IIT Madras

ONLINE DEGREE

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Mathematics for Data Science 2

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Week 1 Tutorial

System of Linear Equations: Geometric Visualization

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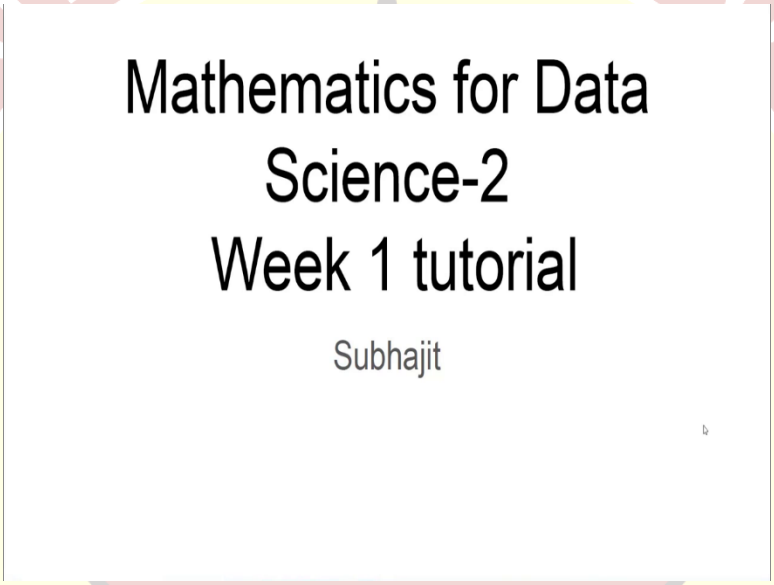

Hello. Welcome to Mathematics for Data Science 2 Week 1 Tutorial.

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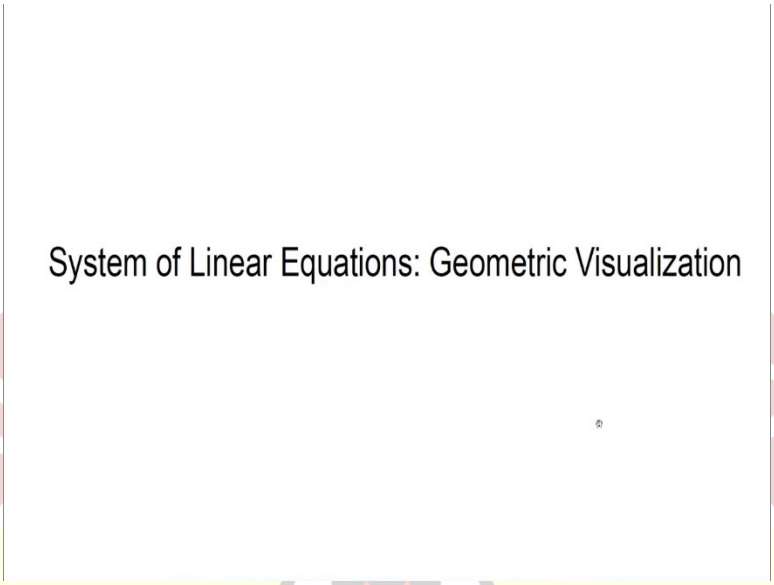

So, today we will discuss on System of Linear Equations and we will mainly concern in this tutorial about the geometric visualization of system linear equation. In the lectures we have seen many examples of system of linear equation and professor has also taught about the, how to visualize it geometrically when those equations have a unique solution or no solution, infinitely many solutions. Now, in this tutorial, we will try to visualize with some examples. So, let us see the first example.

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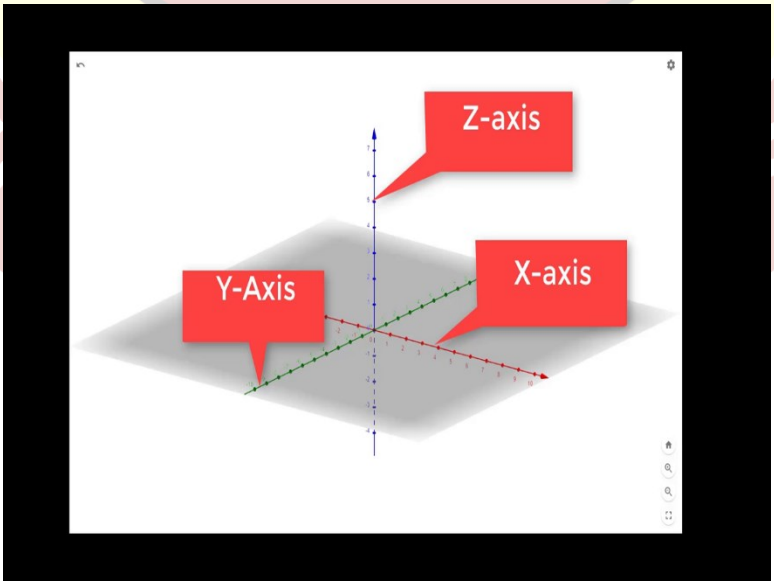

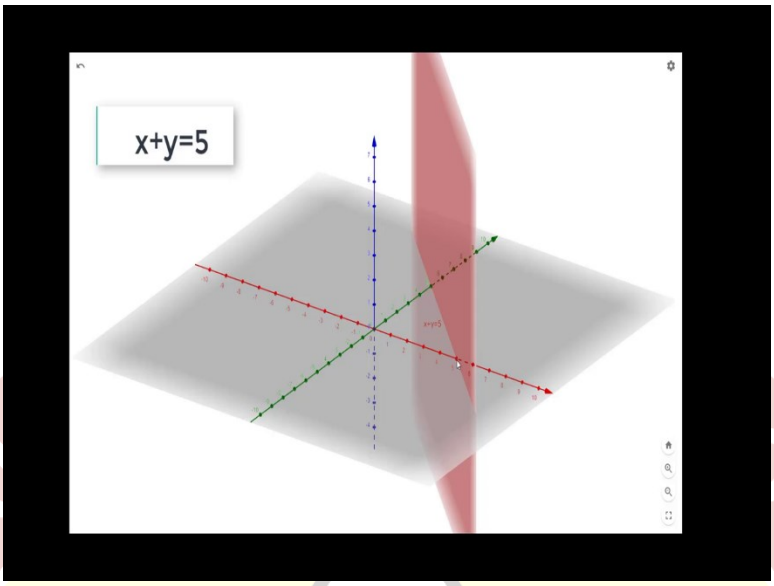

So we are using this software called GeoGebra, where we can draw this plane in 3D. So here this red line is basically x-axis, this y line is, this green line is a y-axis and this blue line is z-axis. So we can see the xy plane here which is grey in color. So let us consider the first question. Let us see how that equation looks like.

So the first equation is $x + y = 5$. So it is a plane, which is parallel to z-axis as we are seeing here. So it will intersect the x-axis at the point (5,0,0). It will intersect the y-axis at the point (0,5,0). So this red plane which we are seeing right now is the plane represented by the equation x+y=5.

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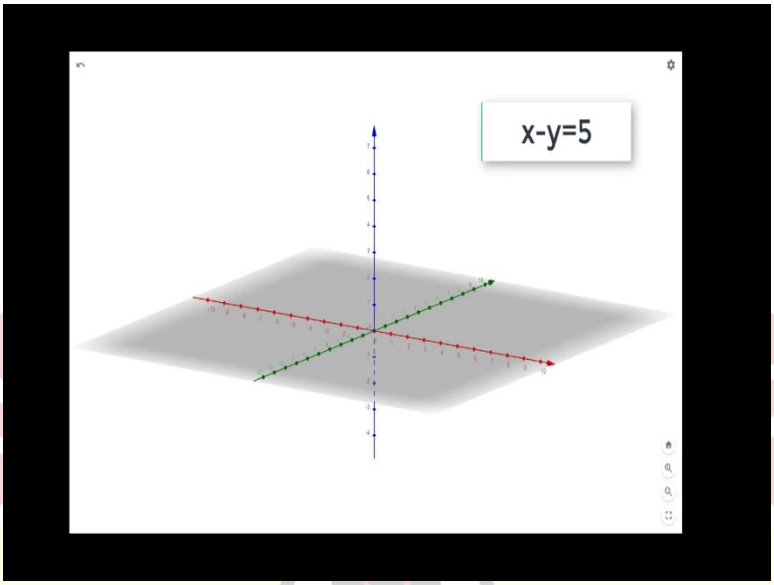

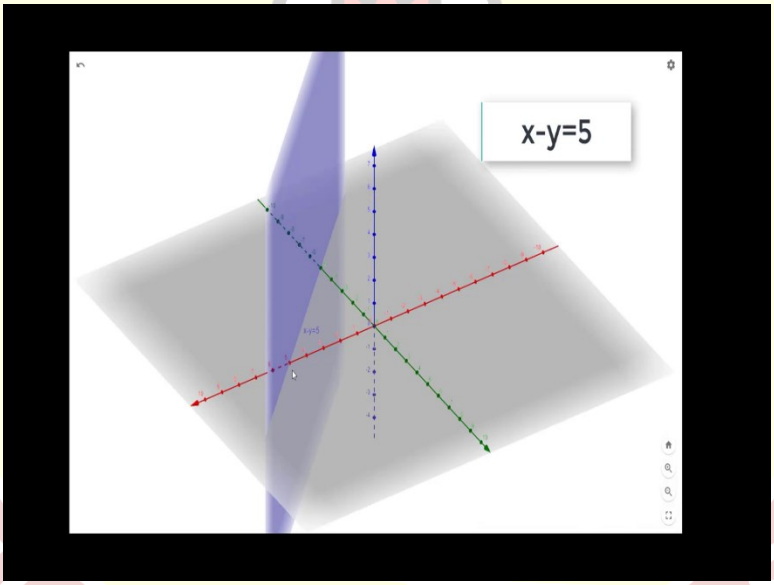

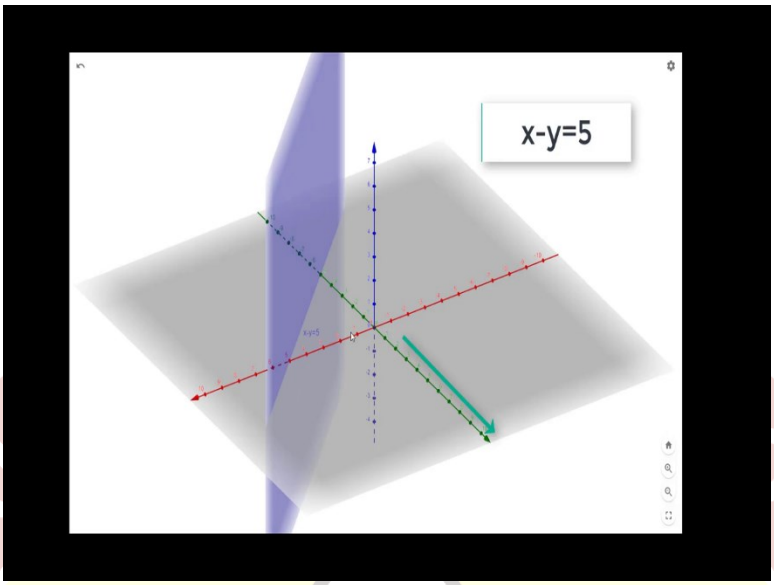

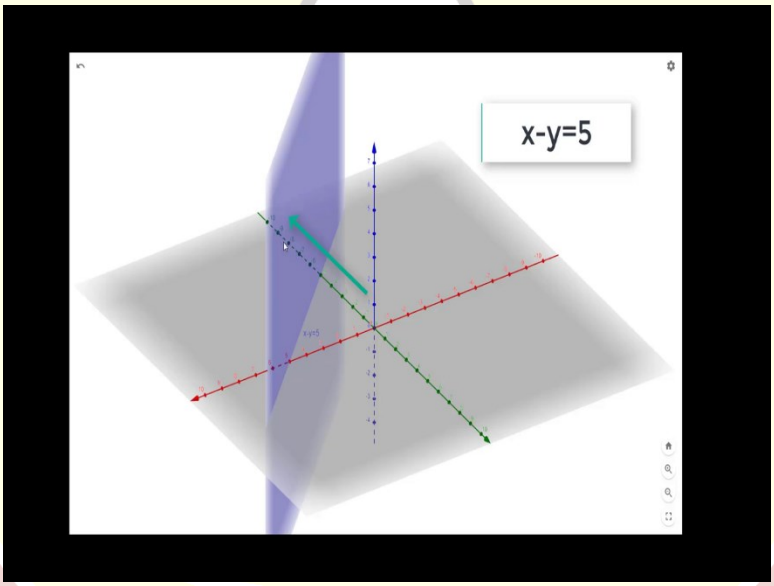

Now, the second equation was $x - y = 5$. Let us see how it look like. So this is $x - y = 5$ plane. So observe that. Again, it will intersect x-axis at the point (5,0,0). It will intersect y-axis at the point 0,minus 5,0. So this plane is intersecting the negative direction of y-axis. So this direction positive direction of y-axis and this direction is the negative direction of y-axis. So it is intersecting the y-axis at that direction. So this blue plane is basically the geometric representation of the equation x-y=5.

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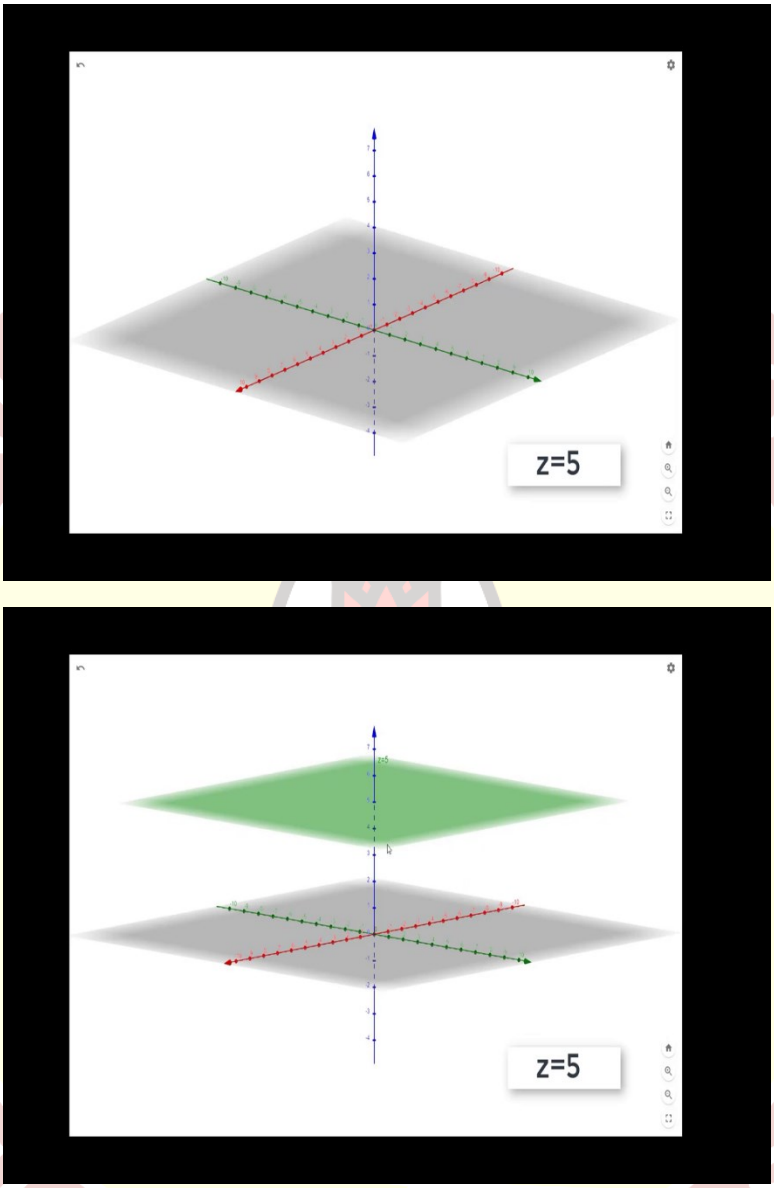

And there is a third equation which is represented by $z = 5$. So this is the plane $z = 5$ which is clearly parallel to the xy plane.

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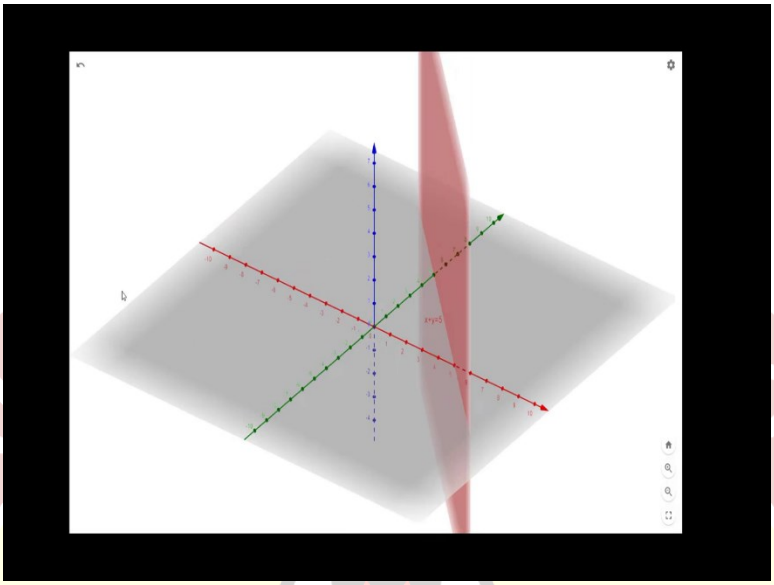

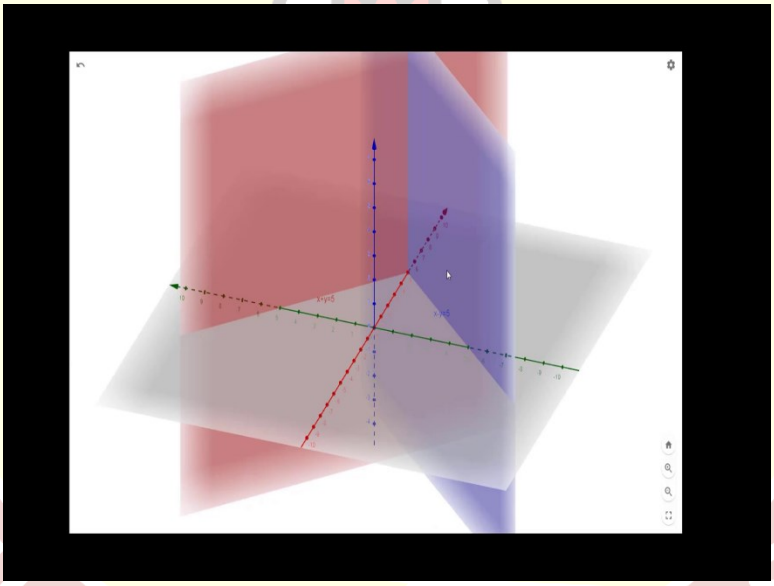

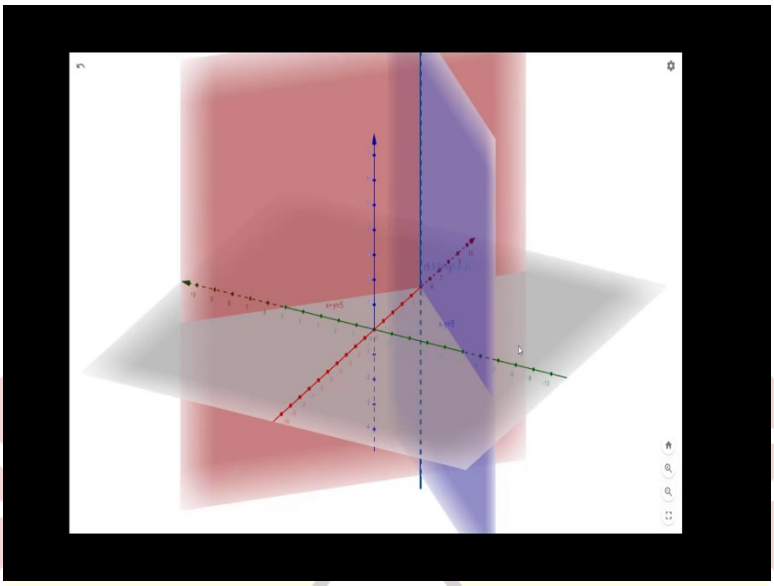

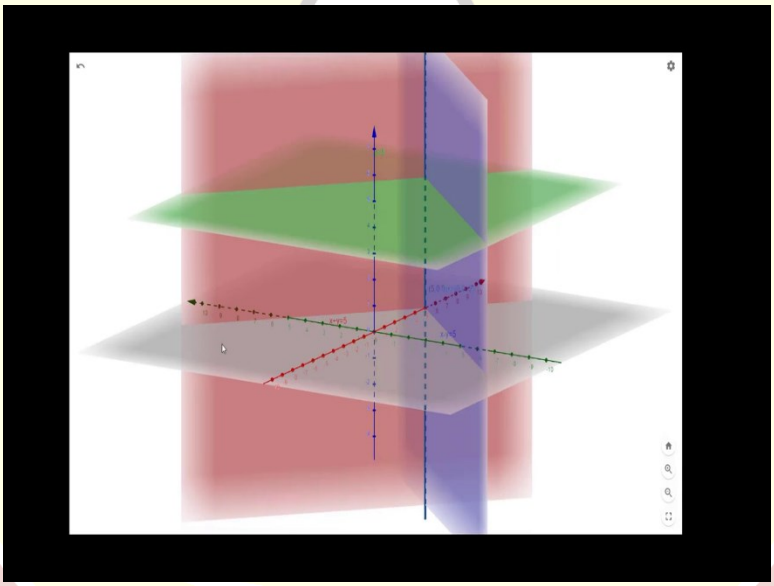

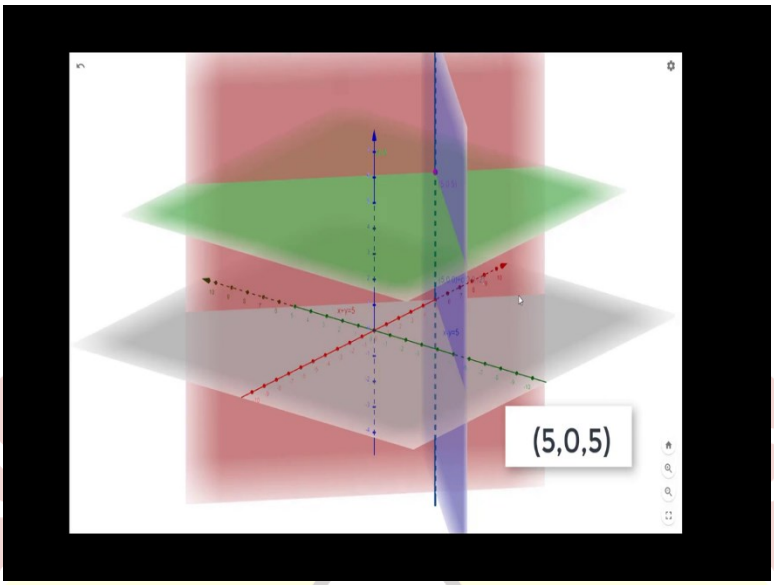

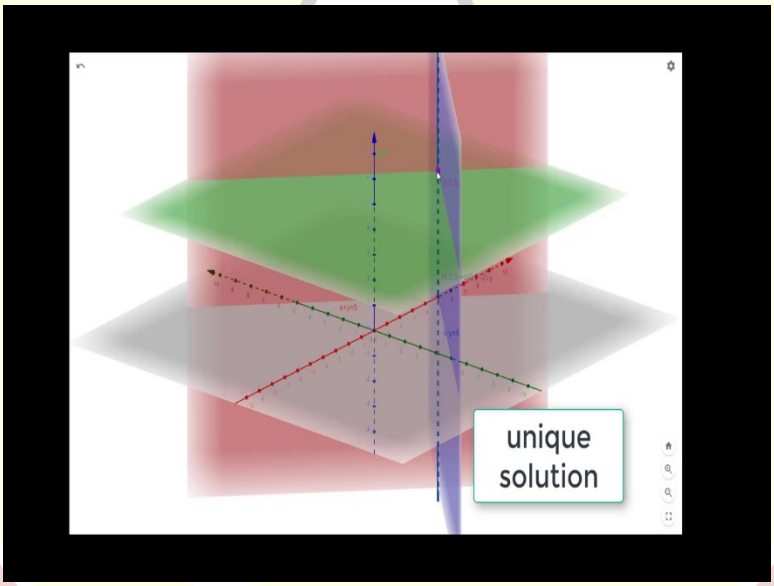

So let us start with the first two equations. So this is the first plane as we seen earlier. This is the second plane. The second, the plane corresponding the second equation. So we are seeing that these two plane are intersecting at a line and you can see that the line is basically parallel to the z-axis and passing through the point (5,0,0) on the x-axis.

So let us see how this line look like. So this dotted line is basically the line which is intersection of these two plane. And you can see that the line is passing through the point (5,0,0), which is on x-axis. Now, let us introduce the third plane which is $z = 5$. So this is $z = 5$. So it will intersect the line at one point as you can see and that point is basically the intersection of all these three planes.

So this is the point where all these three planes are intersecting and the coordinate of the point is (5, 0, 5), as we can see in the picture. In Week 2, we will see how to solve these three equations to get this point. Now, here we are seeing the geometrical, geometric visualization of these three equations. So we are getting three planes and the three planes are passing through a single point. So it will have a unique solution. Thank you.