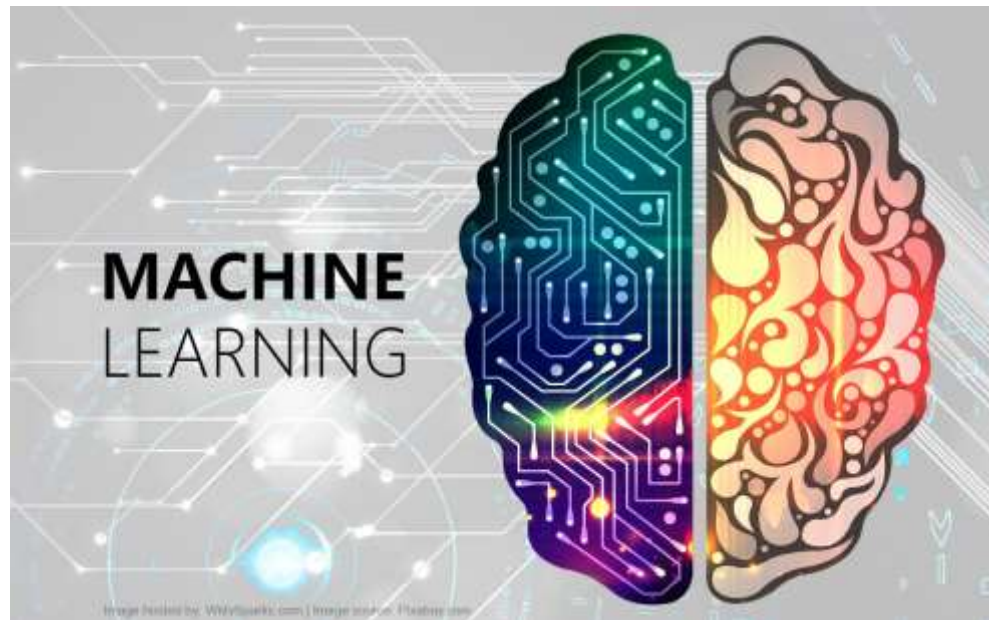


Department of Artificial Intelligence and Machine Learning



23AMB201 –Machine Learning
II B.Tech. AIML - B/ III SEMESTER

UNIT I : Introduction

Topic : Decision Theory

Lets Recall

Probability Distribution Explained

What is a probability distribution?

It describes how probabilities are assigned to all possible outcomes of a random variable.

How does it help?

It quantifies uncertainty by showing which outcomes are more likely and which are less likely.

What are the types of probability distributions?

Mainly two types: discrete (finite outcomes) and continuous (infinite outcomes).

How are they used in Machine Learning?

For prediction, decision-making, and risk analysis.



Learning Objectives

- Understand what **Decision Theory** is and why it is important in Machine Learning
- Explain the **decision-making process under uncertainty**
- Identify different **types of decision theory**
- Relate decision theory concepts to **real-world and ML applications**
- Understand how **probability, risk, and utility** influence decisions

Definition of Decision Theory

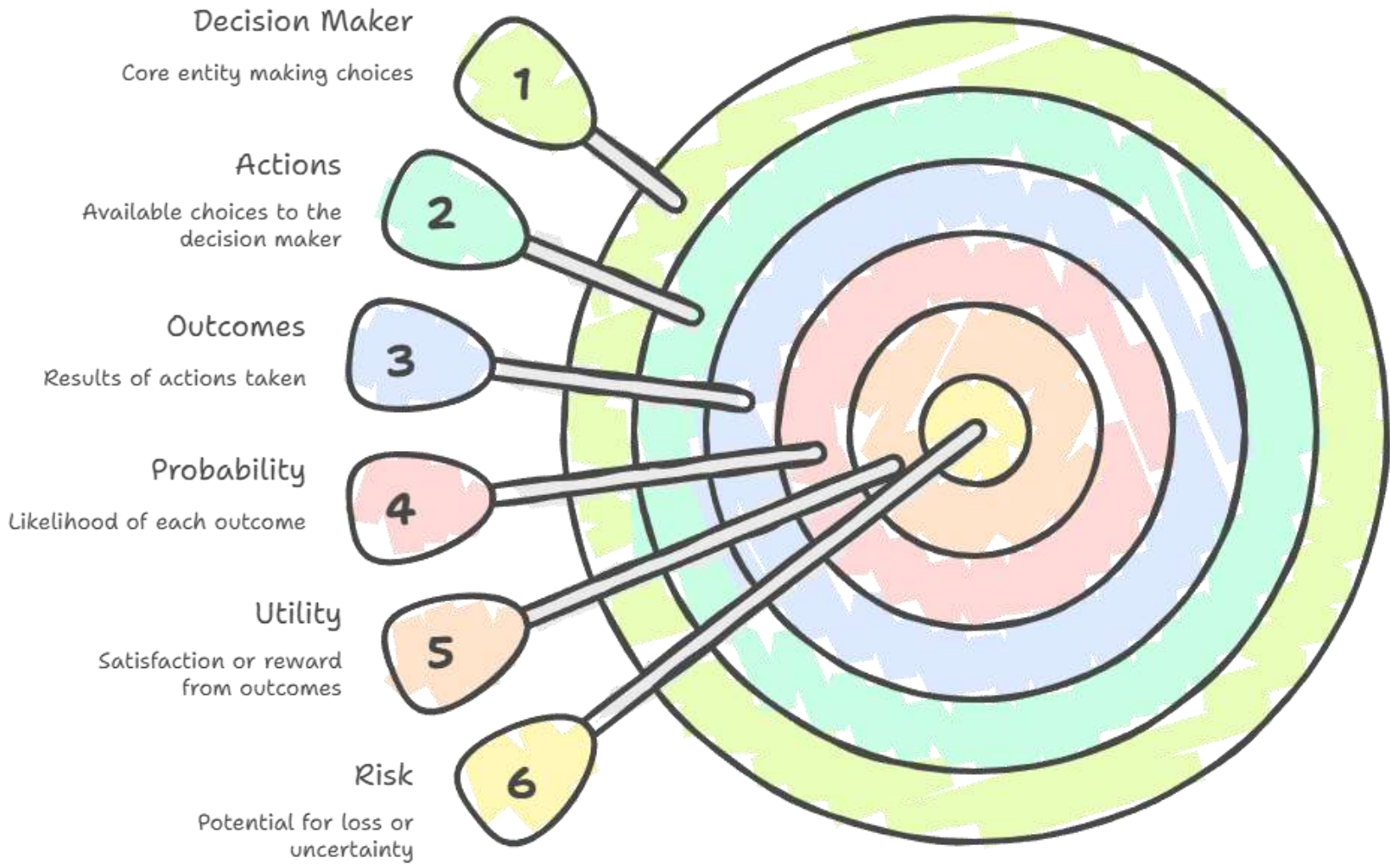
- **Decision Theory** is a mathematical and logical framework used to make **optimal decisions** when outcomes are uncertain.



Decision Theory Process Cycle



Decision Theory Key Concepts



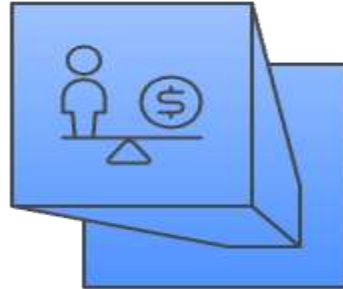
Types:

1.

Normative Decision Theory

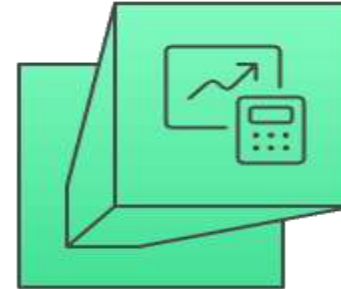
Simple cost-benefit analysis

Relies on basic analysis assuming rational decision-making.



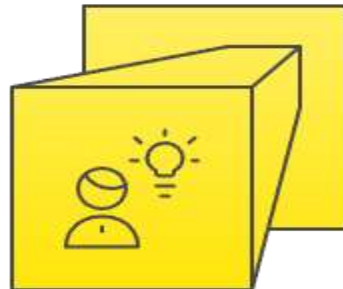
Choosing the option with the highest expected profit

Maximizes profit using sophisticated mathematical models and rationality.



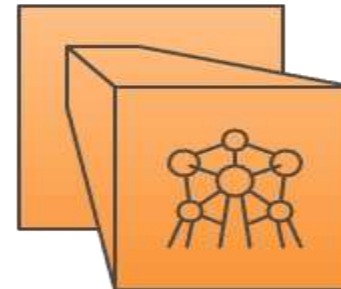
Intuitive decision-making

Makes decisions based on gut feeling without formal analysis.



Complex simulation with behavioral factors

Incorporates intricate models but acknowledges irrational behavior.



Descriptive Decision Theory

2.

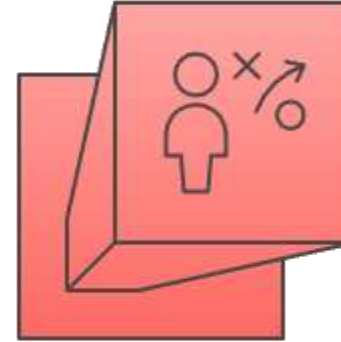
Idealized emotional response

Represents emotional responses in idealized scenarios.



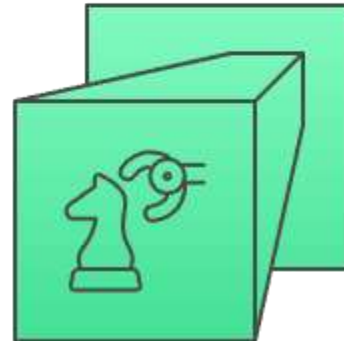
Risk-averse behavior

Reflects emotional biases in actual decision-making.



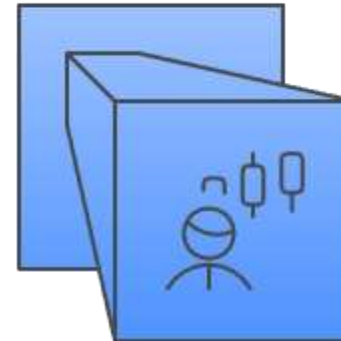
Optimal decision-making

Achieves rational decisions based on normative principles.



Biased rationalization

Rationalizes decisions influenced by cognitive biases.

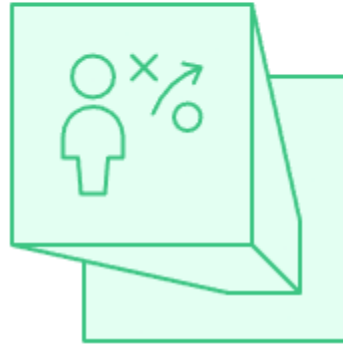


Prescriptive Decision Theory

3.

Behavioral economics

Behavioral economics emphasizes human behavior with limited logical rigor.



Decision support systems

Decision support systems effectively integrate logic with human behavior.



Intuitive decision making

Intuitive decision making relies on minimal logic and human behavior.



Mathematical modeling

Mathematical modeling prioritizes logic with minimal consideration for human behavior.



Decision Theory Cycle in Machine Learning



MIND MAP

Decision Theory Recap

Decision Making

Helps make best decisions under uncertainty.

Evaluation

Uses probability and utility to evaluate choices.

Machine Learning

Plays a crucial role in Machine Learning and AI.

Real-World Applications

Widely applied in real-world intelligent systems.

Assessment

1. Define Decision Theory and explain its role in Machine Learning?
2. Describe the decision-making process in Decision Theory, explaining the significance of actions, outcomes, probabilities, and utility?
3. Explain how Decision Theory helps in selecting the optimal action, and illustrate your answer with a suitable example.

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