→ Dataset entropy:

[8+, 6-]

Entropy $= \frac{-8}{14}\log_2\frac{8}{14} - \frac{6}{14}\log_2\frac{6}{14} = 0.985$

→ Early registration IG:

(+) [4+, 2-]

Entropy $= \frac{-4}{6}\log\frac{4}{6} - \frac{2}{6}\log\frac{2}{6}$

$= 0.9183$

(-) [4, 4]

Entropy = 1

$\therefore$ IG $= 0.985 - \left(\frac{6}{14} * 0.9183 + \frac{8}{14} * 1\right) \simeq 0.02$

→ Finished homework IG:

(+) [5+, 2-]

Entropy $= \frac{-5}{7}\log_2\frac{5}{7} - \frac{2}{7}\log_2\frac{2}{7}$

$= 0.863$

(-) [3+, 4-]

Entropy $= \frac{-3}{7}\log\frac{3}{7} - \frac{4}{7}\log\frac{4}{7}$

$= 0.985$

IG $= 0.985 - (0.5 * 0.863 + 0.5 * 0.985) \simeq 0.061$

→ Senior IG:

(+) [5+, 3-]

Entropy $= \frac{-5}{8}\log\frac{5}{8} - \frac{3}{8}\log\frac{3}{8}$

$= 0.954$

(-) [3+, 3-]

Entropy = 1

$\therefore$ IG $= 0.985 - \left(\frac{8}{14} * 0.954 + \frac{6}{14}\right) \simeq 0.013$

→ like coffe IG:

(+) [3+, 1-] Entropy = 0.8113

(-) [5+, 5-] Entropy = 1

$$IG = 0.985 - \left(\frac{4}{14} * 0.8113 + \frac{10}{14}\right) \simeq 0.039$$

→ like the homework IG:

(+) [5+, 4-] $Entropy = -\frac{5}{9}\log\frac{5}{9} - \frac{4}{9}\log\frac{4}{9} \simeq 0.991$

(-) [3+, 2-] $Entropy = -\frac{3}{5}\log\frac{3}{5} - \frac{2}{5}\log\frac{2}{5} = 0.971$

$$IG = 0.985 - \left(\frac{9}{14} * 0.991 + \frac{5}{14} * 0.971\right) \simeq 0.001$$

∴ IG (finished Homework) bigger than the rest

∴ finished homework is the root

Finished home work

[5+, 2-] yes [3+, 4-] no

• Entropy of finished home work (yes):

$$Entropy = -\frac{5}{7}\log\frac{5}{7} - \frac{2}{7}\log\frac{2}{7} = 0.863$$

→ Early registration IG:

(+) [3+ 0-] Entropy = 0

(-) [2+, 2-] Entropy = 1

$$IG = 0.863 - \left(0 + \frac{4}{7}\right) \simeq 0.291$$

→ Senior IG:

(+) [3,2] (−) [2,0]

Entropy = 0.971 Entropy = 0

$\therefore IG = 0.863 - \left(\frac{5}{7} * 0.971\right) \simeq 0.1694$

→ like Coffee

(+) [1, 1] (−) [4+, 1−]

Entropy = 1 Entropy $= \frac{4}{5}\log\frac{5}{4} - \frac{1}{5}\log\frac{1}{5} \simeq 0.7219$

$IG = 0.863 - \left(\frac{2}{7} + \frac{5}{7} * 0.7219\right) \simeq 0.0616$

→ liked the home work IG:

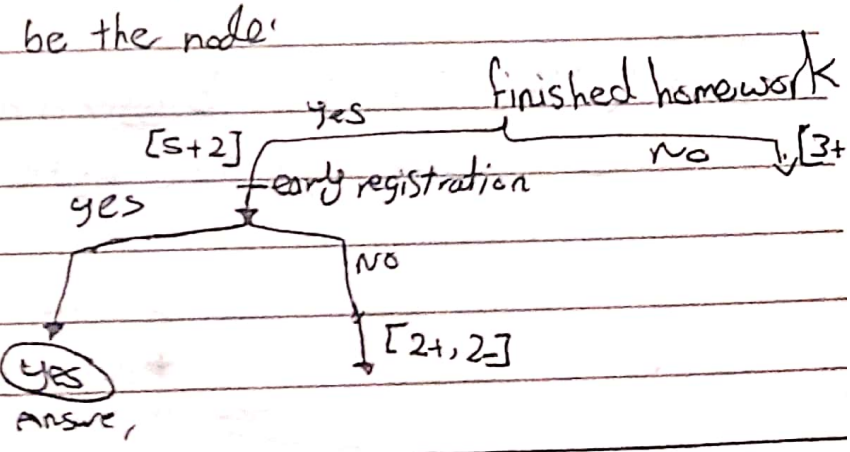
(+) [+3, −2] (−) [2, 0]

En Entropy = 0

$IG = 0.1694$

∴ IG(early registration) bigger than the rest

∴ early registration will be the node



• Entropy for finished howe work (No):

Entropy = 0.985

→ Seniority IG:

(+) [2+, 1-)
Entropy = $-\frac{2}{3}\log\frac{2}{3} - \frac{1}{3}\log\frac{1}{3}$
= 0.9183

(-) [1+, 3-]
Entropy = 0.8113

$IG = 0.985 - \left(\frac{3}{7} * 0.9183 + \frac{4}{7} * 0.8113\right) \simeq 0.1278$

→ like Coffe IG:

(+) [2, 0]
Entropy = 0

(-) [1, 4]
Entropy = 0.7219

$IG = 0.985 - \left(\frac{5}{7} * 0.7219\right) \simeq 0.4693$

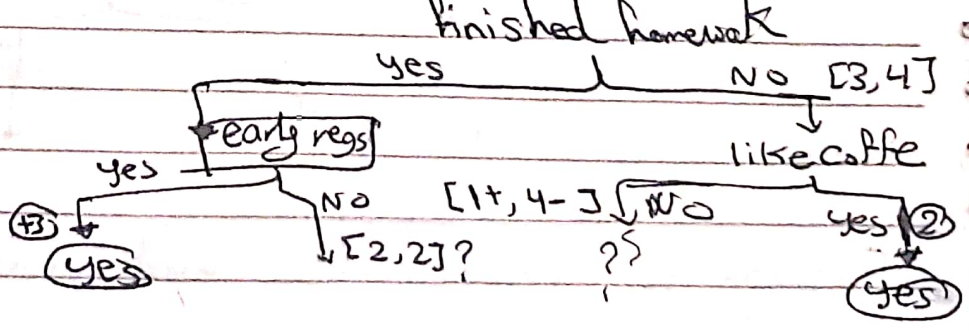
→ like the homework IG:

(+) [2, 2]
Entropy = 1

(-) [1+, 2]
Entropy = 0.9183

$IG = 0.985 - \left(\frac{4}{7} * 1 + \frac{3}{7} * 0.9183\right) = 0.02$

∴ IG(like Coffe) bigger than the rest.
∴ like coffe is the node



- Entropy for finished Hw(yes) early registration(No):

Entropy = 1

→ Senior IG:

H[1+, 2-] (-) [1+, 0]

Entropy = 0.9183 Entropy = 0

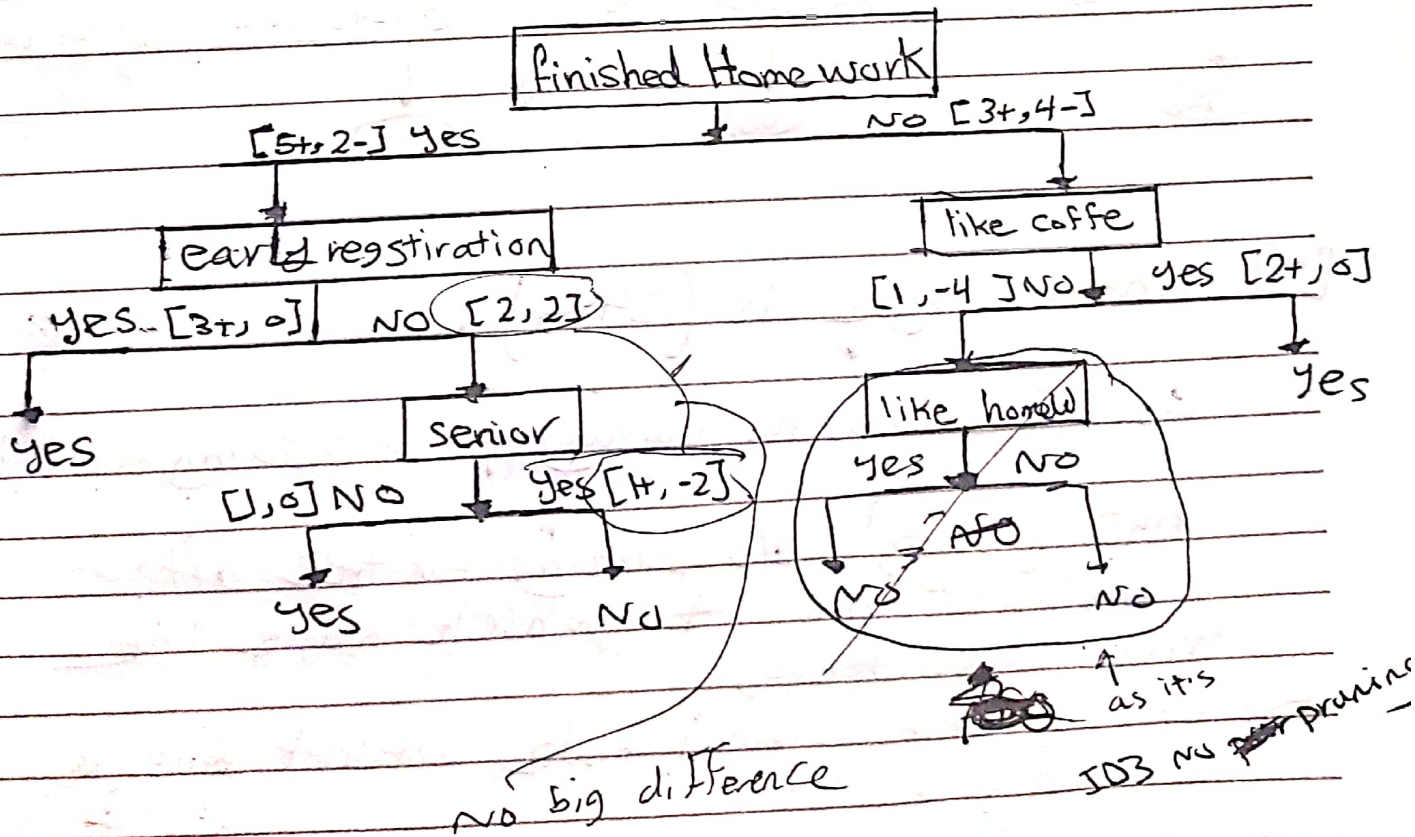
$IG = 1 - \left(\frac{3}{4} * 0.9183\right) = 0.311$

→ liked the homework IG:

(+) [1, 2] (-) [1, 0]

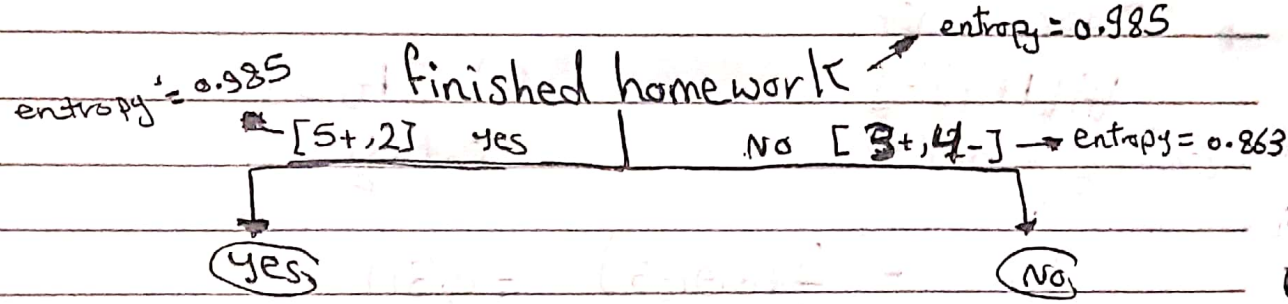
IG = 0.311

have the same IG take (Senior)

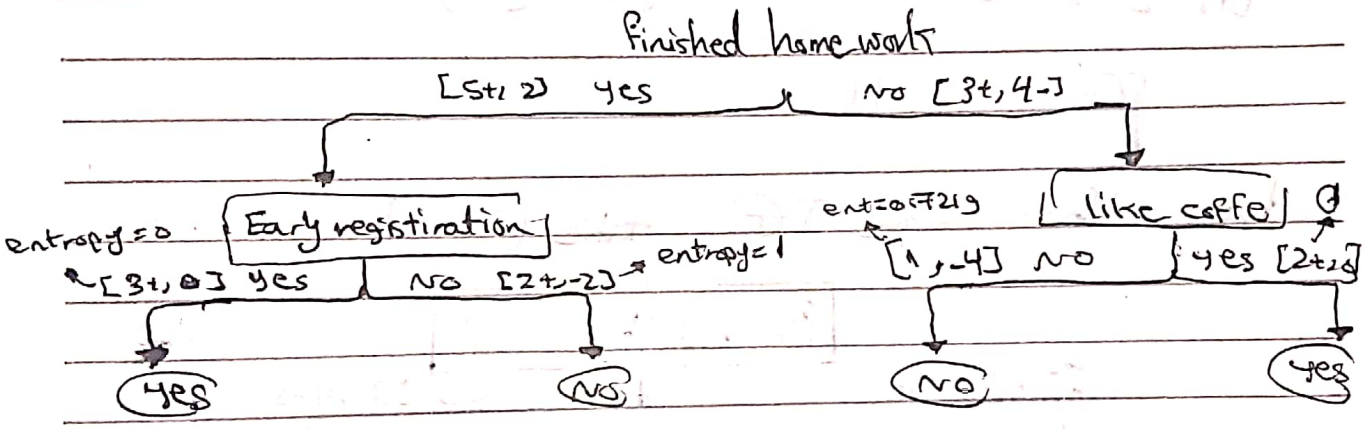


Answer of Problem [1]:

[1] ⊛ decision tree of depth (1):



⊛ decision tree of depth (2):



[2] another type is (C4.5),

as ID3 has no purning or solving overfiting

but (C4.5) do purning for tree after constructing it which make the tree less deep,

for ex; (like home work) node desnt give as any benifit

(senior no) without it there is only error in one training ex