Machine Learning Roadmap for Beginners

Phase 1: Fundamentals

1. **Introduction to Machine Learning**
   - What is Machine Learning?
   - Types of Machine Learning (Supervised, Unsupervised, Reinforcement)
   - Applications of Machine Learning

2. **Mathematics for Machine Learning**
   - Linear Algebra: Vectors, Matrices, Dot Product, Eigenvalues/Eigenvectors
   - Probability and Statistics: Bayes' Theorem, Mean, Variance, Probability Distributions
   - Calculus: Derivatives and Gradients
   - Optimization: Gradient Descent Basics

3. **Programming Basics**
   - Python for Machine Learning
   - Key Libraries: NumPy, Pandas, Matplotlib, Scikit-learn

Phase 2: Core Machine Learning Concepts

4. **Data Handling**
   - Data Collection and Cleaning

- Data Visualization and Exploration

- Feature Engineering and Selection

5. **Supervised Learning**

- Regression: Linear Regression, Polynomial Regression

- Classification: Logistic Regression, Decision Trees, k-Nearest Neighbors

- Evaluation Metrics: Accuracy, Precision, Recall, F1 Score, ROC Curve

6. **Unsupervised Learning**

- Clustering: K-Means, Hierarchical Clustering

- Dimensionality Reduction: PCA (Principal Component Analysis), t-SNE

7. **Model Optimization**

- Hyperparameter Tuning

- Cross-Validation

- Regularization (L1, L2)

Phase 3: Advanced Topics

8. **Introduction to Neural Networks**

- Perceptron Model

- Forward and Backpropagation

- Activation Functions (ReLU, Sigmoid, Softmax)

9. **Deep Learning Basics**

- Convolutional Neural Networks (CNNs)

- Recurrent Neural Networks (RNNs)

- Intro to Frameworks: TensorFlow, PyTorch

10. **Model Deployment**

- Saving and Loading Models

- Deployment Tools: Flask, FastAPI, Docker

Phase 4: Hands-On Practice

11. **Projects for Practice**

- Build a Spam Classifier

- Predict House Prices

- Customer Segmentation using Clustering

- Image Recognition using CNNs

12. **Competitions and Platforms**

- Kaggle: Participate in beginner-friendly challenges

- Google Colab: Practice coding in the cloud