Homework 3

ECE/CS 4720-7720 Machine Learning and Pattern Recognition

Question 1.

Problem 27 on page 72, chapter 2 of Duda's textbook.

Question 2

Solve by hand (turn it also in), and then write a program to evaluate the Bayesian belief net for fish in Example 3 of the textbook, including the information in $P(x_i|a_j)$, $P(x_i|b_j)$, $P(c_i|x_j)$, and $P(d_i|x_j)$.

Test your program on the calculation given in that same Example.

Then, apply your program to the following cases, and state any assumptions you need to make.

(a) A light, thin fish is caught in the South Atlantic in the Winter. What is the probability it is a salmon?

(b) A thin, dark fish is caught in the South Atlantic. What is the probability it is winter? spring? summer? autumn?

(c) A dark, wide fish is caught in the Summer. What is the probability it came from the North Atlantic?

HW3 Solution Key

THE MAIN FUNCTION CAN BE CALLED USING ANY COMBINATION OF 'a1', 'a2', ... 'b1', 'winter', 'summer', 'thin', 'c1', etc... (and in any order)

For example:

pabxcd_cond_abxcd('winter'); ⟹ P(a2)

pabxcd_cond_abxcd('salmon', '1', 'winter') ⟹ P(x1|a2)

pabxcd_cond_abxcd('salmon', '1', 'thin', 'dark') P(x1|d2,c2)

File: /home/gdesouza/Classes/ece7720_S18/Code/pabxcd_cond_abxcd.m   #1

function ret = pabxcd_cond_abxcd(varargin)

The second function is used to actually calculate P(a,b,x,c,d). Please, notice that nested loops are **not** required.

File: /home/gdesouza/Classes/ece7720/Code/pabxcd.m   #1

function ret = pabxcd(a,b,x,c,d)

This loop is simply because Matlab doesn't multiply 3D matrices.

The last function is not really necessary. I used it only to scan the input and also to find and to sort the possible linguistic terms (e.g. 'winter' 'a1', 'b1', 'thin', etc...).

That is: The only purpose of this function is to allow the main function (1st one) to be called w/ variable # of parameters and in any order
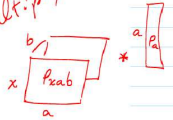
File: /home/gdesouza/Classes/ece7720/Code/scaninput.m   #1

function [a,b,x,c,d,ca,cb,cx,cc,cd] = scaninput(varargin)
% This function scans the input parameters and convers from
%   'winter' to 'a1', 'salmon' to 'x1', 'thin' to 'd2', etc...
% If the input parameters are already 'a1', 'x1', etc..., then it
%   just keeps them as they are.

This is just a few examples of the program being called.

File: /home/gdesouza/Classes/ece7720/Code/hw3.m   #1

```
% Main program -- test

clear all

global pa pb pxab pcx pdx

pa=[0.25;0.25;0.25;0.25];
pb=[0.6;0.4];
pxab(:,:,1)=[0.5 0.6 0.4 0.2; 0.5 0.4 0.6 0.8];
pxab(:,:,2)=[0.7 0.8 0.1 0.3; 0.3 0.2 0.9 0.7];
pcx=[0.6 0.2; 0.2 0.3; 0.2 0.5];
pdx=[0.3 0.6; 0.7 0.4];

% Ex. on Page 59
pabxcd_cond_abxcd('summer', 'north', 'sea', 'dark', 'thin')   %   P(a3,b1,x2,c3,d2) = 0.018

% Ex. on Page 61
pabxcd_cond_abxcd('x1','b2','c1')                 %   P(x1,c1,b2) = alpha*0.114
pabxcd_cond_abxcd('c1','b2','x2')                 %   P(x2,c1,b2) = alpha*0.042

pabxcd_cond_abxcd('south','light')               %   P(c1,b2) = alpha = 0.156

pabxcd_cond_abxcd('x1','|','b2','c1')             %   P(x1|c1,b2) = P(x1,c1,b2)/P(c1,b2) = 0.73
pabxcd_cond_abxcd('x2','|','b2','c1')             %   P(x2|c1,b2) = P(x2,c1,b2)/P(c1,b2) = 0.27

% HW question 2 on Page 81 - Ex.9a
pabxcd_cond_abxcd('salmon','|','dark','thin','north','summer')

% HW question 2 on Page 81 - Ex.9b

% HW question 2 on Page 81 - Ex.9c
```

initialization of the Network

Figure 1: Solution for Question 2

Above is my solution (blacked out) ;-) just to give you an idea of how long you should expect the Matlab code to be. **You do NOT have to do it in Matlab.** Again, this is just to give you an idea of the complexity, or should I say "how easy" this problem is. ;-)