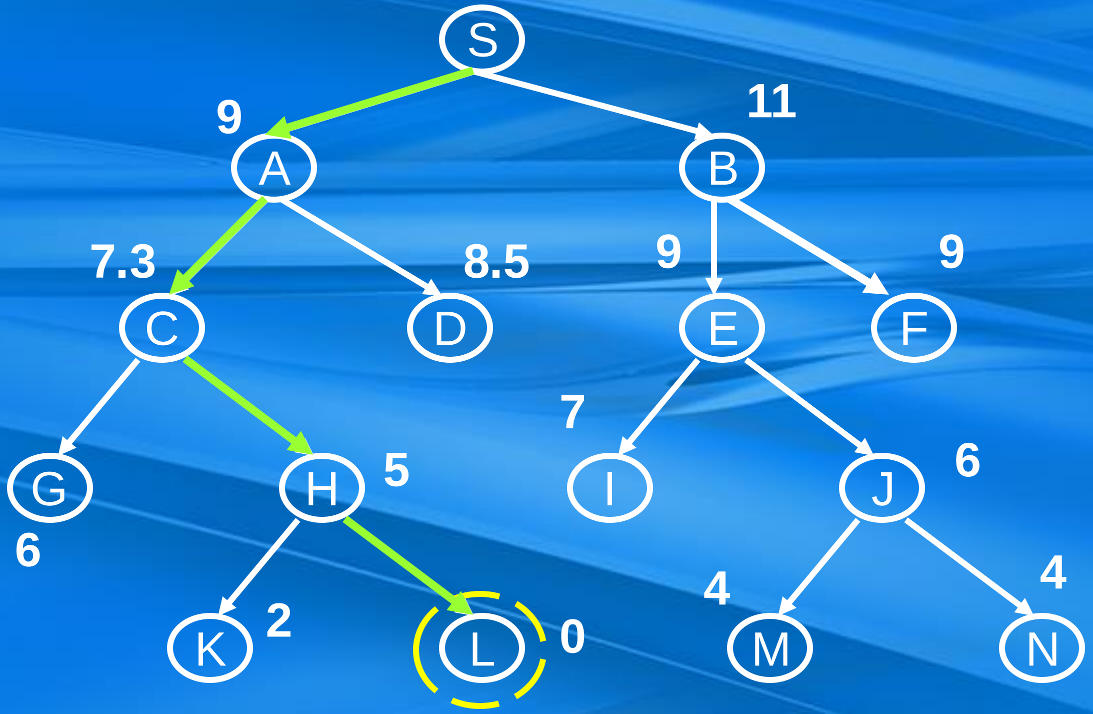
Best First Search



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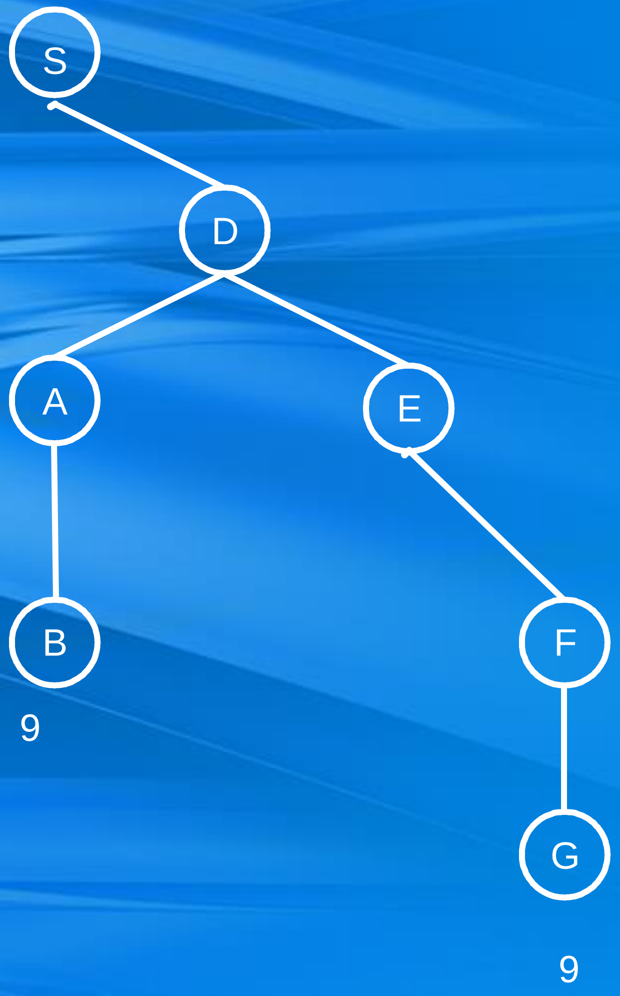
Optimal Search

- British Museum search
  - Look for each and every possible solution then compare them to get best solution.
- Branch and Bound
- Adversarial search

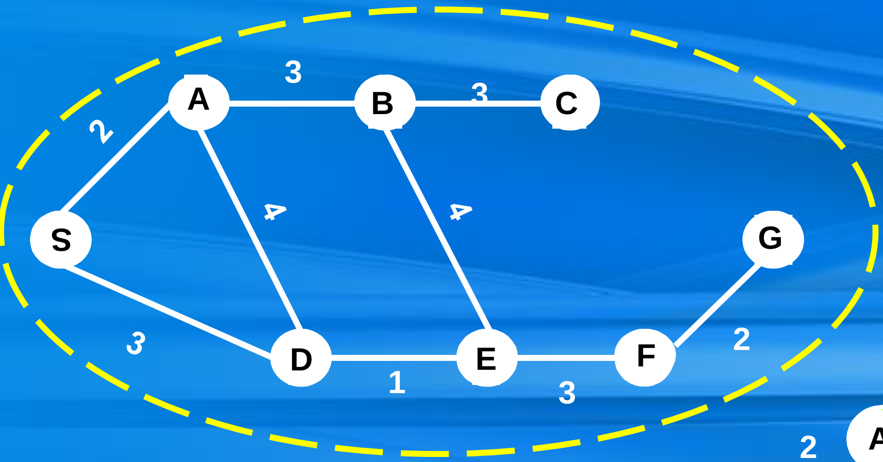
Branch and Bound
Basic Observation

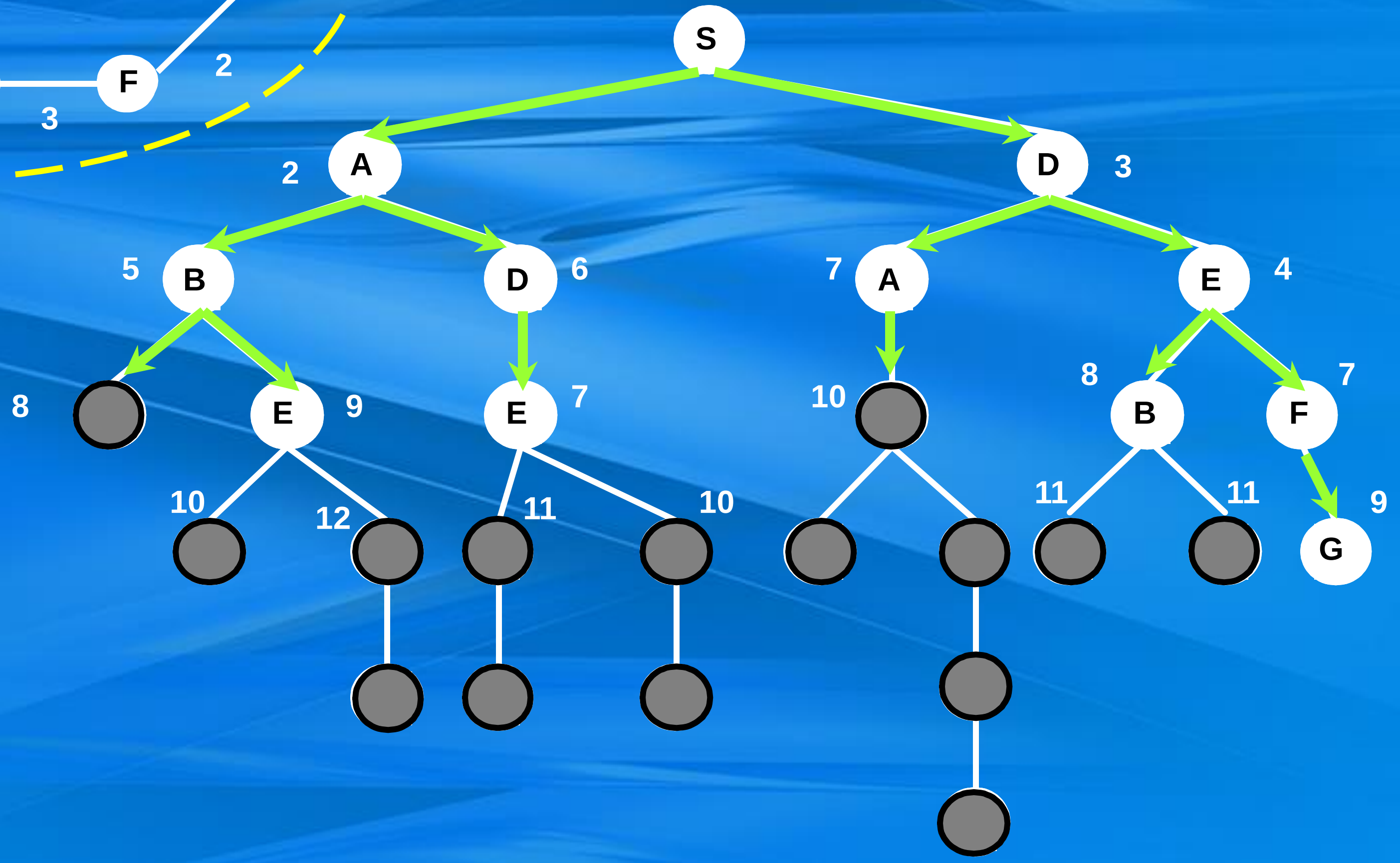
The length of complete path from S to G, S-D-E-F-G is 9

Similarly the length of the partial path S-D-A-B also is 9 and any additional movement along a branch will make it longer than 9

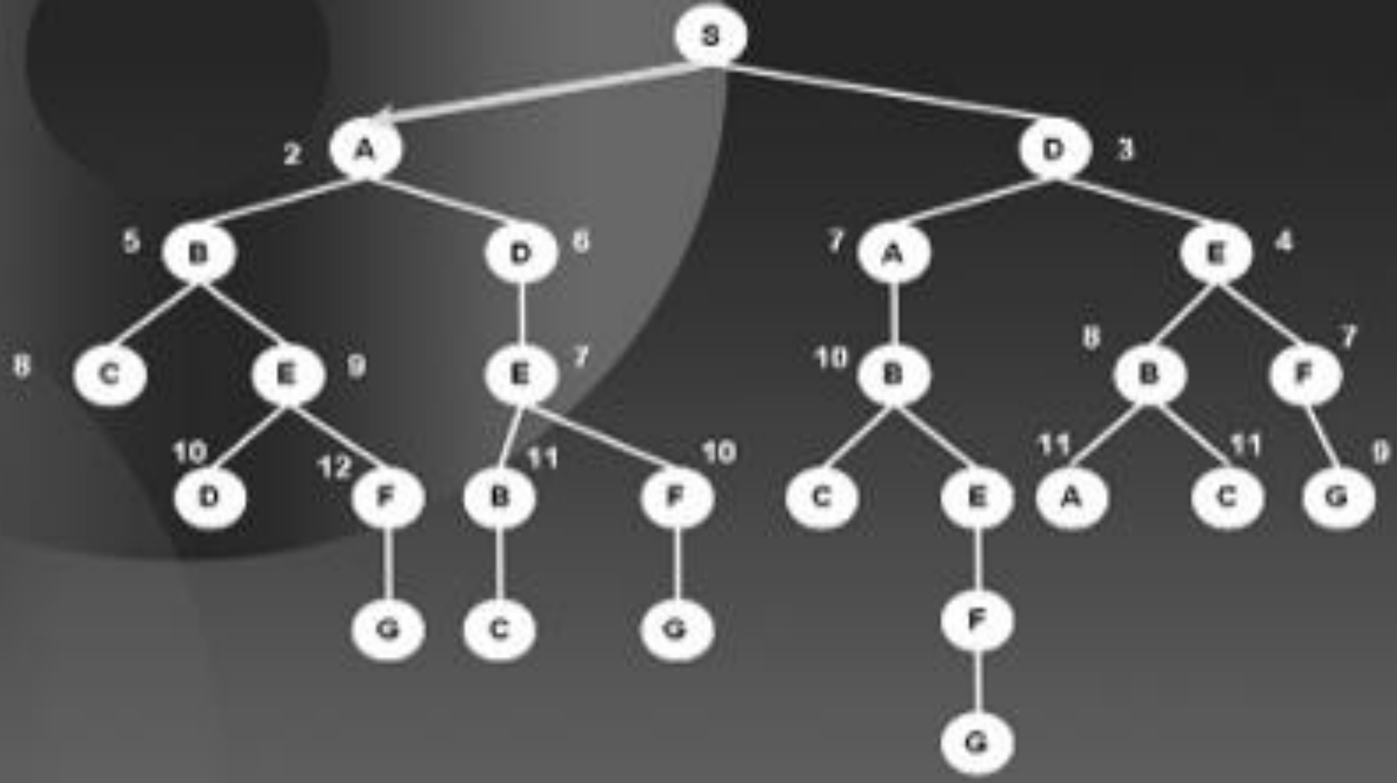


Branch and Bound



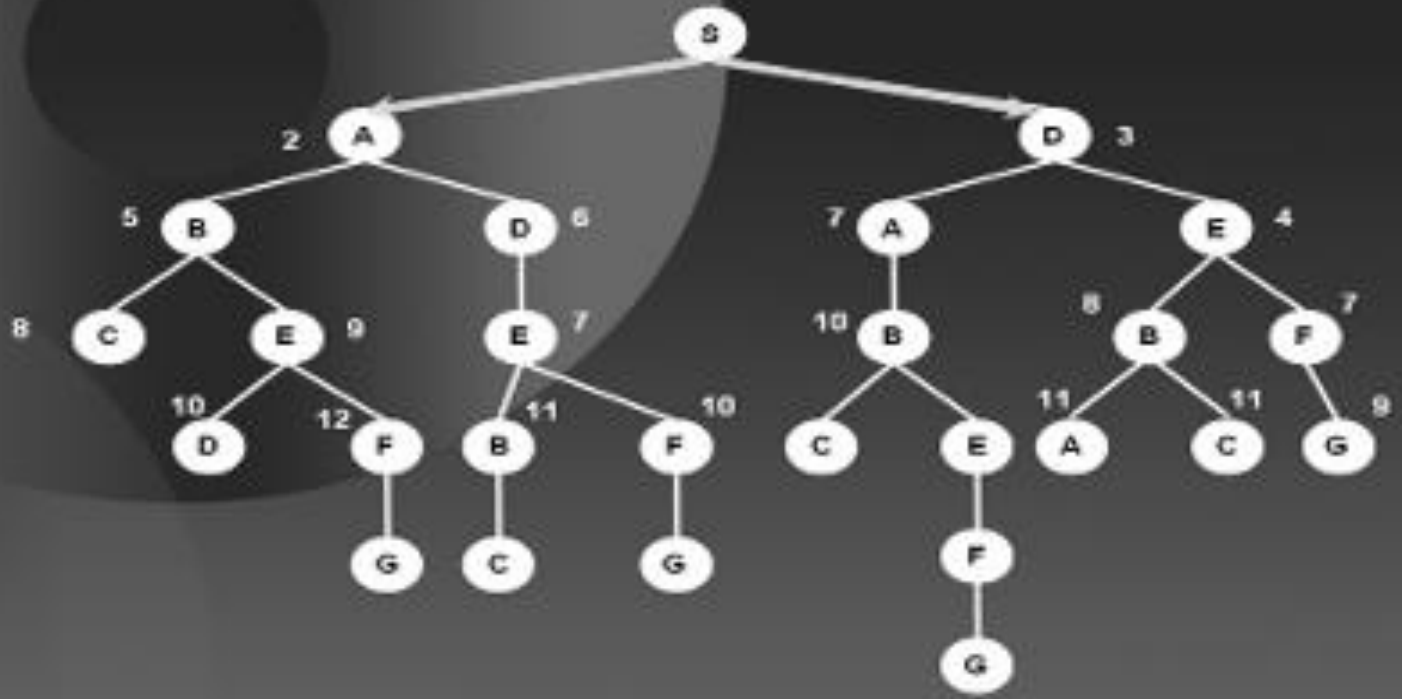


Branch and Bound



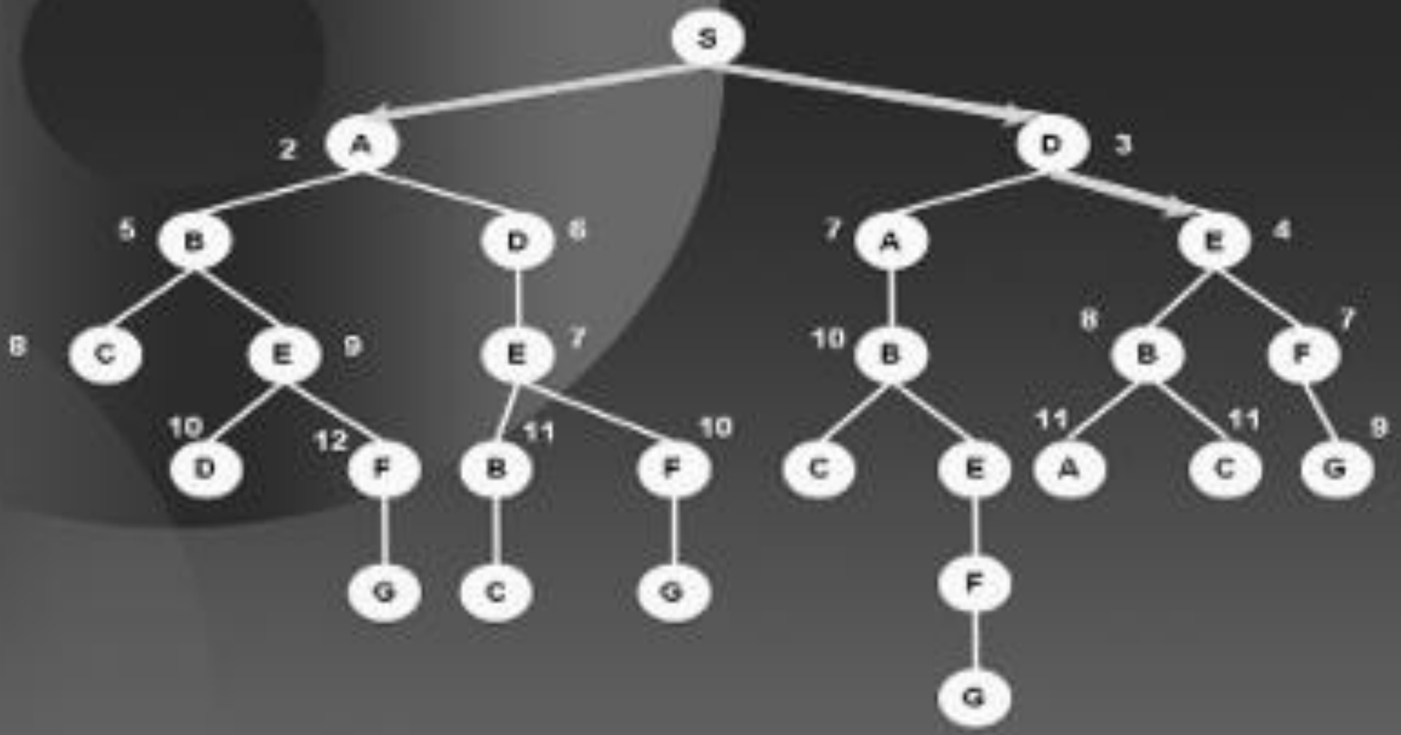
From S the options to travel are B and D, the children of A and D the child of S. Among these, D the child of S is the best option. So we explore D.

Branch and Bound

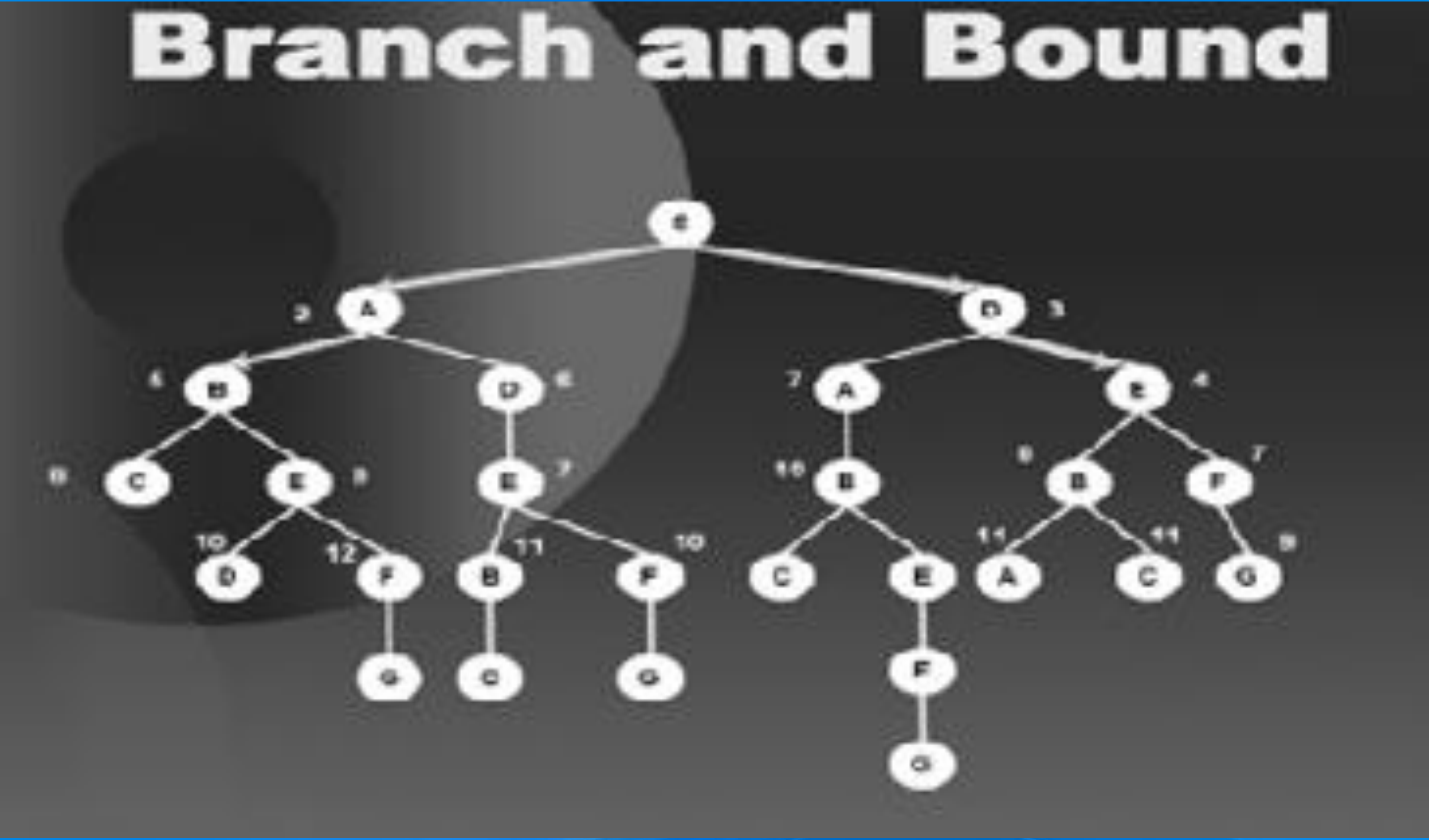


From here the best option is E so we go there,

Branch and Bound

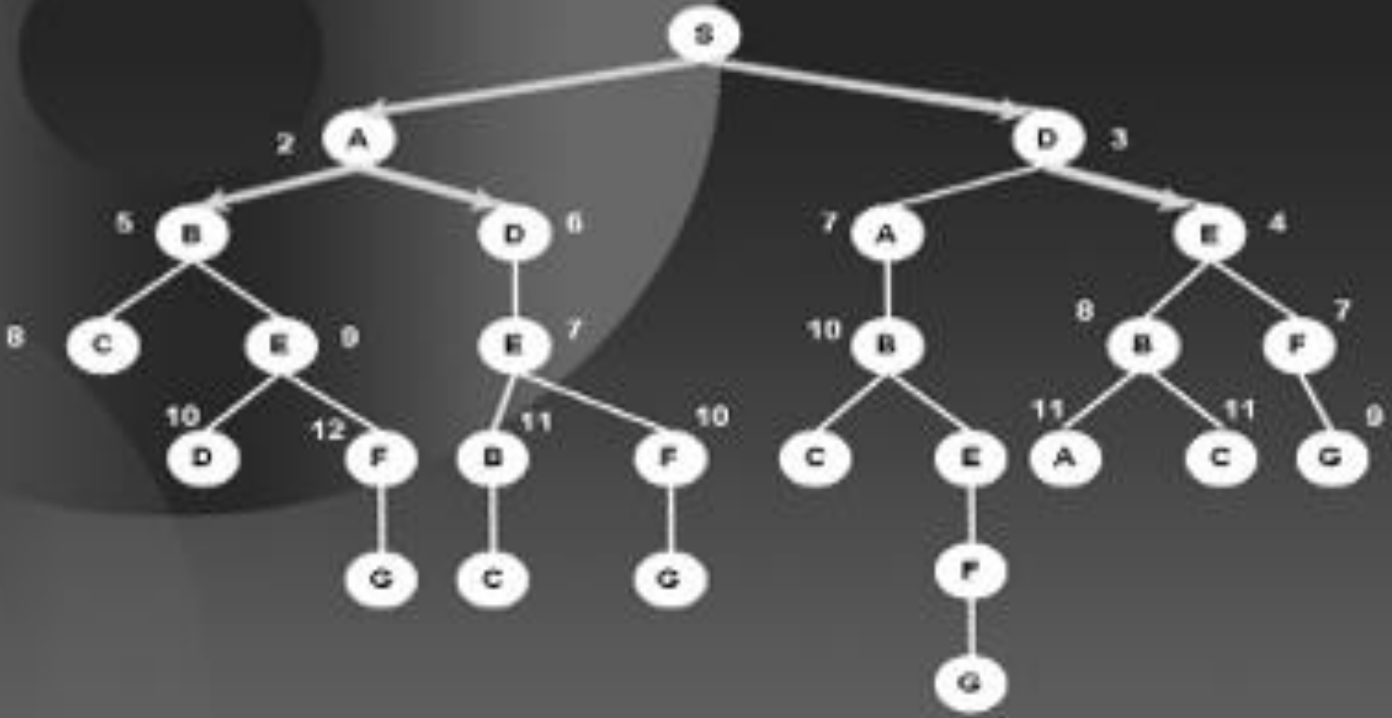


then B,

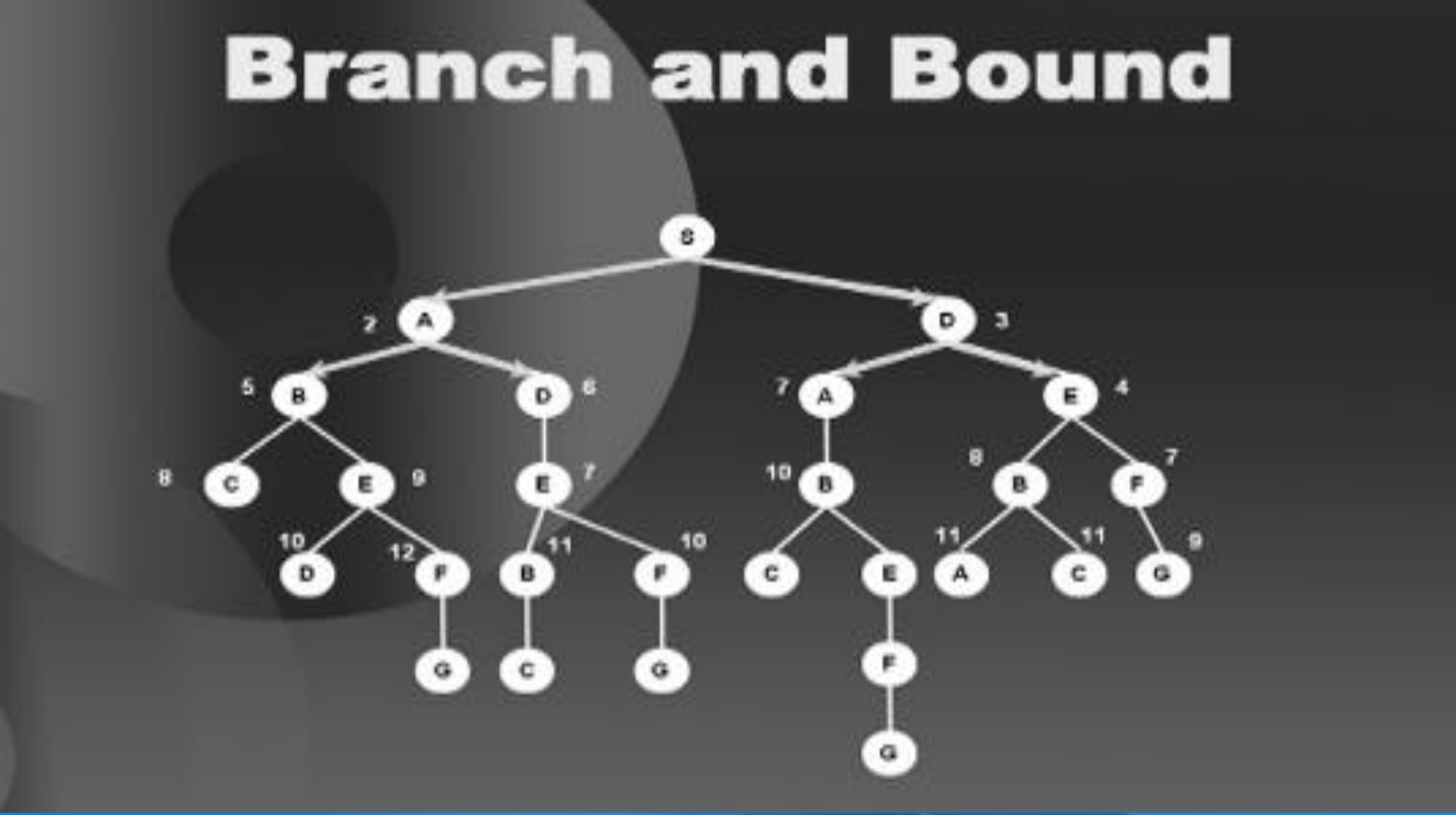

Branch and Bound
S
3
A
D
3
4
B
D
6
7
A
E
4
8
C
E
9
E
7
10
B
5
B
F
7
10
D
12
F
B
11
F
10
C
E
11
A
11
C
9
G
G
G
G
F
G

then D

Branch and Bound

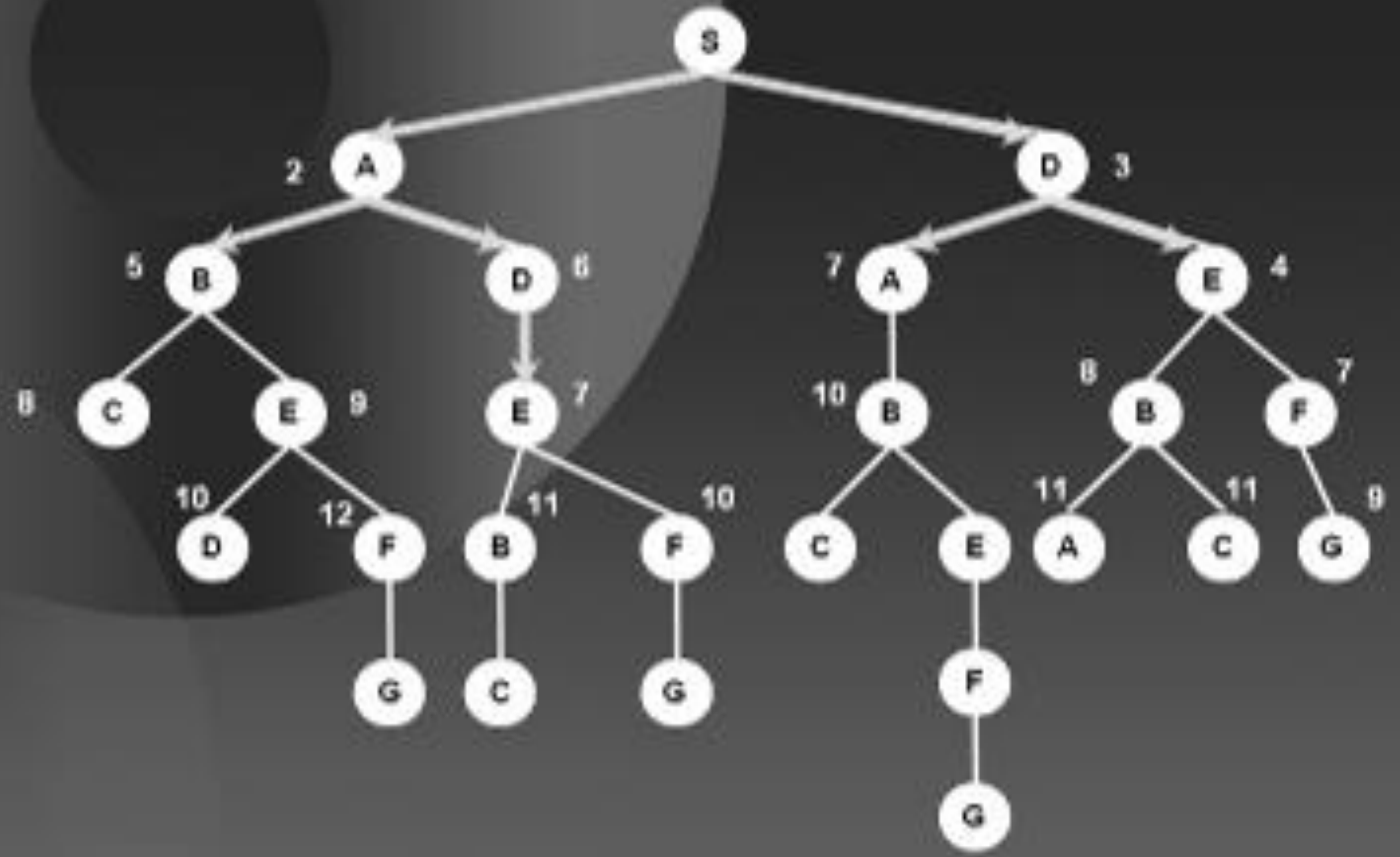


Here we have E, F and A as equally good options so we select arbitrarily and move to say A,


Branch and Bound
S
2 A
D 3
5 B
D 6
7 A
E 4
8 C
E 9
E 7
10 B
8 B
F 7
10 D
12 F
B 11
F 10
C
E
11 A
C 11
G 9
G
C
G
F
G

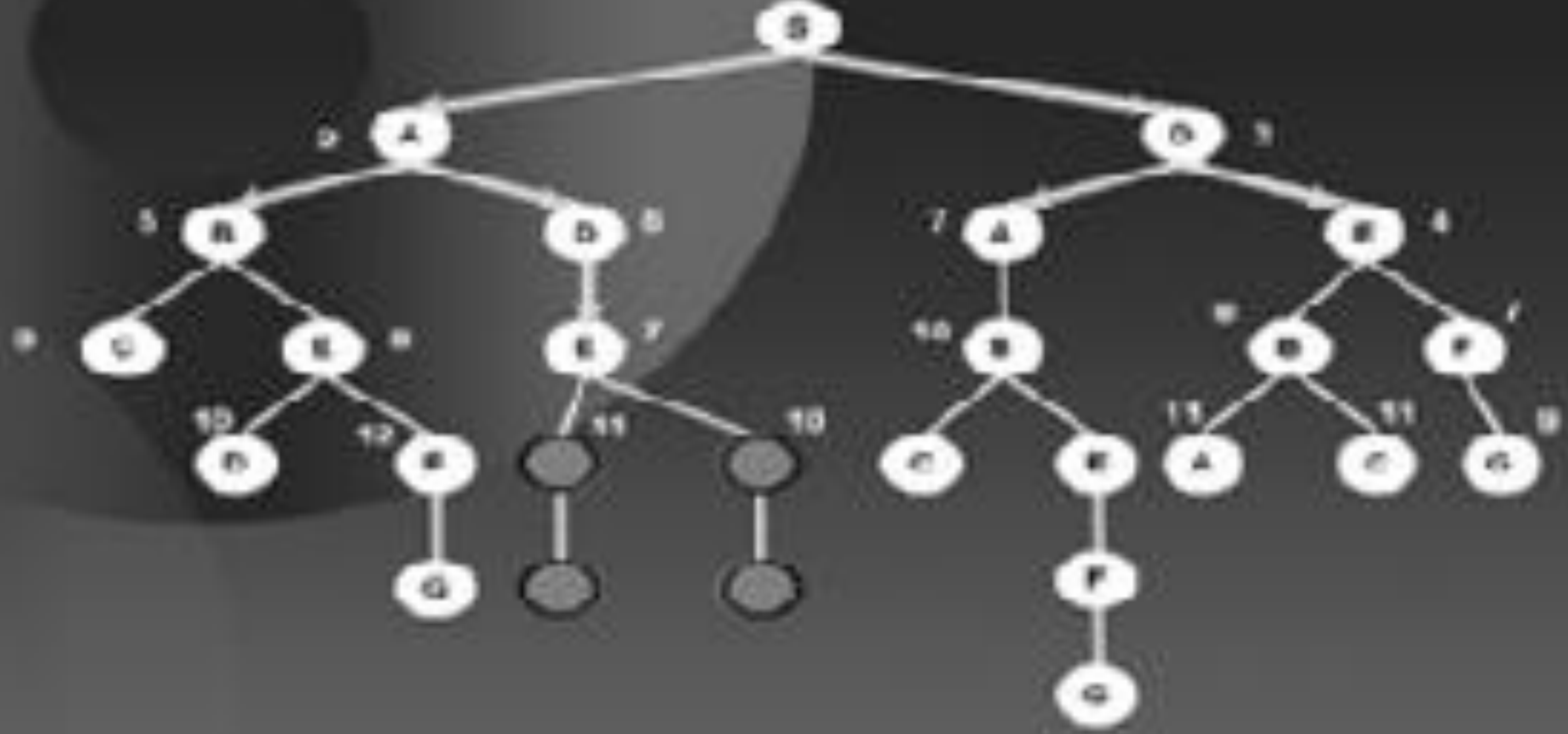
then E.

Branch and Bound



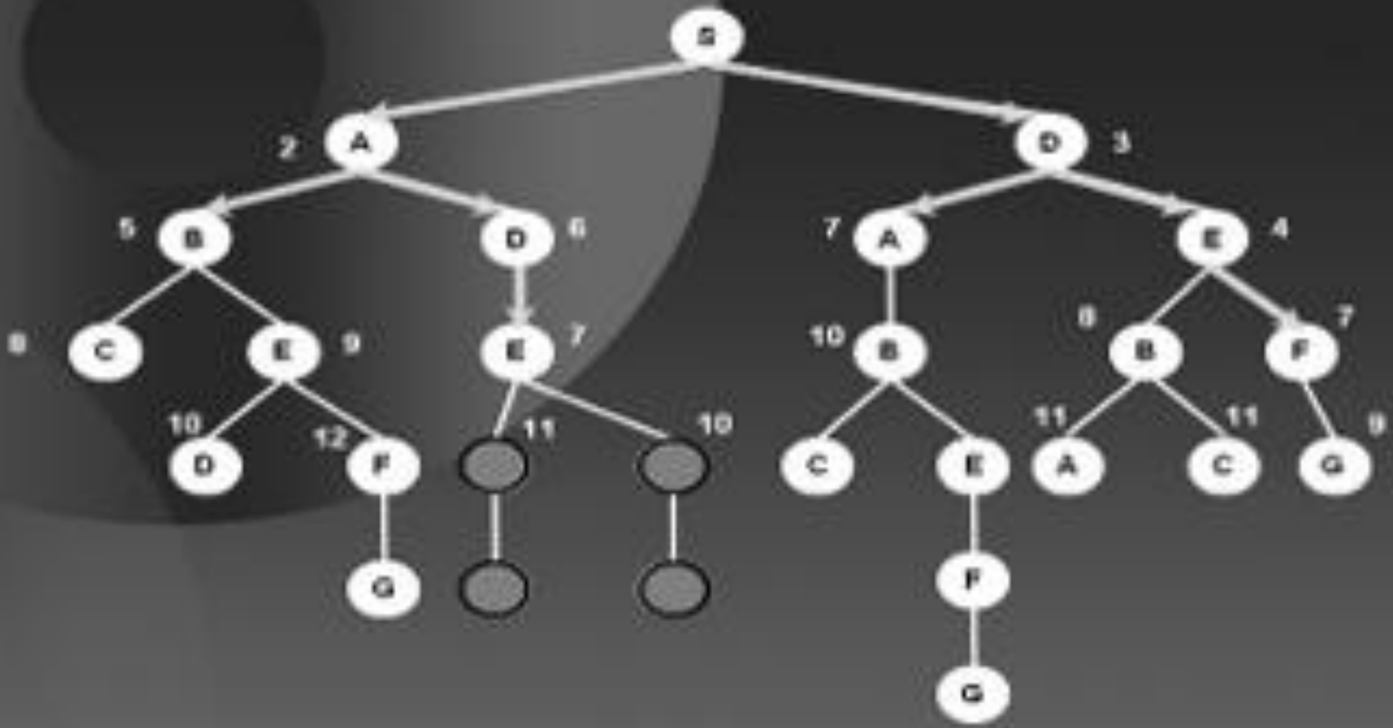
we explore E we find out that if we follow this path further, our path length will increase beyond 9 which is the distance of S to G. we block all the further sub-trees along this paths.

Branch and Bound



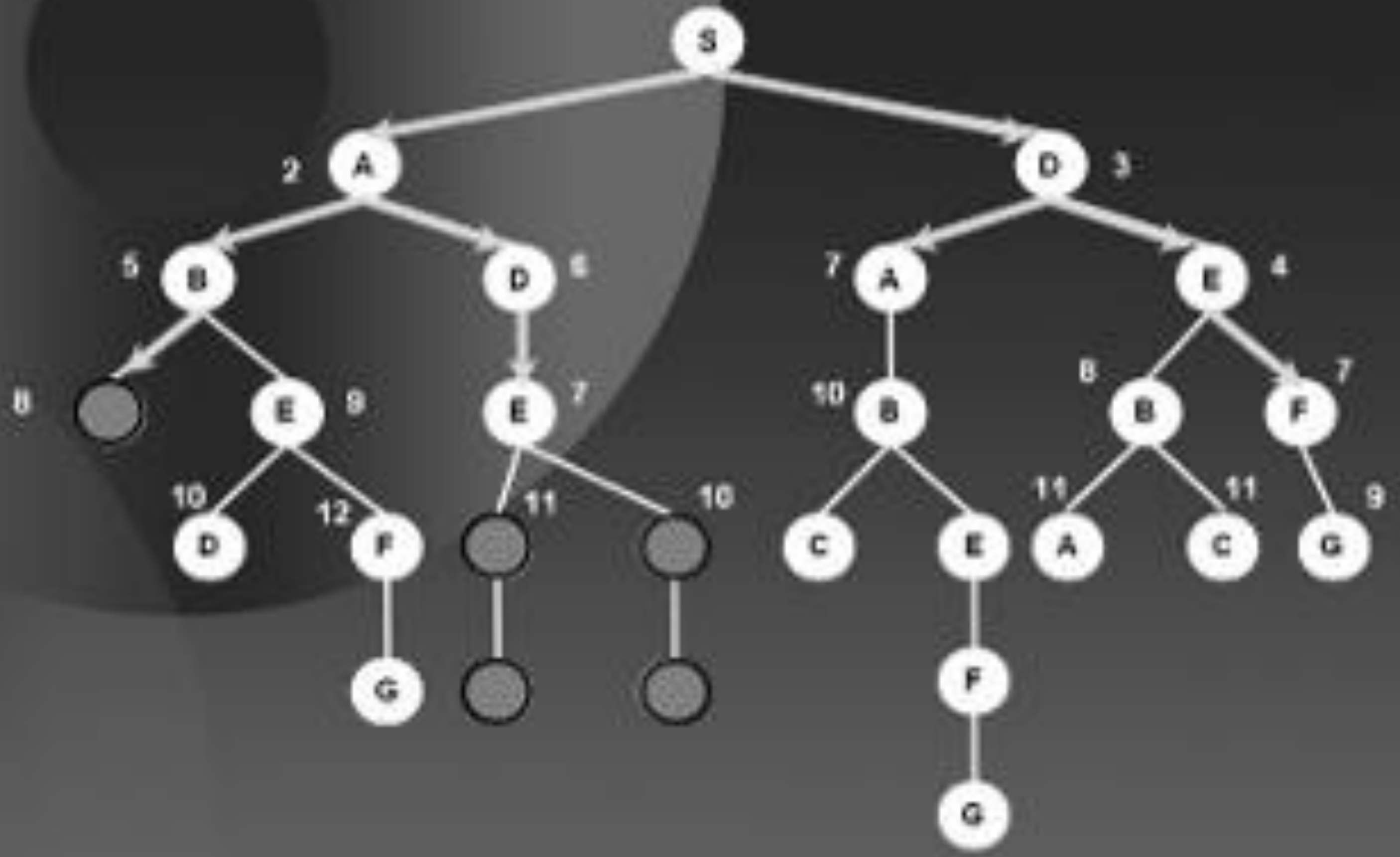
Then move to F as that is the best option at this point with a value 7.

Branch and Bound



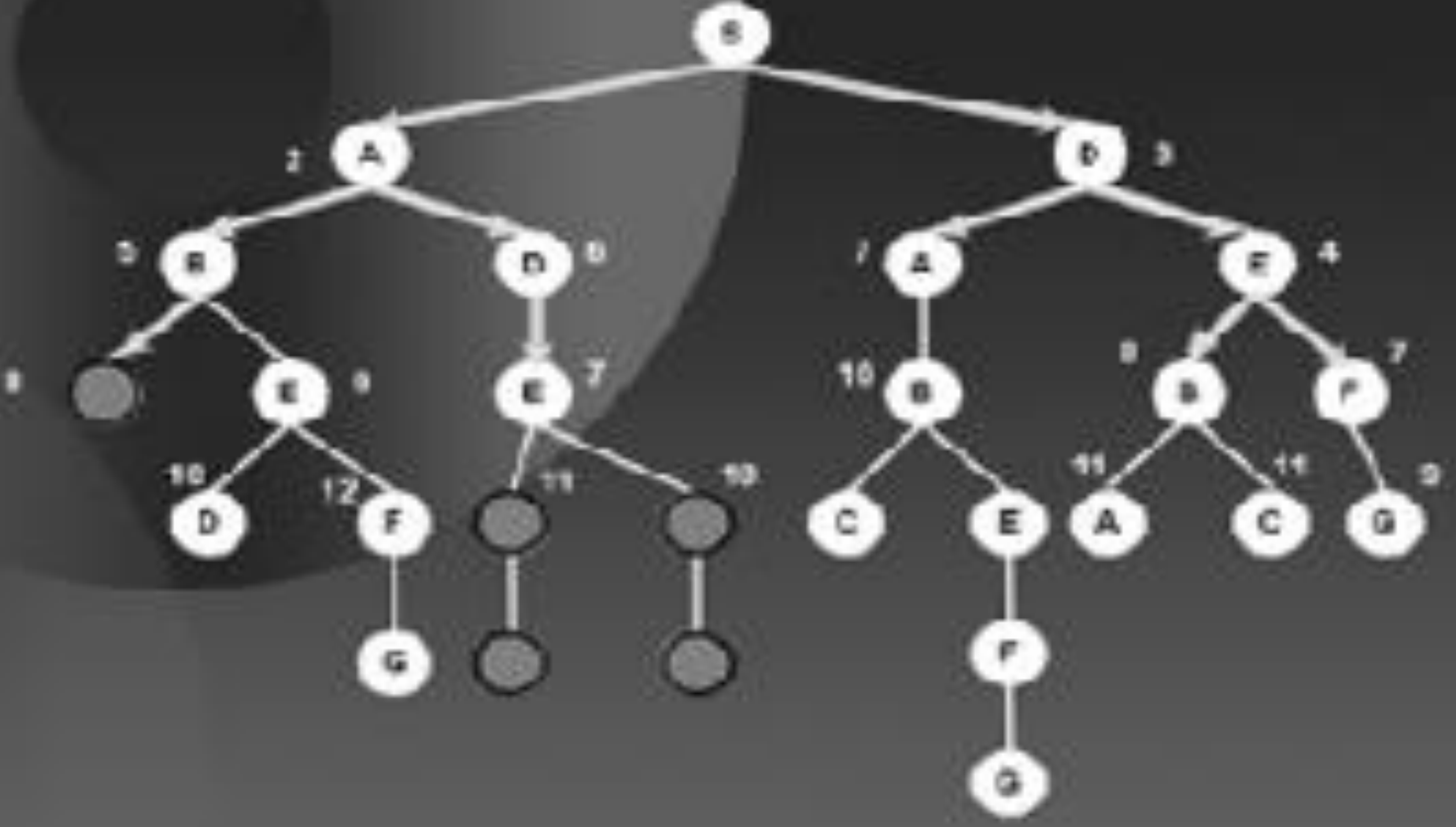
then C,

Branch and Bound

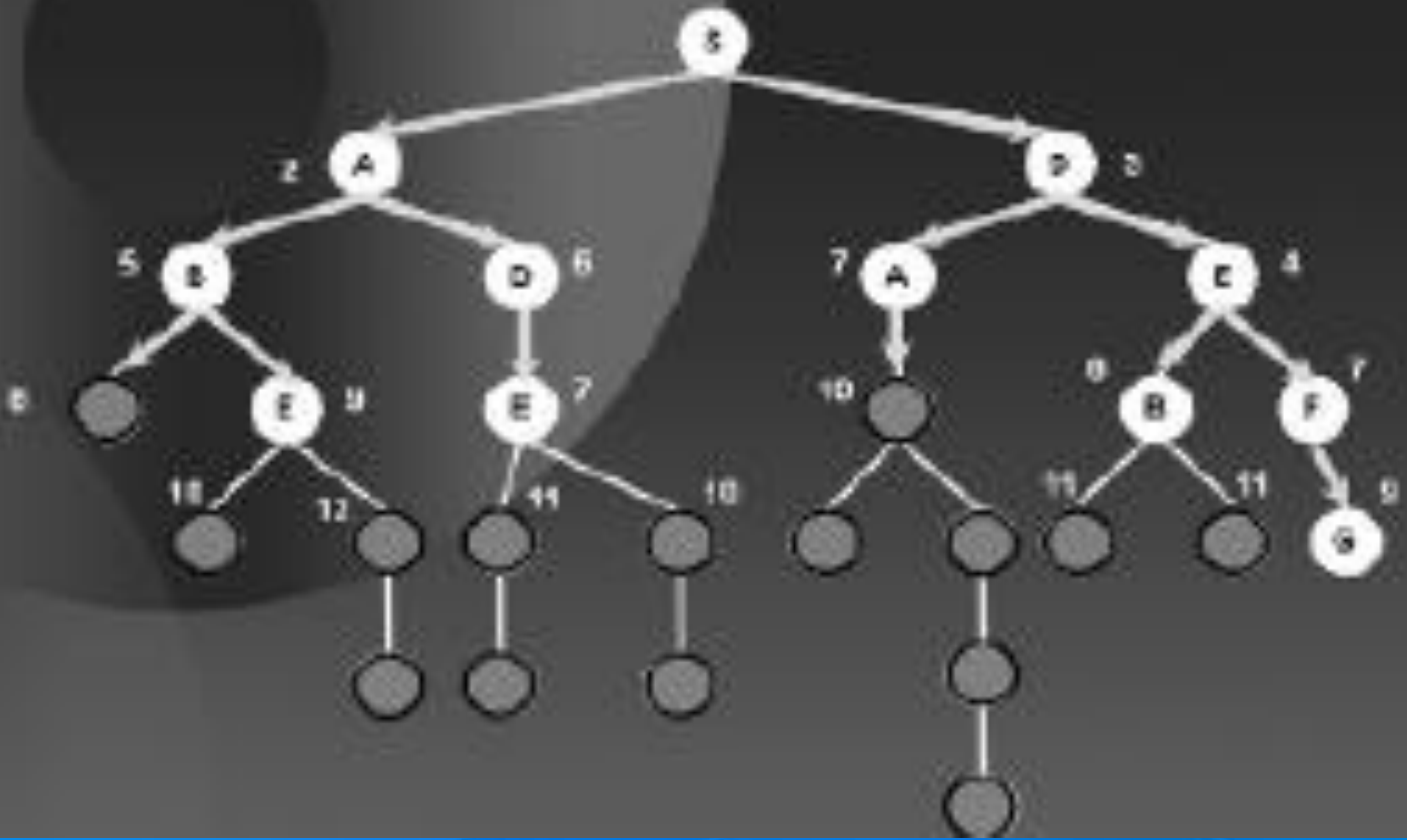


C is a leaf node so we bind C too as in diagram we move to B on the right hand side of the tree and bind the sub trees ahead of B as they also exceed the path length 9.

Branch and Bound



Branch and Bound



We go on proceeding in this fashion, binding the paths that exceed 9 and hence we are saved from traversing a considerable portion of the tree. The subsequent diagrams complete the search until it has found all the optimal solution, that is along the right hand branch of the tree

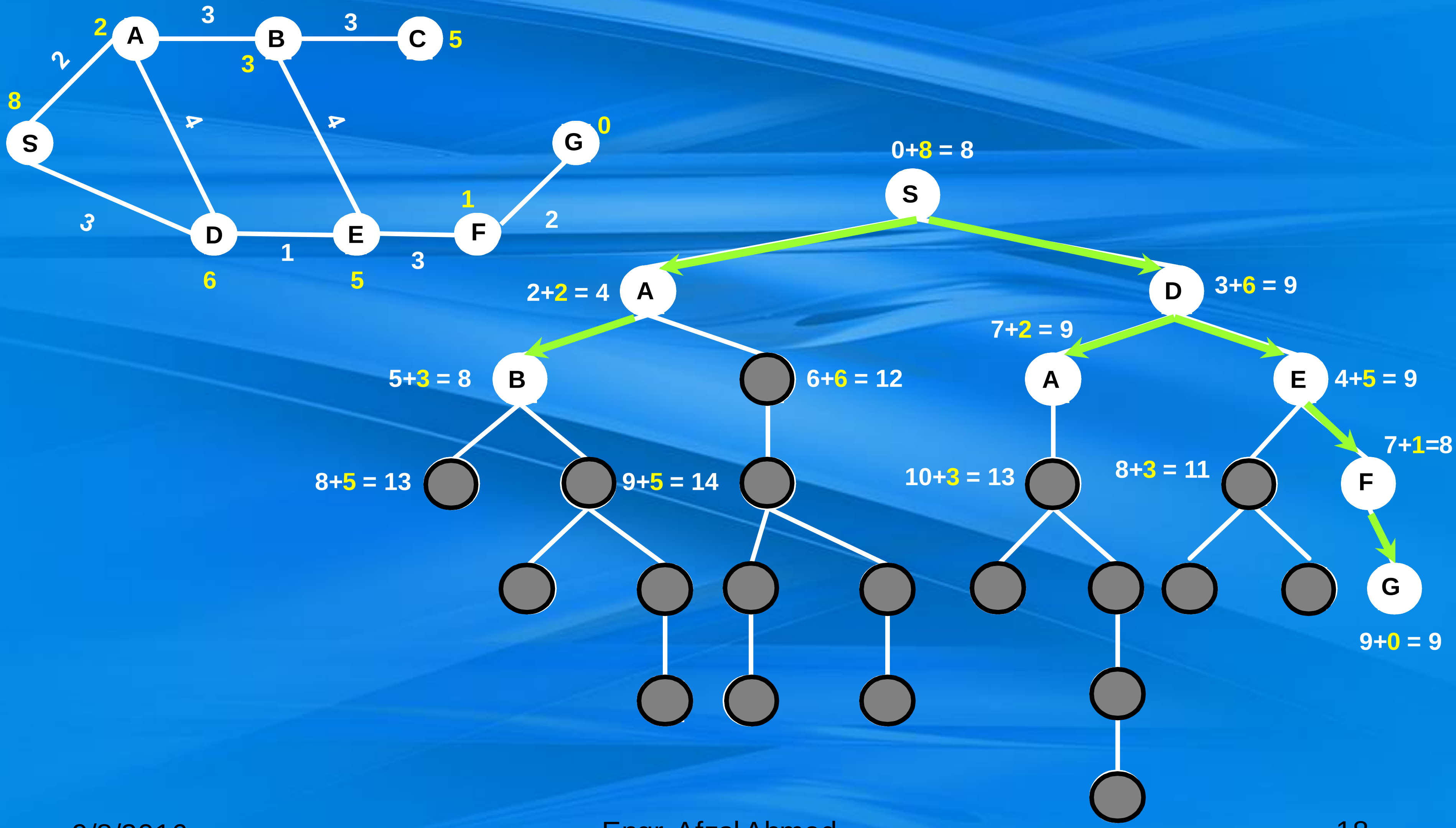
Branch and Bound

The basic idea was to reduce the search space by binding the paths that exceed the path length from S to G.

We will discuss the two most famous ways to improve it.

- 1. Estimates
- 2. Dynamic Programming
  - Choose optimized way for intermediate states

A* Procedure

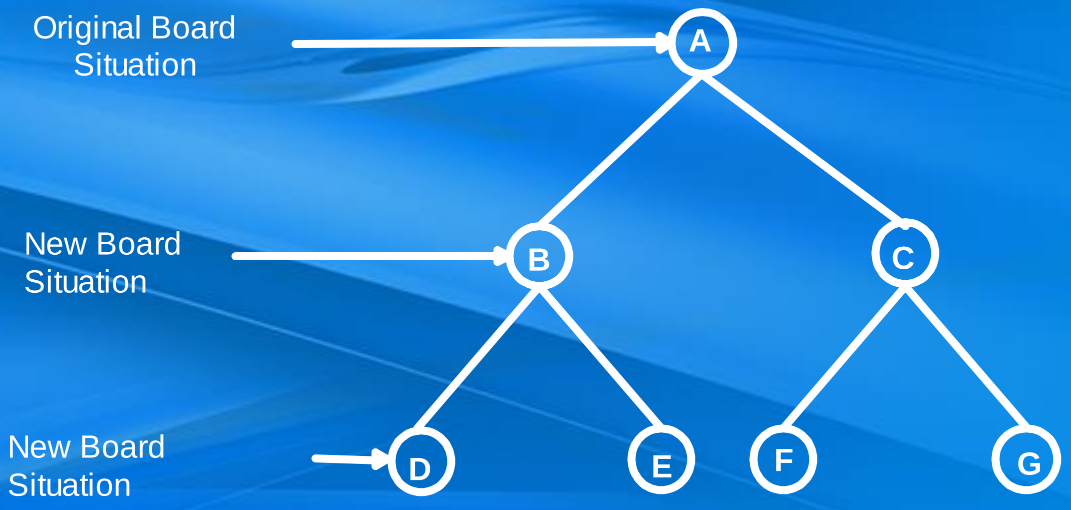


S
A
B
C
D
E
F
G
8
2
3
5
6
5
1
0
2
3
3
4
4
3
1
3
2
0+8 = 8
S
2+2 = 4
A
D
3+6 = 9
5+3 = 8
B
6+6 = 12
7+2 = 9
A
E
4+5 = 9
8+5 = 13
9+5 = 14
10+3 = 13
8+3 = 11
7+1=8
F
G
9+0 = 9

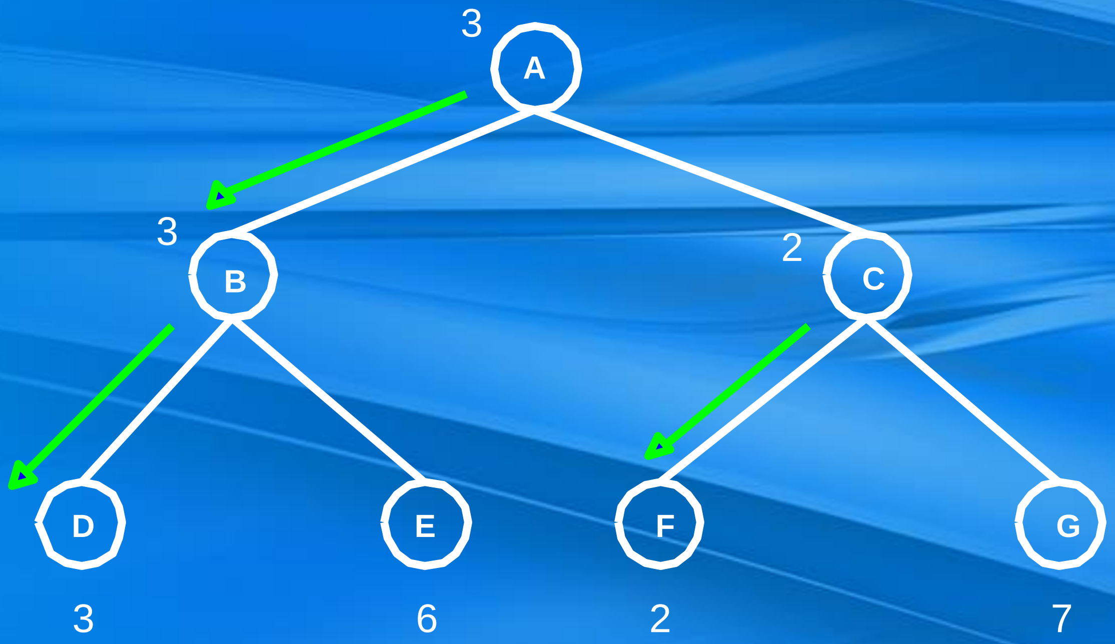
Search and Game Playing

- We will focus on Board Games
- We will represent the game as a tree

- The node is a game tree represent board configuration, and the branches indicate how moves can connect them.



The Minimax Procedure

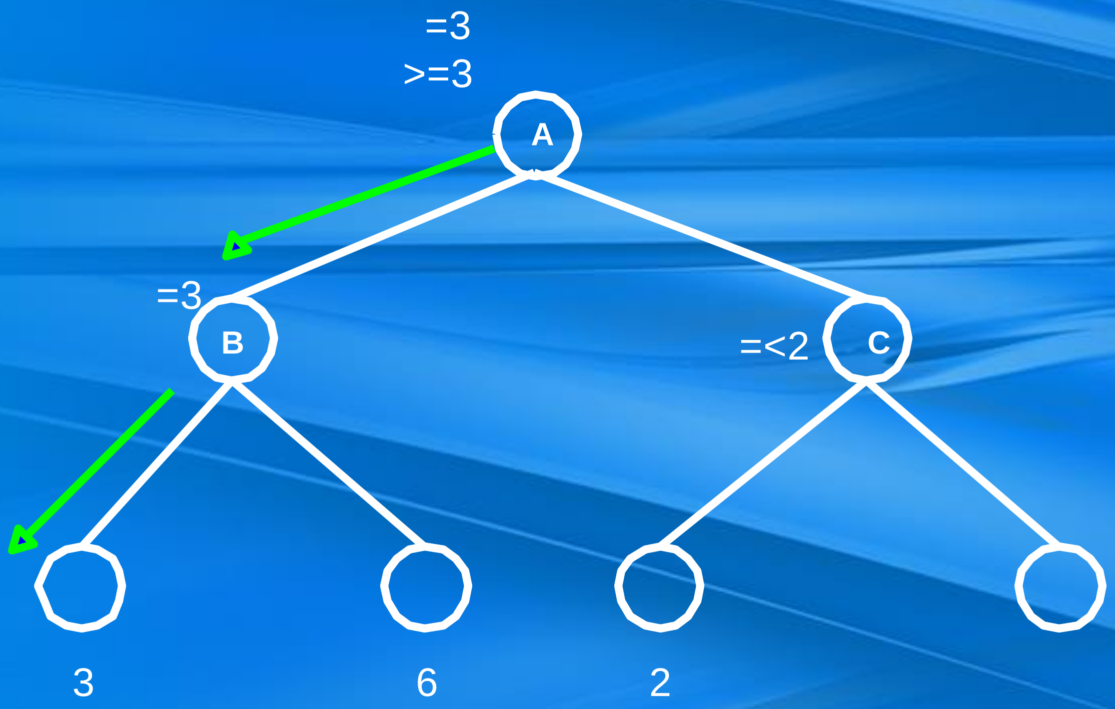


Maximizing Level

Minimizing Level

Maximizing Level

Alpha Beta Pruning

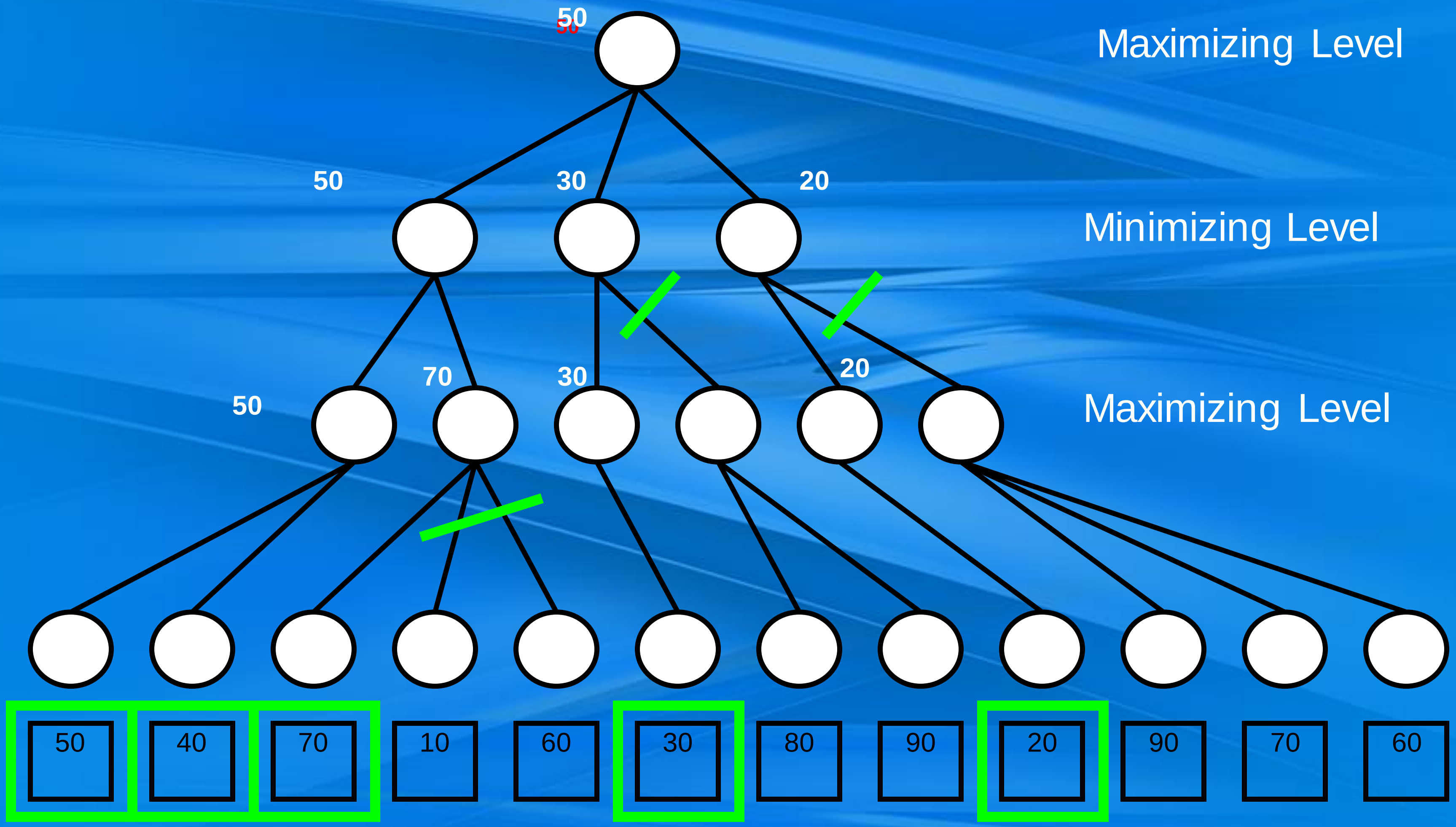


Maximizing Level

Minimizing Level

Maximizing Level

Alpha Beta Pruning



Maximizing Level

Minimizing Level

Maximizing Level