

EM 589-001/589-601 Artificial Intelligence for Engineering Managers

Welcome to Artificial Intelligence for Engineers, a transformative course designed for forward-thinking professionals eager to harness the potential of AI in engineering management. As AI continues to revolutionize industries, this course provides you with the essential knowledge and tools to lead AI-driven innovation, making you a trailblazer in this era of unprecedented technological growth.

This course takes a holistic approach to AI, equipping engineers and managers with a deep understanding of its history, applications, and future trends. From the birth of AI in the 1950s to its exponential growth in the 21st century, we'll explore the evolution of machine learning, generative AI, and other groundbreaking technologies that are shaping industries ranging from manufacturing to healthcare. The future of AI will be discussed extensively.

But this isn't just about understanding AI—it's about leading it. Artificial Intelligence for Engineers focuses on empowering students to manage AI projects effectively, bridging the gap between engineering and leadership. You'll learn to:

- **Evaluate and Select AI Tools:** Gain hands-on experience with cutting-edge tools and compute platforms, ensuring you choose the best solutions for your organization's unique needs.
- **Plan and Budget AI Projects:** Develop detailed project plans, from cost estimation to deployment, ensuring a streamlined approach to implementing AI technologies.
- **Address Real-World Challenges:** Understand data sourcing, cleaning, training, and testing techniques, addressing some of the most pressing challenges in AI project management.
- **Assess AI's Organizational Impact:** Dive deep into the ethical, economic, and workforce implications of AI, enabling you to make informed decisions that balance innovation with responsibility.

This course is tailored for engineers with a managerial mindset. Whether you're leading teams in manufacturing, software development, or beyond, you'll acquire skills that set you apart as a forward-thinking leader who understands how to integrate AI into business strategies.

Guided by industry experts and seasoned academics, this course offers practical insights drawn from real-world case studies, interactive discussions, and hands-on assignments. By the end of the program, you'll not only understand the technical and managerial aspects of AI but also be equipped to drive transformative projects that impact your organization and industry.

In today's rapidly changing technological landscape, understanding AI is no longer optional—it's essential. Join us in Artificial Intelligence for Engineers and take the next step in your career by becoming the leader who shapes the future.

SYLLABUS

EM 589-001 / EM 589-601 AI for Engineering Managers

Spring 2025 | CAMPUS: Tuesday 4:30 MRC 313 | ONLINE: EM 589-601

With the proliferation of artificial intelligence (AI) to almost every enterprise, it is quickly becoming a necessity that engineering managers are competent to manage AI, LLM and machine learning projects that include the identification of relevant data sets, choosing appropriate algorithms, training, testing, tuning and deployment. In addition, the engineering manager must be able to judge when and where AI adds value and should be used. To manage engineers who are carrying out AI projects, engineering managers must have a reasonable degree of technical understanding of AI. This is a broad survey course rather than a deep technical dive. Topics include the history of AI, machine learning, and generative AI, and touches on computer vision, natural language processing, humanoid robots, and agent-based models.

The course begins with a history of Artificial Intelligence explaining why things evolved as they did. A survey of AI methods and algorithms will then be covered, including machine learning, deep learning, generative AI and transformers, computer vision, natural language processing and large language models (LLMs). The objective is to train the engineering manager to understand the scope and limitations of each technique. An overview of data science, including the identification of relevant data sets will be included.

Applications of AI will be addressed including but not limited to AI in FinTech, AI in Healthcare and AI to understand buyer behavior. By the end of the course, students will be able to estimate compute resources required for a project, create a project plan, and estimate the costs and time required, including the types of people and amount of labor needed, and students will understand AI and relevant terminology sufficient to communicate and lead a team of people, and to assess the impact of a given application on the firm, the workplace, or the economy.

This is not a course that teaches the student to be a machine learning or AI engineer. Students may or may not have that as their prior background. This course focuses on how to deploy and manage AI projects and how to make decisions about whether to adopt AI for a particular problem or product. Students will learn to create project plans for AI products and projects. In addition, students will learn to assess the impact of the disruptive changes of AI on the workplace and the economy.

This course is offered both as a campus section (in hybrid format) course and an online course. The course requirements are the same for both, but the venue is different. Campus students attend classroom lectures and meet with teams at the end of class and have a final presentation in class. Discussions occur both in class and in the forum. Online students view lectures in Panopto, discussion in the forums, and submit assignments online, with final presentations done by recorded video.

• Prerequisite

Admission to the MEM Program or an engineering management graduate certificate. Other engineering graduate students, including Engineering Online students may take the course with permission.

• Course Topics

- History of AI
- Limitation of AI
- Terminology for AI
- Introduction to machine learning and deep learning
- Overview of computer vision
- Overview of natural language processing
- Introduction to Generative AI and Transformer Architectures
- Generative Adversarial Networks
- Exposure to agent-based models
- Overview of Humanoid Robots
- Survey of other AI methods: Bayesian Reasoning, Genetic Algorithms, Expert Systems
- Relationship with the field of signal processing, pattern recognition and data analytics
- Open-Source Tools and Licensing
- Sourcing and Managing Data, Managing Rights
- Scrubbing and cleansing of data, and cost estimation
- Re-use of AI Models
- LLMs, Prompt Engineering and Responsible Use, ChatGPT
- Adopting LLMs in an Organization
- Multi-Modal Generative AI
- Agentic AI and Multi Agent AI
- Computer Power Required for Training LLMs and AI Models
- Disruptive Nature of AI and Impact on the Work Force
- Impact of AI on the Economy
- Great Debates about AI and Society, Ethics, Perils
- Product Management for AI Projects
- Choosing Tools, data sets, people
- Project Management Planning for AI projects and products
- Building an AI Native Product
- Applications: Market Analytics, FinTech, Drug Discovery, Sports Analytics, Law
- Application to Scientific research
- Managing Engineering Teams for AI Projects
- Future of AI

• Course Objectives

By the end of the course, students will be able to

- Identify areas where AI will provide a technical or competitive advantage
- Pose the question or problem that an AI system is intended to solve
- Determine data requirements for an AI or machine learning system including type, quality, quantity
- Source data sets internally, on the web or externally through vendors
- Explain the major AI paradigms including neural networks, deep learning, transformers, generative AI, large language models, natural language processing and computer vision
- Understand which paradigm is applicable and why
- Understand responsible uses of LLMs and how to train and implement them
- Determine whether a novel algorithm is needed or if an open-source algorithm may be used, and assist in choosing which one
- Manage the training of a machine learning system, followed by performance measurement, tuning and improvement
- Estimate compute resources and cost necessary for a particular AI project
- Create a project plan for an AI project including staffing, labor loading, Gantt chart, development, training, performance evaluation, tuning and deployment
- Be inspired to create and implement tomorrow's new systems and products using AI

• Course Requirements

Expectations:

Your success in the class depends on a mix of learning from others and developing ideas and concepts of your own. The course requires learning from assigned readings, threaded discussions, and a term project to develop a product launch plan. Students are expected to complete reading assignments (available on the course website) before viewing the twice-weekly posted videos. You will need to provide a webcam and headset (earphones and microphone) to record your final presentation at the end of the course. You must complete the requirements under Grading below.

Grading:

Grades are a necessary part of earning a degree. That said, this is an elective course, and we hope you are here to learn and have fun. Your grade is based on the following requirements and weightings.

Attendance, Participation, Course Engagement and Peer Review	20%	Based on active participation in class discussions.
Online Quizzes	15%	3 short open book 10-question online quizzes worth 5% each, designed to test comprehension of readings. The last quiz will be in an essay format.
Group Project #1: Kaggle Machine Learning Exercise Using Open-Source Tools	15%	Students perform a simple machine learning exercise using open-source models and data. The purpose is exposure to machine learning.
Individual Project #2: Choice of LLM Implementation Plan or Generative AI Case Study	15%	Student use LLMs, learn their strengths and limitations, and form an adoption plan. Grade based on research depth, insight, accuracy, conclusions, and support.
Group Project #3: Management Plan for an AI Project or Product	35%	Student groups will work on a substantial AI project plan. Problems will be selected from potential AI impact projects. The grade is based on problem statement, data source selection, tool selection, labor budget, schedule, cost estimates. Students may choose to implement or demo aspects of their project to prove feasibility.

• Textbooks and Materials

Required. The following books are required for the course, total cost of all 4 is ~\$80:

Artificial Intelligence for Managers, "Leverage the Power of AI to Transform Your Organization", Malay Upadhyay, bpb, 2021, ISB: 9789389898385

Introduction to LLMs for Business Leaders, I. Ameida, Now, 2023, ISBN: 9780645510584

Technomics: Life Changing Economics of Disruptive Technologies, Toasha Wang, 2023

ChatGPT and the Future of AI, Terence Sejnowski, 2024, ISBN: **0262049252**

The AI Product Manager's Handbook, Irene Bratsis, packt, 2023, ISBN: 978-1-80461-293-4

• **Office Hours:**

Virtual by Zoom or Tuesday after class. Zoom appointment may be made by emailing the instructor. The instructor is generally available immediately after class.

• **Computer and Internet Requirements, Platform**

NCSU and Engineering Online have recommended minimum specifications for computers. This course will be administered from Moodle and Panopto. Students should log in to Moodle for course modules, announcements, links to videos and other course activities. See course policies below.

• **Instructor Information**

Dr. Edwin R. Addison (Ed), Lecturer
Engineering Online and MEM Program
Bio provided in Moodle and on LinkedIn

Email: eraddiso@ncsu.edu
Email preferred contact
Text for emergencies

Mobile Phone: 910.398.1200
Text for urgent matters only

Course Modules

MOD	TOPICS (Subject to Change due to AI being a rapidly advancing field)	READING	COURSE ACTIVITIES	Start DATE
1	Course Overview, Requirements. What is AI? Applications and use cases for AI**	Moodle Platform	Post Your BIO	1/7
2	Overview and History of AI: Introduction, History, Limits, Terminology. Machine Learning and Deep Learning Projects.	Upadhyay 1-3 Outside Refs.	Class Discussion	1/14*
3	Capabilities and Breadth of AI: Computer Vision, Bayesian, Agent Based Models, Generative AI, GANs. Examples.	Upadhyay 4-8	Class Discussion Quiz #1	1/21
4	Available Tools, Open-Source License, Commercial Tools, Sourcing and Scrubbing of Data, Reuse of Models. Example.	Upadhyay 9-10	Class Discussion	1/28
5	LLMs Use Cases, Transformers, NLP, Available LLMs, ChatGPT, Errors, Markov Models. Multi-modal Gen-AI. Hugging Face. No code AI for Python, Analytics.	Almeida 1-10 Sejnowski portions of Parts 1-2	Class Discussion due 2/12	2/4
	WELLNESS DAY – NO CLASS NO MODULE THIS WEEK		Quiz #2 Due 2/14 Project #1 due 2/17	2/11
6	LLMs Adopting – Project Management Approach to Implementing LLMs. Responsible Use. AI Agents.	Almeida 11-21 Bratsis – select sections	Class Discussion	2/18
7	Disruption and AI: Impact on Economy, Jobs and Labor Force. Adoption Rates. Market Size. Economic and human factors.	Wang, selected portions	Class Discussion Quiz #3	2/25*
8	Engineering Management Approach to AI Projects	Selected Links	Class Discussion	3/04*
	SPRING BREAK NO MODULE THIS WEEK	N/A	NONE – No Posting Project #2 Due 3/17	3/11
9	Project Management: AI Model Development: Infrastructure, Tools, Data Sources, Model Development, Tuning. Data Science.	Select Papers Bratsis – select sections	Team Meetings for Project #3	3/18
10	AI Product Management. Impact on Product Management, Commercialization. Staffing a Project. Agile. Impact on Costs. KPIs. Assessing ROI. Deliverables.	Select Papers Bratsis – select sections	Class Discussion	3/25
11	Assessing Data and Compute Requirements, CPU Requirements, and Memory. Data Centers.	Selected articles	Class Discussion	4/01
12	Advanced Topics, Humanoid Robots, Ai “Scientists” and “Employees”. Multi Agent Systems. Future Directions in AI. AGI.	Select Articles. Sejnowski Part 3	Class Discussion	4/08
13	AI Startup Companies and Venture Capital. Ethical Considerations. Vision Setting. Project Work Period. Evaluating Ai Talent.	Bratsis – select sections, Select articles	Participation Report Due	4/15
14	Final Presentations COURSE ENDS		Project #3 Due Peer review Due	4/22

**Market Analytics, Buyer Behavior, Healthcare Applications, Drug Discovery, Technical Product Design, Sports Analytics, Law Enforcement, Application to Scientific Research, FinTech

● Course Policies

Assignment Submission. All assignments must be submitted in Moodle. Assignments submitted via email are not accepted.

Grades – The instructor assigns grades on a consistent basis for all students. It is against the course policy for students to argue for extra points, ask for extra credit, or dispute subjective grades. However, students may notify the instructor if a technical error is made, such as a misplaced file. Final grades are based on the university grading scale, are assigned by machine, and are not modified. This is for fairness.

Late Assignments – Assignments must be submitted by the due date. Late assignments are penalized 10% and accepted up to one week late, but no assignment may be submitted beyond one week late for any reason. Assignments may not be submitted after the last day of the course. Quizzes have firm due dates with no late submission. ***Moodle assignment due dates will not be changed for any reason.***

Quizzes – The quizzes in this course are open book and notes. Neither the Internet (i.e. Google, ChatGPT), nor other people, may be consulted during a quiz. Quizzes must be completed during the specific period in one single sitting subject to a time limit. Quizzes may be comprehensive, covering primarily the lectures and readings, but topics discussed in the forums are fair game.

Posting to Discussion Forums – Discussion forums are an important part of this course and a way to dialog about the course content extensively ***for both online and classroom sections of this course only.*** The initial questions will be posted at the beginning of the week, but additional questions may be added at any time. These are intended to be conversations, not solo essays. You are not graded as if it were a homework assignment, but rather you are graded for your active contribution to an intelligent conversation. You need not be comprehensive in your posts. Instead, just keep the conversation flowing and post only one idea at a time. You should log in periodically between Wednesday and the end of the week. You are required to read everything that any student posts. You should make an initial post by Thursday and at least two (and not more than three) follow-up posts by Sunday.

Incomplete Grades. You may be given an Incomplete grade for the course if you were not able to finish for an unforeseen circumstance. This requires permission from the instructor by Module 12. Incomplete grades must be made up within 30 days.

Course Calendar. The course calendar is posted both in this syllabus and in Moodle. Students are expected to remain on the currently scheduled module. Moodle modules are open on the Friday before the week they are scheduled and all work for the current module is due by Tuesday at 4:30 pm following the week of the module,

Accommodations. “Reasonable accommodations will be made for students with verifiable disabilities. To take advantage of available accommodations, students must

register with the Disability Resource Office at Holmes Hall, Suite 304, 2751 Cates Avenue, Campus Box 7509, 919-515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (NCSU [REG 02.20.01](#)).”

Digital Course Components. Students are required to access this course through Moodle. Students will need a laptop, desktop or other access to a computer and the internet to do so. The course will use the software Turnitin to detect plagiarism and inappropriate use of ChatGPT in written assignments. ChatGPT may be used and is encouraged for research, but you must cite it and write your own final copy. The use of Grammarly is encouraged and permitted without an attribution requirement.

Privacy. Students may be required to disclose personally identifiable information to other students in the course, via digital tools, such as email or web-postings, where relevant to the course. Examples include online discussions of class topics and posting of student coursework. All students are expected to respect each other's privacy by not sharing or using such information outside the course.

Academic Integrity. Students are required to comply with the academic integrity standards in the Student Code of Conduct ([NCSU POL11.35.01](#)). Students may not turn in other students' work and claim it is theirs. Students must abide by the instructions on assignments and quizzes as to what is permissible for that assignment or quiz. “Violations of academic integrity will be handled by the Student Discipline Procedures ([NCSU REG 11.35.02](#)).”

This course has zero tolerance for students who

- ...receive unauthorized aid from others/internet on graded events.
- ...give unauthorized aid to others/internet regarding graded events.
- ...fail to provide proper attribution for help received (plagiarism).
- ...post course materials online without the instructor's permission.

Students who engage in these behaviors may be referred for academic discipline or receive a failing grade in the course or both.

Additional NC State Rules and Regulations. Students are responsible for reviewing the NC State University Policies, Rules, and Regulations (PRRs) that pertain to their course rights and responsibilities, including those referenced both below and above in this syllabus:

Equal Opportunity and Non-Discrimination Policy
Statement <https://policies.ncsu.edu/policy/pol-04-25-05>
with additional references at <https://oied.ncsu.edu/divweb/policies/>

Code of Student Conduct
<https://policies.ncsu.edu/policy/pol-11-35-01>.