# A STAR

**node** visited

**node** expanded

**node** dead

**huristic**

**actual cost**

S = START
G = GOAL

4.3 A Star

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## Graph

- S h=23
- T h=23
- N h=21
- M h=22
- O h=18
- P h=14
- J h=14
- K h=17
- H h=11
- Q h=13
- F h=8
- R h=11
- V h=17
- U h=22
- B h=5
- E h=12
- A h=7
- C h=4
- D h=2
- Z h=0
- G h=3
- I h=5
- L h=6

Edges:
S→T 1, S→M 1, T→N 2, M→N 1, N→O 3, O→P 4, O→J 5, O→K 4, P→K 3, P→Q 1, J→H 2, J→K 4, K→J 4, H→F 3, Q→R 2, Q→U 5, F→B 3, F→E 1, B→A 2, E→A 5, B→C 1, R→V 6, V→R 6, U→V 5, C→D 2, D→Z 2, Z←G 3, G←I 2, I←L 1, L→I, Q→L 5

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**1** initial step — A* search

Visited :

Q : (23, S)

S [23 / 23]

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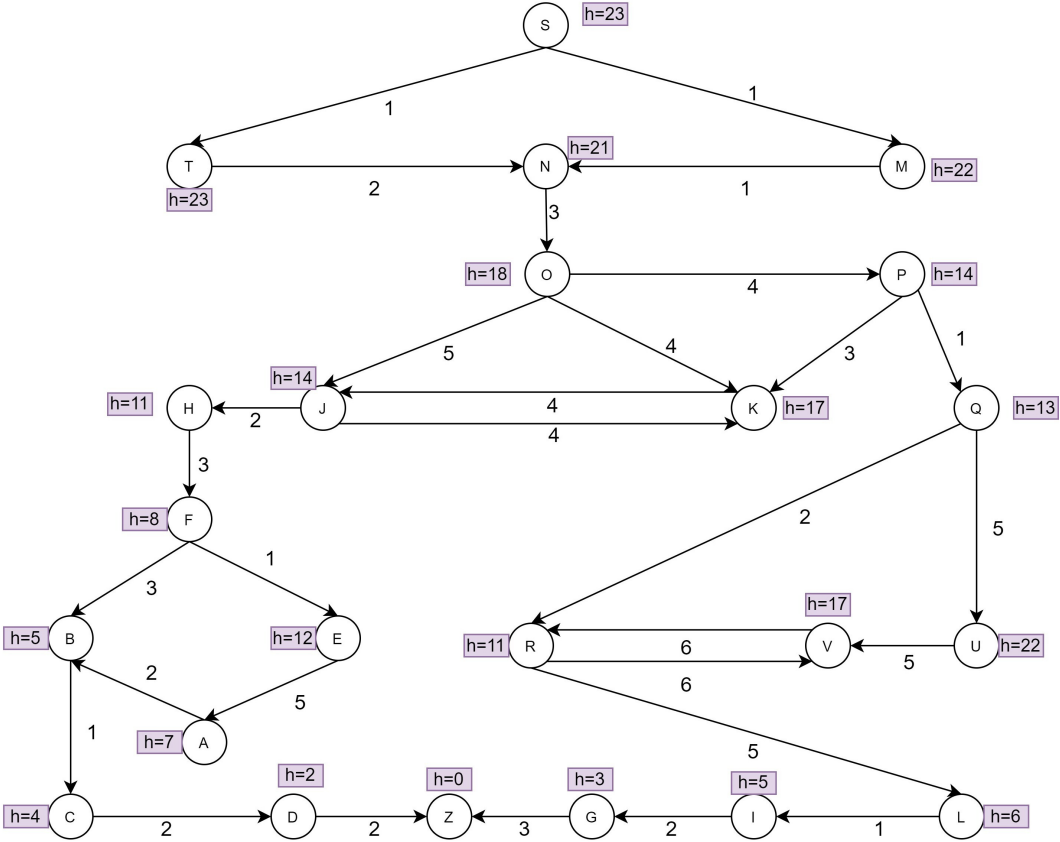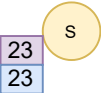
**2** repeating step — A* search

Visited : S

Q : (24, T, S), (24, M, S)

S [23 / 23]
→ 1 → T [23 / 24]
→ 1 → M [22 / 24]

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**3** repeating step — A* search

Visited : S, T

Q : (24, M, S), (24, N, T, S)

S [23 / 23]
→ 1 → T [23 / 24]
→ 1 → M [22 / 24]
T → 2 → N [21 / 24]
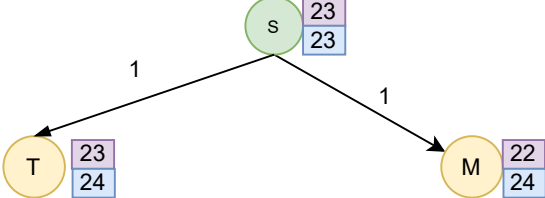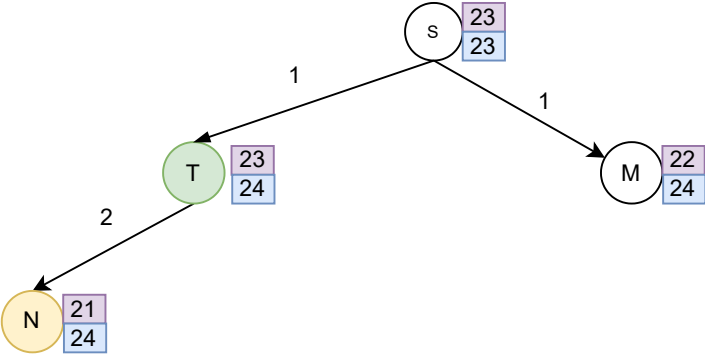
**A\* search**

4 repeating step

Visited : S, T, M

Q : (23, N, M, S), (24, N, T, S)

S [23 / 23]

1 → T [23 / 24]
1 → M [22 / 24]

2 → N [21 / 24]

1 → N [21 / 23]

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**A\* search**
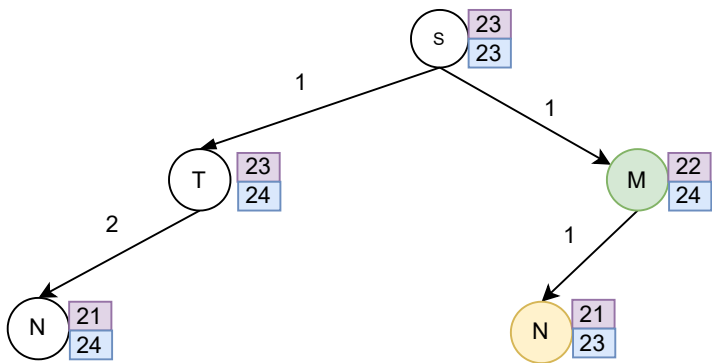
5 repeating step

Visited : S, T, M, N

Q : (18, O, N, M, S), (24, N, T, S)

S [23 / 23]

1 → T [23 / 24]
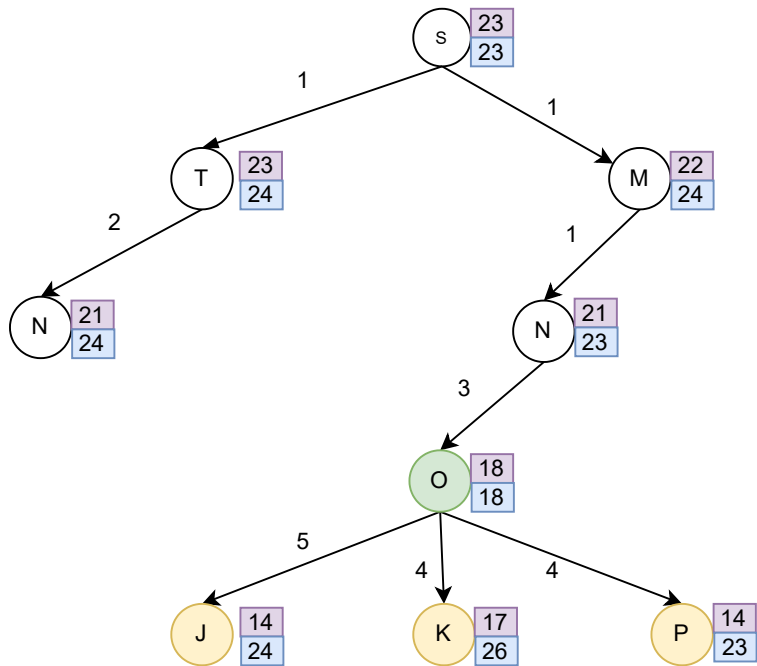1 → M [22 / 24]

2 → N [21 / 24]

1 → N [21 / 23]

3 → O [18 / 18]

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**A\* search**
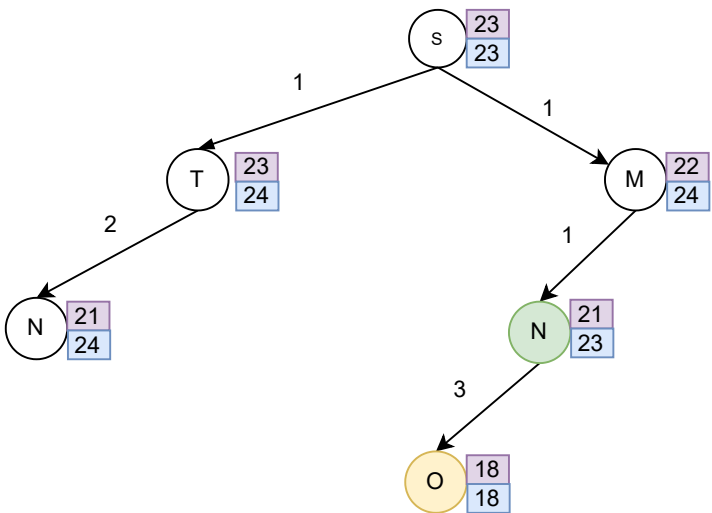
6 repeating step

Visited : S, T, M, N, O

Q : (23, P, O, N, M, S), (24, N, T, S), (24, J, O, N, M, S), (26, K, O, N, M, S)

S [23 / 23]

1 → T [23 / 24]
1 → M [22 / 24]

2 → N [21 / 24]

1 → N [21 / 23]

3 → O [18 / 18]

5 → J [14 / 24]
4 → K [17 / 26]
4 → P [14 / 23]

7 repeating step    Visited : S, T, M, N, O, P

Q : (22, Q, P, O, N, M, S), (24, N, T, S), (24, J,  O, N, M, S), (26, K,  O, N, M, S)

S — 23 / 23

S →(1)→ T — 23 / 24
S →(1)→ M — 22 / 24
T →(2)→ N — 21 / 24
M →(1)→ N — 21 / 23
N →(3)→ O — 18 / 18
O →(5)→ J — 14 / 24
O →(4)→ K — 17 / 26
O →(4)→ P — 14 / 23
P →(1)→ Q — 13 / 22
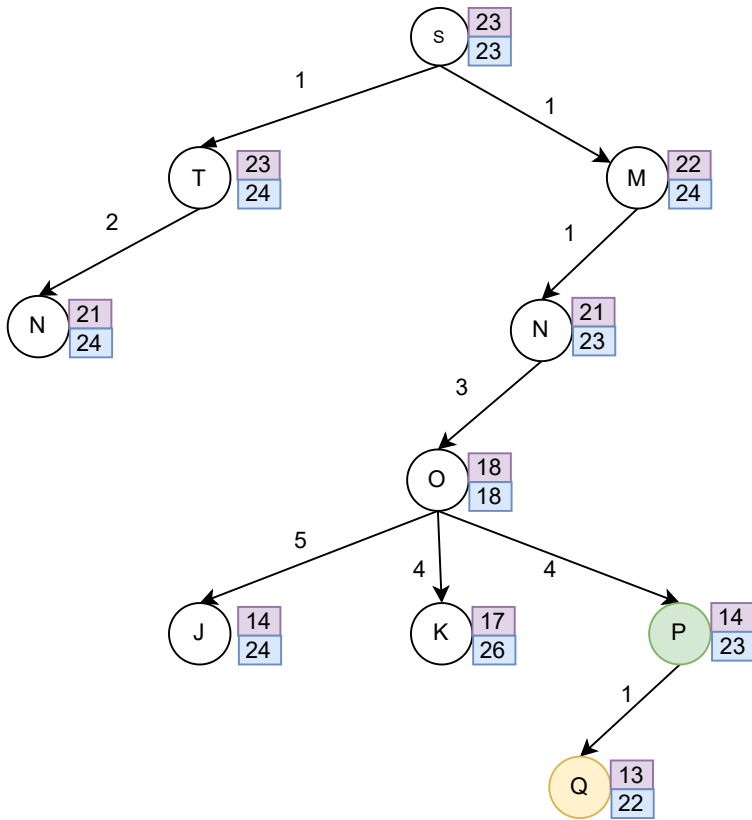
8 repeating step    Visited : S, T, M, N, O, P, Q

Q : (23, R, Q, P, O, N, M, S), (24, N, T, S), (24, J,  O, N, M, S), (26, K,  O, N, M, S), (37, U, Q, P, O, N, M, S)

S — 23 / 23

S →(1)→ T — 23 / 24
S →(1)→ M — 22 / 24
T →(2)→ N — 21 / 24
M →(1)→ N — 21 / 23
N →(3)→ O — 18 / 18
O →(5)→ J — 14 / 24
O →(4)→ K — 17 / 26
O →(4)→ P — 14 / 23
P →(1)→ Q — 13 / 22
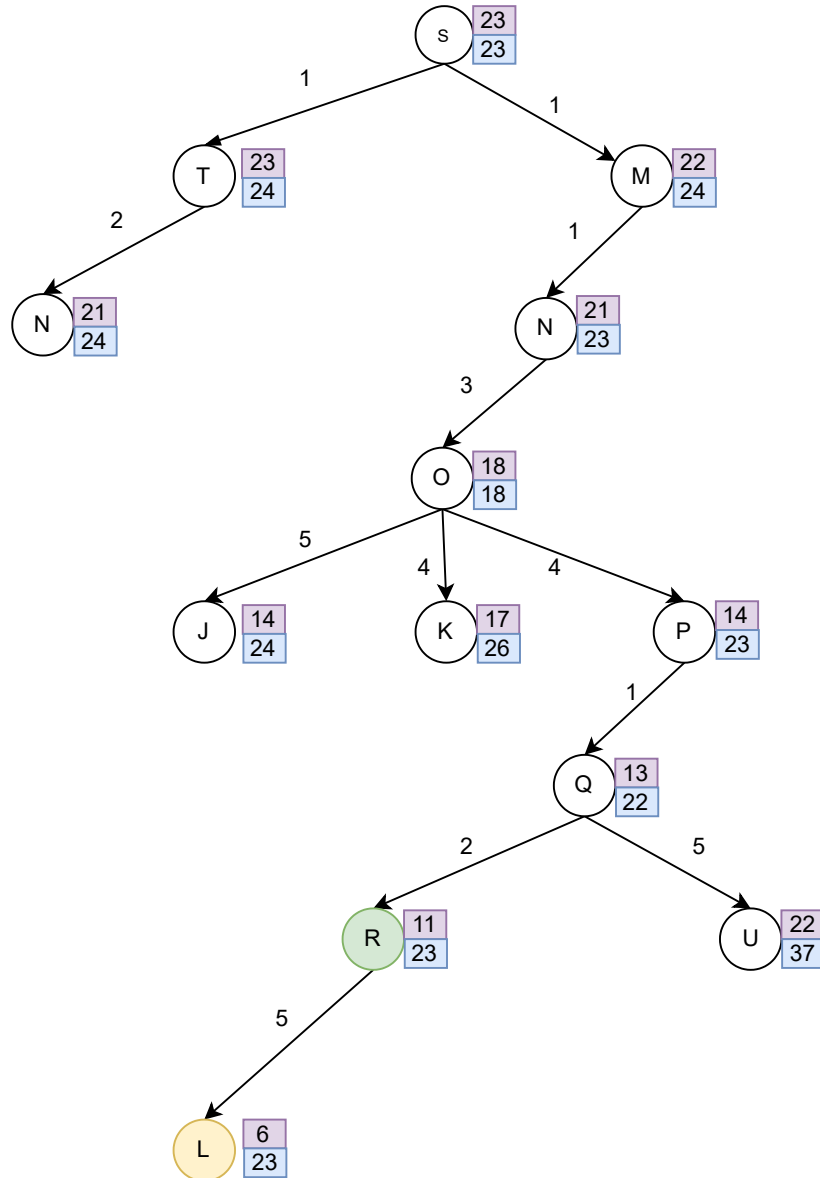Q →(2)→ R — 11 / 23
Q →(5)→ U — 22 / 37

9 | repeating step

Visited : S, T, M, N, O, P, Q, R

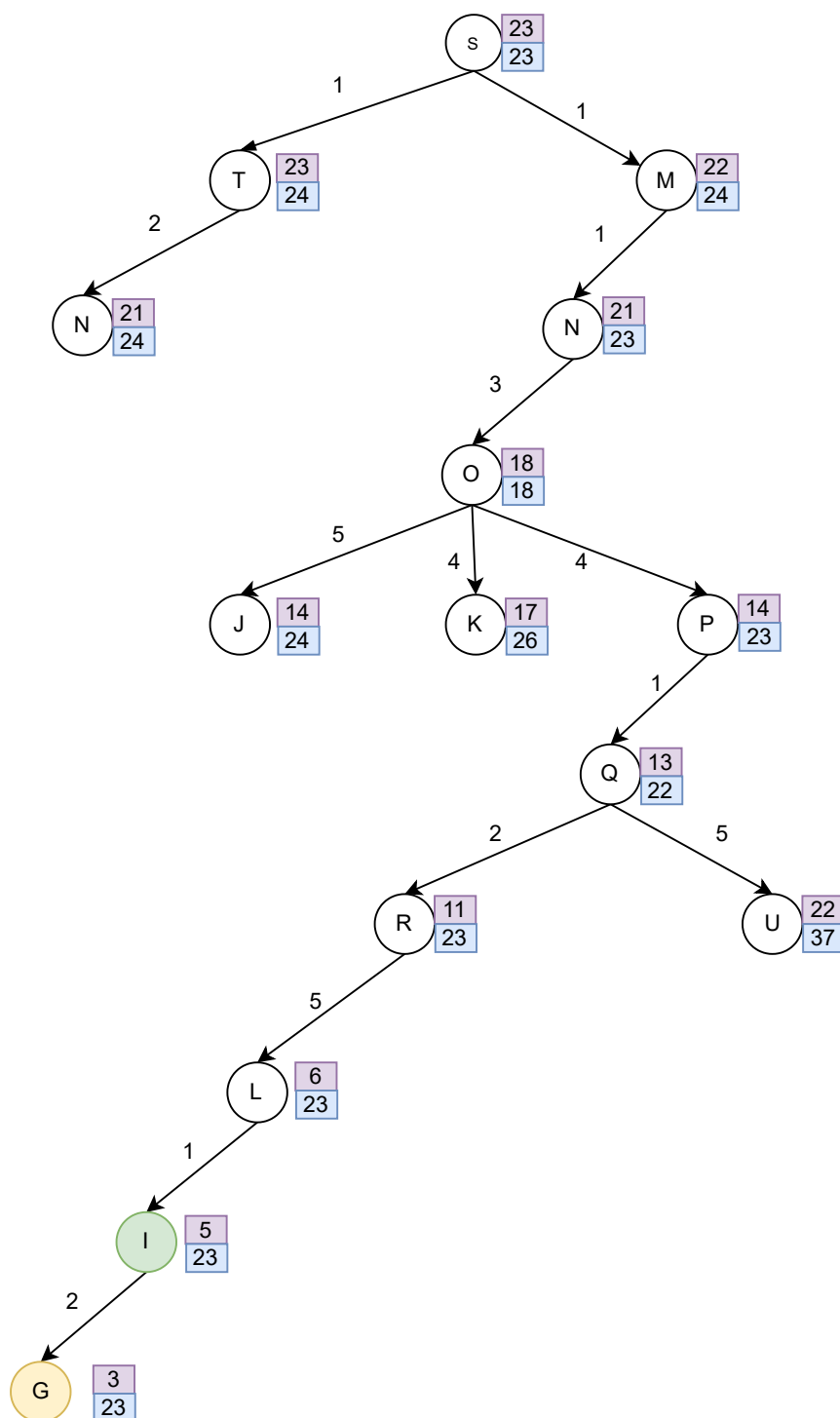Q : (23, L, R, Q, P, O, N, M, S), (24, N, T, S), (24, J,  O, N, M, S), (26, K,  O, N, M, S), (37, U, Q, P, O, N, M, S)

S  23 / 23

1      1

T  23 / 24          M  22 / 24

2              1

N  21 / 24      N  21 / 23

3

O  18 / 18

5      4        4

J  14 / 24    K  17 / 26    P  14 / 23

1

Q  13 / 22

2              5

R  11 / 23          U  22 / 37

5

L  6 / 23

10 | repeating step

Visited : S, T, M, N, O, P, Q, R, L

Q : (23, I, L, R, Q, P, O, N, M, S), (24, N, T, S), (24, J,  O, N, M, S), (26, K,  O, N, M, S), (37, U, Q, P, O, N, M, S)

11  repeating step

Visited : S, T, M, N, O, P, Q, R, L, I

Q : (23, G, I, L, R, Q, P, O, N, M, S), (24, N, T, S), (24, J,  O, N, M, S), (26, K,  O, N, M, S), (37, U, Q, P, O, N, M, S)
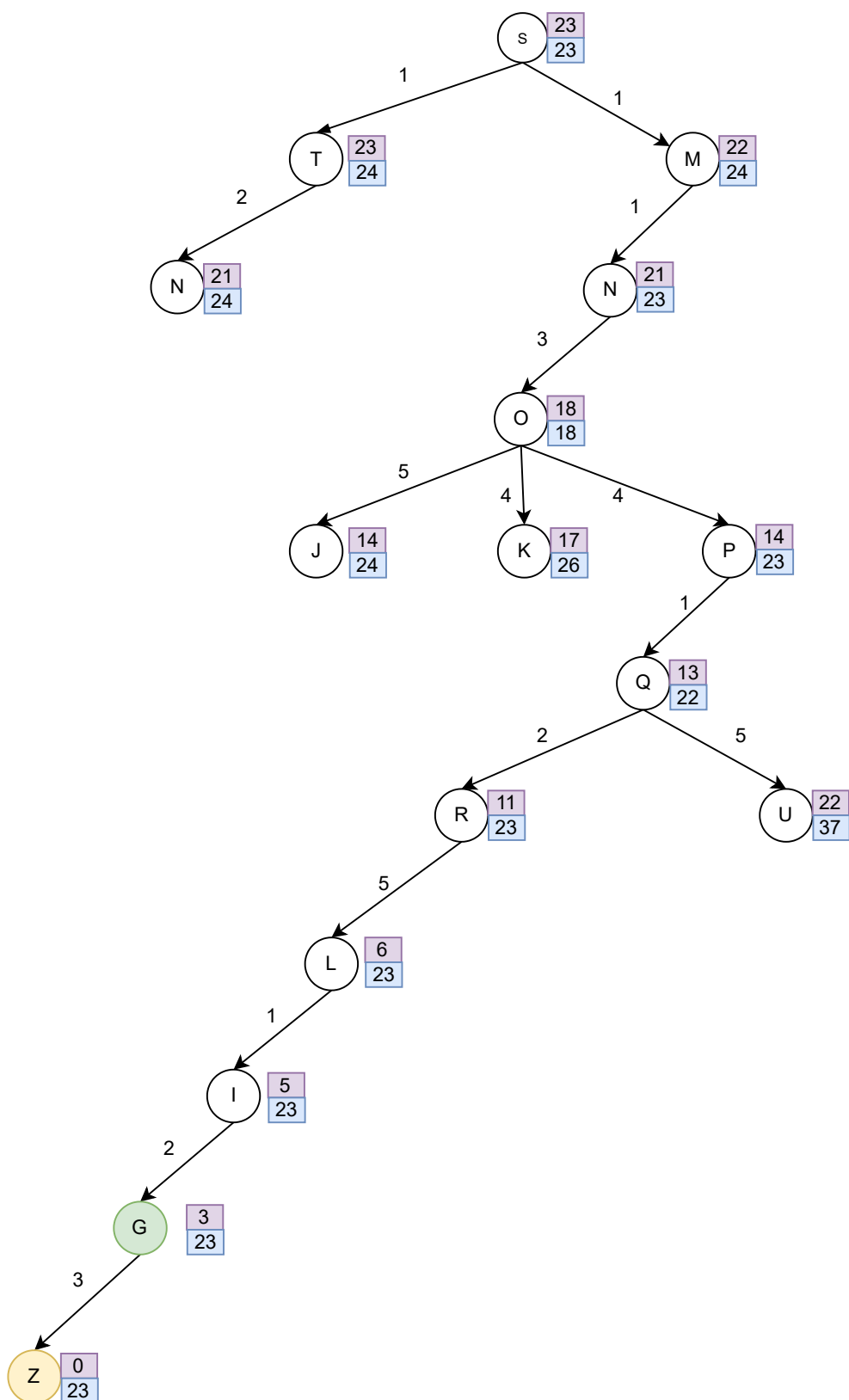
12 | repeating step

Visited : S, T, M, N, O, P, Q, R, L, I, G
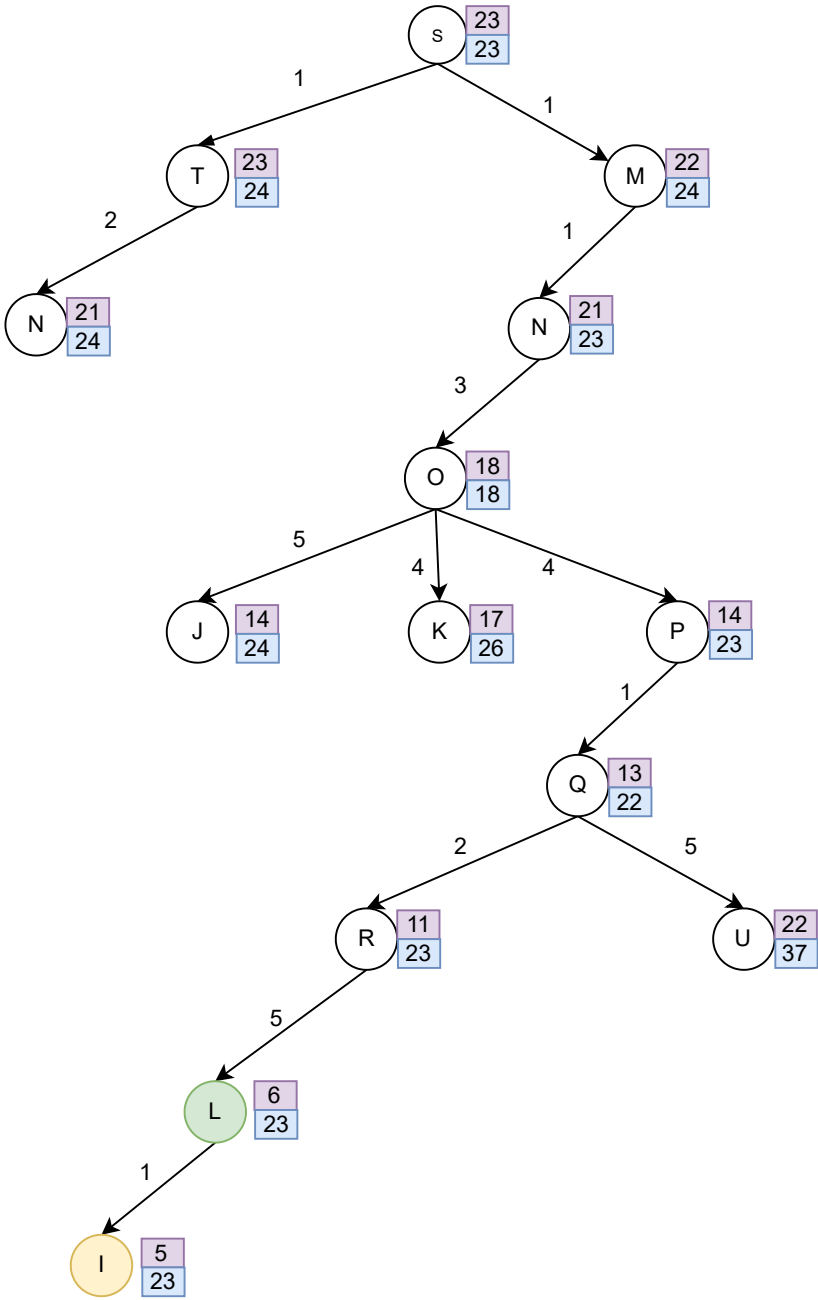
Q : (23, Z, G, I, L, R, Q, P, O, N, M, S), (24, N, T, S), (24, J,  O, N, M, S), (26, K,  O, N, M, S), (37, U, Q, P, O, N, M, S)

| | Q | V |
|---|---|---|
| 1 | (23, S) | |
| 2 | (24, T, S), (24, M, S) | S |
| 3 | (24, N, T, S), (24, M, S) | S, T |
| 4 | (23, N, M, S), (24, N, T, S) | S, T, M |
| 5 | (18, O, N, M, S), (24, N, T, S) | S, T, M, N |
| 6 | (23, P, O, N, M, S), (24, N, T, S), (24, J, O, N, M, S), (26, K, O, N, M, S) | S, T, M, N, O |
| 7 | (22, Q, P, O, N, M, S), (24, N, T, S), (24, J, O, N, M, S), (26, K, O, N, M, S) | S, T, M, N, O, P |
| 8 | (23, R, Q, P, O, N, M, S), (24, N, T, S), (24, J, O, N, M, S), (26, K, O, N, M, S), (37, U, Q, P, O, N, M, S) | S, T, M, N, O, P, Q |
| 9 | (23, L, R, Q, P, O, N, M, S), (24, N, T, S), (24, J, O, N, M, S), (26, K, O, N, M, S), (37, U, Q, P, O, N, M, S) | S, T, M, N, O, P, Q, R |
| 10 | (23, I, L, R, Q, P, O, N, M, S), (24, N, T, S), (24, J, O, N, M, S), (26, K, O, N, M, S), (37, U, Q, P, O, N, M, S) | S, T, M, N, O, P, Q, R, L |
| 11 | (23, G, I, L, R, Q, P, O, N, M, S), (24, N, T, S), (24, J, O, N, M, S), (26, K, O, N, M, S), (37, U, Q, P, O, N, M, S) | S, T, M, N, O, P, Q, R, L, I |
| 12 | (23, Z, G, I, L, R, Q, P, O, N, M, S), (24, N, T, S), (24, J, O, N, M, S), (26, K, O, N, M, S), (37, U, Q, P, O, N, M, S) | S, T, M, N, O, P, Q, R, L, I, G |
| | (23, Z, G, I, L, R, Q, P, O, N, M, S) | S, T, M, N, O, P, Q, R, L, I, G |