Artificial Intelligence 2 – SS 2020
Assignment 3: Bayesian Networks
– Given May 8., Due May 17. –

Hint: Exercises need to be handed in via StudOn at 23:59 on the day they are due or earlier. Please use only the exercise group of your tutor to hand in your work.

If any concepts here seem unfamiliar to you or you have no idea how to proceed, consult the lecture materials, ask a fellow student, your tutor, or on the Forum.

If a problem asks for code, comment it or make it otherwise self-explanatory. You do not need to write a lot, but it should be enough to convince your tutor that you understand what the code does. We may deduct up to 30% for uncommented and unclear code, but would prefer not to.

Problems with no points (0pt) will not be graded, but might appear on the exam in a similar form. For these, we will provide a reference solution after the submission deadline. If you find the reference solution unclear, ask about it on the forum or in in a tutorial.

Problem 3.1 (Medical Bayesian Network 2)

Both Malaria and Meningitis can cause a fever, which can be measured by checking for a high body temperature. We consider the following random variables for a given patient: 0pt

- Mal: The patient has malaria.
- Men: The patient has meningitis.
- HBT: The patient has a high body temperature.
- F: The patient has a fever.

1. Draw the corresponding Bayesian network for the above data using the algorithm presented in the lecture, assuming the variable order Mal, Men, HBT, F. Explain rigorously(!) the exact criterion for whether to insert an arrow between two nodes.
2. Which arrows are causal and which are diagnostic? Which order of variables would be better suited for constructing the network?
3. How do we compute the probability the patient has malaria, given that he has a fever? State the query variables, hidden variables and evidence and write down the equation for the probability we are interested in.

Problem 3.2 (Stochastic Wumpus)

Robby lives in Wumpus world and wants to visit field F_1. He is pretty confident, that the Wumpus is not in field F_1; in fact, he is 90% sure. He thinks the Wumpus is probably in field F_2 with 60% confidence. Robby also thinks, that places without a Wumpus should rarely stink (in only 20% of cases), whereas every field with a Wumpus stinks. 70pt

Unfortunately, when Robbie approaches F_1, he notices a stench.

25 pt

1. Give that F_1 stinks, how should Robbie update his belief that the Wumpus is not in F_1? How does the probability change, that it is in F_2?

35 pt

2. Just to be sure, Robbie takes a slight detour to F_2 and notices that it stinks there as well. Given this new piece of information, how should Robbie update his beliefs, that a) the Wumpus is in F_2 and b) he is not in F_1?

10 pt

3. Which random variables in this example are conditionally independent given which other random variable?

Note that F_1 and F_2 are **not** the only fields that exist; so e.g. If the Wumpos isn't in F_1,that does not imply that it is in F_2.