Week 1: Introduction to Machine Learning

- **Day 1-2:** Overview of Machine Learning
  - Definition, Types of Machine Learning (Supervised, Unsupervised, Reinforcement Learning)
  - Real-world Applications
- **Day 3-4:** Mathematical Foundations
  - Basic Linear Algebra (Vectors, Matrices)
  - Basic Calculus (Derivatives)
- **Day 5:** Probability and Statistics
  - Basic Probability, Bayes' Theorem
  - Introduction to Distributions

Week 2: Data Preprocessing

- **Day 1-2:** Data Cleaning
  - Handling Missing Values
  - Data Transformation (Normalization, Standardization)
- **Day 3-4:** Exploratory Data Analysis (EDA)
  - Descriptive Statistics
  - Data Visualization (Histograms, Scatter Plots)
- **Day 5:** Practical Session on Data Preprocessing using Python (pandas, NumPy)

Week 3: Supervised Learning - Regression

- **Day 1-2:** Linear Regression
  - Simple Linear Regression
  - Multiple Linear Regression
- **Day 3-4:** Logistic Regression
  - Binary Classification
  - Multiclass Classification
- **Day 5:** Practical Session on Regression using scikit-learn

Week 4: Supervised Learning - Classification

- **Day 1-2:** K-Nearest Neighbors (KNN)
  - Introduction, Distance Metrics
  - Implementing KNN in Python

- **Day 3-4:** Decision Trees
    - Concept, Gini Index, Entropy
    - Pruning Techniques
- **Day 5:** Practical Session on Classification using scikit-learn

Week 5: Supervised Learning - Advanced Models

- **Day 1-2:** Support Vector Machines (SVM)
    - Hyperplanes, Kernel Trick
- **Day 3-4:** Ensemble Methods
    - Bagging, Boosting
    - Random Forests
- **Day 5:** Practical Session on SVM and Ensemble Methods using scikit-learn

Week 6: Model Evaluation and Selection

- **Day 1-2:** Evaluation Metrics
    - Accuracy, Precision, Recall, F1 Score
    - ROC Curve, AUC
- **Day 3-4:** Model Selection
    - Cross-Validation
    - Grid Search, Random Search
- **Day 5:** Practical Session on Model Evaluation and Selection

Week 7: Unsupervised Learning - Clustering

- **Day 1-2:** K-Means Clustering
    - Algorithm, Choosing K
    - Implementing K-Means in Python
- **Day 3-4:** Hierarchical Clustering
    - Agglomerative, Divisive Clustering
- **Day 5:** Practical Session on Clustering

Week 8: Unsupervised Learning - Dimensionality Reduction

- **Day 1-2:** Principal Component Analysis (PCA)
    - Concepts, Eigenvalues, Eigenvectors
- **Day 3-4:** t-SNE

    - Concepts, Applications
- **Day 5:** Practical Session on Dimensionality Reduction

Week 9: Neural Networks

- **Day 1-2:** Introduction to Neural Networks
    - Perceptrons, Activation Functions
- **Day 3-4:** Backpropagation and Gradient Descent
    - Concepts, Implementation
- **Day 5:** Practical Session on Neural Networks using TensorFlow/Keras

Week 10: Deep Learning

- **Day 1-2:** Convolutional Neural Networks (CNNs)
    - Concepts, Applications
- **Day 3-4:** Recurrent Neural Networks (RNNs) and LSTMs
    - Concepts, Applications
- **Day 5:** Practical Session on CNNs and RNNs using TensorFlow/Keras

Week 11: Natural Language Processing (NLP)

- **Day 1-2:** Text Preprocessing
    - Tokenization, Lemmatization, Stemming
- **Day 3-4:** Text Classification
    - Sentiment Analysis
    - Word Embeddings (Word2Vec, GloVe)
- **Day 5:** Practical Session on NLP using NLTK and spaCy

Week 12: Time Series Analysis

- **Day 1-2:** Introduction to Time Series Analysis
    - Time Series Decomposition
- **Day 3-4:** ARIMA Models
    - Concepts, Implementation
- **Day 5:** Practical Session on Time Series Analysis

Week 13: Advanced Topics in Machine Learning

- **Day 1-2:** Reinforcement Learning

    - Markov Decision Processes (MDP)
    - Q-Learning
- **Day 3-4:** Deep Q-Networks (DQN)
    - Concepts, Applications
- **Day 5:** Practical Session on Reinforcement Learning

Week 14: Ethics in AI and Machine Learning

- **Day 1-2:** Bias and Fairness
    - Types of Bias, Mitigation Techniques
- **Day 3-4:** Interpretability and Explainability
    - SHAP, LIME
- **Day 5:** Case Studies and Discussion

Week 15: Capstone Project Week 1

- **All Days:** Start Capstone Project
    - Problem Selection, Data Collection, and Preprocessing

Week 16: Capstone Project Week 2

- **All Days:** Continue and Complete Capstone Project
    - Model Building, Evaluation, and Presentation