Uncertainty

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Acting Under Uncertainty

Belief state

qualification problem

rational decision

From Logic to Uncertainty

Problems: - exhaustivity - theoretical ignorance - practical ignorance

degree of belief

probability theory

ontological commitments

epistemological commitments

Probabilities refer to our knowledge of the world state, not the actual world state.

Rational Decisions

Outcomes

Preferences

utility: the quality of being useful. Utility theory: quantitative representation of preferences associate a utility with each possible outcome, which induces a preference ordering

Decision theory

Maximum expected utility

Each action, a, leads to a probability distribution over outcomes, or "result states":

$$\sum_{s \in S} Pr(s) = 1$$

And each outcome state has a utility. A rational decision-theoretic agent chooses the action that maximize expected utility, that is:

$$\underset{a}{\text{argmax}} \sum_{s \in S} Pr(s)U(s)$$

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Probability Models

Sample space

event probabilities

$$0 \leq Pr(\omega) \leq 1 \text{ for every } \omega \text{ and } \sum_{\omega \in \Omega} Pr(\omega) = 1$$