Introduction to Machine Learning - Part 1

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1 Overview of Machine Learning

Machine Learning (ML) is a **subfield of artificial intelligence (AI)** that enables computers to learn patterns from data without being explicitly programmed. ML algorithms can improve their performance over time as they are exposed to more data.

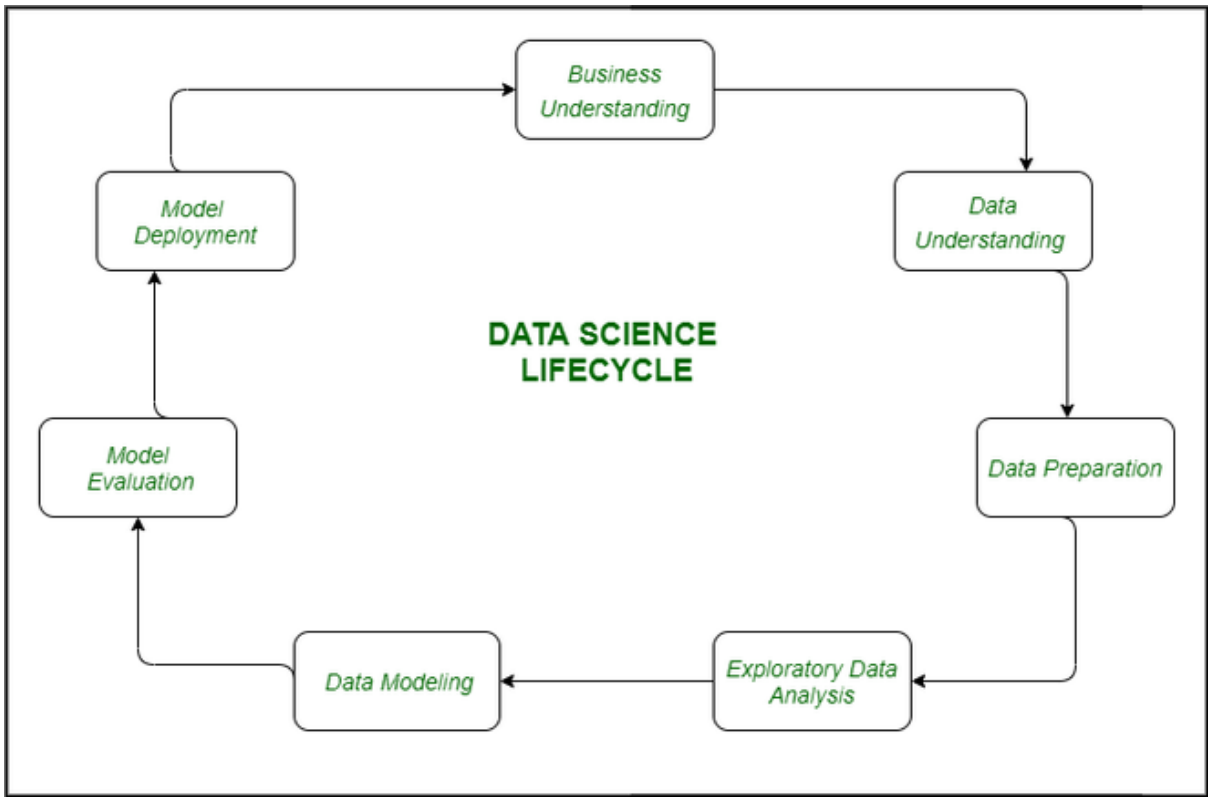

Figure 1: DS Life Cycle

1.1 Key Concepts

- **Learning from Data** – ML models learn patterns from historical data.
- **Generalization** – Models must not only memorize but also generalize to unseen data.
- **Model Evaluation** – Performance of models is assessed using metrics such as accuracy, precision, recall, etc.

2 Applications of Machine Learning

Machine Learning is widely used in various domains:

- **Healthcare** – Disease prediction, medical imaging, personalized medicine.
- **Finance** – Fraud detection, stock price prediction, risk assessment.
- **Retail** – Recommendation systems, demand forecasting, customer segmentation.
- **Autonomous Systems** – Self-driving cars, robotics, drones.
- **Natural Language Processing (NLP)** – Chatbots, speech recognition, machine translation.

3 Types of Machine Learning

Machine Learning can be categorized into the following types:

3.1 Supervised Learning

- Learning from labeled data (input-output pairs).
- Examples: Regression, Classification.
- Algorithms: Linear Regression, Logistic Regression, Support Vector Machines (SVM), Random Forest, Neural Networks.

3.2 Unsupervised Learning

- Learning from unlabeled data to find patterns.
- Examples: Clustering, Dimensionality Reduction.
- Algorithms: K-Means, Hierarchical Clustering, Principal Component Analysis (PCA).

3.3 Reinforcement Learning

- Learning through rewards and penalties.
- Example: Training an AI agent in a game.
- Algorithms: Q-Learning, Deep Q Networks (DQN), Policy Gradient Methods.

4 Types of Data in Machine Learning

Machine Learning models work with different types of data:

Data Type	**Description**
Numerical (Continuous)	Data that can take any value in a range, e.g., age, temperature.
Categorical	Data that represents categories, e.g., gender, color, country.
Ordinal	Categorical data with a meaningful order, e.g., small, medium, large.
Text Data	Data in the form of words or sentences, used in NLP applications.
Image Data	Pixel values used in computer vision applications.
Time-Series Data	Data indexed over time, e.g., stock prices, sensor readings.

Table 1: Types of Data in Machine Learning

5 Feature Engineering

Feature engineering is the process of transforming raw data into meaningful features that improve machine learning model performance.

5.1 Feature Engineering Techniques

- **Feature Selection** – Choosing the most relevant features for a model.
- **Feature Extraction** – Creating new features from existing data.
- **Feature Scaling** – Normalizing numerical values to improve model performance.
- **One-Hot Encoding** – Converting categorical data into numerical form.
- **Polynomial Features** – Creating new features by combining existing ones.

6 Conclusion

Machine Learning is transforming industries by automating decision-making and improving efficiency. A solid understanding of ML types, data, and feature engineering is essential for building robust AI models.