Decision Tree Induction

Contoh 1:

No	Mahasiswa	Status
1	Aktif	Positif
2	Aktif	Negatif
3	Tidak Aktif	Negatif
4	Tidak Aktif	Negatif
5	Tidak Aktif	Positif
6	Aktif	Positif
7	Tidak Aktif	Negatif
8	Tidak Aktif	Negatif
9	Tidak Aktif	Negatif
10	Aktif	Negatif

$P_+ = 3/10$

$P_- = 7/10$

$$Info(D) = -\sum_{i=1}^{m} p_i \, log_2(p_i)$$

$$Info(D) = \left(-\frac{3}{10} x \, Log_2\left(\frac{3}{10}\right)\right) + \left(-\frac{7}{10} x \, Log_2\left(\frac{7}{10}\right)\right) \approx 0.88$$

Contoh 2:

No	Nilai	Bonus
1	Excellent	Normal
2	Excellent	Normal
3	Excellent	Normal
4	Excellent	High
5	Good	Normal
6	Good	Normal
7	Good	Normal
8	Good	Normal
9	Good	High
10	Good	High
11	Poor	High
12	Poor	High
13	Poor	High
14	Poor	High

1. Hitung entropi dari target attribute

$$Info(D) = \left(-\frac{7}{14} x Log_2\left(\frac{7}{14}\right)\right) + \left(-\frac{7}{14} x Log_2\left(\frac{7}{14}\right)\right) = 1$$

2. Hitung entropi dari tiap kelas pada predictor attribute

$$Info_{Nilai}(D) = \sum_{j=1}^{v} \frac{|D_j|}{|D|} \times Info(D_j)$$

- $Info(D_{Excellent}) = \left(-\frac{3}{4} x Log_2\left(\frac{3}{4}\right)\right) + \left(-\frac{1}{4} x Log_2\left(\frac{1}{4}\right)\right) = 0{,}811$
- $Info(D_{Good}) = \left(-\frac{4}{6} x Log_2\left(\frac{4}{6}\right)\right) + \left(-\frac{2}{6} x Log_2\left(\frac{2}{6}\right)\right) = 0{,}918$
- $Info(D_{Poor}) = \left(-0 x Log_2(0)\right) + \left(-\frac{4}{4} x Log_2\left(\frac{4}{4}\right)\right) = 0$

$$Info_{Nilai}(D) = \left(\left(\frac{4}{14} x\ 0{,}811\right) + \left(\frac{6}{14} x\ 0{,}918\right) + \left(\frac{4}{14} x\ 0\right)\right) = 0{,}625$$

3. Hitung Information Gain setiap Attribute prediktor

$Gain(Nilai) = Info(D) - Info_{Nilai}(D)$
$= 1 - 0{,}625$
$= 0{,}375$

Contoh 3:

ID	Outlook	Temperature	Humidity	Wind	Decision
0	Sunny	Hot	High	Weak	No
1	Sunny	Hot	High	Strong	No
2	Overcast	Hot	High	Weak	Yes
3	Rain	Mild	High	Weak	Yes
4	Rain	Cool	Normal	Weak	Yes
5	Rain	Cool	Normal	Strong	Yes
6	Overcast	Cool	Normal	Strong	Yes
7	Sunny	Mild	High	Weak	No
8	Sunny	Cool	Normal	Weak	Yes
9	Rain	Mild	Normal	Weak	Yes
10	Sunny	Mild	Normal	Strong	Yes
11	Overcast	Mild	High	Strong	Yes
12	Overcast	Hot	Normal	Weak	Yes
13	Rain	Mild	High	Strong	No

Langkah 1: Tentukan Root

1. Hitung entropi dari Attribute target

$$Info(D) = \left(-\frac{4}{14} x Log_2\left(\frac{4}{14}\right)\right) + \left(-\frac{10}{14} x Log_2\left(\frac{10}{14}\right)\right) \approx 0{,}863$$

2. Hitung entropi dari tiap kelas pada Attribute prediktor

A. **Outlook**

- $Info(D_{Overcast}) = \left(-\frac{0}{4} x Log_2\left(\frac{0}{4}\right)\right) + \left(-\frac{4}{4} x Log_2\left(\frac{4}{4}\right)\right) = 0$
- $Info(D_{Rain}) = \left(-\frac{1}{5} x Log_2\left(\frac{1}{5}\right)\right) + \left(-\frac{4}{5} x Log_2\left(\frac{4}{5}\right)\right) = 0{,}722$
- $Info(D_{Sunny}) = \left(-\frac{3}{5} x Log_2\left(\frac{3}{5}\right)\right) + \left(-\frac{2}{5} x Log_2\left(\frac{2}{5}\right)\right) = 0{,}971$

$$Info_{Outlook}(D) = \left(\left(\frac{4}{14} x\ 0\right) + \left(\frac{5}{14} x\ 0{,}722\right) + \left(\frac{5}{14} x\ 0{,}971\right)\right) = 0{,}605$$

B. **Temperature**

- $Info(D_{Cool}) = \left(-\frac{0}{4}xLog_2\left(\frac{0}{4}\right)\right) + \left(-\frac{4}{4}xLog_2\left(\frac{4}{4}\right)\right) = 0$
- $Info(D_{Hot}) = \left(-\frac{2}{4}xLog_2\left(\frac{2}{4}\right)\right) + \left(-\frac{2}{4}xLog_2\left(\frac{2}{4}\right)\right) = 1$
- $Info(D_{Mild}) = \left(-\frac{2}{6}xLog_2\left(\frac{2}{6}\right)\right) + \left(-\frac{4}{6}xLog_2\left(\frac{4}{6}\right)\right) = 0{,}918$

$$Info_{Temperature}(D) = \left(\left(\frac{4}{14}x\ 0\right) + \left(\frac{4}{14}x\ 1\right) + \left(\frac{6}{14}x\ 0{,}918\right)\right) = 0{,}679$$

C. **Humidity**

$$Info_{Humidity}(D) = 0{,}493$$

D. **Wind**

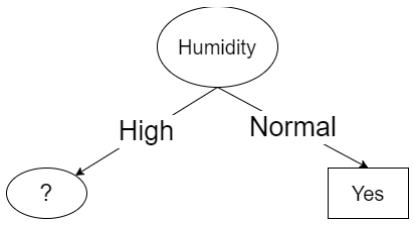
$$Info_{Wind}(D) = 0{,}857$$

3. Hitung Information Gain setiap Attribute prediktor

$Gain(Outlook) = Info(D) - Info_{Outlook}(D)$
$= 0{,}863 - 0{,}0679$
$= 0{,}259$
$Gain(Temperature) = Info(D) - Info_{Temperature}(D)$
$= 0{,}863 - 0{,}679$
$= 0{,}184$
$Gain(Humidity) = Info(D) - Info_{Humidity}(D)$
$= 0{,}863 - 0{,}493$
$= 0{,}371$
$Gain(Wind) = Info(D) - Info_{Wind}(D)$
$= 0{,}863 - 0{,}857$
$= 0{,}006$

Attribute	Decision			Entropy	Information Gain
	Yes	No	Total		
Outlook					
• Overcast	4	0	4	0	0,256
• Rain	4	1	5	0,722	
• Sunny	2	3	5	0,971	
Temperature					
• Cool	0	4	4	0	0,184
• Hot	2	2	4	1	
• Mild	2	4	6	0,918	
Humidity					
• High	4	3	7	0,985	0,371
• Normal	7	0	7	0	
Wind					
• Weak	2	6	8	0,985	0,006
• Strong	4	2	6	0,918	

ID	Outlook	Temperature	Humidity	Wind	Decision
0	Sunny	Hot	High	Weak	No
1	Sunny	Hot	High	Strong	No
2	Overcast	Hot	High	Weak	Yes
3	Rain	Mild	High	Weak	Yes
4	Rain	Cool	Normal	Weak	Yes
5	Rain	Cool	Normal	Strong	Yes
6	Overcast	Cool	Normal	Strong	Yes
7	Sunny	Mild	High	Weak	No
8	Sunny	Cool	Normal	Weak	Yes
9	Rain	Mild	Normal	Weak	Yes
10	Sunny	Mild	Normal	Strong	Yes
11	Overcast	Mild	High	Strong	Yes
12	Overcast	Hot	Normal	Weak	Yes
13	Rain	Mild	High	Strong	No



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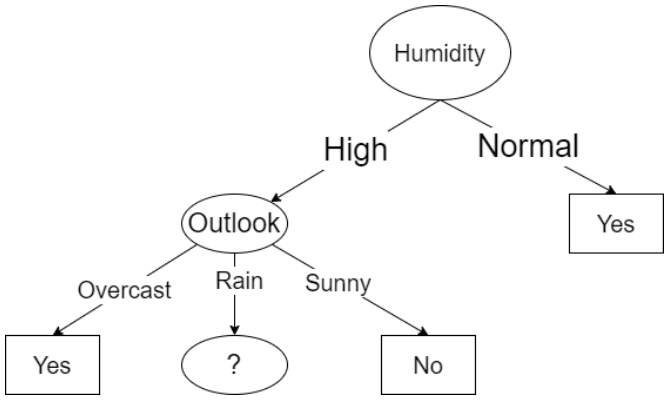
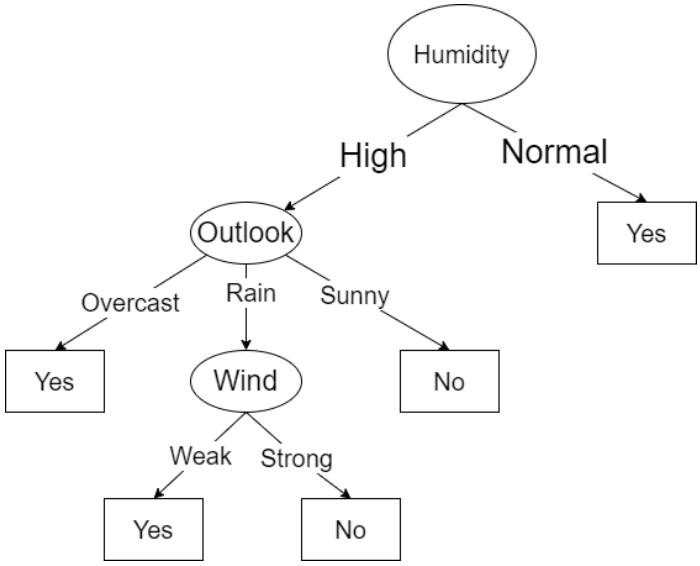
0	Sunny	Hot	High	Weak	No
1	Sunny	Hot	High	Strong	No
2	Overcast	Hot	High	Weak	Yes
3	Rain	Mild	High	Weak	Yes
7	Sunny	Mild	High	Weak	No
11	Overcast	Mild	High	Strong	Yes
13	Rain	Mild	High	Strong	No

Attribute	Decision			Entropy	Information Gain
	Yes	No	Total		
Humidity|High	4	3	7	0,985	
Outlook					
• Overcast	2	0	2	0	0,6995
• Rain	1	1	2	1	
• Sunny	0	3	3	0	
Temperature					
• Cool	0	0	0	0	0,0203
• Hot	1	2	3	0,918	
• Mild	2	2	4	1	
Wind					
• Weak	2	2	4	1	0,0203
• Strong	1	2	3	0,918	



ID	Outlook	Temperature	Humidity	Wind	Decision
3	Rain	Mild	High	Weak	Yes
13	Rain	Mild	High	Strong	No

Attribute	Decision			Entropy	Information Gain
	Yes	No	Total		
Humidity|High and Outlook| Rain	1	1	2	1	
Temperature					
• Cool	0	0	0	0	0
• Hot	0	0	0	0	
• Mild	1	1	2	1	
Wind					
• Weak	1	0	1	0	1
• Strong	0	1	1	0	



Aturan If-Else dari hasil Decision Tree

- If Humidity = Normal, then Yes
- If Humidity = High and Outlook = Sunny, then No
- If Humidity = High and Outlook = Overcast, then Yes
- If Humidity = High and Outlook = Rain and Wind = Strong then No
- If Humidity = High and Outlook = Rain and Wind = Weak then Yes