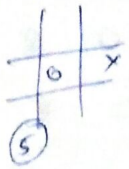
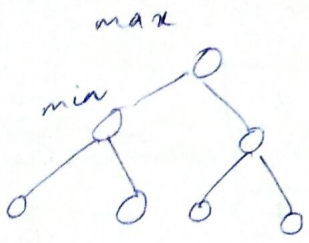
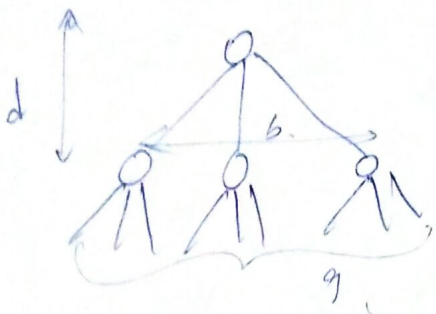
* MIN MAX





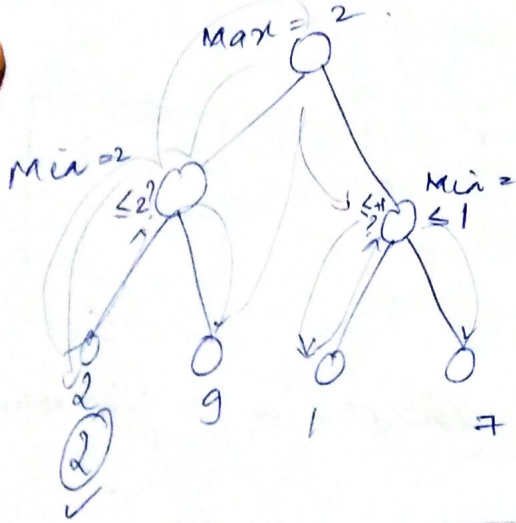
$S = g(c_1 f_1 + c_2 f_2 + c_3 f_3 + \dots + c_n f_n)$ = static fn



$b^d = 3^2 = 9$ = Gives no. nodes/terminal at a level

$\langle b = 3, d = 2 \rangle$

* MIN-MAX searches using DFS.

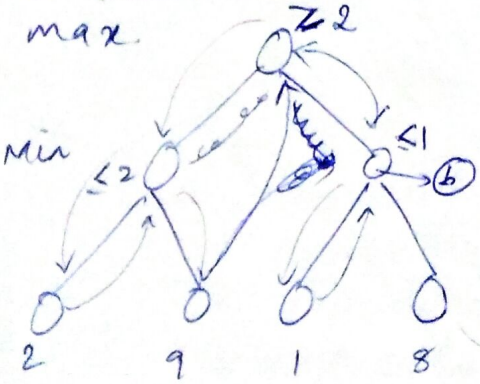


Max (2, 1) = 2.

Logic

→ To minimise the opponents chances of winning and maximise my chance of winning

② α-β pruning



max is searching for ≥ 2 but in node (b), it is looking for ≤ 1 so obviously, you don't have to visit node = 8

So one node is less traversed "Pruning"

Magic squares

10	3	8
5	7	9
6	11	4

3 × 3

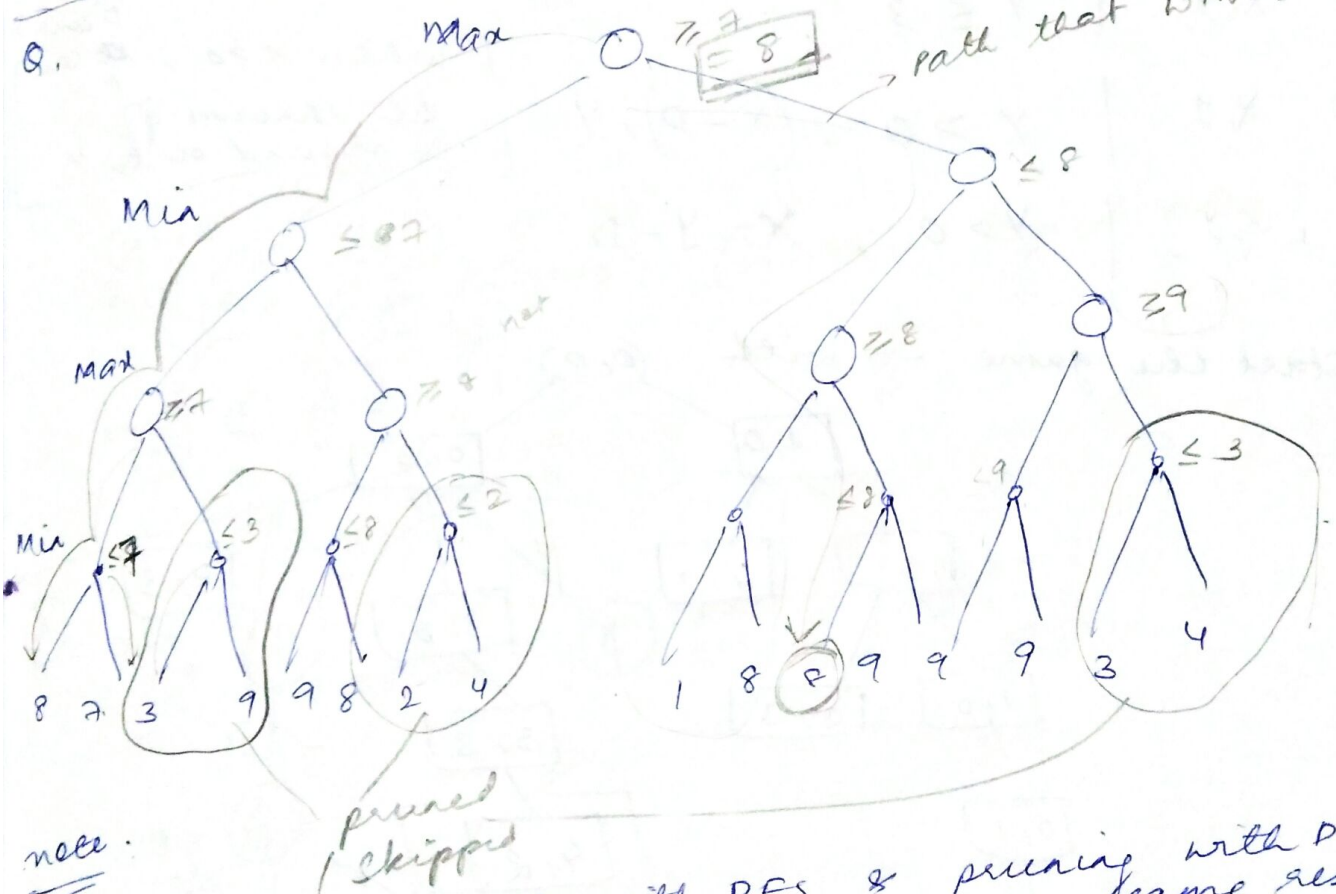
$\frac{15}{3} = 15 - 4 = 1$

$\frac{21}{3} = 7 - 4 = 3$ starting no

each row / col sum = 21.

for (even no × even no) logic is diff.

Q.



note:

Both british search with DFS & pruning with DFS methods will produce the same result.

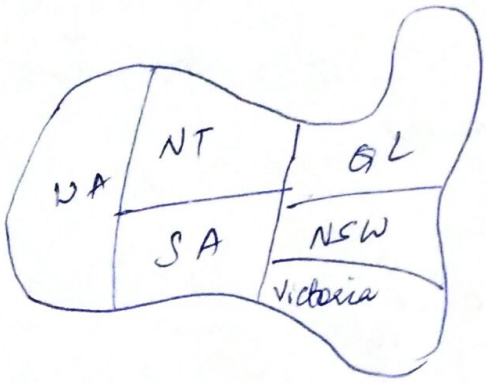
22/02/2020

* Constraint satisfaction Problem (CSP)

(Peter Norvig 6th chapter)

Ex :→ Sudoku game
→ scheduling college classes

Q.



Tansania

* colors to be filled on the map
  - Red
  - Blue
  - Green

* Constraint

"No 2 territories shared have same colors attached to it"

consider DFS.

Step 1
* set of variables → {WA, NT, SA, QL, NSW, V, T}
* Domain = {R, G, B}

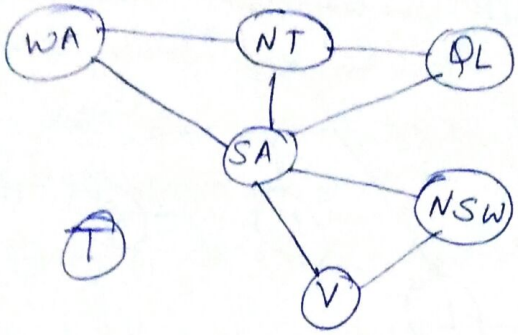
Notice → southern states (SA) is touching most of the territories → hence better to touch that last.

NT → (R) G B
QL → R (G) B
NSW → (R) G B
V → R (G) B
SA → ~~R~~ ~~G~~ (B)
WA → R (G) B
T → R G (B) → anything so randomly chosen 'B'

step 4

ans

step2: Create a constraint diagram using arcs.
↓ means there is a constraint



step3: Use DFS to solve the problem.

Q. 4 slots - 1:00pm - 4:00pm
1 hr for each person
4 people.

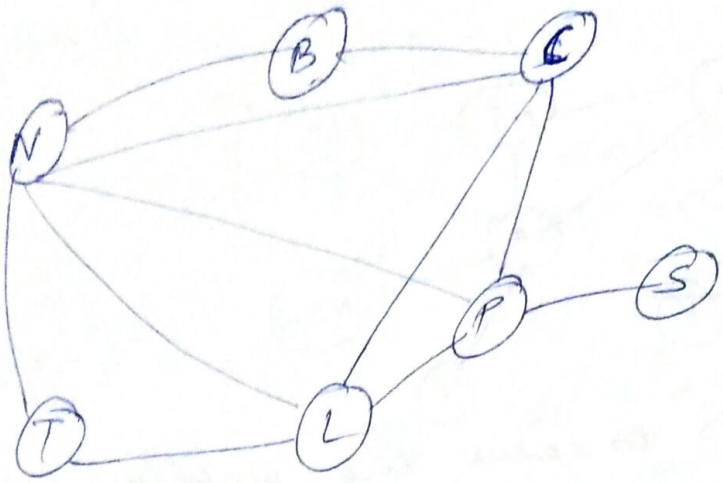
Constraint:

* NV & IN should not speak at the same time
* list of guest lecturers
  - Alan Turing - AT
  Ada Londace - AL
  Niels Bohr - NB
  Marie Curie - MC
  Socrates - SO
  Pythagorous - P
  Isaac Newton - IN

* AT has to get the 1pm slot
* Physicists want to see both, B, Curie and Newton.
* Mathematians want to listen to AL, P, IN.
* Members of the ancient greece club want to list to SO and P
* Female students - AL, MC
* AI students - AT, AL, IN
- C & P

AT	1pm
AL	
NB	
MC	
SO	
P	
IN	

A :



DFS - 1st APPROACH :

Time cost

T → 1 2 3 4
L → ~~1~~ 2 3 4
B → 1 2 3 4
C → ~~1~~ ~~2~~ 3 4
S → 1 2 3 4
P → 1 2 3 4 → NO slot left for N. So go with FC
N → 1 2 3 4

* Forward checking (FC)

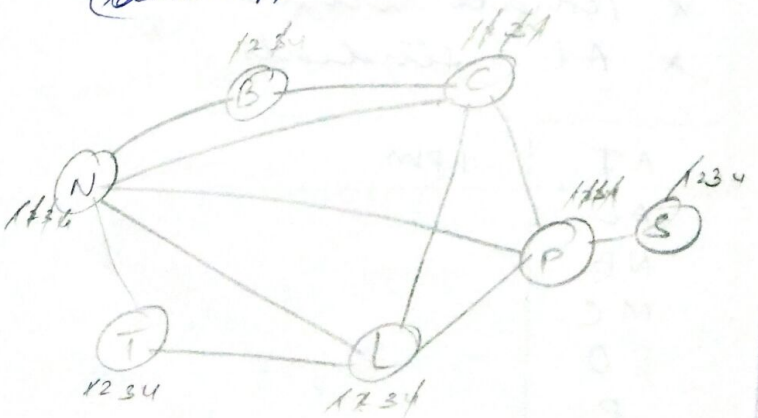
① In this, after each assignment, eliminate incompatable values from neighbouring domains

② while backtracking, uncross the values that hade been previously crossed out.

→ DFS + FC - 2nd APPROACH.

T → 1
L → 2 3 4
B → 1 2 3 4
C → 3 4
S → 1 2 3 4
P → 4
N →

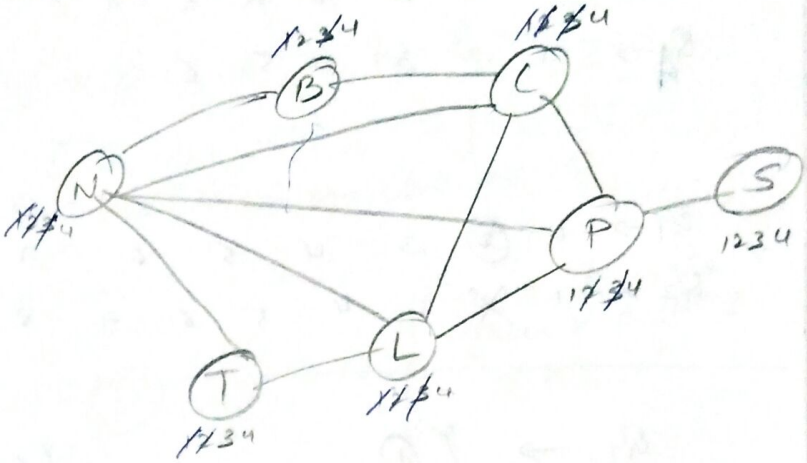
(cancell 1 for L & N)



① After (DFS + FC), check for newly created singleton ~~point~~ domains.
② If one ① is ~~fats~~ found, don't assign it yet, but use it to eliminate values from neighbour's domain.
③ If this creates a new singleton, then propagate.

→ **DFS + FC + singleton propagation** :- 3rd APPROACH (Best)

T — ①
L — ② 3 4
B — ① 2 3 4
C — ③ 4
S — ~~X~~ ② 3 4
P — back ① 4
N — ④



N → singleton → 4
check its neighbours → P — ~~X~~ cancel.
check P's neighbours → S — ~~X~~, 2, 3, 4 (left)
cancel.

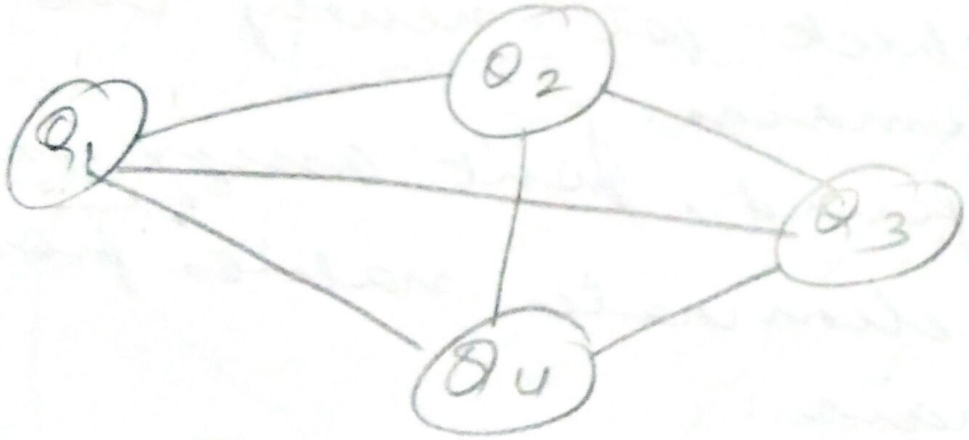
8.

8. QUEEN PROBLEM :-

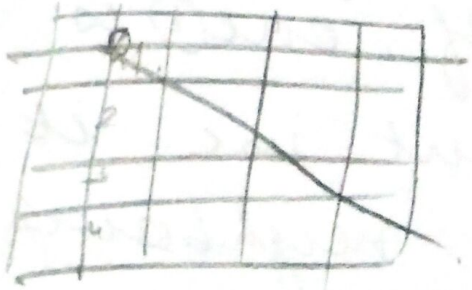
	1	2	3	4
1	1	5	9	13
2	2	6	10	14
3	3	7	11	15
4	4	8	12	16

* A King has 4 Queens.
* Each queen has to be placed in such a way that they are not in the vicinity of each other. Else they will fight.
→ Queen should not be ~~in the~~ adjacent to each other
→ They should not be in the line of sight of each other.

Step 1:-



variable $\{Q_1 Q_2 Q_3 Q_4\}$
domain $\{1, 2, \ldots, 16\}$



$Q_1 \rightarrow$ (1) (2) 3 4 5 6 7 8 9 10 11 12 13 14 15 16

$Q_1 \rightarrow \{1, \ldots, 16\}$ DFS + FC

$Q_2 \rightarrow [7, 8, 10, 12, 14, 15]$

$Q_3 \rightarrow \{14\}$

$Q_4 \rightarrow$ No slot left

So. Backtrack

I $Q_1 \Rightarrow \{1, \ldots, 16\}$

$Q_2 \Rightarrow [7, 8, \ldots]$

$Q_3 \Rightarrow [10, 15]$

$Q_4 \Rightarrow \phi$

II

$Q_3 \Rightarrow [10, 15]$

$Q_4 \Rightarrow \phi$

III

Q_1

$Q_2 \Rightarrow [7, 8, 10, 12, 14, 15]$

$Q_3 \Rightarrow \{8\}$

$Q_4 \Rightarrow \phi$

IV

$Q_2 = [7, 8, 10, 12, 14, 15]$

$Q_3 = \{14\}$

$Q_4 = \phi$

till $Q_2 = [7, 8, 10, 12, 14, 15]$ then →

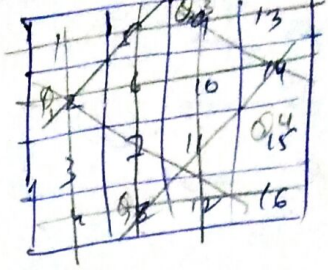
$Q_1 = \{1, (2), \ldots, 16\}$

$Q_1 = \{(2), 9, 11, 13, 15, 16\}$

$Q_2 = \{(2), 13, 15\}$

$Q_3 = \{(2), 15\}$

$Q_4 = \{(15)\}$ ✓



H/W : Queen Problem for 6 X 6 & 8 X 8

Let the Queens be in the respective cols

** INTERVIEW QUES | - INFOSYS

9. TWO + TWO = FOUR

var = {F, O, U, R, T, W}

Domain = {0, 1, . . . , 9}

* left most ao (MSB) cannot be 0

Point to note
There is a carry
F = 1.

2T = 0
F = 1.

2O = R —
2W = U
2T = 0.
4T = R

① carry is there => 1

F = 1

② 2 nos add^n → will always be even.

③ Just assume there is $C_1 + C_2$

C_2 C_1
T W O
T W O
F O U R

F → ①
O → ②, . . , 9)
R → {④, 6, 8}
W → {3, 5, 6, 7, 8, 9}
U →

5 cannot be taka because 5+5 = 10, C_2

But $C_2 \neq 1$ because (T+T) = even no.
If there is $C_2 = 1$, then (T+T) = ~~odd~~ no which is not true
O = even = 2

F → 1
O → 3
R → 6

F → 1
O → 4
R → 8
W → [2, 3, 5, 6, 7, 8]
U → 6
T → 7

So:

```
  7 3 4
  7 3 4
-------
1 U 6 8
```

Q2.

```
  C3 C4
  NOON
  MOON
  SOON
-------
  JUNE
```

var: [J, U, N, E, O, M, S]

domain: [0, 1, ..., 9]

N - [1, 3, 5, 7, 9]

E - [

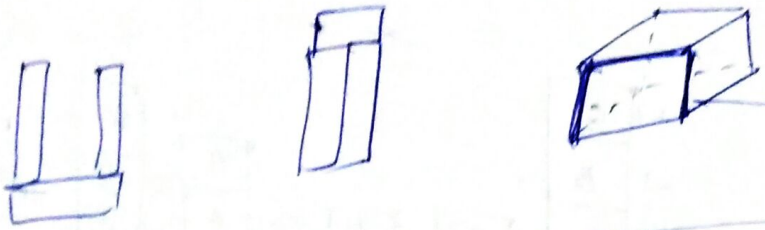
"UNIT-4"

"Learning" DArch → rule telling if what an area is

UNIT-4

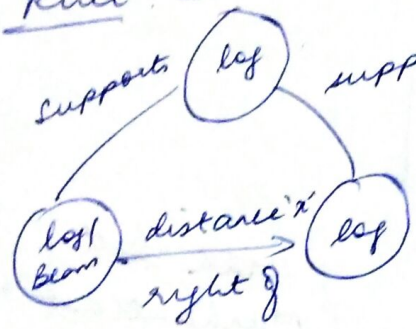
* Good ex

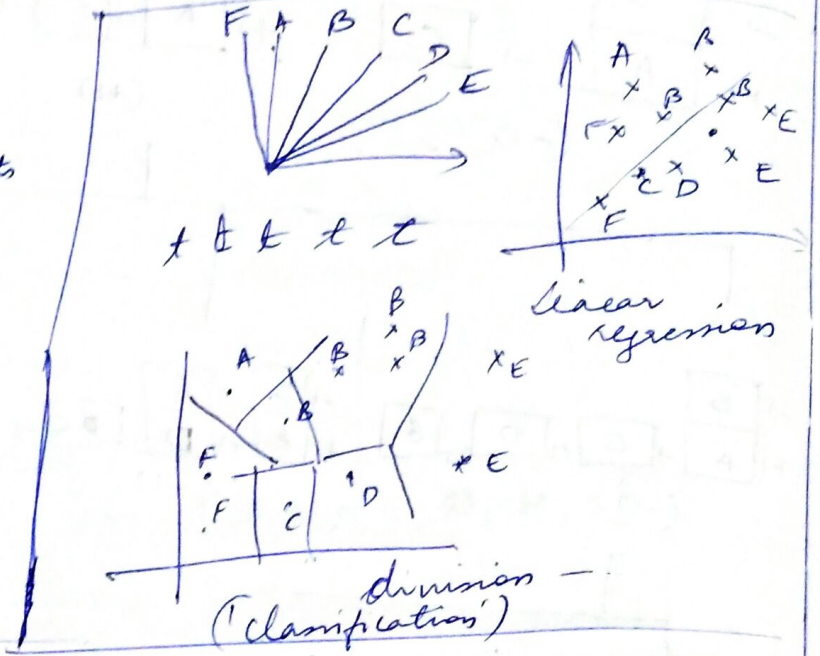
* Bad ex → also imp to learn. Because you will know what is not an arch.



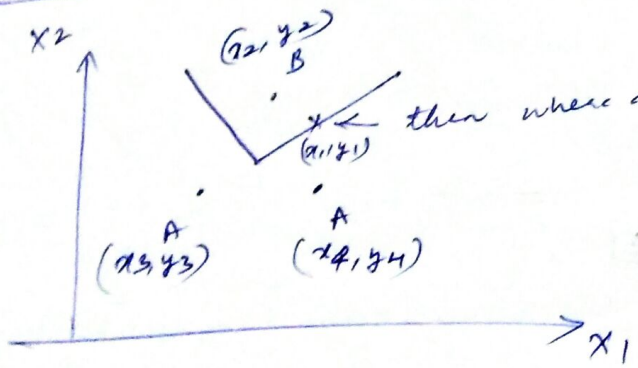
if A sees only this, comp may think it is an arch

Rule: ARCH





* KNN - K Nearest neighbour → usually odd no is chosen.



then where does it fall? A or B?

lol?

1. Manhattan Distance (Taxicab unit)
2. Euclidean Distance
3. Hamming distance.
4. Cosine distance
5. (Polar) pow

* Euclidean distance

U - B - 2 d

U - A - 1 d

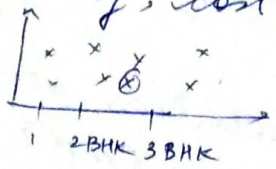
U - A - 1.5 d.

U - A - 60.5 d.

So belongs to A cluster

* Supervised learning

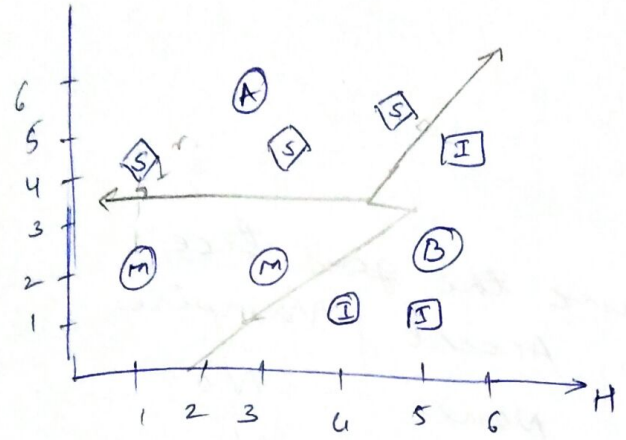
Ex → Boolean classification (Either this or that)
→ Based on locality, cost & rent can be identified



→ continuous classification

→ KNN
→ Identity Trees / Identification Trees
→

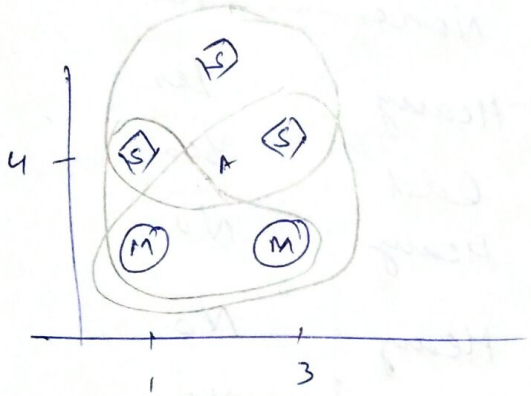
Q. How will you the one KNN

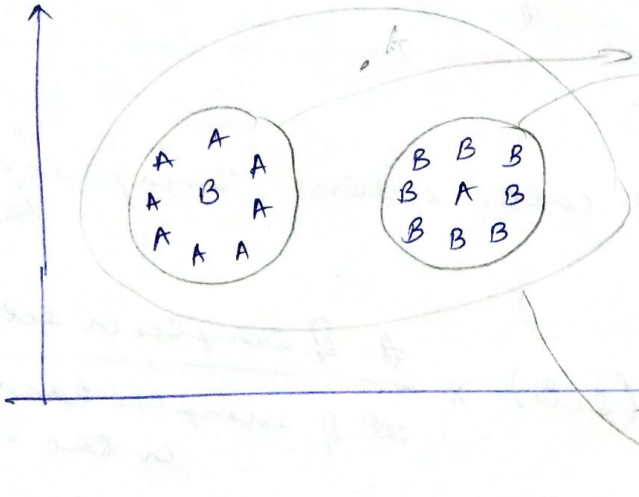


	1NN	3NN
A	S	
B	I	

"unknown" is also an ans.

3-NN





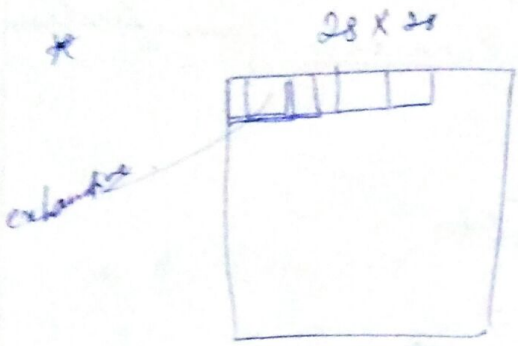
Overfitting - tryig to ~~out~~ fit in a place it does not belong.

↑ no of items/elements

- underfitting

* 70% to train - train set } → train test
  30% to test - test set } → CROSS VALIDATION

*



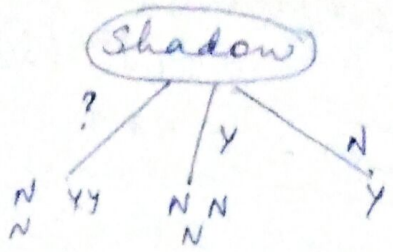
* confusion matrix
  false positive
  false -negetive
  true positive
  true negetive

* Identification trees :
Q. Based on the data given derive the goal tree :

Shadow	Garlic	Complexion	Accent	Vampire
?	Yes	Pale	None	No
Yes	Yes	Ruddy	None	No
?	No	Ruddy	None	Yes
No	No	Any	Heavy	Yes
?	No	~~Any~~ Pale	Odd	Yes
Yes	No	Pale	Heavy	No
Yes	No	Any	Heavy	No
?	Yes	Ruddy	odd	No

* disorder set calc. is done using information theory.

$$* \text{ Disorder} = \sum_{\text{sets produced}} D(\text{sets}) \times \frac{\#\text{ of samples in set}}{\#\text{ of samples handled in the set}}$$



$$D(set) = \frac{T_L}{T}\left[-\frac{+ve}{N}\log\left(\frac{+ve}{N}\right) - \left(\frac{-ve}{N}\right)\log\left(\frac{-ve}{N}\right)\right]$$

+ve outcome "yes"

branch tot

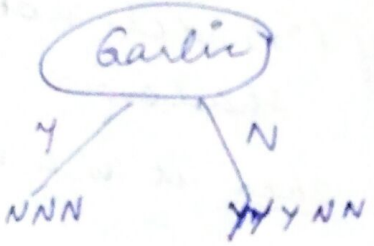
total outcome

-ve outcome Ex "No"

Tot no of outcomes

$$= \frac{4}{8}\left[-\frac{2}{4}\log_2\frac{2}{4} - \frac{2}{4}\log_2\frac{2}{4}\right] + 0 + 0$$

$$\boxed{D(set) = 0.5}$$

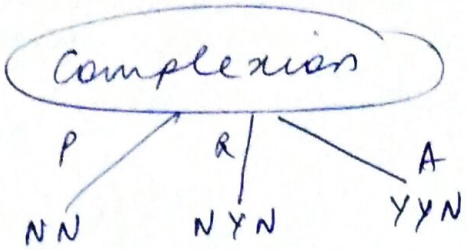


$$D(set) = 0 + \frac{5}{8}\left[-\frac{3}{5}\log_2\left(\frac{3}{5}\right) - \frac{2}{5}\log_2\left(\frac{2}{5}\right)\right]$$

$$= \frac{5}{8}\left[3\log_2(5) - 3\log_2(3) + 2\log_2(5) - 2\log_2(2)\right]$$

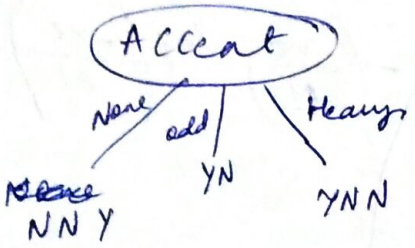
$$= \frac{15}{8}\left[5\log_2(5) - 3\log_2(3) - 2\right]$$

$$\boxed{D(set) = 0.6068}$$



$$D(set) = 0 + \frac{3}{8}\left[-\frac{1}{3}\log_2\left(\frac{1}{3}\right) - \frac{2}{3}\log_2\left(\frac{2}{3}\right)\right] + \frac{2}{8}\left[-\frac{2}{3}\log_2\left(\frac{2}{3}\right) - \frac{1}{3}\log_2\left(\frac{1}{3}\right)\right]$$

$$\boxed{D(set) = 0.542}$$

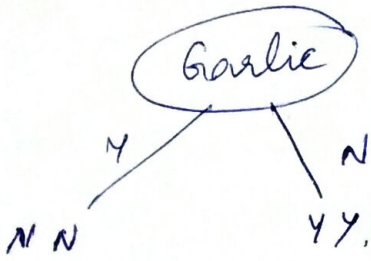


$$D(set) = \frac{3}{8}\left[-\frac{1}{3}\log\left(\frac{1}{3}\right) - \frac{2}{3}\log\left(\frac{2}{3}\right)\right] + \frac{2}{8}\left[-\frac{1}{2}\log\left(\frac{1}{2}\right) - \frac{1}{2}\log\left(\frac{1}{2}\right)\right] + \frac{3}{8}\left[-\frac{1}{3}\log\left(\frac{1}{3}\right) - \frac{2}{3}\log\left(\frac{2}{3}\right)\right]$$

$$\boxed{D(set) = 0.792}$$

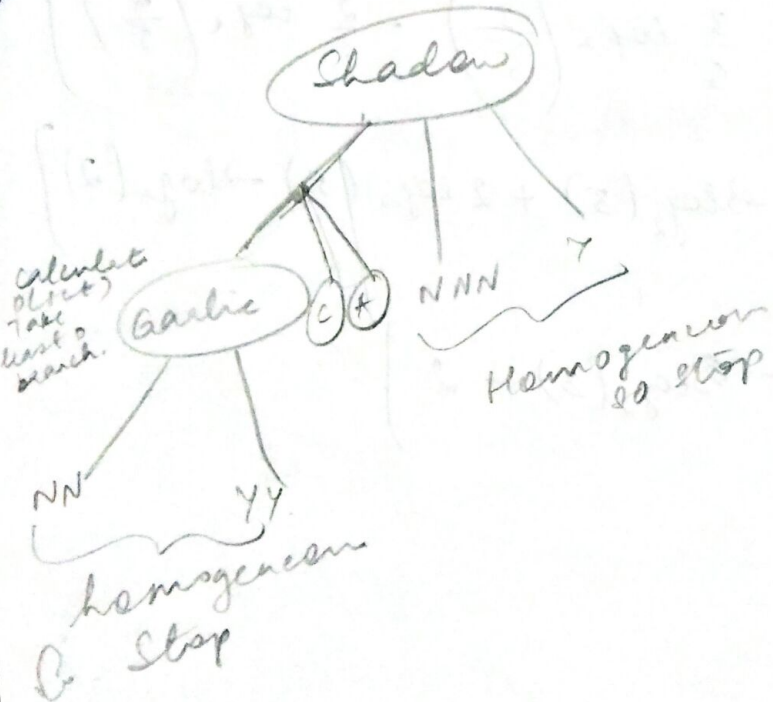
Choose the branch which has MIN [D(set)] value

⇒ shadows. (→ 0.5)



If (?x) has shadow
Then Not a vampire

If (?x) does not have shadow
Then it is a vampire



If (?x) has unknown
AND (?x doesn't like Garlic)
Then (?x) is vampire

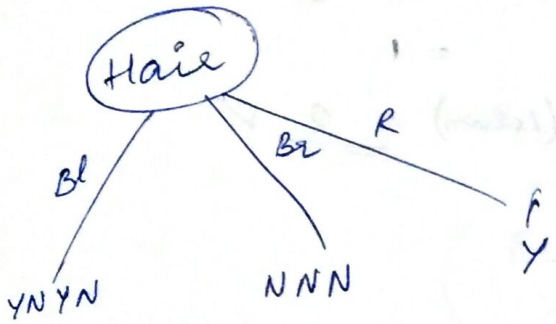
If (?x) has unknown
AND (?x likes Garlic)
Then, (?x) is not a vampire

	Hair	Height	Weight	Lotion	Result
1	Blonde	Avg	Light	No	Y SB
2	Blonde	Tall	Avg	Yes	No
3	Blonde	Short	Avg	Yes	No
4	Blonde	Short	Avg	No	Y SB
5	Red	Avg	Heavy	No	Y SB
6	Brown	Tall	Heavy	No	No
7	Brown	Avg	H	No	No
8	Blonde	Short	Light	Yes	No.

sunburnt

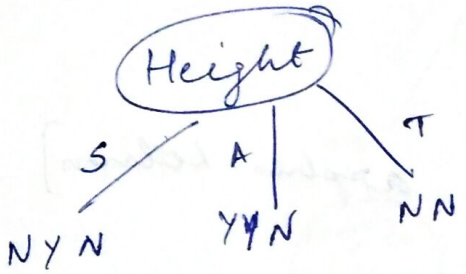
$$D(set) = \frac{4}{8}\left[-\frac{2}{4}\log_2\left(\frac{2}{4}\right) - \frac{2}{4}\log_2\left(\frac{2}{4}\right)\right] + 0 + 0$$

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



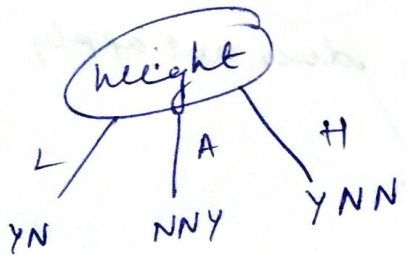
$$D(set) = \frac{3}{8}\left[-\frac{1}{3}\log_2\left(\frac{1}{3}\right) - \frac{2}{3}\log\left(\frac{1}{3}\right)\right]^{\times 2} + \frac{3}{8}[\quad] + 0$$

$$= 0.542$$



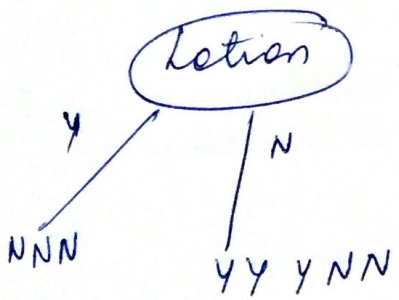
$$D(set) = \frac{2}{8}\left[-\frac{1}{3}\log\left(\frac{1}{3}\right) - \frac{1}{3}\log\left(\frac{1}{3}\right)\right] + \frac{3}{8}\left[-\frac{1}{3}\log_2\left(\frac{1}{3}\right) - \frac{2}{3}\log\left(\frac{1}{3}\right)\right] + \frac{3}{8}\left[-\frac{1}{3}\log\right.$$

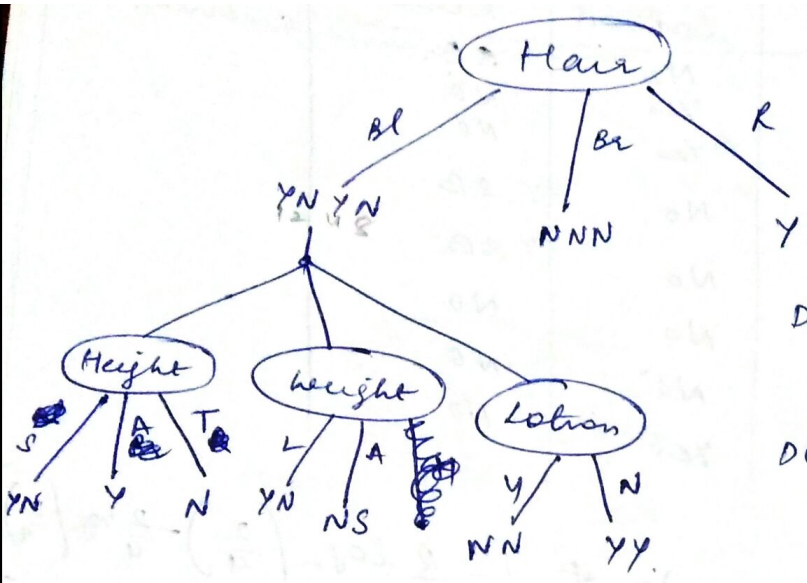
$$=$$



$$D(set) = 0 + \frac{5}{8}\left[-\frac{3}{5}\log\left(\frac{3}{5}\right) - \frac{2}{5}\log\left(\frac{2}{5}\right)\right.$$

$$= 0.606$$





$$D(\text{Set})[\text{Height}] = \frac{2}{4}\left[-\frac{1}{2}\log\left(\frac{1}{2}\right)-\frac{1}{2}\log\left(\frac{1}{2}\right)\right.$$

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

$$D(\text{Set})[\text{wt}] = \frac{2}{4}\left[-\frac{1}{2}\log\left(\frac{1}{2}\right)-\frac{1}{2}\log\left(\frac{1}{2}\right)\right.$$

$$+ \frac{2}{4}\left[-\frac{1}{2}\log\left(\frac{1}{2}\right)-\frac{1}{2}\log\left(\frac{1}{2}\right)\right.$$

$$= 1$$

$$D(\text{Set})(\text{Lotion}) = 0 \quad \checkmark$$

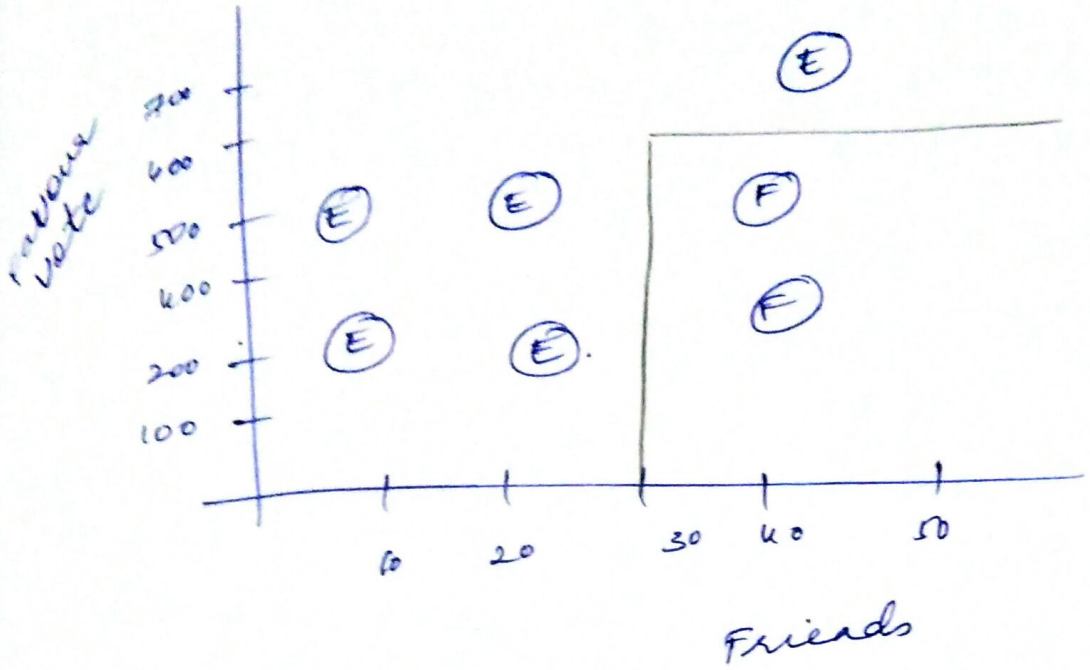
- If (?x) hair is Blown
  THEN, (?x) is not sunburnt

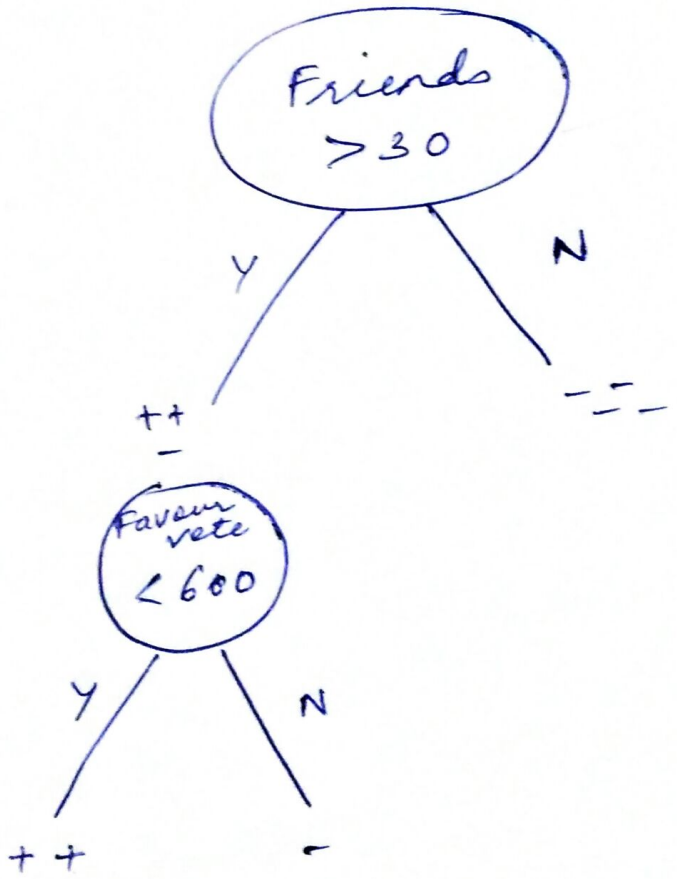
IF (?x) has Red hair
THEN (?x) is sunburnt

IF [(?x) has Blond hair AND applies Lotion]
THEN (?x) is not sunburnt

IF [(?x) has Blond hair AND does not apply Lotion
THEN (?x) is sunburnt

83. classify


favour vote
700
600
500
400
200
100
E
E
E
E
E
F
F
10
20
30
40
50
Friends


Friends
>30
Y
N
++
-

Favour vote
<600
Y
N
++
-