# Artificial Intelligence/Machine Learning Roadmap

\*Prepared for Abhishek Rathor\*

## 1. Prerequisites

### A. Mathematics

1. Linear Algebra  
- Matrices and vectors  
- Eigenvalues and eigenvectors  
- Matrix operations

2. Probability and Statistics  
- Basic probability rules  
- Probability distributions (normal, binomial, etc.)  
- Hypothesis testing and p-values

3. Calculus  
- Differentiation and integration  
- Partial derivatives  
- Chain rule

4. Optimization  
- Gradient descent  
- Convex functions

### B. Programming Skills

- Python (mandatory for ML/AI)  
 - Libraries: NumPy, Pandas, Matplotlib, Seaborn  
- Familiarity with version control (Git/GitHub)

### C. Basic Computer Science Concepts

- Data Structures (Arrays, Lists, Trees, Graphs)  
- Algorithms (Sorting, Searching, Dynamic Programming)

## 2. Machine Learning Foundations

### A. Introduction to ML

- Types of ML: Supervised, Unsupervised, Reinforcement Learning  
- Applications of ML

### B. Supervised Learning

- Linear regression and logistic regression  
- Decision trees and random forests  
- Support Vector Machines (SVM)

### C. Unsupervised Learning

- Clustering algorithms: K-means, DBSCAN  
- Dimensionality reduction: PCA, t-SNE

### D. Evaluation Metrics

- Accuracy, precision, recall, F1-score  
- ROC and AUC curves

### E. Projects

- Predict house prices using regression  
- Classify handwritten digits using the MNIST dataset

## 3. Deep Learning (DL)

### A. Neural Networks

- Perceptron and multi-layer perceptrons  
- Activation functions (ReLU, Sigmoid, Tanh)

### B. Deep Learning Frameworks

- TensorFlow  
- PyTorch

### C. Advanced Topics

- Convolutional Neural Networks (CNNs) for image processing  
- Recurrent Neural Networks (RNNs) for time-series data  
- Transfer learning

### D. Projects

- Image classification (CIFAR-10 or ImageNet)  
- Sentiment analysis of text

## 4. Natural Language Processing (NLP)

- Text preprocessing (tokenization, stemming, lemmatization)  
- Bag of Words (BoW) and TF-IDF  
- Word embeddings (Word2Vec, GloVe)  
- Transformers and large language models (e.g., BERT, GPT)

### Projects

- Build a chatbot  
- Summarize articles

## 5. Reinforcement Learning (Optional)

- Q-learning  
- Deep Q-networks (DQN)  
- OpenAI Gym for practical implementation

## 6. Tools and Technologies

- Cloud Platforms: AWS, Google Cloud, Microsoft Azure  
- Version Control: GitHub  
- Visualization: Tableau, Power BI

## 7. Real-World Projects

- Fraud detection using classification models  
- Recommendation systems (e.g., for e-commerce)  
- Autonomous driving simulation

## 8. Advanced Topics

- Generative Adversarial Networks (GANs)  
- Explainable AI (XAI)  
- AI Ethics and Bias

## 9. Learning Resources

### Courses

- Andrew Ng's Machine Learning (Coursera)  
- Deep Learning Specialization (Coursera)  
- Fast.ai courses

### Books

- "Deep Learning" by Ian Goodfellow  
- "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron

### Websites

- Kaggle (competitions and datasets)  
- Papers with Code

## 10. Career Preparation

- Build a portfolio on GitHub showcasing ML projects  
- Participate in hackathons and Kaggle competitions  
- Prepare for interviews by practicing coding problems and ML theory