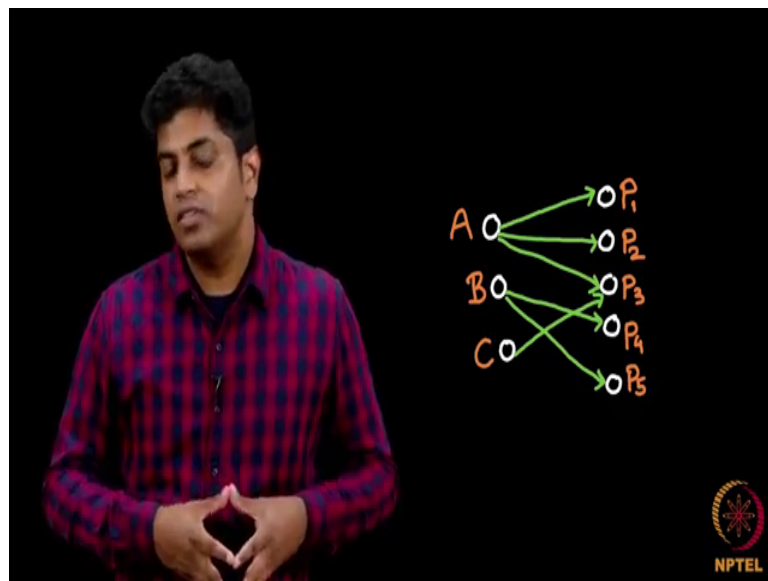**Social Networks**
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Link Analysis (Continued)
Lecture - 104
Hubs and Authorities

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So, as we saw; there is A B C this side; P 1, P 2, P 3, P 4, P 5 this side, someone if a recommends a person this side, he gets a point, and A gets the point, of the person. That he is recommending to whether place that he is recommending.B gets some points based on the places that B recommends. And the places get the points based on the points that B has, correct.

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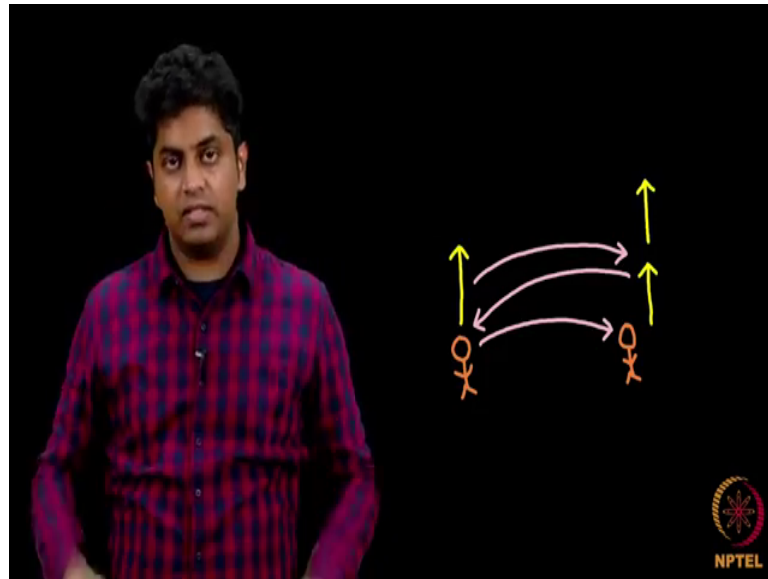
So, it sounds very weird you see, I am famous and if I say you are famous you become famous, you become famous and you say I am famous and I become famous. And I am famous and I say you are famous you become famous and this sort of goes on I have been using this animation from the beginning of this chapter right.

So, because you are pointing to this, he gets your reputation, you are pointing to this person. So, you get his reputation, so, on and so on and so, on. You climb up like this; correct this is called the principle of repeated improvement.

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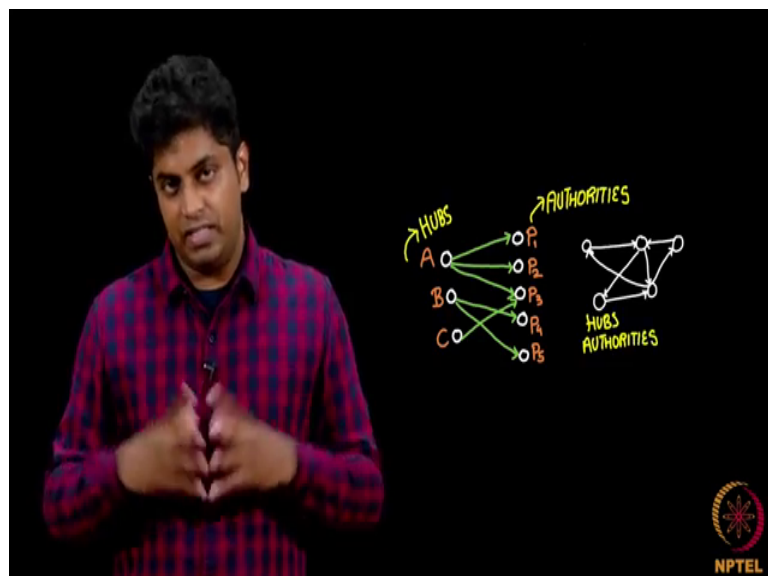
Now the question is in a complicated graph, a graph which is G of V comma E, every single node is adjacent to a few nodes. Let us first consider that, a node acts as both, the left side like A B C as well as on the right side, let us say P 1, P 2, P 3, P 4, P 5.

So, what do I mean by this? This is a recommender; this is a place. So, a recommender is let us call it by a name, the standard name for it. Let us call it hubs, hub means a place where you get information. And the place itself P 1, P 2, P 3, P 4, P 5, we will call it authorities, ok; if you want some advise, you go and ask this A B Cs. They point you to P 1, P 2, P 3, P 4, P 5, where you have your solution. In the previous example, it was people recommend my friends recommending places to visit, it can be anything for that matter.

So, given a graph G, all I am saying is a node can be given points as hubs. It can even be given points as authorities; what do I mean by this? So, let us take a nice example and try explaining this concept.

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You have, let us say 30 people in a class, in a room, you go to some person randomly; and ask, can you help me with a solution to this problem? And that person says, I cannot help you, but I can point you to someone who can help. That person points to someone; and who points to whom is given as a directed graph, for example, Sonia is a node; there are 30 nodes 30 people in this room Sonia is one of them and she has arrows going to some three people.

So, she will point to these 3 people. If I ask her for solution, there are people who point to Sonia also, maybe 10 people point to Sonia ok.

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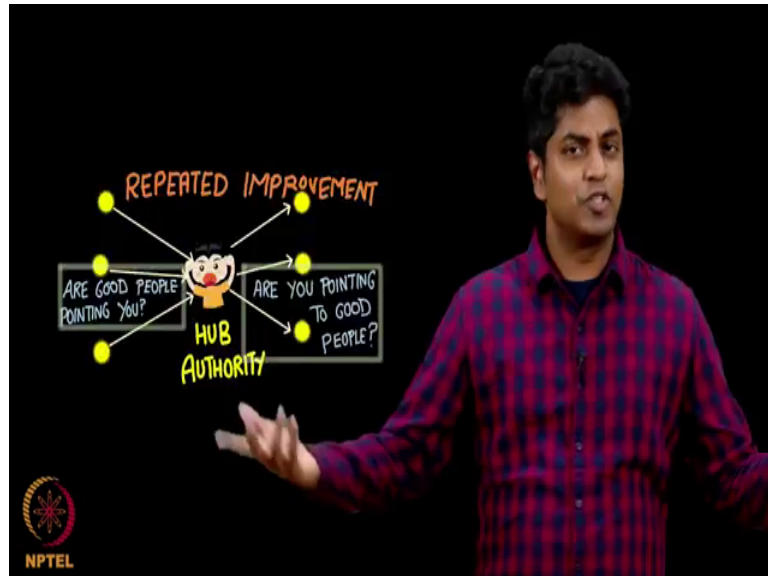
Who points to you and whom do you point, are two different things are you pointing to good people? Is one way of measuring a person or good people pointing to you, or good number of people pointing to you; is another measure. So, every person has this two parameters, are you pointing to good resources; good people or good people pointing to you right.

This is exactly similar to the previous case, where people who are recommending and people who and the places or people who are advising that there is a solution this side and you go and find the solution this side, these were two different shells. Now I can combine them, I am trying to combine them and I am give trying to you in easy piece. That given a node, you try to give both the values stored. How well the node is being pointed to is one value to the node, how well is the node pointing to is another value of the node.

So, as you saw there is a hubs score and authorities score for a node. There are two parameters that decide how important a node is. One is what does it point to, second one is what is it pointed to, who are pointing to him, him to a particular node? As you can see that definition itself is slightly recursive, you see a node is good if it is pointing to people; and people are good, if they are being pointed at by good people. And how do

you achieve this? You achieve this by repeated improvement. where are our earth is this useful?

But then, in the late 90s; it was a requirement for people to maintain pages, which had the list of all possible news material right.

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And they were called the news lists; how do you trust a news list If it is good or not. If it has some good articles; point us to good articles. Now how do you know an article is good or not? You would click on it go there and see that it is good, and then you would say this news list is good. Because it points me to the right articles, just the Raj, Ramesh example I gave you right. So, this was the way in which you could rate a bunch of bolts, which would point you to nice news articles.

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And that was a birth of this concept called hubs and authorities. Mathematically speaking, in fact, one can show that; whenever you take a graph, and start with this hubs and authorities repeated improvement process. You will always converge to a point, what do I mean by converging to a point? You see this repeated improvement, results in points getting accumulated in a node; at the end after a long process.

Let us say you tried several iterations; and you will observe that the proportion of allocation, the proportion of points; that each node takes with respect to other nodes this always remains the same. For example, a node A and node B, if node a accumulates half as much as node B it will continue to accumulate; half as much as node B in the future, that is called the convergence state. So, given any graph, the hub and authorities score, as you keep doing this principle of repeated improvement it converges.