IIT Madras

ONLINE DEGREE

Mathematics for Data Science 1
Week 03 – Tutorial 08

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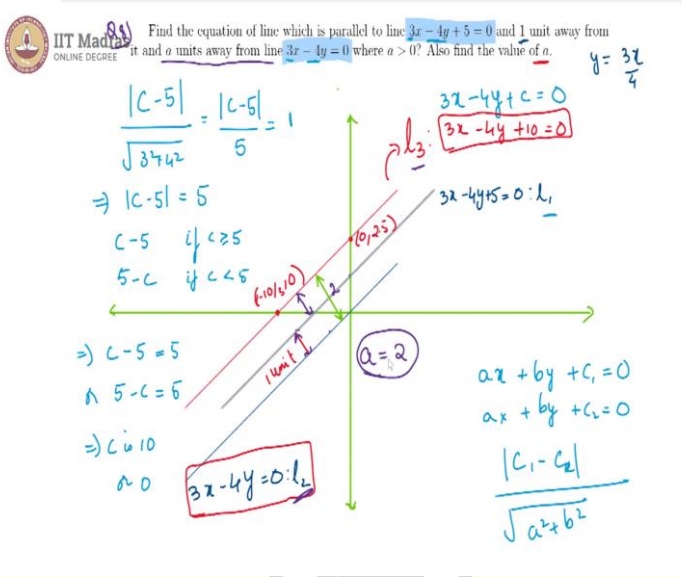

In our eighth question, we want the equation of a line which is parallel to this given line. So, let us first plot the line that is given, lets plot this line. If you look at that line, it is $3x - 4y = -5$, which gives us $\frac{x}{\frac{-5}{3}} + \frac{y}{\frac{5}{4}} = 1$. So, the x intercept and y intercepts can be marked out as 1.6s. So, if we take this to be 1 and this to be 2, so this is - 1 roughly and this is - 2, roughly. Yeah, this might be our intercept, which is $(\frac{-5}{3}, 0)$ and our y intercept, again, if we take this to be 1 and this to be 2, 1.25 is somewhere likely here.

So, this is probably our y intercept, $(0,\frac{5}{4})$. As you can see, we are doing a thoroughly rough plotting, we do not always have to be very accurate with our plotting. This is only for an indication. So, this would be our line, $3x - 4y + 5 = 0$ and now we have another line given to us, which is $3x - 4y = 0$.

Clearly, these two lines are parallel to each other because they have the same slope and that slope would be, we write it as y is equal to, we will get 3x / 4, so the slope is $\frac{3}{4}$ and it is passing through the origin, because if I put x = 0 and y = 0, the line equation is satisfied, that is there is no constant term. So, this line is our $3x - 4y = 0$ and we are trying to find a line that is parallel to these 2 and it is at a distance of 1 unit from the $3x - 4y + 5 = 0$ line.

Let us name these lines as well. Let us call this l_1 and this is l_2. I am going to erase the intercepts to make it look a little clear and now, we can find our equation and for that, we will

use the formula of separation between 2 parallel lines. So, that two parallel lines and we write them with the same coefficients.

So, $ax + by + c_1 = 0$ and the other one would be $ax + by + c_2 = 0$. This is how two parallel lines would look like. You can reduce them to have the same coefficients for x and y, like in this case so this is 3 and this is - 4, this is also 3 and this is also - 4. In this case, the separation between these two parallel lines would be $c_1 - c_2$ the modulus divided by ($\sqrt{a^2 + b^2}$). So, the equation we are looking for, the line we are looking for also is going to be some 3x - 4y + c = 0.

So, its separation from our l1 is going to be applying the formula modulus of $\frac{c-5}{\sqrt{3^2+4^2}}$. $3^2 + 4^2$ is 25. Therefore, you have modulus of $\frac{c-5}{5}$, which is what is expected to be 1 unit. That gives us modulus of c - 5 = 5.

Now the model is, indicates that there are two possible values here, one could be c - 5 if $c \geq 5$,. Because then c - 5 would be positive, and the other would be 5 - c if c < 5. So, what we get is two separate solutions, one is c - 5 = 5 or 5 - c = 5, in which case we get c is 10 or 0. So, we have 2 lines, one is $3x - 4y + 10 = 0$, the other is our $3x - 4y = 0$, this is our line.

So now, because of this, we can say that this length between, the separation between these two lines is now one unit and therefore, the other line, which is our 3x - 4y + 10 = 0 is going to come on the other side of l_1, which is going to look like this. So, this line is our l_3 and it will have intercepts equal to, this should be 0,$\frac{10}{4}$ which is 2.5 and this would be (- $\frac{10}{3}$,0), this is our other plan.

And now, we should also find out what the value of a is, because a would be the distance between the lines l_2 and l_3 that is what they are saying, its units away from our l_2 and we know that this is one unit and this is also one unit. So, this total length is going to be 2 units. So, a = 2.