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SUMMARY KEYWORDS

input, output, function, squared, graph, horizontal axis, coordinate, emphasize, injective, draw, equal, axis, labeled, point, write, height, put, horizontal line, orange, parentheses

SPEAKERS

Catherine Pfaff

Welcome, in this lecture I'm going to go through another example of like what the graph of a particular function will look like. And particularly, we're going to mix this one up a little bit in terms of kind of changing the variable so that you can see how that would impact it. Okay, so the question for this one is, so our question is, what does the graph of the function, and the function that we're gonna want to look at is going to be the function, so we're gonna have G of T equals, and then we have $3T$ squared plus 1. And we're gonna want to know, what does this look like.

Okay, now, because T is our input, we're going to want for the horizontal axis to actually be the T axis. And we'll continue with our convention that this is orange. So this will be the T axis. Okay, and then we're going to want to have the vertical axis is going to be well, and this is where there's kind of, okay, that's not the most straightly drawn, but it's okay. So this is axis, there's kind of a discrepancy as to what people might call this. Okay, so some would call this, so some still call it Y .

And then some would call it, some still call it Y , or call it another thing that people might call it is actually G , okay? Because it's kind of what the output is. Okay, so one of these. But it just depends on kind of who the person is. And now let's go ahead and draw, so maybe I want to particularly look at, well, let's draw this first, actually, that's a good idea. So let's just kind of draw the graph of this function. So it's gonna look like, I know that this is a quadratic, because I've squared T . So I know it kind of goes like this, right, T is squared in there. The 3 just kind of will have to do with this, but it won't change it, it's upward. It'll just change like this. And then the 1 actually just kind of shifts it up. So it looks a little bit like this. And then this here, and then we'll mark on here we have 1 and minus 1. So let's mark that here. So I have 1, and I have minus 1 that I'm gonna want to specifically look at. Okay, so then what is a point on here actually look at like? Well, first, let's look at kind of like a generic point. So let's look at one, I'm going to stick it kind of way over here. So if I have a generic point like this, then as we kind of talked about before, so our input is T , right, and let's just kind of underline that to kind of emphasize, or underline that in orange. That's the input that's kind of showing up orange everywhere here. And so the first coordinate is going to be T , and then the second coordinate. So let's go ahead and put that. The second coordinate's T , the first coordinate's T . The second coordinate is actually G of T . So we obtain the second coordinate by plugging our T into that

function that we have over there. And that's what any point on this looks like. Okay, and another way to write that, because we know the formula for G of T , because it's right here, maybe even I'll box that.

So it's kind of the output. And so this here, this kind of generic point like this, this is actually equal to, well, I could write it right here. So I can start with a T again, that's the same, it's always my input is whatever my T value is I specifically want to look at. But then for the output, now, I can go ahead and look over here and see oh, it's gonna be $3T$ squared plus 1. Okay, so let's go ahead and write that as $3T$ squared plus 1. But I want to emphasize something here. So these are equal. I want to emphasize that this T is still that T . So we're going to be plugging it in there. So let's kind of watch us do this. We're going to kind of go through one of them a little carefully over here. So I'm going to put as my T value, remember, my horizontal axis tells me what T value I have. So we're going to go up from 1, I get a point here. Okay, and now this is I'm looking at where T equals 1, that tells me my first coordinate has to be 1.

And then I'm going to remind myself, before I actually go and do it, that what I need to do is I need to stick 1 into this function over there. So to stick my first coordinate into my function, and then we're going to go ahead and do that. So this is going to equal this whole thing, this whole point is going to equal, well, what happens when I do this? So I get 1. And then I think I've talked with you before about the trick of every time I see a T replacing with parentheses. First, when I do this, so that then I can just stick one in everywhere. So let's just go ahead and do that. So I see a T , I put parentheses, right, so I took $3T$ squared plus 1. So I know what I'm going to be doing here. And then I am just going to go ahead and put that 1 into there. And then I can just compute this, right, this is 3 times 1 squared, 1 squared is 1, 3 times 1 is 3, I add 1, I get 4. So this point here is actually the point 1, 4.

Okay, so when I looked at the point that was above 1. 1 was my input. The first coordinate came from exactly what I was above. And that's my input. The second coordinate came from inputting my first coordinate into my function, that specific function that's over there, right. And then I might have even written on here, and I didn't do it, because it kind of emphasizes, I might have written on the graph of the function here, a lot of people do this, they actually go ahead and write that this is the graph of the function G of T equals $3T$ squared plus 1, so that they can keep on checking that and not getting confused, it's very good to label everything possible to label. Okay, so the next part of this is that let's look at, I want to kind of emphasize something else here is what happens when I put minus 1 into here. So again, that gives me my first coordinate. And then I'm actually just going to go ahead and write down what we get. So my first coordinate is minus 1. And then my second coordinate, this is the thing I want to emphasize is that this is actually indeed 4. But we can put that on here so that it's kind of clear, you should be at the same height. So this is actually okay. Sometimes you're going to get the same output. Even though your inputs are different, that's a totally okay thing to say. Okay, so let's just kind of emphasize a few things in what happened here. I, the first thing I want to emphasize, I can do that, is why I labeled this T , okay. So I labeled this T because T is the input of the function G of T that I'm graphing this function which I've also written there, okay. So I labeled this T , right, since T is the input of the function G of T .

Okay, and then so let's kind of break down the rest of what's been going on. So breaking it down. So the first thing as I kind of said over there, is we labeled the horizontal axis by our input, okay. So the

horizontal axis, the horizontal axis, is labeled by our input variable, which is here is T . So our input variable, which here is T , okay. The second thing is that we couldn't work backwards from the output to find the input, right? Sometimes you can, but the problem is you might get more than one thing, right? So we, you can't always work backwards from the output to find a single input. Right, and to kind of emphasize how this kind of manifests itself here, which is that this value 4 came from, right, because 4 came from both 1 and minus 1, right? So 4 came from both 1 and minus 1 as the input. So 1 and minus 1 as the inputs i.e., the T value.

Okay. And this is because, so why is this? And this is something that's kind of talked about more in other lectures. But this is because we have that this function G that we've been kind of looking at, that we are graphing here. Because G , this function, is not injective. Another word for that is one to one. So it's not injective. It's not one to one. Or another way to kind of say that is it, it fails a horizontal line test, as kind of a way to test for that. Meaning that you get two points on the graph that are at the same horizontal height, or the same level, right, we can draw a line through here and we hit the graph twice. Okay, so think about this for a moment. So what all did we do to kind of orient our minds? The graph of a function first coordinates are input, so that's our horizontal axis, right. And so the point that we're looking at is going to sit above whatever the input value is, okay. And then the second coordinate is going to be the output of the function, which you're going to get by taking the first coordinate and placing it into the function, and then what you get, so we put 1 into the function G . That output that you get will give you the second coordinate, and that's gonna be your height. And you're not always going to be able to work backwards in order to get your input from your output, at least not to get a single value such as in this circumstance. It's okay that they both had output 4. It just means you're not an injective function. You have more than one input value that gives you out the same output value. Okay, so I hope that made some sense, and I'll see you in the next lecture.