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A New Course on "Artificial Intelligence for Engineering Managers" - Objectives, Teaching Methods and Structure

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A New Course on "Artificial Intelligence for Engineering Managers": Objectives, Teaching Methods, and Structure

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Abstract

The course *Artificial Intelligence for Engineering Managers* has been offered four times, and this paper showcases its bold vision, pioneering teaching strategies, agile structure, and critical lessons learned through real-world delivery. As one of the first courses of its kind, it empowers engineering managers with a robust understanding of artificial intelligence (AI) and machine learning—without requiring technical programming skills. Participants are equipped to confidently lead AI initiatives and drive transformative change within their organizations. Through a deep dive into AI methodologies—including machine learning, deep learning, and natural language processing—students develop critical thinking and practical skills to evaluate when and how AI can unlock organizational value.

Beyond foundational concepts, the course offers strategic insights into data sourcing, project planning, and resource estimation, essential for executing successful AI initiatives. Sometimes delivered through a dynamic inverted classroom model, students engage with thought-provoking lectures online, then apply theory to practice in lively, interactive sessions. Activities include solving real-world machine learning challenges, architecting the adoption of large language models (LLMs), and developing comprehensive AI management roadmaps.

The curriculum underscores how AI is revolutionizing industries, reshaping economies, and redefining the workforce, while emphasizing the ethical imperatives necessary for responsible deployment. This paper highlights the course's most effective elements, illustrating how its innovative structure and targeted learning objectives prepare engineering managers to lead AI-driven innovation with strategic vision.

Introduction

Artificial intelligence (AI) today is not merely a set of tools—it is a transformative force, reshaping industries, economies, and our approach to solving complex global challenges. As AI accelerates, engineering managers find themselves at a pivotal crossroads between technology and strategy, tasked with harnessing its potential while navigating its ethical and operational implications. Recognizing this evolving demand, *Artificial Intelligence for Engineering Managers* was created as a trailblazing educational initiative, designed to equip professionals with the skills, strategic insight, and ethical frameworks necessary to lead AI-powered transformations.

This paper explores the course's design, implementation, and outcomes, capturing its profound impact on student growth and its groundbreaking contribution to the future of engineering management education.

Course Design and Objectives

This course was carefully crafted to strike a balance between technical depth and strategic breadth. Its core goal is to empower engineering managers with a comprehensive understanding of AI technologies—without requiring them to become expert coders or data scientists. The focus is on developing strategic insight, ethical leadership, and practical skills essential for overseeing AI initiatives with confidence.

The course serves as an elective for students from three different categories:

- Students at NC State University's Master's in Engineering Management program
- Working professionals earning an engineering master's degree
- Other graduate and honors undergraduate engineering students at NC State

As AI increasingly reshapes industries from healthcare to finance to manufacturing, engineering managers must rise to the challenge of leading AI-driven projects. This course equips future

engineering leaders with the critical understanding needed to evaluate AI solutions, measure their potential, and guide AI project teams to successful outcomes.

The course begins with a sweeping history of AI, tracing its evolution from its ambitious origins to today's transformative breakthroughs. This narrative lays the groundwork for a broader survey of AI methods. Topics are presented conceptually, ensuring students understand the essential components without the burden of deep technical mastery. Students engage hands-on with existing models while focusing on application rather than coding.

Key topics include:

- History, limitations, and terminology of AI
- Introduction to machine learning and generative AI technology and projects
- Overview of computer vision, natural language processing, and transformer architectures and how they fit into larger systems
- Generative adversarial networks and survey of AI methods (Bayesian reasoning, genetic algorithms, expert systems) and when they are used
- Relationship with signal processing, pattern recognition, and data analytics
- Open-source tools, data sourcing, licensing, and rights management
- Data cleansing strategies and data cost estimation, including cost of data generation
- LLMs, prompt engineering, ChatGPT, and organizational adoption and use
- Multi-modal AI, agent-based models, and humanoid robotics
- Computing infrastructure for AI, including compute requirements and platform selection
- The disruptive impact of AI on the workforce and society, and how to manage it
- Ethics, societal perils, and responsible AI leadership
- Project and product management techniques specific to AI initiatives
- Applications across industries: market analytics, FinTech, drug discovery, sports analytics, and law
- Managing and motivating technical teams in AI-driven organizations
- Future trends and debates in AI including artificial general intelligence (AGI)

Students emerge with a working fluency in AI's diverse capabilities and constraints, allowing them to evaluate which techniques are best suited for specific business challenges. In addition to technical literacy, the course instills essential management techniques:

- Application of project management frameworks to AI projects
- Determining project feasibility, value, and ROI
- Managing licensing, data rights, and acquisition costs
- Leading technical experts and bridging knowledge gaps
- Making informed GO/NO-GO project decisions

Practical application is woven throughout the course. Students learn to identify relevant datasets, estimate computational needs, and craft robust project plans with detailed budgets and timelines. Accessible to students from diverse professional backgrounds, the course emphasizes managerial leadership over technical execution. Graduates leave able to confidently advocate for AI adoption, draft project plans, and communicate effectively with technical teams, stakeholders, and executives. The students who take this course include Master of Engineering Management students, working professionals earning a master's degree in engineering, and other engineering students who choose it as an elective, including honors undergraduates.

To accommodate diverse learning styles, the course is delivered in both hybrid and fully online formats. Hybrid students participate in live classroom discussions and deliver presentations in person; online students access dynamic recorded content, online forums, and video presentations. Both formats emphasize collaboration and high engagement.

By course completion, students are equipped with a strategic toolkit for leading AI initiatives—prepared to drive innovation, navigate disruption, and help their organizations harness AI's transformative potential in an ever-evolving landscape.

Teaching Strategies

To maximize engagement and learning outcomes, the course deployed a dynamic combination of innovative teaching methods. Often used is an inverted classroom model: students absorb theoretical content through online lectures before attending live, in-person sessions. This flipped approach optimizes class time for hands-on workshops, collaborative exercises, and real-world application.

Beyond instructor-led presentations that deliver foundational knowledge and industry context, students engage with case studies, ethical debates, and discussions on the societal and economic impacts of AI. Live demonstrations of AI tools—ranging from predictive modeling platforms to natural language processing software—bring abstract concepts into practical focus.

Group exercises bridge theory and practice. Students collaborate in teams to tackle challenges such as designing predictive maintenance systems or integrating large language models into enterprise workflows. Teams identify relevant datasets, evaluate AI tools, and create detailed implementation strategies, including timelines, resource plans, and cost projections.

A cornerstone of the course is the development of AI adoption plans for hypothetical organizations. These projects require students to assess technical feasibility, organizational readiness, workforce impacts, and ethical considerations—giving them a holistic, systems-level view of managing AI initiatives.

The curriculum also incorporates hands-on activities to gain a feel for what AI projects are like, such as model tuning, data preparation, and deployment strategy development. These exercises cultivate the practical skills essential for navigating the real-world complexities of AI project leadership.

This blend of online lectures, live demonstrations, applied exercises, and collaborative projects keeps students energized and equips them with the strategic mindset needed to lead AI initiatives successfully.

The course has been delivered in three formats:

- Fully online
- Inverted classroom
- Traditional classroom

While all formats proved effective, the traditional classroom model consistently fostered the high levels of engagement. Online delivery occasionally led to feelings of isolation, which can be managed through threaded discussions and live Zoom office hours. The inverted classroom format sparked lively debates and strong teamwork. For full engagement, students are required to view the assigned lectures in advance of discussion periods. Some teams self-organized effectively outside class, but overall in-class engagement could be somewhat lower compared to the traditional setting unless attendance to the class discussions is required.

Recognizing these dynamics, the next iteration will experiment with a hybrid model that combines the strengths of both traditional and inverted classrooms—offering a balance of structure, interaction, and autonomy to optimize student learning.

Impact and Outcomes

The course has received enthusiastic feedback from students, who praised its practical focus, real-world relevance, and emphasis on actionable strategies. Many reported a significant boost in their confidence to lead AI initiatives, crediting the course's hands-on learning and managerial frameworks as key drivers of their development.

Several students have already applied course concepts within their organizations, launching AI projects ranging from operational workflow optimization to AI-driven customer engagement systems. This translation of classroom learning into tangible outcomes highlights the course's impact. Example projects developed through the required AI project management plans include:

- An AI-based system for timely detection of injured horses on farms
- A predictive maintenance platform for Caterpillar equipment
- An AI-driven traffic congestion management system for smart cities
- Smart drones for shark detection over public beaches
- HVAC optimization systems for energy efficiency in public buildings

Beyond project execution, the course has sparked a broader shift in mindset. Students now view AI as a critical tool across industries—whether in healthcare, manufacturing, finance, or education. By removing the technical barriers traditionally associated with AI, the course enables participants to harness AI's transformative potential with confidence.

Student feedback further illustrates the course's impact:

- *"I really enjoyed his teaching style and firsthand experience. I would have liked the project management portion to be introduced earlier, but the AI foundation was strong."*
- *"Dr. Addison made the three-hour sessions both enjoyable and highly informative. His passion for the subject was contagious."*
- *"Excellent course. It provided a clear explanation of AI's back-end functionality and prepared us to manage AI projects effectively."*
- *"Before this class, I had no understanding of AI. Now, I see its relevance everywhere. I especially appreciated the reading recommendations."*

The course has also ignited a desire for continued learning. Many students expressed interest in pursuing advanced certifications and additional coursework in AI, reflecting a successful

cultivation of a lifelong learning mindset. While formal tracking is limited, follow-up emails from alumni confirm the application of course content in their workplaces.

To date, four sections of the course have been offered, enrolling 80 students in total. One section reached full capacity with a waitlist, another achieved 80% enrollment, and the overall enrollment across offerings averaged 73% of maximum capacity—a strong indicator of demand and impact.

Ethical and Economic Considerations

A distinctive strength of the course is its emphasis on the broader societal and economic implications of AI—moving well beyond technical and managerial dimensions. Students engage deeply with complex ethical dilemmas, examining issues such as bias in machine learning models, data privacy, algorithmic transparency, and the potential misuse of AI in surveillance and misinformation.

Through a combination of case studies and occasional expert guest lectures, students build a nuanced understanding of these challenges. They debate potential solutions and develop actionable frameworks for embedding ethical principles into AI development and deployment.

The course also confronts the economic realities of AI adoption. Students explore how AI disrupts labor markets, creates new job roles, and transforms entire industries. By analyzing real-world examples—such as AI's impact on manufacturing and healthcare—students gain a comprehensive understanding of how AI can simultaneously drive efficiency and create workforce challenges.

This dual focus on ethics and economics ensures that students are prepared to lead AI initiatives responsibly, maximizing organizational value while promoting long-term societal well-being.

Conclusion

Artificial Intelligence for Engineering Managers represents a bold evolution in engineering education. By weaving together technical literacy and strategic leadership, the course empowers students to lead AI-driven initiatives with clarity, confidence, and vision. Its success lies in its ability to inspire, challenge, and equip students to navigate the complex, rapidly evolving landscape of AI adoption.

Future iterations of the course will continue to evolve—incorporating emerging technologies, addressing new challenges, and refining its focus to meet the demands of an AI-driven world. As AI continues to reshape industries and societies, the role of engineering managers as forward-thinking leaders becomes ever more critical.

This course stands as a powerful testament to the transformative potential of education—not only in shaping individual careers, but also in advancing industries and influencing society at large.

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