Deep Learning & Generative AI Course Outline

Total Class 24

Module	Class	Topics
Module 1: Introduction to Deep Learning and AI (4 Classes)	**Class 1**	**Introduction to AI and Machine Learning**
		● Overview of AI, ML, and DL
		● Key Concepts and Terminologies
		● Historical Context and Evolution
		● Key Concepts: Generative AI, LLM, Vector Database, Hugging Face, LangChain
		● Importance of Kaggle profile
		○ Kaggle Competition
		● The job of DL, LLM, Generative AI
	Class 2	**Basics of Neural Networks**
		● Artificial Neurons
		● Activation Functions: Linear, Sigmoid, Softmax, Tanh, ReLu, Leaky ReLu
		● Dying ReLu Problem
		● ANN Architecture
		● Forward and Backward Propagation
		● Training Neural Networks with Python
	Class 3	**Deep Learning Frameworks and Tools**
		● Introduction to Popular Frameworks: Keras, TensorFlow, PyTorch
		● Setting up the Environment
		● Basic Operations
		● Model Creation with Python
	Class 4	**Training Deep Learning Models**
		● Data Import, Preparation, and Preprocessing
		● Loss Functions and Optimization Algorithms
		○ Gradient Descent Optimizer
		○ Variants of Gradient Descents (Momentum, Nesterov Momentum, AdaGrad, RMSProp, Adam, Nadam)
		● Gradient Problems (Vanishing & Exploding)
		● Key Concepts of Overfitting, Underfitting, and Bestfitting
		● Regularization Techniques
Module 2: Computer Vision (8 Classes)	**Class**	**Introduction to Computer Vision**

Module	5 Class	Topics
		● Overview of Computer Vision Tasks
		● Image Data Handling
		● Data Augmentation
	Class 6	**Convolutional Neural Networks (CNNs)**
		● CNN Architecture and Components
		● Convolution and Pooling Layers
		● Fully Connected Layer
	Class 7	**Advanced CNN Architectures**
		● Popular CNN Models (LeNet, AlexNet, VGG, ResNet, Inception)
		● Transfer Learning
		● Fine-tuning
	Class 8	**Object Detection and Localization**
		● Techniques (R-CNN, Fast R-CNN, Faster R-CNN, YOLO)
		● Implementation and Applications
	Class 9	**Semantic Segmentation and Image Segmentation**
		● Techniques (U-Net, Fully Convolutional Networks)
		● Practical Examples and Use Cases
		● Implementation with Python
	Class 10	**Generative Adversarial Networks (GANs) in Computer Vision**
		● Introduction to GANs
		● Architecture
		● Training of GANs with Python
	Class 11	**Applications of GANs in Computer Vision**
		● Image Generation and Transformation
		● Style Transfer and Super-Resolution
		● Implementation with Python
	Class 12	**Computer Vision Projects**
		● Implementing a Real-World Project
		● Best Practices and Troubleshooting
		● Project Name: Automatic Dhaka Traffic Detection using the YOLO Model

Module	Class	Topics
Module 3: Natural Language Processing (NLP) (7 Classes)	**Class 13**	**Introduction to NLP**
		● Overview of NLP Tasks
		● Text Preprocessing Techniques
		● Regex
		● Implementation with Python
	Class 14	**Word Embeddings and Representations**
		● Tf-idf, Word2Vec, GloVe, FastText
		● Contextual Embeddings (ELMo, BERT)
		● Implementation with Python
	Class 15	**Recurrent Neural Networks (RNNs) and Variants**
		● Basic RNN Architecture
		● Long Short-Term Memory (LSTM)
		● Gated Recurrent Unit (GRU)
		● Implementation with Python
	Class 16	**Attention Mechanisms and Transformers**
		● Attention Mechanism
		● Transformers: Input Embeddings, Positional Encodings, Encoder, Decoder, Output Layer
	Class 17	**Advanced Transformer Models**
		● BERT, GPT, T5, and Their Applications
		● Fine-Tuning Pre-trained Transformers
		● Evaluate NLP Models
	Class 18	**Sequence-to-Sequence Models and Applications**
		● Machine Translation, Text Summarization
		● Practical Examples
		● Implementation with Python
	Class 19	**NLP Projects**
		● Implementing a Real-World Project
		● Best Practices and Troubleshooting
		● Project Name: Word Spelling Correction
Module 4: Generative AI (6 Classes)	**Class 20**	**Introduction to Generative AI**
		● Overview of Generative Models

Module	Class	Topics
		● Applications and Use Cases
	Class 21	**Variational Autoencoders (VAEs)**
		● VAE Architecture and Training
		● Applications in Image and Text Generation
		● Implementation with Python
	Class 22	**Advanced GAN Techniques**
		● Variants of GANs (DCGAN, CycleGAN, StyleGAN)
		● Training Stability and Challenges
		● Implementation with Python
	Class 23	**Generative AI in NLP**
		● Langchain & Hugging Face Introduction
		● LLM Model Introduce & Fine-Tuning LLM Model (Gemma and LLAMA Models)
		● Text Generation with LLM Models
		● Applications in Chatbots and Content Creation
		● Implementation with Python
	Class 24	**Generative AI Project**
		● Project Name: LLM Langchain Project using Vector Database