Lab Assignment No. 9

Q4. Write a python program to design a Hopfield Network which stores 4 vectors

Code:

```python
import numpy as np

class HopfieldNetwork:
    def __init__(self, num_neurons):
        self.num_neurons = num_neurons
        self.weights = np.zeros((num_neurons, num_neurons))

    def train(self, vectors):
        num_vectors = len(vectors)
        for vector in vectors:
            vector = np.reshape(vector, (self.num_neurons, 1))
            self.weights += np.dot(vector, vector.T) / num_vectors
            np.fill_diagonal(self.weights, 0)

    def recall(self, input_vector, max_iter=100):
        output_vector = np.copy(input_vector)
        for _ in range(max_iter):
            prev_output = np.copy(output_vector)
            output_vector = np.sign(np.dot(self.weights, output_vector))
            if np.array_equal(output_vector, prev_output):
                break
        return output_vector

network = HopfieldNetwork(4)

vectors = np.array([[1, 1, 1, 1],
                    [1, -1, 1, -1],
                    [-1, 1, -1, 1],
                    [-1, -1, -1, -1]])


network.train(vectors)

for vector in vectors:
    output = network.recall(vector)
    print("Input:", vector)
    print("Output:", output)
    print()
```

Output:

```
Input: [1 1 1 1]
Output: [1. 1. 1. 1.]

Input: [ 1 -1  1 -1]
Output: [ 1. -1.  1. -1.]

Input: [-1  1 -1  1]
Output: [-1.  1. -1.  1.]

Input: [-1 -1 -1 -1]
Output: [-1. -1. -1. -1.]
```