

# BCA - THIRD YEAR FIFTH SEMESTER

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CSA 7101T



## Introduction to Artificial Intelligence and Machine Learning

*BCA - 5th Semester Notes*

# 1. Artificial Intelligence (AI): Introduction

## Definition of Artificial Intelligence

AI is a branch of computer science that focuses on creating machines or software capable of performing tasks that normally require human intelligence, such as:

- Learning
- Reasoning
- Problem-solving
- Perception
- Decision-making
- Language understanding

In simple words, AI makes machines "think" and "act" like humans.

## Formal Definitions

- John McCarthy: "Artificial Intelligence is the science and engineering of making intelligent machines."
- Russell & Norvig: "AI is the study of agents that receive percepts from the environment and perform actions."







## 2. AI Problems

An AI problem is one that requires intelligence to solve and cannot be solved efficiently using traditional algorithms.

### Characteristics of AI Problems

- Large search space
- Uncertainty
- Incomplete information
- Requires reasoning or learning

### Examples of AI Problems

- Playing chess or carrom 
- Speech recognition 
- Face detection 
- Medical diagnosis 
- Autonomous driving 
- Chatbots 

# 3. Applications of Artificial Intelligence

## 1. Healthcare

- Disease diagnosis
- Medical imaging
- Virtual health assistants

## 2. Education

- Intelligent tutoring systems
- Automated grading

## 3. Banking & Finance

- Fraud detection
- Credit scoring
- Algorithmic trading

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## 4. Transportation



- Self-driving cars
- Traffic prediction

## 5. E-commerce



- Recommendation systems
- Chatbots

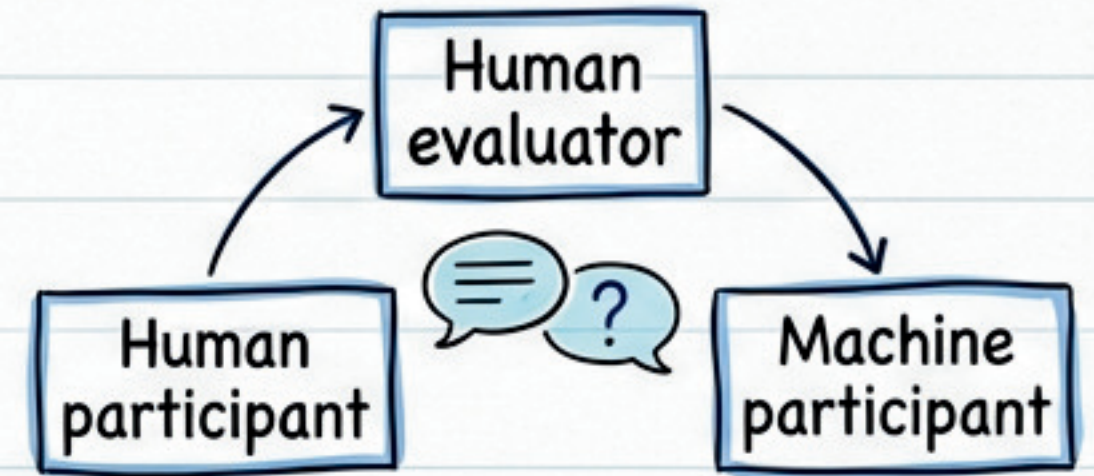
## 4. Challenges of Artificial Intelligence

1. High development cost 
2. Data dependency 
3. Lack of common sense 
4. Ethical issues 
5. Bias in data 
6. Job displacement concerns 

## 6. Turing Test (Proposed by Alan Turing, 1950)

### Concept

A machine is said to be intelligent if a human cannot distinguish whether the responses come from a machine or another human during a conversation.



**Components** • Human evaluator  • Human participant  • Machine participant 

**Limitation** • Focuses only on conversation • Does not measure real understanding

## 7. Agent and Environment

**Agent:** An entity that **Perceives** its environment through sensors and **Acts** upon the environment through actuators.

**Environment:** The surroundings in which an agent operates.

Agent	Sensors	Actuators
Human	Eyes, ears	Hands, legs
Robot	Camera	Motors
Software Agent	Keyboard input	Screen output



## 8. Rational vs Non-Rational Reasoning

**Rational Reasoning:** Based on logic, Goal-oriented, Produces optimal results.



**Non-Rational Reasoning:** Based on emotions or instincts, May not always be optimal.

# 9. Nature of Environments

## 1. Fully Observable vs Partially Observable

- Fully: Agent gets complete information. 
- Partially: Incomplete or noisy information. 




## 2. Single-Agent vs Multi-Agent

- Single: Only one agent acts. 
- Multi: Multiple agents interact. 

## 3. Deterministic vs Stochastic

- Deterministic: Same action  $\rightarrow$  same result.   $\rightarrow$  
- Stochastic: Uncertain outcomes.   ?

## 4. Static vs Dynamic

- Static: Environment does not change. 
- Dynamic: Environment changes during action.   $\rightarrow$  

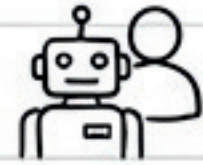
## 5. Discrete vs Continuous

- Discrete: Finite states. 
- Continuous: Infinite states. 

# 10. Nature of Agents

## 1. Autonomy vs Semi-Autonomous

- **Autonomous:** Works **independently.** 


- **Semi-Autonomous:** Requires **human assistance.** 

## 2. Types of Agents

a) **Simple Reflex Agent:** Acts based on **current perception, No memory.** 

b) **Model-Based Agent:** Maintains **internal state.** 

c) **Goal-Based Agent:** Works to achieve **specific goals.** 

d) **Utility-Based Agent:** Maximizes performance using **utility function.** 

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## 11. Importance of Perception and Environment Interaction

• **Perception** helps the agent **understand surroundings** 

• **Interaction** allows **learning** 

• **Feedback** improves performance 

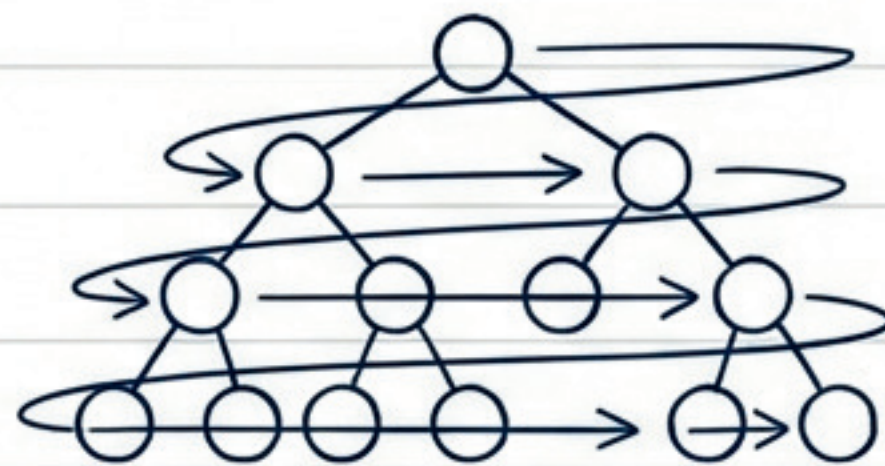
## 12. Basic Search Concepts

- **Problem Space:** Set of all possible states in which a solution can exist.
- **Search:** Systematic exploration of problem space to find a solution.

## 13. Uninformed Search Strategies

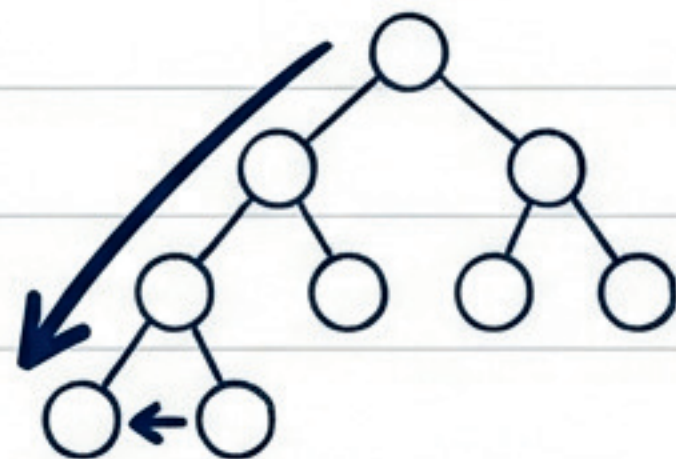
### 1. Breadth-First Search (BFS)

- Explores level by level
- Uses queue
- Guarantees shortest path
- High memory usage



### 2. Depth-First Search (DFS)

- Explores depth first
- Uses stack
- Less memory

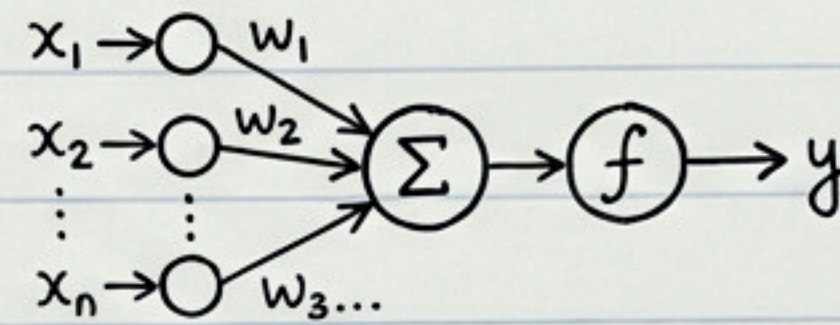
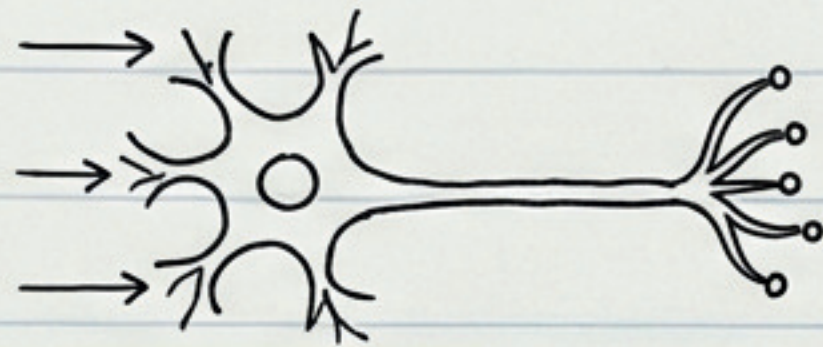


### 3. Depth-First Iterative Deepening (DFID)

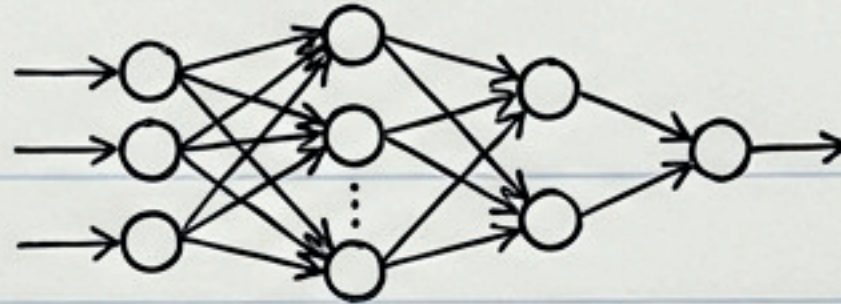
- Combines BFS and DFS - May get stuck
- Optimal and memory efficient

## 14. Perceptron & Neural Network Learning

**Perceptron:** Basic unit of neural networks. Inspired by human neuron.



**Neural Network:** A network of interconnected perceptrons.



## 15. Feed Forward Neural Network

- Data flows in one direction (Forward  $\rightarrow$ )  $\longrightarrow$
- No loops

## 16. Back Propagation Algorithm

- Error is propagated backward (Backward  $\leftarrow$ )  $\longleftarrow$
- Weights are adjusted
- Used for training neural networks

# 17. Machine Learning (ML): Introduction

Definition: Machine Learning is a subset of AI that enables systems to learn from data without explicit programming.

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## 18. Machine Learning Algorithms

### 1. Supervised Learning

Uses labeled data.

#### a) Regression

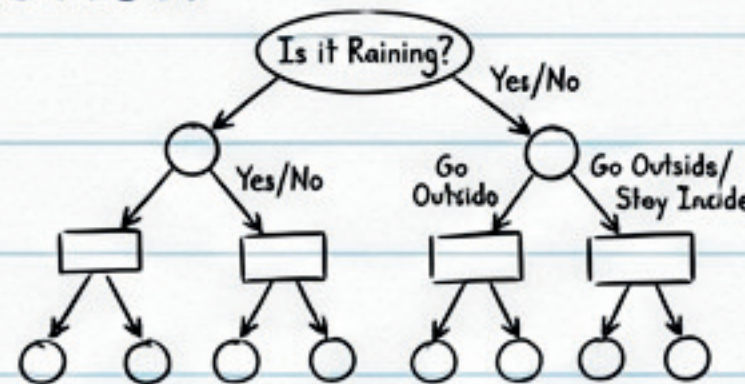
- Predicts continuous values
- Example: House price prediction

#### b) Classification

- Predicts categories
- Example: Spam detection

### Decision Trees

- Tree-like structure
- Easy to interpret



# Measuring Classifier Accuracy

$$\text{Accuracy} = \frac{\text{Correct Predictions}}{\text{Total Predictions}}$$

## Confusion Matrix

- TP, TN, FP, FN
- Used to evaluate performance

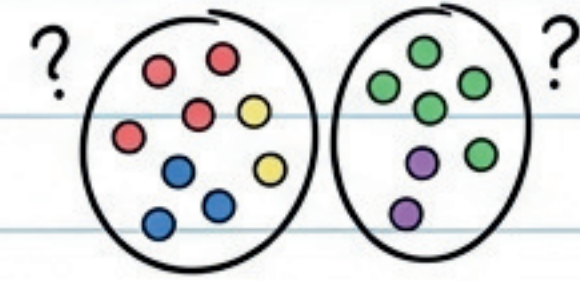
	Predicted	
Actual	TP	FP
	FN	TN

## Support Vector Machine (SVM)

- Separates data using hyperplane
- Effective for high-dimensional data

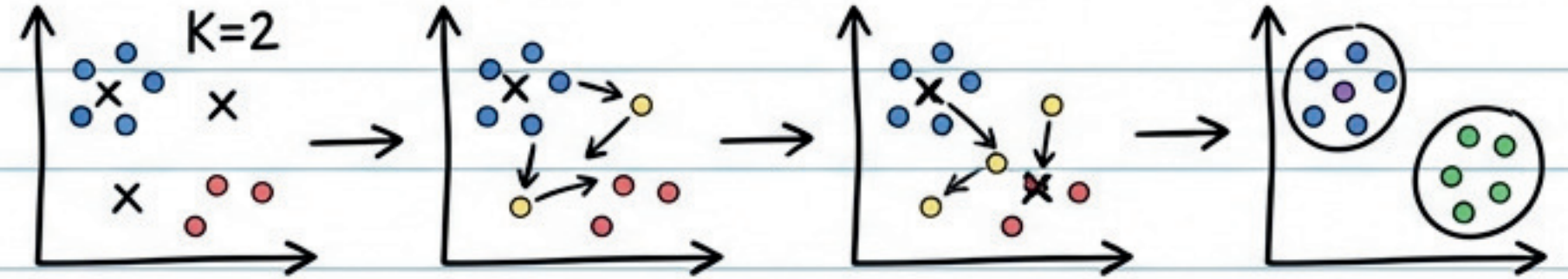
# 19. Unsupervised Learning

**Clustering:** Groups similar data. No labels.



## K-Means Algorithm

1. Choose K clusters
2. Assign data points
3. Update centroids
4. Repeat until stable



# 20. Reinforcement Learning

**Concept:** Learning by trial and error. Uses reward and punishment.

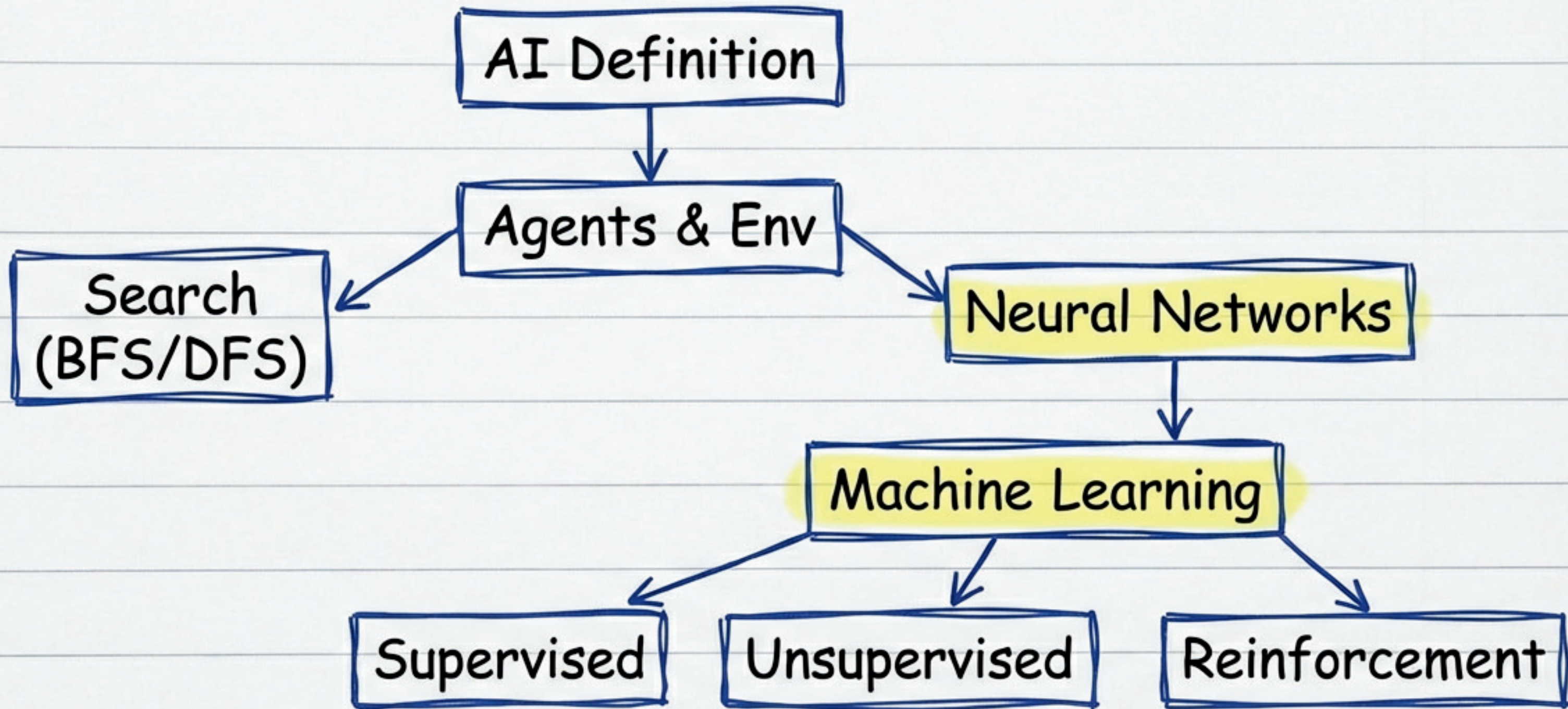
**Components:** Agent, Environment, Action, Reward.



**Example:** Game playing, Robotics.



# Quick Summary



End of Notes 😊