

A Proposal for a

**MASTER OF SCIENCE DEGREE IN ARTIFICIAL
INTELLIGENCE**



Marlan and Rosemary Bourns College of Engineering
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Submitted by

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A Proposal for a	1
EXECUTIVE SUMMARY	5
SECTION 1: INTRODUCTION	6
1.1 Program Objectives	6
1.2 Historical Development of the Field and Departmental Strengths	6
1.3 Enrollment Projections	7
1.4 Relation to Other Programs in UCR and the UC System	7
1.5 Contributions to Diversity	8
1.6 Comments from other UC programs	9
1.7 Administration of the Program	9
1.8 Evaluation of the Program	9
SECTION 2: PROGRAM	10
SECTION 3: PROJECTED NEEDS	13
SECTION 4: PROGRAM FACULTY AND STAFF	17
SECTION 5: COURSES	18
SECTION 6: RESOURCE REQUIREMENTS	19
SECTION 7: GRADUATE STUDENT SUPPORT	20
SECTION 8: GOVERNANCE	21
SECTION 9: SENATE REGULATION CHANGES	22
Appendix	23
APPENDIX A: PROGRAM BYLAWS	23
APPENDIX B: NEW COURSE SYLLABI	25
APPENDIX C: LETTERS OF SUPPORT & MOUs	25
APPENDIX D: COMPARABLE PROGRAM FEEDBACK	25

EXECUTIVE SUMMARY

This document is a proposal for a (state-supported) Master of Science (M.S.) degree in **Artificial Intelligence (AI)**, to be offered by the Departments of Computer Science and Engineering (CSE) and Electrical and Computer Engineering (ECE) in the Marlan and Rosemary Bourns College of Engineering at the University of California, Riverside. Degree requirements and administration of the program are described in this document.

Artificial Intelligence has become a foundational technology impacting nearly every sector of the economy. Recent advances in deep learning and generative models have significantly expanded the scope and impact of AI systems, increasing demand for professionals with deep technical expertise in AI methods and systems. As a result, there is a growing need for graduate-level training programs that provide a rigorous preparation in artificial intelligence that is more focused than a typical computer science master's degree.

At UCR, instruction and research in artificial intelligence, machine learning, data mining, computer vision, natural language processing, robotics, and related areas have long been strengths of the CSE and ECE departments. While AI-related courses are regularly offered and are among the most popular electives in the Computer Science program, the current degree structure does not permit students to obtain a focused master's-level education dedicated specifically to artificial intelligence. The proposed M.S. in Artificial Intelligence is designed to address this gap by providing a coherent curriculum centered on the foundations of modern AI.

The proposed program emphasizes both theoretical foundations and hands-on experience. Students will gain in-depth knowledge of machine learning, deep learning, probabilistic modeling, and AI systems, while also developing practical skills through project-based coursework and a capstone experience focused on real-world applications. The program is intended to prepare graduates for AI-focused careers in industry, government, and research, as well as to provide a strong foundation for students who may later pursue doctoral studies.

The M.S. in Artificial Intelligence will be built on existing graduate courses offered by the CSE and ECE departments. The program will leverage existing instructional facilities, computing resources, and faculty expertise. No new facilities or infrastructure are required.

The proposed M.S. in Artificial Intelligence complements existing graduate programs at UCR, including the M.S. in Computer Science, the M.S. in Computational Data Science, and the M.S. in Robotics, by offering a distinct and clearly defined pathway focused specifically on artificial intelligence. It is also complementary to a parallel effort from the College of Natural and Agricultural Sciences to establish an M.S. in Applied AI for Science; the two colleges have discussed both programs and mutually agreed to support their creation. This proposed MS focuses on foundational AI concepts and prepares students to work across a variety of AI related industries. The MS in Applied AI for Science focuses instead on how to apply AI tools to various scientific problems. As a result, these programs complement each other. Together, these programs reflect a coordinated, university-wide response to increasing student interest and workforce demand for advanced training in AI.

SECTION 1: INTRODUCTION

1.1 Program Objectives

The objective of the Master of Science in Artificial Intelligence (MS in AI) is to provide rigorous training in the specialized algorithms, theories, and applications that drive intelligent systems. Unlike a traditional MS in Computer Science, which provides broad coverage of computing systems, software engineering, and theory, the MS in AI focuses exclusively on the core disciplines of machine intelligence: machine learning, deep learning, computer vision, natural language processing (NLP), and robotics.

Students in this program will gain a deep understanding of the mathematical foundations of AI (optimization, probabilistic reasoning, linear algebra) and the engineering skills required to deploy these models in real-world environments. A key objective of the program is to prepare students for specialized roles such as Machine Learning Engineer, AI Scientist, and Computer Vision Engineer—roles that require a level of technical depth often unattainable in generalist CS and ECE degrees.

The program aims to admit students with strong quantitative backgrounds, including degrees in Computer Science, Mathematics, Statistics, Physics, and Engineering. We expect applicants to demonstrate competence in calculus, linear algebra, and probability, as the curriculum emphasizes the mathematical underpinnings of modern AI systems.

1.2 Historical Development of the Field and Department Strengths

Artificial Intelligence has evolved from a theoretical subfield of Computer Science into a transformative general-purpose technology. The recent explosion in Generative AI and Large Language Models (LLMs) has fundamentally changed the scientific and industrial landscape, creating an urgent demand for a workforce capable of not just using AI tools, but designing, verifying, and optimizing them.

UCR is uniquely positioned to offer this degree due to a recent and rapid expansion of faculty expertise in core AI disciplines. The Department of Computer Science and Engineering (CSE) and the Department of Electrical and Computer Engineering (ECE) have critically strengthened their research profile in AI.

- **Machine Learning Foundations:** Established faculty (e.g., **Greg Ver Steeg**, **Christian Shelton**, **Vagelis Papalexakis**, **Yinglun Zhu**) provide the essential theoretical backbone in generative models, graphical models, tensor decomposition, and graph neural networks.
- **Computer Vision and Computational Imaging:** Faculty such as **Salman Asif**, **Vishwanathan Saragadam**, and **Amit Roy-Chowdhury** lead cutting-edge research in computational sensing, physics-based imaging, and visual analysis.

- **Robotics and Autonomous Systems:** Faculty including **Jiachen Li, Igor Spasojevic, Jun Sheng, Mingyu Cai, Ioannis Karamouzas** and **Konstantinos Karydis** provide strength in motion planning, crowd simulation, and embodied AI.
- **Natural Language Processing:** With the addition of faculty such as **Yue Dong** and **Yinglun Zhu**, the department has deepened its expertise in text generation, summarization, and large language models.
- **Trustworthy and Reliable AI:** New faculty like **Zhouxing Shi, Basak Guler**, and **Emiliano De Cristofaro** bring critical expertise in formal verification, neuro-symbolic AI, and ensuring the safety and robustness of ML models.

This concentration of expertise, combined with the resources of the newly formed RAISE@UCR AI Institute, allows UCR to offer a comprehensive AI curriculum that rivals top-tier institutions.

1.3 Enrollment Projections

We aim to start with a cohort of approximately 20 students in the first year, reaching a steady state of around 60 students within five years.

- **Year 1:** 20 students
- **Year 2:** 30 students
- **Year 3:** 40 students
- **Year 4:** 50 students
- **Year 5:** 60 students

These projections are consistent with the high demand for AI specialization seen at peer institutions and the general growth of graduate enrollment in BCOE. We do not anticipate this program will significantly reduce enrollment in the MS in Computer Science or Robotics; rather, it will attract a different pool of applicants specifically seeking specialized AI training who might otherwise choose dedicated AI programs at other universities.

We anticipate strong international interest in the program, in part because the MS in Artificial Intelligence will be designated under a STEM CIP code, making graduates eligible for a 24-month OPT extension and up to three years of post-graduation work authorization in the United States. At the same time, we are committed to building a diverse and domestically representative cohort. BCOE's established outreach infrastructure and partnerships with undergraduate institutions will support active recruitment of domestic students, including those from underrepresented communities.

1.4 Relation to Other Programs in UCR and the UC System

The MS in AI is distinct from existing programs at UCR in the following ways:

MS in Computer Science (CSE): The MS in CS is a broad degree requiring coverage of general computing infrastructure — operating systems, compilers, computer architecture, and theory. The MS in AI replaces these general computing requirements entirely with focused

coursework in mathematical foundations of learning, advanced AI techniques, and intelligent system design. A CS graduate and an AI graduate will have almost no overlap in core courses. MS students in CS can take AI courses for their electives, they have limited slots and would not be able to achieve the depth and breadth of AI coverage that an MS in AI would achieve.

MS in Electrical Engineering (EE): The MS in EE is a broad degree in which students choose one of three focus areas: Signals, Systems, and Machine Intelligence (SSMI); VLSI Circuits and Systems (VCS); and Nanomaterials and Devices (NMD). While the SSMI track includes themes in machine learning and robotics/computer vision, these represent a subset of AI rather than a coherent, integrated program. The MS in AI provides the systematic breadth and depth — spanning foundations of ML, deep learning, reinforcement learning, NLP, computer vision, and AI ethics — that no single EE track can offer.

MS in Computational Data Science (CDS): The MS in CDS is centered on the data lifecycle — acquisition, cleaning, mining, management, and visualization of large datasets. The MS in AI is concerned with what happens after the data pipeline: building intelligent agents and models that learn, reason, and make decisions. The technical core is fundamentally different, emphasizing deep learning architectures, reinforcement learning, and probabilistic modeling rather than data engineering and analytics.

MS in Robotics (CSE/ECE/ME): The MS in Robotics is organized around physical systems — hardware integration, control theory, kinematics, and electromechanical implementation. The MS in AI focuses on the computational intelligence that may power such systems — perception, planning, and learning — but is not constrained to robotic applications. A robotics student learns how to build and move a system; an AI student learns how to make any system think.

System-wide Context: Several other UC campuses have launched or are launching AI-related degrees.

- **UCI:** Offers a Master of Applied Artificial Intelligence for Science. Unlike our proposed state-supported technical MS, the UCI program is self-supporting and specifically targeted at applying AI to physical sciences.
- **UCLA:** Offers an MEng with an AI focus, which is a professional degree rather than a research-oriented MS.
- **UCSD:** Offers a Master of Data Science and Engineering but does not yet have a standalone MS in AI.

Our proposed MS in AI differentiates itself by offering a technical, state-supported curriculum that balances theoretical rigor (suitable for PhD preparation) with the applied skills (ML Ops, deployment) demanded by industry.



Figure: A map of *undergraduate* AI majors compiled by an NSF-funded study and made available at <https://cicmap.ai/> shows the rapid spread of AI-focused education.

1.5 Contributions to Diversity

The lack of diversity in AI and computer science — particularly among women and underrepresented minorities (URMs) — is a well-documented and urgent challenge. AI is not only among the least diverse technical fields but is also one whose outputs directly reflect the composition of those who build it: biased training data and homogeneous development teams produce systems that can perpetuate or amplify social inequities. Addressing this problem is therefore both an ethical imperative and a practical necessity for the field.

The scale of underrepresentation is significant. According to the Stanford AI Index 2024, women hold only 22% of AI roles and 18% of AI research positions worldwide

(<https://hai.stanford.edu/ai-index/2024-ai-index-report>). The NSF reports that women earned only 26% of bachelor's degrees in mathematical and computer sciences in 2020, and Hispanic/Latino students, while comprising 22% of the U.S. college-age population, received only 17% of science and engineering bachelor's degrees

(<https://www.congress.gov/bill/118th-congress/senate-bill/4028/text/is>). These gaps widen further at the graduate level and in specialized fields like AI and machine learning.

UCR is exceptionally well positioned to address this challenge. As a federally designated Hispanic Serving Institution (HSI) and Asian American and Native American Pacific Islander Serving Institution (AANAPISI), UCR has a demonstrated institutional commitment to serving students from underrepresented communities. More than 80% of UCR undergraduates identify as people of color, and approximately 40% are Latino/Chicano — making UCR one of the most racially and ethnically diverse research universities in the nation

(<https://diversity.ucr.edu/hispanic-serving-institution-hsi-committee>). The proposed MS in Artificial Intelligence will leverage this distinctive institutional context to contribute meaningfully to broadening participation in one of the most consequential and currently least-diverse technical fields.

Vision

The MS in AI program is committed to enrolling and retaining a student body that reflects the diversity of UCR and of California's workforce. Within the first two years, we aim to meet or exceed the current BCOE MS enrollment benchmarks for women (~23%) and URMs (~13%). Our targets for year four are 30% women and 18% URMs, rising to approximately 35% women and 22% URMs by year five. These goals are ambitious but realistic given UCR's institutional strengths and the program's specific recruitment and support strategies outlined below.

We will follow the evidence-based best practices below for recruitment, retention, and success of diverse student populations in STEM and computing, adapted from the research literature and from UCR's existing diversity initiatives.

- Minimize or remove the presence of ambient stereotypes in the classroom [CP+2009].
- Include real-world context in the curriculum [BD2016], [DF2007].
- Emphasize collaborative problem solving and interdisciplinary projects [PH+2007], [PW2009].
- Provide multiple pathways to attract computing majors [PH+2007].
- Enable student participation in undergraduate research programs [CS+2014], [CC+2009], [DF2007], [GTH2016], [VG+2013], [WH+2012].

- Provide introductory course options that separate students with prior experience in computer science from those with no experience [CL2011].
- Provide learning environments other than those expected in the normative culture of computer science [SA+2015].
- Enlist a diverse team of faculty, instructors, and mentors.
- Perform active assessment and refinement of institutional culture and practices with an eye to inclusivity.

Citations on best practices

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[DF2007] Davis, C. G., & Finelli, C. J. (2007). Diversity and retention in engineering. *New Directions for Teaching and Learning*, 2007(111), 63–71.

[PH+2007] Peckham, J., Harlow, L. L., Stuart, D. A., Silver, B., Mederer, H., & Stephenson, P. D. (2007, June 23–27). Broadening participation in computing: Issues and challenges [Paper presentation]. ITiCSE 2007, Dundee, Scotland, United Kingdom.

[PW2009] Pulimood, M., & Wolz, U. (2009, March 12–15). Problem solving in community: A necessary shift in CS pedagogy [Paper presentation]. SIGCSE 2008, Portland, OR, United States.

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[GTH2016] Gates, A. Q., Thiry, H., & Hug, S. (2016). Reflections: The computing alliance of Hispanic-serving institutions. *ACM Inroads*, 7(4), 69–73.

[VG+2013] Villa, E. Q., Kephart, K., Gates, A. Q., Thiry, H., & Hug, S. (2013). Affinity Research Groups in practice: Apprenticing students in research. *Journal of Engineering Education*, 102(3), 444–466. <https://doi.org/10.1002/jee.20016>

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[CL2011] Cohoon, J., & Luther, T. (2011, March 9–12). Analysis of a CS1 approach for attracting diverse and inexperienced students to computing majors [Paper presentation]. SIGCSE 2011, Dallas, TX, United States.

[SA+2015] Simon, R. A., Aulls, M. W., Dedic, H., Hubbard, K., & Hall, N. C. (2015). Exploring student persistence in STEM programs: A motivational model. *Canadian Journal of Education*, 38(1), 1–27.

Recruitment

UCR's HSI status and its deep roots in the Inland Empire provide a natural recruitment pipeline for underrepresented students. The MS in AI will actively recruit from UCR's undergraduate programs in CSE, ECE, Mathematics, and Statistics, as well as from nearby HSIs in Southern California — including Cal State San Bernardino, Cal Poly Pomona, California Baptist University, and La Sierra University. Recruitment will emphasize the program's STEM-OPT eligibility and the strong career outcomes associated with AI specialization.

The program will also build on existing BCOE diversity infrastructure, including:

- Google exploreCSR awards received by BCOE faculty, which support workshops to demystify graduate admissions and provide summer research experiences for students from historically marginalized groups (aligned with BP5).
- NSF CAHSI (Computing Alliance of Hispanic-Serving Institutions) grant activities that expose underrepresented undergraduates to research pathways and graduate school preparation (aligned with BP4, BP5). Several AI faculty have already been successful in winning these awards to support Hispanic students.
- Bridge program pathways under development by CSE and ECE, allowing students from non-CS backgrounds (e.g., Biology, Economics, Physics) to complete foundational coursework and transition into the MS in AI, broadening the applicant pool and entry points (aligned with BP4, BP6).

Curriculum and Pedagogy

The MS in AI curriculum is designed with inclusion in mind. Several features directly address barriers that have historically limited participation by underrepresented students:

- Ethics as a core requirement. CS 212 / STAT 212 (Data Science Ethics) is mandatory for all students. This course addresses algorithmic bias, fairness, and the societal impacts of AI systems — ensuring that graduates understand and can mitigate harms that disproportionately affect marginalized communities (aligned with BP2).
- Real-world, collaborative capstone. The CS/EE 279 Capstone Project uses project-based learning (PBL) in which student teams design and evaluate AI systems for real-world applications. This format has been shown to increase engagement among students from underrepresented backgrounds and to foster the collaborative skills valued in diverse workplaces (aligned with BP2, BP3).
- Interdisciplinary breadth electives. The breadth elective structure allows students to connect AI methods to domains such as computational biology, autonomous systems, and information retrieval — making the field more accessible to students entering from non-traditional CS backgrounds (aligned with BP4).
- Addressing ambient stereotypes. Program faculty will be encouraged to participate in inclusive pedagogy workshops, in line with BCOE's ongoing ADVANCE and Northeastern Center of Inclusive Best Practices grant activities, to reduce stereotype threat in the classroom (aligned with BP1, BP7, BP8).

Outreach

MS in AI students will be encouraged to engage with the broader community through BCOE student organizations with strong outreach records, including IEEE@UCR, ACM@UCR, and

Women in Computing (WinC). Specific opportunities include participation in RoseHack (a women-centric hackathon), the ECE department's annual robotics camp for middle and high school students, and UCR's role as a WiDS (Women in Data Science) ambassador site. Graduate students in the program will also be encouraged to mentor undergraduates through programs such as the Chicano Link Peer Mentor Program and the Sankofa Mentorship Program, creating a pipeline that reinforces diversity at multiple levels.

Assessment of Diversity Goals

The Program Oversight Committee will track diversity metrics annually, including enrollment and retention rates disaggregated by gender and race/ethnicity, and will report these to the BCOE Dean. The committee will also conduct anonymous student surveys at the end of each academic year to collect qualitative feedback on program climate and inclusivity. These data will inform continuous improvement of recruitment, curriculum, and mentoring practices. The program will collaborate closely with the CSE and ECE Broadening Participation in Computing (BPC) committees to align assessment with departmental and college-wide initiatives.

Faculty Diversity

A diverse faculty is essential to creating an inclusive program environment and to serving as role models for students from underrepresented groups (aligned with BP8), and our program faculty includes females and URM. Program faculty will be encouraged to participate in the training and resources provided through BCOE's NSF ADVANCE grant, including workshops on unconscious bias and bystander intervention. The Program Director will also work with the Dean's office to identify and support faculty from underrepresented groups in taking on leadership roles within the program.

1.6 Comments from other UC programs

To be updated after the system-wide review.

1.7 Administration of the Program

The program will be led by a Program Director, assisted by an Associate Director. While the Director will focus on the overall program and coordination among the departments, the Associate Director will serve the role of Graduate Advisor taking care of all graduate student advising issues within the program. A staff member will help the faculty Directors in administering the program. The program faculty will consist of Senate faculty in related research areas from the two departments (see list of the initial program faculty in Section IV). In the interest of efficient administration, a core group of faculty will be appointed to oversee the program and coordinate efforts with the two departments. This Oversight Committee will consist of 5 faculty from the two departments (three from CSE and two from ECE), including the Director and Associate Director.

This proposal was created by the following group of faculty:

Committee:

- Greg Ver Steeg (CSE) - Committee Chair
- Salman Asif (ECE)
- Ioannis Karamouzas (CSE)
- Nanpeng Yu (ECE)

Advisors:

- Vassilis Tsotras (CSE)
- Amit Roy-Chowdhury (ECE)

1.8 Evaluation of the Program

As is the norm for all graduate programs at the UCR campus, the program will follow the Senate-mandated review (once every six or seven years). Beginning with the second year, the Program Committee will initiate an internal review of the M.S. in Artificial Intelligence Program.

SECTION 2: PROGRAM

2.1 Admission Requirements

All applicants to this program must have completed a Bachelor's degree or its approved equivalent from an accredited institution and have attained an undergraduate record that satisfies the standards established by the Graduate Division and University Graduate Council.

We expect applicants to have a strong quantitative background with specific competence in programming, calculus, linear algebra, and probability. Competence in these areas is defined by the following UCR undergraduate courses (or their equivalents):

- **CS 10C or EE 16:** Introduction to Data Structures and Algorithms / Data Analytics for Engineering Applications
- **MATH 10A:** Calculus of Several Variables
- **MATH 31 or EE 20B:** Applied Linear Algebra / Linear Methods for Engineering Analysis and Design Using MATLAB
- **STAT 155 or EE 114:** Probability/Statistics for Science and Engineering

Applicants who fail to meet these criteria may be admitted with course deficiencies, provided they take remedial steps to cover the deficiencies. A student who is deficient in a competency area may be asked to complete the corresponding UCR course with a letter grade of at least B, or to pass a challenge examination. All such remedial work cannot be counted towards the MS degree requirements and should be completed within the first year of graduate study. In all cases, the deficiency(s) must be corrected **BEFORE** a student can enroll in any graduate course from the same specialty area. The details will be decided by the Graduate Advisor of the program in consultation with the student. Applicants whose first language is not English are required to submit acceptable scores from the TOEFL or IELTS unless they have a degree from an institution where English is the exclusive language of instruction.

2.2 Artificial Intelligence MS Program

The MS in Artificial Intelligence is a **49-unit** program designed to be completed in **4 quarters**. It consists of 12 four-unit graduate courses (48 units) and 1 unit of professional development (colloquium).

The curriculum is divided into **Core Courses** (20 units), **Elective Courses** (24 units), a **Capstone Project** (4 units), and a **Professional Development** requirement (1 unit). The program follows the Master's II Plan (Capstone). Students can petition to replace the Capstone with an optional Master's research project, as described below.

Core Courses (24 units): All students must complete the following six mandatory courses:

1. **CS 205:** Artificial Intelligence
2. **CS 224 / EE 242A:** Foundations of Machine Learning

3. **CS 228 / EE 228:** Introduction to Deep Learning
4. **CS 258 / EE 227:** Introduction to Reinforcement Learning
5. **CS 212 / STAT 212:** Data Science Ethics

Elective Courses (20 units): Students must complete **5 elective courses** from defined "Depth" and "Breadth" lists.

- **Depth Requirement:** Students must choose at least **3 courses** from the Depth List (advanced technical AI/ML courses).
- **Breadth Requirement:** Students must choose at most **2 courses** from the Breadth List (applications of AI or complementary computing areas).

Depth Elective List

1. CS 210: Scientific Computing OR EE 230: Mathematical Methods for Electrical Engineers
2. CS 222: Natural Language Processing
3. CS 227: Probabilistic Models for Artificial Intelligence
4. CS 229 / EE 242B: Machine Learning
5. CS 235: Data Mining Techniques OR STAT 208: Statistical Data Mining Methods
6. CS/EE 248: Optimization for Machine Learning
7. CS/EE 265A: Foundations of Robotics: Planning and Control
8. EE 243: Advanced Computer Vision
9. EE268: Trustworthy AI for Autonomy
10. EE269: Foundation Models and Advances in AI

Breadth Elective List

1. CS 225: Spatial Computing
2. CS 226: Big Data Management
3. CS 230: Computer Graphics
4. CS 231: Computer Animation
5. CS 236: Database Management Systems
6. CS 238: Computational Biology
7. CS 242: Information Retrieval
8. CS 252A / EE251A: Data Analytics and Exploration
9. CS/EE 265B: Foundations of Robotics: Sensing and Navigation
10. EE/ME 239: Optimal Control
11. EE 240: Computational Learning
12. EE 241a: Advanced Digital Image Processing (recently renumbered from 241 to 241a)
13. EE 241b: Computational Imaging (recently approved course)
14. EE 247: Advanced Topics in Computer Vision and Pattern Recognition
15. EE 250: Information Theory
16. EE 267: Introduction to Autonomous Driving Systems

Capstone Experience (4 units): Students must complete the capstone course CS/EE 279: Capstone Project in Data Science/AI (existing course title to be broadened). This course covers combining technical, analytic, and interpretive skills to design and execute a large-scale AI project with a focus on real-world applications. It provides an opportunity to integrate all core skills learned throughout the program. Students will work in teams to propose, implement, and evaluate an AI system, emphasizing collaboration and communication in both written and oral forms. Alternately, students may petition to use a research project with a faculty advisor for their Capstone experience. In that case, the final project has to be presented to, and approved by, a committee of at least two faculty members.

Professional Development Requirement (1 unit): Students will satisfy the professional development requirement by enrolling in CS 287 (Colloquium in Computer Science) or an equivalent 1-unit professional development seminar approved by the Graduate Advisor.

2.3 Other Requirements There are no field or qualifying examinations. There is no thesis/dissertation requirement.

2.4 Sample Program

The following is a sample four-quarter (16-month) plan for a full-time student to complete the 49-unit MS in Artificial Intelligence program:

Term	Courses	Units
Year 1, Fall	CS 205: Artificial Intelligence (4), CS 224 / EE 242A: Foundations of Machine Learning (4), Elective (4)	12
Year 1, Winter	CS 229 / EE 242B: Machine Learning (4) as Elective, CS 228 / EE 228: Introduction to Deep Learning (4), Elective (4), CS 287: Colloquium (1)	13
Year 1, Spring	CS 258 / EE 227: Introduction to Reinforcement Learning (4), CS 212 / STAT 212: Data Science Ethics (4), Elective (Depth) (4)	12
Year 2, Fall	Elective (4), Elective (4), CS/EE 279: Capstone Project (4)	12
Total Units		49

Note: The total unit count of 49 includes 5 Core Courses (20 units), 6 Elective Courses (24 units), the Capstone Project (4 units), and Professional Development (1 unit). This schedule requires 12 units per term, except for Winter (13 units). Students may adjust the distribution of electives and the Capstone over the final two quarters in consultation with the Graduate Advisor.

SECTION 3: PROJECTED NEEDS

3.1 Student Demand and Opportunities

Student interest in Artificial Intelligence has exploded in recent years, mirroring the rapid adoption of AI technologies in industry and society. At UCR, this interest is visible in the overwhelming demand for undergraduate and graduate courses related to AI and Machine Learning.

- **Undergraduate Demand:** Enrollment in our primary undergraduate AI courses—**CS 170 (Introduction to Artificial Intelligence)** and **CS 171 (Introduction to Machine Learning)**—is consistently strong. These courses are taught multiple times per year.
- **Graduate Demand:** Our existing graduate courses in Machine Learning (**CS 224, CS 229**) and Deep Learning (**CS 228**) are among the most heavily subscribed in the College of Engineering. Current MS CS students frequently exhaust their elective options seeking more AI-specific content.
- **Global Trends:** According to the **2024 AI Index Report** by Stanford University, the number of AI-related degree programs in North America has tripled since 2017 (<https://hai.stanford.edu/ai-index/2024-ai-index-report>, page 22). This surge reflects a shift in student preference from general computer science to specialized training in intelligent systems.

3.2 Opportunities for Placement of Graduates

The job market for AI specialists is distinct from, and growing faster than, the general software engineering market. Graduates of this program will be positioned for high-demand roles such as *AI Engineer, Machine Learning Engineer, Computer Vision Engineer, and AI Research Scientist*.

- **Job Market Growth:** The **World Economic Forum's "Future of Jobs Report 2023"** identifies "AI and Machine Learning Specialists" as the fastest-growing job role globally, with a projected growth of 40% by 2027 (<https://www.weforum.org/publications/the-future-of-jobs-report-2023/>, Ch. 4.2).
- **Emerging Roles:** LinkedIn's **"Jobs on the Rise" (2026)** lists "Artificial Intelligence Engineer" as the #1 fastest-growing job in the United States (<https://www.linkedin.com/pulse/linkedin-jobs-rise-2026-25-fastest-growing-roles-us-linkedin-news-dlb1c/>). This reflects a shift in industry needs: companies no longer just need data analysts; they need engineers capable of designing, training, and deploying complex neural network architectures.
- **Salary and Value:** Specialized roles in Deep Learning and Computer Vision command a significant salary premium. Industry data from 2024 indicates that AI Engineers and Deep Learning Engineers earn average base salaries exceeding \$160,000, significantly higher than general Data Scientist roles.
- **National Needs:** The U.S. Bureau of Labor Statistics projects that employment for **Computer and Information Research Scientists** (the category encompassing AI researchers) will grow 20% from 2024 to 2034, classified as "much faster than average"

<https://www.bls.gov/ooh/computer-and-information-technology/computer-and-information-research-scientists.htm>).

3.3 Importance to the Discipline

Artificial Intelligence has evolved from a subfield of Computer Science into a "General Purpose Technology" that is fundamentally reshaping the engineering discipline.

- **The "Software 2.0" Paradigm:** As described by Andrej Karpathy (former Director of AI at Tesla), the field is undergoing a transition from "Software 1.0" (programmers writing explicit code) to "Software 2.0" (programmers curating data and defining optimization criteria for neural networks). This shift requires a fundamentally different educational approach—focusing on probability, optimization, and data curation rather than just traditional logic and control flow.
- **Scientific Discovery:** Tools like AlphaFold have revolutionized biology, and AI simulations are accelerating materials science and physics. An MS in AI is essential to train the next generation of "AI for Science" researchers who can bridge the gap between computational methods and domain sciences.

3.4 Meeting the needs of Society

The societal impact of AI is profound, creating a need for professionals who are not only technically proficient but also ethically grounded.

- **Workforce Readiness:** As AI automates routine cognitive tasks, the workforce must transition to roles that involve managing, tuning, and verifying AI systems. This program directly addresses this workforce transformation.
- **Ethical AI:** By including **CS 212 (Data Science and AI Ethics)** as a core requirement, this program ensures that graduates are prepared to address the risks of algorithmic bias, hallucinations, and safety—critical concerns for the deployment of AI in healthcare, finance, and autonomous systems.

3.5 Relation to Research and Faculty Interests

This program is a natural extension of the robust research ecosystem at UCR. The Bourns College of Engineering has strategically hired faculty to build a critical mass in AI.

- **Core AI:** Faculty such as **Christian Shelton**, **Greg Ver Steeg**, and **Vagelis Papalexakis** lead research in foundational machine learning.
- **Generative & Trustworthy AI:** Recent hires including **Jiachen Lin** (Robotics), **Yue Dong** (NLP) and **Zhouxing Shi** (Reliable AI) bring state-of-the-art expertise in safe learning and control, Large Language Models, and verification.
- **Embodied AI:** Faculty such as **Ioannis Karamouzas**, **Konstantinos Karydis**, and **Salman Asif** bridge the gap between AI algorithms and the physical world (robotics, computational imaging). The MS in AI will serve as a pipeline for these research labs,

allowing master's students to contribute to cutting-edge projects via the Capstone or independent study.

3.6 Program Differentiation

The MS in Artificial Intelligence at UCR is distinct from other programs in the UC system and the Southern California region due to its state-supported status, engineering focus, and accessibility.

Differentiation from other UC Programs (System-wide and Local) While other UC campuses are establishing AI degrees, the UCR MS in AI fills a specific niche:

- **UC Irvine:** UCI recently approved a *Master of Applied Artificial Intelligence for Science*. That program is self-supporting (with significantly higher tuition) and is housed within the School of Physical Sciences, targeting students with science backgrounds who want to apply AI to their specific domain. In contrast, the UCR program is state-supported, housed in the College of Engineering, and targets students with strong quantitative/computing backgrounds who intend to become creators and architects of AI systems, rather than just applicators.
- **UC San Diego:** UCSD offers a *Master of Data Science and Engineering*, but it does not yet offer a standalone MS in Artificial Intelligence.
- **Professional Degrees (e.g. UCLA):** Many AI master's programs in the UC system like the "Master of Engineering" (MEng) with AI concentration offered by UCLA are self-supporting professional degrees designed for working professionals. Our program follows a traditional academic MS structure (Plan II), allowing for deeper theoretical engagement and direct interaction with Senate faculty research labs.

Differentiation from Internal UCR Programs

The MS in CS requires breadth across systems, theory, and architecture. The MS in AI replaces these generalist requirements with focused depth in machine learning, deep learning, and ethics, serving students who already know they wish to specialize. The MS in Robotics (jointly offered by CSE, ECE, and ME) focuses on the physical actuation, control, and kinematics of robots. The MS in AI focuses on the "computational foundations of intelligent systems"—perception, planning, and decision-making—making it distinct from Robotics degree emphasis on embodied cognition. The MS in CDS is centered on the data lifecycle — acquisition, cleaning, mining, management, and visualization of large datasets. The MS in AI is concerned with what happens after the data pipeline: building intelligent agents and models that learn, reason, and make decisions.

Differentiation from Private Institutions There are AI-related offerings from private Southern California institutions, such as the *MS in Computer Science (Artificial Intelligence)* at USC. Private programs often carry a very high cost of attendance. We believe we offer a highly competitive alternative: a rigorous, research-led program from a top-tier public research university at a price point that is accessible to a diverse student body. Unlike many private

"professional" master's degrees that rely heavily on adjunct lecturers, our program is taught primarily by tenure-track Senate faculty who are active researchers in the field.

SECTION 4: PROGRAM FACULTY AND STAFF

Due to the transformative nature of AI, a large number of faculty are associated with related topics. Below, we list faculty in the ECE and CSE who regularly teach some of the courses associated with the program. As with the existing M.S. degrees in Computational Data Science and Robotics, initial administrative support may be shared (using less than 1.0 FTE) and may increase gradually as the program matures. See Resource requirements section for more details.

Electrical and Computer Engineering (ECE)

- Salman Asif (Associate Professor, PhD; [Google Scholar](#))
- Bir Bhanu (Distinguished Professor, PhD; [Google Scholar](#))
- Basak Guler (Assistant Professor, PhD; [Google Scholar](#) | [dblp](#))
- Konstantinos Karydis (Associate Professor, PhD; [Google Scholar](#))
- Jiachen Li (Assistant Professor, PhD; [Google Scholar](#) | [dblp](#))
- Cong Liu (Professor, PhD; [Google Scholar](#))
- Shaolei Ren (Professor, PhD; [Google Scholar](#) | [dblp](#))
- Wei Ren (Professor, PhD; [Google Scholar](#))
- Amit K. Roy-Chowdhury (Professor, PhD; [Google Scholar](#))
- Vishwanath Saragadam (Assistant Professor, PhD; [Google Scholar](#) | [dblp](#))
- Igor Spasojevic (Assistant Professor, PhD; [Google Scholar](#) | [dblp](#))
- Nanpeng Yu (Professor, PhD; [Google Scholar](#))
- Yinglun Zhu (Assistant Professor, PhD; [Google Scholar](#) | [dblp](#))
- Jia Chen (Associate Teaching Professor, PhD; [Google Scholar](#))
- Fatemeh Asgarinejad (Assistant Teaching Professor, PhD; [Google Scholar](#))

Computer Science and Engineering (CSE)

- Ahmed Eldawy (Associate Professor, PhD; [Google Scholar](#))
- Yue Dong (Assistant Professor, PhD; [Google Scholar](#))
- Vagelis Hristidis (Professor, PhD; [Google Scholar](#))
- Ioannis Karamouzas (Associate Professor, PhD; [Google Scholar](#) | [dblp](#))
- Eamonn Keogh (Distinguished Professor, PhD; [Google Scholar](#) | [dblp](#))
- Paea LePendou (Associate Teaching Professor, PhD; [Google Scholar](#))
- Neftali Watkinson (Assistant Teaching Professor, PhD; [Google Scholar](#))
- Weizi Li (Assistant Teaching Professor, PhD; [Google Scholar](#))
- Amr Magdy (Associate Professor, PhD; [Google Scholar](#))
- Evangelos Papalexakis (Associate Professor, PhD; [Google Scholar](#) | [dblp](#))
- Mariam Salloum (Associate Teaching Professor, PhD; [Google Scholar](#))
- Christian Shelton (Professor, PhD; [Google Scholar](#) | [dblp](#))
- Greg Ver Steeg (Associate Professor, PhD; [Google Scholar](#) | [dblp](#))
- Zhouxing Shi (Assistant Professor, PhD; [Google Scholar](#))
- Vassilis Tsotras (Professor, PhD; [Google Scholar](#))

SECTION 5: COURSES

Existing Core Courses

CS 205 *Artificial Intelligence (4)* Lecture, 3 hours; research, 3 hours. Prerequisite(s): CS 170 or equivalent; graduate standing. Examines knowledge representation and automated reasoning and their use in capturing common sense and expert knowledge. Also addresses predicate and nonmonotonic logics; resolution and term rewriting; reasoning under uncertainty; theorem provers; planning systems; and belief networks. Includes topics in natural language processing, perception, logic programming, expert systems, and deductive databases. May be taken S/NC with consent of instructor and graduate advisor.

CS 224 / EE 242A *Foundations of Machine Learning (4)* Lecture, 3 hours; research, 3 hours. Prerequisite(s): CS 100; STAT 155 or EE 114; MATH 031; or consent of instructor; graduate standing. A study of generative and discriminative approaches to machine learning. Topics include probabilistic model fitting, gradient-based loss optimization, regularization, hyper-parameters, and generalization. Includes experience with data science programming environments, data from practice, and performance metrics. May be taken S/NC with consent of instructor and graduate advisor.

CS/EE 228 *Introduction to Deep Learning (4)* Lecture, 3 hours; research, 3 hours. Prerequisite(s): CS 224 or EE 231 or EE 236 or EE 244 or CS 171 or EE 142; graduate standing; or consent of instructor. Explores fundamentals of deep neural networks and their applications in various machine learning tasks. Includes fundamentals of perception, approximation, neural network architectures, loss functions, and generalization. Addresses optimization methods including backpropagation, automatic differentiation, and regularization. Covers non-standard problems including auto-encoders and probabilistic models. Presents applications in machine learning/computer vision. May be taken S/NC with consent of instructor and graduate advisor.

CS 258 / EE 227 *Introduction to Reinforcement Learning (4)* Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): EE 215 or EE 244 or CS 224 or EE 228 or CS 228 or EE 251B or CS 252B; graduate standing; or consent of instructor. Introduces key ideas and algorithms of reinforcement learning (RL). Topics include finite Markov Decision Processes (MDPs), dynamic programming, Monte Carlo methods, temporal-difference learning, policy gradient methods, safety-constrained RL, batch-constrained RL, multi-agent RL, multi-armed bandits, and imitation learning. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

CS 212 / STAT 212 *Data Science Ethics (4)* Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): CS 252A or EE 251A or CS 235 or CS 224 or STAT 207 or STAT 208; graduate standing. Covers ethics specifically related to data science. Topics include data privacy; data curation and storage; discrimination and bias arising in the machine learning process; statistical topics such as generalization, causality, curse of dimensionality, and sampling bias; data communication; and strategies for conceptualizing, measuring, and mitigating problems in

data-driven decision-making. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor. Credit is awarded for one of the following: CS 212, STAT 212, CS 108, or STAT 108.

Elective Depth Courses

CS 210 *Scientific Computing (4)* Lecture, 4 hours. Prerequisite(s): CS 010B, MATH 010A; MATH 031 or equivalent; graduate standing or consent of instructor. Utilizes scientific computing in a specific computer science research area. Provides a foundation for pursuit of further studies of special topics in scientific computing. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

EE 230 *Mathematical Methods For Electrical Engineers (4)* Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): graduate standing or consent of instructor. Covers fundamental theoretical concepts and computational tools for Electrical Engineering graduate students. Presents material relevant to electrical engineering applications. Topics include vector spaces; partitioned, unitary, and positive definite matrices; differential calculus with matrices; matrix decompositions; linear system solution; convex optimization; the Lagrangian method; KKT conditions; and nonlinear optimization methods. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

CS 222 *Natural Language Processing (4)* Lecture, 3 hours; individual study, 3 hours. Prerequisite(s): CS 171 or CS 172 or CS 173; CS 224 or CS 228 or CS 229; or equivalent; graduate standing; or consent of instructor. Introduces Natural Language Processing (NLP), the study of computing systems that understand or communicate with human language. Covers both historical and contemporary NLP tasks and the fundamental methods of NLP, particularly deep learning-based approaches. Topics include basic classification techniques, feedforward neural networks, attention mechanisms, and pre-trained neural models. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

CS 227 *Probabilistic Models for Artificial Intelligence (4)* Lecture, 3 hours; written work, 3 hours. Prerequisite(s): CS 224; graduate standing. Covers methods for representing and reasoning about probability distributions in complex domains. Focuses on graphical models and their extensions such as Bayesian networks, Markov networks, hidden Markov models, and dynamic Bayesian networks. Topics include algorithms for probabilistic inference, learning models from data, and decision making. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

CS 229 / EE 242B *Advanced Machine Learning (4)* Lecture, 3 hours; research, 3 hours. Prerequisite(s): CS 171 or EE 142 or CS 224 or EE 242A; for the CS 229/EE 242B online section: enrollment in the Online Master-of-Science in Engineering program; graduate standing. Advanced topics in generative and discriminative methods in supervised, unsupervised, and robust learning. Prepares students for research in modern machine learning and applications. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

CS 235 *Data Mining Techniques (4)* Lecture, 3 hours; term paper, 1.5 hours; activity, 1.5 hours. Prerequisite(s): CS 141; CS 170 is recommended. CS 235 online section: enrollment in the online Master of Science in Engineering program; graduate standing. Provides a broad background in the design and use of data mining algorithms and tools. Includes clustering, classification, association rules mining, time series clustering, and Web mining. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

STAT 208 *Statistical Data Mining Methods (4)* Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): STAT 201A; STAT 201B; STAT 202A; graduate standing; or consent of instructor. Covers principal data-mining methodologies and applications. Includes Bayes and LDA classifiers, logistic regression and neural network classifiers, support vector classifiers, classification trees, predictive modeling, ridge and lasso regressions, k-means and dendrogram clustering methods, business analytics, and mining association rules. Features R and SAS programming languages.

CS 248 / EE 248 *Optimization for Machine Learning (4)* Lecture, 3 hours; research, 3 hours. Prerequisite(s): CS 229 or EE 231 or EE 244; graduate standing; or consent of instructor. Explores efficient optimization algorithms for machine learning. Emphasizes fundamental principles, provable guarantees, and contemporary results. Includes fundamentals of optimization (first-order methods, stochastic algorithms, accelerated schemes, non-convex optimization, regularization, and black-box optimization). Also covers connections to statistical learning (empirical risk minimization, finite-sample guarantees, and high-dimensional problems). May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

CS/EE 265A *Foundations of Robotics: Planning and Control (4)* Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): graduate standing; or consent of instructor. Provides a theoretical and practical introduction to fundamental concepts used for the development of robotic systems. Covers robot kinematics; motion planning algorithms; robot motion control; and state estimation. Uses mobile robots to teach contemporary robotics software (ROS, Gazebo) that integrates the taught concepts to develop autonomous robot applications.

EE 243 *Advanced Computer Vision (4)* Lecture, 3 hours; research, 3 hours. Prerequisite(s): EE 146 or EE 152 or EE 142 or CS 171 or CS 224 or EE 228 or CS 228 or EE 241 or EE 244; graduate standing or consent of instructor. For the EE 243 online section: enrollment in the Online Master-of-Science in Engineering program; graduate standing; or consent of instructor. Study of advanced computer vision including classical- and learning-based approaches. Topics include feature extraction, segmentation, motion analysis and tracking, object and activity recognition, projective geometry, modeling and calibrating cameras, and three-dimensional reconstruction. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

EE 268 *Trustworthy AI for Autonomy (4)* Lecture, 3 hours; research, 3 hours. Prerequisite(s): EE 142 or EE 146 or EE 148 or CS 148 or CS 171; or equivalent; graduate standing; or consent of instructor. Introduces core principles and practices for developing safe, reliable AI in autonomous systems and robotics, covering foundational and advanced concepts in trustworthy

AI and machine learning. Integrates cutting-edge research on building safe, robust, generalizable, and explainable systems, emphasizing the critical role of trust and ethics in AI deployment. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

EE 269 *Foundation Models and Advances in AI (4)* Lecture, 3 hours; research, 3 hours. Prerequisite(s): CS 228, EE 228, EE 242A, CS 224; graduate standing; or consent of instructor. Explores key concepts in foundation models and recent advances in AI. Covers model architectures such as attention, transformers, and state space models; training pipelines including pretraining, fine-tuning, and reinforcement learning from human feedback; data acquisition strategies; tool augmentations; multimodal models; and techniques for efficient training and inference.

Elective Breadth Courses

CS 225 *Spatial Computing (4)* Lecture, 3 hours; individualized study, 3 hours. Prerequisite(s): graduate standing; or consent of instructor. Introduction to spatial computing technologies and techniques. Covers the fundamentals, current methods, and emerging use cases of spatial data analysis systems. Topics include spatial data modeling, spatial relationships, storage, indexing, query processing, and recent trends in the field. Includes a research-oriented project and hands-on experience with spatial technologies. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

CS 226 *Big-Data Management (4)* Lecture, 3 hours; term paper, 3 hours. Prerequisite(s): CS 166 or CS 236; graduate standing. Introduction to the architecture and design of big data management systems. Covers distributed file systems, high-throughput databases, and programming paradigms for big data including MapReduce and Resilient Distributed Datasets. Includes a course project with hands-on experience using open-source big data systems. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

CS 230 *Computer Graphics (4)* Lecture, 3 hours; research, 3 hours. Prerequisite(s): CS 141 or CS 218; MATH 031 or MATH 131; graduate standing or consent of instructor. Covers advanced topics in computer graphics and necessary fundamentals. Includes geometry representations; affine and perspective transforms; rendering with global illumination and other light models; shading and texture mapping; rasterization and anti-aliasing; and hierarchical and keyframe animation. Includes projects and/or in-depth programming assignments. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

CS 231 *Computer Animation (4)* Lecture, 3 hours; research, 3 hours. Prerequisite(s): CS 130 or CS 230; graduate standing. Covers topics in computer animation including motion capture, inverse kinematics, dynamic simulation, deformable systems, natural phenomena, facial animation, high-level behavior control, creature evolution, and procedural techniques. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

CS 236 Database Management Systems (4) Lecture, 3 hours; research, 3 hours.

Prerequisite(s): CS 141; CS 166 recommended; graduate standing; or consent of instructor. Covers principles of file systems; architecture of database management systems; data models; and relational databases. Examines logical and physical database design; hardware and software implementation; and distributed databases including query processing, concurrency, and recovery. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

CS 238 Algorithmic Techniques in Computational Biology (4) Lecture, 3 hours; research, 3 hours. Prerequisite(s): CS 141 or CS 218; graduate standing. A study of fundamental algorithms for solving combinatorial or computational problems in molecular biology and genomics. Includes sequence alignment and multiple alignment; bio-database search; gene and regulatory signal recognition; DNA sequence assembly; physical mapping; and reconstruction of evolutionary trees. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

CS 242 Information Retrieval and Web Search (4) Lecture, 3 hours; term paper, 1.5 hours; project, 1.5 hours. Prerequisite(s): CS 141, CS 166. CS 242 online section: enrollment in the online Master of Science in Engineering program. Introduces Information Retrieval (IR) principles and techniques for indexing and searching document collections, with emphasis on Web search. Includes text processing, ranking algorithms, search in social networks, search evaluation, and search engine scalability. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

CS 252A / EE 251A Data Analytics and Exploration (4) Lecture, 3 hours; research, 3 hours. Prerequisite(s): CS 141, CS 100; STAT 155 or EE 114 or equivalent; graduate standing; or consent of instructor. Covers important algorithms relevant to the lifetime of data from collection and cleaning to integration, mining, and analytics. Topics include sketch algorithms for data streams; mining social graphs including community detection and graph partitioning; and the Data Science life cycle including data cleaning, integration, exploratory data analysis, and visualization.

CS/EE 265B Foundations of Robotics: Sensing and Navigation (4) Lecture, 3 hours; individual study, 3 hours. Prerequisite(s): EE 245A; CS 224 or EE 242A; graduate standing; or consent of instructor. Covers fundamental topics in robot perception. Provides a theoretical and practical introduction to SLAM and discusses advanced topics in robot sensing and navigation. Teaches mechanisms that allow autonomous robots to move through real-world environments to perform tasks.

EE/ME 239 Optimal Control (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): EE 215, EE 235/ME 235; graduate standing. Presents the theory of stochastic optimal control systems and methods for their design and analysis. Covers principles of optimization; Lagrange's equation; linear-quadratic-Gaussian control; certainty equivalence; the minimum principle; the Hamilton–Jacobi–Bellman equation; and the algebraic Riccati equation. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

EE241a *Advanced Image Processing (4)* Lecture, 3 hours. This course introduces basic principles and tools employed in digital image processing. In a broader sense, this course is about processing high-dimensional visual signals such as images and videos. We will study mathematical models and computational algorithms that enable us to acquire, represent, manipulate, store/transmit, or understand information embedded in images and videos. We will explore how these models and algorithms can be applied to solve interesting problems in computational photography, medical imaging, computer vision, and other related disciplines.

EE241b *Computational Imaging (4)* Lecture, 3 hours. Explores the computational aspects of modern imaging systems including digital photography, focal stacks and light fields, high dynamic range imaging, light transport matrices, photometric stereo, diffractive optics, and novel camera systems.

EE 247 *Advanced Topics in Computer Vision and Pattern Recognition (4)* Lecture, 3 hours; research, 3 hours. Prerequisite(s): EE 243; graduate standing; or consent of instructor. Study of current topics in computer vision focused on machine learning approaches. Topics include image classification, segmentation, object detection, recognition, depth estimation, multimodal analysis, and multi-sensor analysis. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

EE 250: *Information Theory (4)* Lecture, 3 hours; extra reading, 3 hours. Prerequisite(s): EE 215. Provides an overview of fundamental limitations imposed on communication systems. Topics include Shannon's information measures; weak and strong typicality; lossless data compression; source and channel models; Shannon's coding theorems; channel capacity; the rate-distortion function; Gaussian sources and channels; and limits of communication between multiple terminals.

EE 267: *Introduction to Autonomous Driving Systems (4)* Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): EE 128 or EE 131 or EE 142 or EE 146 or EE 148 or EE 227 or CS 258 or EE 242A or CS 224 or CS 205 or CS 131 or CS 153 or CS 160 or CS 148; or equivalent; graduate standing; or consent of instructor. Introduces the state-of-the-art autonomous driving ecosystem from perception to prediction, localization, and planning, and from onboard compute to offboard simulation. Includes mapping, remote operation, and V2X communication. Discusses foundational methods, common practices, and frontier research. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

SECTION 6: RESOURCE REQUIREMENTS

All technical resources required for the proposed M.S. in Artificial Intelligence program are already available within CSE and ECE, including computing infrastructure, library resources, teaching laboratories, and research facilities. CSE maintains substantial computational resources to support coursework and research in machine learning, artificial intelligence, and related areas, and these resources are sufficient to support the proposed program.

The program will rely primarily on existing instructional facilities and shared computing resources, including departmental and campus-supported high-performance computing infrastructure where appropriate. No new specialized teaching laboratories are required for the operation of the program.

The only additional resources anticipated are office space for program administration and administrative staff support. The program will require up to one full-time equivalent (1.0 FTE) staff position for administrative support related to admissions, enrollment, student advising, and program coordination. As with the existing M.S. in Computational Data Science, initial administrative support may be shared (using less than 1.0 FTE) and may increase gradually as the program matures.

SECTION 7: GRADUATE STUDENT SUPPORT

Students enrolled in the M.S. in Artificial Intelligence program are expected to be primarily self-supported. As with other professional and coursework-focused master's programs, financial support in the form of Graduate Student Researcher (GSR) appointments or Teaching Assistantships (TAs) may be available on a limited, case-by-case basis, subject to departmental needs and availability of funds.

Students in the program may be eligible to apply for instructional or research assistant positions offered through the Department of Computer Science and Engineering or through affiliated research groups when such opportunities arise. Availability of such positions will depend on faculty research activity, instructional demand, and external funding, and is not guaranteed.

SECTION 8: GOVERNANCE

The M.S. in Artificial Intelligence program will be overseen by a Program Faculty consisting of Senate faculty whose research and teaching activities are aligned with artificial intelligence, machine learning, and related areas. Program Faculty members may support the program through instruction, student supervision, research activity, or program administration. All Program Faculty members are eligible to vote on matters related to the M.S. in Artificial Intelligence program.

The program will be led by a Program Director, appointed by the Dean of the Bourns College of Engineering in consultation with the Program Faculty. The Program Director will be responsible for the overall academic and administrative leadership of the program, including coordination of curriculum, teaching assignments, and program operations. A staff member will assist the Program Director with administrative duties related to admissions, enrollment, advising coordination, and program logistics. The Program Director will report to the Dean of the Bourns College of Engineering.

A Program Oversight Committee, consisting of a subset of the Program Faculty including the Program Director, may be appointed to assist with program governance and coordination. The Oversight Committee will advise on curriculum matters, program policies, and long-term planning, and will serve as a liaison between the program and the participating department(s). All substantive changes to the program or its curriculum will require approval by a majority of the Program Faculty.

SECTION 9: SENATE REGULATION CHANGES

No changes in Senate Regulations at the Divisional level or in the Assembly of the Academic Senate will be required.

Appendix

APPENDIX A: PROGRAM BYLAWS

I. Objective

A. The M.S. in Artificial Intelligence (MS AI) is housed in the Bourns College of Engineering (BCOE) at the University of California, Riverside, and is administered by the Department of Computer Science and Engineering (CSE) and the Department of Electrical and Computer Engineering (ECE).

B. The objective of the MS AI program is to provide advanced training in artificial intelligence, machine learning, and related areas. Students graduating from the program will gain a deep understanding of the foundational principles, algorithms, and systems underlying modern AI, as well as hands-on experience applying these methods to real-world problems.

II. Membership

A. The faculty associated with the program, referred to as the **Program Faculty**, is drawn from UCR Senate faculty in the Department of Computer Science and Engineering whose research or teaching activities align with the mission of the MS AI program.

B. Program Faculty members shall support the program through instruction of courses, supervision of students, activity in artificial intelligence research, or program administration.

C. All Program Faculty members are eligible to vote on matters related to the MS AI program.

D. All changes to the MS AI program or its curriculum must be approved by a majority vote of the Program Faculty.

E. UCR Senate faculty outside of CSE whose research or teaching activities align with the mission of the MS AI program may be appointed as **Cooperating Faculty**. Cooperating Faculty may participate in program activities and meetings but do not have voting rights.

F. Membership Changes

1. Nominations of prospective Program Faculty or Cooperating Faculty may be made by any Program Faculty member.
2. New Program Faculty or Cooperating Faculty shall be appointed by a majority vote of the Program Faculty, based on a review of the nomination and the recommendation of the Oversight Committee.
3. Members of the Program Faculty may terminate their association with the MS AI program by informing the Program Director in writing.
4. Participation as Program Faculty or Cooperating Faculty shall be reviewed every three years to ensure that members are meeting their obligations to the program.

III. Administration

A. Oversight Committee

A core group of faculty, referred to as the **MS AI Program Oversight Committee**, shall oversee the program and coordinate efforts within the department.

B. Composition

1. The Program Oversight Committee is chaired by the Program Director, or by the Associate Director in the Director's absence.
2. The Program Oversight Committee consists of five (5) members, including the Director and Associate Director, all of whom must be members of the Program Faculty.
3. All members of the Oversight Committee shall be drawn from the Program Faculty.

C. Duties

1. **Duties of the Program Director**

- Provide overall academic and administrative leadership for the program;
- Oversee the development and implementation of program policies;
- Represent the interests of the program to the College, Campus, and University administrators;
- Call and chair meetings of the Program Faculty and Oversight Committee;
- Manage the program's budget;
- Ensure the accuracy of publications related to the program, including web pages and catalog copy;
- Coordinate the program's teaching needs with departmental teaching assignments.

2. **Duties of the Associate Director**

- Serve as the Graduate Advisor for the MS AI program;
- Coordinate administration with the Office of Graduate Studies;
- Submit course change or approval forms as needed;
- Assist the Director in program administration as necessary.

D. Appointments

1. The Dean of BCOE appoints the Program Director with consultation from the Program Faculty, in a manner consistent with the appointment of other program directors. The Program Director reports to the Dean of BCOE.
2. Program Director appointments are for three (3) years, except when circumstances require otherwise.
3. Members of the Program Oversight Committee, other than the Director, are nominated and elected by the Program Faculty.
4. The Associate Director is appointed by the Program Director from among the members of the Oversight Committee.

IV. Meetings

A. Program Faculty

1. The Program Faculty shall meet as necessary, but at least once per academic year.
2. Three or more Program Faculty members may call a meeting.

B. Program Oversight Committee

1. The Program Oversight Committee shall meet at least once per academic term, on a schedule set by the Program Director.
2. Three or more members of the Program Oversight Committee may call a meeting.

C. Notice and Quorum

1. Members shall be notified of meetings at least one week in advance.
2. A quorum for meetings of the Program Faculty shall consist of at least 50% of the Program Faculty.
3. A quorum for meetings of the Program Oversight Committee shall consist of four (4) members.

APPENDIX B: NEW COURSE SYLLABI

No new courses are proposed. The titles of CS 212 and CS 279 will be updated to reflect the full scope of these courses as they are currently taught. CS 212 has long addressed ethical issues arising across the AI pipeline, from data collection and curation through model development, deployment, and societal impact, not merely data science ethics in a narrow sense. Similarly, CS 279 has functioned as a capstone experience spanning computational methods, machine learning systems, and applied AI. The revised titles better communicate this breadth to students and align the course names with their actual content. No changes to course objectives, learning outcomes, or syllabi are required.

APPENDIX C: LETTERS OF SUPPORT & MOUs

February 25, 2026

To whom it may concern:

I am writing this letter in enthusiastic support for the enclosed proposal to establish a Master of Science degree program in Artificial Intelligence. This program will be jointly administered within BCOE by the departments of Electrical and Computer Engineering and Computer Science and Engineering. I have had detailed conversations with Professors Christian Shelton and Ertem Tuncel, chairs of CSE and ECE respectively, and fully support the academic program and administrative structure. I commit to working with them to ensure the program's success.

This program will help address the critical and documented shortage of college graduates educated in Artificial Intelligence and the design, training, and deployment of intelligent systems. We expect students attracted to this program to come from a variety of backgrounds and other interests, increasing the diversity among engineering students, and those in computational fields in particular.

The Bourns College of Engineering looks forward to launching this MS in Artificial Intelligence. It is an important part of keeping our curriculum current and educating our students.



Prof. Christopher S. Lynch
William R. Johnson Jr. Family Chair
Dean, Bourns College of Engineering
University of California, Riverside

February 25, 2026

To Whom It May Concern:

The Department of Computer Science and Engineering and I strongly support the proposed Master of Science (MS) program in Artificial Intelligence at UCR, to be jointly offered by the Departments of Computer Science and Engineering (CSE) and Electrical and Computer Engineering (ECE).

Artificial intelligence (AI) has a history of over fifty years of research into how machines can learn, reason, and act from data. The methods it has produced — spanning machine learning, planning, natural language understanding, and probabilistic modeling — are now indispensable across science, technology, and business, and they drive sustained demand for professionals with rigorous graduate-level training in the field. Recognizing this need, our department has made AI and machine learning a focus of our research and graduate education.

CSE and ECE together have assembled strong faculty expertise across the full breadth of AI, including machine learning theory, deep learning, natural language processing, computer vision, reinforcement learning, and trustworthy AI. This expertise is reflected directly in the proposed curriculum. As a faculty member whose own research is in probabilistic models and machine learning, I can attest that the depth required to deliver this program at a high level is already present.

This program will address the critical and documented shortage of highly trained graduates with advanced degrees in AI in industry, government, and academia. CSE enthusiastically supports the creation of the MS in Artificial Intelligence and is fully committed to providing the necessary resources within its capabilities for the instruction and advising of its students.

Sincerely,

A handwritten signature in blue ink, appearing to read "Christian Shelton".

Christian Shelton
Professor & Department Chair
Computer Science & Engineering

February 23, 2026

Dear Members of the Academic Senate:

It is my pleasure to provide the strongest possible support for the MS in Artificial Intelligence program. This program will be housed in the Bourns College of Engineering, and is cross-disciplinary, across the departments of Computer Science and Engineering (CSE) and Electrical and Computer Engineering (ECE). It will draw upon courses from the existing programs from both departments, including several new cross-listed courses.

Artificial intelligence is a strategically and technically vital area that studies how to build systems that can learn, reason, and make decisions from data. As AI has become ubiquitous in everyday life, it impacts every profession, including manufacturing, logistics, health care, public safety, and the military. AI is also increasingly important in all aspects of science and engineering. The proposed MS in Artificial Intelligence is a comprehensive program covering how intelligent systems can be designed, trained, evaluated, and deployed to solve problems across many application areas. Students will acquire the cross-disciplinary breadth required for this important and rapidly evolving field and can focus, through electives, on specific areas of interest. The proposed program does so at very little expense, since the teaching and research infrastructure are already in place.

ECE expects to interact extensively with the proposed MS in Artificial Intelligence program by participating in teaching the required and elective courses, in AI research and the mentoring of students through projects and advising, and in helping with the program administration. The program will contribute in a great many positive ways to the ECE department.

In summary, I am extremely supportive of this program and believe it will greatly benefit the students and will help raise UCR's profile. Please do not hesitate to contact me should there be any questions.

Sincerely,



Ertem Tuncel
Professor and Chair,
Department of Electrical and Computer Engineering
University of California, Riverside

APPENDIX D: COMPARABLE PROGRAM FEEDBACK

Cover letter and feedback will be included after the system-wide review.