

RESEARCH-DRIVEN PYTHON AND MACHINE LEARNING BASICS

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PYTHON BASICS

- Variables, Data Types, Control Flow (if, for, while)
- Lists, Dictionaries, Tuples
- Functions and basic I/O

ACTIVITIES

- Install Python + Jupyter via Anaconda
- Quiz on syntax and logic
- Mini assignments on loops and conditions

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NUMPY + PANDAS

- NumPy: Arrays, slicing, broadcasting
- Pandas: Reading/writing CSV, exploration, descriptive stats
- Handling missing data (drop, fill, impute)
- Basic data cleaning

ACTIVITIES

- Euclidean distance calc using NumPy
- Hands-on with real dataset (e.g., Titanic)
- Group data exploration task
- Quiz on basic math and data ops

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INTRODUCTION TO MACHINE LEARNING +SEMI-SUPERVISED LEARNING TOPICS

- What is ML? Supervised vs Unsupervised vs Semi-Supervised
- Features, labels, overfitting
- Scikit-learn intro
- Real-world ML examples

ACTIVITIES

- Visual ML demos
- Brainstorm: Where ML fits in daily life
- Kahoot quiz on ML concepts

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CLASSIFICATION ALGORITHMS TOPICS

- k-NN, Decision Tree, SVM, XGBoost
- Train-test split, confusion matrix basics

ACTIVITIES

- Live: Classify Iris dataset
- Group comparison: Best classifier
- Homework on Titanic dataset classification

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REGRESSION ALGORITHMS

- Linear, Polynomial, Decision Tree, XGB Regressor
- Overfitting vs underfitting
- Regression error metrics (MAE, MSE - light intro)

ACTIVITIES

- Predict housing prices
- Visualize regression curves
- Homework: Compare models on visuals + error

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NEURAL NETWORKS TOPICS

- Basic Neural Net architecture
- Intuition: Neuron, weights, activation
- Forward pass idea
- Brief intro to TensorFlow/Keras

ACTIVITIES

- Build small NN on tabular dataset
- Observe loss and accuracy evolution
- Visualize hidden layer outputs (if time allows)

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HYPERPARAMETER TUNING

- Hyperparameters vs parameters
- GridSearchCV, RandomizedSearchCV
- Concept: Bayesian optimization (just theory)

ACTIVITIES

- GridSearchCV on k-NN / Decision Tree
- RandomizedSearchCV on XGBoost / SVM
- Homework: Tune any Week 5-6 model and analyze gains

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EXPLAINABILITY+GRAD-CAM TOPICS:

- Accuracy, Precision, Recall, F1
- SHAP, LIME – intuition only
- Grad-CAM for CNNs (concept + code walkthrough)

ACTIVITIES

- Interpret confusion matrix outputs
- Visualize SHAP values (tabular model)
- Grad-CAM demo (MNIST/small image set)
- Quiz: Metric and interpretation challenge

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A HANDS-ON DEMONSTRATION OF THE DATA ANALYSIS SECTION FROM A Q1-PUBLISHED RESEARCH PAPER WILL BE PRESENTED.

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ACTIVITIES

- Model pipeline (preprocess → train → evaluate)
- Apply 4 classifiers
- Compare accuracy and interpret results
- Group-based implementation and presentation
- Final quiz: full-course recap
- Optional leaderboard challenge



BONUS ENGAGEMENT IDEAS

- Class leaderboard for quizzes and tasks
- Discord/WhatsApp group for help and collaboration
- Completion certificates for motivation
- Optional weekly contests on Kaggle/Datasets



COURSE GOAL

- Enable students (including non-CSE backgrounds) to:
- Understand Python programming basics
- Learn core Machine Learning (ML) concepts
- Apply ML techniques to real-world data
- Solve and interpret the final problem from the target research paper