1. Python
2. EDA
3. ML--> basic
4. DL →basic
5. NLP
6. Generative Model
7. LLM
   1. Prompt Engineering
   2. Vector-database
   3. RAG
   4. Lambaindex, langchain
   5. Api
8. LLM Fine Tuning(LLM,Whiper,Diffusion,LoRa,QLoRa,RLHF/SFT0
9. fastapi/flask (backend code)
10. sagemaker/vertax ai, (

## **Module 1: Introduction to Generative AI**

**Objective:** Understand what Generative AI is and its applications.  
 **Topics:**

* Definition of Generative AI
* Difference between Generative AI vs Traditional AI
* Key types: Text, Image, Audio, Video, Code generation
* Real-world applications: ChatGPT, DALL·E, MidJourney, Deepfake, AI music
* Ethical considerations and biases in AI  
   **Practical:**
* Explore ChatGPT, DALL·E, or other AI tools
* Identify Gen AI examples in daily life  
   **Project Idea:** Create a simple chatbot using a pre-trained model

## **Module 2: Foundations of AI & Machine Learning**

**Objective:** Learn the base of AI models that support Generative AI.  
 **Topics:**

* Machine Learning vs Deep Learning
* Neural Networks basics
* Activation functions, Loss functions
* Introduction to Transformers
* Attention mechanism and self-attention  
   **Practical:**
* Implement a simple neural network in Python
* Visualize how attention works  
   **Project Idea:** Train a simple feedforward network for a classification task

**Production-Level Project:**

* **Project:** Build a predictive engine for customer churn using ML → integrate it with a simple front-end dashboard to demonstrate real-time predictions.
* **Skills Gained:** Neural networks, training, evaluation, deployment concepts

## **Module 3: Natural Language Processing (NLP)**

**Objective:** Understand how text-based Gen AI works.  
 **Topics:**

* NLP basics: Tokenization, Embeddings, Stemming, Lemmatization

**Word Embeddings (Pre-Requisite)**

41. Word2Vec Intro

42. Word2Vec Part 2

43. Pretrained Word2Vec

44. Word2Vec INTUITION

45. Word2Vec 50Features

46. Word2Vec CBOW

47. Word2Vec SkipGrams

48. GloVe

49. fastText

50. Cosine Similarity



Language models: N-grams, RNN, LSTM, Transformer, **GRU, BI-DIRECTIONAL**

**NLP Neural Networks (Pre-Requisites)**

**RNN , LSTM ,DEEP LEARNING PRE-REQUEST**

**NN, ACTIVATION FUNCTION,**

Backpropagation vs Forward Pass, Gradient Descent, CNN ,RNN ,LSTM, PRE-TRAIN MODEL, VGG16, RESNET, ALEXNET, MOBLIENET, TRANSFER LEARNING

* Pre-trained models: BERT, GPT, T5

**TRANSFORMERS(Pre-Train Model)**

103. What are Transformers

104. Self Attention is all you need!!

105. Encoder Architecture

106. Contextual Embeddings

107. Decoder Architecture

Section 14: Encoder Only Architecture (Pre-Requisite)

108. Introduction to BERT

109. BERT Configurations

110. BERT Fine Tuning

111. BERT Pre Training (Masked LM)

112. Input Embeddings BERT

113. ARLM vs AELM

114. RoBERTa

115. DistilBERT

116. AlBERT

**DECODER ONLY ARCHITECTURE**

118. GPT Architecture

119. GPT (Masked Multi Head Attention)

120. GPT Blocks

121. GPT Training

* Text generation techniques: Sampling, Beam Search, Top-k, Top-p  
   **Practical:**
* Generate text using GPT-2/3 small models
* Fine-tune a small language model on custom text  
   **Project Idea:** Build a question-answering chatbot

Section 16: LLM Basics - Tokens, Context Window, Prompt, Prompt Tuning etc.

122. What are Tokens

123. Context Window

124. What is a Prompt?

125. Prompt Engineering

126. Prompt Tuning

127. Prompt Structures

Section 17: RAGs (Retrieval Augmented Generation)

Section 18.LANGCHAIN

Section 19.PROMPT ENGINEERING

Section 18.VECTOR DATABASE VECTOR INDEX

Section 19. MODEL : OLLAMA , OPEN AI, XAI

FINE TUNE

RAG AND EVALUATION MATRICS

DEPLOY GEN AI PROJECT

GEN AI PROJECT

INTERVIEW PREPARATIONS

·

Generative AI(Advance)

* Introduction of fine tuning
* RAG vs Finetuning
* When to use RAG vs When to use Fine-tuned Models
* Fine Tuning

## **Module 3.1: NLP and Text Generation**

**Objective:** Text-based Gen AI, including LLMs.  
 **Production-Level Project:**

* **Project:** Build a **domain-specific chatbot** (Finance, Healthcare, Education) using GPT-3 or open-source LLM like LLaMA or Mistral.
* **Features:**
  + Context retention for conversations
  + Fine-tuned on domain knowledge
  + API deployment for web or mobile integration
* **Skills Gained:** Tokenization, embeddings, prompt engineering, API integration

## **Module 4: Generative Models**

**Objective:** Dive deep into models that generate data.**:** VAE, GAN, Diffusion models for data generation.  
 **Topics:**

* Variational Autoencoders (VAE)
* Generative Adversarial Networks (GAN)  
  + DCGAN, StyleGAN, CycleGAN
* Diffusion models (Denoising Diffusion Probabilistic Models)
* Reinforcement Learning for generation (RLHF)  
   **Practical:**
  + Generate handwritten digits using VAE/GAN
  + Generate synthetic images using StyleGAN  
     **Project Idea:** Create AI art generation application

**Production-Level Project:**

* **Project:** **AI Art Generator Platform**
  + Users input text prompts → generate images
  + Store generated images in cloud (AWS S3/GCP Bucket)
  + Web dashboard for browsing/saving images
* **Skills Gained:** GAN/Diffusion usage, model inference optimization, cloud storage integration

## **Module 5: Vision-Based Generative AI**

**Objective:** Learn image/video generation and manipulation.  
 **Topics:**

* Image generation: GANs, Diffusion Models
* Image-to-image translation
* Text-to-image generation (Stable Diffusion, DALL·E)
* Video generation and deepfakes  
   **Practical:**
* Generate images using Hugging Face diffusion models
* Modify images with text prompts  
   **Project Idea:** Build a meme generator using AI

**Objective:** Image & video generation and editing  
 **Production-Level Project:**

* **Project:** **Deepfake Video Demo App**
  + Replace face in video with another using pre-trained models (ethical demo)
  + Web interface for upload & download
* **Alternative:** AI meme generator platform for social media
* **Skills Gained:** Video/image processing, API deployment, security & privacy considerations

## **Module 6: Audio & Speech Generation**

**Objective:** Understand AI-generated audio and speech.  
 **Topics:**

* Text-to-Speech (TTS): Tacotron, FastSpeech
* Speech-to-Text (STT) basics
* Music generation using AI (Jukebox)
* Voice cloning and speech synthesis ethics  
   **Practical:**
* Convert text to speech using pre-trained models
* Generate AI music clips  
   **Project Idea:** Build a virtual voice assistant with AI-generated voice

**Objective:** TTS, STT, and AI music generation  
 **Production-Level Project:**

* **Project:** **Virtual Voice Assistant / Audiobook Generator**
  + Input: Text
  + Output: Natural-sounding voice (TTS)
  + Web interface or mobile app integration
* **Skills Gained:** Audio processing, TTS/STT integration, multi-modal interface

## **Module 7: Code Generation & Automation**

**Objective:** Explore AI in coding and productivity tools.  
 **Topics:**

* AI code assistants: GitHub Copilot, CodeGPT
* Generating Python scripts, SQL queries, or web code
* Automating repetitive tasks with AI  
   **Practical:**
* Use OpenAI Codex to generate scripts
* Build an AI-powered code helper  
   **Project Idea:** Build an AI code generator web app

**Objective:** Generate code using AI models  
 **Production-Level Project:**

* **Project:** **AI-Powered Code Helper/IDE Plugin**
  + Generate Python/SQL snippets based on natural language queries
  + Integrate with VS Code / Web IDE using API
* **Skills Gained:** API usage, AI-assisted automation, deployment as plugin or web tool

## **Module 8: Fine-Tuning & Custom Gen AI**

**Objective:** Learn to customize pre-trained AI models.  
 **Topics:**

* Transfer Learning for Gen AI
* Fine-tuning LLMs on domain-specific data
* Prompt Engineering & Prompt Optimization
* Embeddings and vector databases (FAISS, Pinecone)
* Retrieval-Augmented Generation (RAG)  
   **Practical:**
* Fine-tune GPT-2 or LLaMA on custom dataset
* Implement RAG with a small knowledge base  
   **Project Idea:** Build a domain-specific chatbot (e.g., Healthcare or Finance)

**Objective:** Customize pre-trained models  
 **Production-Level Project:**

* **Project:** **Domain-Specific Knowledge Chatbot with RAG**
  + Fine-tune a model on company manuals, policies, or docs
  + Embed document vectors using FAISS or Pinecone
  + Deploy as a web API for enterprise use
* **Skills Gained:** Vector embeddings, RAG, fine-tuning LLMs, enterprise-grade deployment

## **Module 9: Deployment of Gen AI**

**Objective:** Deploy Gen AI models in real applications.  
 **Topics:**

* APIs for Gen AI (OpenAI API, Hugging Face Inference API)
* Model serving frameworks: FastAPI, Flask, Streamlit, Gradio
* Scaling and optimization  
   **Practical:**
* Deploy a small chatbot web app
* Integrate Gen AI into a website or app  
   **Project Idea:** Deploy AI chatbot for customer support

**Objective:** Deploy Gen AI models for production  
 **Production-Level Project:**

* **Project:** Deploy **AI-powered Customer Support Bot**
  + Multi-modal: text, image, audio support
  + Backend: FastAPI/Flask
  + Frontend: Streamlit / React / Tailwind CSS
  + Scalable using Docker + Kubernetes
* **Skills Gained:** Model serving, containerization, scaling, cloud deployment, CI/CD

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## **Week 10: Workflow Automation & Autonomous Agents**

**Objective:** Automate AI tasks using workflows and autonomous agents  
 **Topics:**

* Autonomous AI agents (Agentic)
* Multi-step task planning
* Workflow automation (n8n)
* Trigger-action pipelines

**Practical:**

* Build AI agent to fetch documents, summarize, and notify via email/Slack
* Create automated AI workflow in n8n

**Production Project:**

* **Autonomous AI Report Generator**

**✅ Tools Integrated Across Syllabus:**

* **AI/ML: PyTorch, TensorFlow, Hugging Face Transformers, Diffusers**
* **Deployment: FastAPI, Flask, Streamlit, Gradio, React, Tailwind CSS**
* **Automation: n8n, Agentic**
* **Model Management: MCP / MLflow**
* **Database: FAISS / Pinecone**
* **Production Operations: Docker, Kubernetes, CI/CD pipelines**
* **Monitoring: Prometheus, Grafana**

## **Module 10: Ethics, Bias, and Responsible AI**

**Objective:** Learn to handle risks and responsibilities of AI.  
 **Topics:**

* Bias in datasets and models
* Deepfake regulations
* Privacy, IP, and copyright in AI-generated content
* AI safety and explainability

**Practical:**

* Detect biased AI outputs
* Explore tools for ethical AI evaluation

**Objective:** Ensure responsible use in production  
 **Production-Level Project Integration:**

* Add bias detection & moderation for all deployed AI systems
* Content filtering (NSFW, offensive prompts)
* Logging AI outputs for compliance audits

## **Capstone Project Ideas**

* Build a multi-modal AI assistant (text + image + speech)
* AI-powered content creation tool (blogs, images, videos)
* AI tutor for a specific domain with RAG
* Personalized music generator using AI
* Virtual AI interviewer with feedback (like an AI mock interview app)

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## **Capstone Production-Level Projects**

These can combine multiple modules and mimic enterprise-level Gen AI applications:

1. **AI Multi-Modal Assistant:**
   * Chat + Image + Speech generation
   * Fine-tuned on domain-specific knowledge
   * Web app deployment with user authentication
2. **AI Content Creation Platform:**
   * Generate blogs, social media posts, images
   * Integrate scheduling, saving, and analytics
   * Cloud deployment & multi-user support
3. **Virtual AI Interviewer:**
   * Face detection, emotion analysis, TTS-based question asking
   * Feedback scoring using ML/AI models
   * Deployment via Flask/Streamlit, Dockerized
4. **AI-Powered Education Tool:**
   * Student asks questions → AI tutor answers with text, images, or audio
   * Personalized content based on learning style

## **Suggested Tools & Frameworks for Production**

* **AI & ML:** PyTorch, TensorFlow, Hugging Face Transformers, Diffusers
* **Web & APIs:** FastAPI, Flask, Streamlit, Gradio, React, Tailwind CSS
* **Database & Search:** PostgreSQL/MySQL, FAISS, Pinecone
* **Deployment:** Docker, Kubernetes, AWS/GCP/Azure, CI/CD pipelines
* **Monitoring & Logging:** Prometheus, Grafana, ELK Stack

## **Suggested Tools & Libraries**

* Python, PyTorch, TensorFlow
* Hugging Face Transformers & Diffusers
* OpenAI API
* Gradio, Streamlit, FastAPI
* FAISS or Pinecone for vector databases

**course Resources**

Congrats on enrolling in the **Mastering Generative AI: LLMs, Prompt Engineering & More!** Course

**Download the resources:**

1.Python: <https://github.com/pik1989/PythonforDS>

3.NLP: <https://drive.google.com/drive/folders/1u7MYQMiVh-2Eus0f2d3KLbi0FCxg6kci?usp=sharing>

5. Deep Learning: <https://drive.google.com/drive/folders/1vA-jClnGCd1GeqvEin9SP-d3hr2puHRA>

7. Deployment: <https://drive.google.com/drive/folders/1laq9u4sNkkNYv_L_q99NQnYEU01icC9w?usp=sharing>

9. Projects: Individual project codes are shared in the Projects section

10. Click here to download the presentation used: <https://drive.google.com/drive/folders/1rejrw6o6Naz8oX8D9tHSMC5P2efibfwF?usp=sharing>