

An Introduction to Machine Learning

BY AUTHORS

JOURNAL FULL NAME, YEAR PUBLISHED

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November 1, 2024



MOTIVATION

- Motivation

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- Motivation
- Continued

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INTRODUCTION

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- **What is Machine Learning?**

- A subset of artificial intelligence that provides systems the ability to automatically learn and improve from experience without being explicitly programmed.

- **Why is it Important?**

- Enables computers to find hidden insights without being explicitly programmed where to look.

- **Applications**

- Image recognition, speech recognition, medical diagnosis, stock market trading, etc.

TYPES OF MACHINE LEARNING

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- **Supervised Learning**

- The model is trained on labeled data.
- Examples: Regression, Classification.

- **Unsupervised Learning**

- The model is trained on unlabeled data.
- Examples: Clustering, Association.

- **Reinforcement Learning**

- The model learns through rewards and punishments.
- Examples: Game AI, Robotics.

SUPERVISED LEARNING ALGORITHMS

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- **Linear Regression**
- **Logistic Regression**
- **Decision Trees**
- **Support Vector Machines**
- **Neural Networks**

UNSUPERVISED LEARNING ALGORITHMS

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- **K-Means Clustering**
- **Hierarchical Clustering**
- **Principal Component Analysis (PCA)**
- **Anomaly Detection**

APPLICATIONS OF MACHINE LEARNING

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- **Healthcare**

- Disease prediction, personalized medicine.

- **Finance**

- Fraud detection, algorithmic trading.

- **Transportation**

- Autonomous vehicles, traffic prediction.

- **Retail**

- Customer segmentation, demand forecasting.

CONCLUSION

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- Machine learning is transforming industries by enabling data-driven decisions.
- Understanding the basics is essential for leveraging its full potential.
- Continuous learning and adaptation are key in this rapidly evolving field.

KEY TAKEAWAYS

Machine Learning is a powerful tool for extracting insights from data.

- It is essential to choose the right algorithm for the task.
- Data quality significantly impacts model performance.
- Ethical considerations are crucial when applying machine learning.

Note: Always validate your models with real-world data.

IMPORTANT CONSIDERATIONS

- **Bias and Fairness:** Ensure your models do not perpetuate biases.
- **Privacy:** Protect sensitive data and comply with regulations.
- **Interpretability:** Strive for models that are explainable.

MATHEMATICAL FOUNDATIONS

Linear Regression Model:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n + \epsilon \quad (1)$$

- y : Dependent variable
- x_i : Independent variables
- β_i : Coefficients
- ϵ : Error term

Cost Function:

$$J(\theta) = \frac{1}{2m} \sum_{i=1}^m (h_{\theta}(x^{(i)}) - y^{(i)})^2 \quad (2)$$

CODE EXAMPLE: LINEAR REGRESSION IN PYTHON

```
1 import numpy as np
2 from sklearn.linear_model import LinearRegression
3
4 # Sample data
5 X = np.array([[1, 1], [1, 2], [2, 2], [2, 3]])
6 y = np.dot(X, np.array([1, 2])) + 3
7
8 # Create model and fit
9 model = LinearRegression().fit(X, y)
10
11 # Predictions
12 predictions = model.predict(X)
13 print(predictions)
```

COMPARISON OF ALGORITHMS

Algorithm	Type	Complexity	Interpretability
Linear Regression	Regression	Low	High
Decision Trees	Both	Medium	Medium
Neural Networks	Both	High	Low

Table: Comparison of common machine learning algorithms.

THANK YOU!



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REFERENCES I

ADDITIONAL RESOURCES

- Books:

- *Pattern Recognition and Machine Learning* by Christopher M. Bishop
- *Machine Learning: A Probabilistic Perspective* by Kevin P. Murphy

- Online Courses:

- Coursera: Machine Learning by Andrew Ng
- edX: Introduction to Artificial Intelligence (AI)

MATHEMATICAL BACKGROUND

- **Probability and Statistics**
- **Linear Algebra**
- **Calculus**
- **Optimization Techniques**