Python for AI & ML

Module 1: Python Basics

- Variables & Data Types
- Operators & Expressions
- Conditional Statements (if, else, elif)
- Loops (for, while)
- Functions & Modules
- Lists, Tuples, Dictionaries, Sets
- File Handling
- Exception Handling

Module 2: Python Libraries for ML/AI

- NumPy: Arrays and vectorized computations
- Pandas: Data manipulation and analysis
- Matplotlib / Seaborn: Data visualization
- Scikit-learn: ML models and preprocessing
- TensorFlow / PyTorch: Deep learning frameworks

Module 3: Mathematics for ML

- Linear Algebra
  - Vectors, Matrices, Matrix Operations
  - Eigenvalues & Eigenvectors

- Statistics & Probability
  - Mean, Median, Mode, Variance
  - Probability distributions
  - Bayes Theorem

- Calculus (Basic)
  - Derivatives & Gradients (for optimization)
  - Chain Rule (for backpropagation)

Module 4: Data Preprocessing & Visualization

- Data Cleaning (nulls, duplicates)
- Feature Engineering
- Feature Scaling (Normalization, Standardization)
- One-hot Encoding & Label Encoding
- Data Splitting: Train-Test Split, Cross-validation
- Data visualization techniques

Module 5: Machine Learning

- Supervised Learning
  - Regression
  - Linear Regression
  - Polynomial Regression
  - Classification
  - Logistic Regression
  - K-Nearest Neighbors (KNN)
  - Decision Trees
  - Random Forest
  - Support Vector Machines (SVM)
  - Naive Bayes

- Unsupervised Learning
  - Clustering
  - K-Means
  - Hierarchical Clustering
  - Dimensionality Reduction
  - PCA (Principal Component Analysis)
  - t-SNE

- Model Evaluation
  - Confusion Matrix
  - Precision, Recall, F1 Score
  - ROC & AUC Curve
  - Cross-validation

- Hyperparameter Tuning
  - Grid Search
  - Random Search

Module 6: Deep Learning (AI)

- Neural Networks Basics
  - Perceptron
  - Activation Functions
  - Loss Functions
  - Optimizers (SGD, Adam)

- Deep Neural Networks (DNN)
  - Feedforward & Backpropagation
  - Overfitting and Dropout

- TensorFlow / PyTorch (Choose one)
  - Building neural nets with layers

- Compiling and training models

- Convolutional Neural Networks (CNN)
  - Image Classification
  - Filters, Pooling, Flattening

- Recurrent Neural Networks (RNN)
  - Time Series and Text Data
  - LSTM & GRU

- Natural Language Processing (NLP)
  - Text Cleaning (Tokenization, Stopwords)
  - Bag of Words & TF-IDF
  - Word Embeddings (Word2Vec, GloVe)
  - Sentiment Analysis
  - Chatbots (Basic with NLP pipeline)

Module 7: AI Concepts

- Introduction to Artificial Intelligence
- Search Algorithms (A*, BFS, DFS)
- Game Playing – Minimax Algorithm
- Expert Systems (Rule-Based AI)
- Fuzzy Logic Basics
- Reinforcement Learning (Q-Learning, SARSA)

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