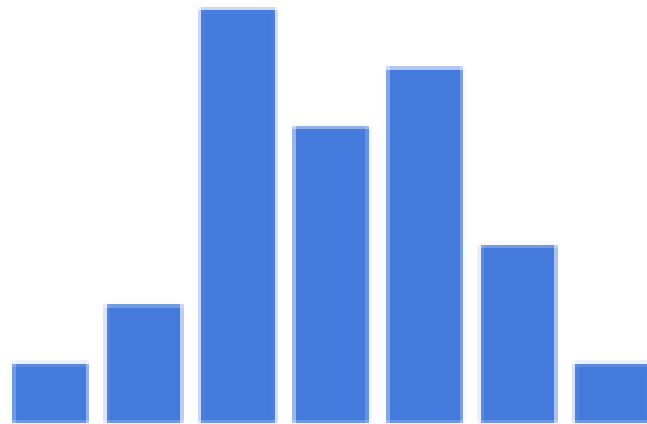# Graphing the Fast Class Count
- or -
Making a LINEPLOT on the Plotly Website

Counting people in a room

Last time we counted the people in the classroom in two ways:

- Brute force: One person counted 1, 2, 3 ...
- Divide and conquer: Each person counted 1, then pairs added their results, ...

The divide and conquer algorithm

Algorithm to count people in a room (and fast!):

Step 1 Each person in the room stands up and is assigned the number 1.

Step 2 Each standing person pairs with another stander (if available), and they combine their totals;

Step 3 For each pair of standers, one sits down;

Step 4 If more than one person is standing, go back to Step 2.

Step 5 The last stander knows the number of people in the room.

Compared to brute force, this algorithm is more complicated, but much faster.

Counting a room of 21 people

What happens for bigger classes?

Computers solve big problems; one algorithm is better than another if it can solve big problems faster.

We know the brute force method takes n steps to count n people, so if the class doubles, the work doubles. What happens with the Divide and Conquer method?

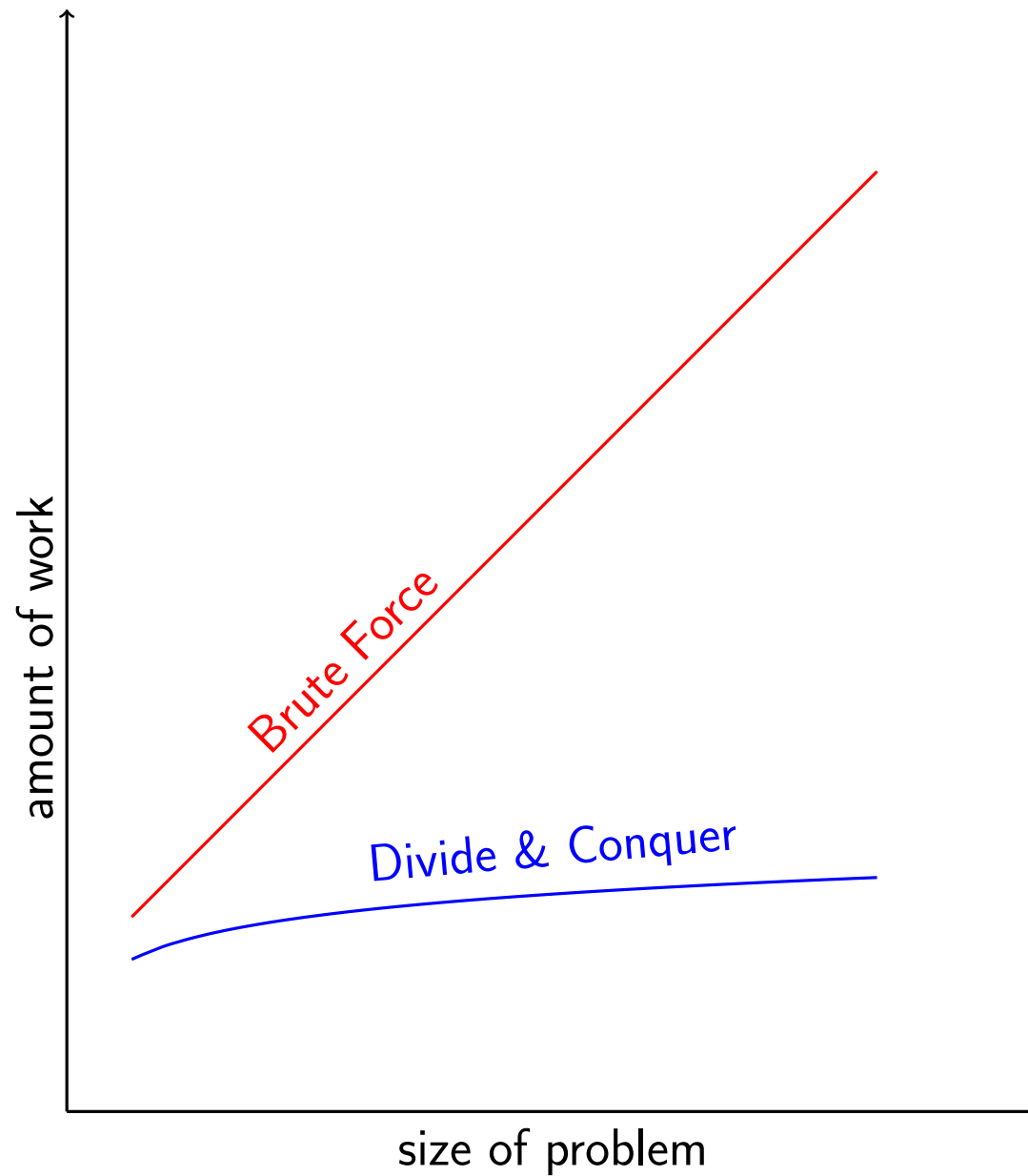| Loop #	# people standing after each loop			
	class: 21	class: 42	class: 84	class: 168
1	11	21	42	84
2	6	11	21	42
3	3	6	11	21
4	2	3	6	11
5	1	2	3	6
6		1	2	3
7			1	2
8				1

We can see a pattern in our data

So counting classes of size 21, 42, 84 and 168 takes about 5, 6, 7 and 8 loops respectively. Now we can easily fill in our table for the number of loops required for classes of size 336, 672, etc.

The rule seems to be: *Every time the class doubles, the number of loops goes up by 1.*

Class Size	Number of loops required
21	5
42	6
84	7
168	8
336	9
672	10
1344	11
2688	12

There's a formula to predict this value for any class size, but we don't need to know that yet.

Brute Force

Divide & Conquer

amount of work

size of problem

How can we make one of these plots?

The previous plot, which compares the number of steps required to count the class size using either method, makes it easy to believe that Divide and conquer is better, and extremely better as the problem size increases.

Now we'd like to look at the process of creating such a graph ourselves.

To begin with, it will help to make a table, with labels, of exactly the data we want to compare, in this case the problem size, and the amount of work.

A plot has horizontal and vertical directions, called the x and y directions.

While the final plot will display lines, we construct lines by specifying points.

A mathematical, straight, line only needs two points to specify it. Our plot is more complicated, and for the divide and conquer data, we will specify a number of points that we will connect to form our line.

Our table

The class size is the x variable.

The work for brute force and divide and conquer are y variables, and we distinguish them as $y1$ and $y2$:

Size	Brute	Divide
x	y1	y2
21	21	5
42	42	6
84	84	7
168	168	8
336	336	9
672	672	10
1344	1344	11
2688	2688	12

What plot program to use?

There are many programs available that can turn data into plots.

A common program for storing, analyzing, and plotting data is Microsoft Excel. However, you have to buy and install this program to use it, and it's really more powerful and complicated than we need. (But you are welcome to do your plotting for this course using Excel, if you are already familiar with it.)

An alternative is to use Plotly, a program which is freely available through your web browser. You can simply search for **Plotly** or else go directly to the address https://plot.ly/

The first time you use Plotly, you need to set up a username and password. This way, Plotly can preserve your work and make it available to you the next time you log in.

I will demonstrate Plotly version 1. Plotly version 2.0 has a slightly different look and feel.

Entering our data

When you start up Plotly, you want to go to the new chart page. You may have to find a menu item like $+\mathbf{NEW}$ and highlight it to get the $\mathbf{Chart}$ option.

If I get put into Plotly version 2.0, I switch back to Plotly 1.0.

Now the main thing I see is a table, with columns labeled $\mathbf{Col1}$, $\mathbf{Col2}$ and so on, and possibly some data already placed in the first three columns.

We can simply type our table data into these three columns.

As a help, we can rename each column, so $\mathbf{Col1}$ becomes $\mathbf{Work}$, and the next two columns might be $\mathbf{Brute}$ and $\mathbf{Divide}$.

Plotly's New Chart Page

Plotting our data

To plot just the Brute Force data, we want to highlight **choose as x** for column 1, and **choose as y** for column 2, and then select **LINEPLOT**.
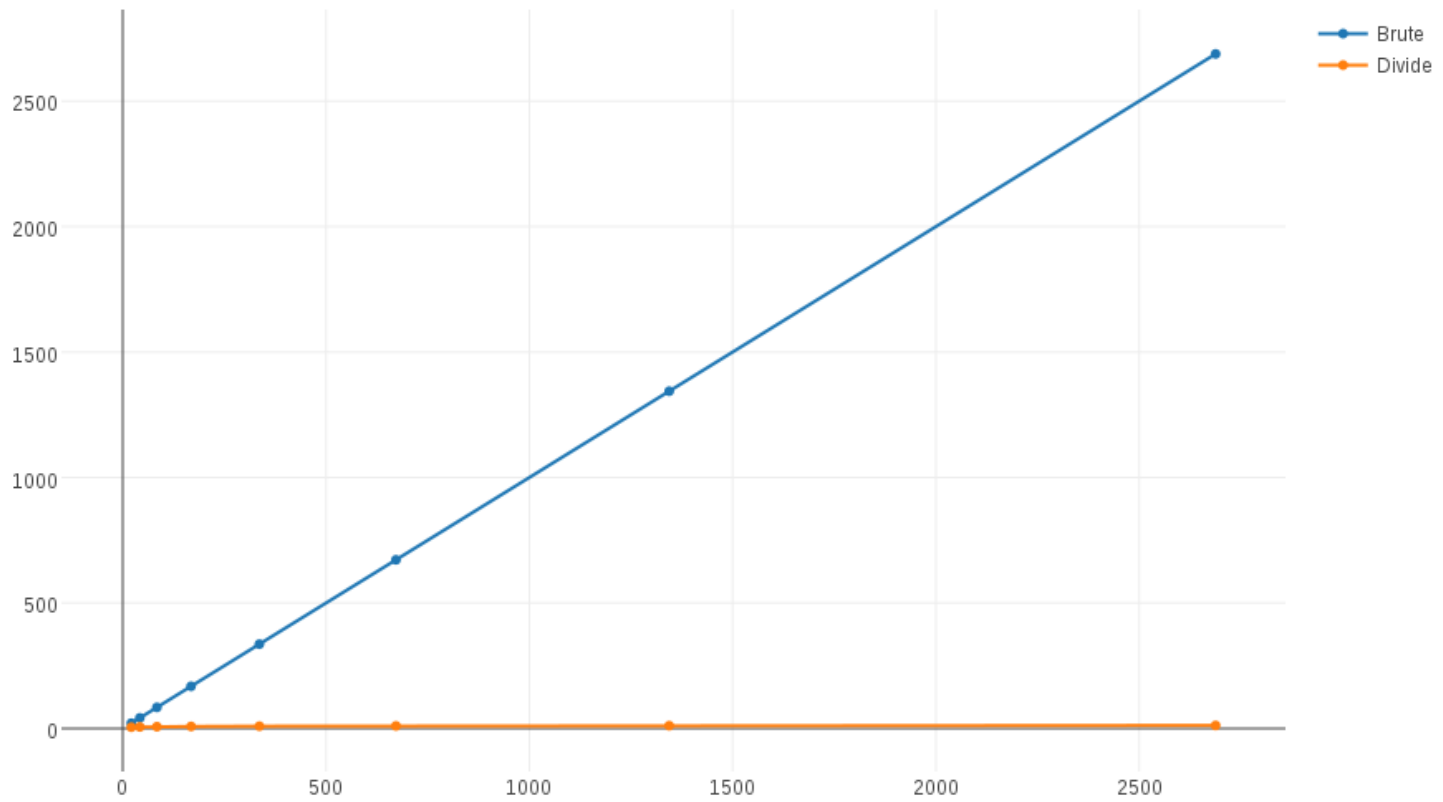
This turns out to be a boring straight line.

We can go back to the starter data page and select column 3 instead, to see the Divide and Conquer Curve.

This is a more interesting plot, because it's a curve that rises, but slower and slower.

To see both curves together, highlight **choose as y** in both columns 2 and 3.

Because the brute force numbers grow so rapidly, it's hard to see both sets of data on one plot.

Plotting our data

Improving our plot

Plotly's lines might not be thick enough for you. Click on the **Traces** box on the left, then select the **Style** tab. At the **Line** row, you can select the line style, line thickness, or line color.

Plotly's data markers might not be big enough for you to see. The same Traces/Style option includes a **Marker** line that allows you to select the marker type, size, and color.
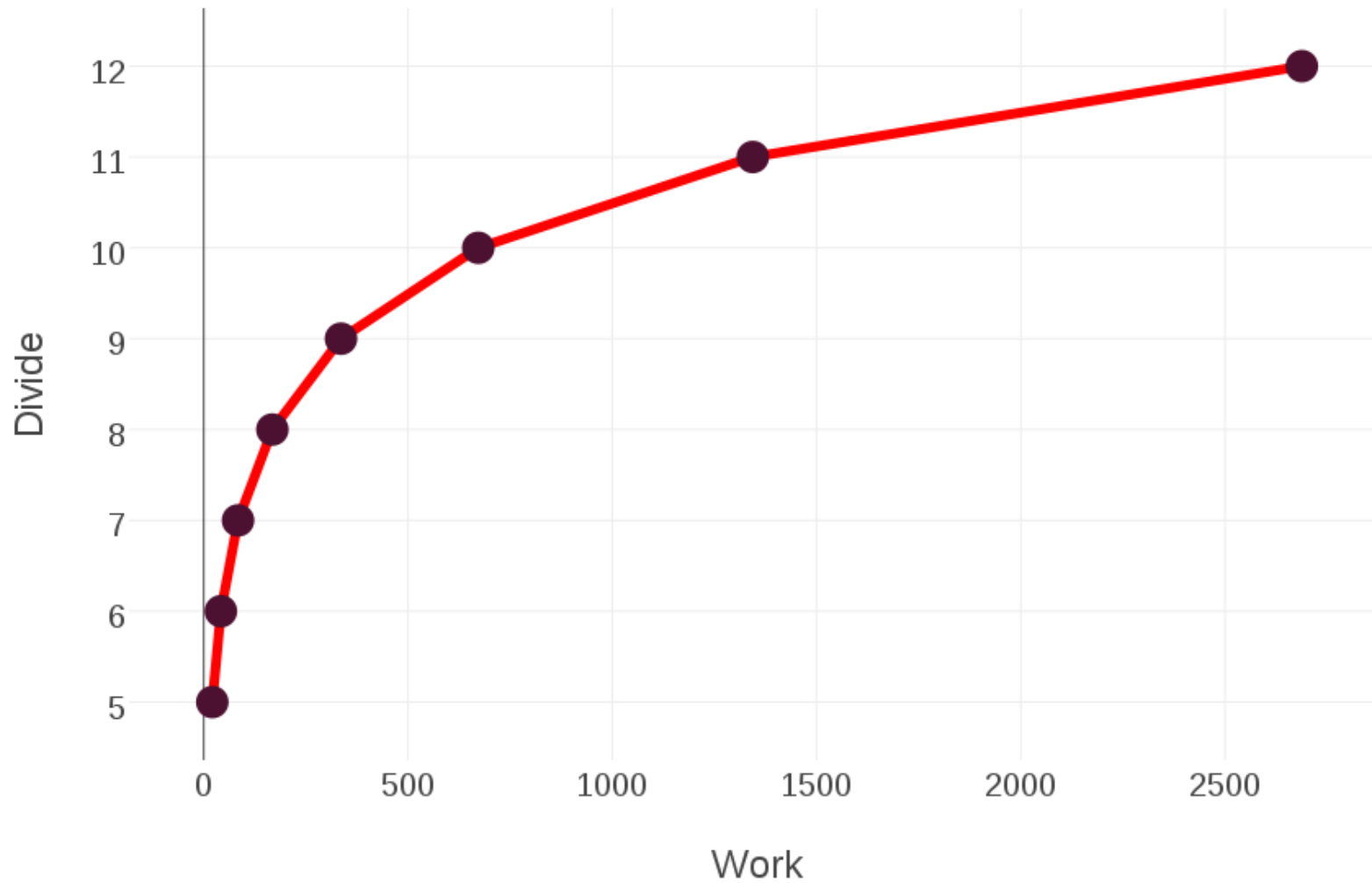
You can label the X axis if you notice the faint words *Click to enter x-axis title.* The same thing goes for the Y axis, and for a plot title at the top of the page.

Once you have a plot the way you like it, you can download a copy as a PNG file, by clicking on the little camera icon in the list that will appear around the top right area of the plot.

If you want to save more than one plot, you need to change the names after you save each one.

An improved plot

Just the Divide and Conquer Data

Pay attention!

Please give Plotly a try.

See if you can create the plots as shown here.

There will be a homework assignment given soon, which will include a part which requires a data plotting assignment similar to what we have down today.

From time to time over the semester, we will return to Plotly to make some other kinds of plots.