Uncertainty

Up till now our agents all operated under the assumption that everything is true, false, or unknwon

Would like agents that can operate given some probability that something is true.

For example, we would like to make plans and say plan will succeed provided certain conditions are met at time of execution. Then estimate probability those conditions will be met to do reasoning.

Example: Having fun in park plan
Will succeed if not raining
then estimate this probability to try to figure out if we want to execute plan at a given time in future.

This kind of activity is called making rational decisions given a qualified plan.

How to make a logical model of uncertainty.

Consider

For All P Symptom(P, toothache) => Disease(P, cavity) // (not always true)
gum disease might be cause

Could try to fix this as

For all P Symptom(P, toochache) => Disease(P, cavity) V Disease(P, Gum Disease) V …

We are too lazy or don't know all the possibilities.

Point of above is modeling uncertainty using just first-order logic or propositional logic is both awkward and potentiall hard to do. Want to use a formalism more geared to modeling these things.

Want to use a formalism more geared to modeling these things. So we will use probability theory we keep notino of propositional of 1st order sentences, but now add a notion ofd egree of believe in that sentence.

Note this is a different from degree of truth which fuzzy logic tries to model. (degree of truth models thing like probability people would view a shirt as yellow).

How to come up with probabilities for propositions.

Need notion of a random variable.

A random variable is a function from a set of possible states into probabilities (values between 0 and 1).
We require sum of all X(S) S exists in states = 1.

Example: A boolean random variable
Might have variable cavity with domain {truth, false}
Have cavity (true) = P exists in [0,1]
Have cavity (false) = 1 – P

Example: Discrete random variable

Weather has domain {Sunny, rainy, cloudy, snowy}
Weather(Sunny) = .4
Weather(rainy) = .2
Weather(cloudy) = .38
Weather(snowy) = .02

Continuous random variable.

In this situation space usually has an infinite number of states. For example real line.
Requirement on such a random variable X is the function X:space -> [0,1] is continuous $\int X(s)\,ds = 1$.