Assignment 2

*****There are three different questions for Assignment 2. You can solve these questions manually or using any software program.**

1) Let x_1 and x_2 be the two input variables for the logical operation **OR.** The combinations of all variables are shown below to operate the **OR** gate.

Truth tables for the basic logical operations

Input variables		OR
x_1	x_2	$x_1 \cup x_2$
0	0	0
0	1	1
1	0	1
1	1	1

a) Construct two-input and one perceptron neural network model and use the following algorithm to estimate the weights of the network model. Initial weight values are +0.5 for w_1 (connected to the x_1) and +0.1 for w_2 (connected to the x_2). Learning rate is 0.01 and threshold (bias) is -0.1. Find the final weights for this model. Use step function as activation function.

Step 1: ***Initialisation***
Set initial weights $w_1, w_2, \ldots, w_n$ and threshold θ to random numbers in the range $[-0.5, 0.5]$.

Step 2: ***Activation***
Activate the perceptron by applying inputs $x_1(p), x_2(p), \ldots, x_n(p)$ and desired output $Y_d(p)$. Calculate the actual output at iteration $p = 1$

$$Y(p) = step\left[\sum_{i=1}^{n} x_i(p) w_i(p) - \theta\right],$$

where n is the number of the perceptron inputs, and *step* is a step activation function.

Step 3: ***Weight training***
Update the weights of the perceptron

$$w_i(p+1) = w_i(p) + \Delta w_i(p),$$

where $\Delta w_i(p)$ is the weight correction at iteration p.
The weight correction is computed by the **delta rule**:

$$\Delta w_i(p) = \alpha \times x_i(p) \times e(p)$$

Step 4: ***Iteration***
Increase iteration p by one, go back to Step 2 and repeat the process until convergence.

Note: Other parameters are up to you in this question such as number of iterations, etc.

2) *K means clustering* algorithm has been used to cluster the pixel values for the given input image. In this question, the algorithm has been used to detect the changes and unchanges pixels between two images (given below as *image A* and *image B* with 10x10 pixel values). The main purpose is to obtain whether there is a big difference between two pixel values at the same pixel coordinate or not. There are two steps to detect the changes and unchanges between two images which are:

a) *Subtract two images first to obtain the difference image*

Difference= |A-B| for each pixel coordinate in the images (|...| is shown as absolute value of the value)

b) After that, apply *K means clustering algorithm* to the difference image to obtain the changed pixels as 1 and unchanged pixels as 0.

Image A

154	157	157	157	150	150	170	170	175	190
154	157	157	151	153	155	180	180	170	190
154	157	150	154	160	160	160	155	155	165
157	157	148	148	148	160	150	155	155	165
100	102	104	157	142	180	170	165	10	20
100	103	105	165	155	180	175	162	40	50
100	102	108	132	180	180	172	167	25	63
18	28	48	12	13	20	5	15	30	40
15	36	46	18	21	22	28	32	30	36
17	21	24	26	35	45	28	30	40	20

Image B

152	156	157	156	149	150	170	160	175	190
154	159	157	151	153	155	180	180	170	190
153	157	155	154	160	160	160	155	155	165
157	157	148	148	148	160	150	155	155	165
101	102	104	159	143	180	170	165	110	220
99	103	105	164	155	179	175	162	240	250
100	102	108	132	180	180	172	167	155	163
118	123	148	129	109	120	155	215	140	180
156	136	210	218	175	122	128	232	180	156
178	231	245	226	215	145	188	230	170	140

3) Assume that we have five different crypto currency prices which they cannot be less than $0 and greater than $20.000. These prices were obtained and stored in each two hours in a day. However, some values were corrupted when they were stored. All stored prices are shown in the table below. Use K-means clustering method to cluster the prices into 6 different clusters and detect the corrupted prices (Anomaly detection).

- **a.** Write down the corrupted prices.
- **b.** Write down the maximum prices.
- **c.** Write down the minimum prices.
- **d.** After you used K-means clustering, write your conclusion about the results.
- **e.** If you use less than 6 clusters (e.g. 4), what would happen. Could you still detect the corrupted prices?

$7845, $778, 942, $143, $0.75, $7956, $810, $976, $146, $0.76, $8215, $825, $1002, $152, $0.78, $8542, $847, $1038, $157, $0.78, $8150, $100587, $807, $1015, $150, $0.72, 8386, $884, $101964, $1085, $138, $0.82, $8219, $827, $995, $158, $0.82, $7500, $745, $948, $135, $0.67, $9257, $901, $120967, $1154, $148, $0.72, $8553, $811, $1218, $175, $0.84

IMPORTANT

* The submission deadline of your results is ***13th of March until 23:00***. You can solve questions manually or use any software program.

*Please upload your document including **your answers (show how to solve the questions), your name** and **personal number** into the itslearning

* The outcome of your results will be **pass** or **fail**.