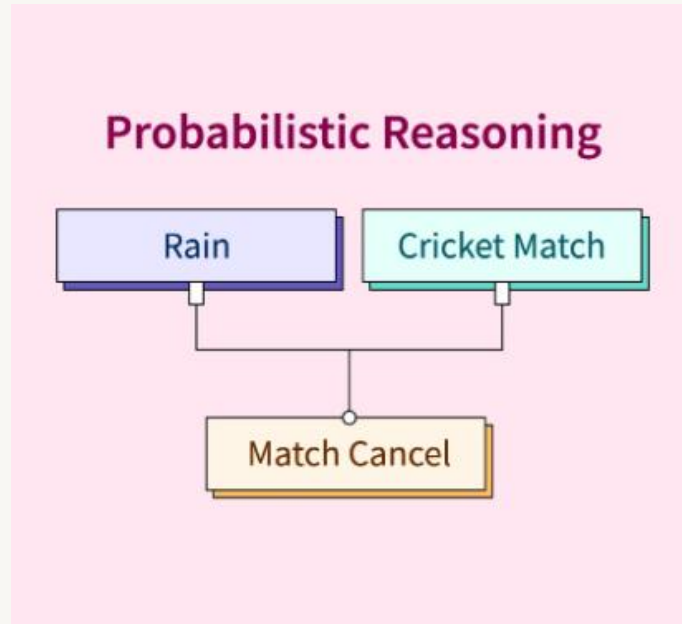


Unit-5

Probabilistic Reasoning



- ❑ Probabilistic reasoning is a key aspect of artificial intelligence (AI) that allows for handling uncertainty and ambiguity in decision-making.
- ❑ It is a powerful technique that enables AI systems to make informed decisions even when faced with incomplete or noisy data.
- ❑ Probabilistic reasoning is widely used in various AI applications such as machine learning, natural language processing, robotics, computer vision, and many more.

Introduction

AI has made significant strides recently, with probabilistic reasoning playing a crucial role.

- **Probabilistic Reasoning:** Making decisions based on probabilities and likelihoods rather than absolute facts.
- **Core Idea:** Involves reasoning about the probabilities or likelihoods of events or outcomes.
- **Purpose:** Allows AI systems to model and reason about uncertain situations in a principled and quantitative manner.
- **Uncertainty:** Considers the inherent uncertainty in real-world data and evidence.
- **Mathematical Framework:** Provides a structured way to deal with uncertainty and make rational decisions in uncertain environments.

Acting Under Uncertainty



- ✓ From self-driving cars to virtual personal assistants, AI technologies have become integral to our daily routines. However, one of the key challenges that AI systems face is dealing with uncertainty.

Definition:

Uncertainty refers to the lack of certainty or the state of having limited knowledge where it is impossible to exactly describe the existing state or future outcome.

Factors Contributing to Uncertainty:

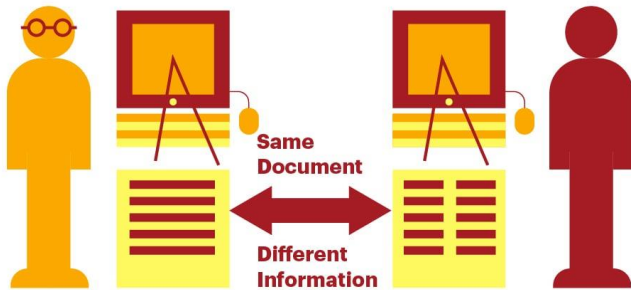
- **Unreliable Sources of Information:** Inconsistent or incorrect data sources can lead to uncertain outcomes.
- **Experimental Errors:** Mistakes or variations in experiments can introduce uncertainty.
- **Equipment Faults:** Malfunctions or inaccuracies in measurement tools and devices.
- **Temperature Variations:** Changes in temperature that can affect processes or data integrity.
- **Climate Change:** Environmental changes that introduce unpredictability in various systems

CAUSES OF UNCERTAINTY:

- **Information Occurred from Unreliable Sources:**

AI systems rely on data to make decisions and predictions. However, data obtained from various sources may not always be reliable. Data can be incomplete, inconsistent, or biased, leading to uncertainty in the outcomes generated by AI systems.

Inconsistent Data





- **Experimental Errors:**

In scientific research and experimentation, errors can occur at various stages, such as data collection, measurement, and analysis. These errors can introduce uncertainty in the results and conclusions drawn from the experiments.



- **Equipment Fault:**

In many AI systems, machines and sensors are used to collect data and make decisions. However, these machines can be subject to faults, malfunctions, or inaccuracies, leading to uncertainty in the outcomes generated by AI systems.

- **Climate Change:**

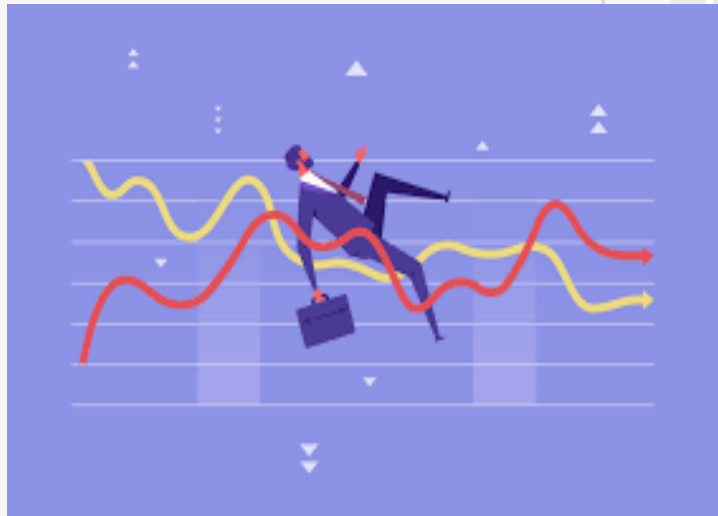


Climate change is a global phenomenon that introduces uncertainty in various aspects of our lives. For example, predicting the impacts of climate change on agriculture, water resources, and infrastructure requires dealing with uncertain data and models.

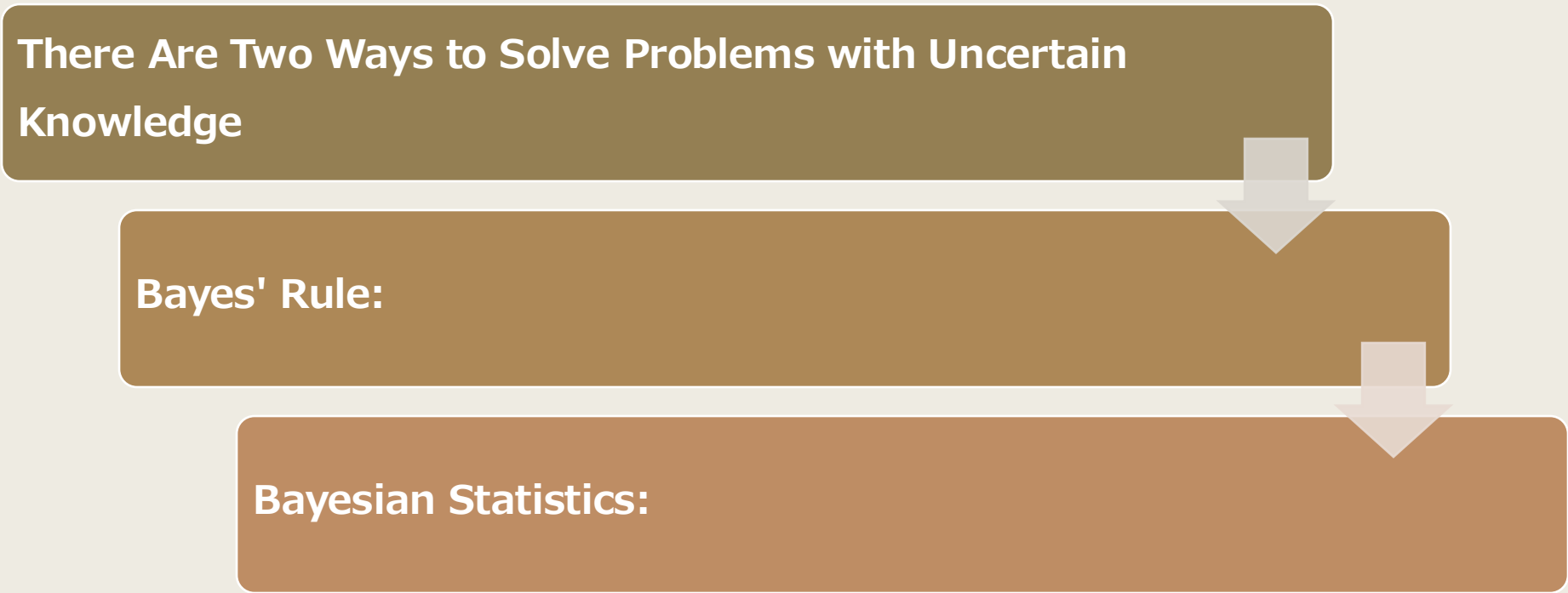


Need for Probabilistic Reasoning in AI

The need for probabilistic reasoning in AI arises because uncertainty is inherent in many real-world applications. **For example**, there is often uncertainty in the symptoms, test results, and patient history in medical diagnosis. In autonomous vehicles, there is uncertainty in the sensor measurements, road conditions, and traffic patterns. In financial markets, there is uncertainty in stock prices, economic indicators, and investor behavior.



There Are Two Ways to Solve Problems with Uncertain Knowledge



Bayes' Rule:

Bayesian Statistics: