

age	income	student	credit rating	buys computer
<=30	high	no	fair	no
<=30	high	no	excellent	no
31...40	high	no	fair	yes
>40	medium	no	fair	yes
>40	low	yes	fair	yes
>40	low	yes	excellent	no
31...40	low	yes	excellent	yes
<=30	medium	no	fair	no
<=30	low	yes	fair	yes
>40	medium	yes	fair	yes
<=30	medium	yes	excellent	yes
31...40	medium	no	excellent	yes
31...40	high	yes	fair	yes
>40	medium	no	excellent	no

$$Info(D) = I(8,4) = -\frac{8}{12} \log_2\left(\frac{8}{12}\right) - \frac{4}{12} \log_2\left(\frac{4}{12}\right) = 0.918$$

$$Info_{age}(D) = \frac{4}{12} I(2,2) + \frac{3}{12} I(3,0) + \frac{5}{12} I(3,2)$$

$$= \frac{4}{12} \left(-\frac{2}{4} \log_2\left(\frac{2}{4}\right) - \frac{2}{4} \log_2\left(\frac{2}{4}\right)\right) + \frac{3}{12} (0) + \frac{5}{12} \left(-\frac{3}{5} \log_2\left(\frac{3}{5}\right) - \frac{2}{5} \log_2\left(\frac{2}{5}\right)\right)$$

$$= 0.738$$

$$Gain_{age} = 0.918 - 0.738 = 0.180$$

$$Info_{income}(D) = \frac{3}{12} I(2,1) + \frac{5}{12} I(4,1) + \frac{3}{12} I(2,2)$$

$$= \frac{3}{12} \left(-\frac{2}{3} \log_2\left(\frac{2}{3}\right) - \frac{1}{3} \log_2\left(\frac{1}{3}\right)\right) + \frac{5}{12} \left(-\frac{4}{5} \log_2\left(\frac{4}{5}\right) - \frac{1}{5} \log_2\left(\frac{1}{5}\right)\right) + \frac{3}{12} \left(-\frac{2}{4} \log_2\left(\frac{2}{4}\right) - \frac{2}{4} \log_2\left(\frac{2}{4}\right)\right)$$

$$= 0.864$$

$$Gain_{income} = 0.918 - 0.864 = 0.054$$

$$Info_{student}(D) = \frac{6}{12} I(3,3) + \frac{6}{12} I(5,1)$$

$$= \frac{6}{12} \left(-\frac{3}{6} \log_2\left(\frac{3}{6}\right) - \frac{3}{6} \log_2\left(\frac{3}{6}\right)\right) + \frac{6}{12} \left(-\frac{5}{6} \log_2\left(\frac{5}{6}\right) - \frac{1}{6} \log_2\left(\frac{1}{6}\right)\right)$$

$$= 0.825$$

$$Gain_{student} = 0.918 - 0.825 = 0.093$$

$$Info_{credit}(D) = \frac{7}{12} I(6,1) + \frac{5}{12} I(2,3)$$

$$= \frac{7}{12} \left(-\frac{6}{7} \log_2\left(\frac{6}{7}\right) - \frac{1}{7} \log_2\left(\frac{1}{7}\right)\right) + \frac{5}{12} \left(-\frac{2}{5} \log_2\left(\frac{2}{5}\right) - \frac{3}{5} \log_2\left(\frac{3}{5}\right)\right)$$

$$= 0.750$$

$$Gain_{credit} = 0.918 - 0.750 = 0.168$$

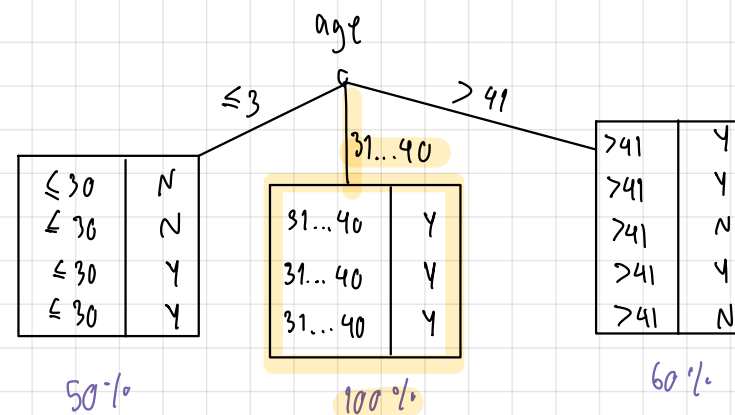
$$Gain_{age} = 0.180$$

$$Gain_{income} = 0.054$$

$$Gain_{student} = 0.093$$

$$Gain_{credit} = 0.168$$

$$Gain_{age}$$



$$\text{Info}(D, \leq 30) = I(2, 2) = -\frac{2}{4} \log_2\left(\frac{2}{4}\right) - \frac{2}{4} \log_2\left(\frac{2}{4}\right) = 1$$

income	p_i	n_i	$I(p_i, n_i)$
low	1	0	0
medium	1	0	0
high	0	2	0

$$I(1, 0) = -\frac{1}{1} \log_2\left(\frac{1}{1}\right) - \frac{0}{1} \log_2\left(\frac{0}{1}\right) = 0$$

$$I(1, 0) = -\frac{1}{1} \log_2\left(\frac{1}{1}\right) - \frac{0}{1} \log_2\left(\frac{0}{1}\right) = 0$$

$$I(0, 2) = -\frac{0}{2} \log_2\left(\frac{0}{2}\right) - \frac{2}{2} \log_2\left(\frac{2}{2}\right) = 0$$

$$\begin{aligned} \text{Info}_{\text{income}}(D, \leq 30) &= \frac{2}{4} I(1, 0) + \frac{2}{4} I(1, 0) + \frac{2}{4} I(0, 2) \\ &= \frac{2}{4}(0) + \frac{2}{4}(0) + \frac{2}{4}(0) \\ &= 0 \end{aligned}$$

$$\text{Gain}(\text{income}) = 1 - 0 = 1$$

Student	p_i	n_i	$I(p_i, n_i)$
yes	2	0	0
no	0	2	0

$$I(2, 0) = -\frac{2}{2} \log_2\left(\frac{2}{2}\right) - \frac{0}{2} \log_2\left(\frac{0}{2}\right) = 0$$

$$I(0, 2) = -\frac{0}{2} \log_2\left(\frac{0}{2}\right) - \frac{2}{2} \log_2\left(\frac{2}{2}\right) = 0$$

$$\begin{aligned} \text{Info}_{\text{student}}(D, \leq 30) &= \frac{2}{4} I(2, 0) + \frac{2}{4} I(0, 2) \\ &= \frac{2}{4}(0) + \frac{2}{4}(0) \\ &= 0 \end{aligned}$$

$$\text{Gain}(\text{student}) = 1 - 0 = 1$$

credit rate	p_i	n_i	$I(p_i, n_i)$
fair	1	1	1
excellent	1	1	1

$$I(1, 1) = -\frac{1}{2} \log_2\left(\frac{1}{2}\right) - \frac{1}{2} \log_2\left(\frac{1}{2}\right) = 1$$

$$I(1, 1) = -\frac{1}{2} \log_2\left(\frac{1}{2}\right) - \frac{1}{2} \log_2\left(\frac{1}{2}\right) = 1$$

$$\begin{aligned} \text{Info}_{\text{credit rate}}(D, \leq 30) &= \frac{2}{4} I(1, 1) + \frac{2}{4} I(1, 1) \\ &= \frac{2}{4}(1) + \frac{2}{4}(1) \\ &= 1 \end{aligned}$$

$$\text{Gain}(\text{credit rate}) = 1 - 1 = 0$$

ข้อ 1

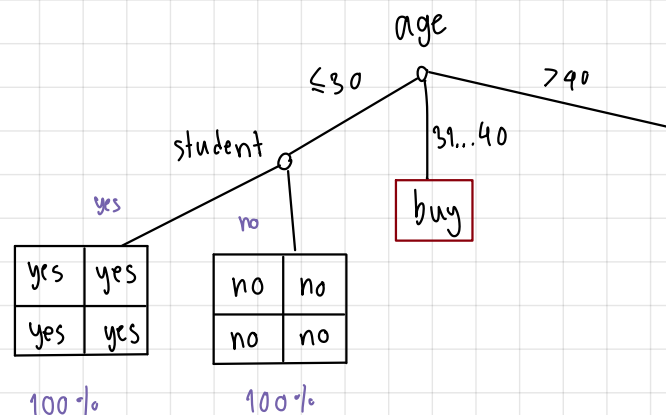
$$\text{Gain}(\text{income}) = 1$$

$$\text{Gain}(\text{student}) = 1$$

$$\text{Gain}(\text{credit rate}) = 0$$

ข้อ 2

$$\text{Gain}(\text{student})$$



$$\text{Info}(D_1 > 40) = I(3, 2) = -\frac{3}{5} \log_2\left(\frac{3}{5}\right) - \frac{2}{5} \log_2\left(\frac{2}{5}\right) = 0.971$$

income	p_i	n_i	$I(p_i, n_i)$
low	1	1	1
medium	2	1	0.918
high	0	0	0

$$I(1, 1) = 1 \quad I(0, 0) = 0$$

$$I(2, 1) = -\frac{2}{3} \log_2\left(\frac{2}{3}\right) - \frac{1}{3} \log_2\left(\frac{1}{3}\right) = 0.918$$

$$\begin{aligned} \text{info}_{\text{income}}(D_1 > 40) &= \frac{2}{5} I(1, 1) + \frac{3}{5} I(2, 1) + \frac{0}{5} I(0, 0) \\ &= \frac{2}{5}(1) + \frac{3}{5}(0.918) \\ &= 0.951 \end{aligned}$$

$$\text{Gain}(\text{income}) = 0.971 - 0.951 = 0.020$$

Student	p_i	n_i	$I(p_i, n_i)$
yes	2	1	0.918
no	1	1	1

$$I(2, 1) = 0.918 \quad I(1, 1) = 1$$

$$\begin{aligned} \text{info}_{\text{student}}(D_1 > 40) &= \frac{3}{5} I(2, 1) + \frac{2}{5} I(1, 1) \\ &= \frac{3}{5}(0.918) + \frac{2}{5}(1) \\ &= 0.951 \end{aligned}$$

$$\text{Gain}(\text{student}) = 0.971 - 0.951 = 0.020$$

credit rate	p_i	n_i	$I(p_i, n_i)$
fair	3	0	0
excellent	0	2	0

$$I(3, 0) = -\frac{3}{3} \log_2\left(\frac{3}{3}\right) - \frac{0}{3} \log_2\left(\frac{0}{3}\right) = 0$$

$$I(0, 2) = 0$$

$$\begin{aligned} \text{info}_{\text{credit}}(D_1 > 40) &= \frac{3}{5} I(3, 0) + \frac{2}{5} I(0, 2) \\ &= \frac{3}{5}(0) + \frac{2}{5}(0) \\ &= 0 \end{aligned}$$

$$\text{Gain}(\text{credit rate}) = 0.971 - 0 = 0.971$$

$$\therefore \text{Gain}(\text{income}) = 0.020$$

$$\text{Gain}(\text{student}) = 0.020$$

$$\text{Gain}(\text{credit rate}) = 0.971$$

$$\therefore \text{Gain}(\text{credit rate})$$

