
MACHINE LEARNING

1. Introduction To Machine Learning

- What Is Machine Learning?
- Difference Between AI, ML, & Deep Learning
- Types Of Machine Learning:
 - Supervised (Regression, Classification)
 - Unsupervised (Clustering, Dimensionality Reduction)
 - Reinforcement Learning (Basics)
- ML Pipeline Overview: Data → Model → Evaluation → Deployment



2. Mathematics For ML

- Linear Algebra- Vectors, Matrices, Matrix Operations, Eigenvalues
- Calculus- Derivatives, Partial Derivatives, Gradients
- Probability & Statistics-
 - Bayes Theorem
 - Probability Distributions (Normal, Binomial, Poisson)
 - Hypothesis Testing
- Optimization- Gradient Descent, Cost Functions

3. Python For ML

- Data Types, Functions, Loops, OOP Basics
- Libraries-
 - NumPy (Arrays, Broadcasting)
 - Pandas (DataFrames, Data Cleaning)
 - Matplotlib & Seaborn (Visualization)

4. Data Preprocessing

- Handling Missing Values & Duplicates
- Encoding Categorical Data (One-Hot, Label Encoding)
- Feature Scaling (Normalization, Standardization)
- Outlier Detection & Treatment
- Train-Test Split & Cross-Validation

5. Supervised Learning

- Linear Regression, Multiple Linear Regression
- Polynomial Regression
- Regularization (Ridge, Lasso)
- Logistic Regression
- K-Nearest Neighbors (KNN)
- Decision Trees, Random Forest
- Support Vector Machines (SVM)
- Naïve Bayes
- Accuracy, Precision, Recall, F1-score
- Confusion Matrix
- ROC & AUC Curve

6. Unsupervised Learning

- Clustering: K-Means, Hierarchical Clustering, DBSCAN
- Dimensionality Reduction: PCA, t-SNE
- Anomaly Detection
- Market Basket Analysis (Apriori, Association Rules)

7. Ensemble Learning

- Bagging & Boosting
- Random Forest (Bagging Example)
- AdaBoost, Gradient Boosting, XGBoost, LightGBM, CatBoost
- Stacking & Bleeding

8. Model Selection & Optimization

- Hyperparameter Tuning (GridSearchCV, RandomSearchCV, Bayesian Optimization)
- Bias-Variance Tradeoff
- Feature Selection Techniques

9. Introduction To Deep Learning (Optional But Recommended)

- Perceptron & Neural Networks
- Activation Functions
- Backpropagation
- Using TensorFlow / Keras For Basic Models

10. Practical Applications & Projects

- Predictive Modeling (House Price Prediction, Stock Price Prediction)
- Classification (Spam Detection, Disease Diagnosis)
- Clustering (Customer Segmentation)
- Recommendation Systems (Collaborative Filtering, Content-Based)

11. ML Tools & Deployment

- Jupyter Notebook / Google Colab
- Git & GitHub For Version Control
- Model Deployment Using Flask, FastAPI, Or Streamlit
- Introduction To MLOps (CI / CD For ML Models).

Trainer	Dr. Snehalata Agasti
Discounted Fee	₹ 29,999
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