Artificial Intelligence 2 – SS 2020
Assignment 4: More Bayesian Networks
– Given May 15., Due May 24. –

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 4.1 (Medical Bayesian Network) 70pt

Dyspnea (shortness of breath) can be caused by several medical conditions; among them lung cancer, tuberculosis and bronchitis. Tuberculosis and cancer lead to abnormal x-ray results. Lung cancer and bronchitis can be caused by smoking, tuberculosis occurs more often in asia. We use the following random variables for some given patient:

- *Asia*: The patient recently visited asia.
- *Smoke*: The patient is a smoker.
- TBC: The patient has tuberculosis.
- LC: The patient has lung cancer.
- *Bron*: The patient has bronchitis.
- $Xray$: The patient's X-ray result is abnormal.
- *Dysp*: The patient is short of breath.

50 pt

1. Model the dependencies stated above as a bayesian network, choosing a suitable(!) ordering of the variables. **Justify** your choices. 10 pt
2. Are there any deterministic nodes in the network? Explain. 10 pt
3. Could you say that some nodes are noisy? Which ones and why?

Problem 4.2 (Expected Utility) 0pt

1. What is the formal(!) definition of *expected utility*? Explain every variable in the defining equation.
2. What is the principle of maximum expected utility?