Graph Theory:

* Paper written by Leonhard Euler on Seven bridges of Konigsberg which is published in 1736 is considered first paper of graph theory.

Konigsberg bridge problem.

* Euler proved that problem has no solution

Graph:

* Graph consists of two elements called vertex and edges.
* Edges can have direction or no => directed graph or undirected graph.
* In directed graph, (4,2) represents that vertex 4 has an edge that points to vertex 2.
* In undirected graph, (4,2) or (2,4) means the same thing.

Terminologies:

* Degree:
  + Number of edges connected to a vertex.
  + In directed graphs depending on whether edges are going out or coming in, it is called out-degree or in-degree.
* Path:
  + When going from vertex A to vertex B there may be many separate ways of getting there, one of them is called a “path”
  + Length of path = number of edges crossed going from A to B.
* Simple path
  + Path that crosses least edges.
  + All vertex must be unique, cannot cross same edge twice.
* Cycle(순환) and simple cycle
  + Where start vertex = end vertex. Ex: 1 -> 2-> 3-> 1.
  + simple cycle is a cycle with no overlapping vertex
* Acycle graph : graph with no cycles
* A connected graph: In a graph, whenever you pick 2 vertex they will be connected (no direction).
* Connected components:
  + Subgraph where any two vertices are connected to each other by paths and not connected to additional vertices in whole graph.
* Strongly connected:
  + In directed graph when two vertex point to each other.
  + If there is a path between all pairs of vertices.
* Strongly connected components: ??
* Complete graph:
  + You can reach any vertex in one crossing.
* Forest:
  + Acyclic undirected graphs
* Tree:
  + Connected graph without cycle.
  + Forest that is connected.
* Can be Forest that is also a Tree
* Dag = Directed acyclic graph

Graph and its representations:

* Two most common ways of representing a graph is using 1. Adjacency matrix and 2. Adjacency list.

Adjacency Matrix:

* Symmetric matrix for undirected graphs.
* In Directed graphs, how to show directions???

Adjacency List:

Weighted graphs:

* each edge has a weight
* In adjacency list, simply add a weight beside vertex. EX: A -> [b,2] -> [c,4] -> so on..
* In adjacency matrix, instead of 1 simple add weight w.

Questions:

* Why/when would we change undirected graph to directed and vice versa?

References:

* <https://www.geeksforgeeks.org/graph-and-its-representations/>
* <https://en.wikipedia.org/wiki/Graph_theory>
* <https://en.wikipedia.org/wiki/Component_(graph_theory)>