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Machine Learning for Robotics and Computer Vision
Summer term 2013

Homework Assignment 3
Topic: Graphical Models
Tutorial November 29th, 2013

Exercise 1: Reading a graphical model

We have the following graphical model:

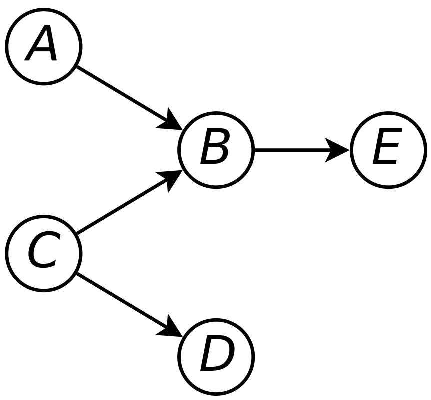


Figure 1: Graphical model.

a) Write the joint probability distribution corresponding to Fig. 1.

b) What are the conditional independence assumptions of this model?

c) Which of the following assertions are true, and why?

- B is d-separated from D by C,
- A is d-separated from C by E,
- A is d-separated from C by D,
- E is d-separated from D by B,
- E is d-separated from D by A.

Exercise 2: Writing a graphical model

We have a robot with a camera in a corridor with several offices. The robot has a map of the environment and we want it to bring the coffee to some goal door. The robot is able to stop in front of a door, to move to the next/previous door, and to knock at the door. The doors are not different from one other but there are big red doors at the end of the corridor. We arrange so that the camera always looks at those doors and we use their apparent size to estimate the location of the robot (the larger the doors appear, the closest from them we are).

We denote as O_t the observed size of the doors at time t; S_t and S_{t+1} the location of the robot at times t and $t+1$; and A_t the action to be taken by the robot at time t. Additionally we have contextual variables that are assumed to stay constant during a trial: M the map of the environment, and G the goal location.

a) Which variables are observed (known)?

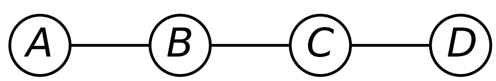
b) What should be the conditional independence assumptions for this model?

c) Deduce the joint probability distribution.

d) Draw the graphical model associated.

Exercise 3: Markov Chain

We have the following Markov Chain:



a) Write the joint probability distribution associated to this Markov Chain.

b) Each variable can take value 0 or 1, and we want to express that it is 9 times more probable that neighboring variables have equal values than they have different value. Give the potentials functions of this Markov Chain.

c) Compute the probability distributions $p(A)$ and $p(C)$.

d) Now, we observe that D is 1, recompute the distributions over A and C: $p(A \mid [D = 1])$ and $p(C \mid [D = 1])$.

e) Compute $p(C \mid [A = 0], [D = 1])$.

The next exercise class will take place on **June 21st, 2013**.

For downloads of slides and of homework assignments and for further information on the course see

`http://vision.in.tum.de/teaching/ws2013/ml_ws13`
