CityFinder

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Administrivia

Assignment one is still out!

Drop by the lair tonight 8-12 for questions!

CityFinder

- Today we're going to do something different
- I've dumped a lot of information on you these last 5 lectures
- Instead of throwing more words at you, we're going to spend most of today applying the concepts we've learned to do an “assignment”

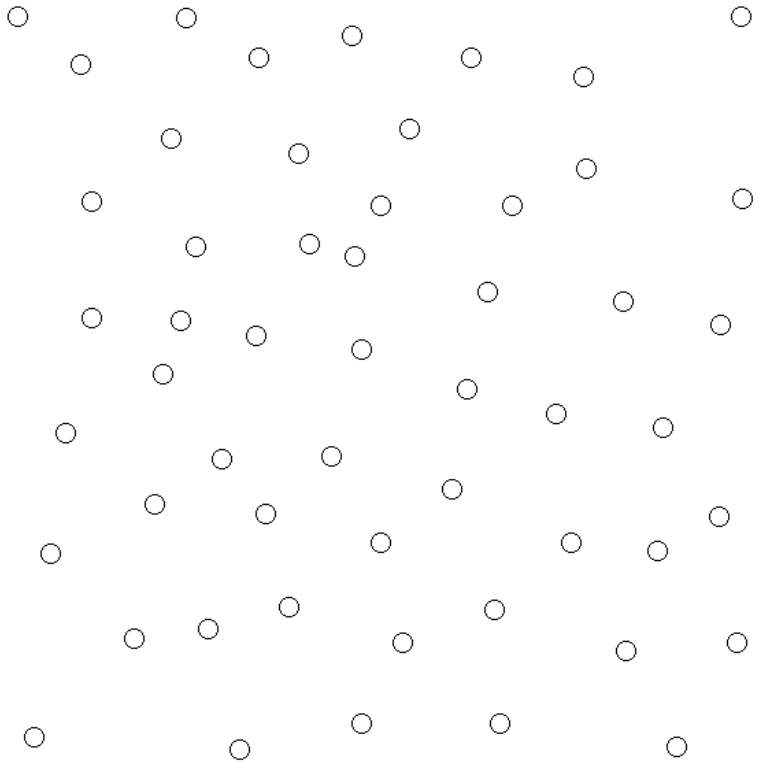
CityFinder

CityFinder answers the question:

Which cities are within `d` miles of city `y`?

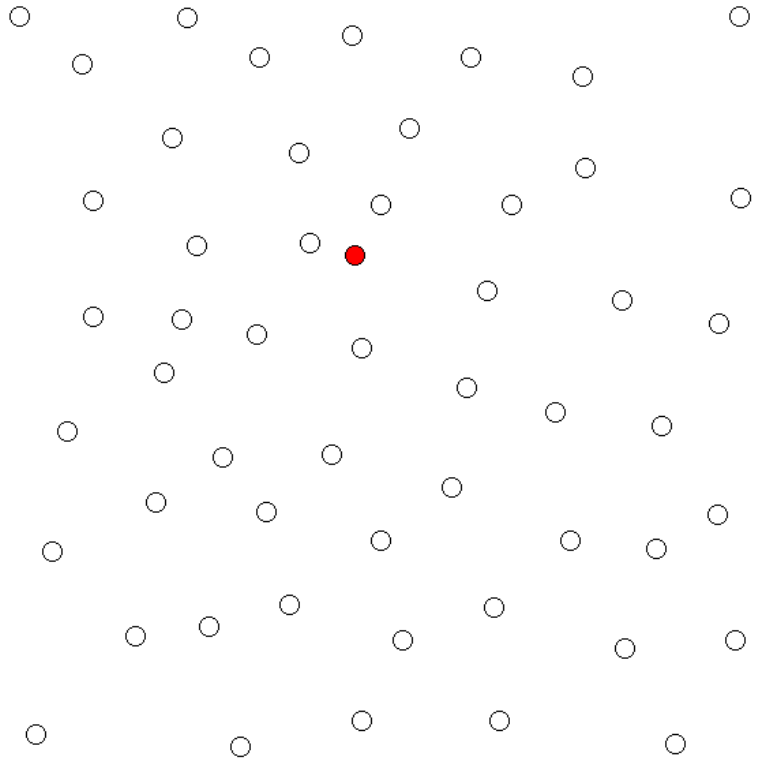
CityFinder

Say that we had a bunch of cities arranged like this:



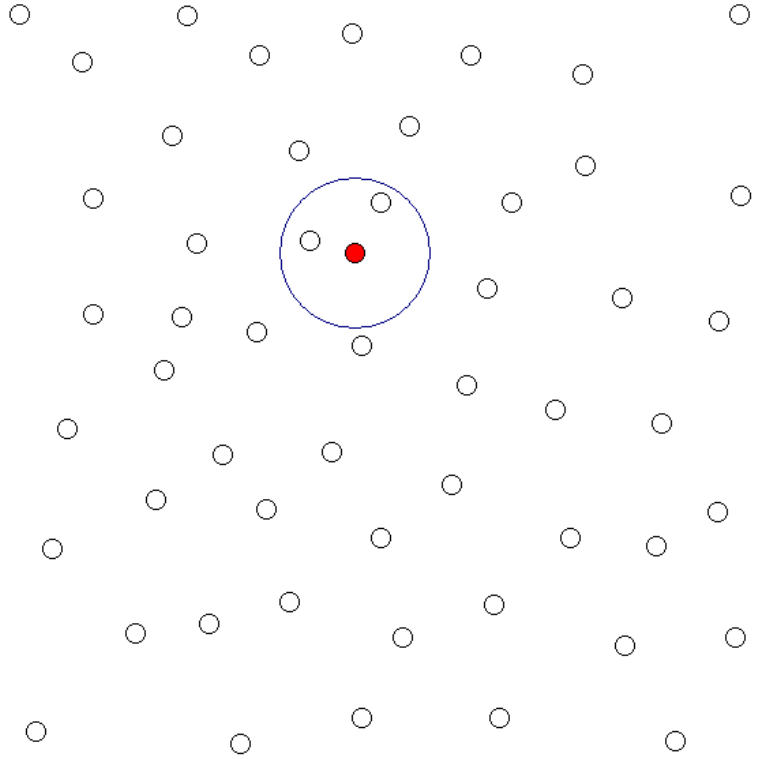
CityFinder

Say that we're considering this city



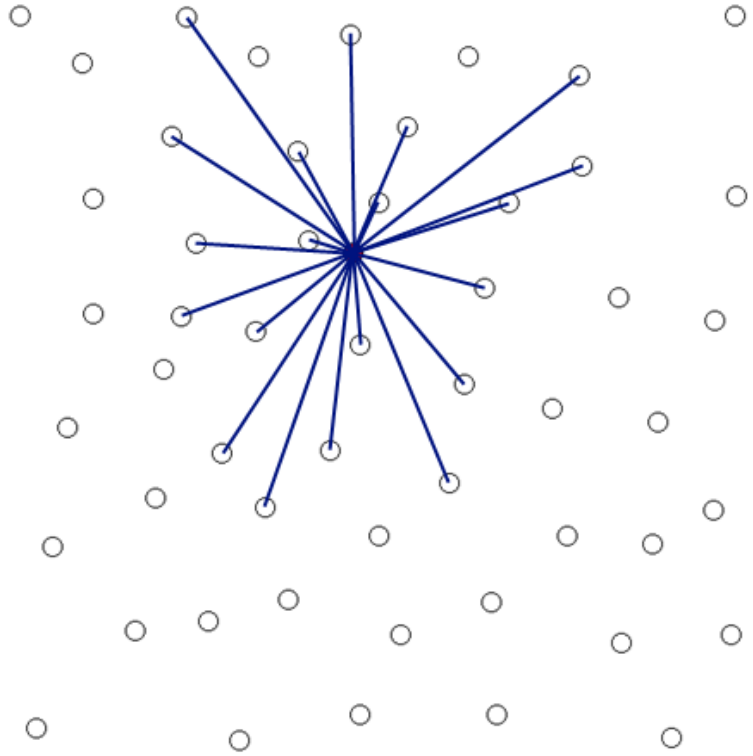
CityFinder

Say we wanted to find the names of all cities within a certain distance of our city



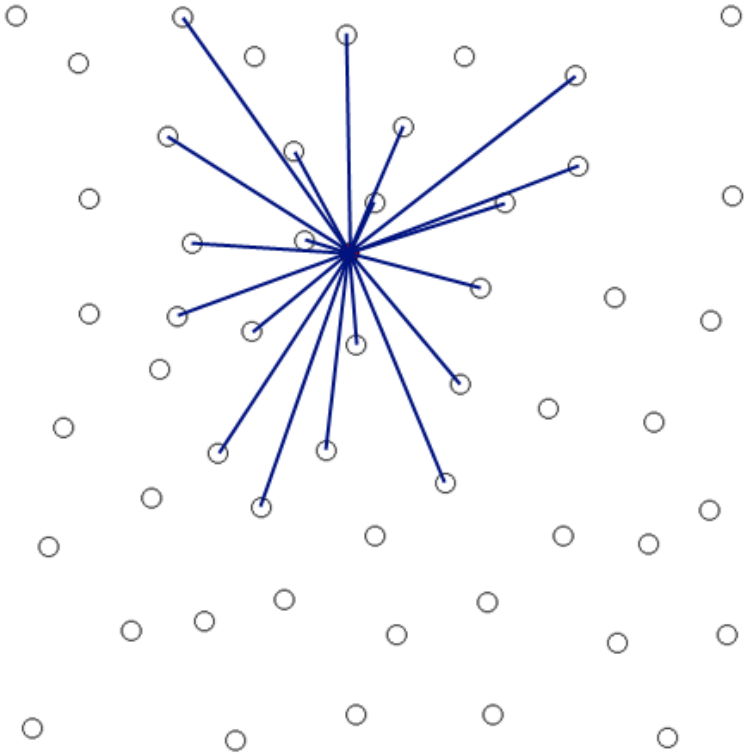
CityFinder

We could compare the distances between our city and every other city



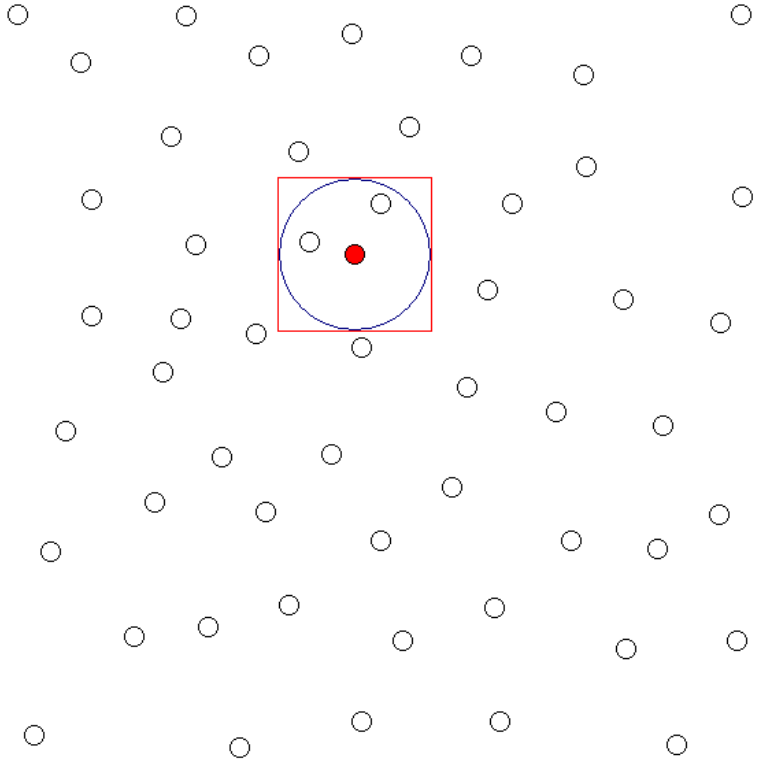
CityFinder

This would be too slow -- computing distance can be expensive!



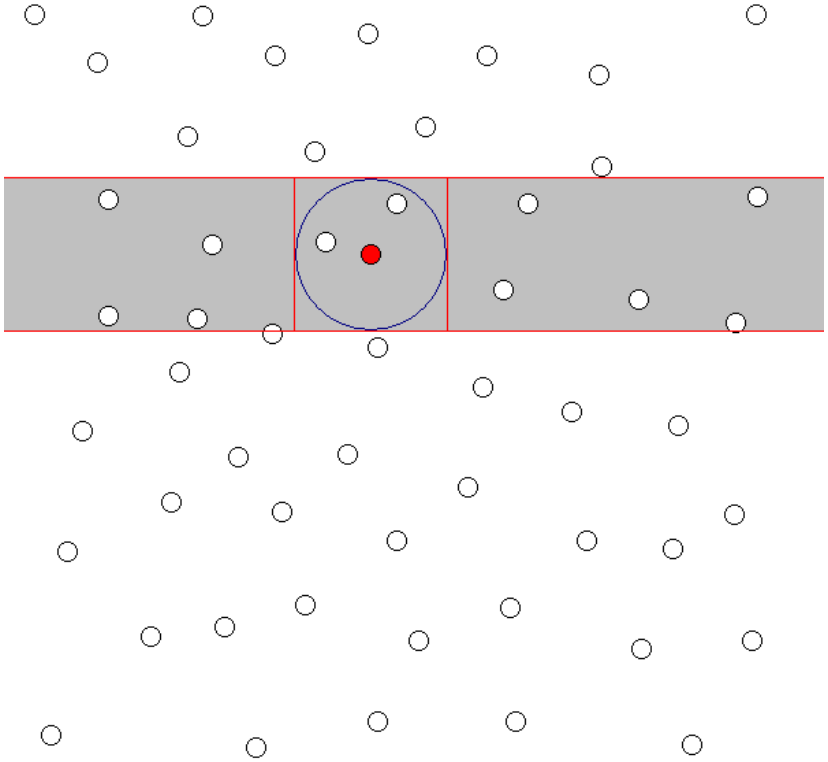
CityFinder

What if we used the same process, but only needed to check a smaller number of cities?



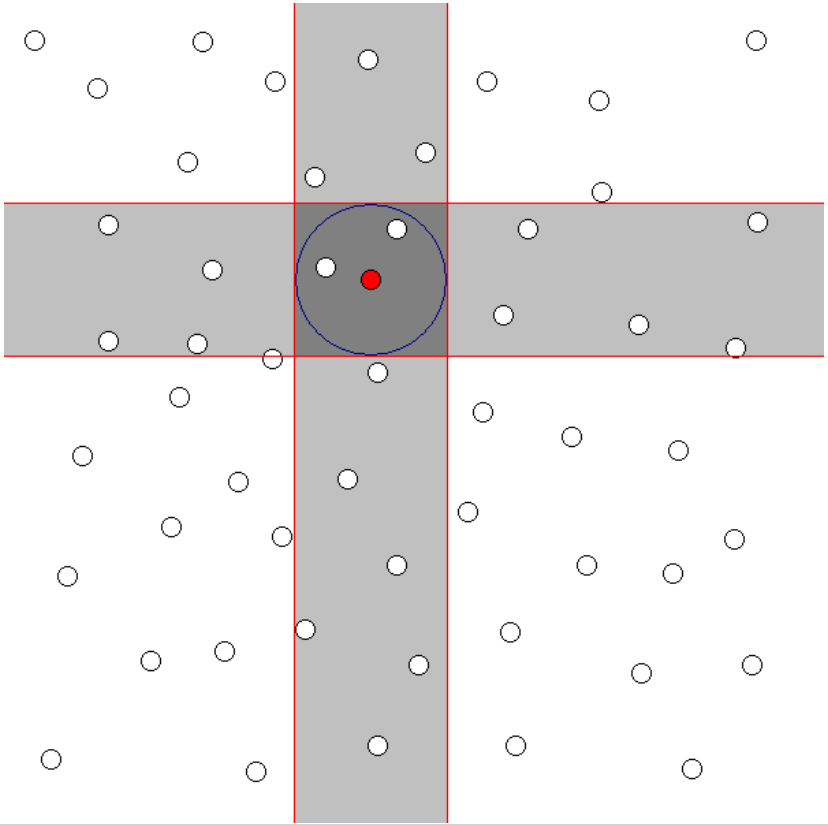
CityFinder

We could start by excluding cities who have y coordinates which are too large or too small



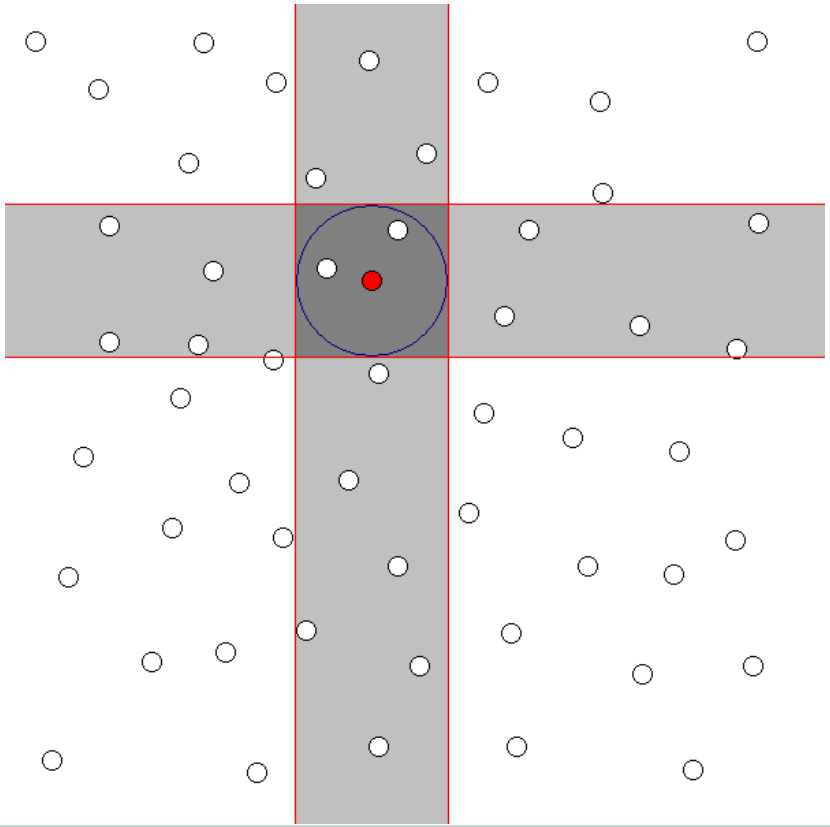
CityFinder

Then, we could filter out elements whose x coordinates are too large or too small



CityFinder

We could then check a much smaller area yet still recover all valid points!



How can we model this in C++?

- We need to be able to efficiently filter cities based off of their x and y coordinates
  - We should be able to only examine cities whose x (or y) coordinate falls in a certain range
- We can do this using iterator ranges!
  - If we keep a mapping between latitude and cities at that latitude, we can iterate through cities within a certain range using `upper_bound` and `lower_bound`

How can we model this in C++

Keep a map from latitude to city name

37.422	Stanford, CA
37.760	San Francisco, CA
39.973	Carmel, IN
43.165	Rochester, NY
43.665	Portland, ME

How can we model this in C++

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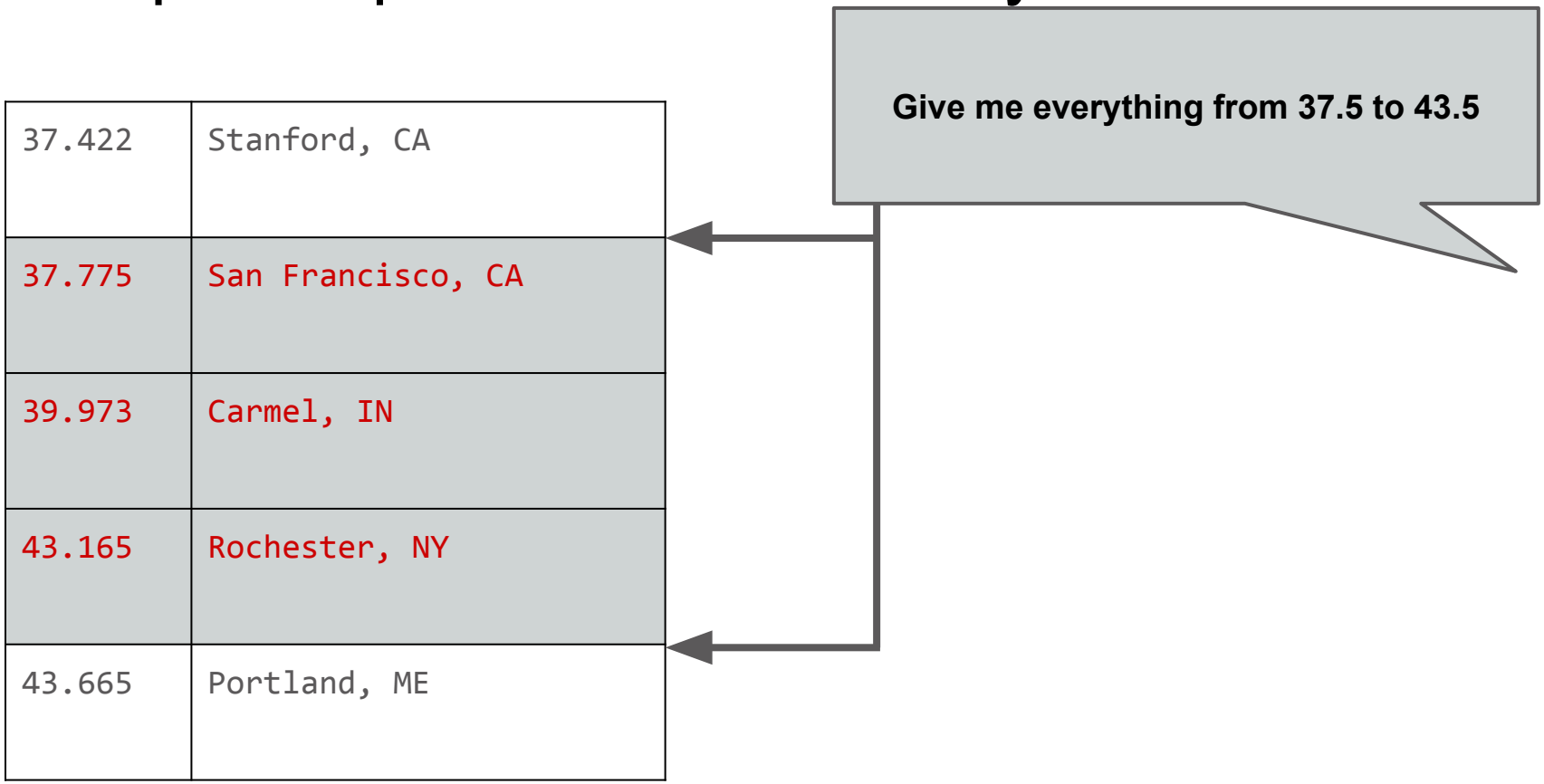

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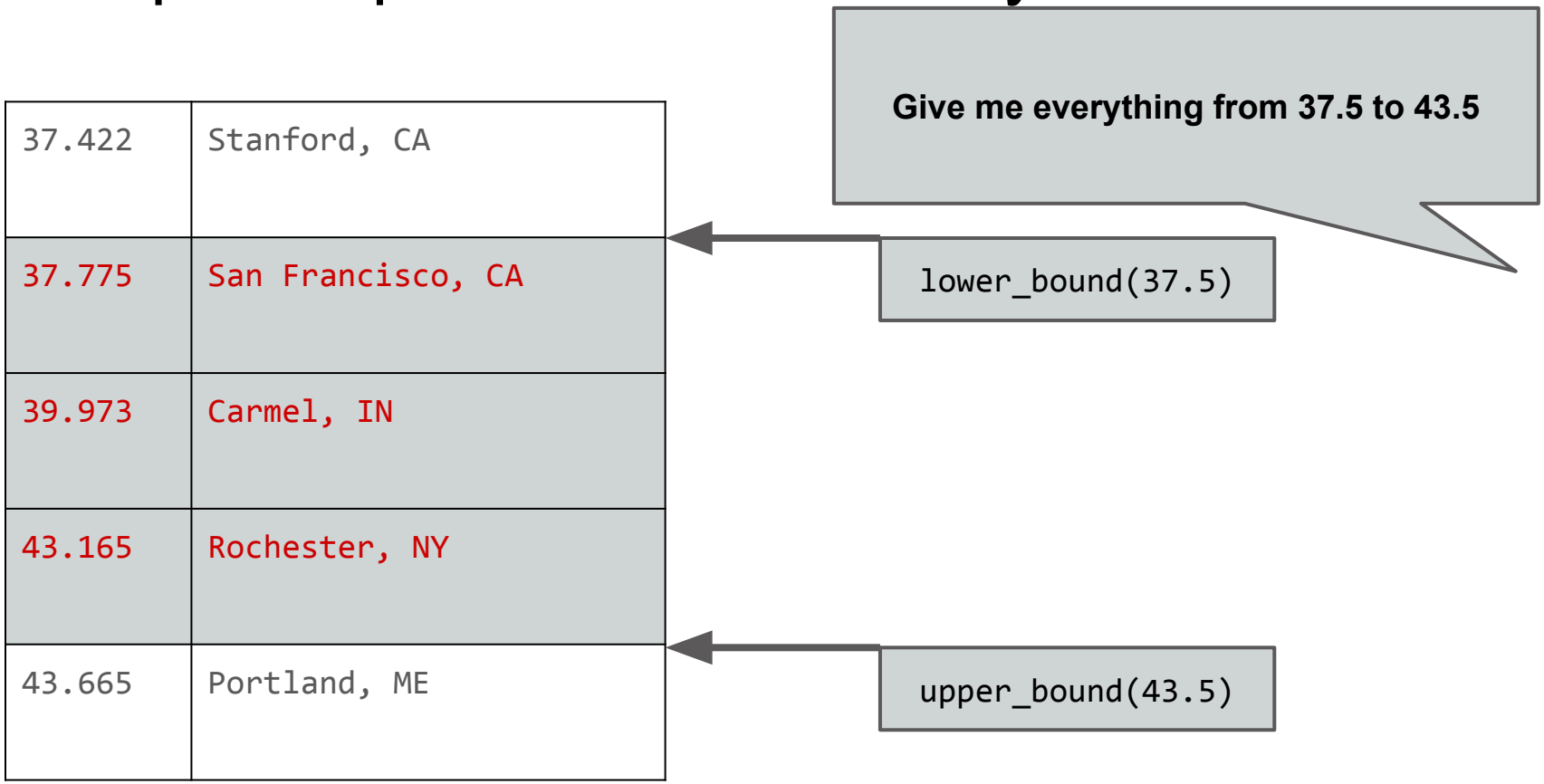

37.422	Stanford, CA
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A Couple of C++ Tidbits

Before we get started with the code, I want to quickly mention a few bits of C++ we'll use

A Couple of C++ Tidbits

`typedef` allows us to refer to one type using a different name. For example, if I write

```
typedef map<string, CityLocation>
CityMap;
```

Then I can write `CityMap` any time I would have had to write out `map<string, CityLocation>`

This makes code easier type and easier to

A Couple of C++ Tidbits

Two cities might have the same latitude but different longitudes.

If we stored a simple mapping from latitude values to city names, we might end up overwriting a city which had the same latitude.

A Couple of C++ Tidbits

We can use a **multimap**, which is identical to a map, except that a single key can have multiple values.

This means that if we have multiple cities with the same latitude they will be handled appropriately.

Enough Talk!

Time for the code!