

# CONSTRAINT SATISFACTION PROBLEM (CSP).

→ Used in Sudoku, graph colouring.

→ CSP consist of three component  $V, D, C$

→  $V$  is a set of variable  $\{V_1, V_2, \dots, V_n\}$  → finite var only

→  $D$  is set of domain  $\{D_1, D_2, \dots, D_n\}$  one for each variable

→  $C$  is set of constraint  $\{C_1, C_2, C_3, \dots\}$  that specify allowable comb.  
kind of rules that  $V$  of values

$C_i = (\text{scope}, \text{rel})$

→ Scope is set of var that participate in constraints

Variable =  $V_1, V_2$

Domain =  $A, B$

$C_1$  kehata  $V_1, V_2$  ki value unequal honi chahye

$C_1 = (V_1, V_2), (V_1 \neq V_2)$

→ Rel is relation that define the value that variable can take

Another way of representing

$C_1 = (V_1, V_2), (A, B)$



$$A = (1, 2)$$

$$B = (2, 4)$$

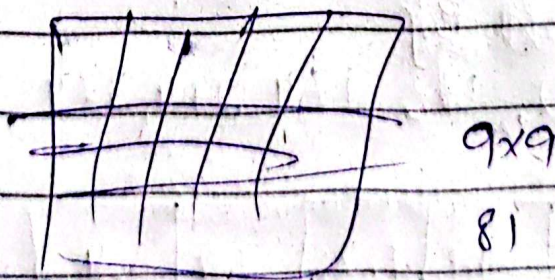
$$C_1 = (V_1, V_2), (1, 2), (1, 4), (2, 4)$$



Constraint kehta  $V_1, V_2$  barabar na hon.

Sudoku mein var ka mtlb ktny space hai  
↓  
81

Domain mein ek sq. mein konse number daal  
skta, har sq. ki domain 1-9 hai



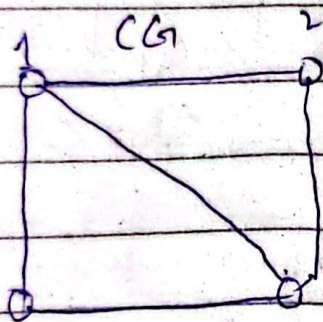
Constraint hai puri row ya column mein  
wo same number nh hona chahy



CSP ko solve krny k lye backtracking use hota hai

Ismein Intelligent backtrack use hoga

Constraint graph



$$V = \{1, 2, 3, 4\}$$

$$D = \{R, G, B\}$$

$$C = \{1 \neq 2, 1 \neq 3, 1 \neq 4, 2 \neq 4, 3 \neq 4\}$$

	1	2	3	4
Initial Dom.	R, G, B	R, G, B	R, G, B	R, G, B
1 = R	R	G, B	G, B	G, B
2 = G	R	G	G, B	B
3 = B	R	G	B	(B)
3 = G	R	G	G	B

Backtrack krta

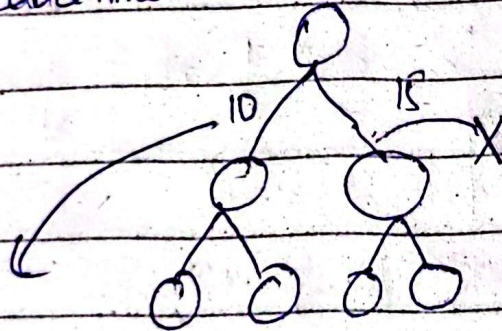
Constraint because rule violate

# HEURISTIC. (Rule of Thumb)

→ It is technique designed to solve problem quickly.

Heuristic → making assumption for anything, trying to find quick solution

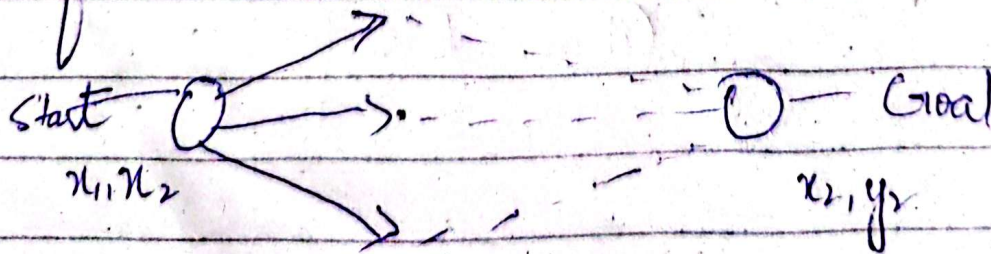
→ Reduce Time



best exchange

Find out Heuristic value?

from Euclidean distance:



$$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Blind search mein hai jagah jana.



Manhattan distance is used to find vertical and horizontal distance.

1	3	2
6	5	4
	8	7

→ Start State

1	2	3
4	5	6
7	8	

→ Goal state

1 apris jagah pr hai tu 0 movement, 3 and 2 jab swap honge tu 1+1, 4 two times left move, 5 on right position (0), 6 two right move, 7 two left move, 8 on right pos.

$$M.D = 0+1+1+2+0+2+2+0$$

No. of Misplaced Tiles.

1 is on right, 2 is not, 3 is not, 4 is not,  
5 is on right, 6 is not, 7 is not, 8 is on right

$$1 + 1 + 1 + 1 + 1 = 5$$

No. of misplaced tiles = 5

The way without main (Heuristic)

→ good solution, not optimal solution

### 8-Puzzle Problem With Heuristic (Informed Search)

1	2	3
	4	6
7	5	8

Initial

1	2	3
4	5	6
7	8	

Goal

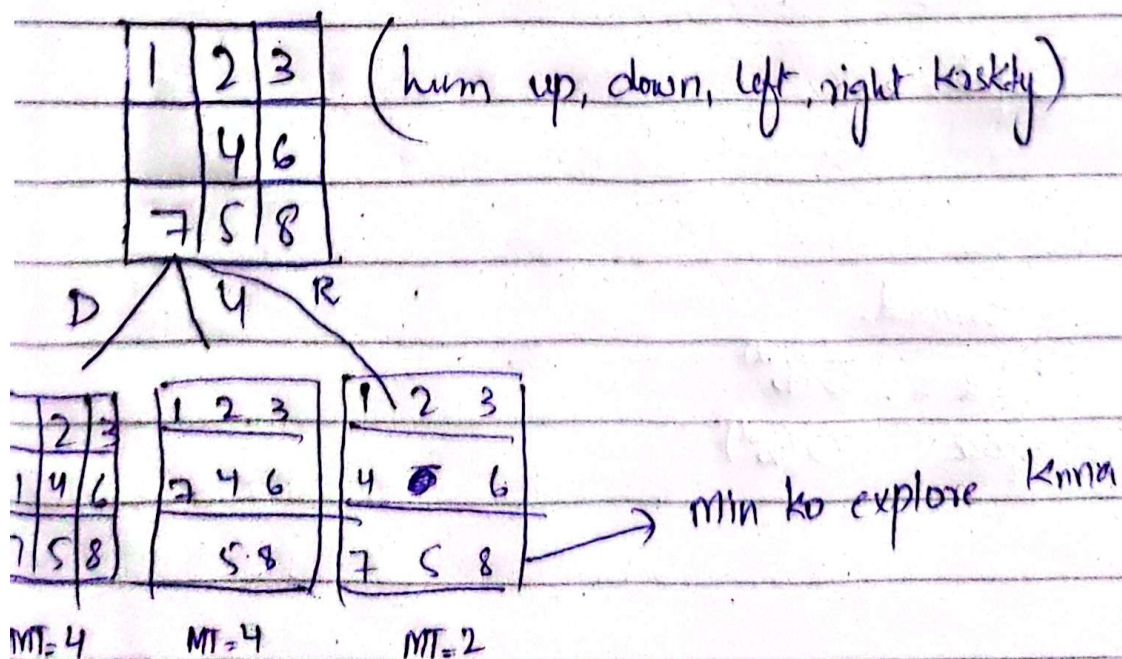


$$h(\text{heuristic value}) = 3$$

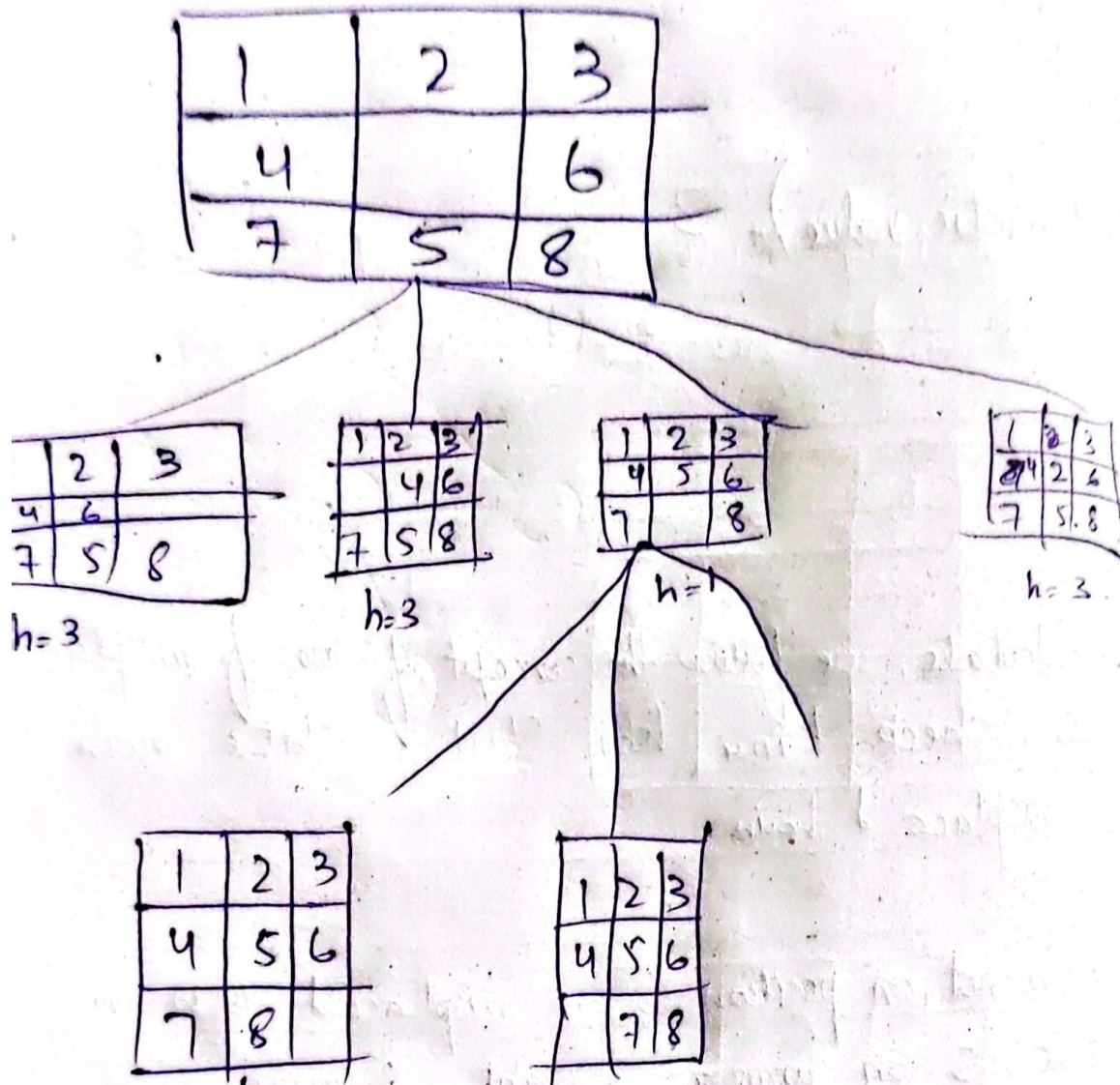
To calculate, we follow the concept of no. of misplaced tiles, check karna hai start state mein kitni misplaced hain.

4 is not on position so one misplaced, 6 is on right, 5 on wrong, 7 right, 8 wrong.

$$1 + 1 + 1 = 3.$$



Blind & uniformed hota hai baqi bhi explore krty



Depth = 3.

Uniformed =

Time =  $O(b^d)$

Space =  $O(b^d)$