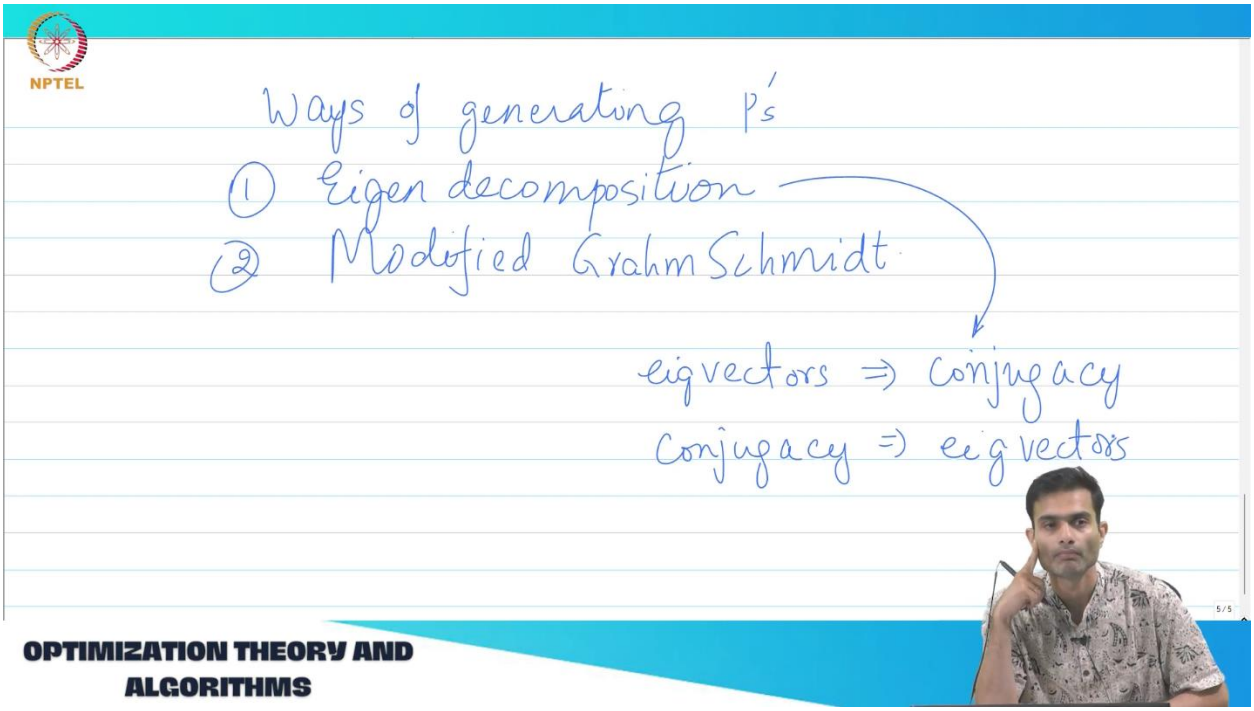
Course Name: Optimization Theory and Algorithms
Professor Name: Dr. Uday K. Khankhoje
Department Name: Electrical Engineering
Institute Name: Indian Institute of Technology Madras
Week - 06
Lecture - 39

Ways of Generating Conjugate Directions

All right. So, now we can write down ways of, we already discussed this, but let us just note it down, ways of generating p's, right. The first way we already saw was do eigenvector, I mean do the eigen decomposition, which is guaranteed to exist eigen. The second step, which I've already given you a hint is what? Gram Schmidt, modified Gram Schmidt. Okay. So, in the case of the eigen decomposition there is one interesting thing that we have seen that eigenvectors tell me which statement is true, which of these two statements is true, right. We saw that eigenvectors turned out to be conjugate, but there is no necessity for conjugate vectors to also be eigenvectors; this is not ok.



So, this is something important to keep in mind, ok. So, these are the standard ways by which we can generate the p's and you may not see it yet; this is also the reason why the CDM, right. What was CDM? Conjugate Directions Method. This is also the reason why the CDM did not take off for a very long time.

Can you tell me why? Anyone else? It looks very nice, right, when we are doing homework problems, getting an eigen decomposition is the command in MATLAB, which is eigs, and job is done, right. So, it does not work for large problems, right. Both of these methods, what is the computational complexity? In terms of order, big O notation, what is eigen decomposition like the decomposition, eigen decomposition of matrix, what is the complexity? It is order n^3 to get

all the eigenvectors is order n^3. What about Gram Schmidt? Turns out that is also order n^3, ok. So, that is the reason why these two methods, they look very nice in theory, guaranteed convergence in N steps, etc., but it did not make its way into big problems and we will probably not come to it in this class, but next class we will come.

The modification or the specialization that happens in going from CDM to CGM is a much more efficient way of generating the conjugate vectors is what gave rise to the conjugate gradient method, ok, CGM, which does not entail a order n^3 operation to get the p's. But that's more like a trailer of what is to come.