Graph essentials

Graph basics

- Nodes(which is called vertices or actors in somewhere)
  - Nodes represent entities
- Edges(which is called relationships or social ties)
  - Edges indicate inter-node relationships
- Degree
  - The num of edges connected to a node is degree
  - The num of Input directed edges called in-degree
  - The num of Output directed edges called out-degree

Graph Representation

- Goal
  - Does not lose info
  - Can be manipulated easily by computers
  - Can have mathematical methods applied easily
- Adjacency matrix(sociomatrix)
  - Aij = 1 (if Vi is connected to Vj) or 0(otherwise)
- Edge list
  - denoted as (Vi,Vj) which means the edge from Vi to Vj

Type of graphs

- Null graph
  - No nodes
- Empty graph
  - There are no nodes but no edge
- Directed/Undirected/Mixed graphs
- Simple or multigraphs
  - multiple edges between nodes
- Weighted graphs
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Connectivity in graphs

- Traversing an edge
  - Visiting an edge can start at a and end at b.
- Walk
  - Walk is a sequence of incident edges traversed one after another.
  - If a walk traverses edges e1,e2 ... en, V1 is starting node and Vn is ending node.
    - If V1 != Vn, it is open walk
    - If V1 = Vn, it is closed walk
- Trail
  - Trail is a walk where edge is traversed only once.
    - A closed trail which ends where it started(tour or circuit)
  - All edges are distinct
- Path
  - Nodes and edges are distinct
  - Closed path is called cycle

Special graphs

- Trees and forests
  - Tree is a graph structure which has no cycle in it.
  - Forest is a set of disconnected trees.
- Special subgraphs
  - Spinning tree
    - It need guarantee there is a path connects every two nodes.
    - Minimum spanning tree is minimize the total distance of path.
  - Steiner tree
    - It aims to find a tree that it spans all the V' nodes and the weight of the tree is minimized.(V' is a subset of V)
- Planar graphs
  - No two edges cross each other
- Bipartite graph
  - A bipartite graph is where the node set can be partitioned into two sets.
    - V=Va U Vb
    - Va ∩ Vb = empty set
    - E = Va * Vb
  - Affiliation networks
- Bridge
  - The edges between two components

Graph Algorithms

- Graph traversal
  - DFS
  - BFS
- Shortest path
- Minimum Spanning trees
- Network flow
- Maximum Bipartite matching
- Bridge detection