UNCERTAIN KNOLEDGE AND REASONING

IV UNIT

Uncertainty

- We have learned knowledge representation using first-order logic and propositional logic with certainty, which means we were sure about the predicates.

- With this knowledge representation, we might **write A→B, which means if A is true then B is true,** but consider a situation where we are not sure about whether A is true or not then we cannot express this statement, this situation is called **Uncertainty.**

- So to represent uncertain knowledge, where we are not sure about the predicates, we need uncertain reasoning or probabilistic reasoning.

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- **Causes of uncertainty:**

Following are some leading causes of uncertainty to occur in the real world.

1. Information occurred from unreliable sources.
2. Experimental Errors
3. Equipment fault
4. Temperature variation
5. Climate change.

Probabilistic Reasoning

Probabilistic reasoning:

- Probabilistic reasoning is a way of knowledge representation where we apply the concept of probability to indicate the uncertainty in knowledge. In probabilistic reasoning, we combine probability theory with logic to handle the uncertainty.

- In the real world, there are lots of scenarios, where the certainty of something is not confirmed, such as

1. "It will rain today,“
2. "behavior of someone for some situations,“3.
3. "A match between two teams or two players.“

- These are probable sentences for which we can assume that it will happen but not sure about it, so here we use probabilistic reasoning.

Cont…

- **Need of probabilistic reasoning in AI:**
- When there are unpredictable outcomes.
- When specifications or possibilities of predicates becomes too large to handle.
- When an unknown error occurs during an experiment.
- In probabilistic reasoning, there are two ways to solve problems with uncertain knowledge:
- **Bayes' rule**
- **Bayesian Statistics**

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- let's understand some common terms:

- **Probability:** Probability can be defined as a chance that an uncertain event will occur. It is the numerical measure of the likelihood that an event will occur. The value of probability always remains between 0 and 1 that represent ideal uncertainties.

1. $0 \leq P(A) \leq 1$, where P(A) is the probability of a n event A.
2. P(A) = 0, indicates total uncertainty in an event A.
3. P(A) =1, indicates total certainty in an event A.

Cont…

- We can find the probability of an uncertain event by using the below formula.

$$\text{Probability of occurrence} = \frac{\text{Number of desired outcomes}}{\text{Total number of outcomes}}$$

- P(¬A) = probability of a not happening event.
- P(¬A) + P(A) = 1.
- **Event:** Each possible outcome of a variable is called an event.

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- Conditional probability:
- Conditional probability is a probability of occurring an event when another event has already happened.
- Let's suppose, we want to calculate the event A when event B has already occurred, "the probability of A under the conditions of B", it can be written as:

$$P(A|B) = \frac{P(A \wedge B)}{P(B)}$$

- **Where P($A \wedge B$)= Joint probability of a and B**
- **P(B)= Marginal probability of B.**

Cont…

- If the probability of A is given and we need to find the probability of B, then it will be given

$$P(B|A) = \frac{P(A \wedge B)}{P(A)}$$

- It can be explained by using the below Venn diagram, where B is occurred event, so sample space will be reduced to set B, and now we can only calculate event A when event B is already occurred by dividing the probability of **P(A∧*B*) by P(B)**.

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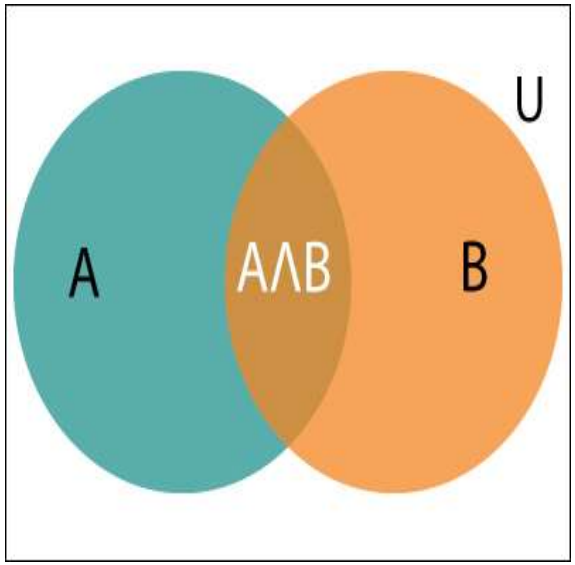

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- In a class, there are 70% of the students who like English and 40% of the students who likes English and mathematics, and then what is the percent of students those who like English also like mathematics?

- Solution??????????????????

Cont…

- **Solution:**
- Let, A is an event that a student likes Mathematics
- B is at a student likes Engl

$$P(A|B) = \frac{P(A \wedge B)}{P(B)} = \frac{0.4}{0.7} = 57\%$$