INDIAN INSTITUTE OF TECHNOLOGY MADRAS

सिद्धिर्भवति कर्मजा

IIT Madras

ONLINE DEGREE

Mathematics for Data Science 2
Professor. Sarang S. Sane
Department of Mathematics
Indian Institute of Technology, Madras
Week 9 Tutorial 01

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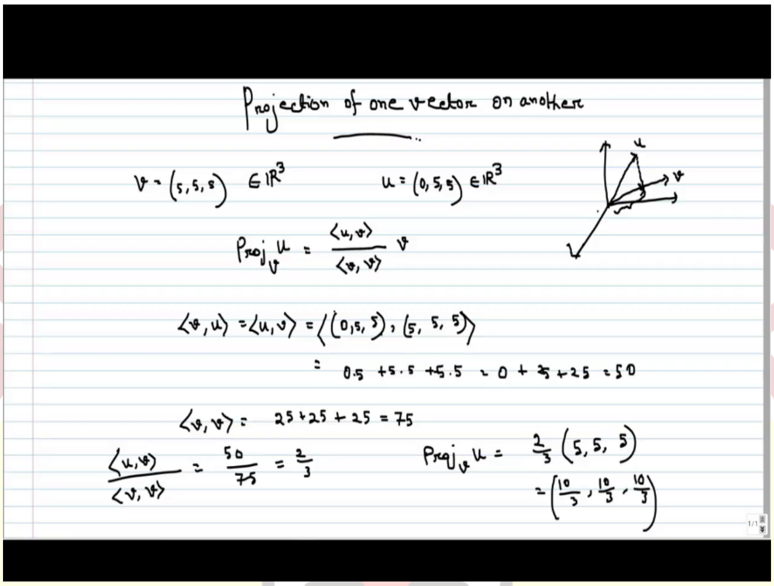

Hello everyone, so in this video let us try to calculate projection of one vector on another vector. So, let us begin with this example, suppose, I am taking a vector v which is (5, 5, 5). So, this is a vector on $\mathbb{R}^3$ Now, suppose there is another vector u and I am denoting it by (0, 5, 5). So, I am taking another vector on $\mathbb{R}^3$ And I want to calculate the projection of vector u on v.

So, projection of vector u in the direction of v this one we have to calculate. So, in the lecture we have seen the formula to calculate it, so, we have to calculate the inner product of u and v <u, v>, we also have to calculate the inner product of v and v. And as we are calculating the projection in the direction of v, so we have to multiply the vector v with this scalar.

$$Proj_v u = \frac{\langle u, v\rangle}{\langle v, v\rangle} v$$

So, as you calculate the inner product of u and v, you will get an scalar if we calculate inner product v and v, we will get another scalar you have to multiply this scalar with this vector to get the projection. So, let us calculate. So, what is inner product u and v? So, inner product u and v which is same as inner product v and u obviously, so it is nothing but the dot product.

So, we have two vectors here, (0, 5, 5) and (5, 5, 5). So, if we calculate the inner product, if we calculate the dot product, so, we will get $0 \times 5 + 5 \times 5 + 5 \times 5$ So, what do we get, we will get 0 + 25 + 25. So, will get 50. Similarly, if you calculate inner product of v and v, the same vector, so you will get 25 + 25 + 25, which is 75.

So, the scalar you get here is $\frac{\langle u, v \rangle}{\langle v, v \rangle}$ So, this will give you 50 by 75. So, it is nothing but 2/3. Now, in the direction of v, we have to calculate the projection. So, our projection of u in the direction of v is nothing but $\frac{2}{3} \times v$ So, v is (5, 5, 5). So, it is (10/3, 10/3, 10/3).

So, geometrically what we are doing, we are starting with two vectors, suppose, this is my v and this is my u. So, this is why u vector, this is my v vector and I am taking projection of u on this vector. So basically, I am calculating this vector with this much magnitude in the direction of v. So, this is the geometric representation of this. Now, let us try to visualize this in GeoGebra.

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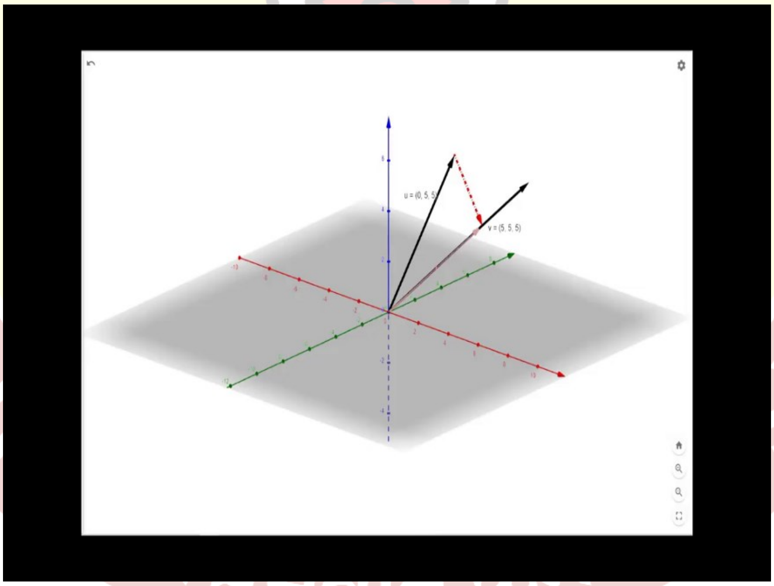

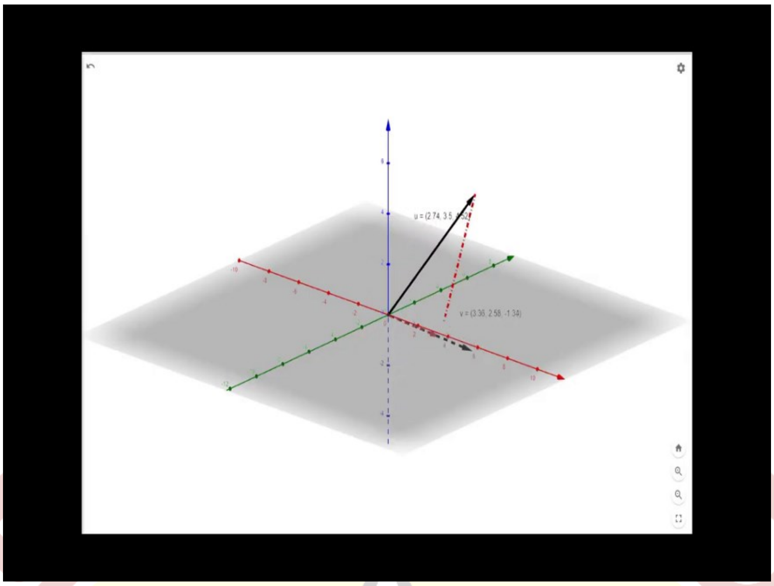

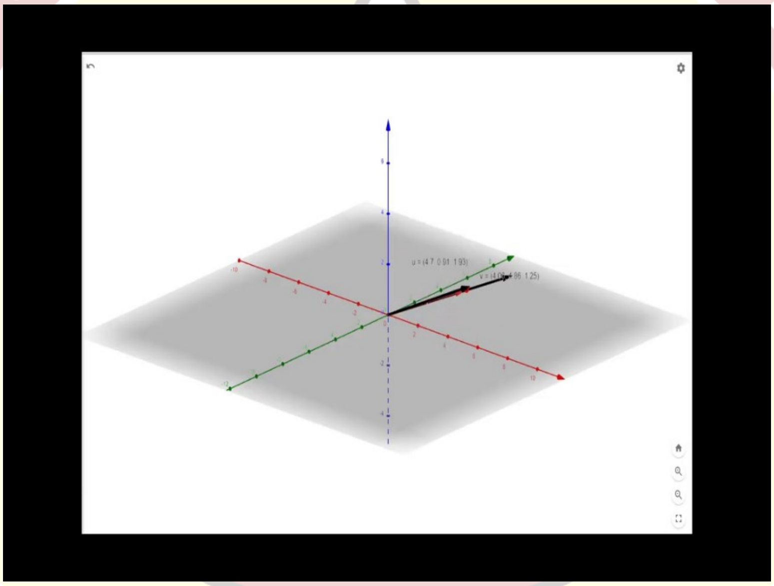

So, this is $\mathbb{R}^3$ we can see here, so at first we will take the vector v which is (5, 5, 5). So this is the vector v. Now, where is the vector u? So, here is the vector u which is (0, 5, 5). Now, we have to take the projection of u on v as we have calculated it already. So, we can see that this will give us the projection on u in the direction of v. So, as you can see, this vector along the rejection of v is the projection of u on the direction of v. So, the dotted line basically gives us a perception how we calculate the projection.

Now, if we change the this u and v we can see that this projection will also change. So, now let us try to see this animation where do we change u and v all together and we can see the projection is changing. So, in this animation we can see how the change of u and v is changing the projection in the direction of v. So, this animation helps us to visualize this projection. Thank you.