## **🔥 Course Title: Mastering Large Language Models (LLMs)**

### **📌 Target Audience:**

* Beginners in AI/ML or software engineers exploring LLMs
* Data scientists and ML engineers
* Researchers or educators in NLP/AI

## **🧠 Prerequisites**

* Python programming
* Basics of Machine Learning
* Understanding of neural networks
* Familiarity with NLP is a plus

## **📚 Course Structure**

### **Module 1: Introduction to Natural Language Processing (NLP)**

* What is NLP?
* Common NLP tasks (tokenization, POS tagging, NER)
* NLP vs traditional ML
* Classical models (Bag of Words, TF-IDF)

### **Module 2: Neural Networks for Language**

* Word Embeddings: Word2Vec, GloVe, FastText
* Recurrent Neural Networks (RNNs)
* LSTM and GRU
* Encoder-Decoder architecture

### **Module 3: Transformers and Attention**

* Problems with RNNs
* Self-attention mechanism
* Transformer architecture (Encoder-Decoder)
* Positional encoding
* BERT vs GPT: Key Differences

### **Module 4: Large Language Models (LLMs)**

* What is a Language Model?
* Scaling Laws of LLMs
* Architecture of GPT, BERT, T5, PaLM, LLaMA
* Open-source vs proprietary LLMs
* LLM lifecycle: Pretraining, Fine-tuning, Inference

### **Module 5: Hands-on with LLMs (using Hugging Face / Ollama)**

* Using Hugging Face Transformers
* Text generation with GPT-2/GPT-3
* Zero-shot and few-shot prompting
* Fine-tuning a small transformer model
* Prompt engineering basics

### **Module 6: Retrieval-Augmented Generation (RAG)**

* What is RAG?
* Vector stores and embeddings (FAISS/Chroma)
* LangChain and LlamaIndex usage
* Building a custom chatbot with RAG

### **Module 7: Safety, Ethics, and Limitations**

* Bias and fairness in LLMs
* Hallucination in LLMs
* Ethical considerations in deployment
* Guardrails and content moderation

### **Module 8: Deploying and Using LLMs in Production**

* Serving LLMs via API (OpenAI, Cohere, Hugging Face)
* Hosting LLMs locally
* Using LLMs with LangChain or Rasa
* Cost and performance trade-offs
* LLMOps: Monitoring and managing LLMs

## **🧪 Projects & Assignments**

1. Text summarizer using BERT
2. Blog generator using GPT-2
3. Question-answering chatbot using RAG
4. Fine-tune a sentiment classification model
5. LLM-powered knowledge assistant using LangChain + FAISS

## **🛠️ Tools & Libraries**

* Hugging Face Transformers
* LangChain
* LlamaIndex
* FAISS / ChromaDB
* OpenAI API
* Streamlit / Gradio (for app interface)

## **🧑‍🏫 Certification / Learning Path**

* Quiz at the end of each module
* Mini-projects per week
* Capstone project + deployment

## **🌐 Recommended Free Courses/Resources**

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| **Platform** | **Course Name** | **Link** |
| Hugging Face | [Hugging Face Course](https://huggingface.co/learn/nlp-course) | [huggingface.co/learn/nlp-course](https://huggingface.co/learn/nlp-course) |
| DeepLearning.AI | [ChatGPT Prompt Engineering for Developers](https://www.deeplearning.ai/short-courses/chatgpt-prompt-engineering-for-developers/) | [deeplearning.ai - ChatGPT](https://www.deeplearning.ai/short-courses/chatgpt-prompt-engineering-for-developers/) |
| Coursera | [Natural Language Processing Specialization](https://www.coursera.org/specializations/natural-language-processing) | [coursera.org - NLP Specialization](https://www.coursera.org/specializations/natural-language-processing) |
| Fast.ai | [Practical Deep Learning for Coders](https://course.fast.ai/) | [course.fast.ai](https://course.fast.ai/) |
| Andrej Karpathy | [Neural Networks: Zero to Hero (YouTube)](https://www.youtube.com/playlist?list=PLpVm2D2bEgw34kRTOUu44bBfL_Z8vRMRz) | [YouTube Playlist](https://www.youtube.com/playlist?list=PLpVm2D2bEgw34kRTOUu44bBfL_Z8vRMRz) |

## **🚀 Add-on: AI Tools Demo (Optional for bonus)**

* OpenAI Playground
* Hugging Face Spaces
* Gradio app deployment
* Chatbot with LangChain + Streamlit