Homework 2

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

$$Info(D) = I(\overset{yes}{9},\overset{No}{5}) = -\frac{9}{14}\log_2\left(\frac{9}{14}\right) - \frac{5}{14}\log_2\left(\frac{5}{14}\right) = 0.940$$

$$Info_{age}(D) = \frac{5}{14}\overset{\leq 30}{I(2,3)} + \frac{4}{14}\overset{31-40}{I(4,0)} + \frac{5}{14}\overset{>40}{I(3,2)}$$

$$= \frac{5}{14}\left[-\frac{2}{5}\log\left(\frac{2}{5}\right) - \frac{3}{5}\log_2\left(\frac{3}{5}\right)\right] + \frac{4}{14}\left[-\frac{4}{4}\log_2\left(\frac{4}{4}\right) - \frac{0}{4}\log_2\left(\frac{0}{4}\right)\right]^{0} +$$

$$\frac{5}{14}\left[-\frac{3}{5}\log_2\left(\frac{3}{5}\right) - \frac{2}{5}\log_2\left(\frac{2}{5}\right)\right] = 0.694$$

$$Info_{income}(D) = \frac{4}{14}\overset{high}{I(2,2)} + \frac{6}{14}\overset{medium}{I(4,2)} + \frac{4}{14}\overset{low}{I(3,1)}$$

$$= \frac{4}{14}\left[-\frac{2}{4}\log_2\left(\frac{2}{4}\right) - \frac{2}{4}\log_2\left(\frac{2}{4}\right)\right] + \frac{6}{14}\left[-\frac{4}{6}\log_2\left(\frac{4}{6}\right) - \frac{2}{6}\log_2\left(\frac{2}{6}\right)\right] +$$

$$\frac{4}{14}\left[-\frac{3}{4}\log_2\left(\frac{3}{4}\right) - \frac{1}{4}\log_2\left(\frac{1}{4}\right)\right] = 0.911$$

$$Info_{student}(D) = \frac{7}{14}\overset{yes}{I(6,1)} + \frac{7}{14}\overset{No}{I(3,4)}$$

$$= \frac{7}{14}\left[-\frac{6}{7}\log_2\left(\frac{6}{7}\right) - \frac{1}{7}\log_2\left(\frac{1}{7}\right)\right] + \frac{7}{14}\left[-\frac{3}{7}\log_2\left(\frac{3}{7}\right) - \frac{4}{7}\log_2\left(\frac{4}{7}\right)\right] = 0.788$$

$$Info_{credit\text{-}rating}(D) = \frac{6}{14}\overset{excellent}{I(3,3)} + \frac{8}{14}I(6,2)$$

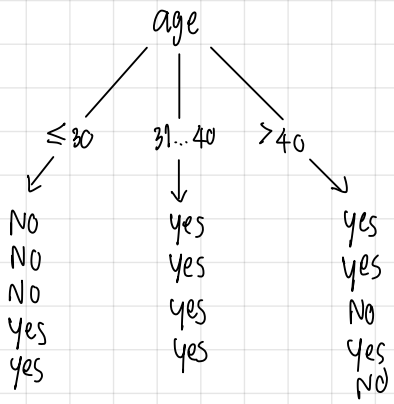
$$= \frac{6}{14}\left[-\frac{3}{6}\log_2\left(\frac{3}{6}\right) - \frac{3}{6}\log_2\left(\frac{3}{6}\right)\right] + \frac{8}{14}\left[-\frac{6}{8}\log_2\left(\frac{6}{8}\right) - \frac{2}{8}\log_2\left(\frac{2}{8}\right)\right] = 0.892$$

Gain age = 0.940 − 0.694 = 0.246

Gain income = 0.940 − 0.911 = 0.029

Gain student = 0.940 − 0.788 = 0.152

Gain credit rating = 0.940 − 0.892 = 0.048



Age ≤ 30

$$Info_{age\leq 30}(D) = I(2,3) = -\frac{2}{5}\log_2\left(\frac{2}{5}\right) - \frac{3}{5}\log_2\left(\frac{3}{5}\right) = 0.971$$

$$Info_{income}(D) = \frac{2}{5}\overset{high}{I(0,2)} + \frac{2}{5}\overset{medium}{I(1,1)} + \frac{1}{5}\overset{low}{I(1,0)}$$

$$= \frac{2}{5}\left[-\frac{0}{2}\log_2\left(\frac{0}{2}\right) - \frac{2}{2}\log_2\left(\frac{2}{2}\right)\right] + \frac{2}{5}\left[-\frac{1}{2}\log_2\left(\frac{1}{2}\right) - \frac{1}{2}\log_2\left(\frac{1}{2}\right)\right] +$$

$$\frac{1}{5}\left[-\frac{1}{1}\log_2\left(\frac{1}{1}\right) - \frac{0}{1}\log_2\left(\frac{0}{1}\right)^{0}\right] = 0.4$$

$$Info_{student}(D) = \frac{2}{5}\overset{Yes}{I(2,0)} + \frac{3}{5}\overset{No}{I(0,3)}$$

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

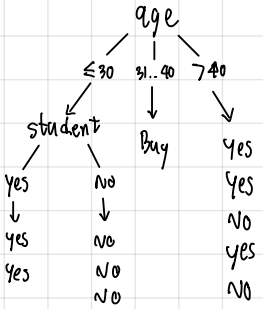
$$Info_{credit\text{-}rating}(D) = \frac{2}{5}\overset{excellent}{I(1,1)} + \frac{3}{5}I(1,2)$$

$$= \frac{2}{5}\left[-\frac{1}{2}\log_2\left(\frac{1}{2}\right)-\frac{1}{2}\log_2\left(\frac{1}{2}\right)\right]+\frac{3}{5}\left[-\frac{1}{3}\log_2\left(\frac{1}{3}\right)-\frac{2}{3}\log_2\left(\frac{2}{3}\right)\right] = 0.951$$

$Gain_{income} = 0.971 - 0.4 = 0.571$

$Gain_{student} = 0.971 - 0 = 0.971$ *

$Gain_{credit\text{-}rating} = 0.971 - 0.951 = 0.020$



Age > 40

$Info_{age>40}(D) = I(3,2) = -\frac{3}{5}\log_2\left(\frac{3}{5}\right)-\frac{2}{5}\log_2\left(\frac{2}{5}\right) = 0.971$

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

$= 0.951$

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

$= 0.951$

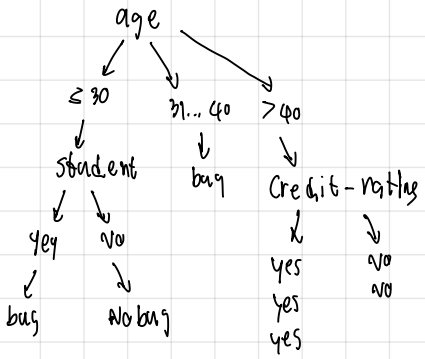
$Info_{credit\text{-}rating}(D) = \frac{2}{5}I(0,2) + \frac{3}{5}I(3,0)$

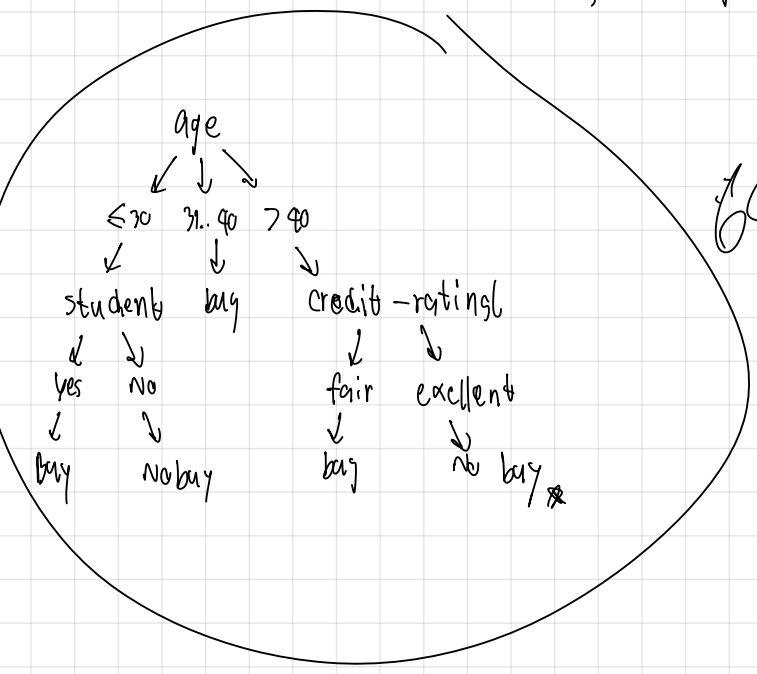
$= 0$

$Gain_{income} = 0.971 - 0.951 = 0.020$

$Gain_{student} = 0.971 - 0.951 = 0.020$

$Gain_{credit\text{-}rating} = 0.971 - 0 = 0.971$ *





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