CMPG-765/CMPT- 465 Neural Networks and Learning Systems
Homework-4

There are two options for undergraduate students (1 and 2).
Graduate students shall start from 2)

Follow a sequence of steps

1) **Assignment for undergraduate students – Option 1 (you may get 100 points)**

a→c) → d)→e)→f)

2) **<u>Assignment for graduate students</u>**
and optional assignment for undergraduate students (instead of the one above)

b→c) → d)→e)→f) (you may get 130 points)

a) (**20 points**) Use the errorCorrectionRmse.m function, which is shared with you. Modify it by creating a dynamic array for accumulation of the RMSE values obtained on every single iteration. Also add plotting of the accumulated RMSE values right before returning to a calling program (right before the break statement in the 76th line).

b) (**50 points**) Design your own function utilizing the error-correction learning algorithm (you may follow slide 21 from the Lecture 5 class notes) for real-valued input and output in conjunction with the **tanh** activation function and stopping criterion based on RMSE. You may use m-language in Matlab or any high-level language. Create a dynamic array for accumulation of the RMSE values obtained on every single iteration. If you use Matlab then add also plotting of accumulated RMSE values right before returning to a calling program. Your function should return a weighting vector resulted from the learning process, the number of learning iterations, and an array containing all RMSE values. Your function should accept an array containing inputs and desired outputs, a tolerance threshold for RMSE and possibly an external starting weighting vector along with a parameter determining starting weights (random or external).

c) (**30 points**) Design a function for mapping a k-valued discrete inputs/output represented by integers {0, 1,…, k-1} onto the [-1, 1] interval. This function should divide the [-1, 1] interval into k subintervals $\underbrace{[-1,a_1),[a_1,a_2),...,[a_{k-2},a_{k-1}),[a_{k-1},1)}_{0 \quad 1 \quad ... \quad k\text{-}2 \quad k}$ (length of each one of them is $2/k$) and transform integers {0, 1,…, k-1} into real numbers in the middle of these subintervals. The example for k=8 is shown in slide 17 of Lectture-5.

d) (**20 points**). Design a short program to learn the following 4-valued input/output mapping using the error-correction learning rule with the RMSE criterion. Do not forget to transform integers into real numbers using a function designed in c)

x1	x2	x3	Output
0	2	1	0
1	2	3	1
2	1	3	2

Also design a small function to interpret the results (to transform them into integers {0, 1,…, *k*-1} depending on a subinterval where a corresponding output is located $[-1, a_1) \to 0;\ [a_1, a_2) \to 1;\ ...;\ [a_{k-2}, a_{k-1}) \to k-2;\ [a_{k-1}, 1) \to k-1$

e) (**20 points**) Run a program designed in d) 3 times for different values of a tolerance threshold. Do not forget that its value should not exceed $1/2k$ and in fact must be even smaller. Display neuron's outputs and their integer interpretation for each of these experiments.

f) (**10 points**) Write a technical report presenting your results (you may include test run screen shots there).

Turn in your source codes and a brief technical report