

Homework # 7

Due Monday Dec 3 at 4pm.

NAME: _____

Signature: _____

STD. NUM: _____

Email: _____

General guidelines for homeworks:

You are encouraged to discuss the problems with others in the class, but all write-ups are to be done on your own.

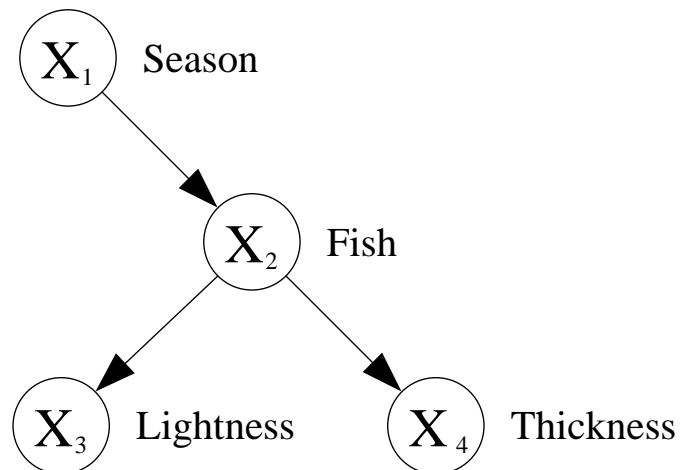
Homework grades will be based not only on getting the “correct answer,” but also on good writing style and clear presentation of your solution. It is your responsibility to make sure that the graders can easily follow your line of reasoning.

Try every problem. Even if you can't solve the problem, you will receive partial credit for explaining why you got stuck on a promising line of attack. More importantly, you will get valuable feedback that will help you learn the material.

Please acknowledge the people with whom you discussed the problems and what sources you used to help you solve the problem (e.g. websites, books from the library). This won't affect your grade but is important as academic honesty.

When dealing with Matlab exercises, please attach a printout with all your code and show your results clearly.

1. Inference in Graphical models:



Consider the graphical model shown above. Here, the nodes represent the following variables

$$X_1 \in \{\text{winter, spring, summer, autumn}\}$$

$$X_2 \in \{\text{salmon, sea bass}\}$$

$$X_3 \in \{\text{light, medium, dark}\}$$

$$X_4 \in \{\text{wide, thin}\}$$

The corresponding conditional probability tables are

$$p(x_1) = (.25 \ .25 \ .25 \ .25)$$

$$p(x_2|x_1) = \begin{pmatrix} .9 & .1 \\ .3 & .7 \\ .4 & .6 \\ .8 & .2 \end{pmatrix}$$

$$p(x_3|x_2) = \begin{pmatrix} .33 & .33 & .34 \\ .8 & .1 & .1 \end{pmatrix}$$

$$p(x_4|x_2) = \begin{pmatrix} .4 & .6 \\ .95 & .05 \end{pmatrix}$$

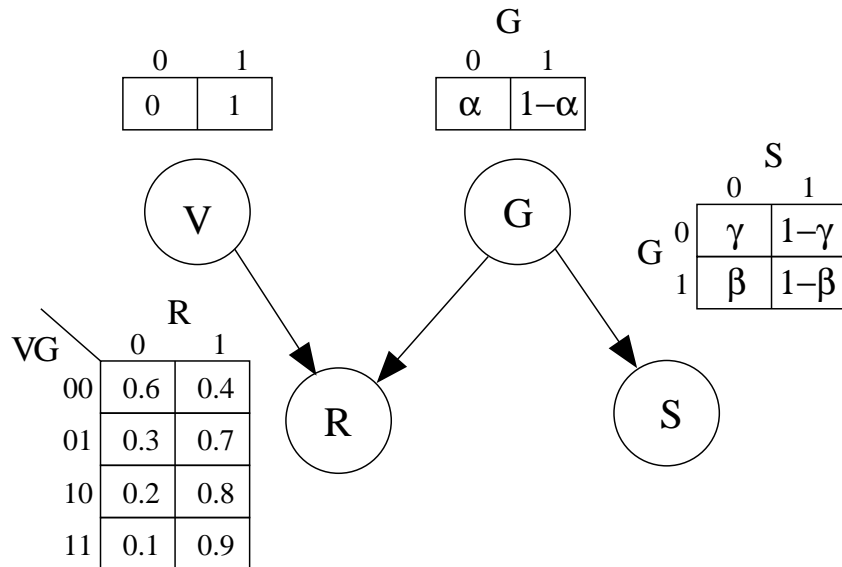
Answer the following questions by hand. You should also verify the answers using the Junction Tree Algorithm (and hand in the code) as follows:

- Download the Bayes Net toolbox of Kevin Murphy from <http://www.cs.ubc.ca/~murphyk/Software>
- Familiarise yourself with the software by reading the usage instructions file and the tutorial at: <http://bnt.sourceforge.net/usage.html>

- (a) Suppose the fish was caught on December 20 — the end of autumn and the beginning of winter — and thus let $p(x_1) = (.5 \ 0 \ 0 \ .5)$. Suppose the lightness has not been measured but it is known that the fish is thin. Classify the fish as salmon or sea bass.

- (b) Suppose all we know is that the fish is thin and medium lightness. What season is it now, most likely?

2. **Parameter Learning:** In this question you must model a problem with 4 binary variables: G = "gray", V = "Vancouver", R = "rain" and S = "sad". You are given the following graphical model describing the relationship between these variables:



and the following data:

V	G	R	S
1	1	1	1
1	1	0	1
1	0	0	0

(a) Write down the expressions for the following binomial probabilities:

$$p(G|\alpha) \propto$$

$$p(S|G = 1, \beta) \propto$$

$$p(S|G = 0, \gamma) \propto$$

(b) Write down the values (estimated from the data) for the following quantities:

$$\alpha =$$

$$\beta =$$

$$\gamma =$$