

GENERATIVE A.I CURRICULUM

CNN | RNN | LSTM | GRU | VAE | GAN | DCGAN | WGAN | cGANs | NLP
| RAG | Langchain | HuggingFace | PromptEngineering

Topic 1: Foundations of AI and Machine Learning

Day 1: Introduction to AI, ML, and DL

- Intro to AI, ML, and DL.
- **Project 1:** Simple linear regression model using scikit-learn to predict housing prices.

Day 2: Python for Machine Learning

- Intro to Essential libraries: NumPy, Pandas, Matplotlib.
- Data loading, cleaning, and preprocessing.
- **Project 2:** Data analysis on the Iris dataset, visualizing distributions and correlations.

Day 3: Linear Algebra and Calculus for ML

- Essential linear algebra concepts (vectors, matrices, dot product).
- Gradient descent optimization.
- **Project 3:** Implementing gradient descent to find the minimum of a simple quadratic function.

Day 4: Supervised and Unsupervised Learning

- Supervised and unsupervised learning.
- Classification and regression problems.
- **Project 4:** Implementing k-means clustering on the Iris dataset.

Day 5: Model Evaluation and Cross-Validation

- Evaluation metrics (accuracy, precision, recall, F1-score, confusion matrix).
- Cross-validation.

- **Project 5:** Comparing classification models on the MNIST dataset using cross-validation.
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Topic 2: Neural Networks and Deep Learning

Day 6: Introduction to Neural Networks

- Perceptrons, activation functions, backpropagation.
- **Project 6:** Building a neural network to classify the MNIST dataset using TensorFlow/Keras.

Day 7: Convolutional Neural Networks (CNNs)

- Convolution, pooling, and fully connected layers.
- **Project 7:** Training a CNN on the CIFAR-10 dataset to classify images.

Day 8: Recurrent Neural Networks (RNNs)

- RNN architecture, vanishing gradient problem.
- **Project 8:** Building a character-level language model using an RNN to generate text.

Day 9: LSTM and GRU Networks

- LSTM and GRU architecture, advantages over RNNs.
- **Project 9:** LSTM and GRU for sentiment analysis on the IMDB dataset.

Day 10: Autoencoders and Variational Autoencoders (VAEs)

- Undercomplete and overcomplete autoencoders, denoising autoencoders.
- Introduction to VAEs, latent space, and reparameterization tricks.
- **Project 10:** Autoencoders for image compression and reconstruction on the MNIST dataset.

Topic 3: Generative Adversarial Networks (GANs)

Day 11: Introduction to GANs

- GANs, generators, and discriminators.
- **Project 11:** Basic GAN to generate simple images using TensorFlow/Keras.

Day 12: Deep Convolutional GAN (DCGAN)

- Deep Convolutional GAN architecture.
- **Project 12:** Train a DCGAN on the MNIST dataset to generate realistic digits.

Day 13: Wasserstein GAN (WGAN)

- Limitations of vanilla GANs, Wasserstein distance.
- **Project 13:** Experiment with WGAN to generate more stable images.

Day 14: Conditional GANs (cGANs)

- Conditional generation.
- **Project 14:** Train a cGAN to generate images based on class labels.

Day 15: Advanced GANs (StyleGAN, Progressive GANs)

- Advanced architectures for high-quality image generation.
 - **Project 15:** StyleGAN hyperparameters to generate high-quality images.
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Topic 4: Natural Language Processing and Language Models

Day 16: Introduction to Language Models

- Pre-trained language models (Word2Vec, GloVe).
- **Project 16:** Simple RNN language model on a text corpus.

Day 17: Transformer Architecture

- Encoder-decoder architecture, attention mechanism.
- **Project 17:** Implement a simplified transformer block.

Day 18: Hugging Face and Pre-trained Models

- Introduction to the Hugging Face library.
- **Project 18:** Using Hugging Face transformers to perform text classification with BERT.

Day 19: Text Summarization and Question Answering

- Extractive and abstractive summarization.
- **Project 19:** Building a basic extractive summarizer using pre-trained models from Hugging Face.

Day 20: Machine Translation and Multimodal Generation

- Sequence-to-sequence models, attention mechanism in translation.
 - **Project 20:** Attention mechanisms for machine translation.
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Topic 5: Advanced Topics in Generative AI

Day 21: Introduction to Retrieval-Augmented Generation (RAG)

- Concept of RAG, combining retrieval and generation.
- **Project 21:** Implementing a RAG system using Hugging Face transformers and a retrieval model.

Day 22: LangChain for LLMs

- Introduction to LangChain for building LLM applications.
- **Project 22:** Building a simple conversational agent using LangChain.

Day 23: Few-shot and Zero-shot Learning

- Techniques for few-shot and zero-shot learning with LLMs.
- **Project 23:** GPT-3 for zero-shot text classification.

Day 24: Prompt Engineering

- Effective prompt design techniques.
- **Project 24:** Generating diverse text outputs using different prompts with GPT-3.

Day 25: Deployment of Generative Models

- Techniques for deploying generative models in production environments.
 - Containerization using Docker, serving models with FastAPI or Flask.
 - **Project 25:** Deploying a trained generative model using FastAPI and Docker.
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Topic 6: Applications and Future Trends

Day 26: Generative Models for Healthcare Applications

- Applications of generative models in healthcare - medical imaging and drug discovery.

- Data augmentation techniques and synthesis in medical datasets.
- **Project 26:** GANs for generating synthetic medical images to augment a training dataset

Day 27: Generative Models for Scientific Applications

- Applications in drug discovery, material science, and protein structure prediction.
- **Project 27:** Molecular generation using a variational autoencoder.

Day 28: Generative Models for Art and Design

- Generative art, design patterns.
- **Project 28:** Creating generative art using a GAN.

Day 29: Generative Models for Audio and Time Series

- Audio generation models (WaveGAN, MelGAN).
- Time series forecasting and generation.
- **Project 29:** Generating synthetic audio or time series data using appropriate models.

Day 30: Real-world Projects and Capstone

- Integration of learned concepts into real-world projects.
- Collaborative project development.
- **Project 30 - Capstone project** : Develop a comprehensive generative AI application incorporating multiple techniques and models covered in the course (e.g., a chatbot using RAG, a text-to-image generator, or a multimodal application).

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