Generative AI Learning Roadmap for Data Science Engineers

Part 1: Foundations (23 weeks)

- Topics:
  - Generative vs Discriminative models
  - Probability basics: MLE, KL Divergence, Entropy
  - Neural networks refresher (MLP, CNN, RNN)
  - PyTorch or TensorFlow fundamentals
- Resources:
  - Deep Learning Specialization Andrew Ng
  - PyTorch Tutorials

Part 2: Core Generative Models (34 weeks)

- Topics:
  - Variational Autoencoders (VAE)
  - Generative Adversarial Networks (GAN, DCGAN, WGAN, CycleGAN)
  - Autoregressive models (PixelCNN, WaveNet)
- Projects:
  - VAE on MNIST
  - DCGAN on CelebA
- Resources:
  - CS231n (Stanford)
  - GANs in Action (Book)

Part 3: Text & Language Models (34 weeks)

- Topics:
  - Word embeddings (Word2Vec, GloVe)
  - Transformer architecture (Attention, Self-attention)
  - GPT family: GPT-2, GPT-3
- Projects:
  - GPT-2 text generator using HuggingFace

- Fine-tune on custom dataset

Part 4: Multimodal Generation (45 weeks)

- Topics:
  - Text-to-image models (Stable Diffusion, DALLE)
  - Vision Transformers, CLIP
  - Diffusion models
- Projects:
  - Image generation from text using Stable Diffusion
  - CLIP-guided image creation
- Resources:
  - HuggingFace Diffusers
  - Diffusion Models Demystified

Part 5: Advanced Topics & Deployment (4 weeks)

- Topics:
  - RLHF (Reinforcement Learning with Human Feedback)
  - LangChain, LLM pipelines, vector stores (FAISS, Chroma)
  - LoRA, PEFT, quantization
  - Web deployment: Streamlit, Gradio, FastAPI
- Projects:
  - Chatbot with LangChain
  - Image captioning app
  - Web app for text/image generation

Capstone Ideas

- AI content creation suite (text, image, audio)
- Memory-enabled assistant (LangChain + ChromaDB)
- Custom AI-powered search system

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Bonus Resources

- The Illustrated Transformer: https://jalammar.github.io/illustrated-transformer/
- Full Stack Deep Learning: https://fullstackdeeplearning.com/
- Papers with Code Generative Models: https://paperswithcode.com/task/generative-modeling