Q1 1

20 Points

Design a two-input perceptron that implements the Boolean function

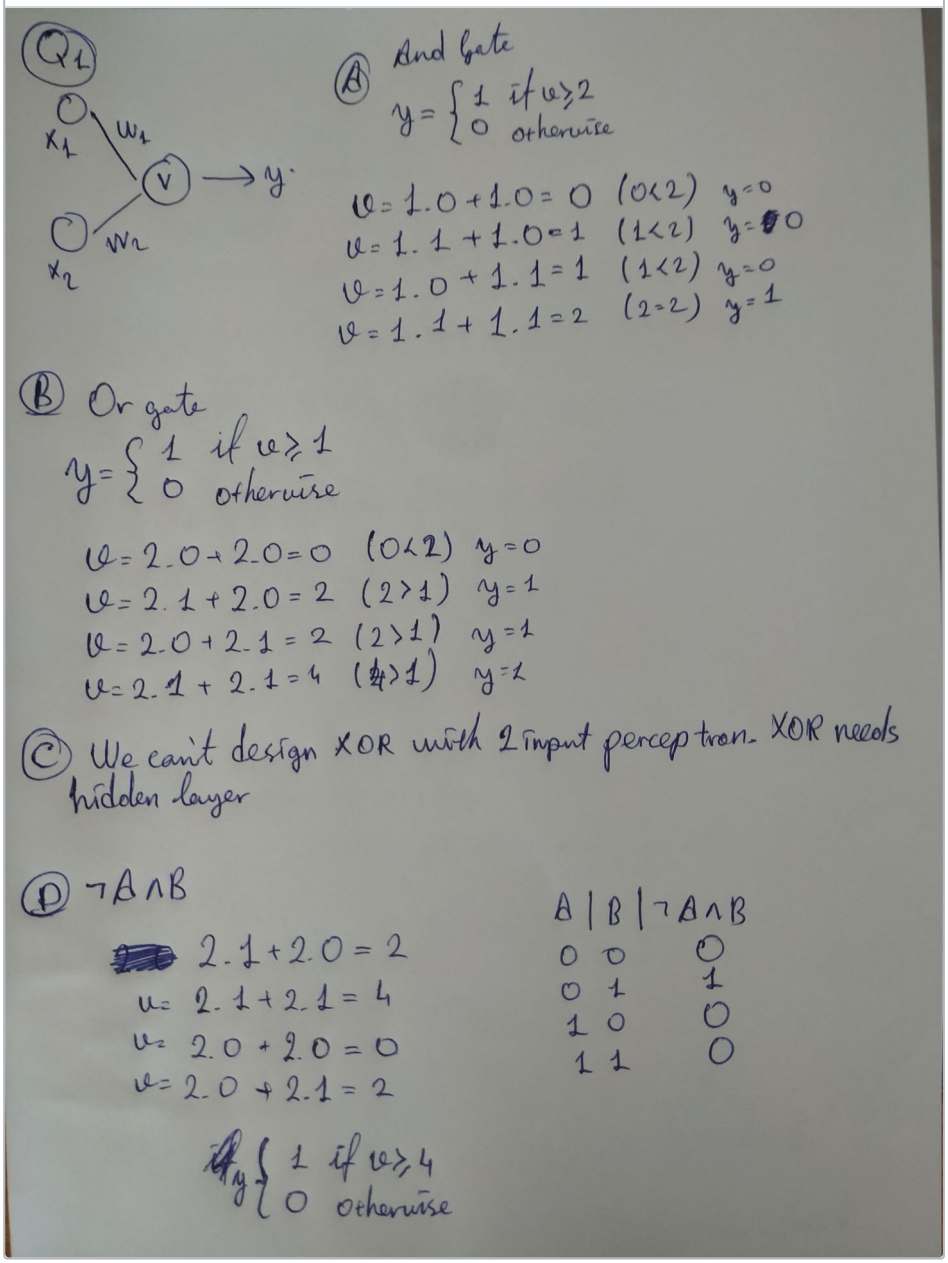
(a) AND

(b) OR

(c) XOR

(d) $\neg A \wedge B$

Q1.jpg Download



Q2 2

25 Points

A Naive Bayes classifier has to decide whether the document “cat dog” is news about the class a or class b.

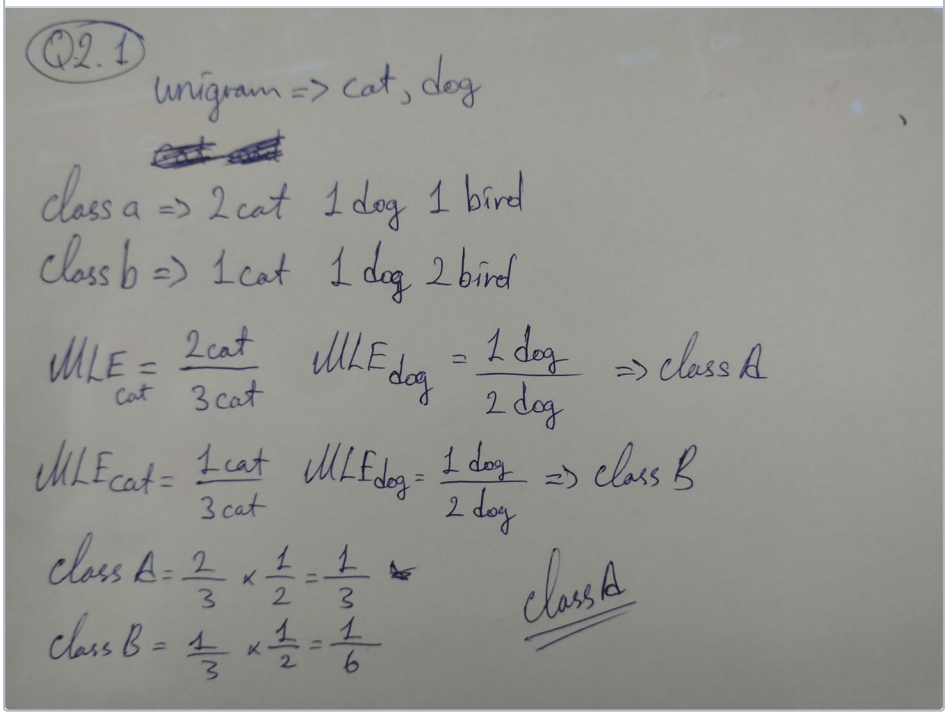
document	class
cat dog	a
bird cat	b
cat bird	a
bird dog	b

Q2.1 a

15 Points

Estimate the probabilities that are relevant for this decision from the following document collection using Maximum Likelihood estimation (without smoothing).

▾ Q21.jpg Download

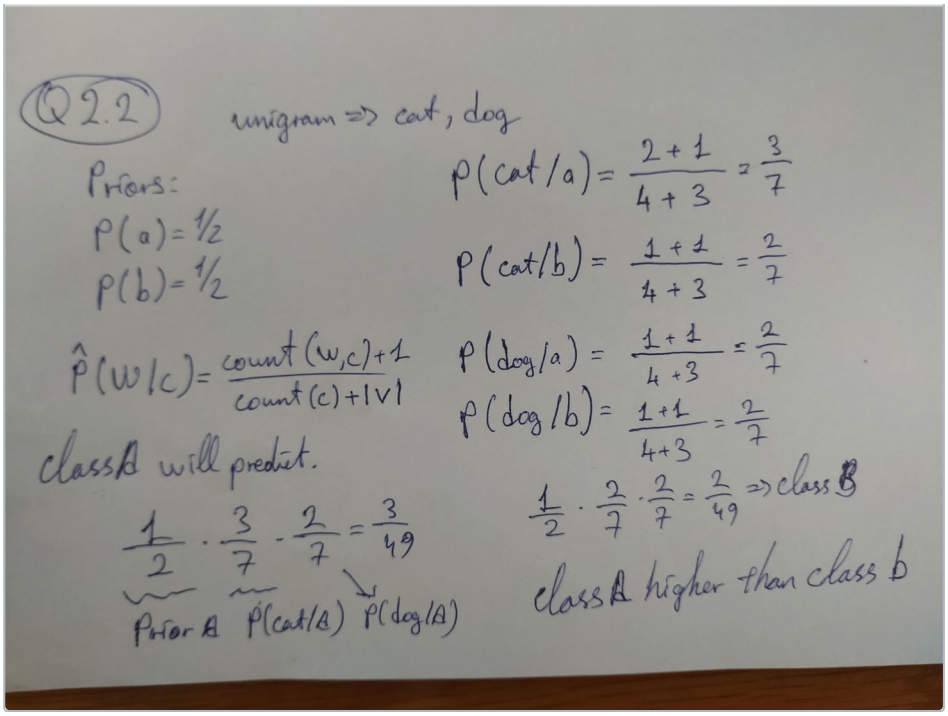


Q2.2 b

5 Points

Based on the estimated probabilities, which class does the classifier predict? Explain. (Show that you have understood the Naive Bayes classification rule.)

▾ Q22.jpg Download



Q2.3 c

5 Points

Practical implementations of a Naive Bayes classifier often use log probabilities. Explain why?

> Since the multiplied numbers are fractional numbers, log is used to avoid underflowing.

Q3 3

25 Points

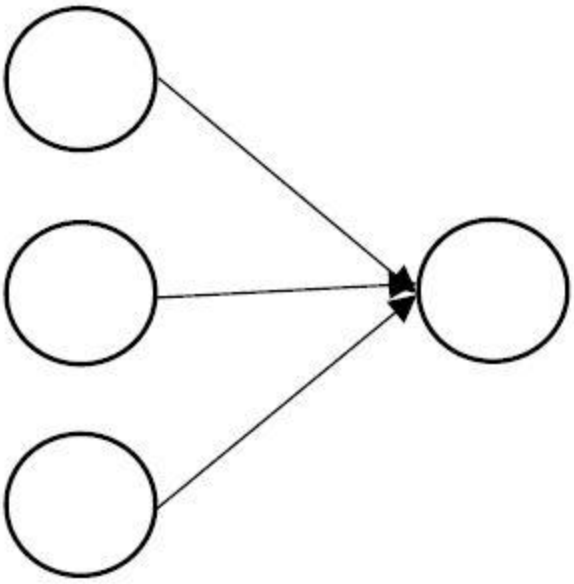
A neural network with three input neurons and 1 output neuron is given below.

Suppose that the output neuron uses an identity activation function, i.e., $z = f(z)$ where z is the total input to the neuron. Let d be the desired output and d=4, and let $E = -d\ logz - (1 - d)\log(1 - z)$ be the cross-entropy error. For the inputs (1,2,1) and weights (1,3,1), perform a forward pass to compute the output of the network and then apply backpropagation with gradient descent for one iteration.

Write down the weights after the forward pass and also after the backward pass separately. Learning rate $\mu = 10$.

Hint: The derivative of the identity function is simply 1. The derivative of the logarithm is given
below:

$$\frac{\partial log u}{\partial u} = \frac{1}{u} \qquad \frac{\partial \log (1-u)}{\partial u} = \frac{-1}{1-u}$$



Q3.1 1

5 Points

Forward pass

Q3.2 2

20 Points

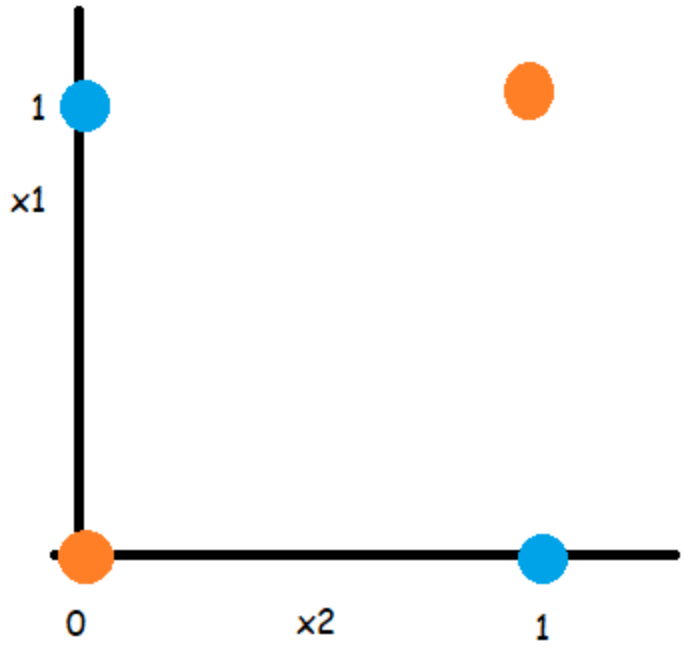
Backward pass (backpropagation)

No files uploaded

Q4

30 Points

A dataset with two attributes (x_1, x_2) and two classes (y=1 (blue) and y=-1 (orange))are given below.



Q4.1 1

10 Points

To classify the given dataset ($Score(x) = w_0 + w_1x_1 + w_2x_2$), can we use logistic regression with the given features? (Yes/No) Why? If Yes, show which weights we need to use for classification?

First) x1 = 1, x2 = 0 => w1 needs to be > 0.5 Second) x1 = 0, x2 = 1 => w2 needs to be > 0.5 LAST) x1 = 1, x2 = 1 => w1+w2 needs to be < 0.5 => impossible due to previous two cases

Q4.2 2

20 Points

If we add an extra feature to the model (x_1x_2), is it possible to classify the datasets? (Yes/No) Why? If Yes, show which weights we need to use for classification?

No, model need extra layer

Quiz3

GRADED

STUDENT
MEHMET TAHA USTA

TOTAL POINTS
25 / 100 pts

QUESTION 1

1		**20** / 20 pts

QUESTION 2

2		**5** / 25 pts
2.1	a	**0** / 15 pts
2.2	b	**0** / 5 pts
2.3	c	**5** / 5 pts

QUESTION 3

3		**0** / 25 pts
3.1	1	**0** / 5 pts
3.2	2	**0** / 20 pts

QUESTION 4

(no title)		**0** / 30 pts
4.1	1	**0** / 10 pts
4.2	2	**0** / 20 pts