**Deep Learning**
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**Module – 6.6**
**Lecture - 06**
# PCA: Interpretation 3

And now you go to the third interpretation, where we will try to say something about the variance ok.

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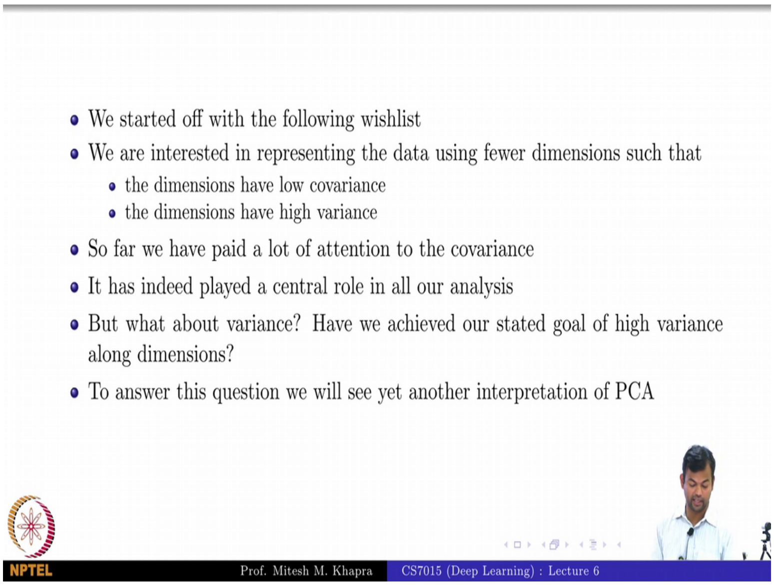


So, we started off with the following the wish list, that we wanted low covariance and we wanted high variance. So, far we have paid attention to the covariance because everything was revolving around this covariance matrix in both the solutions ah, but what about variance have we achieved the goal with respect to high variance.

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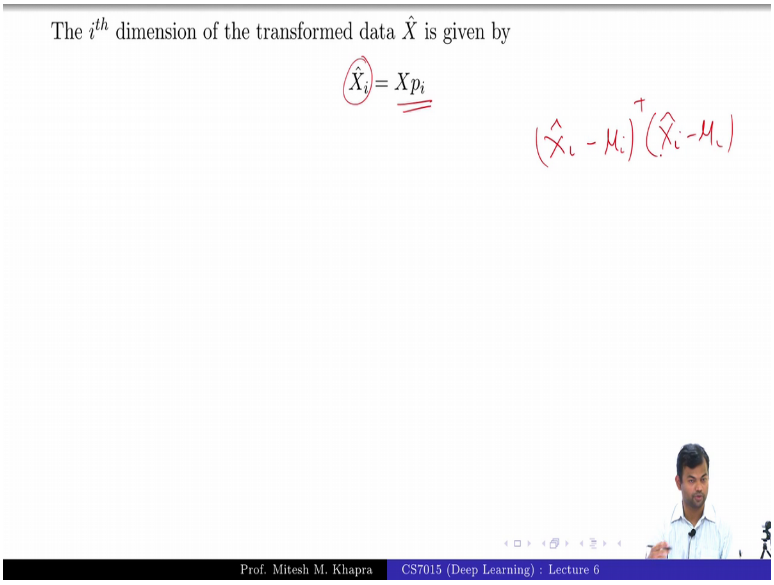


So, let us see. So, what is the ith dimension of the transformed data it is this, you take your data and project it onto the ith dimension right. So, X hat is equal to X into pi now what is the variance along this dimension, how do you compute the variance? So, this is my projected data and let me just call it X hat i.

So, this is the ith column after projection is that fine everyone is with this? Now, for this ith column I want to compute the variance; how will I do that? Remember that the data is zero mean what is the formula actually? It is going to be X hat i minus mu i into X hat i minus mu i right, but mu i is 0. So, it just turns out to be the dot product dot product of X i hat with itself and of course, divided by m is this fine?

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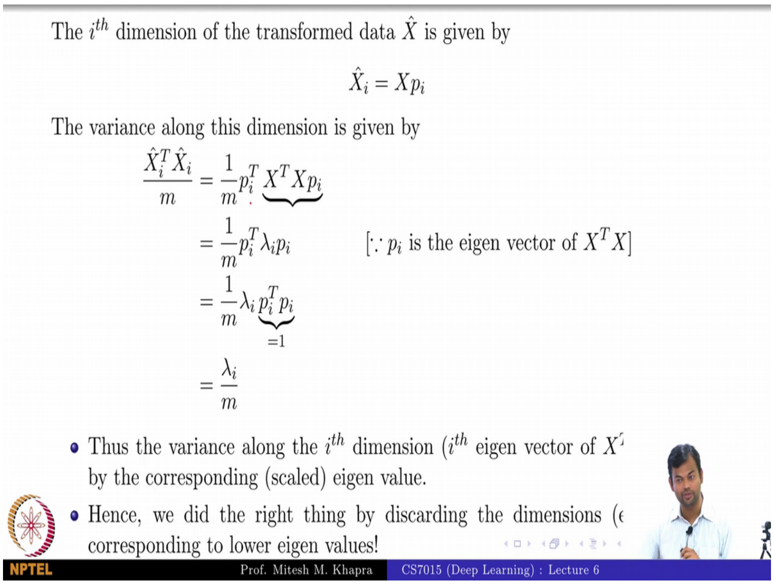


I can write this as X p i and then when I take the transpose I will get this ok. Now what is this quantity? This is exactly the moment where I feel like saying [FL] what is this quantity?

Student: (Refer Time: 02:00).

No look at the circle, what is X transpose x times p i?

Student: (Refer Time: 02:08).

What is p i with respect to x transpose x?

Student: Eigenvector eigenvector

Eigenvector so what is this product going to be?

Student: Lambda (Refer Time: 02:14).

Lambda i p i is that fine, what is p i transpose p i?

Student: 1.

1 ok so what is actually the variance along the ith dimension?

Student: Lambda (Refer Time: 02:26).

What is lambda i?

Student: Eigenvalue.

So, what will happen if I retain the highest eigenvalues?

Student: (Refer Time: 02:33).

I will get the highest variance dimensions right fine. So, all roads lead to.

Student: (Refer Time: 02:39).

Eigenvectors eigenvalues right. So, Andrew ng in one of his lecture says that there are 10 different interpretations of PCA, I only know 3 of these I do not know the remaining 7. Maybe he was bluffing so that people like ask him keep busy how this is getting recorded fine.

So ya, so, you get this. So, we have satisfied everything in our wish list variance, covariance and also did this detour where we saw that it actually amounts to minimizing the error in reconstruction where we are throwing away the dimensions, along which reconstruction did not add much to our knowledge about the data ok. So, these are the three different interpretations that I have right. So, hence we did the right thing by throwing away those dimensions, which correspond to the lowest eigenvalues because lowest eigenvalues is nothing the lowest variance also ok.

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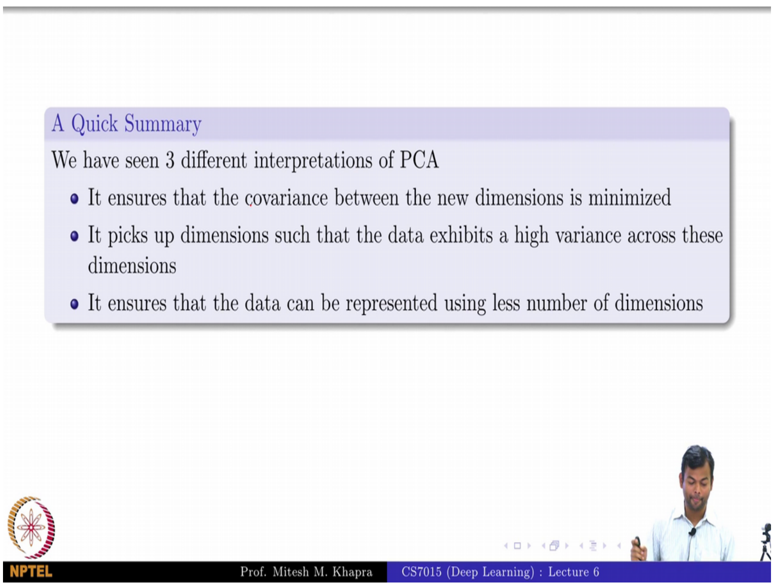

So, this is the quick summary, the covariance between the new dimensions, you can leave actually those you can just read it later on.