AI/ML Training Curriculum

This 8-week curriculum provides a comprehensive introduction to Artificial Intelligence (AI) and Machine Learning (ML), covering foundational concepts, advanced techniques, MLOps, and modern generative AI methodologies, including Retrieval-Augmented Generation (RAG), Agentic AI, and Transformers. The course combines theoretical learning with hands-on projects, culminating in a capstone project to build a full-stack AI application. The content is organized into a 5-day-per-week schedule (Monday to Friday), totaling 40 days, to ensure a structured learning pace without weekend commitments.

Month 1: Foundations of AI/ML, Deep Learning, and MLOps

Week 1: Introduction to AI/ML and Development Tools

- **Day 1 (Monday): Overview of AI/ML and Data Science**
    - Learn the scope, history, and applications of AI/ML and Data Science.
    - **Free Online Resources**:
        - **Coursera (Audit for Free)**: "AI For Everyone" by Andrew Ng, Module 1 (https://www.coursera.org/learn/ai-for-everyone).
    - **Learning outcomes:** Grasp the foundations of AI/ML and Data Science, including their scope, history, differences, and major real-world applications.
- **Day 2 (Tuesday): Types of Machine Learning and Terminology**
    - Study Supervised Learning (classification, regression), Unsupervised Learning (clustering, dimensionality reduction), and key terms: Features, Labels, Models, Training, Testing, Overfitting, Underfitting.
    - **Free Online Resources**:
        - **Coursera (Audit for Free)**: "Machine Learning" by Andrew Ng, Week 1 (https://www.coursera.org/learn/machine-learning).
        - **Towards Data Science**: Articles on ML terminology (https://towardsdatascience.com/tagged/machine-learning).
    - **Learning outcomes:** Distinguish supervised vs. unsupervised learning, understand classification, regression, clustering, dimensionality reduction, and key ML terminology.
- **Day 3 (Wednesday): Reinforcement Learning and Tools (Part 1)**
    - Explore basic concepts of Reinforcement Learning and tools: Python, Jupyter Notebooks, VS Code.
    - **Free Online Resources**:
        - **Google Colab**: Free Jupyter Notebook environment (https://colab.research.google.com).

    - **Learning outcomes:** Learn core reinforcement learning concepts (agent, environment, rewards, policies) and get hands-on with Python, Google Colab, and VS Code.
- **Day 4 (Thursday): Tools Overview (Part 2)**
    - Learn Git, GitHub, and MLOps tools: MLflow, DVC, Docker.
    - **Free Online Resources**:
        - **GitHub Docs**: Git and GitHub basics (https://docs.github.com/en/get-started).
        - **MLflow Tutorials**: Getting started guide (https://mlflow.org/docs/latest/getting-started/intro-quickstart/index.html).
    - **Learning outcomes:** Develop practical knowledge of Git/GitHub workflows, understand experiment tracking with MLflow, data versioning with DVC, and environment setup using Docker.
- **Day 5 (Friday): Hands-on Setup and Review**
    - Set up development environment (Python, Anaconda, Git, MLflow) and review Week 1 concepts.
    - **Free Online Resources**:
        - **Docker Getting Started**: Docker basics tutorial (https://www.docker.com/get-started/).
    - **Learning outcomes:** Complete installation of Python, Anaconda, Git, MLflow, and Docker, run test projects, and consolidate all Week 1 concepts into a high-level ML pipeline view.

Week 2: Python for Data Science and MLOps Basics

- **Day 6 (Monday): Python Basics (Part 1)**
    - Learn data structures (lists, dictionaries) and functions.
    - **Free Online Resources**:
        - **Kaggle Learn**: "Python" course, Modules 1-2 (https://www.kaggle.com/learn).
    - **Learning outcomes:** Master Python fundamentals including variables, control flow, lists, dictionaries, and writing reusable functions.
- **Day 7 (Tuesday): Python Basics (Part 2)**
    - Study Object-Oriented Programming (OOP) in Python.
    - **Free Online Resources**:

        - **DataCamp (Free Chapters)**: "Introduction to Python" (https://www.datacamp.com).
    - **Learning outcomes:** Understand Object-Oriented Programming (OOP) in Python, including classes, objects, inheritance, and encapsulation.
- **Day 8 (Wednesday): Key Libraries**
    - Explore NumPy (numerical operations) and Pandas (data manipulation).
    - **Free Online Resources**:
        - **Kaggle Learn**: "Pandas" course (https://www.kaggle.com/learn).
        - **DataCamp (Free Chapters)**: "Data Manipulation with Pandas" (https://www.datacamp.com).
    - **Learning outcomes:** Gain hands-on experience with NumPy for numerical computing and Pandas for efficient data manipulation and analysis.
- **Day 9 (Thursday): Data Preprocessing**
    - Learn handling missing values, encoding categorical variables, and feature scaling.
    - **Free Online Resources**:
        - **Kaggle Notebooks**: Titanic preprocessing tutorials (https://www.kaggle.com/code).
    - **Learning outcomes:** Learn practical data preprocessing techniques such as handling missing values, encoding categorical features, and feature scaling.
- **Day 10 (Friday): MLOps Basics and Hands-on**
    - Study model tracking with MLflow and data versioning with DVC. Preprocess a dataset (e.g., Titanic) and track an experiment with MLflow.
    - **Free Online Resources**:
        - **DVC Tutorial**: Official guide for data versioning (https://dvc.org/doc/start).
        - **MLflow Tutorials**: Experiment tracking (https://mlflow.org/docs/latest/getting-started/intro-quickstart/index.html).
    - **Learning outcomes:** Apply MLOps basics by preprocessing a dataset, versioning data with DVC, and tracking experiments with MLflow.

Week 3: Core ML Algorithms and Model Evaluation

- **Day 11 (Monday): Core Algorithms (Part 1)**
    - Study Linear Regression and Logistic Regression.

    - **Free Online Resources**:
        - **scikit-learn Tutorials**: Linear models (https://scikit-learn.org/stable/user_guide.html).
    - **Learning outcomes:** Understand and implement Linear Regression and Logistic Regression for regression and binary classification tasks.
- **Day 12 (Tuesday): Core Algorithms (Part 2)**
    - Learn K-Nearest Neighbors (KNN) and Decision Trees.
    - **Free Online Resources**:
        - **Coursera (Audit for Free)**: "Machine Learning" by Andrew Ng, Week 2 (https://www.coursera.org/learn/machine-learning).
    - **Learning outcomes:** Learn K-Nearest Neighbors (KNN) and Decision Trees, focusing on intuition, implementation, and use cases.
- **Day 13 (Wednesday): Core Algorithms (Part 3)**
    - Explore Random Forests.
    - **Free Online Resources**:
        - **scikit-learn Tutorials**: Ensemble methods (https://scikit-learn.org/stable/user_guide.html).
    - **Learning outcomes:** Explore Random Forests as an ensemble method to improve accuracy and reduce overfitting.
- **Day 14 (Thursday): Model Evaluation and Tuning**
    - Learn Train-Test Split, K-Fold Cross-Validation, metrics (Accuracy, Precision, Recall, F1-Score, MSE, R^2), and hyperparameter tuning (Grid Search, Random Search).
    - **Free Online Resources**:
        - **Towards Data Science**: Model evaluation metrics (https://towardsdatascience.com/tagged/machine-learning).
        - **scikit-learn Tutorials**: Hyperparameter tuning (https://scikit-learn.org/stable/modules/grid_search.html).
    - **Learning outcomes:** Master model evaluation techniques (train-test split, cross-validation, accuracy, precision, recall, F1, MSE, R^2) and hyperparameter tuning methods (Grid Search, Random Search).
- **Day 15 (Friday): Hands-on ML and Review**
    - Implement and tune a Random Forest model using scikit-learn, log results with MLflow, and review Week 3 concepts.
    - **Free Online Resources**:

        - **Kaggle Notebooks**: Titanic ML tutorials (https://www.kaggle.com/code).
    - **Learning outcomes:** Build, tune, and evaluate a Random Forest model using scikit-learn, log experiments with MLflow, and consolidate Week 3 learnings.

Week 4: Introduction to Neural Networks and Deep Learning

- **Day 16 (Monday): Neural Network Basics (Part 1)**
    - Learn Perceptrons and Multilayer Perceptrons (MLPs).
    - **Free Online Resources**:
        - **DeepLearning.AI (Audit for Free)**: "Neural Networks and Deep Learning," Week 1 (https://www.coursera.org/learn/neural-networks-deep-learning).
    - **Learning outcomes:** Understand perceptrons and multilayer perceptrons (MLPs) as the foundation of neural networks.
- **Day 17 (Tuesday): Neural Network Basics (Part 2)**
    - Study activation functions (ReLU, Sigmoid) and backpropagation.
    - **Free Online Resources**:
        - **TensorFlow Tutorials**: Neural network basics (https://www.tensorflow.org/tutorials).
    - **Learning outcomes:** Learn the role of activation functions (ReLU, Sigmoid) and the concept of backpropagation in training neural networks.
- **Day 18 (Wednesday): Optimizers and Frameworks**
    - Explore optimizers (SGD, Adam) and TensorFlow/Keras (or PyTorch).
    - **Free Online Resources**:
        - **PyTorch Tutorials**: Neural network basics (https://pytorch.org/tutorials/beginner/blitz/neural_networks_tutorial.html).
    - **Learning outcomes:** Explore key optimization algorithms (SGD, Adam) and get hands-on with TensorFlow/Keras or PyTorch frameworks.
- **Day 19 (Thursday): Convolutional Neural Networks (CNNs)**
    - Learn CNN architecture for image classification (e.g., LeNet).
    - **Free Online Resources**:
        - **TensorFlow Tutorials**: CNN guide (https://www.tensorflow.org/tutorials).

    - **Learning outcomes:** Study convolutional neural networks (CNNs), their architecture, and applications in image classification.
- **Day 20 (Friday): Hands-on CNN and Review**
    - Build and train a CNN for image classification (e.g., MNIST) and review Week 4 concepts.
    - **Free Online Resources**:
        - **Kaggle**: MNIST digit classification notebooks (https://www.kaggle.com/datasets/zalando-research/fashionmnist).
    - **Learning outcomes:** Build and train a CNN model on MNIST/Fashion-MNIST datasets and review all Week 4 deep learning concepts.

Month 2: Advanced Deep Learning, Generative AI, and Application Development

Week 5: Advanced Neural Networks (RNNs, LSTMs, Transformers)

- **Day 21 (Monday): Recurrent Neural Networks (RNNs)**
    - Learn sequence modeling for time-series or text.
    - **Free Online Resources**:
        - **DeepLearning.AI (Audit for Free)**: "Sequence Models," Week 1 (https://www.coursera.org/learn/nlp-sequence-models).
    - **Learning outcomes:** Understand Recurrent Neural Networks (RNNs) and their role in modeling sequential data such as text and time-series.
- **Day 22 (Tuesday): Long Short-Term Memory (LSTMs)**
    - Study LSTMs for handling long-term dependencies.
    - **Free Online Resources**:
        - **PyTorch Tutorials**: RNN and LSTM examples (https://pytorch.org/tutorials/intermediate/char_rnn_classification_tutorial.html).
    - **Learning outcomes:** Learn Long Short-Term Memory (LSTM) networks to capture long-term dependencies in sequential data.
- **Day 23 (Wednesday): Transformers (Part 1)**
    - Learn attention mechanisms and self-attention.
    - **Free Online Resources**:
        - **Hugging Face Course**: Introduction to Transformers (https://huggingface.co/course).
    - **Learning outcomes:** Study the attention mechanism and self-attention, the foundation of Transformer models.

- **Day 24 (Thursday): Transformers (Part 2)**
    - Explore NLP applications (e.g., BERT, GPT).
    - **Free Online Resources**:
        - **Colab Notebooks**: Hugging Face BERT tutorials (https://colab.research.google.com/#search/huggingface).
    - **Learning outcomes:** Explore Transformer-based NLP applications such as BERT and GPT for text understanding and generation.
- **Day 25 (Friday): Hands-on LSTM, Transformers, and Review**
    - Build an LSTM for text prediction, explore a pre-trained Transformer (e.g., Hugging Face's BERT), and review Week 5 concepts.
    - **Free Online Resources**:
        - **PyTorch Tutorials**: LSTM examples (https://pytorch.org/tutorials/intermediate/char_rnn_classification_tutorial.html).
        - **Hugging Face Course**: Practical Transformer examples (https://huggingface.co/course).
    - **Learning outcomes:** Implement an LSTM for sequence prediction, experiment with a pre-trained Transformer model using Hugging Face, and review Week 5 concepts.

Week 6: Generative AI and RAG

- **Day 26 (Monday): Generative Models (Part 1)**
    - Learn Generative Adversarial Networks (GANs).
    - **Free Online Resources**:
        - **DeepLearning.AI (Audit for Free)**: "Generative Adversarial Networks (GANs)" specialization (https://www.coursera.org/specializations/generative-adversarial-networks-gans).
    - **Learning outcomes:** Understand the architecture and training process of Generative Adversarial Networks (GANs) for synthetic data generation.
- **Day 27 (Tuesday): Generative Models (Part 2)**
    - Study Variational Autoencoders (VAEs) and applications (e.g., GPT, DALL·E).
    - **Free Online Resources**:
        - **DeepLearning.AI (Audit for Free)**: GANs specialization (https://www.coursera.org/specializations/generative-adversarial-networks-gans).

    - **Learning outcomes:** Learn Variational Autoencoders (VAEs) and their role in generative modeling, alongside applications like GPT and DALL·E.
- **Day 28 (Wednesday): Retrieval-Augmented Generation (RAG)**
    - Learn RAG: combining retrieval and generation with LangChain, Haystack.
    - **Free Online Resources**:
        - **LangChain Docs**: RAG tutorials (https://python.langchain.com/docs/get_started).
        - **Haystack Tutorials**: Q&A systems (https://haystack.deepset.ai/tutorials).
    - **Learning outcomes:** Explore Retrieval-Augmented Generation (RAG) and implement retrieval + generation pipelines with LangChain and Haystack.
- **Day 29 (Thursday): MLOps for Generative AI**
    - Study model deployment with FastAPI and monitoring with Prometheus/Grafana.
    - **Free Online Resources**:
        - **FastAPI Docs**: Model deployment guide (https://fastapi.tiangolo.com/tutorial/).
    - **Learning outcomes:** Study deployment of generative AI models using FastAPI and monitoring strategies with Prometheus and Grafana.
- **Day 30 (Friday): Hands-on RAG and Review**
    - Build a RAG-based Q&A system using LangChain and review Week 6 concepts.
    - **Free Online Resources**:
        - **LangChain Docs**: RAG practical examples (https://python.langchain.com/docs/get_started).
    - **Learning outcomes:** Build a hands-on RAG-based Q&A system with LangChain and consolidate all Week 6 learnings.

Week 7: Agentic AI and MLOps Deployment

- **Day 31 (Monday): Agentic AI (Part 1)**
    - Learn autonomous systems with memory, planning, and tool usage.
    - **Free Online Resources**:
        - **LangChain Docs**: Building agents (https://python.langchain.com/docs/modules/agents/).

    - **Learning outcomes:** Learn the fundamentals of Agentic AI, including autonomous systems with memory, planning, and tool usage.
- **Day 32 (Tuesday): Agentic AI (Part 2)**
    - Explore frameworks: LangChain, AutoGPT, n8n.
    - **Free Online Resources**:
        - **AutoGPT GitHub**: AutoGPT setup (https://github.com/Significant-Gravitas/AutoGPT).
        - **n8n Docs**: Automation workflows (https://docs.n8n.io/).
    - **Learning outcomes:** Explore Agentic AI frameworks like LangChain, AutoGPT, and n8n for automation and orchestration.
- **Day 33 (Wednesday): Advanced MLOps (Part 1)**
    - Study CI/CD for ML pipelines (e.g., GitHub Actions).
    - **Free Online Resources**:
        - **GitHub Actions Docs**: CI/CD basics (https://docs.github.com/en/actions).
    - **Learning outcomes:** Understand advanced MLOps concepts with CI/CD pipelines for ML using GitHub Actions.
- **Day 34 (Thursday): Advanced MLOps (Part 2)**
    - Learn model serving with TensorFlow Serving or TorchServe and scalable deployment with Kubernetes.
    - **Free Online Resources**:
        - **TensorFlow Serving Guide**: Model deployment (https://www.tensorflow.org/tfx/serving).
        - **Kubernetes Basics**: Minikube tutorial (https://minikube.sigs.k8s.io/docs/start/).
    - **Learning outcomes:** Learn scalable model serving with TensorFlow Serving or TorchServe, and deployment using Kubernetes.
- **Day 35 (Friday): Hands-on Agentic AI and Review**
    - Develop an Agentic AI for a task (e.g., web search + RAG), deploy with Docker, and review Week 7 concepts.
    - **Free Online Resources**:
        - **n8n Docs**: Practical automation examples (https://docs.n8n.io/).

- **Learning outcomes:** Build a hands-on Agentic AI system (e.g., web search + RAG), containerize with Docker, and review Week 7 concepts.

Week 8: Full-Stack AI Applications and Capstone Project

- **Day 36 (Monday): Full-Stack AI Applications (Part 1)**
  - Learn React for frontend development.
  - **Free Online Resources**:
    - **React Official Tutorial**: React basics (https://react.dev/learn).
  - **Learning outcomes:** Learn React fundamentals to build interactive frontends for AI-powered applications.
- **Day 37 (Tuesday): Full-Stack AI Applications (Part 2)**
  - Study FastAPI for backend model serving.
  - **Free Online Resources**:
    - **FastAPI Docs**: Build APIs (https://fastapi.tiangolo.com/tutorial/).
  - **Learning outcomes:** Study FastAPI for serving ML/DL models as backend APIs in full-stack projects.
- **Day 38 (Wednesday): Capstone Project (Part 1)**
  - Start developing a generative AI application (e.g., chatbot using RAG or Agentic AI).
  - **Free Online Resources**:
    - **freeCodeCamp**: Full-stack tutorials (https://www.freecodecamp.org/learn).
  - **Learning outcomes:** Start developing a capstone generative AI application (e.g., chatbot using RAG or Agentic AI).
- **Day 39 (Thursday): Capstone Project (Part 2)**
  - Continue building the application, integrating frontend, backend, and MLOps pipeline (MLflow, Docker).
  - **Free Online Resources**:
    - **Kaggle Notebooks**: Full-stack AI project examples (https://www.kaggle.com/code).
    - **MLflow Tutorials**: Experiment tracking for projects (https://mlflow.org/docs/latest/getting-started/intro-quickstart/index.html).
  - **Learning outcomes:** Integrate frontend, backend, and MLOps components (MLflow, Docker) into the capstone project.

- **Day 40 (Friday): Capstone Project Presentation and Wrap-up**
    - Finalize the application, present to peers and instructors (evaluated on functionality, creativity, technical rigor), and review the entire curriculum.
    - **Free Online Resources**:
        - **freeCodeCamp**: Presentation skills tutorials (https://www.freecodecamp.org/learn).
    - **Learning outcomes:** Finalize, present, and evaluate the capstone project while reviewing the complete 8-week AI/ML curriculum.

Weekly Assignments

- **Week 1: Environment & Tools Setup**
  👉 Assignment: Set up Python, GitHub, MLflow, and Docker; create a sample GitHub repo with version control and log a dummy experiment in MLflow.

- **Week 2: Python & Data Preprocessing**
  👉 Assignment: Use Pandas and NumPy to clean and preprocess the Titanic dataset (handle missing values, encode categorical features, scale data) and version the dataset using DVC.

- **Week 3: Core ML Models**
  👉 Assignment: Train Logistic Regression, Decision Tree, and Random Forest models on the Titanic dataset, compare results using evaluation metrics, and track experiments with MLflow.

- **Week 4: Neural Networks & CNNs**
  👉 Assignment: Build a simple feedforward neural network (MLP) for binary classification and a CNN for MNIST image classification using TensorFlow or PyTorch.

- **Week 5: RNNs, LSTMs & Transformers**
  👉 Assignment: Train an LSTM for text prediction (e.g., next word prediction) and fine-tune a pre-trained Transformer (BERT) for sentiment analysis using Hugging Face.

- **Week 6: Generative AI & RAG**
  👉 Assignment: Implement a Retrieval-Augmented Generation (RAG) pipeline that answers domain-specific questions using LangChain and a local knowledge base (e.g., CSV/Docs).

- **Week 7: Agentic AI & Advanced MLOps**
  👉 Assignment: Build a simple Agentic AI that can perform multi-step reasoning with a tool (e.g., search + summarization), and deploy a trained model using Docker + FastAPI + GitHub Actions CI/CD.

- **Week 8: Capstone Project**
  👉 Assignment: Develop and present a full-stack AI application (e.g., a Generative

AI chatbot with RAG) integrating React frontend, FastAPI backend, MLflow experiment tracking, and Docker deployment.

Learning Outcomes

By the end of this course, students will:

- Master core AI/ML algorithms and deep learning models (CNNs, RNNs, LSTMs, Transformers).
- Be proficient in Python, data science libraries, and deep learning frameworks.
- Understand and apply MLOps practices (MLflow, DVC, Docker, Kubernetes).
- Build and deploy generative AI models, including RAG and Agentic AI systems.
- Create full-stack AI applications with modern web technologies.
- Complete a capstone project showcasing end-to-end AI/ML skills.

Prerequisites

- Basic programming knowledge (preferably Python).
- Familiarity with high school-level mathematics (algebra, statistics).

Tools and Resources

- **Software**: Python, Anaconda, VS Code, Git, Docker.
- **Libraries**: scikit-learn, TensorFlow/Keras, PyTorch, LangChain, Haystack, Hugging Face Transformers.
- **MLOps Tools**: MLflow, DVC, Prometheus, Grafana, TensorFlow Serving, Kubernetes.
- **Datasets**: Open datasets (e.g., Kaggle, UCI ML Repository).
- **Cloud Platforms**: Google Colab, AWS (optional for deployment).

This 5-day-per-week curriculum ensures students gain hands-on experience with traditional AI/ML, advanced deep learning (including RNNs, LSTMs, and Transformers), generative AI, and MLOps, preparing them for real-world AI applications in just 8 weeks.