University Council

January 10, 2025

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Dear Colleagues:

The attached proposal from the Franklin College of Arts and Sciences for an Undergraduate Certificate in Artificial Intelligence – Computing will be an agenda item for the January 17, 2025, Full University Curriculum Committee meeting.

Sincerely,

Susan Sanchez, Chair

cc: Provost S. Jack Hu
Dr. Marisa Pagnattaro

PROPOSAL FOR A CERTIFICATE PROGRAM

Date: September 20, 2024

School/College/Unit: Franklin College of Arts and Sciences
Office of the Senior Vice President for Academic Affairs and Provost

Department/Division: Institute for Artificial Intelligence (IAI)

Certificate Title: Undergraduate Certificate in Artificial Intelligence - Computing

CIP: 11010200

Effective Term: Fall 2025

Which campus(es) will offer this certificate? Athens

Level (Undergraduate, Graduate, or Post-Baccalaureate): Undergraduate

Program Abstract

The Undergraduate Certificate in Artificial Intelligence - Computing is intended to provide a foundation in the principles and techniques of contemporary artificial intelligence (AI). It is also intended to provide the skills necessary to apply AI-based technologies to solve problems, evaluate both the technical performance of AI-based solutions and their potential ethical/societal implications, and communicate AI concepts and findings to others. The certificate is especially suited to students majoring in computer science, data science, computer systems engineering, and other mathematical and scientific fields.

1. Purpose and Educational Objectives

State the purpose and educational objectives of the program. How does this program complement the mission of the institution?

Though artificial intelligence as a field of study has existed for approximately 70 years, and though there has been relatively steady progress, the rate of advancement and adoption has increased dramatically in the last 10 years. Very suddenly, AI technologies have become ubiquitous in society, and AI tools are used in essentially all fields.

The rate of change has been sudden enough that current curricula of many academic programs do not adequately provide students with an understanding of AI or provide the skills necessary to apply AI technologies in a responsible manner. The proposed certificate is intended to help fill this gap. It is consistent with the mission of the University which includes “a commitment to excellence in a teaching/learning environment dedicated to serving a diverse and well-prepared student body, to promoting high levels of student achievement, and to providing

appropriate academic support services"; it will provide training to students in multiple disciplines in an important technology that they will undoubtedly encounter in their professional and personal lives.

2. Need for the Program

Explain why this program is necessary.

The certificate is interdisciplinary and requires both computation-oriented training as well as training in the ethical and social implications of AI. The certificate complements existing bachelor's degree programs, as there is no undergraduate major in Artificial Intelligence at the University at this time at the University which includes all of the topics presented in the certificate's core set of courses. Even to students in a STEM field such as computer science, the certificate would indicate to potential employers that the student has AI training. Bachelor's degrees specifically in AI are rare in the United States. Currently, the National Center for Education Statistics lists only 19 schools in the nation with a bachelor's degree using the CIP code for Artificial Intelligence (11.0102).[1]

Demand for workers skilled in AI techniques and technologies is expected to grow, though faster in some sectors than in others. An NSF analysis published in May 2024 and intended to assess the feasibility of establishing a program to train the next generation of AI professionals for federal, state and local governments estimates that up to 3,400 new AI workers will be needed in federal agencies by 2028.[2] In a March 2024 U.S. Census Bureau whitepaper,[3] AI use by businesses across all sectors rose from 3.7% in September 2023 to 5.4% in February 2024, with a projection of 6.6% in for early Fall 2024. The data indicates a small but positive change in usage. Importantly, adoption varies drastically by sector, with the Information sector showing current adoption of 18% and a projection to 21.5% by Fall 2024. According to the data, a high percentage of AI users indicate attempts to train staff to use AI technologies.

Regarding AI-related professions, according to the most recent U.S. Bureau of Labor Statistics Occupational Outlook Handbook,[4] employment of Computer and Information Research Scientists is expected to grow 26% over the period 2023-2033. Employment of Computer and Information Systems Managers will grow by 17%, as will employment of Software Developers, Quality Assurance Analysts, and Testers. For each of these, adoption of AI technologies is viewed as driving force.

In addition, provide the following information:

a. Semester/Year of Program Initiation: **Fall 2025**
b. Semester/Year of Full Implementation of Program: **Fall 2025**
c. Semester/Year First Certificates will be awarded: **Fall 2026**
d. Annual Number of Graduates expected (once the program is established): **25-35**
e. Projected Future Trends for number of students enrolled in the program: **25-35**

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[1] https://nces.ed.gov/collegenavigator/?s=all&p=11.0102&l=93. Search performed 9/3/2024.
[2] https://www.nsf.gov/edu/Pubs/2024SFSAIReport.pdf. Accessed Dec 20, 2024.
[3] https://www.census.gov/hfp/btos/downloads/CES-WP-24-16.pdf. Accessed Dec 20, 2024.
[4] https://www.bls.gov/ooh/. Accessed Dec 20, 2024.

3. Student Demand

a. Provide documentation of evidence of student demand for this program, including a student survey.

Interest in AI at a societal level is currently exceptionally high and likely to remain so for many years. This is also true at UGA and most other institutes of higher education. In the last 5-10 years, many universities across the country have developed artificial intelligence certificate, bachelor's, and graduate degree programs. At UGA, there is strong enrollment in the Computer Science (B.S.), Data Science (B.S.), and Computer Systems Engineering (B.S.C.S.E.), and it is expected many of these students would find the certificate attractive as enrollment in the graduate programs offered by the Institute for Artificial Intelligence is increasing. In Fall 2024, the Institute received its largest incoming class. In total, there are over 50 graduate students currently enrolled in the graduate programs.

To better gauge interest in the certificate, a survey was created and sent to the IAI Faculty Fellows with a request to forward it to listservs in their unit. There are over 70 faculty fellows, collectively representing many units across campus. In addition, the survey was sent to undergraduate coordinators or advisors in the following units:

- College of Family and Consumer Sciences
- Department of Chemistry
- Department of English
- Department of Geography
- Department of History
- Department of Linguistics
- Department of Management Information Systems
- Department of Philosophy
- Department of Physics and Astronomy
- Department of Psychology
- Division of Biological Sciences
- Mary Frances Early College of Education
- School of Computing
- School of Public and International Affairs

The survey received 222 responses. Statistics for the survey questions are provided below.

Results of Survey on AI Certificates

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Q1. If an AI certificate is created, I would consider pursuing it.	7 (3.2%)	10 (4.5%)	13 (5.9%)	70 (31.5%)	122 (55.0%)
Q2. An AI certificate would complement my chosen primary degree program and/or provide skills I anticipate needing in my work after graduation.	6 (2.7%)	8 (3.6%)	21 (9.5%)	62 (27.9%)	125 (56.3%)
Q3. It is important to me that the certificate provides training to understand how AI tools work and how to successfully use them	5 (2.3%)	7 (3.2%)	7 (3.2%)	52 (23.4%)	151 (68.0%)
Q4. It is important to me that the certificate provides training to create new or modify existing AI technologies.	4 (1.8%)	7 (3.2%)	16 (7.2%)	61 (27.5%)	134 (60.4%)

b. Provide evidence that demand will be sufficient to sustain reasonable enrollment.

Given the above, the faculty do not believe that continued demand will be an issue.

c. To what extent will minority student enrollments be greater than, less than, or equivalent to the proportion of minority students in the total student body?

Below are recent statistics from the Office of Institutional Research for the Computer Science bachelor's degree (FY2021-2022) and for UGA as a whole (Fall 2022). The faculty anticipate that student demographics will be similar to those enrolled in the Computer Science (B.S.) program, though possibly with more gender equality. For the interdisciplinary Artificial Intelligence (M.S.) degree, which the proposed certificate somewhat resembles, roughly 36% of students identify as female.

Computer Science (B.S.):

- Female: 23.3%; Male: 76.7%
- Asian: 33.7%; Black or African American: 10.4%; Hispanic or Latino: 7.1%; Two or more races: 4.7%; White: 42.3%; Not reported: 1.8%

UGA's Fall 2022 statistics:

- Female: 58%; Male: 42%
- American Indian or Alaskan Native: 0.1%; Asian: 12.9; Black or African American: 6.3%; Hawaiian or Pacific Islander: 0.1%: Hispanic or Latino: 7.4%; Two or more races: 4.2%; White: 67.9%; Not reported: 1.2%

4. Program of Study

Provide a detailed program of study for the certificate program, including:

a. Specific course prefixes, numbers, and titles

Students completing the certificate must earn a grade of "C-" or better in each of the required courses.

At least 16 credit hours are required to earn the certificate, as described below. Additionally, some courses have MATH 1113, Precalculus, as a minimal prerequisite.

Foundational AI Courses (9-10 hours)

CSCI(PHIL) 4550/6550, Artificial Intelligence (3 hours)

Choose one of the following:

CSCI 1360, Foundations for Informatics and Data Analytics (4 hours)
CSCI 2610, Discrete Mathematics for Computer Science (4 hours)
CSCI 2611, Discrete Mathematics for Engineers (3 hours)
PHIL 2500, Symbolic Logic (3 hours)

Choose one of the following:

ARTI 2130, AI for Humans: Learning to Live with AI (3 hours)
ARTI(PHIL) 4340/6340, Ethics and AI (3 hours)

AI, Computer Science Electives (7-8 hours): Pick at least two elective classes chosen from the lists below. *Note: Students pursuing the Bachelor of Science (B.S.) in Data Science must take at least 1 class in Group I.*

Group I

CSCI(ARTI) 4530/6530, Introduction to Robotics (4 hours)
CSCI 4560/6560, Evolutionary Computation and Its Applications (4 hours)
CSCI 4800/6800, Human-Computer Interaction (4 hours)
CSCI(ARTI) 4600/6600, Reinforcement Learning (3 hours)

Group II

CSCI 3360, Data Science I (4 hours)
CSCI 4360/6360, Data Science II (4 hours)
CSCI 4380/6380, Data Mining (4 hours)
CSCI 4850/6850, Biomedical Image Analysis (4 hours)

b. Identify any new courses created for this program.

No new courses are proposed specifically for the program.

5. Model Program and Accreditation

a. Identify any model programs, accepted disciplinary standards, and accepted curricular practices against which the proposed program could be judged. Evaluate the extent to which the proposed curriculum is consistent with these external points of reference and provide a rationale for significant inconsistencies and differences that may exist.

Over the last few years, several certificates in artificial intelligence, at both the undergraduate and graduate levels, have been developed at universities in the United States. In preparation for developing this proposal, a survey of these programs was conducted. The survey concluded that graduate and professional certificate programs outnumber undergraduate certificates programs. Undergraduate certificates are either heavily oriented towards STEM fields or else oriented towards non-programmers. The former typically do not require an ethics component, which the Institute for Artificial Intelligence considers essential.

University System of Georgia: There is no university within the University System of Georgia which offers an undergraduate certificate in AI comparable to the one proposed here. Several data science certificate programs exist.[5] The USG database of authorized degrees and majors indicates[6] that Georgia College and State University has a certificate of less than one year in Artificial Intelligence, but the program does not appear to be active.

University of Florida: The University of Florida offers several AI certificates, many of them domain specific. A few are presented below. The Undergraduate certificate in AI Fundamentals and Applications is the closest to the one proposed here.

- Artificial Intelligence Fundamentals and Applications Certificate (9 hours): Includes a fundamental AI course, an ethics course, followed by a domain specific elective.
- Artificial Intelligence in Public Health and Healthcare Certificate (9 hours)
- Geographic Artificial Intelligence and Big Data Certificate (12-13 hours)

Florida Atlantic University: Offered by the Department of Electrical Engineering and Computer Science, the AI Certificate (15 hours) provides two tracks: a programming track, and another track intended for students without programming experience. The certificate does not require an ethics course.

University of Missouri at Saint Louis: The Undergraduate Certificate in Artificial Intelligence (15 hours) is offered by the Department of Computer Science. The certificate consists of an algorithms course, an introductory AI course, and 3 computer science electives.

University of Central Florida: An example of a non-STEM certificate is the Artificial Intelligence, Big Data, and Human Impacts certificate (12 hours) offered by the Department of Rhetoric. Both an ethics course and an AI literacy course are required.

University of South Carolina: The Graduate Certificate in Artificial Intelligence (12 hours) is offered by the Department of Computer Science and Engineering. No ethics course is required. The courses, all STEM oriented, are graduate-level courses focusing on selected

[5] https://apps.ds.usg.edu/ords/f?p=118:6::::RP:P6_SEARCH:data. Accessed Sept 3, 2024.
[6] https://apps.ds.usg.edu/ords/f?p=118:6::::RP:P6_SEARCH:artificial. Accessed Sept 3, 2024.

subfields of AI.

Wilmington University: The Artificial Intelligence Certificate (18 hours) requires 6 courses with no electives; the courses include an ethics course, an introductory data science course with Python, and an introduction to AI course.

b. If program accreditation is available, provide an analysis of the ability of the program to satisfy the curricular standards of such specialized accreditation.

There are no accreditation bodies for AI programs.

6. Student Learning Outcomes

Describe the proposed learning outcomes for the certificate.

Upon completing the certificate program, the student will be able to do the following:

1. **Understanding AI Fundamentals**
   - **PO-1:** Identify and explain the basic concepts and principles of artificial intelligence.
   - **PO-2:** Explain the ethical issues and societal impacts created by AI technologies.
2. **Application and Evaluation**
   - **PO-3:** Analyze a problem, evaluating the suitability of different AI technologies.
   - **PO-4:** Apply AI concepts and technologies to solve problems within their field of work or study.
   - **PO-5:** Evaluate the performance and quality of AI-based solutions.
3. **Communication**
   - **PO-6:** Effectively communicate AI concepts and findings, including potential ethical considerations.

Course Learning Outcomes

Learning outcomes for the central non-elective courses comprising the degree are shown below.

CSCI 4550

This course presents a survey of topics in artificial intelligence most relevant to students studying computer engineering. At the end of the semester, all students will be able to do the following:

1. Represent the environments of decision-making problems including their observability, determinism, continuousness, and other criteria.
2. Identify and compare agent types, such as reflex, goal-based, and utility-based.
3. Implement uninformed search strategies such as BFS, DFS, depth-limited search, and bidirectional search.
4. Implement heuristics in informed search strategies, as well as identify the aspects of a good heuristic.
5. Evaluate the effectiveness of local search algorithms, including hill climbing, simulated annealing, and beam searches.
6. Evaluate competitive game outcomes by using minimax algorithms, alpha-beta pruning, and evaluation functions.
7. Utilize basic inferencing rules in propositional logic, such as resolution and forward/backward chaining.
8. Express propositional statements using quantifiers and functions in First-Order logic
9. Implement Java or written algorithms that evaluate goal-oriented problems using propositional or first-order propositional logic.
10. Represent knowledge using constructs such as Ontologies.

		Program Outcomes					
CSCI 4550 Course Learning Outcomes		**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
	1	•			•		
	2	•		•	•	•	
	3				•	•	
	4				•		
	5			•	•	•	
	6			•	•	•	
	7				•		
	8	•			•		
	9				•		
	10				•		

ARTI 2130

Students who are successful in this course will:

1. Describe basic approaches to machine learning.
2. Identify issues of bias that affect artificial intelligence.
3. Practice creative approaches to problem-solving to prepare them for meeting future challenges with artificial intelligence and technology.
4. Create and evaluate arguments about the promises and effects of artificial intelligence.

		Program Outcomes					
		PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
ARTI 2130 Course Learning Outcome	**1**	•					•
	2	•	•				
	3		•		•		
	4		•			•	•

ARTI 4340

Students who are successful in this course will:

1. Explain ethical positions and problems related to artificial intelligence.
2. Explain aspects of artificial intelligence in relation to its effects on individuals and society.
3. Take and defend ethical positions on AI topics.

		Program Outcomes					
		PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
ARTI 4340 Course Learning Outcome	**1**		•				•
	2		•				•
	3		•				•

Learning outcomes for selected electives are shown below.

CSCI 3360

Students who are successful in this course will be able to:

1. Use existing Python tools to read and preprocess raw data of various formats (text, images, binary).
2. Choose a proper statistical model for extracting knowledge from a particular dataset, given the advantages and disadvantages of the model.
3. Implement at least one algorithm from the categories of regression, classification, clustering, and convex optimization.
4. Design and document analytical pipelines to be reproducible by others.
5. Use and interpret the results of dimensionality reduction on high dimensional datasets.
6. Choose the most effective visualization to convey the knowledge learned from the data.

		Program Outcomes					
		PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CSCI 3360 Course Learning Outcomes	**1**			•	•		
	2			•	•	•	
	3				•	•	
	4	•			•		•
	5				•	•	
	6		•	•	•		•

CSCI 4360

This course builds on the concepts from Data Science I by introducing students to more advanced analytics techniques. At the end of the semester, all students will be able to do the following:

1. Design and implement a full data science pipeline, from data preprocessing and feature selection to model evaluation and performance optimization.
2. Rigorously and quantitatively select the optimal model for a given problem.
3. Understand the technical, ethical, and logistical trade-offs of some models over others for certain situations.
4. Select existing packages or employ techniques to handle analysis of data that is too large to load into memory at once.
5. Scale analyses beyond single cores to highly parallel and fully distributed heterogeneous computing environments.

		Program Outcomes					
		PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CSCI 4360 Course Learning Outcomes	**1**				•		
	2			•	•		
	3		•	•			
	4			•	•		
	5				•		

CSCI 4380

This course presents a survey of topics in data mining. At the end of the semester, all students will be able to do the following:

1. Analyze a real-world data set and identify appropriate data mining techniques to apply thereto.

2. Write a program or use a package to implement a data mining algorithm.
3. Conduct data mining experiments and properly report and discuss the results.
4. Effectively present a data mining article to an audience.
5. Review and critique data mining articles.

		Program Outcomes					
		PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CSCI 4380 Course Learning Outcomes	**1**			•			
	2				•		
	3	•		•	•	•	•
	4	•					•
	5			•		•	•

CSCI 4530

1. Familiar with robot control architectures.
2. Familiar with the robot perception and planning algorithms that provide meaningful outcomes for autonomous mobile robots.
3. Design and analyze the complexities of designing and constructing small autonomous mobile robots that achieve specific goals.
4. Utilize robot simulators and software development frameworks for programming mobile robots that achieve specific goals.
5. Design, analyze, and implement mobile robot algorithms using simulated and real-world sensor data.
6. Familiar with the state-of-the-art of autonomous mobile robotics.

		Program Outcomes					
		PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CSCI 4530 Course Learning Outcomes	**1**	•					
	2	•					
	3			•	•	•	
	4				•	•	
	5			•	•	•	
	6	•					

CSCI 4560

This course presents a survey of topics in evolutionary computation. At the end of the semester, all students will be able to do the following:

1. Formulate a problem as an evolutionary computation search/optimization by specifying representations, selection and variation operators.
2. Write a program or use a package to implement an evolutionary algorithm.
3. Conduct evolutionary optimization experiments and properly report and discuss the results.

4. Effectively present an evolutionary computation article to an audience.
5. Review and critique evolutionary computation articles.
6. Reason about the schema theorem and the theory of evolutionary computation.

		Program Outcomes					
		PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CSCI 4560 Course Learning Outcomes	**1**			•	•		
	2				•		
	3				•	•	•
	4	•					•
	5			•		•	
	6	•			•		

CSCI 4600

1. Situate and understand a key area of artificial intelligence and specifically in the field of machine learning. Understand the corresponding class of problems.
2. Study the challenges and algorithms for reinforcement learning by agents situated in uncertain single-agent and multi-agent environments.
3. Gain proficiency in the use of computing tools related to reinforcement learning, designing and giving effective research presentations, and working in a team.

		Program Outcomes					
		PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CSCI 4600 Course Learning Outcome	**1**	•					
	2			•			
	3				•	•	•

CSCI 4800

This course presents an introduction to Human-Computer Interaction. At the end of the semester, all students will be able to do the following:

1. Apply the principles of user-centered design, via group projects, in formulating user interface prototypes in novel domains.
2. Create a hierarchical task analysis to analyze and specify which tasks should be supported in a user interface.
3. Gather design requirements from users and conduct a requirements analysis.
4. Describe the paradigm shifts in HCI and explain the causal factors for each.
5. Develop and implement a testing plan for evaluating a user interface design.
6. Develop and implement benchmark testing.
7. Generate several user interface design alternatives that satisfy a set of user requirements.
8. Use programming or a software package to create prototypes.
9. Assess and compare the success of a user interface along multiple dimensions.
10. Evaluate the trade-offs of usability considerations (e.g. novice vs experienced users, efficiency) in all stages of the design process.

		Program Outcomes					
		PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CSCI 4800 Course Learning Outcomes	**1**			•		•	
	2						
	3			•			
	4						
	5					•	
	6					•	
	7			•			
	8				•		
	9					•	
	10					•	

7. Assessment

Describe how the learning outcomes for the program will be assessed. Describe the process and criteria for how students will be admitted to and retained in the program.

Assessment of the Program Learning Outcomes will be performed using tests, reports, papers, and other graded assignments in each of the courses comprising the certificate. Each course has specific learning outcomes. For each course, a matrix which maps course learning outcomes for core courses to program outcomes is shown above. Collectively, the non-elective courses ensure that each program learning outcome is covered. Course outcomes for electives provide additional reinforcement.

Review of the certificate will occur annually through the use of an exit survey taken by graduating students. It will also form part of the Institute's regular 7-year unit review.

Documentation of Approval and Notification

Proposal: Undergraduate Certificate in Artificial Intelligence – Computing

College: Franklin College of Arts and Sciences; Office of the Senior Vice President for Academic Affairs and Provost

Departments: Institute for Artificial Intelligence

Proposed Effective Term: Fall 2025

School/College:

- Institute for Artificial Intelligence Interim Executive Director, Dr. Khaled Rasheed, 9/12/2024
- Franklin College of Arts and Sciences Associate Dean, Dr. Paula Lemons, 10/18/2024
- Franklin College of Arts and Sciences Dean, Dr. Anna Stenport, 9/13/24

Letters of Support:

- Department of Philosophy Department Head, Dr. Aaron Meskin, 9/12/24
- Franklin College of Arts and Sciences Dean, Dr. Anna Stenport, 9/13/24
- Institute for Artificial Intelligence Interim Executive Director, Dr. Khaled Rasheed, 9/12/2024
- School of Computing Director, Dr. Gagan Agrawal, 9/12/24
- Vice Provost for Academic Affairs, Professor Jeanette Taylor, 9/13/24