Probabilistic Reasoning

Partially observable

* Full observability not true in the real world
* Can be partial due to many reasons: - world structure vs sensor ability
  + Sensor noise (extra noise)
  + Computational complexity
* ALL THIS LEADS TO UNCERTAINTY

Uncertainty

Action At = leave airport t minutes before flight

* Have to take into account multiple problems that may occur

Not allowing ofr partial observability approach either:

* Leads to not enough being taken into account
* Or taking too many precautions

HOW TO DEAL WITH UNCERTAINTY

* Use probability
* Issues: computational complexity, obtaining values & semantics
* FUZZY LOGIC DEALS WITH DEGREE OF TRUTH NOT UNCERTAINTY

Probablistic assersions summarize effects of:

* Laziness
* Ignorance

Subjective or Bayesian probability

* Probabilities relate propositions to one knowledge
* Probabilities of propositions change with new evidence

Depends on our preferences for certain other factors e.g. missing flight vs plane food

Utility Theory is used to represent and infer preferences

Decision Theory = Utility theory + probability theory

Propositions

* We describe the world in terms of propositions
* A propositions as the event where the proposition is true
* Given Boolean random variables A & B:
  + Event a = set of sample poits where A = true
* A State can be defined by a set of Boolean values

The definitions imply that certain logically related events must have related probabilities

* Propositional or Boolean random variables
  + Cavity = true is a proposition (after giving it a value ‘=’)
  + False is written with ¬
* Discrete random variables (finite or infinite)
  + Weather is one of sunny, rain, cloud
  + Weather=Rain is a proposition
  + Values must be exhaustive (allow every possibility) and mutually exclusive (must not overlap)
* Continuous random variables (bounded or unbounded)
  + Temperature = 21.8, allow temp < 22.0

Probability (Extended)

Joint probability distribution: for a set of r.v.s gives probability of every atomic event on those r.v.s (every sample point)

* Every question about a domain can be answered by the joint distribution because every event is a sum of sample points

Normalisation

General Version

Let X be all the variables. ‚

Typically, we want the posterior joint distribution of the query variables Y given specific values e for the evidence variables E ‚

Let the hidden variables be H = X - Y - E

Independence

Conditional independence

Bayes’ Rule

The wrong underwear

Bayes rule & knowledge representation