

22c:145 Artificial Intelligence

Uncertainty

- Reading: Ch 13. Russell & Norvig

Lecture 14 - 1

Problem of Logic Agents

- Logic-agents almost never have access to the whole truth about their environments.
- A rational agent is one that makes rational decisions in order to maximize its performance measure.
- Logic-agents may have to either risk falsehood or make weak decisions in uncertain situation
- A rational agent's decision depends on *relative importance* of goals, *likelihood* of achieving them.
- Probability theory provides a quantitative way of encoding likelihood

Lecture 14 - 2

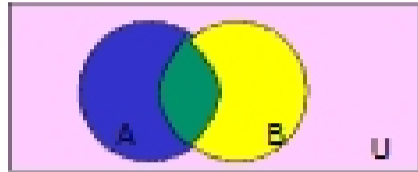
Foundations of Probability

- Probability Theory makes the same ontological commitments as FOL
- Every sentence S is either true or false.
- The *degree of belief, or probability*, that S is true is a *number P* between 0 and 1.
- $P(S) = 1$ iff S is certainly true
- $P(S) = 0$ iff S is certainly false
- $P(S) = 0.4$ iff S is true with a 40% chance
- $P(\text{not } A) =$ probability that A is false
- $P(A \text{ and } B) =$ probability that both A and B are true
- $P(A \text{ or } B) =$ probability that either A or B (or both) are true

Lecture 14 - 3

Axioms of Probability

- All probabilities are between 0 and 1
- Valid propositions have probability 1. Unsatisfiable propositions have probability 0. That is,
 - $P(A \vee \neg A) = P(\text{true}) = 1$
 - $P(A \wedge \neg A) = P(\text{false}) = 0$
 - $P(\neg A) = 1 - P(A)$
- The probability of disjunction is defined as follows.
 - $P(A \vee B) = P(A) + P(B) - P(A \wedge B)$
 - $P(A \wedge B) = P(A) + P(B) - P(A \vee B)$



Lecture 10 - 6

Exercise Problem I

Prove that

$$P(A \vee B \vee C) = P(A) + P(B) + P(C) - P(A \wedge B) - P(A \wedge C) - P(B \wedge C) + P(A \wedge B \wedge C)$$

Lecture 10 - 8

How to Decide Values of Probability

$P(\text{the sun comes up tomorrow}) = 0.999$

- Frequentist
 - Probability is inherent in the process
 - Probability is estimated from measurements

Probs can be wrong!

Lecture 10 - 9

A Question

Jane is from Berkeley. She was active in anti-war protests in the 60's. She lives in a commune.

- Which is more probable?
 1. Jane is a bank teller
 2. Jane is a feminist bank teller

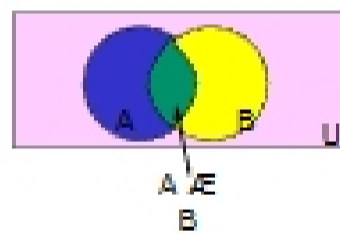
Lecture 10 - 7

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1. A
2. $A \cap B$



Lecture 10 - 8

Conditional Probability

- $P(A)$ is the unconditional (or prior) probability
- An agent can use unconditional probability of A to reason about A only in the absence of no further information.
- If some further evidence B becomes available, the agent must use the conditional (or posterior) probability:

$$P(A|B)$$

the probability of A given that the agent already knew that B is true.

- $P(A)$ can be thought as the conditional probability of A with respect to the empty evidence:

$$P(A) = P(A|).$$

Lecture 10 - 9
