Practical : 9

Topic :

Implementation of SOM based procedures for dataset analysis.

Implementation :

(a) A teacher wants to form the clusters of 4 students based on their performance in 4 subjects: English, Hindi, Maths, and Science respectively. The performance of the students is judged by the parameters high and low. Consider low as 0 and high as 1 as given in the matrix. Student A has a low performance in English and Hindi whereas high in Math and Science. The performance of student B is only high in English. Student C was recorded high in Hindi and Math with a low score in English and Science. Lastly, the performance of student D was only observed high in Science. Assume that there are two clusters formed and the initial learning rate is 0.5. Construct KSOM for the above situation with the following matrix.

```
#include <iostream>
#include <conio.h>
#include <iomanip>
#include <cmath>
using namespace std;

const int maxClusters = 2;
const int vectors = 4;
const int vectorLen = 4;
const double decayRate = 0.96;
const double minAlpha = 0.01;

double alpha = 0.5;
double d[maxClusters];
```

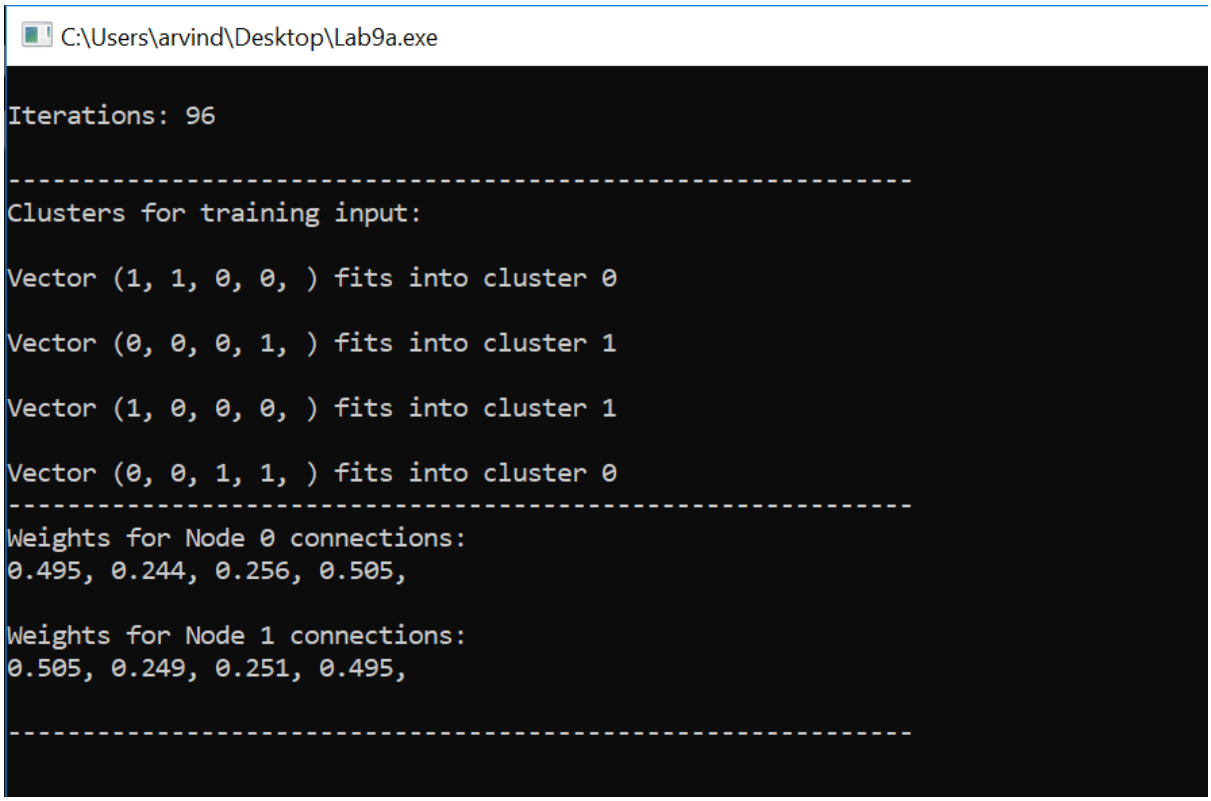
```
double w[maxClusters][vectorLen] = {{0.2, 0.6, 0.5, 0.9},
        {0.8, 0.4, 0.7, 0.3}
};

int pattern[vectors][vectorLen] = {{1, 1, 0, 0},
        {0, 0, 0, 1},
        {1, 0, 0, 0},
        {0, 0, 1, 1}
};

int tests[vectors][vectorLen] = {{0, 0, 1, 1},
        {1, 0, 0, 0},
        {0, 1, 1, 0},
        {0, 0, 0, 1}
};

int minimum(double valueA, double valueB) {
        if (valueA > valueB) {
                return 1;
        } else {
                return 0;
        }
}

void computeInput(int vectorNumber) {

        d[0] = 0.0;
        d[1] = 0.0;
        for (int i = 0; i <= (maxClusters - 1); i++) {
                for (int j = 0; j <= (vectors - 1); j++) {
```

```
                        d[i] += pow((w[i][j] - tests[vectorNumber][j]), 2);


                }
        }
}

void training() {
        int iterations = 0;
        int dMin = 0;

        do {
                iterations += 1;

                for (int vecNum = 0; vecNum <= (vectors - 1); vecNum++) {
                        computeInput(vecNum);
                        dMin = minimum(d[0], d[1]);

                        //Update the weights on the winning unit.
                        for (int i = 0; i <= (vectors - 1); i++) {
                                w[dMin][i] = w[dMin][i] + (alpha * (pattern[vecNum][i] -
                                                        w[dMin][i]));


                        }
                }
                //Reduce the learning rate.
                alpha = decayRate * alpha;

        } while (alpha > minAlpha);

        cout << "Iterations: " << iterations << "\n\n";
}
```

```
void showResult() {
	int dMin;

//Print clusters created.
	cout << "------------------------------------------------------------\n";
	cout << "Clusters for training input:" << endl;

	for (int vecNum = 0; vecNum <= (vectors - 1); vecNum++) {
		computeInput(vecNum);
		dMin = minimum(d[0], d[1]);
		cout << "\nVector (";
		for (int i = 0; i <= (vectors - 1); i++) {
			cout << pattern[vecNum][i] << ", ";
		}
		cout << ") fits into cluster " << dMin << endl;

	}

//Print weight matrix.
	cout << "------------------------------------------------------------\n";
	for (int i = 0; i <= (maxClusters - 1); i++) {
		cout << "Weights for Node " << i << " connections:" << endl;
		for (int j = 0; j <= (vectorLen - 1); j++) {
			cout << w[i][j] << ", ";
		}
		cout << "\n\n";
	}

	cout << "------------------------------------------------------------\n";
}
```

```
int main() {
        cout << fixed << setprecision(3) << endl;
        training();
        showResult();

        getch();

        return 0;
}
```

Output :



(b) Problem described in (a) extended to ‘n’ number of students .

```
#include <iostream>
#include <conio.h>
#include <iomanip>
#include <cmath>
#include<vector>
using namespace std;
#define vint vector<int>

const int maxClusters = 2;
const int vectorLen = 4;
const double decayRate = 0.82;
const double minAlpha = 0.01;

double alpha = 0.5;
int vectors = 4;
double d[maxClusters];

double w[maxClusters][vectorLen] = {
        {0.2, 0.4, 0.7, 0.3}, {0.4, 0.6, 0.5, 0.9}
};

int pattern[10][10];
int tests[10][vectorLen] = {{0, 0, 0, 1},
        {0, 0, 0, 0},
        {0, 0, 1, 1},
        {0, 0, 1, 0},
        {0, 1, 0, 0},
        {0, 1, 0, 1},
        {0, 1, 1, 0},
```

```
        {1, 0, 0, 1},
        {0, 1, 1, 0},
        {0, 0, 1, 1}
};

int minimum(double valueA, double valueB) {
        if (valueA > valueB) {
                return 1;
        } else {
                return 0;
        }
}

void computeInput(int vectorNumber) {

        d[0] = 0.0;
        d[1] = 0.0;

        for (int i = 0; i < maxClusters; i++) {
                for (int j = 0; j < vectors; j++) {
                        d[i] += pow((w[i][j] - tests[vectorNumber][j]), 2);

                }
        }
}

void training() {
        int iterations = 0;
        int dMin = 0;

        do {
```

```
                iterations += 1;

                for (int vecNum = 0; vecNum <= (vectors - 1); vecNum++) {
                        computeInput(vecNum);
                        dMin = minimum(d[0], d[1]);

                        //Update the weights on the winning unit.
                        for (int i = 0; i <= (vectors - 1); i++) {
                                w[dMin][i] += (alpha * (pattern[vecNum][i] - w[dMin][i]));

                        }
                }
                //Reduce the learning rate.
                alpha = decayRate * alpha;

        } while (alpha > minAlpha);

        cout << "Iterations: " << iterations << "\n\n";
}

void showResult() {
        int dMin;


//Print weight matrix.
        cout << "----------------------------------------------------------\n";
        for (int i = 0; i <= (maxClusters - 1); i++) {
                cout << "Weights for Node " << i << " connections:" << endl;
                for (int j = 0; j <= (vectorLen - 1); j++) {
                        cout << w[i][j] << ", ";
                }
```

```
                cout << "\n\n";
        }

        //Print clusters created.
        cout << "------------------------------------------------------------\n";
        cout << "Clusters for training input:" << endl;

        for (int vecNum = 0; vecNum <= (vectors - 1); vecNum++) {
                computeInput(vecNum);
                dMin = minimum(d[0], d[1]);
                cout << "\nVector (";
                for (int i = 0; i <= (vectorLen - 1); i++) {
                        cout << pattern[vecNum][i] << ", ";
                }
                cout << ") fits into cluster " << dMin << endl;

        }
        cout << "------------------------------------------------------------\n";
}
int main() {
        cout << "Enter Number of inputs :";
        cin >> vectors;

        //pattern = vector<vint> (vectors, vint(vectorLen, 0));

        cout << "Enter " << vectors << " input patterns :\n";
        for (int i = 0; i < vectors; ++i)
        {
                for (int j = 0; j < vectorLen; ++j)
                {
                        cin >> pattern[i][j];
```

```
                }
        }


        cout << "-------------------------------------------------------------\n";
        cout << fixed << setprecision(3) << endl;
        training();
        showResult();
        getch();
        return 0;
}
```

Output :

C:\Users\arvind\Desktop\Lab9b.exe

```
Enter Number of inputs :6
Enter 6 input patterns :

0 0 1 1
0 1 0 0
0 1 1 1
0 0 1 1
0 1 0 1
0 1 1 1
------------------------------------------------------------

Iterations: 20

------------------------------------------------------------
Weights for Node 0 connections:
0.000, 0.992, 0.531, 1.000,

Weights for Node 1 connections:
0.000, 0.318, 0.758, 0.758,

------------------------------------------------------------
Clusters for training input:

Vector (0, 0, 1, 1, ) fits into cluster 1

Vector (0, 1, 0, 0, ) fits into cluster 1

Vector (0, 1, 1, 1, ) fits into cluster 1

Vector (0, 0, 1, 1, ) fits into cluster 1

Vector (0, 1, 0, 1, ) fits into cluster 0

Vector (0, 1, 1, 1, ) fits into cluster 0
------------------------------------------------------------
```