

Challenges and Limitations of Machine Learning

Introduction

Although Machine Learning provides powerful solutions across many domains, it also faces several challenges and limitations. Understanding these issues is important for building reliable, fair, and effective ML systems.

1. Data-Related Challenges

- 1 Lack of sufficient data for training
- 2 Poor data quality (missing, noisy, or inconsistent data)
- 3 Data bias leading to unfair predictions
- 4 High cost of data collection and labeling

2. Model-Related Challenges

- 1 Overfitting and underfitting problems
- 2 Difficulty in selecting the right algorithm
- 3 Model interpretability issues (black-box models)
- 4 Hyperparameter tuning complexity

3. Computational Challenges

- 1 High computational cost and memory usage
- 2 Need for powerful hardware (GPUs/TPUs)
- 3 Long training times for large models

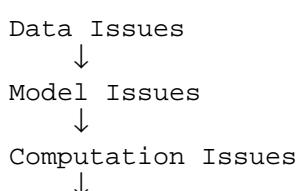
4. Ethical and Legal Challenges

- 1 Privacy concerns with personal data
- 2 Bias and discrimination in predictions
- 3 Lack of transparency in decision-making
- 4 Legal and regulatory compliance issues

5. Deployment and Maintenance Challenges

- 1 Model performance degradation over time (data drift)
- 2 Difficulty integrating models into existing systems
- 3 Continuous monitoring and retraining required

Overall Challenge Flow



Ethical & Legal Issues



Deployment Issues

Real-Life Example

In loan approval systems, biased training data may result in unfair decisions, while model complexity can make it difficult to explain why an application was rejected.

Summary

Machine learning systems face challenges related to data, models, computation, ethics, and deployment. Addressing these limitations is essential to ensure responsible and effective use of machine learning technologies.