GenAI RoadMap

Phase 0: Foundations of GenAI

> Goal: Set up environment, understand the basics

1. **Intro to GenAI & LLMs**
    - What is Generative AI? LLMs? RAG?
    - Overview of OpenAI, Hugging Face, and GPT
    - Tools: Jupyter, VSCode, Python setup
2. **Project 1: Your First Chatbot with OpenAI API**
    - Use OpenAI `chat-completion` API
    - Simple CLI chatbot
    - Intro to prompt engineering

🔍 Phase 1: Prompt Engineering & Token Management

> Goal: Learn the art and science of interacting with LLMs

1. **Prompt Engineering Deep Dive**
    - Zero-shot, Few-shot, Chain-of-thought
    - Temperature, top_p, tokens, max_length
2. **Project 2: Smart Email Generator**
    - Take a subject and generate email copy
    - Use prompt templates and roles

📦 Phase 2: LangChain Essentials

> Goal: Understand how to build production apps using LangChain

1. **LangChain Basics**
    - Components: Chains, Tools, Agents, Memory, PromptTemplates
2. **Project 3: AI-Powered PDF Q&A Bot**
    - Upload PDF → Chunk it → Embed → Query using OpenAI
    - Tools: LangChain, FAISS, PyPDF, OpenAIEmbeddings

🕸️ Phase 3: RAG (Retrieval-Augmented Generation)

> Goal: Build RAG-based systems from scratch

1. **Intro to Embeddings & Vector Stores**
    - ChromaDB, Pinecone
    - Cosine similarity, chunking, indexing
2. **Project 4: Resume Analyzer Bot**
    - Upload resume, analyze it, and suggest job matches
    - RAG pipeline using Chroma + LangChain
3. **Project 5: YouTube Video Q&A Bot**
    - Use `yt-dlp` to extract transcripts
    - Create embeddings, and answer questions based on video

🤖 Phase 4: Agents & Tools

> Goal: Use LLMs with tools and create autonomous workflows

1. **LangChain Agents Explained**
    - ReAct, MRKL, Tool usage
2. **Project 6: Multi-Tool Research Assistant**
    - Toolset: SerpAPI, Calculator, WebSearch, DocsReader

3. **Project 7: AI Travel Planner**

- Input: Dates + preferences → Output: Itinerary
- Uses tools like Maps, Flights, Weather, Budget planner

🔁 Phase 5: LangGraph & Multi-Agent Systems

> Goal: Master LangGraph for dynamic multi-agent orchestration

1. **LangGraph Intro**
    - Graph-based reasoning
    - Building agent workflows
2. **Project 8: Autonomous Startup Ideation Bot**
    - One agent ideates, one critiques, one validates market fit

📡 Phase 6: API Deployment + Web App Integration

> Goal: Serve models via API & build full-stack apps

1. **Serving LLM Apps with FastAPI**
    - API routing, auth, JSON I/O
2. **Project 9: AI Code Review API**
    - Input: PR diff → Output: Review comment suggestions

3. **Frontend Integration (Optional React/Firebase)**
    - Connecting FastAPI backend with frontend
    - Deploy on Vercel/Render

🔁 Phase 6: MCP (Model Customization & Personalization)

> Goal: Personalize LLM behavior per user, domain, or app context

☁️ Phase 7: Deployment & Production-Ready AI

> Goal: Take apps to production

1. **Caching, Rate Limiting, and Logging**
    - Redis, Pinecone persistence
    - Tracing with LangSmith / OpenTelemetry

2. **Project 10: Full-stack AI Feedback App**
    - Input: Student project uploads
    - Output: Instant AI feedback, stored in database
    - Dashboard view with ranking/score

🧠 Bonus Modules (Optional Advanced Topics)

- Fine-tuning vs RAG
- Open-source LLMs: LLaMA, Mistral, Ollama
- Local vector DBs & embedding models (e.g., `Instructor-XL`)
- Cost optimization techniques (token counting, streaming)
- Use Hugging Face Transformers directly