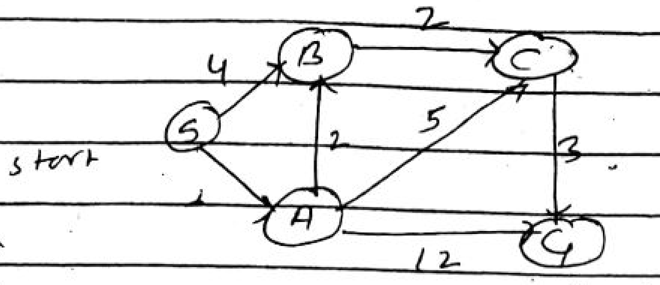
chapter 8: Numerical

① Find the path using A* search



Given h(n)

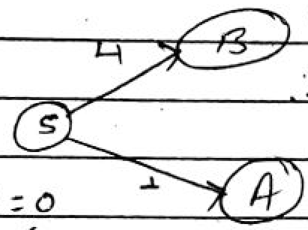
S - 7
A - 6
B - 2
C - 1
G - 0

evaluation function formula

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

soln:

step 1:



$g(n) = 4$
$h(n) = 2$
$\therefore f(n) = 6$

$g(n) = 0$ start point

$g(n) = 1$
$h(A) = 6$
$\therefore f(n) = 7$

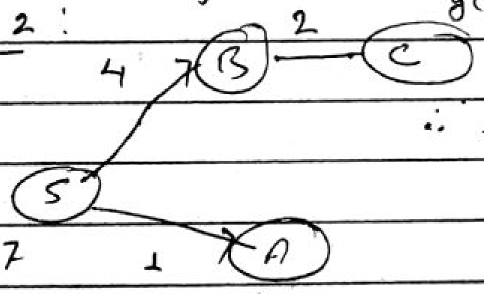
$h(n) = 7$

$\therefore f(n) = g(n) + h(n) = 7$

[जहाँ path search गर्न सकिन्छ त्यो path evaluation function)

step 2:

$f(n) = 6$



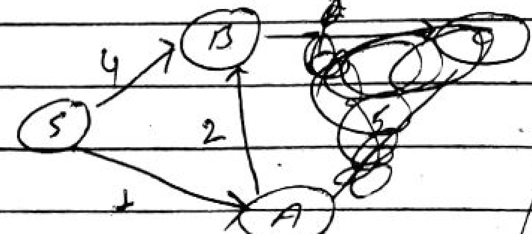
$g(n) = 4 + 2 = 6$
$h(C) = 1$
$\therefore f(n) = 7$

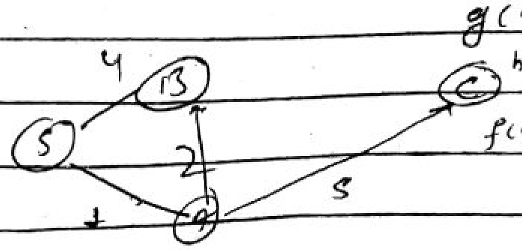
$f(n) = 7$

$f(n) = 7$

step 3:

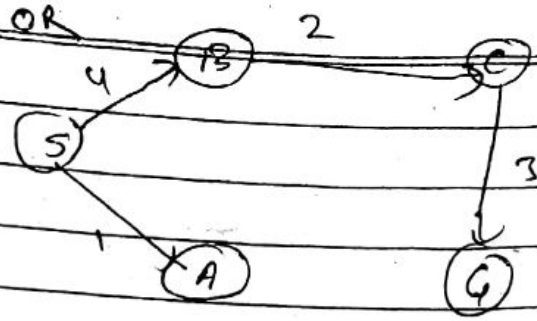
$g(n) = 1 + 2 = 3$
$h(n) = 2$
$\therefore f(n) = 5$





$g(n) = 6$
$h(n) = 1$
$f(n) = 7$

OR



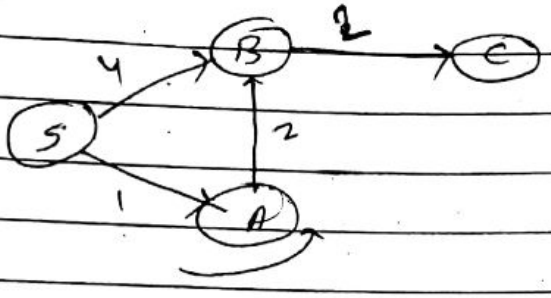
$f(n) = 7$

$g(n) = 9$

$h(n) = 0$

$\therefore f(n) = 9$

Step 4 $f(n) = 5$

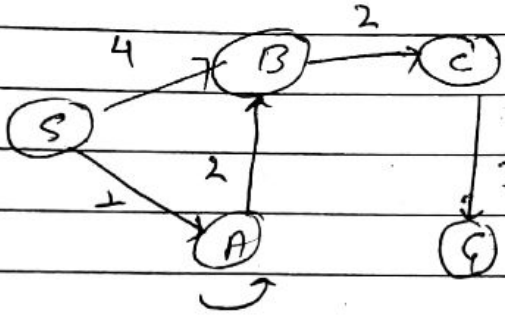


$g(n) = 2 + 2 + 1 = 5$

$h(n) = 1$

$\therefore f(n) = 6$

Step 5:



$f(n) = 6$

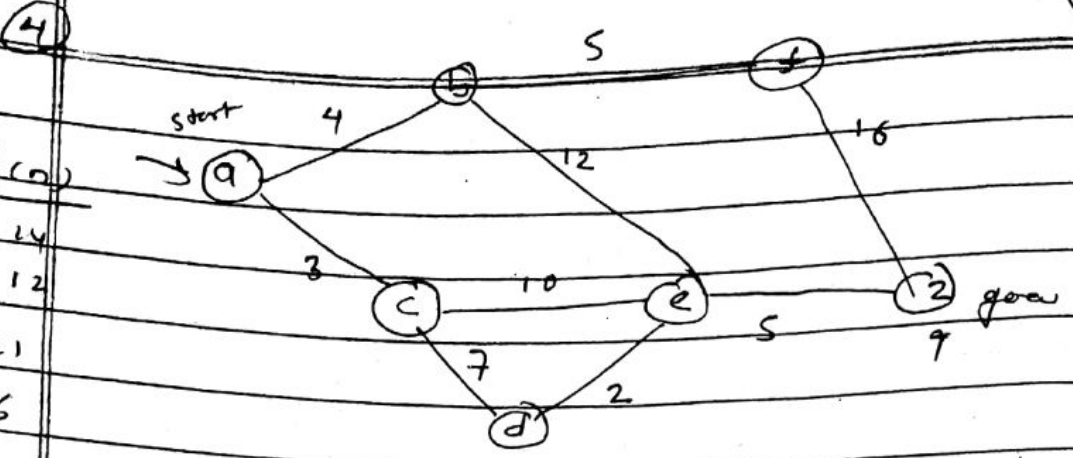
$g(n) = 1 + 2 + 2 + 3 = 8$

$h(n) = 0$

$\therefore f(n) = 8$

$\therefore f(n) = 8$ is the optimal soln.

i.e $S \rightarrow A \rightarrow B \rightarrow C \rightarrow G$



Given h(n)

a - 14

b - 12

c - 11

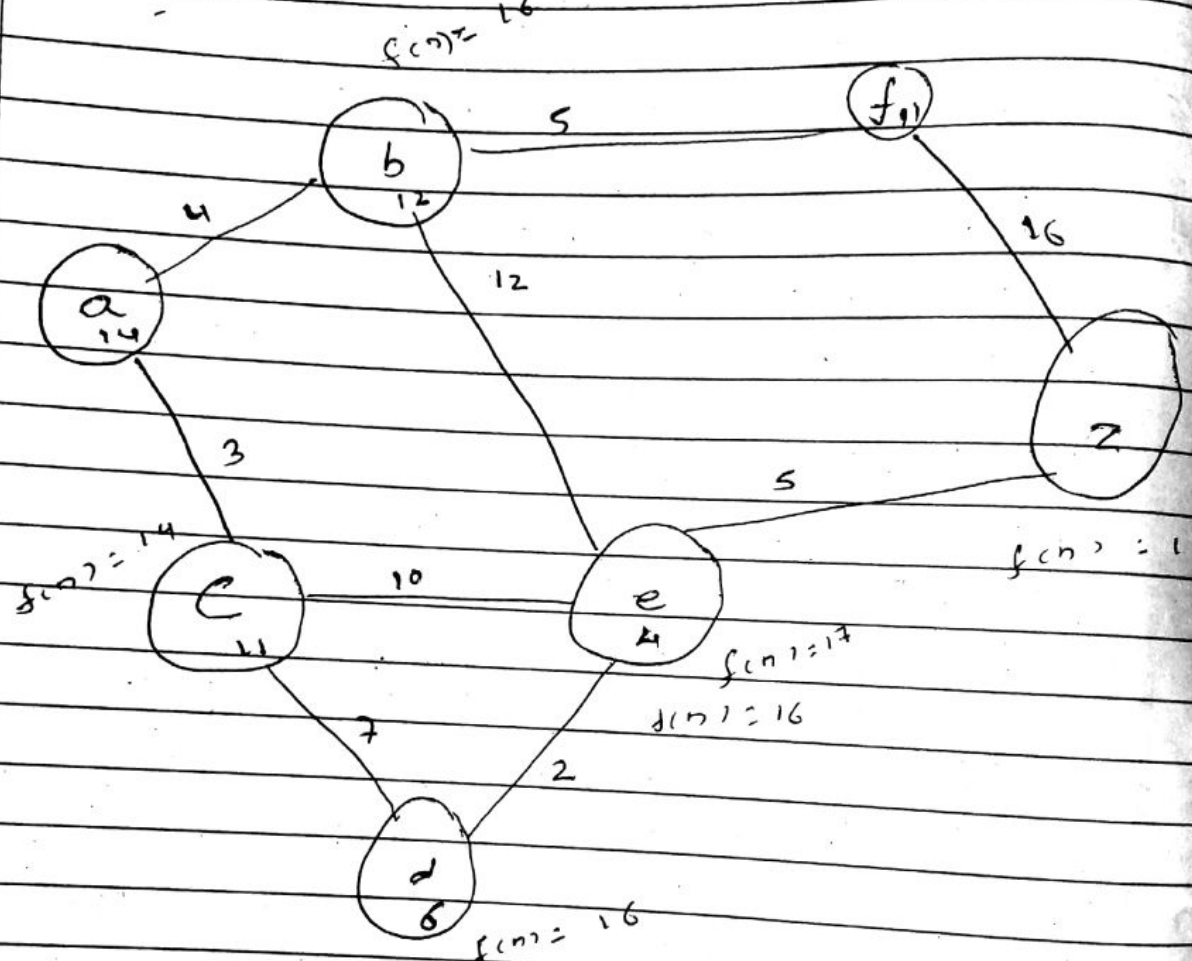
d - 6

e - 4

f - 11

z - 0

Sol^n



Hence, optimal path is a - c - d - e - z

optimal sol is f(n) = 17

Ch-2 pattern recognition

Q.

n=165	predicted: NO	predicted: YES
Actual: NO	50	10
Actual: YES	5	100

What can we learn from this matrix.

- There are two possible predicted classes: "Yes" and "No". If we were predicting the presence of a disease, for eg. "yes" would mean they have the disease and "no" would mean they don't have the dease.

- The classifier made a total of 165 predictions (eg: 165 patient were being tested for the presence of that disease)

- out of these 165 cases, the classifier predicted "yes" 110 times, and "no" 55 times.

- in reality, 105 patients in the sample have the dease, and 60 patients do not.

Now find:

(1) Accuracy
(2) Misclassification rate
(3) True positive rate./ Recall or sensetivity
(4) False positive rate
(5) true Negative rate
(6) precision
(7) prevalence.

Solution:

True positive (TP)

True negative (TN)

False positive (FP) - Type I error

False negative (FN) - Type II error

n = 165	predicted: NO	predicted: YES	
Actual: NO	50 = TN	10 = FP	60
Actual: YES	5 = FN	100 = TP	105
	55	110	

(1) Accuracy:

$$A = \frac{TP + TN}{Total} = \frac{100 + 50}{165} = 0.91$$

(2) Misclassification rate = $\frac{FP + FN}{Total} = \frac{10 + 5}{165} = 0.09$

(1 - Accuracy)

(3) True positive rate = TP/Actual yes = $\frac{100}{105} = 0.95$

(4) False positive rate = FP/Actual NO = $\frac{10}{60} = 0.17$

(5) True negative rate = TN/Actual NO = 50/60 = 0.83

(6) precision = TP/predicted yes = 100/110 = 0.91

(7) prevalence = ~~FP/predicted~~ NO = $\frac{\text{actual yes}}{\text{total}} = \frac{105}{165} = 0.64$

How often does the yes condⁿ actually occur in our sample.

Bayes Theorem numerical

2015/17

Q. while watching a game of champions league footb
a cafe, you observe someone who is cheering
supporting manchester united in the game
using Bayes rule calculate the probability that
they were actually born within 30 miles of manch
Assume that.

- The probability that a randomly selected person
a typical local bar environment is born wi
30 miles of manchester is 1/20
- The chance that a person born within 30 miles
of manchester actually supports manchester united is
7/10
- The probability that a person not born with
miles of manchester supports manchester united
with probability 1/10

Solution:

Let M : set of born within 30 miles of manchester
N : set of NOT born within 30 miles of manchester.
S : set of supporter of manchester

Given that

$P(M) = 1/20$

$P(N) = 1 - 1/20 = 19/20$

$P(M/S) = 7/10$

$P(N/S) = 1/10$

$P(b/M) = ?$

We know from Bayes theorem

$$P(S/M) = \frac{P(M) \cdot P(M/S)}{P(M) \cdot P(M/S) + P(N) \cdot P(N/S)}$$

$$= \frac{1/20 * 7/10}{\frac{1}{20} * \frac{7}{10} + \frac{19}{20} * \frac{1}{20}}$$

$$= 7/26 \quad \text{Ans}$$

$$P(A/B) = \frac{P(A) * P(B/A)}{P(B)}$$

20/1/25

Numerical

A farmer has to cross a river with his Fox, Goose and Grain. Each trip his boat can only carry himself and one of his possessions. How can he cross the river if the fox is left alone with goose, the goose will be eaten. If the goose is left alone with the grains, it will be eaten?

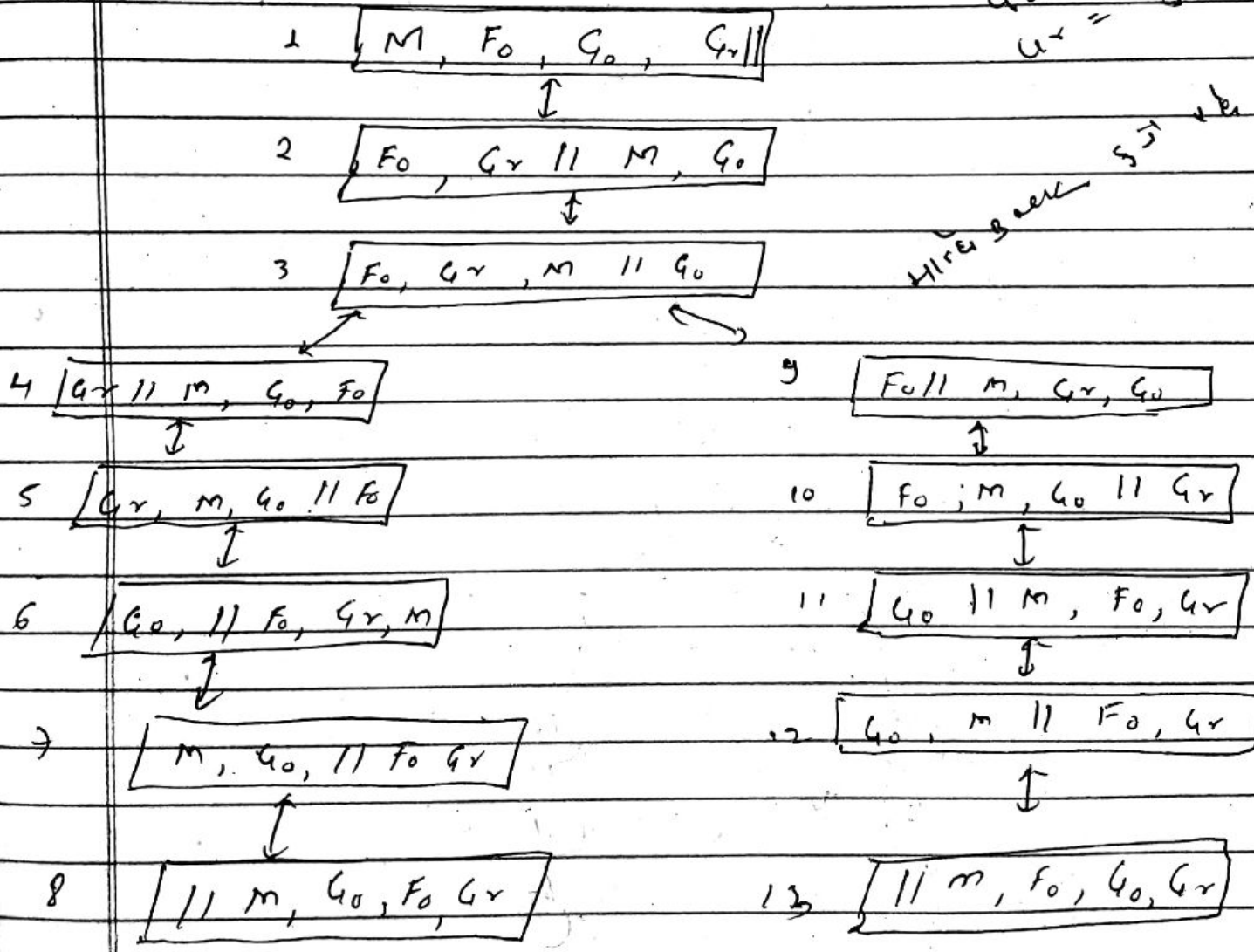
(i) construct a complete search tree.

(ii) perform DFS

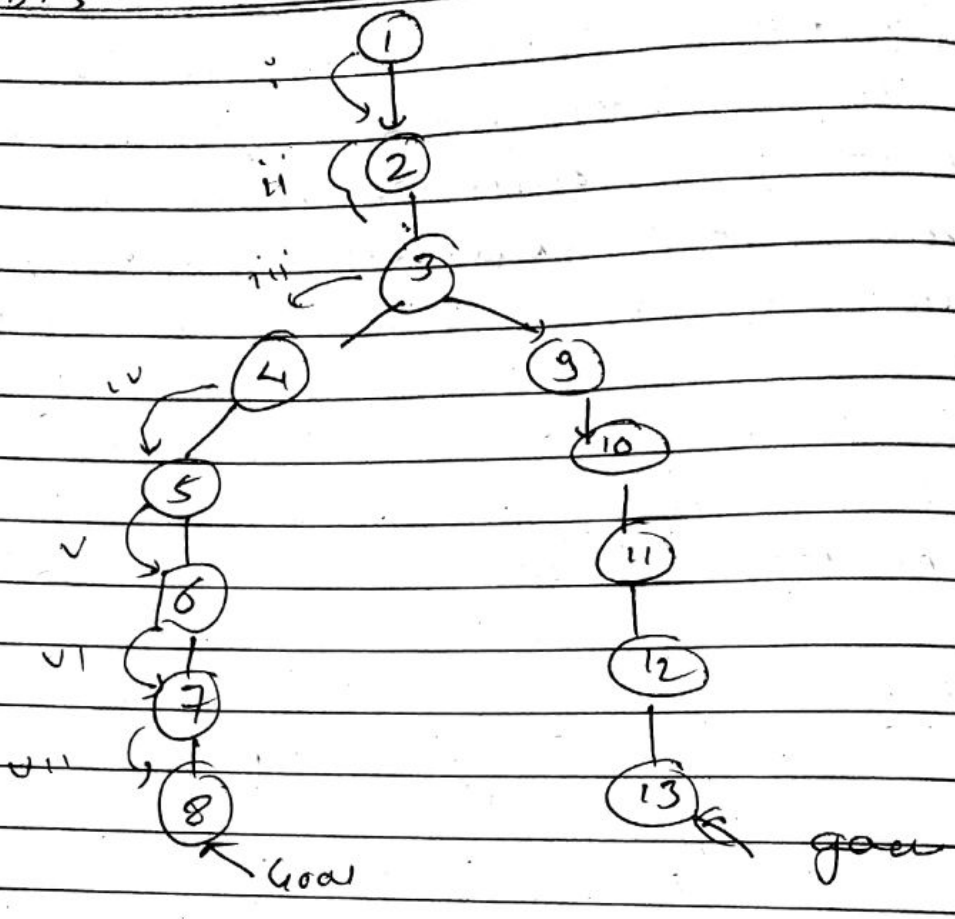
(iii) perform BFS

M = man
F_0 = fox
G_0 = goose
G_r = grain

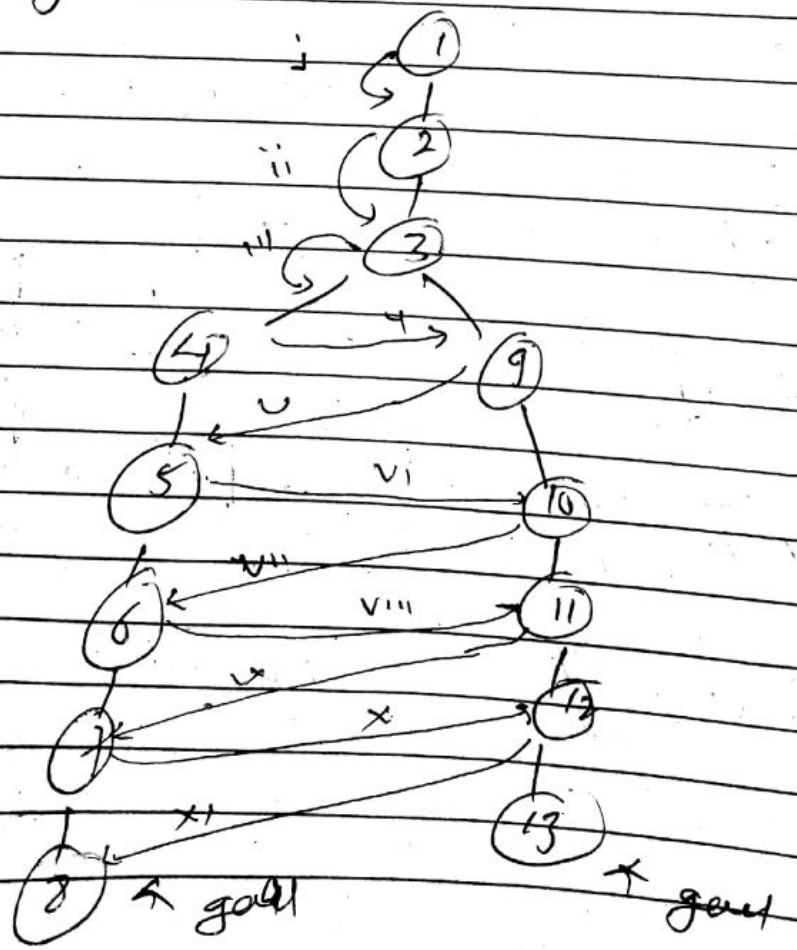
Solution:



(1) using DFS



(2) using BFS



Water Jug Problem

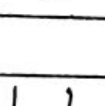
You are given two jugs, a 4 litre one and 3 ltr one. None of them have measuring marks on it. There is pump that can be used to fill the jugs with water. How can you get exactly a 2 ltr. of water into a 4 ltr. jug. ?

Soln:

4L 3L

Initial cond^n : (0, 0)

Final cond^n (2, n)

1  

1. (4, 0)

2  1L  3L

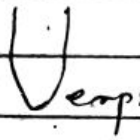
2. (4, 0) → (1, 3)

3. (1, 3) → (1, 0)

3  1L  empty

4. (1, 0) → (0, 1)

5. (0, 1) → (4, 1)

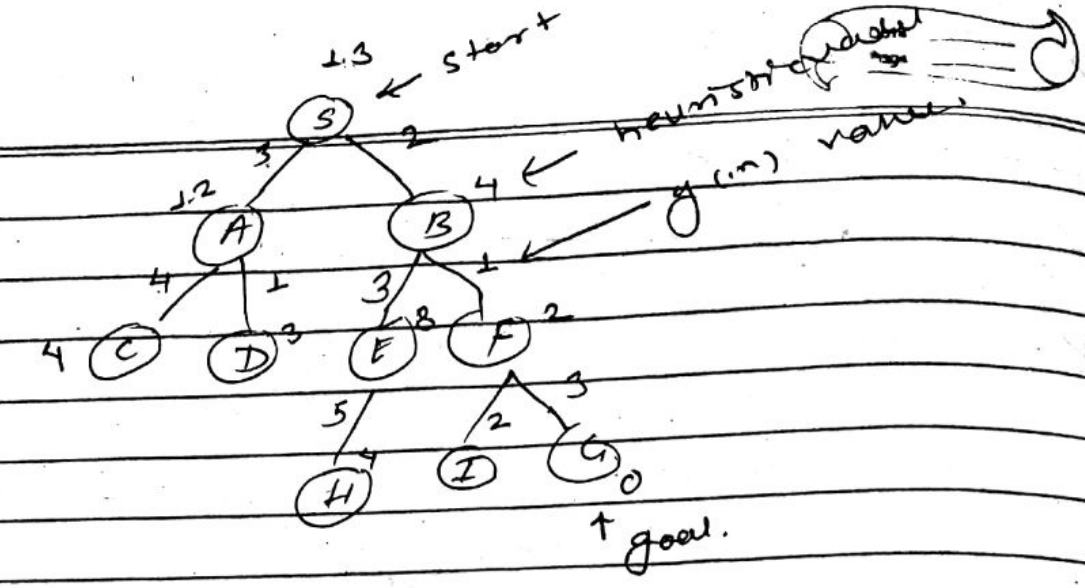
4  empty  1L

6. (4, 1) → (2, 3)

5  4L full  1L

6  2L  3L

Q.no 2



find the shortest path using BFS, Greedy BFS and A* search.

Soln: (1) using BFS. (only g(n) value

step1: OL [S]
CL [ ]

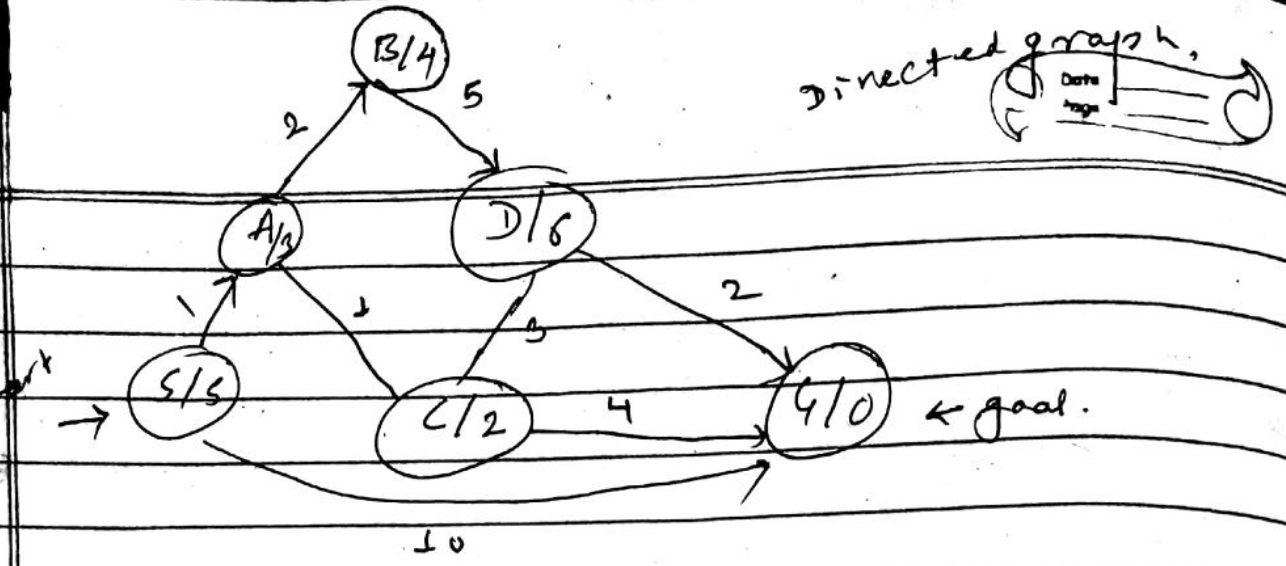
step2: OL [A B]
CL [S]

step3: OL [A E B]
CL [S B]

step4: OL [A E I G]
CL [S B F]

step5: OL [A E I]
CL [S B F G]

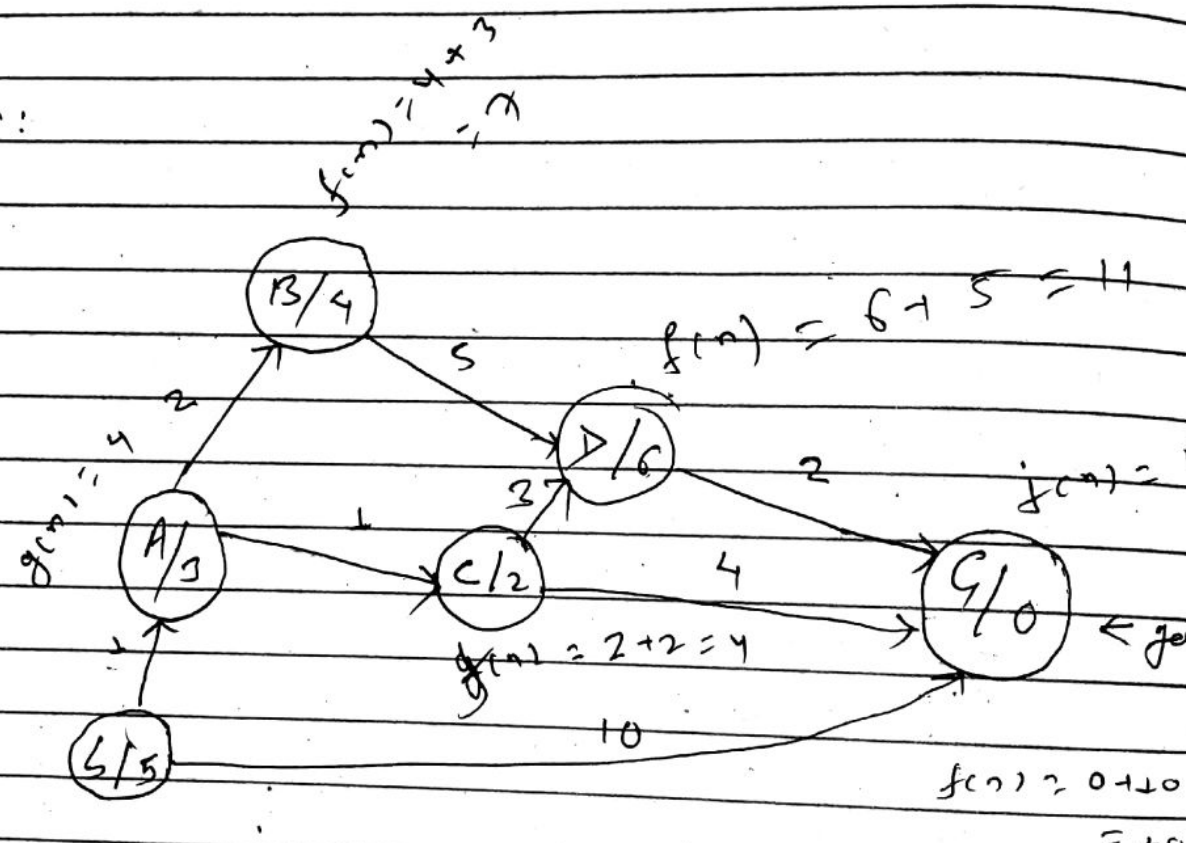
Hence, the shortest path using BFS is S → B → F → G



directed graph.

find A* search to find S to G.

Join:



S – A – C – G

optimal cost = 6

Q

A dentist schedule all his patients for 30 min appointments. Some patients take more or less than 30 min depending on type of therapies to be done. The following summary shows the various categories of therapies their probabilities and the time actually needed to complete the work.

Now, simulate the dentist's clinic for four hours and find out the average waiting time for the patients as well as the idle time of the dentist. Assume that all patients come on time arrival time starts at 8:00 am use the following random numbers for handling the above problem: 40, 82, 11, 34, 25, 66, 17, 79

Category	time req	No. of patients
filling	45 min	40
crown	60 min	15
cleaning	15 min	15
extracting	45 min	10
checkup	15 min	20

Soln:

	Category	Time req^d	No. of patient	probability	cumulative probability	Random No.
(1)	filling	45	40	40/100 = 0.4	0.4 (0.4)	0-39
(2)	crown	60	15	0.15	0.55 (0.4 + 0.15)	40-54
(3)	cleaning	15	15	0.15	0.7 (0.55 + 0.15)	55-69
(4)	extracting	45	10	0.1	0.8 (0.7 + 0.1)	70-79
(5)	checkup	15	20	0.2	1	80-99
			$\Sigma N = 100$			

patients	Schedule arrival	Random number	category	service times (needed)
1	8:00	40	crown	60 min
2	8:30	82	chekup	45 min
3	9:00	11	filling	45 min
4	9:30	34	filling	45 min
5	10:00	25	filling	45 min
6	10:30	66	cleaning	15 min
7	11:00	17	filling	45 min
8	11:30	79	extracting	45 min

Again,

patient	Schedule arrival (A)	start (service time) (B)	service duration	service ends	service - Arrival (patient) waiting time (A-B)	doctor Idle time
1	8:00	8:00	60 min	9:00	0	0
2	8:30	9:00	15 "	9:15	30	0
3	9:00	9:15	45 "	10:00	15	0
4	9:30	10:00	45 "	10:45	30	0
5	10:00	10:45	45 "	11:30	45	0
6	10:30	11:30	45 "	11:45am	60	0
7	11:00	11:45	45 "	12:30pm	45	0
8	11:30	12:30 pm	45 "	1:15pm	60	0
					285	

Hence, Average time of patient = $285/8 = 35.625$ min

idle time for doctor/dentist = 0