, CPUs, single- and multi-core architectures, GPUs, memory and I/O systems, persistent storage, and virtual memory. Parallel processing architectures, multiprocessing and cluster processing.
Restriction: Must be in the MPS in Machine Learning program.

MSML606 Algorithms and Data Structures for Machine Learning (3 Credits)
Provides both a broad coverage of basic algorithms and data structures. Topics include sorting, searching, graph and string algorithms; greedy algorithm, branch-and-bound, dynamic programming and job scheduling; Arrays, linked lists, queues, stacks, and hash tables; Algorithm complexity, best/average/worst case analysis. Applications selected from machine learning problems.

MSML612 Deep Learning (3 Credits)
Provides an introduction to the construction and use of deep neural networks: models that are composed of several layers of nonlinear processing. The class will focus on the main features in deep neural nets structures. Specific topics include backpropagation and its importance to reduce the computational cost of the training of the neural nets, various coding tools available and how they use parallelization, and convolutional neural networks. Additional topics may include autoencoders, variational autoencoders, convolutional neural networks, recurrent and recursive neural networks, generative adversarial networks, and attention-based models. The concepts introduced will be illustrated by examples of applications chosen among various classification/clustering questions, computer vision, natural language processing.
Prerequisite: DATA603 or MSML603. Cross-listed with: DATA612.
Credit Only Granted for: DATA612 or MSML612.

MSML640 Computer Vision
An introduction to basic concepts and techniques in computer vision. Topics include low-level operations such as image filtering, correlation, edge detection and Fourier analysis. Image segmentation, texture and color analysis. Perspective, cameras and 3D reconstruction of scenes using stereo and structure from motion. Deep learning for object detection, recognition and classification in images and video.
Prerequisite: DATA603 or MSML603

MSML641 Natural Language Processing (3 Credits)
Introduces fundamental concepts and techniques involved in getting computers to deal more intelligently with human language. Focused primarily on text (as opposed to speech), the class will offer a grounding in core NLP methods for text processing (such as lexical analysis, sequential tagging, syntactic parsing, semantic representations, text classification, unsupervised discovery of latent

structure), key ideas in the application of deep learning to language tasks, and consideration of the role of language technology in modern society.
Prerequisite: DATA603 or MSML603. Cross-listed with: DATA641.
Credit Only Granted for: DATA641 or MSML641.

MSML642 Robotics
This course offers an introduction to the design and programming of robotics systems. Topics include kinematics, differential motion and velocity, dynamics and forces. Sensors, actuators and drive systems. Trajectory planning and motion control systems, open-loop and closed-loop controllers, state estimation and Kalman filters. It will also discuss recent applications of machine learning to motion planning, grasping, manipulation, and related areas.
Prerequisite: DATA603 or MSML603

MSML650 Cloud Computing (3 Credits)
Presents the state of the art in cloud computing technologies and applications. Topics will include: telecommunications needs, architectural models for cloud computing, cloud computing platforms and services. Data center networking, server, network and storage virtualization technologies, and containerization. Cloud operating and orchestration systems. Security, privacy, and trust management; resource allocation and quality of service; interoperability and internetworking.Cross-listed with: DATA650.
Credit Only Granted for: MSML650 or DATA650.

MSML651 Big Data Analytics
The course will focus on the challenges, tools and methods to design and implement machine learning algorithms for very large datasets, and the configuration and operation of distributed computing platforms to execute them. Topics include scalable learning techniques, data streaming and data flow analytics, machine learning on large graphs. Massively parallel computing models such as map-reduce, and techniques to reduce the memory, disk storage and/or communication requirements of parallel machine learning algorithms. SQL and no-SQL database systems, distributed file systems, key-value stores, document databases, graph databases and large dataset visualization.
Prerequistie: DATA601 or MSML602; and DATA603 or MSML603

Revisions to the School of Public Policy (PLCY) Plan of Organization

PRESENTED BY	**Gene Ferrick, Chair**
REVIEW DATES	**SEC – October 20, 2023　│　SENATE – November 1, 2023**
VOTING METHOD	**In a single vote**
RELEVANT POLICY/DOCUMENT	**[Plan of Organization for Shared Governance at the University of Maryland, College Park](#)**
NECESSARY APPROVALS	**Senate, President**

ISSUE

The University of Maryland Plan of Organization for Shared Governance mandates that all Colleges and Schools be governed by a Plan of Organization. These Plans must conform to provisions and principles set forth in the University's Plan, the Bylaws of the University Senate, the Policy on Shared Governance in the University System of Maryland, and best practices in shared governance. Revisions to the Plan of Organization of each College, School, and the Library must be reviewed and approved by the University Senate. The Senate Elections, Representation, & Governance (ERG) Committee is the standing Committee responsible for conducting these reviews. In October 2019, the School of Public Policy (PLCY) submitted a revised version of its Plan of Organization, including changes to its Appointment, Promotion, and Tenure (APT) policy. The School indicated that there have been no changes to its Appointment, Evaluation, and Promotion (AEP) policy since it was last approved in 2016.

RECOMMENDATION(S)

The Elections, Representation, & Governance Committee recommends that the Senate approve the revised Plan of Organization for the School of Public Policy.

COMMITTEE WORK

The PLCY Plan of Organization review process started in November 2019. The review process entailed collaborative feedback discussion between PLCY representatives and both the ERG Committee and the Faculty Affairs Committee (FAC). The ERG Committee provided initial feedback to the PLCY noting that there is no single body that meets the requirements of the "Faculty Advisory Council" required by the University Plan, and the procedures for electing University Senators are insufficient. The committee also noted areas where shared governance and administrative functions are not clearly delineated, and observed that there are inadequate opportunities for participation by staff and students in the School's governance.

The ERG Committee received a revised PLCY Plan that addressed a majority of the feedback the ERG Committee previously provided and notable changes to the committees were made. An additional committee called the Faculty Committee was created to be chaired by the Dean to

facilitate a method to receive information from faculty members. ERG Committee members provided feedback on this revision that clarity was needed of committee's membership process with term lengths that are stated rather than implied and specified term limits and quorums. Also, a version of the Faculty Advisory Council required by the UMD Plan was needed with the specified duties and has an elected chair with elected representation from faculty, staff and students, as written it appeared the council was split between two committees, the Assembly Executive Committee (IX.A) and the Faculty Advisory Council (IX.B).

Over the summer 2023 PLCY acted on the ERG Committee's feedback by providing a further revised Plan that included the delineation of committee roles, established a Faculty Advisory Council as specified in the UMD Plan, and clarified committee membership processes. Additional revisions were made to specify constituency groups of students as undergraduate and graduate, and staff as non-exempt and exempt. At the September 2023 ERG Committee meeting, the committee reviewed the revised PLCY Plan noting PLCY addressed the ERG Committee's feedback. At the October ERG Committee meeting, the committee voted to approve the revised PLCY Plan.

In conjunction with the PLCY Plan review, the FAC Working Group reviewed the APT and Post-Tenure Review policies. The Working Group's initial review raised concerns about the PLCY's inclusion of non-unit-based faculty members representation on the Initial Advisory Subcommittee and requested clarity of voting members on the APT Committee. PLCY responded by clarifying PTK and other non-tenure track faculty's input will be considered but they will not be involved in the discussion or deliberation of APT cases and clarifying the voting members on the APT Committee.

PLCY addressed FAC Working Group concerns and revised the policies to align with UMD governing documents when it was noted the policies were missing required elements that may have been present at one time but were deleted during the Plan revision process.

The FAC reviewed and approved the PLCY APT and Post-Tenure Review policies by vote on October 11, 2023.

The ERG Committee voted to approve the revised PLCY Plan on October 13, 2023.

The School of Public Policy College Assembly voted to approve the revised Plan of Organization in a vote concluding October 23, 2023.

ALTERNATIVES

The Senate could reject the revised Plan of Organization and the existing Plan would remain in effect.

RISKS

There are no risks to the University in adopting the revised Plan of Organization.

FINANCIAL IMPLICATIONS

There are no known financial implications.

Revisions to the School of Public Policy (PLCY) Plan of Organization

2023-2024 Committee Members

Gene Ferrick (Chair)
Paul Brown (Faculty)
Marck Coulbourne (Faculty)
Jon Crocker (Faculty)
Jenna Dimaggio (Undergraduate Student)
Orna Garrett (Ex-Officio Director of HR Rep)
Lian Kish (Exempt Staff)
Soomin Kim (Undergraduate Student)
Serena Mlawsky (Graduate Student)
Polly O'Rourke (Faculty)

Abdulazeez Olukose (Graduate Student)
Pamela Phillips (Ex-Officio Associate VP IRPA Rep)
Hilary Thompson (Faculty)
Michael Werre (Non-Exempt Staff)

Date of Submission

October 13, 2023

BACKGROUND

The University of Maryland Plan of Organization for Shared Governance mandates that all Colleges, Schools, and the Libraries be governed by a Plan of Organization. These Plans must conform to provisions and principles set forth in the University's Plan, the Bylaws of the University Senate, and the Policy on Shared Governance in the University System of Maryland, as well as with best practices in shared governance. Revisions to the Plan of Organization of each College, School, and the Libraries must be reviewed and approved by the University Senate. The Senate Elections, Representation, & Governance (ERG) Committee is the standing committee responsible for conducting these reviews in conjunction with Faculty Affairs Committee (FAC).

In October 2019, the School of Public Policy (PLCY) submitted a revised version of its Plan of Organization, including changes to its Appointment, Promotion, and Tenure (APT) policy. The School indicated that there have been no changes to its Appointment, Evaluation, and Promotion (AEP) policy since it was last approved in 2016.

COMMITTEE WORK

In November 2019, the ERG Committee conducted an in-depth assessment of the revised PLCY Plan. The committee noted that there was no single body that meets the requirements of the "Faculty Advisory Council" required by the University Plan, and the procedures for electing University Senators was insufficient. The committee also noted areas where shared governance and administrative functions were not clearly delineated, and observed there were inadequate opportunities for participation by staff and students in the School's governance.

In August 2020, PLCY submitted a revised Plan. Upon the review of the revisions in March 2021, the ERG Committee provided feedback to PLCY that revisions were needed to the Faculty Advisory Council, noted a range of unclear or missing language related to PLCY bodies, and that representation for students was potentially inadequate.

A newly revised PLCY Plan was submitted in December 2021. After a review of the revised PLCY Plan ERG Committee feedback was provided to the PLCY representative in April 2022. In May

2022, ERG Committee Chair Montgomery provided an update to the Committee that the most recent Plan submission received from the PLCY required additional clarification and the remaining concerns were reviewed with the PLCY representative at a meeting. These included concerns such as clarity and expressed intention on the makeup of the Policy Student Government Association, clarity on the formation of subcommittees and membership terms, and confusing references to Staff body and University Staff senators.

The ERG Committee received PLCY Plan revisions in February 2023. Overall, the revised PLCY Plan addressed a majority of the feedback the ERG Committee previously provided and notable changes to the committees were made. An additional committee called the Faculty Committee was created to be chaired by the Dean to facilitate a method to receive information from faculty members.

ERG Committee members provided feedback in March 2023 noting the newly created committees needed clear delineation of the committee's role as either administrative or shared governance. Clarity was needed of these committee's membership process with term lengths that are stated rather than implied, specified term limits, and quorums. A version of the Faculty Advisory Council was needed, as required by the UMD Plan, that has the specified duties and an elected chair with elected representation from faculty, staff and students, as written it appeared the council was split between two committees, the Assembly Executive Committee (IX.A) and the Faculty Advisory Council (IX.B).

Over the summer 2023 PLCY acted on the ERG Committee feedback by providing a revised Plan that included the delineation of committee roles, established a Faculty Advisory Council as specified in the UMD Plan, and clarified committee membership processes. Additional revisions were made to specify constituency groups of students as undergraduate and graduate, and staff as non-exempt and exempt. At the September 2023 ERG Committee meeting, the committee reviewed the revised PLCY Plan noting this version corrected and clarified committee's roles and the representational issues among staff and students. At the October ERG Committee meeting, the committee voted to approve the PLCY Plan.

In conjunction with the PLCY Plan review, the FAC Working Group reviewed the APT and Post-Tenure Review policies. PLCY addressed concerns and revised the policies to align with UMD governing documents when it was noted the policies were missing required elements that may have been present at one time but were deleted during the Plan revision process.

The Working Group's initial review raised concerns about the PLCY's inclusion of non-unit-based faculty members representation on the Initial Advisory Subcommittee and requested clarity of voting members on the APT Committee. PLCY responded by clarifying PTK and other non-tenure track faculty's input will be considered but they will not be involved in the discussion or deliberation of APT cases and clarifying the voting members on the APT Committee.

PLCY addressed all the concerns that were raised by the Working Group. The Working Group submitted the revised PLCY APT and Post-Tenure Review policies for the FAC Committee's consideration and recommendation. After a review of the final APT and Post-Tenure Review policies, FAC voted to approve the APT policy and the Post-Tenure Review policies in the PLCY Plan on October 11, 2023.

The Faculty Affairs Committee approved PLCY's APT and Post-Tenure Review policies at the October 11, 2023 meeting. On October 13, 2023, the ERG Committee voted to approve the revised PLCY Plan.

The PLCY College Assembly voted to approve the revised Plan of Organization in a vote that concluded on October 23, 2023.

RECOMMENDATIONS

The Elections, Representation, & Governance Committee recommends that the Senate approve the revised Plan of Organization for the School of Public Policy as shown immediately following this report.

APPENDICES

Appendix 1 — 2013 School of Public Policy (PLCY) Plan of Organization

As adopted by the SPP School Assembly on May 24, 2023 | Edited October 13, 2023 | Awaiting approval of Senate

SCHOOL OF PUBLIC POLICY
UNIVERSITY OF MARYLAND

PLAN OF ORGANIZATION

Table of Contents

Article I: Name and Mission

The name of the unit shall be the "School of Public Policy" of the University of Maryland at College Park, hereinafter referred to as the "School."

The School exists to:

1. develop innovative leaders in the art of policy and governance;
2. advance the frontiers of applied interdisciplinary knowledge; and
3. promote local, national, and global public good.

Article II: Authorization and Purpose

This plan of organization is formulated pursuant to the Plan of Organization for Shared Governance at the University of Maryland. Should there be discrepancies between any University policy and the provisions of this plan, University policies shall take precedence.

The purpose of this plan is to establish a framework for the shared governance of the School so as to provide for the orderly and effective discharge of the School's mission. The plan advances the School's mission within its strong and enduring commitment to shared governance, which ensures that all members of the School community join in shaping the School and its future. Executive authority flows from the Provost through the Deans, whereas shared governance authority originates in the University Plan of Organization and flows through the Senate to the Colleges.

Article III: School Programs and Subunits

A. Composition

The School's academic programs consist of the various Bachelor's, Master's, and Doctoral degrees that have been approved to be offered by the School, in addition to various approved certificate programs. The School has the following degree programs (as of the date of this Plan revision):

a. Bachelor of Arts in Public Policy (BAPP)
b. Master's of Public Policy (MPP)
c. Master's of Public Management (MPM)

   d. Executive Master's of Public Management (EMPM)
   e. Master's of Professional Studies—Public Administration (MPS-PA)
   f. Master's of Public Administration (MPA)
   g. Master's of Engineering and Public Policy (MEPP)
   h. Master's of Public Policy/Master's of Social Work (MPP/MSW)
   i. Ph.D. in Policy Studies

The research and service sub-units established within the School and subject to the School's governance are (as of the date of this Plan revision):

   a. Center for Global Sustainability
   b. Center for Governance and Technology and Systems
   c. Center for International and Security Studies at Maryland
   d. Civic Innovation Center
   e. Do Good Institute
   f. Institute for Public Leadership

B. Administration

Each sub-unit shall be headed by a director who is appointed according to University policies. Directors shall report to the Dean or the Dean's representative.

Article IV: Constituencies of the School

A. Faculty

For the purposes of this plan, the term Faculty shall designate those persons who hold an appointment in the School in one of the University's faculty categories, with the exception of those holding 0 percent appointments.

B. Affiliate Members of the Faculty

Members of the University of Maryland College Park faculty who do not otherwise have an appointment in the School but are engaged with the School may be given affiliate status with the School, during the term of their engagement, for a period of up to three years, with a title appropriate to the nature of their association with the School.

Individuals from outside the University who are connected with the work of the School and with its research and service sub-units may be given affiliate status for terms of up to one year in the School.

Nominations for affiliate status should be made in writing to the Dean, or the Dean's delegated representative. Any member of the Faculty Committee may nominate an individual for affiliate status in the School. The proposal should include a description of the nature of the association and a copy of the nominee's curriculum vitae.

The Dean will submit proposals for School affiliate status to the Faculty Committee for discussion and approval. The Dean may approve individuals for affiliate status with the School's research centers or institutes without such faculty consultation, but must notify the Faculty Committee by the time of the next scheduled meeting of that committee.

All affiliate appointments are renewable, as many times as desired, for a period of up to the term of the original appointment.

C. Students

The Students of the School shall include all undergraduate and/or graduate students who are enrolled in the School's degree or certificate programs. For purposes of this plan, students who also teach in one of the programs, or assist with teaching, are considered students, unless they have a 50 percent or greater appointment in a Faculty or Staff position.

D. Staff

For governance purposes, the Staff shall include all employees of the School who occupy positions other than those designated above as Faculty or Students. In cases where a particular individual occupies more than one role (such as a staff member who also teaches) they shall be considered a staff member if more than 50 percent of their time is spent in a position designated by the University as a staff position.

Article V. University Senate Representation

Upon being notified of a vacancy in the University Senate representation of the School, the Dean (with the advice of the committee on committees established under Article IX.B.2(a)) shall appoint a committee that includes both TTK and PTK faculty to conduct elections for University Senators. Elections shall take place during the next regularly scheduled meeting of the Faculty Committee, or may be conducted electronically. The representatives shall be elected by a simple majority; in the case of a tie, a runoff election among the tied candidates shall be held, using the same procedure as the original vote. Any representative of tenure track (TTK) faculty will be elected by a vote of the TTK faculty who are eligible to vote under University Senate guidelines, while any representative of professional track (PTK) faculty will be elected by a vote of the PTK

faculty who are eligible to vote under University Senate guidelines. Elections for Senator will conclude by February 1 of the year in which Senators are seated. If a replacement Senator is necessary, said replacement will be elected according to the above process.

Article VI: Student Governance

The Policy Student Government Association (PSGA) of the School shall be led by an Executive Board comprised of up to fourteen officers. The process by which officers are elected and the duties to be discharged shall be defined in the constitution of the PSGA. All students currently enrolled in the School's degree and certificate programs shall be eligible to serve on the PSGA Executive Board. The PSGA shall elect up to six of its members to be members of the School Assembly, as provided for in Article VII. B. below.

The PSGA:

1. Represents the needs and interests of all registered Policy students before the administration and faculty of the School and the University;
2. Works to create and enhance a sense of community among the students, faculty, administration, and staff of the School; and
3. Establishes, supports, and maintains oversight of all School student clubs.

Article VII: Assembly

A. Composition

The Assembly of the School, herein referred to as the "Assembly," shall include faculty, staff, and student representatives.

B. Membership

All members of the Faculty and Staff (both exempt and non-exempt) who have at least a 50 percent appointment in the School over an academic year shall be members of the Assembly. In addition, the co-chairs should reach out to any Faculty and Staff who have less than a 50 percent appointment to permit them to "opt-in" as regular members of the Assembly for a given academic year. The student body shall be represented by up to six elected representatives of the Policy Student Government Association, according to their own bylaws, but must include at least two undergraduate students and two graduate students (see Article VI.B).

C. Duties and Responsibilities

The Assembly shall advise the Dean and Associate and Assistant Deans on matters pertaining to the School's governance and mission. The Assembly supports the School's strategy of shared governance and provides the Faculty, Staff, and Students with the opportunity to exercise their responsibilities to carry out the mission of the School; promote excellence; and achieve the highest standards of research, education, and impact.

The functions of the School Assembly shall include:

1. providing a regular opportunity for the Faculty, Staff, and Students to collectively express their viewpoints and concerns about the direction, policies, and practices of the School.
2. providing a regular opportunity for promoting effective communication among the Faculty, Staff, and Students within the School and around the University.
3. promoting collaborative activities that advance the mission of the School.

D. Meetings

The Assembly shall meet at least twice in each of the spring and fall semesters. One of the fall meetings must be held in the first two weeks of the fall semester in order to elect committee memberships. Special meetings of the Assembly may be called at any time by any member, provided the call is endorsed by a sufficient number to constitute a quorum of the Assembly. An agenda shall be distributed to the membership at least seven days prior to any meeting. Any proposals that may require a vote shall be presented in writing and shall be submitted to the membership together with the agenda seven days prior to the meeting.

Meetings of the Assembly shall be conducted in accordance with Robert's Rules of Order. A quorum shall be defined as 50 percent of the total membership of the Assembly for a given academic year. No vote shall be taken in the absence of a quorum. Minutes of each Assembly meeting shall be provided to all Assembly members within one week of each Assembly meeting.

The Assembly shall, at the first meeting of the fall semester, elect both a Parliamentarian and a Secretary. These individuals shall serve in these roles through the conclusion of the first fall meeting in the following year. These two positions are to be occupied by two different Assembly members, and are also to be individuals who are not co-chairs of the Assembly.

1. The Parliamentarian is responsible, in part, for determining the necessary number of members for a quorum and whether a quorum has been achieved.
2. The Secretary is responsible for keeping minutes of the Assembly, including the results of recorded votes, and providing those minutes to Assembly members and the Dean.
3. Should a vacancy occur in one of these roles, the co-chairs may appoint replacements.

E. Subcommittees

The Assembly shall organize itself into subcommittees in order to provide advice or analyze policies or procedures that may benefit the School in achieving the mission identified in Article I. Two subcommittees are required:

1. A subcommittee on strategic priorities, the purpose of which is to serve in an advisory role concerning the development, revision, and implementation of the school's strategic plan.
2. A subcommittee on diversity, equity, inclusion and belonging (DEIB), the purpose of which is to serve as an advisory role relative to development and implementation of the DEIB strategic plan.

The Assembly shall vote, at the final meeting of the spring semester, to establish additional subcommittees that it wants to constitute for the following academic year. Members of each subcommittee shall be elected by the Assembly during the first meeting of the Assembly of the academic year. All Faculty, Staff, and Students of the School are eligible to stand for election to a subcommittee, or accept to stand for election upon nomination by another person. In the event that a given subcommittee is not ratified by a majority of the Assembly, the co-chairs must establish a new set of subcommittee members, who will then be again presented to the Assembly for ratification.

A majority of subcommittee members is considered a quorum for voting purposes. Each subcommittee of the Assembly:

1. shall elect its own chair from among its members.
2. may include a member of the School's senior staff, as an ex-officio member.
3. shall report, at least twice a year, to the Assembly on its activities. These reports shall be in writing, but may also be discussed, as necessary, at Assembly meetings.
   shall make recommendations, as necessary, to be adopted or rejected by vote of the Assembly for delivery to the Dean, Associate Dean, or Assistant Dean. Said official must respond to the recommendations made by the Assembly with a plan for adoption, rejection, or feedback for further review by the next Assembly meeting.

Article VIII: Administration

A. The Dean

1. Appointment and Terms

The Dean is the chief executive officer of the School. The Dean shall be appointed and reviewed in accordance with University policy.

2. Duties and Responsibilities

The Dean shall be responsible for:

a. Exercising their authority consistent with the powers and responsibilities delegated to them by the Senior Vice-President and Provost, and consistent with the role of a Dean and also the responsibilities of a Department Chair outlined in the University of Maryland resource on "Chair Roles, Responsibilities, and Authorities." As noted in that document, the Dean may delegate specific responsibilities to others in the School, but remains accountable for their execution.

b. Formulating and presenting policies relating to matters of the shared governance of the School to the School Assembly for its consideration, and formulating and presenting policies related to the educational and research missions of the School to the Faculty Committee for its consideration. This shall not be interpreted to abridge the right of either the Faculty Committee or the School Assembly to propose their own policies or policy changes.

c. Administering the educational policy and programs of the School and regularly reporting to the Assembly on key indicators associated with School strategic priorities and success.

d. In consultation with the School Assembly and the Associate and Assistant Deans, preparing and managing a budget for funds within the School, as well as preparing and implementing the School's Strategic Plan.

e. In consultation with individual faculty members, assigning teaching duties to those members. In doing so, the Dean shall provide for teaching assignments, as required by the program, consistent with the expertise and scholarly focus of each faculty member and with the University's and the School's workload policies, as approved by the Senate.

f. Following all hiring guidelines as established by the University, University Human Resources, and University Faculty Affairs.

g. In consultation with the appropriate faculty members and committees, recommending the appointment, reappointment, non-reappointment, or promotion of Faculty and Staff. The Dean shall be responsible for informing the School's APT Committee in a timely fashion of all upcoming candidacies of TTK faculty for appointment, promotion, and tenure. Similarly, the Dean is responsible for informing the School's AEP Committee of any PTK faculty requesting or recommended for promotion. Staff appointment, reappointment and promotion are governed by the appropriate University policies and procedures.

h. Serving as the conduit of communication for all official business of the School with the University administration, faculty, staff, students, alumni/ae, and the public. In particular, the Dean shall be responsible for informing the School Assembly, including the Faculty Advisory Council, in writing of the yearly proposed and approved budgets of the School and of the allocation of budgetary resources.

i. Consulting with the Faculty Committee on all matters relevant to the Committee's duties and responsibilities and reporting to the Faculty

        Committee as to the action on any of its recommendations or the recommendations from other committees.

j. Consulting with the School Assembly on all matters relevant to the Assembly's duties and responsibilities and reporting to the Assembly as to the action on any of its recommendations or the recommendations.

k. Representing the School to the University community, professional and scholarly organizations, and the public at large.

l. With the support of relevant members of the school community, fundraising and revenue generation to ensure an appropriate fiscal base for the School's mission critical activities.

m. Maintaining appropriate supervision of the use of buildings, equipment, and spaces assigned to the School.

n. Reviewing annual reports prepared by faculty in response to University faculty reporting requirements.

o. At their discretion, and with the advice of the Faculty Committee or the School Assembly, as appropriate, appointing any standing or ad-hoc administrative committees, in addition to those established and referenced by this Plan, as may be necessary. Such appointments shall be made in writing and shall specify the duties, chair, size, and composition of each.

p. Establishing and applying resources necessary for the enactment and maintenance of the School's Plan of Organization as articulated herein.

q. Delegating to each Associate or Assistant Dean any or all of the above responsibilities regarding such matters that properly pertain to the direction, administration, and management of their respective duties.

B. Associate and Assistant Deans

1. Appointment and Terms

The Associate and Assistant Deans shall be appointed by the Dean in accordance with applicable University policy. Searches for appointments to these administrative positions will be guided by University procedures. The Dean will inform the Assembly of the progress of such searches in a timely fashion.

2. Duties and Responsibilities

The Associate and Assistant Deans will be responsible for all tasks delegated by the Dean.

3. Periodic Reviews

All Associate and Assistant Deans shall receive periodic performance reviews as specified by University policy. Such reviews may include input from the faculty, staff, and students in the School.

Article IX: Administrative Committees

Without prejudice to the Dean's authority in regard to the constitution of committees as specified in Article VIII.A.2(o), the following shall be standing administrative committees of the School.

A. Assembly Executive Committee

1. Membership and Terms

   The Assembly Executive Committee shall be comprised of three members of the Faculty, three members of the Staff, and three students.

   a. The Faculty representatives shall be elected either by Faculty who are members of the Assembly and are present at the last Assembly meeting of the academic year, or through a separate online election, at which all Faculty who are members of the Assembly are eligible to serve and to vote. It must include at least one TTK faculty member and at least one PTK faculty member.
   b. The staff representatives shall be elected either by Staff who are present at the last Assembly meeting of the academic year, or through a separate online election, at which all staff are eligible to serve and to vote.
   c. The students will be selected by the Policy Student Government Association (PSGA), and must include at least one undergraduate and one graduate student.
   d. By September 25th, the Executive Committee shall elect co-chairs of the Assembly (one faculty member and one staff member) from among its membership. One student may be elected from its membership as co-chair unless the student members choose not to elect one. The faculty co-chair shall serve as the chair of the Faculty Advisory Council.
   e. Faculty and Staff representatives shall serve two-year terms. Two staff representatives shall be elected in even-numbered years, and one in odd-numbered years. Two faculty representatives shall be elected in odd-numbered years, and one in even-numbered years. Student representatives shall serve one-year terms.
   f. In the event that a vacancy occurs in the membership of the Assembly Executive Committee, a replacement shall be made through the same process as that identified above.

2. Duties and Responsibilities

   The Assembly Executive Committee shall serve as the Faculty Advisory Council, and be responsible for:

   a. Ensuring that Assembly meetings are held, and assisting the co-chairs in setting the agenda of the Assembly.

b. Serving as the conduit of information between the faculty, staff, students, and the Dean.

c. Providing input to the Dean on matters including, but not limited to, administrative staffing, facilities use and planning, and the Academic Program's proposed annual budget. The Dean shall provide to the Assembly Executive Committee a report of the School's expenditures of the prior fiscal year.

d. Serving as a nominating committee (a Committee on Committees for university purposes). The nominating committee must meet once per year with the Dean for the purpose of developing a slate of candidates for any faculty committees that relate to governance of the School. This will include, at a minimum, the Programs, Curricula, and Courses (PCC) Committee and the Appointment, Evaluation, and Promotion (AEP) Committee.

e. Reporting on its activities at least once a year to the Assembly.

B. Faculty Committee

1. Membership and Terms

   The Faculty Committee shall consist of all Assistant, Associate, and (full) Professors, Assistant, Associate, and Clinical Professors; Assistant, Associate, and Research Professors; Professors of the Practice; Assistant, Associate, and Research Scholars; and Lecturers, Senior Lecturers, and Principal Lecturers with academic year appointments of 50 percent or more in the School of Public Policy. The Dean may invite other members of the community, including Emeriti Faculty, College Park Professors, and senior administrators to participate in meetings of the Faculty Committee as ex officio members. The Dean will chair the Faculty Committee. Meetings of the Faculty Committee shall occur a minimum of two times per semester.

2. Duties and Responsibilities

   The Faculty Committee shall be responsible for recommending educational policy. It shall recommend students for the award of degrees. It may advise the Dean and/or Associate or Assistant Deans on any matters pertaining to the School mission and programs. In particular, the Faculty Committee shall be responsible for:

   a. Serving as the conduit of information between the Dean and the faculty.

   b. Advising the Dean concerning the curriculum of the various academic programs of the school. This advice shall be provided in coordination with the Programs, Curriculum and Courses (PCC) Committee, as described below. In addition, however, the Dean shall ensure that responsible administrators brief the Faculty Committee, on an annual basis, concerning progress in meeting the learning objectives and the status of assessment processes for each credentialed academic program.

    c. Electing members of the Faculty Merit Review Subcommittee, to perform the functions described in Article IX.G.

    d. Consistent with the procedures outlined in Article IV.B, approving, as necessary, affiliate members of the faculty.

    e. Hiring and appointment of new faculty members: SPP shall follow all UMD hiring policies. In addition, the Faculty Committee commits to regular review of best practices regarding notification and consultation for different types of faculty hires.

    f. Making recommendations on admissions of graduate students to the School's academic programs. The Faculty Committee may establish subcommittees, made up of individuals who teach in these programs, to facilitate this function.

    g. Supporting the recruitment of students to any of the School's academic programs.

3. The Dean shall solicit input from members of the Faculty Committee regarding agenda items for meetings of the Faculty Committee. The Dean must put any item on the agenda if that item has been requested by five (5) or more members of the Faculty Committee. The agenda is to be provided to the Faculty Committee at least one week prior to the meeting.

4. Minutes of meetings of the Faculty Committee will be provided to all members of the Faculty Committee within one week of each faculty meeting. The Dean, as chair of the Faculty Committee, is responsible for ensuring compliance with this requirement.

5. A quorum of 50 percent or more of the total membership of the Faculty Committee will be necessary in order to conduct business and conduct votes. The Faculty Committee shall enact policies specifying the circumstances under which its advice to the Dean needs to be by means of a recorded vote.

6. The Faculty Committee may, by majority vote, establish subcommittees to facilitate any of the above functions. Subcommittees of the Faculty Committee shall routinely report to the Faculty Committee on their activities.

7. The faculty representatives to the University Senate shall routinely report to the Faculty Committee on Senate deliberations and actions germane to the Faculty Committee.

C. Staff Committee

1. Membership and Terms

    Membership is open to all exempt and non-exempt staff in the School of Public Policy. The Staff Committee shall meet no less than twice per academic year in order to advance the mission of the School; to serve as representatives of various units in the School to ensure that administrative departments and areas work effectively and efficiently together to further the overall mission of the School. The Staff Committee

shall elect two co-chairs from amongst its membership. Such an election will occur by September 1 of each year and may take place electronically.

2. Duties and Responsibilities

The Staff Committee shall be responsible for recommending School policy and procedures pertinent to our mission, academic and co-curricular programs, and operations. As integral members of the School, staff advise the Dean and School Leadership on matters pertaining to the School mission and programs via the Staff Committee. Serving as an important conduit of information between the Dean/Associate/Assistant Deans and the staff, the Staff Committee shall make recommendations on governance and policy, to include any issue important to our School and to advocate for the staff. As such, the Staff Committee's central responsibilities include, but are not limited to the following:

The Staff Committee will contribute to Policy Decisions by:

a. Actively soliciting information and feedback from staff on pending decisions related to administrative and/or academic policies and procedures.
b. Identifying and addressing common issues directly affecting staff, and advocate for solutions to those challenges.
c. Advocating on behalf of staff toward a continuously improving climate and make recommendations that improve the atmosphere and functioning of the School.

The Staff Committee will contribute to matters of Governance by:

a. Recommending staff representatives on search committees for the selection of a new Dean.
b. Recommending staff representatives on search committees for the selection of School leadership, faculty, and staff.
c. Creating staff sub-committees as needed to inform policy and governance at the School.

D. Programs, Curricula & Courses Committee (PCC Committee)

1. Membership

The PCC shall consist of at least five faculty members elected from the Membership of the Faculty Committee from the slate of candidates recommended by the Committee on Committees established in Article IX.A.2(d). The membership of the PCC shall include faculty who teach in a broad range of the School's academic programs, and shall include both TTK and PTK faculty. Any Associate Dean with authority over educational programs shall be an ex-officio member of the PCC. The PCC shall elect a chair and a secretary from among its elected members.   In order

to promote continuity, the PCC members shall serve two year terms, with three such members elected in even-numbered years and two in odd-numbered years.

2. Duties and Responsibilities

The PCC shall be responsible for:

a. Advising the Dean on the long-range educational goals and policies of the School.
b. Periodically reviewing the educational programs and curricula and recommending measures to the Dean, Associate Deans, and the Faculty Committee to ensure the most effective use of resources and an appropriate level of coordination among the various programs and areas.
c. Recommending to the Dean, Associate Deans, and the Faculty Committee any changes in courses and curricula that are either generated by the PCC itself, or considered by the PCC in response to proposals that may be submitted by the Faculty, Faculty committees, Staff, Assembly, or the Policy Student Government Association. The PCC is required to obtain input from the faculty who teach in a credentialed academic program, students in the program, and staff with relevant administrative responsibilities over those programs, prior to recommending any changes to the curriculum in that program.
d. Keeping minutes of PCC meetings and disseminating these minutes to members of the PCC, the Faculty Committee, and the Assembly within one week after each PCC meeting.
e. The PCC shall be responsible for advising program committees about university regulations for the review, revision, and creation of programs, tracks, specializations, certificates, and courses. The PCC shall review all recommendations regarding programs, tracks, specializations, or certificates before the information is presented to the Faculty Committee for approval. PCC approval is required: 1) before new courses can be offered; 2) when courses are to be removed from the course inventory; 3) when Special Topics courses are recommended for conversion to permanent numbers; and 4) for all substantial changes in the characteristics of an existing course. This approval must take place before the recommendations are submitted to the Vice President's Advisory Committee (VPAC). Substantial changes are defined as changes in title, catalog description, prerequisites, credit level, course number, or learning outcomes.
f. The PCC shall establish, as subcommittees of the PCC, assessment committees for each of the School's academic programs. These subcommittees will include at least one member of the PCC, but otherwise may be populated by any faculty to teach in the program being assessed. Each year the PCC will consider assessment reports delivered from the Faculty chair of each assessment committee in order to inform review and revision of programs of study.

E. Appointment, Promotion, and Tenure (APT) Committee

1. Membership

   a. The membership of the APT Committee consists of all tenured faculty in the School, excluding the Dean. The Dean may attend APT Committee meetings as an observer but has no voice in the proceedings.
   b. When considering an individual for appointment or promotion to the rank of Associate Professor or Professor, the APT committee shall consist of only those members of the larger APT committee who hold the rank under consideration, or higher.
   c. The Committee shall elect an APT chair, chosen from among the Committee's membership. The chair's term will be for two years. The chair must hold the rank of Professor, and shall be responsible for conducting the college APT review meetings, recording the transactions at the review meetings, preparing the APT committee report and the promotion dossiers for all candidates for appointment at, or promotion to, the rank of Associate Professor or Professor, and serving as spokesperson at higher levels of review. The Dean, or designee, is responsible for ensuring that such election takes place. The election of the following year's APT chair will be conducted at the last meeting of the APT Committee in an academic year.

2. Duties and Responsibilities

   The deliberations of the APT Committee shall be conducted in strict compliance with all applicable University policies, specifically including the University's APT Guidelines. The deliberations shall be confidential. The Committee shall be responsible for:

   a. Reviewing candidates' dossiers and making recommendations on the basis of those reviews. The APT Chair will appoint advisory subcommittees, comprised of a minimum of two APT committee members including a subcommittee chair, to review candidates' records, prepare the dossiers, and report on the candidates to the APT committee. for consideration by the full committee. The APT chair also will designate one of these subcommittee members as chair. Subcommittees may seek information and/or input from Professors of the Practice or other professional track faculty members within the School and faculty from units outside the School, when appropriate, to assess the performance of a candidate whose expertise is deemed under-represented on the School's tenure-track faculty. Tenured faculty members from other University units may also serve on APT subcommittees as long as they have the rank appropriate for consideration of the rank in consideration. External members that are members of the subcommittee may be present when the School's full APT Committee considers the case and may have a voice but not a vote.
   b. Making independent recommendations to the University, consistent with University policy, on all cases of tenure-track faculty appointment, promotion,

non-promotion, and award of tenure. Such evaluations will be made by vote of the School's APT Committee. To conduct business and to take votes, the APT Committee must have a quorum of its members present. For the purposes of APT Committee discussion and action, a quorum is defined as one faculty more than half of all tenured faculty members in the School holding the rank and above for the rank under consideration, not including those faculty members on leave or on sabbatical. Thus only those candidates with positive votes at or exceeding the quorum will be recommended to the University for appointment, promotion, and award of tenure. Proxy voting is not permitted. Votes will be conducted by secret ballot. When necessary and approved by the majority of the members present, electronic ballots may be used, which must be confidential.

3. Meetings

Written notice of APT Committee meetings and copies of the candidate's dossier shall be distributed to the membership at least one week in advance of the meeting at which a vote on that candidate is to be held, unless the majority of the APT Committee agrees to waive such notice.

a. Meetings of the School's APT Committee shall be chaired by the Chair of the School APT Committee.

4. APT Actions

a. The criteria for promotion and tenure and pre-tenure reviews of Assistant Professors in the School are to be adopted by a full vote of the APT Committee, to include all Associate and Full Professors. Tenure-track Assistant Professors shall have the opportunity to provide comment on any changes that are proposed to the APT criteria.

b. Criteria for promotion and tenure and pre-tenure reviews of Assistant Professors should be made available to any tenure-track Assistant or Associate Professor upon their appointment. It should also be publicly available at all points in the promotion and tenure process.

c. All information in the promotion and tenure process, including the content of dossiers and the deliberation of APT proceedings, is to be kept confidential and must not be discussed outside of the committee.

d. The Dean shall provide an independent assessment separately; the recommendation of the Dean shall be considered together with all other relevant materials by any reviewing committee at a higher level.

e. Requests for information from higher level review units shall be transmitted to both the advisory subcommittee and the Dean.

f. Upon completion of the first-level review, the Dean shall, within two weeks of the date of the decision, inform the candidate whether the recommendations made by the APT Committee and the Dean were positive or negative (including specific

information on the number of faculty who voted for tenure and/or promotion, the number who voted against, and the number of abstentions), and prepare for the candidate a letter summarizing in general terms the nature of the considerations on which those decisions were based.

g. For candidates being appointed at the Associate or Full Professor level, the same procedures are in effect, as outlined above, as for an internal promotion case. The Dean shall report decisions regarding tenure and promotion to the APT Committee.

F. Appointment, Evaluation, and Promotion of Professional Track Faculty (AEP Committee)

1. The AEP Committee consists of three (3) faculty, elected by the Faculty Committee, and shall include at least two PTK faculty members, each of whom must be members of the Faculty Committee. A TTK faculty member may serve on one of the three AEP committee slots, but an AEP committee can also be composed of three PTK faculty.
2. The AEP Committee will elect a chair from among its elected members.
3. Members of the AEP Committee shall serve two-year terms. Each member of the committee shall be a full voting member.
4. Requests for promotion may come from either the faculty member desiring to be promoted, that individual's supervisor, or the Dean. The procedures for consideration of requests for promotion are outlined in the School's approved "AEP Policies and Procedures for Professional Track Faculty" (hereinafter referred to as "AEP Policy"). This policy outlines the process for review of the request for promotion, communication requirements, and appeal procedures, as necessary.

G. Faculty Merit Review Committee

1. The Faculty Merit Review Committee (FMRC) evaluates the performance of faculty in teaching, research, and service, and makes recommendations to the Dean on faculty members' performance and, when available, the allocation of the faculty merit salary pool.
2. The FMRC consists of four members including 2 TTK and 2 PTK representatives each elected by their respective constituency, through a secret ballot, to serve terms of one year. If the Dean believes that any group has been systematically underrepresented, they may appoint a member of that group as an additional member of the FMRC.
3. The FMRC review is conducted during the spring semester. The elements of the review are as follows:

a. The Faculty Committee elects FMRC members by secret ballot during the first faculty meeting of the year when other committees are elected. Faculty who served on the FMRC in the previous two years are not eligible to serve, except when there are fewer than three eligible faculty members. Tie votes are resolved by random draw among those who have not served in the last five years. In the event that a member of the committee has a personal or professional relationship that creates a conflict of interest on the faculty, that person will also be evaluated separately by the Dean and their designee.

4. All faculty members must complete activity reports by the required date established by the University. The activity reports should include a description of the faculty member's contributions to scholarship, teaching, service to the School, administrative duties, and public service. Faculty who do not complete an activity report will not be eligible for merit awards in that fiscal year. In general, the FMRC should examine the performance of faculty members over the previous three years. Faculty may choose to submit additional documentation to be considered by the FMRC.

5. Upon completion of the faculty activity reporting as determined by the University, the Dean or an individual delegated by the Dean shall provide the FMRC with a list of eligible faculty and copies of their faculty activity reports. All faculty members who were hired prior to the current academic year are eligible for review.

6. FMRC will elect one of its members to serve as chair. FMRC examines the activity reports, on the basis of each faculty member's contributions to scholarship, teaching, service to the School, and public service. The assessment will examine the degree to which these contributions fit with the School's standards for promotion and tenure, as outlined in the School's APT and/or AEP policies and the individual's contract and delegated responsibilities in line with the School's Merit Evaluation Policy. The School will establish a Workload Policy for faculty, and the merit review committee will be provided with the workload percentages for each faculty member reviewed and use it as a guide in reviewing each faculty activity report. The Dean and a designee of the Dean will separately assess the performance of the members of the FMRC. The FMRC prepares a written evaluation of each faculty member. The evaluations are submitted to the Dean by April 1, unless the Dean grants an extension.

7. Each faculty member shall be given the review committee's (or, in the case of members of the FMRC, the Dean's) evaluation report and is permitted to provide a written response to the evaluation report within 14 days of receipt of said report.

8. The FMRC's role is advisory to the Dean. The Dean makes the final decisions on merit salary awards, based on the FMRC's evaluations. The Dean reports to the committee the final merit awards.

9. Any faculty member who is dissatisfied with the merit salary increase should file a written appeal with the Dean. The Dean will consider the issues raised in the appeal, meet with the faculty member to discuss the issues, and inform the faculty member of the decision on the salary increase. If a faculty member remains dissatisfied, the faculty member may initiate a grievance according to the University of Maryland Policies and Procedures Governing Faculty Grievances.

Article X: Post-Tenure Review

1. In accordance with the policy of the University System of Maryland (19.0 II-1.19) and the policy of the University of Maryland College Park (II-1.20(A)), the School will conduct a regular, comprehensive review of tenured faculty. These reviews shall:
   a. Occur on a regular basis, not less than once every five years. A review may be delayed if a faculty member is on leave (sabbatical, leave without pay, etc.), administrative assignment, or by other factors for an equivalent time period as the factor.
   b. Be a major formative process for future faculty development and rewards, enhancing the learning environment of students, and improving the School's programs.
2. Reviews conducted as part of an assessment for appointment and promotion will be considered a comprehensive review, for the purposes of this policy.
3. The APT Committee, in consultation with the Dean, shall determine and define the criteria for satisfactory and unsatisfactory performance. This criteria shall be made available to all TTK faculty.
4. Reviews will be scheduled, starting with the faculty who have served the longest in rank since the previous comprehensive review. The School shall endeavor to allocate the comprehensive reviews of tenured faculty so that approximately the same number of tenured faculty are reviewed each year. Faculty members shall be informed by the Dean, by September 1, of the schedule of the faculty members who will undergo post-tenure comprehensive reviews in each year.
5. By January 1 of the academic year in which a faculty member is scheduled to undergo a post-tenure comprehensive review, the faculty member will:
   a. Prepare a brief summary of the faculty member's contributions in teaching, research, and public service since the last review.
   b. Submit copies of assessments of the impact of the faculty member's work, including citation counts and other measures of scholarly accomplishment.
6. Each year, the Appointment, Promotion and Tenure Committee shall elect, from its members, a Post-Tenure Review Committee of three (3) tenured full professors. None of the members of the committee shall be faculty members scheduled for review in the current year. The Committee is responsible for preparing a written appraisal of the faculty member's report as described in Article X.4.
7. The faculty member shall be provided with the review committee's appraisal and is allowed to submit a written response within 14 calendar days of the faculty member's receipt of the appraisal.
8. The review portfolio, consisting of the items in Article X.5, the review committee's appraisal, and the faculty member's response (if applicable) must be submitted to the Dean by March 31.

9. The Dean and faculty member shall meet to discuss the review and create a written development plan and timetable designed to support and improve the faculty member's performance.
10. Two consecutive periodic reviews that find a faculty member is materially deficient in meeting expectations shall necessitate an immediate comprehensive review.
11. The annual reviews conducted by the School as part of the annual merit assessment (See Article IX.G) shall be used as part of the comprehensive review.

Article XI: General

A. Rules

Unless otherwise specified, Roberts Rules of Order Newly Revised will set the procedures for the conduct of business during the meetings of the School's committees.

B. Review

The School's Plan of Organization shall be reviewed at least every ten years by a committee appointed by the School Assembly, using the procedure outlined in Article VII.E. This committee shall be comprised of representatives of the Faculty, Staff, and Students. The Assembly may also appoint a committee to review and propose changes to the Plan in the period in between these comprehensive reviews.

1   **SCHOOL OF PUBLIC POLICY**
2   **UNIVERSITY OF MARYLAND**
3
4   **PLAN OF ORGANIZATION**
5
6
7   (Approved by the Faculty on April 24. 2013)
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Article I: Name and Mission

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21
22 The name of the unit shall be the "School of Public Policy" of the University of Maryland at
23 College Park, hereinafter referred to as the "School."
24
25 The School exists to improve the design and implementation of public policies by:
26
27   a. Attracting highly capable people to careers in public service within the public, non-profit,
28   and private sectors;
29
30   b. Providing current and future participants in the policymaking process with the knowledge
31   and skills to analyze and implement public policies through use of multi-disciplinary
32   tools, scholarly findings, and the insights of the best practitioners; and
33
34   c. Conducting and disseminating broadly to policymakers, other policy analysts, and

interested citizens, useful analyses of current public policy issues and processes.

d. Creating knowledge relevant to important policy problems, and ensuring that this knowledge has impact.

Article II: Authorization and Purpose

This plan of organization is formulated pursuant to Article II of the Plan of Organization for the University of Maryland at College Park as approved by the Senate on April 1, 1993. It is deemed to be in compliance with all applicable University and Campus policies and regulations. However, should there be discrepancies between these and the provisions of this plan, University and Campus statutes shall take precedence.

The purpose of this plan is to establish a framework for shared governance of the School so as to provide for the orderly and effective discharge of the School's mission. The plan advances the School's mission within its strong and enduring commitment to shared governance, which ensures that all members of the School community join in shaping the School and its future.

Article III: Academic Programs

A.   Composition

1.   The School has the following degree programs:
    a.   Master's of Public Policy (MPP)
    b.   Master's of Public Management (MPM)
    c.   Executive Master's of Public Management (EMPM)
    d.   Master's of Professional Studies – Public Administration (MPPA)
    e.   Dual MPP/MBA (with the Smith School of Business)
    f.   Dual MPP/JD (with the University of Maryland School of Law)
    g.   Dual MPP/CONS (with the College of Computer, Mathematical, and Natural Sciences)
    h.   Master's of Engineering and Public Policy (MEPP)
    i.   Ph.D. in Policy Studies

2.   The following research and service sub-units are established within the School and are subject to the School's governance, within university procedures:

1		a.	Center for Integrative Environmental Research
2		b.	Center for International and Security Studies at Maryland
3		c.	Center for Philanthropy and Nonprofit Leadership
4		d.	Center for International Policy Exchanges
5		e.	Center for Public Policy & Private Enterprise
6		f.	Institute for Philosophy and Public Policy

7

8   **B.**   **Plan of Organization**

9

10   Each sub-unit shall develop and adopt a Plan of Organization. Upon approval by Faculty,
11   these plans shall become an integral part of the Plan of Organization of the School.

12

13   **C.**   **Administration**

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15   Each sub-unit shall be headed by a faculty member, who serves as director and who is
16   appointed according to University and campus policies. Directors shall report to the
17   Dean or the Dean's representative.

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20   **Article IV: Assembly**

21

22   **A.**   **Composition**

23

24   The Assembly of the School, herein referred to as the "Assembly," shall include faculty,
25   staff, and students.

26

27   **B.**   **Membership**

28

29   All members of the Faculty and of the Staff, both exempt and nonexempt, shall be
30   members of the Assembly. The student body shall be represented by the elected
31   representatives of the Policy Student Government Association (see Article VI(b)). A
32   member of the Faculty or of the Staff shall be elected during the spring semester each
33   year to chair the Assembly for the following academic year.

34

35   **C.**   **Duties and Responsibilities**

36

37   The Assembly shall advise the Dean, Directors, and Faculty on matters pertaining to the
38   School's governance and mission, which can be brought before it by any member or

1 group of members of the Assembly.
2

3 **D.   Meetings**
4
5   The Assembly shall meet at least twice a year, once during the fall and once during the
6   spring semesters. Special meetings of the Assembly may be called at any time by any
7   member, provided the call is endorsed in writing by two-thirds of the membership. A
8   written agenda shall be distributed to the membership at least one week prior to any
9   meeting. Any proposals that may require a vote shall be presented in writing and shall be
10   submitted to the membership in advance, together with the agenda. Meetings of the
11   Assembly shall be conducted in accordance with Robert's Rules of Order. A majority of
12   the membership shall constitute a quorum. No vote shall be taken in the absence of a
13   quorum.
14

15 **E.   Functions**
16
17   The School Assembly supports the School's strategy of shared governance and provides
18   the Faculty, Staff, and students with the opportunity to exercise their responsibilities to
19   carry out the mission of the School; promote excellence; and achieve the highest
20   standards of research, education, and impact.
21
22   The functions of the School Assembly shall include:
23
24   a. A regular opportunity for the Faculty, Staff, and students to collectively express their
25   viewpoints and concerns.
26
27   b. A regular opportunity for promoting effective communication among all the Faculty,
28   Staff, and students, within the School and around the University.
29
30   c. Promotion of collaborative activities that advance the mission of the School.
31
32   d. To encourage the effective pursuit of policies that advance the School.
33
34

35 **Article V: Faculty**
36

37 **A.   Membership**
38
39   For the purposes of this plan, the term Faculty shall designate those persons who hold at
40   least a 50 percent appointment in one of the University's faculty categories:

5

- Adjunct Assistant, Associate, and (full) Professors
- Assistant Professor, Associate Professor, and Professor
- College Park Professor
- Emeriti Faculty
- Lecturer and Senior Lecturer
- Research Faculty
- Professor of the Practice
- Clinical Assistant Professor, Clinical Associate Professor, and Clinical Professor

B.   Senate Representation

Upon being notified of a vacancy in Senate representation of the School, the Dean shall solicit nominations from the Faculty by means of a written memorandum. Faculty must submit nominations in writing to the Dean no later than fifteen days from the date of the Dean's memorandum. Faculty shall be responsible to ascertain from any nominees, prior to submitting their names, whether they are willing to serve if elected. Elections shall take place during the next regularly scheduled faculty meeting. The representative shall be elected by a simple majority; in the event of a tie, a runoff election among the tied candidates shall be held, using the same procedure as the original vote.

C.   Affiliate members

1. Members of the University of Maryland College Park faculty who do not otherwise have an appointment in the School but are engaged with the School may be given affiliate status with the School, during the term of their engagement, up to three years, with a title appropriate to the nature of their association with the School.

2. Individuals from outside the university who are connected with the work of the School and with its research centers may be given an appointment for up to a year in the School, of either nonresident fellow or nonresident senior fellow, depending on their level of professional accomplishment.

3. Proposals for affiliate, nonresident fellow, or nonresident senior fellow status should be made in writing to the Dean. The proposal should include a description of the nature of the association and a copy of the curriculum vitae of the individual.

4. The Dean will submit proposals for affiliate status to the faculty for discussion and approval.

5. All appointments as affiliate, nonresident fellow, and nonresident senior fellow are renewable, for a period of up to the term of the original appointment.

Article VI: Students

A. Membership

The Students of the School shall include all students who are enrolled in the School's academic programs.

B. Governance

The Policy Student Government Association (PSGA) of the School shall consist of up to eight elected representatives and the president of any other student organizations of the School duly recognized by the PSGA and the Dean. The elected representatives shall consist of six representatives, elected by the Students of the School in April to one-year terms from along all students enrolled at that time, and two representatives elected in October to six-month terms from students who matriculated into their programs since the previous spring semester. All representatives, whether elected or ex officio, shall have full voting rights. The PSGA shall elect a present and vice president from among its representatives.

C. Meetings

The PSGA shall meet at least twice during the academic year, once in the fall semester and once in the spring semester.

D. Purpose

The PSGA shall organize social activities and represent the interests of the Students to the Faculty, Staff, and Administration of the School. To accomplish this purpose, the PSGA shall foster community among the Students, organize activities and organizations of interest to the students, and represent the interests of Students with the Dean, the Faculty, and the Staff. In pursuit of this purpose, the PSGA or its officers shall:

a. Organize periodic social gatherings and community service projects.

b. Help establish and support other student organizations focused on specific needs and interests.

c. Meet at least once a semester with the Dean to discuss topics of interest to Students.

d. Organize at least once a semester an opportunity for all Students to ask questions and raise concerns with the Dean.

Article VII: Staff

A. **Membership**

The Staff shall include all employees of the School other than those with primarily faculty or student appointments.

Article VIII: Administration

A. **The Dean**

1. Appointment and Terms

   The Dean is the chief executive officer of the School. The Dean shall be appointed and reviewed in accordance with University and Campus policy.

2. Duties and Responsibilities

   The Dean shall be responsible for:

   a. Exercising his/her authority consistently with the powers and responsibilities delegated to him/her by the Vice-President for Academic Affairs and Provost.

   b. Formulating and presenting policies to the Faculty for its consideration. This shall not be interpreted to abridge the right of any faculty member or of the Faculty as a whole to present any matter to the Faculty.

c.   Administering the educational policy and programs of the School.

d.   In consultation with the Faculty Committee and the Directors, preparing and managing a budget for funds within the School, as well as preparing and implementing the School's Strategic Plan.

e.   In consultation with individual faculty members, assigning teaching duties to those members. In so doing, the Dean shall provide for teaching assignments, as required by the program, consistent with the expertise and scholarly focus of each faculty member and with the Campus workload policy as approved by the Senate.

f.   In consultation with the appropriate faculty members and Committees, recommending the appointment, reappointment, non-reappointment, or promotion of faculty and staff. The Dean shall be responsible for informing the School's APT Committee in a timely fashion of all upcoming candidacies for appointment, promotion, and tenure.

g.   Serving as the conduit of communication for all official business of the School with the Campus administration, the Faculty, the Staff, students, alumni/ae, and the public. In particular, the Dean shall be responsible for informing the Faculty in writing of the yearly proposed and approved budgets of the School and of the detailed allocation of budgetary resources.

h.   Consulting with the Faculty Committee (see Article IX) on all matters relevant to the Committee's duties and responsibilities and reporting to the Faculty Committee as to the action on any of its recommendations or the recommendations from other committees.

i.   Representing the School to the Campus and University communities, professional and scholarly organizations, and the public at large.

j.   Maintaining appropriate supervision of the use of buildings, equipment, and spaces assigned to the School.

k.   At his or her discretion, appointing any standing or ad-hoc administrative committees as may be necessary. Such appointments shall be made in writing and shall specify the duties, chair, size, and composition of each.

l.   Delegating to each Director any or all the above responsibilities regarding such matters that properly pertain to the direction, administration, and management of his/her respective Programs, provided such matters do not

fall within the purview of other School Programs.

B.   Associate and Assistant Deans

    1.   Appointment and Terms

       The Associate and Assistant Deans shall be appointed by the Dean for fixed terms in accordance with applicable University and Campus Policy.

    2.   Duties and Responsibilities

       One Associate Dean will be designated the School's Executive Dean and will report to the Dean and be responsible for all tasks delegated to him/her by the Dean. The other Associate and Assistant Deans will report to the Dean, and will be responsible for all tasks delegated by the Dean.

C.   Program Directors

    1.   Appointment and Terms

       The Program Directors shall be appointed by the Dean to fixed terms in accordance with applicable University and Campus Policy.

    2.   Duties and Responsibilities

       The Program Directors report to the Dean and shall be responsible for all tasks delegated to them by the Dean.

Article IX: Administrative Committees

Without prejudice to the Dean's authority in regard to the constitution of committees as specified in Article VIII.A.2.k, the following shall be standing administrative faculty committees of the School.

A.   Faculty Committee

    1.   Membership and Terms

The Faculty Committee shall consist of all Assistant Professors, Associate Professors, Professors, Professors of the Practice, Clinical Professors of all ranks, and such other members of the Faculty, as defined in Article V.A., with academic year appointments of 50 percent or more, which the Dean, with the concurrence of the Faculty Committee, deems to be sufficiently knowledgeable about the School to warrant appointment to the Faculty Committee. The Dean or the Dean's representative shall serve as Chair.

2.   Duties and Responsibilities

The Faculty Committee shall be responsible for formulating and recommending educational policy. It shall recommend students for the award of degrees. It shall consider and deliberate questions of School governance, advise the Dean and/or Directors on any matters pertaining to the School mission, and determine any such matters as do not affect relations with units outside the School or properly come under the supervision of larger administrative units.

In particular, the Faculty Committee shall be responsible for:

a.   Consulting with the Dean at least once a semester during the academic year on matters of interest and concern to the School, including budget decisions and facility planning.

b.   Serving as the conduit of information between the Dean and the Faculty.

c.   Assisting the Dean in the preparation and implementation of the School's Strategic Plan.

d.   Hearing Faculty or Staff grievances, which have not been otherwise resolved through the School's administrative processes, and making recommendations to the Dean and Directors for the fair resolution of such grievances. In such cases, there shall be a subcommittee of the Faculty Committee, appointed by the dean, and the subcommittee shall elect its own chair.

e.   Serving as a Committee on Committees to nominate slates of candidates from which the Dean or administrators above the School level may appoint members for all School committees or representatives to participate in the search, nomination, and review of administrators and units at any Campus and University level.

f.   Electing members of the Faculty Merit and Salary Review Committee, to perform the functions described in Article IX.D.

B.   Programs, Curricula & Course Committee (PCC or Curriculum Committee)

1.   Membership

The PCC shall consist of at least five faculty members appointed by the Dean in consultation with the Faculty Committee. The Dean shall designate a Chair from among the Committee's membership.

2.   Duties and Responsibilities

The PCC shall be responsible for:

a.   Advising the dean on the long-range educational goals and policies of the School.

b.   Periodically reviewing the educational programs and curricula and recommending measures to the Dean, Directors, and Faculty to ensure the most effective use of resources and an appropriate level of coordination among the various programs and areas.

c.   Recommending to the Dean, Directors, and Faculty any changes in courses and curricula as may be submitted by the Faculty, faculty committees, or the Policy Student Government Association.

C.   Appointment, Promotion, and Tenure Committee (APT)

1. Membership

a. The membership of the APT committee generally consists of all tenured and tenure-track faculty in the School

b. When considering an individual for appointment to the rank of Associate

Professor or Professor, the APT committee shall consist of only those members of the larger APT committee who hold the rank under consideration, or higher.

c. The Committee shall elect an APT chair, chosen from among the Committee's membership. The Chair's term will be for one year. The Chair shall hold the rank of Professor, and shall be responsible for preparing the APT committee report and the promotion dossiers for all candidates for appointment at the rank of Associate Professor or Professor.

2. Duties and Responsibilities

The deliberations of the APT Committee shall be conducted in strict compliance with all applicable University and Campus policies. The deliberations shall be confidential. The Committee shall be responsible for:

a. Reviewing candidates' dossiers and making recommendations on the basis of those reviews. The Dean may appoint 3- member subcommittees, as well as a chair for the subcommittees, in concert with the APT chair, to review candidates' records and prepare the dossiers for consideration by the full committee. Such subcommittees may include Professors of the Practice within the School and faculty from units outside the School, when appropriate, to assess the performance of a candidate whose expertise is deemed under-represented on the School's faculty. These external members may be present when the School's full APT committee considers the case and may have voice but not vote.

b. Making recommendations to the Dean in regard to all cases of appointment, promotion, non-promotion, and award of tenure. Recommendations will be made by vote of the School's APT committee. To conduct business and to take votes, the APT Committee must have a quorum of its members present. For the purposes of APT Committee discussion and action, a quorum is defined as one faculty more than half of all faculty members holding the rank and above for the rank under consideration, not including those faculty members on leave or on sabbatical. Thus only those candidates with positive votes at or exceeding the quorum will be recommended for appointment, promotion, and award of tenure. Only those APT Committee members present may cast a vote for candidates being considered for promotion from assistant professor to associate professor with tenure. For APT Committee votes on appointments of external candidates, electronic ballots may be used, which must be confidential.

3. Meetings

Written notice of APT committee meetings and copies of the candidate's dossier shall be distributed to the membership with at least one-week advance notice, unless the majority of the APT Committee agrees to waive such notice.

> a. Meetings of the School's APT committee shall be chaired by the chair of the School APT.

> b. The Dean may attend the meetings of the APT committee, and will have a voice but not a vote in these meetings.

4. APT actions

> a. The vote of the APT committee is advisory to the Dean, who provides an independent decision on behalf of the School when recommending candidates to the Provost and President for appointment as associate and full professors and for questions of tenure. The Dean has the final decision on appointment of candidates.

> b. Within two weeks of the vote of the APT committee and the Dean's decision, the Dean shall (1) inform the candidate whether the recommendations made by the faculty committee and the Dean were positive or negative (including specific information on the number of faculty who voted for tenure and/or promotion, the number who voted against, and the number of abstentions), and (2) prepare for the candidate a letter summarizing in general terms the nature of the considerations on which those decisions were based. Summaries shall be provided to the candidate whenever either or both faculty and the Dean's recommendations are negative. The chair of the faculty APT committee shall review the letter prepared by the Dean to ensure that it accurately summarizes the considerations regarded as relevant by the faculty APT committee. The chair of the faculty APT committee shall be provided access to the Dean's letters to the candidate and to the campus APT committee to ensure that the summary accurately reflects the recommendation and rationale provided to higher levels of review. In addition, both letters shall be made available for review in the office of the Dean by any member of the faculty APT committee. In the event that the chair of the faculty committee and the Dean are unable to agree on the appropriate language and contents of the summary letter, each shall write a summary letter to the candidate. A copy of all materials provided to the candidate shall be added to the tenure or promotion file as the case proceeds through higher levels of review.

D. Faculty Merit and Salary Review Committee

1. The Faculty Merit and Salary Review Committee (FMSRC) evaluates the performance of faculty in teaching, research, and service, and makes recommendations to the Dean on faculty members' performance.

2. The FMSRC consists of three members elected by a majority of the Faculty Committee of the School of Public Policy, through a secret ballot, and serve terms of one year. The committee consists of one professor (including professor of the practice), one assistant professor, and one professor without regard to rank. If the Dean believes that any group has been systematically underrepresented, he or she may appoint a member of that group as an additional member of the FMSRC.

3. The Dean may reserve a portion of the merit pool to address special salary problems within the School.

4. The FMSRC review is conducted during the spring semester. The elements of the review are as follows:

   a) The Faculty Committee elects FMSRC members by secret ballot during a faculty meeting before 15 March. Faculty who served on the FMSRC in the previous two years are not eligible to serve, except when there are fewer than three eligible faculty members. Tie votes are resolved by random draw among those who have not served in the last five years.

   b) Faculty members complete activity reports by 15 March. The activity reports should include a description of the faculty member's contributions to scholarship, teaching, service to the School, public service, and a summary of the findings of the Post-Tenure Review Committee (see Article X). Faculty who do not complete an activity report will not be eligible for merit awards in that fiscal year. In general, the FMSRC should examine the performance of faculty members over the previous three years, including student teaching evaluations and comprehensive reviews conducted for appointment and promotion. For years when merit pay is not available, the achievements of the faculty members for that year (or years) will be taken into consideration during the next year in which merit pay is available.

   c) In late March, the Dean or an individual delegated by the Dean shall provide the FMSRC with a list of eligible faculty and copies of their faculty activity reports. All faculty members who were hired prior to the current academic year are eligible for review.

d) FMSRC will elect one of its members to serve as chair. FMSRC examines the activity reports, on the basis of each faculty member's contributions to scholarship, teaching, service to the School, and public service. The assessment will examine the degree to which these contributions fit with the School's standards for promotion and tenure. (Please see the separate School policy outlining the promotion and tenure standards.) The Dean will separately assess the performance of the members of the FMSRC. The FMSRC prepares a written evaluation of each faculty member. The chair will certify that the FMSRC has followed the merit pay distribution plan; if the FMSRC deviates from the plan, the chair will indicate the areas in which the deviations occur and provide a written rationale in its report. These evaluations are submitted to the Dean by 15 April.

e) The FMSRC's role is advisory to the Dean. The Dean makes the final decisions on merit salary awards, based on the FMSRC's evaluations, and reports these decisions to the FMSRC. The FMSRC produces a written report expressing its views on whether the Dean has followed the School's merit and salary review policy.

f) The Dean notifies individual faculty members of their salary for the next fiscal year, the FMSRC's evaluation of the faculty member, the faculty member's right to request a meeting with the Dean to discuss the salary, and the right to appeal the salary decision.

g) Any faculty member who is dissatisfied with the merit salary increase should file a written appeal with the Dean. The Dean will consider the issues raised in the appeal, meet with the faculty member to discuss the issues, and inform the faculty member of the decision on the salary increase. If a faculty member remains dissatisfied, the faculty member may initiate a grievance according to the *University of Maryland Policies and Procedures Governing Faculty Grievances*.

5. The Dean will annually review the composition of the FMSRC over the past five years to assure that the FMSRC achieves a reasonable representation of faculty diversity. If the FMSRC has not proven sufficiently diverse, the Dean will take that fact into account in appointing the next year's FMSRC.

6. The Dean will annually review the salary structure of the School. If the review reveals salary inequities or salary compression, the Dean will either adjust salaries to rectify the issue, or consult with the Provost on steps to address the issue.

Article X: Post-Tenure Review

1. In accordance with the policy of the University System of Maryland (19.0 II-1.19) and the policy of the University of Maryland College Park (II-1.20(A)), the School of Public Policy will conduct a regular, comprehensive review of tenured faculty. These reviews shall:

   a. Occur on a regular basis, not less than once every five years.

   b. Be a formative process for future faculty development, enhancing the learning environment of students, and improve the School's programs.

   c. Take place in a process of collegial assessment.

2. Reviews conducted as part of assessment for appointment and promotion will be considered a comprehensive review, for the purposes of this policy.

3. Reviews will be scheduled, starting with the faculty who have served the longest in rank since the previous comprehensive review. The School shall endeavor to allocate the comprehensive reviews of tenured faculty so that approximately the same number of tenured faculty are reviewed each year. Faculty members shall be informed by the Dean, by July 1, of the schedule of the faculty members who will undergo post-tenure comprehensive reviews in each year.

4. By September 1 of the academic year in which a faculty member is scheduled to undergo a post-tenure comprehensive review, the faculty member will:

   a. Prepare a brief summary of the faculty member's contributions in teaching, research, and public service since the last review.

   b. Submit copies of assessments of the impact of the faculty member's work, including citation counts and other measures of scholarly accomplishment.

5. Each year, the Dean shall appoint a Post-Tenure Review Committee of three full professors. None of the members of the committee shall be faculty members scheduled for review in the current year. For each faculty member undergoing a comprehensive review, the Committee shall:

   a. Assess the faculty member's teaching performance.

b.   Assess the research, including the quality and impact of the scholarship.

c.   Assess the public service, including contributions to the broader field of public policy and the impact of the service.

d.   Assess the contributions to the School and University communities.

e.   Rely on such additional information, such as citation indexes and other externally available data, as might prove useful in assessing the faculty member.

f.   Write an appraisal that summarizes the faculty member's contributions and impact. This appraisal shall normally be completed before the end of the fall term.

g.   Share the draft appraisal with the faculty member, who shall have 14 days (or a mutually agreeable alternative date) to respond to the Review Committee's comments.

h.   Submit the final appraisal to the Dean.

6.   The Dean shall communicate the review to the faculty member, along with an overall assessment of "meeting expectations" or "not meeting expectations."

a.   The Dean will discuss with the faculty member all aspects of the report.

b.   For faculty members "not meeting expectations," the Dean shall counsel faculty members on matters identified by the Review Committee as deficient, and the Dean shall work with the faculty member to create a faculty development plan. The plan shall include a procedure for evaluation of progress on an annual basis, and it shall be signed by the Dean and the faculty member.

c.   The comprehensive review shall be considered in decisions by the School on promotion, merit pay, and other rewards.

7. The annual reviews conducted by the School as part of the annual salary and workload assessment (See Article IX Section D) shall be used as part of the comprehensive review. Two consecutive annual reviews that indicate a faculty member is materially deficient shall occasion a comprehensive review in the next academic year. That comprehensive review shall be in addition to reviews otherwise required by this policy.

Article XI: General

A. Quorum

Unless otherwise specified, to conduct business, a majority of members of each committee must be present.

B. Rules

Unless otherwise specified, *Roberts Rules of Order* will set the procedures for the conduct of business during the meetings of the School's committees.

C. Review

The School's Plan of Organization shall be reviewed at least every ten years by a committee elected by the School Assembly. This committee shall be comprised of representatives of the Faculty, Staff, and students.