**Computational Intelligence *third* assignment**

**Mohammad ali farahat**

**97521423**

* 1. First point is that when we save an input into Hopfield network, the reverse of that input also saves into network. So, for saving this list: [ (1,1,1,1) , (-1,-1,-1,-1) , (1,1,-1,-1) , (-1,-1,1,1) ] , we only need to save (1,1,1,1) and (1,1,-1,-1), the others will save automatically and we don’t need to add them.

Therefore, answer is **YES**, we can save them all.

Here is calculation of weights matrix:

**Apply (1,1,1,1)**

|  |  |  |  |
| --- | --- | --- | --- |
| **X** | **0** | **0** | **0** |
| **0** | **X** | **0** | **0** |
| **0** | **0** | **X** | **0** |
| **0** | **0** | **0** | **X** |

|  |  |  |  |
| --- | --- | --- | --- |
| **X** | **1** | **1** | **1** |
| **1** | **X** | **1** | **1** |
| **1** | **1** | **X** | **1** |
| **1** | **1** | **1** | **X** |

|  |  |  |  |
| --- | --- | --- | --- |
| **X** | **1** | **1** | **1** |
| **1** | **X** | **1** | **1** |
| **1** | **1** | **X** | **1** |
| **1** | **1** | **1** | **X** |

|  |  |  |  |
| --- | --- | --- | --- |
| **X** | **2** | **0** | **0** |
| **2** | **X** | **0** | **0** |
| **0** | **0** | **X** | **2** |
| **0** | **0** | **2** | **X** |

**Apply (1,1,-1,-1)**

in the next page I’m going to test network and find energy of each input to see if it is stable or not.

(1,1,1,1) --> 0 + 2 + 0 + 0 = 2 🡺 1  
2 + 0 + 0 + 0 = 2 🡺 1  
0 + 0 + 0 + 2 = 2 🡺 1

**STABLE**

0 + 0 + 2 + 0 = 2 🡺 1(-1,-1,-1,-1) --> 0 -2 + 0 + 0 = -2 🡺 -1  
-2 + 0 + 0 + 0 = -2 🡺 -1  
0 + 0 + 0 -2 = -2 🡺 -1

**STABLE**

0 + 0 -2 + 0 = -2 🡺 -1

(1,1,-1,-1) --> 0 + 2 + 0 + 0 = 2 🡺 1  
2 + 0 + 0 + 0 = 2 🡺 1  
0 + 0 + 0 -2 = -2 🡺 -1

**STABLE**

0 + 0 -2 + 0 = -2 🡺 -1

(-1,-1,1,1) --> 0 + 2 + 0 + 0 = -2 🡺 -1  
-2 + 0 + 0 + 0 = -2 🡺 -1  
0 + 0 + 0 + 2 = 2 🡺 1

**STABLE**

0 + 0 + 2 + 0 = 2 🡺 1All of them are stable, so we are finished.

* 1. In this question we are going to implement simple Hopfield network, and save 2 inputs in it. And after that we show that inputs are stable.
* My Hopfield class have two methods: Save() , CheckInput()

Save method is used to save input list into network, and CheckInput is used to check if an input is stable or not and if input was unstable tell us nearest saved data.

* We could also find nearest stable data in a loop, but for this example we don’t need more depth to find it, one is enough.
* If we input pattern (-1,1,1,-1,-1,-1), our network finds nearest stable pattern to it, and as shown in output, it is :  
  (1,1,1,-1,-1,-1)
* Code is also clear and commented for better understanding.
* Output should look like this:

