

# Machine Learning and Generative AI

## Course Overview

This course aims to cover the fundamentals of machine learning and dive deep into the current hot topics of generative AI, including large language models (LLMs) like GPT and image/video content generation.

Prerequisites: Basic understanding of Python programming, linear algebra, and probability theory.

## Course Agenda

### Introduction to Machine Learning (8 hours)

- Overview of machine learning, types of machine learning (supervised, unsupervised, reinforcement learning)
- Essential Python libraries for ML (NumPy, Pandas, Matplotlib)

### Introduction to Neural Networks and Deep Learning (12 hours)

- Fundamentals of neural networks
- Deep Learning concepts
- Introduction to TensorFlow and PyTorch

### Fundamentals of Generative AI (24 hours)

- Understanding generative AI and its significance
- Overview of generative models and how they work
- Ethical considerations and societal impacts of Generative AI
- Tools and libraries: PyTorch, Hugging Face
- Hands-on: Fine-tuning a pre-trained model using parameter-efficient fine-tuning (PEFT)

### Fundamentals of Large Language Models (LLMs) and Text Generation (28 hours)

- Basics of natural language processing (NLP)
- Introduction to recurrent neural networks (RNNs) and transformers
- Deep dive into LLMs: architecture, training, and applications
- Introduction to GPT (Generative Pre-trained Transformer) models
- Case studies: GPT-4 (OpenAI), Gemini (Google), LLaMA (Meta), and other prominent language models.
- Text generation techniques, prompt engineering, retrieval augmented generation
- Explainability and interpretability of LLMs
- Hands-on: Building a custom chatbot

### Computer Vision and Image Generation (24 hours)

- Basics of computer vision, image processing with AI
- Overview of generative adversarial networks (GANs)
- Introduction to autoencoders and variational autoencoders (VAEs)
- Training GANs for image generation
- Case studies: StyleGAN, DALL-E, and other image generation models
- Hands-on: Creating new images with Generative AI models

### Video Generation Techniques (12 hours)

- Introduction to video generation using recurrent neural networks
- Overview of video prediction models
- Hands-on: Implementing video generation using deep learning architectures