Artificial Intelligence

Exercise Sheet 1

November 2, 2021

Exercise 1.1

1/2

Given:	Single Agent	**Opposite:**	Multi-Agent
Example:	Crossword Puzzle vs Chess		

Given:	Deterministic	**Opposite:**	Stochastic
Example:	Crossword Puzzle vs Monopoly (Board Game)		

Given:	Sequential	**Opposite:**	Episodic
Example:	Chess vs. Sorting machine		

Exercise 1.1

Given:	Discrete	**Opposite:**	Continous
Example:	Tic-tac-toe vs. Racing Game		

Given:	Unkown	**Opposite:**	Known
Example:	Robot on Mars vs. Tic-tac-toe		

Exercise 1.2

	Chess	Conveyor-Belt Sorter	Poker
Observable	Completely	Completely	Partially
Single Agent?	Multi	Single	Multi
Deterministic	Determ.	Determ.	Stochastic
Episodic	Sequential	Episodic	Sequential
Static	Static	Static	Static
Discrete?	Discrete	Discrete	Discrete
Known?	Knwon	Known	Known

Exercise.1

Task: State the necessary actuators.

- Drive Forward
- Rotate
- Vacuum Pump

Exercise 2.2

Task: State at least two useful performance measure.

- Count of clean tiles
- $\frac{\text{Count of clean tiles}}{1+\text{Time}\cdot g}$ where g is the time weighing factor

Exercise 2.3

Question:: Which types of sensors are required or useful?

- Is there any dirt on the current tile?
- Are there obstacles in front / behind or to either side?
- RPS (Room Positioning System) (only if the agent has a map).

Exercise 2.4

Question: Which are the required conditions in order to correctly assume the environment to be static?

- Obstacles / Walls do not change
- Dirt neither disappears, nor does new dirt spawn.
- ...

Exercise 2.5

Question: Which are the required conditions in order to correctly assume the environment to be deterministic?

- Rotations always work flawlessly
- Driving forward always works flawlessly, if the space in front is open
- Vacuuming dirt always works

Exercise 2.6

Question: Is the environment sequential or episodic?

Sequential, because vacuuming or driving changes the state of the world and therefore influences, which tiles still have to be vacuum later on.

Exercise 2.7

With Memory

Task: Specify how the agent can proceed to clean an unknown room. Sketch out the procedure using pseudocode. Consider both cases. (Agent with and without a memory)

```
currentNode = (0, 0); openNodes = {(0, 0)}; closedNodes = {};
direction = [1, 0];

while openNodes != {}:
    destination = removeNearestNode(openNodes);
    path = getShortestPathTo(destination);
    walkPathAndUpdateDirectionAndCurrentNode(path);
    if (sensor.dirt):
        suck;
    for node in (neighbours - (closedNodes + sensor.obstacles)):
        openNodes = openNodes + { node };
    closedNodes = closedNodes + { currentNode };
```

Exercise 2.7

Without Memory

Question: Specify how the agent can proceed to clean an unknown room. Sketch out the procedure using pseudocode. Consider both cases. (Agent with and without a memory)

```
while true:
    if (sensor.dirt):
        suck
    direction = getRandomOf(sensor.freeDirections);
    turnTo(direction);
    stepForward();
```

Exercise 2.8

Question: How would the agent solve the task if a map of the room was available? For this, we assume the environment to be deterministic and static. In this case, would it require a memory or sensors?

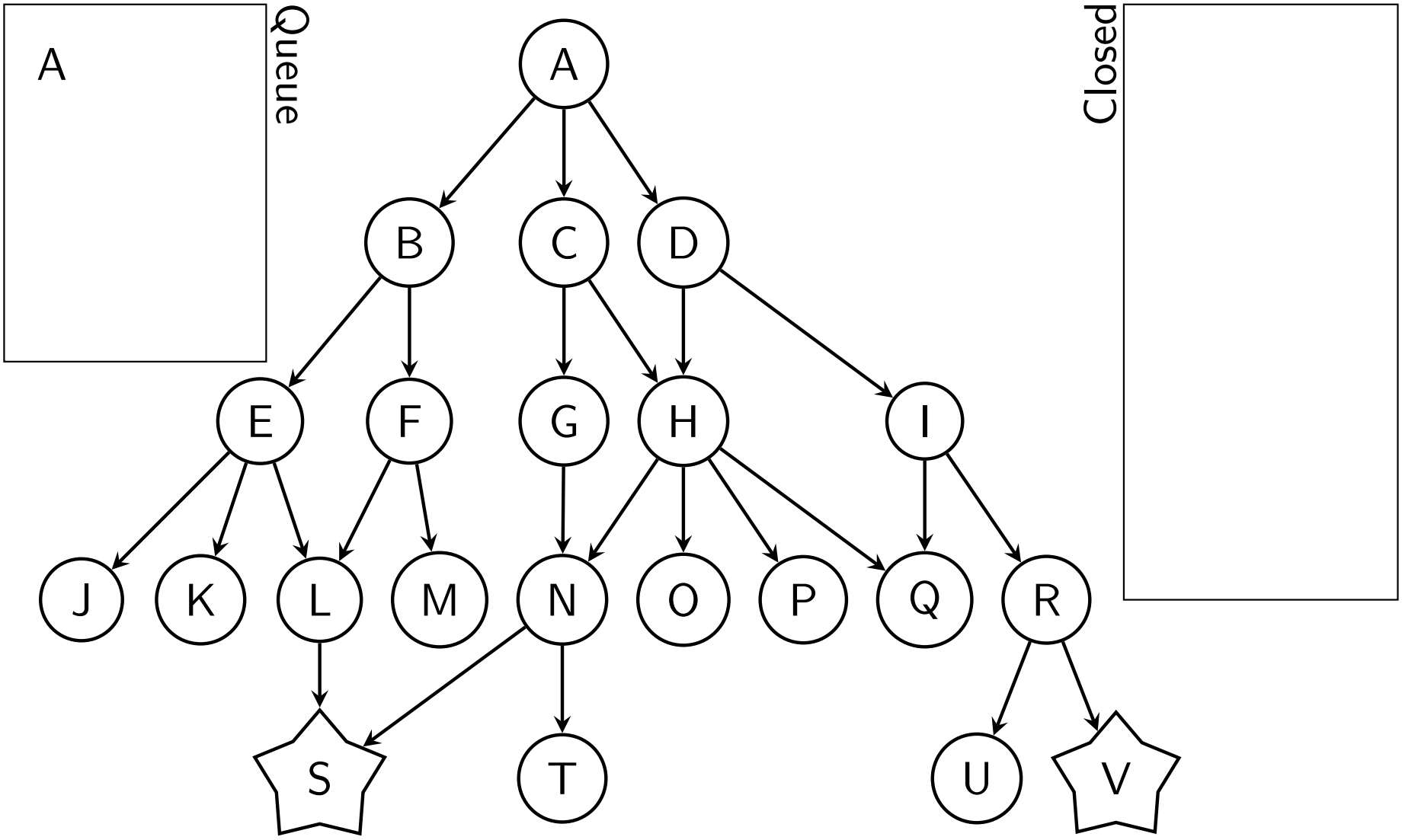
- If the dirt is recorded on the map no sensor is needed.
- If the dirt is recorded on the map and updated on changes no memory is needed, too.
- If the dirt is not recorded on the map, sensor and memory is needed.

Exercise 3

States	HWGC| |HWGC HGC|W HWH|C HWH|C G|HWC C|HWG W|HGC HG|WC WC|HG
Initial state	HWGC|
Actions	H, HG, HC, HW
Transition model	The final state, after the farmer crossed the river alone, with an animal or an object
target test	== |HWGC
Pathcost	Length of the path to accomplish the target test

Task 4.1

Breath-First-Search



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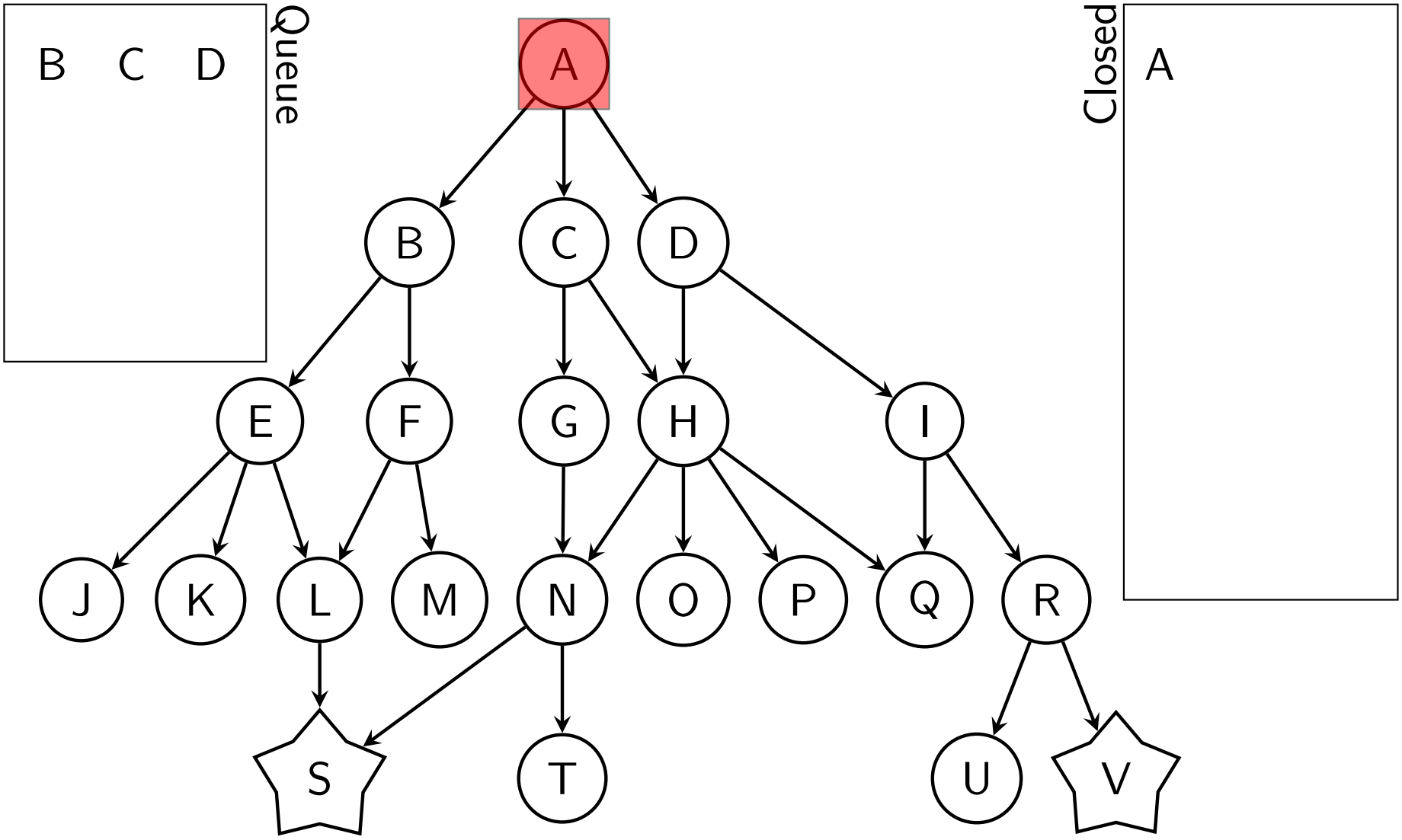

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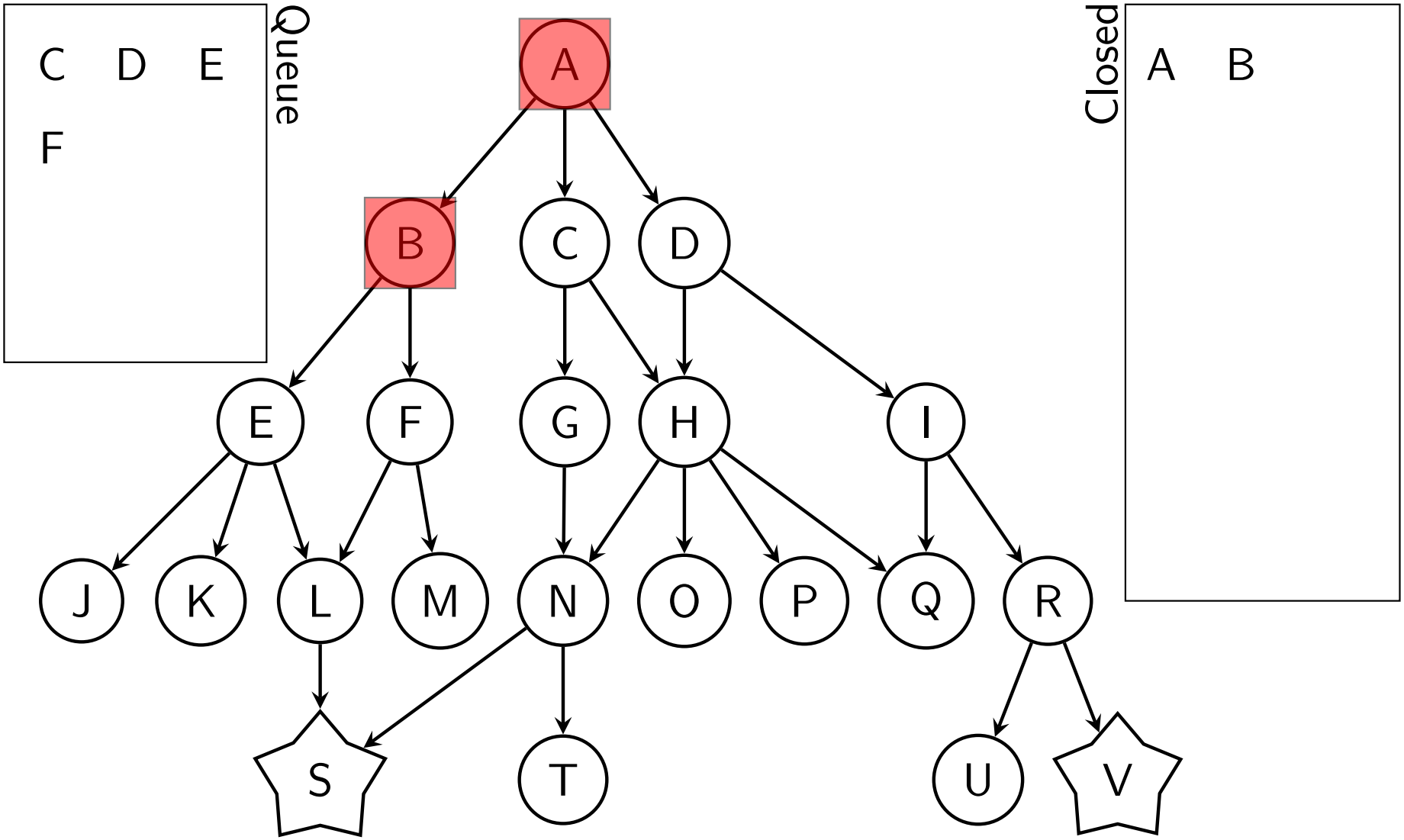

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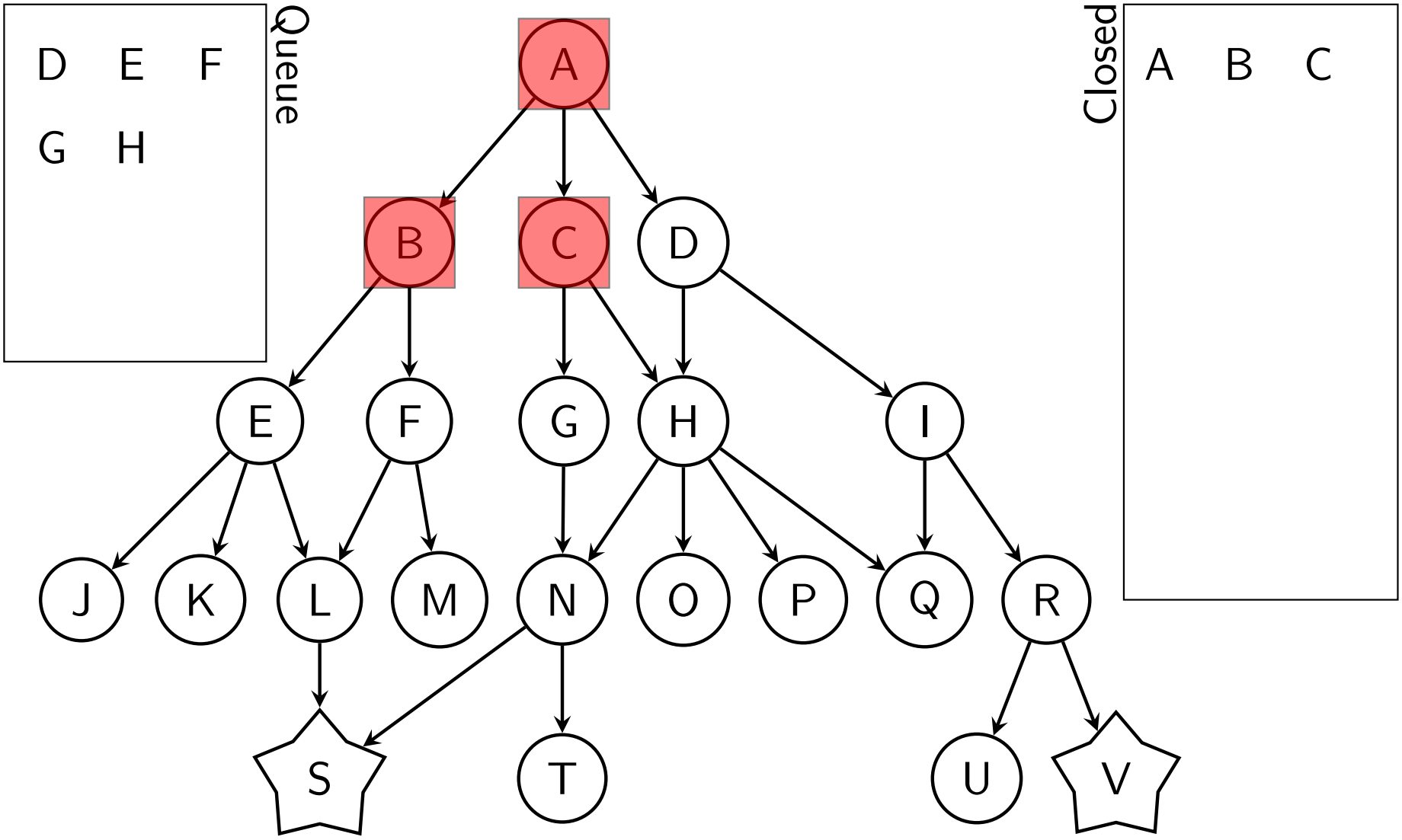

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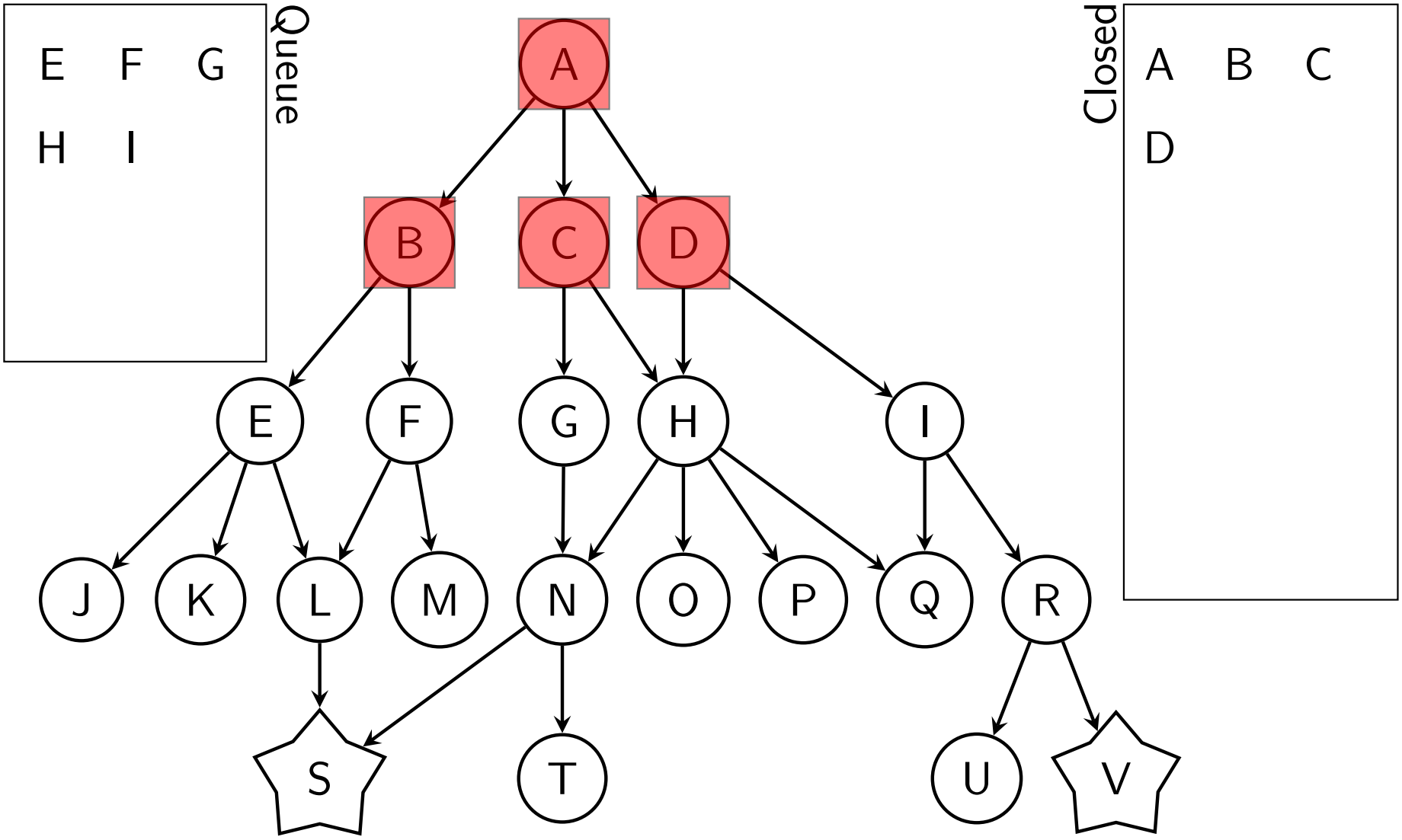

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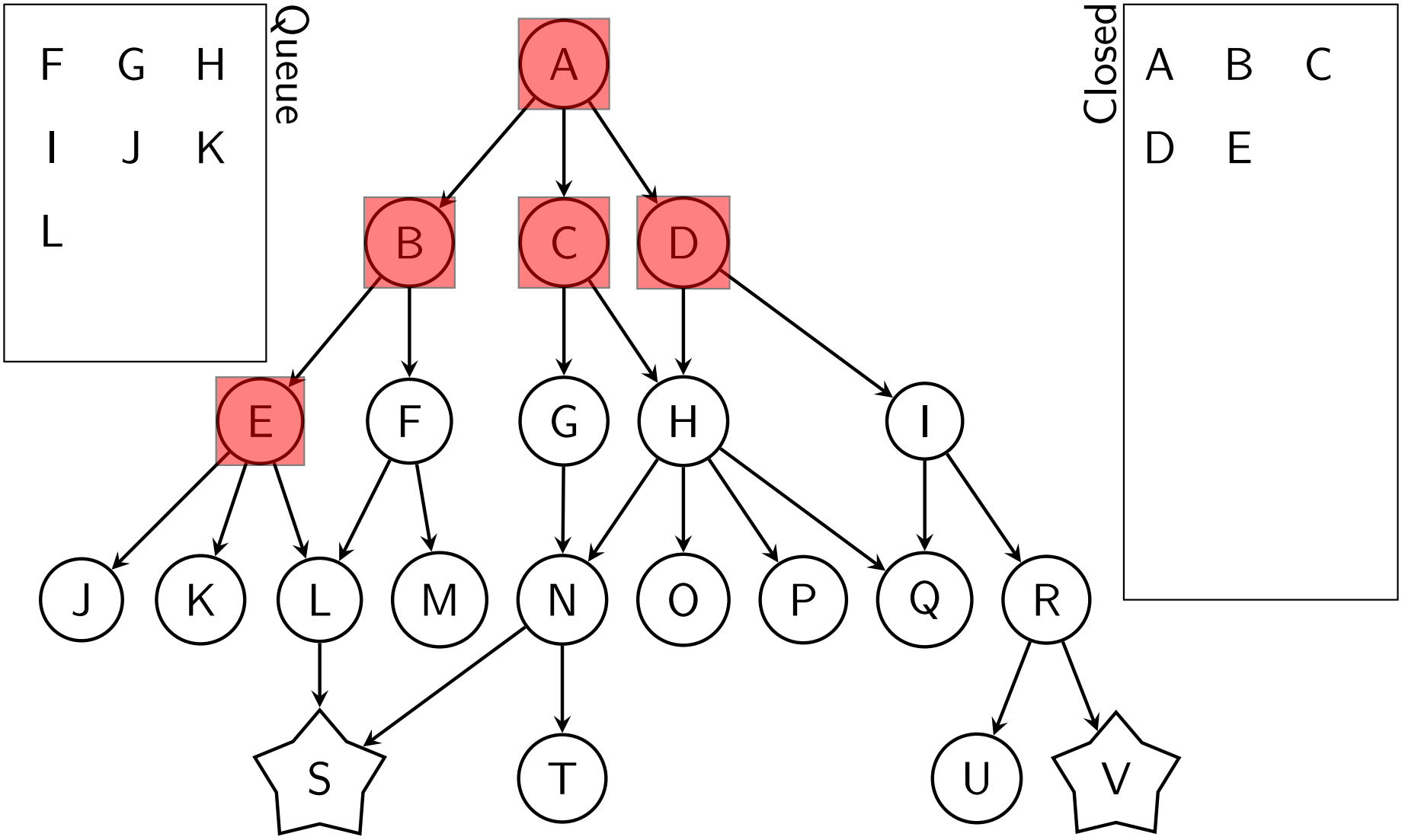

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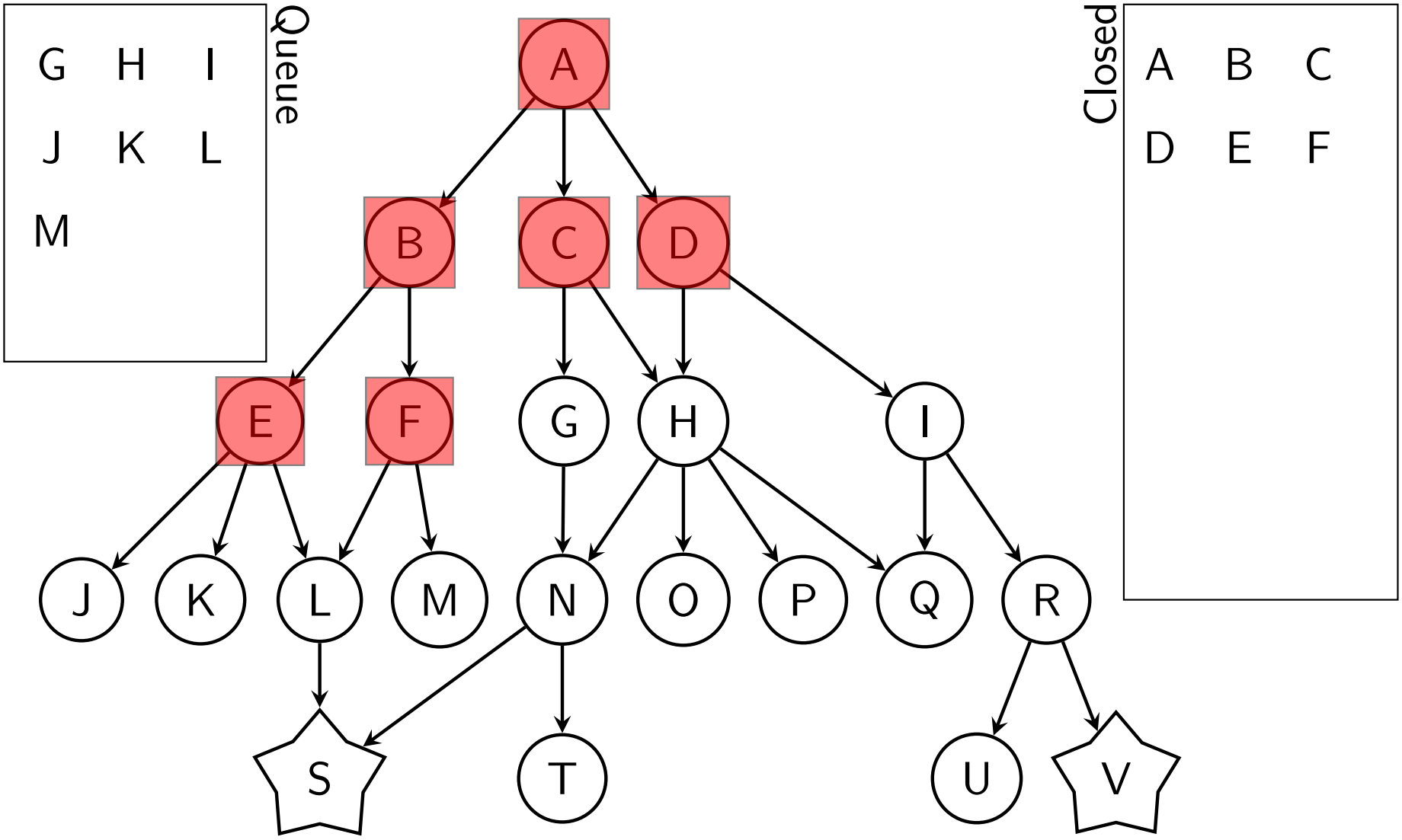

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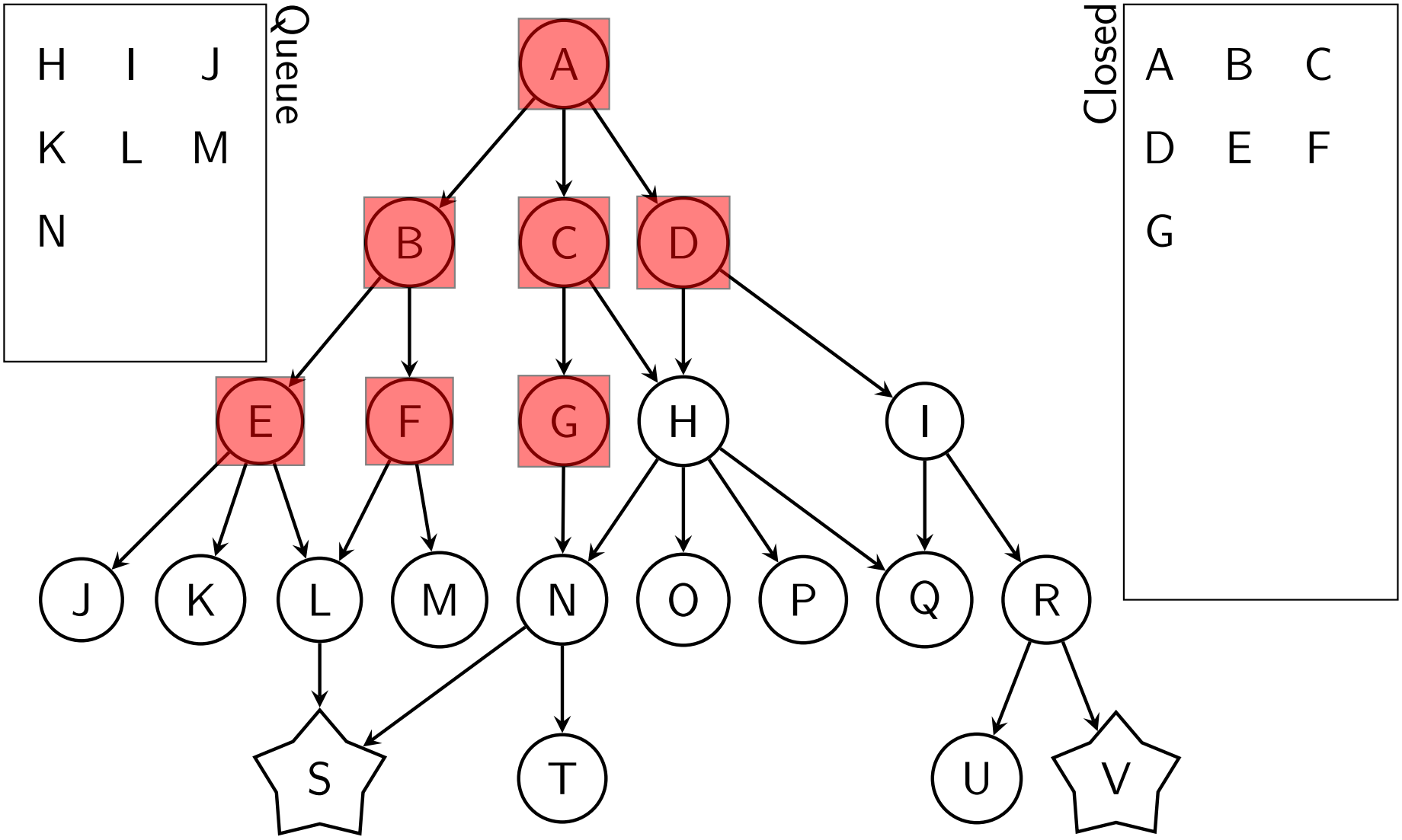

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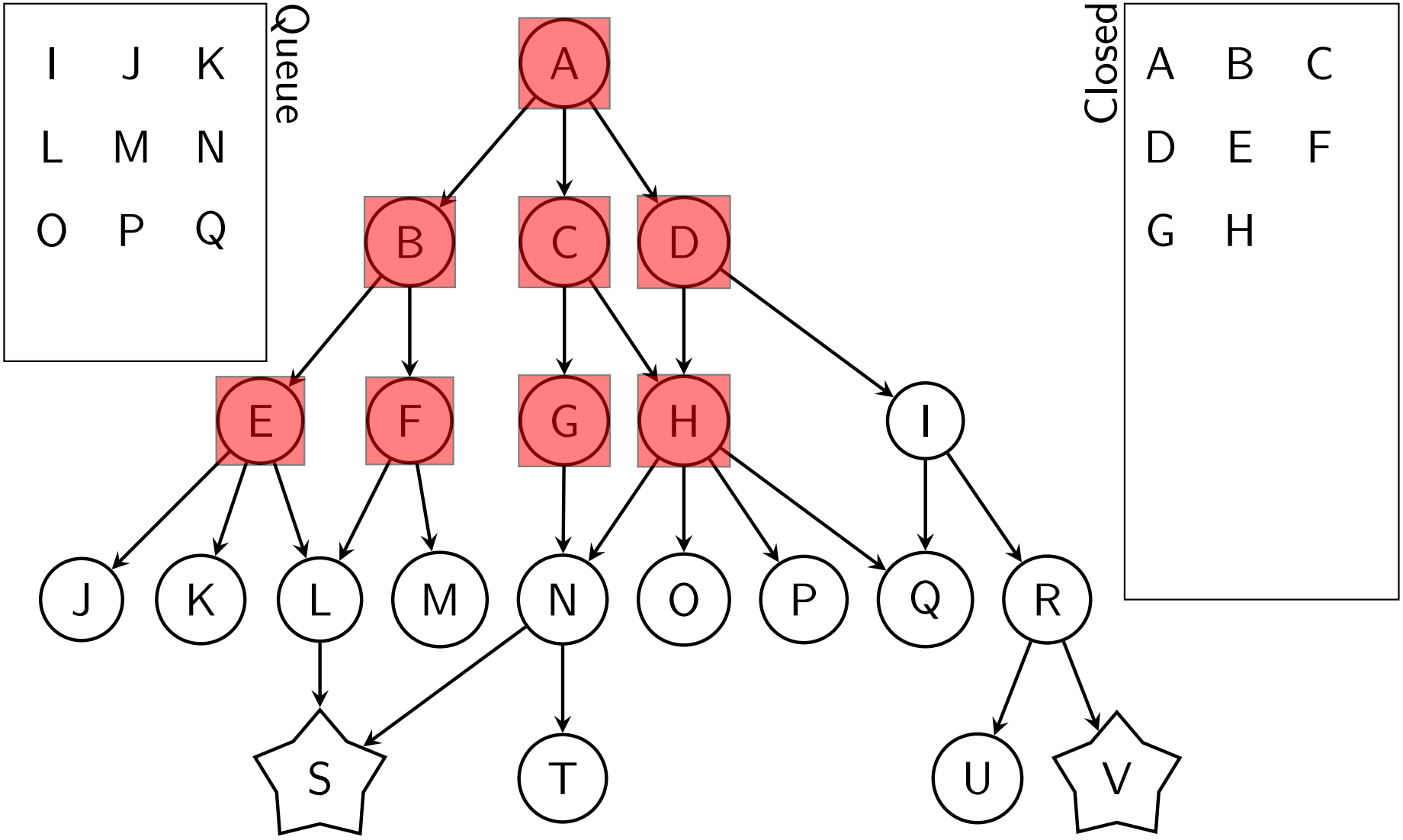

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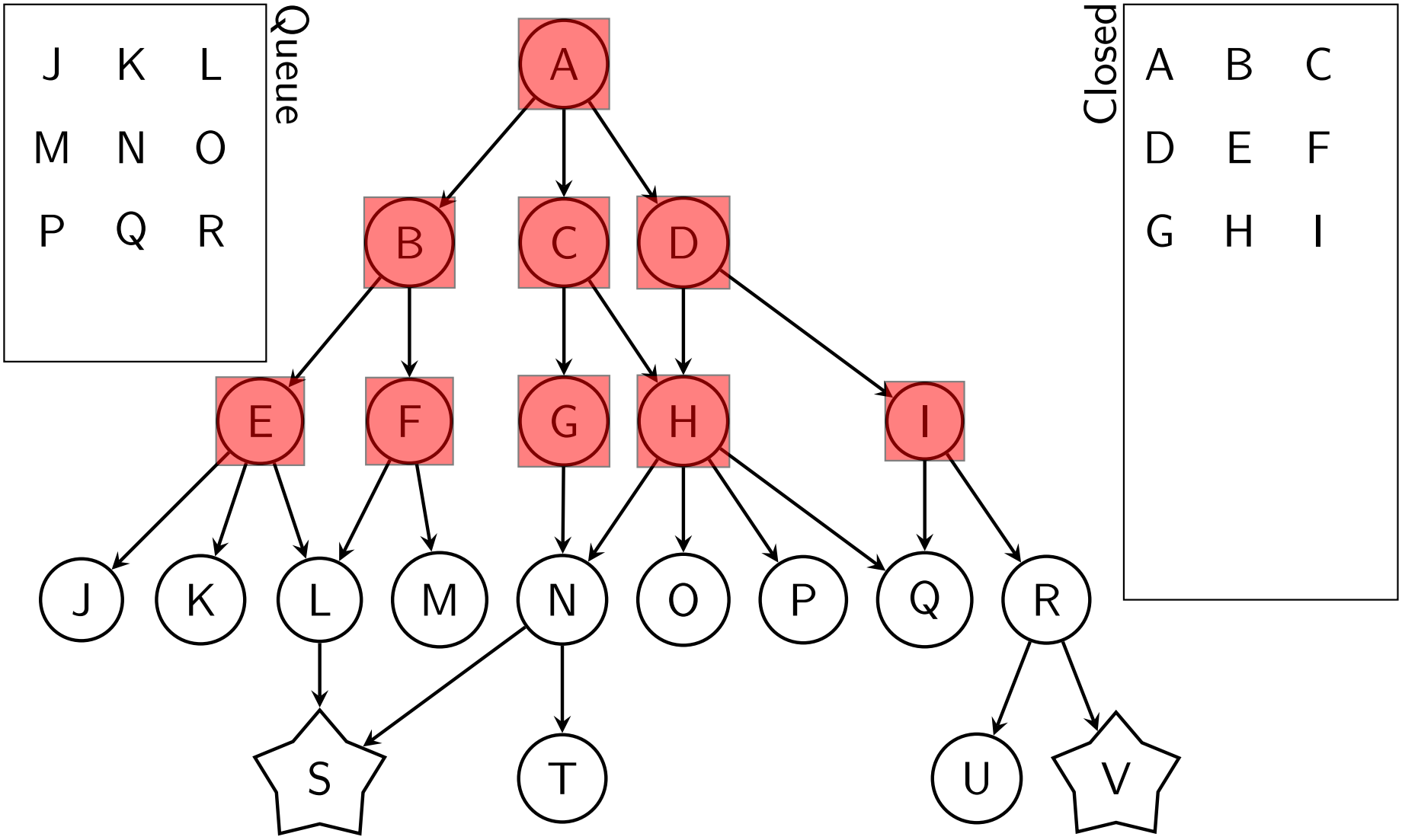

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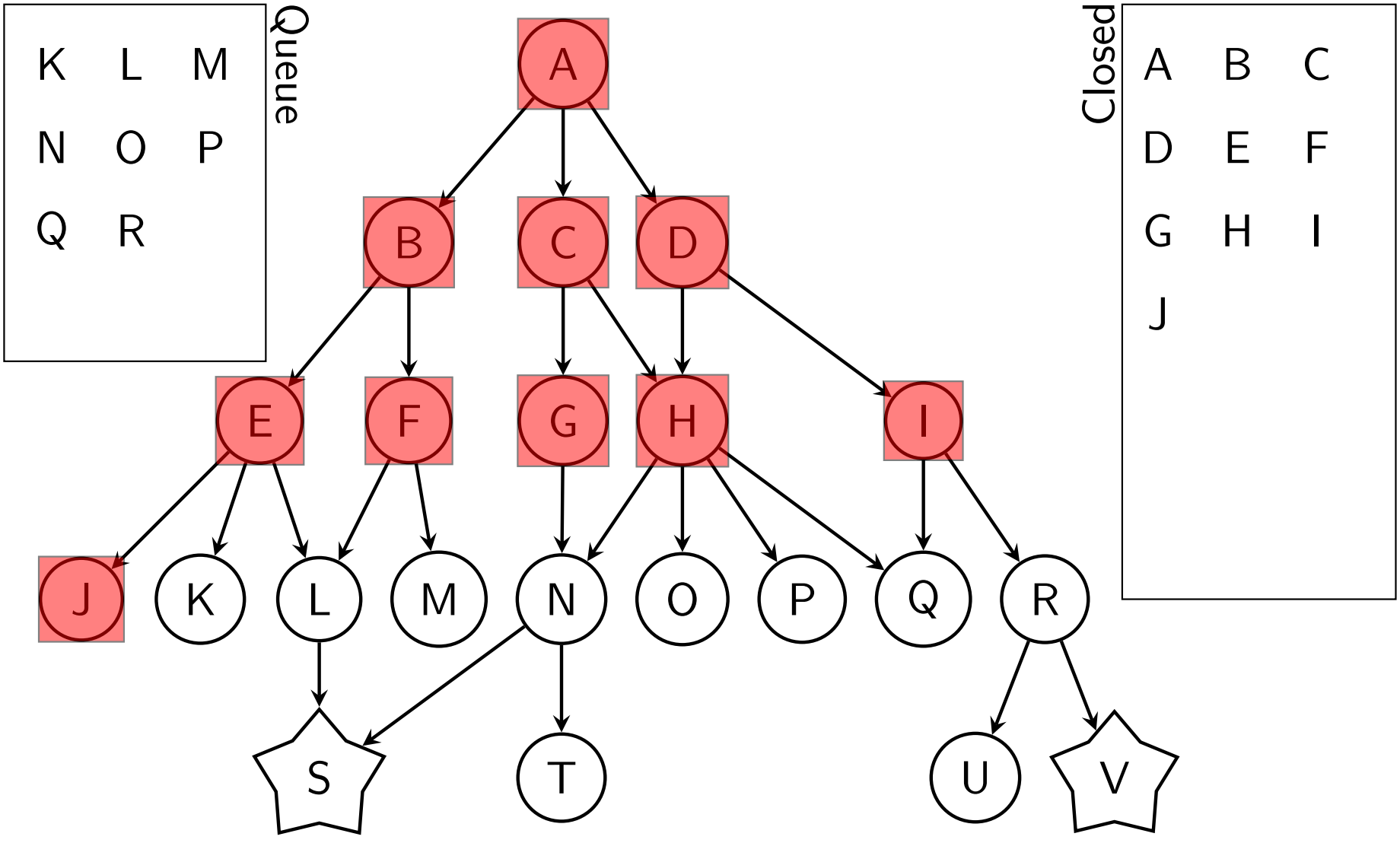

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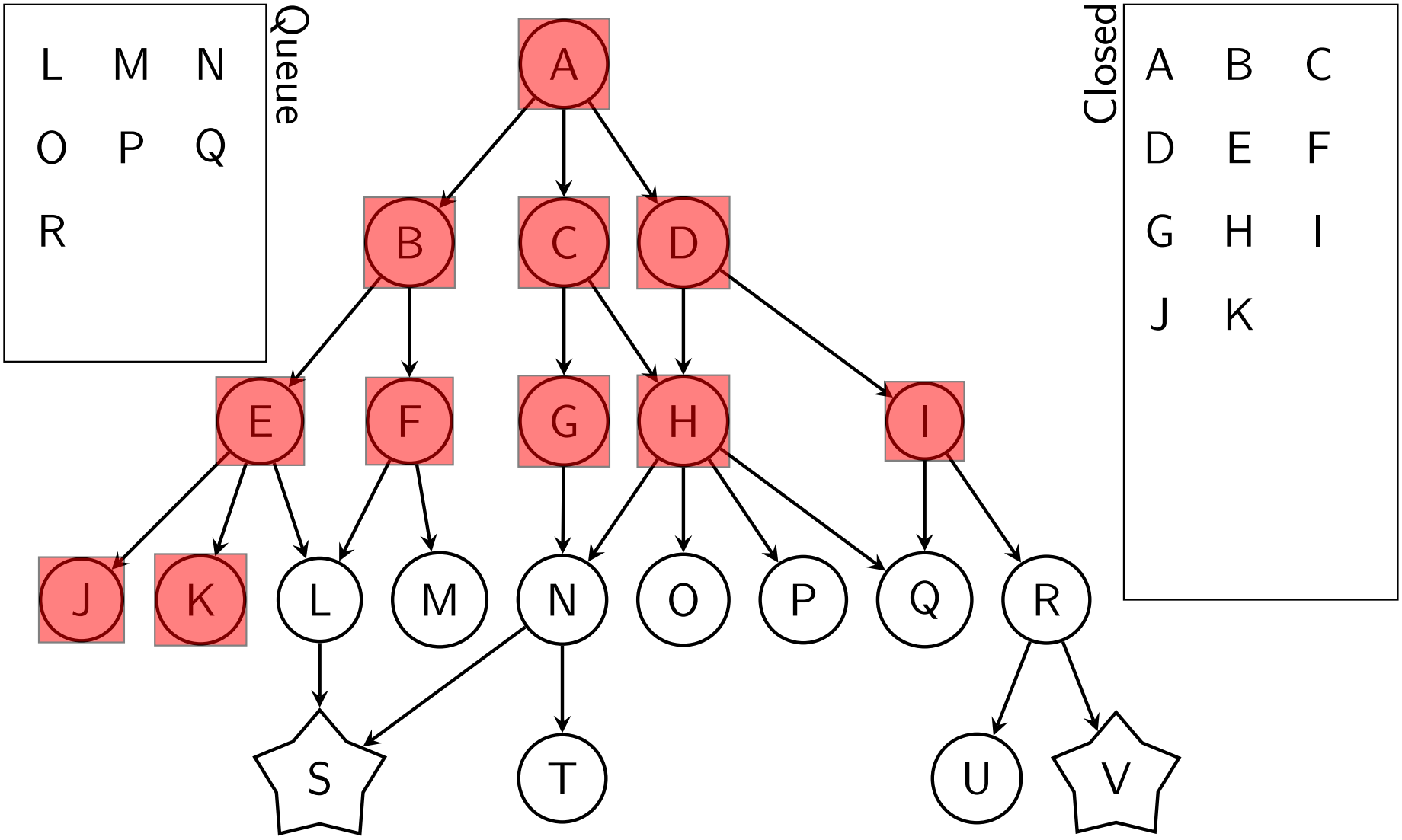

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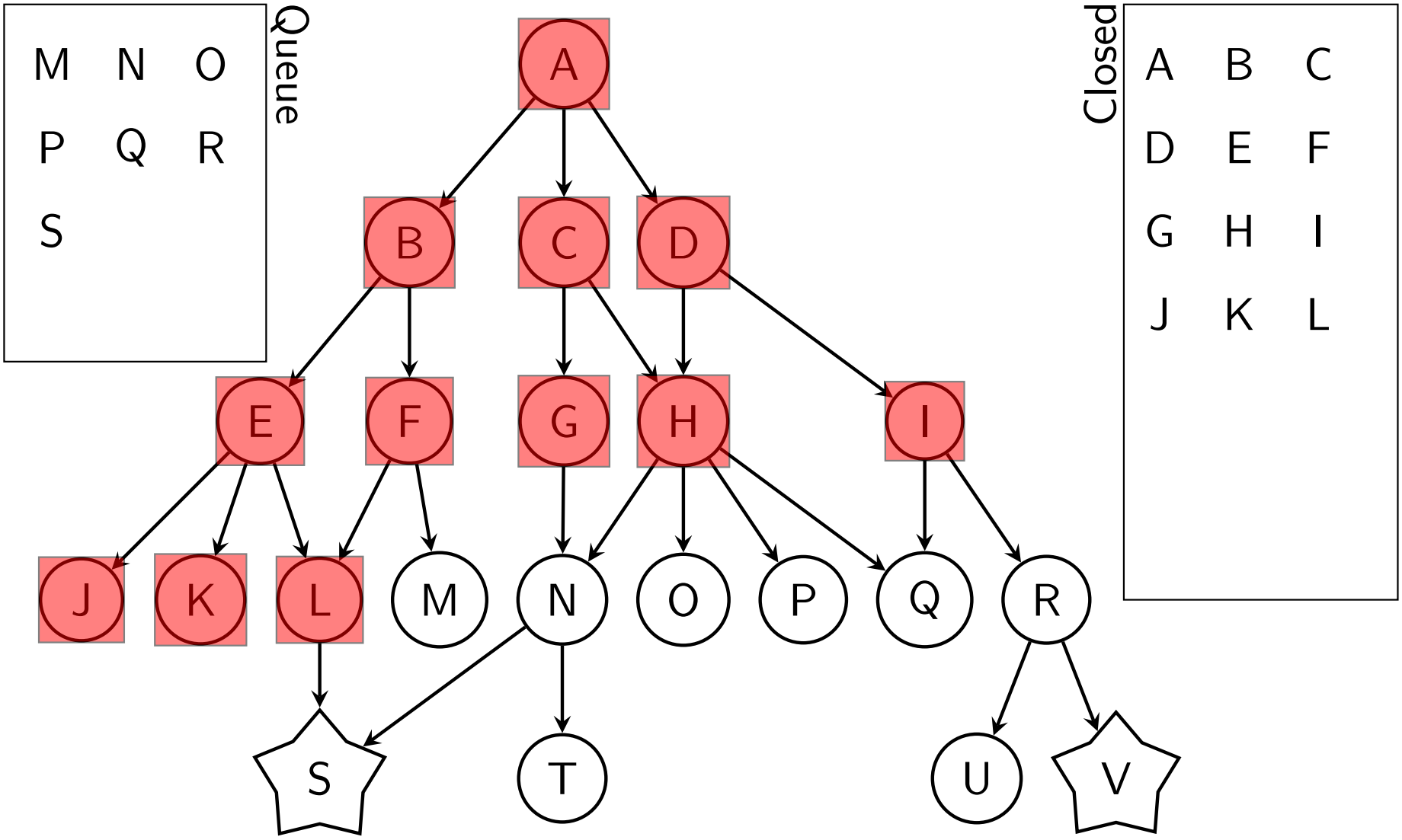

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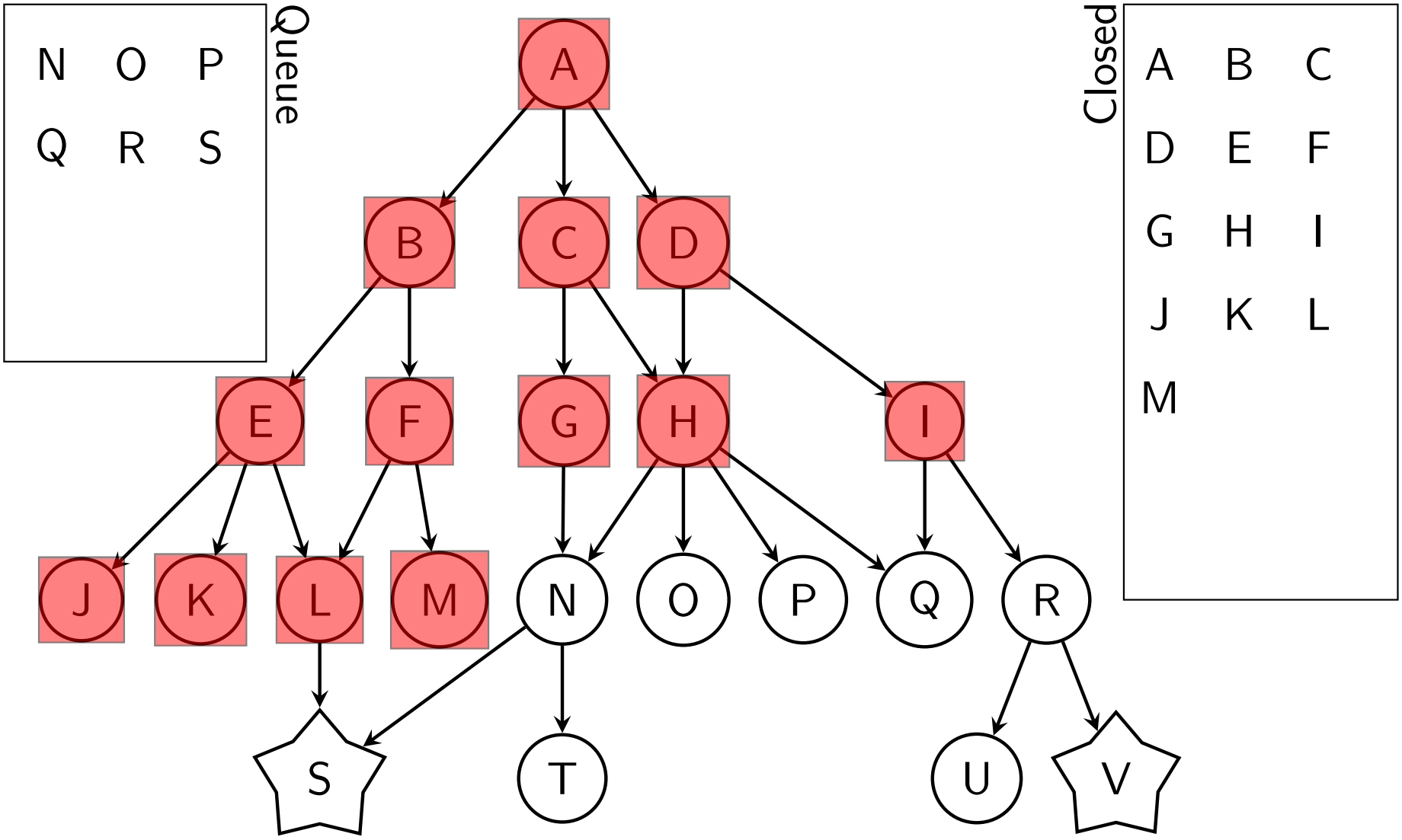

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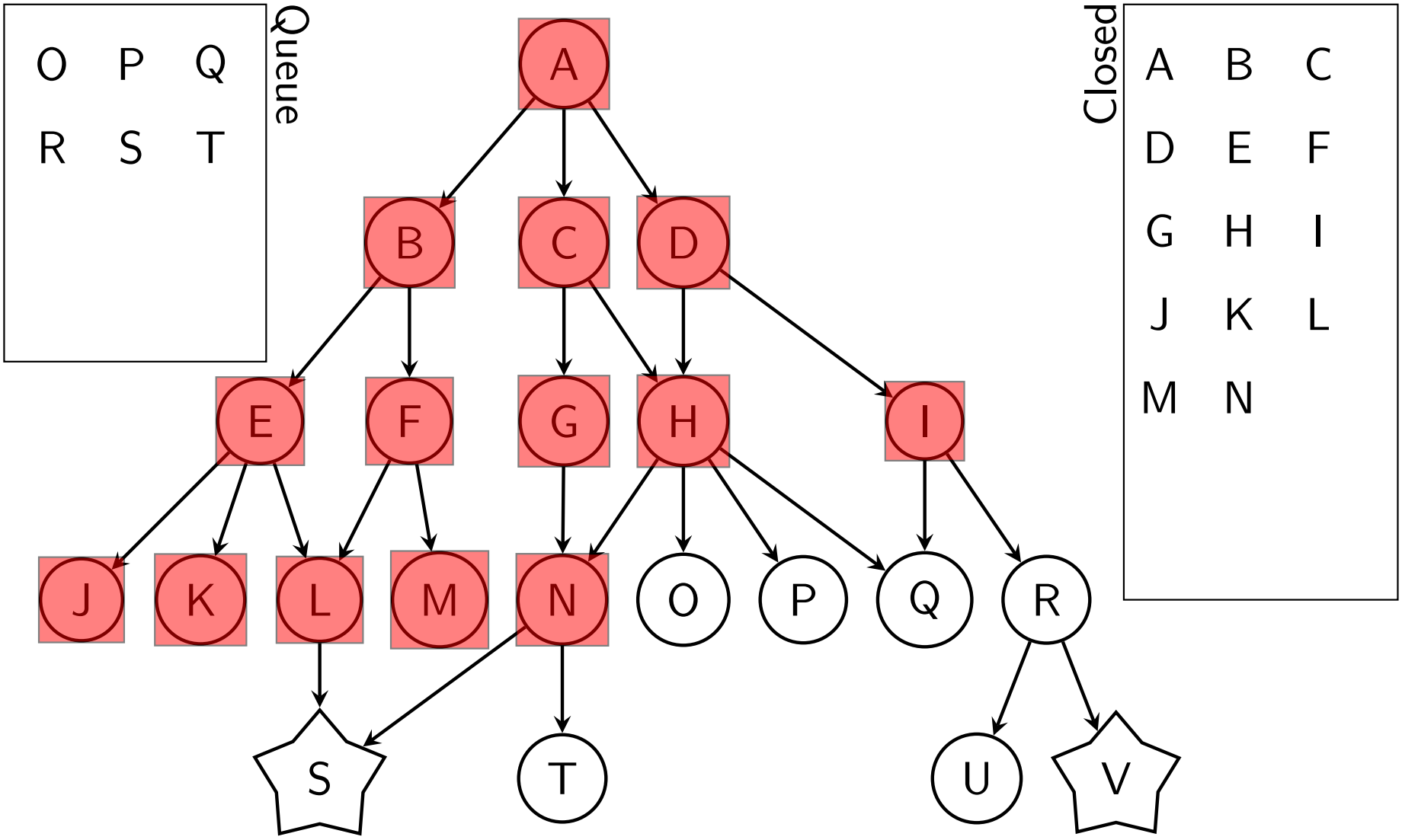

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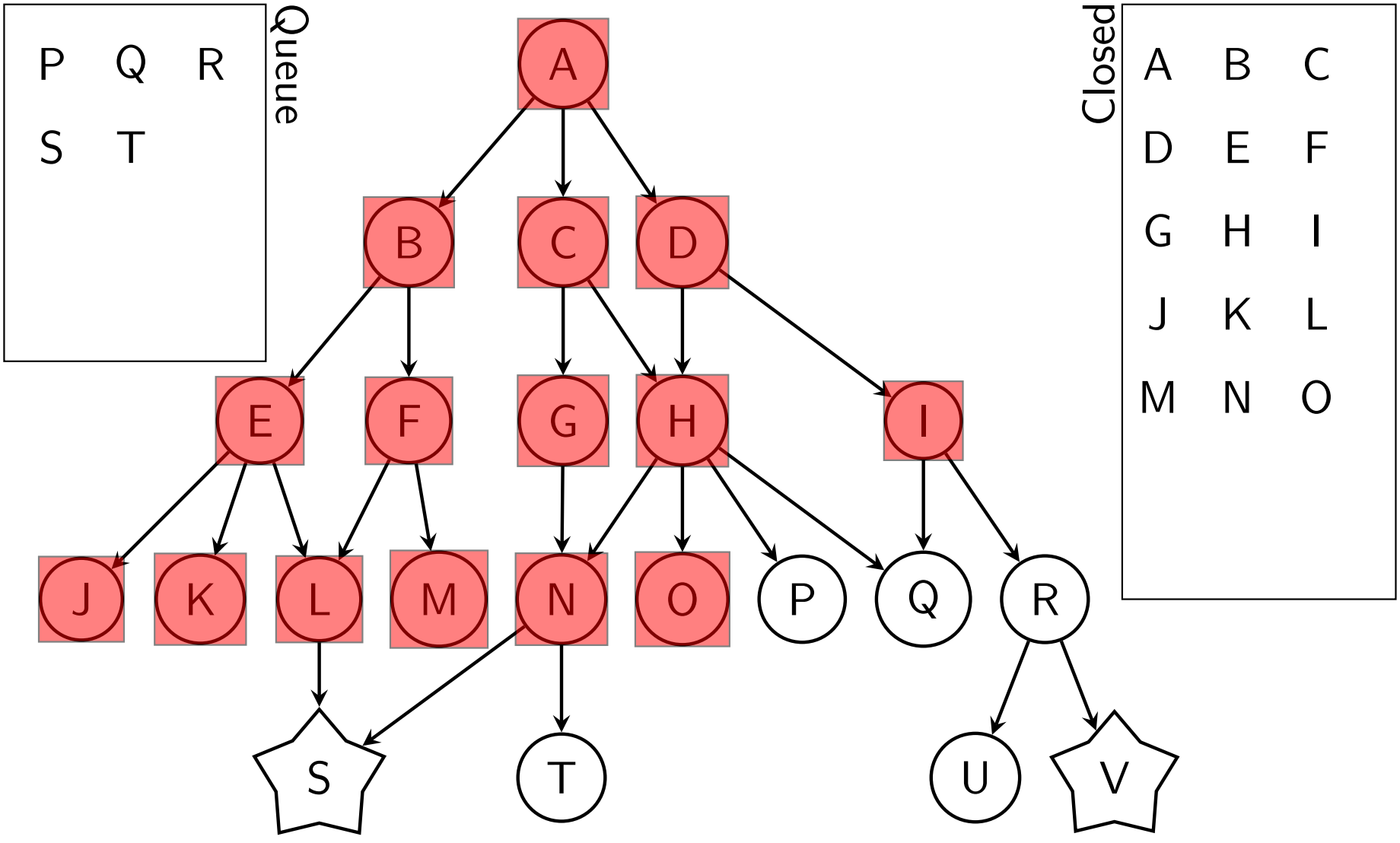

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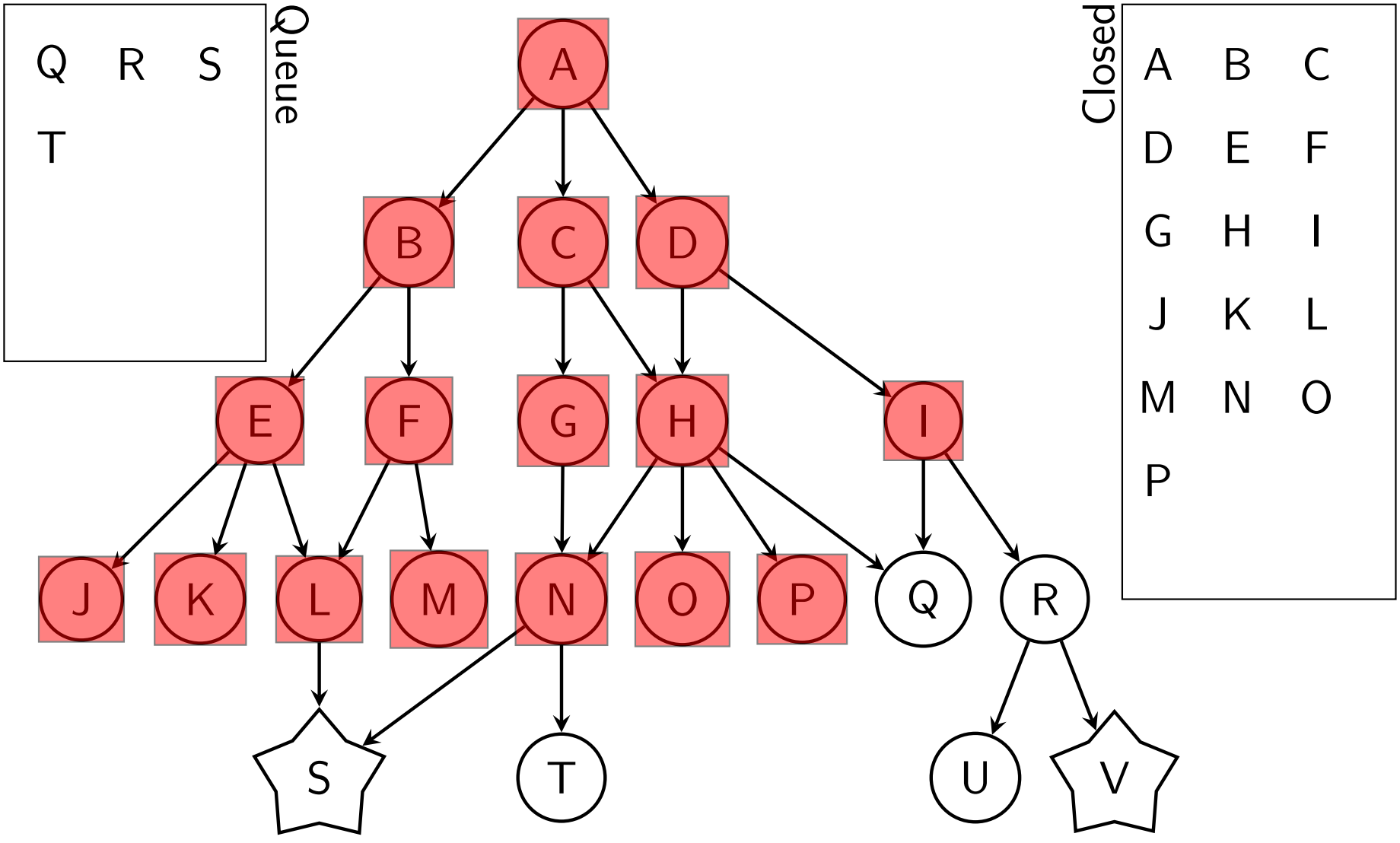

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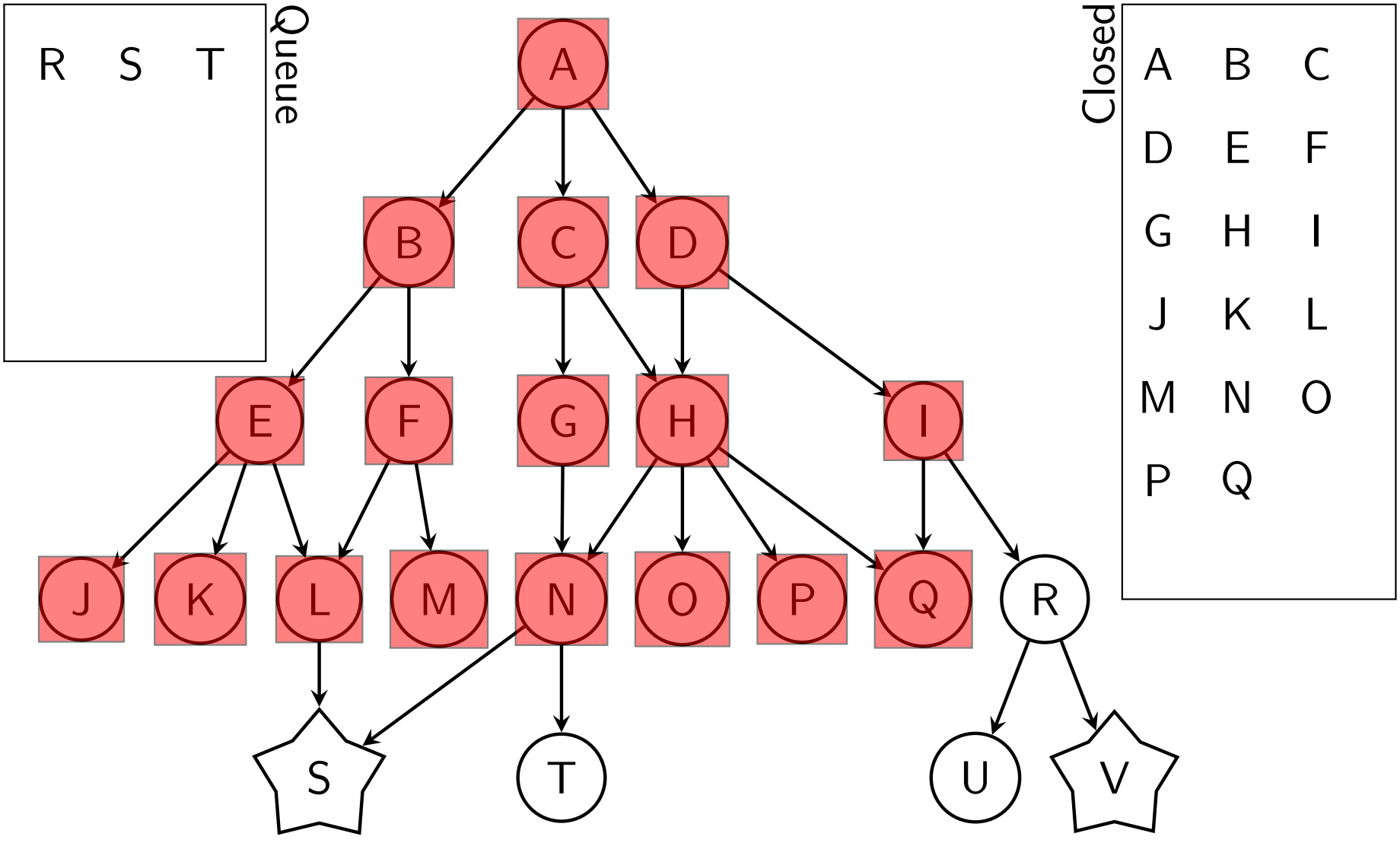

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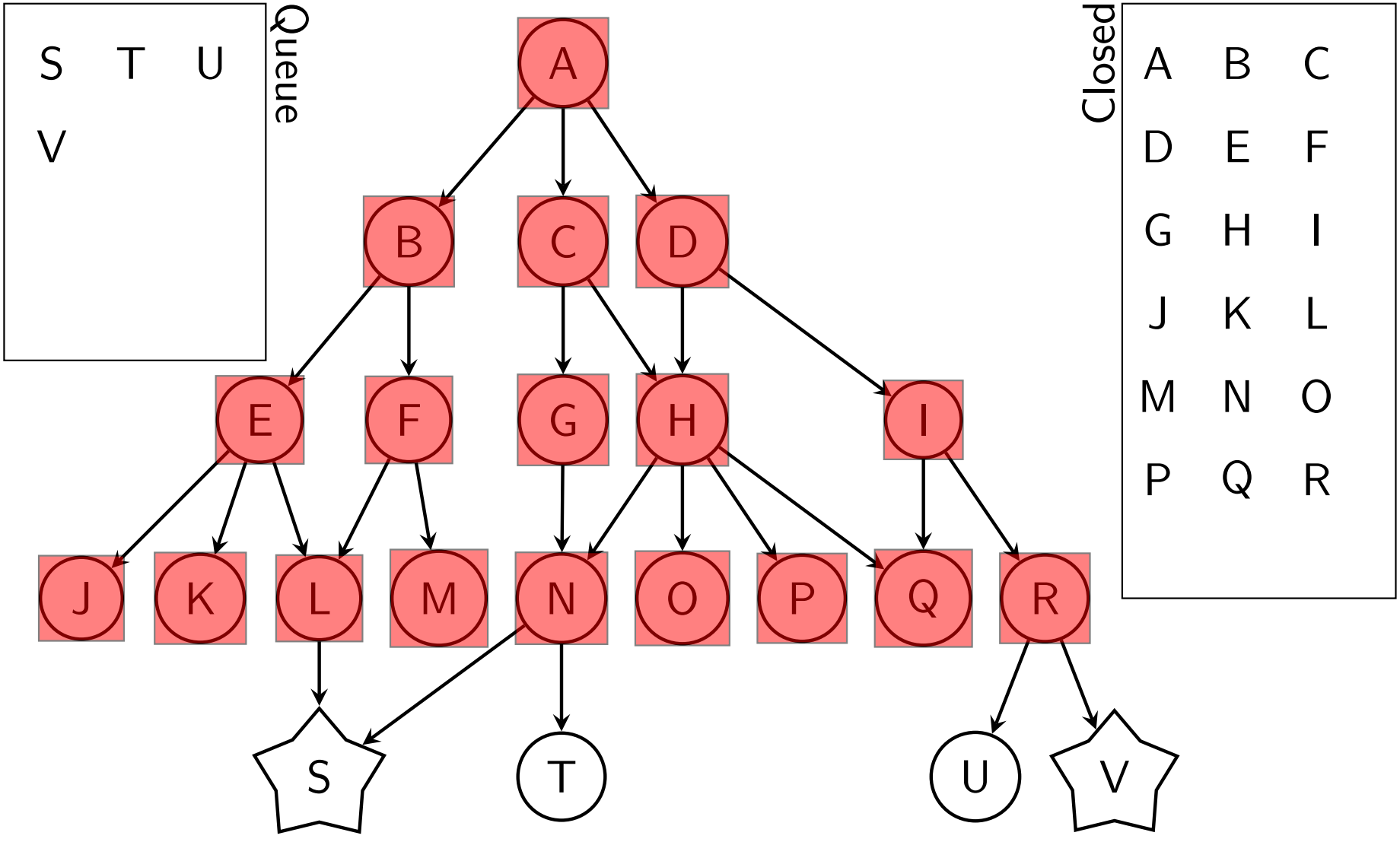

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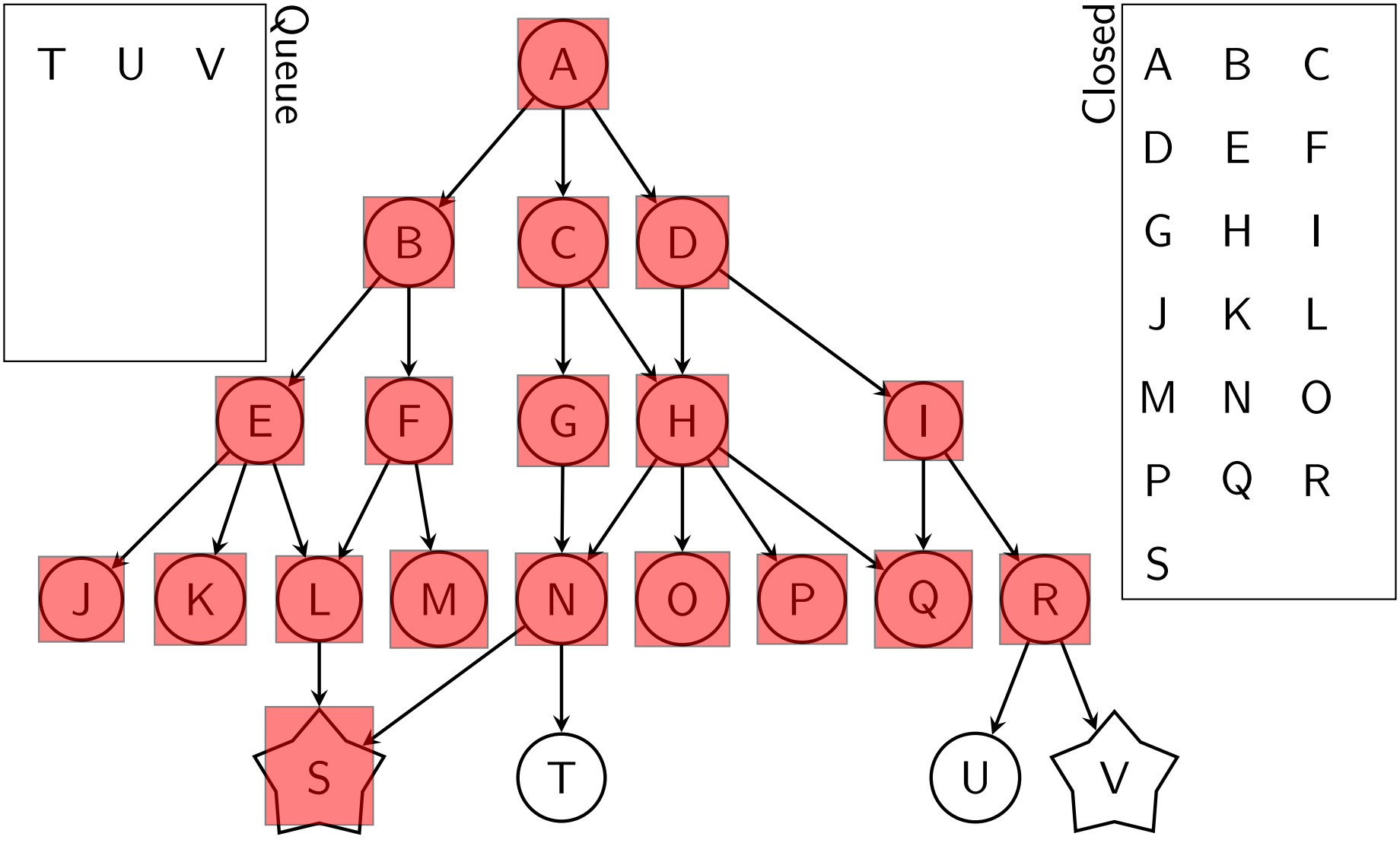

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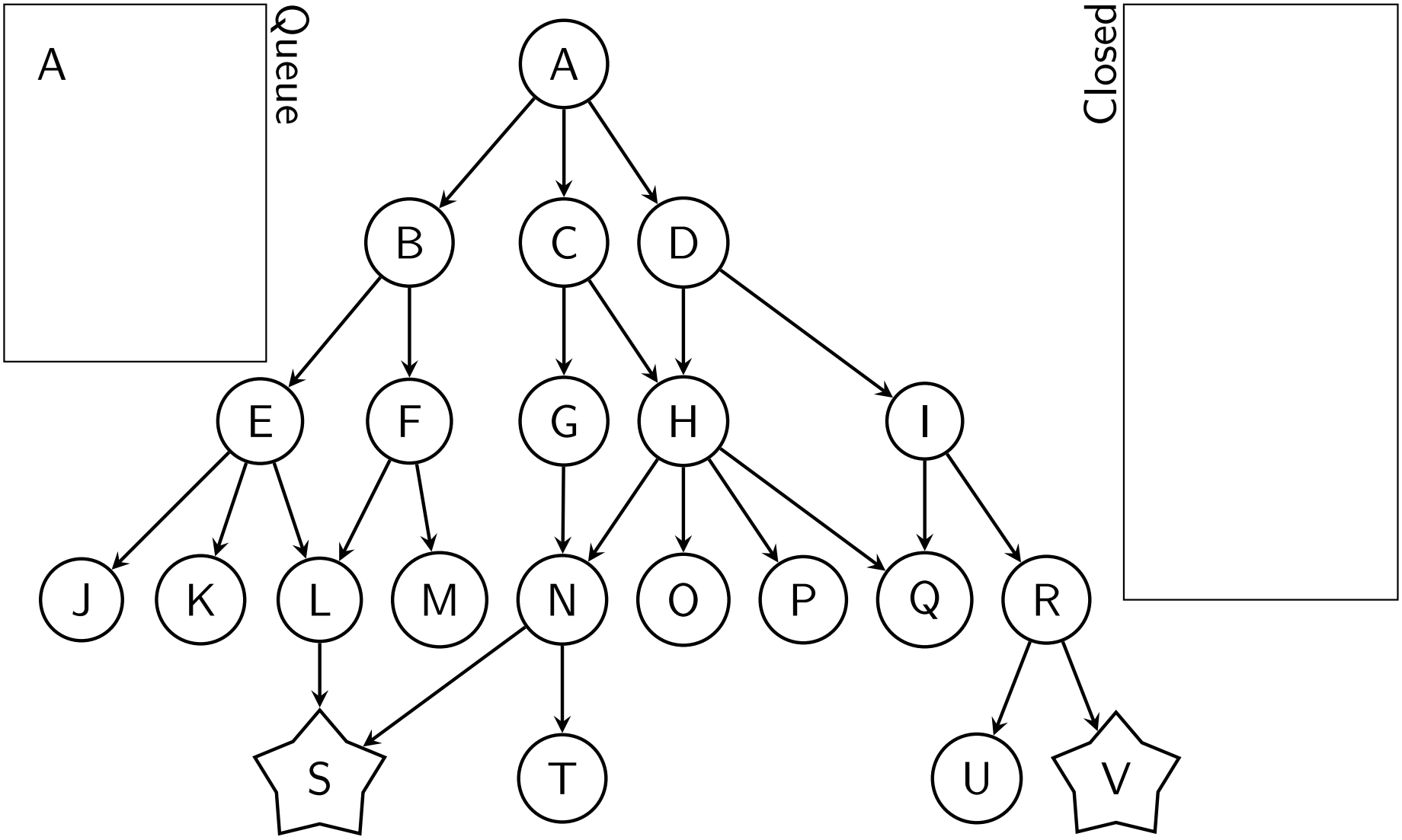

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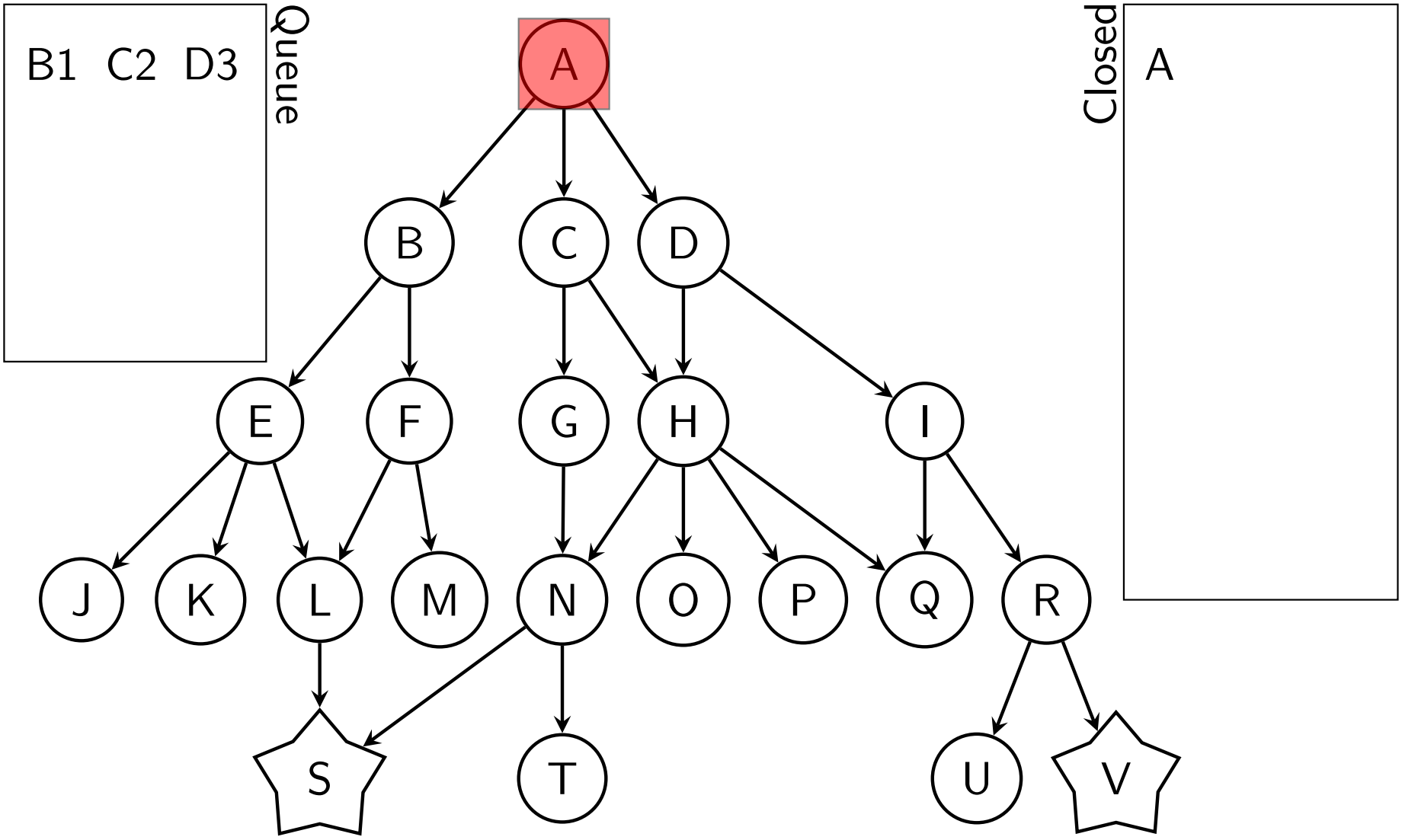

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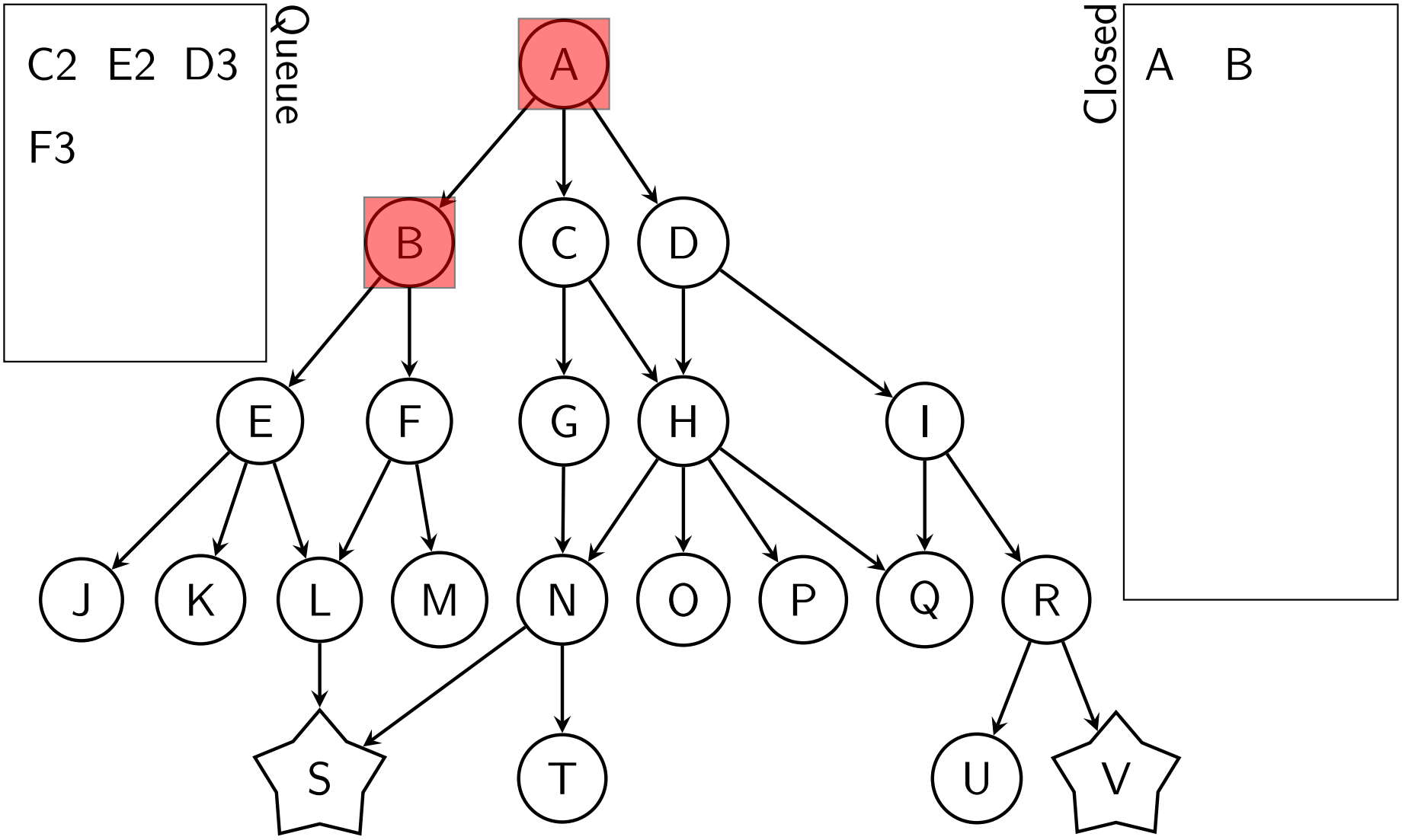

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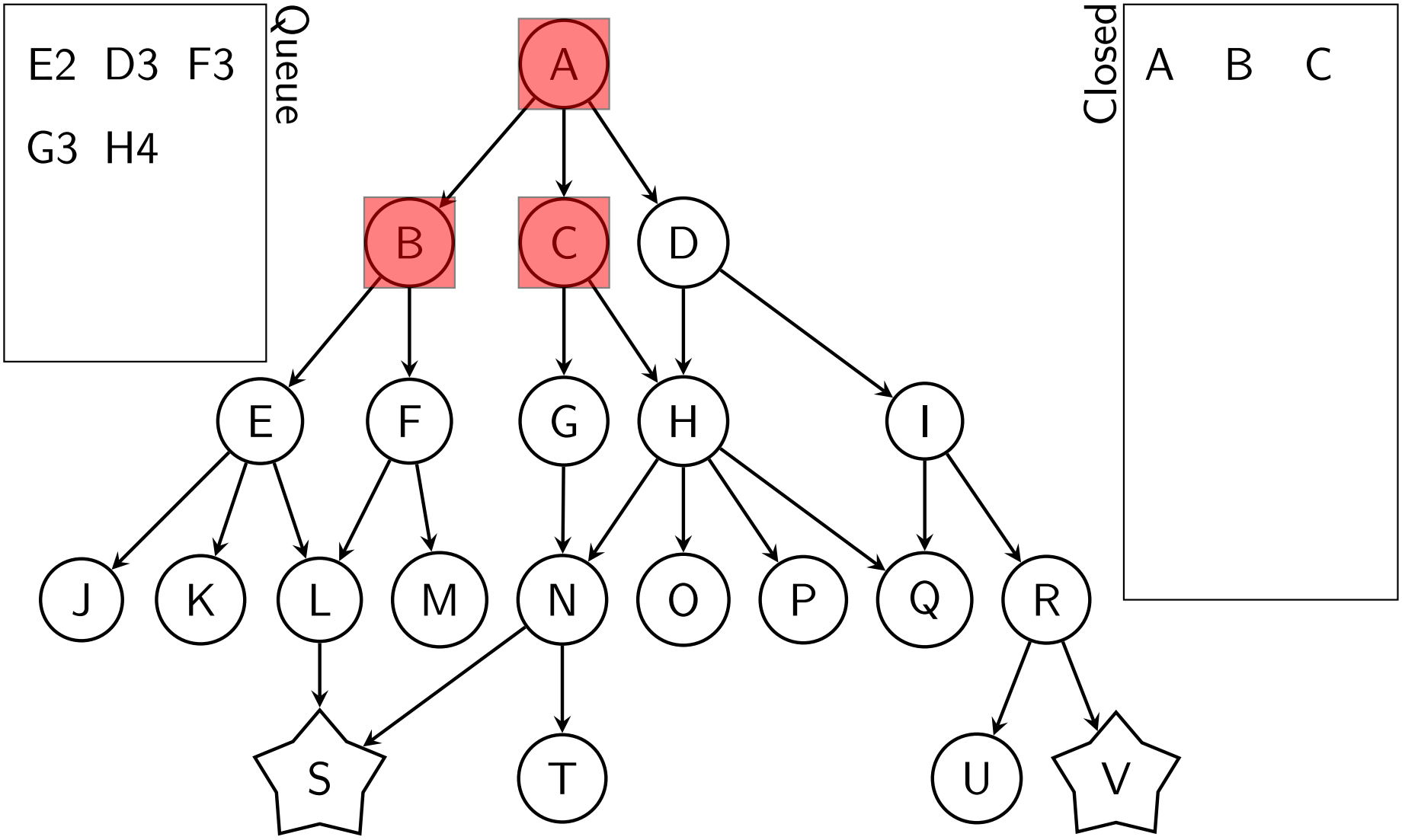

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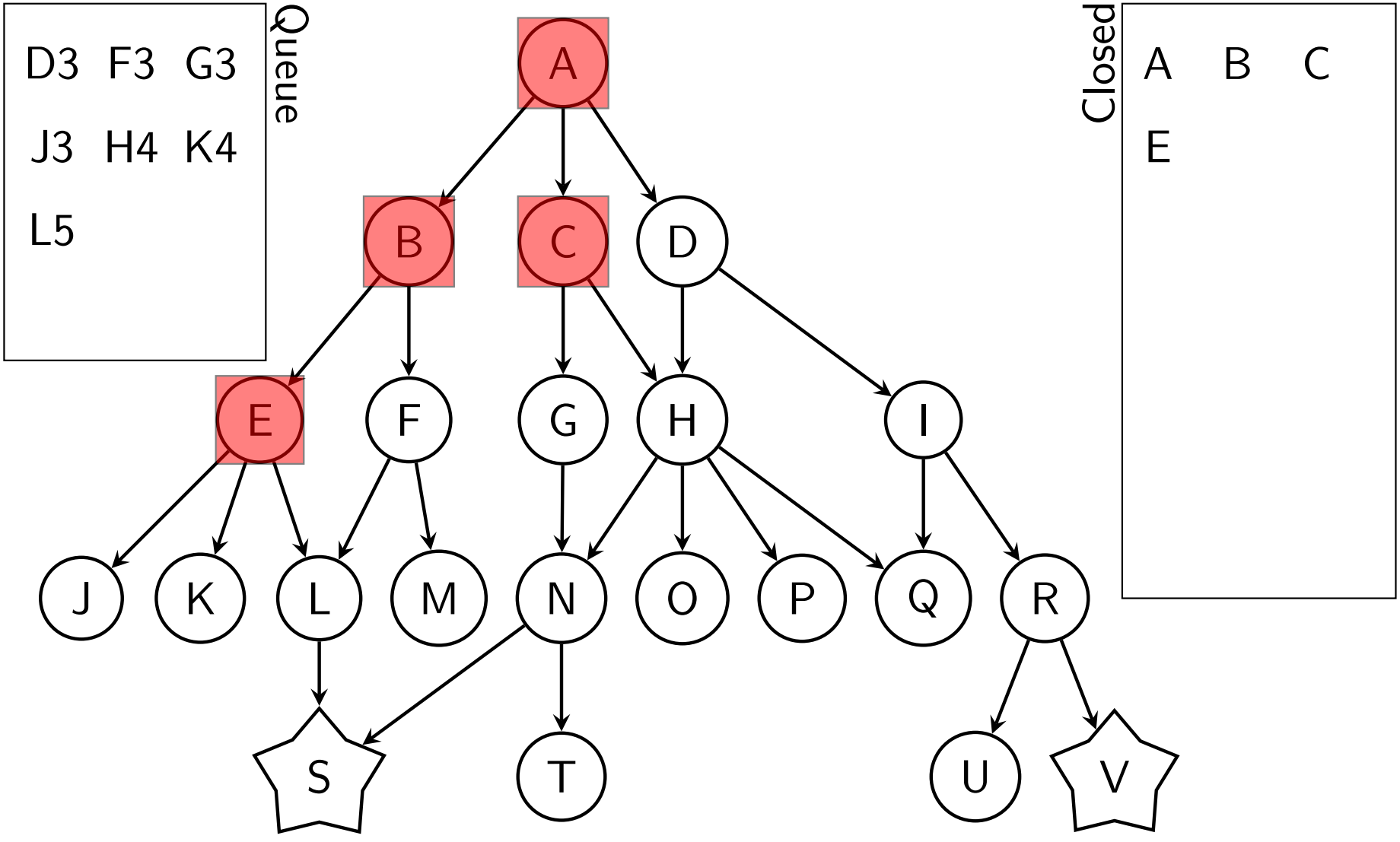

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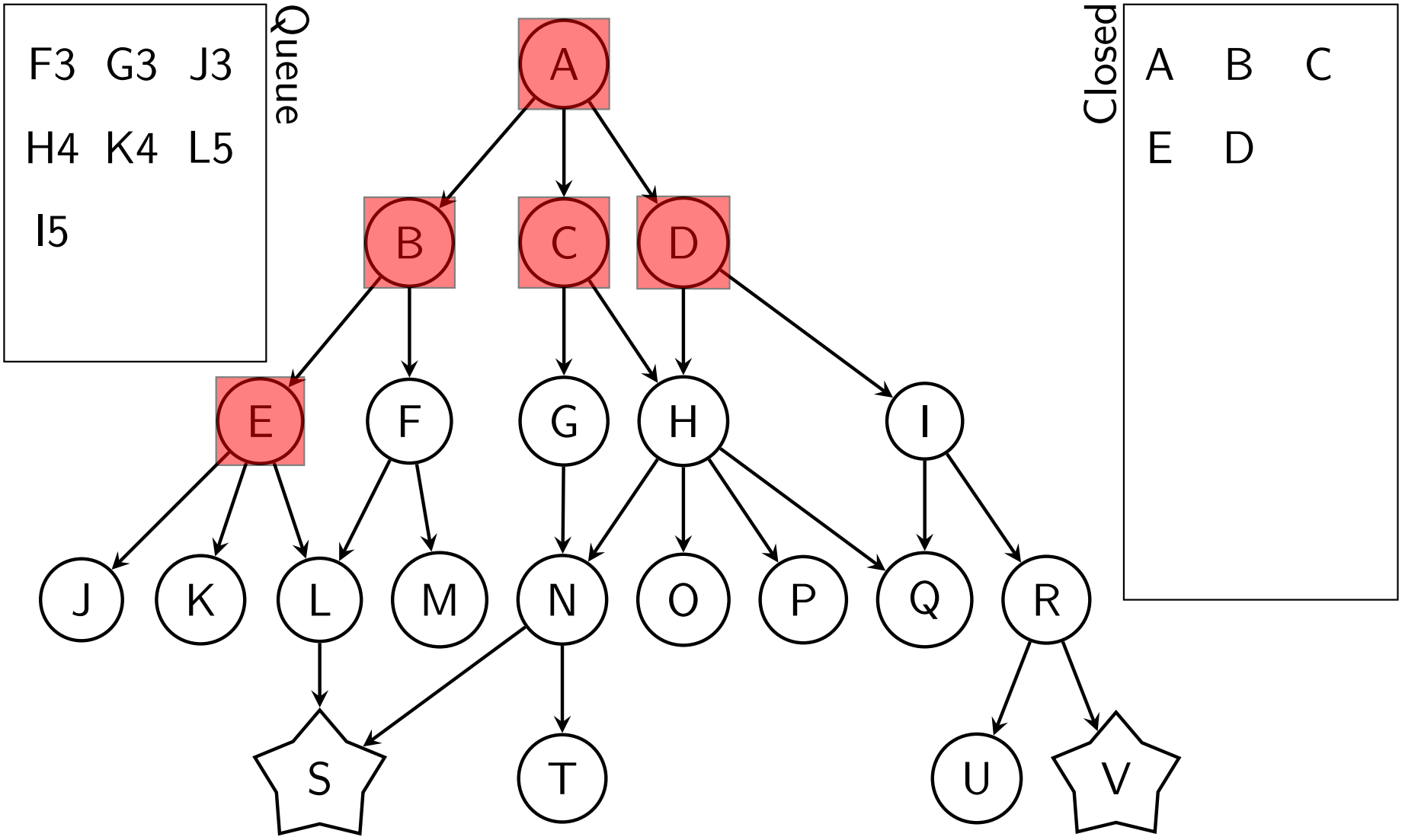

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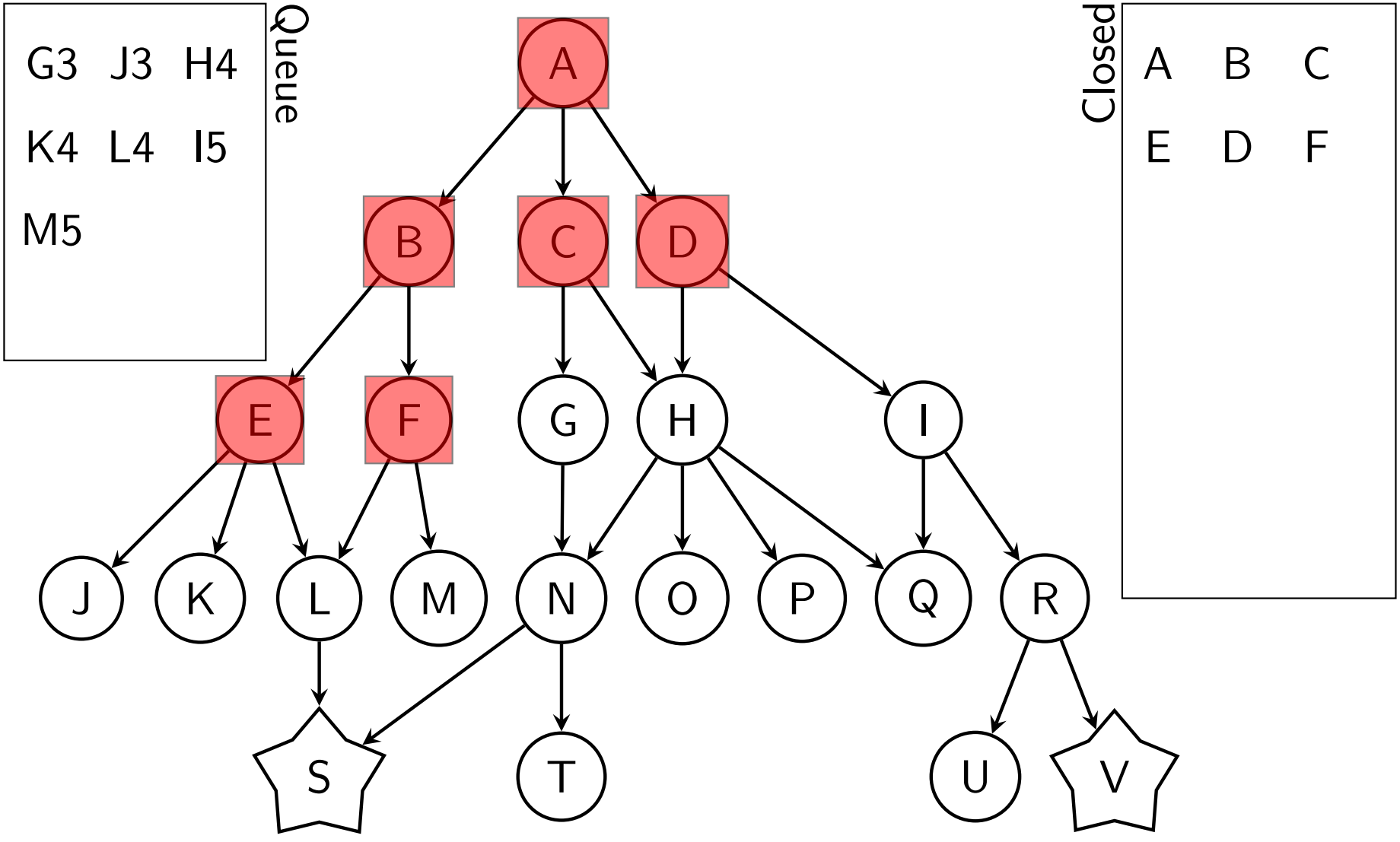

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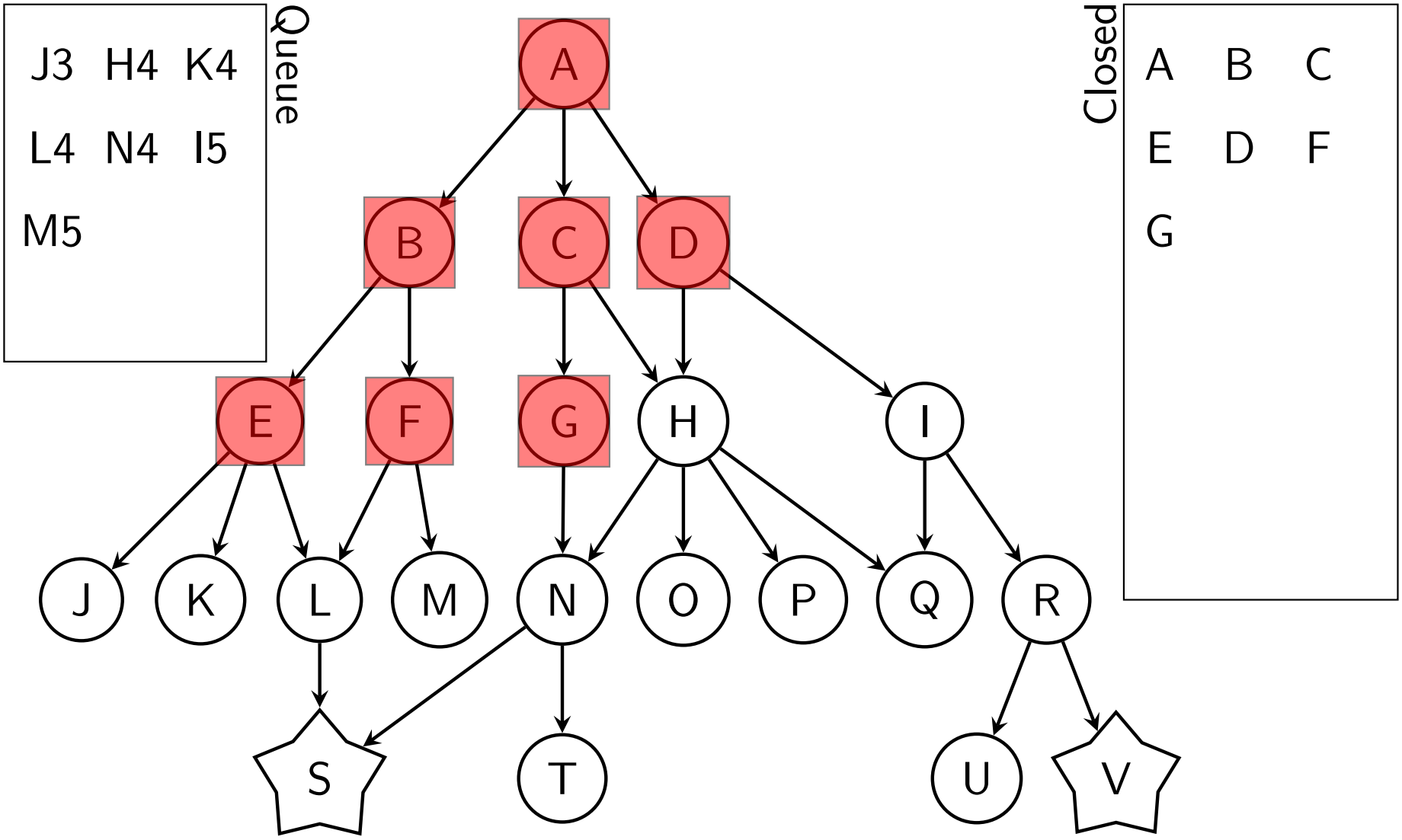

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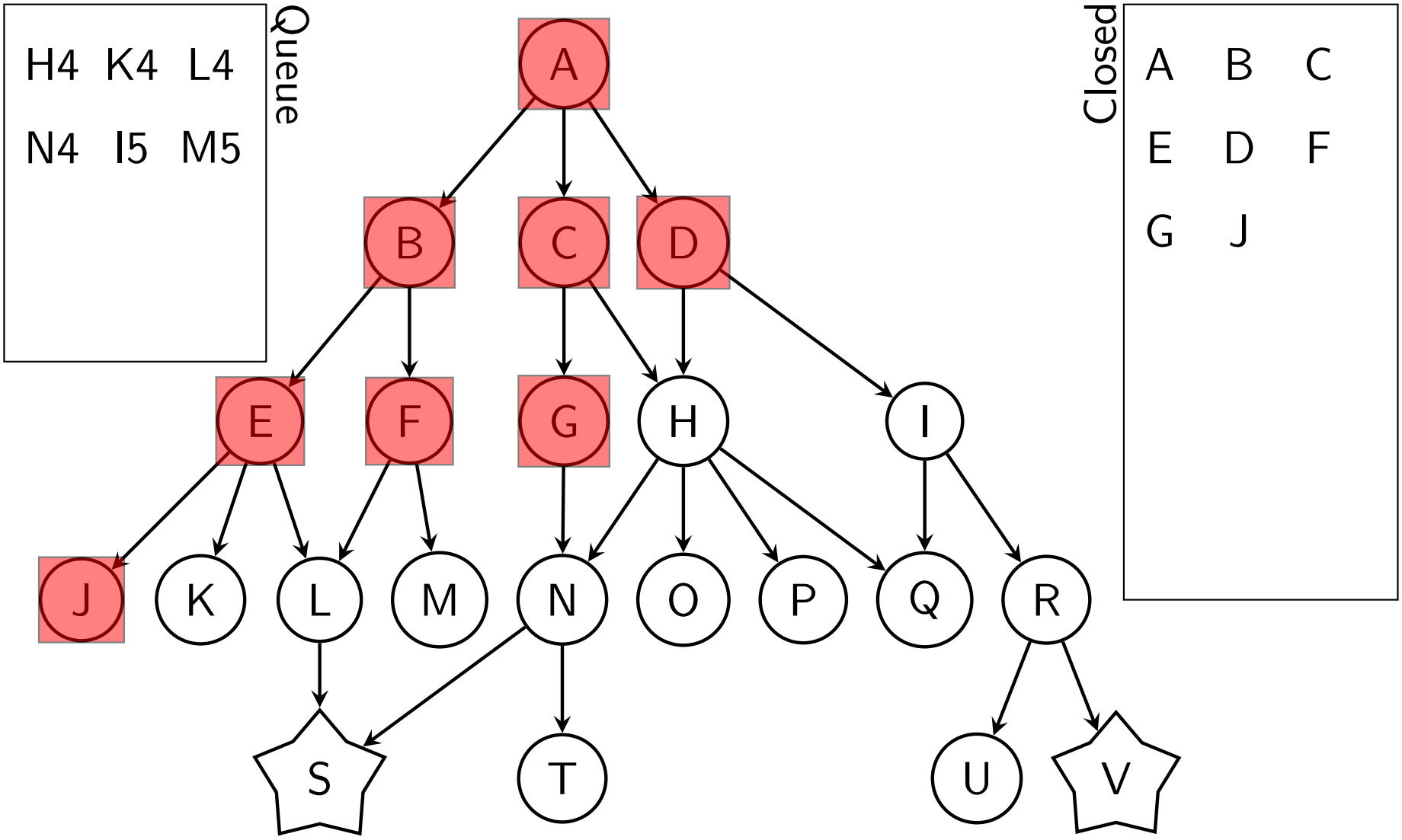

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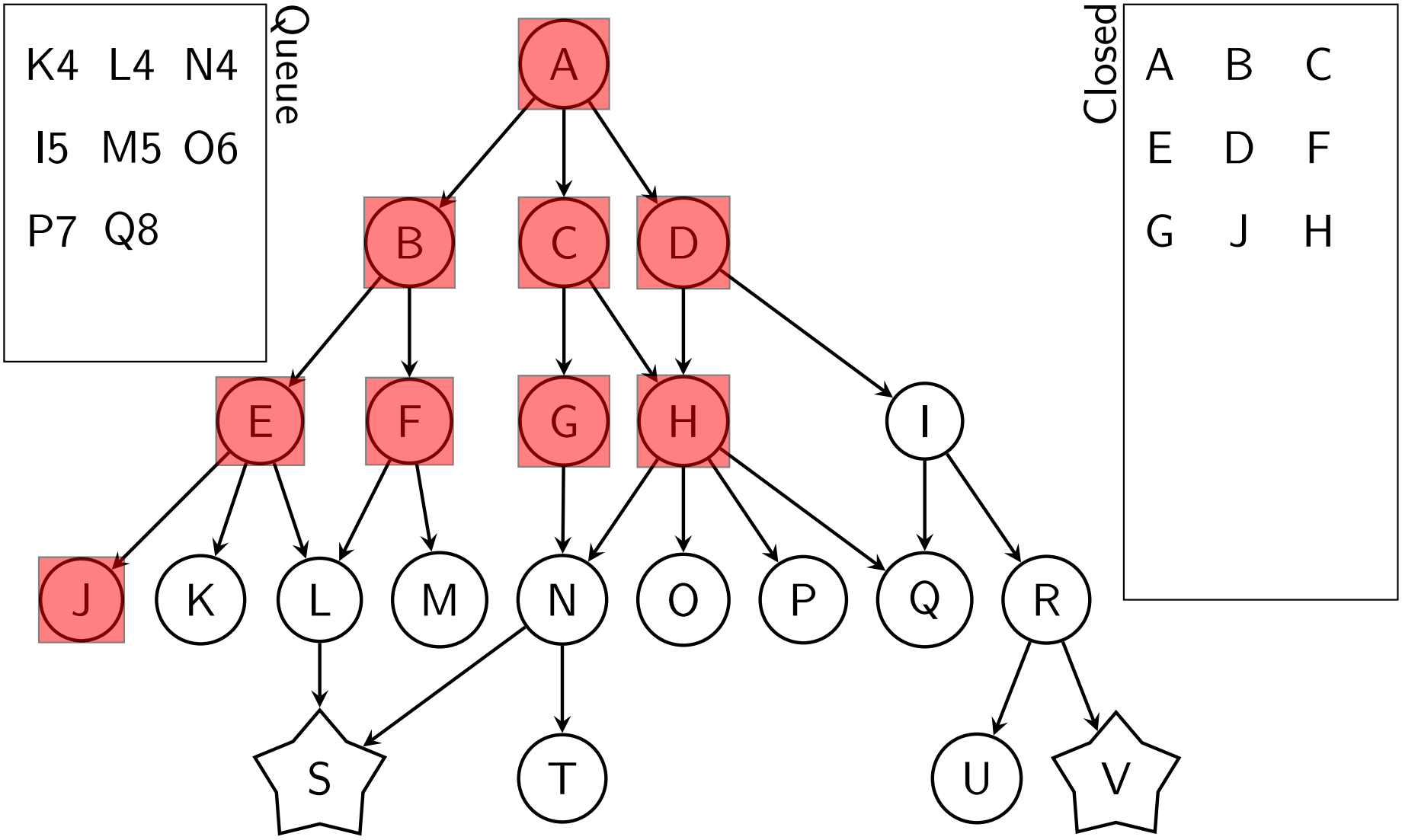

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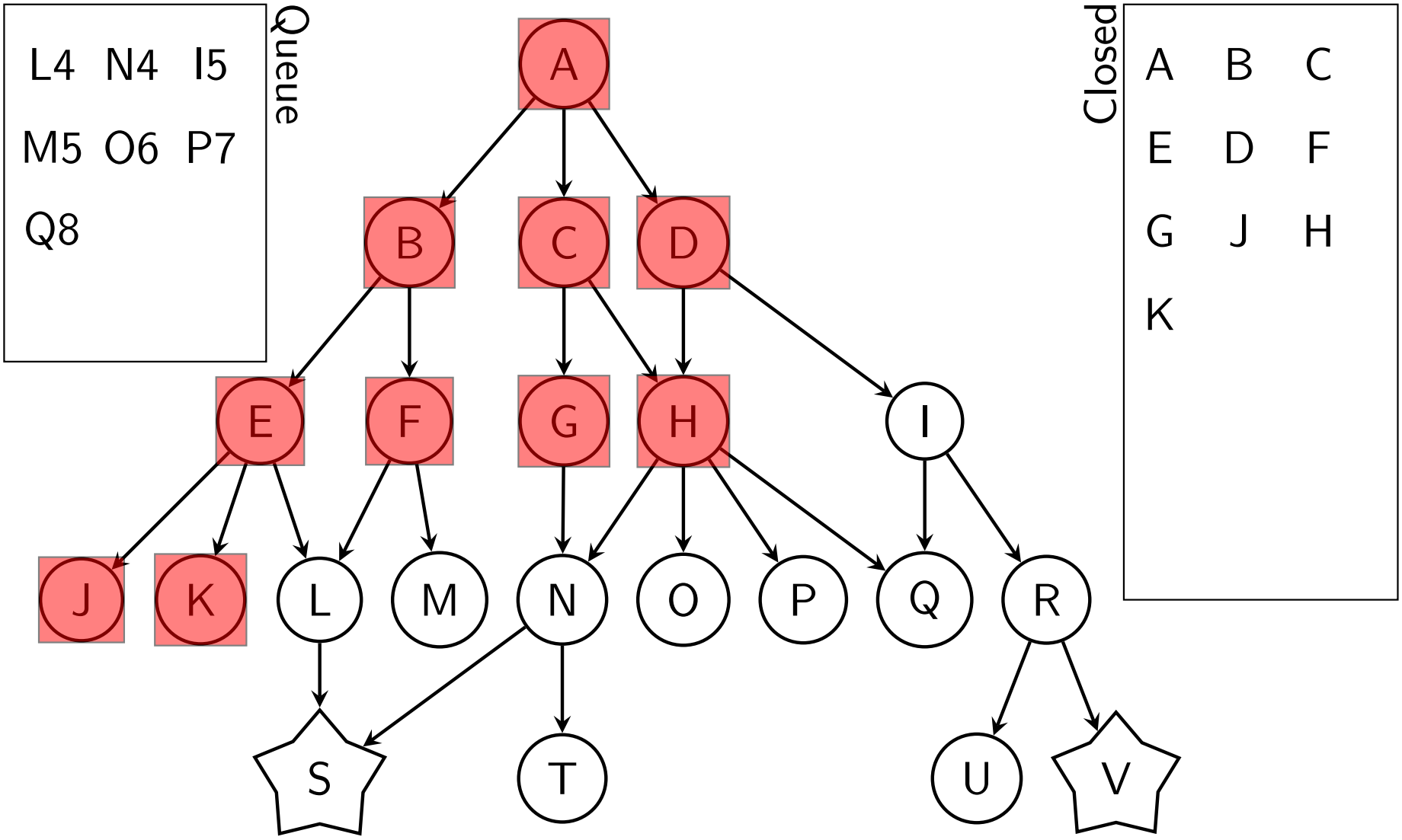

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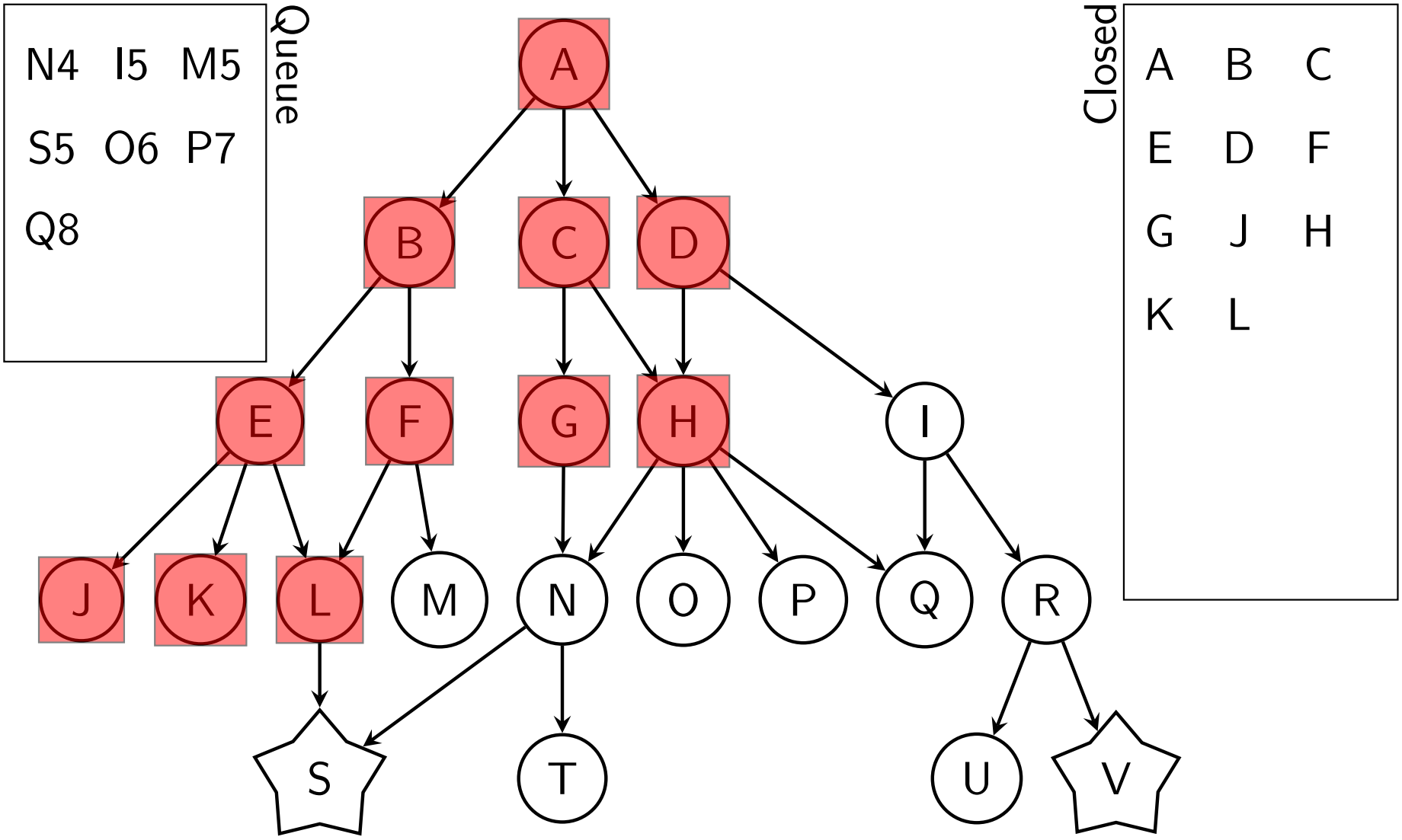

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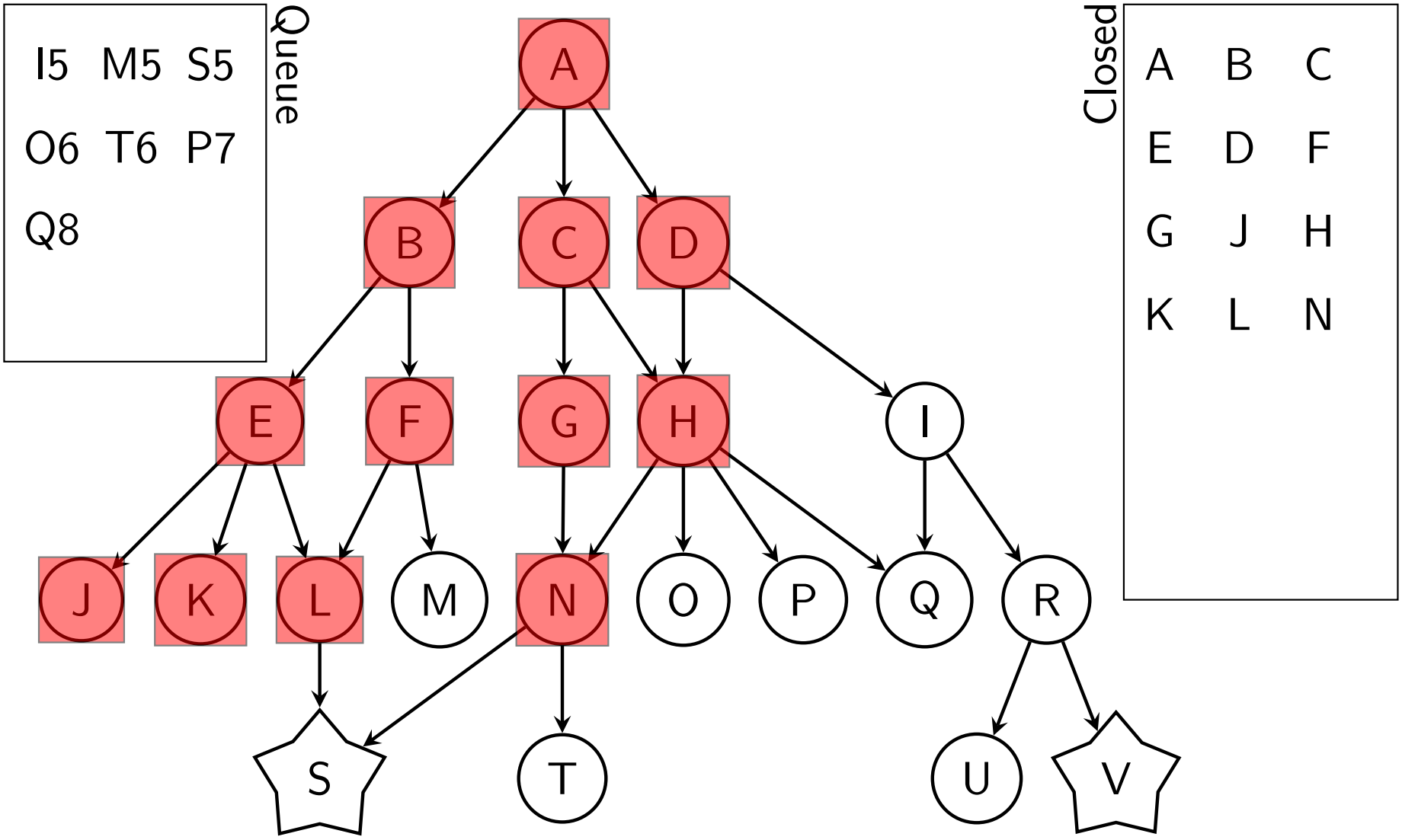

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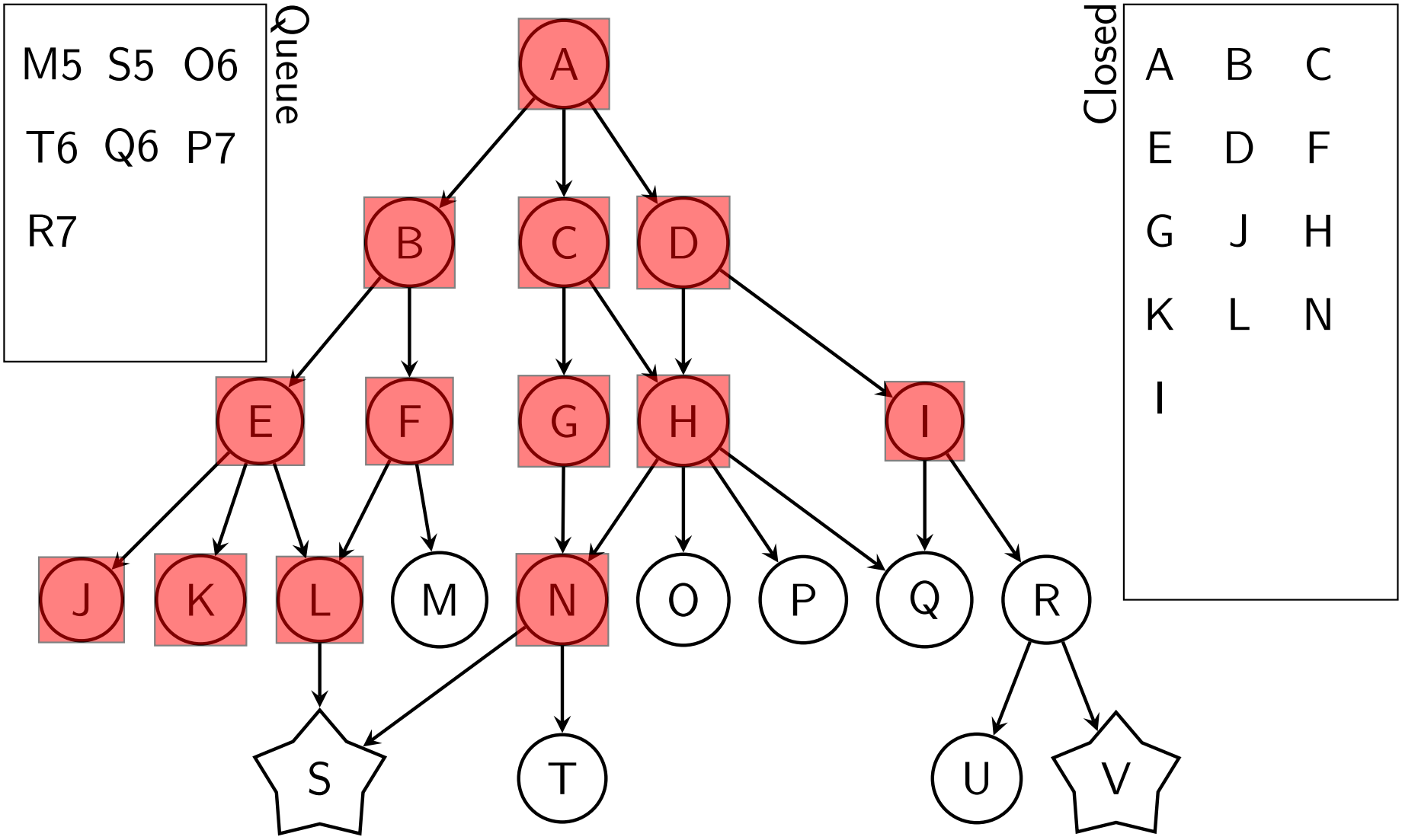

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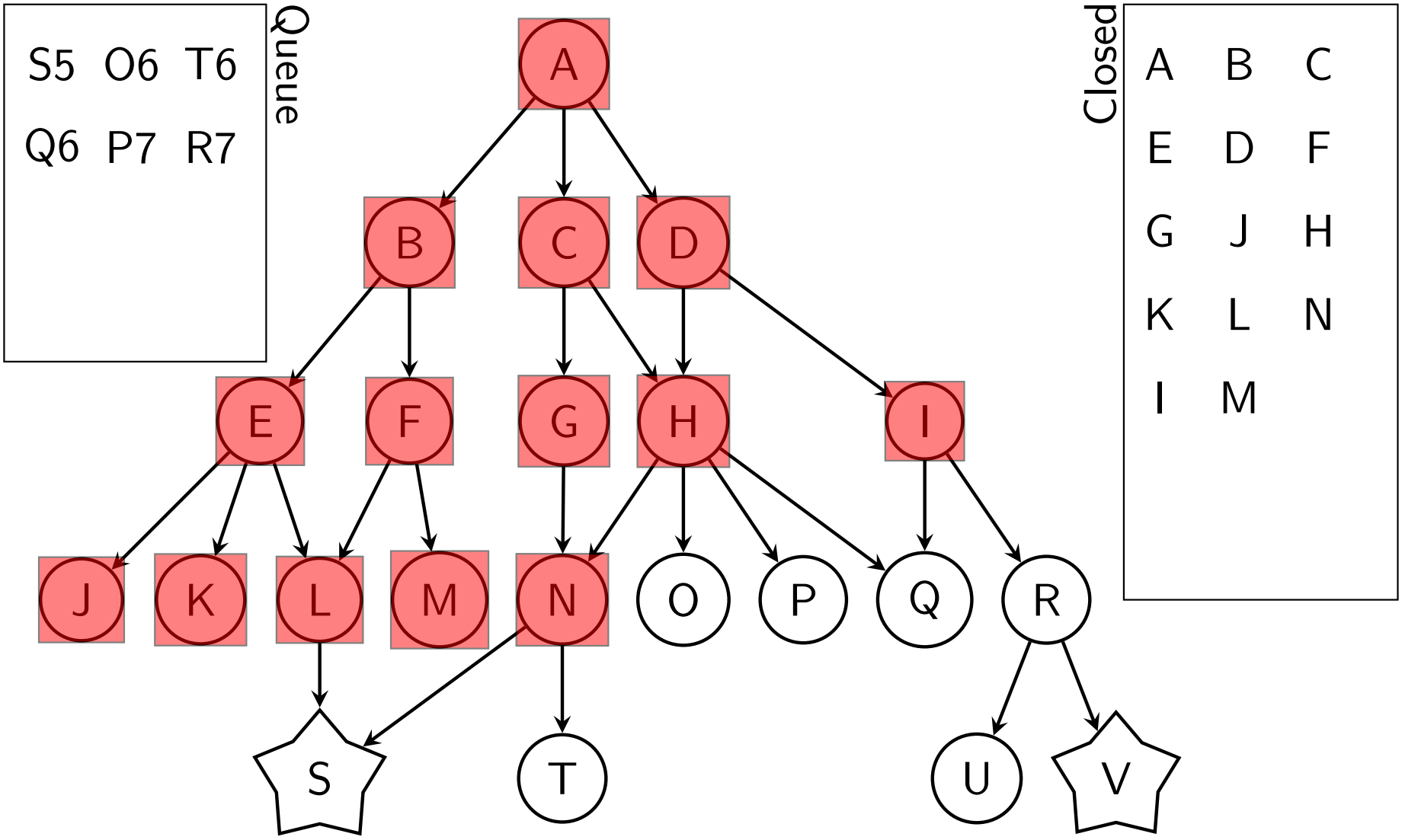

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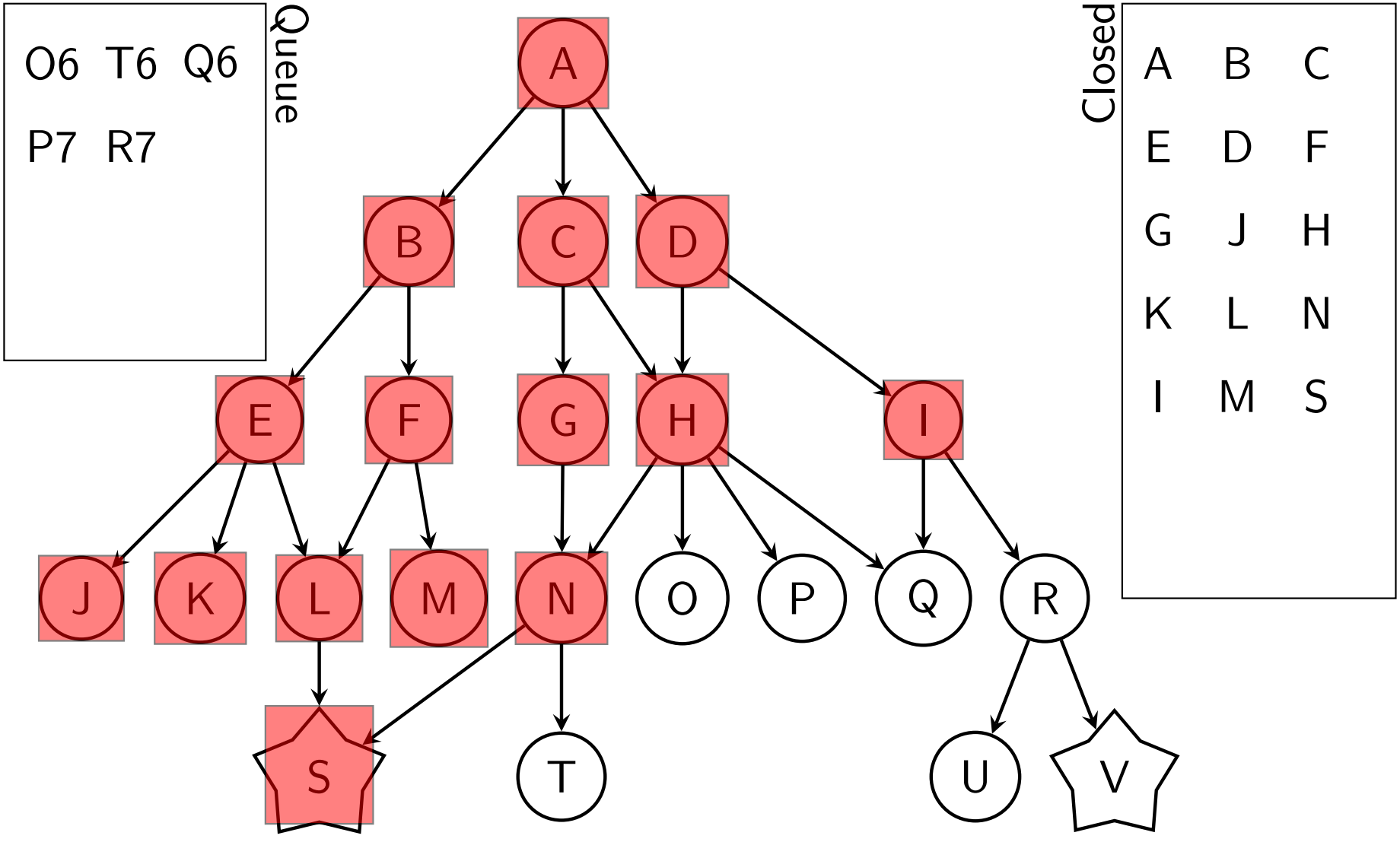

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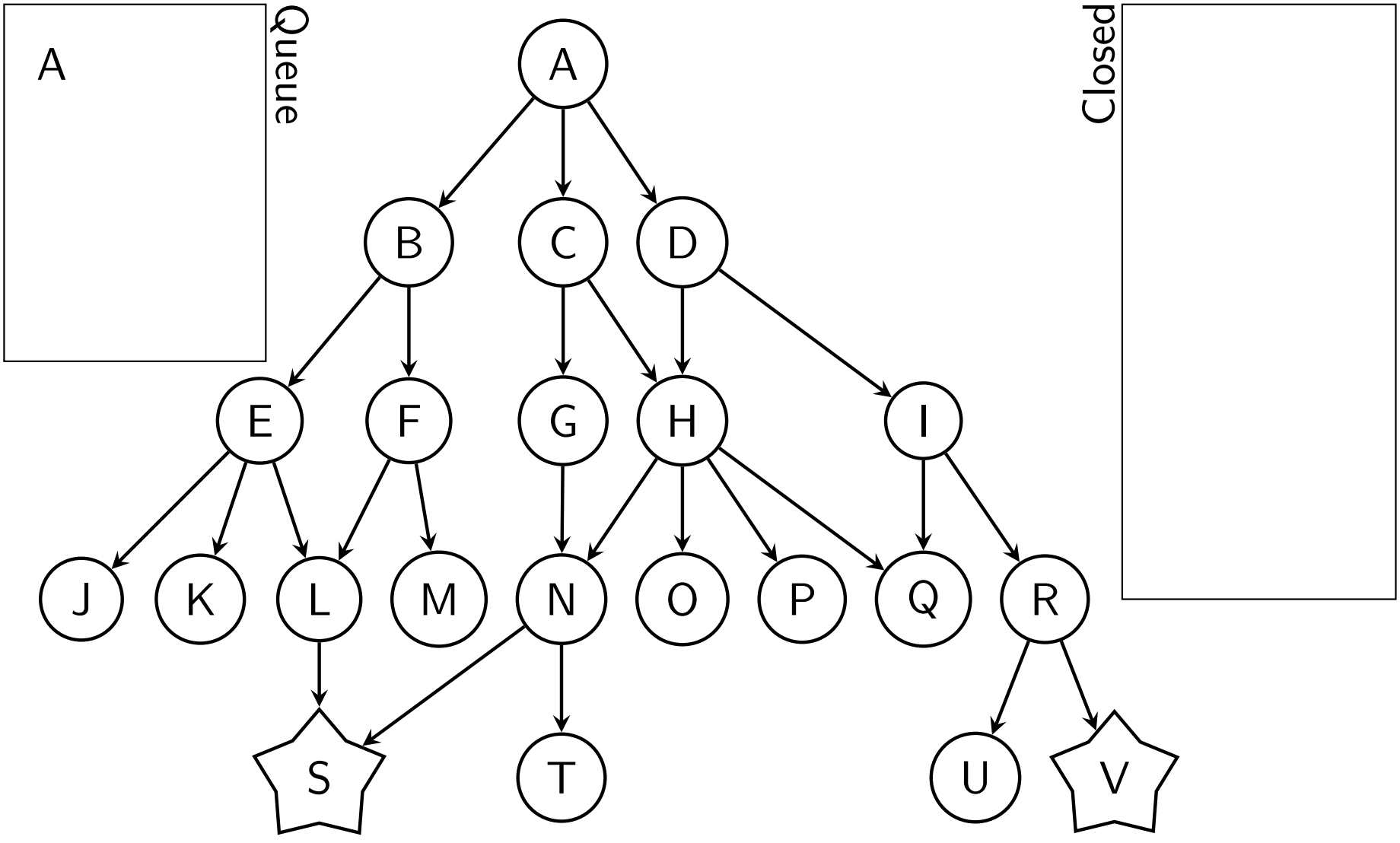

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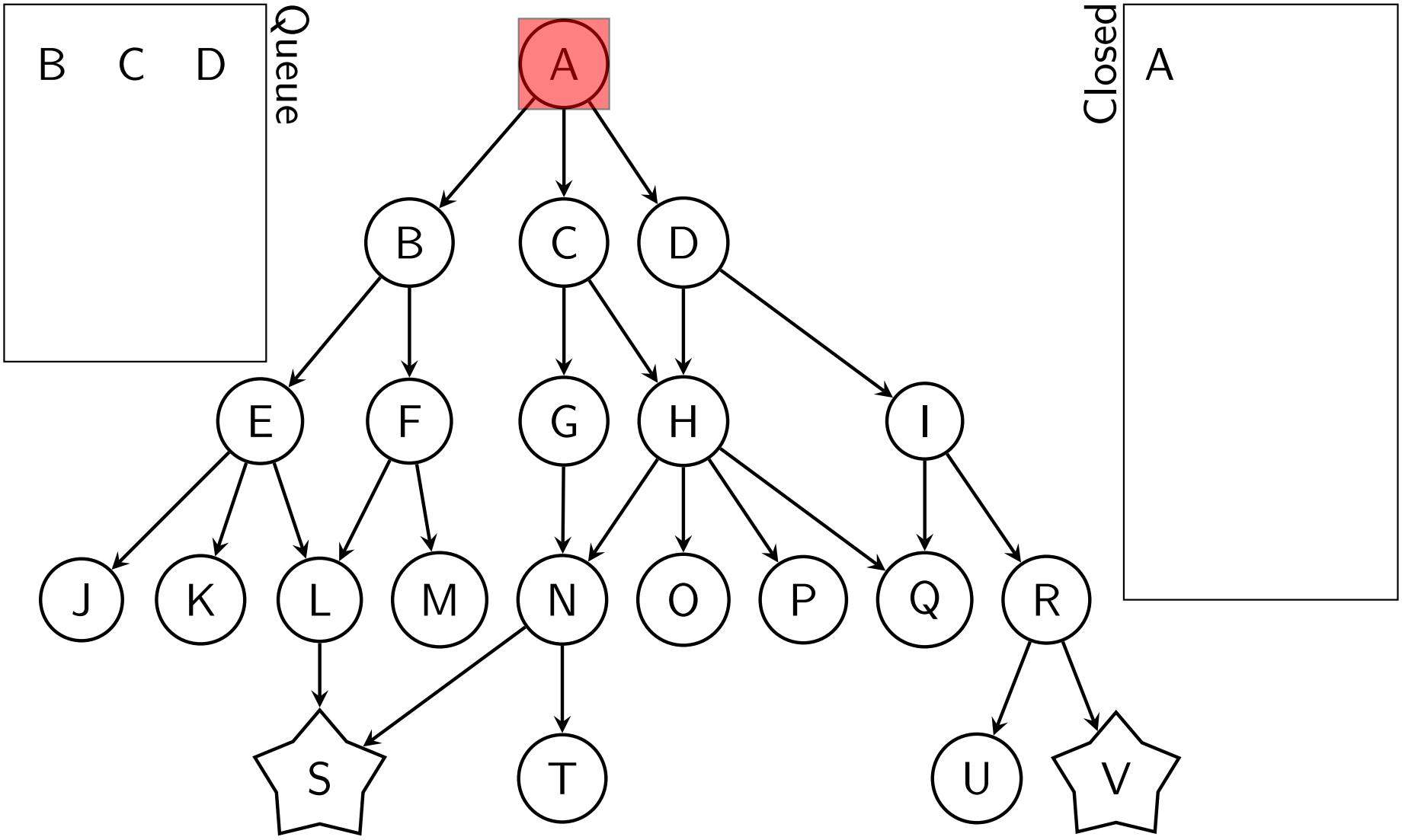

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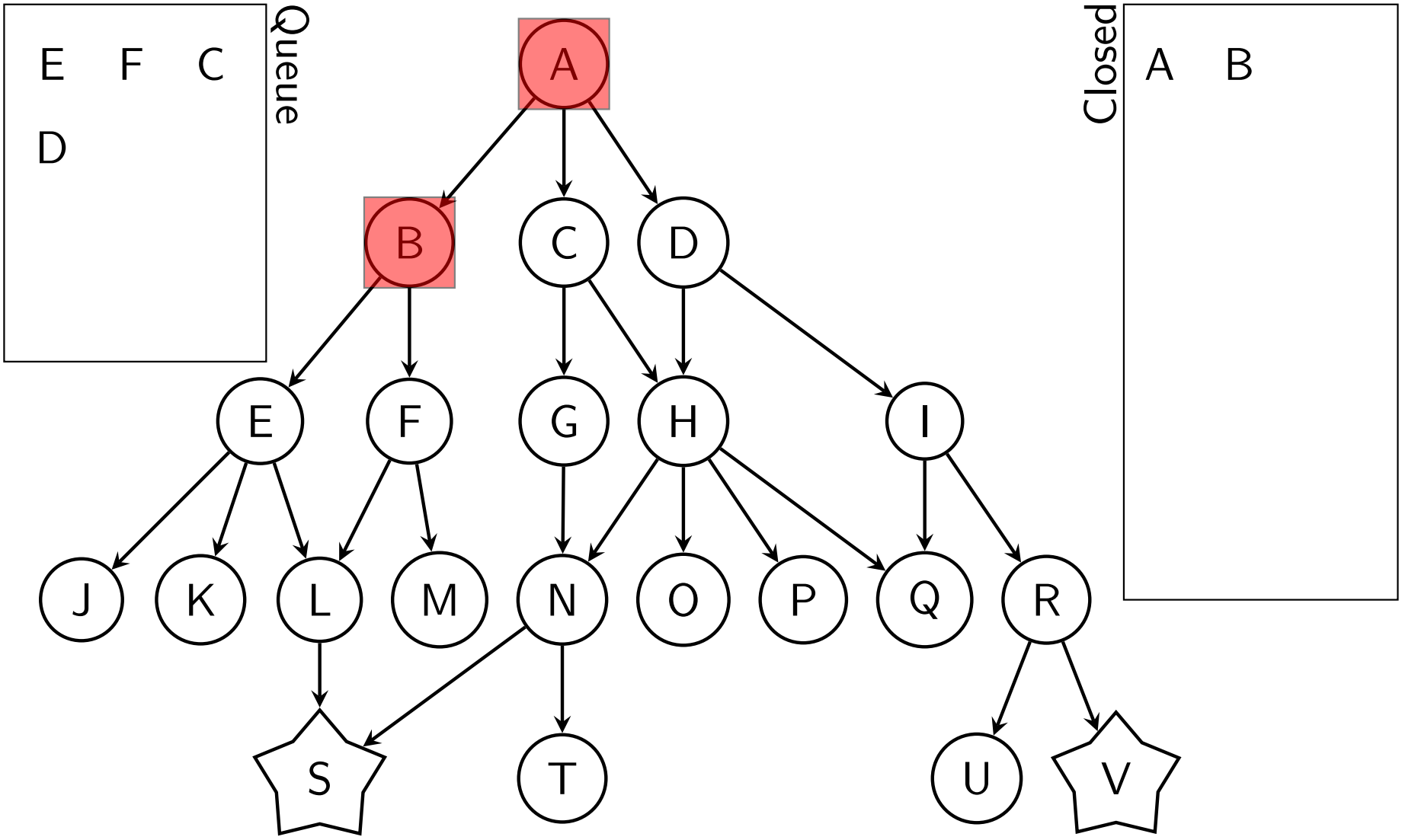

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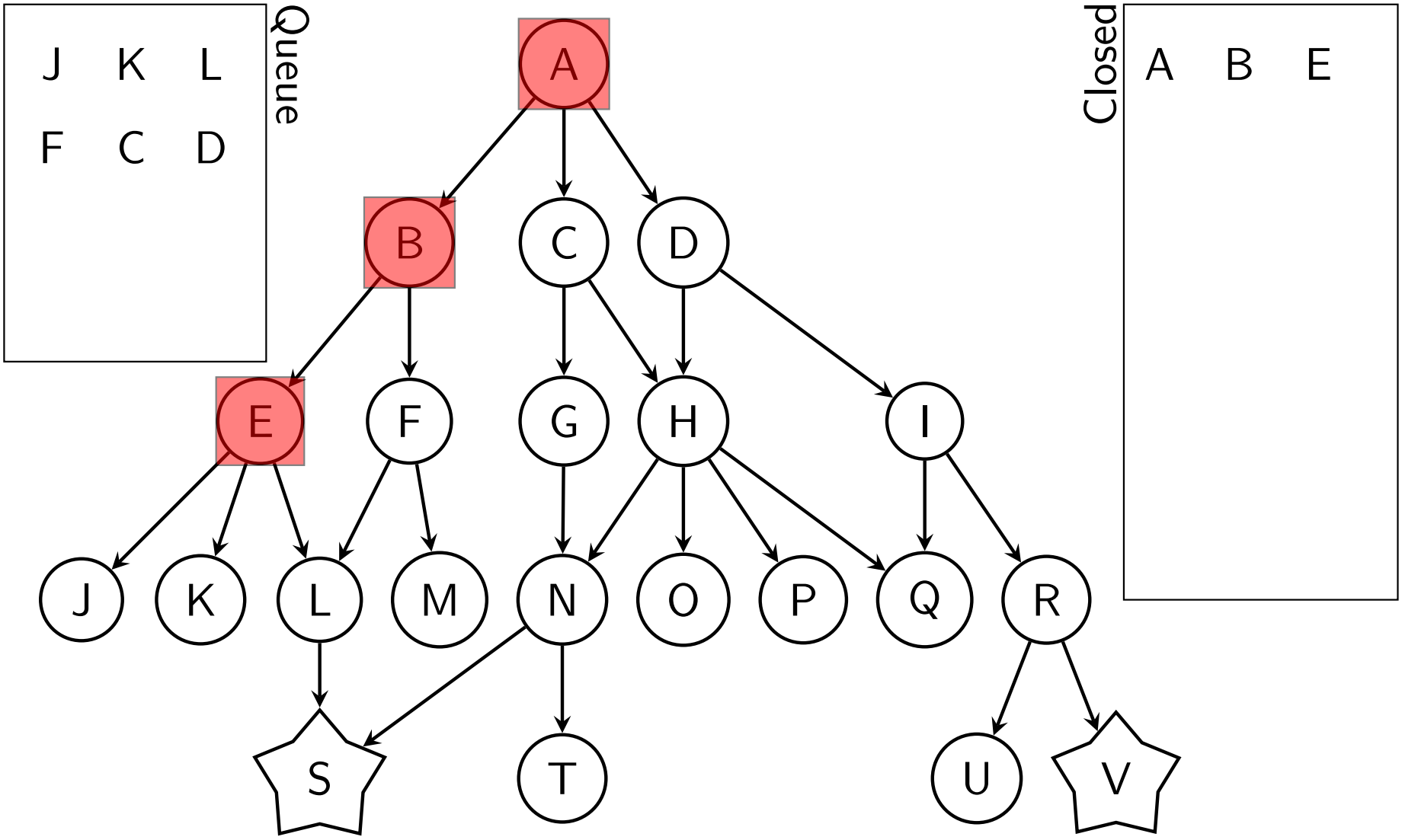

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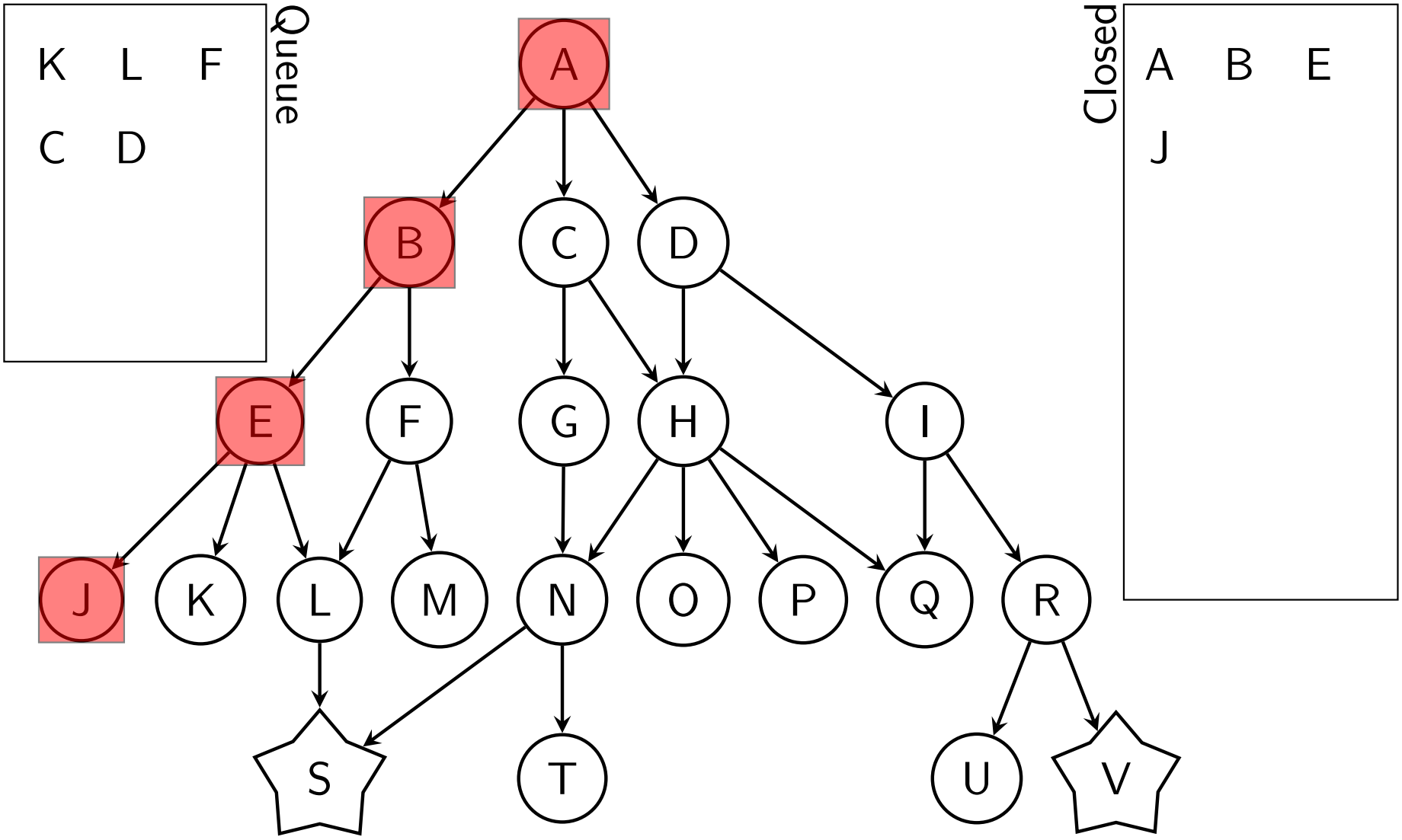

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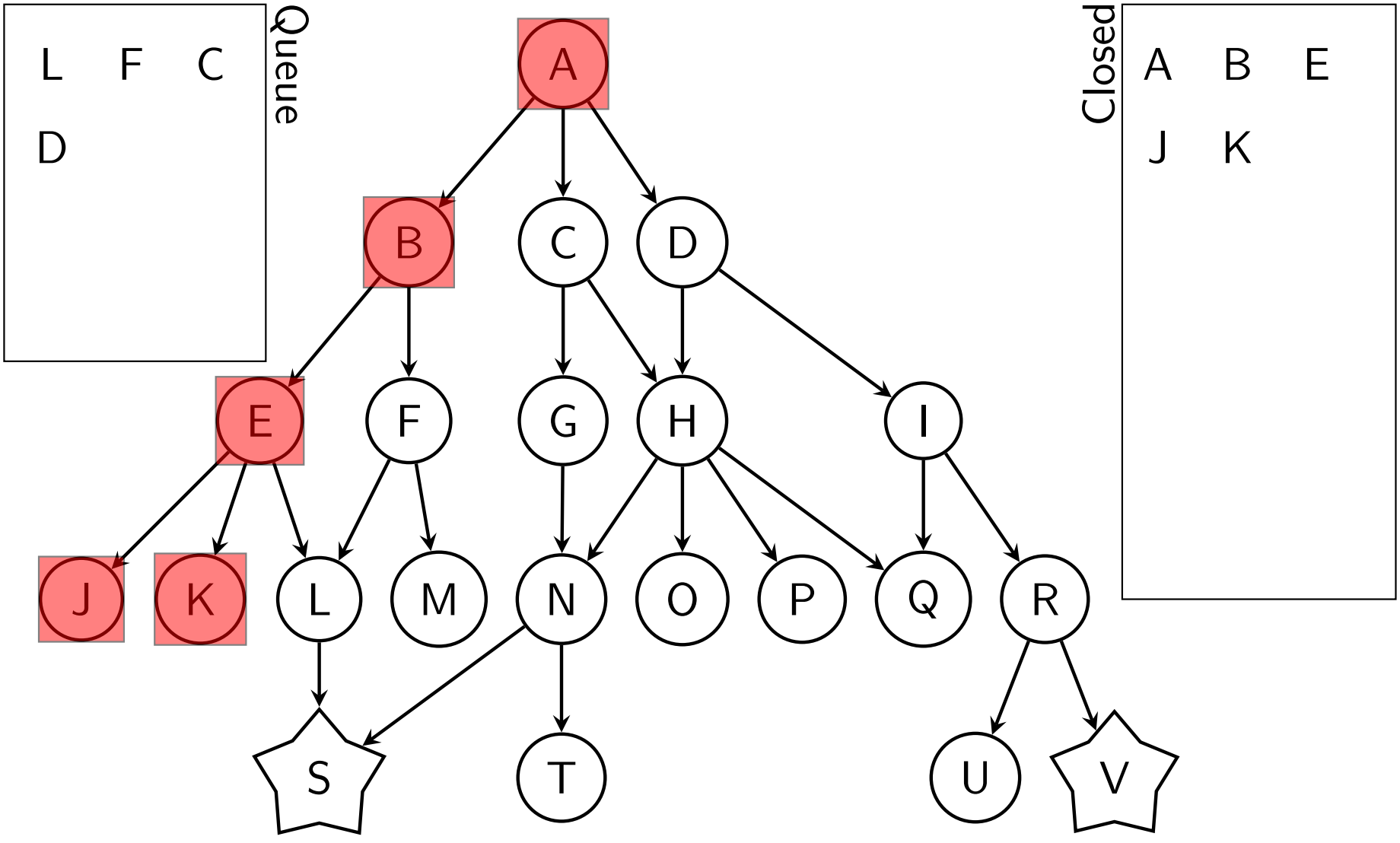

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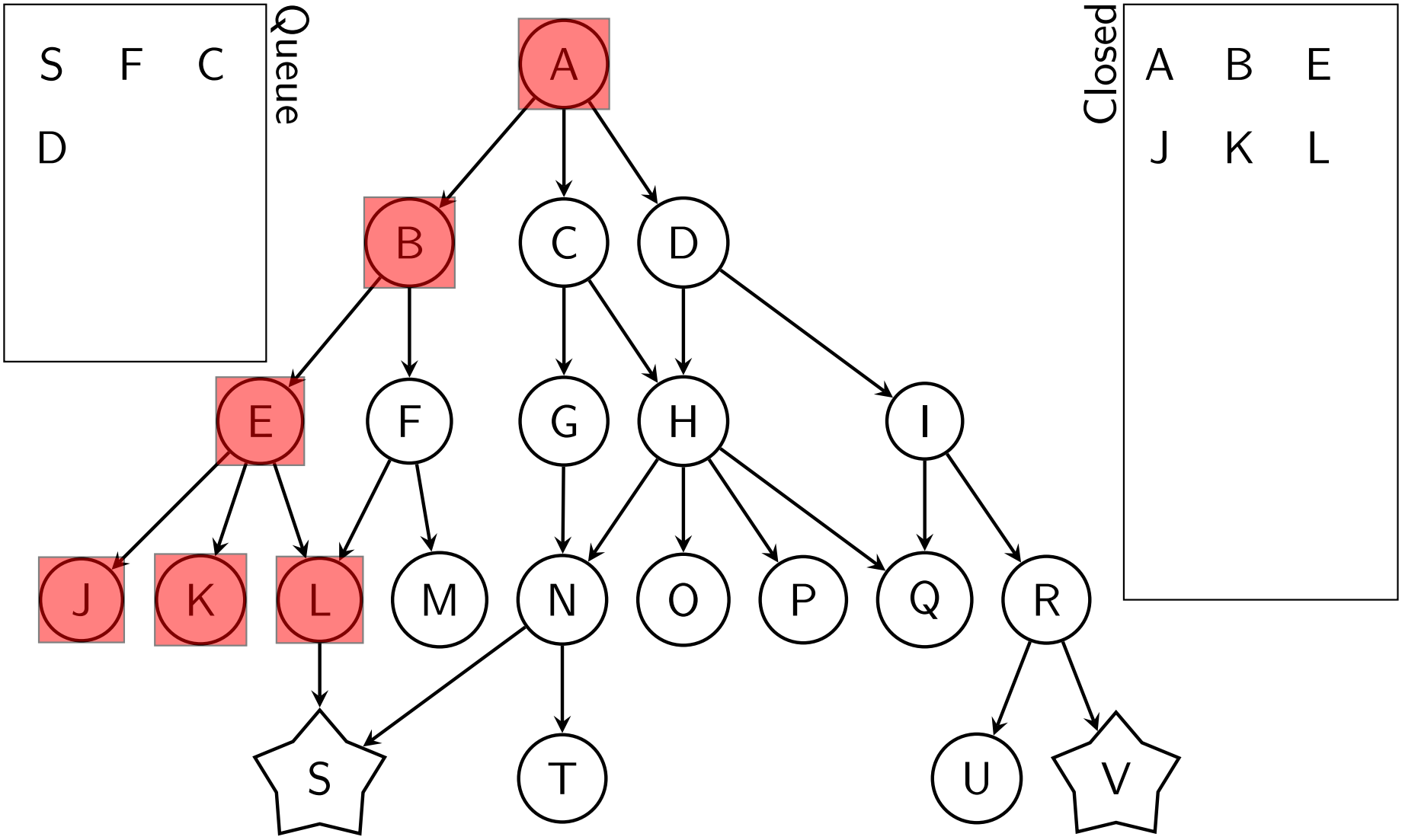

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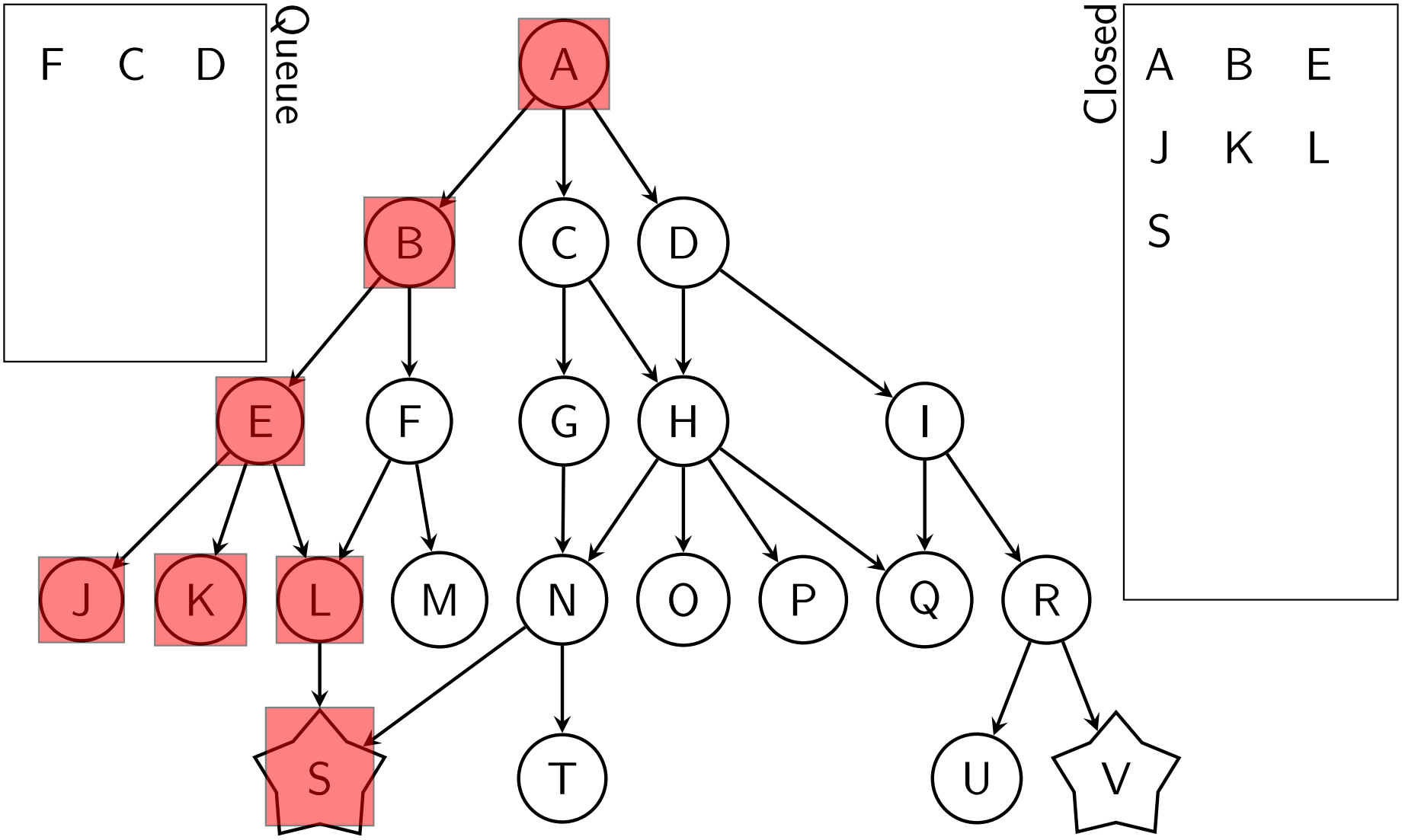

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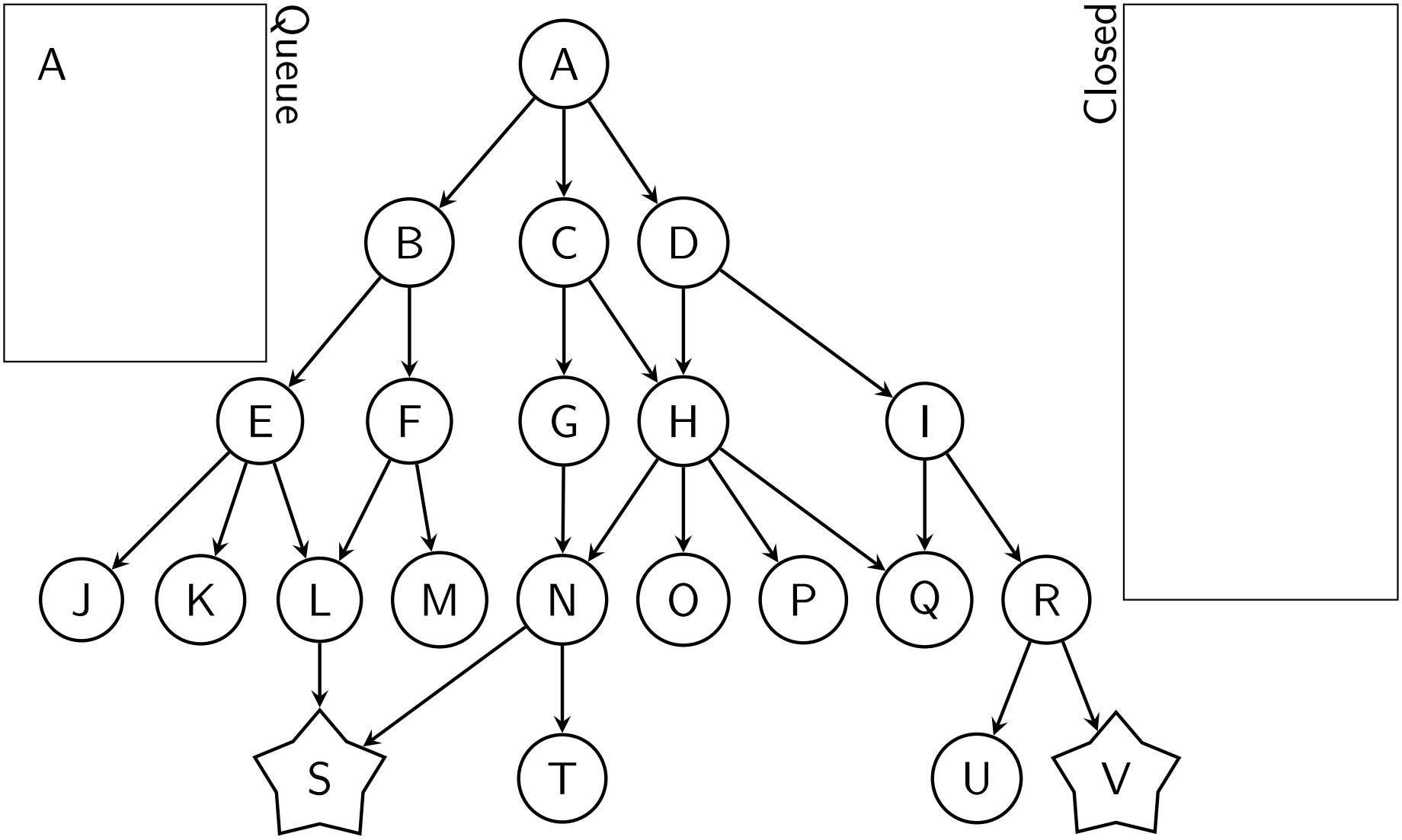
Iterative Depth-First-Search



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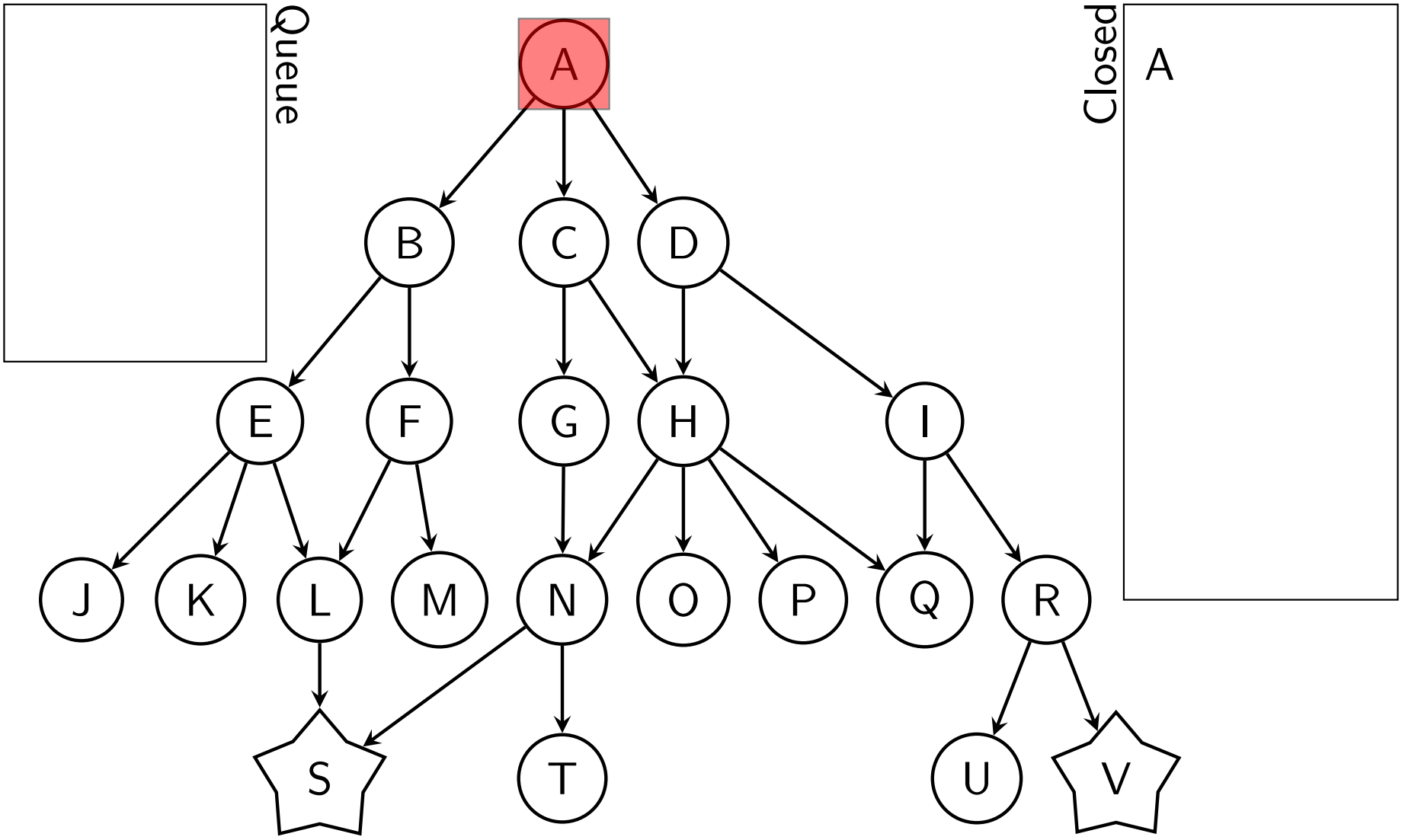

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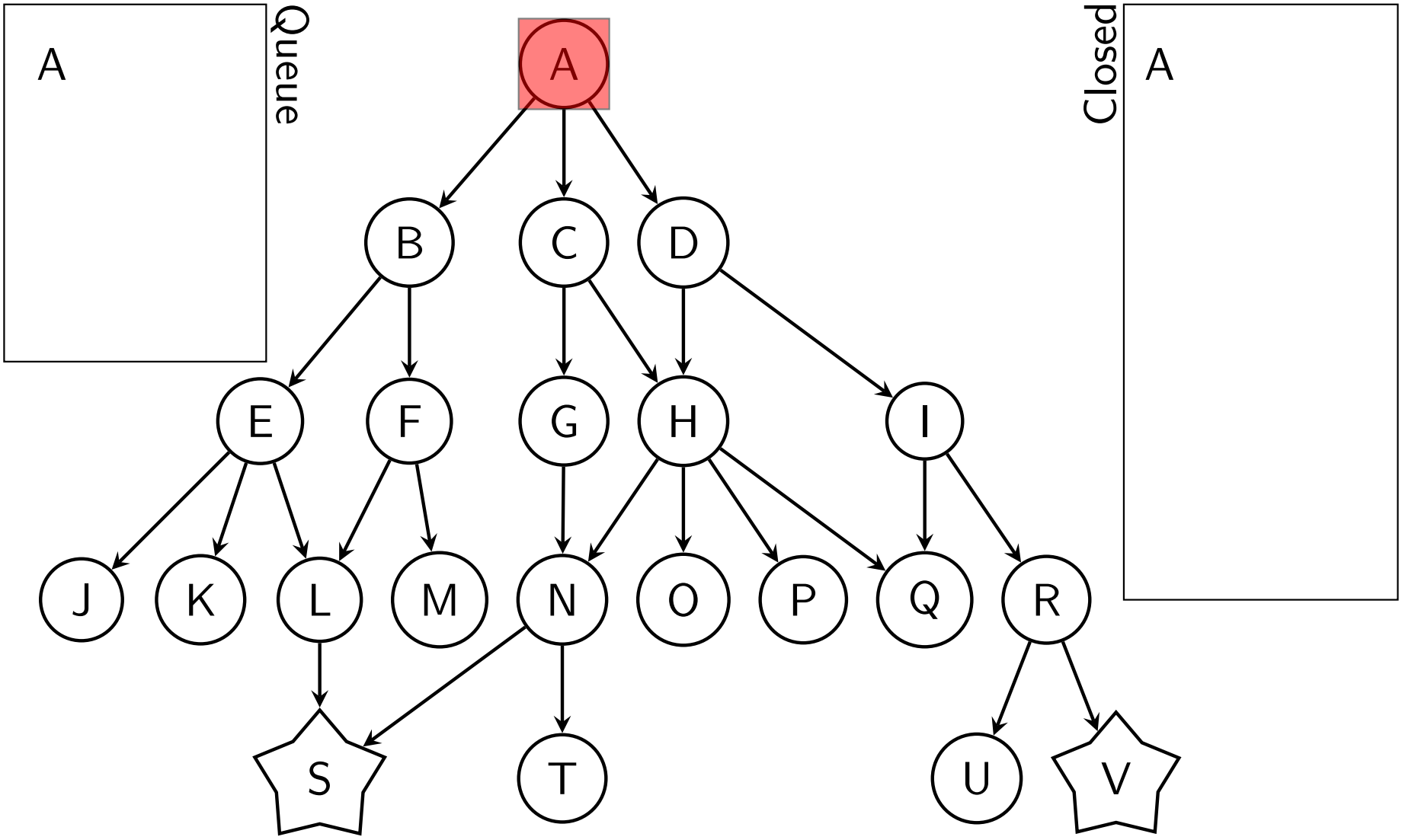

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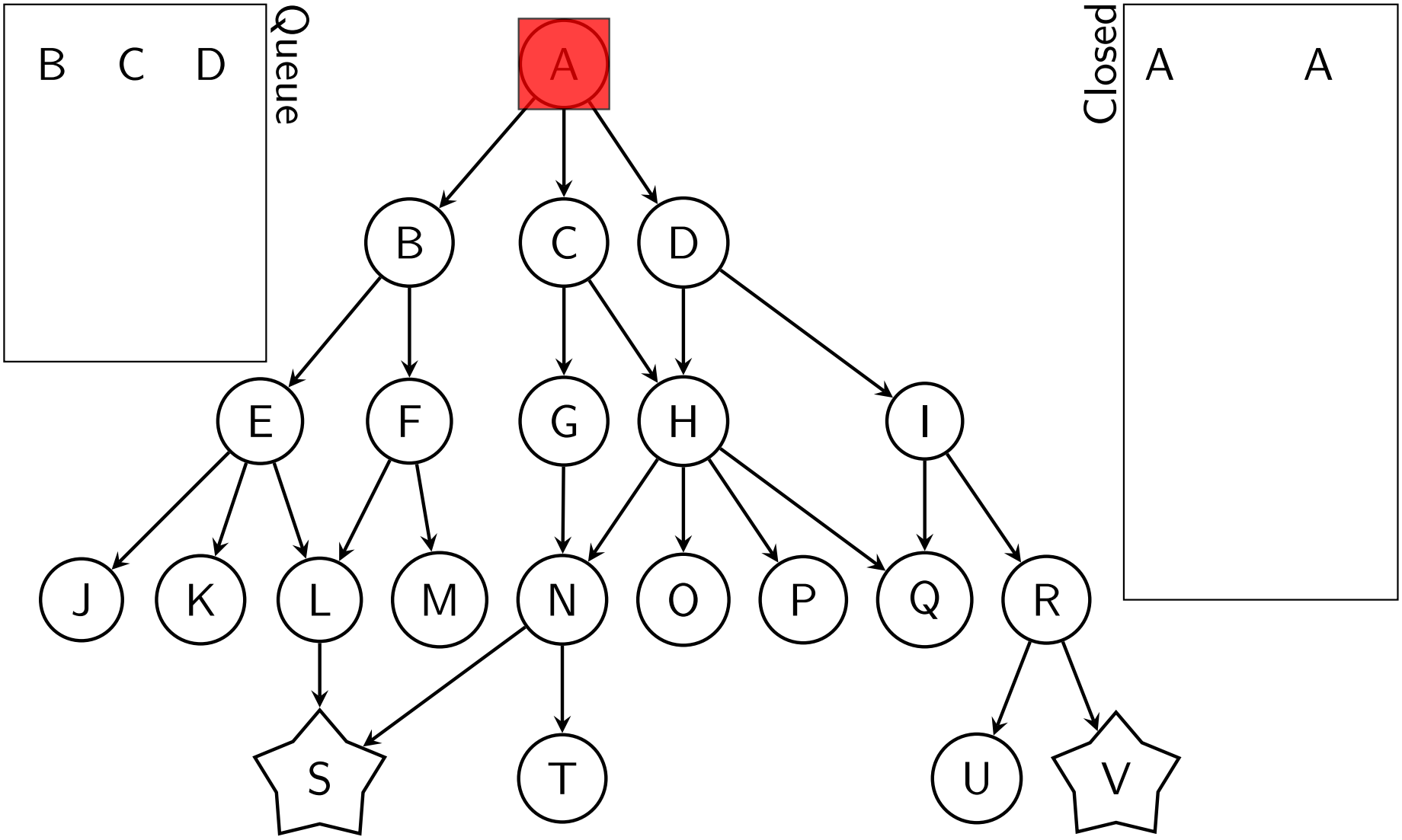

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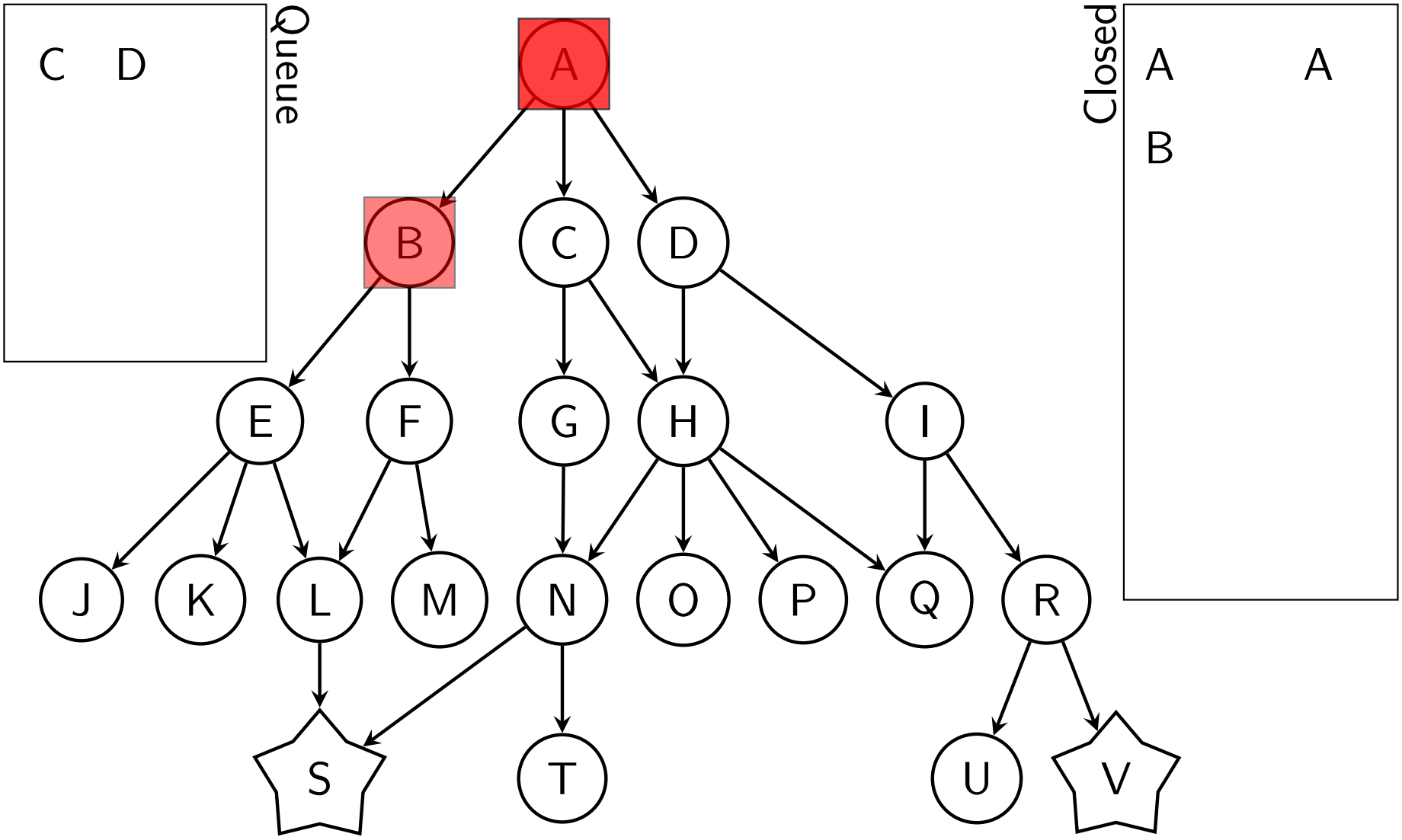
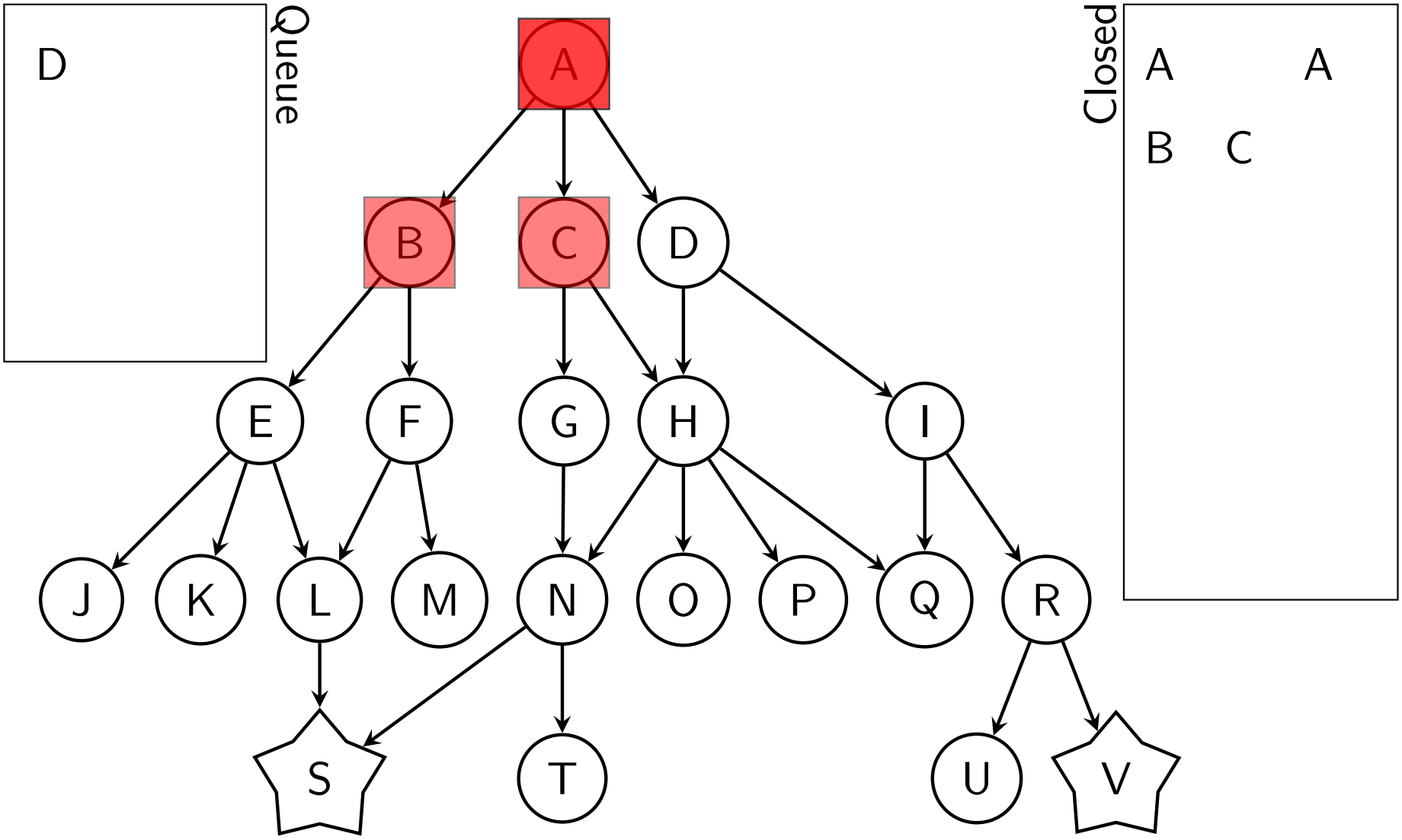


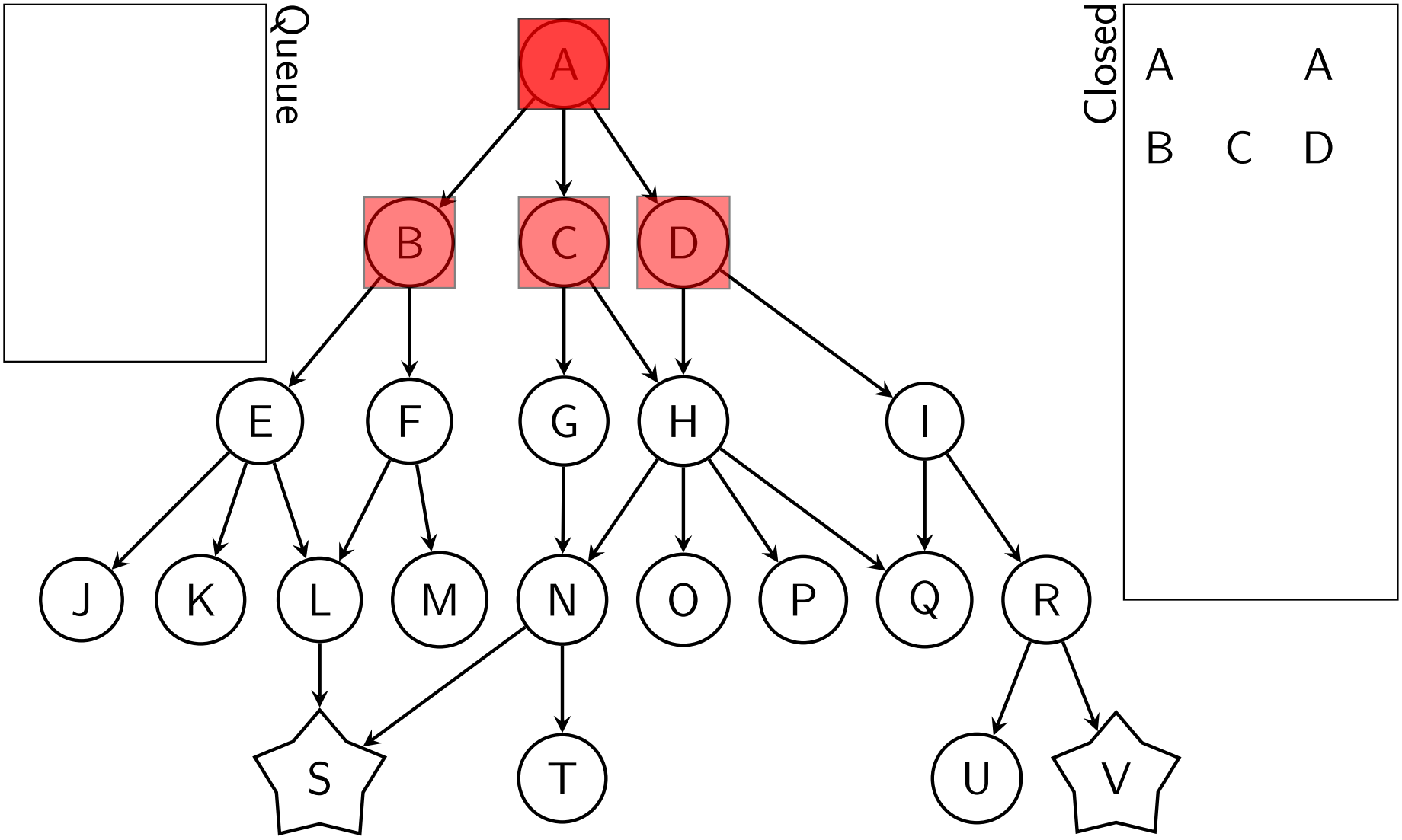
Task 4.4

Iterative Depth-First-Search



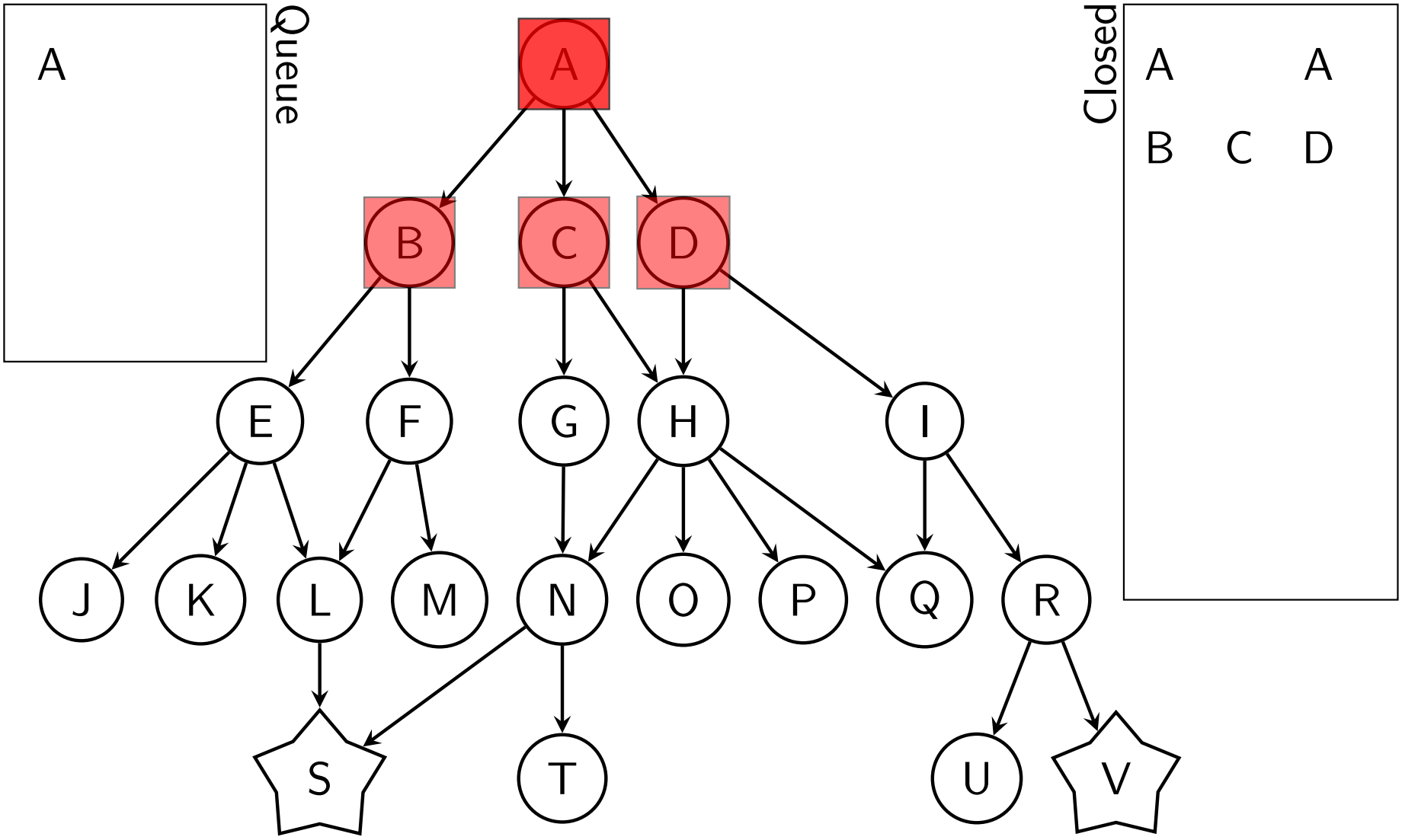
Task 4.4

Iterative Depth-First-Search



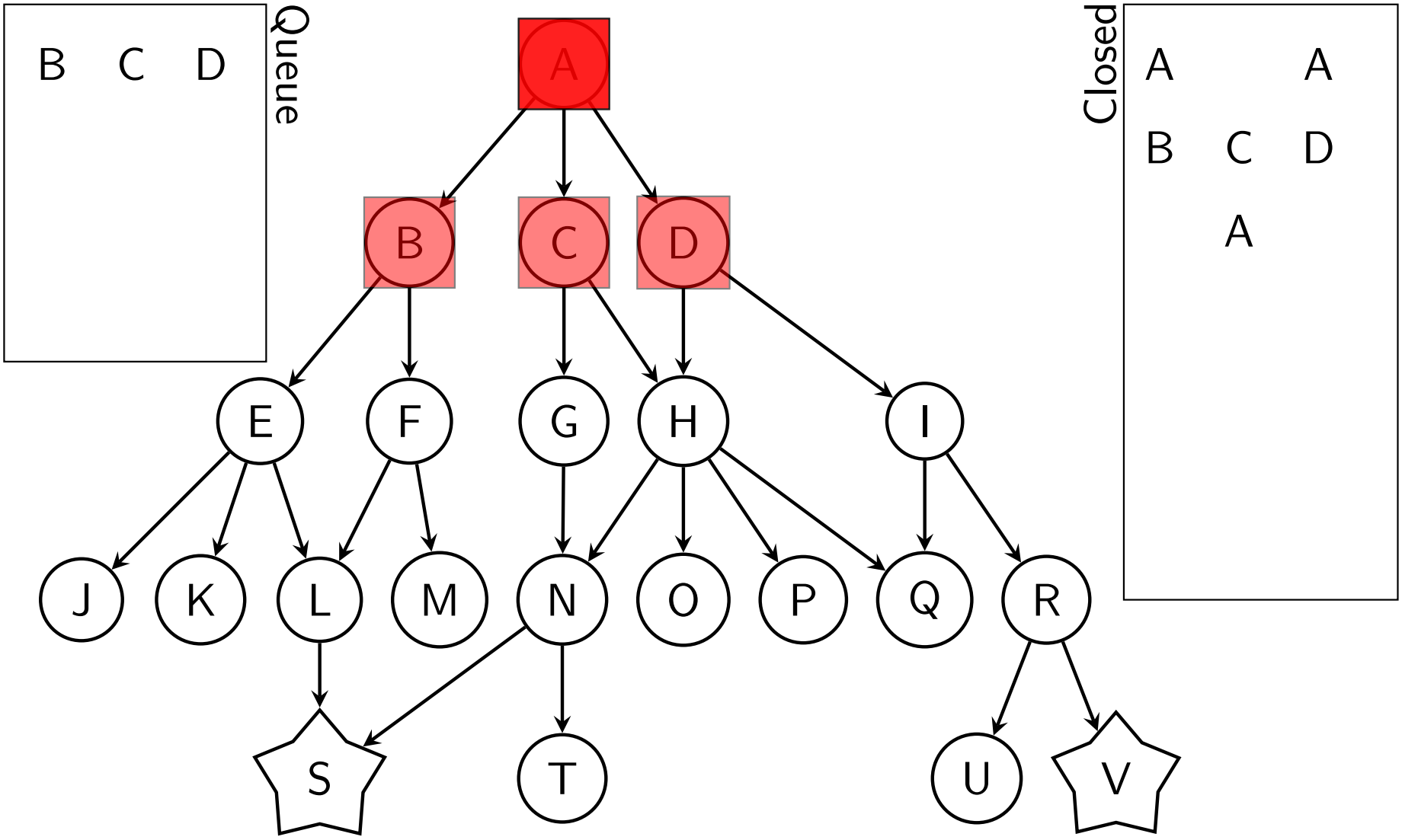
Task 4.4

Iterative Depth-First-Search



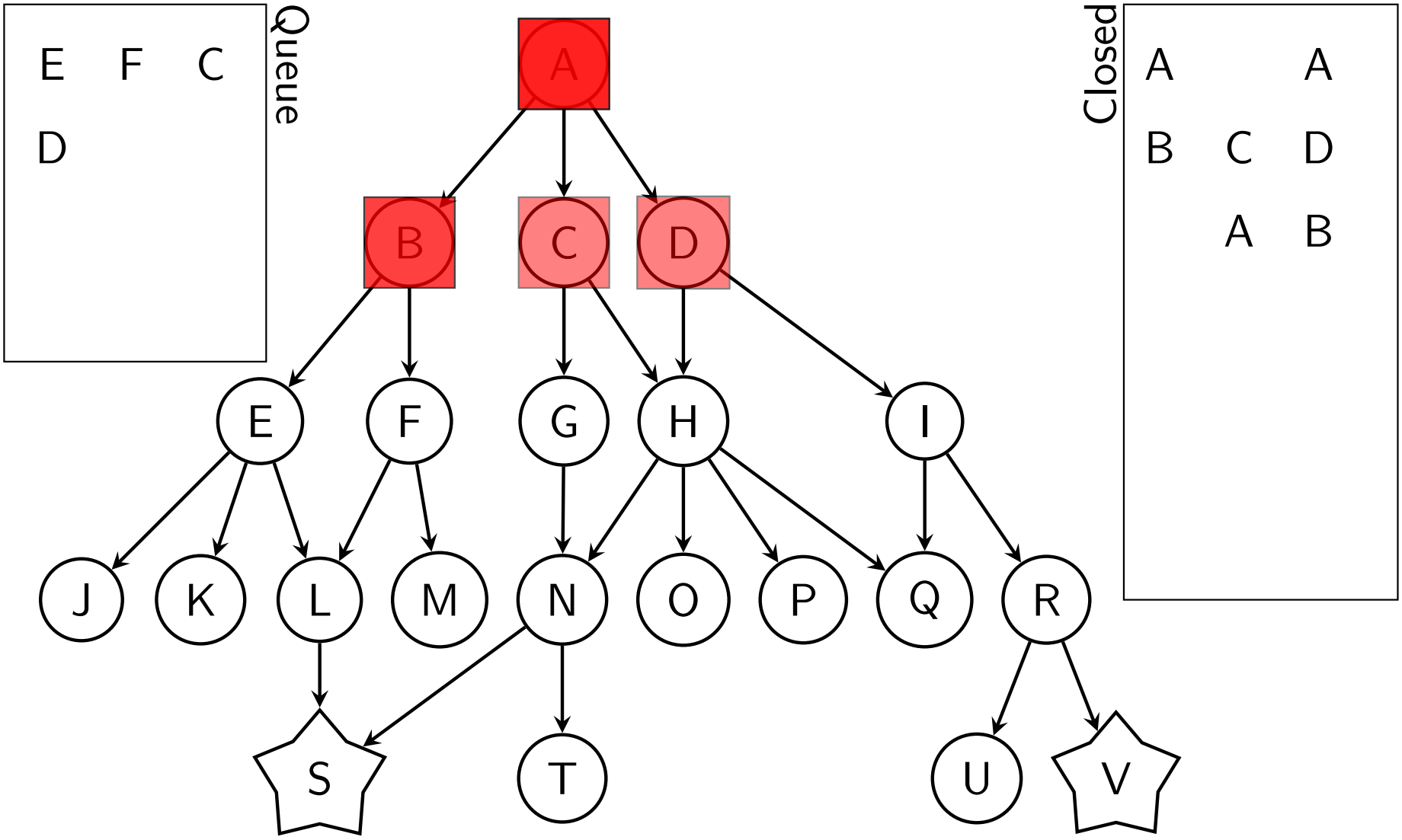
Task 4.4

Iterative Depth-First-Search



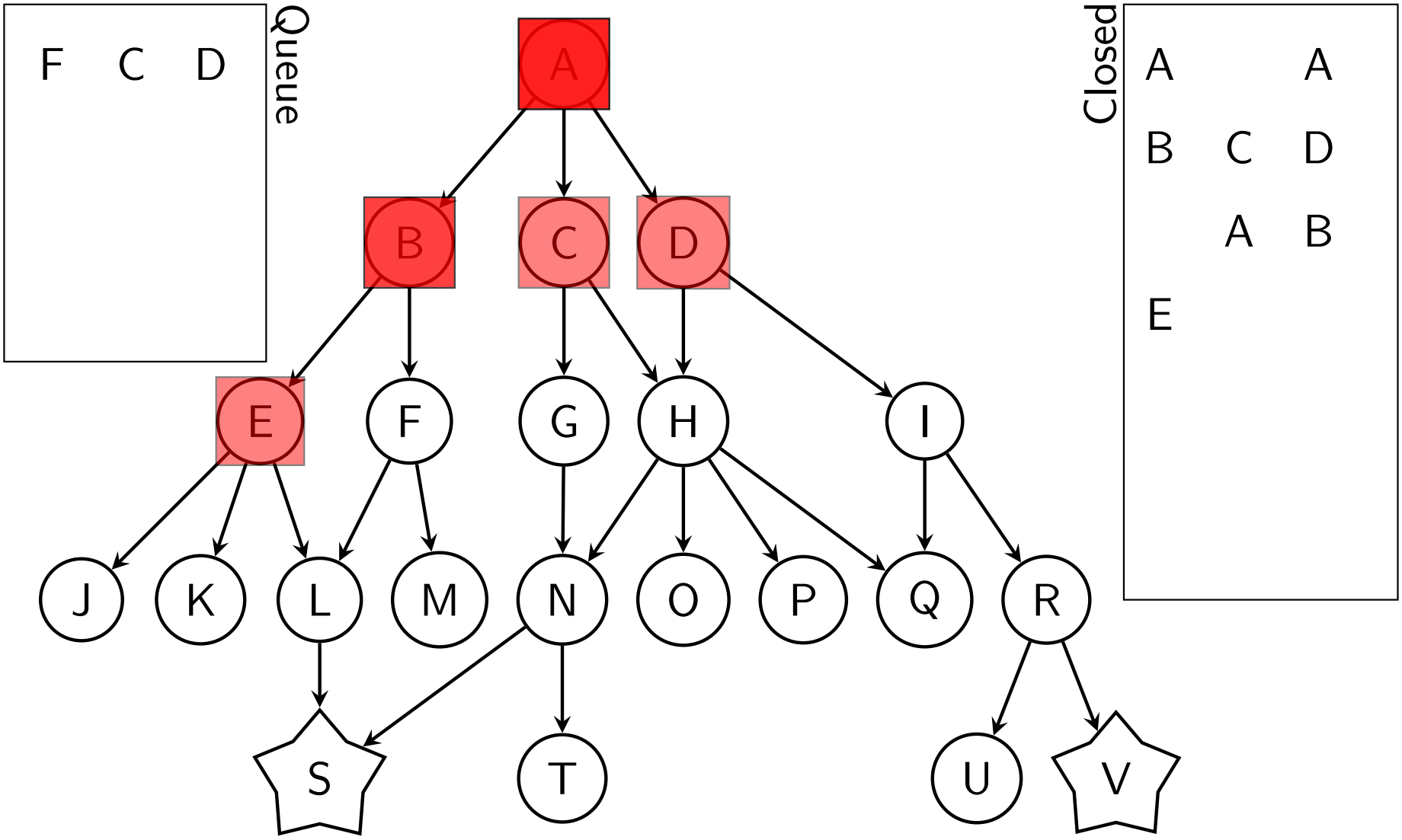
Task 4.4

Iterative Depth-First-Search



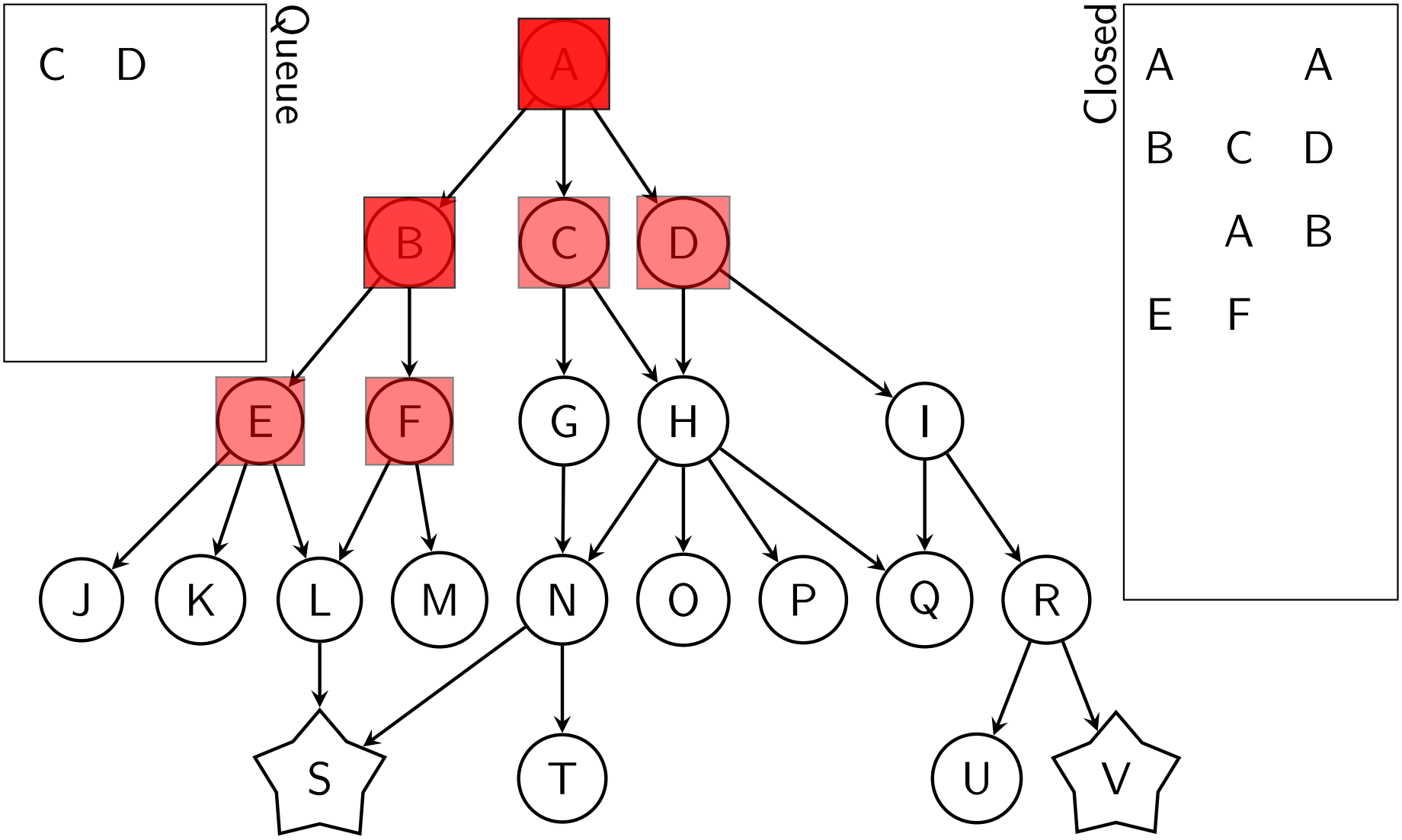
Task 4.4

Iterative Depth-First-Search



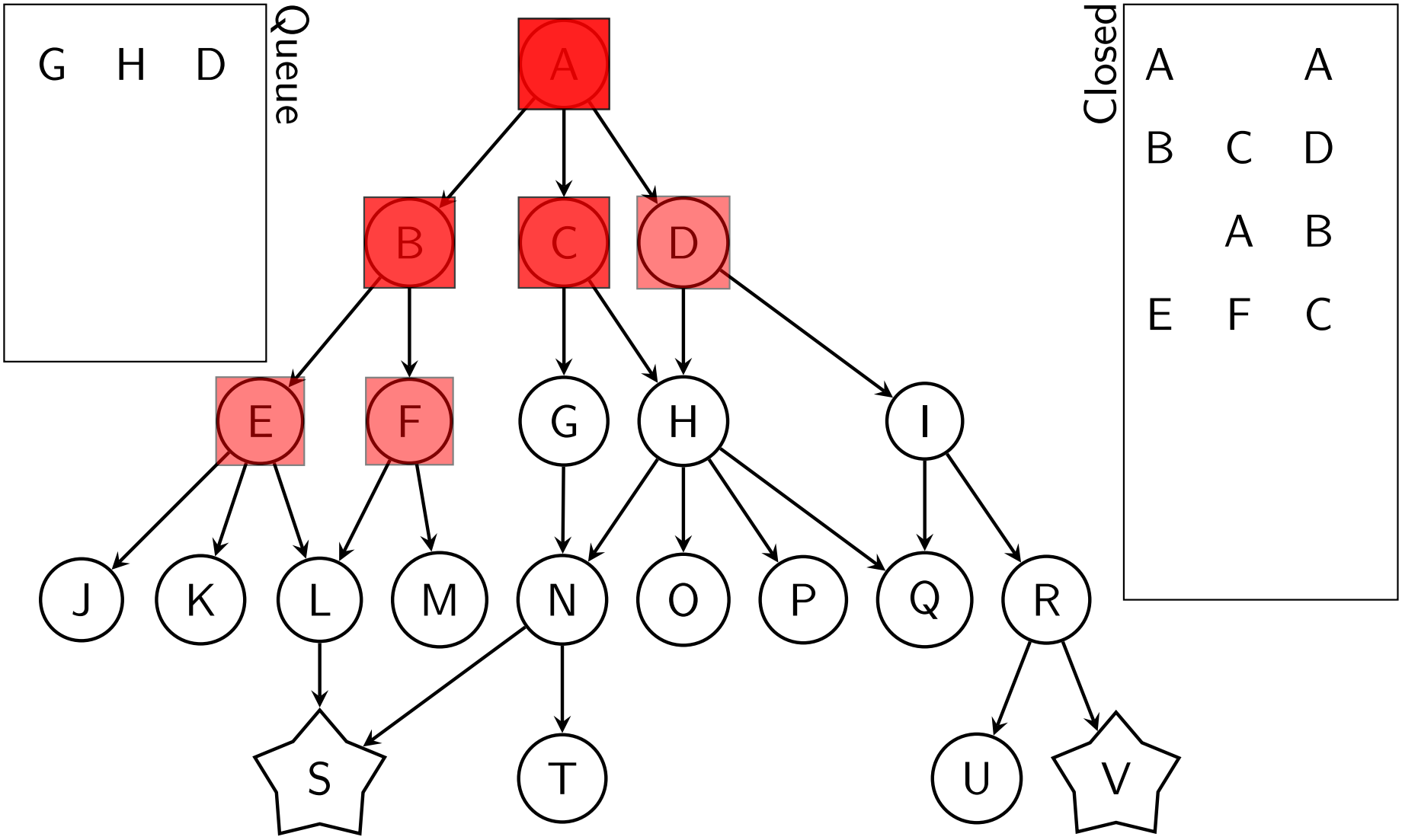
Task 4.4

Iterative Depth-First-Search



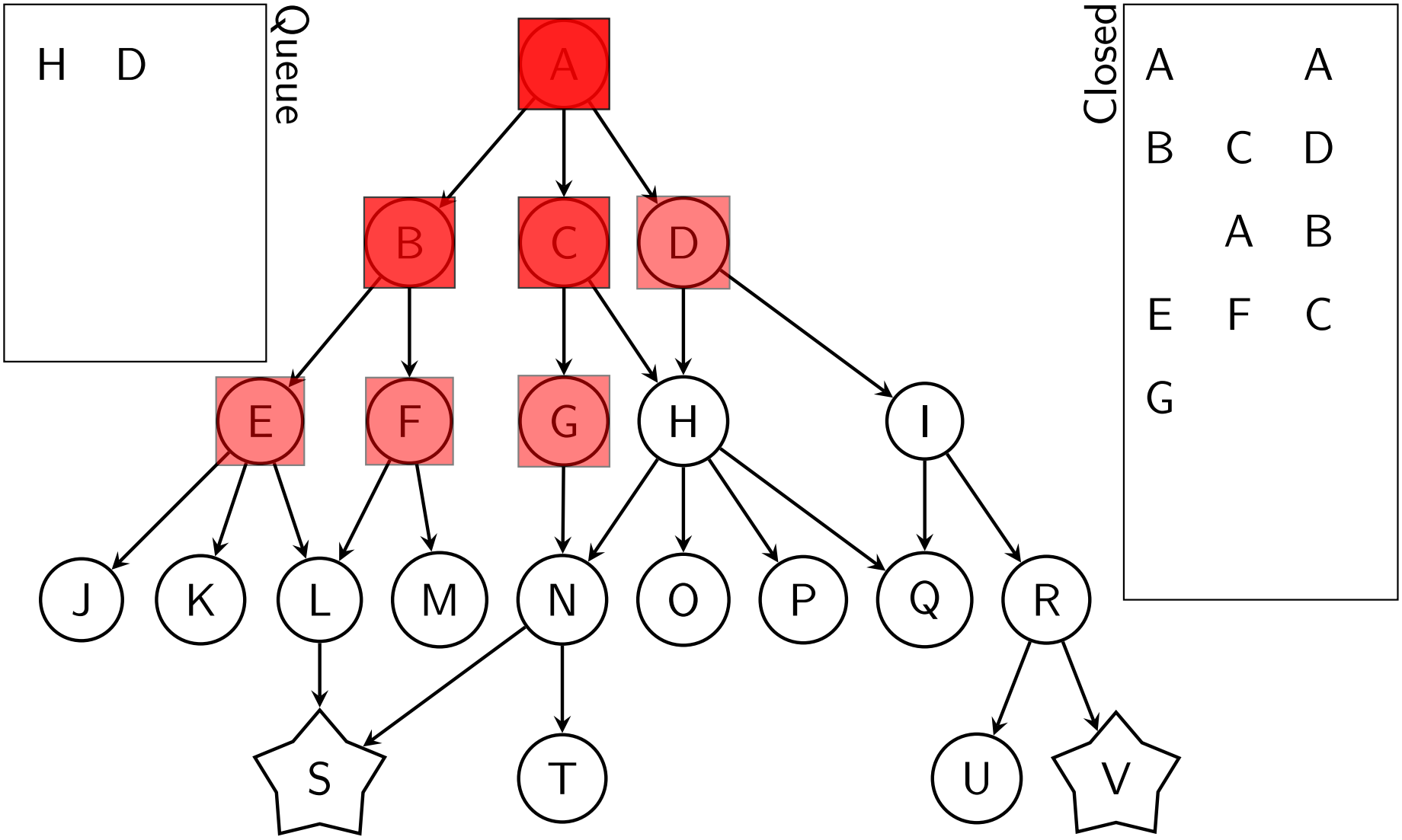
Task 4.4

Iterative Depth-First-Search



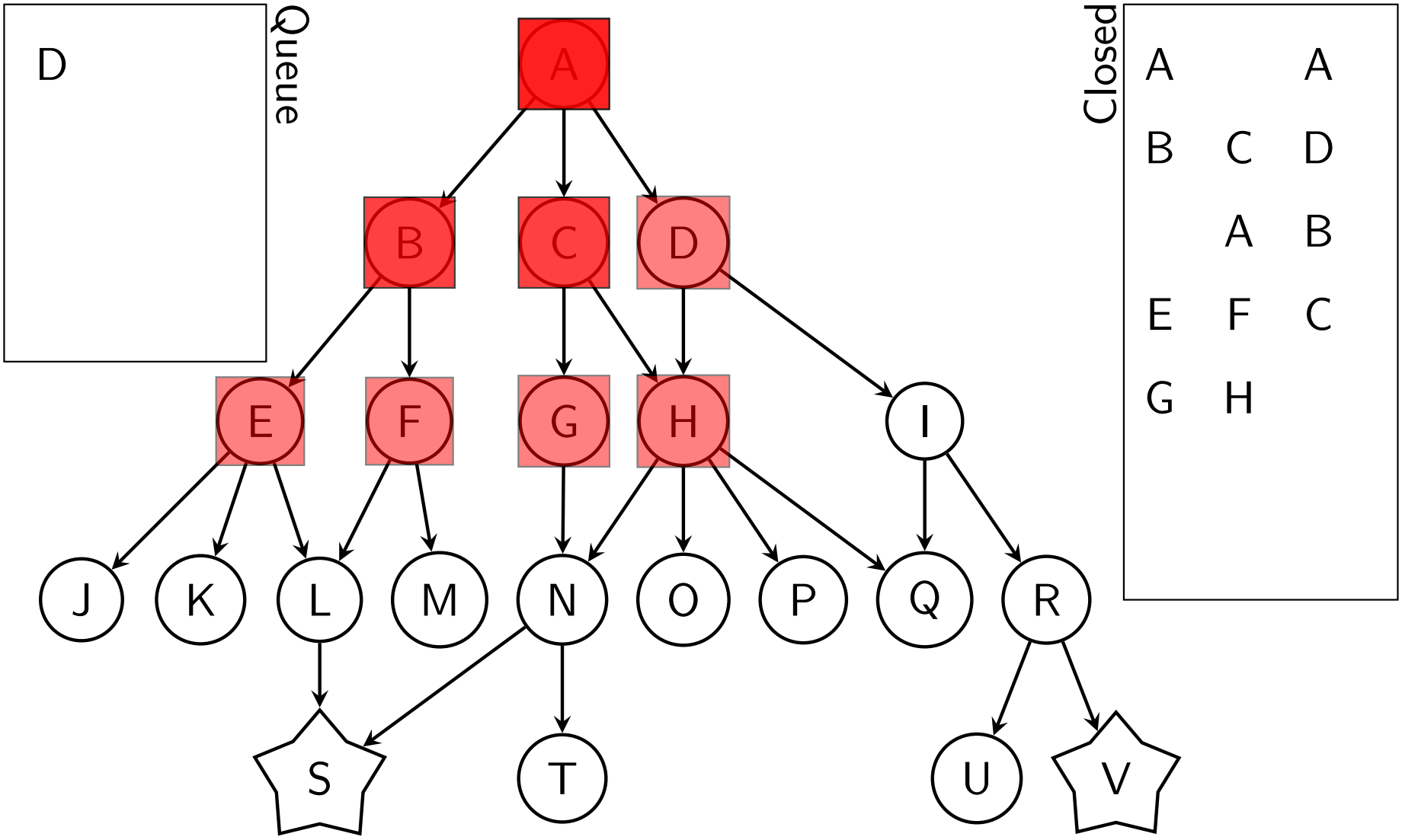
Task 4.4

Iterative Depth-First-Search



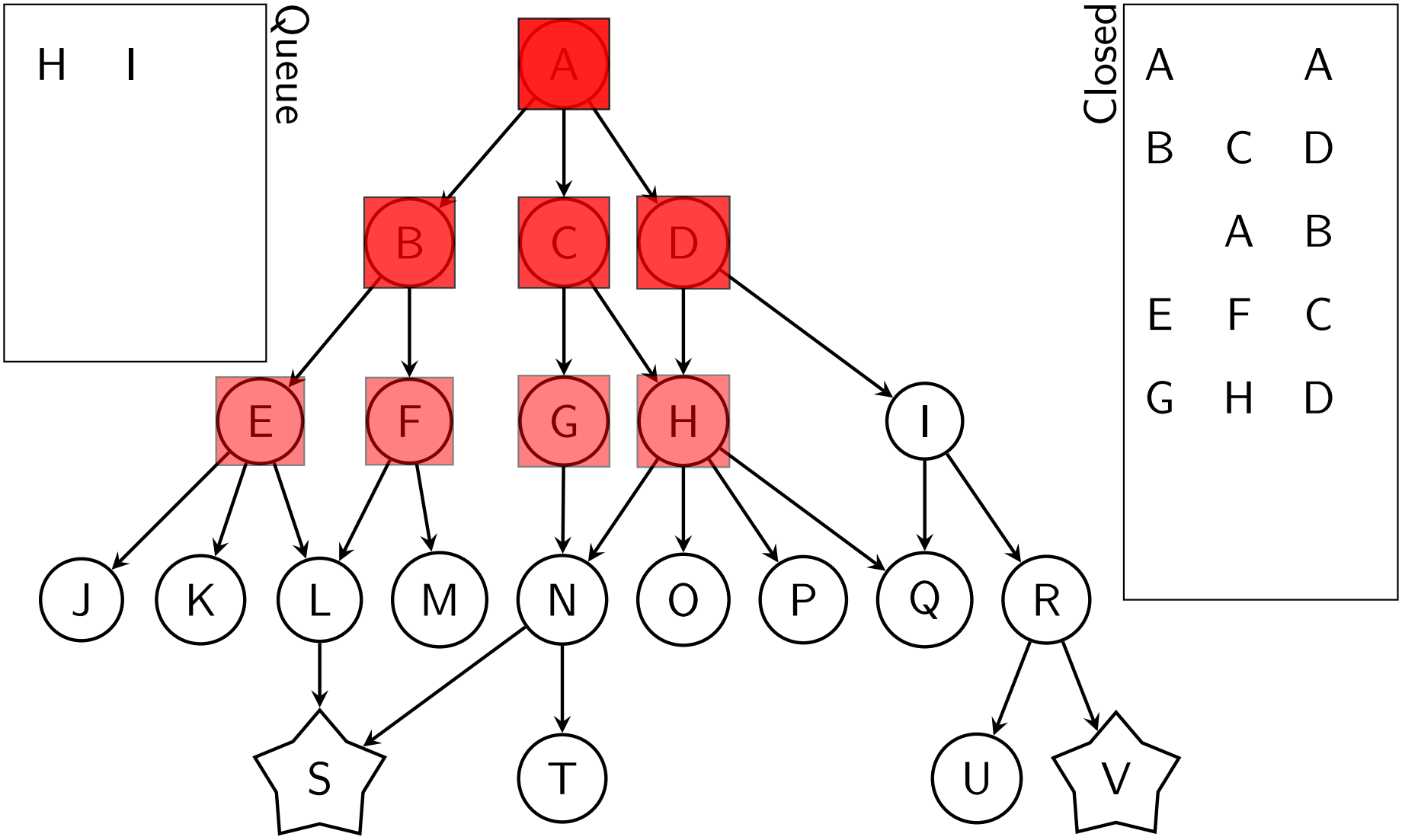
Task 4.4

Iterative Depth-First-Search



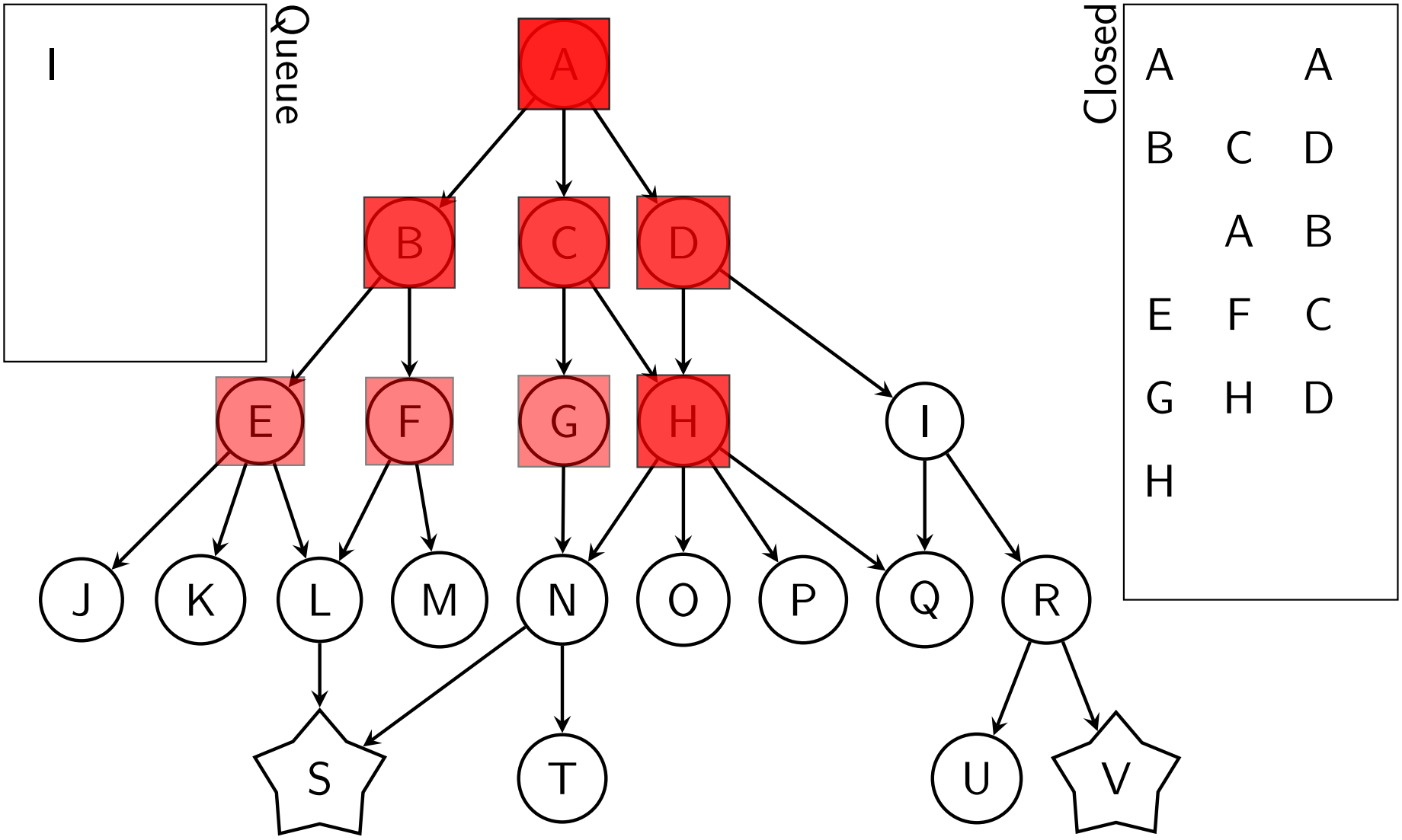
Task 4.4

Iterative Depth-First-Search



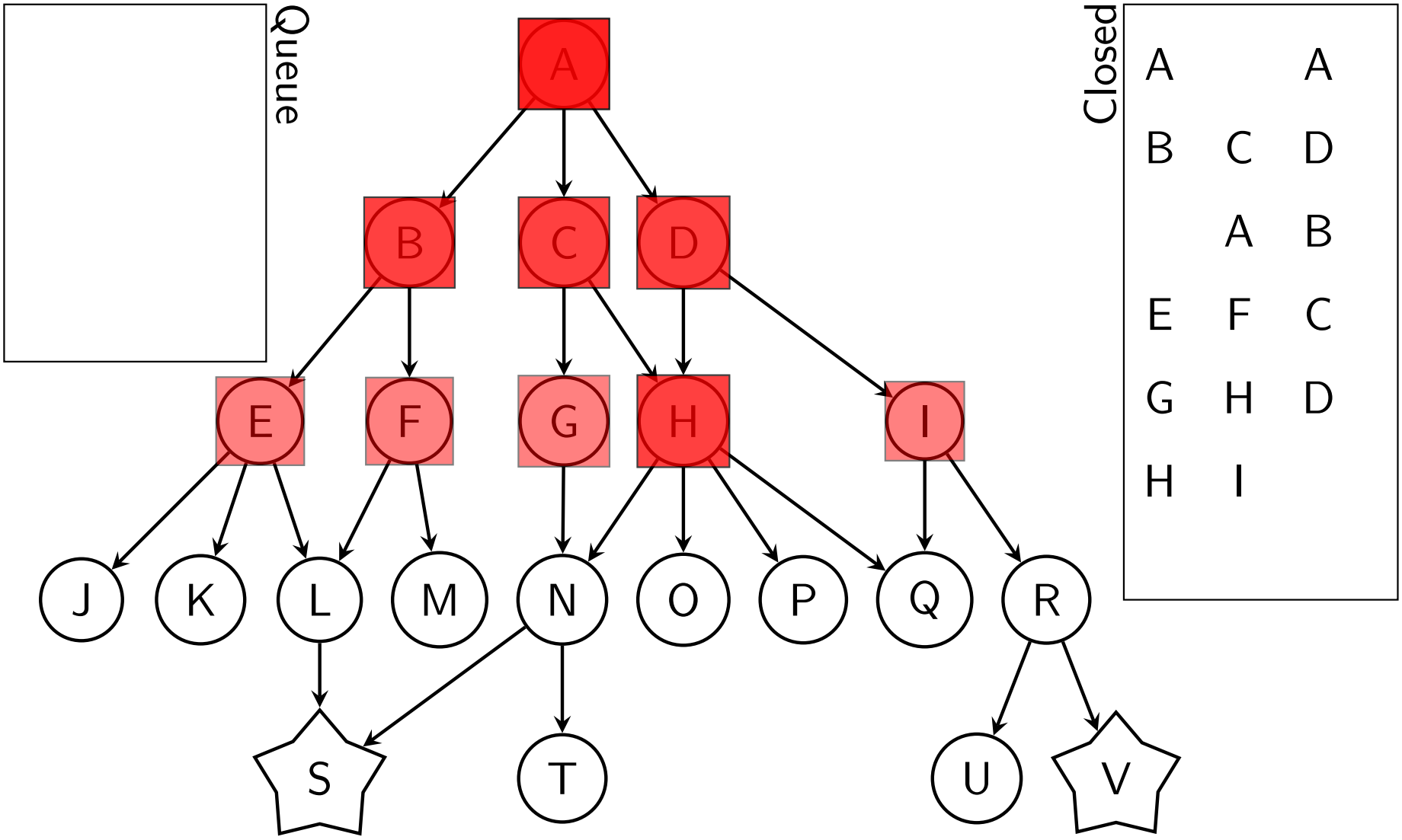
Task 4.4

Iterative Depth-First-Search



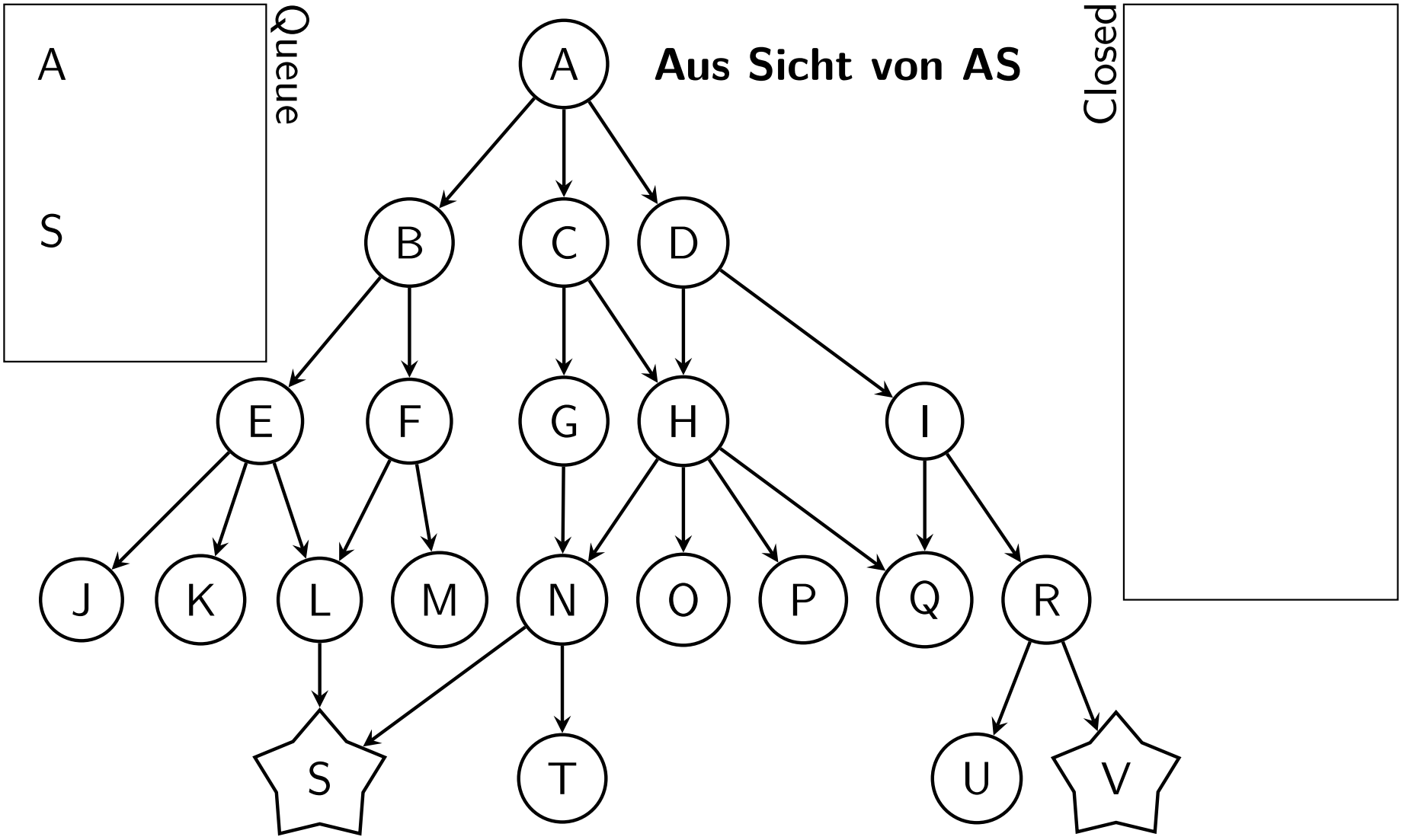
Task 4.4

Iterative Depth-First-Search



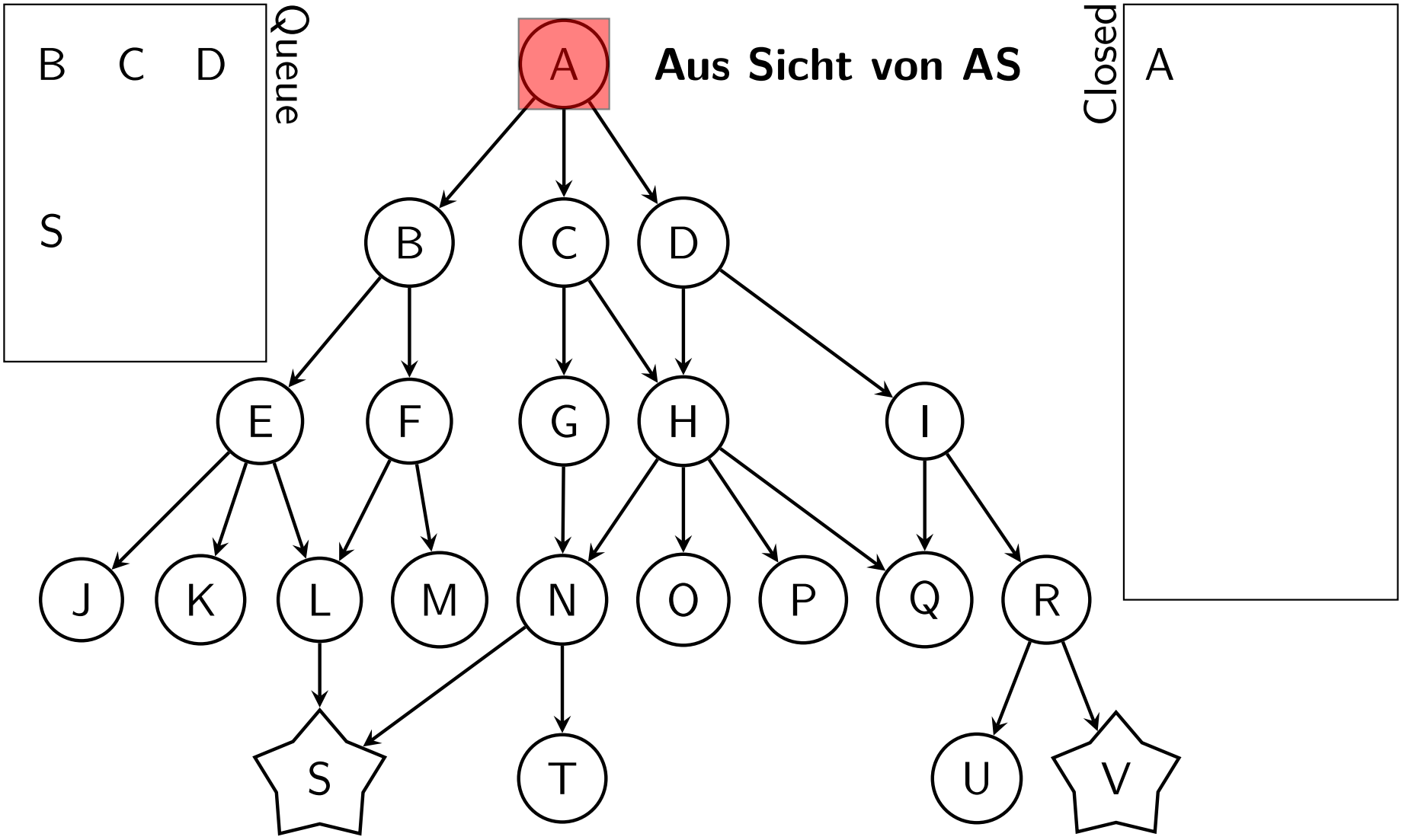
Task 4.5

Bidirectional Search



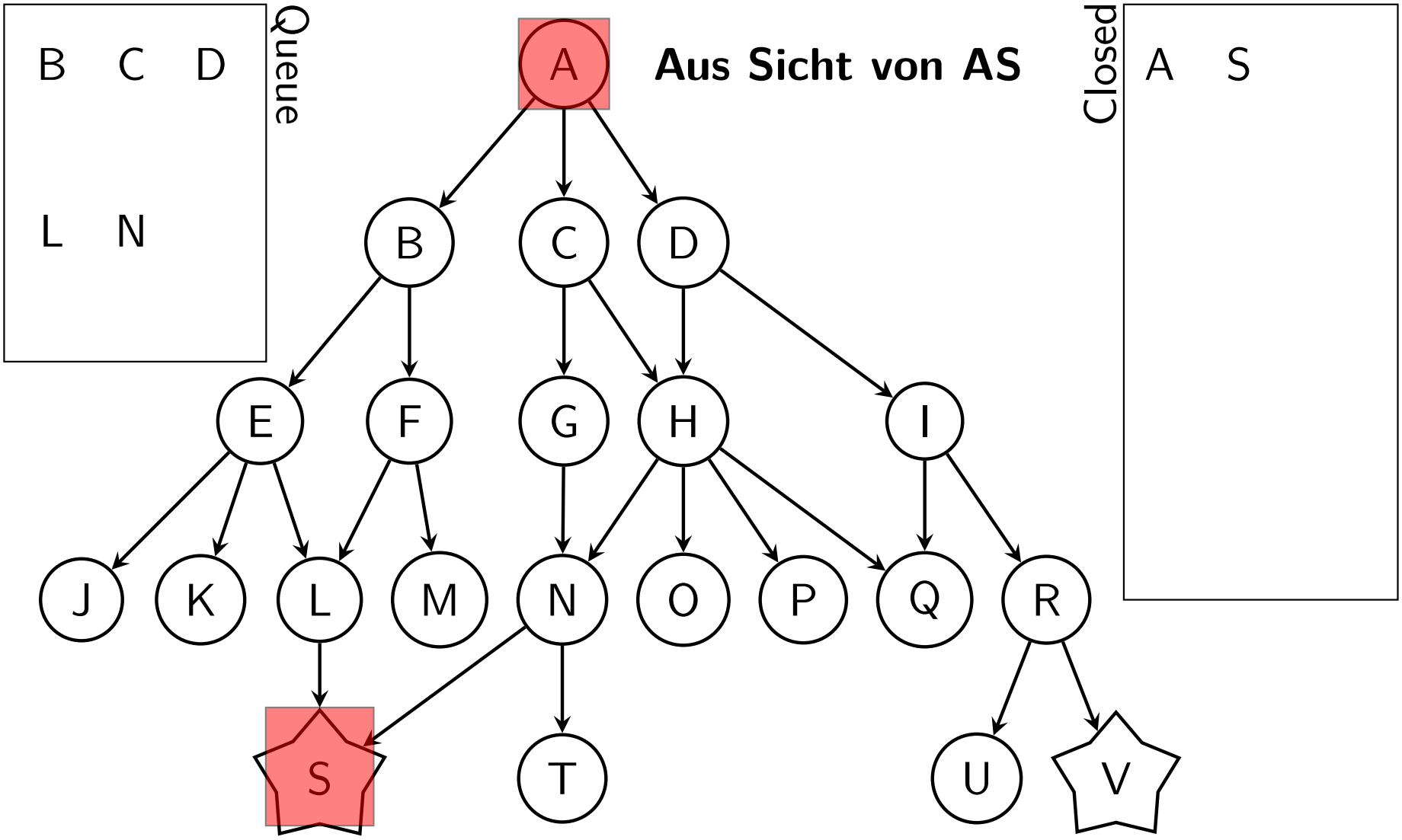
Task 4.5

Bidirectional Search



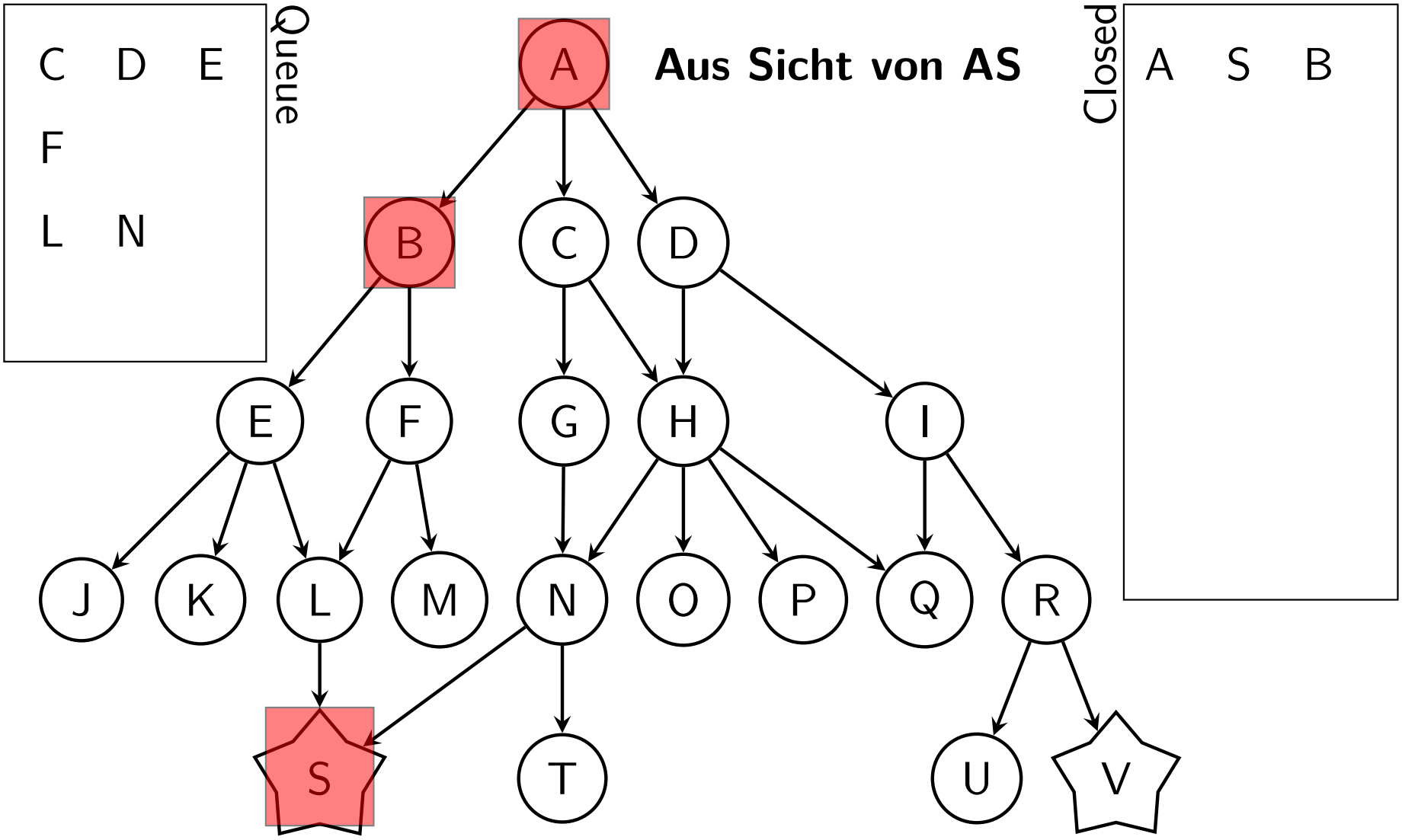
Task 4.5

Bidirectional Search



Task 4.5

Bidirectional Search



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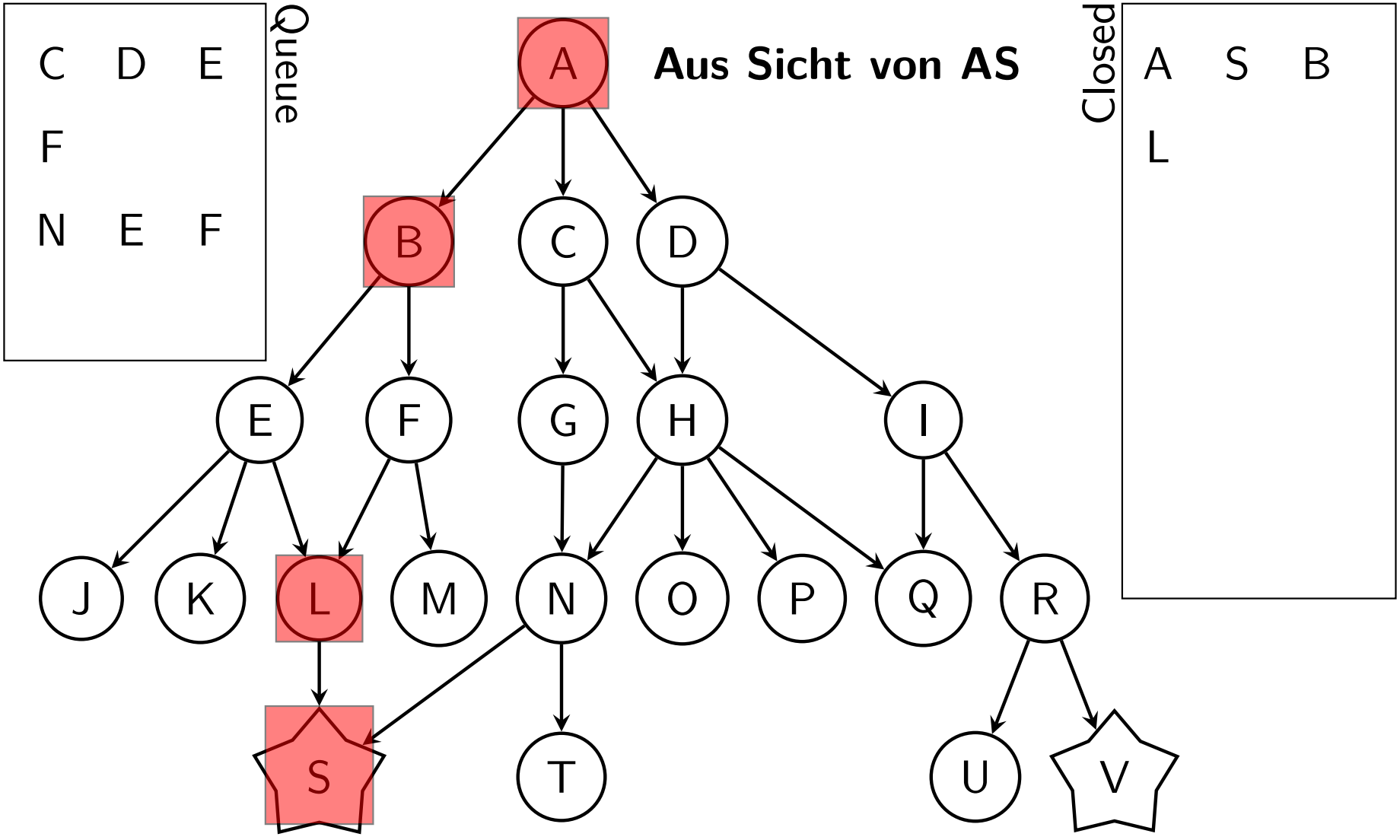
Bidirectional Search



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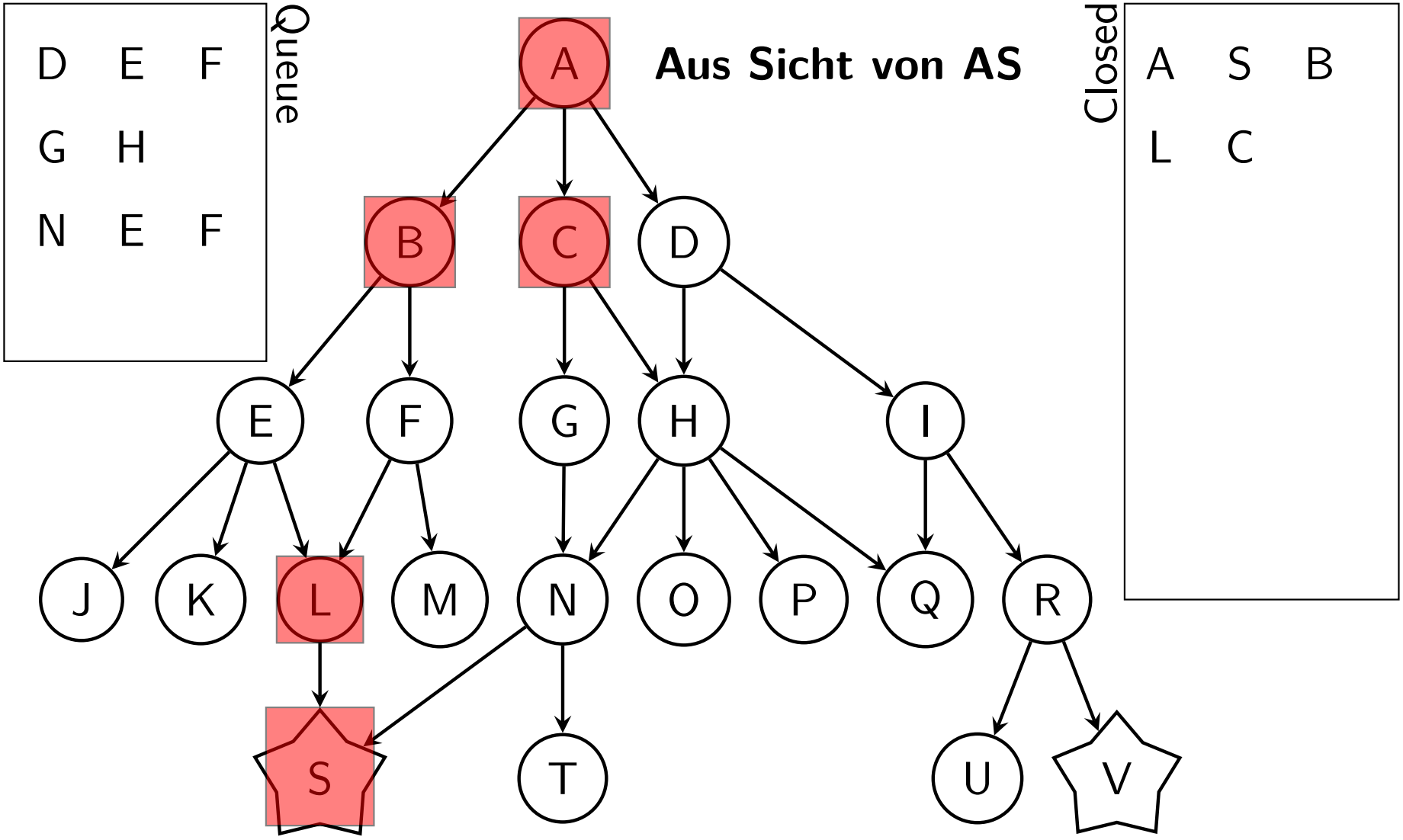
Bidirectional Search



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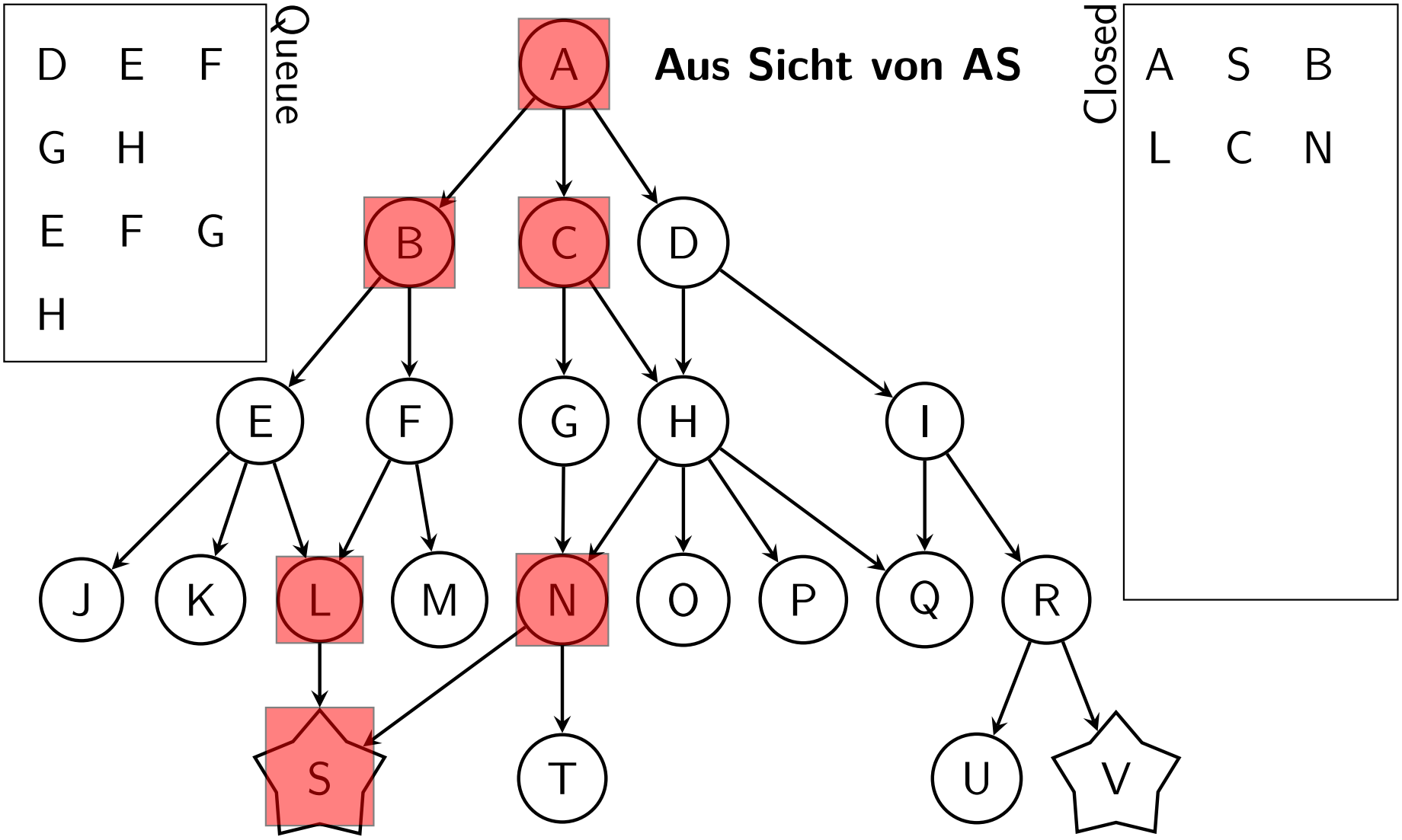
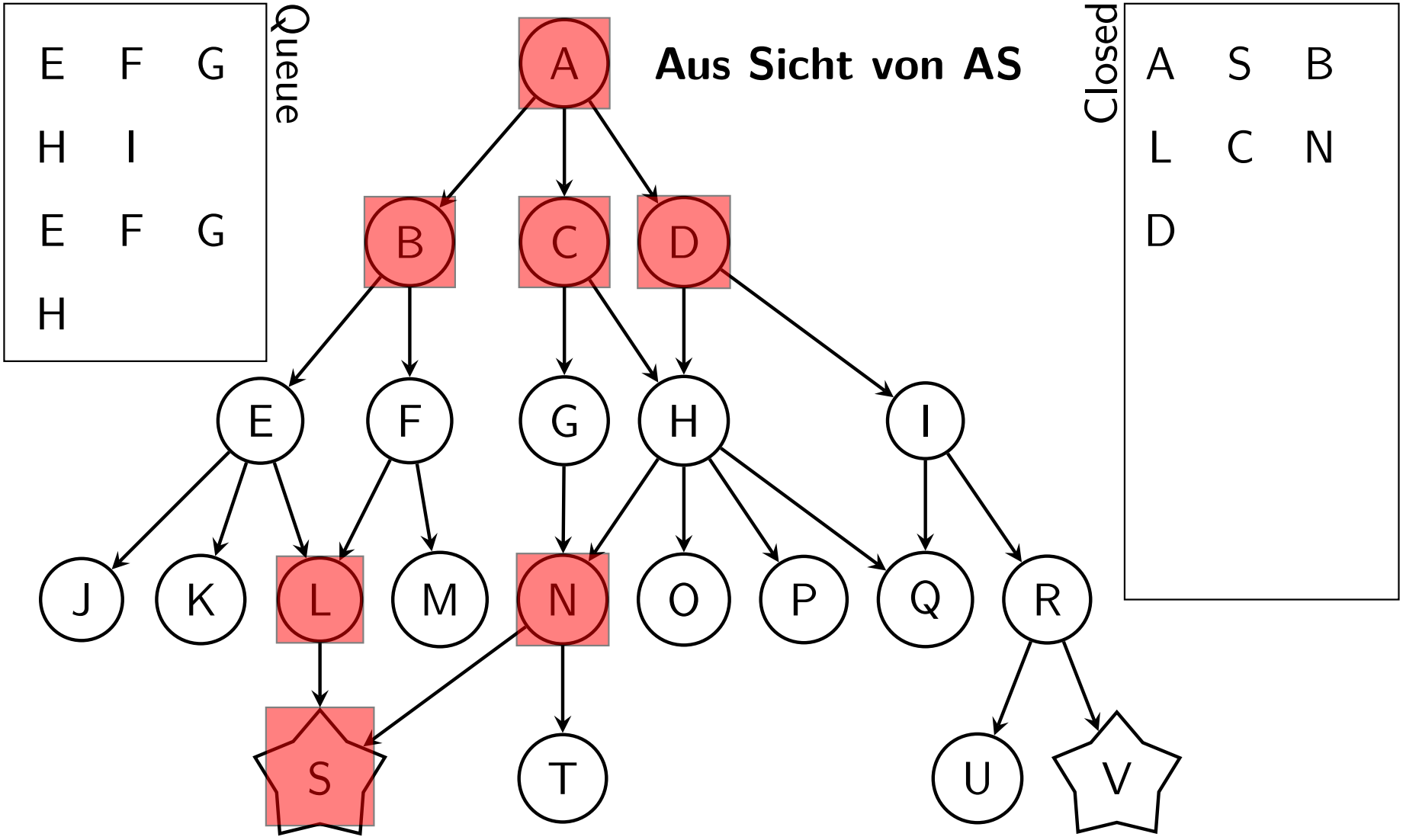
Bidirectional Search



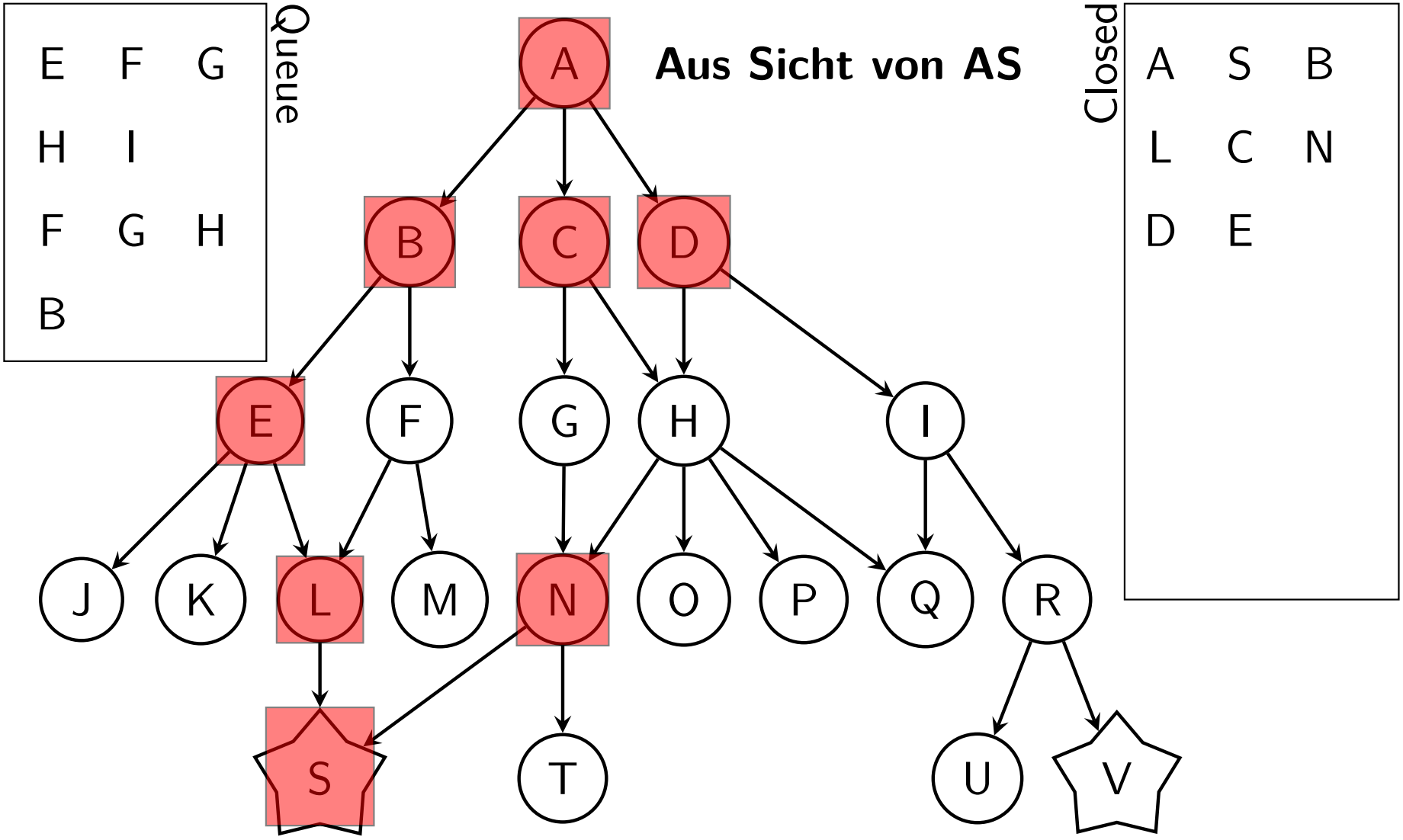
Task 4.5

Bidirectional Search



Task 4.5

Bidirectional Search



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Bidirectional Search