

DS & AI ENGINEERING



Artificial Intelligence

Informed Search

Lecture No.- 01



By- Aditya sir

Recap of Previous Lecture



Topic

Topic

Topic

Topic

Uninformed Search

Topics to be Covered



Topic

Informed Search

↳ GBFS
↳ A* Search





About Aditya Jain sir



1. Appeared for GATE during BTech and secured AIR 60 in GATE in very first attempt - City topper
2. Represented college as the first Google DSC Ambassador.
3. The only student from the batch to secure an internship at Amazon. (9+ CGPA)
4. Had offer from IIT Bombay and IISc Bangalore to join the Masters program
5. Joined IIT Bombay for my 2 year Masters program, specialization in Data Science
6. Published multiple research papers in well known conferences along with the team
7. Received the prestigious excellence in Research award from IIT Bombay for my Masters thesis in ML
8. Completed my Masters with an overall GPA of 9.36/10
9. Joined Dream11 as a Data Scientist
10. Have mentored 15,000+ students & working professions in field of Data Science and Analytics
11. Have been mentoring & teaching GATE aspirants to secure a great rank in limited time
12. Have got around 27.5K followers on LinkedIn where I share my insights and guide students and professionals.

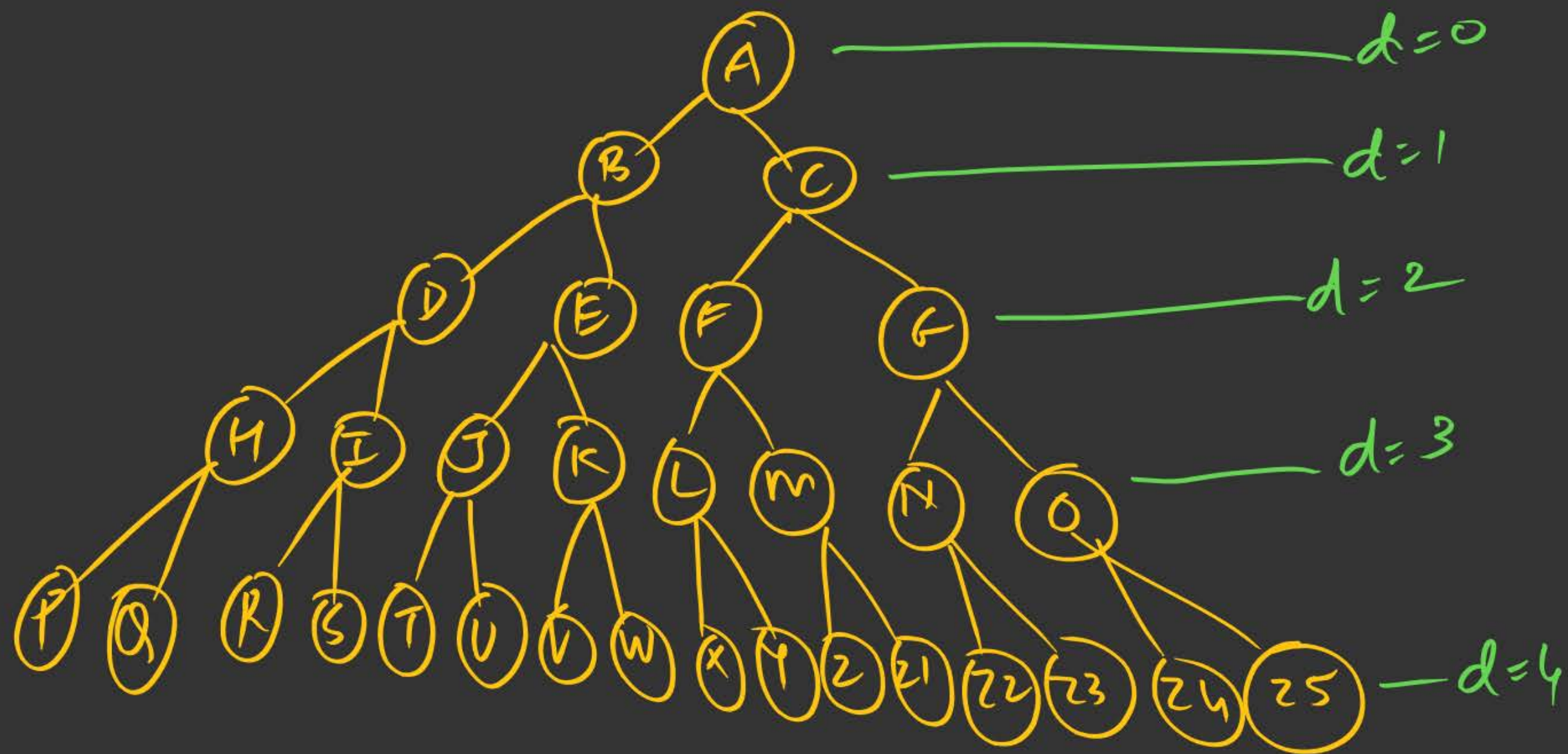


Telegram

Telegram Link for Aditya Jain sir:

https://t.me/AdityaSir_PW

Bidirectional Search Eg:-





01
~~ABC~~

A
 C1

02
~~Z5~~ 0

Z5
 C2



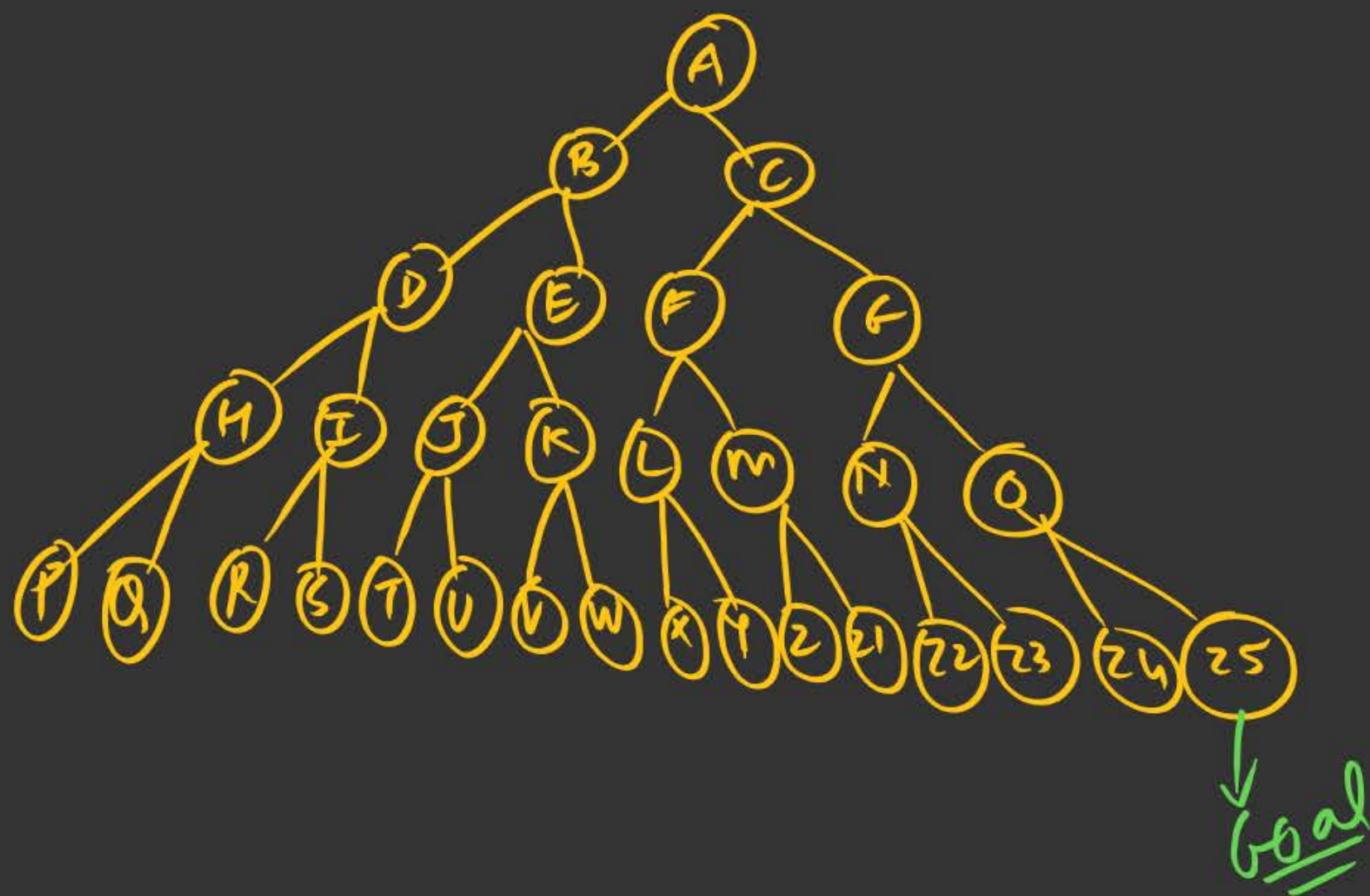
Step 2

O1
~~A B C D E~~

A B
 C1

O2
~~Z5~~ ~~Ø~~ G Z4

Z5 O
 C2



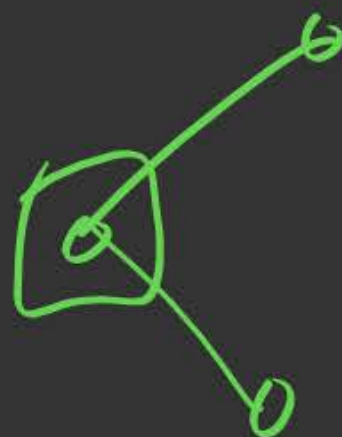
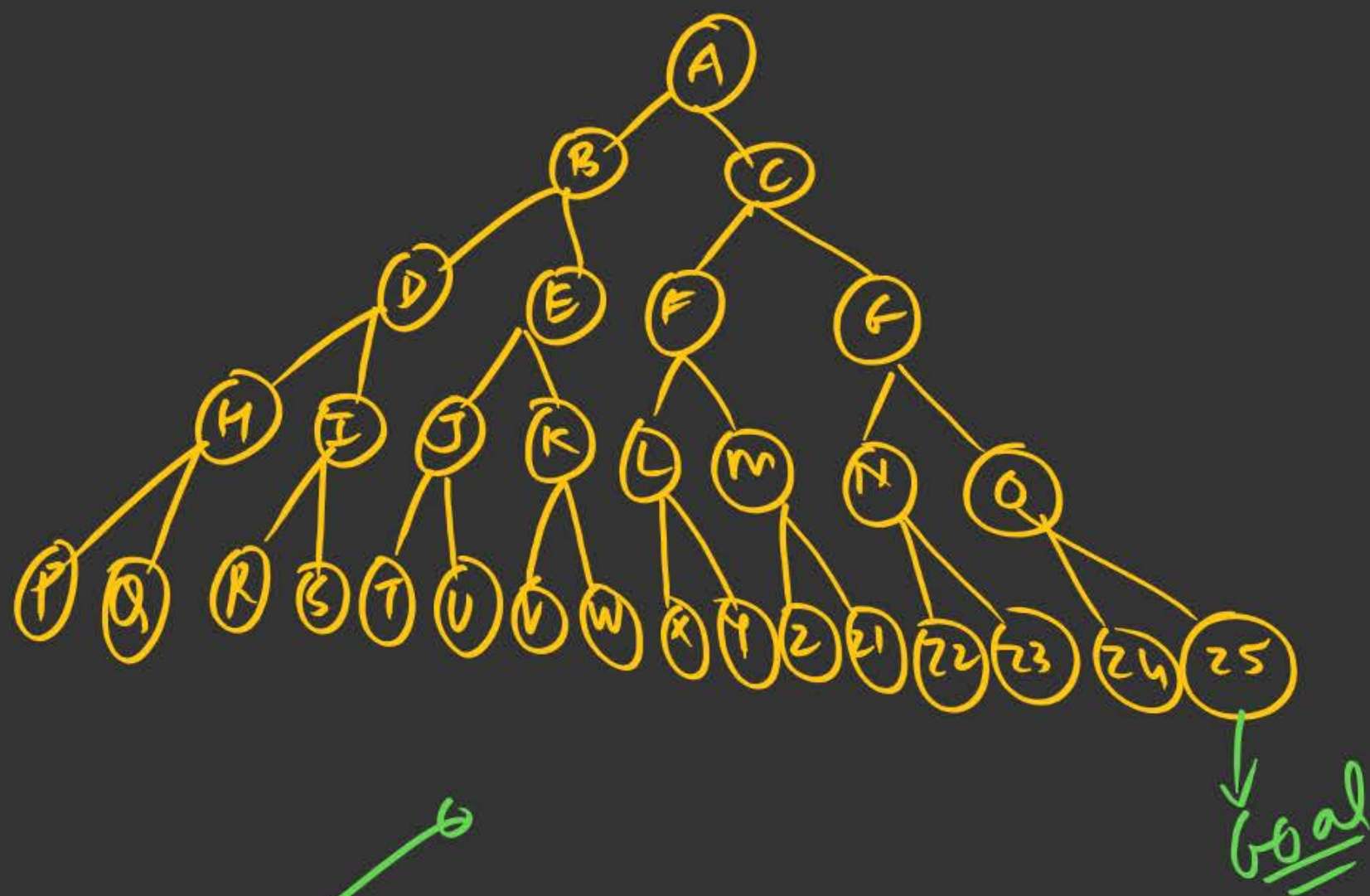
Step 3:

O1
~~A B C D E F G~~

A B C
 C1

O2
~~Z5~~ ~~Ø~~ ~~G~~ Z4 C N

Z5 O G
 C2



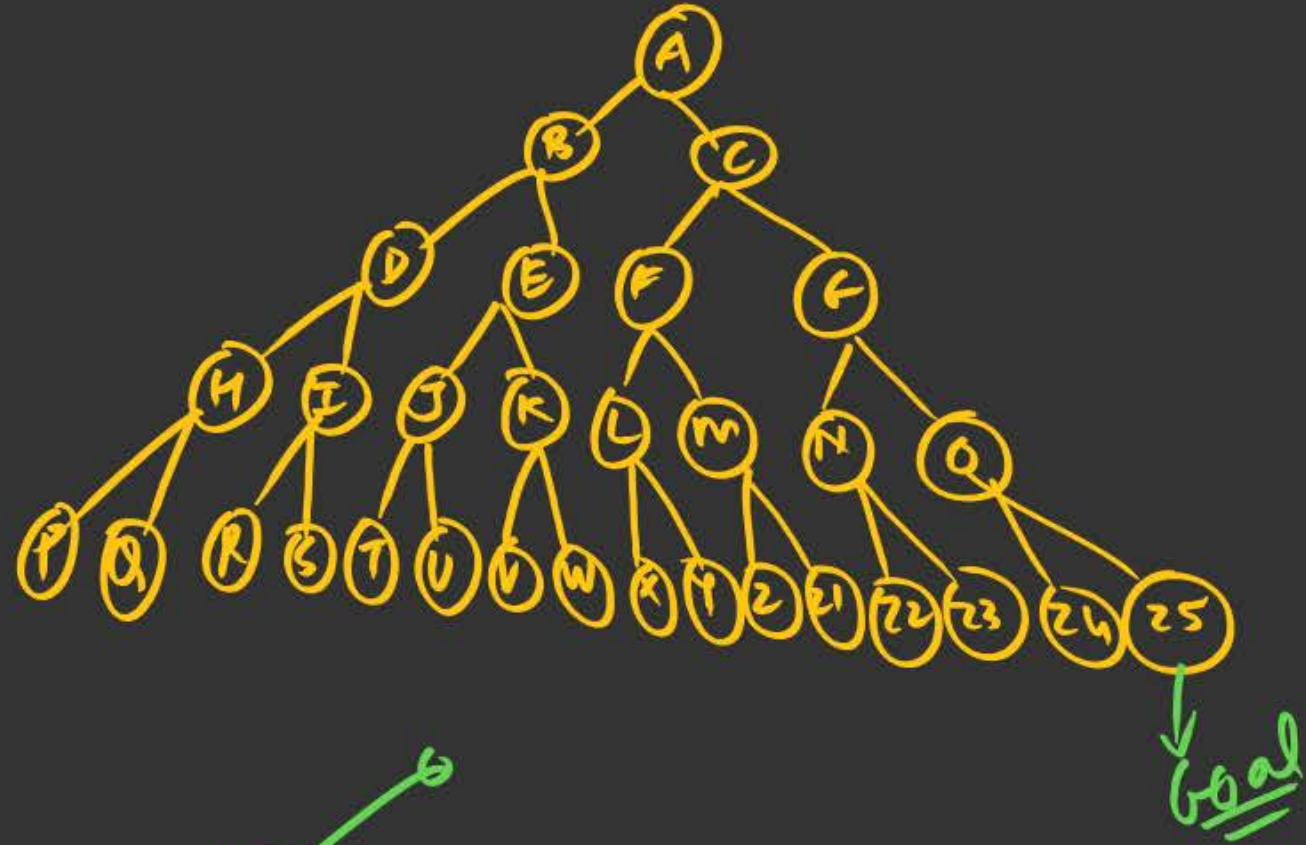
Step 4:

O1
~~A~~ ~~B~~ ~~C~~ ~~D~~ ~~E~~ ~~F~~ ~~G~~ ~~H~~ ~~I~~

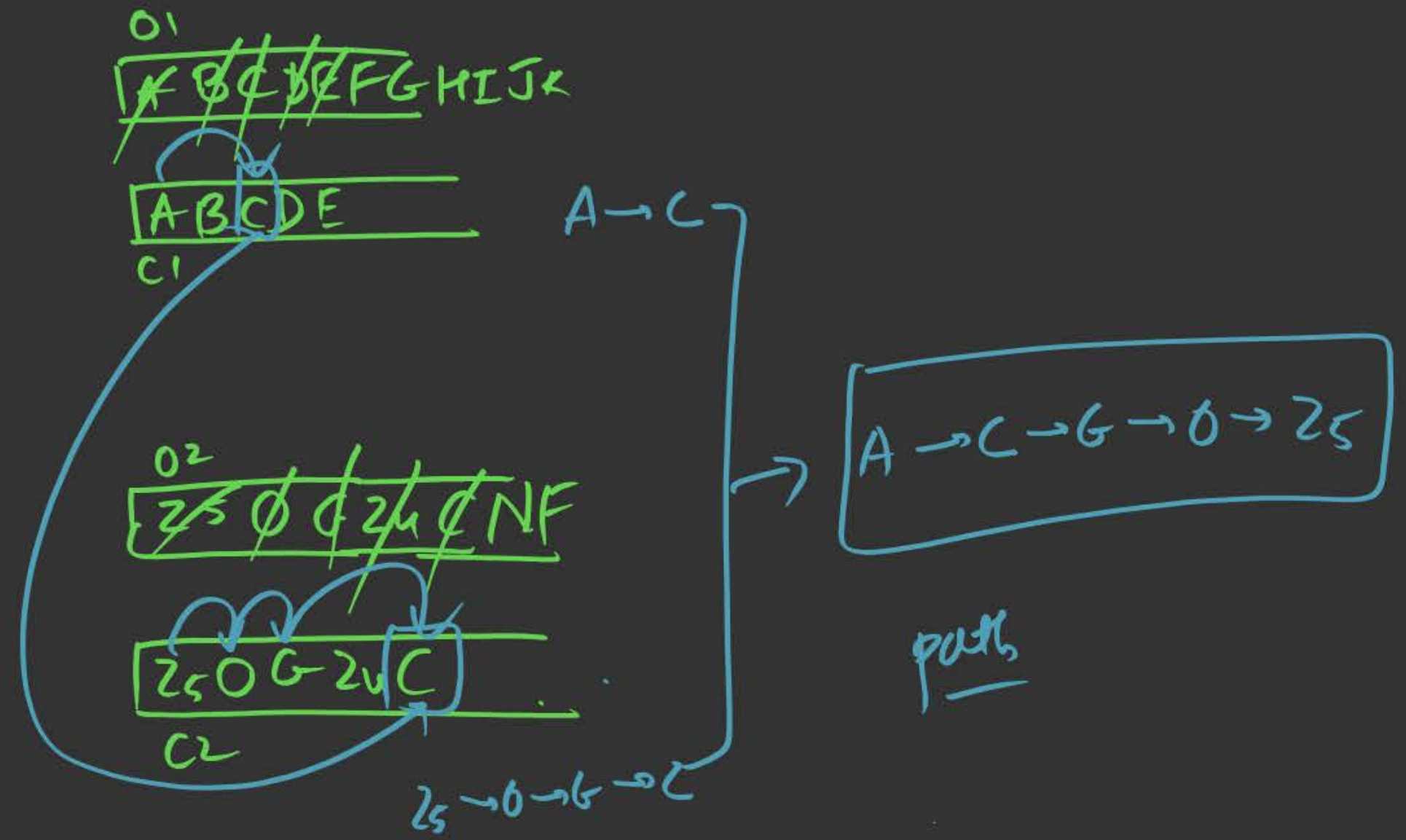
A B C D
 C1

O2
~~Z5~~ ~~Ø~~ ~~C~~ ~~Z4~~ C N

Z5 O G Z4
 C2



Step 4:

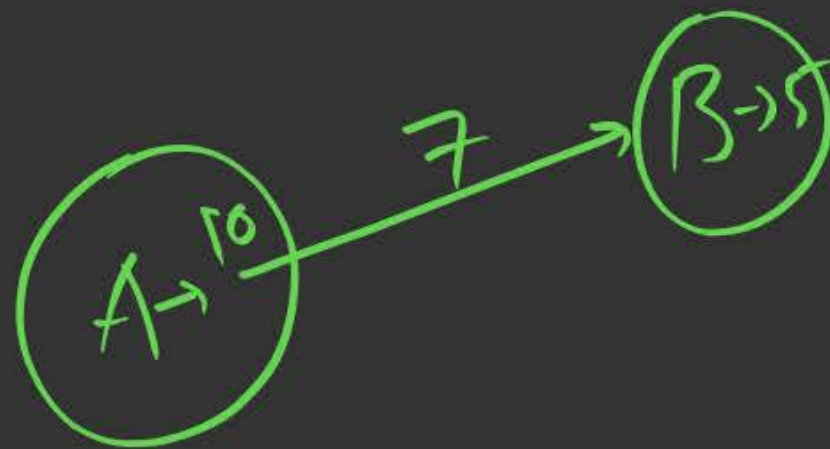


| Algo | Complete | Optimal | TC | SC | |
|-------------------------|----------|---------|-----------------------|-----------------------|--|
| 1) BFS | Yes | Yes | $O(b^d)$ | $O(b^d)$ | |
| 2) DFS | No | No | $O(b^d)$ | $O(b \times d)$ | |
| 3) UCS | Yes | Yes | $O(b^{C^*/\epsilon})$ | $O(b^{C^*/\epsilon})$ | |
| 4) Bidirectional Search | Yes | Yes | $O(b^{d/2})$ | $O(b^{d/2})$ | |

Informed Search

Informed Searches : Heuristics → estimation

↓
more efficient
than
uninformed search



Heuristic function: gives an estimate of the
Smallest/cheapest cost of
going from a node to the goal node.

① GBFS

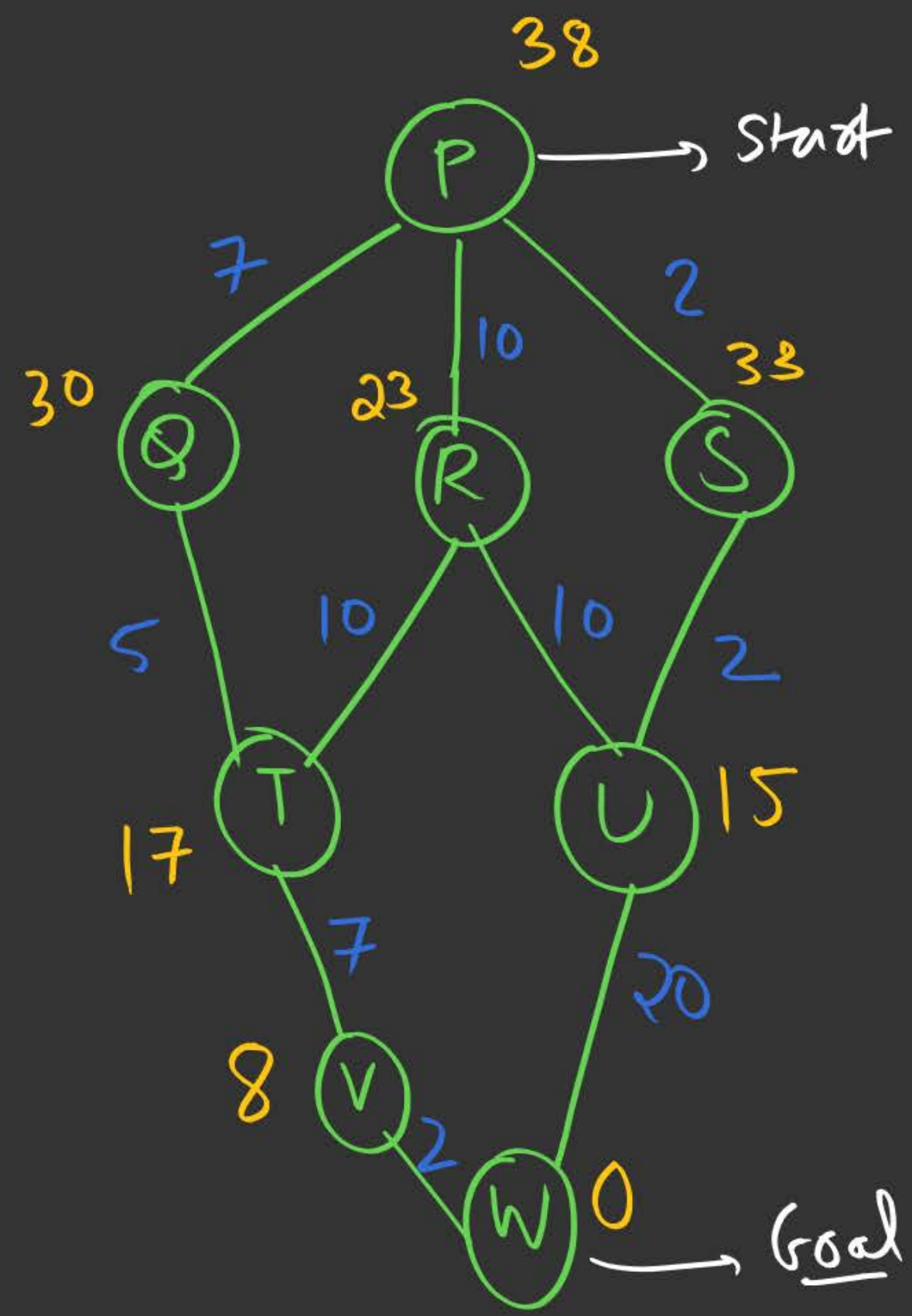


Greedy Best First Search.

GBFS:

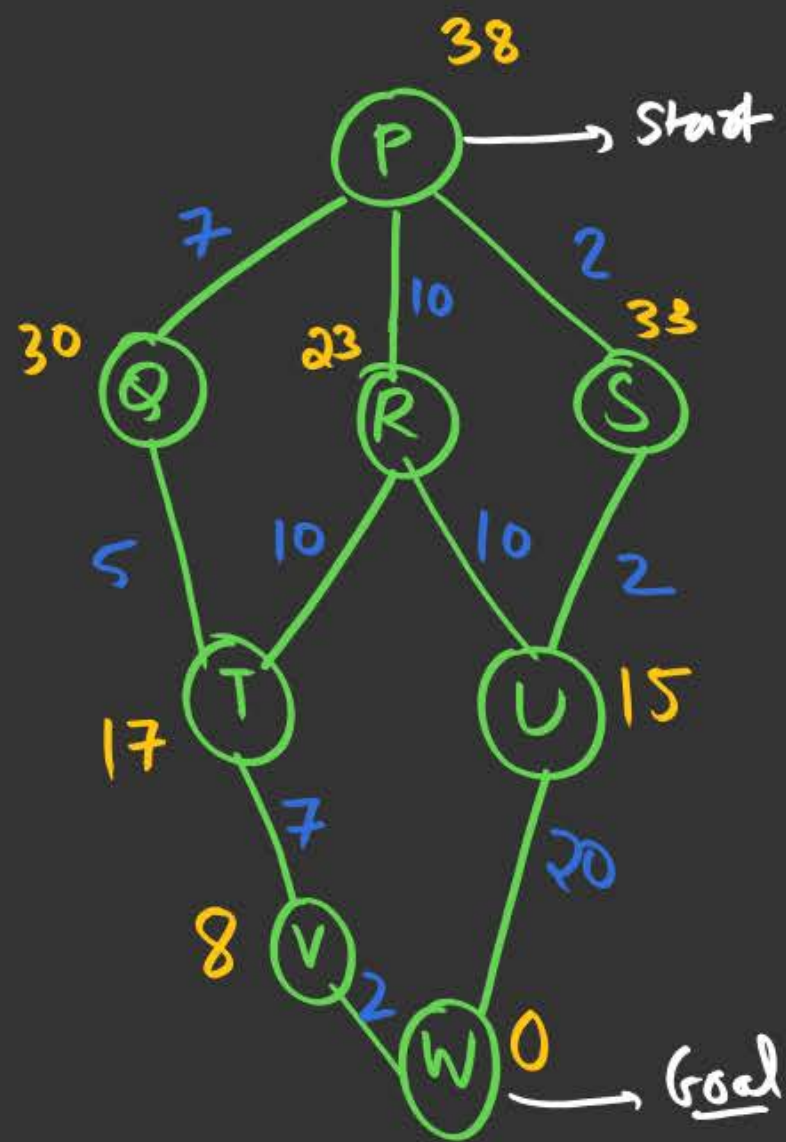
- ↳ move \rightarrow on basis of $h(n)$.
- ↳ if multiple child nodes,
move to the child
with min $h(n)$.

Eg:-



① UCS

Eg:-



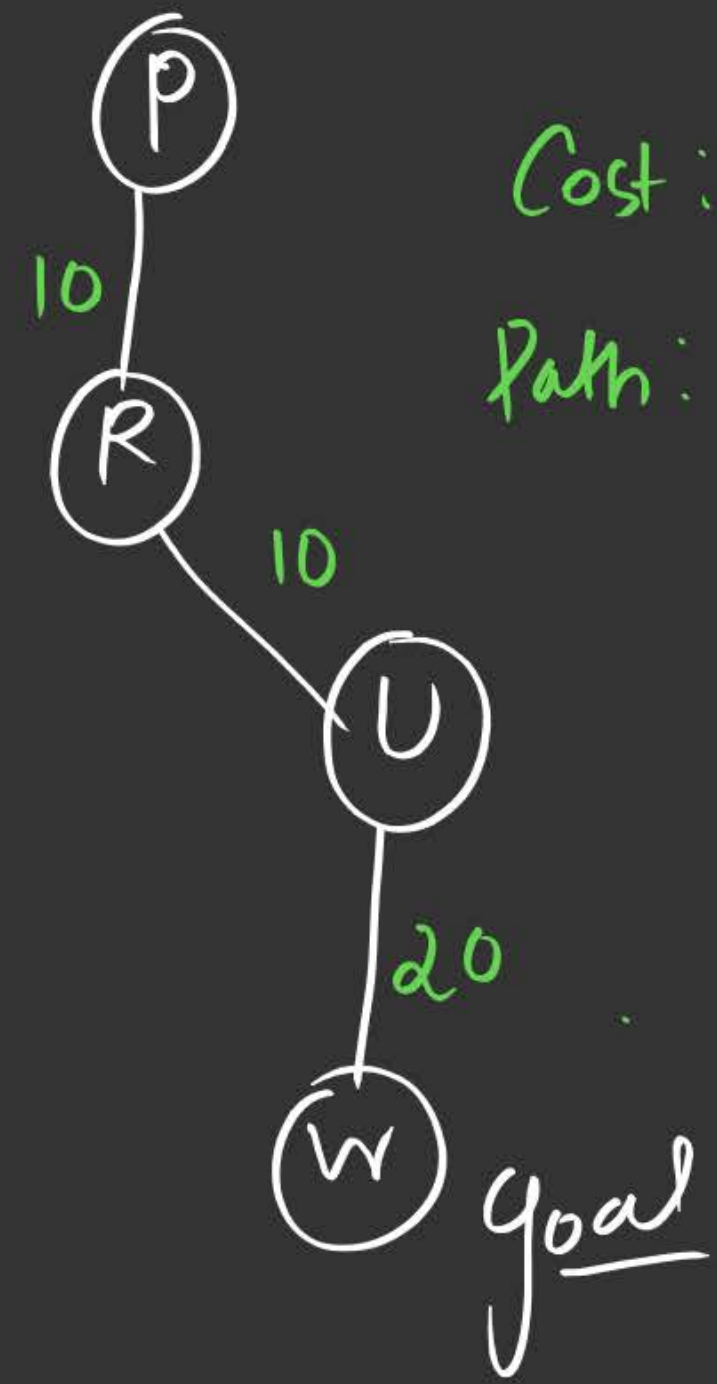
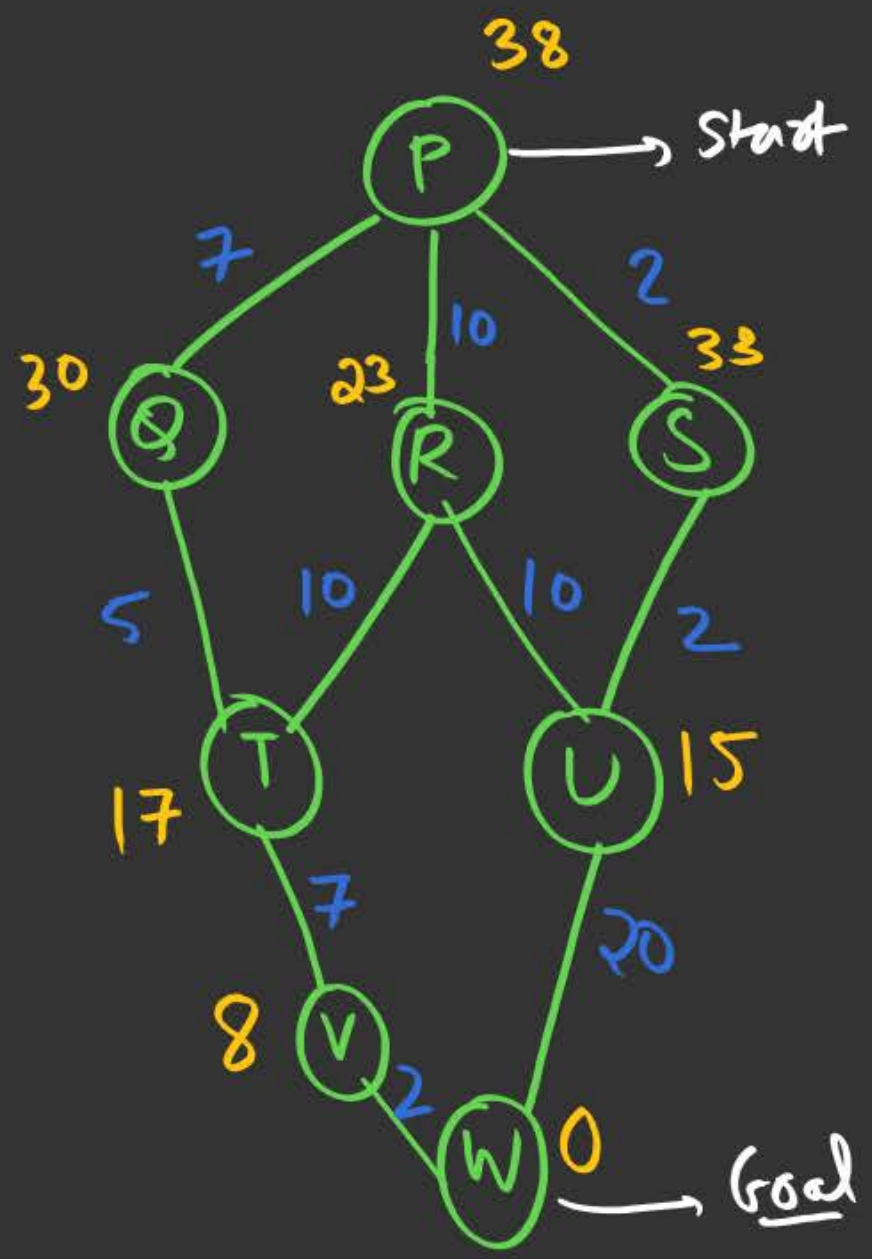
① UCS

| open | closed. | | | | | | |
|----------------|---------|-----|-----|------|------|------|-------------|
| P ^x | P | S | U | Q | R | T | ✓ |
| Q ^x | 7 | 7 | (7) | 7 | 7 | 7 | 7 |
| R ^x | 10 | 10 | 10 | (10) | 10 | 10 | 10 |
| S ^x | (2) | 2 | 2 | 2 | 2 | 2 | 2 |
| U ^x | x | (4) | 4 | 4 | 4 | 4 | 4 |
| W | x | x | 24 | 24 | 24 | 24 | (21) → Goal |
| T ^x | x | x | x | 12 | (12) | 12 | 12 |
| V | x | x | x | x | x | (19) | 19 |

UCS: Cost = 21

[P → Q → T → V → W]

Eg:-
(2) GBFS



Cost: 40
Path: PRUW

Imp :-

Disadvantages: If the Heuristics are incorrect/Bad.

W.C TC & SC:

↓ $O(b^d)$

visit
all nodes

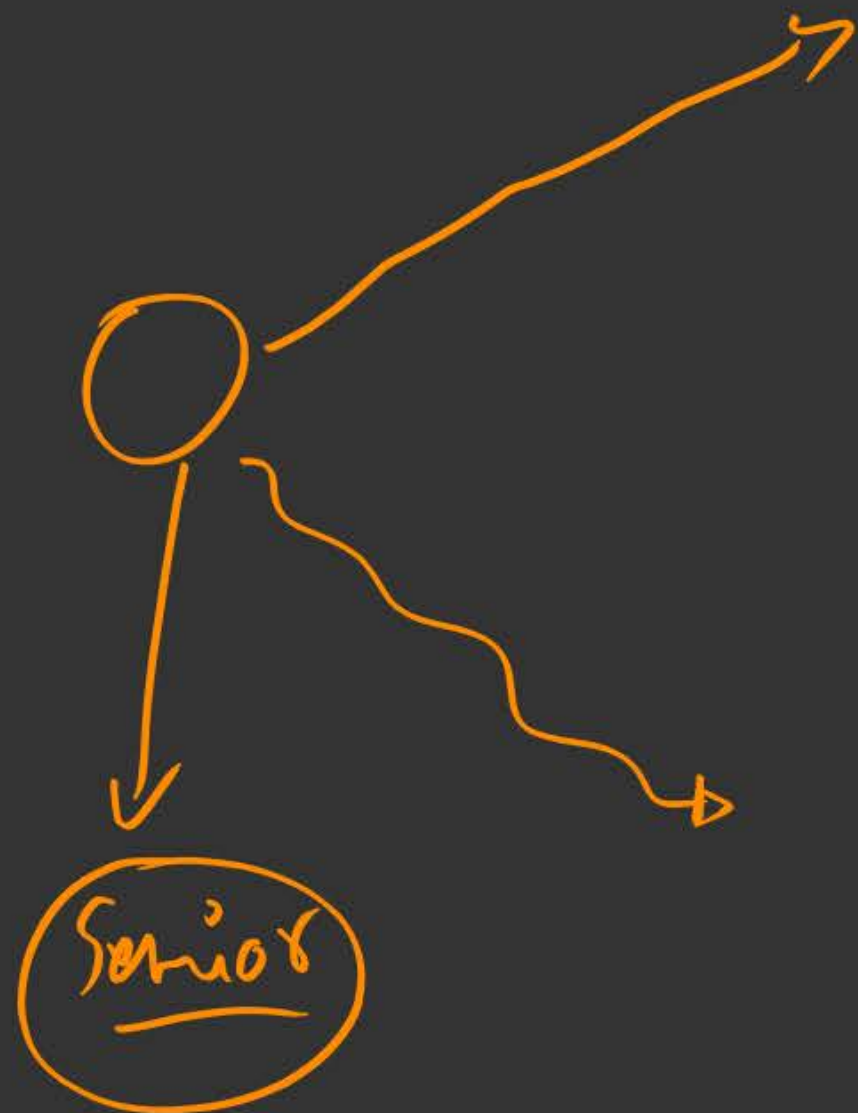
Advantages :-

If Heuristics are correct:

① Optimal ✓

② Complete ✓

- ① Not Optimal → ^{as} not considering path costs
- ② Not Complete
 - Cycle
 - Dead-end



② A^{*} Search:

↳ Similar to UCS.

UCS: Cost of a node = $\left[\begin{array}{l} \text{Sum of} \\ \text{from} \end{array} \overset{\text{cost of all the path}}{\text{start to that node.}} \right]$

↓
g(n)

↓
g(n)

★ GBFS : $\rightarrow h(n)$

cost of node = sum of all the Heuristics
($h(n)$) \downarrow

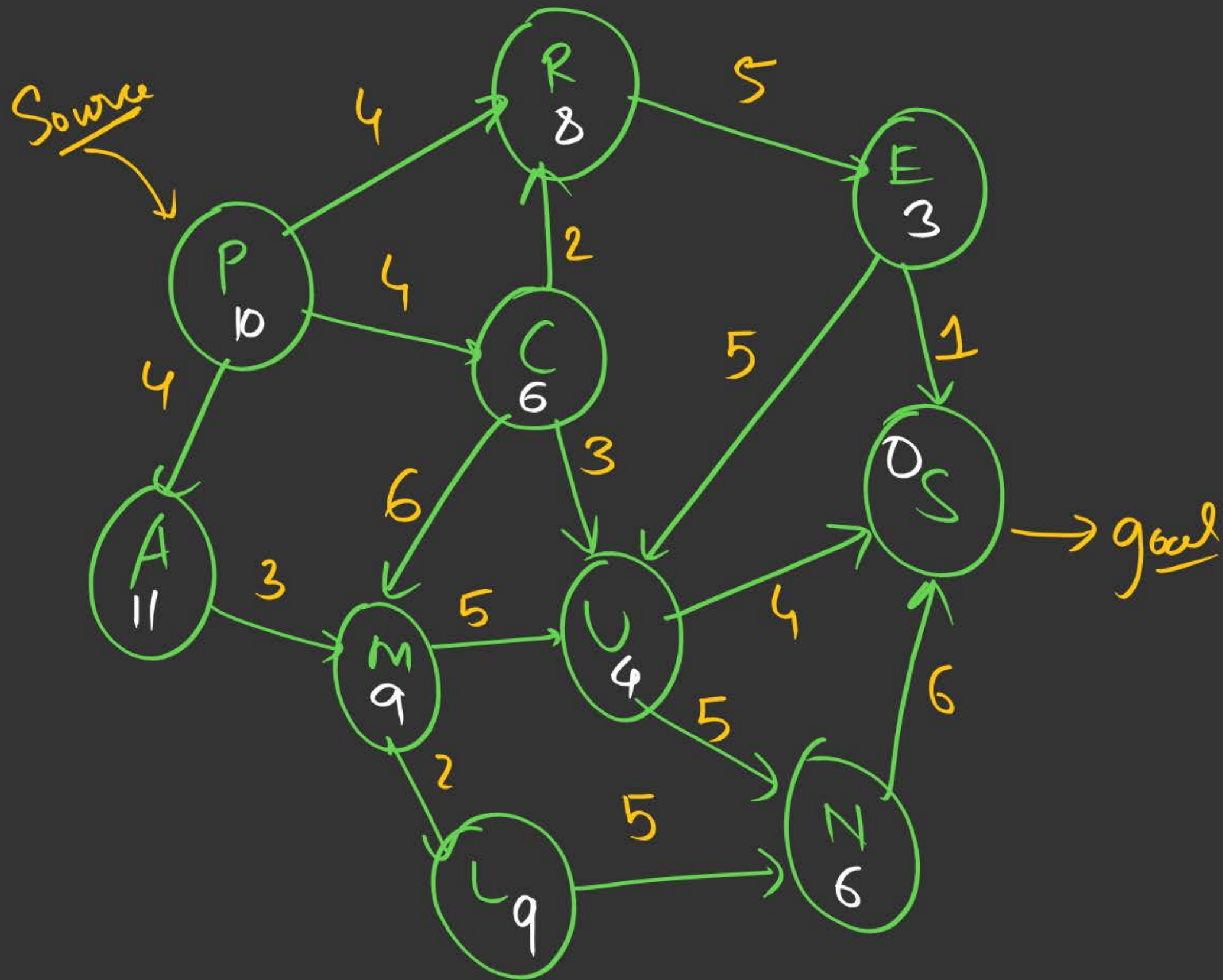
A* Search:

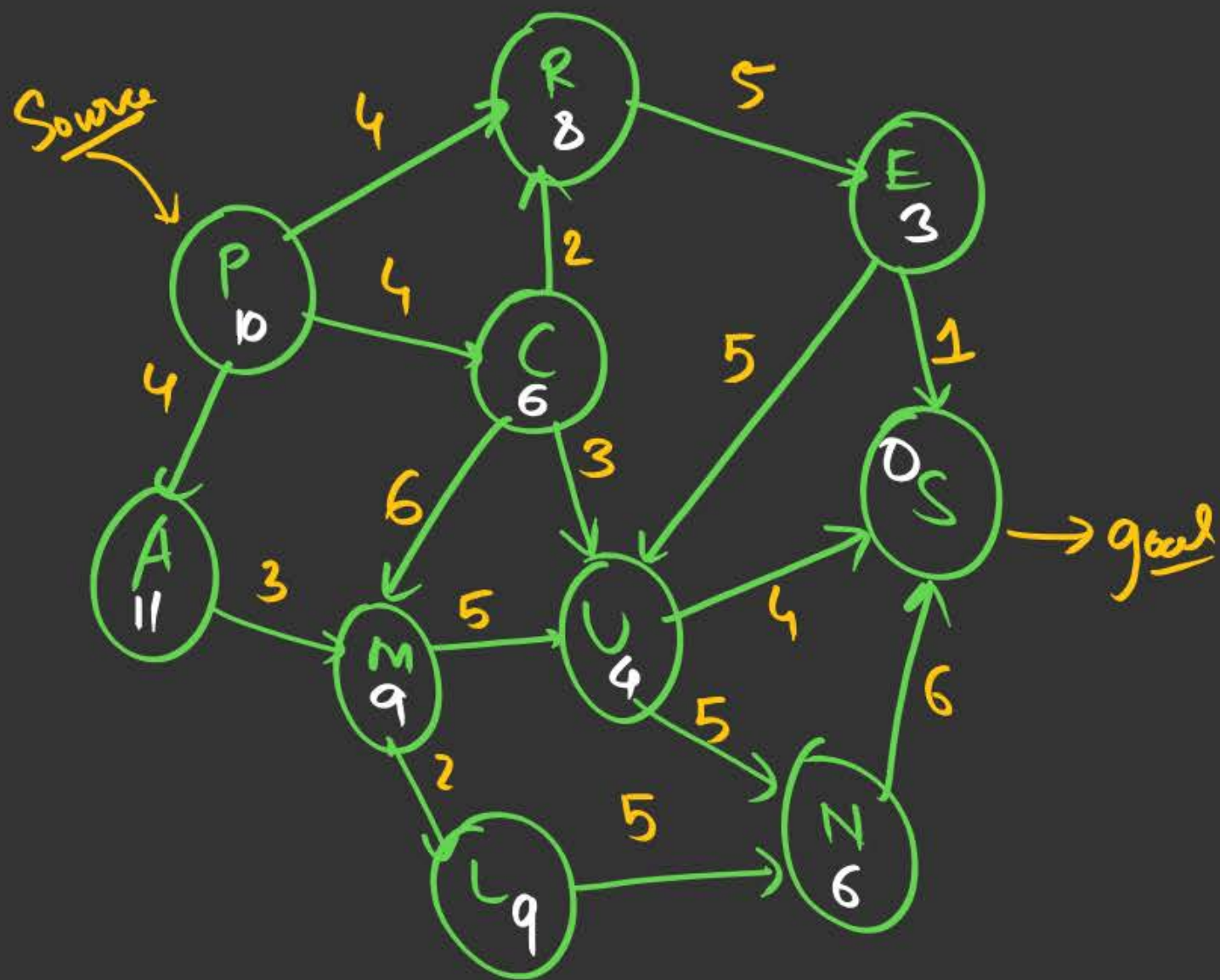
Same as UCS, but Cost of a node ($F(n)$)

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

↓
path cost till that node.

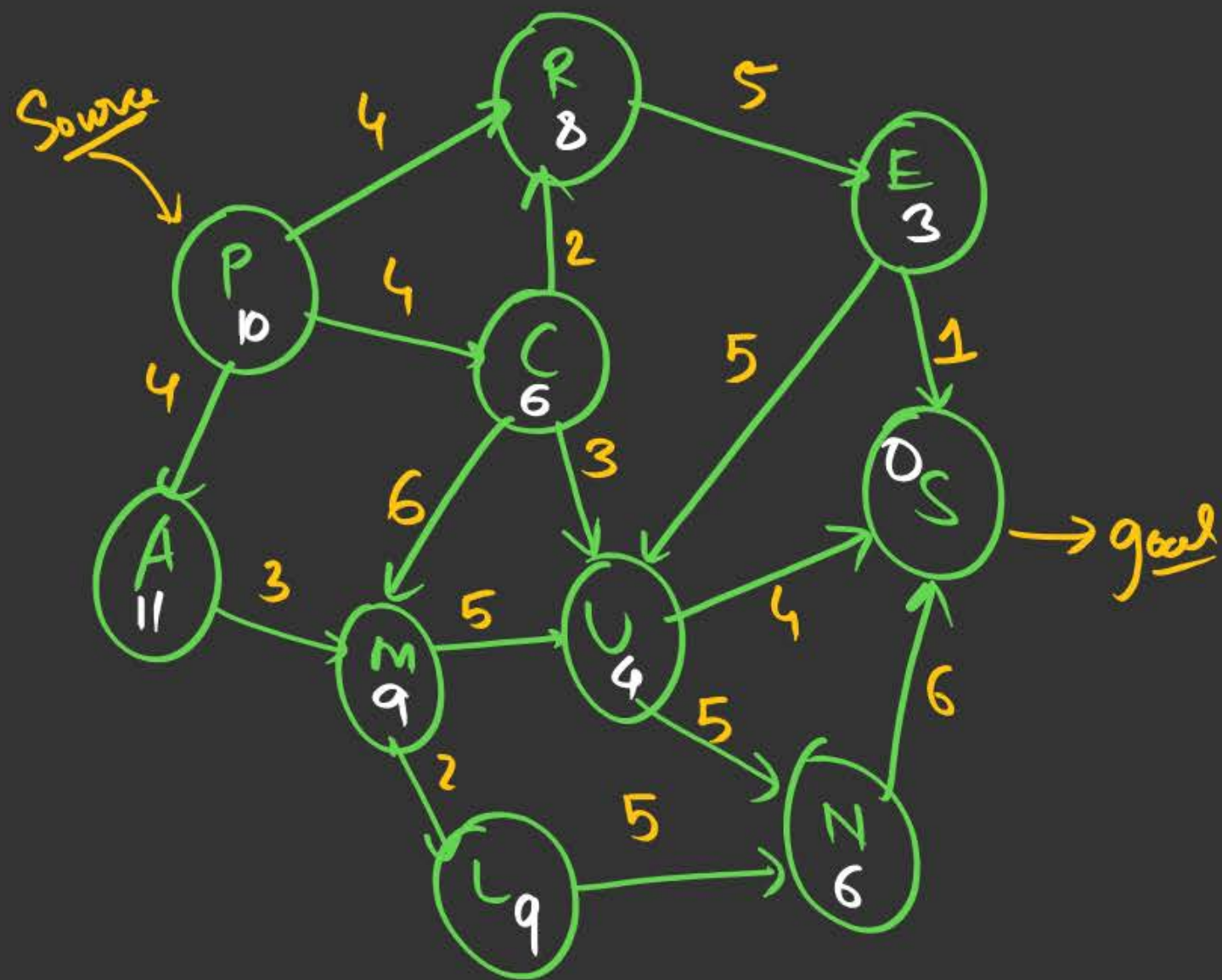
→ Heuristic value of that node





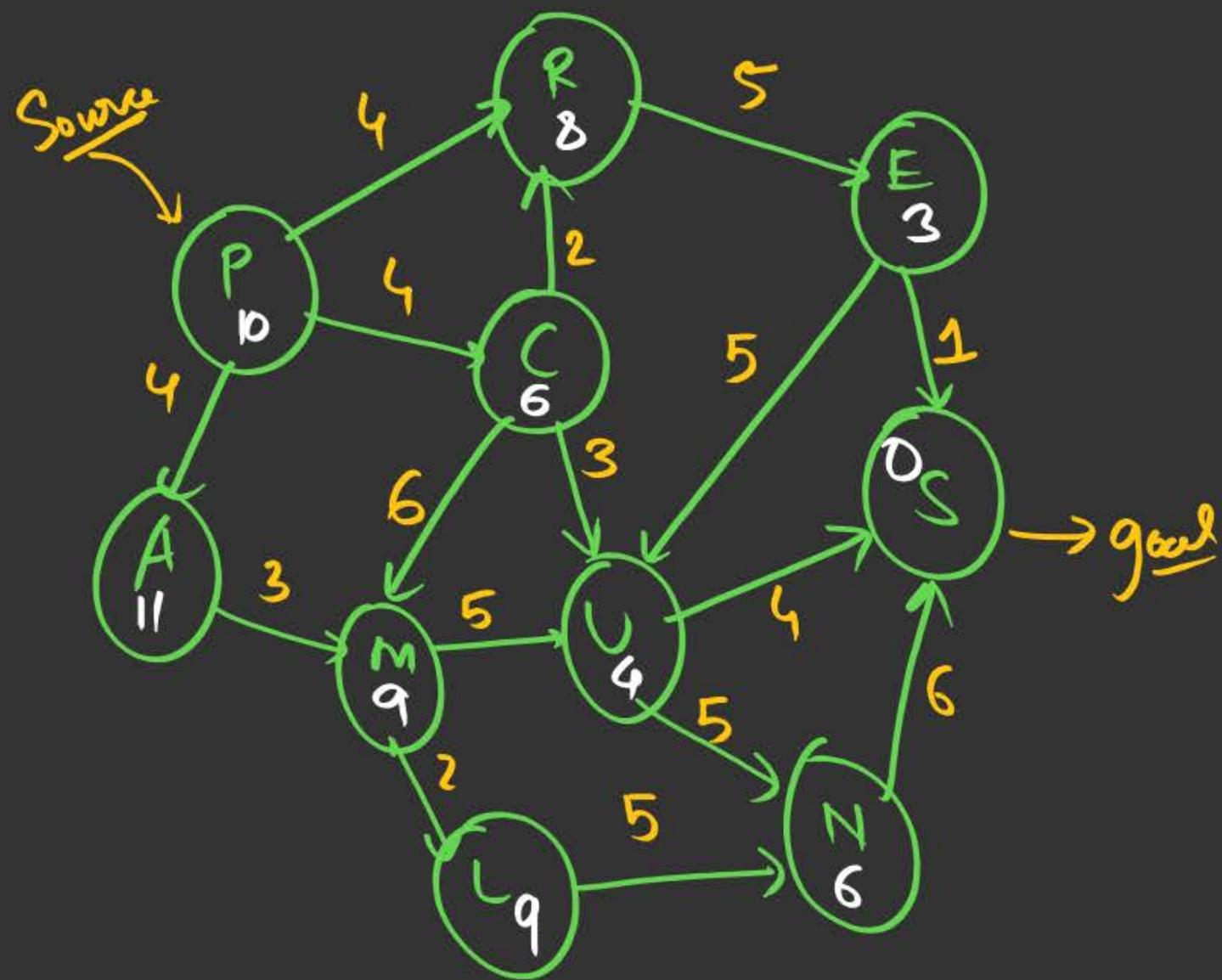
① UCS

| open | Closed | | | | | | | | |
|----------------|--------|---|---|---|---|----|----|----|--------|
| | P | A | C | R | M | U | E | L | |
| P ^x | | | | | | | | | |
| A ^x | 4 | | | | | | | | |
| C ^x | 4 | 4 | | | | | | | |
| R ^x | 4 | 4 | 4 | | | | | | |
| M ^x | x | 7 | 7 | 7 | | | | | |
| U ^x | x | x | 7 | 7 | 7 | | | | |
| E ^x | x | x | x | 9 | 9 | 9 | | | |
| L ^x | x | x | x | x | 9 | 9 | 9 | | |
| N ^x | x | x | x | x | x | 12 | 12 | 12 | |
| S | x | x | x | x | x | 11 | 10 | 10 | → goal |

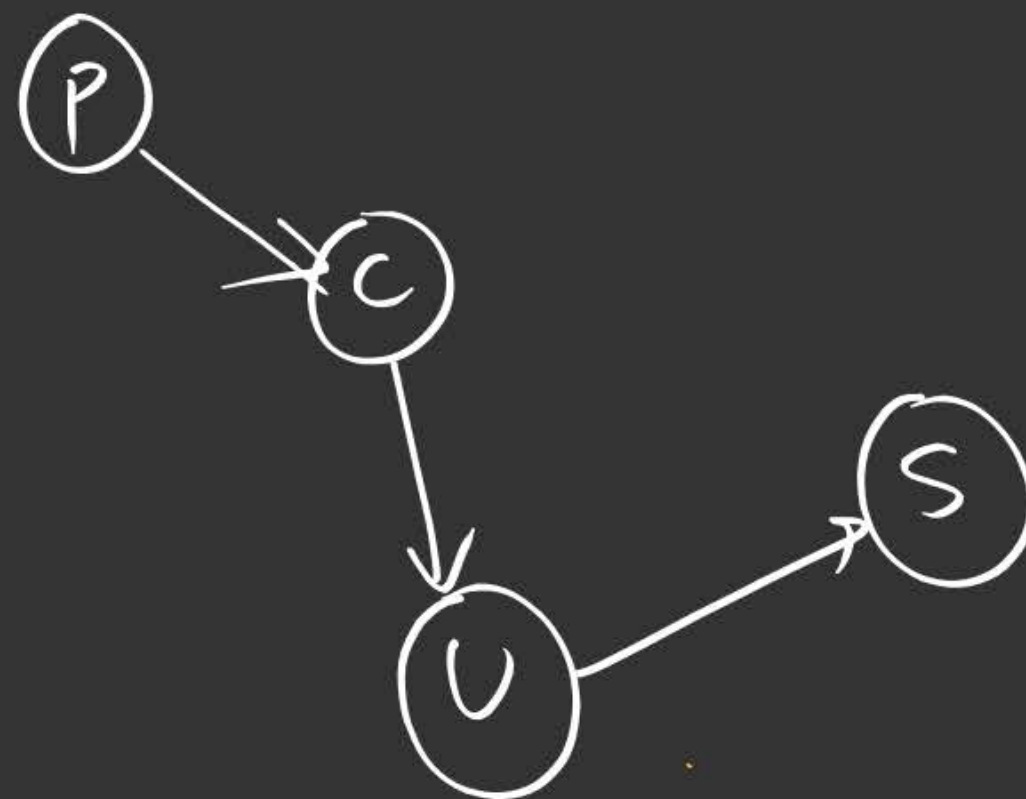


② A* Search

| open | Closed. | | | Reached goal |
|----------------|---------|----|----|---------------------|
| P ^x | P | C | U | S |
| A | 15 | 15 | 15 | Path <u>PCUS</u> |
| C ^x | 10 | 10 | 10 | |
| R | 12 | 12 | 12 | <u>Cost = 11</u> |
| M | x | 19 | 19 | |
| U ^x | x | 11 | 11 | |
| S ^x | x | x | 11 | |
| N | x | x | 18 | |



③ BFS





THANK - YOU