

Nama : Inaz Rehan Fauzi

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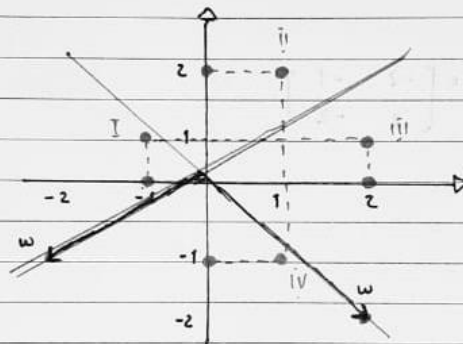
STr Teknologi Rekayasa Otomasi

Diketahui :

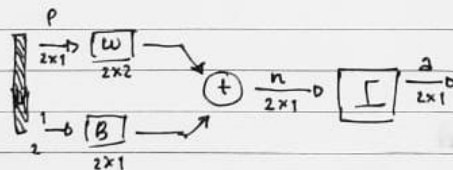
Kategori I : $\left\{ \begin{bmatrix} -1 \\ 1 \end{bmatrix}, \begin{bmatrix} -1 \\ 0 \end{bmatrix} \right\}$; Kategori II : $\left\{ \begin{bmatrix} 0 \\ 2 \end{bmatrix}, \begin{bmatrix} 1 \\ 2 \end{bmatrix} \right\}$

Kategori III : $\left\{ \begin{bmatrix} 2 \\ 0 \end{bmatrix}, \begin{bmatrix} 2 \\ 1 \end{bmatrix} \right\}$; Kategori IV : $\left\{ \begin{bmatrix} 1 \\ -1 \end{bmatrix}, \begin{bmatrix} 0 \\ -1 \end{bmatrix} \right\}$

(i) Desainlah two neuron perceptron network (single layer) dan buat decision boundary



(ii) Gambarkan diagram network nya



$a = \text{hardlim}(wp + b)$

$n = wp + b$

$b = -w \cdot p$

Tentukan nilai w :

$$\Rightarrow w_1 = \begin{bmatrix} -2 \\ -1 \end{bmatrix}$$

$$\Rightarrow w_2 = \begin{bmatrix} 2 \\ -2 \end{bmatrix}$$

Nilai Target

$$\cdot \text{Category I: } \left\{ t_1 = \begin{bmatrix} 0 \\ 0 \end{bmatrix}; t_2 = \begin{bmatrix} 0 \\ 0 \end{bmatrix} \right\} \quad \cdot \text{Category II: } \left\{ t_3 = \begin{bmatrix} 0 \\ 1 \end{bmatrix}; t_4 = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \right\}$$

$$\cdot \text{Category III: } \left\{ t_5 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}; t_6 = \begin{bmatrix} 1 \\ 1 \end{bmatrix} \right\} \quad \cdot \text{Category IV: } \left\{ t_7 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}; t_8 = \begin{bmatrix} 1 \\ 0 \end{bmatrix} \right\}$$

Menghitung nilai bias dari decision boundary

$$\begin{aligned} b_1 &= -w^T \cdot p \\ &= - \begin{bmatrix} -2 & -1 \end{bmatrix} \begin{bmatrix} 0 \\ 0 \end{bmatrix} = 0 \end{aligned}$$

$$\begin{aligned} b_2 &= -w^T \cdot p \\ &= - \begin{bmatrix} 2 & -2 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \end{bmatrix} = 0 \end{aligned}$$

$$\text{Maka } b = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$w = \begin{bmatrix} w_1^T \\ w_2^T \end{bmatrix} = \begin{bmatrix} -2 & -1 \\ 2 & -2 \end{bmatrix}$$

(iii) Screenshoot hasil perhitungan learning rule menggunakan matlab

```
MATLAB 7.5.0 (R2007b)
File Edit Debug Distributed Desktop Window Help
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Shortcuts How to Add What's New

Current Directory
Nama : Inaz Rehan Fauzi
NIM : 40040318650001
Program Two Neuron Perceptron Learning Rule for 4 Categories

Category 1 : P1 [-1 1; -1 0; -1 -3] - T1 [0 0; 0 0; 0 0]
Category 2 : P2 [0 2; 1 2] - T2 [0 1; 0 1]
Category 3 : P3 [2 0; 2 1] - T3 [1 0; 1 0]
Category 4 : P4 [1 -1; 0 -1] - T4 [1 1; 1 1]

Masukkan W11 : -2
Masukkan W12 : -1
Masukkan W13 : 2
Masukkan W14 : -2
Masukkan b1 : 0
Masukkan b2 : 0

eT =

    0    1    1    1    1    1    1    1
    0    1    1    1    1    1    1    1

eT =

    0    0    1    1    1    1    1    1
    0    0    1    1    1    1    1    1

eT =

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

eT =
```

```
MATLAB 7.5.0 (R2007b)
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Shortcuts How to Add What's New

Current Directory

eT =

    0    0    0    0    0    0    0    0    1
    0    0    0    0    0    0    0    0    0

eT =

    0    0    0    0    0    0    0    0    1
    0    0    0    0    0    0    0    0    0

eT =

    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0

Train finished...

W =

    9   -4
    1    1

b =

   -4
   -2

IterCount =

    26
```

Screenshot script

```
Editor - D:\KULIAH\Semester 6\Sistem Kontrol Cerdas\PerceptronInaz.m
File Edit Text Go Cell Tools Debug Desktop Window Help
1 disp('Nama : Inaz Rehan Fauzi')
2 disp('NIM : 40040318650001')
3 disp('Program Two Neuron Perceptron Learning Rule for 4 Categories')
4 disp(' ')
5 disp('Category 1 : P1 [-1 1; -1 0; -1 -3] - T1 [0 0; 0 0; 0 0]')
6 disp('Category 2 : P2 [0 2; 1 2] - T2 [0 1; 0 1]')
7 disp('Category 3 : P3 [2 0; 2 1] - T3 [1 0; 1 0]')
8 disp('Category 4 : P4 [1 -1; 0 -1] - T4 [1 1; 1 1]')
9 disp(' ')
10 m=input('Masukkan W11 : ');
11 n=input('Masukkan W12 : ');
12 o=input('Masukkan W13 : ');
13 p=input('Masukkan W14 : ');
14 b1=input('Masukkan b1 : ');
15 b2=input('Masukkan b2 : ');
16 % z=input('Masukkan alpha : ');
17
18 % Dengan Bias
19 P = [-1 1; -1 0; -1 -3; 0 2; 1 2; 2 0; 2 1; 1 -1; 0 -1]';
20 T = [0 0; 0 0; 0 0; 0 1; 0 1; 1 1; 1 1; 1 0; 1 0]';
21 eT = [1 1; 1 1]'; % Check Error
22 W = [m n; o p]';
23 b = [b1; b2];
24 % alpha = z; % Learning Rate
25 maxIter = 200;
26
27 for c = 1:maxIter
28     % Train
29     for i = 1:size(P,2);
30         a = hardlim(W*P(:,i) + b);
31         e = T(:,i) - a;
32         % Update W dan b
33         W = W + e*P(:,i)';
34         b = b + e;
35         % Update W dan b dengan learning rate
36         W = W + alpha*e*P(:,i);
37     end
38
39     % Check
40     for j = 1:size(P,2);
41         a = hardlim(W*P(:,j) + b);
42         eT(:,j) = T(:,j) - a;
43     end
44
45     % find non-zero error
46     k = find(eT);
47     if isempty(k) % no error found...
48         break;
49     end
50 end
51
52 if c == maxIter
53     disp('Max iteration reached --> FAIL')
54 else
55     disp('Train finished...')
56 end
57
58 W
59 b
60 %eT
61 IterCount = c
```

```
Editor - D:\KULIAH\Semester 6\Sistem Kontrol Cerdas\PerceptronInaz.m
File Edit Text Go Cell Tools Debug Desktop Window Help
26
27 for c = 1:maxIter
28     % Train
29     for i = 1:size(P,2);
30         a = hardlim(W*P(:,i) + b);
31         e = T(:,i) - a;
32         % Update W dan b
33         W = W + e*P(:,i)';
34         b = b + e;
35         % Update W dan b dengan learning rate
36         W = W + alpha*e*P(:,i);
37         b = b + alpha*e;
38     end
39
40     % Check
41     for j = 1:size(P,2);
42         a = hardlim(W*P(:,j) + b);
43         eT(:,j) = T(:,j) - a;
44     end
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53 if c == maxIter
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59 W
60 b
61 %eT
62 IterCount = c
```