University of Louisville
New Academic Program Proposal Template

Undergraduate, Graduate, and Professional Programs

After approval of the Letter of Intent, undergraduate, graduate, and professional programs are to complete this New Academic Program Proposal template. There is a separate template for certificate credentials.

All templates and forms are available at:
http://louisville.edu/oapa/new-academic-program-approval-page/new-academic-program-approval

To avoid unnecessary delays, please ensure that all questions are addressed clearly and completely and that all necessary forms are completed and submitted.

Some questions may seem repetitive, but they reflect CPE questions and must be answered exactly in the format requested. CPE readers won't have access to previous information submitted. Responses to the questions in this template are needed exactly in the format requested in each question.

If the question asks for a description, you must provide a description rather than referencing information provided elsewhere in a different format (such as a table). As well, if you decide to provide additional information in tables (such as assessment rubrics, data, etc.) you must also describe the material. We are unable to copy tables into the CPE online portal.

Questions about the template and process can be directed to the Office of Academic Planning and Accountability through the Program Approval Service Account (PROGAPPR@louisville.edu).

NOTE: All unit approval processes must be completed and documented before submitting this proposal.

Send the following materials, as well as any questions or concerns, to the Program Approval Service Account (PROGAPPR@louisville.edu). The program approval process will not begin until all of the above documents are received. Please submit all materials listed below at the same time.

- This Completed Proposal Template
- Proposed Program Curriculum
- Course syllabi for any new course offerings
- SACSCOC Faculty Roster Form
- CV for Program Director/Coordinator
- Course Template Form
- Proposal Budget Form
- Letter of Support from the UofL Libraries
- Letter of Support from the unit Dean
- Letter(s) of Support from any units, departments, or internal or external entities that have indicated their support for the program

General Program Information	
Program Name:	**Master's Program in Artificial Intelligence in Medicine**
Degree Level:	Master's of Science
Date:	7/6/2023
Department and Department Chair:	Bioengineering Department (Ayman El-Baz) and Department of Bioinformatics and Biostatistics (K.B. Kulasekera)
School/College:	J.B. School of Engineering and School of Public Health and Information Sciences
Program Director and Contact (if different); (please also include title):	Program Director: Patricia Soucy, PhD; Associate Professor Contact: Martin O'Toole, PhD: Associate Professor
CIP Code:	11.0102
Program Type (collaborative, joint, or single institution):	Joint Program
Is this program an advanced practice doctorate?	Yes ☐ No ☒
Number of Credit Hours required:	30
Method of Delivery (online, face-to-face):	Online
Is an approval letter from the Education Professional Standards Board (EPSB) required for this program? If so, attach a copy to this proposal.	No
(Tentative) Institutional Board Approval Date:	May 5, 2024
Proposed Implementation Date (semester and year):	Fall 2024
Anticipated Date for Granting First Degree:	Summer 2025
Have all unit approval processes been completed? **Please provide a list of unit approval processes with approval dates:**	Yes ☒ No ☐ Approved: Public Health: 7/20/23 Speed School: 10/17/23

A. Overview

1. Provide a brief description of the program with its estimated date of implementation. (250 words or less; program's purpose/focus, primary areas of study, intended audience, academic level—undergraduate, graduate, or professional, length of the program, goals/objectives, rationale for program, skills or knowledge that students will acquire, relationship of program to general field). This description will be used for external reporting and should

provide a concise programmatic overview.

CPE Instructions: *The succinct program description should be readily understandable to a constituent who is not familiar with the proposed discipline.*

The Departments of Bioengineering and Bioinformatics & Biostatistics propose a new Master's degree Program in Artificial Intelligence in Medicine. The program will prepare students to analyze medical or public health care data. Given the large amount and complexity of these data, manual or empirical methods of data analysis are inadequate. With this degree, students will learn to analyze, present, and use data through computation, modeling and simulation, machine learning, and advanced statistical analysis. The program will prepare students for ongoing changes in patient and public health data analysis, making them more marketable in these and other fields. The intended audience are students with a Bachelor's degree in Bioengineering or Public Health, or healthcare professionals interested in earning advanced knowledge in the field of Artificial Intelligence and who wish to be trained to apply these techniques to medical problems. The program is intended to be one full year (Fall, Spring and Summer) for full-time graduate students. The curriculum is flexible to allow interested students to enroll part-time. The program's relationship to the general fields of engineering and public health provides a unique emphasis on interdisciplinary engagement. Thus, the expected impact of this degree includes supporting healthcare professionals to help improve health outcomes and patient experiences.

2. Describe how the new program is consistent with the mission and goals of the institution.

CPE Instructions: *Describe how the program will address the institution's mission and strategic goals. Highlight which areas of the institutional plan will be furthered through implementation of this program.*

Establishing this Master's Program in Artificial Intelligence in Medicine will address several goals of the University's Strategic 2023-2025 Plan and the 21st Century Initiative. Specifically, as related to the relevant goals/actions stated in these initiatives, the master's program will accomplish the following goals:

University 2023-2025 Strategic Plan

1. Create interdisciplinary degrees and credentials driven by community, society, and workforce needs.
2. All students will be provided with a foundation of essential skills that each recognizes as translational to career, professional and life opportunities.

University 21st Century Initiative

1. Revenue Enhancement: "Strategically grow enrollment in high demand fields".

In addition to these university-wide goals, this master's program will also address several goals outlined in the JB Speed School of Engineering 2023 Strategic Plan:

1. Establish areas of research excellence in engineering human health and cyber enabled discovery
2. Attract motivated, prepared, and talented students into all Speed engineering degree programs
3. Provide a wide variety of outstanding experiential learning experiences

4. Engage students with state-of-the-art accredited engineering curricula
5. Greatly increase the national and international recognition of Speed School research activities

Diversity and Inclusion
The Master's program will promote accessibility and equity for strategic populations through outreach of both departments' faculty and staff to engage potential rising undergraduates and graduate students to make them aware of the opportunities available for advanced degrees in AI in medicine. This includes annual outreach sessions at local high schools in underserved communities, departmental representation in the Brown Forman Engineering Academy, and participation in Diversity Week at the University. We also plan outreach to present the program to Identity-based student organization chapters such as the American Society of Engineers of Indian Origin (ASEI), National Society of Black Engineers (NSBE), Society of Hispanic Professional Engineers (SHPE), Society of Women Engineers (SWE), and Speed Spectrum chapters at UofL. Additionally, all faculty and staff involved in the program are expected to attend University trainings such as Green Dot, Implicit Bias, and Microaggressions training.

3. Is there a specialized accrediting agency related to this program? Yes ☐ No ☒
a. If yes, please identify the agency.
b. If yes, will the program seek accreditation?

4. Does this program have a clinical component? Yes ☒ No ☐
If yes, discuss the nature, appropriateness, and availability of clinical sites.

The clinical component of the program involves the possible use of de-identified clinical data sets for analysis. Such data will only be used in full compliance with HIPPA guidelines, UofL IRB, and best practices as followed by the University of Louisville. Data analysis sites are expected to be in faculty research labs and not in clinical settings, thus the availability of clinical sites should not be an issue for the proposed program.

5. Identify where the program will be offered.
a. Indicate the projected life of the program. (Is the institution intending to offer it for a limited timeframe, or will it be ongoing?)
b. Describe the primary target audience.
c. Describe the instructional delivery methods to be used.
d. Describe the strength of the institution to undertake this new program.

A. The program is designed to be ongoing and will be a continual offering at the University of Louisville.
B. The intended audience of this Master's Program in Artificial Intelligence in Medicine are students with Bachelor's degrees in Bioengineering or Public Health or healthcare

professionals who are interested in earning advanced knowledge in the field of Artificial Intelligence and wish to be trained to apply these techniques to medicine or public health.

C. The curriculum will be available in on-line classes through the University of Louisville.
D. The University of Louisville has a rich history of scientific research and discovery. "The Carnegie Classification of Institutions of Higher Education, recently finalized, once more has designated UofL a "Research 1" doctoral university with very high research activity. UofL is one of only 146 universities – roughly 4% of those considered – to receive this designation. In the past fiscal year, 2022-2023, UofL was awarded $153.8 million in competitive research funding. This funding supported groundbreaking research to address the biggest global problems of our time, including climate change and providing robotic solutions for manufacturing, health care and logistics. In addition to being a Research 1 institution, UofL, also holds the Carnegie community-engaged designation, which recognizes institutions that work with community partners to exchange knowledge and resources for public benefit. UofL is one of just 79 U.S. institutions to hold both designations."*
   * https://louisville.edu/oapa/institutional-research-and-planning/quick-facts/2023JusttheFactsADAfinal.pdf

6. Describe the rationale and need for the program to include how the institution determined need.

The field of computation and, in particular, machine learning, has experienced a renewed interest in the past five years with the progress of deep learning and artificial intelligence (AI) technologies. Briefly, machine learning involves the training of computer programs to automatically detect patterns within data, such as the analysis of patient lung x-rays to detect tumors. The training of machine learning algorithms with large medical data sets allows discovery of correlations and predictions of future occurrences that are not possible with simple data mining technologies. Deep learning is a subset of machine learning that uses artificial neural networks to learn patterns within data. Artificial Intelligence is a broader term that includes machine learning, image processing, language recognition, and other functions integrated together to enable machines to synthesize information and make autonomous decisions, such as self-driving vehicles. In medicine, AI is envisioned to help clinicians improve diagnoses, prognoses, and treatment by providing efficient, timely, and accurate data analysis. Medical and Public Health data include very large and complex data sets. An understanding of the computational and modeling tools such as machine learning, deep learning, data mining, and statistics is important for development of optimal AI technologies in these fields. AI enables simulations of human intelligence processes by machines, which can be applied to complex medical issues such as genomics, metabolomics, clinical biomarkers, medical imaging data, etc., in a way that goes beyond traditional data analysis approaches.

The confluence of increased computer hardware capabilities, e.g., via GPU architectures, and the advancement of computational algorithms, is opening a broad application of AI and associated technologies such as machine learning in a diversity of fields, including transportation, retail business, medicine, and telecommunications. Consequently, most major universities in the U.S., including the University of Louisville (UofL), Stanford, Harvard, Cornell, and Johns Hopkins, have implemented machine learning certificate programs. We believe that the next step in the evolution for advanced degrees in AI will be master's degree programs such as the one in the current proposal. In light of this driving force, more advanced degrees in AI are developing rapidly, such as those offered in Kentucky at Campbellsville University and the University of the Cumberlands. It is important to note, however, that no existing AI program in Kentucky focuses on its use in medicine.

The number of employment opportunities has correspondingly mushroomed, with the projected growth of jobs for computer and information research scientists expected to grow 19% within the next 9 years, according to the University of California, Irvine (https://ce.uci.edu/areas/it/machine_learning/). Additionally, certificate programs are also being offered by large companies driving this innovative field, including IBM and Google.

A Google search for Master's Programs in Artificial Intelligence in Medicine currently yields 22 related programs, with 5 devoted to medical data analysis (Lightcast Q4 2022 Data set, www.economicmodeling.com). These programs achieved 175% growth between 2017 and 2022, with 116% growth in completion rate. Target occupations for this type of advanced degree reached 107,214 annual openings in 2020 with an attractive average salary of $118.2k/yr. These numbers, while promising, represent what we believe is just the beginning of an explosion of opportunity in the Artificial Intelligence sector, with specialization in the analysis of medical data having an under-developed potential. Our aim is to place UofL at the international forefront of Artificial Intelligence in Medicine. In the past five years, the volume of medical data has exploded. For example, the collection of patient information from electronic medical records and connected medical devices (e.g., wearable monitors) requires integration and analysis.

The state of Kentucky represents an underdeveloped market for Artificial Intelligence, as there were no Master's Program completions in AI in the state between the years 2017-2022 (Lightcast Q4 2022 Data set, www.economicmodeling.com). This shows a great opportunity for UofL to serve as a local leader in the field of Artificial Intelligence. Despite the lack of AI graduates, 2221 students in Kentucky earned Master's degrees in related fields such as Computer/Information Technology Services, Information Technology, and Computer Engineering. As the field of Artificial Intelligence in Medicine matures over the next few years, we plan to harvest this interest in advanced degrees in additional computer technology areas to help UofL become a leader in Artificial Intelligence in Medicine.

Obtaining the proposed Master's degree will enhance a student's engineering skillset in a demonstrable manner, specifying the ability to perform at a highly specialized level in the computational analysis of medical data. A recent search on www.glassdoor.com for regional job opportunities yielded 575 job openings for Machine Learning Engineers and Artificial Intelligence Engineers with a projected growth of 180%. Please see appendix A for current employer demand numbers and references.

B. Program Quality and Student Success

The curriculum should be structured to meet the stated objectives and student learning outcomes of the program.

7. Provide specific programming goals (objectives) and specific student learning outcomes for the program in the areas that are required for SACSCOC.

For UNDERGRADUATE programs, that would be:

- Competency Related to Major
- Competency which Builds upon the Cardinal Core Curriculum (Choose either Cultural Diversity or Effective Communication)
- Competency Related to the Culminating Undergraduate Experience (CUE)
- Competency Related to Critical Thinking

For GRADUATE programs, that would be:

- Competency Related to Content Knowledge
- Competency Related to Engagement in Research -OR-
- Competency Related to Professional Practice and Training Experiences

Programming Goal 1: Competency Related to Content Knowledge- Train highly motivated graduate students who demonstrate advanced level Artificial Intelligence knowledge applied to Medical and/or Public Health applications.

SLO1: Students will demonstrate advanced knowledge of Artificial Intelligence applied to the field of Medicine or Public Health through the application of graduate level principles of programming and math, and effectively communicate this knowledge.

Programming Goal 2: Competency Related to Engagement in Research- Develop students with advanced skills in methods and tools in Artificial Intelligence in Medicine for employment in industry, academia or government, or further profession/ graduate studies.

SLO2: Students will gain hands-on and practical experience in Artificial Intelligence research topics through use of modern computing techniques/ tools to conduct appropriate experimentation, analysis, and interpretation of data, and to use scientific judgment to draw conclusions.

8. Describe how each program-level student learning outcome will be assessed.

If you wish to attach any SLO documents you may do so, but you still need to provide a narrative response to this question.

CPE Instructions: *Explain which student learning outcome(s) will be assessed by each assessment method and how frequently each assessment method is administered. Include both direct and indirect methods. Explain how assessment results will be used to make improvements to the program. Note that this item refers to a program-level, not course-level, assessment and thus course grades are not an appropriate source of data for program-level assessment.*

The direct measure of both SLOs will be the student's performance on assignments related to the student's Artificial Intelligence in Medicine Design/Research Project. This project is required for BE 691, a core course in this program. This course is strongly recommended to be completed in the student's last semester of their tenure in the MS-AIM program. Students enrolling in BE 691 will identify a project with a primary faculty advisor from either Bioengineering or Public Health. Through their graduate research project, students will demonstrate their ability to achieve the program's Student Learning Outcomes. The student's performance will be assessed by their primary faculty mentor and at least 1 additional faculty who is not involved in the project, the instructor of BE 691. The class will require students to give an oral presentation and a written report on their project.

Student Competency Related to Content Knowledge will be assessed based on the student's oral presentation in BE 691. The program will review the scores of the student based on the average of the evaluators' rating of the overall oral presentation. The faculty evaluation will consider the following six categories: 1) Intro/Background & Significance, 2) Aim(s), Objective(s), Hypotheses, 3) Methods, 4) Results, 5) Discussion/ Conclusions, and 6) Presentation Quality. A 5-point rating scale is used: 1-unacceptable, 2-poor, 3-satisfactory, 4-good, 5-excellent.

Student Competency Related to Engagement in Research will be assessed based on the student's written report in BE 691. The program will review the scores of the student based on the average of the evaluators' rating of the overall written report. This overall assessment will consider the following six categories: 1) Intro/Background & Significance, 2) Aim(s), Objective(s), Hypotheses, 3) Methods, 4) Results, 5) Discussion/ Conclusions, and 6) Report Quality. A 5-point rating scale is used: 1-unacceptable, 2-poor, 3-satisfactory, 4-good, 5-excellent.

The expected student performance threshold for the above metrics is to have 75% of students who complete the MS-AIM program achieve an average overall assessment of 3 (satisfactory) or greater on the overall written and oral components of their Artificial Intelligence in Medicine Design/Research Project. The evaluation rubrics will be collected electronically each semester by the Bioengineering department administrator and the BE 691 course instructor. This data will be summarized annually by the MS-AIM academic advisor.

A summary of annual analyses of all graduating students in the MS-AIM program will be reported each year in the annual report to UofL's Office of Institutional Effectiveness. It will be presented at the Bioengineering Department's annual curriculum meeting to review Bioengineering programs, as well as faculty meetings and Bioengineering administrations meetings as deemed appropriate. Student performance, exit survey feedback, and student feedback through course evaluations will be used to inspire program and course level improvements.

The following Table summarizes the student learning outcomes and direct measures of achievement.

Table 1. Student learning outcomes to be assessed and associated indicators of achievement.

Student Learning Outcome	**Direct Measure**
a) Students will demonstrate advanced knowledge of Artificial Intelligence applied to the field of Medicine and/or Public Health through the application of graduate level principles of programming and math, and effectively communicate this knowledge.	Completion of graduate project oral presentation in BE 691 with 75% of students earning an average overall satisfactory score (3) or higher from their primary faculty advisor and an additional faculty in this program who is not directly involved in the student's research project.
b) Students will gain hands-on and practical experience in Artificial Intelligence research topics through the use of modern computing techniques/ tools to conduct appropriate experimentation, analysis, and interpretation of data, and to use scientific judgment to draw conclusions.	Completion of graduate project report presentation in BE 691 with 75% of students earning an average overall satisfactory score (3) or higher from their primary faculty advisor and an additional faculty in this program who is not directly involved in the student's research project.

9. Highlight any distinctive qualities of the proposed program.

CPE Instructions: *Note any factors that make the program unique (e.g. whether any faculty are nationally or internationally recognized for expertise in this field; the program builds on the expertise of an existing locally, nationally or internationally recognized program at your institution; etc).*

There is a strong bioengineering community at the University of Louisville; this community is built upon established collaborations between faculty at the Bioengineering Department and the School of Public Health and Information Sciences, the Schools of Medicine and Dentistry, along with faculty in other departments within the Speed School of Engineering. These multidisciplinary collaborations have led to extensive federal and private foundation research funding that targets the development of bioengineering solutions to improve patient outcomes and quality of life. An example of such programs includes the now-concluded Wallace H. Coulter Foundation Translational Partnership award to the U of L Department of Bioengineering in collaboration with the U of L School of Medicine and Office of Technology Transfer for the purposes of establishing a translational research program. This prestigious award placed the University of Louisville in the "Sweet 16" of US Institutions in the area of Translational Research. The proposed MS in Artificial Intelligence in Medicine will leverage the successes from the Coulter Translational Partnership Award to further accelerate the development and growth of clinical translational research at the University of Louisville.

The extensive bioengineering community at U of L will provide a rich multidisciplinary training environment for students in the proposed program, enabling them to receive extraordinary experience in their Artificial Intelligence in Medicine Design/Research Project (BE 691). Students in the program will have a unique opportunity to apply their knowledge and skills in AI Medicine while working on multidisciplinary teams that are based upon established engineer-clinician collaborations and an associated track record of successful development and translation of medical innovations.

The proposed Master of Science in Artificial Intelligence in Medicine also represents the first formal Master's degree program collaboration between the Bioengineering Department in the J.B. Speed School of Engineering and the Department of Biostatistics and Bioinformatics in the School of Public Health and Information Sciences. This unique partnership will capitalize on the strengths of the faculty from both departments to provide students with an unparalleled opportunity to learn from world renowned experts in Artificial Intelligence and Bioinformatics.

10. Describe the admission and graduation requirements for the program.

This information will be viewed by an external audience, so please be clear and specific.

CPE Instructions: *Be as detailed as possible and address all three components – admission, retention, and completion.*

A) Admission Requirements

Applicants must meet Speed School graduate admission requirements along with additional program requirements. Applicants must, as a minimum, have completed a Bachelor's Degree in engineering, mathematics, statistics, basic sciences, or related discipline from an accredited program. Successful applicants will typically have a 3.00 cumulative GPA in their BS degree with a college level statistics course and introductory computer programing course. Students without these courses are encouraged to apply but may be asked to take pre-requisite courses in statistics and/ or computer programming as a condition of their acceptance. Applicants with an undergraduate GPA of 2.75 will be considered for provisional acceptance; however, they must maintain a 3.00 GPA at a minimum in their first semester of study or they will not be allowed to continue in the program.

Applicants must submit: 1) transcripts of all college-level courses; 2) a written statement by the applicant describing previous experience related to Artificial Intelligence in Medicine; 3) a statement as to how the Master's Program will allow them to fulfill their career goals; and 4) 2 letters of recommendation. Students whose native language is non-English, or degree is from a non-US accredited institution are required to submit TOEFL/IELTS/ Duolingo scores. The successful applicant will typically have a TOEFL score of 80 or higher or overall IELTS score of 6.5 or higher or a Duolingo score of 105 or higher.

B) Graduation Requirements

Students must meet degree requirements established by the University of Louisville's Graduate School, Speed School of Engineering, in addition to Program requirements. Students must complete the courses (30 credit hours) in the Master's Program with a 3.00 cumulative GPA or higher for all graduate courses used to satisfy degree requirements. A student cannot receive a C+ or lower grade in courses counting towards the Master's Degree in Artificial Intelligence in Medicine program. All program requirements must be completed within six years from admission into the program. In addition, all students enrolled in the Master's Degree in Artificial Intelligence in Medicine program must complete the University of Louisville's Responsible Conduct in Research training. Training requirements can be found at the following website: https://louisville.edu/research/researchers/compliance/research-integrity/research-training-guide.

11. Provide the following information for the program and for each track, concentration, or specialization (some categories may not apply to all programs).

CPE Instructions: *A guided elective is any elective that is part of a major. A free elective is an elective from any academic area not required for a major or minor.*

Program/Track, Concentration, or Specialization	Total number of hours required for degree	Number of hours in degree program core	Number of hours in track	Number of hours in guided electives	Number of hours in free electives
AI in Medicine	30	24	N/A	6	0

12. Describe administrative oversight to ensure the quality of the program.

Who will oversee the program and how do their credentials/qualifications align with that role? How does program oversite include curriculum review and approval to ensure program integrity and rigor?

The MS-AIM Program Academic Advisor/ Coordinator will be responsible for analysis of data and preparation of the annual SLO report and program summaries. These will be shared with the entire department faculty at the annual BE faculty and staff retreat to review BE programs, as well as at faculty meetings and Bioengineering administration meetings as deemed appropriate. The MS-AIM data will also be shared with the Department of Biostatistics and Bioinformatics for review and feedback.

The faculty includes world renowned experts in Artificial Intelligence in Medicine. As a part of these annual BE retreats, the curriculum will be reviewed, the program strengths and weaknesses will be evaluated and as needed recommendations for improvement will be discussed. In addition, the Bioengineering Director of Graduate Studies will meet monthly with the MS-AIM Program Academic Advisor/ Coordinator to review student progress, applications to the programs, and any policy updates affecting all Bioengineering programs.

Course evaluations provide direct student feedback to course instructors, who are able to address areas needing improvement. In addition, course evaluations are measured outcomes of teaching performance; as a result, the Department Chair will discuss and address any identified weaknesses with instructors during their annual review. Additionally, course instructors have access to the Delphi Learning Center's monthly workshops designed to improve teaching effectiveness. Typically, these one-hour training workshops are designed to present new teaching approaches, education paradigms, and instruction of emerging technology to improve teaching effectiveness. Additionally, all graduating students will complete Exit Surveys that will allow direct student feedback to guide future considerations for course content and delivery.

13. For a program offered in a compressed timeframe (e.g., with 8-week courses), describe the methodology for determining that levels of knowledge and competencies comparable to those required in traditional formats have been achieved. (You must provide an entry.)

All courses are anticipated to be offered in a regular 15-week (semester-based) time frame.

14. Please answer the following:

a) Will this be a 100% distance learning program? Yes ☐ No ☒

CPE Instructions: *This is defined as an academic program in which all of the required courses in a program occur when students and instructors are not in the same place. Instruction may be synchronous or asynchronous.*

b) Will this program utilize alternative learning formats (e.g., distance learning, technology-enhanced instruction, evening/weekend classes, accelerated courses)? Yes ☒ No ☐

If yes, please check all that apply below.

NOTE: If you check "yes" to this question, you must check at least one of the items listed below.

- ☐ X Distance Learning
- ☐ X Courses that combine various modes of interaction, such as face-to-face, videoconferencing, audio-conferencing, mail, telephone, fax, e-mail, interactive television, or World Wide Web
- ☐ X Technology-enhanced instruction
- ☐ Evening/weekend/early morning classes
- ☐ Accelerated courses
- ☐ Instruction at nontraditional locations, such as employer worksite
- ☐ Courses with multiple entry, exit, and reentry points
- ☐ Courses with "rolling" entrance and completion times, based on self-pacing
- ☐ Modularized courses

15. Will this program replace or enhance any existing program(s) or tracks, concentrations, or specializations within an existing program? Yes ☐ No ☒

This program will not replace any existing programs. The program will enable graduates with engineering, public health or related degrees to pursue a MS in Artificial Intelligence in Medicine at UofL. Students graduating with Bachelor's degrees in Bioengineering from UofL may opt to enroll in the MS-AIM program rather than the Master's in Engineering in Bioengineering program.

16. How will the program support or be supported by other programs and/or units within the institution? Please also describe potential for collaboration with other programs within the institution.

The program is built on a close collaboration between the Speed School of Engineering and the School of Public Health and Information Sciences within which the Bioengineering Department and Department of Biostatistics and Bioinformatics are each providing the unique expertise of their representative faculty. In contrast to the existing Certificate in Artificial Intelligence in Medicine, this collaboration between the Speed School of Engineering and the School of Public Health will greatly expand the appeal and reach of the program to a wide student base, including students interested in engineering and public health as well as health care professionals and computer scientists who wish to expand their skillset and earn an advanced degree in Artificial Intelligence in Medicine.

In addition, the Artificial Intelligence in Medicine Design/Research Project (BE 691) may give students an opportunity to work on projects in collaboration with researchers at the School of Medicine and Arts and Science. In particular, BE faculty have established collaborations with the Cardiovascular Innovation Institute, the Kentucky Spinal Cord Injury Research Center, the Brown Cancer Center, the Center for Predictive Medicine, and the Departments of Oncology and Radiology. Faculty in the Department of Bioinformatics and Biostatistics have a long history of collaboration with these same groups as well as faculty in School of Arts and Sciences, including the Departments of Mathematics and Psychology. Importantly, the Artificial Intelligence in Medicine Design/Research Project (BE 691) will be able to be completed 100% remotely if the student wishes. The faculty and program administrators for the program will work to make sure that online students have opportunities to work on virtual projects if needed.

17. Are new or additional faculty needed? Yes ☐ No ☒

a) If yes, please explain, indicating the number and role of each new faculty member and whether they will be part-time or full-time. Specify if part-time faculty or graduate assistants are included in the additional faculty resources needed.

b) If yes, please provide a plan to ensure that appropriate faculty resources are available, either within the institution or externally, to support the program.

We are requesting a Graduate Teaching Assistant at the end of year 3 who will assist in administrations of the courses and grading. This person is not considered to be faculty in the Speed School of Engineering.

18. a. Describe the library resources available to support this program.

Please also submit a letter of support from the UofL Libraries. You can request this letter at https://library.louisville.edu/forms/new-program-proposal.

Access to the qualitative and quantitative library resources must be appropriate for the proposed program and should meet recognized standards for study at a particular level or in a particular field where such standards are available. Adequacy of electronic access, library facilities, and human resources to service the proposed program in terms of students and faculty will be considered.

BACKGROUND

University of Louisville (UofL) Libraries are comprised of:

1) Ekstrom Library serving humanities, social sciences, life sciences, business, engineering, physical sciences, and technology,
2) Kornhauser Health Sciences Library serving dentistry, medicine, nursing, and public health,
3) Anderson Music Library,
4) Bridwell Art Library,
5) The Law Library, and

6) University Archives and Special Collections.

UofL's library system supports the teaching and research needs of more than 22,000 students and more than 7,000 faculty and staff. UofL belongs to the Association of Research Libraries (ARL), an organization of 126 North American library systems affiliated with large, comprehensive research institutions; the State-Assisted Academic Library Council of Kentucky (SAALCK); and Kentuckiana Metroversity, a consortium of Louisville area libraries.

This report provides a summary of library resources that support teaching and research in the area being proposed. It identifies areas of weakness and concludes whether the library's current resources are adequate to support the new program or not. When necessary, this report also identifies resources that could be purchased to increase and strengthen the library's support for this program.

SERVICES

Research Assistance and Instruction
Each library within the University of Louisville Libraries offers instruction programs designed to meet the needs of its researchers. Ekstrom Library's information literacy program provides both face-to-face and online research instruction tailored to specific courses and assignments. The library's Research DIY website offers additional online support for students, with brief video tutorials, infographics, and other instructional materials.

Ekstrom Library also provides research assistance through in-person consultations, e-mail, telephone, and online chat. Ekstrom also has an assigned library liaison and subject specialist for the **Public Health and Information Sciences** department.

Interlibrary Loan and Document Delivery
Faculty and students can access books and articles not held by UofL Libraries through Interlibrary Loan. Document delivery services allow patrons to request that library-owned articles or book chapters less than 50 pages in length, and within copyright fair use guidelines, be scanned and delivered to them electronically. Ekstrom Library has a Distance Learning Services Specialist who provides online learners with access to print and electronic resources.

STAFFING

According to the most recent data available from ARL, UofL Libraries' staff to student ratio is slightly above average compared to our established benchmark institutions.

FY 2019-2020	Library Staff	Full-Time Students	Ratio Staff : FT Students
University of Louisville	**102**	**18,650**	**1:183**
SUNY @ Buffalo	121	26,616	1:220
Stony Brook University	74	22,188	1:300
Temple University	135	33,783	1:250

University of Alabama @ Birmingham	114	38,103	1:334
University of California – Irvine	171	35,809	1:209
University of California – San Diego	223	37,150	1:167
University of New Mexico	129	27,074	1:210
University of Cincinnati – Main Campus	130	34,575	1:266
University of Illinois @ Chicago	133	28,606	1:215
University of Iowa	198	26,045	1:132
University of North Carolina @ Chapel Hill	311	25,423	1:82
University of Pittsburgh – Main Campus	246	30,746	1:125
University of South Carolina	176	33,094	1:188
University of Utah	198	25,142	1:127
Virginia Commonwealth University	151	25,550	1:169
Wayne State University	113	18,635	1:165

COLLECTIONS

Books

Here is a breakdown of the library's current holdings of both print and eBooks, categorized by relevant Library of Congress subject heading:

LC Subject	# of Print Books	# of eBooks	Print Books published in last 5 years	eBooks published in last 5 years
Artificial Intelligence in Medicine or AI in Medicine	**79**	**54**	**20**	**16**
Medical Image Computing	**113**	**115**	**0**	**15**
Medical Imaging	**2,000**	**1,200**	**13**	**249**
Machine Learning in Medicine	**50**	**33**	**1**	**9**
Digital Pathology and Computer Science	**3**	**15**	**0**	**10**
Big Data	**506**	**984**	**71**	**395**
Biostatistics	**150**	**38**	**0**	**8**
Experimental Data	**1,200**	**587**	**13**	**47**
Healthcare Information	**506**	**433**	**13**	**70**

Periodicals

UofL currently has online full-text access to the following journals that focus on topics related to the proposed program.

Journal	Online Full-Text Holdings

Intelligence-based medicine	**2020-present**
Intelligent medicine	**2021-present**
Machine learning with applications	**2020-present**
Annals of 3D printed medicine	**2021-present**
Machine learning with applications	**2020-present**
Clinical imaging	**1995-present**
International conference on artificial intelligence and big data	**2021-present**
PLOS digital health	**2021-present**
Biostatistics	**2000-present**
Applied medical informatics	**2009-present**
Healthcare analytics	**2021-present**
IEEE Transactions on Pattern Analysis and Machine Intelligence	**1979-present**

Online Databases

The following databases offer indexes, abstracts, and full-text access to the periodicals listed above plus thousands of other publications and data related to the proposed program.

- **BrowZine**
- **EDS (EBSCO Discovery)**
- **Worldcat**
- **EMBASE**
- **Elsevier Science Direct**
- **PubMed**
- **Cochrane Library**
- **Web of Science**

Other Resources

There are online research guides in **the Public Health Portal**, **Engineering and Technology** which can be used to support the proposed program. Graduate students may also benefit from the Productive Researcher Portal, which provides advanced research strategies and tools. Ekstrom Library and Kornhauser Library also provide regular training in EndNote citation management software.

Analysis of Collections

- There currently exist approximately 4,800 books (print and electronic) available to support this program. Of the 4,800 books available only 627 (print and electronic) of those have been published within the last 5 years. I don't believe any specific books were requested for this program; the current collection may be sufficient at this time. We have access to several of the top journal in the field related to this program. The databases that we have access to adequately compare to that of our benchmark institutions.

b. Describe the physical facilities and instructional equipment available to support this program.

Physical facilities and instructional equipment must be adequate to support a high quality program. The proposal must address the availability of classroom, laboratory, and office space as well as any equipment needs.

Offices - The Bioengineering Department is located on the University of Louisville Belknap campus in Lutz Hall, which contains the department office, two teaching classrooms, two instructional laboratories, a conference room, and faculty research laboratories. Offices for faculty and staff are located in buildings across the Belknap Campus (Lutz Hall and Shumaker Research Building) and Health Sciences Campus (Cardiovascular Innovation Institute, Clinical Translation Research Building and Health Sciences Research Tower). Offices for faculty and staff in the School of Business are located in Harry Frazier Hall on the Belknap campus. In addition, department and faculty offices for other Speed School of Engineering departments are located in Ernst Hall (Chemical Engineering), Duthie Center (Computer Engineering & Computer Science), J.B. Speed Building (Industrial Engineering), Sackett Hall (Mechanical Engineering), W.S. Speed Building (Electrical & Computer Engineering). Offices for faculty and staff on the Health Sciences Campus are located in Building A Research Tower (Biochemistry & Molecular Biology; Microbiology & Immunology; Physiology & Biophysics), Medical & Dental Research Building (Anatomical Sciences & Neurobiology) and School of Dentistry.

Classrooms and Instructional Laboratories – The proposed bioengineering-specific courses are offered primarily in Lutz Hall, and the additional program courses are offered in classrooms across both the Belknap and Health Sciences Campuses including Duthie Center, Ernst Hall, HSC A Building, and J.B. Speed Building. All classrooms have adequate lighting, climate control and acoustic characteristics, and are equipped with interface to overhead LCD projectors. All buildings on the Belknap and Health Sciences Campuses are equipped with wireless internet access.

Computing Resources - The University of Louisville central research computing or Cardinal Research Cluster (CRC) is housed in the UofL Information Technology Data Center located in the Miller IT Center on the university's Belknap campus. This facility provides over 5000 square feet of secure, environmentally controlled data center space including a FM200 fire suppression system. The data center is fed by 1000kVA electrical service with backup power provided by a large UPS and an 1125 kVA diesel generator. The research cluster is equipped with its own dedicated in-row cooling systems, and utilizes cold aisle containment to improve cooling efficiency. The facility is physically secure with limited keycard access and is monitored 24 hours a day. The UofL CRC infrastructure became available in spring 2009 and was upgraded in spring 2011. This infrastructure includes multiple systems serving the research needs of the entire university, including a general-purpose high-performance distributed-memory computation cluster, a high-memory SMP system and several general-purpose web and software servers. The general-purpose compute cluster is composed of 312 IBM iDatplex nodes each equipped with two Intel Xeon L5420 2.5 GHz quad-core processors for a total of 2496 processor cores. Each node has 16 or 32 GB of memory, and the node interconnects are a mixture of Gigabit Ethernet (1Gbps) and InfiniBand (16 Gbps) technology. The cluster is estimated to have a peak performance rating of 20+ TFLOPS. The University of Louisville's campuses are served by a 40 Gigabit per second (Gpbs) campus backbone network. This backbone is comprised of over 80 miles of fiber in a dual ring configuration. The wired network can provide 100Mbps and 1Gbps Ethernet service for faculty and staff communications needs. With the recently completed Pervasive Wireless Project, the U of L campus wireless network provides 802.11n wireless connectivity to wireless devices at speeds up to 300Mbps. This wireless connectivity is available across all of U of L's campuses, classrooms and buildings. The University of Louisville is connected to the Internet2 node via dedicated 10Gbps optical fiber backbone network. The Internet2 connection gives the University of Louisville direct, high bandwidth, access to national research and education networks such as XSEDE/Teragrid. The University of Louisville

is also a member of the Kentucky Regional Optical Network (KyRON). This regional optical network is managed and operated through a consortium including the University of Louisville, the University of Kentucky and the Kentucky Council on Postsecondary Education. Participating universities are interconnected using 10Gbps optical links. The Kentucky RON extends the research data sharing capabilities of the University of Louisville with other participating universities throughout the state, and provides new opportunities for collaboration.

Multi-Disciplinary & Core Research Facilities - To support the training of students in state-of-the-art research methodologies and techniques, MS BE students will have access to a number of multidisciplinary and core research facilities (described below), as well as to individual faculty laboratories. Specifically, students will have access to the multi-disciplinary facilities described below:

BIOINFORMATICS LABORATORY is housed in the CECS department in room 238 of the Duthie Center. The facilities include a: visualization wall consisting of an assembly of 3x6 Dell monitors and used to visualize complex images; video conferencing system; powerful computers including Dell precision T7400 (8 processors, 20 gb RAM, 2 TB HDD, NVIDIA card) and Dell Alienware computers (8 processors, 12 GB RAM, 1 TB HDD, NVIDIA card); library with bioinformatics and related fields books; and, panaboard (Panasonic White board) that can take pictures of the discussion and can be saved and printed from computer.

CENTER FOR REGULATORY AND ENVIRONMENTAL ANALYTICAL METABOLOMICS (CREAM) ANALYTICAL LABORATORY FOR METABOLOMICS FACILITY is a 1400 sq. ft laboratory in chemistry building room 316 is equipped for bioanalytical chemistry work. Dr. Zhang also has a 150 sq. ft office in the new Shumaker Research Building (SRB) room 349 outfitted with one 3.00 GHz Intel Core2 Duo workstation, one 1.6 GHz Intel Core2 Duo laptop computer, and one Samsung 3UinU1 laser printer. Full secretarial support is available to support Dr. Zhang's teaching and research activities. The support services include machine and electronic shops, library facilities, art and graphics shop, etc. Dr. Zhang has two other 150 sq. ft offices for bioinformatics development in the SRB building (room 343 and 344) fully equipped with online computers and printer systems.

CORE PROTEOMICS LABORATORIES are directed by Jon B. Klein, MD, PhD and Michael L. Merchant, PhD. Dr. Klein is a Professor of Medicine and Biochemistry and holds the James Graham Brown Endowed Chair in Proteomics. Dr. Merchant is an Associate Professor in the Department of Medicine, University of Louisville and is the Technical Director of the Proteomics Laboratories. These facilities operate with the contributions of four technicians and one post-doctoral fellow. The Proteomics Laboratories have 1,475 sq. ft of dedicated space in the Donald Baxter Research Building for core projects. The MS instruments, all HPLC enabled, include a UHPLC-nanospray-Thermo Orbitrap Elite equipped with ETD fragmentation, a Thermo LTQ ion trap, TSQ triple quadrupole instrument, an ABI Q-Star qTOF instrument and ABI 4700 MALDI TOFUTOF. Additionally, one AB Biovision FPLC and one Dionex U3000 microflow instrument are utilized for preparative and semi-preparative protein and small molecular purification. Dr. Merchant and Dr. Klein each have 679 sq. ft of research space in the Donald Baxter Research Building. Dr. Merchant's space is used to conduct research funded by the NIDDKUNIH to confirm biomarkers of hypo-responsiveness to erythropoiesis stimulating agents as well as collaborative research projects. Dr. Klein's space is dedicated to research funded by the NIDDK – U01 Consortium for Biomarkers of Chronic Kidney Disease Research, NIDDK UM1 CureGN

Consortium. All these laboratories are located in the state-of-the-art Donald E. Baxter Biomedical Research Building (opened in 1999).

C. Demand

Student Demand

19.a. Provide evidence of student demand.

Evidence of student demand is typically in the form of surveys of potential students or enrollments in related programs at the institution, but other methods of gauging student demand are acceptable.

CPE Instructions: *Explain how faculty and staff systematically gathered data, studied the data and estimated student demand for the program. Anecdotal evidence is not sufficient. If student surveys have been collected, provide information regarding sample size, sampling methodology, and response rate.*

According to the 2023 Artificial Intelligence Index Report produced by Stanford University, the number of graduates with Master's degrees in Artificial Intelligence roughly doubled to 15,000 graduates.* The current surge in jobs in AI has led many schools to establish advanced degree programs in AI, such as the University of Texas, which established a Master's program in January, 2023.** Based on similar programs (University of Wisconsin – Madison and University of Washington – Seattle) across the country, their existing faculty resources during the first five years of the program, as well as expected enrollment by students residing internationally, we project an initial enrollment of 3-5 students, with the number of students admitted and enrolled increasing yearly by this same number. The first graduates (if they are full-time students) are expected at the end of the first year of the program. Thus, an enrollment of approximately 15-25 students (including both full and part-time students) is projected by Year 5, yielding annual tuition revenue reaching approximately $436,464. The Bioengineering program currently offers a certificate program in AI in Medicine. While the initial enrollment numbers have not been as high as anticipated, we believe this to be related to economic factors during the COVID-19 pandemic when the certificate program was started. As the economy recovers, we anticipate that enrollment in the certificate program will increase. Additionally, we believe the Master's in AI in Medicine program will have broader appeal to both national and international students since as it is an advanced degree that will yield greater returns for students who complete the program. In terms of students in the certificate program, they may be able to apply some of their course credits to the Master's program if these credits are applicable to the Master's degree. Transfer of credits from a Certificate Program in Artificial Intelligence or from related programs from an accredited institution is permitted. However, the number of transfer credits (up to a maximum of 6 credit hours) will be evaluated on a case-by-case basis by the Program Director, who will forward the petition to the Dean(s) of the Speed School of Engineering/ Public Health for final approval. Sufficient course descriptions and a transcript must accompany the petition so that the request can be evaluated.

* HAI_AI-Index-Report-2023_CHAPTER_5.pdf
** https://news.utexas.edu/2023/01/26/ai-masters-program-launches-with-ability-to-serve-thousands/

b. Project estimated student enrollment and degrees conferred for the first five years of the program.

Academic Year	Degrees Conferred	Majors (Headcount) Fall Semester
2025	3	5
2026	6	10
2027	10	15
2028	14	20
2029	18	25

Employer Demand

20. If the program is designed for students to enter the workforce immediately, please complete Appendix A.

Academic Disciplinary Needs

21. If the program proposal is in response to changes in academic disciplinary need, as opposed to employer demand, please outline those changes. Explain why these changes to the discipline necessitate development of a new program.

Development of the Master of Science in Artificial Intelligence in Medicine Program is based upon demand in this relatively new discipline. There are no known or anticipated changes in this academic discipline at this time.

D. Cost and Funding

The resource requirements and planned sources of funding of the proposed program must be detailed in order to assess the adequacy of the resources to support a quality program. This assessment is to ensure that the program will be efficient in its resource utilization and to assess the impact of this proposed program on the institution's overall need for funds.

22. Will this program require additional resources? Yes ☒ No ☐

If so, please provide a brief summary of new or additional resources that will be needed to implement this program over the next five years.

We are requesting a Graduate Teaching Assistant at the end of year 3 who will assist in administrations of the courses and grading. This person is not considered to be faculty in the Speed School of Engineering. Projections are based on Resident tuition rates.

The library has requested $6550 in the first year of the program to purchase subscriptions for 4 journals deemed relevant to the program during the library evaluation. The courses of the program are currently supported by the Ekstrom (Main) and Kornhauser Libraries which house over 2.1 million volumes, approximately 16,000 current journal subscriptions, special collections, media and

microforms. In addition, the library has an on-line virtual library that provides faculty, staff and students access to over 20,000 full text electronic journals, inter-library loan services, electronic books and databases, reference materials and other library resources. The library resources are more than adequate to support the needs of the faculty and students in the proposed Master's Program.

23. Will this program impact existing programs and/or organizational units within your institution? Yes ☐ No ☒

If so, please describe the impact. (Examples: reallocation of resources, faculty or staff reassigned, changes to other programs and/or course offerings or other programs, reduction or increase in students served, any other possible impact.)

The proposed program is not anticipated to impact other programs.

24. Provide adequate documentation to demonstrate sufficient return on investment to the state to offset new costs and justify approval for the proposed program.

CPE Instructions: *Note whether the program is predicted to increase retention rates, and, therefore, generate tuition dollars; increase revenue by attracting a new pool of students; meet employment needs in the state; feed into graduate that have been shown to be beneficial to the economic needs of the state, etc. If no new costs are anticipated, please explain.*

	Year 1	Year 2	Year 3	Year 4	Year 5
Full-Time	3	6	10	14	18
Part-Time	2	4	5	6	7
Projected tuition revenue	$62,213	$126,914	$203,424	$282,945	$365,564

The Master of Science in Artificial Intelligence in Medicine (MS-AIM) program requires students to complete 30 credit hours, with each credit hour generating revenue of $790/credit hour for both residents and non-residents. We used 75% of these values to calculate the return of tuition revenue to Speed School. The projected tuition revenue is conservatively estimated by calculating it at the resident student rate for full time students and non-resident rate for part time students and assuming a 3% yearly inflation-related increase in tuition.

In addition to advancing Kentucky's STEM initiatives by producing highly trained bioengineers, this program is expected to grow overall enrollment at UofL. We project an enrollment of approximately 20 students by Year 4 or 5, yielding annual tuition revenue of roughly $314,829. This revenue will offset the annual investment cost of a new graduate teaching assistant ($50,735) needed to deliver the program. Less tangible benefits will also potentially include attracting graduates of the MS-AIM program into our ISSTBE PhD program. Those who join the workforce following graduation from the MS-AIM program and choose to remain in

Kentucky will contribute to the growth of Kentucky's economy and to improvements in the quality of life of residents in this state.

25.a. Complete the New Program Budget Spreadsheet.

Found at: http://louisville.edu/oapa/new-academic-program-approval-page/new-academic-program-approval

Notes for completing the Budget Spreadsheet:

- Provide an estimate of the level of new and existing resources that will be required to implement and sustain the program.
- Any existing resources reallocated to support this new offering should be estimated as an "internal reallocation" in both the Funding Sources and Expenses sections of the budget.
- Any new resources for which the unit/department plans to allocate funding should be listed as an internal "allocation" in the Funding Sources section of the budget.
- The program proposal is to be developed without the expectation of tuition-sharing or recovery agreements with the Provost. This approach ensures that the "cost" of operating the program is somewhat reflective of reality.
- For every place you add numbers (in both the Funding Sources and Expenses spreadsheet) provide a written explanation for the numbers, including how they were calculated. The CPE system won't let us submit the proposal without explanations for the budget numbers.
- The budget for the proposed program is to be in alignment with the latest budget assumptions (provided below as of 10/7/19) from the Budget Model Workgroup.

  Undergraduate*
  70% (net of mandatory student fees) of resident per credit hour tuition rate (i.e., the listed rate on the bursar's website) charged to undergraduate students is allocated to the academic unit where the instruction takes place. Every credit hour is treated the same under the model.

  Graduate/Professional*
  Graduate: 75% (net of mandatory student fees) of tuition revenue allocated according to a student's home academic program.
  Professional: 85% of tuition revenues generated from professional degree (law, dentistry, medicine) programs allocated to the student's home academic program.

  Note: The new budget model will allocate resources to the academic unit based on where the credit hour is instructed. The unit dean will decide how to distribute funds within the college.

  *These definitions of the Budget Model are as of 10/7/19 and are subject to change.

- Note that there are three tabs to the Budget spreadsheet.

Funding Sources tab:

- Indicate funding to be supplied by the unit (include direct funding & In-kind support):

- Internal allocation and reallocation are those estimated dollars needed to fund the start-up and support the new academic program – typically defined as faculty, administrative/staff, and operational expenses.
- When calculating funding, consider the impact on current faculty workloads.
- Include the expected tuition revenue generated by anticipated student enrollment.
- If the program will use existing faculty or other existing resources, the amount of funding represented by those resources are to be listed in the Funding Sources table as reallocation of funds.
- If reallocation of "existing" funds are included in the Funding spreadsheet, the numbers should also be reflected in the Expenses spreadsheet.
- If the unit has allocated funds for any new expenses in the Funding Sources spreadsheet, the numbers should also be added to the Expenses spreadsheet.

Expenses tab:

- You do not have to estimate classroom space unless you believe that existing space is not sufficient to support the academic program.
- Any expenses identified as "existing" funds in the expenses spreadsheet should also be added to the Funding Sources spreadsheet as either internal reallocation or internal allocation.

Funding Source/Expenses Combined tab:

- This spreadsheet will pre-populate based upon the numbers entered into the Funding Sources and Expenses spreadsheets. The program must have more funding than expenses.

25.b. Please provide contingency plans in the event that required resources do not materialize.

In the event the enrollment numbers are low in year one, the library expense of $6550 will be covered by the Bioengineering Department. If enrollment numbers are low for the first three years, a TA position will not be requested at that time for the program.

E. Program Review and Assessment

Describe program evaluation procedures for the proposed program. These procedures may include evaluation of courses and faculty by students, administrators, and departmental personnel as appropriate. Program review procedures shall include standards and guidelines for the assessment of student outcomes implied by the program objectives and consistent with the institutional mission.

26. Provide a brief description of institutional assessment processes.

The Office of Institutional Effectiveness has prepared an institutional response to this CPE question. Please review the response and edit as needed.

UofL is committed to institutional effectiveness and continuous quality improvement of all academic programs. The university's mission and strategic planning processes are supported by regular, annual outcomes assessment reporting for academic programs in the form of Student Learning Outcomes (SLO) reports. These reports document that UofL is engaged in evaluative processes that (1) result in continuing improvement in institutional quality and (2) demonstrate the institution is effectively accomplishing its mission. In their SLO reports programs identify student

learning outcomes and measures and targets for the outcomes. Programs review data surrounding their student learning outcomes to determine if their set targets were met and then use this assessment to plan for future improvement in student learning. Course syllabi include course objectives that feed into SLOs and program goals.

The SLO process begins in May when templates and instructions for completing SLO reports are sent to department chairs/heads. The SLO process lags behind by one academic year to enable programs to utilize and report assessment results from the previous academic year. Academic programs submit their competed reports by early November. The provost's office reviews all SLO reports and returns feedback to assist programs with further development and assessment of their learning outcomes. The feedback suggests changes needed to the SLO process and areas for improvement. The expectation is that these revisions be fully incorporated into the SLO reporting process for the next data collection reporting cycle. Training, workshops, and resources on student learning outcome development are provided to faculty and staff to support their efforts and to assist them in continuous improvement of their SLO reports and assessment process.

27. Describe how the institution will incorporate the change (program, site, distance education, or other change) into the institution-wide review and assessment processes.

The Office of Institutional Effectiveness has prepared an institutional response to this CPE question. Please review the response and edit as needed.

When a new program is created, an "Academic Alert" is sent to responsible parties. This alert is used by the Office of Institutional Effectiveness (IE) to add the new program to the SLO reporting process. With the creation of the new program, IE reaches out to the department head with information about the annual SLO reporting process and to set up an orientation session to familiarize them with the reporting requirements and provide whatever support is needed.

28. What are the plans to evaluate students' post-graduate success?

New Academic programs undergo an interim program review after five years for undergraduate programs, four years for masters programs, and three years for doctoral programs. After the interim review, all programs are placed on the university's regular program review schedule.

The program review template requires that programs provide feedback from graduates, alumni, and employers. In your response to this question consider how you will collect satisfaction feedback from these groups.

CPE Instructions: *Explain how the program will identify graduate schools and employers and what questions will be asked in order to assess graduate school and/or workforce success.*

Short-term post-graduate success will be defined based upon placement in industry, government agency, and academic positions. Intermediate and long-term success will be characterized by contributions to the field of Artificial Intelligence in Medicine as evidenced by employment advancement, scientific publications, patents issued, honors, start-up companies established, and professional attainment by alumni (targets for these outcome measures are shown in the table below). Students will complete an exit survey prior to graduation to provide student feedback about

the effectiveness of the program. Additionally, the MS-AIM program will survey alumni in the first year following graduation and every 5 years thereafter to receive feedback on the effectiveness of the program for preparing the students for post-graduation success.

Program assessment: targets for post-graduate measures of success

A. Outcome measure	**B. Target within 5 years post-graduation**
Employment advancement	30% of alumni
Scientific publications (co-author on peer-reviewed journal paper or conference proceeding)	50% of alumni
Patents submitted or issued	20% of alumni
Honors	20% of alumni
Start-up companies established	10% of alumni

Feedback from employers will be gathered by reaching out to employers of MS-AIM graduates after the first year of student employment with a survey that will allow employers to give feedback pertaining to the competency of MS-AIM graduates. These surveys will be issued 1 year after graduation and every 5 years thereafter.

NOTE: All actions in the approval of new programs for public institutions are subject to a stipulation regarding the program's ability to attain specified goals that have been established by the institution and approved by the Council on Postsecondary Education (the Council). At the conclusion of an appropriate period of time, the program's performance shall be reviewed by Council staff following criteria established in the Council's Academic Programs Policy. For more information on the program review process see http://louisville.edu/oapa/academic-program-review-process.

Appendix A. Employer Demand.

1. If the program is designed for students to enter the workforce immediately, please complete the following table (see resources below the table)

2. Please provide source of employer demand information and time frame for the projections:

Type of Job	Regional Avg Wage	Regional # of openings	Regional Growth Projections (%)	State Avg Wage	State # of openings	State Growth Projections (%)	National Avg Wage	National # of openings	National Growth Projections (%)
Machine Learning Engineer	$149k	195	344	$125k	39	344	$146k	4604	344
Artificial Intelligence Engineer	$101k	380	16	$101k	51	16	$115k	7062	16% (through 2028)
Software Developer	$101k	48k	4.1	$98k	620	-3.6%	$118k	120k	2.6%

Employer Demand Resources:

Regional searches were performed on glassdoor.com using Kentucky, Indiana, and Ohio as regional examples.
https://www.glassdoor.com/Job/kentucky-ai-machine-learning-engineer-jobs-SRCH_IL.0,8_IS1141_KO9,37.htm
https://onlinedegrees.sandiego.edu/machine-learning-engineer-career/

https://www.computersciencedegreehub.com/faq/how-is-the-career-outlook-for-artificial-intelligence-jobs/
https://www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm#tab-6
Lightcast Q4 2022 Dataset for Kentucky, Region (Kentucky, Tennessee, Alabama, Mississippi), and United States