

# Self organising map

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```
data = readmatrix("iris-data.csv");
targets = readmatrix("iris-labels.csv");
maxValue = max(max(data));
data = data / maxValue;
nInputs = height(data);
nEpochs = 10;
```

```
eta_0 = 1
```

```
eta_0 = 1
```

```
eta_decay = 0.01;
```

```
sigma_0 = 10;
sigma_decay = 0.05;
```

```
w_ij = rand(40,40,4);
nNeurons = 40;
```

```
% Plotting untrained network
```

```
r_0List = [];
class0 = [];
class1 = [];
class2 = [];
```

```
for iInput = 1:nInputs
    dataPoint = data(iInput,:);
    minDistance = Inf;
```

```
% Computing the winning neuron
```

```
for i = 1:nNeurons
    for j = 1:nNeurons
        distance = sqrt((w_ij(i,j,1) - dataPoint(1))^2 + ...
                        (w_ij(i,j,2) - dataPoint(2))^2 + ...
                        (w_ij(i,j,3) - dataPoint(3))^2 + ...
                        (w_ij(i,j,4) - dataPoint(4))^2);
```

```
        if distance < minDistance
            minDistance = distance;
            r_0 = [i+((2*rand)-1)*0.02,j+((2*rand)-1)*0.02];
```

```
        end
```

```
    end
```

```
end
```

```
r_0List = [r_0List ; r_0,targets(iInput)];
```

```
if r_0List(iInput,3) == 0
    class0 = [class0 ; r_0List(iInput,:)];
```

```
elseif r_0List(iInput,3) == 1
    class1 = [class1 ; r_0List(iInput,:)];
```

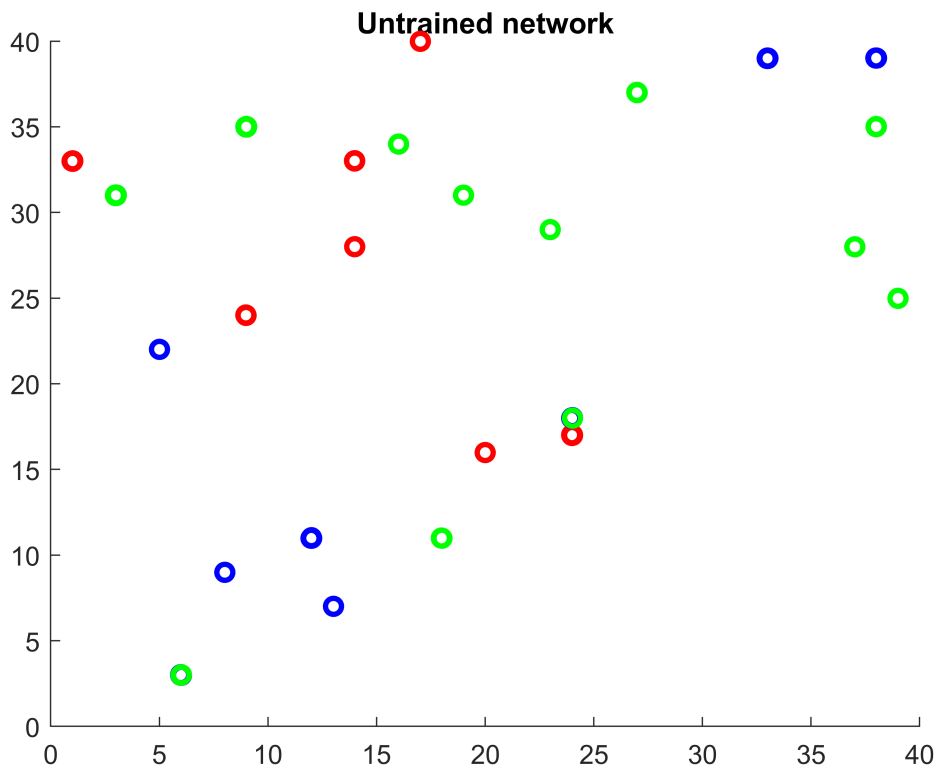
```
elseif r_0List(iInput,3) == 2
```

```

        class2 = [class2 ; r_0List(iInput,:)];
    end
end

figure
hold on
plot(class0(:,1),class0(:,2),"or","Linewidth",2)
plot(class1(:,1),class1(:,2),"ob","Linewidth",2)
plot(class2(:,1),class2(:,2),"og","Linewidth",2)
title("Untrained network")
hold off

```



```

% Training
for iEpoch = 1:nEpochs

    % Updating learning parameters
    eta = eta_0*exp(-eta_decay*iEpoch);
    sigma = sigma_0*exp(-sigma_decay*iEpoch);

    for iInput = nInputs

        randPoint = randi(nInputs);
        dataPoint = data(randPoint,:);
        minDistance = Inf;
        r = [];

        % Computing the winning neuron
        for i = 1:nNeurons

```

```

        for j = 1:nNeurons
            distance = sqrt((w_ij(i,j,1) - dataPoint(1))^2 + ...
                            (w_ij(i,j,2) - dataPoint(2))^2 + ...
                            (w_ij(i,j,3) - dataPoint(3))^2 + ...
                            (w_ij(i,j,4) - dataPoint(4))^2);

            if distance < minDistance
                minDistance = distance;
                iMin = i;
                jMin = j;
            end
        end
    end

    % Computing nearest neighbours to the winning neuron
    for i = 1:nNeurons
        for j = 1:nNeurons
            distance = sqrt((i - iMin)^2 + (j - jMin)^2);
            if distance < 3*sigma
                r = [r ; i,j,distance];
            end
        end
    end

    % Updating weights
    nIncrements = height(r);
    deltaWeight = zeros(40,40,4);
    for iIncrement = 1:nIncrements
        i = r(iIncrement,1);
        j = r(iIncrement,2);
        rDistance = r(iIncrement,3);

        h = exp(-1/(2*sigma^2) * rDistance^2);
        for k = 1:length(dataPoint)
            deltaWeight(i,j,k) = deltaWeight(i,j,k) + eta*h*(dataPoint(k) - w_ij(i,j,k));
        end
    end
    w_ij = w_ij + deltaWeight;
end

% Plotting trained network
r_0List = [];
class0 = [];
class1 = [];
class2 = [];
for iInput = 1:nInputs
    dataPoint = data(iInput,:);
    minDistance = Inf;

    % Computing the winning neuron
    for i = 1:nNeurons
        for j = 1:nNeurons
            distance = sqrt((w_ij(i,j,1) - dataPoint(1))^2 + ...

```

```

        (w_ij(i,j,2) - dataPoint(2))^2 + ...
        (w_ij(i,j,3) - dataPoint(3))^2 + ...
        (w_ij(i,j,4) - dataPoint(4))^2);

        if distance < minDistance
            minDistance = distance;
            r_0 = [i+((2*rand)-1)*0.02 ,j+((2*rand)-1)*0.02];
        end
    end
end

r_0List = [r_0List ; r_0,targets(iInput)];

if r_0List(iInput,3) == 0
    class0 = [class0 ; r_0List(iInput,:)];
elseif r_0List(iInput,3) == 1
    class1 = [class1 ; r_0List(iInput,:)];
elseif r_0List(iInput,3) == 2
    class2 = [class2 ; r_0List(iInput,:)];
end
end

figure
hold on
plot(class0(:,1),class0(:,2),"or","Linewidth",2)
plot(class1(:,1),class1(:,2),"ob","Linewidth",2)
plot(class2(:,1),class2(:,2),"og","Linewidth",2)
title("Trained network")
hold off

```

