

**Terna Engineering College
Computer Engineering Department**

Program: Sem VII

Course: Artificial Intelligence & Soft Computing (AI&SC)

Experiment No. 09

PART B

(PART B: TO BE COMPLETED BY STUDENTS)

(Students must submit the soft copy as per the following segments within two hours of the practical. The soft copy must be uploaded on the Blackboard or emailed to the concerned lab in charge faculties at the end of the practical in case there is no Blackboard access available)

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Class: BE-COMPS-50	Batch: B3
Date of Experiment: 06-10-2021	Date of Submission: 06-10-2021
Grade :	

Aim: To Implement Kohonen self-organizing Map- un-supervised learning algorithm.

B.1 Software Code written by a student:

```
clear all;

clc;

disp('Kohonen Self Organizing Feature Maps');

disp('The input patterns are');

x=[1 1 0 0; 0 0 0 1; 1 0 0 0; 0 0 1 1]

%x=[0.2 0.4];

t=1;

alpha(t)=0.6;

%alpha(t)=0.2;

e=1;

disp('Since we have four input pattern and cluster unit to be formed is 2, the weight matrix is');

w=[0.2 0.8; 0.6 0.4; 0.5 0.7; 0.9 0.3]
```

```
disp('The learning rate of this epoch is');
```

```
alpha
```

```
while(e<=3);
```

```
i=1;
```

```
j=1;
```

```
k=1;
```

```
m=1;
```

```
disp('Epoch = ');
```

```
e
```

```
%while(i<=2)
```

```
while(i<=4)
```

```
for j=1:2
```

```
temp=0;
```

```
for k=1:4
```

```
%temp=temp+((w(k,j)-x(i,k))2);
```

```
temp=temp+((w(k,j)-x(i,k)));
```

```
end
```

```
D(j)=temp
```

```
end
```

```
if(D(1)<D(2))
```

```
J=1;
```

```
else
```

```
J=2;
```

```
end
```

```
disp('The winning unit is ');
```

```
J
```

```
disp('Weight updation ');
```

```

for m=1:4
w(m,J)=w(m,J)+(alpha(e)*(x(i,m)-w(m,J)));
end
w
i=i+1;
end
temp=alpha(e);
e=e+1;
alpha(e)=(0.5*temp);
alpha(e)
End

```

B.2 Input and Output:

```

Command Window

Kohonen Self Organizing Feature Maps
The input patterns are

x =

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

Since we have four input pattern and cluster unit to be formed is 2, the weight matrix is

w =

    0.2000    0.8000
    0.6000    0.4000
    0.5000    0.7000
    0.9000    0.3000

The learning rate of this epoch is

alpha =

    0.6000

Epoch =

e =

    1

```

D =

0.2000

D =

0.2000 0.2000

The winning unit is

J =

1

Weight updation

W =

0.6800	0.8000
0.8400	0.4000
0.2000	0.7000
0.3600	0.3000

D =

1.0800 0.2000

D =

1.0800 1.2000

The winning unit is

$J =$

1

Weight updation

$W =$

0.2720	0.8000
0.3360	0.4000
0.0800	0.7000
0.7440	0.3000

$D =$

0.4320	1.2000
--------	--------

$D =$

0.4320	1.2000
--------	--------

The winning unit is

$J =$

1

Weight updation

$W =$

0.7088	0.8000
0.1344	0.4000
0.0320	0.7000
0.2976	0.3000

$D =$

-0.8272	1.2000
---------	--------

$D =$

-0.8272	0.2000
---------	--------

The winning unit is

$J =$

1

Weight updation

$W =$

0.2835	0.8000
0.0538	0.4000
0.6128	0.7000
0.7190	0.3000

```

ans =

    0.3000

Epoch =

e =

    2

D =

   -0.3309    0.2000

D =

   -0.3309    0.2000

The winning unit is

J =

    1

Weight updation

W =

    0.4985    0.8000
    0.3376    0.4000
    0.4290    0.7000
    0.5033    0.3000

```

D =

0.7684	0.2000
--------	--------

D =

0.7684	1.2000
--------	--------

The winning unit is

J =

1

Weight updation

W =

0.3489	0.8000
0.2363	0.4000
0.3003	0.7000
0.6523	0.3000

D =

0.5379	1.2000
--------	--------

D =

0.5379	1.2000
--------	--------

The winning unit is

$J =$

1

Weight updation

$W =$

0.5442	0.8000
0.1654	0.4000
0.2102	0.7000
0.4566	0.3000

$D =$

-0.6235	1.2000
---------	--------

$D =$

-0.6235	0.2000
---------	--------

The winning unit is

$J =$

1

Weight updation

$W =$

0.3810	0.8000
0.1158	0.4000
0.4471	0.7000
0.6196	0.3000

$ans =$

0.1500

Epoch =

$e =$

3

$D =$

-0.4364	0.2000
---------	--------

$D =$

-0.4364	0.2000
---------	--------

The winning unit is

$J =$

1

Weight updation

$W =$

0.4738	0.8000
0.2484	0.4000
0.3801	0.7000
0.5267	0.3000

$D =$

0.6290	0.2000
--------	--------

$D =$

0.6290	1.2000
--------	--------

The winning unit is

$J =$

1

Weight updation

$W =$

0.4028	0.8000
0.2112	0.4000
0.3231	0.7000
0.5977	0.3000

$D =$

0.5347	1.2000
--------	--------

$D =$

0.5347	1.2000
--------	--------

The winning unit is

$J =$

1

Weight updation

$W =$

0.4923	0.8000
0.1795	0.4000
0.2746	0.7000
0.5080	0.3000

D =

-0.5455 1.2000

D =

-0.5455 0.2000

The winning unit is

J =

1

Weight updation

W =

0.4185 0.8000

0.1526 0.4000

0.3834 0.7000

0.5818 0.3000

ans =

0.0750

B.3 Observations and learning:

After successful completion of this experiment students will have become familiar with neural networks that can learn from available examples and can demonstrate Unsupervised learning algorithms.

B.4 Conclusion:

We have successfully implemented Kohonen self-organizing Map– an unsupervised learning algorithm.

B.5 Question of Curiosity

1. Construct KSOM to cluster the four given vectors $[0\ 0\ 1\ 1]$, $[1\ 0\ 0\ 0]$, $[0\ 1\ 1\ 0]$, $[0\ 0\ 0\ 1]$ with no clusters into 2 assume that the learning rate is 0.5.

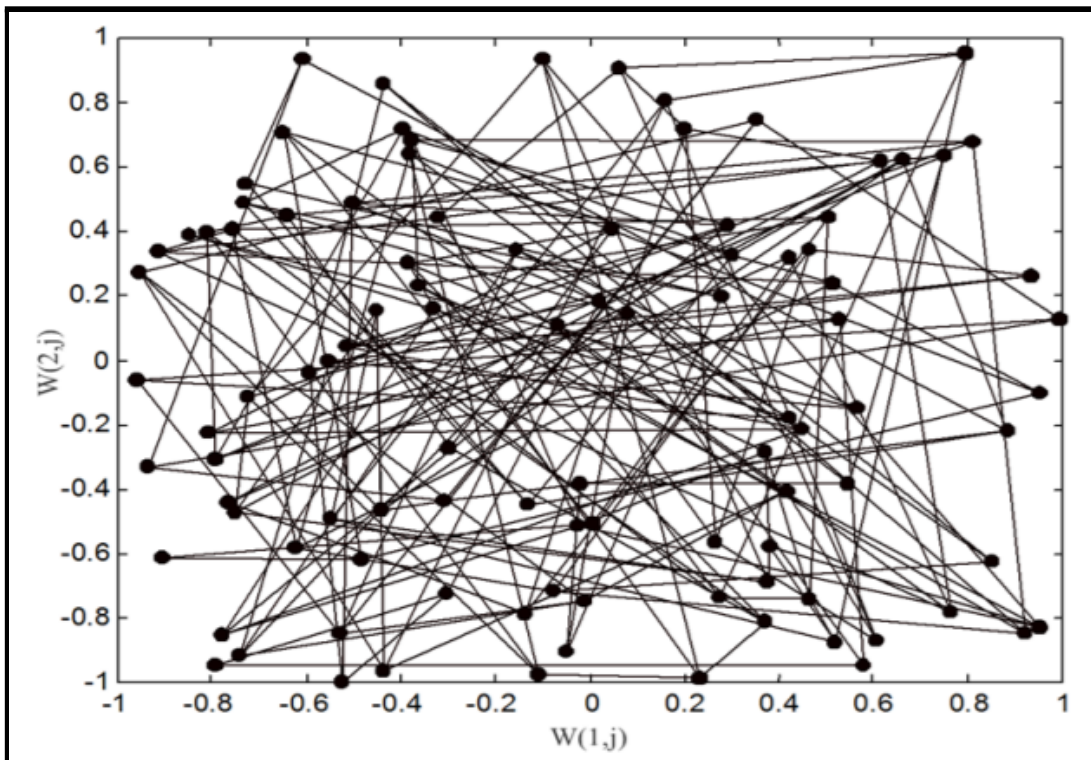
Ans:

Initial Weights:

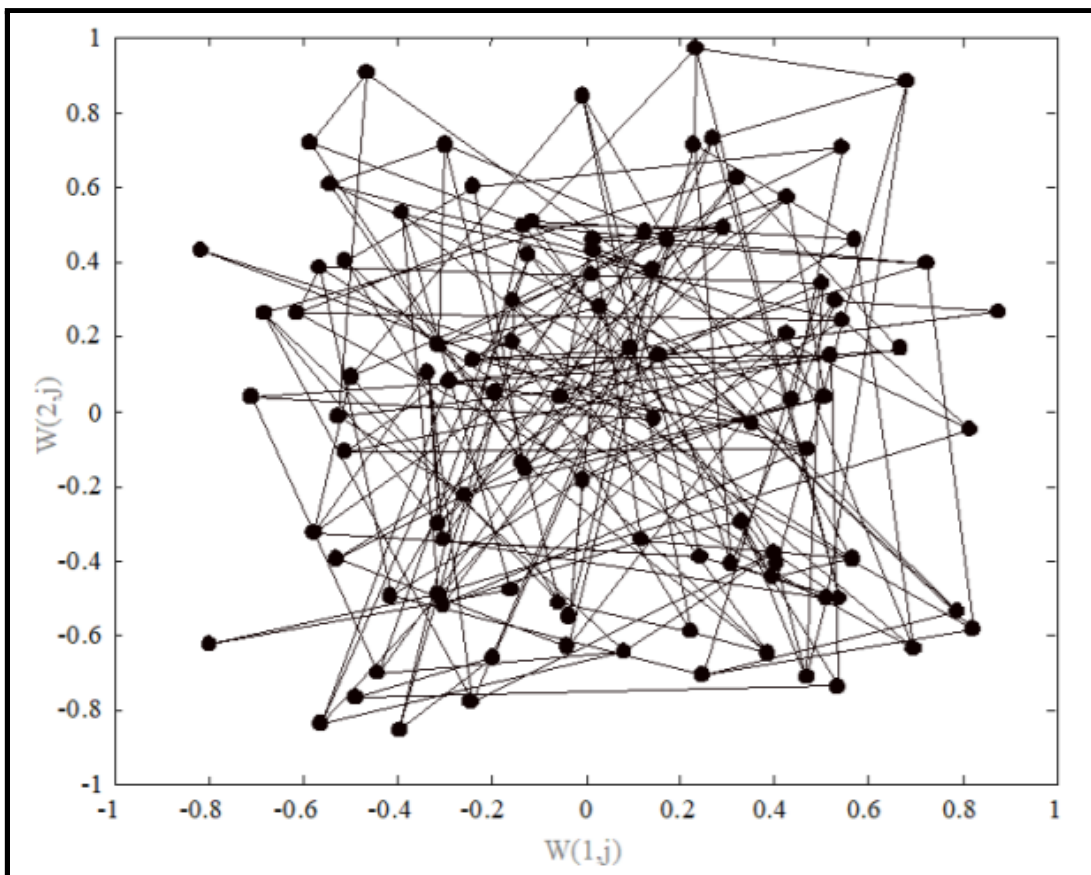
$$\begin{bmatrix} 0.2 & 0.9 \\ 0.4 & 0.7 \\ 0.6 & 0.5 \\ 0.8 & 0.3 \end{bmatrix}$$

Input vector	Winner	Weights
$[0\ 0\ 1\ 1]$	D(1)	$[0.1\ 0.2\ 0.8\ 0.9]$
$[1\ 0\ 0\ 0]$	D(2)	$[0.95\ 0.35\ 0.25\ 0.15]$
$[0\ 1\ 1\ 0]$	D(1)	$[0.05\ 0.6\ 0.9\ 0.95]$
$[0\ 0\ 0\ 1]$	D(1)	$[0.025\ 0.3\ 0.45\ 0.975]$

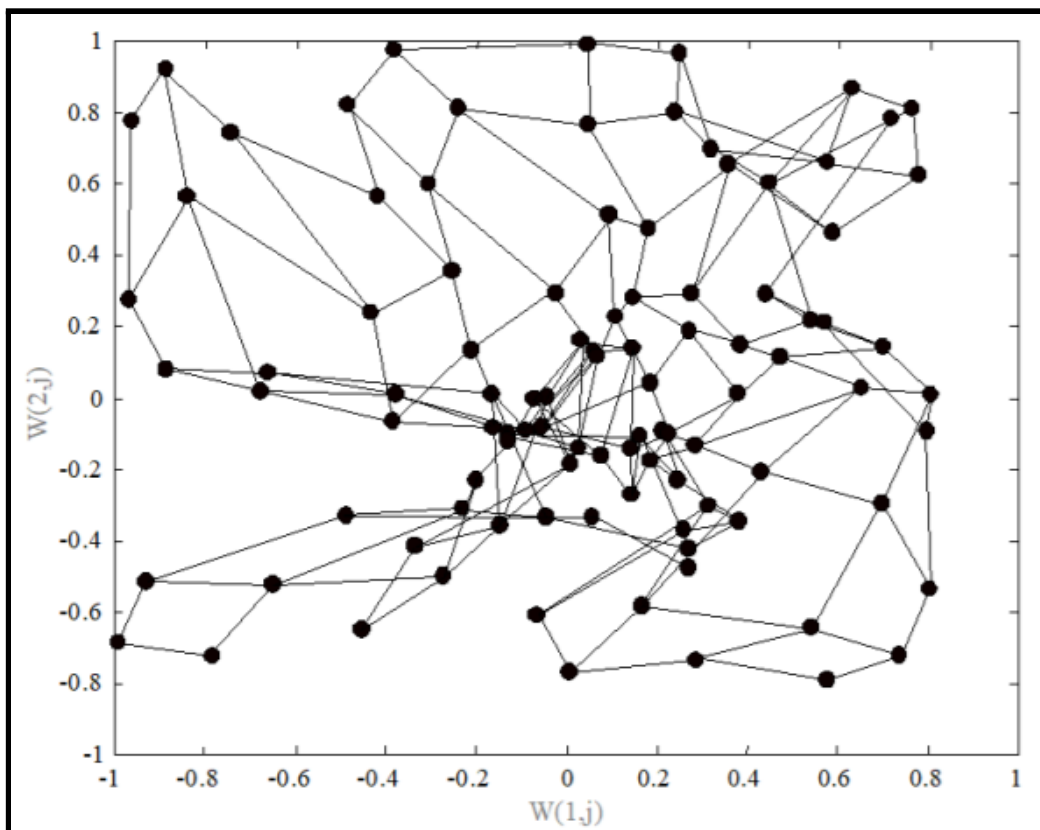
Inference Initial random weights:



Network after 100 iterations:



Network after 1000 iterations:



Network after 10000 iterations:

