Machine Learning Fundamentals

Introduction to Machine Learning

Machine learning is a subset of artificial intelligence (AI) that focuses on the development of algorithms and statistical models that enable computer systems to improve their performance on a specific task through experience, without being explicitly programmed.

Types of Machine Learning

Supervised Learning

Supervised learning involves training a model on a labeled dataset, where the input data is paired with the correct output. The model learns to map inputs to outputs and can then make predictions on new, unseen data.

Examples include:

• Linear regression

• Decision trees

• Support vector machines

• Neural networks

Unsupervised Learning

Unsupervised learning deals with finding hidden patterns in data without labeled examples. The algorithm tries to identify structure in the data.

Examples include:

• Clustering algorithms (K-means, hierarchical clustering)

• Dimensionality reduction (PCA, t-SNE)

• Association rule learning

Reinforcement Learning

Reinforcement learning is about learning optimal actions through trial and error, receiving rewards or penalties for actions taken in an environment.

Key Concepts

Features and Labels

• **Features**: Input variables used to make predictions
• **Labels**: The target variable we want to predict (in supervised learning)

Training and Testing

• **Training set**: Data used to train the model
• **Test set**: Data used to evaluate model performance
• **Validation set**: Data used for model selection and hyperparameter tuning

Overfitting and Underfitting

• **Overfitting**: Model performs well on training data but poorly on test data
• **Underfitting**: Model is too simple to capture underlying patterns

Model Evaluation

Common evaluation metrics include:
• Accuracy: Percentage of correct predictions
• Precision: True positives / (True positives + False positives)
• Recall: True positives / (True positives + False negatives)
• F1-score: Harmonic mean of precision and recall

Conclusion

Machine learning is a powerful tool for extracting insights from data and making predictions. Understanding the different types of learning and evaluation methods is crucial for building effective ML

systems.