DS & AI ENGINEERING

Artificial Intelligence

Informed search

Lecture No.- 02

By- Aditya sir

Recap of Previous Lecture

- Topic
- Topic
- Topic
- Topic

Intro to Informed Search

GBFS

A*

Topics to be Covered

- Topic
- Topic
- Topic

Properties of Heuristics.

Types of A*.

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 Link for Aditya Jain sir:

https://t.me/AdityaSir_PW

Topic : Analysis of Informed Search

Heuristics

- (1) Admissible
- (2) Consistent

Topic : Informed Search

Type of Heuristic values

In the context of search algorithms, especially in artificial intelligence and pathfinding (like A* algorithm), a heuristic function helps estimate the cost of reaching the goal from a given state. There are two important properties that a heuristic function can have: admissibility and consistency (also known monotonicity).

* Informed search will give optimal result if h (n) are consistent & admissible.

Topic : Informed Search

Type of Heuristic values

Admissible Heuristic

- A heuristic is admissible if it never overestimates the cost to reach the goal. In other words, it is always equal to or less than the true cost from the current state to the goal.
- Formally, for a heuristic h(n) to be admissible, it must satisfy $h(n) \leq h^*(n)$
- where h(n) is the heuristic cost from node n to the goal, and $h^*(n)$ n is the true cost from to the goal.
- Admissibility ensures that an algorithm like A* will find the optimal solution.

underestimate

For every node

A

min cost

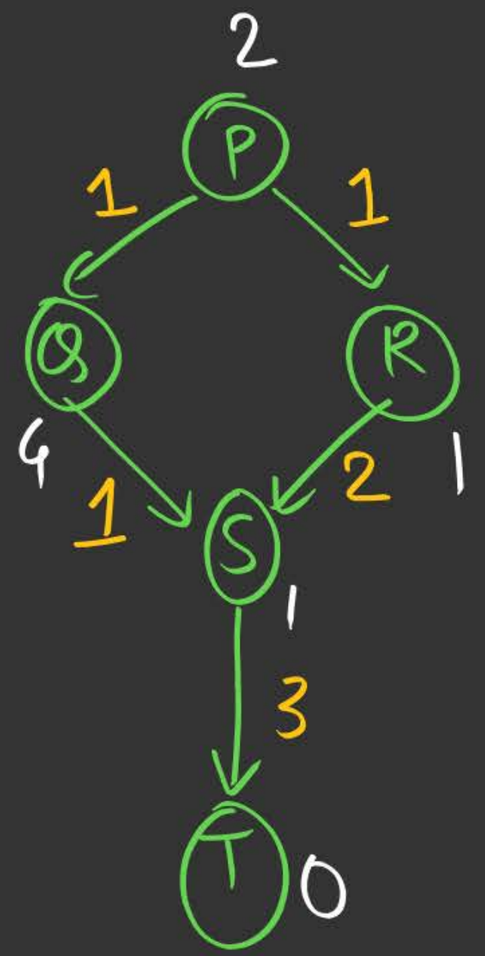
Topic : Informed Search

Type of Heuristic values

Consistent (Monotonic) Heuristic

- A heuristic is consistent if the estimated cost is always less than or equal to the estimated cost from any neighbouring node plus the step cost of reaching that neighbour.
- Formally, for a heuristic h(n) to be consistent, it must satisfy the following condition for every node n and every successor n' of n:$(h(n) \leq c(n,n') + h(n'))$
- where c(n,n') is the actual cost from node n to its successor n', and h(n') is the heuristic cost from n' to the goal.

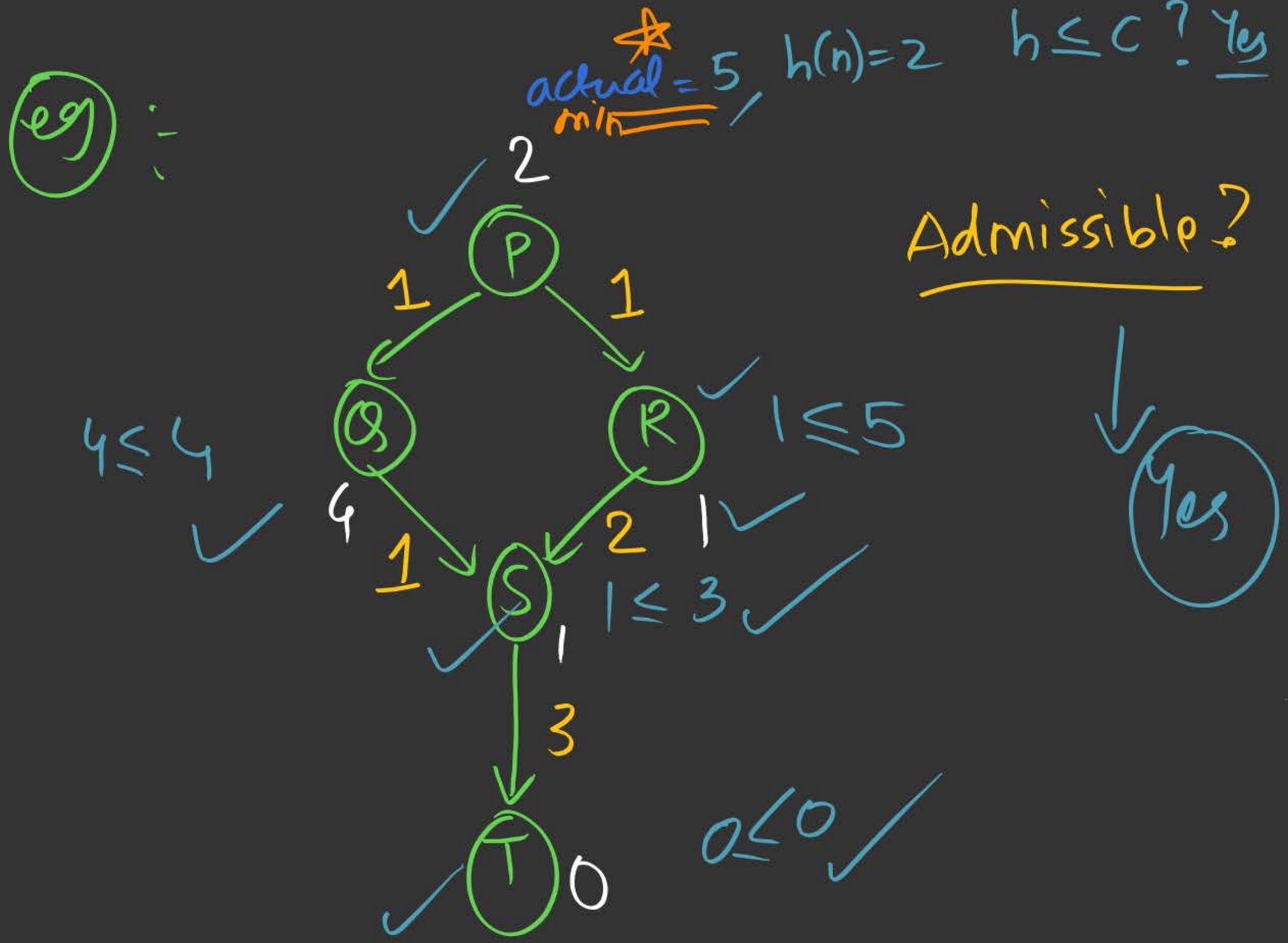
eg :-

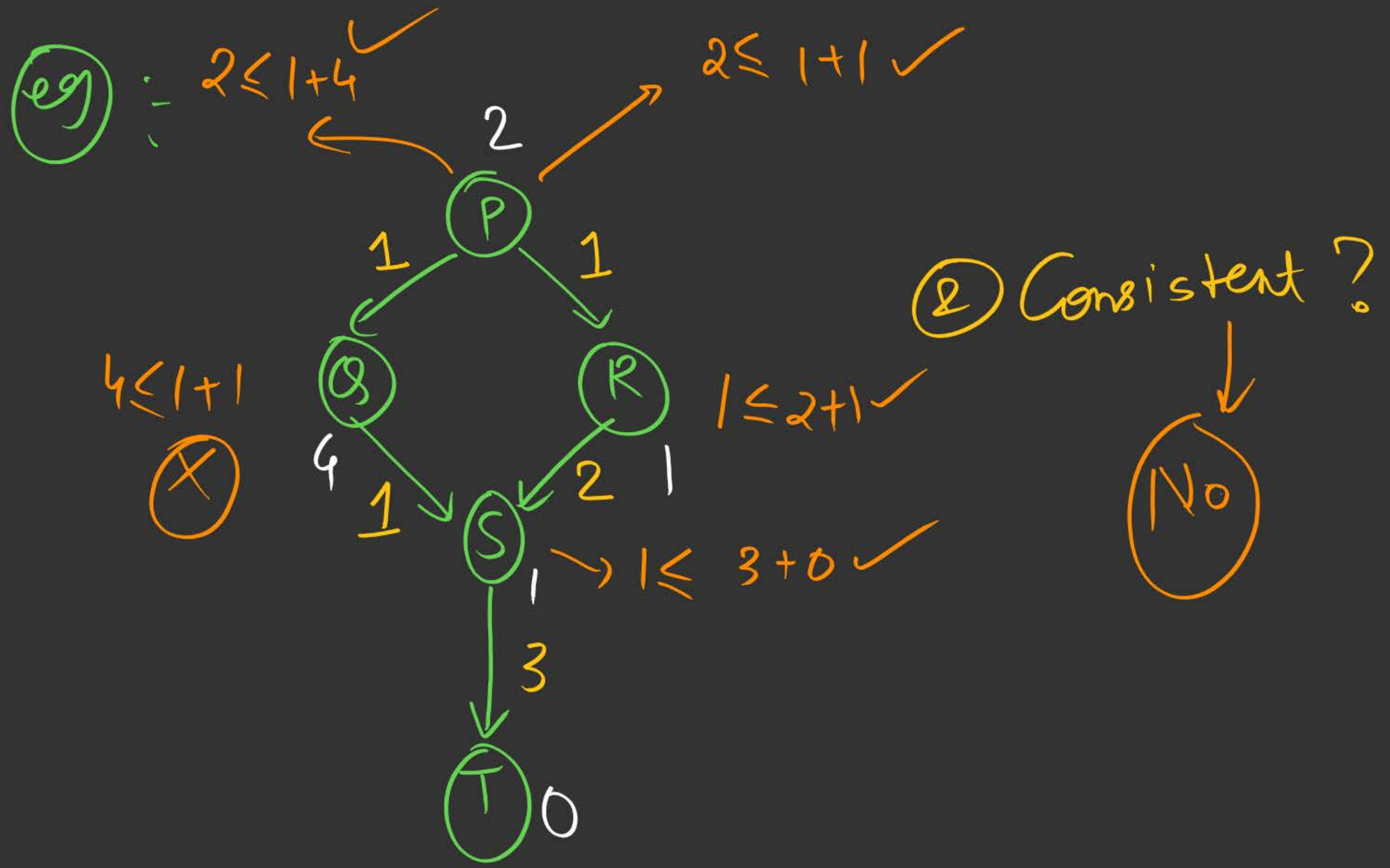


Is

1) Admissible ?

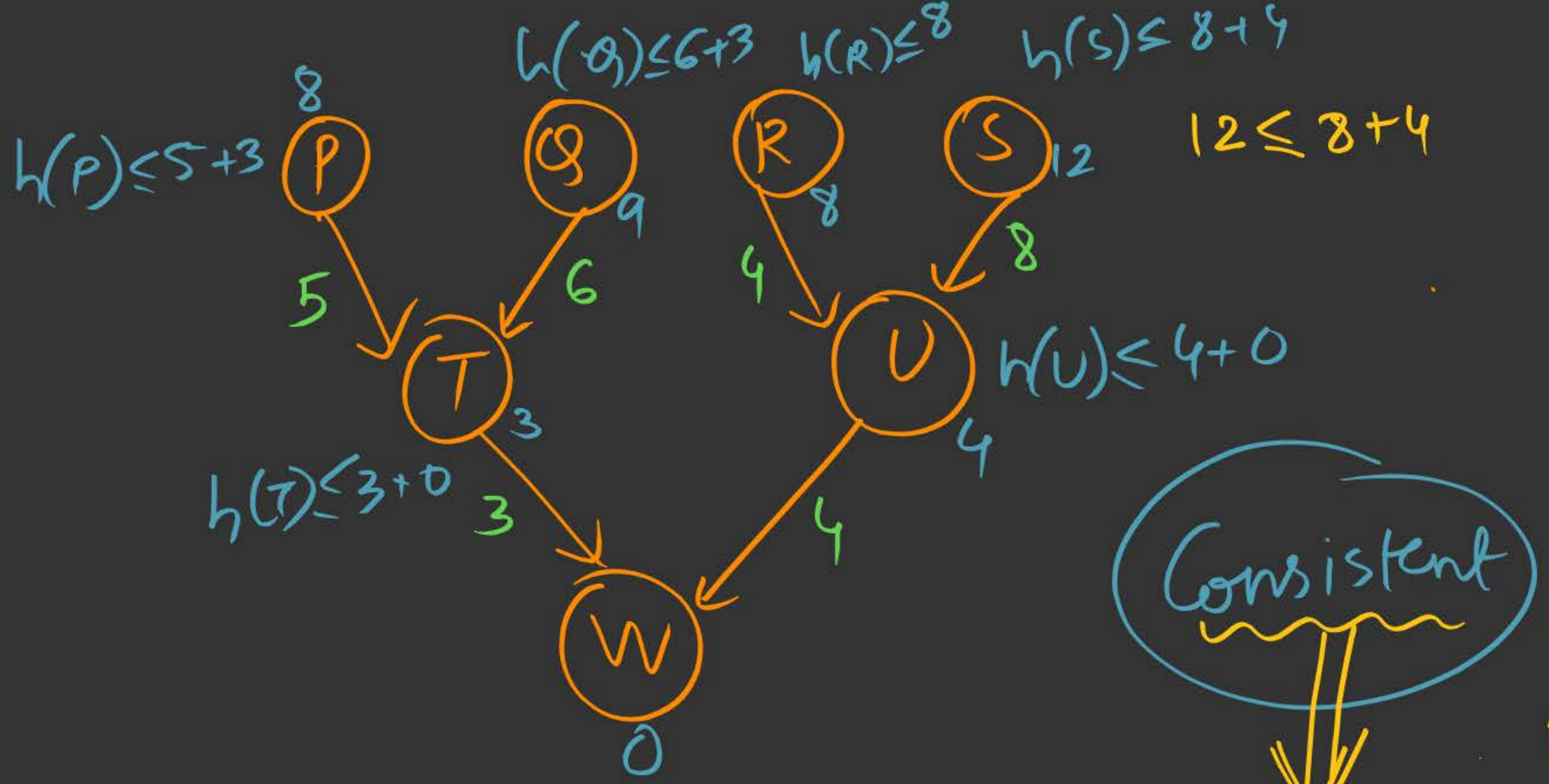
2) Consistent ?


eg :-
actual = 5
min
h(n)=2
h ≤ c ? Yes
2
P
1
1
Q
R
4
1
2
1
S
3
T
0
4 ≤ 4
1 ≤ 5
1 ≤ 3
0 < 0
Admissible?
Yes


eg :
2 ≤ 1+4 ✓
2 ≤ 1+1 ✓
2
P
1
1
Q
R
4 ≤ 1+1
X
4
1
2
1
1 ≤ 2+1 ✓
S
1
1 ≤ 3+0 ✓
3
T
0
② Consistent ?
No

Imp

If Heuristic Consistent ⟶ then automatically admissible



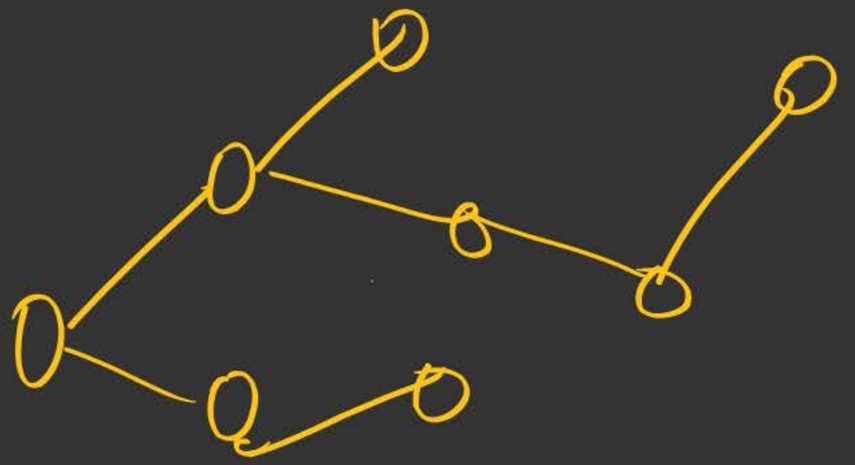
Consistent

Admissible

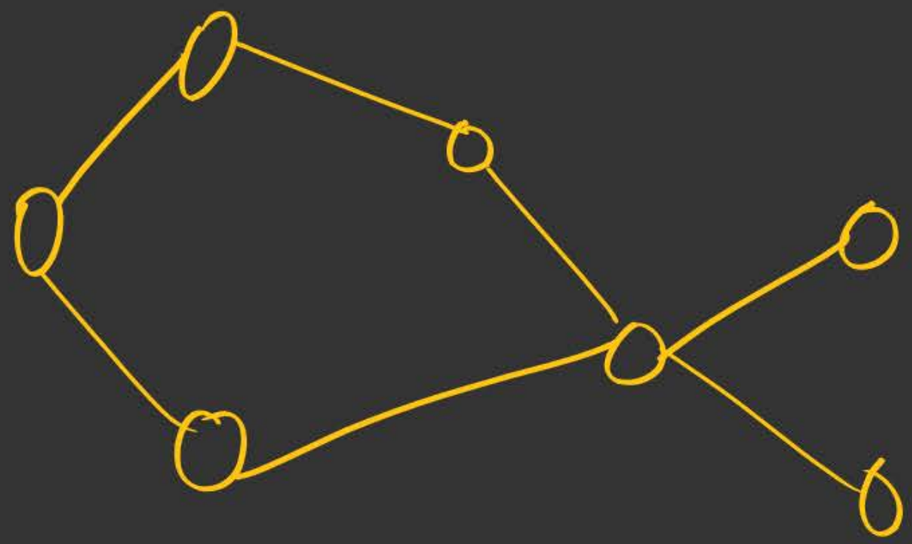
But not vice versa

Graph vs Tree Search: (DSA pov)

Tree → Acyclic



Graph → can have Cycles



Tree & Graph Search (AI pov)

① Graph Search: a node present in a closed list cannot be visited again.

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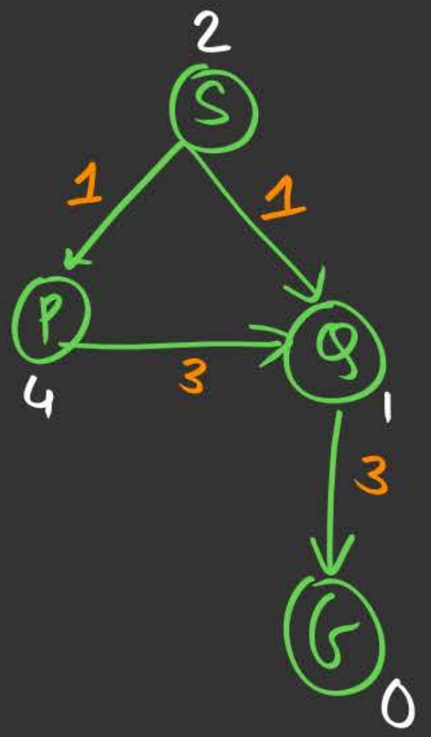
② Tree Search: " " closed list can be visited again.

(basically, can be further minimised and then again get selected)

eg :-



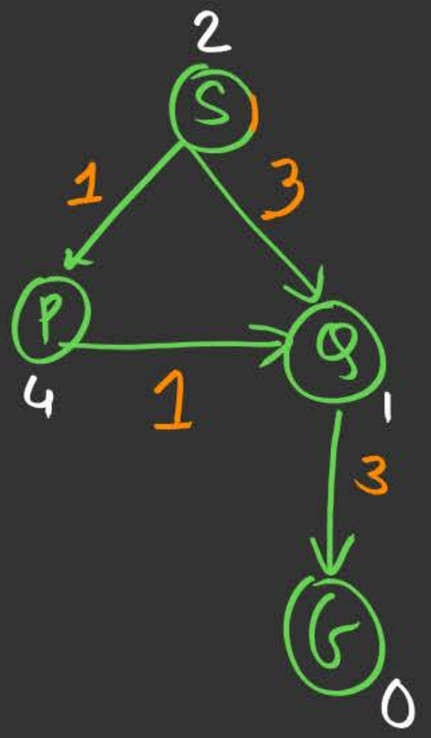
A* Graph Search:

Open	Closed
S^X	S Q
P	5 5
Q	(2) 2
G	X (4) → goal:

S → Q → G

Cost: 4

eg 2



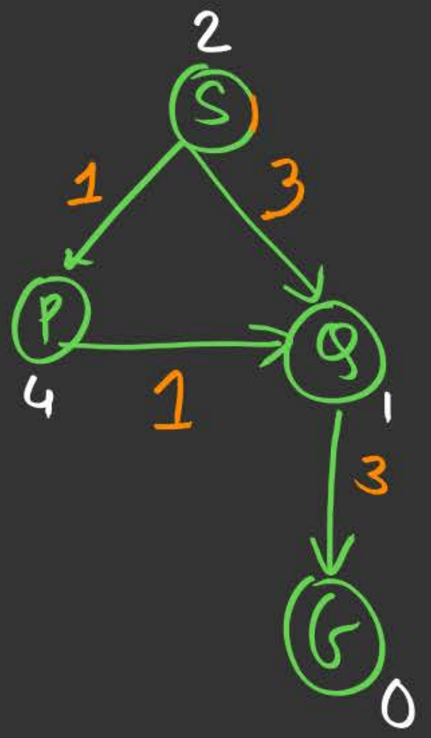
① A* graph Search

Open	Closed			
S✗	S	Q	P	G
P	5	5	5	
Q	4	4	4	
G	✗ 6	6		

S → Q → G

Cost = 6

eg 2



① A* Tree Search

Open	Closed
S^x	S Q P Q G
P	5 (5) 5 5
Q	(4) 4→(3) 3
G	X 6 6 (5)

↳ stop

[S→P→Q→G]

Cost = 5

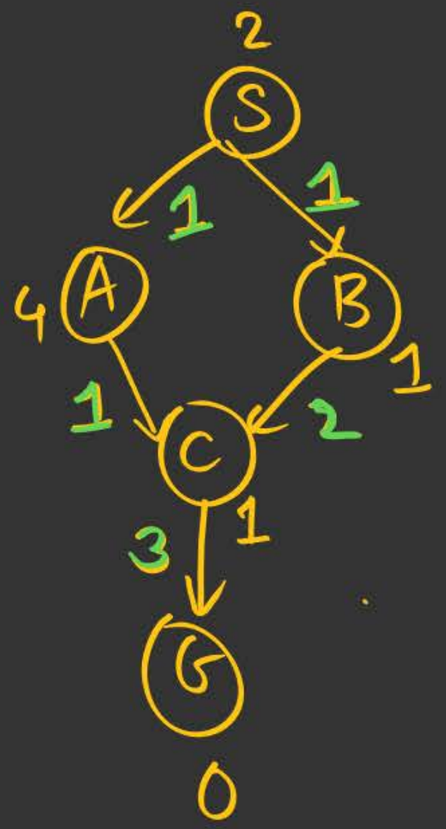
① WC TC & SC of both can be same.

② Tree Search are better to provide optimal Solution.

③ Tree Search can be less efficient as they may visit a node multiple times.

Property	A* Graph Search	A* Tree Search
1) Closed list used?	Yes	No
2) Re-explores node?	No (unless better path found)	Yes
3) Optimal with admissible h?	Not always (needs consistent h or re-expansion)	Always
4) Space usage	High (visited nodes stored)	High (all paths stored)
5) Time efficiency	More efficient (if good heuristic)	Less efficient due to re-expansion

① Admissible but not Consistent.



A*

1) graph Search

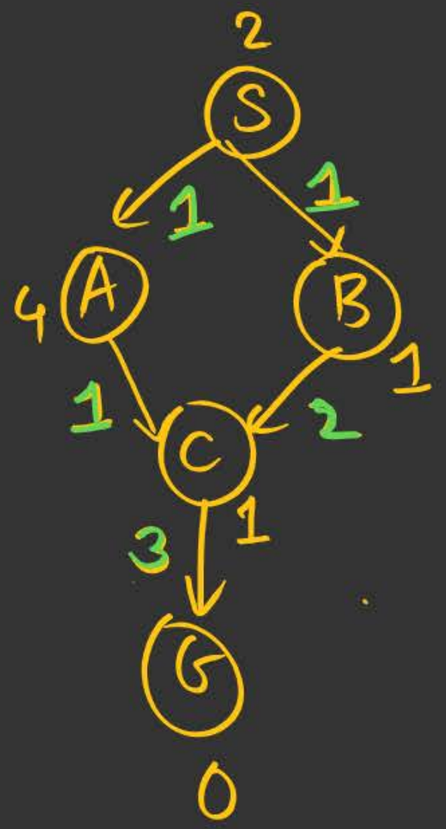
open	closed				
S^x	S	B	C	A	G
A	5	5	(5)	5	
B^x	(2)	2	2	2	
C	x	(4)	4	4	
G	x	x	6	6	

↳ stop

S B C G

Cost = 6

① Admissible but not Consistent.



2) A* Tree Search

open	closed					
S^r	S	B	C	A	C	G
A	5	5	(5)	5	5	↳ stop
B	(2)	2	2	2	2	
C	X	(4)	4	(3)	3	
G	X	X	6	6	(5)	

SACG

Cost = 5

Summary for A* Search Optimality

Admissible	Consistent	A* Graph Search	A* Tree Search
✗	✗	✗	✗
✓	✗	✗	✓
✓	✓	✓	✓

THANK - YOU