6. Uncertainty Management and Decision Making

6.1. Acting under Uncertainty using Probabilistic Reasoning

A. Fundamental aspects of acting under uncertainty

1. Agents almost never have access to the whole truth about their environments, but rational agents must do the right thing, that is, make rational decisions.

2. In most judgmental domains like medicine, law, business, design etc., the agents' knowledge can at best provide only a degree of belief in the truth of a given proposition.

3. Main tool here, to deal with degree of belief, is the probability theory. Probability provides a way of summarizing the uncertainty that comes from the laziness and ignorance of the agent.

4. Next comes preference, that is, choosing from alternatives.

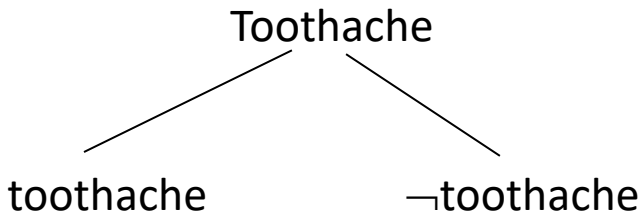
5. The tool to deal with preference is utility theory, where the utility functions describing degree of usefulness of alternatives are considered.

6. So, Decision theory = Probability theory + Utility theory.

B. Inference using Full Joint-Probability Distribution

i) Example: Full joint-probability distribution of 3 Boolean random variables, Toothache, Cavity and Catch:

	toothache		¬toothache	
	catch	¬catch	catch	¬catch
cavity	0.108	0.012	0.072	0.008
¬cavity	0.016	0.064	0.144	0.576



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ii) Features:

1. Sum of the probabilities is 1.

2. Probability of truth of a proposition is equal to the sum of the probabilities of the atomic events (complete specification of the domain) where it holds:

$P(p_1) = \Sigma_i P(e_i)$, where e_i is the ith atomic event holding the truth of p_1.

3. Posterior probabilities are computed as conditional probabilities based on prior (given/ obtained) probabilities.

4. A given full joint distribution is used as a complete KB to answer any question about the domain involving the variables.