Introduction to Machine Learning

Machine learning is a subset of artificial intelligence that enables systems to learn and improve from experience without being explicitly programmed. It focuses on developing algorithms that can access data and use it to learn for themselves.

Key concepts include:

- Supervised Learning: Training with labeled data
- Unsupervised Learning: Finding patterns in unlabeled data
- Reinforcement Learning: Learning through rewards and penalties

Neural Networks Architecture

Neural networks are computing systems inspired by biological neural networks. They consist of:

1. Input Layer: Receives the initial data
2. Hidden Layers: Process information through weighted connections
3. Output Layer: Produces the final prediction

Deep learning uses multiple hidden layers to learn hierarchical representations of data. Common architectures include CNNs for images, RNNs for sequences, and Transformers for attention-based processing.

Model Evaluation Metrics

Evaluating ML models requires appropriate metrics:

Classification Metrics:

- Accuracy: Overall correctness
- Precision: True positives / Predicted positives
- Recall: True positives / Actual positives
- F1 Score: Harmonic mean of precision and recall

Regression Metrics:

- MAE: Mean Absolute Error
- MSE: Mean Squared Error
- R-squared: Proportion of variance explained