HOCHSCHULE BONN-RHEIN-SIEG

PMR, Quiz 04

SUMMER SEMESTER 2018

1. Answer the following questions:

   (a) Write down the specification of a Bayesian network.

   (b) What does a Bayesian network represent?

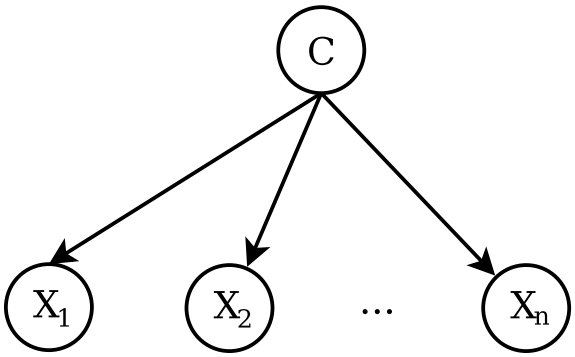
   (c) When creating a Bayesian network, how do we decide which variables should be parents of other variables?

   (d) What is the main benefit of representing probability distributions as Bayesian networks?

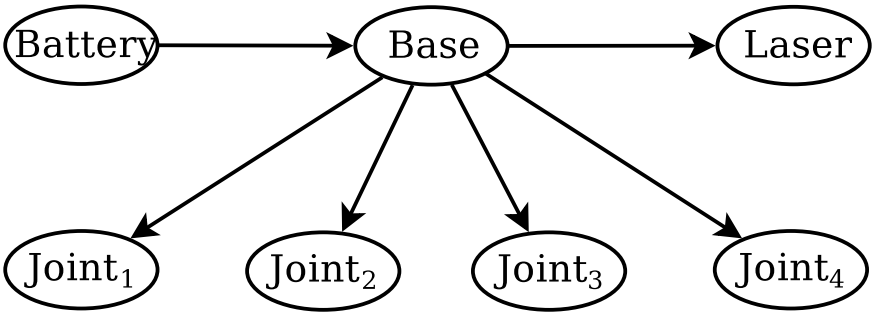
   (e) Write down the law of total probability (the conditioning rule).

2. Suppose that we have a simple differential drive robot that moves around in a known environment, using visual odometry for estimating its position. The quality of the estimate of the visual odometry depends on the robot's camera; if the camera is working, the visual odometry gives a correct estimate of the robot's position, while if the camera is not working, the estimate is likely to be wrong. The default action that our robot performs is moving in a straight line, but if the position estimate indicates that the robot is approaching an obstacle, the robot will turn either to the left or to the right, depending on where the obstacle is. Whether the robot crashes into an obstacle thus depends not only on whether the position estimate is correct, but also on whether the motors controlling the left and right wheels are working. Draw a Bayesian network that describes this problem.

3. Write down the joint probability distribution of the following Bayesian network:



4. Let's consider the simplified youBot diagnosis network from the assignment:



Assuming that the variable $Battery$ takes the values { empty, full } and all other variables take the values { working, not working }:

(a) how many parameters are required for describing the probability distribution represented by the network?

(b) how many parameters would we need if $Battery$ was also a parent of $Joint_{1:4}$?

Justify your answers.
