Spring 2023
CI02 / ct#01

A* search algorithm -

Solve = given, G = goal node
S = start node

2 last digit =

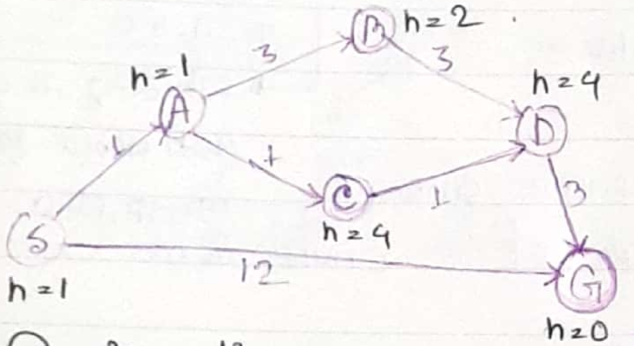
$h(S) = 84 \% 3 + 1 = 1$

$h(A) = 84 \% 2 + 1 = 1$

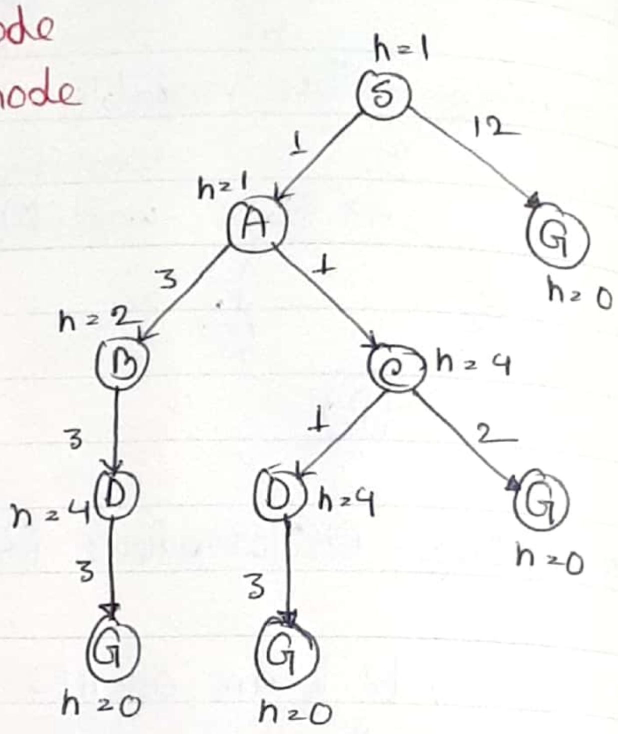
$h(B) = 84 \% 4 + 2 = 2$

$h(C) = 2 + 2 = 4$

$h(D) = 1 + 3 = 4$



Search tree -



for iteration -

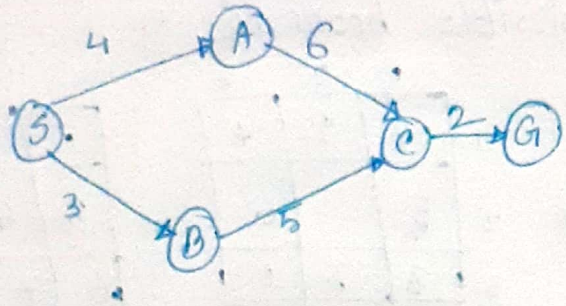
knowing, $f(n) = h(n) + g(n)$

iteration	state expand	h(n)	g(n)	f(n)	close fringe	Open
0	S	1	0	1	{ }	{S}
1	S → A ✓	1	1	2	{S}	{A,G}
	S → G	0	12	12		
2	S → A → B ✓	2	4	6	{S, A}	
	S → A → C	4	2	6		
	S → G	0	12	12		{B,C,G}
3	S → A → B → D	4	7	11	{S, A, B}	
	S → A → C ✓	4	2	6		
	S → G	0	12	12		{D, C, G}
4	S → A → B → D	4	7	11	{S, A, B, C}	
	S → A → C → D	4	3	7		
	S → A → C → G ✓	0	4	4		{D, D, G, G}
	S → G	0	12	12		

Scanned with CamScanner

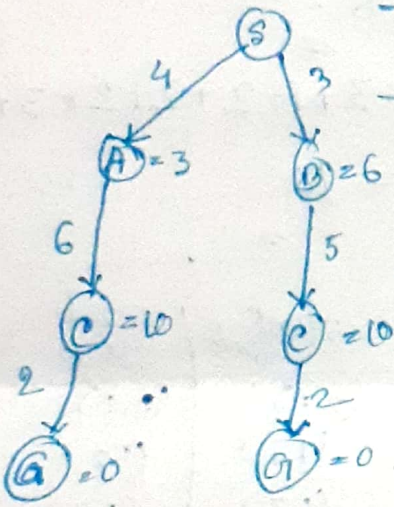
(5)

= A* search



Node	h(n)	
S	~~0~~ 1	S = 1
A	h(S)+2	A = 3
B	h(A)+3	B = 6
C	h[B]+4	C = 10
G	0	G = 0

search tree -



it	state expand	h(n)	g(n)	f(n)	fringe close	open fringe
0	S	1	0	1	{ }	{S}
1	S→A ✓	3	4	7	{S}	{A, B}
	S→B	6	3	9		
2	S→A→C	10	10	20.	{S, A}.	{C}
3	S→A→C→G	0	12	12	{S, A, C}	{G}

$\boxed{f(n) = h(n) + g(n)}$

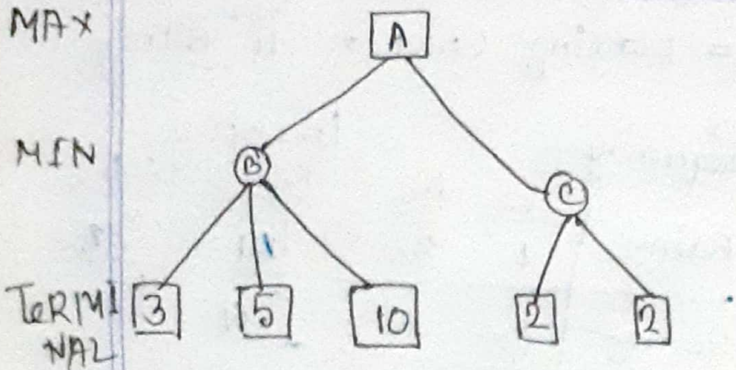
after 3 iteration, we find goal state G from minimum f(n) in optimal path cost

so, shortest path = S A → C → G

optimal ~~cost~~ path cost = 12

Ac

$\alpha \geq B$ purunning



<u>step 1</u> = $\alpha = -\infty$

$B = +\infty$.

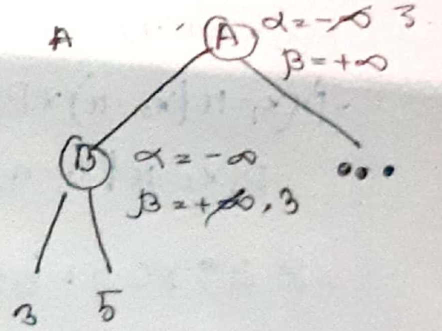
pass it $\boxed{A}\boxed{B}$

<u>step 2</u> = for B, $\alpha = -\infty$

$B = Min((3, +\infty), (5, +\infty))$

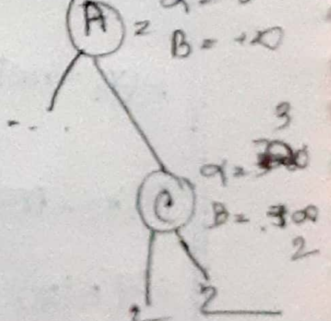
$= Min(3, 5)$

$= 3.$



Bracfrating B to A, then A pass C.

<u>step 3</u> = for C,



$\alpha = \cancel{-\infty}\ 3$

$B = Min((2, +\infty), (2, +\infty))$

$= Min(2, 2)$

$= 2 \rightarrow \alpha \geq B$ so it's prunning.

so, C bad

A ~~node~~ ~~an~~ Max(3, 2)

2 3

B = +∞

path = $A \rightarrow B \rightarrow \boxed{3}$

crossover:

Mating   xover   offspring   u   fitness

M D E

∴ a

8-Puzzle game has admissible heuristic ?

$h_1(S)$ = misplaced tiles

$h_2(S)$ = total Manhattan distance.

	1	2	3
1	7	2	4
2	5		6
3	8	3	1

.	1	2
3	4	5
6	7	8

Solve =

node	start state	goal state	
1	(3,3)	(1,2)	x
2	(1,2)	(1,3)	x
3	(3,2)	(2,1)	x
4	(1,3)	(2,2)	x
5	(2,1)	(2,3)	x
6	(2,3)	(3,1)	x
7	(1,1)	(3,2)	x
8	(3,1)	(3,3)	x

$h_1(S) = 8$

$h_2(S) = 3+1+2+2+2+3+3+2$

$= 18$

2	4	3
1	6	8
5		7

1	2	3
4		8
5	6	7

node	start state	goal state	
1	(2,1)	(1,1)	x
2	(1,1)	(1,2)	x
3	(1,3)	(1,3)	✓
4	(1,2)	(2,1)	x
5	(3,1)	(3,1)	✓
6	(2,2)	(3,2)	x
7	(3,3)	(3,3)	✓
8	(2,3)	(2,3)	✓

$h_1(S) = \cancel{8}\ 4$

$h_2(S) = \cancel{1+1+2+}\ 1+1+1+2$

$= 5$

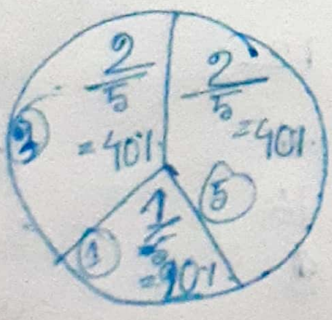
GA.

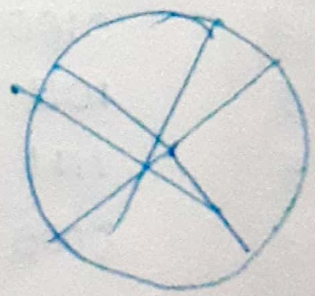
$f(x) = \{ MAX(x^2) : 0 \leq x \leq 15 \}$ over $\{0, 1, \cdots, 15\}$.

x value 4 bits , Population Size = 5.

selection

string no	intial Population	x value	x^2 fitness	Probability x/sum	expected count. Pro x size	Actual count
1	0100	4	16	0.117	0.585	1
2	0010	2	4	0.029	0.145	0
3	0111	7	49	0.358	1.79	2
4	0010	2	4.	0.029	0.145	0
5	1000	8	64	0.467	2.335	2
	sum		137	1.00	5.00	5
	Avrg		27	0.2	1.00	1
	MAX		64	0.467	2.335	2





Crossover

String	Mating pool	Xover point	offspring after Xover	x value	fitness x^2
1	010|0	1	0101	5	25
3	011|1	1	0110	6	36
3	01|11	2	0100	4	16
5	10|00	2	1011	11	121
5	1|000	3	1111	16	256
3	0|111	3	0000	0	0
	SUM				454
	AVRG				90.8
	MAX				256

mutation

string no	offspring after Xover	offspring after mutation	x value	x^2 fitness
1	0101	1101	13	169
3	0110	1110	14	196
3	0100	1100	12	144
5	1011	1011	11	121
5	1111	1111	16	256
3	0000	1000	8	64
SUM				950
AVR				190
MAX				256

Ans

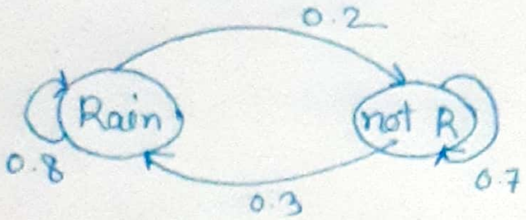
(1)

Markov

Sunday ~~= 0.5~~ rain = 0.5

Tuesday = not rain = ?

~~Rain, Rain = 0.8~~



$P(x_0 = rain) = 0.5$

$P(x_0 = not\ rain) = 1 - 0.5 = 0.5$

$P(x_1 = rain)$

$= P(x_1 = r / x_0 = r) \times P(r) +$
$P(x_1 = r / x_0 = n) \times P(n)$

$= 0.8 \times 0.5 + 0.3 \times 0.5$

$= 0.55$

$P(x_1 = not\ rain) = 1 - 0.55 = 0.45$

$P(x_2 = rain)$

$= P(r|r) \times P(r) + P(r|n) \times P(n)$

$= 0.8 \times 0.55 + 0.3 \times 0.45$

$= .576$

$\therefore P(not\ rain) = 0.425$

Ans

Naive

X = playing Cricket if cloudy.

frequency / Likehood

	Yes	No	P(Y)	P(N)
Rainy	1	2	1/4	2/5
Sunny	2	1	2/4	1/5
Cloudy	1	2	1/4	1/5
total	4	5	4/9	5/9

$$P(Yes|cloudy) = \frac{P(C|Yes) \cdot P(Y)}{P(C)}$$

$$= \frac{1/4 \times 4/9}{3/9}$$

$= 0.33$