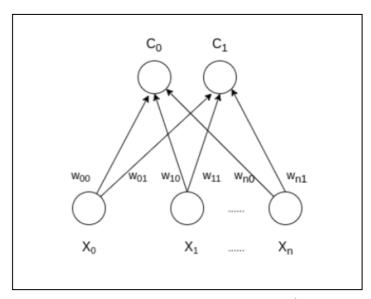
20CS2032L – MACHINE LEARNING TECHNIQUES | URK22AI1023

EXERCISE	8. SELF ORGANIZING MAPS
DATE	17.09.2024

AIM:

To implement Self Organizing Map (SOM) to cluster the given data points.

DESCRIPTION: It follows an unsupervised learning approach and trained its network through a competitive learning algorithm. SOM is used for clustering and mapping (or dimensionality reduction) techniques to map multidimensional data onto lower-dimensional which allows people to reduce complex problems for easy interpretation. SOM has two layers, one is the Input layer and the other one is the Output layer.



Weight updation rule is given by: $w_{ij} = w_{ij}(old) + alpha(t) * (x_i^k - w_{ij}(old))$

Training:

Step 1: Initialize the weights w_{ij} random value may be assumed. Initialize the learning rate α .

Step 2: Calculate squared Euclidean distance.

$$D(j) = \Sigma (wij - xi)^2$$
 where $i=1$ to n and $j=1$ to m

Step 3: Find index J, when D(i) is minimum that will be considered as winning index.

Step 4: For each j within a specific neighborhood of j and for all i, calculate the new weight.

$$wij(new)=wij(old) + \alpha [xi - wij(old)]$$

Step 5: Update the learning rule by using:

$$\alpha(t+1) = 0.5 * t$$

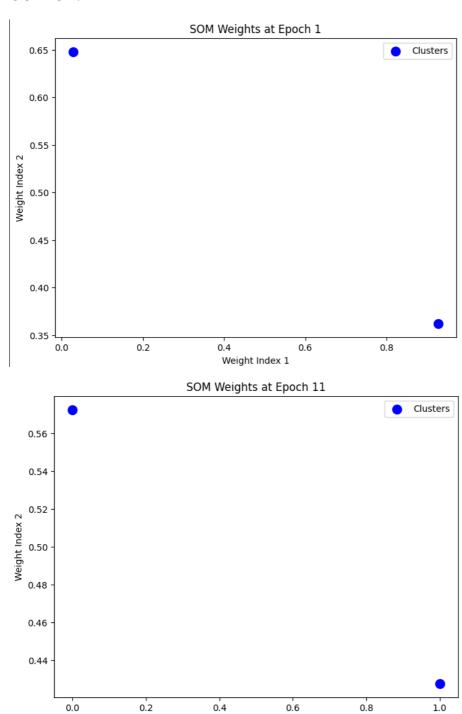
Step 6: Test the Stopping Condition.

```
PROGRAM:
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```
import numpy as np
import matplotlib.pyplot as plt
import math
class SOM:
  def __init__(self, m, n, num_clusters, alpha=0.5, epochs=100):
    Initialize the SOM with the given dimensions, number of clusters,
    learning rate, and number of epochs.
    self.m = m # Rows (number of neurons in the grid)
    self.n = n \# Columns (number of neurons in the grid)
    self.num clusters = num clusters # Number of neurons/clusters
    self.alpha = alpha # Learning rate
    self.epochs = epochs # Number of epochs
    # Initialize weights (random values between 0 and 1)
    # Now initializing weights for 2 features (same as input data)
    self.weights = np.random.rand(num clusters, 2)
    self.grid shape = (m, n)
  def winner(self, sample):
    Compute the Euclidean distance between the sample and each weight vector.
    The weight vector with the minimum distance is the winning neuron (cluster).
    distances = np.linalg.norm(self.weights - sample, axis=1)
    return np.argmin(distances) # Index of the minimum distance
  def update(self, sample, winner index):
    Update the weights of the winning neuron.
    self.weights[winner index] += self.alpha * (sample - self.weights[winner index])
  def train(self, data):
    Train the SOM using the given data for a number of epochs.
    for epoch in range(self.epochs):
       # For each sample, find the winning neuron and update the weights
```

```
for sample in data:
         winner index = self.winner(sample)
         self.update(sample, winner index)
       # Optionally decay the learning rate over time
       self.alpha = self.alpha * (1.0 - epoch / float(self.epochs))
       # Plot the weights at the end of each epoch to visualize the training
       if epoch % 10 == 0: # Visualize every 10 epochs
         self.plot weights(epoch)
  def plot_weights(self, epoch):
    Plot the weights of the SOM at each epoch.
    plt.figure(figsize=(8, 6))
    plt.title(fSOM Weights at Epoch {epoch + 1}')
    plt.scatter(self.weights[:, 0], self.weights[:, 1], s=100, c='blue', label='Clusters')
    plt.xlabel('Weight Index 1')
    plt.ylabel('Weight Index 2')
    plt.legend()
    plt.show()
# Driver code to demonstrate SOM
def main():
  # Sample training data (4 samples, 2 features)
  data = np.array([[1, 1], [0, 0], [1, 0], [0, 1]])
  # Define the size of the SOM grid (2x2 grid)
  m = 2 \# Rows
  n = 2 \# Columns
  num clusters = 2 # Number of clusters
  som = SOM(m, n, num_clusters, alpha=0.5, epochs=50)
  som.train(data)
  test sample = np.array([0.8, 0.8]) # Example test sample
  winner index = som.winner(test sample)
  print(fTest sample {test sample} belongs to Cluster: {winner index}')
if name == " main ":
  main():
```

OUTPUT:



RESULT:

The above code is executed successfully using self- organizing maps.

Weight Index 1