	Outlook	Temp	Humidity	Windy	Play
1	Sunny	Hot	High	False	No
2	Sunny	Hot	High	True	No
3	Overcast	Hot	High	F	yes
4	Rainy	Mild	High	F	yes
5	Rainy	Cool	Normal	F	yes
6	Rainy	Cool	Normal	T	No
7	Overcast	Cool	Normal	T	yes
8	Sunny	Mild	High	F	No
9	Sunny	Cool	Nor	F	yes
10	Rainy	Mild	Nor	F	yes
11	Sunny	Mild	Nor	T	yes
12	Overcast	Mild	High	T	yes
13	Overcast	Hot	Nor	F	yes
14	Rainy	Mild	High	F	No

$$E(\text{outlook}) = -\left(\frac{9}{}\right)\log\left(\frac{9}{}\right) - \left(\frac{5}{14}\right)\log\left(\frac{5}{14}\right)$$

Gini(S) = $1 - \left[\left(\frac{9}{14}\right)^2 + \left(\frac{5}{14}\right)^2\right]$ = 0.4591

outlook	yes	no	Total
Sunny	2	3	5
Overcast	4	0	4
Raining	2	3	5
			14

Temp	yes	no	Total
Hot	2	2	4
Mild	4	2	6
Cool	3	1	4
			14

Gini(S, outlook) = $\frac{5}{14}$ gini(2,3) + $\frac{4}{14}$ gini(4,0) + $\frac{5}{14}$ gini(2,3)

= $\left(\frac{5}{14}\left[1 - \left(\frac{2}{5}\right)^2 - \left(\frac{3}{5}\right)^2\right]\right) + \left(\frac{4}{14} * 0\right) + \left(\frac{5}{14}\left[1 - \left(\frac{2}{5}\right)^2 - \left(\frac{3}{5}\right)^2\right]\right)$

= 0.342

Gini gain(S, outlook) = 0.459 − 0.342 = **0.117**

Gini(S, temp) = $\frac{4}{14}$ gini(2,2) + $\frac{6}{14}$ gini(4,2) + $\frac{4}{14}$ gini(3,1)

= $\frac{4}{14}\left[1 - \left(\frac{2}{4}\right)^2 - \left(\frac{2}{4}\right)^2\right] + \frac{6}{14}\left[1 - \left(\frac{4}{6}\right)^2 - \left(\frac{2}{6}\right)^2\right] + \frac{4}{14}\left[1 - \left(\frac{3}{4}\right)^2 - \left(\frac{1}{4}\right)^2\right]$

= 0.443

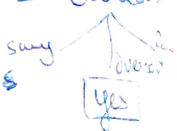
Gini gain(S, temp) = 0.459 − 0.443

= **0.016**

Gini gain(S, humidity) = 0.459 − 0.3674 = **0.0916**

Gini gain(S, wind) = 0.459 − 0.4286 = **0.0304**

Select the feature having largest gini gain or smallest gini index ⇒ outlook



Under sunny

Outlook	Temp	Humidity	Wind	
Sunny	Hot	High	Weak	No
Sunny	Hot	High	Strong	No
Sunny	Mild	High	Weak	No
Sun	Cool	Norm	Weak	yes
Sunny	Mild	Norm	Strong	yes

Humi		yes	no	
	High	0	3	3
	Norm	2	0	2
				5

Temp		yes	No	Tot
	Hot	0	2	2
	cold	1	1	2
	Mild	1	0	1
				5

Wind				
	Weak	1	2	3
	Strong	1	1	2
				5

Gini (sunny, temp) = $\frac{2}{5}$ gini(0,2) + $\frac{2}{5}$ gini(1,1) + $\frac{1}{5}$ gini(1,0)

$= \frac{2}{5}\left[1-\left(\frac{0}{2}\right)^2-\left(\frac{2}{0}\right)^2\right] + \frac{2}{5}\left[1-\left(\frac{1}{2}\right)^2-\left(\frac{1}{2}\right)^2\right] + \frac{1}{5} * 0$

$= \frac{2}{5}\left[1-0.25-0.25\right] = 0.2$

Gini (sunny, hum) = $\frac{3}{5}$ gini(0,3) + $\frac{2}{5}$ gini(2,0) = 0

Gini (sunny, wind) = $\frac{3}{5}$ gini(1,2) + $\frac{2}{5}$ gini(1,1)

$= \frac{3}{5}\left[1-\left(\frac{1}{3}\right)^2-\left(\frac{2}{3}\right)^2\right] + \frac{2}{5}\left[1-\left(\frac{1}{2}\right)^2-\left(\frac{1}{2}\right)^2\right]$

$= \frac{3}{5}\left[1-0.11-0.44\right] + 0.2 = 0.27+0.2 = 0.47$

Humidity has lower gini index

Under rainy

		yes	No	Tot
Temp	Mild	2	1	3
	Cool	1	1	2
				5

		yes	No	Tot
Hum	High	1	1	2
	Norm	2	1	3
				5

		yes	No	Tot
Wind	Strong	0	2	2
	Weak	3	0	3
				5

Gini (rainy, temp) = $\frac{3}{5}$ gini(2,1) + $\frac{2}{5}$ gini(1,1)

$= 0.47$

Gini (rainy, hum) = $\frac{2}{5}$ gini(1,1) + $\frac{3}{5}$ gini(2,1)

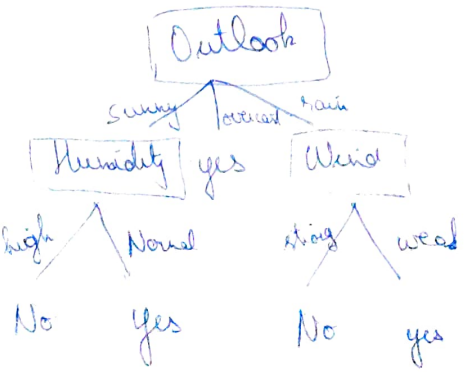
$= \frac{2}{5}\left(1-\left(\frac{1}{2}\right)^2-\left(\frac{1}{2}\right)^2\right) + \frac{3}{5}\left(1-\left(\frac{2}{3}\right)^2-\left(\frac{1}{3}\right)^2\right)$

$= 0.47$

gini (rainy, wind) = $\frac{2}{5}$ gini(0,2) + $\frac{3}{5}$ gini(3,0)

$= 0$

Wind has lower index



Gini (sunny, temp) = $\frac{2}{5}$ gini (0,2) + $\frac{2}{5}$ gini (1,1) + $\frac{1}{5}$ gini (1,0)

$= \frac{2}{5}\left[1-\left(\frac{0}{2}\right)^2-\left(\frac{2}{0}\right)^2\right] + \frac{2}{5}\left[1-\left(\frac{1}{2}\right)^2-\left(\frac{1}{2}\right)^2\right] + \frac{1}{5} * 0$

$= \frac{2}{5}\left[1-0.25-0.25\right] = 0.2$

Gini (sunny, hum) = $\frac{3}{5}$ gini (0,3) + $\frac{2}{5}$ gini (2,0) = 0

Gini (sunny, wind) = $\frac{3}{5}$ gini (1,2) + $\frac{2}{5}$ gini (1,1)

$= \frac{3}{5}\left[1-\left(\frac{1}{3}\right)^2-\left(\frac{2}{3}\right)^2\right] + \frac{2}{5}\left[1-\left(\frac{1}{2}\right)^2-\left(\frac{1}{2}\right)^2\right]$

$= \frac{3}{5}\left[1-0.11-0.44\right] + 0.2 = 0.27 + 0.2 = 0.47$

Humidity has lower gini index

Under raing

		yes	No	Tot
Temp	Mild	2	1	3
	Cool	1	1	2
				5

		yes	No	Tot
Hum	High	1	1	2
	Norm	2	1	3
				5

		yes	No	Tot
Wind	Strong	0	2	2
	Weak	3	0	3
				5

Gini (raing, temp) = $\frac{3}{5}$ gini (2,1) + $\frac{2}{5}$ gini (1,1)

$= 0.47$

Gini (raing, hum) = $\frac{2}{5}$ gini (1,1) + $\frac{3}{5}$ gini (2,1)

$= \frac{2}{5}\left(1-\left(\frac{1}{2}\right)^2-\left(\frac{1}{2}\right)^2\right) + \frac{3}{5}\left(1-\left(\frac{2}{3}\right)^2-\left(\frac{1}{3}\right)^2\right)$

$= 0.47$

gini (raing, wind) = $\frac{2}{5}$ gini (0,2) + $\frac{3}{5}$ gini (3,0)

$= 0$

Wind has lower index