Einführung in die Neuroinformatik

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1 Lernschritt im Perzeptron-Lernalgorithmus

- (a) TODO
- (b)

$$w^* = \begin{pmatrix} 1 \\ 2 \\ -1 \end{pmatrix}$$

$$x^* = \begin{pmatrix} 2 \\ 2 \\ 1 \end{pmatrix}$$

- (c) TODO
- (d) Überprüfen ob bereits korrekt klassifiziert:

$$(w^*)^T \cdot x^* = 2 + 4 - 1 = 5 \ge 0$$

$$\Rightarrow x^* \in \omega_1$$

Lernschritt durchführen:

$$\tilde{w}^* = w^* - \nu \cdot x^* = \begin{pmatrix} -1 \\ 0 \\ -2 \end{pmatrix}$$

$$\Rightarrow \tilde{w} = \begin{pmatrix} -1 \\ 0 \end{pmatrix}$$

$$\tilde{x} = -2$$

(e) TODO

(f) Überprüfen ob bereits korrekt klassifiziert:

$$(\tilde{w}^*)^T \cdot x^* = -2 + 0 - 2 = -4$$

 $\Rightarrow x^* \in \omega_{-1}$

Kein Lernschritt ist notwendig $\Rightarrow w$ wird nicht verändert

2 Perzeptron-Lernalgorithmus

Matlab script:

```
M Initialization
  data = [-3 \ 1 \ -1;
           -3 \ 3 \ 1;
           -2 \ 1 \ -1;
           -2\ 4\ 1;
           -1 \ 3 \ 1;
           -1 \ 4 \ 1;
            2 \ 2 \ -1;
            2 4 1;
            3 \ 2 \ -1;
            4 \ 1 \ -1;;
11
12
  % Create all vectors
  inputs = data(:,1:2);
  inputsExtended = [inputs ones(size(inputs,1),1)];
  classes = data(:,3);
  w = [0, 0, 0];
  % Extended weight vectors; each iteration adds one more row
  % Since we don't know the exact number of rows in advance, we
      preallocate the matrix with a maximum size and crop the
      result in the end
  maxVectors = 100;
  vectorDimension = 3;
  wExtendedMat = zeros (maxVectors, vector Dimension);
  L = size(data, 1);
  numberOfOptimizations = 1;
  wExtendedMat(numberOfOptimizations,:) = w;
27
  changesInLastIteration = 1;
  while changesInLastIteration > 0
```

```
changesInLastIteration = 0;
31
       for c = 1: size (inputs, 1)
32
           currentInput = inputsExtended(c,:);
33
           desiredClass = classes(c,:);
34
           calculatedOutput = w * transpose(currentInput);
35
36
           % Wrong class
37
           if calculatedOutput <= 0 && desiredClass > 0
                w += currentInput;
            elseif calculatedOutput >= 0 && desiredClass < 0
40
                w -= currentInput;
41
           end
42
43
           % Plot the updated weights
            if calculatedOutput * desiredClass <= 0
45
                changesInLastIteration += 1;
46
                numberOfOptimizations += 1;
47
                wExtendedMat(numberOfOptimizations,:) = w;
48
                x = y = 0;
                if w(2) == 0
                    y = -6:0.1:6;
52
                    x = -w(3)/w(1);
53
                else
54
                    x = -6:0.1:6;
55
                    y = -(w(1)*x + w(3))/w(2);
                end
57
                clf();
58
                plot(x,y);
59
                hold on;
60
                scatter(data(:,1), data(:,2), [], data(:,3));
                axis([-6 \ 6 \ -6 \ 6]);
62
63
                while waitforbuttonpress \tilde{}=1
64
                end
65
           end
66
       end
  end
69
70
  % Remove unused weight vector entries
  wExtendedMat = wExtendedMat(1:numberOfOptimizations, :);
```