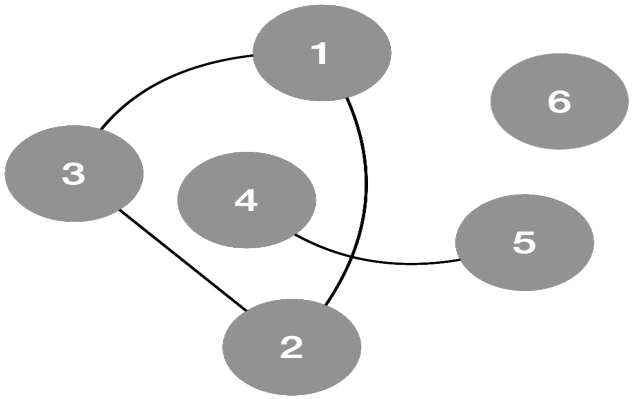
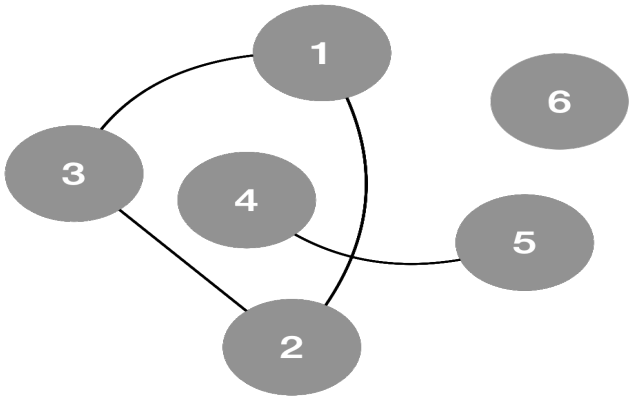
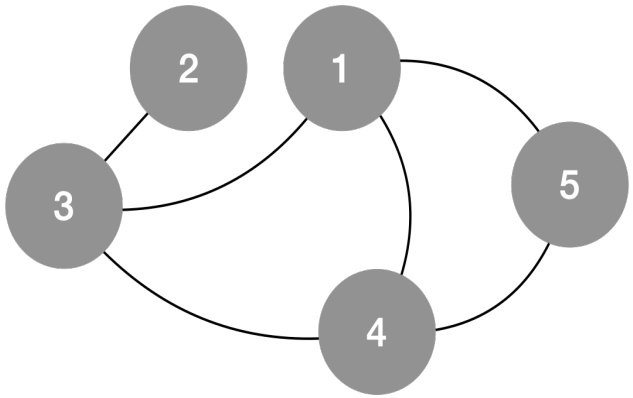
Connected graph

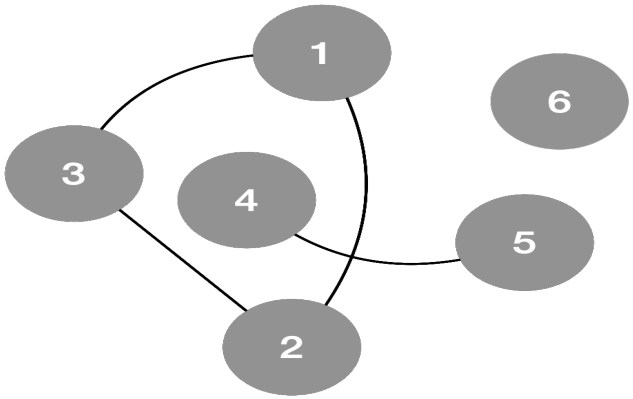


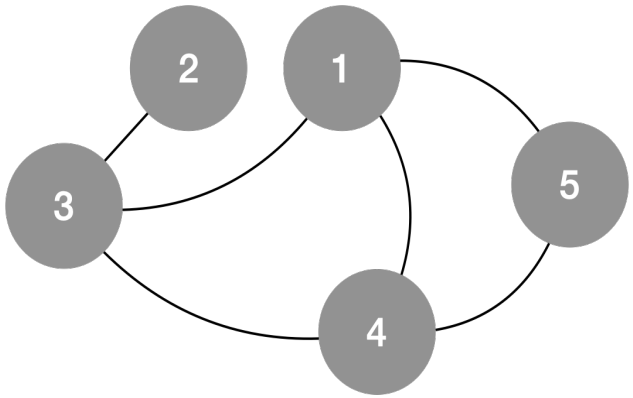
Connected graph





Connected graph

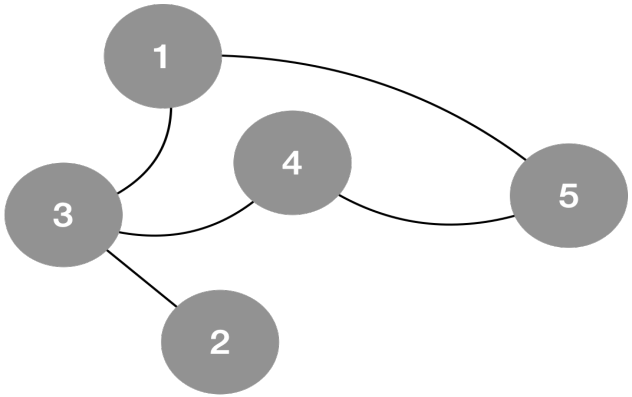




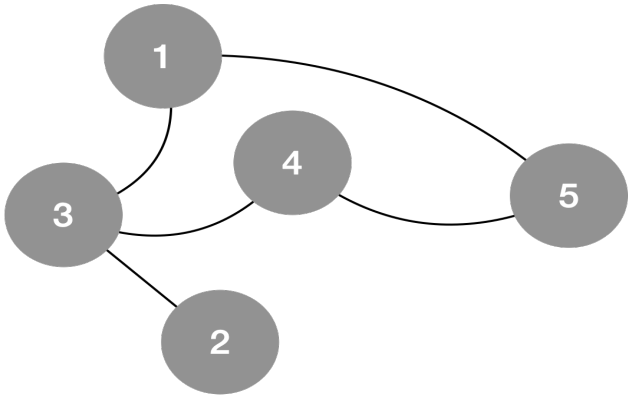
Connected components

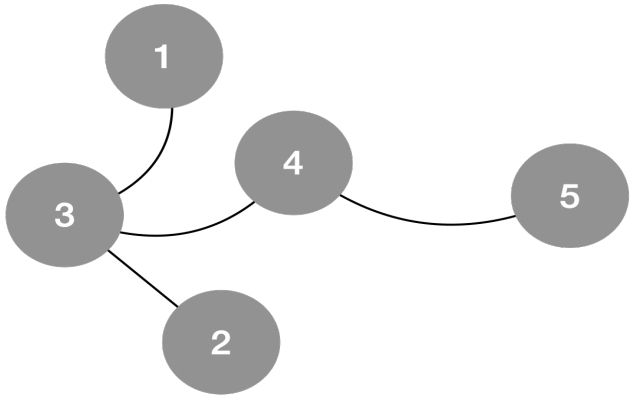
There exists a path between every pair of vertices in an un-directed graph $G = (V, E)$.

Trees



Trees

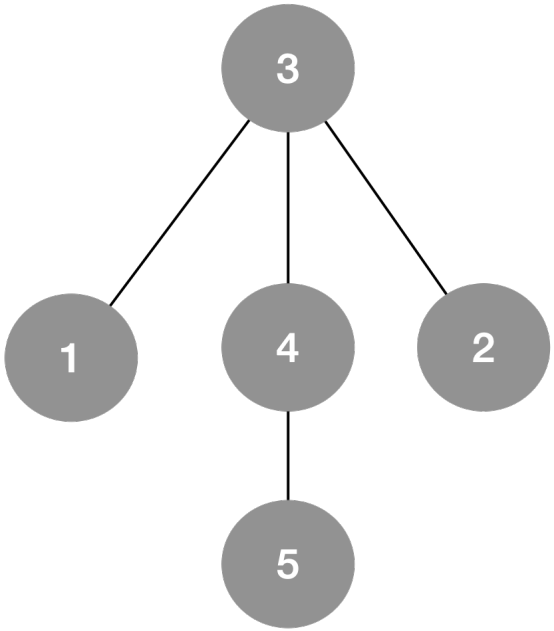




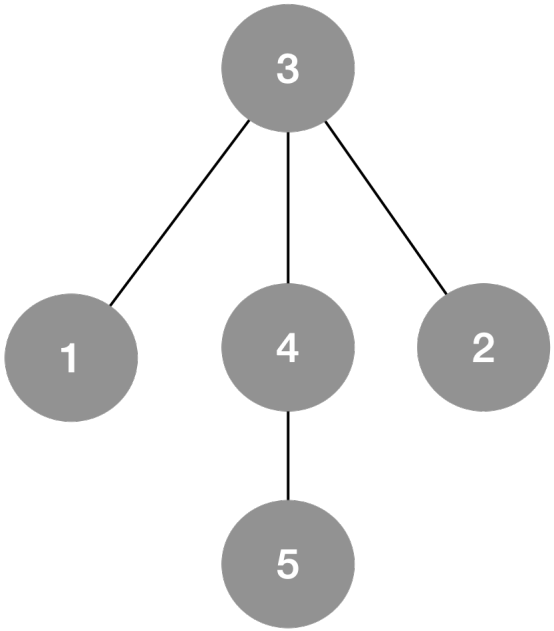
A tree is an un-directed graph G that is connected and contains no cycles.

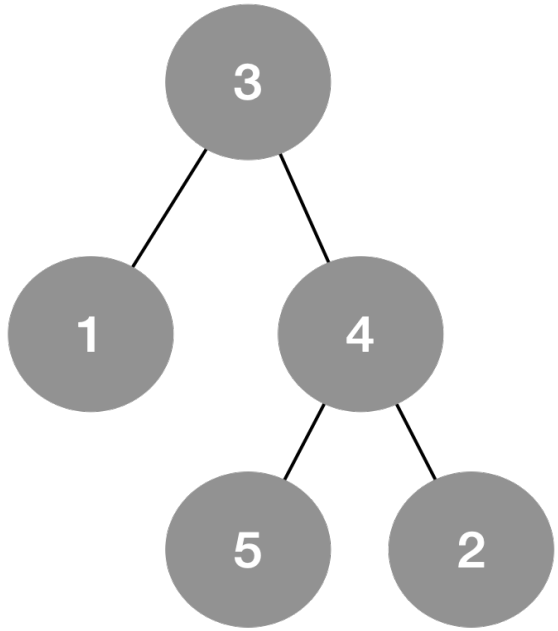
- G is acyclic, and a simple cycle is formed if any edge is added to to G.
- G is connected, but would become disconnected if any single edge is removed from G.
- Any two vertices in G can be connected by a unique simple path.

Basic properties of trees

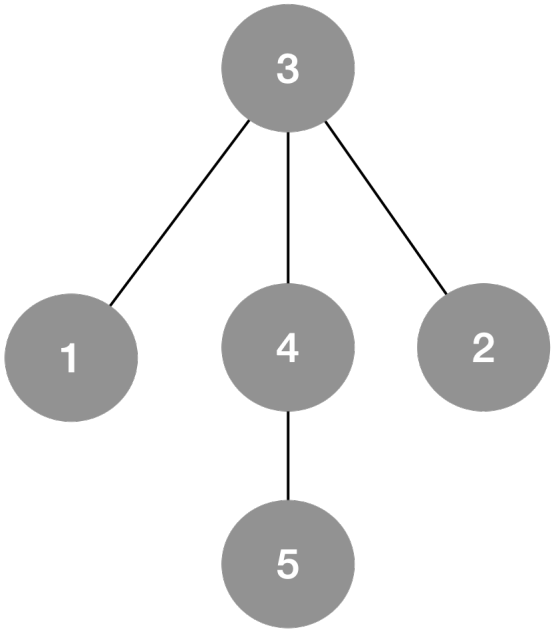


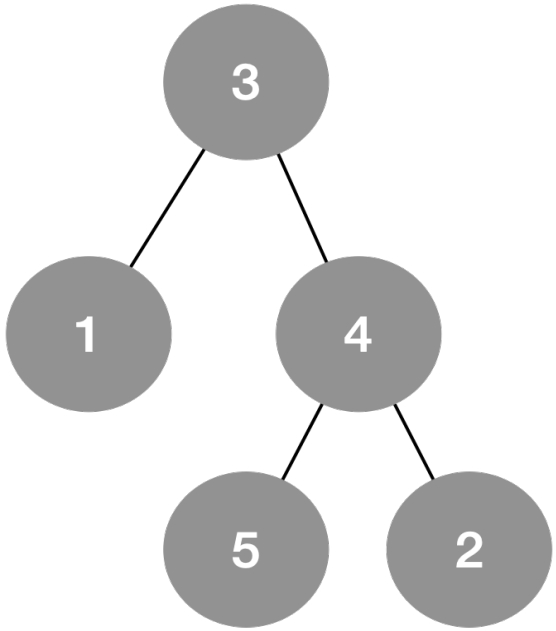
Basic properties of trees





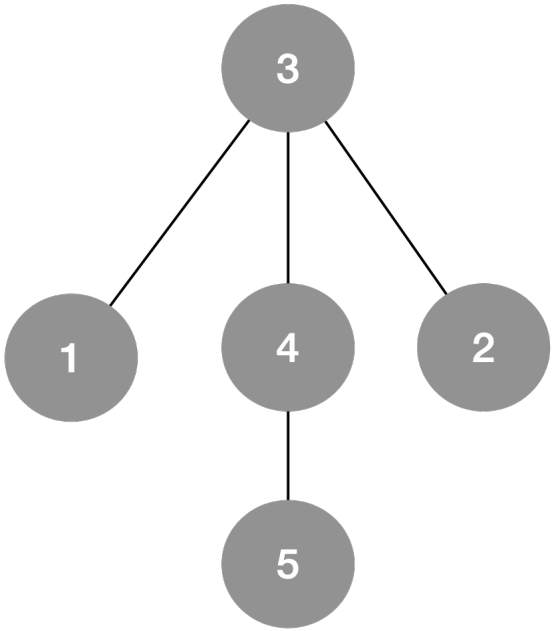
Basic properties of trees

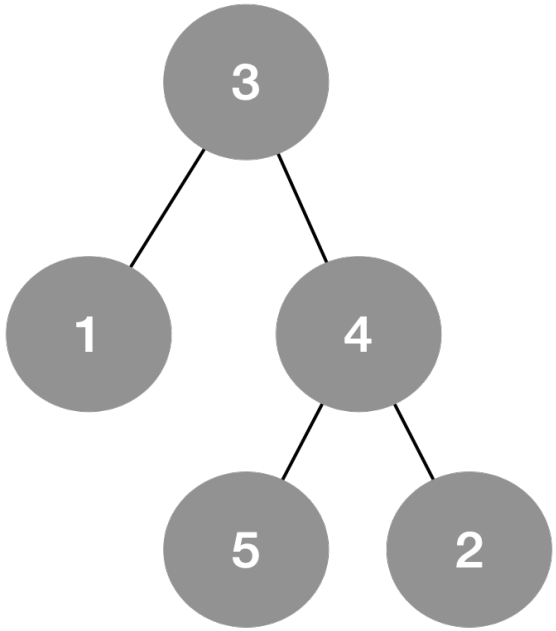




- Parent, Child, Leaf, Root.
- **Level**: a path length from a root r.
- **Height**:

Basic properties of trees





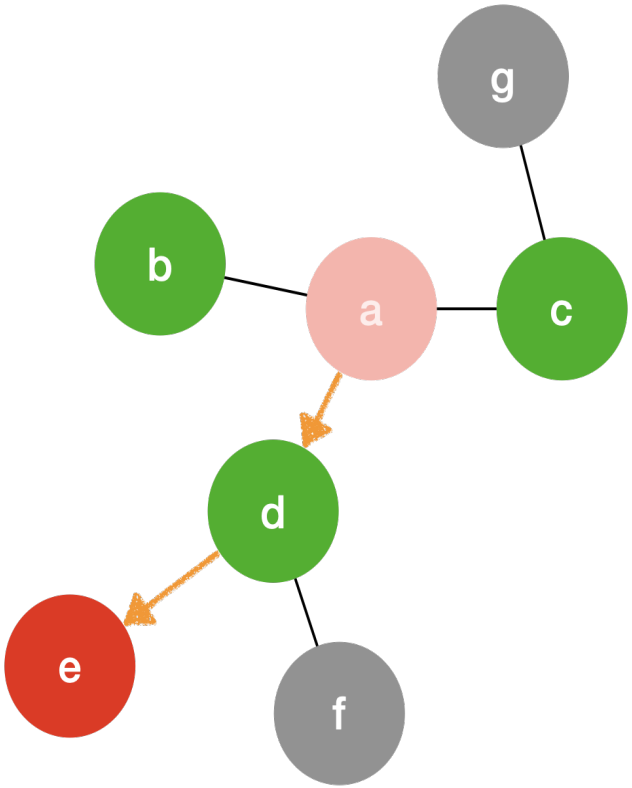
- Parent, Child, Leaf, Root.
- **Level**: a path length from a root r.
- **Height**: maximum level (3), $log_2 n$ for binary tree.

Graph Search

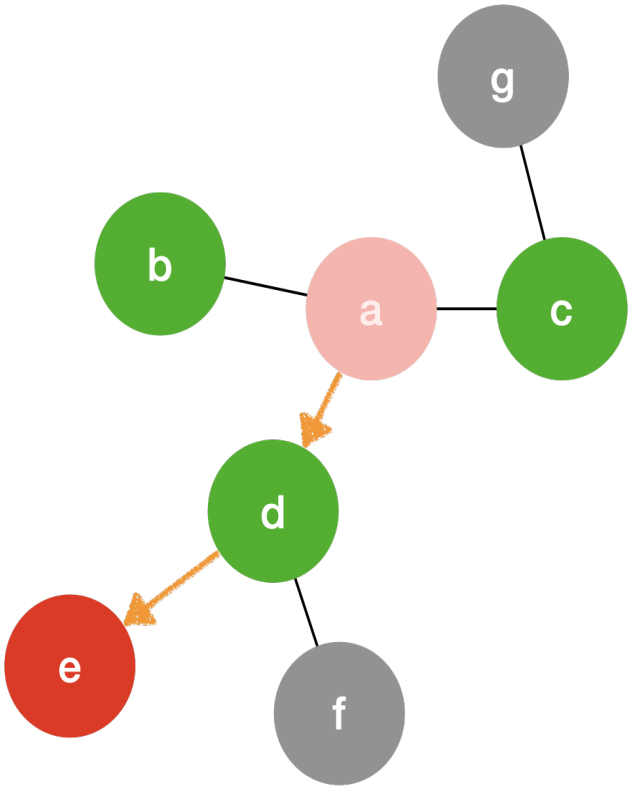
Graph problems are usually concerned about searching for optimal solutions.

- Deep First Search (BFS), go as deep as you can, backtrack when you get stuck.
- Breadth First Search (DFS), explore outward from vertex v, visiting vertices one level/layer at a time.

DFS vs BFS

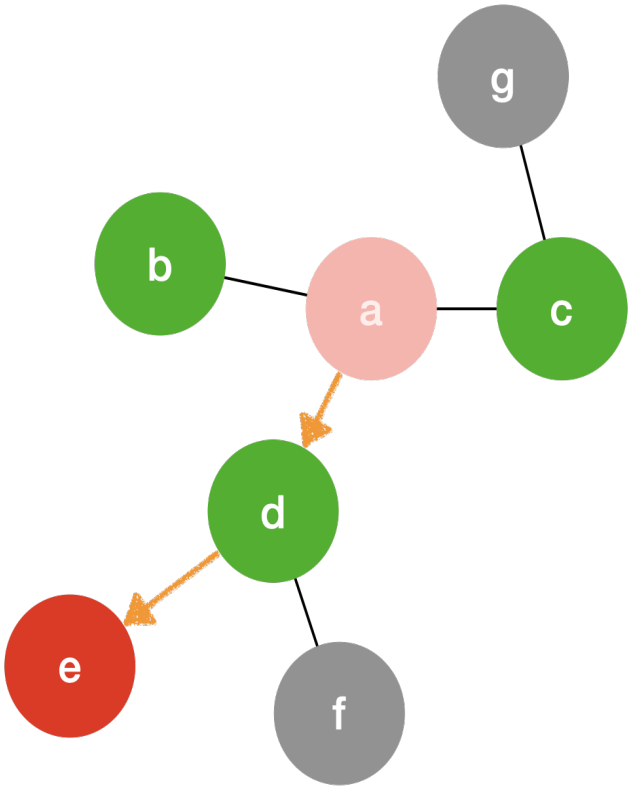


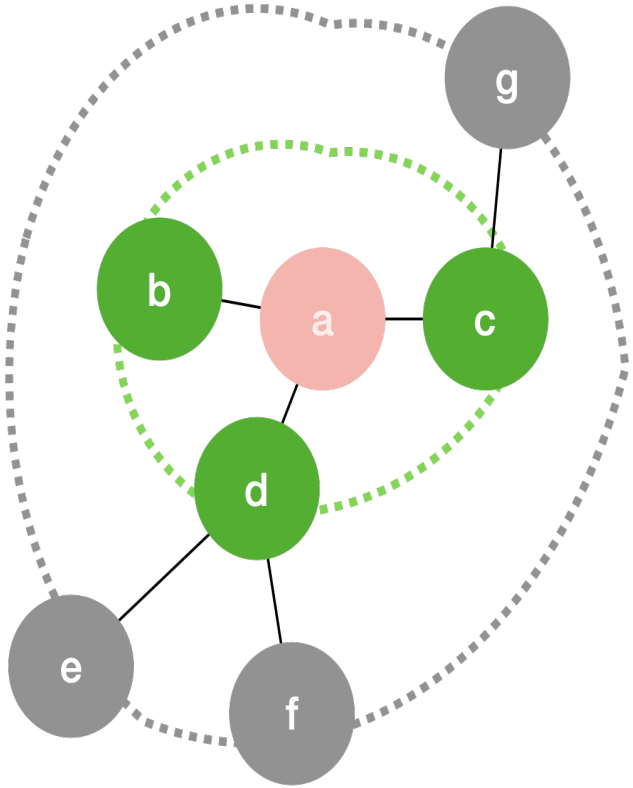
DFS vs BFS



- DFS Visiting sequence:
  a, d, e, f, b, c, g.
- When there are solutions away from source.

DFS vs BFS





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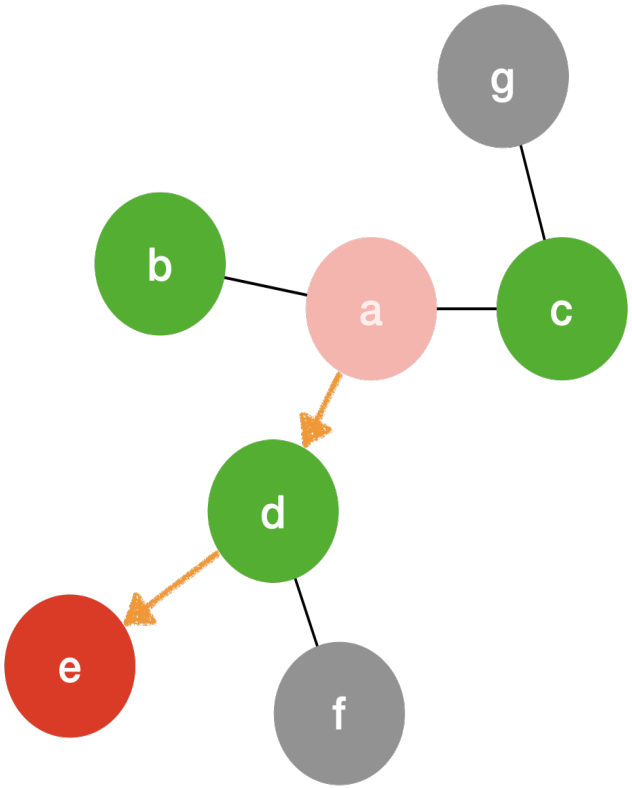
DFS vs BFS



- DFS Visiting sequence:
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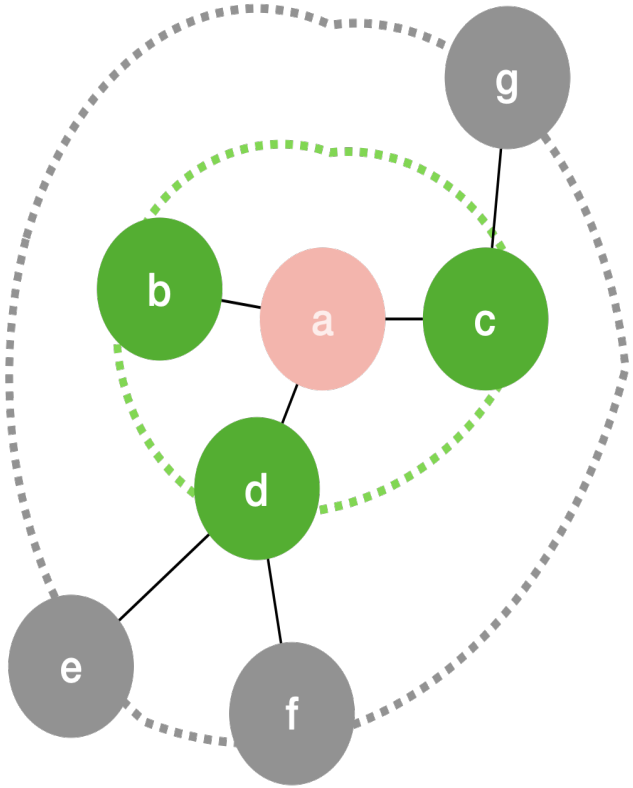
- When there are solutions away from source.

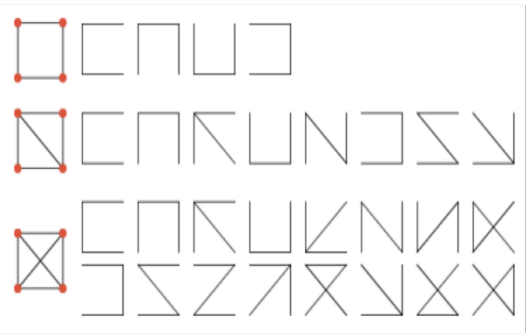


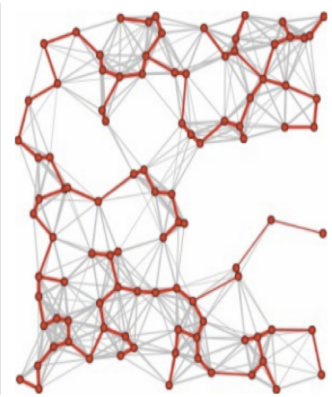
- BFS Visiting sequence:
  a, b, c, d e, f, g.
- Searching vertices closer to the given source.

Spanning trees

Definition

A spanning tree of a connected graph G is a sub-graph of G which contains all the vertices in G and it is a tree.





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[1] https://mathworld.wolfram.com/SpanningTree.html

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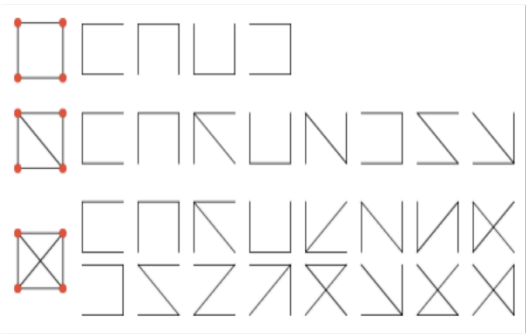

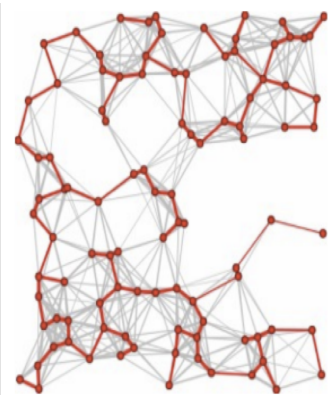

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How to compute spanning trees?

[1] https://mathworld.wolfram.com/SpanningTree.html

Q & A