Deep Learning CS583 Fall 2021
Quiz 2

November 30, 2021

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- **Read these instructions carefully**
- Fill-in your personal info, as indicated above.
- You have 24 hours.
- There are two questions. Each question worths the same (1 point).
- Both computer-typed and hand-writing in the very clear form are accepted.
- This is an open-book test.
- You should work on the exam only by yourself.
- Submit your PDF/Doc/Pages **by 12:30 Dec 1st** on Canvas under Final exam.

good luck!

1 Question

- Tell the difference between supervised and unsupervised learning.

Supervised learning is a type of dataset which also contains the labeled column in it, in other words it also contain the output of the input set and because of it model can measure its accuracy and improve overtime. Supervised learning can be separated in two types:-

- Classification
- Regression

Unsupervised learning is used to analyze and cluster unlabeled datasets. In other words in this dataset the output is not giving there is only input set and by using that it discovers the hidden pattern in data, and unsupervised learning is mainly used in three tasks:

- Clustering
- Association
- Dimensionality reduction

- Give the formula for the loss function used in multiclass classification problems (categorical cross-entropy).

The cross-entropy between two probability distribution, such as dog as "d" and cat as "c"
The cross-entropy is calculated as:

$$\text{Cross-entropy} = \sum_{x} x \, P(X) * \log(q(X))$$

It can also be stated as:

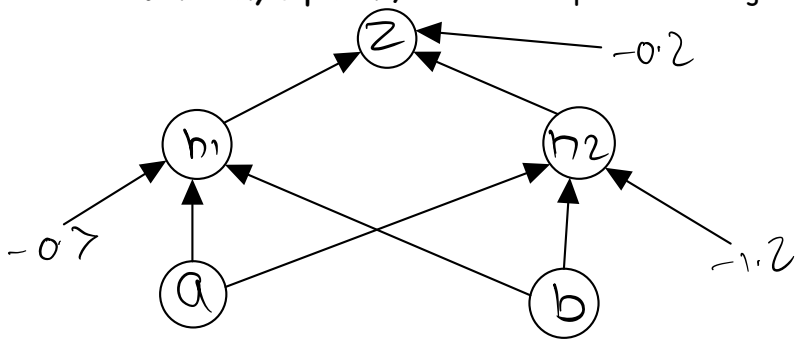
$$\text{cross-entropy} = -\text{sum } x \text{ in } X \; P(x) * \log(q(x))$$

- Is it possible to construct a single layer neural network with threshold activation func- tion implementing XOR of two bits? Construct a neural network implementing XOR.

No, it is not possible to construct a single layer neural network with threshold activation function that implement XOR of two bits as the classes ore not linearly separable, but we con implement it using two layer

XOR :-

A	B	Z
0	0	0
0	1	1
1	0	1
1	1	0



a	b	h_1	h_2	y
0	1	$\delta(0+0-0.7)=0$	$\delta(0+0-1.2)=0$	$\delta(0-0-0.2)=0$
0	0	$\delta(0+1-0.7)=1$	$\delta(0+1-1.2)=0$	$\delta(1-0-0.2)=1$
1	0	$\delta(1+0-0.7)=1$	$\delta(1+0-1.2)=0$	$\delta(1-0-0.2)=1$
1	1	$\delta(1+1-0.7)=1$	$\delta(1+1-1.2)=1$	$\delta(1-1-0.2)=0$

- Is it possible to construct a single layer neural network with threshold activation func- tion implementing addition of two bits?

Addition of two bits i.e binary addition is :-

0 + 0 = 0
0 + 1 = 1
1 + 0 = 1
1 + 1 = 0 (carry 1)

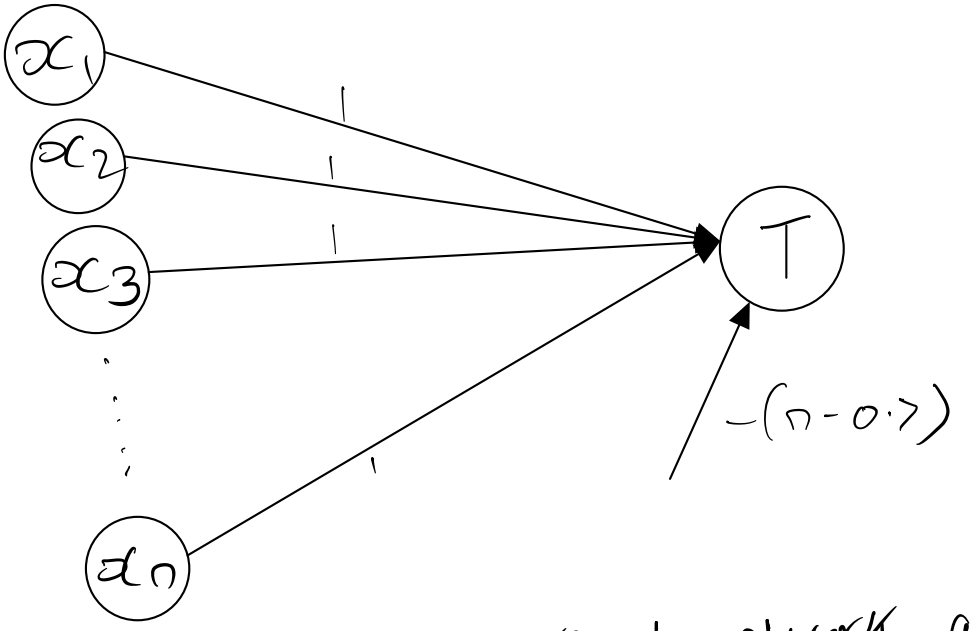
And as we can see it is same as XOR and as XOR can not be constructed using on single layer, we can say that it also cannot be implemented.

- Construct a single layer neural network (define architecture, activation function and give a vector of weights) with a single output implementing conjunction of n bits.

Truth table of conjuction :-

x_1	x_2	y
0	0	0
0	1	0
1	0	0
1	1	1

As we know the output of the And is 1 when all inputs are 1 else it is 0.



Here architecture is neural network, activation function is threshold function and weight vector is $[1, 1, 1, \ldots, 1]$ with bias $-n(-0.5)$