Worksheet 4: Playing with Graphs

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3 Diameter Algorithm

Design an algorithm to find the **diameter** of an unweighted, undirected, **connected** graph. For short, we'll call this problem DIAMETER

3.1. Trivial and Small Instances

1. i. When a graph has a single node, the diameter is 0.
   ii. When a graph has two nodes, there can only be one diameter.
   iii. When a graph has no nodes, there is no diameter.
2. We can make a graph of three nodes, A, B, and C, where A is connected to B and B is connected to C. The diameter of this graph is 2. `A -- B -- C` The diameter of this graph is 2.

3.2. Represent the Problem

1. $G = (V, E)$ is an unweighted, undirected, connected graph. V is the set of vertices in the graph. E set of edges in the graph. Using the graph above, we can say, $V = \{A, B, C\}$ and $E = \{(A, B), (B, C)\}$. $G = (\{A, B, C\}, \{(A, B), (B, C)\})$
2. One trivial case can be represented as $V = \{A, B\}$, $E = \{(A, B)\}$, $G = (\{A, B\})$ Since we only have two nodes, the diameter is always going to be 1.

3.

4. Constraints for a node may not have an edge to itself:

$$\forall v \in V, (v, v) \notin E$$

Constraints for an edge between two nodes may only appear once:

$$\forall v, u \in V, (v, u) \in E \implies (v, u) = (u, v)$$

3.3. Represent the Solution

1.

2.

3.4. Similar Problems

1. Prim's Algorithm
2. Dijkstra's Algorithm