

DS & AI ENGINEERING



Artificial Intelligence

Informed search

Lecture No.- 08



By- Aditya sir

Recap of Previous Lecture



Topic

Topic

Hill climbing

Topic

Beam Search

Topic

GBFS

Topics to be Covered



Topic

Topic

Topic

IDA* Numerical
AO*
practice



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 : Artificial Intelligence

Iterative Deepening A* algorithm (IDA*) - Artificial intelligence

- **Step 1: Initialization**
Set the root node as the current node, and find the f-score.
- **Sep 2: Set threshold**
Set the cost limit as a threshold for a node i.e the maximum f-score allowed for that node for further explorations.
- **Step 3: Node Expansion**
Expand the current node to its children and find f-scores.
- **Step 4: Pruning**
If for any node the f-score > threshold, prune that node because it's considered too expensive for that node, and store it in the visited node list.
- **Step 5: Return Path**
If the Goal node is found then return the path from the start node ^{to} Goal node.



Topic : Artificial Intelligence

Iterative Deepening A* algorithm (IDA*) - Artificial intelligence

- **Step 6:** Update the Threshold

If the Goal node is not found then repeat from step 2 by changing the threshold with the minimum pruned value from the visited node list. And Continue it until you reach the goal node.



Topic : Artificial Intelligence

It 1: fth = 2, AB pruned node

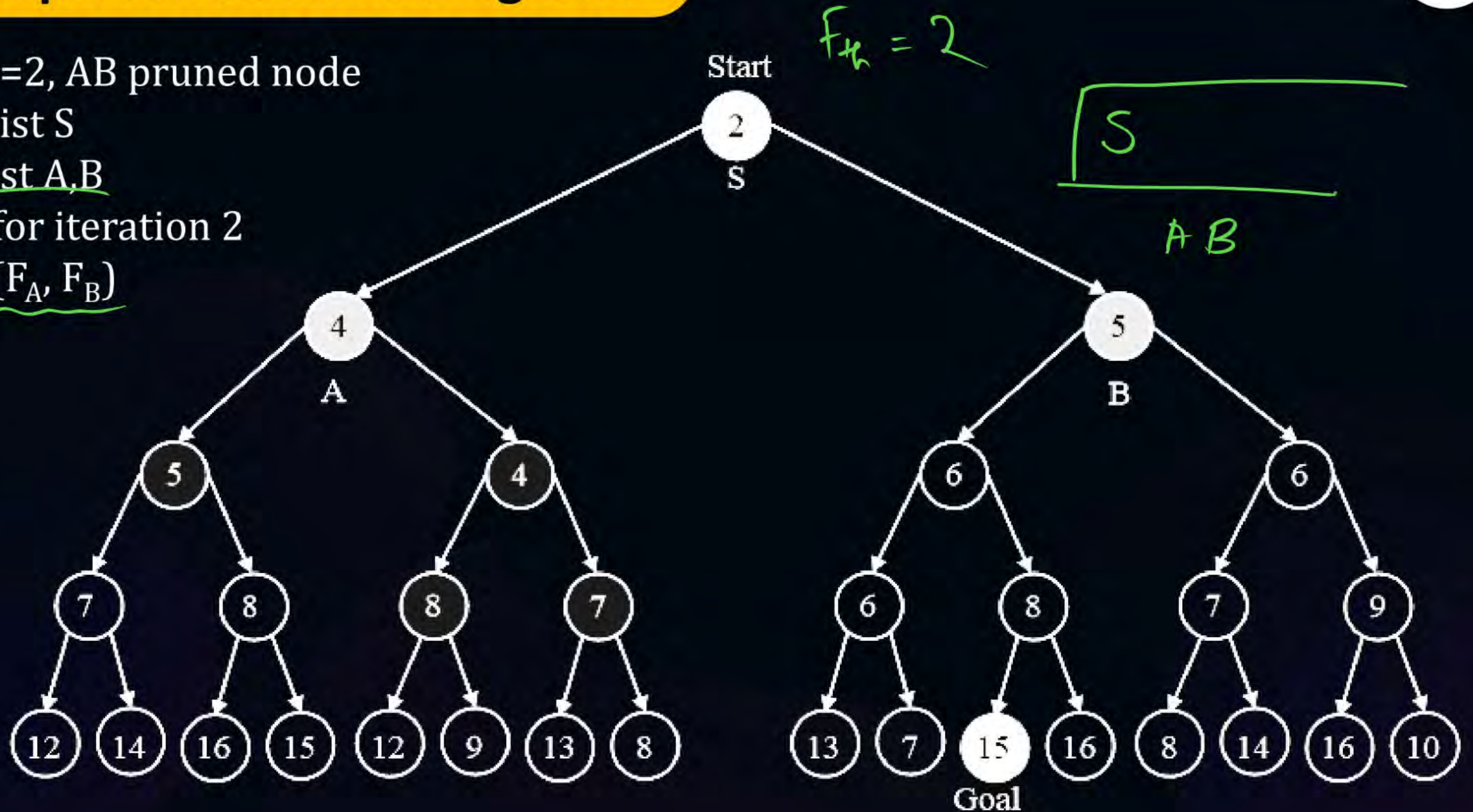
Closed list S

Prune list A,B

- Fth for iteration 2

$\Rightarrow \text{Min}(F_A, F_B)$

$\Rightarrow 4$





Topic : Artificial Intelligence

It 1: $f_{th} = 2$, AB pruned node

It 2: $f_{th} = 4$

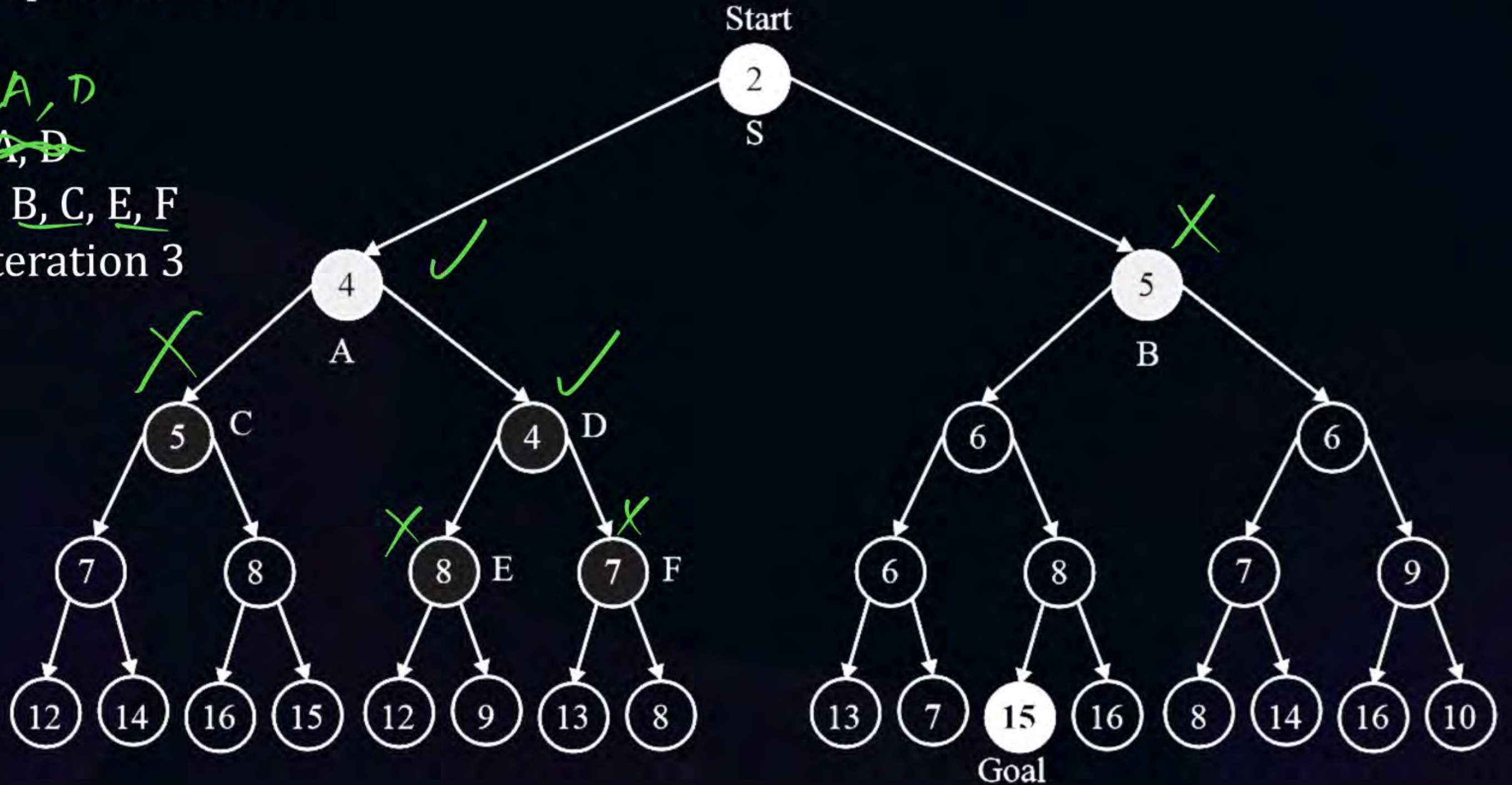
Closed list S A, D

~~Pruned list S, A, D~~

Pruned node B, C, E, F

New F_{th} for iteration 3

\Rightarrow 5





Topic : Artificial Intelligence

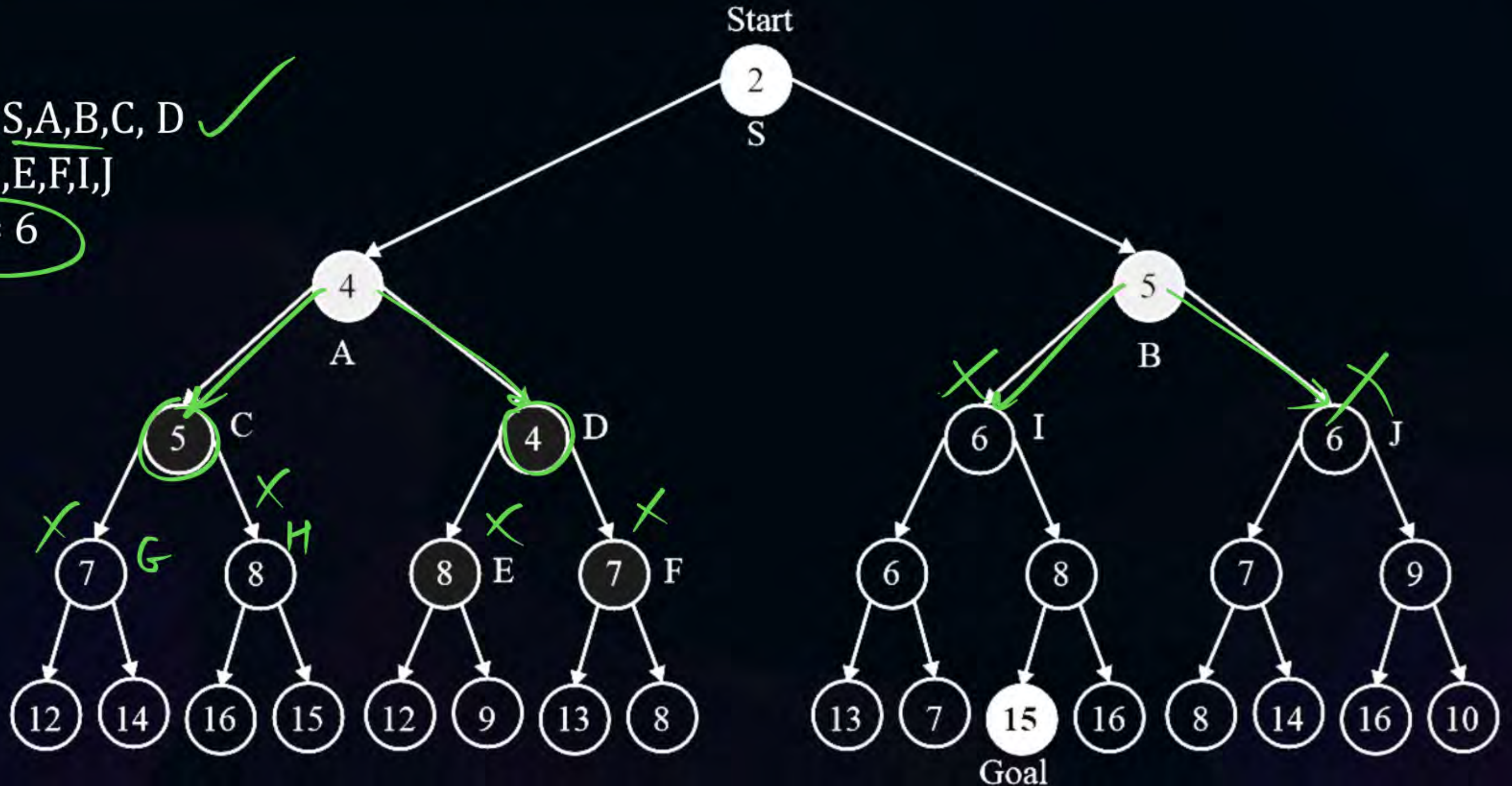
It: 3

Fth = 5

Close list: S,A,B,C, D ✓

Prune G,H,E,F,I,J

It 4: Fth = 6





Topic : Artificial Intelligence

It: 4

$F_{th} = 6$

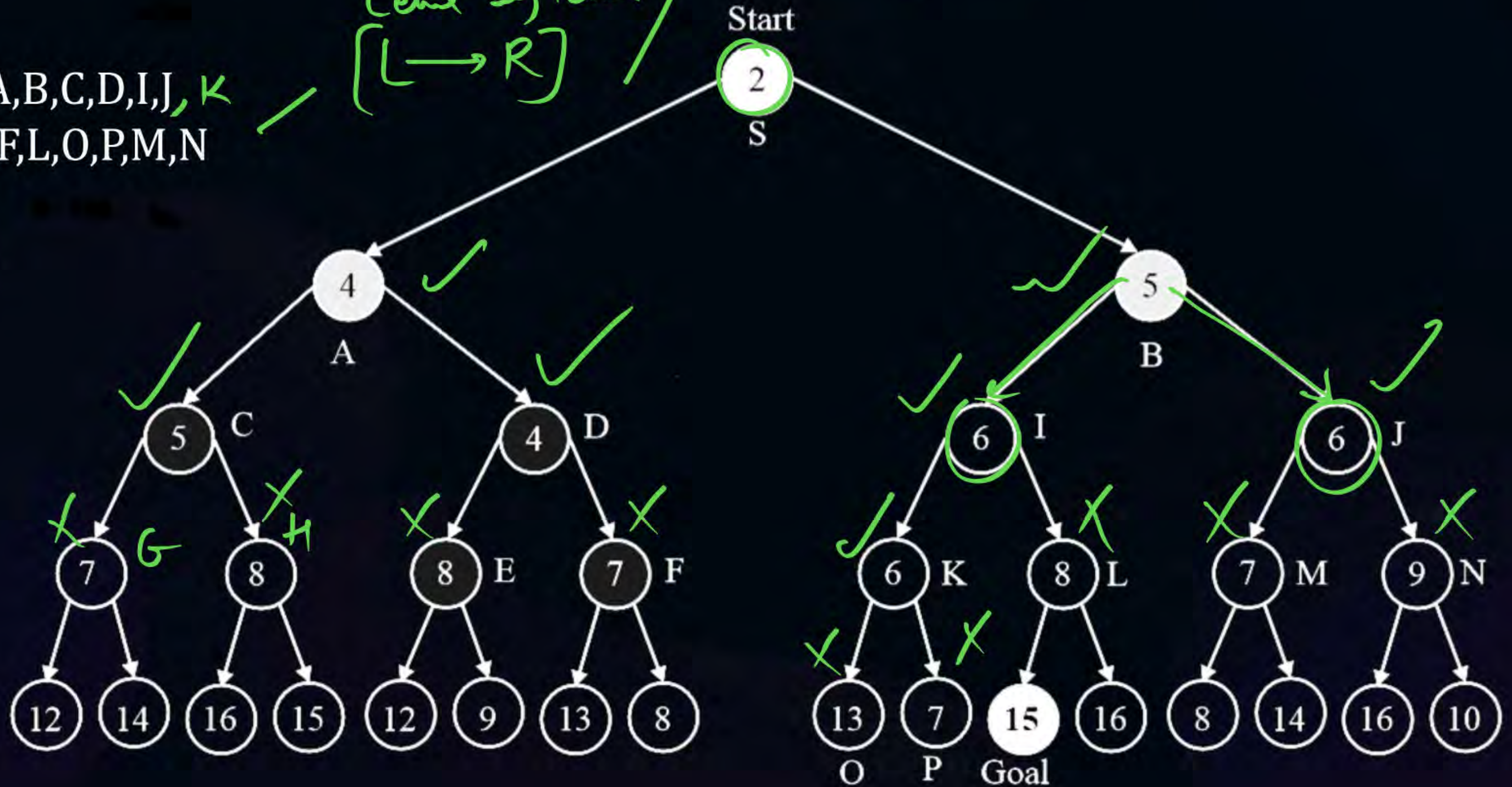
Close list: S, A, B, C, D, I, J, **K**

Prune G, H, E, F, L, O, P, M, N

$F_{th} = 7$

Level by level
[L → R]

DFS fashion ✓





Topic : Artificial Intelligence

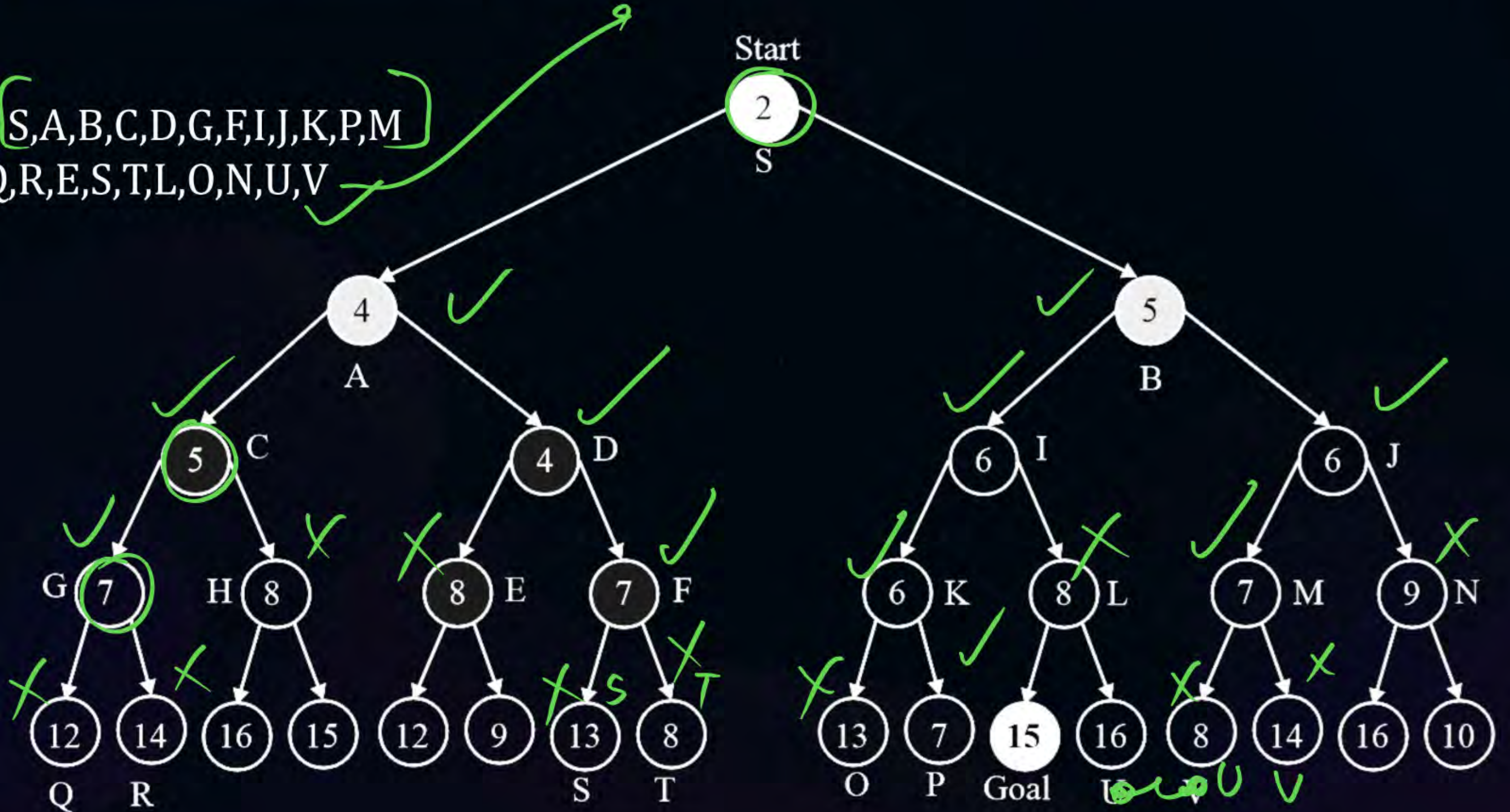
It: 5

$F_{th} = 7$

Close list: S, A, B, C, D, G, F, I, J, K, P, M

Prune H, Q, R, E, S, T, L, O, N, U, V

$F_{th} = 8$





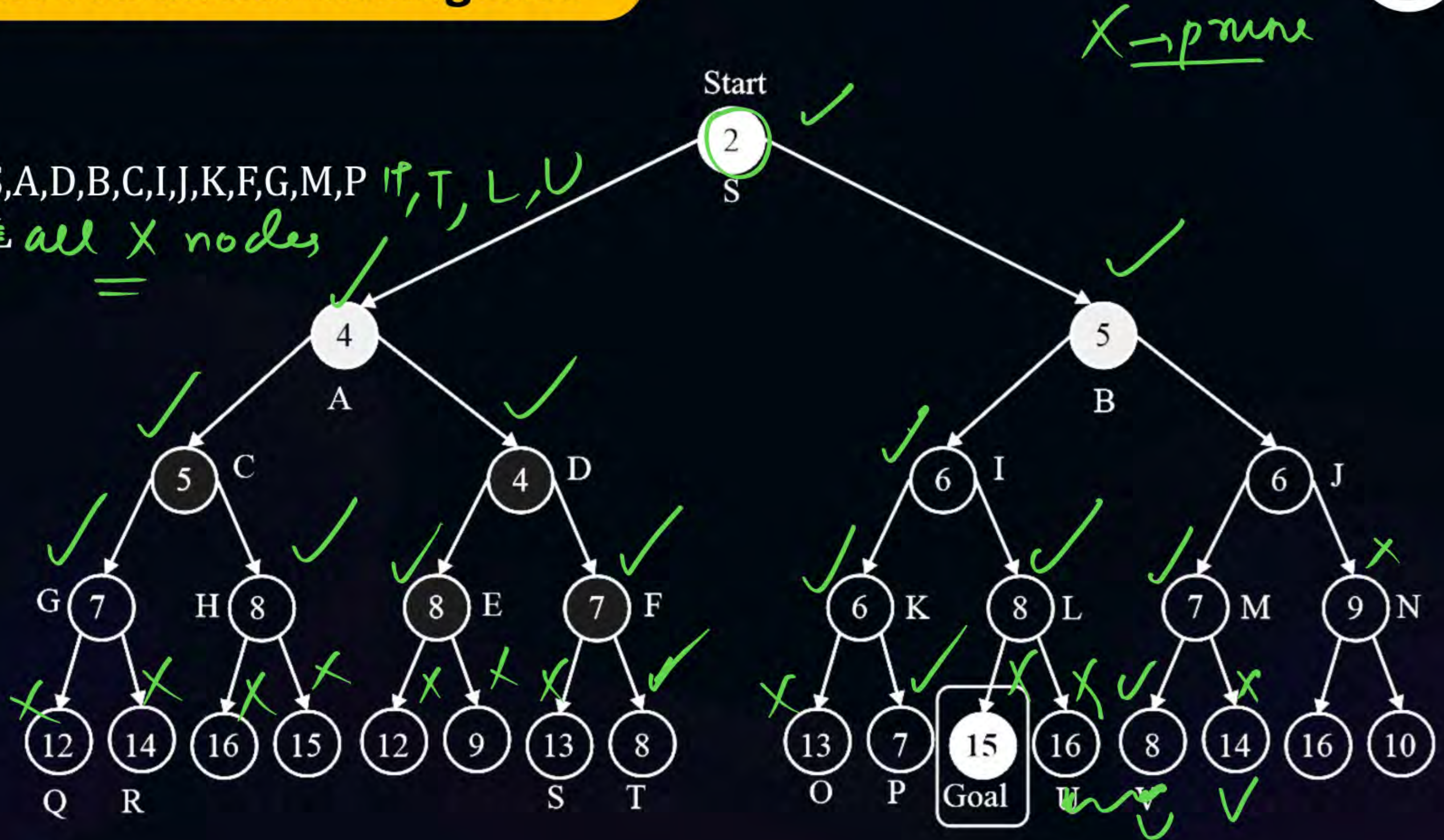
Topic : Artificial Intelligence

It: 6

$F_{th} = 8$

Close list: S,A,D,B,C,I,J,K,F,G,M,P *I, T, L, U*

Prune ~~E,H,L~~ *all X nodes*
=

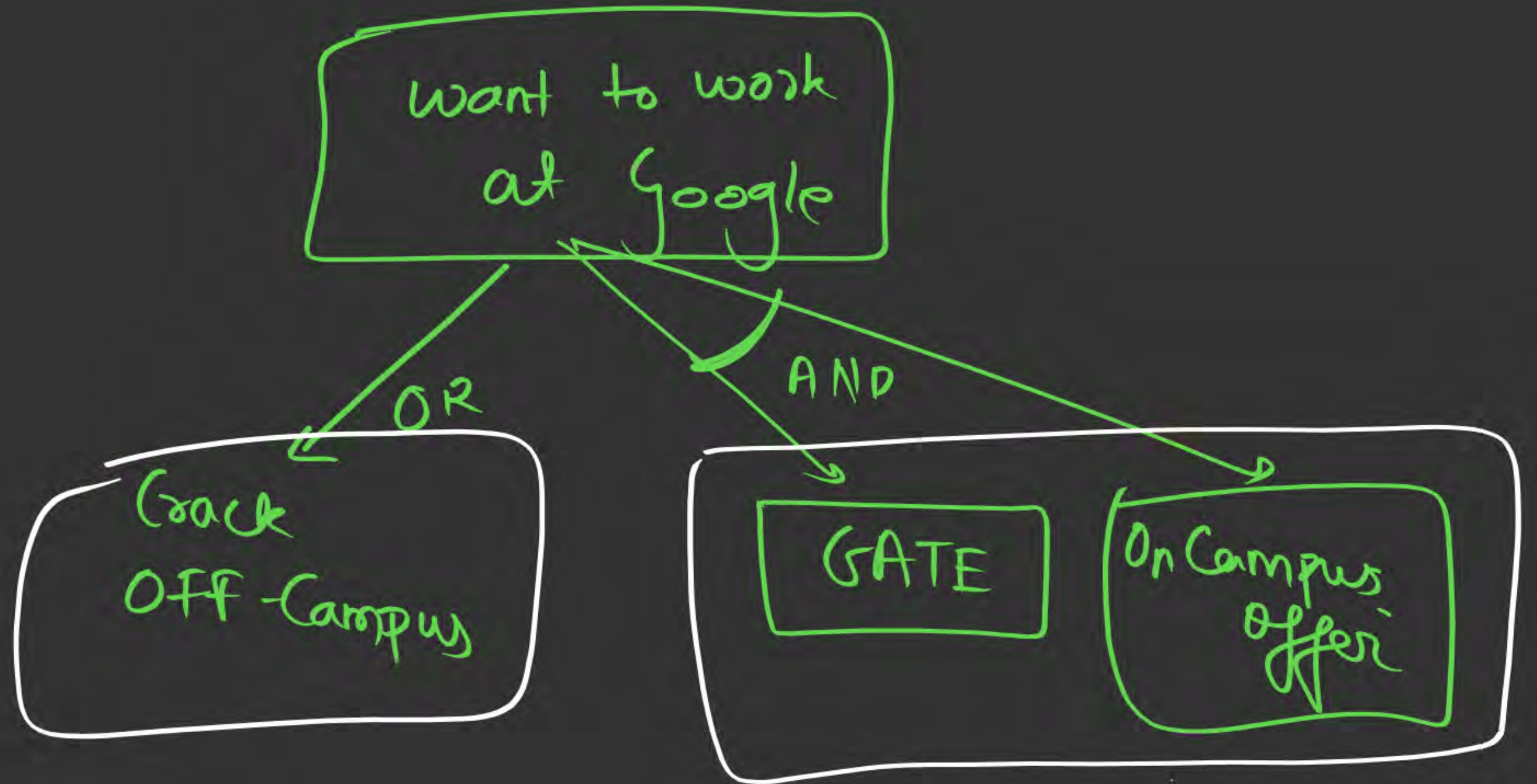


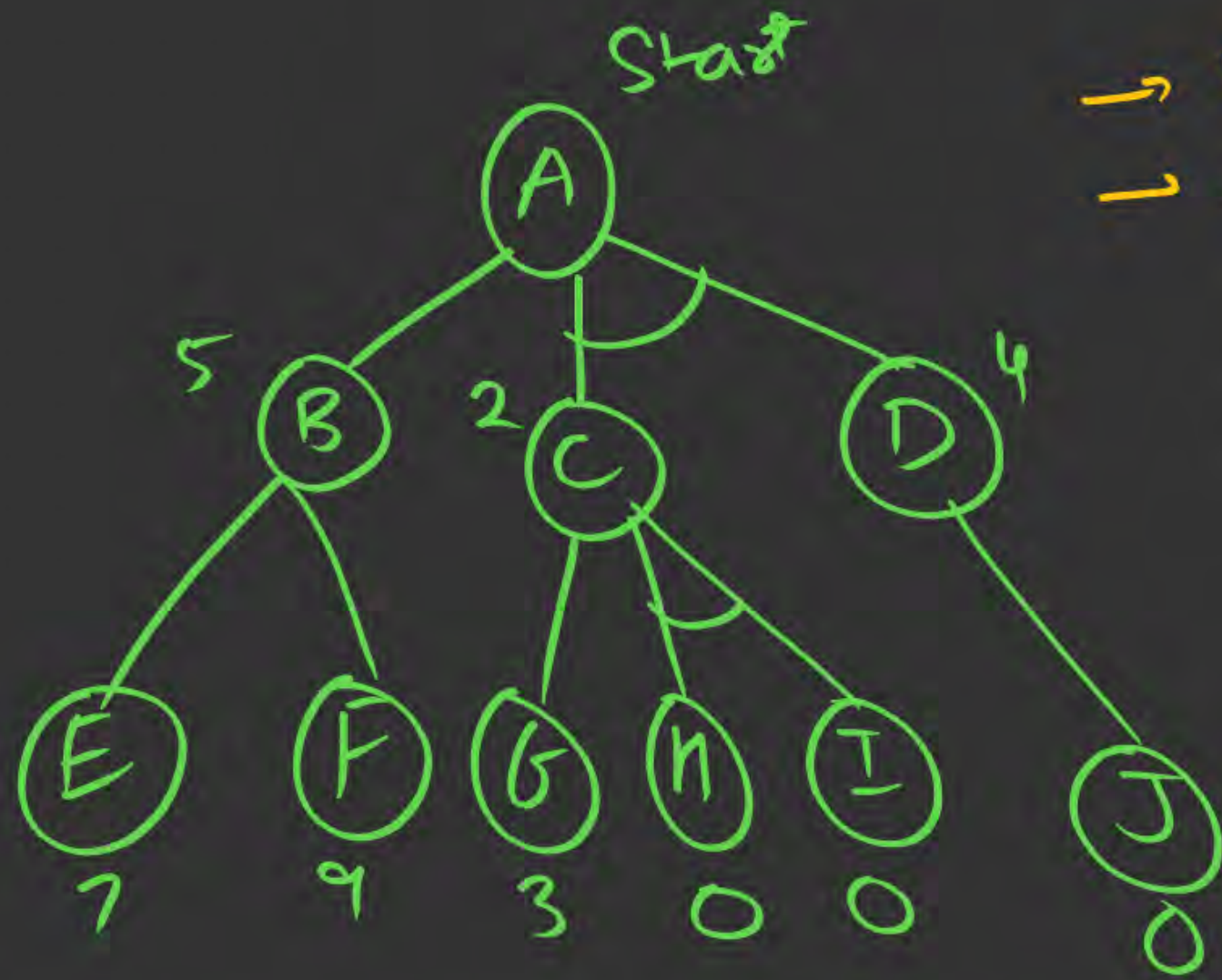
AO^* \rightarrow "And-Or-Star"

\rightarrow on DAG

\rightarrow preferred for AND-OR graphs

\rightarrow Back-propagate updated Heuristics

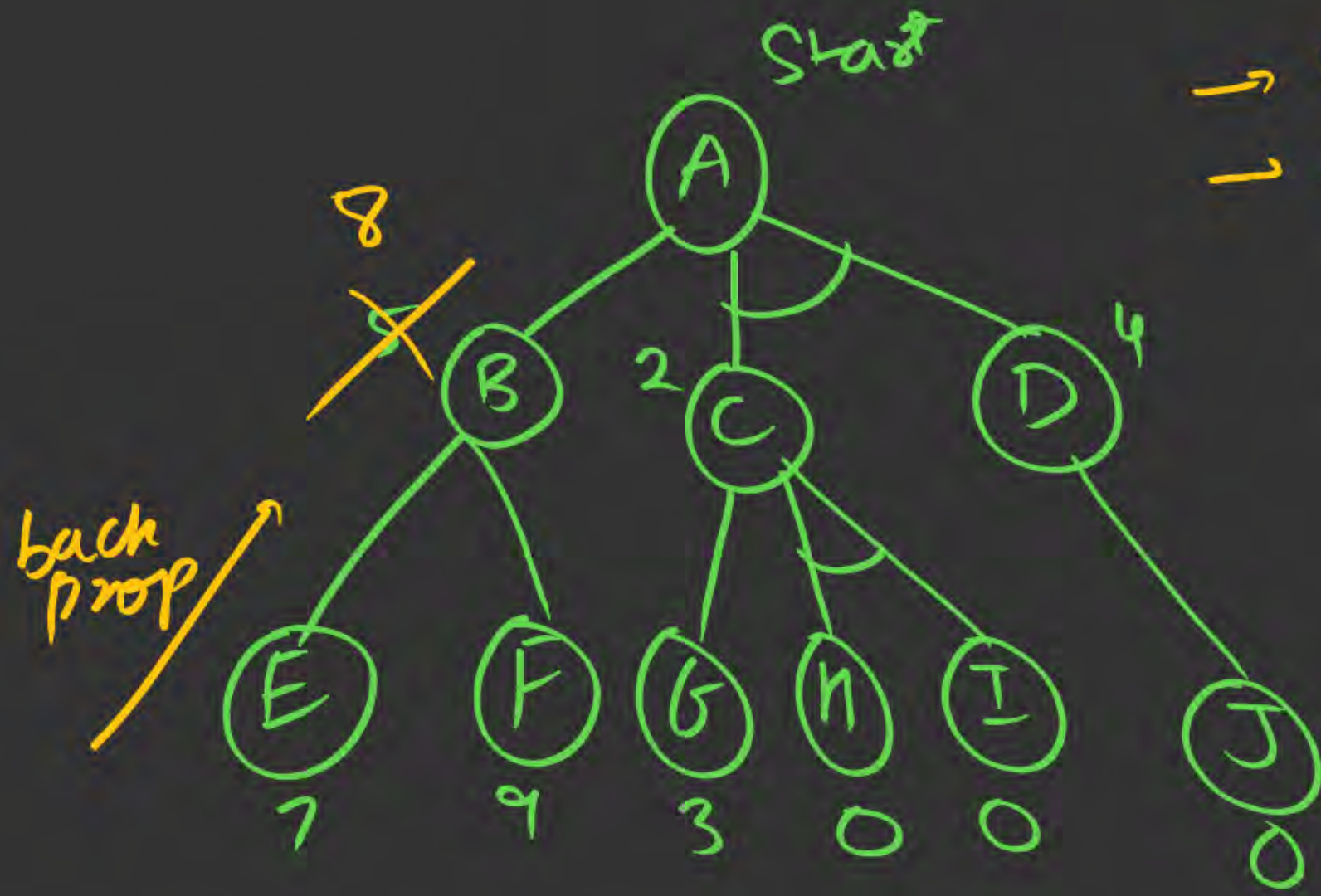




→ values on node → Heuristics
→ edge costs = 1

Step 1: visit A.

- B → $1 + 5 = 6$ ✓
- C and D → $(1 + 2) + (1 + 4) = 8$



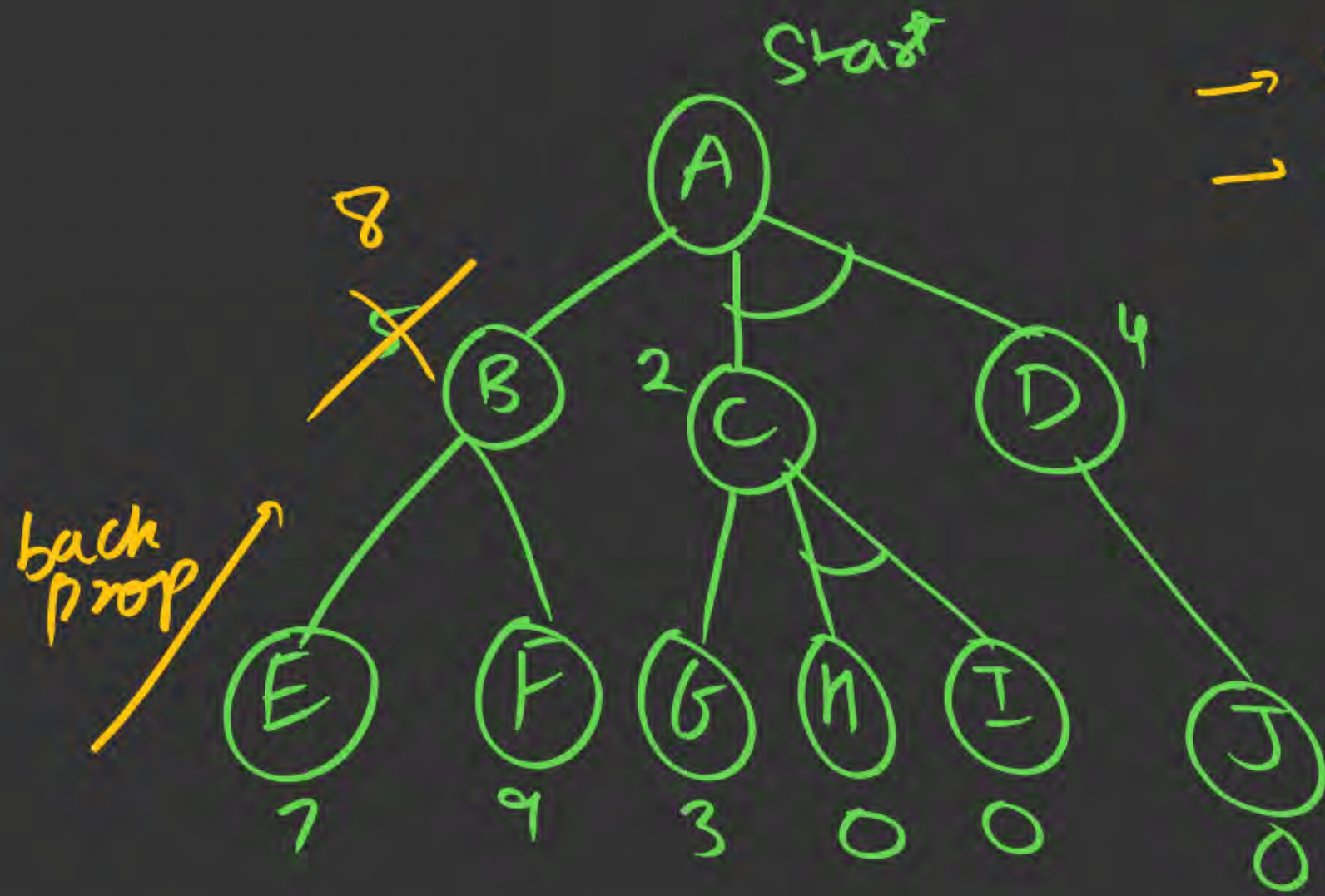
→ values on node → Heuristics
 → edge costs = 1

Step 1: visit A.

- B → $1 + 5 = 6$ ✓
- C and D → $(1 + 2) + (1 + 4) = 8$

Step 2: visit B → (only consider cost after B)

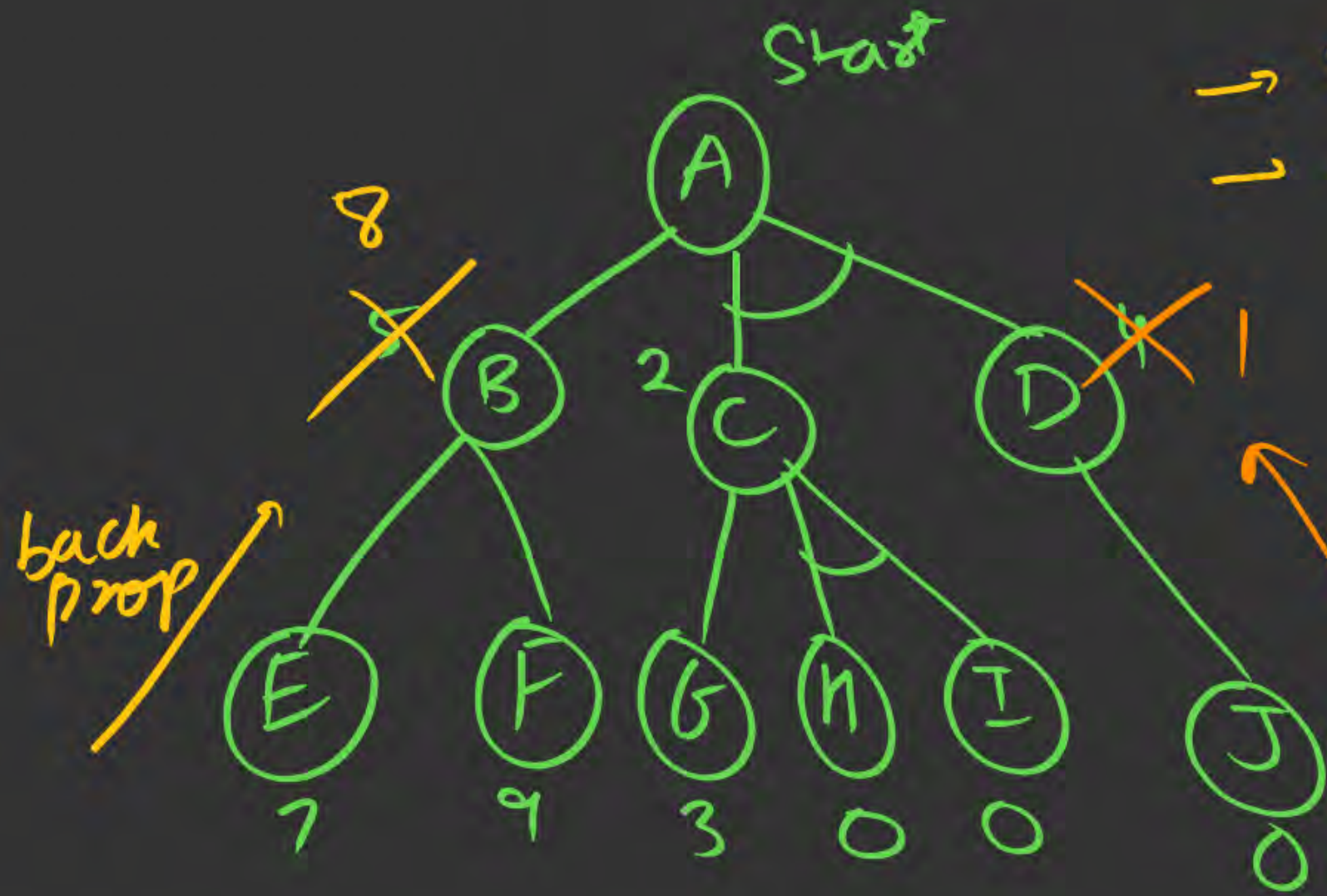
- E → $1 + 7 = 8$
- F → $1 + 9 = 10$
- update $h(B) = \min(8, 10) = \underline{\underline{8}}$



→ values on node → Heuristics
 → edge costs = 1

Step 3: visit A. (with updated B)

- B → $1 + 8 = 9$
- C and D → $(1 + 2) + (1 + 4) = 8$ ✓



→ values on node → Heuristics
 → edge costs = 1

Step 4: visit CD

• C (after c)

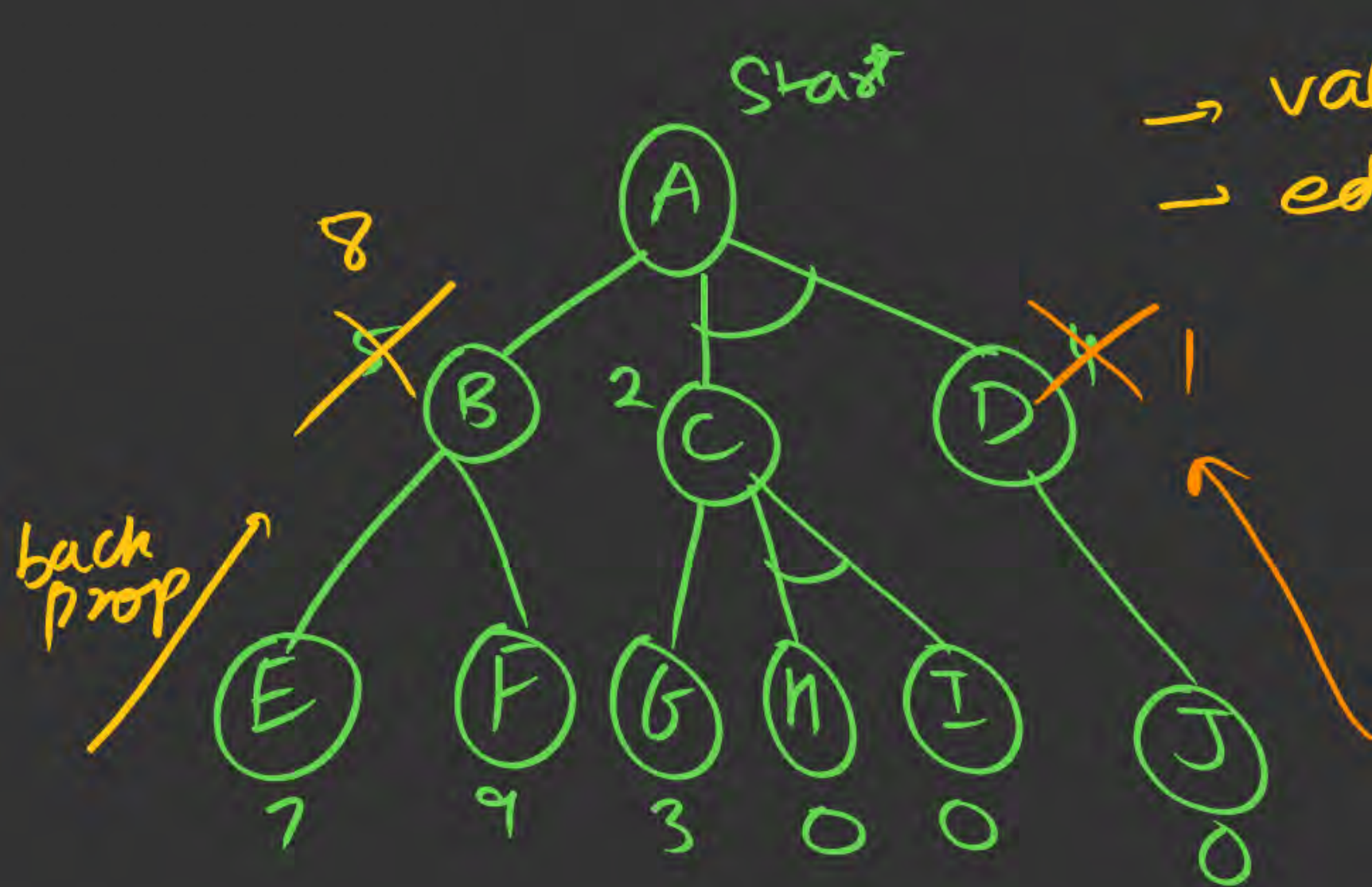
↳ G → $(1+3) = 4$

↳ H and I → $(1+0) + (1+0) = \underline{\underline{2}}$

⇒ $\min(2, 4) = 2$

• D

↳ J → $(1+0) = 1$
 update $h(D) = 1$



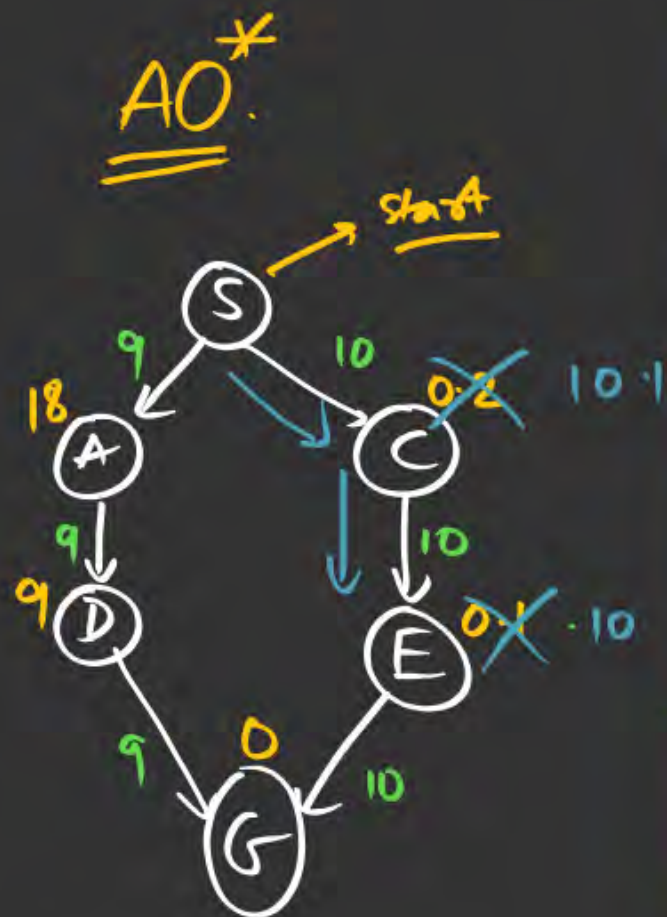
→ values on node → Heuristics
 → edge costs = 1

Step 5: Update A.

A → C and D ✓

$$\hookrightarrow (1+2) + (1+1)$$

$$= 3+2 = \underline{\underline{5}}$$



S1: $S \rightarrow$
 $A = (9 + 18) = 27$
 $C = (10 + 0.2) = 10.2$

new
 $C = (10 + 10.1) = 20.1$

S2: visit C
 $E = (10 + 0.1) = 10.1$
 update $h(C) = 10.1$

$10 + 10 = 20$

S3: visit E
 $G: 10 + 0 = 10$
 update $h(E) = 10$

S $A \rightarrow 27$ ✓
 $C = (10 + 20) = \underline{\underline{30}}$

visit A.
 $D = (9 + 9) = 18$

visit D
 $G = (9 + 0) = 9$

visit G → stop

Both BFS & DFS discussed in Chap 1
were Graph Search.

Graph Search

↓
closed node
not visited
again

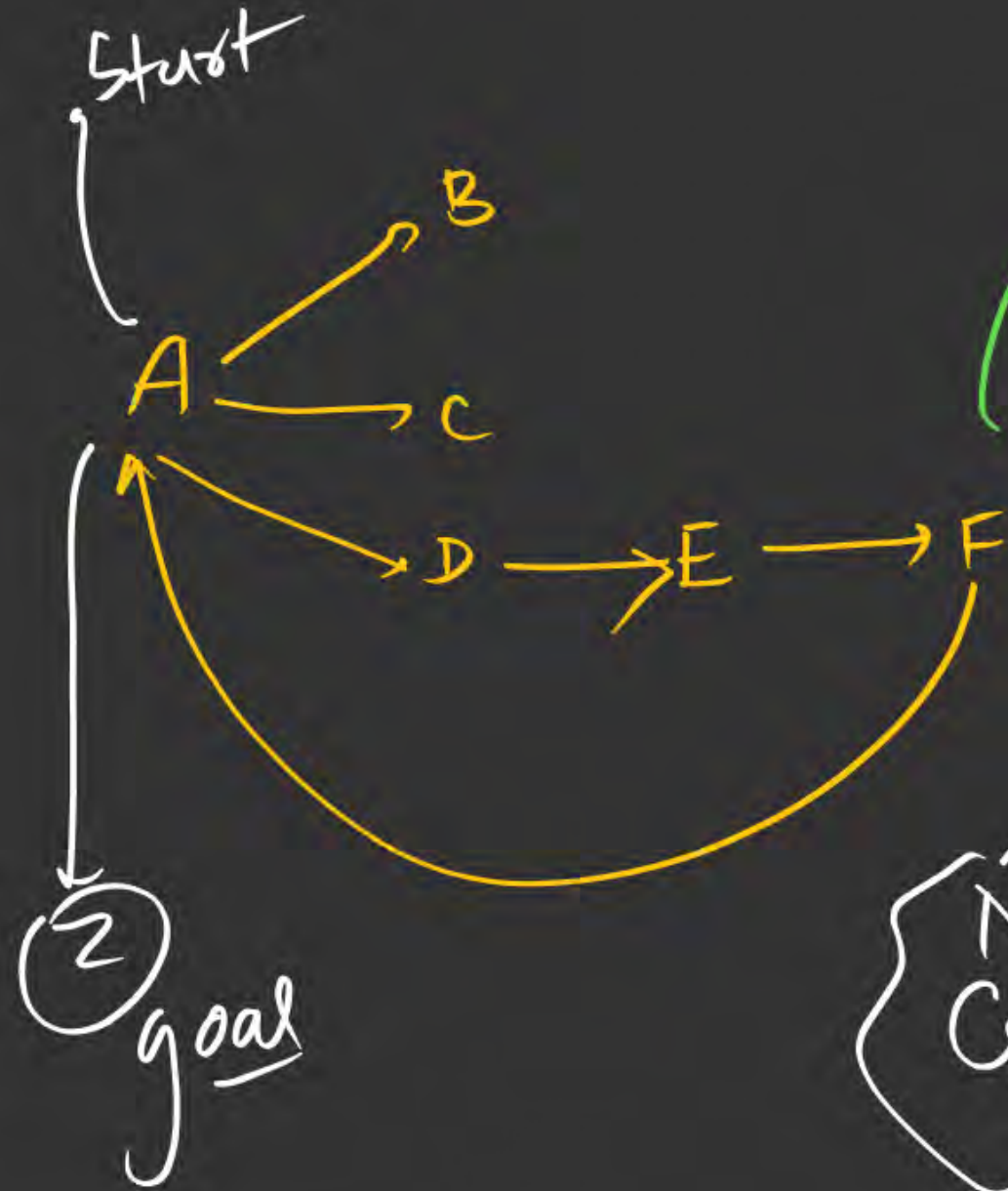
Tree Search

↓
can visit closed
node again

Alphabetical

① DFS Graph Search

ABCDEF → stop



② DFS Tree Search

ABCDEFABCD...



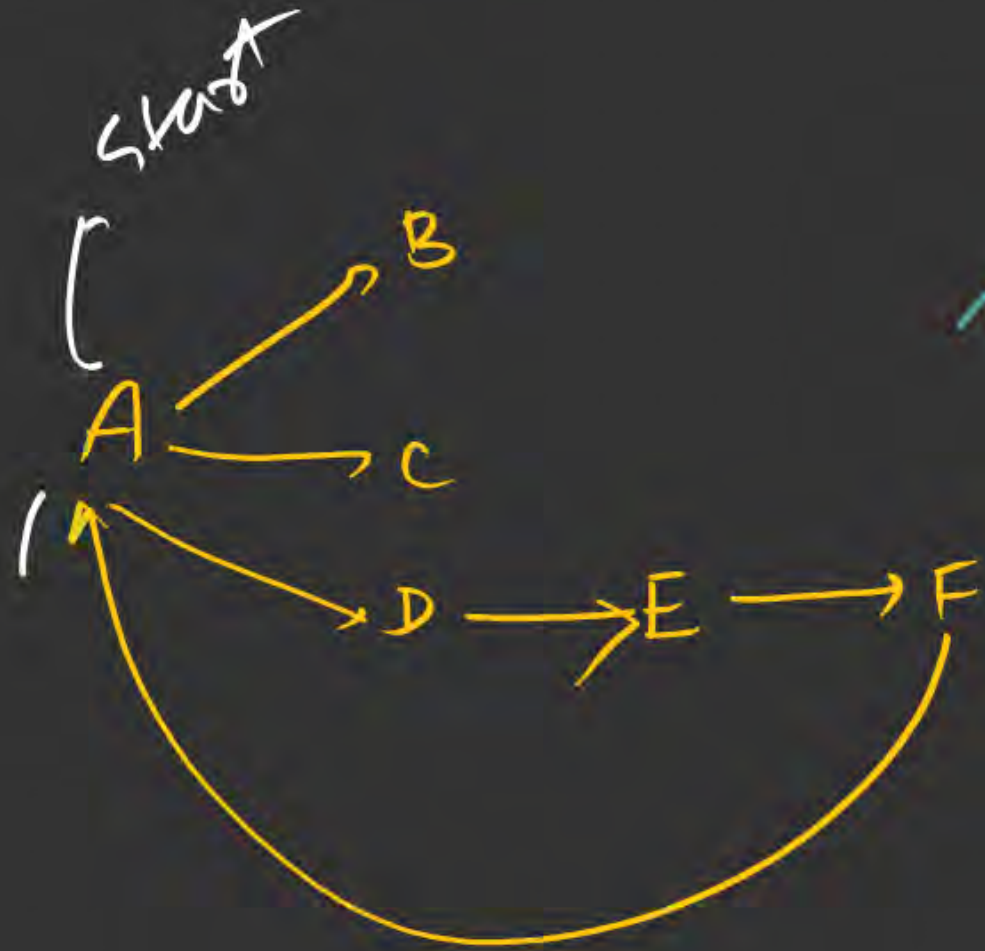
Repeating

(DFS stuck in loop)

Not Complete

Alphabetical

① BFS Graph Search



Open

~~A~~ ~~B~~ ~~C~~ ~~D~~ ~~E~~ ~~F~~

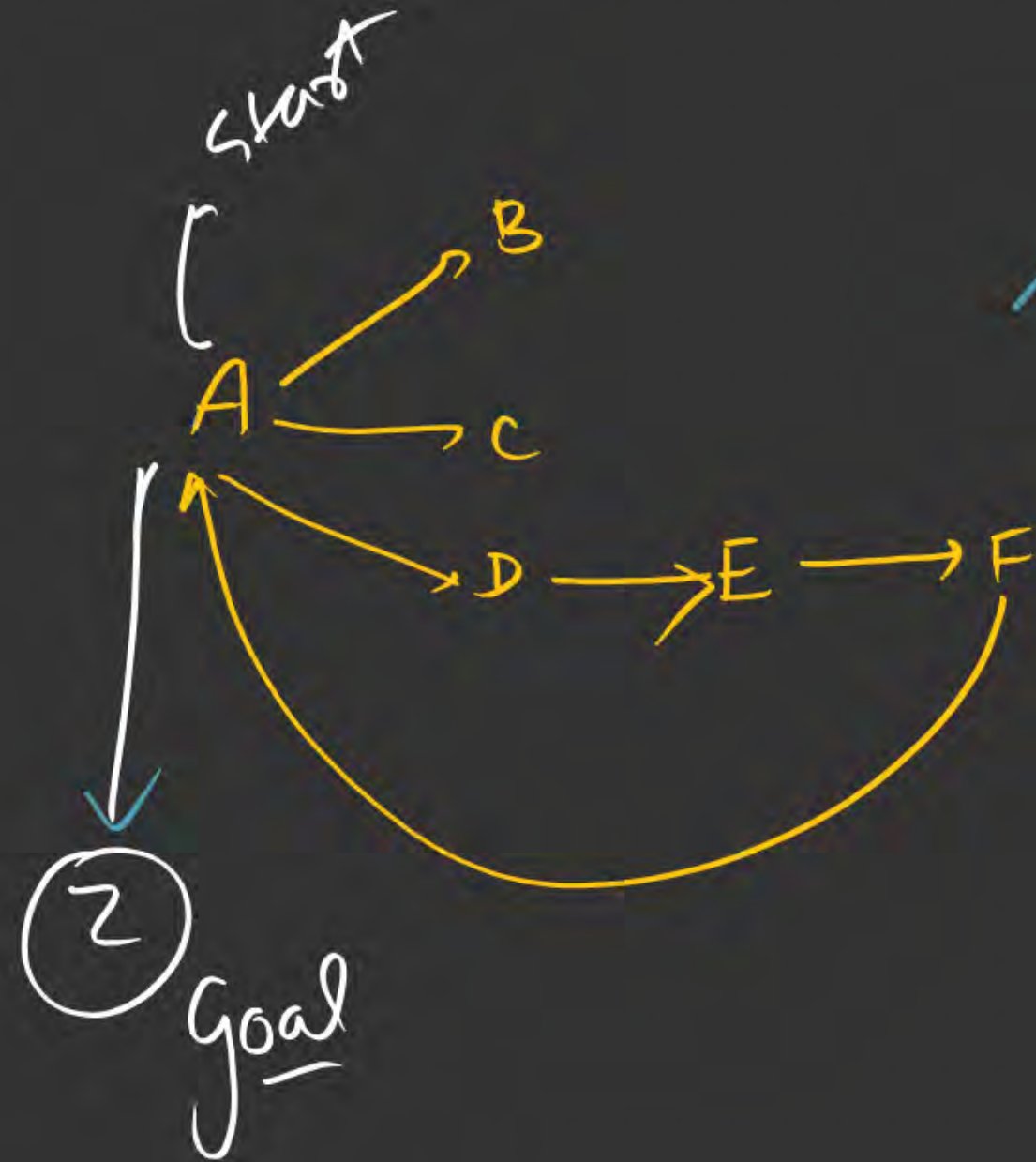
closed

A B C D E F

stop

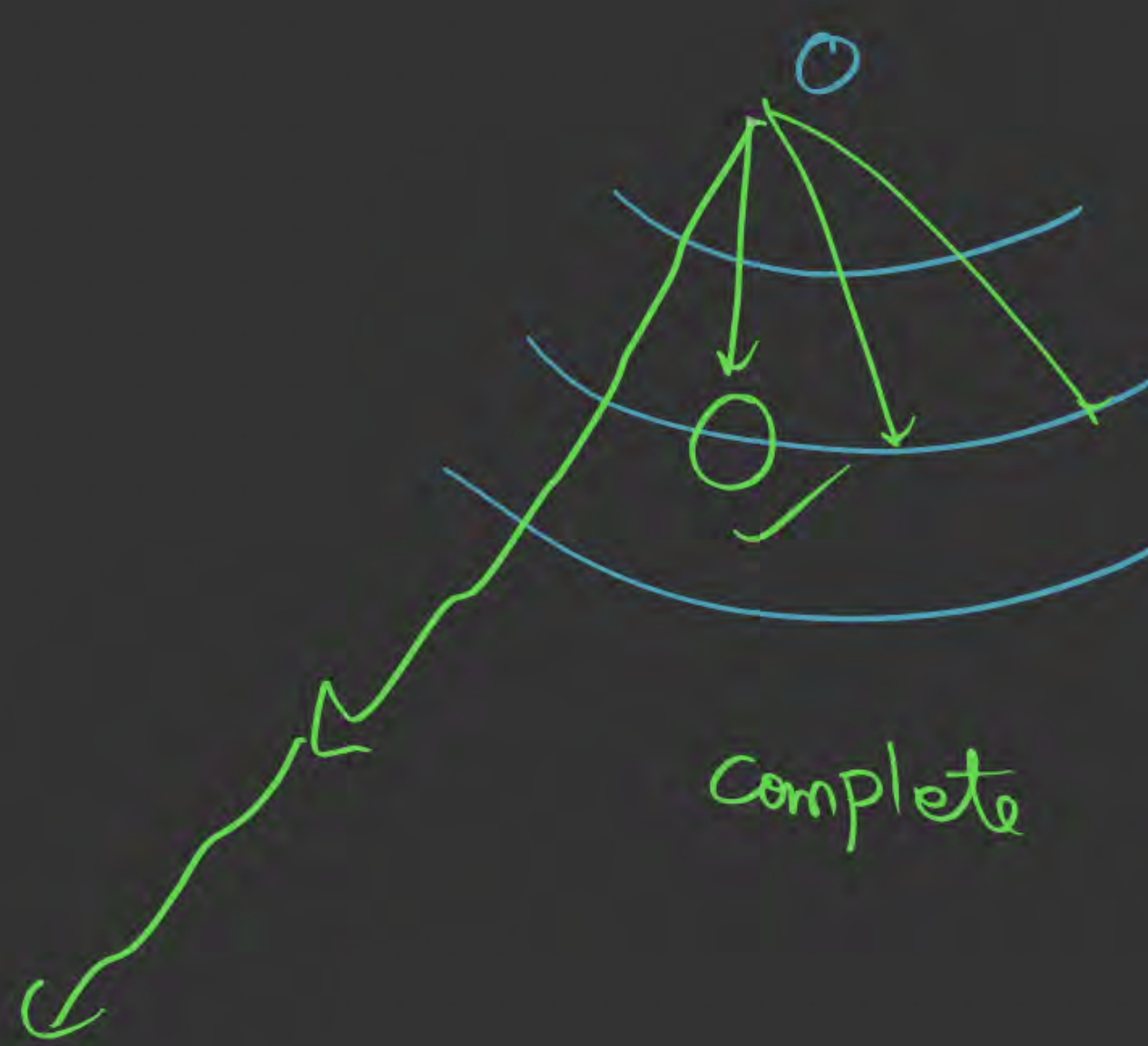
Alphabetical

(2) BFS Tree Search



ABC D Z E F A B C D Z ... Cycle

Goal Reached



complete



DFS

Incomplete

[MCQ]

msg



#Q. Which of the following is/are true?

A, B, D

- ☒ A Breadth First Search explores equally in all directions.
- ☒ B ^{UCS} Dijkstra's Algorithm lets us prioritize which paths to explore.
- ☒ C ^X A* is a modification of Dijkstra's Algorithm that can find paths to all the nodes.
- ☒ D A* is a modification of Dijkstra's Algorithm that is optimized for a single destination.

[MCQ]



#Q. Consider the following graph use the best first search algorithm to find the path from node A to node G (Assume node A is start node and node G is goal node). Which of the following path sequence is correct?



G-BFS

open

A	B	C	D	E	F	G
	30	28	35	19	22	0

A $A \rightarrow D \rightarrow C \rightarrow G$

B $A \rightarrow C \rightarrow E \rightarrow G$

ACEG

C $A \rightarrow C \rightarrow F \rightarrow H \rightarrow G$

D $A \rightarrow D \rightarrow F \rightarrow G$



THANK - YOU