LLM & AI Agents Curriculum

Module: Full-Stack LLM (Sub-module of LLM)

WEEK 1 | August 18-23, 2025

Live Lectures:

1. **Orientation + Introduction to Full Stack** (Friday, August 22)
    - Roadmap, Pre-requisites, Dos, Don'ts
    - Philosophy and UI fundamentals
2. **UI Building (Practical)** (Saturday, August 23)
    - Learn fundamentals of user interfaces and their types
    - Deconstruct the ChatGPT UI
    - Build UIs with Python using
    - Deploy apps on HF Spaces

Pre-recorded Content:

- Introduction to the Full-Stack LLM Module
- Introduction to Programming (Big Binary Practice set)
- Introduction to OPT Framework
- AI ToolKit (Boiler Plate)
- How Web Work(Doc)
- Python Installation and Cursor IDE Setup Guide

Learning Outcomes:

- Set up a programming environment for Python efficiently
- Understand foundational programming concepts and best practices
- Learn to build chatbots and similar apps using Gradio
- Understand fundamentals of UI development
- Learn deployment techniques for python apps

WEEK 2 | August 25-30, 2025

Live Lectures:

1. **Intro to APIs (Theory)** (Friday, August 29)
    - Understand APIs from first principles
    - Understand the need for APIs and their role in connecting systems
    - Practice API development and calling APIs using Postman/curl
2. **Building APIs with Fast API (Practical)** (Saturday, August 30)
    - Learn FastAPI and CRUD operations
    - Design, develop, and deploy robust APIs for AI apps
    - Master API documentation and testing using OpenAPI and Swagger UI

Pre-recorded Content:

- Intro to API (Theory)
- Building Full Stack App with Level
- Introduction to OPT Framework
- How to build APIs using FastAPI
- Building Full-Stack apps Level-2 (Part 1): API
- Building Full-Stack apps Level-2 (Part 2): UI and Deployment
- Building Full-Stack apps Level-2 (Part 3): Lead Qualification
- Building Full-Stack apps Level-2 (Part 4): Lead Qualification - code

Learning Outcomes:

- Understand APIs' fundamental role in app development
- Develop and test APIs using modern tools
- Build communication protocols for apps from scratch
- Understand FastAPIs and CRUD operations
- Deploy a chatbot powered by LLaMA in under 5 minutes
- Learn about GroqCloud SDKs and Render

WEEK 3 | September 5-6, 2025

Live Lectures:

1. **Intro to LLM & Prompt Engineering (Theory)** (Friday, September 5)
    - Understand fundamentals of AI, machine learning, and deep learning
    - Explore Large Language Models (LLMs), including GPT
    - Learn to integrate LLMs into applications for personalized email generation
    - Learn the art of crafting effective prompts
    - Learn about Emergent abilities of LLMs
2. **Prompt Engineering: Building LLM Wrappers (Practical)** (Saturday, September 6)
    - Learn how to build LLM wrappers and their use cases
    - Improve the chatbot by applying relevant prompt engineering techniques

Pre-recorded Content:

- LLM (Pre recorded series) (Theory)
- Domain Modeling & ER Diagrams (Theory)

Learning Outcomes:

- Grasp the core concepts of AI, ML, and LLMs
- Learn how LLMs work and their role in the AI ecosystem
- Integrate LLMs into a chatbot to perform advanced tasks like email writing
- Develop expertise in writing precise and creative prompts using best practices
- Understand the concept of LLM wrappers and their use cases in AI apps

Practice Sets/ Assignments:

- **Assignment: OPT based level-2 full-stack application**

WEEK 4 | September 12-13, 2025

Live Lectures:

1. **- Domain Modeling, ERD and Intro to Database** (Friday, September 12)
    - Understand the basics of domain modelling for application design
    - Learn to create Entity-Relationship (ER) diagrams to represent data structures
    - Map relationships between entities to build scalable database schemas
    - Apply domain modelling to real-world use cases
2. **Connecting the Dots & Database: Supabase (SQL) (Practical)** (Saturday, September 13)
    - Learn the basics of databases and their role in app development
    - Use Notion and Airtable as a lightweight database
    - Connect the frontend (UI), backend (API), and database for seamless data flow
    - Compare relational and NoSQL databases with Supabase

Learning Outcomes:

- Create domain models to build structured application design
- Design ER diagrams to represent entities and their relationships
- Translate domain models into database schemas
- Set up and manage databases using Supabase, Notion, and Airtable
- Write basic SQL queries for data manipulation
- Integrate databases with frontend and backend systems
- Evaluate database options based on project needs

Practice Sets:

- **Practice Set 3:** Create a domain model, ER, Schema DB of your OPT tasks

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WEEK 5 | September 19-20, 2025

Live Lectures:

1. **Building Apps with AI (Lovable and Cursor)** (Friday, September 19)
    - Learn how to use lovable to build UIs
    - Learn the fundamentals of AI accelerated programming
    - Learn advanced cursor tools & techniques to increase the development speed
    - Learn Javascript using modern frameworks like React.js and Next.js
    - Learn how to deploy apps on platforms like Vercel
2. **Intro to GitHub and Open Source (HuggingFace)** (Saturday, September 20)
    - Learn the basics of GitHub and open-source development
    - Understand how teams use GitHub to build apps remotely
    - Discover the importance of open source in the software ecosystem
    - Learn about huggingface

    (Open source- full lecture, Github- recorded and Combined OH)

Pre-recorded Content:

- Lovable/cursor recorded
- Understanding Git and Github

Learning Outcomes:

- Build frontend apps with Lovable, bolt
- Understand how to use cursor, Lovable and thinking mode to accelerate app development
- Learn deployment techniques for JavaScript apps
- Create and deploy a chatbot using React and Next.js on Vercel
- Understand how to collaborate on software development projects
- Learn the value of contributing to open-source projects
- Learn best practices to build remote development teams from Gitlab
- Learn Huggingface platform

Practice Sets:

- **Practice Set 4:** Push all your assignments and practice set to GitHub

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WEEK 6 | September 26-27, 2025

Live Lectures:

1. **MVP Building** (Friday, September 26)
    - Architect generative AI-based full-stack applications
    - Learn how to connect frontend (UI), backend (API), and AI models
    - Deploy applications using serverless platforms like Baseten
    - Learn to build & deploy AI based full stack applications

Module: Augmented LLM (Sub-module of LLM)

2. **Function/Tool Calling and MCP(Theory)** (Saturday, September 27)
    - Learn to integrate tools and 3rd party apps into LLM-based workflows
    - Understand how LLMs interact with external tools for enhanced functionality
    - Explore real-world applications of tool-augmented LLMs

Pre-recorded Content:

- Intro to MCP (1hr) (New video to be recorded on MCP theory and set-up)
- Function Calling (2 videos)

Learning Outcomes:

- Design and build genAI-based full-stack applications
- Deploy serverless applications with Baseten
- How to build a Minimum Viable Product (MVP) in under 2 hours
- Implement function calling in LLM workflows
- Integrate external tools into LLM-based applications

WEEK 7 | October 3-4, 2025

Live Lectures:

1. **Function and Tool Calling in LLM (Practical)** (Friday, October 3)
    - Hands-on implementation of function calling in LLM workflows
    - Building MCP server
2. **Intro to LLM Workflows and Chains (Theory)** (Saturday, October 4)
    - Understand the fundamentals of LangChain for building LLM-powered workflows
    - Explore the framework's components like chains, agents, and memory
    - Build custom workflows for specific AI-driven applications

Learning Outcomes:

- Learn the building blocks of LangChain and their applications
- Build dynamic workflows using chains, agents, and memory components
- Design modular and reusable AI pipelines
- Develop end-to-end applications using LangChain

WEEK 8 | October 10-11, 2025

Live Lectures:

1. **Intro to LLM Workflows and Chains (Practical)** (Friday, October 10)
    - Explore Hugging Face as a hub for open-source AI models and tools
    - Learn how to leverage pre-trained models and datasets
    - Understand the role of open-source contributions in advancing AI
2. **Introduction to Retrieval-Augmented Generation (RAG) (Theory)** (Saturday, October 11)
    - Understand the concept of Retrieval-Augmented Generation (RAG) and its importance in enhancing LLMs
    - Learn how to store, retrieve, and utilize vector embeddings in AI workflows
    - Explore the integration of RAG with LLMs to provide contextually accurate outputs

Learning Outcomes:

- Navigate the Hugging Face ecosystem for models and datasets
- Use pre-trained models for NLP and other AI tasks
- Understand the benefits of open-source AI tools and libraries
- Contribute to and utilise open-source resources for AI development
- Understand RAG from first principles and its applications in LLM apps
- Learn how vector embeddings work and how it helps in RAG
- Learn about vector databases to extend the memory of LLM apps

WEEK 9 | October 17-18, 2025

Live Lectures:

1. **Building RAG Apps with LlamaIndex (Practical)** – Friday, October 17
    - Dive deeper into advanced RAG concepts using LlamaIndex
    - Implement different stages of the RAG pipeline using LlamaIndex.
    - Live code your first RAG app using the OpenAI tools.
2. **Advanced RAG** – (Saturday, October 18)

    - Optimizing components of the RAG pipeline
    - Experiment with different chunking strategies
    - Implement indexing and retrieval optimizations

Learning Outcomes:

- Master advanced RAG techniques using LlamaIndex
- Create efficient indexing and retrieval workflows for large-scale data
- Understand the different stages of RAG, chunking.
- Build and deploy your first RAG app

WEEK 10 | October 24-25, 2025

Live Lectures:

1. **Decision-Making Frameworks for Choosing Between Fine-Tuning and RAG** – *Friday, October 24*

    - Understand the differences between fine-tuning and Retrieval-Augmented Generation (RAG)
    - Learn frameworks for deciding when to use fine-tuning or RAG based on project needs
    - Evaluate cost, scalability, and performance trade-offs of each approach
    - Review practical case studies comparing RAG and fine-tuning

2. **Building and Architecting GenAI Applications** – *Saturday, October 25*

    - Understand modular design patterns for GenAI applications
    - Integrate RAG and fine-tuning approaches in application workflows
    - Design scalable, maintainable GenAI solutions

Learning Outcomes:

- Understand the pros and cons of fine-tuning versus RAG
- Apply structured decision-making frameworks to AI project planning
- Evaluate technical and business factors to choose the optimal approach
- Develop a strategic roadmap for implementing fine-tuning or RAG solutions
- Architect scalable GenAI applications that integrate advanced retrieval and model adaptation techniques

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WEEKS 11-12 | LLM Fine-Tuning Sub-Module

Live Lectures:

1. **Introduction to Fine-tuning LLMs(Combined)** (Friday, October 31)
    - Understanding the concept and use cases of fine-tuning.
    - When to fine-tune vs. when to use prompt engineering or embeddings.
2. **Data Preparation Techniques for Fine-tuning(Combined)** (Saturday, November 1)
    - Structuring datasets for supervised fine-tuning (SFT).
    - Cleaning, formatting, and ensuring data quality.
3. **LLM Fine-tuning Process and Hands-on Demo(Code)** (Friday, November 7)
    - Step-by-step walkthrough of the fine-tuning pipeline.
    - Practical demonstration using an open-source fine-tuning framework.
4. **Evaluation Techniques and Deployment (Code)** (Saturday, November 8)
    - Metrics and benchmarks for evaluating fine-tuned models.
    - Strategies for deploying and monitoring fine-tuned LLMs in production.

Learning Outcomes:

- Understand when and why to fine-tune an LLM.
- Prepare high-quality datasets for fine-tuning.
- Execute the fine-tuning process with practical tools.
- Evaluate model performance and deploy effectively.

WEEKS 13-15 | AI Agents Module

Module: AI Agents

Week 14 | November 21-22, 2025:

- **Introduction to AI Agents** (Friday, November 21)
    - Understanding what an AI Agent is using First Principle Thinking
    - LLM workflow vs Agentic Workflows
    - Defining the components of an AI agent

- **Building your first AI agent (Practical)** (Saturday, November 22)
    - Understanding Single Agents and OpenAI Responses API
    - Building a Level-1 Agent using the Responses API

Learning Outcomes:

- Comprehend the core principles of AI agents and their functionalities
- Difference between LLM Workflows and Agentic Workflows
- Getting started to build Basic Agents.

Week 15 | November 28-29, 2025:

- **Deep Dive: AI Agent Components & Design Patterns** (Friday, November 28)
    - Learn to construct a ReAct agent from the ground up
    - Implement reasoning and action components to enable autonomous decision-makingUnderstand Agent components and characteristics.
    - Master writing system prompts, including ReAct patterns and tool orchestration for single and multi-agent systems.
    - Explore the necessity and components of multi-agent systems.

- **Understanding Multi-Agent Systems** (Saturday, November 29)
    - Explore Decentralized Multi-Agent Systems: Understand how agents can hand off tasks to each other seamlessly.
    - Understand how multiple AI agents can collaborate to achieve complex tasks using MCPs, A2A and other protocols.
    - Integrate Concepts and Discuss Full-Stack Equivalents: Connect the full-stack implications of multi-agent systems.

Learning Outcomes:

- Understand the ReAct framework and its components
- Develop a ReAct agent capable of reasoning and acting autonomously
- Integrate tool use/function calling for taking actions
- Comprehend the architecture of multi-agent systems
- Implement communication protocols between agents
- Develop strategies for agent coordination and collaboration
- Apply multi-agent frameworks to solve complex problems

Week 16 | December 5-6, 2025:

- **Hands-on Building AI Agents**(Friday, December 5)
    - This will be a hands-on lecture focused on building an end-to-end application.
    - The core of the application will involve an agentic process.
    - The workflow for building the application will be showcased using tools like Claude Code and Lovable.
- **Applying Guardrails, Monitoring and Evaluation** (Saturday, December 6)
    - Emphasize the importance of guardrails for AI safety and security, including protection against prompt injections and PII filtering via a proxy layer.

    - Highlight the practical framework for evaluating AI agents, focusing on "LLM as a Judge" and quantitative KPIs.
    - Discuss the various tools and techniques for effective monitoring of AI agent systems in a production environment.

Learning Outcomes:

- Understand the functionalities of the AutoGen framework
- Develop AI agents using AutoGen's tools and libraries
- Learn how to architect agents to perform specific tasks
- Learn Magentic-One: A Generalist Multi-Agent Systems

Module: Diffusion (Sub-module of Generative AI)

WEEK 16 |
Live Lectures:

- **Orientation + Evolution of GenAI + Overview of Diffusion (Friday, August 22)**
    - Evolution of GenAI, key milestones, and effective research with open-source models.
    - Overview and significance of diffusion models.
- **SDXL Core + Prompting + img2img/ControlNet/Inpainting + Intro to AnimateDiff (Saturday, August 23)**
    - Advanced SDXL prompt engineering.
    - Using img2img, ControlNet (guided generation), and inpainting (targeted edits).
    - Introduction to AnimateDiff for creating animations from diffusion outputs.

Pre-recorded Content:

- History of GenAI + Overview of Diffusion Models (primer).
- How Diffusion Works (SDXL prompting deep-dive).
- SDXL Core: img2img, ControlNet, Inpainting (hands-on).
- **Assignment:** Style Transfer (merge style & content).

Learning Outcomes:

- Explain why diffusion models matter in generative AI.
- Craft advanced prompts for SDXL.
- Apply img2img, inpainting, and ControlNet for precise control.
- Create basic animations with AnimateDiff.

WEEK 17 |
Live Lectures:

- **Identity & Editing + Style/Lighting/Segmentation (Friday, August 29)**
    - IP-Adapters, InstantID, and inpainting for identity-aware edits.
    - Style Transfer & Upscalers, IC Light, Segmentation (“Sorting Ceremony” tie-in).
    - Segment Anything + Grounding + IP-Adapters for precise object control.
- **Workflows, Training, Advanced Models & Deployment (Saturday, August 30)**
    - ComfyUI + Flux: migration/tools, automation, and custom workflows.
    - Train LoRA: SDXL (KohyaSS) + Flux LoRA.
    - Advanced models: Wan 2.1 & Hunyuan (incl. Gaussian Splatting/NeRFs, DiffSinger).
    - Deploy models on Replicate; plus AnimateDiff, Hunyuan, Live Portrait, Mimic Motion.

Pre-recorded Content:

- IP-Adapters, InstantID & Inpainting (identity preservation).
- Style Transfer, Upscalers, IC Light, Segmentation.
- Segment Anything + Grounding + IP-Adapters.
- KohyaSS: Train SDXL LoRA.
- ComfyUI + Flux: Migration/Tools & Custom Workflows.
- Advanced Wan 2.1/Hunyuan Workflows.
- Deploy on Replicate; AnimateDiff, Hunyuan, Live Portrait, Mimic Motion.
- **Mid-Capstone Project (end-of-week milestone).**

Learning Outcomes:

- Train and fine-tune LoRA (SDXL/KohyaSS & Flux).

- Build scalable, automated ComfyUI+Flux workflows; integrate extensions.
- Perform style transfer, upscaling, lighting control, and segmentation.
- Apply Segment Anything + Grounding + IP-Adapters for precise manipulation.
- Understand advanced model families (Wan 2.1/Hunyuan), 3D (Gaussian Splatting/NeRFs), and voice (DiffSinger) concepts.
- Deploy production-style demos on Replicate.