

Contact: Rachel Boon

**REQUEST FOR NEW PROGRAM AT IOWA STATE UNIVERSITY:
MASTER OF SCIENCE IN ARTIFICIAL INTELLIGENCE**

Action Requested: Consider approval of the request by Iowa State University for a Master of Science in Artificial Intelligence in the College of Liberal Arts and Sciences.

The Council of Provosts and Board office support approval of this program.

Description of proposed program. In recent years artificial intelligence (AI) has become a very active field with many commercial and scientific applications. As stated in *the National Artificial Intelligence Research and Development Strategic Plan: 2019 Update*: “Artificial intelligence presents tremendous opportunities that are leading to breakthroughs in improved healthcare, safer and more efficient transportation, personalized education, significant scientific discoveries, improved manufacturing, increased agricultural crop yields, better weather forecasting, and much more.”

This Master of Science in Artificial Intelligence (MS in AI) is intended to enable students to compete for leading-edge positions with significant AI components. The target audience is graduate students with strong quantitative backgrounds who are interested in learning basic AI and machine learning techniques and applying AI methods to solve practical problems. The courses are designed to provide students with the knowledge and core skills needed to apply AI and machine learning techniques to address a wide range of practical problems.

The MS in AI consists of 9 credit hours of core AI courses, 9 credit hours of depth requirements, 6 credit hours of electives on AI related topics, 3 credits of advanced AI topics courses at the 600-level, 1 credit hour in a research colloquia course, and a Creative Component on which a final oral examination is required.

At this point, the program will be offered on campus only. The possibility of offering the program online needs further investigation.

Academic objectives. The program will prepare students with the knowledge and core skills to enter the workforce as artificial intelligence scientists. These positions are in high demand today in industry, nonprofit sectors, and government.

Learning Outcomes

After successfully completing the program, MS in AI graduates will demonstrate:

- A. an understanding of the basic concepts, techniques, and applications of artificial intelligence,
- B. an understanding of machine learning algorithms and their use in knowledge discovery,
- C. an ability to design, implement, and evaluate intelligent agents for representative AI problems in problem solving, planning, decision making, and learning,
- D. an understanding of the strengths and weaknesses of different AI algorithms (relative to the characteristics of the application domain), and when needed, design variants of existing algorithms, and
- E. an ability to communicate effectively about AI problems, algorithms, implementations, and their experimental evaluation to stakeholders.

Relationship to existing programs at the institution. There are no other graduate programs at ISU that meet the overall objectives of the MS in Artificial Intelligence degree. AI is currently an area of emphasis within the existing MS in computer science; employer needs and student interest support the need for a specific graduate degree program to provide a curriculum that will prepare students to work in this area of expertise. Iowa State established an undergraduate certificate, minor and major in Data Science programs established in 2016.

While Data Science focuses on topics ranging from study design to modeling to interpretation, artificial intelligence digs deeper into topics that enable computers or automated systems to perform tasks that historically have required human abilities. Data science and Artificial Intelligence have one commonality: machine learning, which focuses on methods of modeling and predictive data analysis – part of the Data Science pipeline. But AI also includes knowledge representation and reasoning, search and planning, vision, natural language processing, and robotics – methods that enable intelligent systems to perceive, reason, plan, learn, and act in complex environments.

ISU has an interdisciplinary graduate degree program in Business Analytics housed in the Ivy College of Business. Business Analytics focuses on business applications of analytics techniques. The MS in AI is a computer science degree that digs deeper into topics that enable computers to understand and make predictions and also considers broader applications (e.g. AI for scientific discovery). Majors, minors and/or individual courses in various ISU colleges (Computer Science, Electrical and Computer Engineering, Mechanical Engineering, Statistics, Business Analytics, Bioinformatics, etc.), provide materials relevant and useful for those pursuing careers in AI but none provides the depth of coverage open to a wide range of students as does this proposed program.

Relationship to existing programs at other colleges and universities. As of this writing, there are no such programs at the public universities in Iowa. The University of Iowa has a graduate program in business analytics that focuses on business applications of analytics techniques, the ISU MS in AI digs deeper into topics that enable computers to understand and make predictions and also considers broader applications for scientific discovery. The University of Iowa also has an undergraduate degree in data science that consists of a carefully selected list of courses from the Statistics and Computer Science at the university. Data Science and Artificial Intelligence have emerged as separate and distinct disciplines.

The University of Northern Iowa doesn't currently have any related programs aside from coursework in computer science, data science and business analytics.

Luther College, a private liberal arts college in Iowa, created an undergraduate Data Science major and a minor degree in 2016. This Data Science major's core consists of six computer science courses, two statistics courses, and three subject matter courses (equivalent to "application areas" in this proposal).

Unique features. Artificial Intelligence and its role in data-driven discovery is a priority area for Iowa State University. For example, ISU President's Destination 2050 initiative features Big Data as one of the six targets in which AI will play an important role. Iowa State University's Presidential Initiative for Interdisciplinary Research has specifically targeted the Big Data area. Artificial Intelligence is also linked to the strategic area of data science in the College of Liberal Arts & Sciences.

Resources to establish a high-quality program. Current facilities and equipment are adequate to establish and maintain a high-quality program. The Department of Computer Science has over 110 PhD students and 60 MS students. The department has well-established processes for graduate application evaluation, mentoring and advising for MS students, as well as career advising for MS students. The MS in AI program will leverage these resources. Additional hires would need to be made as well the program grows. The managing college will support these resource needs.

Student demand. The department anticipates this proposed new program will attract new students to ISU. For instance, during a recent international university recruitment visit organized by the ISU Office of Admissions, there were several inquiries about whether ISU has an AI MS degree, which ultimately led to this proposal.

Additional student demand already exists as evidenced by creation of similar programs across the United States. Further demand from incoming graduate students at Iowa State University will be developed by raising awareness about the program and about the job opportunities available in AI locally and nationally.

Workforce need/demand. There is a great demand for artificial intelligence scientists today both in Iowa and nationally, and the market is quickly growing. LinkedIn's 2020 Emerging Jobs Report names AI specialist as the job that saw the most growth in the past five years with average annual growth rate since 2015 to be 74%¹. Recognizing the importance of artificial intelligence, on February 11, 2019, the President signed Executive Order 13859 on *Maintaining American Leadership in Artificial Intelligence*, which established the American Artificial Intelligence Initiative - a whole-of-government approach for maintaining American leadership in AI.

Iowa State University is well positioned to fill the need due to its long history in data-driven sciences. Iowa State University's significant recent investments in the data science areas have further served to strengthen the university's capacity in AI and machine learning. This program is designed to prepare students with the knowledge and core skills needed to compete for leading-edge AI scientist positions.

Cost.

	Total Costs
Year 1	\$131,531
Year 2	\$165,762
Year 3	\$310,158
Year 4	\$319,462
Year 5	\$329,046
Year 6	\$490,178
Year 7	\$504,884

The estimates presented in the table above are based on the following assumptions:

- The faculty benefits rate is 27.7% and the P&S benefits rate is 34.6%.
- In Year 1 a new tenure track faculty member will be hired to get the program started and to develop new AI courses COM S 536 and COM S 579. The total new costs reflect average LAS salary and benefits for a new tenure track faculty member.
- In Year 2 a part-time graduate program coordinator for the AI program would be hired. The total new costs reflect average LAS salary and benefits for a part-time graduate program coordinator as well as misc. cost such as supplies.
- As the program enrollment exceeds 30 and 60 graduate students, an additional tenure track faculty member will be necessary to help teach core and depth artificial intelligence

related courses and to teach multiple sections of core courses. According to Table 1, this is anticipated in Year 3 and Year 6, but could happen sooner.

- A 3% yearly inflation in costs is assumed.
- The program is also expected to generate revenues, and a significant portion of these costs would be offset by the new revenue. The \$131,531 in Item 13 (see line “Year 1”) is from reallocation of existing funds; the remaining \$373,353 is expected to come from increased revenue.

Projected student enrollment.

	Y1	Y 2	Y3	Y4	Y5	Y6	Y7
Graduate	5	15	26	37	49	59	69

This projection assumes that the program will see an initial enrollment of five students, and the number of first year graduate students would increase by five during years two through six. Subsequently, a steady state enrollment of about 40 new students per year is anticipated.

It is estimated that two or three students will transfer from other programs per year, and that about five students might take longer than two years to complete the program (likely a conservative estimate). Beyond year 8, a steady state enrollment of 80 graduate students is anticipated.

Accreditation. At the time of this writing, accreditation bodies for AI programs have not emerged. The MS degree in Artificial Intelligence will be included as part of Iowa State University Higher Learning Commission (HLC) accreditation in the next cycle. Once the MS in AI degree is well established, the department will discuss with industry partners and with members of the College of Liberal Arts and Sciences advisory councils whether the pursuit of additional accreditations is worthwhile.

Evaluation plan. This program will be incorporated into the university’s normal academic review process. That review process assesses whether the program is achieving its mission, providing high quality academic experiences, and fulfilling the enrollment and success metrics identified for the program. In addition to the academic program review, as a part of the college budgeting process the program will be monitored annually for achievement of enrollment goals.

Date of implementation. August 2021.

Letters of Support



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December 9, 2019

Dear Dr. Rajan,

I am pleased to write to you in support of the proposed M.S. program in Artificial Intelligence to be offered by the Department of Computer Science at Iowa State University.

There is a growing need in Iowa industries for knowledge workers with expertise in AI and its many applications, including machine learning, language processing, and reasoning in the face of uncertainty. The proposed curriculum includes both breadth and depth in AI and terminates in a creative project where students can demonstrate their knowledge and solve a problem of importance.

The Department of Computer Science at the University of Northern Iowa can certainly recommend this program to its graduates who seek more background in Artificial Intelligence before going into industry.

Sincerely,

A handwritten signature in cursive script that reads "Eugene Wallingford".

Eugene Wallingford, Head



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August 4, 2020

Dear Hridesh:

I am writing to express my support for your proposed Master's degree in Artificial Intelligence.

The world has certainly changed! When I began my own graduate studies in Artificial Intelligence over 40 years ago, I never imagined I would some day engage in casual conversations with my kitchen appliances. And while progress was initially slow, society has witnessed incredible advances over the past few years. Your proposed program not only acknowledges these advances and the likelihood that they will continue apace, but also the increasing importance of these applications to commerce, agriculture, media, entertainment and science. Having carefully read your proposal, I find it to be well motivated, soundly configured, and congruent with the goals and aspirations of your Department, Iowa State University, and the State of Iowa.

Speaking for the Department of Computer Science at the University of Iowa, I fully support your initiative, and wish you and the Department every success.

Sincerely yours,

A handwritten signature in black ink, appearing to read "Alberto Maria Segre".

Alberto Maria Segre
Professor and Chair
Gerard P. Weeg Faculty Scholar in Informatics