Advanced Machine Learning

# Homework Assignment 1: Graphical models

Deadline December 8

This is a group assignment. Each group has to submit a pdf document with their answers. Please put your names and group number at the top of document.

For questions concerning the homework assignments use the Discussion Forum on Blackboard!

For all the exercises: Clearly explain how you calculated the answers.

Exercise 1 [10 points]
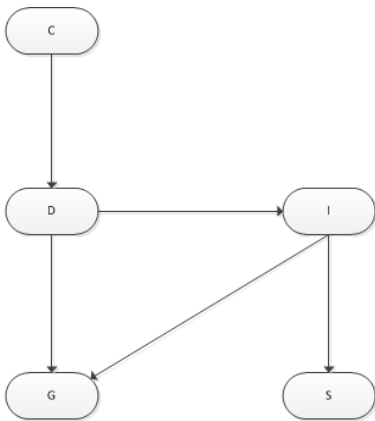
Consider the above Bayesian Network with the Conditional Probability Distributions (CPDs) given as follows:

C:

C	c0	c1
	0.3	0.7

D:

D	d0	d1
c0	0.1	0.9
c1	0.7	0.3

I:

I	i0	i1
d0	0.6	0.4
d1	0.9	0.1

G:

G	g0	g1	g2
d0,i0	0.3	0.2	0.5
d0,i0	0.4	0.2	0.4
d1,i0	0.4	0.3	0.3
d1,i1	0.6	0.3	0.1

S:

S	s0	s1
i0	0.2	0.8
i1	0.7	0.3

Part a:

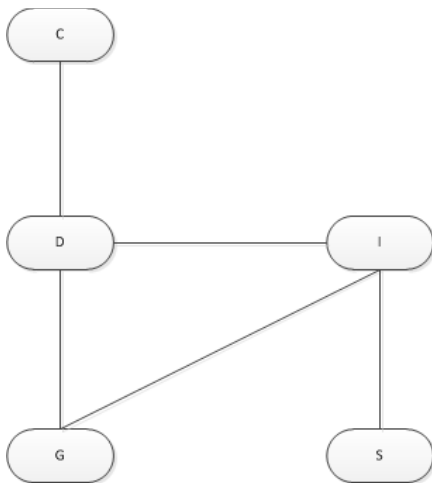Compute the probability distribution P(G)

Part b:

Compute the conditional probability distribution P(S|C=c0)

Part c:

Compute the conditional probability distribution P(D|G=g2)

Exercise 2 [10 points]

Now we model the above example as a Markov network

With the different factors given by

C:

C	c0	c1
	3	10

D:

D	d0	d1
c0	1	9
c1	7	3

I:

I	i0	i1
d0	14	6
d1	18	2

G:

G	g0	g1	g2
d0,i0	6	3	21
d0,i0	12	9	9
d1,i0	12	6	12
d1,i1	18	9	3

S:

S	s0	s1
i0	8	32
i1	24	16

Part a:

Compute the factor $\Phi(G)$ and the corresponding probability function P(G).

Part b:

Compute the conditional factor $\Phi(S|C=c1)$

Part c:

Compute the conditional factor $\Phi(D|G=g2)$ and the corresponding probability function

Exercise 3 [10 points]

For the previous exercise answer part a up to and including c using message passing. Clearly explain the message passing for this particular example.