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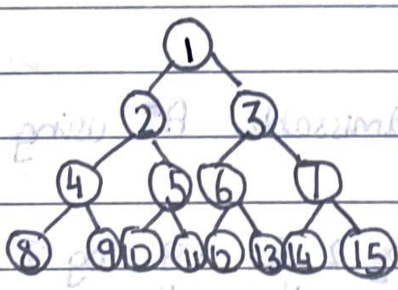
ASSIGNMENT - 1

1a) There are infinite number of states in the state space considering all positions (x, y). Although there is only one optimal path, there are an infinite number of paths to goal.

b) The short distance between any two given point is always straight line. Therefore the shortest path from one polygon vertex to any other in the scene must consist of straight line segment joining some of the vertices of the polygons.
A good state space now would be all the pairs (x, y) where the pair in the vertex of an obstacle, the state space consists of all the vertices of the obstacles.

2a)



b) BFS : 1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → ~~12 → 13 → 14 → 15~~

DFS : 1 → 2 → 4 → 8 → 9 → 5 → 10 → 11 → ~~3 → 6 → 12 → 13 → 7 → 14 → 15~~

IDS : 1 → 2 → 3   1 → 2 → 4 → 5 → 3 → 6 → 7   1 → 2 → 4 → 8 → 9 → 5 → 10 → 11

c) F(n) = { IF (n=1) THEN() ELSE IF (even(n)) THEN
F (FLOOR (n/2)) LEFT ELSE F (FLOOR (n/2) RIGHT)

3. Case 1 : D2 is an elaboration of D1. D1 is extended by extending the -ve branch D2 is more general than D1.
Case 2 : D2 is an elaboration of D1. D1 is extended by extending the +ve branch D2 is more specific than D1.
This is not true as many tree extending the +ve branch will make the original tree more specific.

4. A* Search
A* Search is a form of DFS.
$f(n) = g(n) + h(n)$
A heuristic $h(n)$ is admissable if for every node n $h(n) \le h^*(n)$
Where $h^*(n)$ is the true cost to reach the goal state from n.
An admissable heuristic never overestimates the cost to reach the goal.
It is optimistic.
If $h(n)$ is admissable, A* using tree search is optimal.

5. $E(s) = \frac{-5}{14} \log 2 \frac{5}{14} - \frac{9}{14} \log 2 \frac{9}{14} = 0.94$

INCOME	BUYS	COMP
HIGH	1	3
MEDIUM	2	4
LOW	2	2

$E(\text{income} = \text{medium}) = \left[\frac{-2}{5} \log_2 \frac{2}{6} + \frac{4}{6} \log_2 \frac{4}{6}\right]$

$= -[-0.528 - 0.194] = 0.7233$

$E(\text{income} = \text{high}) = -\left[\frac{-1}{4} \log_2 \frac{1}{4} + \frac{3}{4} \log_2 \frac{3}{4}\right]$

$= -[-0.5 - 0.3112] = 0.811$

$E(\text{income} = \text{low}) = 0$

$E(\text{age}) = 0$

TYPES	BUYS	COMP
Employee	1	6
Student	4	3

$$E(\text{type} = \text{Employee}) = -\left[\frac{1}{7}\log_2\frac{1}{7} + \frac{6}{7}\log_2\frac{6}{7}\right]$$

$$= \left[-0.401 - 0.1906\right] = 0.591$$

$E(\text{type} = \text{Student}) = 0.985$

Credit Rating

	Y	N
Low	0	5
HIGH	5	0

$E(\text{cr} = \text{low}) = 0$

$$E(\text{cr} = \text{high}) = -\left[\frac{5}{9}\log_2\frac{5}{9} + \frac{4}{9}\log_2\frac{4}{9}\right] = -\left[-0.4911 - 0.519\right]$$

$$= 0.991$$

$I(\text{Age}) = 0$

$$I(\text{income}) = \frac{4}{14} \times 0.811 + \frac{6}{14} \times 0.723 + \frac{4}{14} \times 0 = 0.2317 + 0.3098$$

$$= 0.541$$

$I(\text{type}) = \frac{7}{14} \times 0.591 + 7/14 \times 0.985 = 0.783$

$I(\text{Family income}) = 0$

$I(CS) = 0 + \frac{9}{14} \times 0.991 = 0.637$

$G(S, \text{Income}) = 0.94 - 0.541 = 0.39$

$G(S, \text{Type}) = 0.94 - 0.788 = 0.15$

$G(S, CR) = 0.94 - 0.637 = 0.30$

Income has the highest G

INCOME

high medium low

Income = high

TYPE	CR	BUYS
Employee	Low	No
Employee	Low	No
Employee	High	No
Student	High	Yes

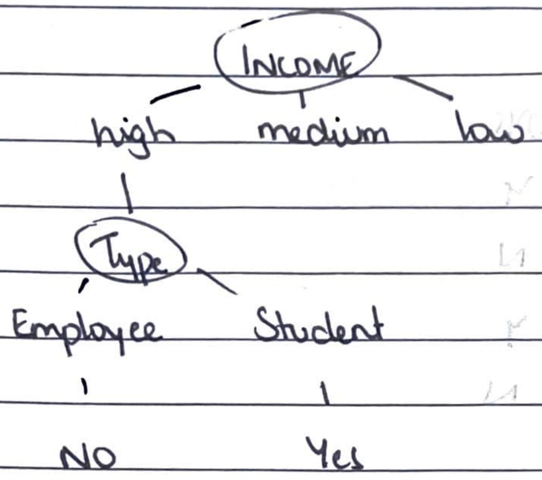
$E(S_{high}) = -\frac{1}{4}\log_2\frac{1}{4} - \frac{3}{4}\log_2\frac{3}{4}$

$= 0.811$

$E(L) = 0$

CR	Y	N
Low	0	2
High	1	1

Type	Y	N
Student	1	0
Employee	0	3



Income = Medium

TYPE	CR	BUYS
Employee	H	Y
Employee	L	N
Student	H	Y
Student	L	N
Employee	H	N

$E(S_{medium}) = 0.97$

Type	Y	N
Employee	1	2
Student	1	1

$E(type) = -\frac{1}{3}\log_2\frac{1}{3} - \frac{2}{3}\log_2\frac{2}{3}$

$= -[-0.528 - 0.3899] = 0.919$

$I(type) = \frac{3}{5} \times 0.917 = 0.5502$

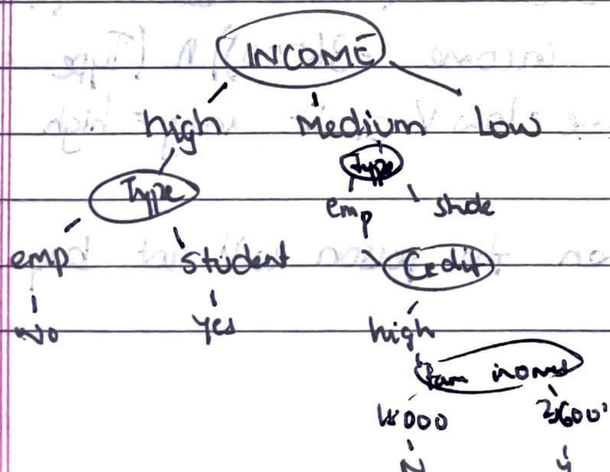
$G(S_{medium}, type) = 0.4198$

CR	Y	N
High	2	1
Low	0	2

$E(high) = -\left[\frac{2}{3}\log_2\frac{2}{3} + \frac{1}{3}\log_2\frac{1}{3}\right] = 1.11$

$I(CR) = 3/5 \times 1.11 = 0.66$

$G(S, CR) = 0.97 - 0.66 = 0.31$



Type = employee

CR	Y	N
High	1	1
Low	0	1

Type = student

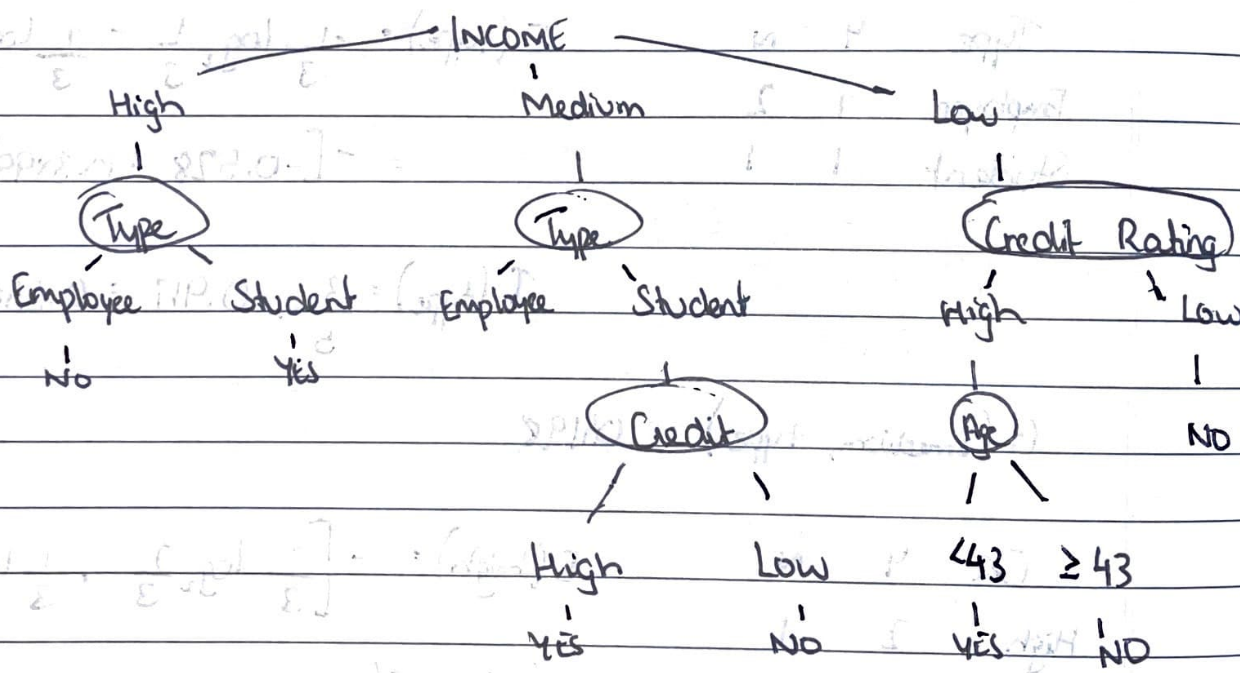
CR	Y	N
High	1	0
Low	0	1

Income = low

TYPE	CR	BUYS
Student	H	Y
Student	H	N
Student	H	Y
Student	L	N

Attributes

Age - 12 Income - 3 Type - 2 Family - 13 CR - 2 Buys - 2



b) Rank

(Income = High V Type = Student) ∧ (Income = medium V ((type = employee V credit = high V family income = 36000)) ∧ (Type = student V credit = high))) ∧ (Income = low V credit rating = high V age < 43)

c) If credit Rating is low, then the person will not buy the computer.

6a) 14

b) $1 + (13 \cdot 4 \cdot 3 \cdot 14 \cdot 3 \cdot 3) = 19657$

c) $14 \cdot 5 \cdot 4 \cdot 15 \cdot 4 \cdot 4 = 67200$

d) 6

ASSIGNMENT -2

A.1 $W_1 + W_2 X + W_3 X_2 = 0$

The line cuts at $A(-1,0)$ and $B(0,2)$

Slope $= \frac{-2}{1}$

Equation of line

$$x_2 = -2x_1 + 2$$

$$\Rightarrow -2 + 2x_1 + x_2 = 0$$

$$\Rightarrow W_0 = -2$$

$$W_1 = \cancel{2}1$$

$$W_2 = 1$$

4.2.

A	B	$A \wedge \neg B$
-1	-1	-1
-1	1	-1
1	-1	1
1	1	-1

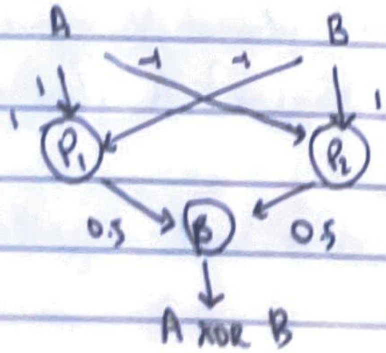
$A = B + 1$

$1 - A + B = 0$

1, -1, 1 for $A = 1$, $B = -1$

$W_0 = -1$, $w_1 = 1$, $w_2 = -1$

$$A \text{ XOR } B = \overset{P_1}{(A \wedge \neg B)} \vee \overset{P_2}{(\neg A \wedge B)}$$



4.3 $w_0 + w_1 x_1 + w_2 x_2 > 0$

A

$w_0 = 1$ $w_1 = 2$ $w_2 = 1$

B

$w_0 = 0$ $w_1 = 2$ $w_2 = 1$

$B(\langle x_1, x_2 \rangle) = 1 \Rightarrow 2x_1 + x_2 > 0$

$A(\langle x_1, x_2 \rangle) = 1 \Rightarrow 1 + 2x_1 + x_2 > 0$

If $B = 1$, then $A = 1$

$\Rightarrow$ B is more generalised

4.5 $O = w_0 + w_1 x_1 + w_2 x_1^2 + \dots + w_n x_n + w_n x_n^2$

Error function

$$E = \sum_{d \in D} (t_d - O_d)^2$$

$$\Delta w_i \leftarrow -\alpha \frac{dE}{dw_i}$$

$$\frac{dE}{dw_i} = \sum (t_d - O_d) \frac{d}{dw_i} \left(t_d - (w_0 + w_1 \dots w_n x_n^2) \right)$$

$$= \sum (t_d - O_d) \left(-x_{ix} - x_{ix}^2 \right)$$