Neural Network’s Project

# Hopfield Network

## Tests Report

By

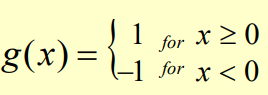
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# Introduction

All the tests were done on a Bipolar Hopfield Network in synchronous mode.

Bipolar function of the below manner is used:



## Test for Vectors of size 2

### Result A)

Vector 0: [ 1, -1 ] or Vector 0: [ 1, 1 ] or Vector 0: [ -1, 1 ] or Vector 0: [ -1, -1 ]

Vector 1: [ -1, -1 ] Vector 1: [ 1, -1 ] Vector 1: [ 1, 1 ] Vector 1: [-1, 1]

Vector 0: [ -1, -1 ] or Vector 0: [ 1, -1 ] or Vector 0: [ 1, -1 ] or Vector 0: [ 1, 1 ]

Vector 1: [ 1, -1 ] Vector 1: [ -1, -1 ] Vector 1: [ 1, 1 ] Vector 1: [ -1, 1 ]

Hopfield Matrix:

[0 0

0 0]

After testing with all combinations of { 1 , -1 }

The network converged to [ 1, 1 ] with 1 to 2 iterations without entering a cycle of length 2.

### Result B)

Vector 0: [ -1, -1 ] or Vector 0: [ 1, 1 ] or Vector 0: [ 1, 1 ] or Vector 0: [ -1, -1 ]

Vector 1: [ -1, -1 ] Vector 1: [ 1, 1 ] Vector 1: [ -1, -1 ] Vector 1: [ 1, 1 ]

Hopfield Matrix:

[0 2

2 0]

Test vector: [ 1, -1 ]

Resulted in two vector loop with:

Result A : [ 1, -1 ] and Result B: [ -1, 1 ]

Test vector: [ 1, 1 ]

Resulted in convergence to Vector 0 = [ 1, 1 ] in 1 iteration.

Test vector: [ -1, 1 ]

Resulted in two vector loop with:

Result A : [ -1, 1 ] and Result B: [ 1, -1 ]

Test vector: [ -1, -1 ]

Resulted in convergence to Vector 0 = [ -1, -1 ] in 1 iteration.

### Result C)

Vector 0: [ -1, 1 ] or Vector 0: [ 1, -1 ] or Vector 0: [ -1, 1 ] or Vector 0: [ 1, -1 ]

Vector 1: [ -1, 1 ] Vector 1: [ 1, -1 ] Vector 1: [ 1, -1 ] Vector 1: [ -1, 1 ]

Hopfield Matrix:

[0 -2

-2 0]

Test vector: [ 1, 1 ]

Resulted in two vector loop with:

Result A : [ 1, 1 ] and Result B: [ -1, -1 ]

Test vector: [ 1, -1 ]

Resulted in convergence to Vector 1 = [ 1, -1 ] in 1 iteration.

Test vector: [ -1, -1 ]

Resulted in two vector loop with:

Result A : [ -1, -1 ] and Result B: [ 1, 1 ]

Test vector: [ -1, 1 ]

Resulted in convergence to Vector 0 = [ -1, 1 ] in 1 iteration.

## Tests for some Vectors of size 3

Result A)

|  |  |  |  |
| --- | --- | --- | --- |
| Vector 0: [ -1 1 1 ]  Vector 1: [ 1 1 1 ]  Vector 2: [ 1 1 1 ] | Vector 0: [ 1 1 1 ]  Vector 1: [ -1 1 1 ]  Vector 2: [ 1 1 1 ] | Vector 0: [ 1 1 1 ]  Vector 1: [ 1 1 1 ]  Vector 2: [ -1 1 1 ] | Vector 0: [ 1 -1 -1 ]  Vector 1: [ 1 1 1 ]  Vector 2: [ 1 1 1 ] |

Hopfield Matrix

[ 0 1 1

1 0 3

1 3 0 ]

Test vector: [ -1, -1, -1 ]

Resulted in convergence to Vector = [ -1, -1, -1 ] in 1 iteration.

Test vector: [ 1, 1, 1 ]

Resulted in convergence to Vector = [ 1, 1, 1 ] in 1 iteration.

Test vector: [ -1, 1, 1 ]

Resulted in convergence to Vector = [ 1, 1, 1 ] in 2 iterations.

Test vector: [ 1, -1, 1 ] , [ 1, 1, -1 ]

Resulted in two vector loop after 2 iterations with:

Result A : [ 1 , -1, 1 ] and Result B: [ 1, 1, -1 ]

Test vector: [ 1, -1, -1]

Resulted in convergence to Vector = [ -1, -1, -1 ] in 1 iterations.

Test vector: [ -1, 1, -1 ]

Resulted in two vector loop in 3 iterations with:

Result A : [ 1 , -1, 1 ] and Result B: [ 1, 1, -1 ]

Test vector: [ -1, -1, 1 ]

Resulted in two vector loop in 3 iterations with:

Result A : [ 1 , -1, 1 ] and Result B: [ 1, 1, -1 ]