

Weekly Exercises 2

Room: 02.09.023

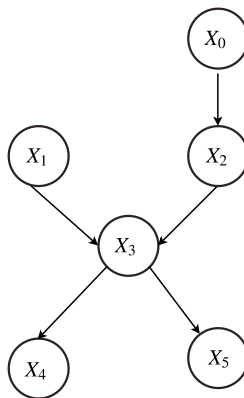
Wednesday, 22.05.2019, 12:15 - 14:00

Bayesian Network

(12+6 Points)

Exercise 1 (4 Points). Given two boolean random variable X and Y , (*i.e.* each can only be true (1) or false (0)). Show that if $X = 0$ is independent to $Y = 0$, we have X and Y are independent.

Exercise 2 (4 Points). Given following Bayesian network:



1. Give the factorization of $p(x_0, x_1, x_2, x_3, x_4, x_5)$.
2. Assume the observation is $\{X_4\}$, give reachable nodes of $\{X_0\}$ via active trail.
3. Assume the observation is $\{X_0\}$, give reachable nodes of $\{X_2\}$ via active trail.

Exercise 3 (4 Points). Given three boolean random variables X , Y and Z , is it possible to find a perfect map for following distribution:

$$p(x, y, z) = \begin{cases} \frac{1}{12} & x \oplus y \oplus z = \text{false} \\ \frac{1}{6} & x \oplus y \oplus z = \text{true} \end{cases} \quad (1)$$

where \oplus is the XOR function. Explain why or draw the corresponding perfect map.

Exercise 4 (6 Points). For a directed graph $\mathcal{G} = (\mathcal{V}, \mathcal{E})$, assume that the max indegree is 2 (*i.e.* any node has maximum 2 parents). Given an observation set Z and a random variable Y , figure out an algorithm to find the reachable nodes of Y via active trail in this graph.

Hint: First of all, assume there is no v-structure in the graph, what should we do? Then include the v-structure, what kind of preprocessing do we have to do?

Programming (Due:27.05)

(12Points)

Exercise 5. In this programming exercise, you are asked to implement an algorithm to find reachable nodes via active trail in a directed graph. See the ipython file for more details.