**Machine Learning from Scratch: A Complete Beginner's Course Outline**

**📦 Module 1: Introduction to Machine Learning**

**🎯 Learning Objectives:**

* Understand what ML is, and why it's important.
* Differentiate between AI, ML, and Deep Learning.
* Learn how ML is used in real life.

**🧠 Topics Covered:**

* What is Machine Learning?
* Types of Machine Learning:
  + Supervised
  + Unsupervised
  + Reinforcement Learning (just conceptual)
* Real-world applications (e.g., Netflix recommendations, spam detection, Google Maps, chatbots)
* The ML Workflow (Data → Model → Prediction → Evaluation)

**👨‍💻 Hands-On:**

* Install Anaconda / Jupyter Notebook
* Write your first Python script: “Hello Machine Learning!”

**📁 Mini Project:**

* Write a Python script that takes user input and classifies it into categories (e.g., positive vs. negative).

**🧮 Module 2: Python & Math Essentials for ML**

**🎯 Learning Objectives:**

* Brush up on Python and essential math required for ML.

**🧠 Topics Covered:**

* Python Basics:
  + Lists, dictionaries, functions, loops
* Libraries:
  + Numpy (arrays, matrix operations)
  + Pandas (DataFrames, reading CSV)
  + Matplotlib / Seaborn (basic plots)
* Math for ML:
  + Mean, Median, Mode, Variance
  + Probability basics

**👨‍💻 Hands-On:**

* Load CSV data using Pandas
* Create a histogram and scatter plot
* Compute basic stats (mean, median, etc.)

**📁 Mini Project:**

* Analyze student grades dataset and visualize average scores per subject.

**📊 Module 3: Understanding Your Data (Exploratory Data Analysis)**

**🎯 Learning Objectives:**

* Learn to clean, explore, and prepare data for machine learning.

**🧠 Topics Covered:**

* What is EDA?
* Identifying:
  + Missing values
  + Duplicates
  + Outliers
* Data Cleaning:
  + Fill missing values (mean, median, mode)
  + Drop irrelevant columns
* Data Visualization:
  + Histograms, scatter plots, heatmaps
* Feature Engineering:
  + Encoding categorical variables (Label vs One-hot encoding)
  + Scaling/Normalizing data

**👨‍💻 Hands-On:**

* Load Titanic dataset
* Identify and clean missing values
* Encode gender column

**📁 Mini Project:**

* Create a dashboard showing basic insights from a real-world dataset (e.g., Titanic, Iris).

**📈 Module 4: Introduction to Supervised Learning**

**🎯 Learning Objectives:**

* Build your first ML models: regression and classification.

**🧠 Topics Covered:**

* What is Supervised Learning?
* Regression:
  + Linear Regression
* Classification:
  + K-Nearest Neighbors
  + Decision Trees
* Training & Testing:
  + Train-test split
  + Model accuracy
* Evaluation:
  + Confusion matrix
  + Accuracy, Precision, Recall

**👨‍💻 Hands-On:**

* Train a Linear Regression model using Scikit-learn
* Use KNN to classify flowers (Iris dataset)

**📁 Mini Projects:**

* Predict house prices using Linear Regression
* Classify Iris flowers using KNN

**🔍 Module 5: Model Improvement & Evaluation**

**🎯 Learning Objectives:**

* Learn how to evaluate and improve ML models.

**🧠 Topics Covered:**

* Underfitting vs Overfitting
* Cross-validation
* Hyperparameters and Grid Search
* Feature importance
* ROC Curve and AUC

**👨‍💻 Hands-On:**

* Tune K value in KNN model
* Perform cross-validation on Titanic dataset

**📁 Mini Project:**

* Predict survival on the Titanic dataset with tuned Decision Tree

**🧠 Module 6: Introduction to Unsupervised Learning**

**🎯 Learning Objectives:**

* Discover how to group data without labels.

**🧠 Topics Covered:**

* What is Unsupervised Learning?
* Clustering:
  + K-Means
  + Visualizing clusters (2D with PCA)
* Use cases: market segmentation, anomaly detection

**👨‍💻 Hands-On:**

* Cluster customers using the Mall Customers dataset

**📁 Mini Project:**

* Segment customers into groups based on spending habits

**🚀 Module 7: Building Your First End-to-End ML Project**

**🎯 Learning Objectives:**

* Build and deploy a machine learning model from start to finish.

**🧠 Topics Covered:**

* ML Project Lifecycle:
  + Define Problem
  + Collect and Clean Data
  + Train & Evaluate Model
  + Deploy
* Export model with joblib
* Simple deployment with Flask (optional for beginners)

**👨‍💻 Hands-On:**

* Build a full pipeline on a new dataset (Heart Disease, Titanic, etc.)

**📁 Capstone Project:**

**“Loan Eligibility Predictor”**

* Input: Applicant info (income, education, etc.)
* Output: Approve or reject loan