Do not show the text formatted in this way!

It is very similar to the exam question!
I changed the numebers

Consider now the following training set (X_i, Y_i): We run a linear regression on

i	1	2	3	4
X	3	2	6	8
Y	3	2	3	2

this data (using the model $Y = w_0 + w_1 X$). (*Hint: by symmetry it is clear that the best fit to the three data points is a vertical line.*)

(a) What is the sum of squared estimate of errors (SSE)?

(b) What is the mean of squared estimate of errors (MSE)?

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You have just acquired the following training set (x_1, x_2, y) in the following order:

Data ID	1	2	3	4
y	+1	-1	+1	-1
x_1	3	1	12	0
x_2	4	1	6	-1

(a) Define the perceptron weight update rule for the following data.

(b) Show the actions of the perceptron algorithm for the above ordered sequence of observations. You should start with an initial set of weights $(\theta_1, \theta_2) = (1, 1)$ and bias $\theta_0 = 0$. and learning rate equal to 1.

Please check the maths, but it should be correct!

(a)

$$\theta_0^{(j+1)} \leftarrow \theta_0^{(j)} + y^i;$$
$$\theta_1^{(j+1)} \leftarrow \theta_1^{(j)} x_1^i;$$
$$\theta_2^{(j+1)} \leftarrow \theta_2^{(j)} x_2^i.$$

Please note that other possible symbols to show the update of the index are correct such as: $[\leftarrow, :=]$

(b) Here each iteration of the algorithm

(i)

$g^1 = +1(3 + 4 + 0) > 0$ True $\rightarrow$ no update
$(\theta_1^1, \theta_2^1) = (1, 1)$
$\theta_0^1 = 0.$

(ii)

$g^2 = -1(1 + 1 + 0) > 0$ False $\rightarrow$ update
$(\theta_1^2, \theta_2^2) = (1, 1) - (1, 1) = (0, 0)$
$\theta_0^1 = 0 - 1 = -1.$

(iii)

$$g^3 = +1(+0 + 0 - 1) > 0 \text{ False} \rightarrow \text{update}$$
$$(\theta_1^3, \theta_2^3) = (0, 0) + (12, 6) = (12, 6)$$
$$\theta_0^3 = -1 + 1 = 0$$

(iv)

$$g^4 = -1(+0 - 6 + 0) > 0 \text{ True} \rightarrow \text{no update}$$
$$(\theta_1^4, \theta_2^4) = (12, 6)$$
$$\theta_0^4 = 0$$

You can use this exercise,

But do not use the same wording , take the image maybe write the text in the slides…

Otherwise the students will figure out where I took the other exercises

Please add the question:

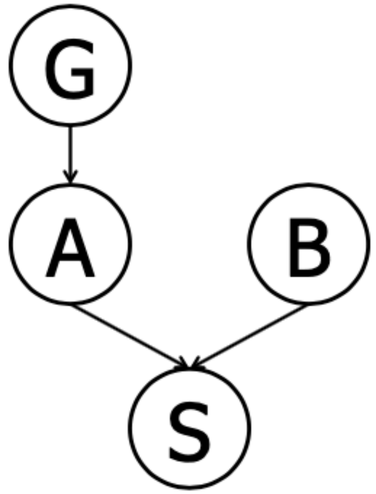
Create a the bases decision tree!

And remove the bases decision tree inside the question

Suppose that a patient can have a symptom (S) that can be caused by two different diseases (A and B). It i that the variation of gene G plays a big role in the manifestation of disease A. The Bayes' Net and corres conditional probability tables for this situation are shown below. For each part, you may leave your answ arithmetic expression.

$\mathbb{P}(G)$	
$+g$	0.1
$-g$	0.9

$\mathbb{P}(A\|G)$		
$+g$	$+a$	1.0
$+g$	$-a$	0.0
$-g$	$+a$	0.1
$-g$	$-a$	0.9



$\mathbb{P}(B)$	
$+b$	0.4
$-b$	0.6

$\mathbb{P}(S\|A,B)$			
$+a$	$+b$	$+s$	1.0
$+a$	$+b$	$-s$	0.0
$+a$	$-b$	$+s$	0.9
$+a$	$-b$	$-s$	0.1
$-a$	$+b$	$+s$	0.8
$-a$	$+b$	$-s$	0.2
$-a$	$-b$	$+s$	0.1
$-a$	$-b$	$-s$	0.9

(a) [2 pts] Compute the following entry from the joint distribution:

$\mathbb{P}(+g, +a, +b, +s) =$

$\mathbb{P}(+g)\mathbb{P}(+a|+g)\mathbb{P}(+b)\mathbb{P}(+s|+b,+a) = (0.1)(1.0)(0.4)(1.0) = 0.04$

(b) [2 pts] What is the probability that a patient has disease A?

$\mathbb{P}(+a) = \mathbb{P}(+a|+g)\mathbb{P}(+g) + \mathbb{P}(+a|-g)\mathbb{P}(-g) = (1.0)(0.1) + (0.1)(0.9) = 0.19$

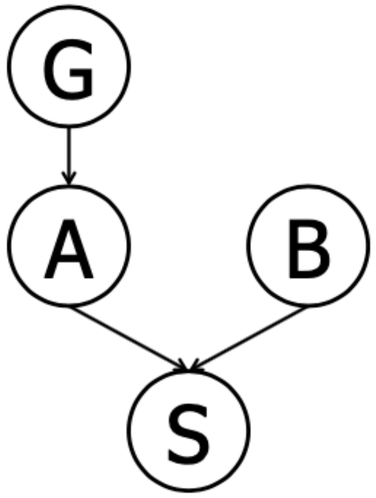
(c) [2 pts] What is the probability that a patient has disease A given that they have disease B?

$\mathbb{P}(+a|+b) = \mathbb{P}(+a) = 0.19$ The first equality holds true as we have $A \perp\!\!\!\perp B$, which inferred from the graph of the Bayes' net.

The figures and table below are identical to the ones on the previous page and are repeated here for your convenience.

$\mathbb{P}(G)$	
$+g$	0.1
$-g$	0.9

$\mathbb{P}(A\|G)$		
$+g$	$+a$	1.0
$+g$	$-a$	0.0
$-g$	$+a$	0.1
$-g$	$-a$	0.9



$\mathbb{P}(B)$	
$+b$	0.4
$-b$	0.6

$\mathbb{P}(S\|A,B)$			
$+a$	$+b$	$+s$	1.0
$+a$	$+b$	$-s$	0.0
$+a$	$-b$	$+s$	0.9
$+a$	$-b$	$-s$	0.1
$-a$	$+b$	$+s$	0.8
$-a$	$+b$	$-s$	0.2
$-a$	$-b$	$+s$	0.1
$-a$	$-b$	$-s$	0.9

(d) [4 pts] What is the probability that a patient has disease A given that they have symptom S and disease B?

$$\mathbb{P}(+a|+s,+b) = \frac{\mathbb{P}(+a,+b,+s)}{\mathbb{P}(+a,+b,+s)+\mathbb{P}(-a,+b,+s)} = \frac{\mathbb{P}(+a)\mathbb{P}(+b)\mathbb{P}(+s|+a,+b)}{\mathbb{P}(+a)\mathbb{P}(+b)\mathbb{P}(+s|+a,+b)+\mathbb{P}(-a)\mathbb{P}(+b)\mathbb{P}(+s|-a,+b)}$$
$$= \frac{(0.19)(0.4)(1.0)}{(0.19)(0.4)(1.0)+(0.81)(0.4)(0.8)} = \frac{0.076}{0.076+0.2592} \approx 0.2267$$

(e) [2 pts] What is the probability that a patient has the disease carrying gene variation G given that they have disease A?

$$\mathbb{P}(+g|+a) = \frac{\mathbb{P}(+g)\mathbb{P}(+a|+g)}{\mathbb{P}(+g)\mathbb{P}(+a|+g)+\mathbb{P}(-g)\mathbb{P}(+a|-g)} = \frac{(0.1)(1.0)}{(0.1)(1.0)+(0.9)(0.1)} = \frac{0.1}{0.1+0.09} = 0.5263$$

(f) [2 pts] What is the probability that a patient has the disease carrying gene variation G given that they have disease B?

$\mathbb{P}(+g|+b) = \mathbb{P}(+g) = 0.1$ The first equality holds true as we have $G \perp\!\!\!\perp B$, which can be inferred from the graph of the Bayes' net.

You have the following training set (X_i, Y_i), with $X_i \in \mathbb{R}$ and Y_i as categorial with only two values (A,B).

Do not show the text formatted in this way!

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i	1	2	3	4
X	4	8	2	10
Y	A	A	B	B

You myst learn the Maximum Likelihood Gaussian Bayes Classifier from this data. Calculate the correct values for:

(a) $\mu_A =$

(b) $\mu_B =$

(c) $\sigma_A^2 =$

(d) $\sigma_B^2 =$

(e) $P(Y = A) =$

(f) $P(Y = B) =$