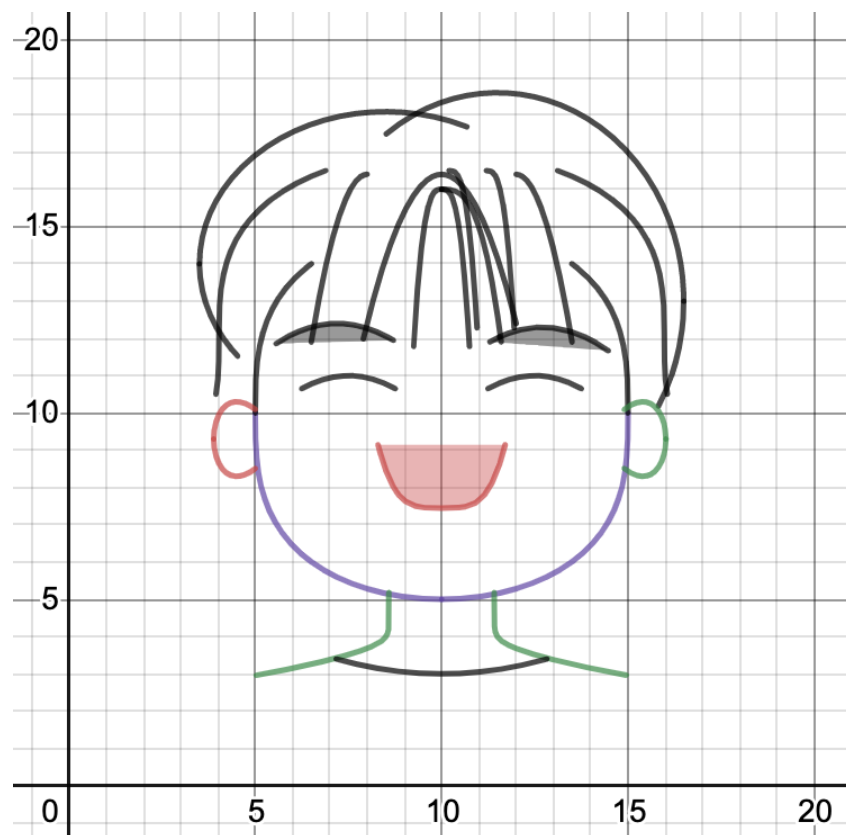


Manual: Desmos 101

Drawing with Functions (A13166)

Splash 2019, November 23-24



Alright Alright! Is everyone hyped yet for some FUNctions?
Welcome to A13166: **Drawing with Functions** at Splash 2019!

In this short 50-minute crash course, we will be exploring (and potentially coming up with) various ways to draw all types of stuff and/or make art with mathematical functions.

Also, let's remember that **this is an art class much more than it is a math class**. One of the goals of this class is for us to realize that mathematics, though seemingly formulaic, can be utilized with much more freedom during creative processes. Don't be discouraged if you don't yet know some of the math that we mention in this class – regardless of your mathematical background, $\lim(\textit{creativity}) = \infty$ (creativity is always limitless!)

Although there are many other powerful & FREE online graphing tools that can do very similar things, we will be using www.desmos.com as it is comparatively easier to master and most suitable for beginner to intermediate level mathy artists!

If you have never heard of Desmos before, don't worry! The following manual will help you get started easily!

If you have already been using Desmos for a while, great! I'd still read the manual though, just to make sure you are comfortable with everything mentioned below!

(Basically, please read this manual.) ☺

Thus, without further due, let's introduce our friend, Desmos!

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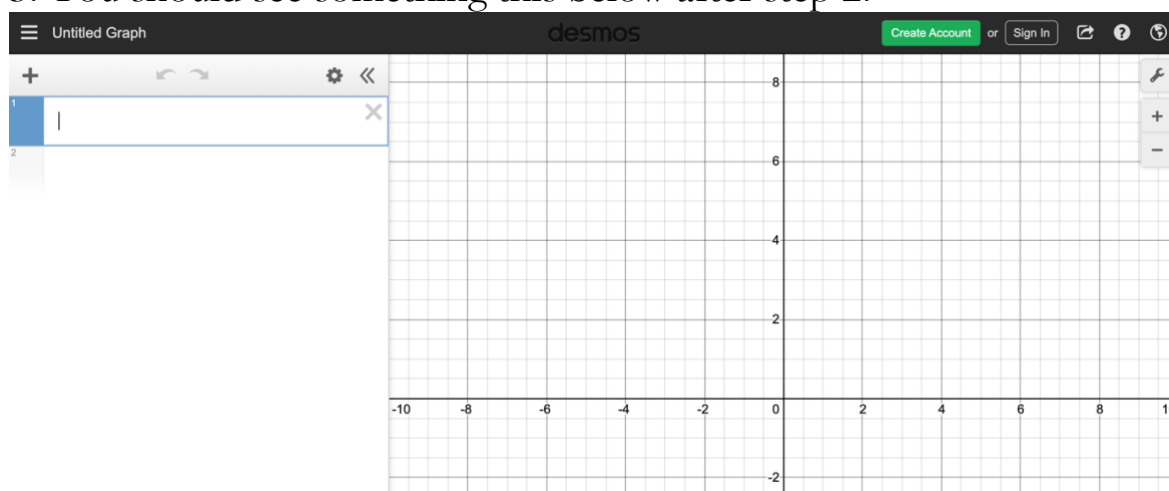
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1. Creating An Account

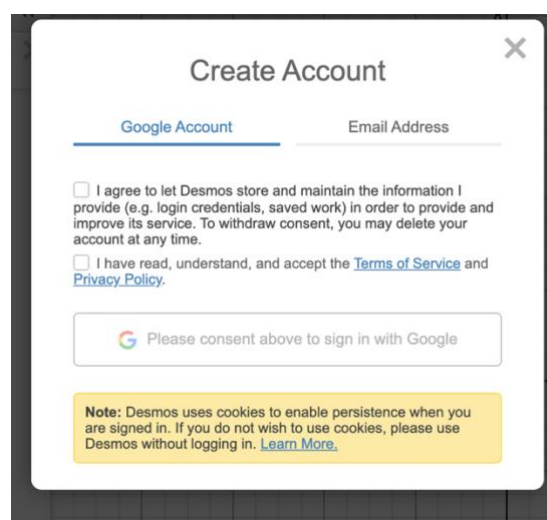
Let's say, after an hour of brainstorm and math, you manage to make an amazing piece of mathwork. Wouldn't it be great to save it so that you can keep it forever? Well, to do that, you'd be better off with an account before you come to class on Splash Weekend!

And here is how you do it:

1. Go to www.desmos.com.
2. You should see something like the picture shown above. Hit "Start Graphing".
3. You should see something this below after step 2:



4. Now, hit "Create Account". You can choose to create account with your email address or directly sign in with your Google account, if you have one.

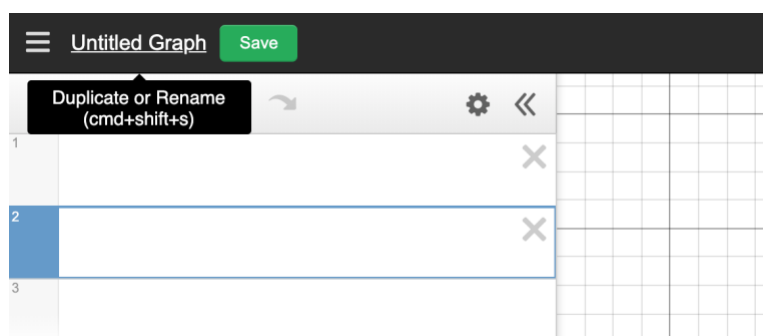


2. Where-is and How-to's

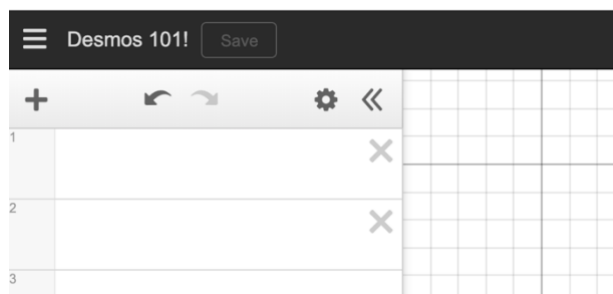
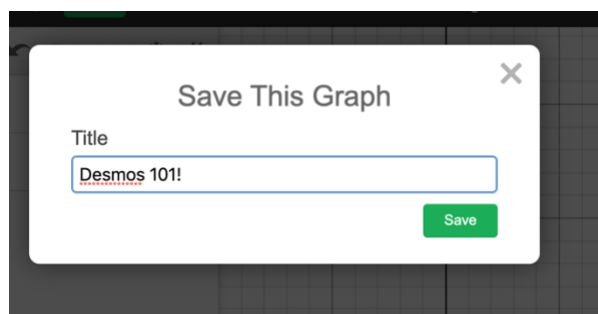
In front of you is a blank gridded canvas and limitless possibilities! Time to start exploring! But wait, how do I...

2.1 Naming My Graph

Click on “Untitled Graph”, located on the top left corner.

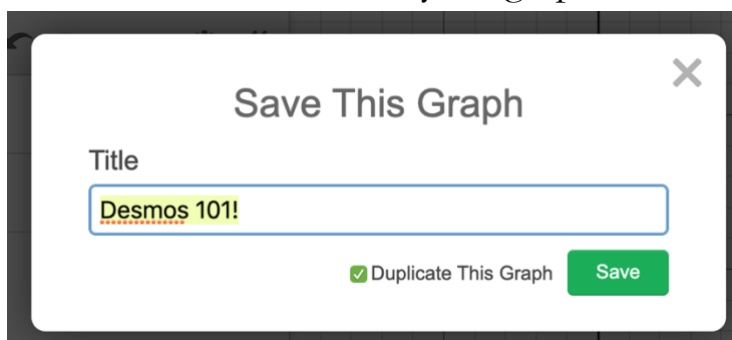


Then, enter a cool name for your graph and hit “Save”.



Now the name you just entered should have replaced “Untitled Graph”. All good!

2.1.1 Remark: Now that your graph is saved, if you wanted to

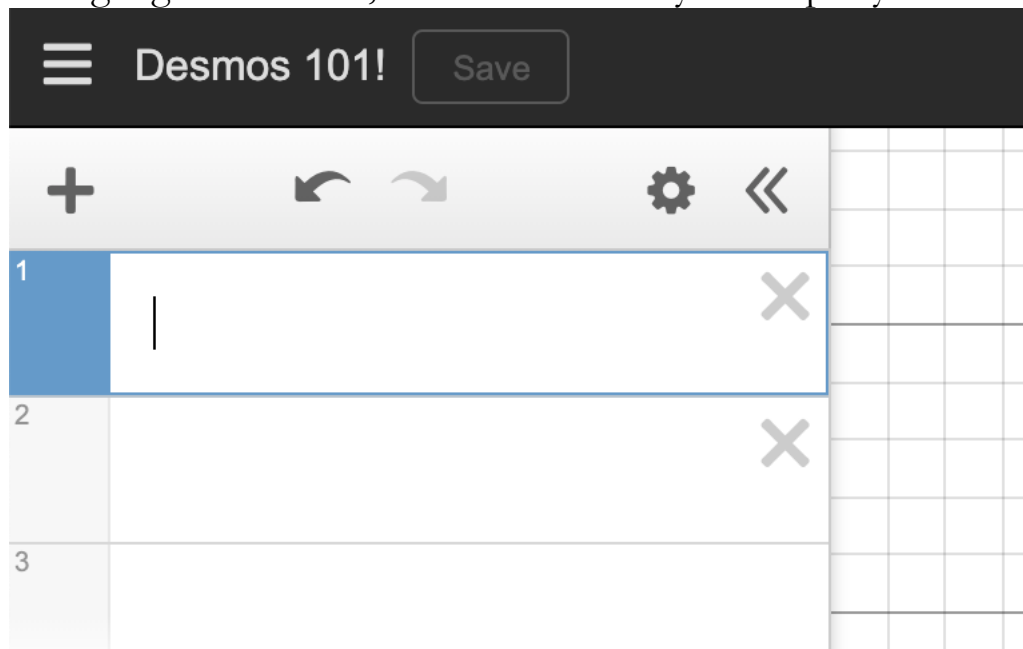


rename/duplicate the graph, simply click on the graph's name again. It will look like this

<—

2.2 Entering Functions

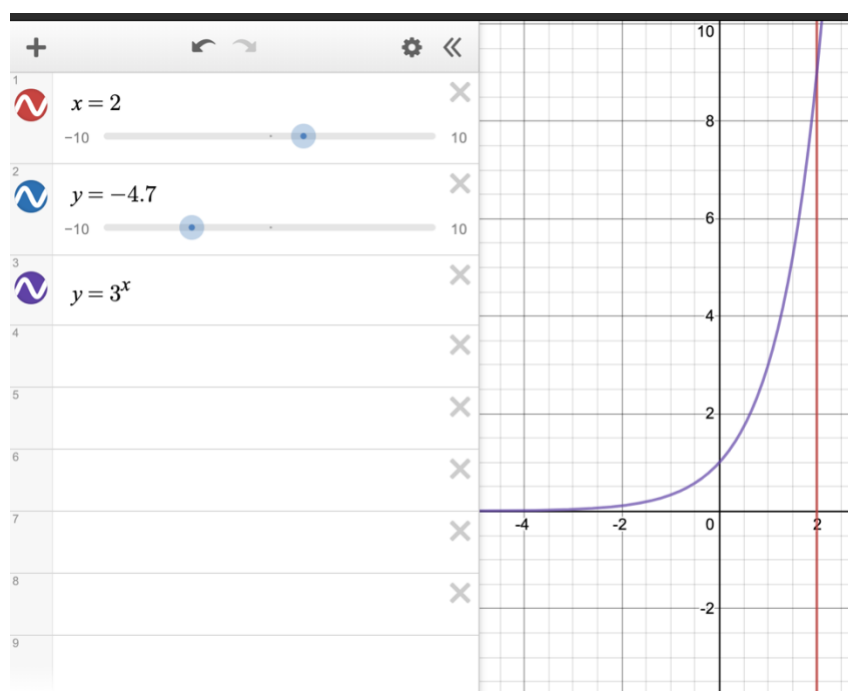
Simply click to the right of where the small number 1 is. A box should be highlighted in blue, and this is where you'll input your function!



To enter another function, hit the Enter/Return key on your computer or click on the second box/third box..., etc.

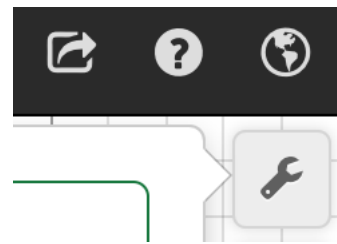
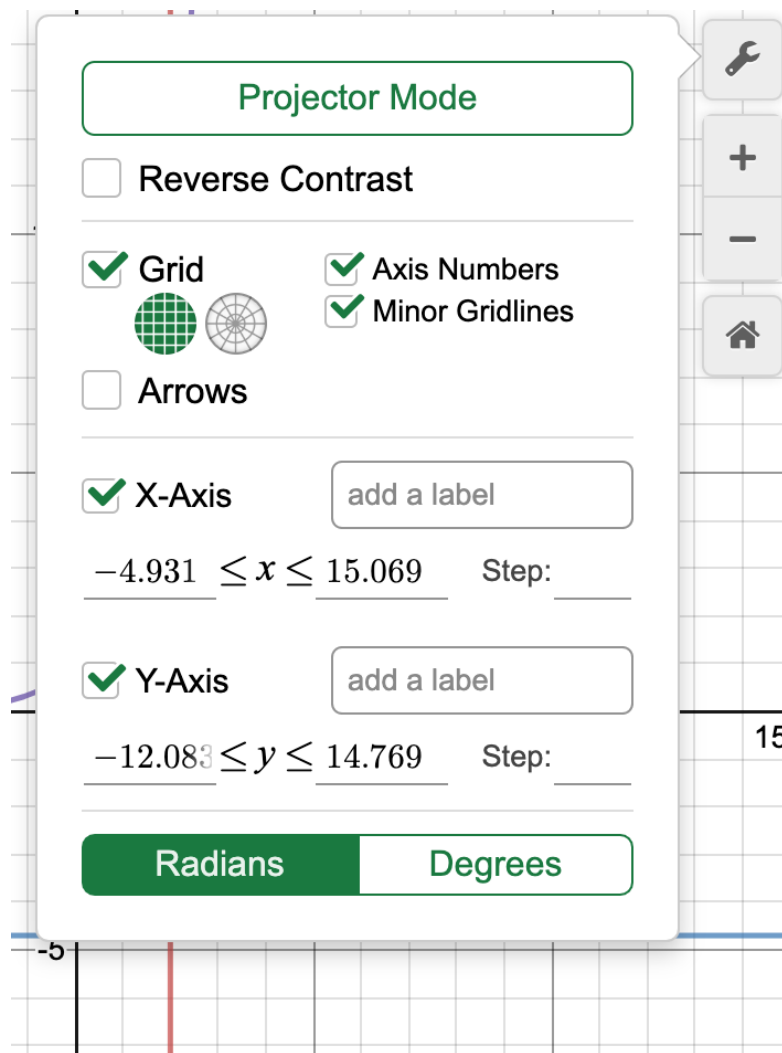
2.2.1 Remark:

Sometimes, it may be convenient to create a list of several empty box slots before you start to enter functions. You can do this by hitting the Enter/Return key multiple times. Like this... (see the empty boxes?)



2.3 Playing with Settings

If you want to change something in the settings, hit the spanner icon located on the right side. This screenshot says it all. Stuff that you can play with include (but are not limited to zooming in/out (+/- icons below the spanner), visibility of grid, changing grid to polar coordinates, radian/degrees...



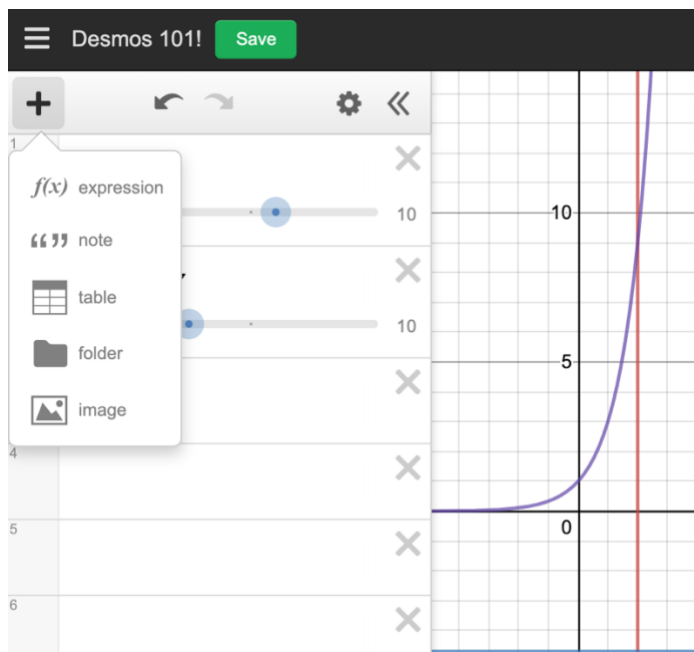
Yes, you can also change the language by clicking on the globe.

3. Making Things Easier

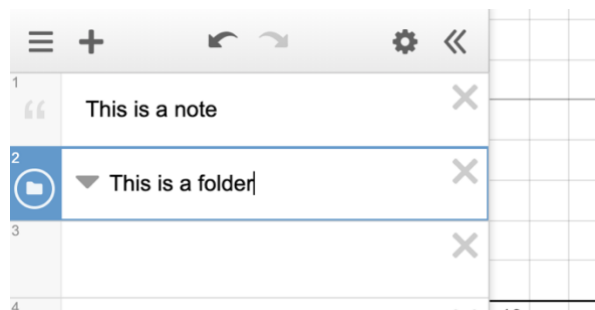
When your graph contains 50 functions, looking through them and “debugging” could be hectic. Worse, sometimes you forget which function correspond to which graph! Luckily, there are some tools to make your life easier:

3.0 Undo/Redo Self-explanatory. See arrows on screenshot below.

3.1 Folders and Notes



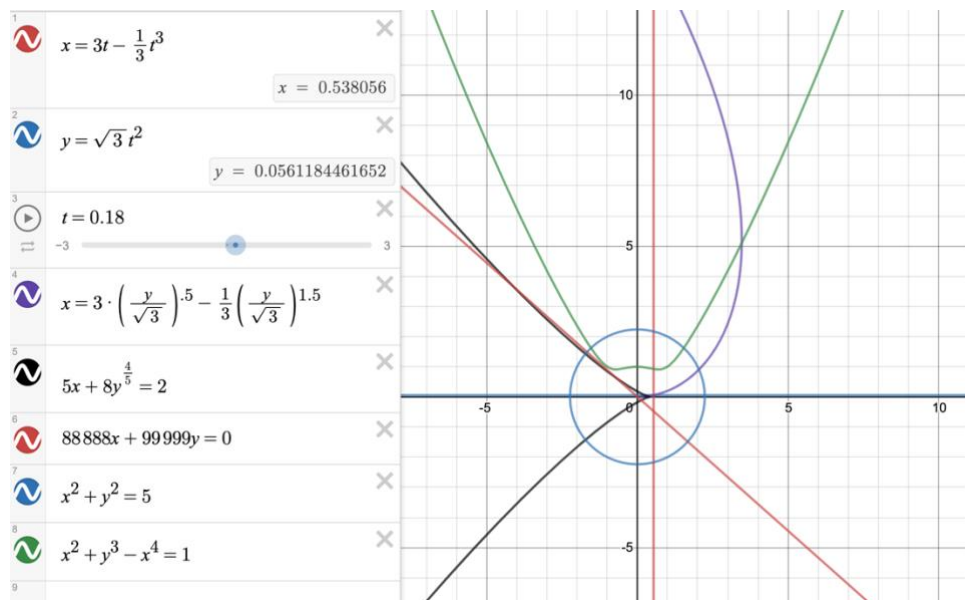
To add a folder or note, click on the “+” icon on the left. A drop-down menu should pop up.



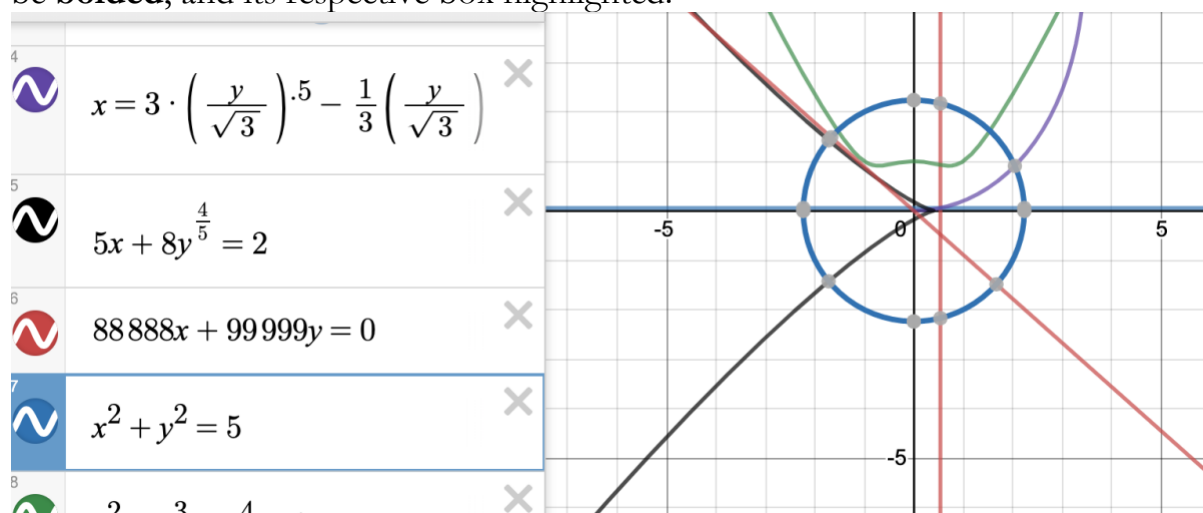
Shown on the left: an example of a note and a folder. You type normal English (or whatever language) in boxes that are labeled folders and notes.

3.2 Selecting and Displaying Functions

Alright, you've made this really awesome graph here, but you want to change a few things. Say you wanted to move the blue circle up a little bit. How do we do that?



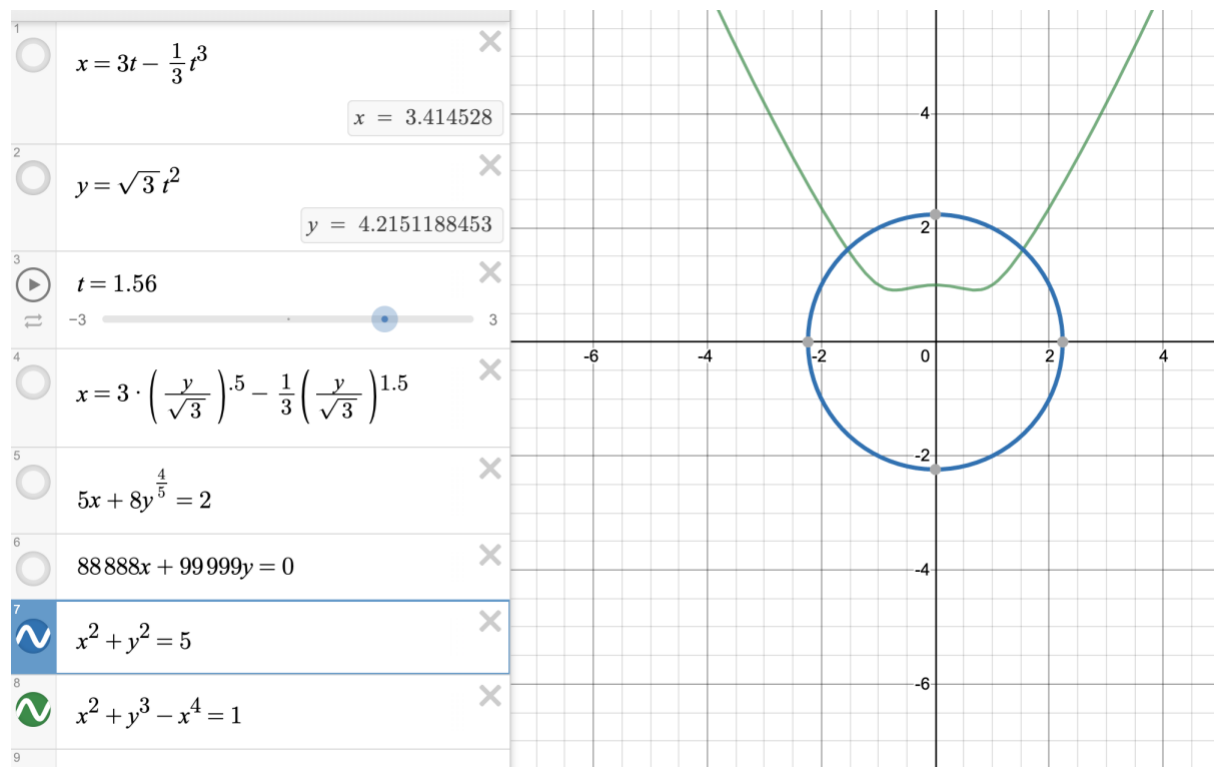
First, we need to locate the function on the list to our left so that we can change it. One easy way is to click on the circle (on the graph). The function's graph will then be **bolded**, and its respective box highlighted:



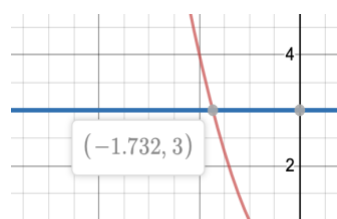
Now you can make changes to your function!

If you ever feel that other functions are bothering you when you make a change to one specific function, you can choose to hide functions by clicking on the circle next to the functions.

When the circles show up with a colored background and a function, that means the function is visible. Clicking it once will hide the function (and the circle shows up as a gray circle outline with nothing in it). Clicking it again will show the function again.



3.2.2. By the way, if you click on the intersections, Desmos will tell you the numerical values of the intersections! Soon you will see this is a very helpful feature... (can you guess those two functions graphed below?)



3.3 Give Em' Names

Okay, okay, playing with a bunch of numbers can be really fun sometimes, but it kinda stings when you have to type some really long expression again and again and again... like, something like this:

$$\sqrt{(x - C_4)^2 + (y - C_5)^2}$$

So, what you do is make another “variable” that represents that long expression: (in this example, I called it “c”. You can call yours almost anything, like something as practical as X_1 , or crazy names like MoOnCaKe (though I don't think that name in particular necessarily makes life easier...?))

$$c = \sqrt{(x - C_4)^2 + (y - C_5)^2}$$

Then you can manipulate “c” without typing the long expression it represents every single time! So then you can do things like:

$$\left(c + \frac{y - C_5}{c} + \left(\frac{x - C_4}{c} \right)^2 - \left(\frac{y - C_5}{c} \right)^2 \right) = 0 \{ -4 \leq y \leq -3 \}$$

Ok I know that's still long, but as compared to this,

$$\left(\sqrt{(x - C_4)^2 + (y - C_5)^2} + \frac{y - C_5}{\sqrt{(x - C_4)^2 + (y - C_5)^2}} + \left(\frac{x - C_4}{\sqrt{(x - C_4)^2 + (y - C_5)^2}} \right)^2 - \left(\frac{y - C_5}{\sqrt{(x - C_4)^2 + (y - C_5)^2}} \right)^2 \right) = 0$$

It's still pretty nice!

(In case you are panicking about C_5 and C_4 – they are *parameters* in this equation, which we will touch on in class 😊)

Now go play with Desmos and see what other cool things you can discover!