Artificial Intelligence & Machine Learning

1. Introduction to AI and ML

- What is Artificial Intelligence?
- What is Machine Learning?
- Differences between AI, ML, and Deep Learning
- Real-world applications of AI and ML

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2. Mathematics for AI & ML

- **Linear Algebra**: Vectors, matrices, operations
- **Calculus**: Derivatives, gradients, optimization
- **Probability and Statistics**: Probability distributions, Bayes' theorem
- **Optimization**: Gradient Descent, Cost functions

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3. Data Preprocessing

- Data Collection and Types
- Data Cleaning: Handling missing values, outliers
- Feature Engineering: Scaling, encoding, and selection
- Data Splitting: Training, validation, and test sets

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4. Supervised Learning

- **Regression**: Linear and Polynomial regression
- **Classification**: Logistic Regression, K-Nearest Neighbors (KNN), Decision Trees
- Model Evaluation: Accuracy, precision, recall, F1 score, ROC curve

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5. Unsupervised Learning

- **Clustering**: K-Means, Hierarchical Clustering

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- **Dimensionality Reduction**: Principal Component Analysis (PCA)

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6. Reinforcement Learning

- Key Concepts: Agent, environment, rewards
- **Q-Learning**
- **Deep Q Networks (DQN)**

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7. Introduction to Deep Learning

- Neural Networks: Architecture, activation functions
- **Backpropagation**: Training neural networks
- **Convolutional Neural Networks (CNNs)**: For image classification
- **Recurrent Neural Networks (RNNs)**: For sequential data

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8. Model Evaluation and Tuning

- Cross-validation, Hyperparameter tuning
- Regularization: L1, L2, Dropout
- Ensemble Methods: Bagging, Boosting

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9. Tools and Frameworks

- **Python for ML**: Libraries like NumPy, pandas, Matplotlib
- **ML Frameworks**: Scikit-learn, TensorFlow/Keras, PyTorch

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10. Practical Projects

- Build and deploy a basic ML model
- Real-world applications like image classification or text sentiment analysis