Chapter 7

Graphs

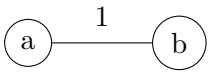
7.1 Introduction

You may have heard about graphs before, however, graphs in CS are not like graphs you have previously encountered in Mathematics... unless you've taken graph theory or something.

7.2 Terminology

- **vertex**
  A vertex is like a node for a tree. Actually, you might hear me say node instead of vertex a lot because they're interchangeable in this case. They will be represented similarly.

- **edge**
  An edge is the line between two vertices in a graph. It shows the relationship between the two vertices. Here is an edge with length 1 between vertices a and b.



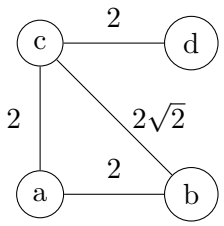
  Edges can be directed or undirected, which is explained lower.

- **weight**
  The weight of an edge is the number assigned to the edge.

- **adjacent**
  Vertices a and b are adjacent to each other if there is a edge between a and b.

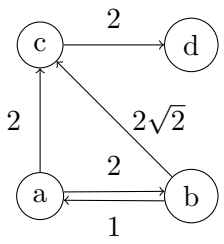
- **loop**
  A loop is an edge that extends from a vertex to itself.

- **undirected graph**
  An undirected graph is a graph whose edges have no direction.



  As you can see, the edge $\{a, c\}$ is the same as the edge $\{c, a\}$ and the same is true for the other edges.

- **directed graph**
  A directed graph is a graph whose edges have direction.



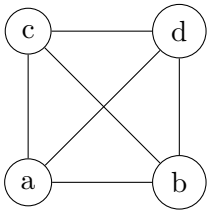
  Here we can see that the edge $\{a, c\}$ exists but the edge $\{c, a\}$ doesn't. Furthermore, we can see that the edges $\{a, b\}$ and $\{b, a\}$ exist but have different weights.

- **mixed graph**
  A mixed graph is a graph that has both directed and undirected edges. In other words, you can consider a directed graph a mixed graph with 0 undirected edges and vice versa for an undirected graph.

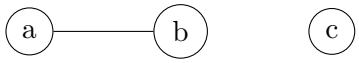
- **simple graph**
  A simple graph is a graph that does not have multiple edges between any pair of vertices and does not have any loops.

- **weighted graph**
  A weighted graph is a graph whose edges have weights.

- **complete graph**
  A complete graph is a graph where all pairs of vertices have an edge. In other words, all possible edges exist.



- **connected graph**
  A connected graph is a graph where there is a path between all pairs of vertices, otherwise it is a disconnected graph. Here is an example of a disconnected graph.



- **tree**
  A tree is a graph with no cycles. I'll leave that to you to confirm.

7.3 Examples

Removed for now.