Machine Learning mastery with Python

Module1: Introduction to Machine Learning

- What is Machine Learning?
- Types of ML: Supervised, Unsupervised, Reinforcement
- Real-world applications
- ML workflow overview
- Installing Python, Jupyter, and necessary libraries

Module 2: Python for Machine Learning

- Python refresher: variables, loops, functions, OOP
- Working with NumPy: arrays, vectorized operations
- Data manipulation with pandas
- Data visualization with matplotlib and seaborn
- Reading/writing data: CSV, Excel, JSON

Module 3: Data Preprocessing & Feature Engineering

- Handling missing data
- Encoding categorical variables
- Scaling and normalization
- Feature extraction & selection
- Binning, outlier detection, log transforms
- Train-test split & cross-validation

Module 4: Supervised Learning – Regression

- Simple Linear Regression
- Multiple Linear Regression
- Polynomial Regression
- Regularization (Ridge, Lasso)
- Evaluation metrics: MAE, MSE, RMSE, R^2

Module 5: Supervised Learning – Classification

- Logistic Regression
- K-Nearest Neighbors (KNN)
- Decision Trees
- Random Forests
- Naïve Bayes
- Support Vector Machines (SVM)
- Model evaluation: Accuracy, Confusion Matrix, Precision, Recall, F1 Score, ROC-AUC

Module 6: Unsupervised Learning

- Clustering basics: distance metrics

- K-Means Clustering
- Hierarchical Clustering
- DBSCAN
- Dimensionality Reduction:
    - PCA (Principal Component Analysis)
    - t-SNE
- Applications: customer segmentation, anomaly detection

Module 7: Model Optimization

- Cross-validation (K-fold, Stratified)
- Grid Search and Randomized Search
- Hyperparameter tuning
- Bias-variance tradeoff
- Feature importance
- Pipelines in scikit-learn

Module 8: Ensemble Methods

- Bagging vs Boosting
- Random Forest in depth
- AdaBoost
- Gradient Boosting
- XGBoost and LightGBM
- Stacking models

Module 9: Introduction to Deep Learning (Optional)

- Overview of deep learning
- Neural Networks with Keras/TensorFlow
- Simple feedforward network
- Hands-on: MNIST digit classification

Module 10: Model Deployment & Production

- Saving models (Pickle, Joblib)
- Creating REST APIs with Flask or FastAPI
- Model monitoring & versioning
- Hosting options: Streamlit, Heroku, AWS, Hugging Face Spaces

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