Self-Organizing Maps - Matlab Code

Lukas Fu

Matlab Code

Main

```matlab
1  clear; clc; clf;
2
3  nEpoch = 10;
4  eta = 0.1;
5  sigma = 10;
6  irisData = load('iris-data.csv');
7  irisLabels = load('iris-labels.csv');
8  maxIrisData = max(irisData);
9  stdIrisData = irisData/maxIrisData;
10
11 nPattern = size(irisData,1);
12 outputDimensions = 40; % dimensions as in matrix dimensions dim x dim
13
14 weights = zeros(40,40,4);
15 for k = 1:size(weights,1)
16     for l = 1:size(weights,2)
17         for m = 1:size(weights,3)
18             weights(k,l,m) = rand;
19         end
20     end
21 end
22
23 for epoch = 1:nEpoch
24
25     for trial = 1:nPattern
26         iPattern = 1 + fix(rand*nPattern);
27         pattern(1,1,:) = irisData(iPattern,:);
28         [i0,j0] = FindWinningNeuron(pattern,weights);
29         i0 = i0 + normrnd(0,0.02);
30         j0 = j0 + normrnd(0,0.02);
31         r0 = [i0 j0];
32
33         for i = 1:outputDimensions
34             for j = 1:outputDimensions
35                 r = [i j];
36                 distanceToR0 = vecnorm(r-r0);
37
38                 if distanceToR0 < 3 * sigma
39                     h = exp(-distanceToR0^2 / (2*sigma^2));
40                     dw = eta * h * (pattern - weights(i,j,:));
41                     weights(i,j,:) = weights(i,j,:) + dw;
```

```
42                     end
43                 end
44             end
45         end
46         if epoch == 1
47             subplot(2,1,1)
48             position = zeros(nPattern,2);
49             for k = 1:nPattern
50                 x(1,1,:) = irisData(k,:);
51                 [i0,j0] = FindWinningNeuron(x,weights);
52                 position(k,:) = [i0,j0];
53             end
54             gscatter(position(:,1),position(:,2),irisLabels)
55         end
56
57         [sigma,eta] = UpdateSigmaEta(sigma,eta,epoch);
58     end
59     subplot(2,1,2)
60     position = zeros(nPattern,2);
61     for k = 1:nPattern
62         x(1,1,:) = irisData(k,:);
63         [i0,j0] = FindWinningNeuron(x,weights);
64         position(k,:) = [i0,j0];
65     end
66     gscatter(position(:,1),position(:,2),irisLabels)
```

Find winning neuron

```
1  function [i0,j0] = FindWinningNeuron(pattern,weights)
2      % weights = 40x40x4, pattern = 1x1x4
3      distance = zeros(40,40);
4      for i = 1:size(weights,1)
5          for j = 1:size(weights,2)
6              distance(i,j) = sqrt(sum((weights(i,j,:) - pattern).^2));
7          end
8      end
9      minDistance = min(min(distance));
10     [i0,j0] = find(distance==minDistance);
11 end
```

Update sigma and eta

```
1  function [sigma,eta] = UpdateSigmaEta(sigma,eta,epoch)
2      dSigma = 0.05;
3      dEta = 0.01;
4      sigma = sigma * exp(-dSigma * epoch);
5      eta = eta * exp(-dEta * epoch);
6  end
```