

Exercises for the Lecture Techniques in Artificial Intelligence

Probability Theory and Bayesian Networks

1) *Conspiracy theory*

Typical for conspiracy theorists is that they accept every kind of evidence as a confirmation of the conspiracy theory. A conspiracy theorist interviews someone connected with a mysterious event. If the subject agrees that there was a conspiracy, then that of course supports the conspiracy theory. If the subject denies it, then clearly he must be part of the cover-up, thus further proving the existence of the conspiracy.

Show that, in Bayesian probability theory, it is not possible for both E and $\neg E$ to be evidence in favor of hypothesis H . That is, it is not possible that both $P(H|E) > P(H)$ and that $P(H|\neg E) > P(H)$.

- 2) Would it be rational for an agent to maintain the three beliefs $P(A) = 0.4$, $P(B) = 0.3$ and $P(A \vee B) = 0.5$? If this is the case, which probability range is rationally to be assumed for $P(A \wedge B)$?
- 3) Two students A and B both attend a particular lecture. Student A is present on 80% of all the lecture dates, student B on 60%. Their presence or absence can be regarded as independent of each other.
 - (a) What is the probability that, on a particular lecture date, none of the two students will be present?
 - (b) What is the probability that at least one of them is present on a particular date?

Assume there is another student C who is present if and only if at least one of A and B is present.

- (c) Is the presence of A still independent of the presence of B ?
- (d) Construct a Bayesian Network that uses the three boolean variables A , B and C (representing the respective students) in order to represent the interrelations described above. Provide the conditional probability tables as well.
- (e) Is A conditionally independent of B given C ?
- (f) Assume that C is present on a particular date. What is the probability of A being present given that B is present, too?