



## Sheet 1 Solutions Uninformed Search

1. How many nodes are expanded (in the worst case) by each of the following search techniques when searching a tree with branching factor  $b$  to find a goal at a depth of  $d$ ? give the sequence used and do not use big O notation.

- (a) Breadth first search

Answer:  $1 + b + b^2 + b^3 + \dots + b^d$

- (b) Depth first search

Answer:  $1 + b + b^2 + b^3 + \dots + b^m - b - b^2 - b^3 - \dots - b^{m-d}$

- (c) Depth-limited search (limit =  $d$ )

Answer:  $1 + b + b^2 + b^3 + \dots + b^d$

- (d) Iterative deepening depth first search

Answer:

1

$1 + b$

$1 + b + b^2$

$1 + b + b^2 + b^3$

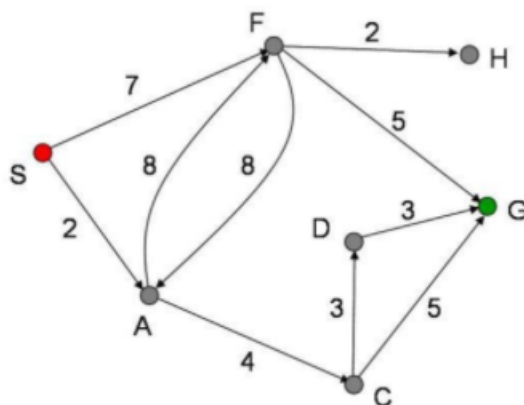
$\vdots$

$1 + b + b^2 + b^3 + \dots + b^d$

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$$(d + 1) + d * b + (d - 1) * b^2 + (d - 2) * b^3 + \dots + b^d$$

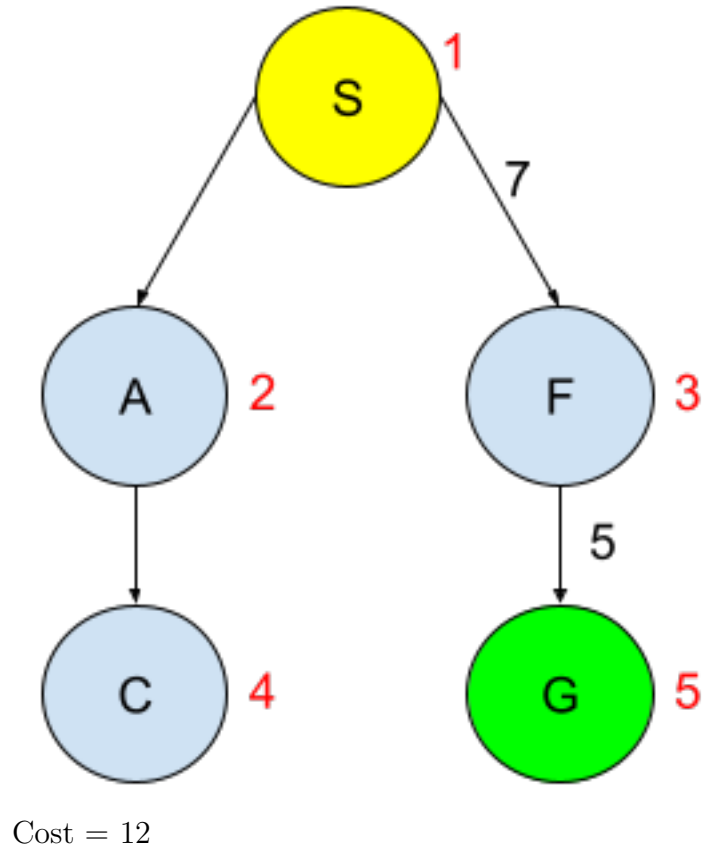
2. Suppose that you need to find a path between S and G in the state space defined by the following directed graph. The number attached to each arc is the cost of traversing the arc.



For each of the following search methods show the search tree(s) at the time the search terminates and give the cost to reach the goal.

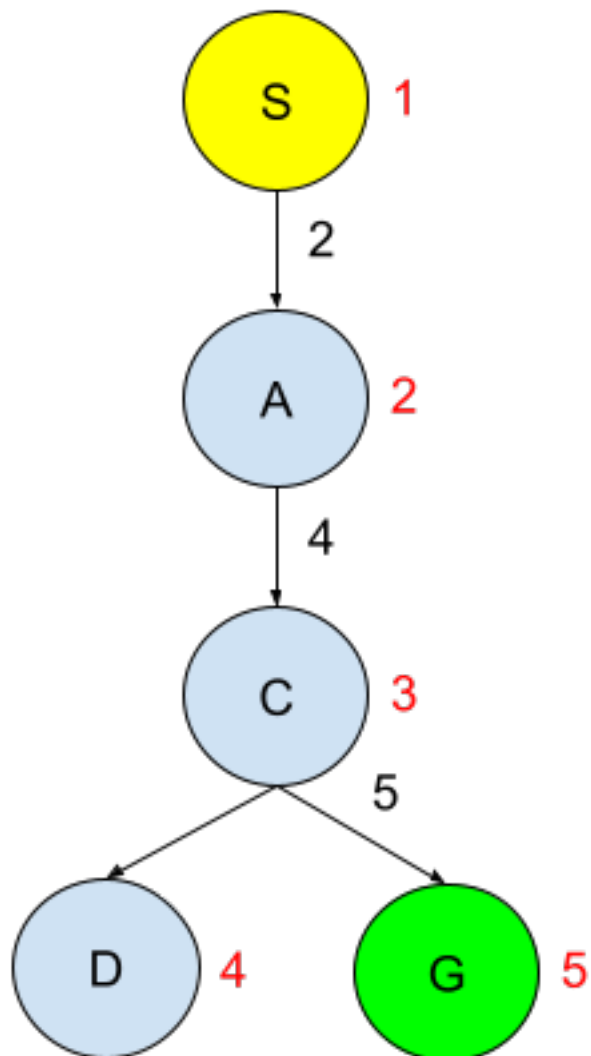


(a) Breadth first search





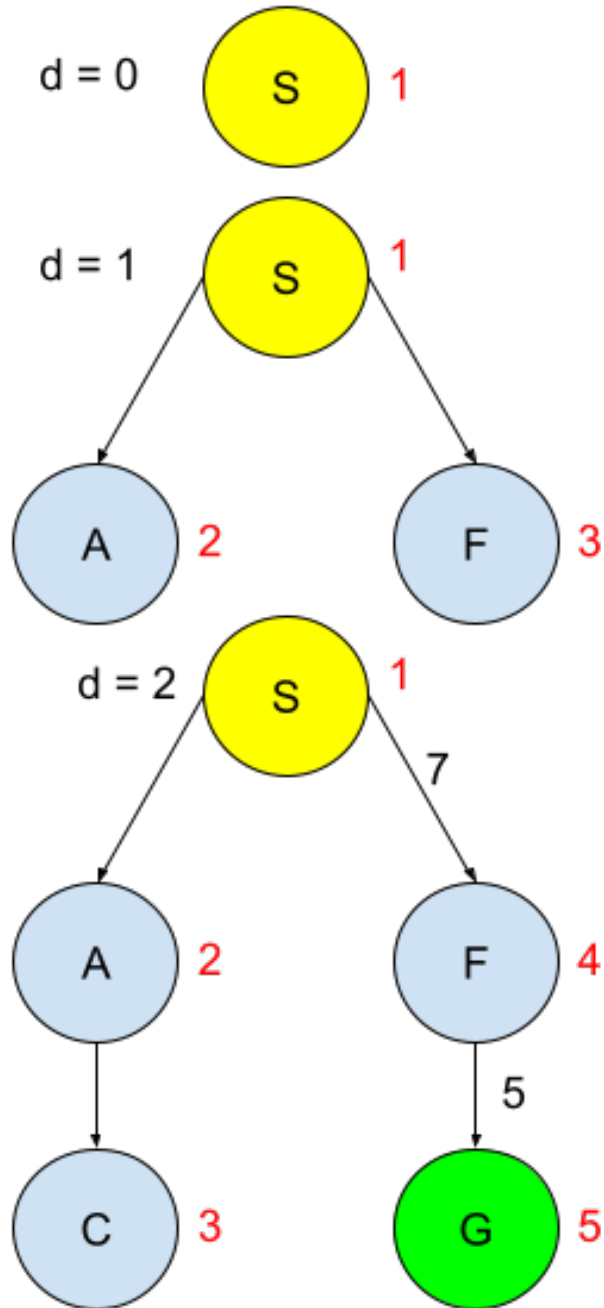
(b) Depth first search



Cost = 11



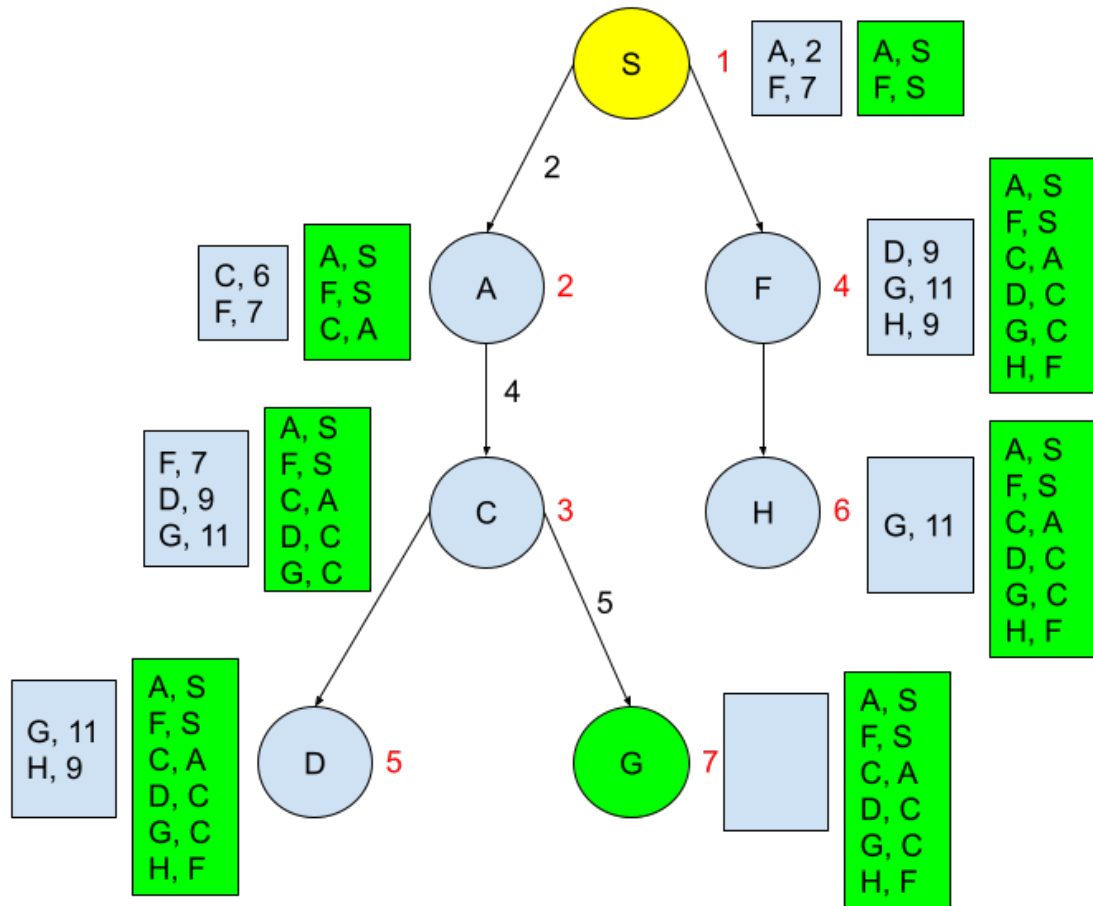
(c) Iterative Deepening Search



Cost = 12

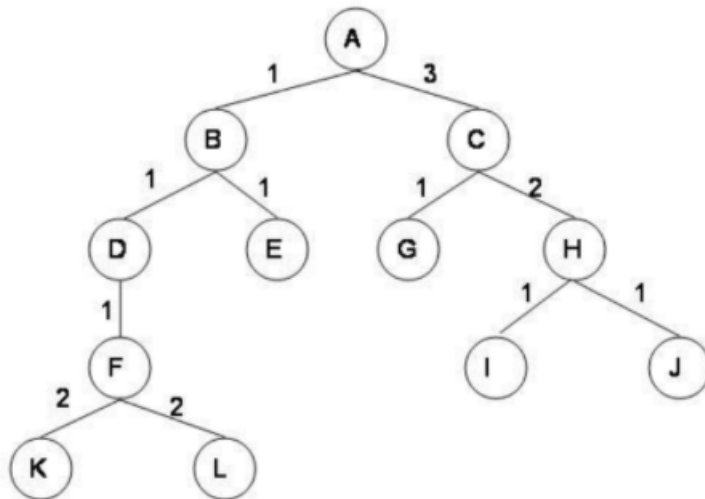


(d) Uniform Cost Search





3. Consider the tree shown below. The numbers on the arcs are the arc lengths. Assume that the nodes are expanded in alphabetical order when no other order is specified by the search, and that the goal is state G. No visited or expanded lists are used. What order would the states be expanded by BFS, DFS, Iterative Deepening and Uniform Cost? Stop when you expand G. Write only the sequence of states expanded by each search.



Answer:

BFS: A - B - C - D - E - G

DFS: A - B - D - F - K - L - E - C - G

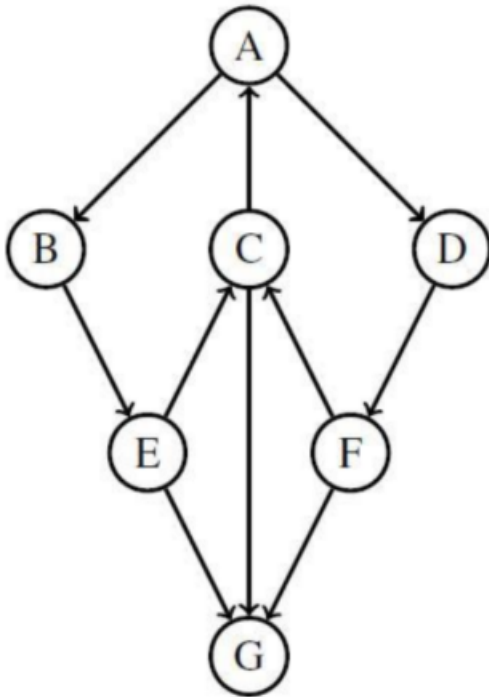
IDS:

- d = 0: A
- d = 1: A - B - C
- d = 2: A - B - D - E - C - G

UCS: A - B - D - E - C - F - G

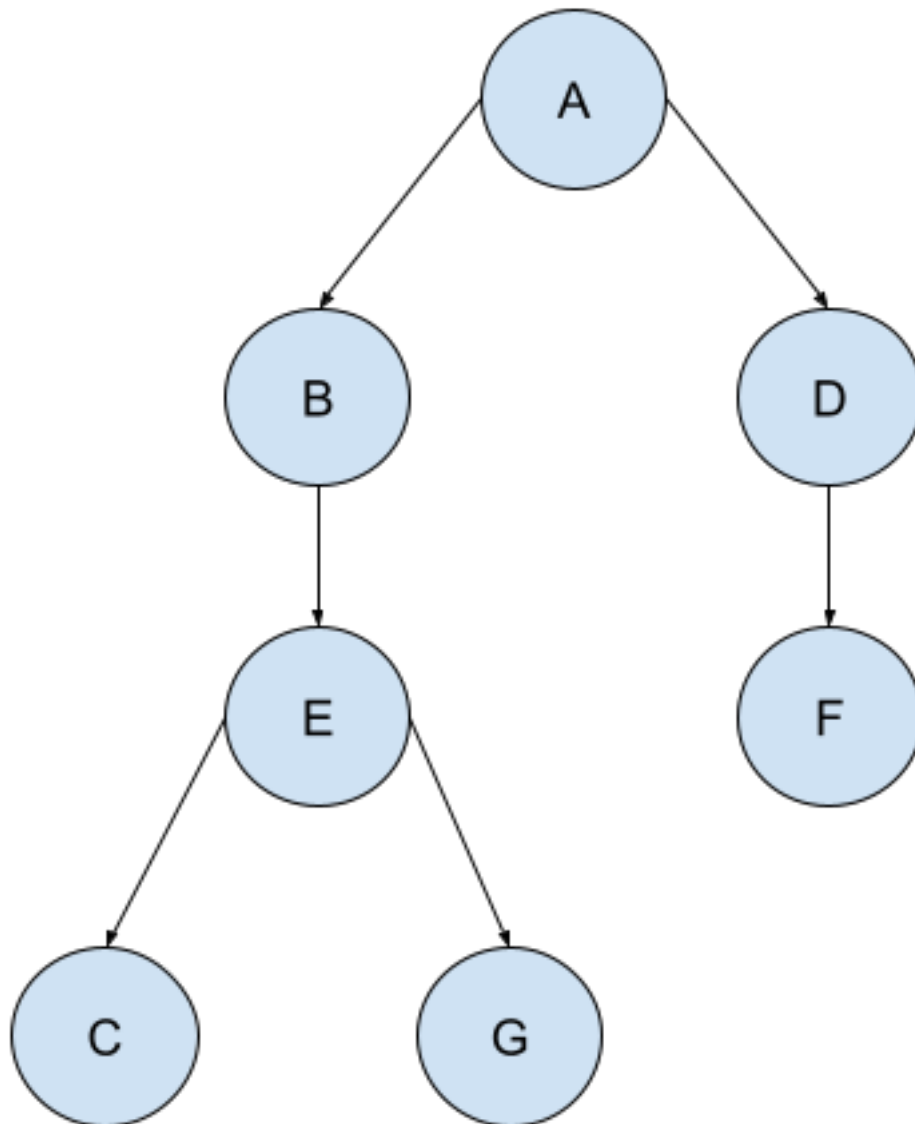


4. Perform a depth first search on the following graph starting at A. Label every edge in the graph with T if it's a tree edge, B if it's a back edge, F if it's a forward edge, and C if it's a cross edge. Assume that whenever faced with a decision of which node to pick from a set of nodes, pick the node whose label occurs earliest in the alphabet.



Answer:

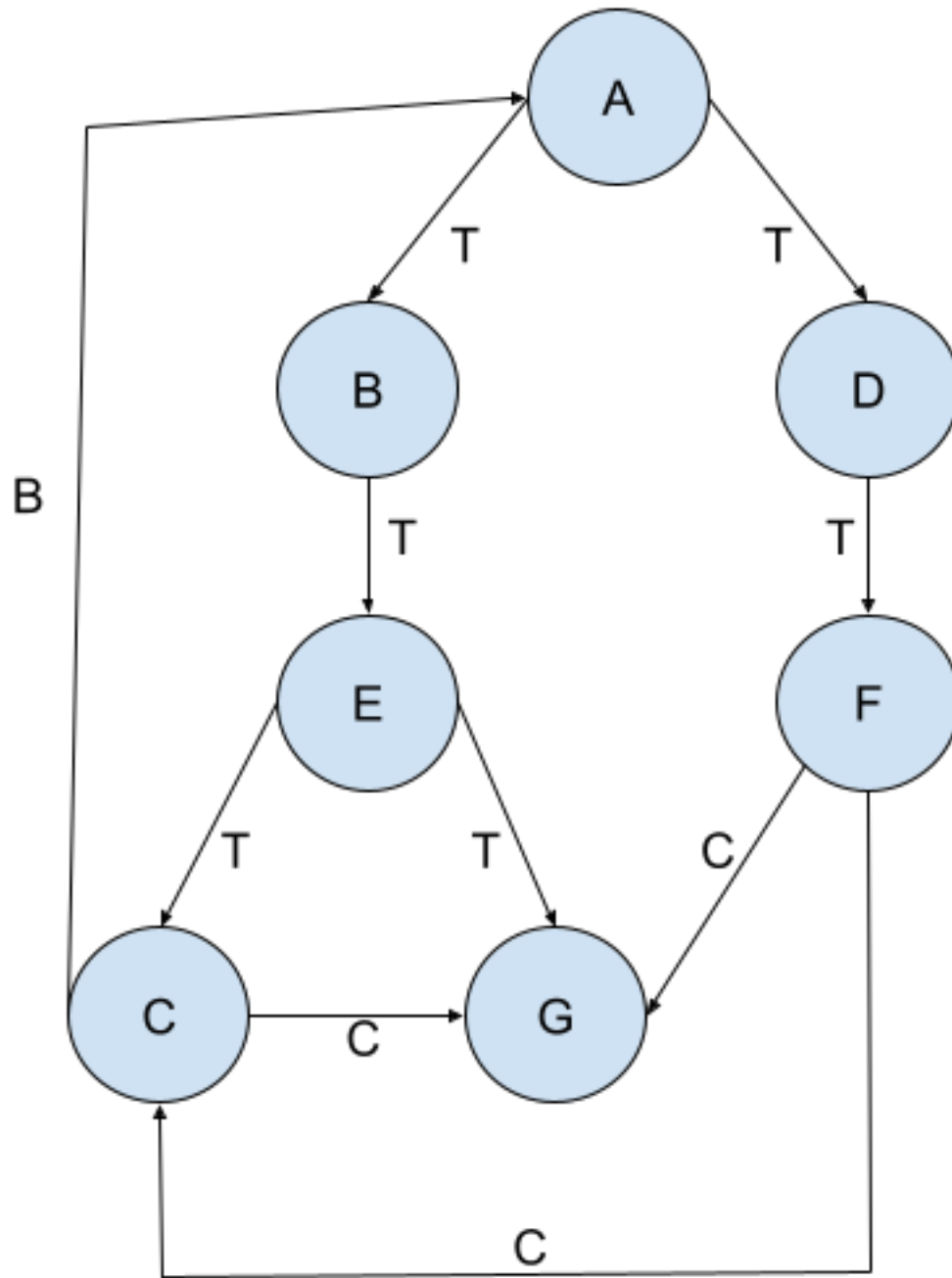
The search tree will be as follows:

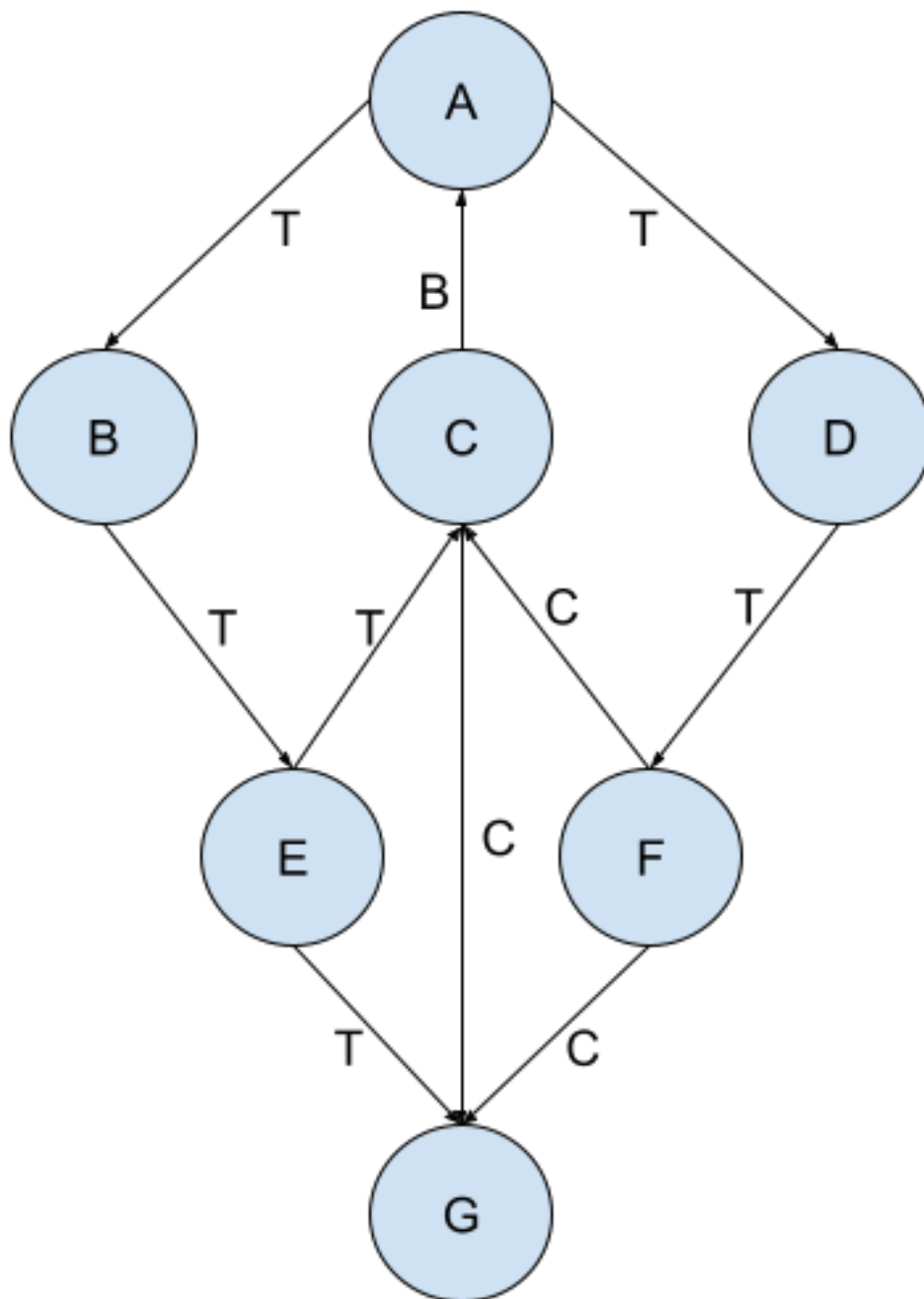






So, The edges labeling is as follows:





Good Luck