CSPC54 - Intro to AI-ML

Date
16/11/21

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Question 5

(a) $P(A, B, B)$, $P(x, y, z)$

$\{x/A, y/B, z/B\}$.

as, progressive unification,

$P(\underline{A}, B, B)$, $P(\underline{x}, y, z) : \{\underline{x/A}\}$

$P(A, \underline{B}, B)$, $P(A, y, z) : \{x/A, \underline{y/B}\}$

$P(A, B, \underline{B})$, $P(A, B, \underline{z}) : \{x/A, y/B, \underline{z/B}\}$

so, $\boxed{\{x/A, y/B, z/B\}}$

(d) progress unification

knows(father(y), y), knows(x, x) : $\{\underline{x/father(y)}\}$

knows(father(y), y), knows(father(y), father(y))

$x/father(y)\}$.

cannot unify, variable y with father(y), which is a term referring to variable y

Question (3)

(a)

$$(\text{smoke} \wedge \text{heat}) \Rightarrow \text{fire}) \Leftrightarrow ((\text{Smoke} \Rightarrow \text{Fire}) \vee (\text{Heat} \Rightarrow \text{Fire}))$$

(b) fire.

So, Let variable names as,

S be smoke, F be Fire, H be Heat.

Now

Truth table,

S	F	H	S∧H	(S∧H)⇒F	S⇒F	H⇒F	(S⇒F) ∨ (H⇒F)	A⇔B
T	T	T	T	T	T	T	T	T
T	T	F	F	T	T	T	T	T
T	F	T	T	F	F	F	F	T
T	F	F	F	T	F	T	T	T
F	T	T	F	T	T	T	T	T
F	T	F	F	T	T	T	T	T
F	F	T	F	T	T	F	T	T
F	F	F	F	T	T	T	T	T

Therefore,

this is valid because its True for all the cases.mailed.

(b)

Big ∨ Dumb ∨ (Big ⇒ Dumb)

Let the variables for.

Big as B

Dumb as D.

B	D	B ∨ D	B ⇒ D	B ∨ D ∨ (B ⇒ D)
T	T	T	T	T
T	F	T	F	T
F	T	T	T	T
F	F	F	T	T

This is also valid because its true for all the models cases.

Question (4)

let, ∃1 : there exists exactly one.

(a) ∃x : Parent (Joan, x) ^ Female (X)

(b) ∃1x : (Parent(Joan, x) ^ Parent(Kevin, x)) ⟶ Female (x)

(c) ∃1x : Parent(Joan, x).

Question 1st

Data set have

3 +ve sample and 7 neg sample

$$\text{Entropy}(S) = \frac{-3}{10}\log_2\frac{3}{10} - \frac{7}{10}\log\frac{7}{10}$$

$$= 0.8813$$

Attributes are

Home owner (HO)

Marital status (MS)

Job expr (JE)

HO → Yes $(1^+\ 3^-)$

HO → No $(2^+\ 4^-)$

$$En(HO_{yes}) = \frac{-1}{4}\log\frac{1}{4} - \frac{3}{4}\log\frac{3}{4}$$

$$= 0.8113$$

$$En(HO_{No}) = -\frac{2}{6}\log\left(\frac{2}{6}\right) - \frac{4}{6}\log\frac{4}{6}$$

$$= 0.9183$$

M.S → single $1^+\ 2^-$

M.S → Married $1^+\ 4^-$

M.S → Divorced $1^+\ 1^-$

$$En(\text{single}) = \frac{-1}{3}\log\frac{1}{3} - \frac{2}{3}\log\frac{2}{3}$$

$$= 0.9183.$$

$$En(\text{Married}) = \frac{-1}{5}\log\frac{3}{5} - \frac{4}{5}\log\left(\frac{4}{5}\right)$$

$$= 0.7219.$$

$$En(\text{Divorced}) = 1$$

Job Exp → 2 $2^+\ 1^-$

Job Exp → 3 $1^+\ 2^-$

Job Exp → 4 $0^+\ 3^-$

Job Exp → 5 $1^-\ 0^+$

$$E(JE_2) = -\frac{2}{3}\log(2/3) - \frac{1}{3}\log 1/3 = 0.9183$$

$$E(JE_3) = \frac{1}{3}\log(1/3) - \frac{2}{3}(\log(2/3) = 0.9183$$

$$E(JE_4) = 0$$

$$E(JE_5) = 0$$

$$\therefore \text{Gain}(S, \text{HomeO}) = 0.8813 - \frac{4}{10} \times 0.8113 - \frac{6}{10} \times 0.9183$$

$$= 0.0058$$

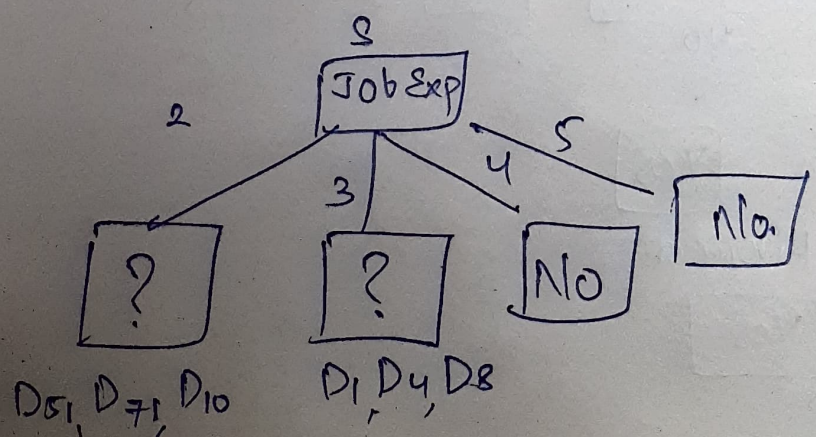
$$\text{Gain}(S, \text{MartS}) = 0.8813 - \frac{3}{10} \times 0.9183 - \frac{5}{10} \times 0.721 - 2/10 \times 1$$

$$= 0.0449$$

$$\text{Gain}(S, \text{Job exp}) = 0.8813 - \frac{3}{10} \times 0.9183 - \frac{3}{10} \times 0.9183 - 0 - 0$$

$$= 0.398 \text{ (min)}$$

So, rootnode is job exp.



Given job exp. 2:

Home owner → Yes 1+ 1−
→ No 1+ 0−

Marital status → Single 1+ 0−
→ Married 0+ 0−
→ Divorced 1+ 1−

E_n (Home ow yes / Jobexp = 2) = 1

E (HO / No) = 0

E (MS = single) = 0

E (M.S Divorced) = 1

E (M.S married) = 0

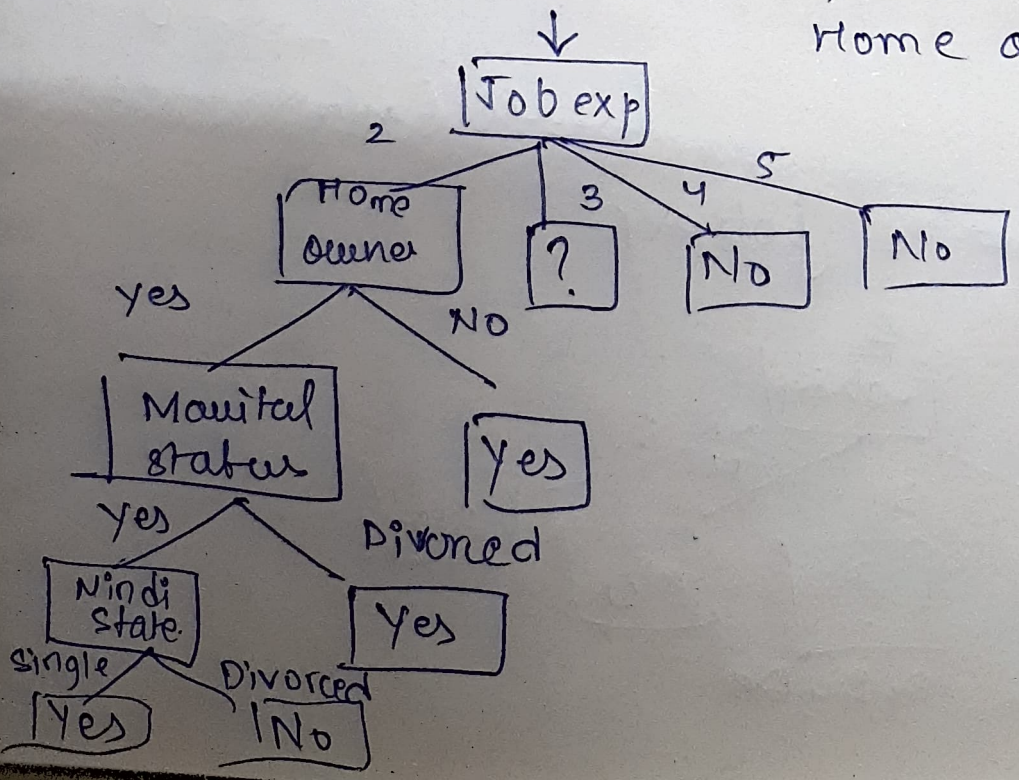
Gain (Jobexp$_2$, HO) = $0.9183 - \frac{2}{3} \times 1$

= 0.2516.

Gain (Jobexp$_2$, MS) = $0.9183 - \frac{2}{3} \times 1$

= 0.2516.

Since both are equal, we consider Home owner



Given Job Exp: 3

Home owner
- Yes - $0^+ 1^-$ $\varepsilon = 0$
- No - $1^+ 1^-$ $\varepsilon = 1$

Marital Status
- Single - $0^+ 1^-$ $\varepsilon = 0$
- divorced $0^+ 0^-$ $\varepsilon = 0$
- married $1^+ 1^-$ $\varepsilon = 1$

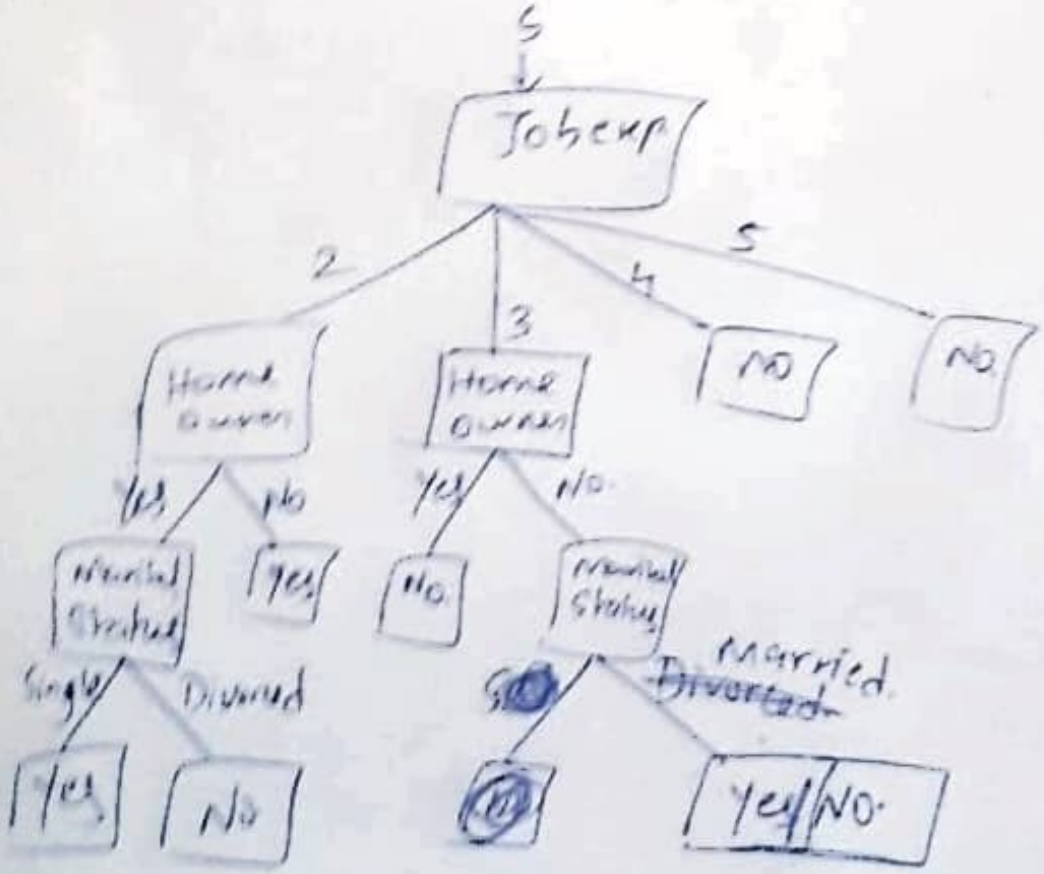
Gain (Job exp, Home owner) $= 0.9183 - \frac{2}{3} \times 1$

$= 0.2516$

Gain (Jobexp=3, Marital Status) $= 0.2516$

$= 0.9183 - \frac{2}{3} \times 1$

∴ The Decision Tree is



∴ Bob is Jobexp=2 & doesn't own a home, so he is defaulted. Probability = 1 //

Quest (2)

(b)

$A \vee B \wedge \sim C$