Discrete Structures
CSC160

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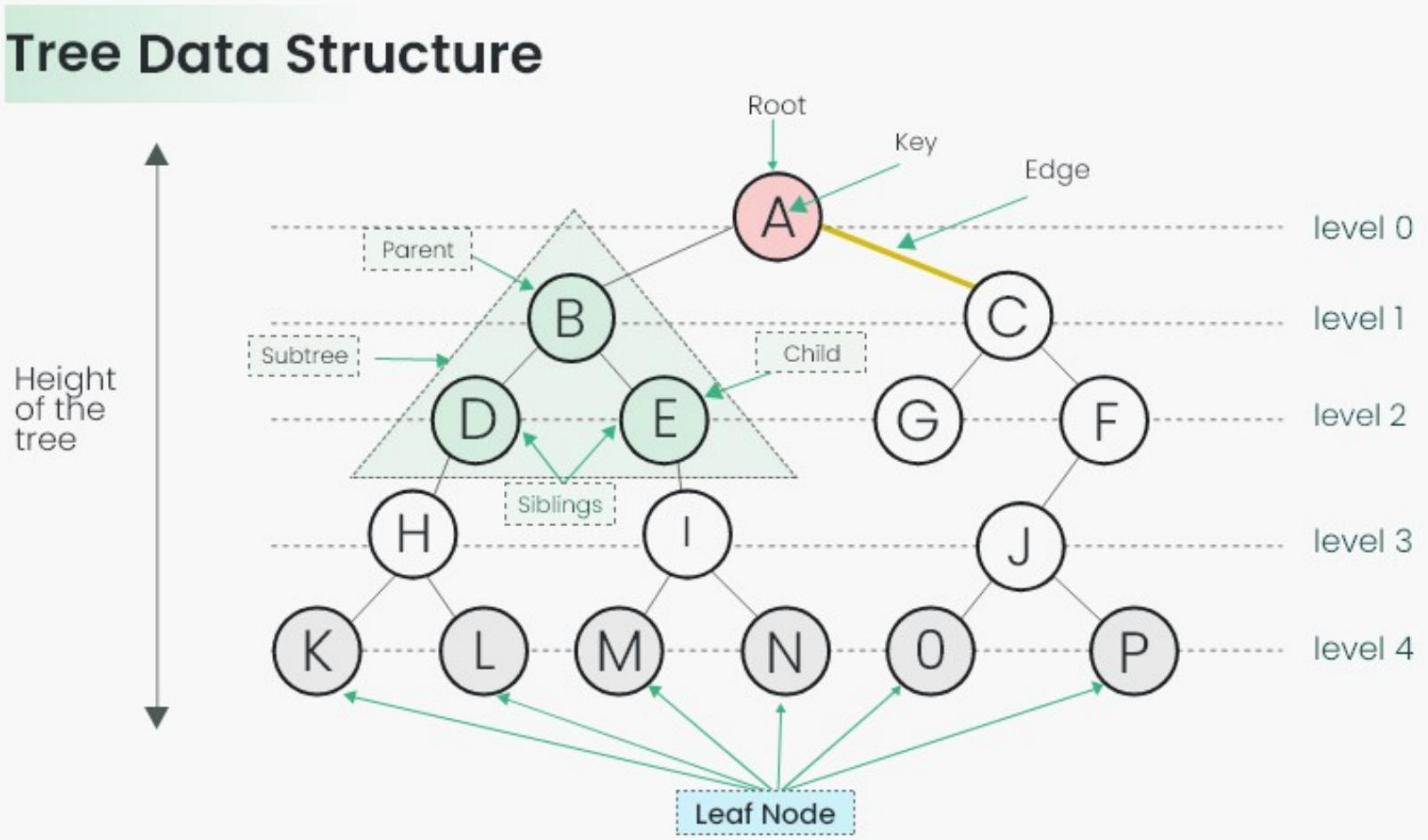
Relations and Grapahs

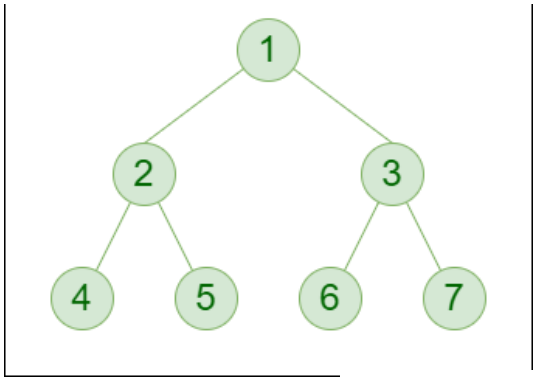


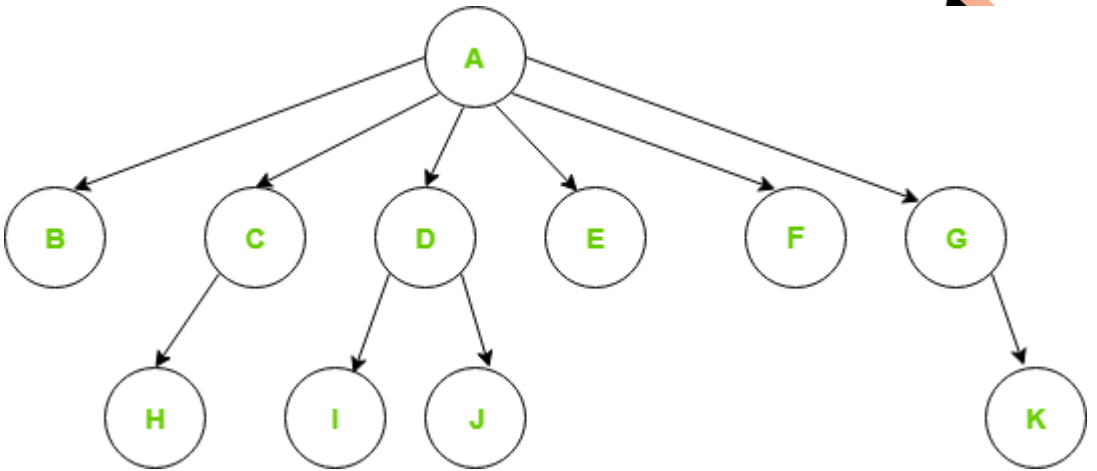
Relations and Grapahs

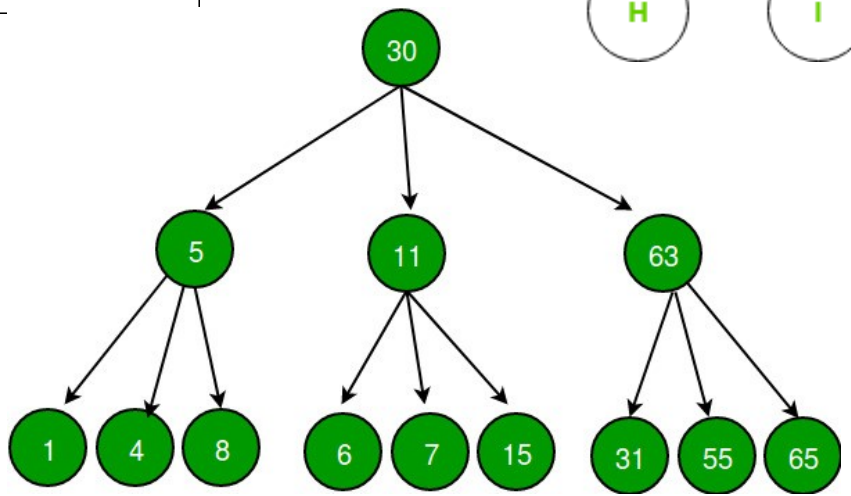
- Tree:
  - A tree is a connected undirected graph with no simple circuits.
  - Trees are particularly useful in computer science, where they are employed in a wide range of algorithms.
    - For instance, trees are used to construct efficient algorithms for locating items in a list.
    - They can be used in algorithms, such as Huffman coding, that construct efficient codes saving costs in data transmission and storage.
    - Trees can be used to study games such as checkers and chess and can help determine winning strategies for playing these games.
    - Trees can be used to model procedures carried out using a sequence of decisions.

Relations and Grapahs

- Tree:

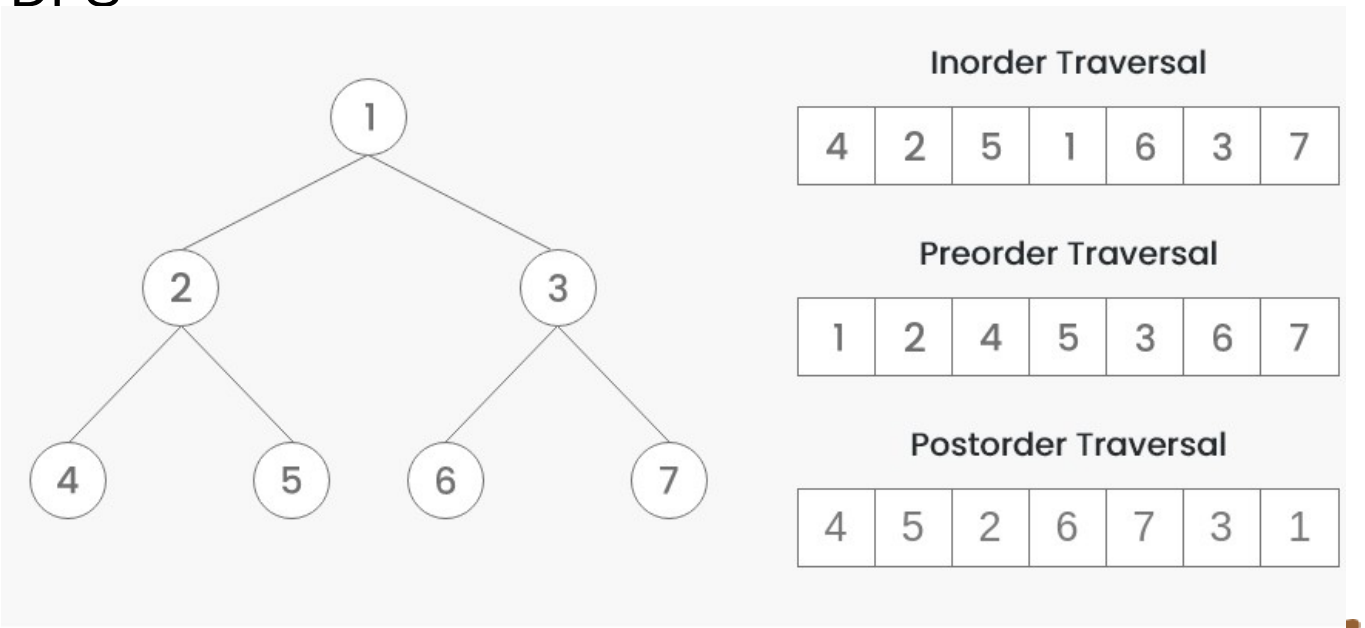






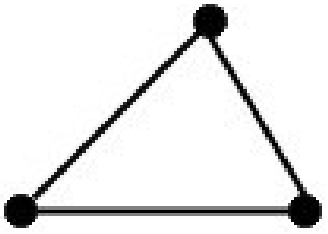
Relations and Grapahs

- Tree Traversals:
  - Unlike linear data structures (Array, Queues, Stacks, etc) which have only one logical way to traverse them, trees can be traversed in different ways.
  - A Tree Data Structure can be traversed in following ways:
  - Depth First Search or DFS
    - Inorder Traversal
    - Preorder Traversal
    - Postorder Traversal

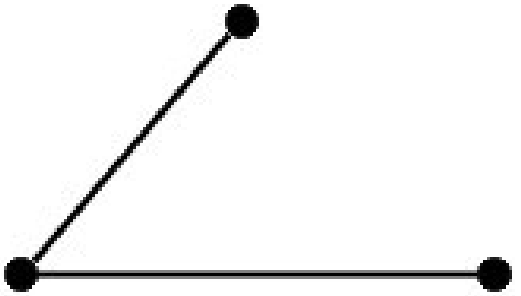


Relations and Grapahs

- Minimum spanning tree:
  - A spanning tree is defined as a tree-like subgraph of a connected, undirected graph that includes all the vertices of the graph.
  - A minimum spanning tree (MST) is defined as a spanning tree that has the minimum weight among all the possible spanning trees.



Cycle Graph



Subgraph/Spanning Tree

- Minimum spanning tree:
  - Prim's algorithm and
  - Kruskal's algorithm
  - Both finds the Minimum Spanning Tree and follow the Greedy approach of problem-solving.

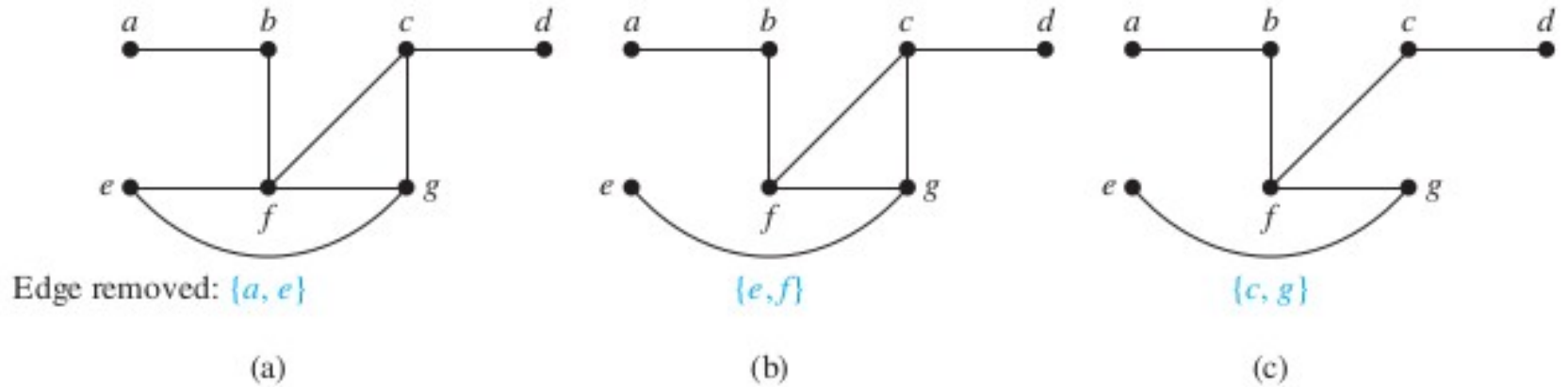
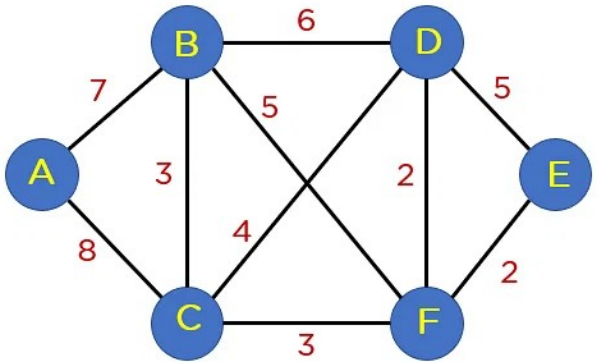


FIGURE 3 **Producing a Spanning Tree for G by Removing Edges That Form Simple Circuits.**

Relations and Grapahs

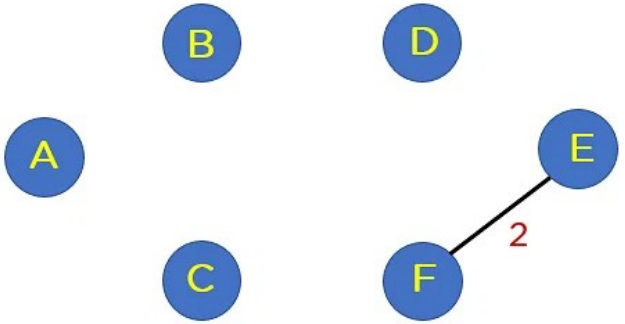
- Minimum spanning tree: Kruskal's algorithm

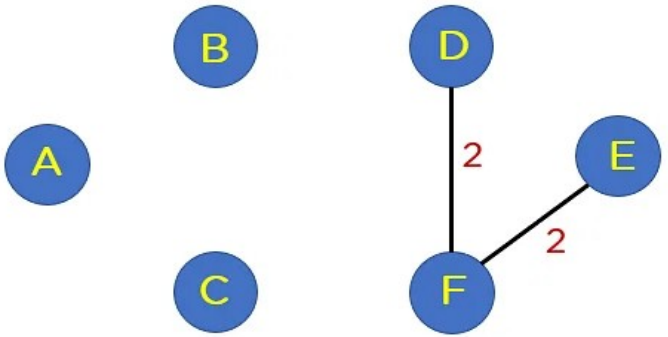


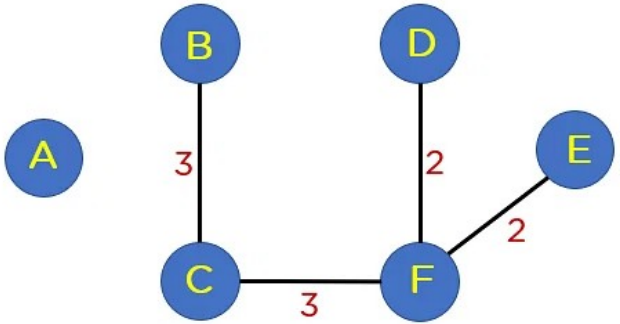
Source Vertex	Destination Vertex	Edge Weight
E	F	2
F	D	2
B	C	3
C	F	3
C	D	4
B	F	5
B	D	6
A	B	7
A	C	8

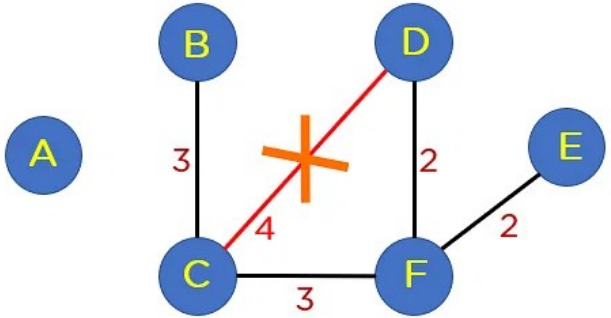
Relations and Grapahs

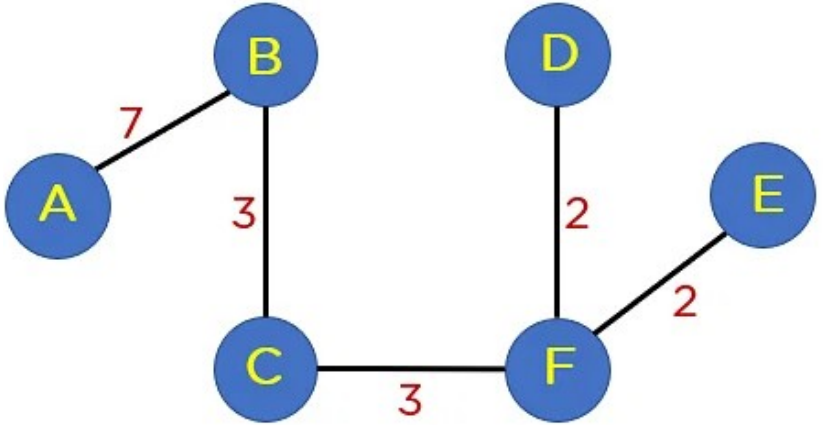
- Minimum spanning tree: Kruskal's algorithm







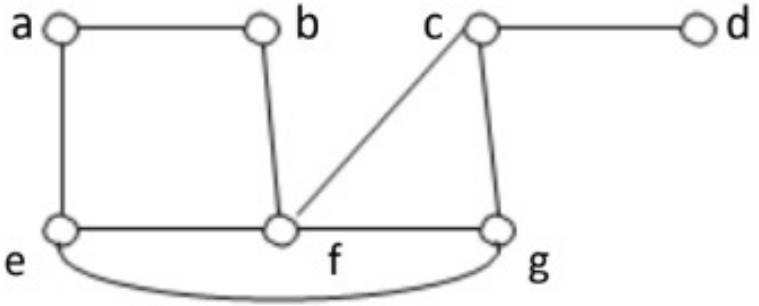


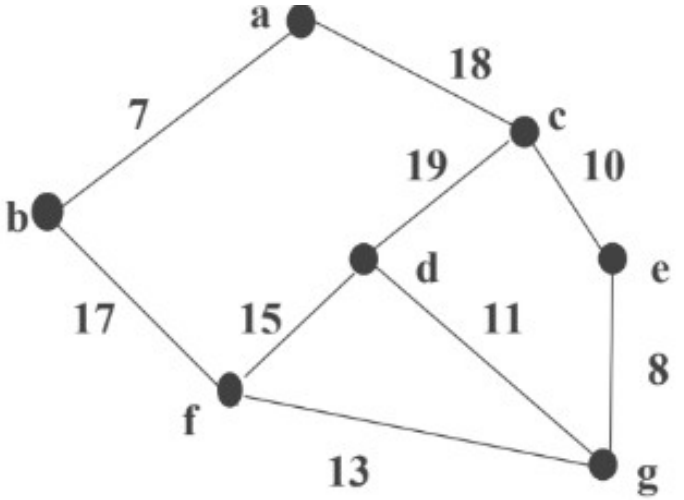


Minimum Spanning Tree.

Relations and Grapahs

- Tree:
  - Find the spanning tree of the given graph if it exist.

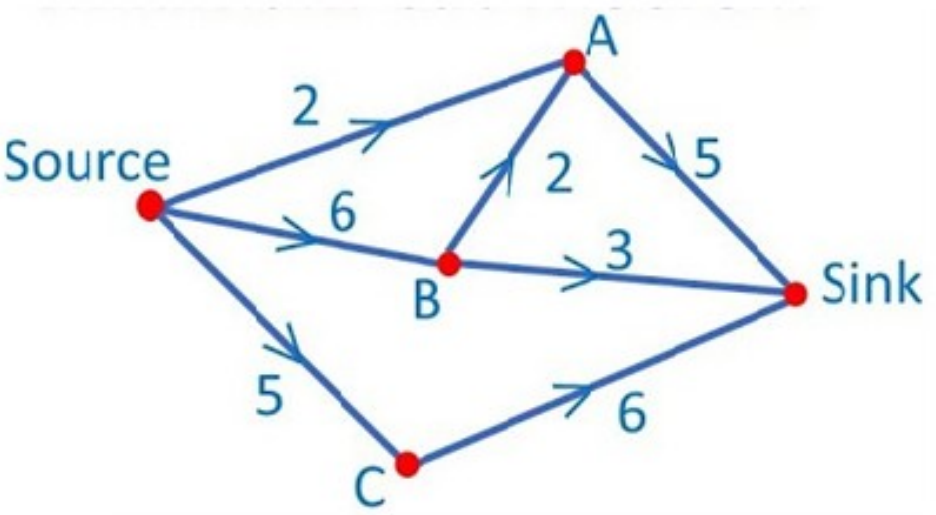




- Network Flows
  - Network flows deals with modelling the flow of a commodity (water, electricity, packets, gas, cars, trains, money, or any abstract object) in a network.
  - The links in the network are capacitated and the commodity does not vanish in the network except at specified locations where we can either inject or extract some amount of commodity.
  - The main question is how much can be sent in this network.

Relations and Grapahs

- Network Flows



  - Terms used:
    - Source
    - Sink
    - Augmented path(any path that starts with source and reach to sink).
    - Bottle Neck Capacity(It is the min. capacity of edge in a augmented path)

Relations and Grapahs

- Network Flows :Example

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- Network Flows :Example

Relations and Graphs

- References:
  - *Kenneth H. Rosen, Discrete mathematics and its applications, Seventh Edition McGraw Hill Publication, 2012.*