Lets consider (age)

{youth, middle_age}, {youth, senior}, {senior, middle age}.

$gini_{age \in \{youth, middle\_age\}}(D) = \left(\frac{7}{14}\right) Gini(D_1) + \frac{5}{14} Gini(D_2)$

$= \frac{7}{14}\left(1 - \left(\frac{6}{7}\right)^2 - \left(\frac{1}{7}\right)^2\right) + \frac{5}{14}\left(1 - \left(\frac{3}{5}\right)^2 - \left(\frac{2}{5}\right)^2\right)$

$= .4571$

$= gini_{age \in \{senior\}}(D)$

$gini_{age \in \{youth, senior\}}(D) = \frac{10}{14}\left(1 - \left(\frac{5}{10}\right)^2 - \left(\frac{5}{10}\right)^2\right) + \frac{4}{14}\left(1 - \left(\frac{4}{4}\right)^2 - \left(\frac{0}{4}\right)^2\right)$

$= .3571$

$= gini_{age \in \{middle\_aged\}}(D)$

$gini_{age \in \{middle\_age, senior\}}(D) = \frac{7}{14}\left(1 - \left(\frac{7}{9}\right)^2 - \left(\frac{2}{9}\right)^2\right) - \frac{5}{14}\left(1 - \left(\frac{2}{5}\right)^2 - \left(\frac{3}{5}\right)^2\right)$

$= .3936$

$= gini_{age \in \{youth\}}(D)$

Let's consider {student}

binary attribute.

$$Gini_{student}(D) = \frac{7}{14}\left(1-\left(\frac{6}{7}\right)^2-\left(\frac{1}{7}\right)^2\right) + \frac{7}{14}\left(1-\left(\frac{3}{7}\right)^2 - \left(\frac{4}{7}\right)^2\right)$$

$$= .3673$$

Similarly,

$$Gini_{credit\_rating}(D) = .4285$$

Reduction of impurity

age → .459 − .3571 = .1019

income → .459 − .4428 = .0162

student → .459 − .3673 = .0917

credit_rating → .459 − .4285 = .0305