Q1: A Back-Propagation Neural Network is specified below, where the current weights of the neural network are: \( w_{13} = w_{34} = 1 \), \( w_{12} = w_{24} = 0.5 \) and the learning rate is 0.2. How would the neural network algorithm update the weights \( w_{24} \) and \( w_{34} \) for the training example (input \( X = 1 \), output \( Y = 0.5 \)) (Use one iteration only).

\[ \begin{align*}
X & \rightarrow a1 \\
a1 & \rightarrow a2, w_{12} \\
a3 & \rightarrow a4, w_{13} \\
a4 & \rightarrow Y, w_{24} \\
a2 & \rightarrow a3, w_{23} \\
a2 & \rightarrow a4, w_{24} \\
\end{align*} \]

Hint: \( e^{-0.5} = 0.606 \) and \( e^{-1} = 0.367 \)

Q2: Choose one branch only to solve:

(A) Write C++ program to perform the Perceptron Neural Network.

(B) Calculate the thresholds and weights for a Hopfield Network that is to learn the following three input vectors:

\[ X1 = [111] \quad X2 = [-1-1-1] \quad X3 = [-111]. \]

Q3: What is the main goal of use the following parameters? (Choose only five)

1- Euclidean Distance 2- Vigilance Parameter 3-Liner Function 4-Sigmoid Function 5-Learning Rate 6-Fitness Function.

Q4: Write a complete algorithm for Adaptive Resonance Theory (ART).
Q5: A kohonen self-organizing map (SOM) to be cluster two vectors Vector1=\((1 \ 1 \ 0)\) and Vector2=\((0 \ 0 \ 0)\). The maximum number of clusters to be formed is m=2 with learning rate \(\alpha = 0.5\) and the initial weight matrix are:
\[
\begin{bmatrix}
0.2 & 0.8 \\
0.6 & 0.4 \\
0.5 & 0.7
\end{bmatrix}
\]
Update its weights at each step (using one iteration only). (10 Marks)

Q6: Find the 5 bit number with the maximum number of 1s in its binary representation using Roulette-wheel selection in Genetic algorithm. Where crossover point is 2 and the initial population is: \(\text{(Use one iteration only)}\).

0 0 1 1 1  
0 0 0 1 1  
0 0 0 0 1  
1 1 1 1 1  

\(\text{(10 Marks)}\)

\textbf{BEST WISHES}