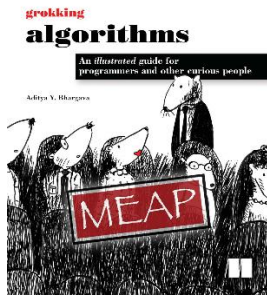


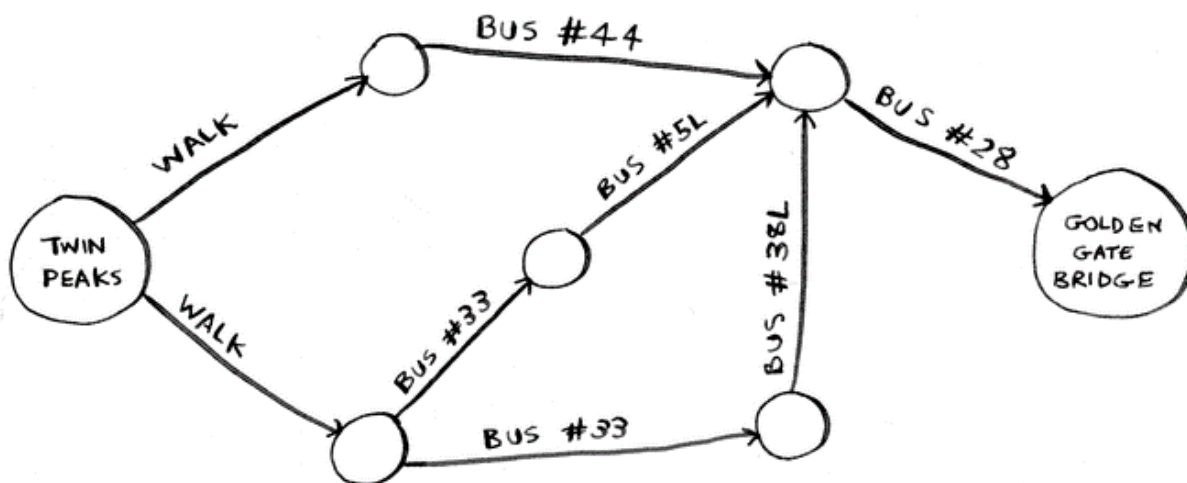
# Introduction to Graphs



In this article Aditya Y. Bhargava introduces graphs (what they are) Hint: they don't involve an X or Y axis). Then he will show you your first graph algorithm.

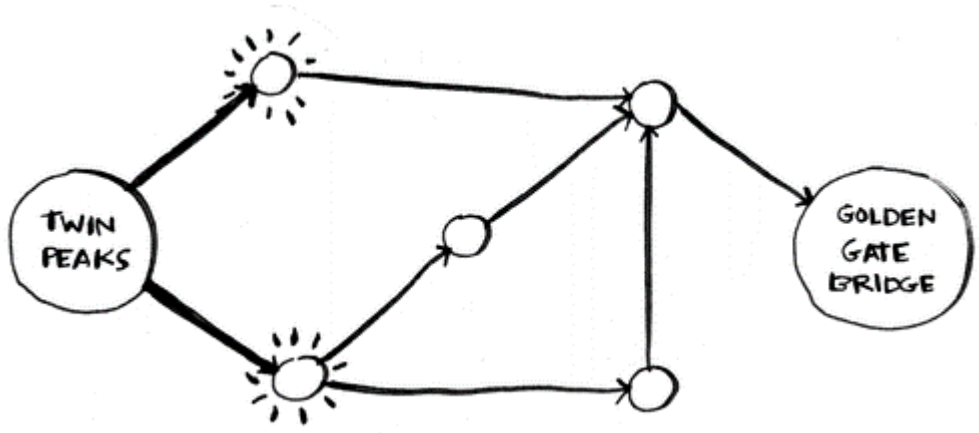
By Aditya Y. Bhargava, author of [Grokking Algorithms](#)

Suppose you are in San Francisco, and you want to go from Twin Peaks to the Golden Gate bridge. You want to get there by bus, in the minimum number of transfers. Here are your options:

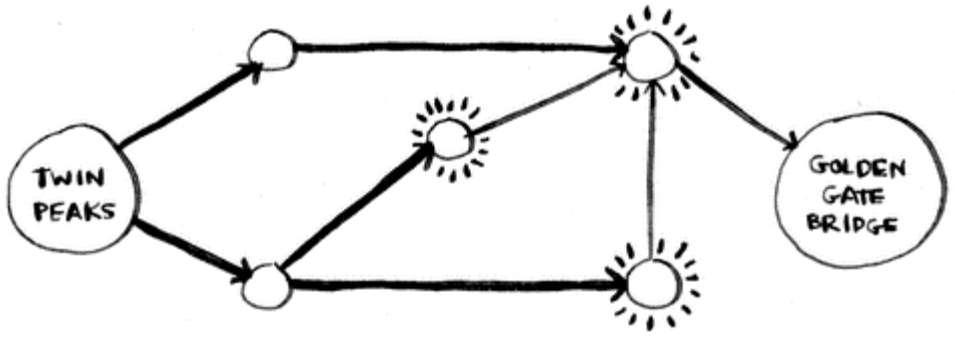


What's your algorithm to find the path with the least number of steps?

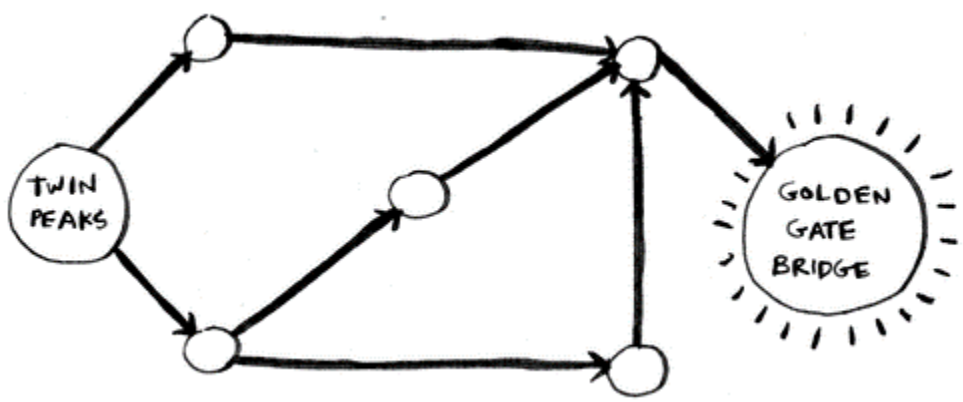
Well, can you get there in one step? Here are all the places you can get to in one step:



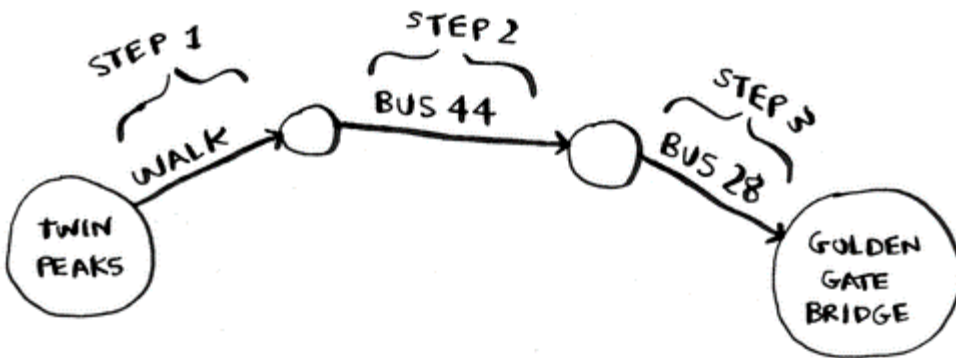
The bridge is not highlighted, you can't get there in one step. Can you get there in two steps?



Again, the bridge isn't there, so we can't get to the bridge in two steps. What about three steps?



Aha! Now the Golden Gate bridge shows up. So it takes three steps to get from Twin Peaks to the bridge using this route:



There are other routes that will get you to the bridge too, but they are longer (4 steps). Our algorithm found that the shortest route to the bridge is three steps long.

This type of problem is called a "shortest path" problem. You are always trying to find the shortest \*something\*. It could be the shortest route to your friend's house.

It could be the shortest number of moves to checkmate in a game of chess. The algorithm to solve a "shortest path" problem is called breadth-first search.

To figure out how to get from Twin Peaks to the Golden Gate bridge, there were two steps:

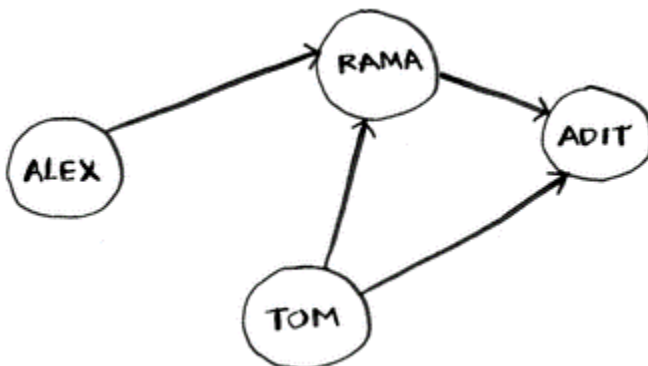
- Model the problem as a *graph*.
- Solve the problem using *breadth-first search*.

I'll cover what graphs are.

A graph models a set of connections. For example, suppose you and your friends are playing poker, and you want to model who owes whom money. Here's how you could say "Alex owes Rama money":

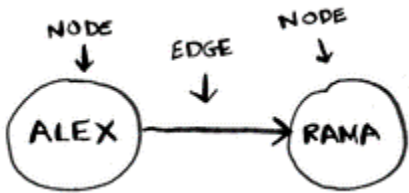


The full graph could look something like this:



( Graph of people who owe other people poker money)

Alex owes Rama money, Tom owes Adit money, and so on. Each graph is made up of nodes and edges:



That's all there is to it! Graphs are made up of nodes and edges. A node can be directly connected to many other nodes. Those nodes are called its *neighbors*. In neighbors this graph, Rama is Alex's neighbor. Adit is not Alex's neighbor, because they are not directly connected. But Adit is Rama's and Tom's neighbor.

Graphs are a way to model how different things are connected to one another.