

Introduction to Machine Learning (ML)

Contents

1. Introduction
 2. What is Machine Learning (ML)?
 3. Applications of ML
 4. Different Types of ML
 5. Algorithms Used in ML
 6. Steps to Build an ML Model
 7. Architecture of an ML System
 8. Popular Tools for ML
-

1. Introduction

Machine Learning (ML) is the ability of computers to detect patterns and perform tasks that traditionally required human intelligence.

2. What is Machine Learning (ML)?

Machine Learning enables systems to learn from data, identify patterns, and make decisions with minimal human intervention.

3. Applications of ML

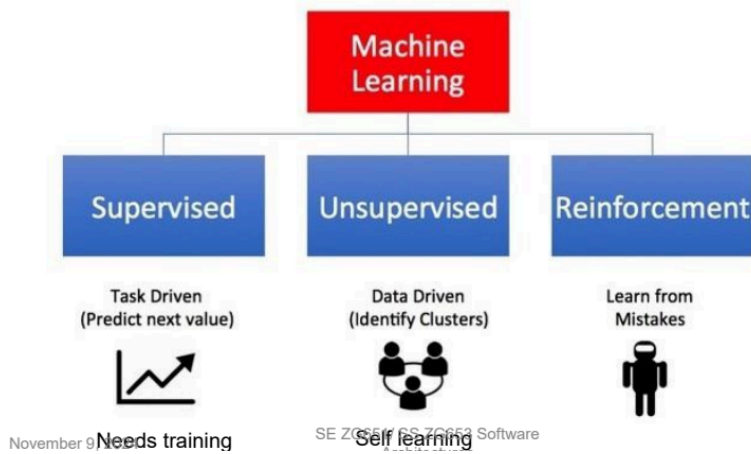
Examples:

1. **Healthcare:** Predicts treatments based on patient demographics, genetics, and lifestyle.
 2. **Industry:** Enables proactive maintenance by monitoring equipment health parameters.
 3. **Finance:** Detects credit card fraud by analyzing spending patterns.
-

4. Different Types of Machine Learning

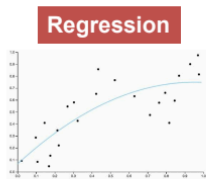
Diagram Placeholder: Major Types of Machine Learning

Types of Machine Learning



1. Supervised Learning

- **Definition:** The model learns from a labeled dataset (where outcomes are already known).
- **Example:** Predicting house prices based on features like size and location.



Eg. Predict price of house given size, location, etc.

November 9, 2024



Eg. Does this person like computer game? (based on age and gender)

SE ZG651/ SS ZG653 Software

6

Diagram Placeholder: Supervised Learning Decision Tree

Decision tree: Data provided to algorithm

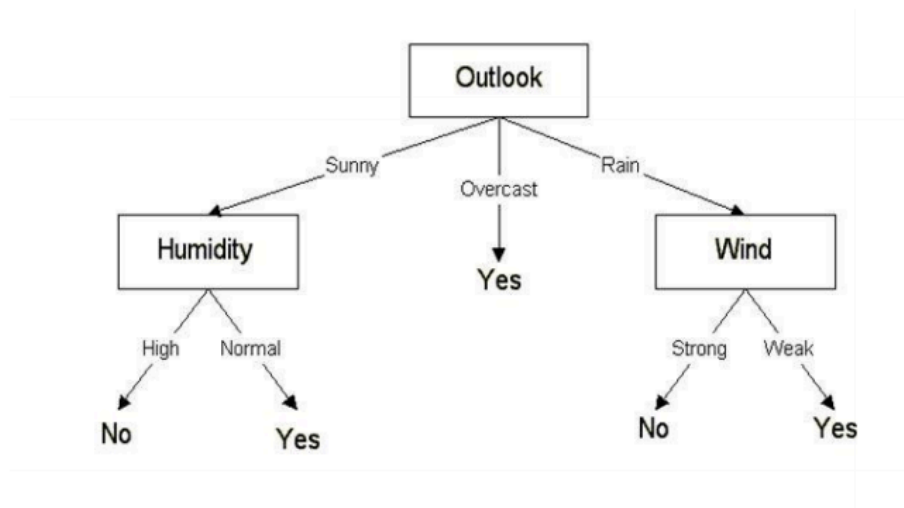


Day	Outlook	Temperature	Humidity	Wind	Play Golf
D1	Sunny	Hot	High	Weak	No
D2	Sunny	Hot	High	Strong	No
D3	Overcast	Hot	High	Weak	Yes
D4	Rain	Mild	High	Weak	Yes
D5	Rain	Cool	Normal	Weak	Yes
D6	Rain	Cool	Normal	Strong	No
D7	Overcast	Cool	Normal	Strong	Yes
D8	Sunny	Mild	High	Weak	No
D9	Sunny	Cool	Normal	Weak	Yes
D10	Rain	Mild	Normal	Weak	Yes
D11	Sunny	Mild	Normal	Strong	Yes
D12	Overcast	Mild	High	Strong	Yes
D13	Overcast	Hot	Normal	Weak	Yes
D14	Rain	Mild	High	Strong	No

November 9, 2024

SE ZG651/ SS ZG653 Software Architectures

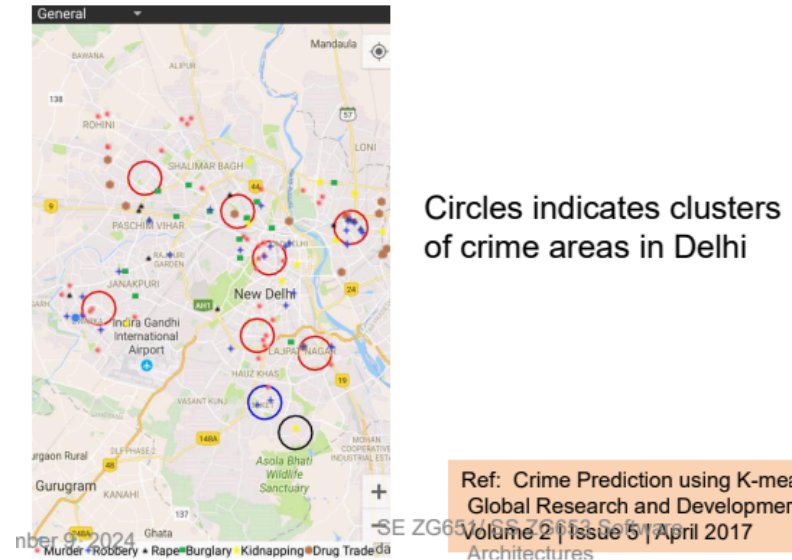
Decision tree built by algorithm to predict whether to play or not



2. Unsupervised Learning

- **Definition:** The model works with an unlabeled dataset and finds patterns or clusters.
- **Example:** Segmenting customers based on purchasing behavior, age, income, etc.

Diagram Placeholder: Clustering in Unsupervised Learning



Clustering

innovate achieve

- Customers can be segmented (clustered) based on Gender, age, annual income, products purchased, etc. (Luxury car buyers)
- We can source potential customer data and determine to which segment they belong to.
- Based on the segment, we can target them and send promotion details for the right product



3. Reinforcement Learning

- **Definition:** The model learns through trial and error, interacting with an environment to maximize rewards.
- **Example:** Robots learning to navigate or play chess.

4. Deep Learning

- **Definition:** A subset of ML that uses neural networks to understand and analyze images, sounds, and text.
- **Example:** Image recognition, Natural Language Processing (NLP) for chatbots.

Diagram Placeholder: Neural Network for Deep Learning

Neural networks

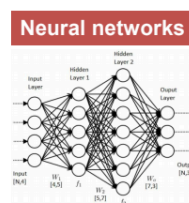
innovate achieve lead

- These networks can learn and **model the relationships between inputs and outputs that are complex.**
- **Examples:** Detecting rare events such as frauds, help doctors with an opinion

Neural networks - SAS

November 9, 2024

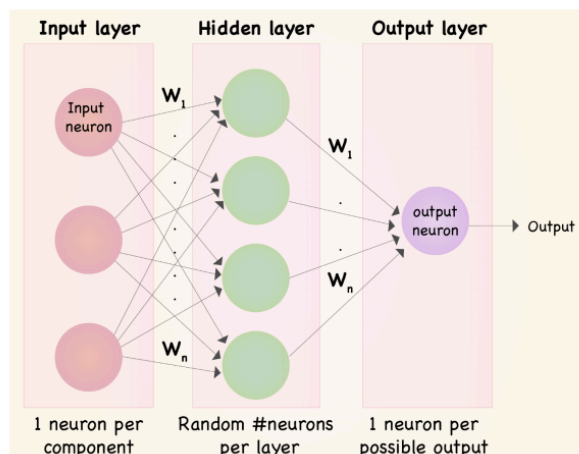
SE ZG651/ SS ZG653 Software Architectures



13

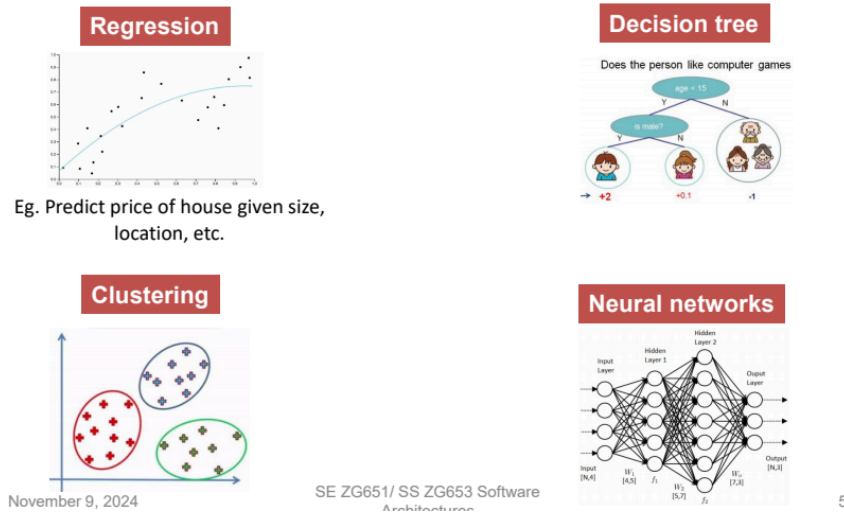
How does a neural network look like?

innovate



5. Algorithms Used in ML

Diagram Placeholder: Types of Algorithms Used in ML



- **Regression:** Used for predicting continuous values (e.g., price prediction).
- **Decision Trees:** Used for classification tasks (e.g., determining if someone likes a product).
- **Neural Networks:** Mimic the human brain to analyze complex data patterns, especially useful in deep learning applications.

6. Steps to Build an ML Model

1. Identify the Problem

- Determine the business value and objective of the model.

2. Select Features

- Use domain knowledge to choose features that impact predictions.
 - **Example:** Age, income, and purchasing behavior for customer segmentation.

3. Choose the Model Type

- Decide on a supervised, unsupervised, or reinforcement learning model.

4. Train, Test, and Validate the Model

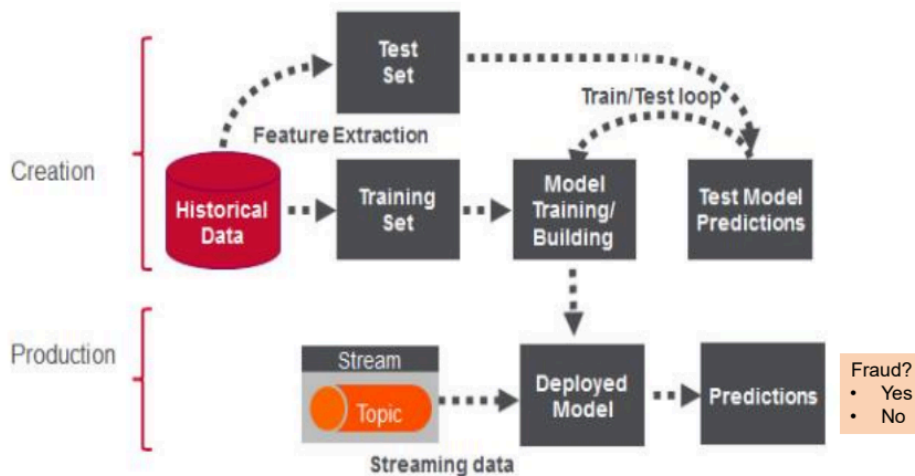
- Split the data into training and testing sets to evaluate performance.

5. Experiment and Improve

- Continuously refine the model to improve accuracy.

Diagram Placeholder: Steps to Build ML Model for Fraud Detection

Building the model: Fraud detection



November 9, 2024

SE ZG651/ SS ZG653 Software Architectures

16

7. Architecture of an ML System

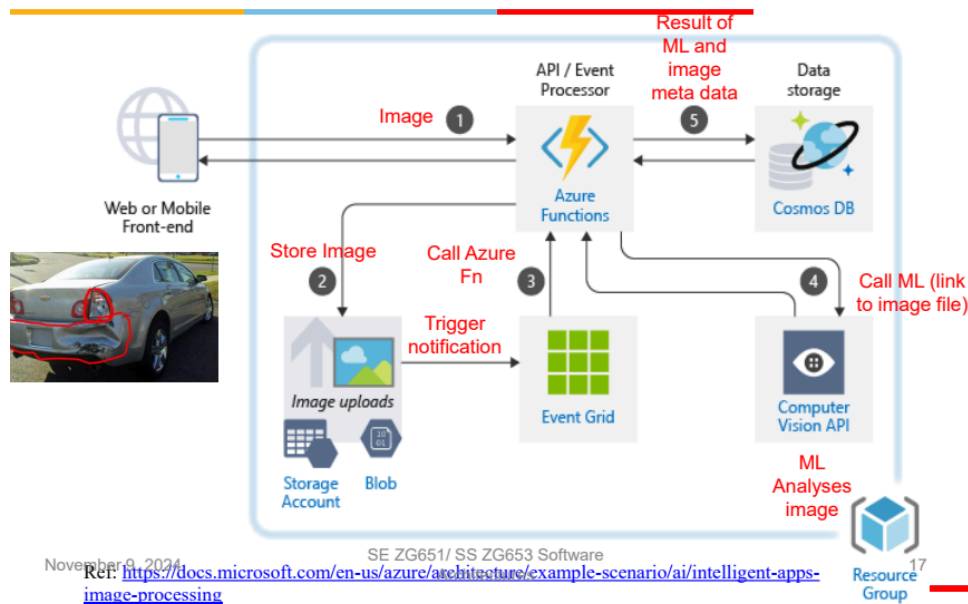
An ML system architecture may involve various components and data flows to handle tasks such as image processing, data storage, and prediction.

Example: Insurance Claim Image Classification

- **Step 1:** Image is uploaded.
- **Step 2:** Image is analyzed by an ML model.
- **Step 3:** Classification result is stored along with metadata.
- **Step 4:** Notifications are triggered based on the classification.

Diagram Placeholder: ML System Architecture for Image Classification

Architecture of ML system: Image classification for insurance claims



8. Popular Tools for ML

- **Scikit Learn:** Provides models for classification, regression, clustering, and more.
- **PyTorch:** Popular for building neural networks, especially in research.
- **TensorFlow:** Widely used for neural networks and deep learning.
- **Apache Mahout:** Tools for clustering, regression, and recommendation.
- **Spark MLlib:** Scalable ML library that integrates with Apache Spark.

Experience Sharing

Reflect on these questions to gain insights from real-world ML applications:

1. What problem did you solve using ML?
2. What steps did you follow to develop the system?
3. What were the key challenges you faced?