

Python to AI & ML – 4 Months Course Modules (ROAD MAP)

Month 1 – Python Foundations

Goal: Build solid Python programming skills.

Module 1: Python Basics

- Introduction to Python, installation, and IDEs (Anaconda, VSCode, Jupyter)
- Data types, variables, operators
- Input/output, type conversion
- Control flow (if, else, elif)
- Loops (for, while)
- Functions (parameters, return values, scope)

Module 2: Data Structures in Python

- Lists, tuples, sets, dictionaries
- String manipulation & formatting
- List comprehensions
- Iterators and generators

Module 3: Error Handling & File Handling

- Exceptions (try, except, finally)
- Reading/writing files (txt, csv, json)
- Modules and packages

Module 4: Object-Oriented Programming (OOP)

- Classes, objects, methods
- Inheritance, polymorphism, encapsulation
- Magic methods (`__str__`, `__init__`)

Mini Project: Build a CLI Student Management System with file storage.

Month 2 – Data Science & Python for AI

Goal: Learn data analysis, visualization, and numerical computing.

Module 5: Python Libraries for Data

- NumPy (arrays, vectorization, matrix operations)
- Pandas (Series, DataFrames, groupby, merge, pivot)
- Handling missing values and duplicates

Module 6: Data Visualization

- Matplotlib (line, bar, scatter plots)
- Seaborn (heatmaps, pairplots, histograms)
- Plotly (interactive visualizations)

Module 7: Statistics & Probability for AI

- Descriptive statistics (mean, median, mode, variance, std)
- Probability distributions (normal, binomial, Poisson)
- Hypothesis testing (t-test, chi-square)
- Correlation & covariance

Module 8: Intro to Machine Learning Concepts

- What is AI, ML, DL?
- Types of ML (supervised, unsupervised, reinforcement)
- Train/test split, cross-validation
- Bias-variance tradeoff
- Overfitting and underfitting

Mini Project: Perform **Exploratory Data Analysis (EDA)** on a real-world dataset (e.g., Titanic survival or COVID dataset).

Month 3 – Machine Learning with Python

Goal: Implement ML algorithms and models using Scikit-learn.

Module 9: Supervised Learning – Regression

- Linear regression, multiple regression
- Polynomial regression

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- Regularization (Ridge, Lasso)
- Evaluation metrics (MSE, RMSE, R^2)

Module 10: Supervised Learning – Classification

- Logistic regression
- Decision trees
- Random forests
- k-Nearest Neighbors (k-NN)
- Support Vector Machines (SVM)
- Evaluation metrics (accuracy, precision, recall, F1, confusion matrix)

Module 11: Unsupervised Learning

- k-Means clustering
- Hierarchical clustering
- DBSCAN
- Dimensionality reduction (PCA, t-SNE)

Module 12: Feature Engineering & Model Optimization

- Feature scaling (standardization, normalization)
- Feature selection methods
- Hyperparameter tuning (GridSearchCV, RandomizedSearchCV)
- Ensemble methods (Bagging, Boosting, XGBoost)

Mini Project: Build an ML model to predict house prices (regression) and spam detection system (classification).

Month 4 – Deep Learning & Advanced AI

Goal: Dive into neural networks, deep learning, NLP, and real-world AI projects.

Module 13: Neural Networks with Python

- Introduction to deep learning
- Perceptron & feedforward neural networks
- Activation functions (ReLU, Sigmoid, Tanh, Softmax)
- Backpropagation & gradient descent
- Implementing NN from scratch with NumPy

Module 14: Deep Learning with TensorFlow/Keras

- Introduction to TensorFlow & Keras
- Building ANN models (classification, regression)
- Model evaluation & optimization
- Dropout, batch normalization

Module 15: Computer Vision with CNNs

- Convolutional Neural Networks (CNN)
- Pooling layers, padding, stride
- Image classification (MNIST, CIFAR-10 datasets)
- Transfer Learning (ResNet, VGG, MobileNet)

Module 16: Natural Language Processing (NLP)

- Text preprocessing (tokenization, stemming, lemmatization)
- Bag of Words & TF-IDF
- Word embeddings (Word2Vec, GloVe, FastText)
- RNN, LSTM, GRU for sequence modeling
- Sentiment analysis with IMDB dataset

Final Capstone Project:

- Choose one of:
 - AI-powered Chatbot with NLP
 - Image Classifier with CNNs
 - Predictive Analytics on a large dataset (finance, health, etc.)
 - Recommender System (movies, products, music)

CLASS CALENDAR

Month 1 – Python Foundations (Weeks 1–4)

Week 1 – Python Basics

- **Mon:** Python setup, IDEs, variables, data types
- **Tue:** Operators, expressions, type conversion
- **Wed:** Conditionals (if/elif/else)
- **Thu:** Loops (for, while) + mini exercises

Week 2 – Functions & Data Structures

- **Mon:** Functions, parameters, return values
- **Tue:** Lists & tuples
- **Wed:** Sets & dictionaries
- **Thu:** String manipulation + list comprehensions

Week 3 – Files, Errors & Modules

- **Mon:** Exception handling (try/except)
- **Tue:** File handling (txt, csv, json)
- **Wed:** Importing & creating modules
- **Thu:** Python standard library (os, sys, datetime)

Week 4 – Object-Oriented Programming

- **Mon:** Classes & objects
- **Tue:** Methods & attributes
- **Wed:** Inheritance, polymorphism, encapsulation
- **Thu:** Magic methods & review

Mini Project 1: CLI Student Management System

Month 2 – Data Science Foundations (Weeks 5–8)

Week 5 – NumPy

- **Mon:** Arrays, indexing, slicing
- **Tue:** Vectorization & broadcasting
- **Wed:** Matrix operations
- **Thu:** NumPy random & linear algebra

Week 6 – Pandas

- **Mon:** Series & DataFrames
- **Tue:** Data cleaning & preprocessing
- **Wed:** Merging, joining, grouping
- **Thu:** Pivot tables & time series

Week 7 – Data Visualization

- **Mon:** Matplotlib basics
- **Tue:** Seaborn plots (heatmaps, pairplots, distributions)
- **Wed:** Plotly interactive graphs
- **Thu:** Visualization project

Week 8 – Statistics & ML Concepts

- **Mon:** Probability, distributions
- **Tue:** Descriptive stats (mean, variance, std)
- **Wed:** Hypothesis testing & correlation

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- **Thu:** Intro to ML (types, bias/variance, overfitting)

✦ **Mini Project 2:** Exploratory Data Analysis (Titanic dataset)

✦ **Month 3 – Machine Learning (Weeks 9–12)**

Week 9 – Regression

- **Mon:** Linear regression
- **Tue:** Multiple regression
- **Wed:** Polynomial regression
- **Thu:** Ridge & Lasso + metrics

Week 10 – Classification

- **Mon:** Logistic regression
- **Tue:** Decision trees & Random Forests
- **Wed:** k-NN
- **Thu:** SVM + model evaluation

Week 11 – Unsupervised Learning

- **Mon:** Clustering (k-Means)
- **Tue:** Hierarchical & DBSCAN
- **Wed:** Dimensionality reduction (PCA)
- **Thu:** t-SNE & visualization

Week 12 – Model Optimization

- **Mon:** Feature scaling & feature selection
- **Tue:** Hyperparameter tuning (GridSearchCV)
- **Wed:** Ensemble methods (Bagging, Boosting, XGBoost)
- **Thu:** Wrap-up & practice

✦ **Mini Project 3:** House Price Prediction + Spam Detection

✦ **Month 4 – Deep Learning & AI (Weeks 13–16)**

Week 13 – Neural Networks

- **Mon:** Intro to deep learning, perceptron
- **Tue:** Activation functions
- **Wed:** Backpropagation & gradient descent
- **Thu:** NN from scratch with NumPy

Week 14 – TensorFlow & Keras

- **Mon:** TensorFlow/Keras basics
- **Tue:** ANN for classification
- **Wed:** ANN for regression
- **Thu:** Dropout & optimization

Week 15 – Computer Vision

- **Mon:** CNN architecture
- **Tue:** Training CNN on MNIST
- **Wed:** CIFAR-10 classification
- **Thu:** Transfer Learning with pre-trained models

Week 16 – Natural Language Processing

- **Mon:** Text preprocessing (tokenization, stemming, lemmatization)
- **Tue:** Bag of Words & TF-IDF

- **Wed:** Word embeddings (Word2Vec, GloVe)
- **Thu:** RNN, LSTM for sentiment analysis

📌 **Final Capstone Project:** Choose from Chatbot, Image Classifier, Recommender, or Predictive Analytics

🐍 Python → Advanced AI/ML (4 Months) – STUDENT ASSIGNMENT CALENDAR

Classes: Mon–Thu | Practice Assignments: Fri–Sun

📌 Month 1 – Python Foundations

Week 1 – Python Basics

- **Classwork:** Variables, operators, conditionals, loops
- **Assignment:**
 - Write a program to calculate compound interest.
 - Print Fibonacci series up to N terms.
- **Coding Challenge:** 10 Easy Python problems on **HackerRank (Warmup)**

Week 2 – Functions & Data Structures

- **Classwork:** Functions, lists, tuples, sets, dicts, strings
- **Assignment:**
 - Build a contact book (add, search, delete).
 - Reverse a string without using slicing.
- **Coding Challenge:** 10 LeetCode Easy problems (arrays, strings)

Week 3 – Files, Errors & Modules

- **Classwork:** File handling, exceptions, modules
- **Assignment:**
 - Save student records to CSV.
 - Write a calculator module & import it.
- **Coding Challenge:** Python practice on file handling (HackerRank).

Week 4 – OOP

- **Classwork:** Classes, inheritance, magic methods
- **Assignment:**
 - Build a BankAccount class with deposit/withdraw.
 - Create Car and ElectricCar classes (inheritance).
- **Mini Project:** CLI Student Management System

📌 Month 2 – Data Science Foundations

Week 5 – NumPy

- **Assignment:**
 - Implement matrix multiplication using NumPy.
 - Generate random dataset and calculate mean/variance.
- **Challenge:** Solve **Kaggle NumPy exercises**

Week 6 – Pandas

- **Assignment:**
 - Clean a CSV dataset (remove nulls, duplicates).
 - Summarize sales by region with Pandas groupby.
- **Challenge:** Kaggle Titanic dataset → load & explore

Week 7 – Visualization

- **Assignment:**
 - Plot a line graph of stock prices.
 - Use Seaborn to plot correlation heatmap.
- **Challenge:** Create 5 different plots from the Titanic dataset

Week 8 – Stats & ML Basics

- **Assignment:**
 - Perform hypothesis testing on dataset.
 - Calculate correlation between 2 variables.
- **Mini Project:** Titanic EDA (cleaning + visualization + insights)

Month 3 – Machine Learning

Week 9 – Regression

- **Assignment:**
 - Train linear regression model on house prices dataset.
 - Compare actual vs predicted results.
- **Challenge:** Kaggle “House Prices” dataset

Week 10 – Classification

- **Assignment:**
 - Build spam detector using Logistic Regression.
 - Compare Random Forest vs Decision Tree accuracy.
- **Challenge:** Kaggle “SMS Spam Collection Dataset”

Week 11 – Clustering

- **Assignment:**
 - Apply k-Means on Iris dataset.
 - Visualize clusters with PCA.
- **Challenge:** Kaggle “Mall Customer Segmentation” dataset

Week 12 – Optimization

- **Assignment:**
 - Tune Random Forest with GridSearchCV.
 - Compare XGBoost vs Random Forest.
- **Mini Project:** House Price Prediction + Spam Detection

Month 4 – Deep Learning & AI

Week 13 – Neural Networks

- **Assignment:**
 - Build NN with NumPy (2 hidden layers).
 - Train it on XOR dataset.
- **Challenge:** Implement backpropagation manually

Week 14 – TensorFlow/Keras

- **Assignment:**
 - Build ANN classifier on MNIST dataset.

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- Add dropout and batch normalization.
- **Challenge:** Compare training results with/without dropout

Week 15 – Computer Vision

- **Assignment:**
 - Build CNN on CIFAR-10 dataset.
 - Use Transfer Learning with ResNet.
- **Challenge:** Image classification on custom dataset (collected by students)

Week 16 – NLP

- **Assignment:**
 - Preprocess IMDB reviews dataset (tokenization, TF-IDF).
 - Build sentiment classifier with LSTM.
- **Final Capstone Project (choose 1):**
 - AI Chatbot (NLP)
 - Image Classifier (CNN)
 - Recommender System (movies/products)
 - Predictive Analytics (finance/healthcare dataset)



Deliverables by Students

- **Weekly coding challenges** (Fri–Sun)
- **4 mini projects** (end of each month)
- **1 final AI Capstone project**
- All projects uploaded to **GitHub portfolio**



Outcome by End of 4 Months

- ✓ Master Python programming
- ✓ Proficient in Data Science with Pandas, NumPy, Matplotlib, Seaborn
- ✓ Build ML models (regression, classification, clustering)
- ✓ Implement deep learning (ANN, CNN, RNN, LSTM)
- ✓ Portfolio with **4 mini-projects + 1 final AI project**



Course Deliverables

- ✓ Weekly assignments
- ✓ 4 Mini projects (one per month)
- ✓ 1 Final Capstone Project
- ✓ Portfolio-ready GitHub repo
- ✓ Guidance on deploying ML models (Flask/Django + Streamlit/Gradio)