IIT Madras

ONLINE DEGREE

Mathematics for Data Science 1
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Week 8 - Tutorial 1

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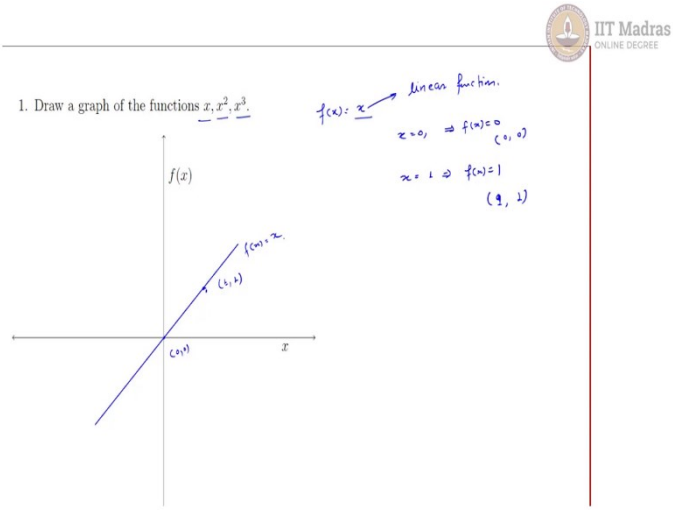

Welcome to week 8 tutorial questions. The first question is about to draw the graph of some functions those are x, x^2 and x^3, so first is x so if I write $f(x) = x$, what comes in my mind first is that this is a linear function. So, if this is a linear function, it will represent a line and to draw a line we need two points. So, let us take some randomly two points, if I take $x = 0$, what will I get? $f(x) = 0$, so my point is 0, 0 if I take $x = 1$, then I will get $f(x) = 1$ what the point is again this is 1, 1.

So, if I try to plot this line I will choose one point here this is (0, 0) and one point somewhere here, this is (1,1) and I will just draw the line, so it will go from here actually, so this is (1,1) and (0,0). So, this is the graph of $f(x) = x$.

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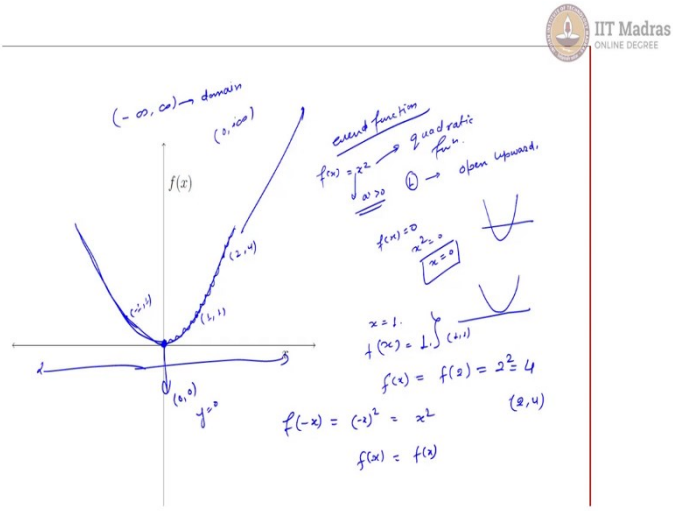

For the second, $f(x) = x^2$, what comes in my mind that is it is a quadratic function, so the quadratic function represent the parabola and parabola could be upward and downward. So, I can see that $a > 0$ which is actually 1, it represent that the parabola is open upward, what I need next that where it will touch or cross the x-axis and those are called the intercepts. So, I do fx equal to 0, then I will get $x^2 = 0$ which means $x = 0$ so my both roots are at origin because I am getting 1 root which is 0.

So, if I am getting one root it means it will never cross x axis, it will not be like it will be here only and as it is going from 0,0 we have only on option that this curve will look like some like this, what will be the points if I say from where it is passing through, so if I get $x = 1$, I will get $f(x) = 1$, 1 is curve equal to 1. If I get $f(x = 2)$, then it will be 2 ×2, 4.

So, here it is passing through 1,1 and here it is passing through 2,4, so this will be 1,1 and this will be 2,4, what will be this point at $x = -1$? As we know that this is a quadratic function and this is also an even function, even function why? Because if you put $f(x) - x$ equal to then it will be $(-x)^2$and it will give you x^2, so $f(-x) = f(x)$ that is why this is an even function and even function are the symmetric about y axis, even functions are symmetric about y axis.

So, if you plot this curve only then this part will be the mirror image around the y-axis only. So, this will be - 1,1, what will be the domain? You can see that this can go from here to here so - ∞ to ∞ is the domain and range we know that this vertex will decide the minimum and that

is 0,0 which means y equal to 0 is the minimum and it can go here so and behaviour shows that at ∞ it will give ∞ only. So, the range will be 0, ∞.

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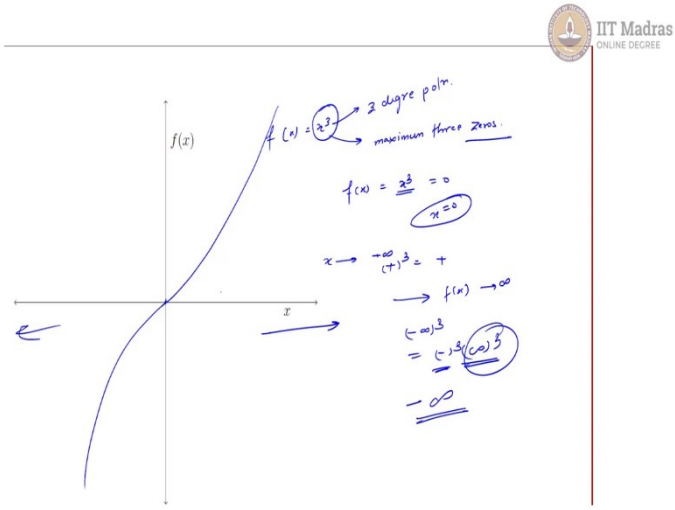

The third graph is of x^3, so if I take $f(x) = x^3$ what comes in my mind first that this is an 3 degree polynomial and if it is 3 degree polynomial it will have maximum 3 roots maximum 3 zeros, what does it mean by 3 zeros? It means this particular curve will cross x axis 3 times but let us see how much actually we are getting the zeros. So, if say $f(x)$ equal to sq I will get $x = 0$ only.

So, I am getting all three roots at 0,0 only because at $x = 0$, I will get 0 only. So, what does it really means that the curve will pass from here and it will never cross x axis again except 0. Now what else needs to see is the n behaviour, what will happen if x goes to positive ∞? Means what will happen if x goes like this? You can see this is the cube of x and if you take + the cube will give + which means at ∞the $f(x) = \infty$.

So, n behaviour shows that when x goes to ∞fx will go also ∞. So, in positive side it will be positive ∞, so this will be like this. What will be happening in negative side of x? So, if I take - ∞this side, then after doing cube I will get - cube and ∞cube, so this is not actually we write just I am writing to understand, so this will give - and this will give some ∞ because ∞ is undefined so cube will also will be ∞but - so it will be downwards, so this is our x^3.

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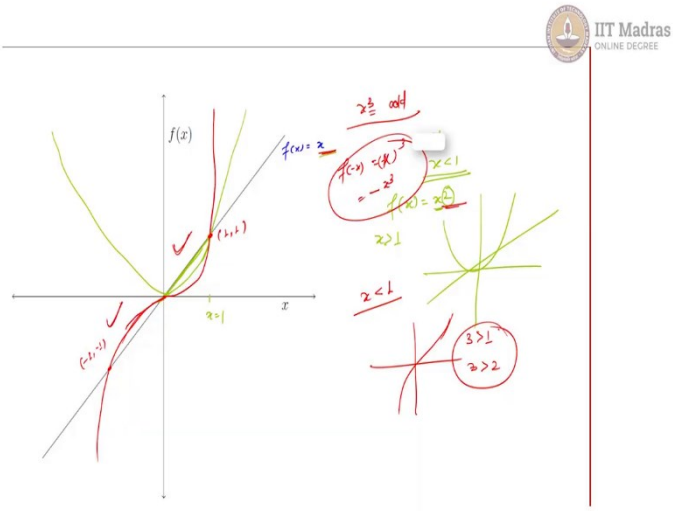

What if I try to draw all three graphs here at 1 coordinate plane, so this is actually $f(x)$=x we can see this is a linear, what will be fx of $f(x) = x^2$? So, $f(x) = x^2$ we saw that the graph was like this but how will it be. I mean will this part be above the line or below the line? So, we knew that if this x which is x>1, if x>1, the more power will give lower value means $at\ x =$ 1 before this the curve will give a lower value in comparison with x so in this part this will be like this.

And what happens in upper part? When $x > 0$ the more power will give the more value, so x^2x square has the higher degree than x then it will give higher value. And we know that this is a even function so this side it will be like this. What about $f(x) = x^3$? Again same thing we will get a graph like this but how because it has 3 degree which is greater than 1 and greater than 3 is greater than 2 also so in the domain less than 1 $x >$ 1, it will give the least value in comparison with x and x^2, so it will be this and when $x > 1$ it will be giving the maximum value in comparision with x and x^2 so this will be and similarly the same way here will happen here.

So, this is a point 1,1 where all are intersecting this is a point where - 1 and - 1 x and x^3 are intersecting, why this is showing the same here because this is an odd function, x^3 is an odd function, what does it mean by odd function, if I take $f\ (-x)$ - it will give $x - x^3$ and then - give - and x gives x. So, $-x^3$, if this is an odd function that will give me that the function is symmetric about origin so what does it mean by origin, the same behaviour will be happening in this and this coordinate.