

Examples

Temporal Models, Bayesian Networks

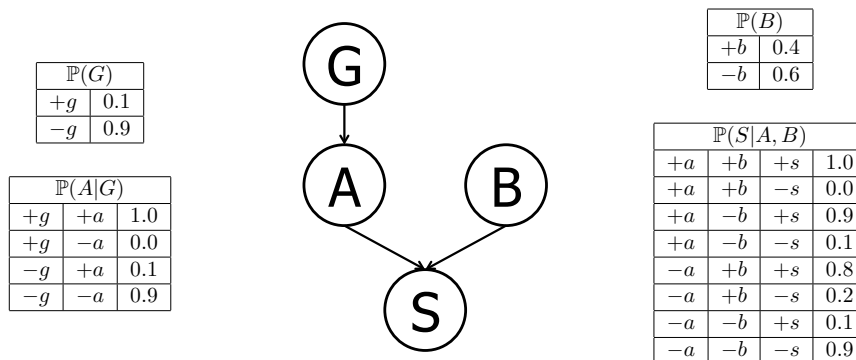
Problem 1:

You are up in your friend's apartment building, watching cars on the street below. They are far enough away that all you can see is their color. You want to catch a taxi home, so you are trying to reason about the probability that a given car is a taxi, given its color. You know that 75% of all taxis are yellow, and that only 10% of non-taxi cars are yellow. You also know that taxis are not likely to bunch up: The car following a taxi is another taxi only 25% of the time. However, non-taxi cars are followed by taxis 50% of the time. Assume 40% of all cars are taxis and 60% are non-taxis.

1. To formulate the above problem as a Hidden Markov Model (temporal model), give the transition model and the evidence model as conditional probabilities (use any correct notation you like).
2. You just saw a car but you could not tell whether it was yellow or not (no evidence at time $t = 0$), and now (at $t = 1$) you see a yellow car. What is the probability that the car you see (at $t = 1$) is a taxi?
3. What is the probability that the next car (at $t = 2$) will be a taxi?
4. You observe that the next car (at $t = 2$) is also yellow. What is the probability that this car (at $t = 2$) is a taxi?
5. Use this new information (car at $t = 2$ is also yellow) to update your belief that the previous car you saw (at $t = 1$) was a taxi.
6. Using the Viterbi algorithm, what is the most likely sequence of cars (taxi or non-taxi) at times 0, 1 and 2 given the observations at times 1 and 2?
7. Given all the current and previous observations, what is the probability of observing a non-yellow car at $t = 3$ and a yellow one at $t = 4$?

Problem 2:

Suppose that a patient can have a symptom (S) that can be caused by two different diseases (A and B). It is known that the variation of gene G plays a big role in the manifestation of disease A . The Bayes' Net and corresponding conditional probability tables for this situation are shown below. ("+" means true and "-" means false).



1. What is the probability that a patient has disease A given that they have symptom S ?