AI System Architecture and Large Language Model Applications

July 14 – July 17, 2025 | In-Person | Lead Instructor: David Martinez

Day 1: Monday, July 14

	TOPIC	DESCRIPTION	HIGHLIGHTS
8:45–10:10 am	**D. Martinez - Introduction and Lecture 1:** Course introduction, AI background, and functional building blocks overview	Course kicks-off. introduction to AI system architecture	AI building blocks used in the design of an LLM application
10:10–10:20 am	Break		
10:20–11:30 am	**D. Martinez – Lecture 2:** GenAI and the Evolution of LLMs	Short history of advances in GenAI focusing on LLMs	Motivation behind the importance of GenAI and LLMs in particular
11:30 am–12:15 pm	**D. Martinez - Lecture 3:** Traditional machine learning	Set the foundation design elements from traditional ML relevant to LLM design	Understand the key components used in the design of traditional ML that are also applied in the design of LLMs
12:15–1:00 pm	Lunch Break		
1:00–2:10 pm	**Course Assistants – Agentic AI implementation techniques**	Conceptualizing , designing and implementing Agentic AI (illustrating prompt engineering, RAG, and implementation)	Introduction to the steps necessary to implement Agentic AI using open-source tools and class project expectations
2:10–2:20 pm	Break		
2:20–3:40 pm	**Course Assistants – Introduction to Agentic AI, Guardrails, & Evaluation (Retrieval augmented generation and performance evaluation)**	Introduction to Agentic AI and its role in augmenting knowledge	Agentic AI requires domain-specific data to make them most valuable and reduce hallucinations
3:40–5:00 pm	**Team class project:** Formulate one project per team	Teams discuss and select one Agentic AI application for the class project	Answer the questions on "Topic and Project Motivation" chart and "GenAI Team Must Be Customer Focused (Questions to Ask)" chart

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Day 2: Tuesday, July 15

	TOPIC	DESCRIPTION	HIGHLIGHTS
8:30–9:00 am	**D. Martinez - Welcome to Day 2:** Day 2 agenda and faculty Q&A	Day 2: What to expect	Discussion on team project guidelines and format
9:00–10:10 am	**D. Martinez – Lecture 4:** LLM fundamentals	High level description of large language model architecture	Introduce participants to LLMs and key processing steps
10:10–10:20 am	Break		
10:20–11:30 am	**D. Martinez - Lecture 5:** Deeper dive on decoder architecture and GPT	Details on a decoder-only architecture and performance metrics	Learn the details of a decoder-only architecture and techniques for assessing the LLMs performance
11:30 am–12:15 pm	**Course Assistants – Introduction to Agentic AI;, Guardrails, & Evaluation (cont.)** **Retrieval augmented generation and performance evaluation**	Introduction to Agentic AI and its role in augmenting knowledge	Agentic AI requires domain-specific data to make them most valuable and reduce hallucinations
12:15–1:00 pm	Lunch Break		
1:00–2:10 pm	**Course Assistants - Hands-On demonstration:** Agentic AI development and implementation (cont.)	Work through a Jupyter notebook illustrating the design of an Agentic AI application. The notebook will be used by teams that are developing Agentic AI applications	Gain practical experience with building Agentic AI using open-source tools and techniques
2:10–2:20 pm	Break		
2:20–5:00 pm	**Team Project:** Design the selected Agentic AI application identifying the building blocks consistent with the GenAI stack	Start implementing the team Agentic AI application	Demonstrate the use of a vector database, embeddings, and existing LLM models

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Day 3: Wednesday, July 16

	TOPIC	DESCRIPTION	HIGHLIGHTS
8:30–9:00 am	**D. Martinez - Welcome to Day 3:** Day 3 agenda and faculty Q&A	Day 3: What to expect	Address any clarification on prior lectures or course project
9:00–10:10 am	**D. Martinez - Lecture 6:** Guidelines for deploying LLM capabilities	Leverage 10 guidelines that incorporate people, processes, and technologies in the successful deployment of AI products and/or services	AI ecosystem environment from business needs to deployment plus perspectives and challenges with responsible AI (RAI)
10:10–10:20 am	Break		
10:20–11:30 am	**D. Martinez - Lecture 7:** LLMOps: transitioning from development into deployment	The foundational elements of LLMOps, techniques, and contemporary tools	Tips and techniques in transitioning from development into operations
11:30 am–12:15 pm	**D. Martinez - Lecture 8:** Responsible AI	Development and deployment of LLMs in a responsible manner	Adhere to a set of principles and discuss tools and techniques to deploy LLMs responsibly
12:15–1:00 pm	Lunch Break		
1:00–2:10 pm	**D. Martinez - Lecture 9:** Robust and and secure LLMs	Address LLM vulnerabilities and discuss approaches to making systems robust	Learn about recognizing adversarial vulnerabilities (intentional and non-intentional) plus methods to address them
2:10–2:20 pm	Break		
2:20–5:00 pm	**Team Project:** Finalize implementations of Agentic AI application demonstrating access to domain-specific data	Finalize implementing the team Agentic AI application concluding with prompts used in inference	Demonstrate the use of Agentic AI and tools using contemporary platform
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Day 4: Thursday, July 17

	TOPIC	DESCRIPTION	HIGHLIGHTS
8:30–9:00 am	**D. Martinez - Welcome to Day 4:** Day 4 agenda and faculty Q&A	Day 5: What to expect	Address any clarification on prior lectures or course project
9:00–10:10 am	**D. Martinez - Lecture 10:** Fostering an innovative team environment	Identify a set of practical performance metrics for assessing the effectiveness and productivity of AI teams	Measuring what matters in AI technology-based organizations
10:10–10:20 am	Break		
10:20 am–12:00 pm	**Team Presentations:** Course projects	Teams present their course projects on the design and implementation of an LLM application	Duration: 15 minutes per team plus 5 minutes Q&A and feedback
12:00–12:45 pm	Lunch Break		
12:45–1:45 pm	**Team Presentations (continuation):** Course projects	Teams present their course projects on the design and implementation of an LLM application	Duration: 15 minutes per team plus 5 minutes Q&A and feedback
1:45–2:00 pm	Break		
2:00–3:00 pm	**D. Martinez - Course Wrap-Up**	Course completion is based on attending all 12 lectures and completing a presentation on team project	MIT Professional Education issues a certificate of completion to participants within 2 weeks

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