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# Assignment 1 Problems

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Neural Networks : Fall 1400 : Dr. Mozayani  
Due Friday, Aban 21, 1400

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## Problem 1

In this problem, we will be focusing on a single Artificial Neuron (a single unit from a neural network). In each part, you should check whether the given Boolean function can be represented by a single unit or not. If the answer is yes, you should state two weights and a threshold and show that with these parameters, the given Boolean function can be represented by a single unit (you have to write your calculations). If the answer is no, you should explain and state the reason. (10 pts)

(a)

| $x_1$ | $x_2$ | $y$ |
|-------|-------|-----|
| 0     | 0     | 1   |
| 0     | 1     | 0   |
| 1     | 0     | 0   |
| 1     | 1     | 1   |

(b)

| $x_1$ | $x_2$ | $y$ |
|-------|-------|-----|
| 0     | 0     | 1   |
| 0     | 1     | 1   |
| 1     | 0     | 1   |
| 1     | 1     | 0   |

## Problem 2

Construct an OR function for an ADALINE neuron. (Choose suitable initial weights, initial bias, and learning rate, and explain your reason.) (Write only four steps) (15 pts)

## Problem 3

In this section you have to do some research.

(a)

Explain the limitations of the Perceptron.

(b)

Explain Sigmoid, tanh, Softmax, ReLU and ELU activation functions and make a comparison between them.

(c)

Optimizers are algorithms or methods used to adjust the parameters of the neural network, such as weights to minimize the loss function. In the course, Gradient Descent and Stochastic Gradient Descent (SGD) were explained. Please explain the disadvantages of SGD and explain the following two optimization algorithms and compare them with SGD:

- SGD with momentum

- RMS-Prop

(For this question, you should search the topics. You can use websites like medium.com and towards-datascience.com) (25 pts)

## Problem 4

In this section, you should implement codes in python.

(a)

Write a python code that can determine the number of humans by asking only yes and no questions. There is some information about these people in the below table. (25 pts)

| Height | Weight | Eyes color | Hair color | Shoe size | Skin color | Number |
|--------|--------|------------|------------|-----------|------------|--------|
| 180    | 60     | black      | blond      | 42        | black      | 1      |
| 170    | 60     | black      | blond      | 42        | black      | 2      |
| 200    | 90     | green      | brown      | 43        | black      | 3      |
| 170    | 80     | brown      | black      | 45        | white      | 4      |
| 130    | 40     | blue       | blond      | 45        | white      | 5      |
| 190    | 60     | black      | black      | 41        | white      | 6      |
| 180    | 80     | brown      | black      | 40        | black      | 7      |
| 200    | 70     | green      | brown      | 41        | white      | 8      |
| 210    | 40     | green      | blond      | 40        | black      | 9      |
| 130    | 70     | blue       | brown      | 40        | black      | 10     |

(b)

In this question, you will learn to implement a simple Perceptron. Please download the dataset and the notebook and complete the desired sections. These sections are shown with the text "code here" in the comments. Also, there is a Bonus section that you can complete for extra points. (25 + 10 pts)

## Notes

- Codes should be implemented in .ipynb format (notebooks).
- All Code cells should be executed before turning in the assignment (Make sure your outputs are there before you submit your assignment).
- Please explain the code and the results in the notebook.
- If you have any questions, feel free to ask. You can ask your questions in the Telegram group.
- Please upload your assignments as a zipped folder with all necessary components. Upload your file in HW1\_NN\_Your Student ID\_Your Name.zip format.