Exercises: Artificial Intelligence

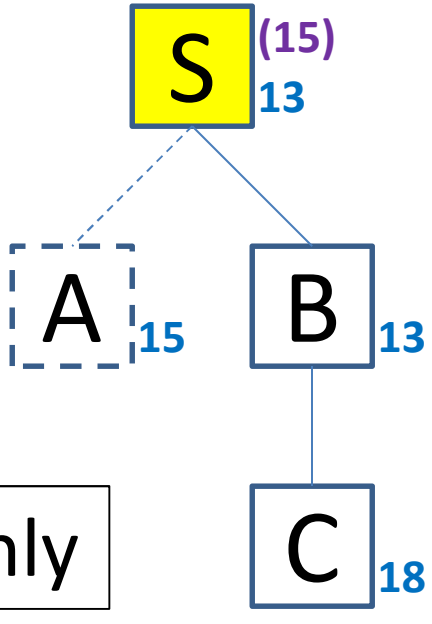
Simplified Memory-bounded A*

Simplified Memory-bounded A*

SMA* ALGORITHM

SMA* Algorithm

- Optimizes A* to work within reduced memory
- ***Key Idea:***
  - **IF** memory **full** for **extra node (C)**
  - **Remove highest f-value leaf (A)**
  - **Remember best-forgotten child** in *each* parent node **(15 in S)**



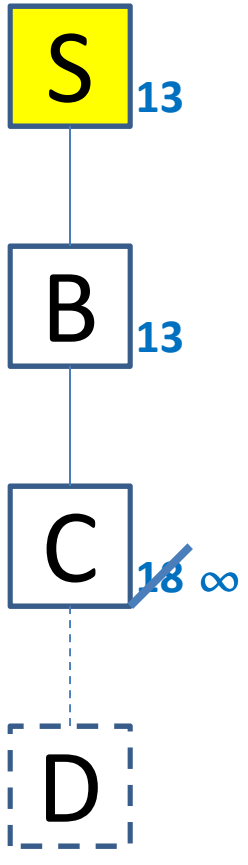
E.g. Memory of 3 nodes only

SMA* Algorithm

- **Generate Children 1 by 1**
  - **Expanding**: add 1 child at the time to QUEUE
  - Avoids **memory overflow**
  - **Allows monitoring** if nodes need deletion

SMA* Algorithm

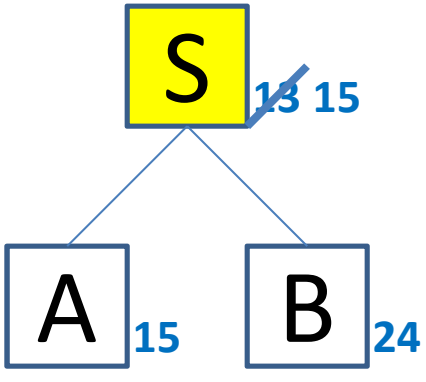
- **Too long paths: Give up**
  - **Extending** path **cannot fit** in **memory**
    - **give up (C)**
  - Set **f-value** node **(C)** to ∞
    - **Remembers:**
      path cannot be found here



E.g. Memory of 3 nodes only

SMA* Algorithm

- **Adjust f-values**
  - **IF** all children M_i of node N have been explored
  - **AND** $\forall i$: $f(S...M_i) > f(S...N)$
  - **THEN reset** (through N $\Longrightarrow$ through children)
    - $f(S...N) = \min\{f(S...M_i) \mid M_i \text{ child of N}\}$



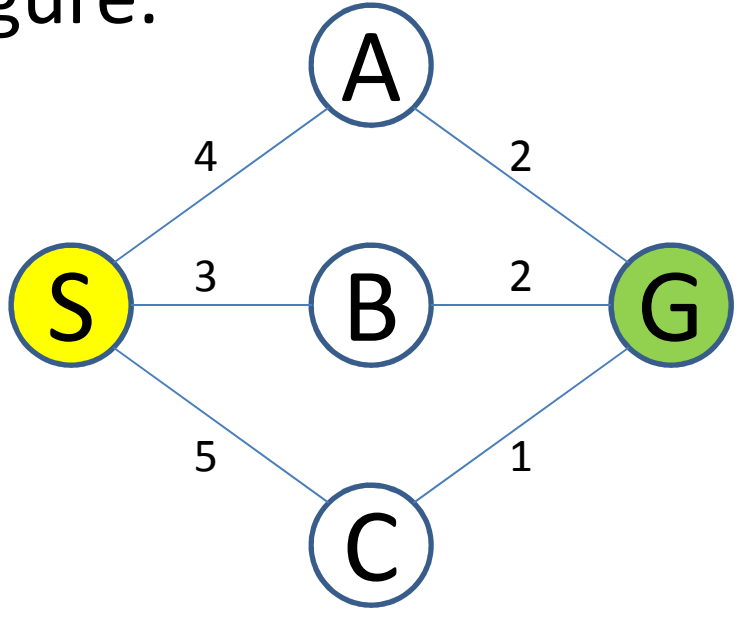
Better estimate for f(S)

Simplified Memory-bounded A*

SMA* BY EXAMPLE

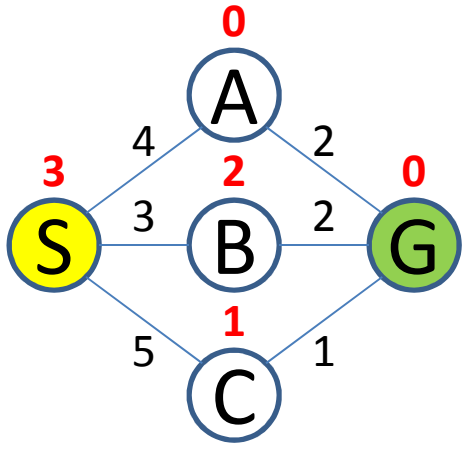
SMA* by Example

- Perform SMA* (memory: 3 nodes) on the following figure.

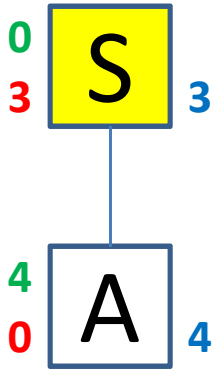


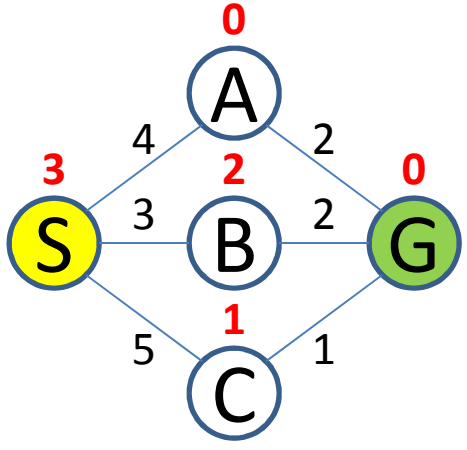
	S	A	B	C	G
heuristic	3	0	2	1	0

SMA* by Example



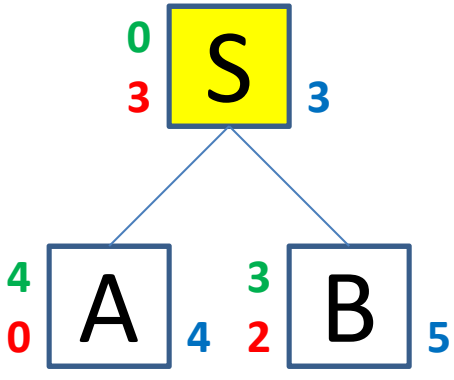
SMA* by Example

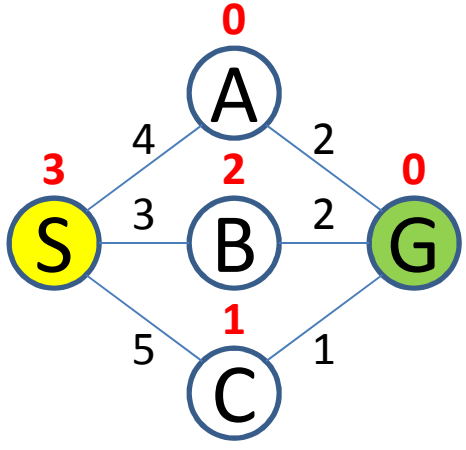




Generate children
(One by one)

SMA* by Example





Generate children
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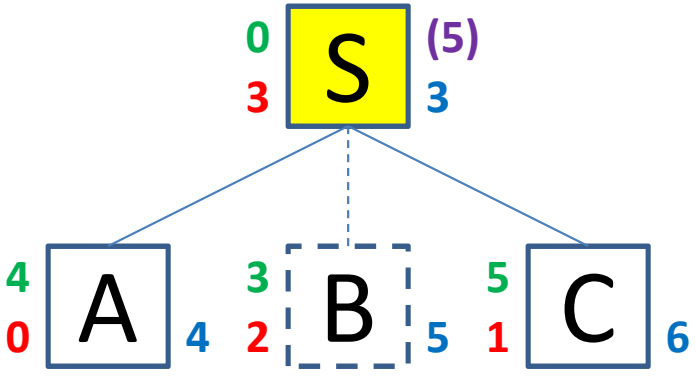
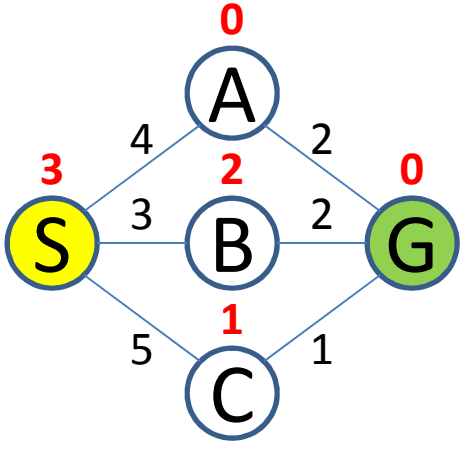
SMA* by Example

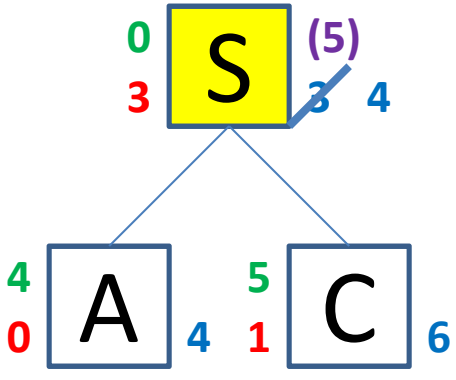


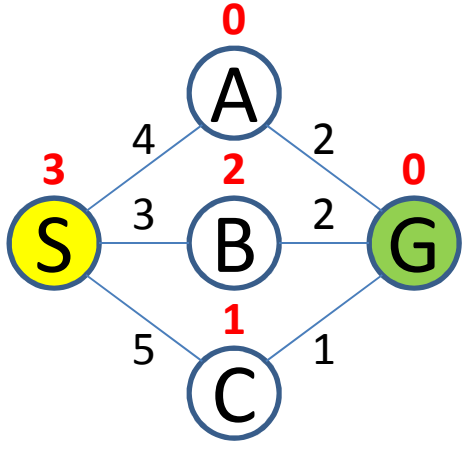


Generate children
(One by one)

Memory full

SMA* by Example

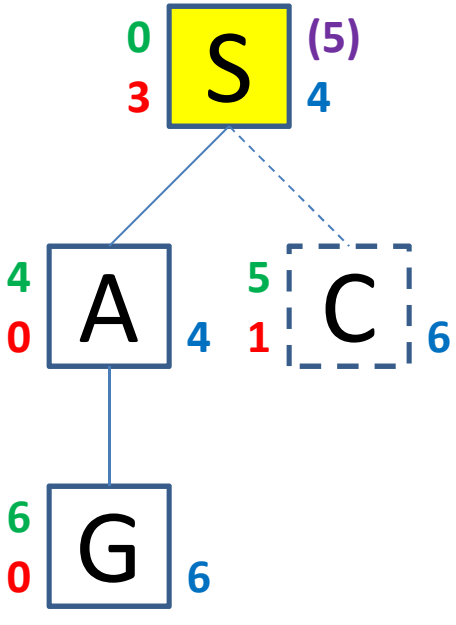


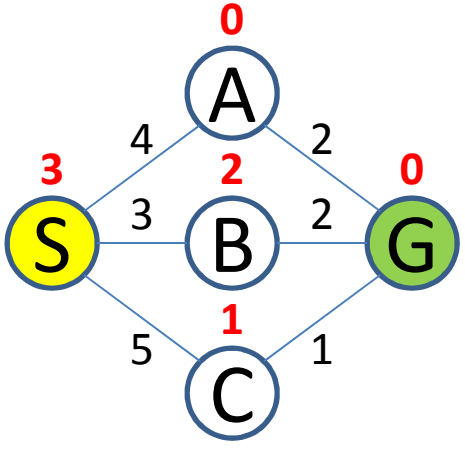


All children are explored

Adjust f-values

SMA* by Example

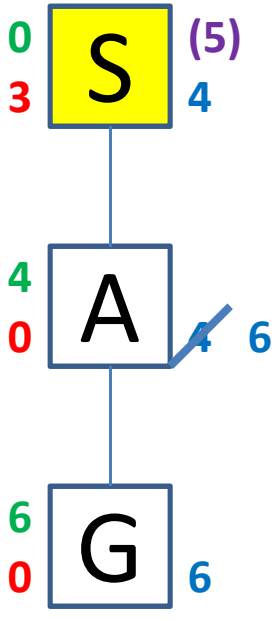


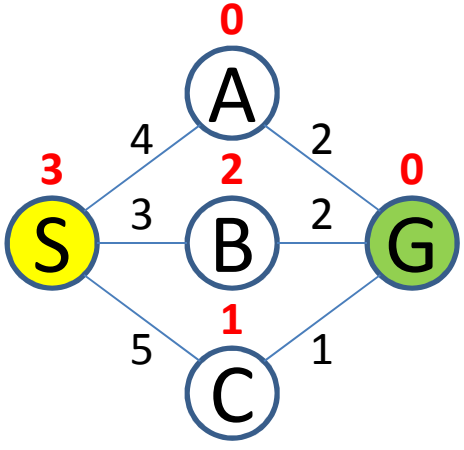


Generate children
(One by one)

Memory full

SMA* by Example

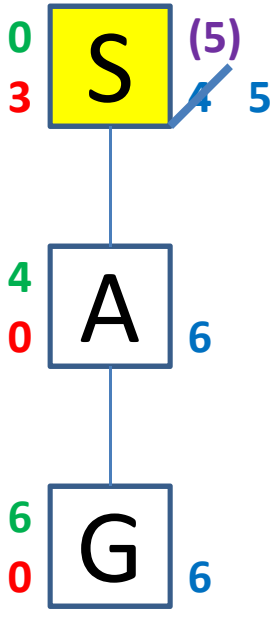


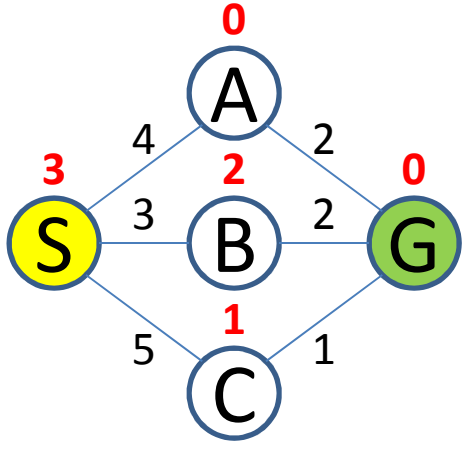


All children are explored

Adjust f-values

SMA* by Example

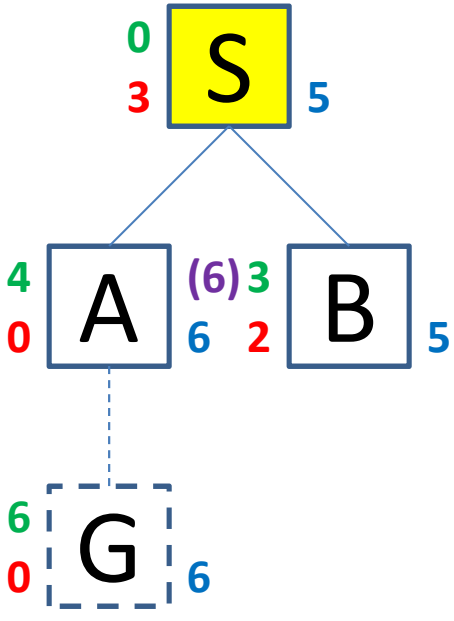


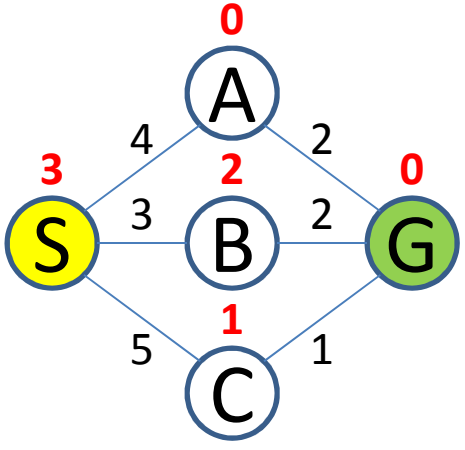


All children are explored (update)

Adjust f-values

SMA* by Example

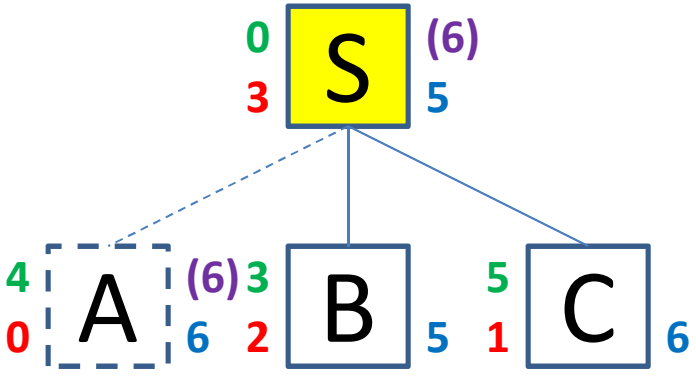


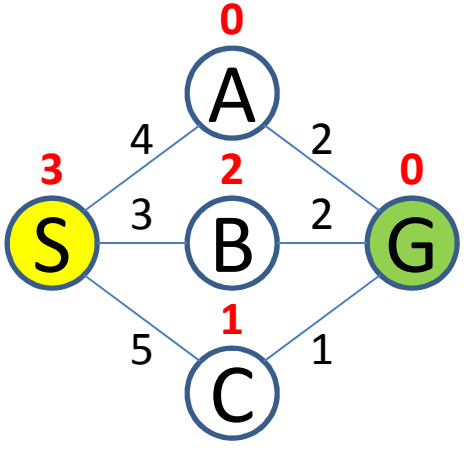


Generate children
(One by one)

Memory full

SMA* by Example

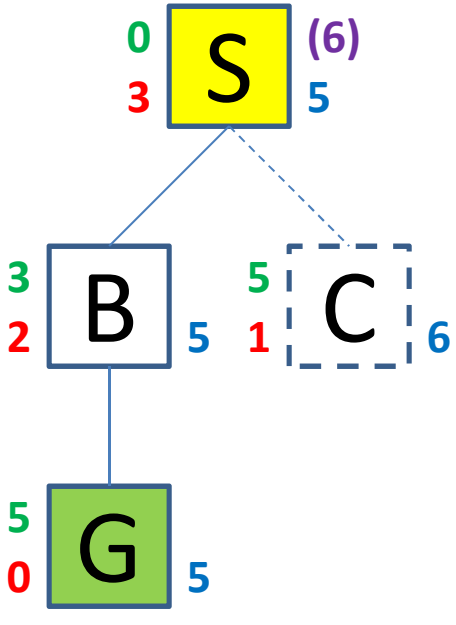


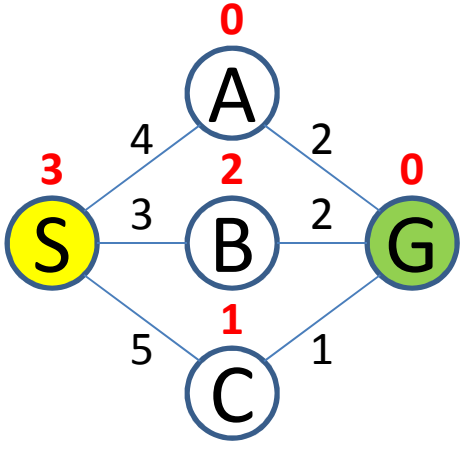


Generate children
(One by one)

Memory full

SMA* by Example





Generate children
(One by one)

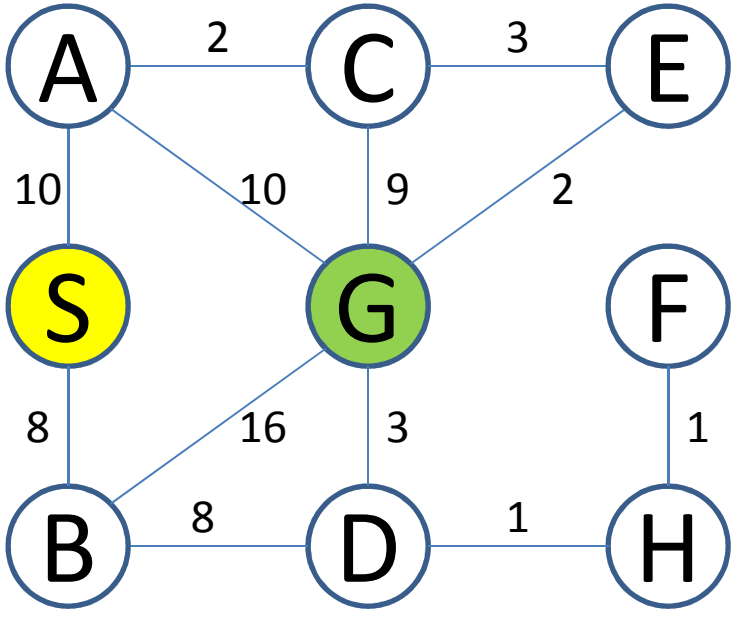
Memory full

Simplified Memory-bounded A*

PROBLEM

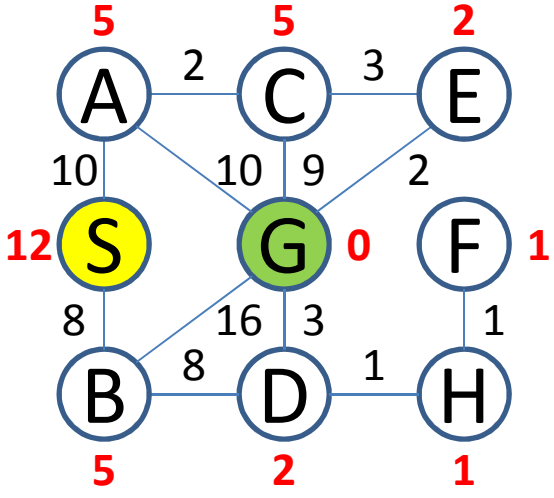
Problem

- Perform SMA* (memory: 4 nodes) on the following figure.

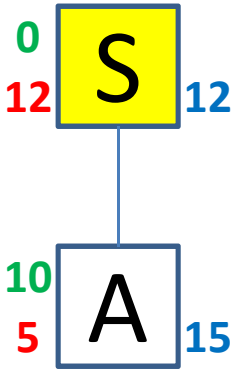


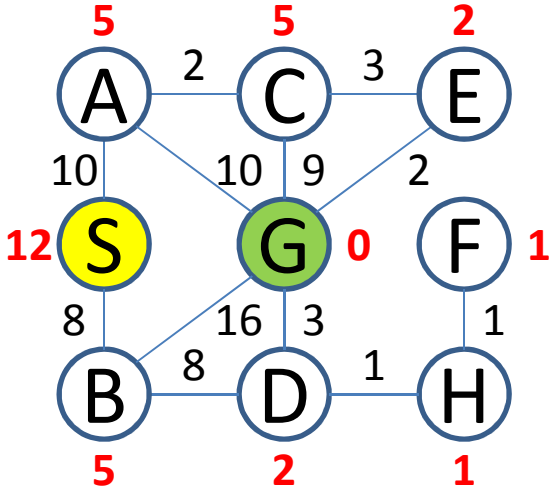
	S	A	B	C	D	E	F	H	G
heuristic	12	5	5	5	2	2	1	1	0

Problem

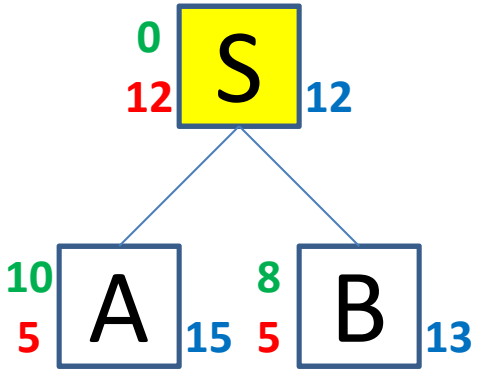


Problem





Problem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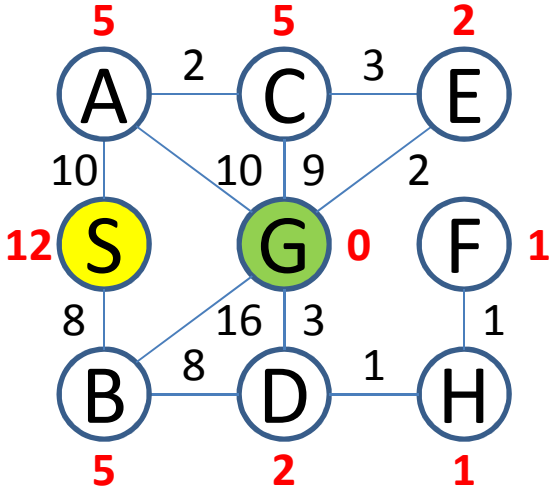
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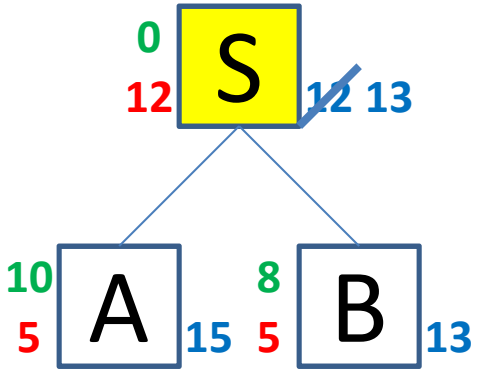
Problem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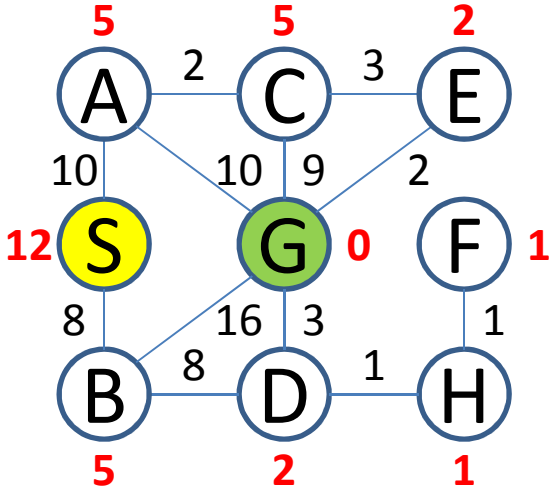
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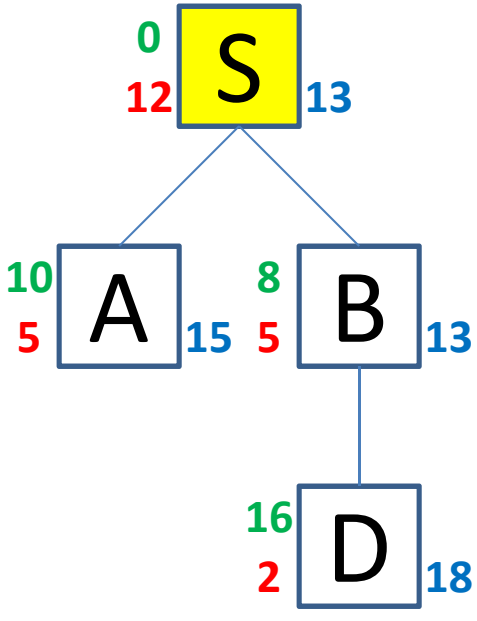
Problem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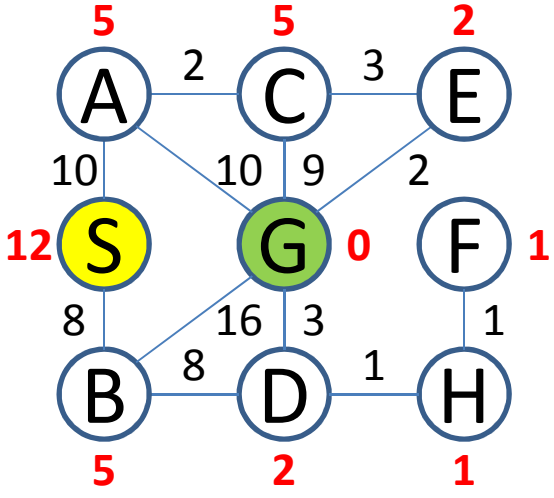
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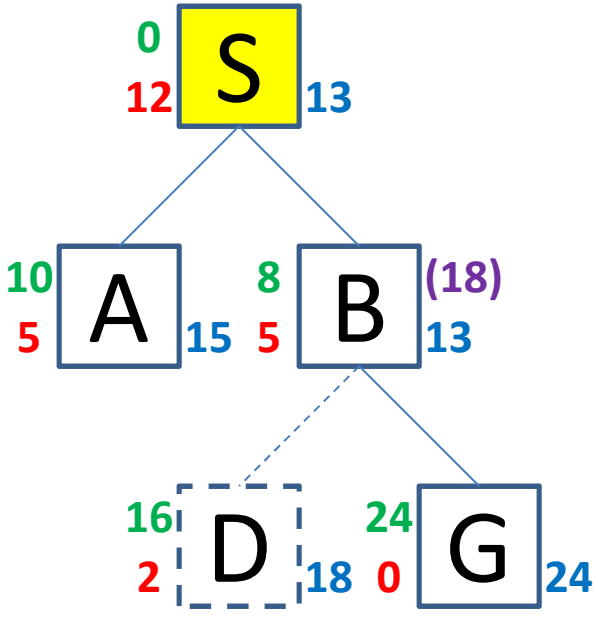
Problem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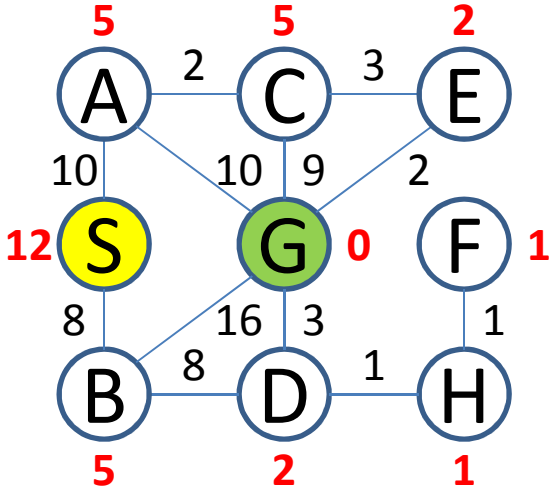
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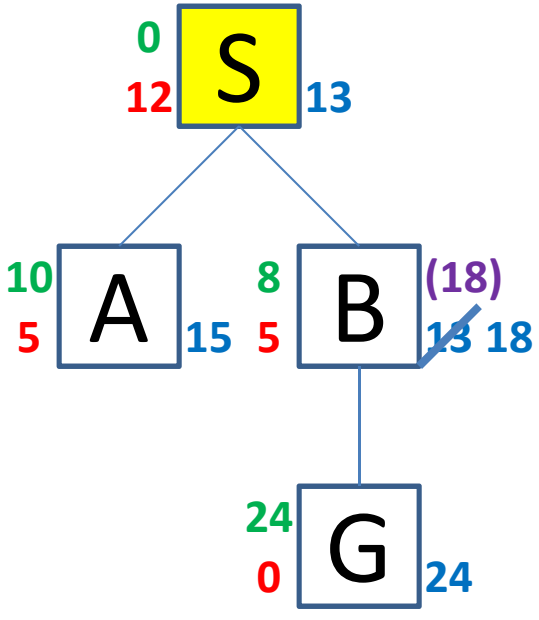
Problem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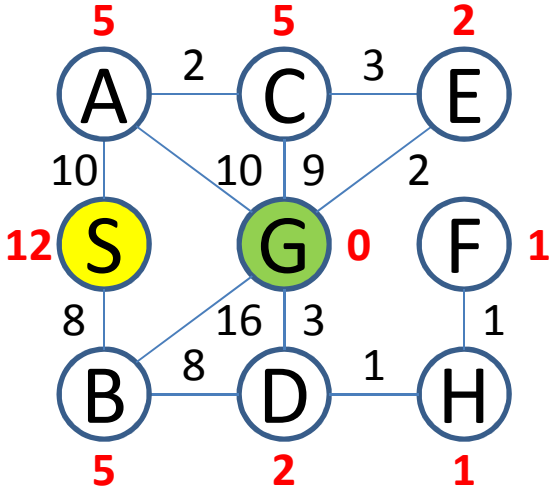
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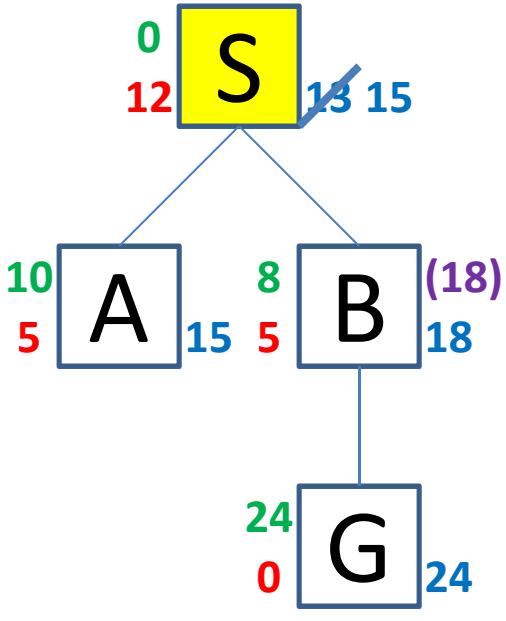
Problem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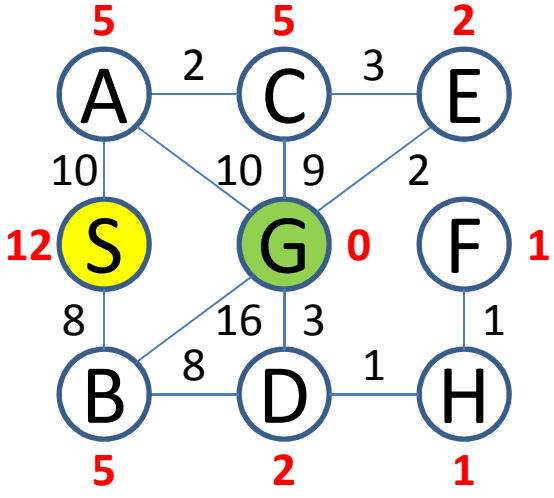
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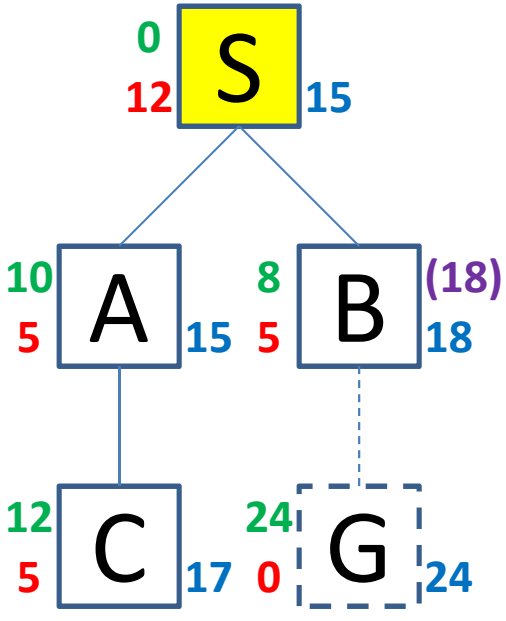
Problem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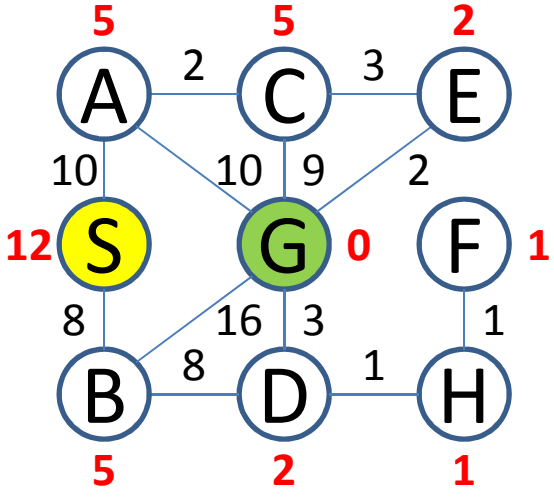
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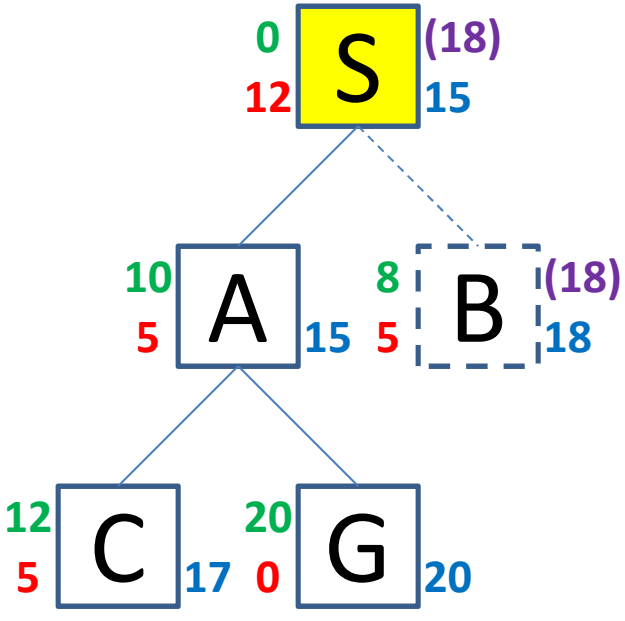
Problem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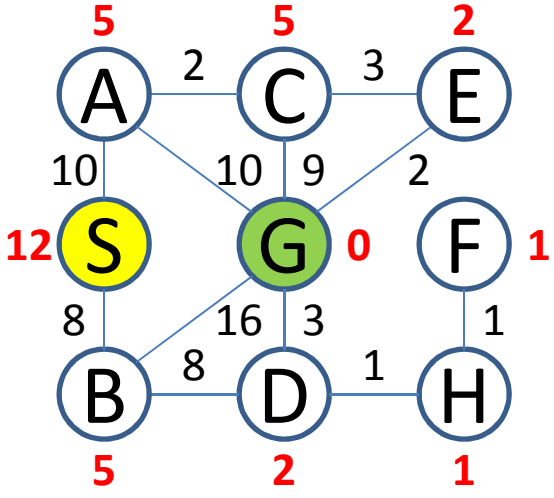
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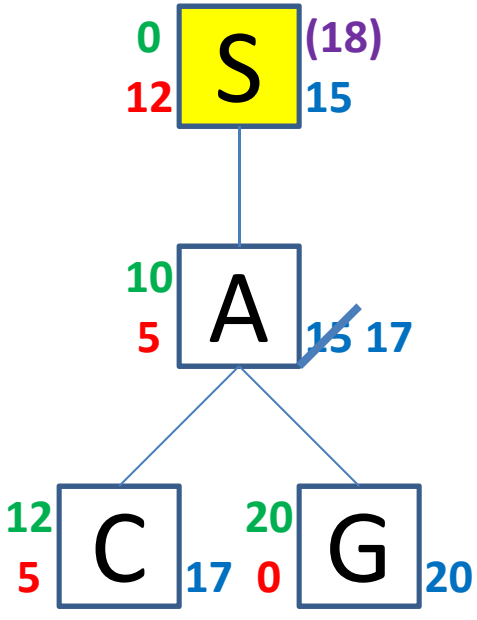
Problem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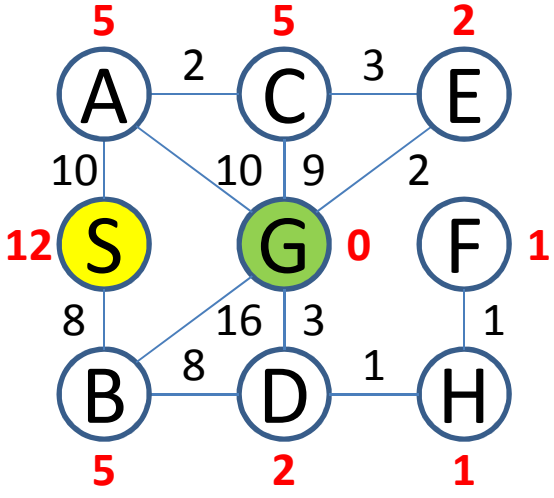
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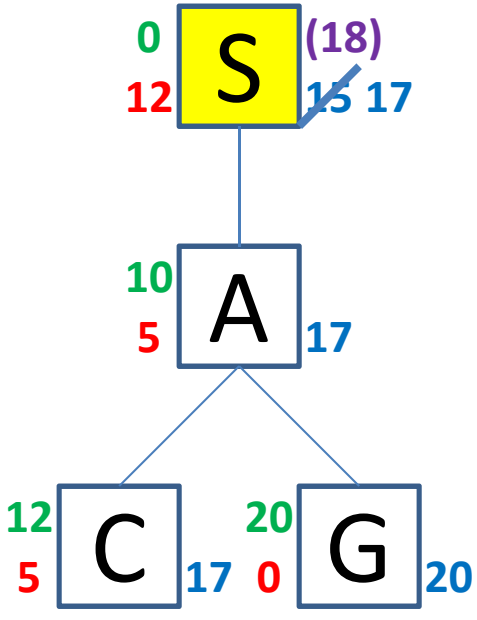
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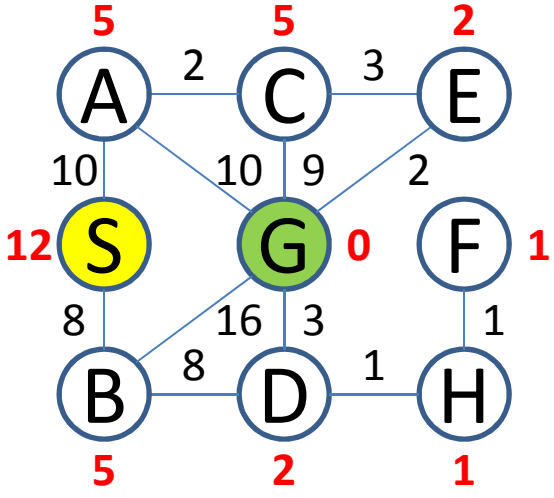
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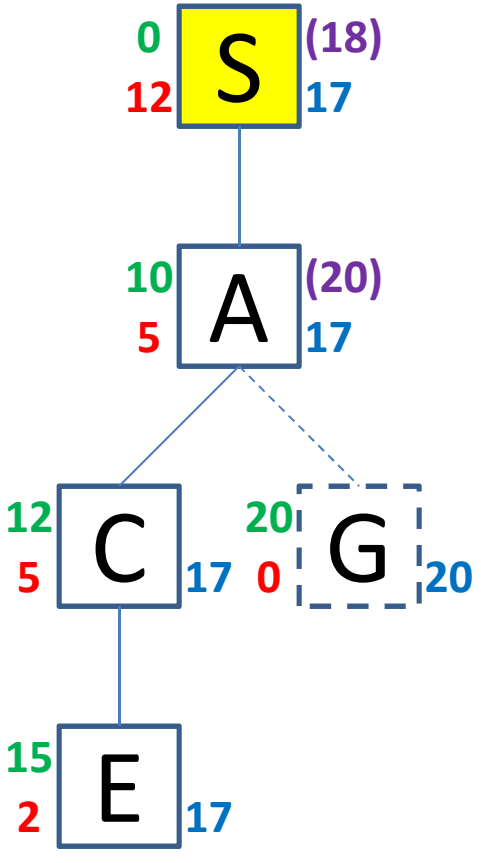
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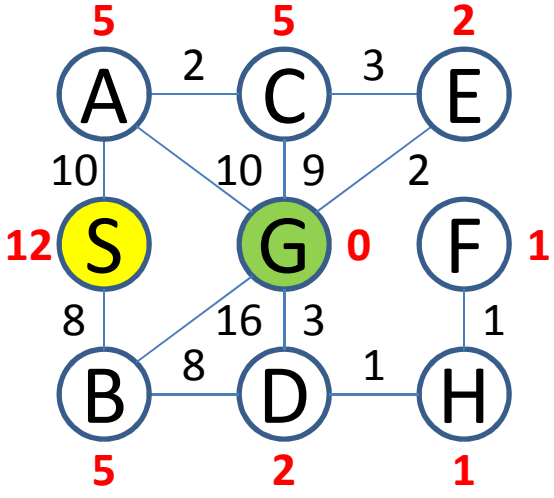
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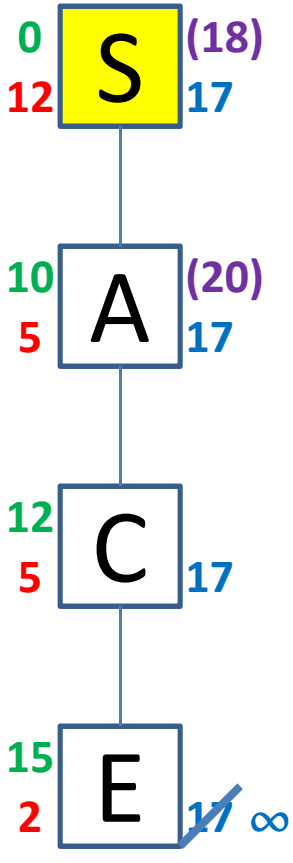
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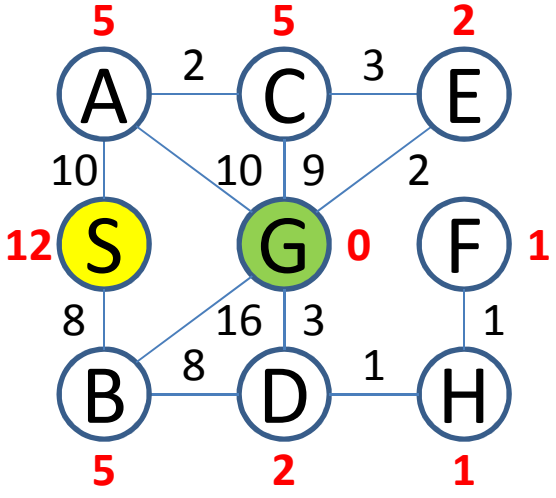
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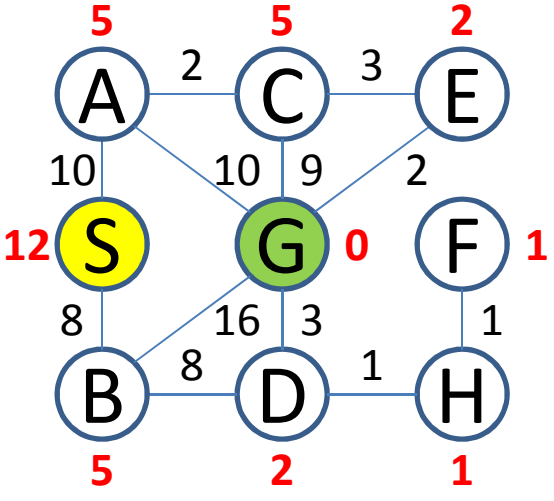
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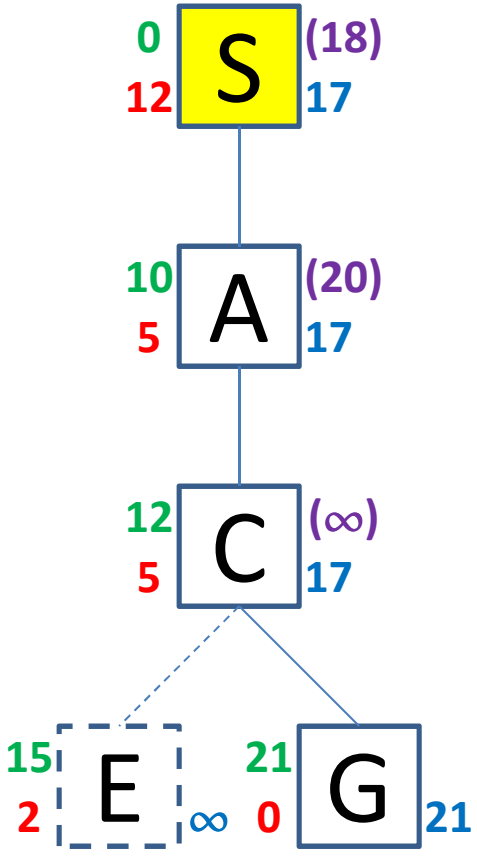
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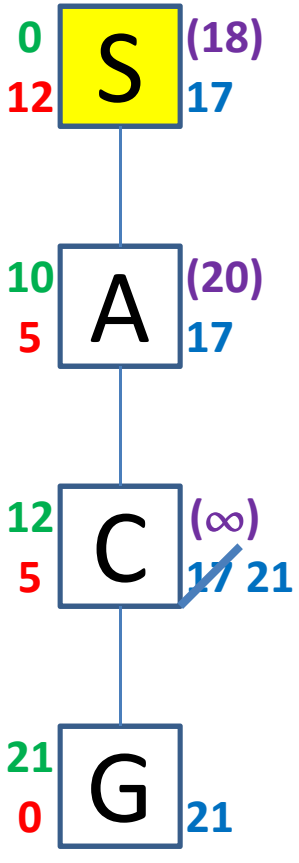
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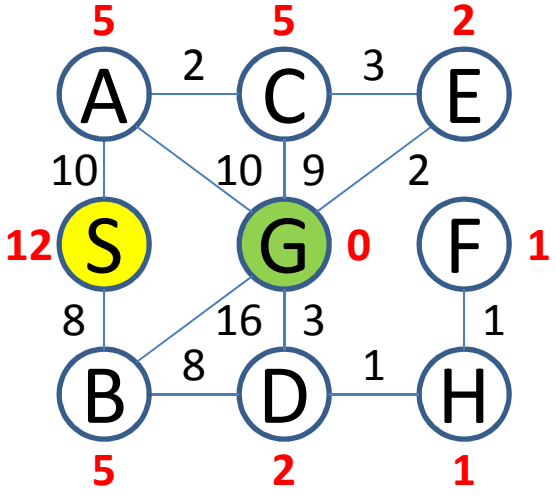
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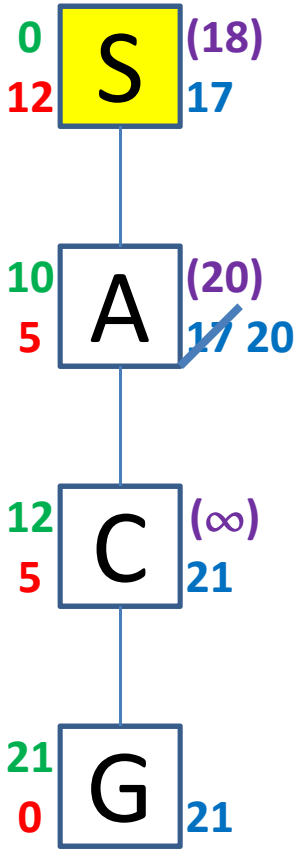
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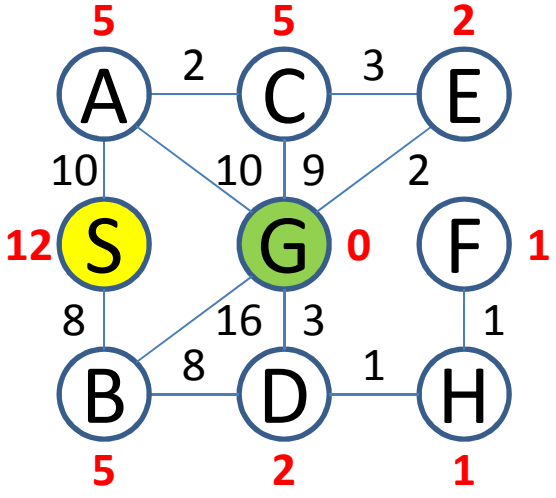
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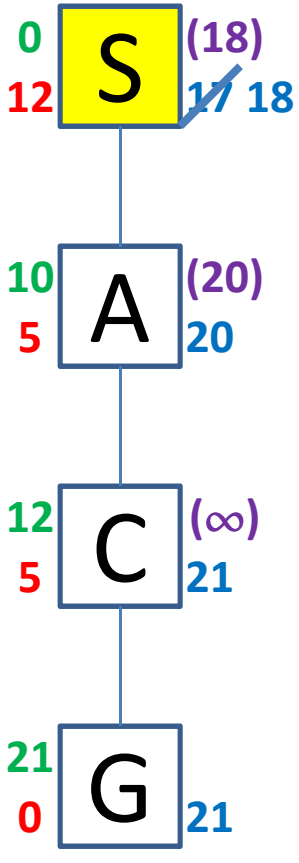
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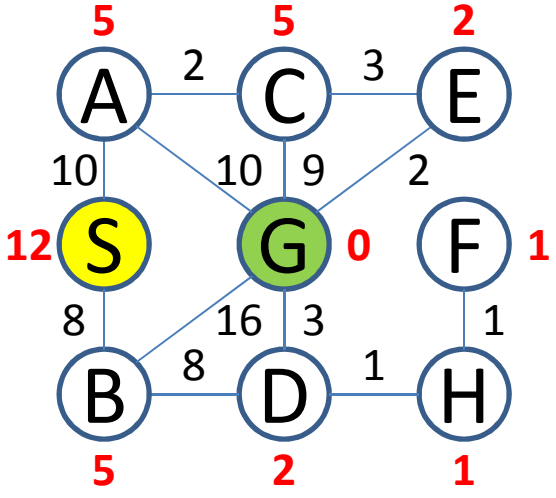
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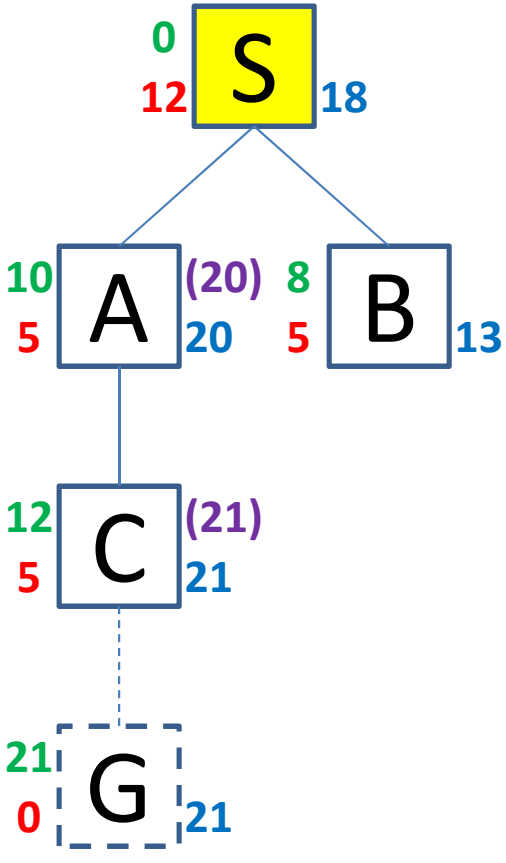
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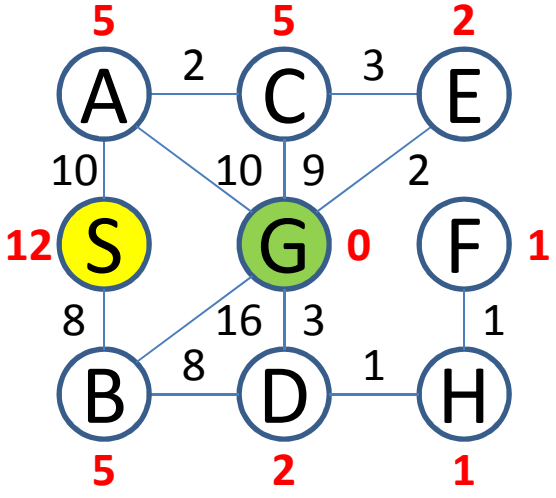
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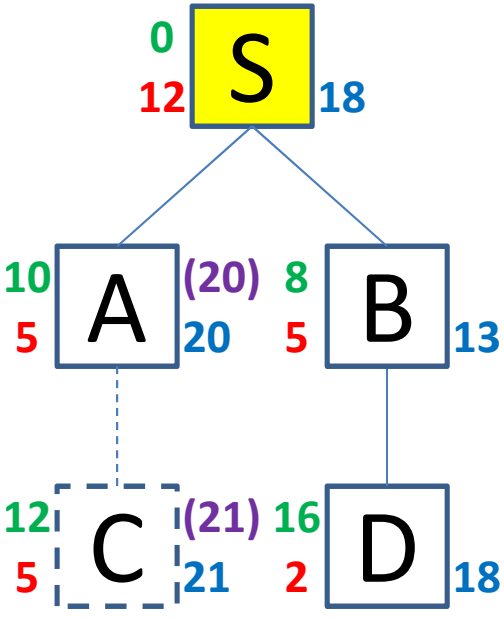
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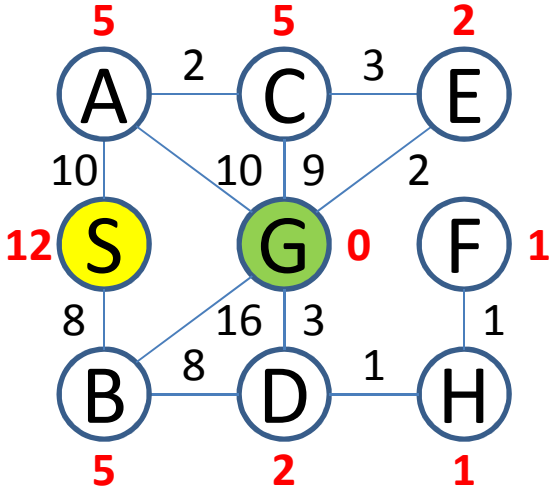
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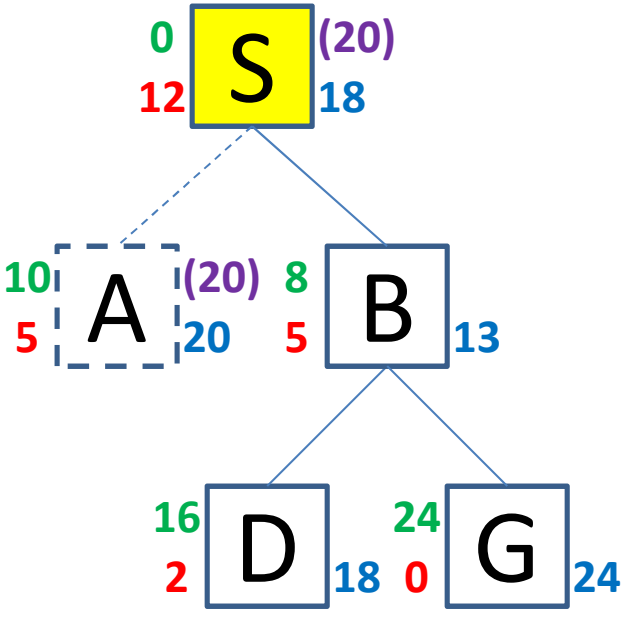
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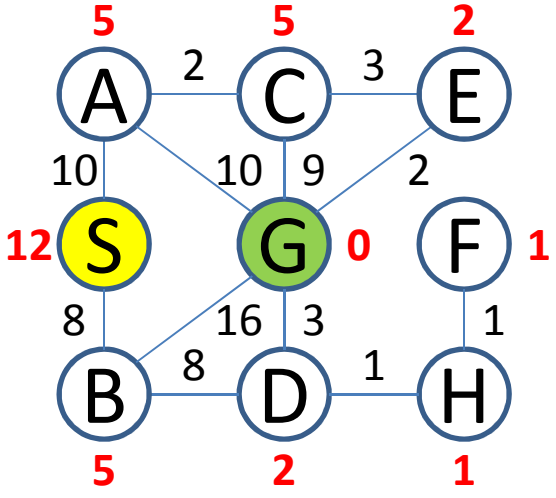
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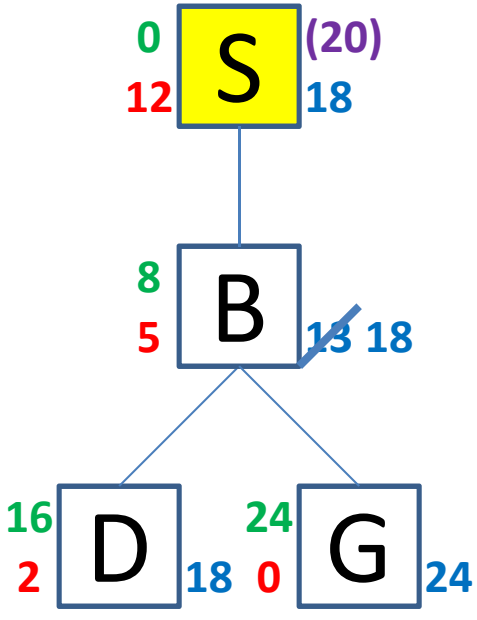
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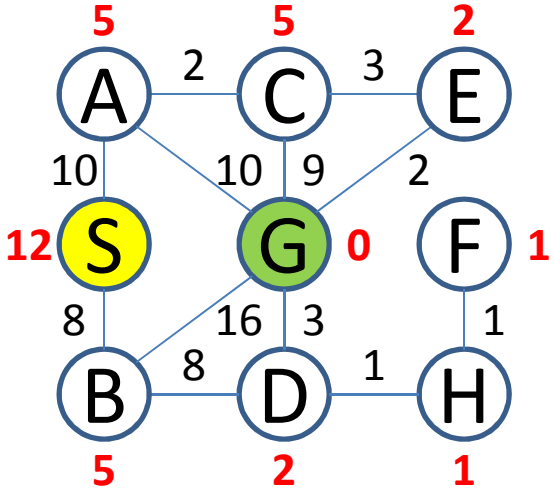
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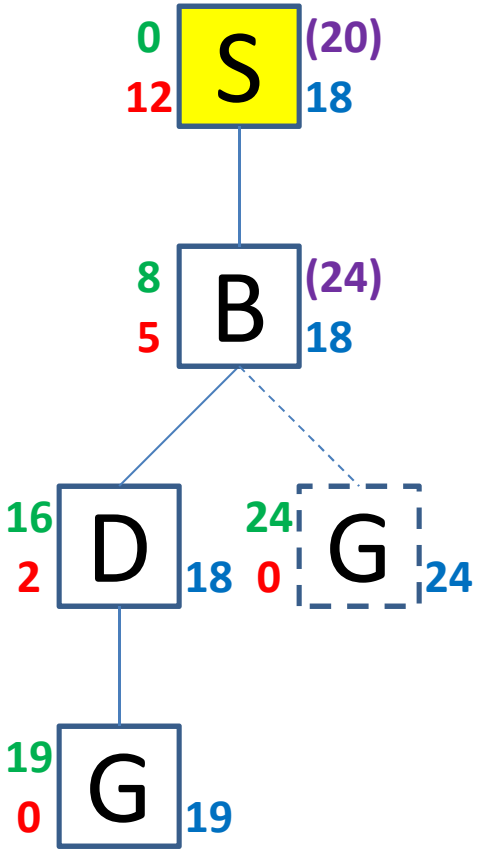
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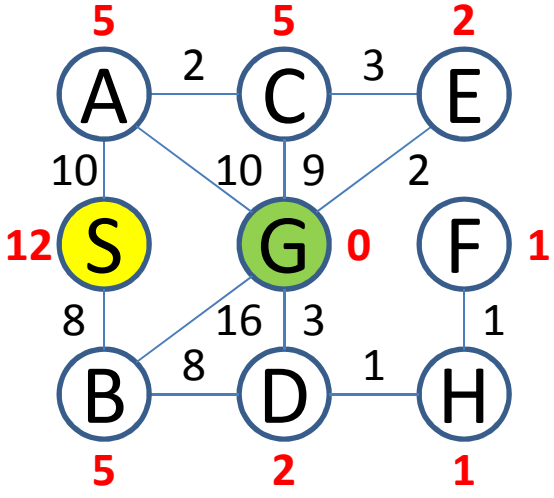
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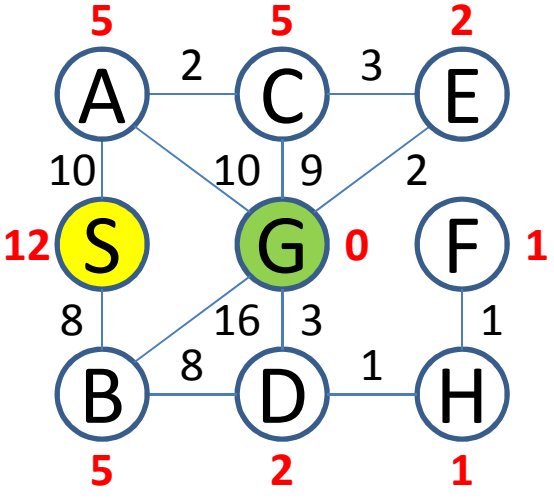
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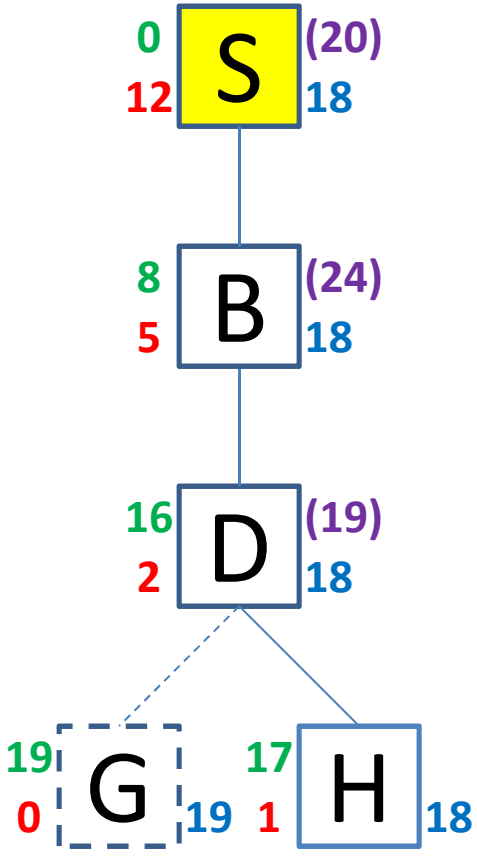
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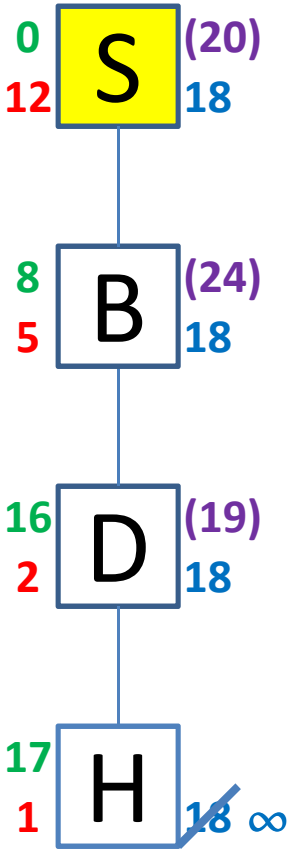
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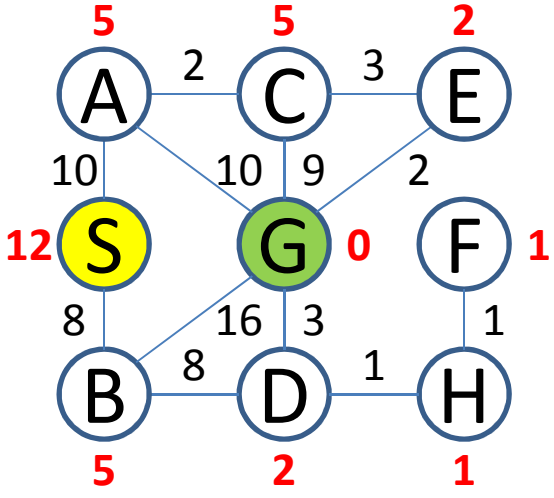
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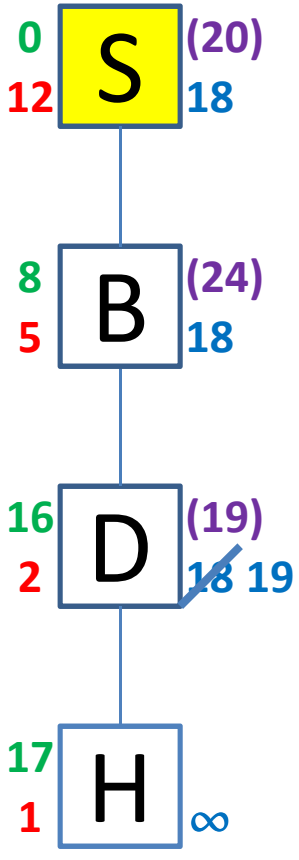
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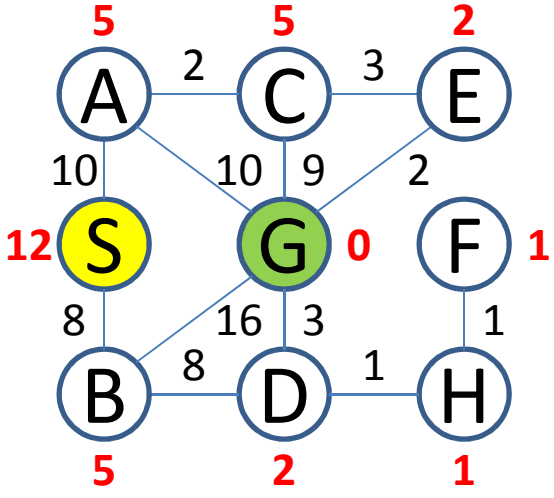
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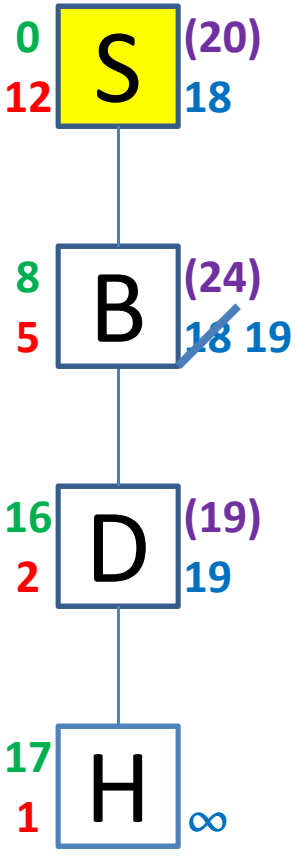
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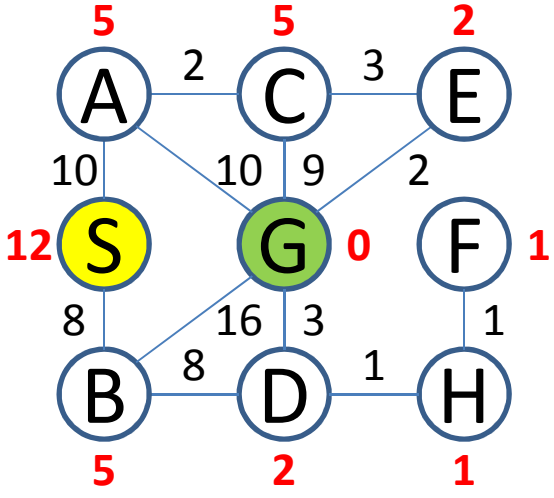
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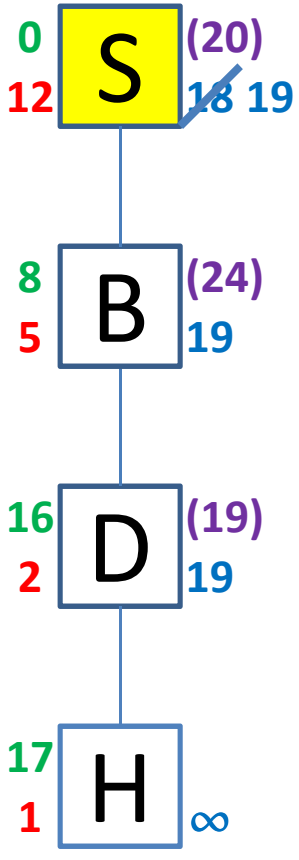
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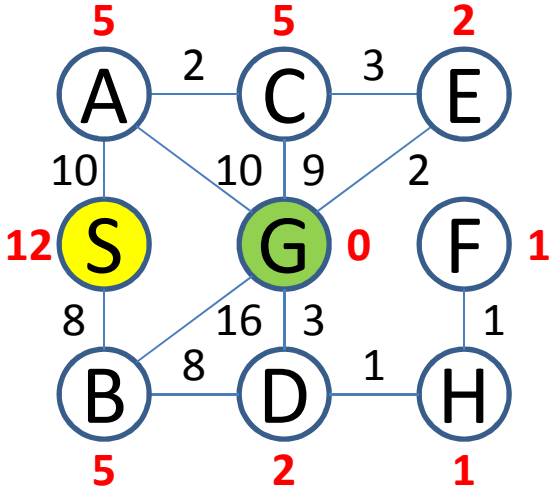
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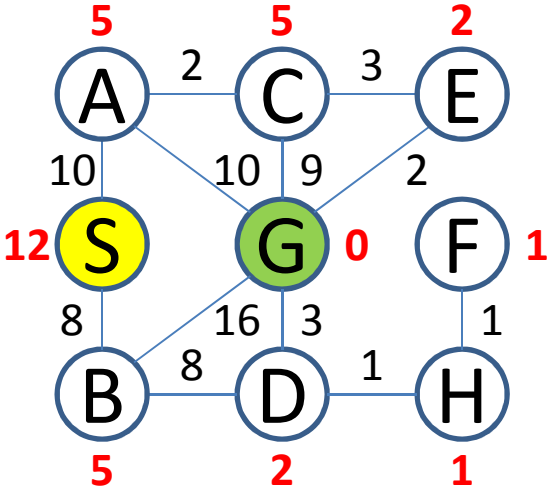
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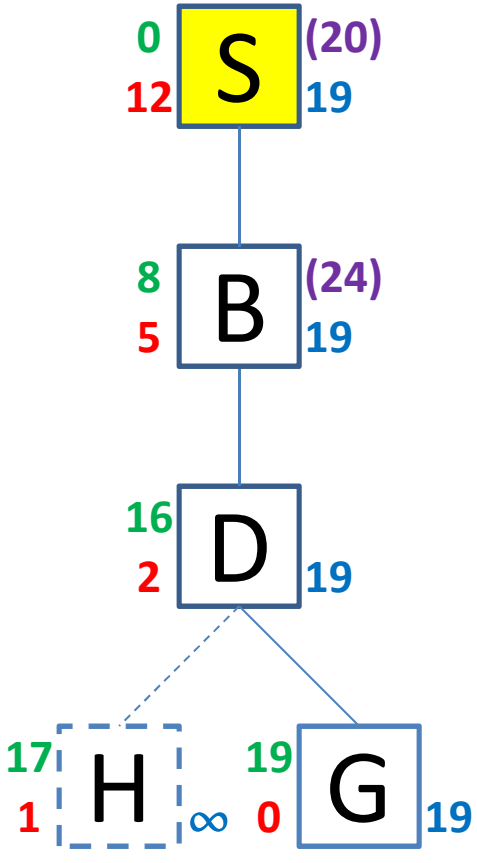
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H
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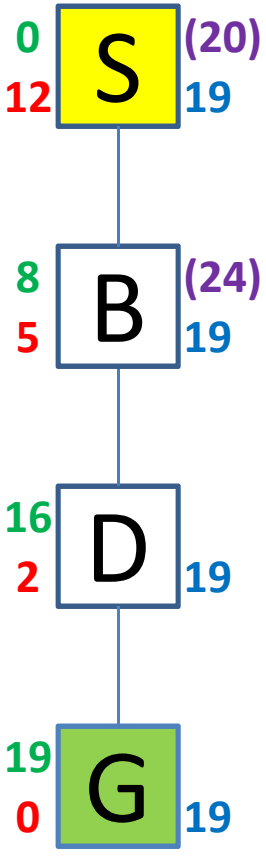
Problem


0
12
S
(20)
19
8
5
B
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16
2
D
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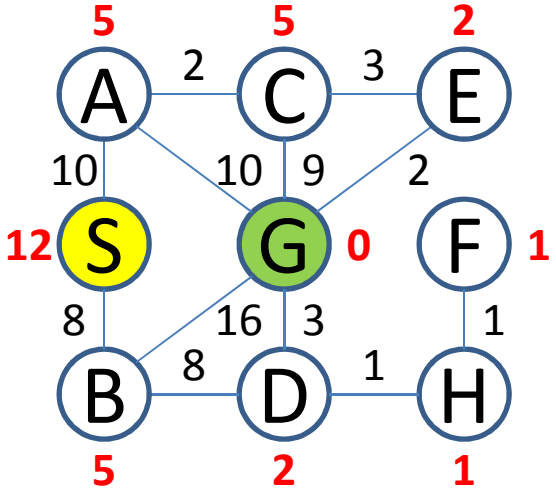
19
0
G
19


5
5
2
A
2
C
3
E
10
10
9
2
12
S
G
0
F
1
8
16
3
1
8
1
B
D
H
5
2
1