**1.4 DEEP LEARNING**

Machine Learning is a branch of Artificial Intelligence that focuses on developing models and algorithms that allow computers to learn from data without being explicitly programmed for every task.  
  
In simple terms, Machine Learning helps systems think and make decisions like humans by learning from patterns in data.

- Supervised Learning: Trains models on labeled data to predict or classify new, unseen inputs.  
- Unsupervised Learning: Finds patterns or groups in unlabeled data, such as clustering student complaints.  
- Reinforcement Learning: Learns through trial and error by maximizing rewards, useful in optimizing complaint resolution decisions.

Machine Learning Pipeline

In order to make useful predictions and automate processes in systems like complaint management, data passes through several steps to build a working ML model:

1. ML Workflow – Designing the learning structure.  
2. Data Cleaning – Removing incomplete or irrelevant data entries.  
3. Feature Scaling – Normalizing inputs to improve learning.  
4. Data Preprocessing in Python – Using libraries like Pandas and Scikit-learn.

Supervised Learning

Supervised learning is typically divided into:  
- Classification – Predicts categories (e.g., whether a complaint is about staff, canteen, or hostel).  
- Regression – Predicts continuous values (e.g., expected complaint resolution time).

Deep Learning vs Machine Learning

While Machine Learning uses simpler models like decision trees or support vector machines, Deep Learning builds on complex multi-layer artificial neural networks that automatically extract features from data.  
  
Traditional ML models require human intervention to select features and tune parameters, whereas Deep Learning models learn features on their own. However, Deep Learning needs a much larger dataset—often in the millions—while ML can perform well on smaller datasets.  
  
In the Paperless Student Complaint System, basic machine learning can be used for categorization and priority detection, while deep learning has future potential for text analysis, sentiment detection, and automated response systems.