Algorithms
Algo-what?!  Why?
Algorithms

The Plan

Why We Need Them
What They Are
How to Make an Algorithm
Testing Your Idea
Computers are really, really fast.
How fast, you ask?

A reasonably powerful computer in 1961 could perform about 56 multiplication operations in one second.

The most powerful supercomputer in the world today can perform:

a) < 500,000 ops per second
b) Between 500,000 and 5,000,000 ops per second
c) Between 5,000,000 and 100,000,000 ops per second
d) > 100,000,000 ops per second
Really, really fast

233,000,000 operations per SECOND
Really, really fast

2,330,000,000 operations per SECOND
Really, really fast

23,300,000,000

operations per SECOND
Really, really fast

233,000,000,000

operations per SECOND
Really, really fast

2,330,000,000,000

operations per SECOND
Really, really fast

23,300,000,000,000 operations per SECOND
Really, really fast

233,000,000,000,000

operations per SECOND
Really, really fast

2,330,000,000,000,000 operations per SECOND
Doors have opened and there's work to be done.
We've got three ways to get our work done faster:

1. Make more computers.

2. Make new computers faster.

3. Make what we're doing faster.
What is an algorithm, anyway?

An algorithm is any well-defined computational procedure that takes some value or set of values as input and produces some value or set of values as output.
An Algorithm You Already Know and Love*

* = or at least appreciate knowing
The Multiplication Algorithm (for humans)

This algorithm will work on any two numbers, positive or negative. It requires some modification to work with decimal numbers.

\[
182 \\
\times 14\\n\hline
8
\]
The Multiplication Algorithm (for humans)

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Popular Algorithms

What is the shortest path between a bunch of interconnected locations?
Popular Algorithms

How can we sort a list of different items quickly?
How can we search through a list of items quickly?
Abstraction in Algorithms

get the shortest path from [ ] to [ ] in [ ]
A block that finds the shortest path between two places in a graph.

sort the list [ ]
A block that (somehow) sorts the input list.

does the number [ ] appear in [ ]?
A block that searches for a particular number in a list.
If there is anything wrong with your algorithm / program, your users WILL find it!
Types of Testing

Black Box

Glass Box
Testing is Really Complex

You want to test as many “paths of execution” as possible!
Which of the following sets of values for *num* would make the best test case for this block?

a) 1, 2, 3
b) -1, 1, 3
c) 12, 100, -3
d) -1, -2, -3
e) no testing needed
Food for Thought:

You have a list of numbers sorted in increasing order.

If someone asked if a particular number exists in the list, what is the fastest way to determine whether it does or doesn't?