Social Networks
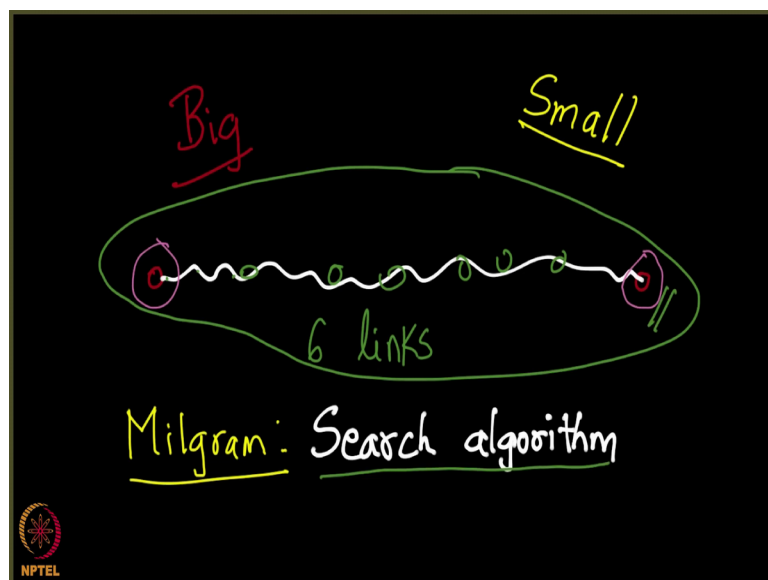**Prof. S. R. S. Iyengar**
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The small World Effect
Lecture - 147
Decentralized Search – I

Fine, we saw how the world is connected.

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The world is way to big on one side and we saw it is actually also small in a different sense right; big in one sense, small in another sense. What is more important here; this experiment was let us we collect. So, there were two people, anywhere in the world, they are connected by some 6 links right; 6 links. I am sure you people now see the point and you sort of appreciated, but what is more worthy of being appreciated is not the fact that given any two people in the world they are connected by near 6 links right 1, 2, 3, 4 links a more interesting fact it is the following.

In the Milgram experiment if you observe, it is actually a search algorithm. It was the search algorithm, why so? You see that a person is holding a letter here and does not know who is here and he supposed to find a path on the friendship graph of the world right. There are so many people over here; he needs to find how to get to the reach this person here right. It is indeed a search algorithm.

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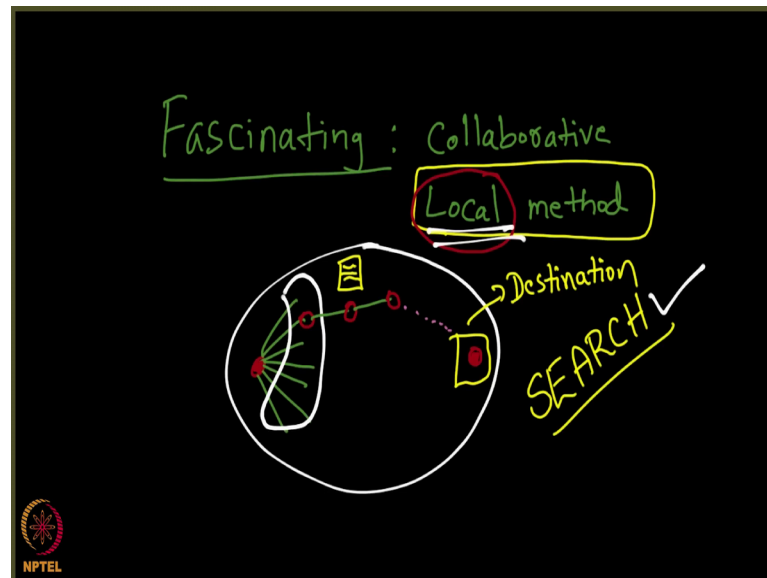
What is more fascinating? What is more fascinating about the Milgram's experiment is the fact that it is a very collaborative attempt. People use a sort of a very local approach, a local algorithm by a local method. We mean they do not know of the global picture in the graph right. So, in the few friendship network: a person here only knows who are his friends and has no clue of who could be the friends of this destination person. He has local this person has local he has only a few friends here. Now he done very intelligently passes on the letter to someone of his friends hoping that it will reach the destination and they someone friend sends it to another friend hoping that it will reach the destination.

So, a point to note here is this is indeed a search algorithm. And what is so fascinating about this is that it uses a local method, he does not know the entire graph given here. Nobody knows entire graph, they only know what is once friends and they just pass on the information to one of his friends, right. And then surprisingly Milgram notes that it finally, reaches the destination. It reaches the destination and the approach is completely local.

I hope you understand what I mean by the word local. By local I mean a person who has the let us say the letter right now, only things about passing it on the most eligible friend of his; hoping that this chain will continue. And finally, help the letter reach the destination. It is a very local algorithm; it is indeed very fascinating to see how this works.
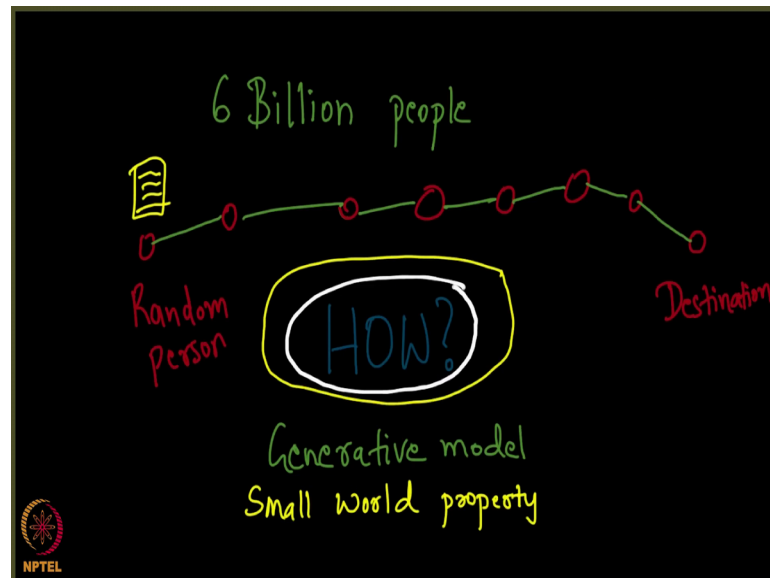
Imagine there are 6 billion people as I was telling the population of the world is more than 6 billion people in this world. And some random person when you take and give a letter to him and ask him to make this letter reach, you take a random person and ask him to help this letter reach the destination the destination. Although, he has no clue how to do this, he somehow manages to give it the impetus. He gives a push to it and every single person does the same thing right; every single person does the same thing. And finally, it was observed that in roughly 6 hops, you reach the destination is in that a sort of misty. Mystifying that without anybody knowing the entire graph, they all are cooperating and helping the letter reach the destination.

Now, our question is how does this happen. How? Is it even it looks unbelievable, does it even happen right? So, if we went to write a computer simulation, what would we write? What coding would we do to see that this indeed is true? You remember the generative model that we discuss in the previous session, the generative model called the Watts Strogatz generative model right. We showed you how to generate such graphs which have what is called the small world property, right. It is called the small world property which means any two people are connected by surprisingly less number of links.

Now, let us slowly understand how exactly this search algorithm gets executed and how exactly it is so local. Nobody knows the global picture at they ensure that within 6 links, the letter reaches the destination.
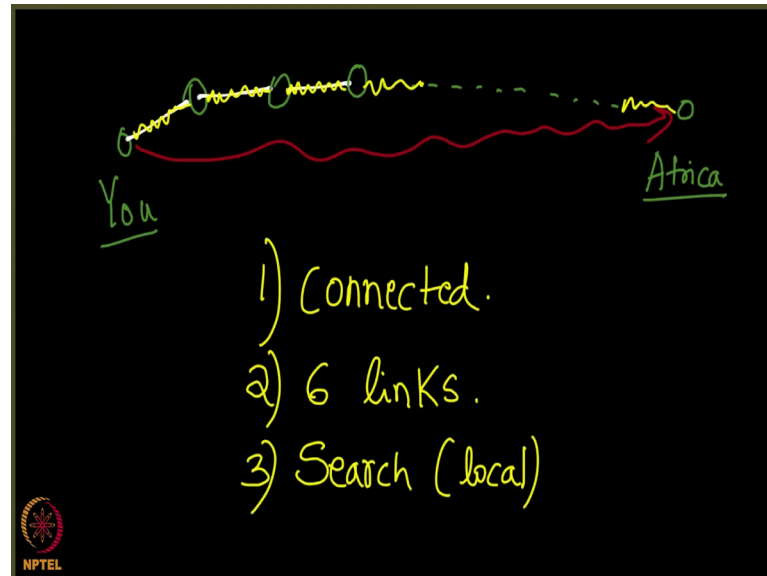
So, assume let us take as an example a real world scenario where this is you. And this is let us say some someone in some part of let us say Africa and you badly want to contact this person for some business and you have no clue how to contact him.

Again an assumptions is we are in the lets say 60s and 70s where there was no internet. Nowadays it is very easy. Although the same phenomena happens; it is not as difficult as it sounds in this example right. If you were want to contact someone in Africa, how would you go about? You will ask someone, again the same story and ask them to help you with someone who might possibly know this person in Africa who might know someone who might know someone in this place called whatever in Africa and so on. And surprisingly as I have been repeating, this helps you reach the destination. This way I mean this has this has sort of this has been one of the most counterintuitive facts in graph theory ever that not only is the world connected look at this.

First point is not only is the world connected, it is surprisingly connected in the sense that in 6 links we can go reach the destination; how awesome is that. And the third and the most fascinating fact is that the search algorithm that people use to go find the destination is a local method. By local method I mean I repeat by a local method, I mean nobody has the global picture; nobody knows who is friends with whom, but they just do their local job. All that the person needs to do is to ensure that he sends it to the

immediate neighbour and this every person follows the same protocol. And finally, it goes and reaches the definition.

Whereas now see the how of this algorithm, how exactly this works. This goes by the name decentralized search and we will see more of it right now.

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Decentralised search, it is actually self explanatory as you would have realised. Centralised means there is central authority; decentralized means there is no central authority still you are able to search.