NAME: Solution____

2.4 Model real-world phenomena using the formal definitions of graphs and trees.

Say you are setting up a network of servers, where you know the latency time for communications between any directly connected servers.

(a) Suppose we wanted to model this situation using a graph. First, identify what the **nodes** and **edges** of the graph could be.

Let the nodes be the servers and the edges be the direct connections between them.

(b) Should this graph be **directed** or **undirected**? Justify your answer in a sentence or two.

I would make this graph undirected, since communication between servers is two-way, and should be the same in either direction. (Though there are ways to justify a directed graph here.)

(c) Suppose we made the graph **weighted**. What could the weights of the graph represent?

I would probably represent the latency times. Though you could also have weights represent the bandwidth, the cost of a connection, or the distance of the cable necessary to physically connect the servers. There are actually a lot of choices here.

(d) Now suppose that we ran *Prim's algorithm* to find a **Minimum Spanning Tree** for this graph. Recall that a *Minimum Spanning Tree* is a tree that spans every node in the graph using edges that have a minimum possible weight. What would a minimum spanning tree represent in the graph you have created?

Since I chose latency times, this minimum spanning tree would represent a way to connect all of the servers to minimize the latency between any pair of directly connected servers. Note: this does not necessarily minimize the latency between any pair of servers. Two servers that are on opposite sides of this tree from each other would have to communicate through multiple other serves, which could be a longer latency time than if they had been directly connected!

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