MORGAN STATE UNIVERSITY
GROWING THE FUTURE • LEADING THE WORLD

Provost and Senior Vice President for Academic Affairs

March 11, 2020

The Honorable Dr. James D. Fielder, Jr.
Maryland Higher Education Commission
6 N. Liberty Street, 10th Floor
Baltimore, MD 21201

Dear Dr. Fielder,

We are submitting the following new academic program proposal to your office for review and approval. The Board of Regents of Morgan State University at its February 4, 2020 meeting approved the following program.

Master of Science in Advanced Computing

We are taking this step with full confidence in Morgan's capacity to offer this program as presented. Morgan State University is quite able to financially support this proposed program. Please keep us informed as to the review process.

If you need any additional information, please do not hesitate to contact me at lesia.young@morgan.edu or (443)885-3350.

Sincerely,

3/11/20

Dr. Lesia Crumpton-Young
Provost and Senior Vice President for Academic Affairs, Morgan State University

cc: Dr. David Wilson, President, Morgan State University
Dr. Farzad Moazzami, Interim Assistant Vice President for Academic Affairs, MSU
Dr. Hongtao Yu, Dean, School of Computer, Mathematical and Natural Sciences, MSU
Dr. Emily Dow, Assistant Secretary for Academic Affairs, Maryland Higher Education Commission

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Cover Sheet for In-State Institutions
New Program or Substantial Modification to Existing Program

Institution Submitting Proposal	Morgan State University

Each action below requires a separate proposal and cover sheet.

- (●) New Academic Program
- ( ) New Area of Concentration
- ( ) New Degree Level Approval
- ( ) New Stand-Alone Certificate
- ( ) Off Campus Program
- ( ) Substantial Change to a Degree Program
- ( ) Substantial Change to an Area of Concentration
- ( ) Substantial Change to a Certificate Program
- ( ) Cooperative Degree Program
- ( ) Offer Program at Regional Higher Education Center

Payment Submitted: (●) Yes ( ) No Payment Type: ( ) R*STARS ( ) Check Payment Amount: $850 Date Submitted: 2/20/2020

Department Proposing Program	Computer Science - School of Computer, Mathematical, & Natural Sciences	
Degree Level and Degree Type	Master of Science	
Title of Proposed Program	Advanced Computing	
Total Number of Credits	30	
Suggested Codes	HEGIS: 703.00	CIP: 11.0701
Program Modality	(●) On-campus	(●) Distance Education (*fully online*)
Program Resources	(●) Using Existing Resources	( ) Requiring New Resources
Projected Implementation Date	(●) Fall ( ) Spring ( ) Summer	Year: 2020
Provide Link to Most Recent Academic Catalog	URL: http://catalog.morgan.edu/	
Preferred Contact for this Proposal	Name: Farzad Moazzami	
	Title: Interim Assistant Vice President for Academic Affairs	
	Phone: (443) 885-3350	
	Email: farzad.moazzami@morgan.edu	
President/Chief Executive	Type Name: Dr. Lesia Crumpton-Young	
	Signature: [signature]	Date: 03/11/2020
	Date of Approval/Endorsement by Governing Board: 2/4/2020	

Revised 3/2019

Proposal for New Instructional Program

Master of Science in Advanced Computing (Online/Onsite)

A. Centrality to Institutional Mission Statement and Planning Priorities

A.1. Program Description and Alignment with Mission

The Department of Computer Science at Morgan State University (MSU) is submitting a proposal to offer a Master of Science in Advanced Computing program. The program will preserve the core of computer science while possessing unique strength in emerging areas in computer science including cloud computing, cybersecurity, data science, and artificial intelligence. The program will be delivered in both onsite and online formats. For the online only delivery, students take ten courses and can complete the degree in a 12-month period. The proposed MS program will be managed by the Department of Computer Science within the School of Computer, Mathematical and Natural Sciences (SCMNS).

The fields of Computer Science and their related advanced computing have been the driver of incredible job growth and innovation throughout our economy, since the emergence of the personal computer in the 1980s and the Internet in the 1990s. Today, the transformation continues, and much is driven by cloud computing, cybersecurity, artificial intelligence (AI), robotics, Internet of Things (IoT), software engineering, and data science. It is well summarized as "the universal connectors that interweave all our big ideas that have the potential to revolutionize everything we do in science" by Dr. France A. Córdova, director of the National Science Foundation (NSF). Cybersecurity has been a top concern for government and private sector and the cyber workforce development has been one of the top priorities to fill the much-needed job vacancies. Computation, from modeling and simulation to data mining, drives progress in many research areas, and has helped to create new fields. Cloud computing, cybersecurity, and AI occupations are the number one source of all new wages in the U.S. and make up over half of all projected new jobs in STEM fields, making them the most in-demand college degrees by far. For example, Forbes released a list of the best and worst MS degrees for 2017 based on analysis of data in compensation to site PayScale where computer science ranks as one of the top MS degrees, with a pay growth of 45% from early to mid-career pay based on earning potential, job satisfaction, and stress level[1]. As more and more students seek to graduate with bachelor's degrees in computer science to fill this employment gap, holding an MS degree in computer science will help individuals stand out from the pack and be considered for the most competitive positions. The advantages of a deeper knowledge of computer science in many domains has also led to the recent emergence of new degree programs at several institutions. An MS in Advanced Computing program at Morgan provides a specialized focus on an area of science and technology, helping develop skills and career prospects. Adding a 100% online option increases the possibility for more students, especially IT professionals currently in the workforce, to study in the program with the flexibility of their own time and schedule.

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 will also meet the needs of students who are already in the workforce and wish to update or improve their knowledge of current computer science. It aims at providing a platform for a growing population of students who are under-represented minorities (URM) to advance their skills necessary for

[1] https://www.forbes.com/sites/jeffkauflin/2017/09/07/the-best-and-worst-masters-degrees-for-jobs-in-2017/#501dbb584cc3

attaining better opportunities in complex and rapidly evolving technological environment and high-tech companies. Graduates will be prepared for specialized jobs with focus on an area of emerging technology, involving cutting edge aspects of Computer Science that are fundamentally important and practically relevant. The possibility of completing a Master's degree in Advanced Computing online in one year make it possible for working professionals to enroll into this program that would otherwise not be possible to study in classrooms during the working hours. Data show that the one year 100% online option and the advanced computing nature with emerging areas of computer science for this MS program are unique in the State of Maryland.

The program will prepare students to enter the local, national, and global workforce as leaders and innovators; which is in line with MSU's mission to "Serve the community, region, state, nation, and world as an intellectual and creative resource by supporting, empowering and preparing high-quality, diverse graduates to lead the world". This in also in line with the new designation of MSU as Maryland's pre-eminent public urban research university and is consistent with the University's Carnegie Foundation classification as a doctoral research university with high research activities (R2) to serve the State of Maryland's urban and underrepresented minority population in an affordable manner by "transitioning from a comprehensive university focused primarily on teaching and instruction, to one with an emphasis more on research and innovation".

The enrollment in computer science at MSU has doubled in the last five years and students have constantly shown interests to pursue an MS degree, but the department was unable to provide them with this opportunity. Surveys conducted by the department indicated that almost half of the students showed interest in pursuing a MS degree.

The mission of the School of Computer, Mathematical and Natural Sciences (SCMNS) is to "provide a comprehensive offering of undergraduate, Master's and doctoral programs to educate and nurture the next generation of scientists, mathematicians and technologists; to advance the frontiers of science and technology through scientific research and innovation; and to serve the local, regional and global communities." The CS department is dedicated to fulfilling these missions by preparing students to be the next generation of scientists and professionals who will be able to effectively compete in the challenging global society. The proposed degree program fully supports this mission statement and MSU's vision, "Growing the Future, Leading the World".[2]

A.2: Alignment with Institutional Strategic Goals

In MSU's ten year strategic plan entitled "Growing the Future, Leading the World: The Strategic Plan for Morgan State University, 2011-2021[2] (Goal 2: Enhancing Morgan's status as a Doctoral Research University)" (p. 16), represents the foundation for the role MSU plays in leading the state of Maryland in graduating underrepresented minority students in STEM disciplines. A near-term objective within that overarching goal is to develop a comprehensive suite of contemporary MS degree offerings, for full- and part-time (professional) students that respond to the needs of tech industry in this region. The proposed program will move MSU a step forward toward that direction and is in line with MSU's mission to offer "a select set of graduate programs to a broad cross section of students in a supportive environment that encourages research and service towards the needs of underserved communities." It is also directly relevant to Strategic Goal I "Enhancing Student Success" in Morgan's current 2011 - 2021 Strategic Plan (p. 14) to "offering challenging, internationally relevant academic curricula". Establishment of the MS degree in Advanced Computing at MSU will likely attract more underrepresented minority students and increase our enrollment. This Program will also contribute to the Strategic Initiatives of the School of Computer,

[2] http://issuu.com/morganstateu/docs/strategicplan2011-21_final?e=2119971/60089621

Mathematical and Natural Sciences (SCMNS) which includes "to expand academic program offerings, including new and online degree programs and up-to-date curricula", and "to enhance research and scholarly activities, including the improvement of infrastructure and capabilities." The program will attract students and professionals in high-demand career opportunities with in-depth knowledge and technical skills in CS and prepare students for technically significant careers within industry and governmental agencies in the surrounding region.

B. Critical and Compelling Regional or Statewide Need as Identified in the State Plan

The proposed program is consistent with the State of Maryland's goals for maintaining and strengthening a preeminent statewide array of postsecondary institutions. It responds to the crucial need as highlighted in the 2017-2021 Maryland State Plan for Postsecondary Education: Student Success with Less Debt by ensuring "equitable access to affordable and quality postsecondary education for all Maryland residents" and promoting and implementing "practices and policies that will ensure student success" and fostering "innovation in all aspects of the Maryland higher education to improve access and student success[3]" (p. 27). The State of Maryland enjoys a national and international reputation, "is among the nation's leaders of innovation in higher education, highly ranked in research and development with 72 federal laboratories" (p. 11), which is also one of the core values of MSU. Understanding the importance of computing education and relevant career opportunities in cybersecurity and IT sectors, Maryland is making $7 million investment over the next three years to bring computer science to every school and to make it the Silicon Valley of the East by recently (May 2018) passing bill HB 281[4].

B. 1. Demonstrate Demand and Need for the Program in Terms of Meeting Present and Future Needs of the Region and the State

While Silicon Valley benefits from its tech giants, such as Google, Facebook, Apple, and the like, the Washington-Baltimore region and the state of Maryland as a whole benefits from being close to the US Capital, Washington, D.C. and to the sprawling region of Northern Virginia. As a result, MSU is very close to federal agencies: NASA, NSA, NSF, NIH; Military establishments: RDECOM, CECOM, Naval Air Systems Command, ARL, APL; contractors: Lockheed Martin, Northrop Grumman, and other tech industries. The region has a diversified population with all kinds of job opportunities in a wide range of fields from defense to cyber security to IT to health care to Biotechnology. Maryland is also home to more than 60 federal agencies and twice as many federal laboratories (74) as any other state. The state features a diversified economy with the second highest concentration of professional and technical workers among the states. Combing through its database, Indeed.com (a Google-like job listing aggregator) put together a list of the top ten metropolitan areas with the most job listings for computer scientists, the Washington, D.C. region with its many defense contractors and government jobs, comes in at number one[5].

The vibrant economy in this region includes artificial intelligence, cybersecurity, data mining, data analytics, and cloud computing, which is dependent upon an educated and professional IT workforce. According to The Computing Technology Industry Association 2017 report, Maryland is fifth in the country for total tech workers in the workforce at 9.5%. Maryland is also third in the nation for the percentage of research and development professionals. Whereas, Baltimore is the third best city for women in technology based on jobs, which observed a 36% growth in the number of tech sector jobs overall from 2013 to 2016,

[3] http://www.mhec.state.md.us/About/Pages/2017StatePlanforPostsecondaryEducation.aspx
[4] https://legiscan.com/MD/bill/HB281/2018
[5] https://www.forbes.com/sites/susanadams/2018/09/20/the-cities-with-the-most-computer-science-jobs/#1ca0ecb7194e

according to data from the U.S. Census Bureau.[6]

Whereas, MSU is a major economic engine for the city and state annually producing $1 billion in statewide economic impact, supporting 6,500 jobs and generating $47 million in state tax revenues.[7] Its proximity to Baltimore, Washington DC, Annapolis and Northern Virginia regions demanding for CS professionals has made the needs of degree programs like this more apparent and will open many opportunities for graduates in federal and state agencies, prominent defense and tech industries, and the commercial sector.

B.2. Provide Evidence that the Perceived Need is Consistent with the Maryland State Plan for Postsecondary Education

The need for an MS in Advanced Computing program is consistent and well aligned with the three goals: Access, Success and Innovation of Maryland's 2017-2021 State Plan for Postsecondary Education[8]. The proposed program is conformed to the first goal **"Access"** which "ensure equitable access to affordable and quality postsecondary education for all Maryland residents". Closing the accessibility and achievement gap is an ongoing endeavor for Maryland, which is a leading state in postsecondary education by maintaining the ongoing commitment to addressing equal access, success, and opportunity through a variety of focused programs. The need for a MS program in Advanced Computing to serve both under-represented minority student population, white or Hispanic students with affordable and lower educational cost compared to other private and public universities in this region is a step closer to fulfill the goal of the state which has a fundamental commitment to equity, equality, and diversity. The state plan also strives for ensuring student "**Success"** by promoting and implementing practices and policies, such as supporting "the unique missions of Historically Black Colleges and Universities" and enhancing "diversity by fostering collaborations between Historically Black Colleges and Universities and traditionally white institutions" (p. 83). Hence, this proposal from an HBCU for a graduate program will definitely promote the above goal and very consistent with the state plan and commitment to equal education opportunities. This program will also allow "long-term graduate education opportunities when considering a student's career trajectory" and will make it easier to "expand support for research and research partnerships" which are depicted as strategies for fostering innovation in all aspects of the Maryland higher education to improve access and student success. **"Innovation"** is also one of the six core values of MSU that encourages and supports in all forms of scholarship including the discovery and application of knowledge in teaching and learning and in developing innovative products and processes of "business-driven credentials".

C. Quantifiable and Reliable Evidence and Documentation of Market Supply and Demand in the Region and State

The demand for employees with Advanced Computing and computing expertise with advanced degree is high and it has grown steadily over time. According to data from the Bureau of Labor Statistics (BLS)[9] employment in computer occupations grew by nearly a factor of 20 between 1975 and 2015, nearly twice as fast as production of CIS bachelor's degrees. BLS has projected that demand for Advanced Computing workers will continue to grow over the next decade at a rate higher than that of overall job growth, particularly as computing becomes more central to a wider range of industrial sectors. Computer science-related jobs are expected to grow 11% between 2014 and 2024, according to the BLS—substantially higher than the seven percent growth expected for all occupations. According to Burning Glass Labor Insights, the

[6] https://www.bizjournals.com/baltimore/news/2018/02/26/baltimore-ranks-third-best-city-for-women-in.html
[7] https://www.morgan.edu/economicimpact
[8] http://www.mhec.state.md.us/About/Pages/2017StatePlanforPostsecondaryEducation.aspx
[9] https://www.bls.gov/ooh/computer-and-information-technology/home.htm

employment demand is particularly intense, and the growth is expected to be even higher for certain occupations: 14% for computer and information research scientists, 20% for software developers, and 23% for computer systems analysts. This healthy growth will keep the job market stable for Computer Science degree holders, ensuring continued value from their degree[10].

At the current number of graduates, 50,962 bachelor's degrees, 22,777 MS degrees, and 1,826 Ph.D.'s in computer science, the supply of computer-science knowledge coming out of America's universities is insufficient to meet growing demand. Currently, it is estimated that there are more than 500,000 open computing jobs across the country, and there are over 115,000 total computer science-related jobs in Maryland with almost 20,000 openings (4.8 times the average demand rate in Maryland)[11]. Data from the Conference Board for job demand, the Bureau of Labor Statistics for state salary, and national job projections data indicate that the average salary for a computing occupation in Maryland is $103,646, which is significantly higher than the average salary in the state ($57,270). A recent study by the Southern Regional Education Board projects that 69% of jobs created in Maryland by 2020 will require at least a four-year degree. Maryland's growing reputation as a center of innovation makes it the home of more and more high-tech businesses that demand highly educated workforce. The challenge for Maryland universities is to widen the pipeline of those workers entering the labor force[12].

Demand for Computer Science workers is expected to grow by another 12 percent over the next decade in Maryland. As a proof, a recent search by Indeed.com reveals that there are 174 new jobs in Baltimore with a requirement of MS in Advanced Computing, and there are close to 10,000 opening throughout the nation. Yet, state colleges and universities graduated fewer than 3,000 Computer Science majors in 2015, and only 20% were female and the number of graduates with an MS degree in Advanced Computing is even much lower. Hence, at the current rate, the supply of computer science workers in Maryland still falls short of the demand demonstrated by the current market, let alone demand expected in the future.

For individuals already working in the information technology (IT) sector, an MS degree may provide a career boost by enabling professionals to expand their expertise in the field. For example, an MS degree gives students specialized skills in one or more areas of technology, including software development, data science or artificial intelligence and machine learning. A MS degree in Advanced Computing can also increase salary potential. According to a 2016 PayScale.com report, an MS degree in Advanced Computing and engineering was the 15th highest paid of all graduate degrees. Early career pay was reported to be $95,900, and mid-career pay jumped to $134,000 per year[13]. For example, most jobs for computer and information research scientists require a MS degree in Advanced Computing or a related field which are expected to grow 19% (much faster than average) between 2016 and 2026 with a median pay $114,520 per year (2017) according to the U.S. Bureau of Labor Statistics[14].

Machine learning engineers, cloud computing professionals, cybersecurity, data scientists, and big data engineers rank among the top emerging jobs -- with companies in a wide range of industries seeking those skills. Data science and machine learning are generating more jobs than candidates are right now, making these two areas the fastest growing tech employment areas today. Data scientist roles have grown over 650% since 2012, but currently 35,000 people in the US have data science skills, while hundreds of

[10] SmartAsset.com, The Best Cities for Women in Tech, March 22, 2017

[11] https://thejournal.com/articles/2017/12/14/maryland-boosting-cs-focus-in-k12.aspx

[12] https://thejournal.com/articles/2017/12/14/maryland-boosting-cs-focus-in-k12.aspx

[13] The Case for Improving U.S. Computer Science Education BY ADAMS NAGER AND ROBERT D. ATKINSON,MAY 2016

[14] https://www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm

companies are hiring for those roles - even those you may not expect in sectors like retail and finance - supply of candidates for these roles cannot keep up with demand. According to LinkedIn's 2017 U.S. Emerging Jobs Report[15] there are 9.8 times more Machine Learning Engineers working today than five years ago with 1,829 open positions listed on the site today. There are 6.5 times more Data Scientists than five years ago, and 5.5 times more Big Data Developers. Based on insights from Glassdoor's 50 Best Jobs In America For 2018[16], Data Scientist has been named the best job in America for three years in a row, with a median base salary of $110,000 with 4,524 job openings. Six analytics and data science jobs are included in Glassdoor's 50 best jobs In America for 2018. Across all six analytics and data science jobs there are 16,702 openings as of today according to Glassdoor. Whereas, software engineering is a common starting point for professionals who are in the top five fastest growing jobs today. The career path to Machine Learning Engineer and Big Data Developer begins with a solid software engineering background. There are 29,187 Software Engineering jobs available today, making this job the most popular regarding Glassdoor postings according to the study.

According to Forbes, Demand for cloud computing expertise continues to increase exponentially and will accelerate in 2020[17]. According to Forbes, there are currently 50,248 cloud-computing positions available in the U.S. with the median salary of $146,350. According to the Association for Computing Machinery (ACM), cloud computing is among the top 10 jobs for the next decade[18]. It continues to be an area of job growth, leading to new titles such as digital logistics manager.

MSU should capitalize on the growing interest in computer science and expand its offerings to accommodate the growing demand of computer skills in those above fields and we expect the degree program to be successful in this regard.

D. Reasonableness of Program Duplication

1. Identify similar programs in the State and/or same geographical area. Discuss similarities and differences between the proposed program and others in the same degree to be awarded.

Although MS in Computer Science is offered in several institutions in Maryland, the proposed advanced computing program with the emerging areas in computer science courses and one-year online option is unique. Our study shows that, MS in computer science, broadly defined, is offered at Bowie State University, Frostburg State University, John Hopkins University, Loyola University of Maryland, Towson University, University of Maryland Baltimore County, University of Maryland University College, and University of Maryland College Park within the State of Maryland.

Johns Hopkins University offers an MS in computer science with a range of tracks including data science, cloud computing, cybersecurity, and software engineering. Johns Hopkins University currently is the only institution in MD to offer an online MS CS degree. The program requires at least one and a half years to complete. The Morgan MS Advanced Computing program will have the option for students to complete 100% online in one year, in addition to study onside only. In addition, the proposed program prepares students with the foundation in emerging areas of computer science in AI, Cybersecurity, Data Science and Cloud Computing so they can have less or no transition from study to workplace.

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[15] https://economicgraph.linkedin.com/research/LinkedIns-2017-US-Emerging-Jobs-Report

[16] https://www.glassdoor.com/List/Best-Jobs-in-America-LST_KQ0,20.htm

[17] https://www.forbes.com/sites/louiscolumbus/2018/11/27/where-cloud-computing-jobs-will-be-in-2019/#2ba9f37c6add

[18] https://www.acm.org/articles/careernews/2018/careernews-05082018

University of Maryland University College (UMUC, now UMGC) offers MS in information technology degree with tracks including data analytics, information technology, and learning design and technology. Though they are related to Computer Science, none of them are considered a CS degree. Despite some similarities between these three programs with our proposed program, none of them totally overlaps with our proposed Master of Science program in Advanced Computing. The main focus of this program is to promote hands on experience in cybersecurity, cloud computing, artificial intelligence, machine learning, and computer science in general. Similarly, the certificates and titles with respect to the courses and credits are different. In addition to Johns Hopkins University and the University of Maryland University College, Towson University offers MS in computer science with four tracks in e-commerce, computer security, software engineering, and data science. Despite limited similarity, none of these tracks are offered online at this time.

There are also other Universities with MS program in computer science, has very limited overlap with our proposed program. University of Maryland Baltimore County offers a general MS in computer science with no tracks; Bowie State University offers an MS in computer science with a specialty in information technology; Loyola University Maryland offers MS in computer science with web programming and networking tracks; Frostburg State University offers MS program in Advanced Computing; and University of Maryland College Park offers a general MS in computer science with no tracks, but with a wide range of research areas. The three HBCU's, Bowie State University, Coppin State University, and University of Maryland Eastern Shore, offer MS program in Computer science. However, none has significant overlap with our program especially the one-year online option. In fact, the concept of cybersecurity, cloud computing, and machine learning which are the key concept in our program are absent in their program. Similarly, the certificates and titles presented in those programs with respect to the courses and credits are different from ours.

Morgan State University is collaborating with Amazon to improve cloud-computing teaching in the CS department. Morgan students can use Amazon Web Services (AWS) (free) in hands-on learning on machine learning, cybersecurity, IoT, and data analytics. The proposed degree program has a strong focus on workforce development. Most classes have lab and projects that use real world problems developed collaboratively with industry professionals, a distinction of the proposed program with other existing programs.

In summary, the proposed MS in Advanced Computing program focuses on cybersecurity, cloud computing, machine learning, and data science with the online and onsite delivery methods is a unique program. It does not duplicate any programs in the State. Instead, it complements the existing programs with a strong workforce development focus and advance computing foundation.

2. Provide justification for the proposed program.

Due to growing market demand among high tech companies, MS in Advanced Computing is widely offered in the U.S. This high-demand also presents an opportunity for MSU to provide underrepresented minority students to major in MS in Advanced Computing.

The interdisciplinary, transdisciplinary, theoretical and practical nature of this MS program in Advanced Computing provides a unique platform for underrepresented students at HBCU to enhance their versatility and marketability in the high-tech job market.

E. Relevance to High-Demand Programs at Historically Black Institutions (HBIs)

With the growing enrollment of computer science majors at MSU from 150 to 300 in the last five years, there is a high demand to provide a platform for those that aim at pursuing higher degree to be able to compete for high paid and important positions in high-tech companies. Despite a growing number of institutions offering such programs, the offering of such programs for underrepresented minorities are rare. This is due to several issues such as high expenses of studying in private institutions, shortage in capacity of taking larger body of students, and affordability for underrepresented minority communities. As such, MSU can play an important role in addressing these issues. The three HBCUs in Maryland, Bowie State University, Coppin State University, and University of Maryland Eastern Shore, offer MS program in Advanced Computing. However, none have significant overlap with our program. In fact, the concept of cyber security, cloud computing, and machine learning which are the key concept in our program are absent in their program. Similarly, the certificates and titles presented in those programs with respect to the courses and credits are different from ours.

In addition, the offering of MS in Advanced Computing provides a platform for possible future extensions for a PhD program in these fields. The introduction of such programs encourage students to continue their education to attain skills and experience to obtain better positions available at high-tech companies, in higher education, and research.

Department of Computer Science at MSU has recently initiated collaborations with the likes of Google and Facebook to train high skill students in computer science to promote diversity in large high-tech companies. These companies have accepted to provide the department with trainers, facilities, and equipment to develop its infrastructure to attain this objective. Also, department of computer science in collaboration with google started a program at Silicon Valley to train students from underrepresented communities and prepare them with skills and expertise to be recruited in this company. In addition, these companies offer over 20 MSU computer science students per year for internships to enhance motivation of our underrepresented minority students to obtain necessary skills to join these companies.

Considering these collaborations, offering of MS degree with a focus on fundamental and innovative fields in computer science such as machine learning with a focus on deep learning, artificial intelligence and intelligence computing, cloud computing, data science, information technology and software engineering can further promote such activities.

F. Relevance to the Identity of Historically Black Institutions (HBIs)

MSU (MSU) is a historically black university with the unique designation as Maryland's "Preeminent Public Urban Research University." MSU serves an ethnically diverse student body consists of full-time and part time college age students and adult learners. MSU is committed to the academic success and achievement of all its students[19].

With the growing number of enrollments at our undergraduate level in computer science and the small capacity of MS program in Advanced Computing in the other HBCU's in Maryland, our proposed program can play an important role in developing such infrastructure in HBIs at the State of Maryland.

G. Adequacy of Curriculum Design and Delivery to Related Learning Outcomes (as outlined in COMAR 13B.02.03.10)

[19] www.morgan.edu/Documents/ACADEMICS/Academic.../ucat_AcademicAffairs.pdf

The Master of Science in Advanced Computing will be offered in both online and onsite formats. For the online only delivery, students take courses only and can complete the degree in a 12-month period. Both the project and thesis tracks can be completed completely online.

Learning Outcomes:

Students pursuing the Master of Science degree in Advanced Computing, upon completion of requirements, will be able to:

- Understand and explore in-depth knowledge in Computer Science, its impact, and connect Computer Science from the perspective of different disciplines and application domains;
- Demonstrate high-level understanding of principles, contributors, developments and contemporary applications of Computer Science in specific area of interest;
- Demonstrate competency, commitment, knowledge and skills in applying principles to practical situations in any area of interest;
- Solve practical and challenging Computer Science problems;
- Use and deploy Computer Science principles and tools;
- Visualize complex and heterogeneous data in user-friendly ways with perceivable inferences and interpretations;
- Collect data through extensive reading, viewing, listening and researching in both print and electronic media online and in databases and evaluate sources for credibility and appropriateness;
- Demonstrate knowledge of problem-solving techniques in the basic concepts and principles of both theoretical and applied sciences;
- Enhance knowledge and demonstrate the impact through both project and thesis; For professionals, to gain necessary foundations and skills through appropriate course work;
- Use the knowledge and skills acquired for advancement in the workplace in different application domains.

A list of courses with title, semester credit hours and course descriptions, along with a description of program requirements

MS in Advanced Computing students are expected to proactively pave a foundation of knowledge and skills in computer science out of course work, independent study, projects, and research. Along with completion of the graduate degree, students will identify and address problems in heterogeneous domains, use the foundation and skills to the professional domain, and contribute and disseminate the progress with the community and to the science.

Program Curriculum:

1. Total Credit Hours: 30

2. Degree Options:

   MS in Advanced Computing (Course Only, Project or Thesis):

   a) **Course Only**: 10 Graduate level courses including 4 core courses, 6 elective courses.
   b) Master's **Project**: 9 Graduate courses including 4 core courses and 5 elective courses (9x3=27 credits) and 1 Project Course (3 credits).
   c) Master's **Thesis**: 8 Graduate Courses including 4 core courses and 4 elective courses (8x3=24 credits), 1 Research Seminar (3 credits) and 1 Thesis Guidance/Thesis Defense (3 credits).

3. Estimated Time to Complete the Degree:
   One year or 12-months for both the course only and project options and 16 months for Thesis. The estimated time can be more flexible for those who study part-time or want to take traditional approach with a slower pace.

4. Prerequisites/Admission Requirements
   a. Minimum GPA and application requirements of the School of Graduate Studies determined by the program director
   b. BS degree in Computer Science or related areas (assessment/approval needed by the program director or department chair)

5. Course Requirements:

   a. **Core Courses** (3 credits each):
   One must complete, with a grade of "B" or higher, the following four (4) courses:

   EEGR 580: Cybersecurity
   COSC 502: Data Science and Artificial Intelligence
   EEGR 581: Network Security
   COSC 504: Secure Cloud Computing

   Prerequisite courses: data structure, discrete math, computer organization, computer architecture, intro to cybersecurity, software engineering, computer networks. Applicants whose prior education does not include the prerequisites may be admitted under provisional status, followed by full admission once they have completed the missing prerequisites. Exception can be made by the program director or the department chair.

   b. **Elective Courses** (3 credits each):
   Students must complete at least 4-6 elective courses from the list below:

   COSC 511: Design and Analysis of Algorithms
   COSC 512: Software Engineering
   COSC 513: Cloud Computing Applications
   EEGR 583: Security Management
   COSC 611: Big Data Analytics
   COSC 612: Deep Learning in the Cloud
   COSC 614: Cryptology and Cryptography
   EEGR 679: Security in Network and Link Applications
   INSS 696: Current Issues in Information Technology

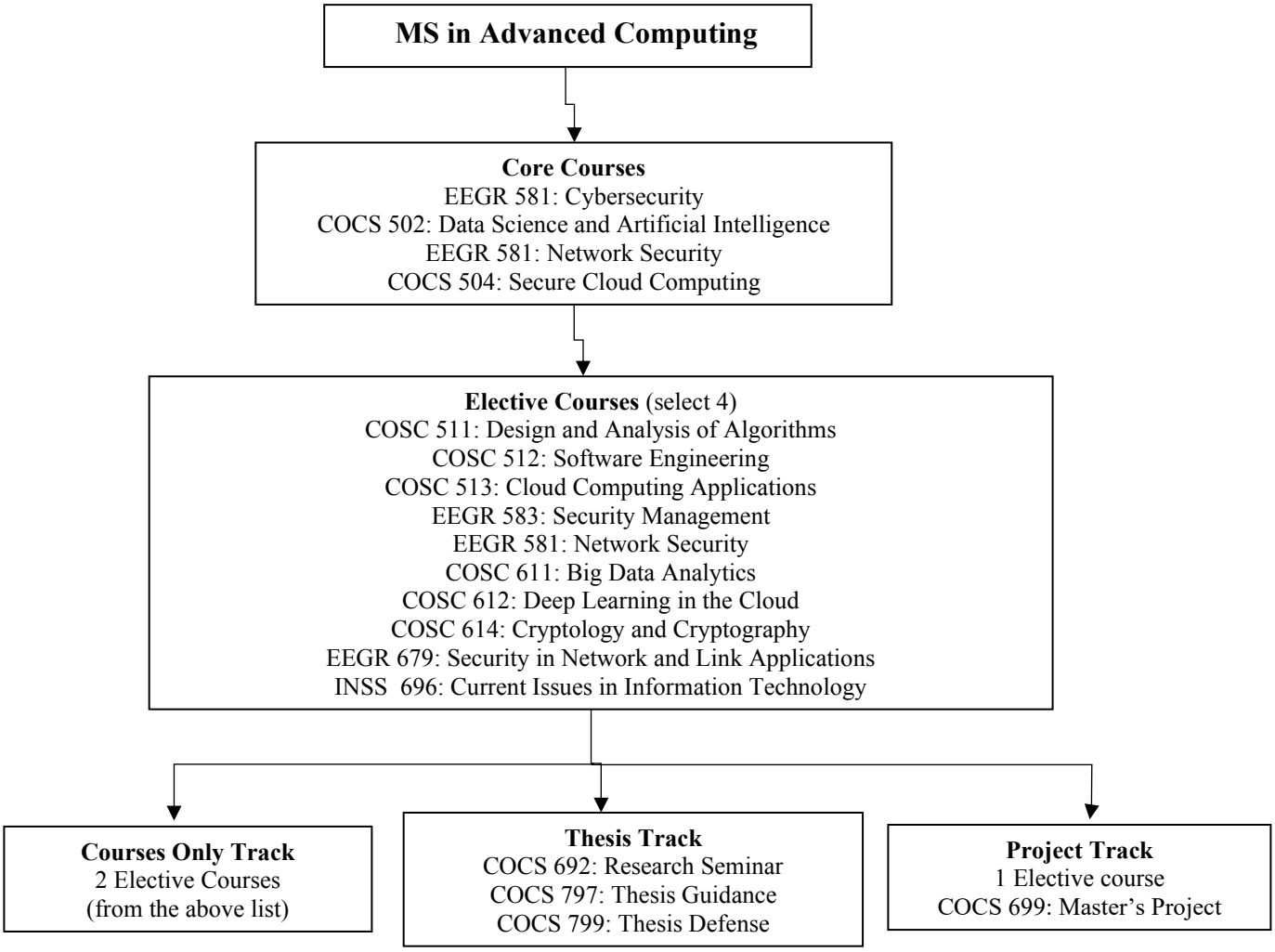
   There are two more elective courses, Independent Study and Special Topics in Computer Science (depending on the need and availability), that a student can choose as approved by the Program Director.

   c**. Special & Culminating Courses:**

   COSC 690: Independent Study (3 credits)
   COSC 691: Special Topics in Computer Science (3 credits)
   COSC 692: Research Seminar (3 credits)
   COSC 699: Master's Project (3 credits)
   COSC 797/799: Thesis Guidance/ Thesis Defense 3/9*

* Note: The student will continuously register in Fall and Spring terms for COSC 797 (Thesis Guidance) until the Master's Thesis is completed and submitted to the School of Graduate Studies for review. The course is used only when the curriculum has been completed, and the student is completing the research and writing of the thesis. The course registration maintains the student status as a matriculated, full-time student (student registers for 3 credit hours each semester, but is acknowledged as having a 9 credit hours load). After the Intent to Defend the Master's Thesis form has been accepted by the School of Graduate Studies, this course registration will be changed to COSC 799 (Thesis Defense) for the given semester and count for 3 credit hours of curricular coursework (COSC 799 will also count for 9 credit hours of load). Other courses cannot be substituted for COSC 797. The only eligible grade for COSC 797 (Thesis Guidance) is the grade of "S" and the only acceptable grade for COSC 799 (Thesis Defense) is "P/F" (Pass/Fail).

MS Advanced Computing Organogram:



Sample Degree Plan:

Degree	Fall	Spring	Summer	Fall
MS (Course only)	2 Core courses 2 Elective courses	2 Core courses 2 Elective courses	2 Elective courses	----------
MS (Project)	2 Core courses 2 Elective courses	2 Core courses 2 Elective courses	1 Elective course Project (3 credits)	----------
MS (Thesis)	2 Core courses 2 Elective courses	2 Core courses 2 Elective courses	Research Seminar (3 credits)	Thesis Guidance /Thesis Defense (3 credits)

Course Description

EEGR 580: Cybersecurity

Three hours lecture; 3 credits.
Prerequisites: none

This course focuses on the protection of information systems against unauthorized access to or modification of information, whether in storage, processing or transit, and against the denial of service to authorized users, including those measures necessary to detect, document, and counter such threats. This course creates sensitivity to the threats and vulnerabilities of information systems, recognition of the need and means to protect data and information, and builds a working knowledge of principles and practices in information security. The course covers cryptography basics, intrusion detection and prevention, digital forensics, and use cybersecurity tools such as Wireshark, FTK Imager, and Kali Linux to simulate attacks and preventions in a live setting.

COSC 502: Data Science and Artificial Intelligence

Three hours lecture; 3 credits.
Prerequisites: none

This course covers a wide range of statistical models in Data Science and advanced concepts of Artificial Intelligence needed to perform and implement intelligent agents/programs and to understand their applications. It focuses on the theory and algorithms underlying different AI and machine learning algorithm including heuristic approach and advanced search, inference in first order logic, knowledge representation, meta heuristic, hyper heuristics, probabilistic reasoning, machine learning and decision trees, Bayesian belief network, Robot control and motion planning. Students will learn TensorFlow and use it to work on a project.

EEGR 581: Network Security

Three hours lecture; 3 credits.
Prerequisites: COSC 501

This course focuses on the protocols, skills and tools needed to support the development and delivery of advanced network and cloud services over the Internet. This graduate-level course is also focused on mastering technical details in a number of areas of advanced networking through reading and hands-on activities of important research topics in the field. The topics covered in this course include 1) network and cloud basics; 2) protocols; 3) network and cloud security; 4) mobile computing; 5) software-defined networking; 6) network and cloud management; 7) datacenter management; 8) big data analytics and cloud.

COSC 504: Secure Cloud Computing

Three hours lecture; 3 credits.
Prerequisites: COSC 501

The course examines the most important cloud services and APIs used in the Amazon and Microsoft Cloud, including the techniques for building, deploying, and maintaining machine images and applications. Students will learn how to use Cloud as the infrastructure for existing and new services. Students will use open source implementations of highly available clustering computational environments, as well as RESTFul Web services, to build powerful and efficient applications. Students also learn how to deal with cloud management, such as load balancing, caching, distributed transactions, and identity and authorization management and security.

COSC 511: Design and Analysis of Algorithms

Three hours lecture; 3 credits.
Prerequisites: COSC 220

Analysis of algorithms and relevance of such analysis to the design of efficient algorithms. The derivation of results that are primarily of theoretical significance shares importance with the practical task of designing efficient algorithms topics covered: searching and sorting graph algorithms, arithmetic, DP, approximation, NP-completeness, lower bound techniques, and quantum algorithms.

COSC 512: Software Engineering

Three hours lecture; 3 credits.
Prerequisites: COSC 220

General survey of software engineering principles with topics on project planning and management, design techniques, verification and validation. It focuses on group projects in which groups of students implement a system from its specification. It also introduces software life cycle models. Techniques for software design and testing. Cost estimation models. Issues in software quality assurance and software maintenance.

COSC 513: Cloud Computing Applications

Three hours lecture; 3 credits.
Prerequisites: None

This course offers the fundamentals and principles of cloud computing and its different aspects. Starting with inception, the essential concepts and technologies of cloud computing, this course will introduce the relevance of platform to the real-world business and applications. Along with covering the constituent components, topics would include cloud models, service requirements, infrastructure, security, costs, and benefits. The course will also discuss different cloud platforms, models, and services.

EEGR 583: Security Management

Three hours lecture; 3 credits.
Prerequisites: None

This course covers how to identify the tampering, destruction or interruption of any information systems and services. The analysis will look at every element of risk that could conceivably happen. Contents include identify hackers, theft, inadequately trained staff, technicians, virus, electrical, and fire etc.
Students learn the fundamentals of cybersecurity risk analysis and management including threat and vulnerability identification/analysis, threat modeling, impact analysis, mitigation planning and tracking, as well as conceptual approaches, guidelines, standards, and security control frameworks. The course includes identification and classification of information assets, formulation of comprehensive risk assessments,

development of threat models, and corresponding security plans to serve as frameworks for implementing measures aimed at protecting information assets and reducing security risks.

COSC 611: Big Data Analytics

Three hours lecture; 3 credits.
Prerequisites: COSC 502

The focus of this course is analyzing Big Data. It serves as an introductory course for graduate students who want to handle challenges with Big Data storage, curation, processing, analysis, visualization, and application at workplaces, research environments, and industry. Get insight on appropriate tools, algorithms, analytics, and platforms to use on real world problems. This interactive course will teach students how to use data science and machine learning techniques to quickly analyze network and security data and ultimately uncover valuable insights from this data. The course will cover the entire data science process from data preparation, feature engineering and selection, exploratory data analysis, log analysis, data visualization, machine learning, model evaluation and optimization and finally, implementing at scale—all with a focus on cybersecurity as the core.

COSC 612: Deep Learning in the Cloud

Three hours lecture; 3 credits.
Prerequisites: COSC 502

This course presents advanced concepts of Deep Learning with the focus on deep learning architecture. These concepts are needed to perform and implement advanced machine learning algorithms. It focuses on the theory and algorithms underlying different machine learning algorithms including Artificial Neural Network (ANN), Kernel methods, and ensemble methods. It also provides the theory and algorithms underlying different deep learning architecture including convolutional, recurrent, bidirectional neural networks. Students will work on a hands-on project using AWS SageMaker.

COSC 614: Cryptology and Cryptography

Three hours lecture; 3 credits.
Prerequisites: COSC 501

This course explores modern cryptographic (code making) and cryptanalytic (code breaking) techniques in detail. Topics covered include cryptographic primitives such as symmetric encryption, public key encryption, digital signatures, and message authentication codes, cryptographic protocols, such as key exchange, remote user authentication, side-channel attacks, replay attacks, power analysis, and quantum cryptography.

COSC 690: Independent Study

Three Hours: 3 credits.
Prerequisites: Program director/chair approval

This course offers to study related course which is approved by the faculty/adviser but carried out independently by students.

COSC 691: Special Topics in CS

Three hours lecture; 3 credits.
Prerequisites: None

The Special Topics course covers various state-of-the-art topics in Computer Science and related areas. This may lead to develop/incorporate new/advanced course in the Computer Science Department.

COSC 692: Research Seminar

Three Hours: 3 credits.
Prerequisites: Program director/chair approval

This Research Seminar is the foundation, preliminary study, and preliminary work toward Thesis Guidance/Thesis Defense.

COSC 699: Master's Project (3 credits)

Three Hours: 3 credits.
Prerequisites: Program director/chair approval

A project addressing real world problems under the supervision of a faculty member and/or a group of faculty members(committee).

COSC 797: Thesis Guidance

Three Hours: Hours: 3 Credits (Reports as 9)
Prerequisites: Program director/chair approval

This course enables a student to develop and execute an approved scholarly research agenda in consultation with the student's thesis chairperson and committee. Students must register for this course continuously to maintain enrollment until the student has completed the thesis. This course is a non-curricular course and is not considered as part of the overall program credit requirement. However, this course maintains the student's status as a matriculated, full-time student (student registers for 3 credit hours each semester, but is acknowledged as having a 9 credit hours load).

COSC 799 Thesis Defense

Three Hours: 3 Credits (Reports as 9)
Prerequisites: Program director/chair approval

This course allows students the opportunity to defend their thesis for approval by the student's thesis chairperson and committee after the thesis has been completed. After gaining approval of the thesis chairperson and committee, the thesis is submitted to the School of Graduate Studies for final processing and approval. This course is a curricular course and may be considered as 3 credit hours of the overall program credit requirement. This course maintains the student's status as a matriculated, full-time student (student is registered for 3 credit hours, but is acknowledged as having a 9 credit hours load).

EEGR 679: Security in Network and Link Applications
Three Hours: 3 Credits

Security Architecture for open, closed, and mixed network topologies. Introduction to security mechanism design and implementation

INSS 696: Current Issues in Information Technology
Three Hours: 3 Credits

This course provides students with opportunities to learn about the current issues in technological advantages in the field of information technology through current readings, discussions and experiences.

The content of the course varies from semester to semester based on paradigm shifts in business. Currently topics include Electronic Commerce, Internet and Intranet, EDI, Applications of World Wide Web, etc.

H. Adequacy of Articulation

1. If applicable, discuss how the program supports articulation with programs at partner institutions.

There are no articulation agreements in place.

I. Adequacy of Faculty Resources (as outlined in COMAR 13B.02.03.11)

1. Provide a brief narrative demonstrating the quality of program faculty. Include a summary list of faculties with appointment type, terminal degree title and field, academic title/rank, status (full-time, part-time, and adjunct) and the course(s) each faculty member will teach.

MSU has distinguished faculty members in the School of Computer, Mathematical and Natural Sciences, and specifically at the department of computer science who have the background and expertise to deliver the MS program in Advanced Computing. The department of computer science will administer this program through a full time program director at MSU. In addition to current faculty at MSU, two (2) new full time assistant professors, with expertise in data science, machine learning, cybersecurity, and artificial intelligence, will be recruited to staff the proposed new program. These positions will be filled in the fall of 2020 and 2021.

Computer Science Department Faculty	
Dr. Shuangbao Wang	Chair and Professor
Dr. Md Mahmudur Rahman	Associate Professor
Dr. Vojislav Stojkovic	Associate Professor
Dr. Eric Sakk	Associate Professor
Dr. Monir Sharker	Assistant Professor
Dr. Edward Dillon	Assistant Professor
Dr. Abdollah Dehzangi	Assistant Professor, MS Bioinformatics Program Director
Dr. Monireh Dabaghchian	Assistant Professor
Assistant Professors (To be Hired: 2 positions)	To be hired after program approval: PhD in Computer Science or a closely related field with expertise and training in Data Science, Machine Learning, Cybersecurity, software engineering, Artificial Intelligence or other related areas
Dr. Gholam Khaksari	Lecturer
Dr. Sam Tannouri	Lecturer
Mr. Roshan Paudel	Lecturer
Ms. Grace Steele	Lecturer
Dr. Arthur Willoughby	Lecturer (Part-time)
Dr. Harriett Gantt	Lecturer (Part-time)

Deval Popat	Lecturer (Part-time)
Joshua Robinson	Lecturer (Part-time)
Jamal Theodore	Lecturer (Part-time)

In addition, the computer science department has the support of the President, Provost, and Dean (SCMNS) of the University to repurpose current vacant salary lines within SCMNS to hire the two faculty members.

In addition to the Department of Computer Science, students in this program will take courses offered in other Departments at MSU: Business Administration, Electrical Engineering, Information Systems Science, Mathematics, Psychology, etc.

Department of Computer Science at MSU has recently initiated collaborations with Google and Facebook to train highly skilled students in computer science to promote diversity in these high-tech companies. These companies have accepted to provide this department with trainers, facilities, and equipment to develop its infrastructure to attain this objective. Also, department of computer science in collaboration with google started a program at Silicon Valley to train students from underrepresented communities and prepare them with skills and expertise to be recruited in this company. In addition, google offers over 20 students at MSU to undertake internship at this institute to promote motivation among underrepresented communities to obtain necessary skills to join this company.

J. Adequacy of Library Resources (as outlined in COMAR 13B.02.03.12)

J.1. MSU Library[20]

The students will have access to MSU Earl S. Richardson Library (MSU Library). MSU Library offers a range of resources and services to MSU community. The library has IEEE, ACM and other common Computer Science area full-text databases and journals. Most of library resources (USMAI Catalog, WorldCat MSU, Libguides, Collections, etc.) and services can be accessed remotely.

In addition, the director of Earl S. Richardson Library, Dr. Richard Bradberry, has affirmed that the library resources will be provided to MS program in Advanced Computing Program in addition to providing additional required materials such as books and journals on: Software Engineering, Data Science, Data Mining, Data Science Tools, Visualization, Image Processing, Pattern Recognition, Machine Learning, Statistical Programming, High Performance Computing, etc.

K. Adequacy of Physical Facilities, Infrastructure, and Instruction Equipment (as outlined in COMAR 13B.02.03.13)

K.1. Physical Facilities: No extra facilities other than the existing are required.

The four to six floors of McMechen building will be renovated and Computer Science department will occupy the space. Specifically, four faculty members currently are on the fifth floor within the to be renovated Cybersecurity Assurance and Policy Center (CAP-Center), twelve office spaces on the sixth floor with the Department office, and classroom and research spaces on the fourth and third floors. The move is schedule in spring 2020. In addition, some of the current space in Calloway Hall will be retained.

[20] http://www.morgan.edu/library

K.2. Infrastructure Equipment: The program does not need additional infrastructure equipment.

K.3. Instruction Equipment:

MSU has comparable research facilities to that of other higher education institutions in the State of Maryland and/or region. School of Computer mathematical and natural science facilities include many research and study labs in Biology, Medical Technology, Chemistry, Computer Science (Robotics, Bioinformatics, Computer, Machine learning, Network, and Cyber Security), Mathematics, Physics, etc. MSU has license for widely used software for analytics such as SAS, and JMP Pro. plus MATLAB, etc.

The Data Science and Machine Learning Laboratory is in Calloway Hall, Room 304. It has 20 PCs connected in a network. Each computer has specific computing platforms installed, and Windows 10 and Linux Operating Systems are available. The laboratory has a variety of software for Computer, Network, and Data Science, Bioinformatics and Computational Biology, Concurrent, Parallel, and Distributed Computing, Modeling and Simulation, Visualization. The laboratory also has a great collection of programming languages such as C, C++, Java, C#, Microsoft Visual Programming Language, MATLAB, Mathematica, Perl, etc.

The Cloud Computing and Cybersecurity Laboratory is being established in Calloway Hall. We plan to have Drones, AWS IoT buttons, DeepLens, DeepRacer, and Siemens PLC 1200 for students to gain hands-on experiences. In addition, students can access the NICE Challenge lab, a virtual lab for students to build work experience before the workforce.

L. Adequacy of Financial Resources with Documentation (as outlined in COMAR 13.B.02.03.14)

1. Resource Allocation

1.1. Resource Allocation Table

TABLE 1: RESOURCES					
Resource Categories	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
1. Reallocated Funds	0	0	0	0	0
2. Tuition/Fee Revenue (c+g)	128,760	209,235	289,710	370,185	450,660
a. Number of F/T Students	10	15	20	25	30
b. Annual Tuition/Fee Rate	16,095	16,095	16,095	16,095	16,095
c. Total F/T Revenue (a*b)	128,760	209,235	289,710	370,185	450,660
d. Number of P/T Students	0	0	0	0	0
e. Credit Hour Rate	536.50	536.50	536.50	536.50	536.50
f. Annual Credit Hour Rate	0	0	0	0	0
g. Total P/T Revenue (d*e*f)	0	0	0	0	0
3. Grants, Contracts, and Other External Sources	0	0	0	0	0
4. Other Sources	130,000	195,000	260,000	320,000	390,000
Total (Add 1-4)	258,760	404,235	549,710	690,185	840,660

1.2. Resource Allocation Justification

1. Reallocated Funds. Program does not have reallocated funds.

2. Tuition/Fee Revenue. We project the program will have five full-time equivalent (FTE) students in the first semester and ten in the second semester, and they all continue on in the summer semester, and five more student increase in subsequent semesters. Part-time students are factored into the FTE. The estimated revenue is based on each student takes a full load of twelve credit hours (12) per semester and six credit hours during the summer, and a tuition and fees rate of $536.50/credit for in-state students (2019-2020 tuition and fee schedule). We also anticipate at least 50 students in the program when the program reaches maturity.

3. Grants, Contracts, and Other External Sources: None

4. Other Sources: No other sources.

2. Expenditures

2.1. Expenditures Table

TABLE 2: EXPENDITURES					
Expenditure Categories	**Year-1**	**Year-2**	**Year-3**	**Year-4**	**Year-5**
1. Faculty (b+c)	0	0	159,400	159,400	159,400
a. # FTE	0	0	1.1	1.1	1.1
b. Total Salary	0	0	112,000	112,000	112,000
c. Total Benefits	0	0	47,040	47,040	47,040
2. Administrative Staff (b+c)	0	0	0	0	0
a. # FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
3. Support Staff (b+c)	0	0	0	0	0
a. # FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
4. Equipment	50,000	50,000	0	0	0
5. Library	0	0	0	0	0
6. New or Renovated Space	TBD	TBD	TBD	TBD	TBD
7. Other Expenses	5,000	5,000	5,000	5,000	5,000
TOTAL (Add 1–7)	55,000	55,000	164,400	164,400	164,400

2.2. Expenses Justification

1. Faculty: Starting in year three, once the enrollment goal is achieved, a Program Director will be appointed within the Department. A stipend of equivalent to one-month salary of $17,400 (fringe benefit included) will be provided to the 9.5-month faculty for the summer. One faculty each will be recruited in the third year of the program once the enrollment projections are reached. Salary $100,000 + Fringe $42,000 = $142,000 for 9.5 months appointment for each faculty. Their research and training will focus on one of the following areas: Artificial Intelligence, Data Science, cybersecurity, Software engineering, etc.

2. Equipment: Necessary computational, visualization, and communications equipment will be purchased in years one and two ($100,000).
3. Other Expenses: Advertising fees for the first two years ($10,000).

3. Profitability

	Year-1	Year-2	Year-3	Year-4	Year-5
Number of Students (FTE)	**10**	**15**	**20**	**25**	**30**
Tuition $326.50/credit	128,760	209,235	289,710	370,185	450,660
Expenses	55,000	55,000	164,400	164,400	164,400
State Support ($13,000/student)	130,000	195,000	260,000	325,000	390,000
Profit	203,760	349,235	385,310	530,785	676,260

While the University will have minimal financial gains in the first two years, significant gains will start in year 3 and beyond. We anticipate enrollment of at least 50 students beyond year eight.

M. Adequacy of Provisions for Evaluation of Program (as outlined in COMAR 13B.02.03.15)

The courses, the program' effectiveness, enrollment, retention and graduation rates, students, instructors, and staff satisfaction will be evaluated using student, faculty, and staff surveys and program committee reviews on a regular basis.

The program faculty will meet each semester for assessment and evaluation of the curriculum. The program committee will meet annually for assessment and evaluation of the program. By needs, the program committee will implement changes to the program.

The program will be subject to external review and evaluation for accreditation by Middle States and the State of Maryland Department of Education.

N. Consistency with the State's Minority Student Achievement Goals (as outlined in COMAR 13B.02.03.05 and in the State Plan for Postsecondary Education)

The State of Maryland has set as its goals for minority achievement implementing policies (Minority Achievement Report Summary, Maryland Community Colleges, University of Maryland System, MSU, St. Mary's College of Maryland, October 1996) to improve recruitment, retention, and graduation of students, particularly minorities and to recruit, promote and retain minorities in faculty and professional staff positions. The proposed MS in Advanced Computing program is aimed at the first of those two goals. By providing an easier path toward graduation for nontraditional students, it should increase significantly its retention and graduation rates.

O. Relationship to Low Productivity Programs Identified by the Commission

There is no relationship with low-productivity programs identified by the Commission.

P. If proposing a distance education program, please provide evidence of the Principles of Good Practice (as outlined in COMAR 13B.02.03.22C)

The Master of Science in Advanced Computing will be offered in both online and onsite formats. For the online delivery, students on the track to take courses only can complete the degree in a 12-month period. Both the project and thesis tracks can be completed completely online.

Morgan is experienced and with adequate infrastructure to support online programs. Morgan Online, **https://www.morgan.edu/online**, established several years ago, was created to help launch various online degree programs. Currently, MSU has the following active online programs:

- Community College Leadership Program (Ed.D.), 15 graduates in 2017-2018
- Master of Business Administration (MBA), 19 graduates in 2017-2018
- Master of Social Work (MSW), 56 graduates in 2017-2018
- Master of Science in Project Management (MSPM), 7 graduates in 2017-2018
- Post-Baccalaureate Certificate in Project Management
- Post-Baccalaureate Certificate in Sustainable Urban Communities

In the past year (2017-2018) alone, MSU graduated 15 doctoral and 82 Master's students through its online degree programs.

Justifications for curriculum and instruction, roles and mission, faculty support are in the preceding sections B-M.