

Closest Points Problem

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1 Points on a Number Line

First, we consider a list of points on a number line (ie, a list of numbers). We want to find the distance between the two which are closest together. Perhaps the most obvious way to find this is to compute all of the distances and then find the smallest one. This is called a **brute force** algorithm. Often, this is a good place to start, but it is usually not the fastest algorithm.

1. Find the distance between the closest two points on a number line by brute force. What is the running time of this algorithm?
2. Use what you know about running time and algorithms we've discussed in class to solve the problem on the number line in $O(n \log n)$ time. Hint: Use the fact that we are working in one dimension to your advantage.

2 Points in the Plane

Now, let's increase the dimension and consider a collection of points in the plane (ie a collection of ordered pairs (x, y) where x and y are numbers).

1. Find the distance between the closest two points in the plane by brute force. What is the running time of this algorithm?
2. Use what you know about running time and sorting algorithms to solve the problem in $O(n \log n)$ time. Note that this algorithm is going to be more complicated than the one for the number line (Question: why?)
3. Use what you've learned so far to write an algorithm for finding the distance between the closest points in 3 dimensional space. Can you write one which is faster than the brute force algorithm?