Social Networks
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How to go Viral on Web
Lecture - 150
Programming illustration- Small world networks: Introduction

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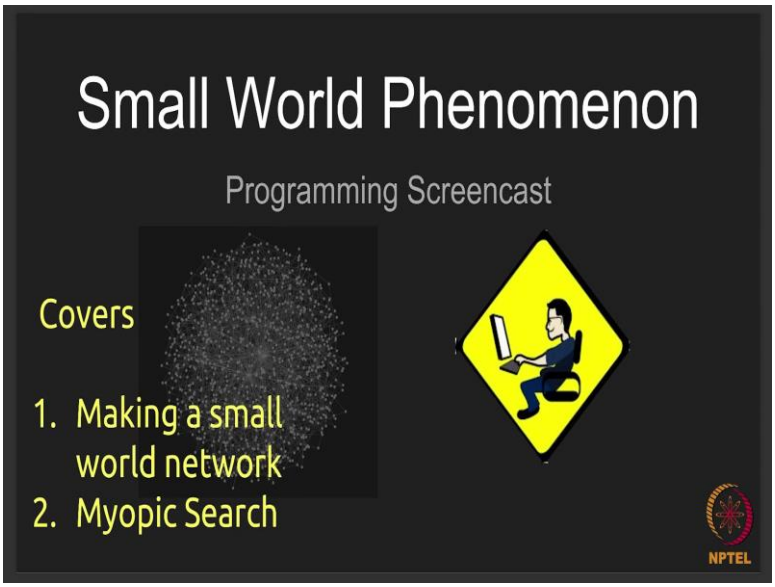

In the previous week, we have looked at the Small World Phenomenon. This week we are starting off with a programming screencast based on small world phenomenon and then we will take up another concept. The first starting off with a programming screencast of small world phenomenon, we are going to do two things there. First of all we are going to look at how do we make a small world network. So, I am sure all of you remember how we make a small world network, I will quickly recap it. And secondly, will do how do one does a myopic search on this network, how do one does a decentralised search on this network.

Now, before starting off with the programming screencast, I will quickly recap both of these concepts; how do we make a small world network and how do we do a myopic search on it ok.

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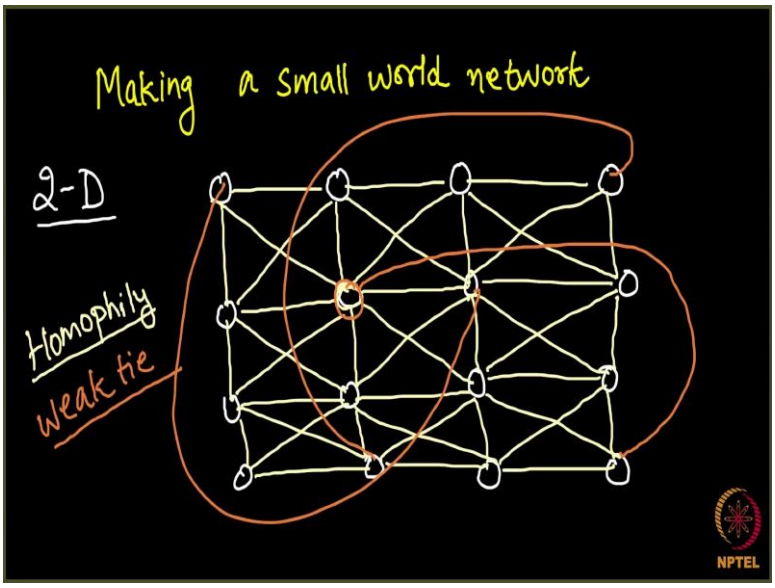

Let us look at the first one. So, the first one was you want to locate how do we code, how do we make a small world network; so making a small world network making a small world network. So, here let us talk about the model which we have looked in the lecture. So, you will remember, how do we modulate in two dimensional in a two-dimensional space. We have certain nodes here. So, let us put some nodes here.

So, let us say I put some 16 nodes over here. So, I have some 16 nodes over here and then we have looked at, how do we make the connections between these two nodes. So, connections between these two nodes were based on two concepts. The first one was homophily. So, in homophily what we have done is, every node was connected to the nodes which are geographically closer to it. For example, this node here it can be connected to this node graphically closer this node, this node and this node.

So, one on it is top bottom right and left. And similarly, for all of these nodes we can do the same thing and all of these links are made because of homophily. So, we get a grid something like this and what even we can do next is we can even connect these nodes to their diagonally opposite partners, because they are also geographically closer. So, we can make a grid like this as well. So, the grid which we had previously, this one is also correct and this one is also correct where we link the diagonally opposite nodes as well.

So, all these links are because of homophily and then we have look that what makes this world small is the presence of weak ties. So, the second reason the second concept which

gave rise to the small world network was weak ties where every node for example, this node will be randomly connected to some of the node which is quite far away from this. So, this node might be connected to somebody here, this node might be connected to somebody here, this node might be connected to somebody here.

So, these weak ties make our world small. So, this was how we can portray our world. So, gets small in two dimensions and rather then we looked at we can portray the small world network with the model with model which got.

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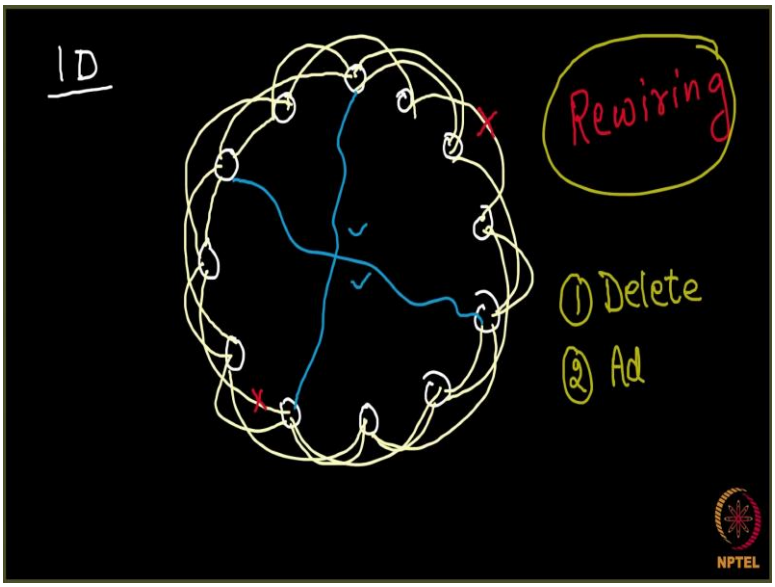

So, gets give in one dimension which is rather more interesting. So, in one dimension, we can assume that the nodes in the network they are in the form of a ring. So, here we have some nodes in this network.

So, these are the nodes and again we have certain connections because of homophily. So, because of homophily the nodes are connected to other nodes which are geographically closer to them. So, we can take let us say 1 on the right-hand side and another on the left-hand side or rather we can take 2 on the right hand side and 2 on the left hand side. And again, this node here is connected to 2 on the right-hand side and 2 on the left hand side. And similarly, all the nodes connected to 2 on the right-hand side and 2 on the left hand side. So, let me make this connection quickly.

So, something like this. Every node is connected to 2 nodes on its left side and 2 nodes on its right side. So, let us say something like this and so on. So, these are the ties which exists because of homophily and again to make this world small, we should have somewhat long range ties weak ties. So, what we have looked previously in the chapter in the previous week was the concept of rewiring was the concept of rewiring. What we did in rewiring was we deleted of some of the edges from here. So, let us say this edge can be deleted and instead of this edge, we randomly put an edge somewhere else in the network.

Similarly, this edge can be deleted, and we can randomly put an edge at some other place in the network and so on. I make a for our coding for our programming screencast, I will make a small change here. And the change which I am doing here is instead of rewiring so, by the basic model which what so, gets has given it is actually rewiring where what you do it consist of two steps. So, the first is step is first of all you delete an edge from the network, you delete a random edge from the network and second you add a random edge in the network.

So, delete one edge and add one edge, but for our programming screencast I am doing a small change to this. What I am going to do is instead of this rewiring so, here instead of this rewiring, what am I going to do is, I do not rewire the edges here rather like in the previous model how did we see I am just simply going to add some long range contacts. And it will not make a as you will see; it will not make much change to the number of edges as you will see just on the addition of two edges, we will have did use the diameter of this network.

So so, let me elaborate it know what i want to say. What we are interested in is looking at the diameter of the network. Let us say we have this network somewhat like this and here can you tell me what the diameter of this network is. So, assume that how many nodes are there, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 say 12 nodes are here.

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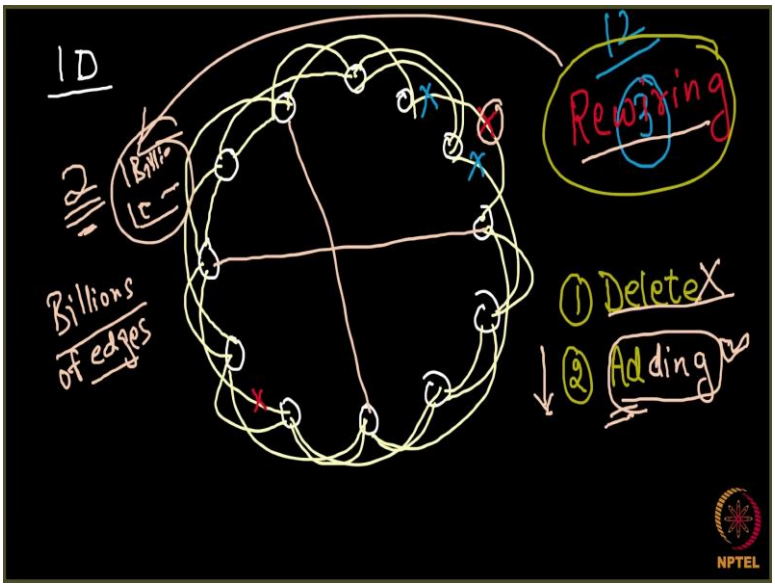

So, when there are 12 nodes, we can see that the diameter of this network is 6 or a node 6 actually it is going to be little bit less than 6. So, so, let us say from these are the two nodes which are at the maximum distance. So, the diameter will be 1, 2 and 3, right. So, the diameter of this network is 3. And what will happen when you are actually going to rewire some edges? So, let us say you rewire this edge and you put an edge here and then you delete this edge and you put an edge here, what it will do it will reduce your diameter.

So, now if you want to arrive from this node to let us say this node, the distance instead of 3 is just 2. So, you can jump from this node to here and you can jump from here. So, the diameter is reduced to 2. So, more the wiring you do, the diameter decreases accordingly.

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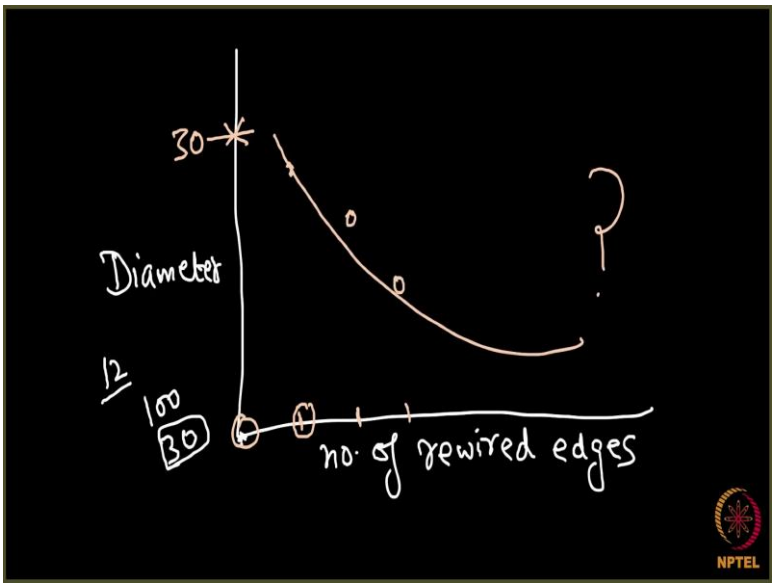

What is our aim our aim is to look at if I plot a. So, if I plot a graph let us say, I plot a graph and on the x axis I have the number of rewired edges. So, I rewire 1 edge, I can rewire 2 edge and so on. Here are my number of rewired edges is and on the y axis I have the diameter.

How will this plot look like? So, initially we know let us say instead of 12, let us say our network consisted of some 100 nodes and what will its diameter be? Its diameter let us say was something like 30. So, initially the diameter of my network was 30. So, here when I have 0 number of rewired edges; here when I have 0 number of rewired edges, the diameter of my network was 30. And then I rewire 1 edge and when I rewire 1 edge, what will happen? My diameter will reduce maybe somewhat here and then I rewire another edge and then again my diameter can reduce and again I rewire my diameter can reduce.

How will this curve look like? We want to study. So, as we do more and more rewiring of edges, how does the diameter of a network reduce is what we aim at is what we aim it studying. And while doing this as I discussed with make a small difference to a network over here and what is a difference is instead of deleting an edge here and adding an edge here we remove this step of deletion and we just add some rewired edges. And as you will see, the number of edges will not change much. So, you will see that on just the addition of let us say 2 or 3 edges.

On just the addition of 2 or 3 edges, the diameter will go down drastically and hence this whether you do rewiring or whether you do simply addition of an edge, these 2 are not these 2 are not very different concepts. The number of edges in the final network is actually going to be almost the same. So, let us say that you take a very big network on let us say some millions of nodes and billions of edges.

And on this network having billions of edges whether you rewire when you require 2 edges so, the number of edges will remain 1 billion only. According to the rewiring principle the number of edges will remain, 1 billion only, but if you add 2 edges, the number of edges will be 1 billion plus 2; 1 billion and 2 which are almost the same. So, here is a little change that we make to this network to this is framework of building your small world network.

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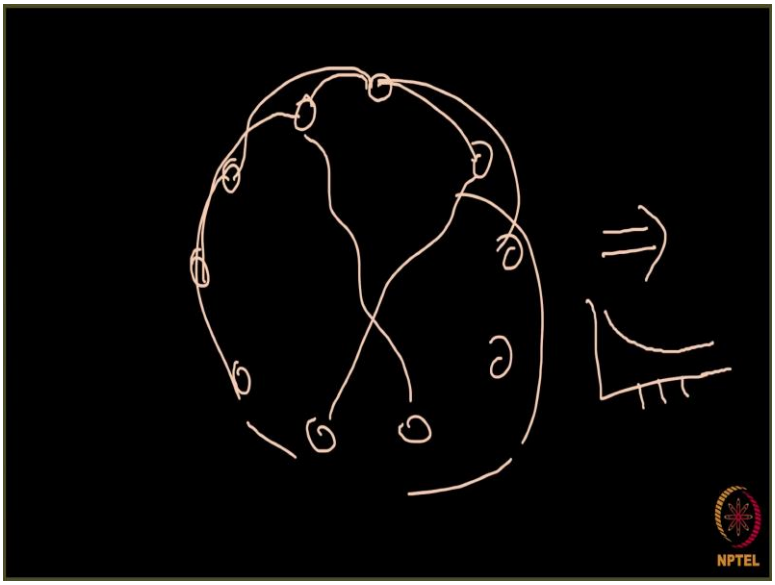

So, we have this ring network. And on this ring network, every node is connected to 1 node on the left side sorry 2 nodes on the left side and 2 nodes on the right side and so on. So, every node is following the same principle and at the end what we are going to do is we will add some extra edges there. And we will look at as we add these extra edges over here, how does the diameter of this network reduce.

And I hope will you remember; what is the diameter of a network.

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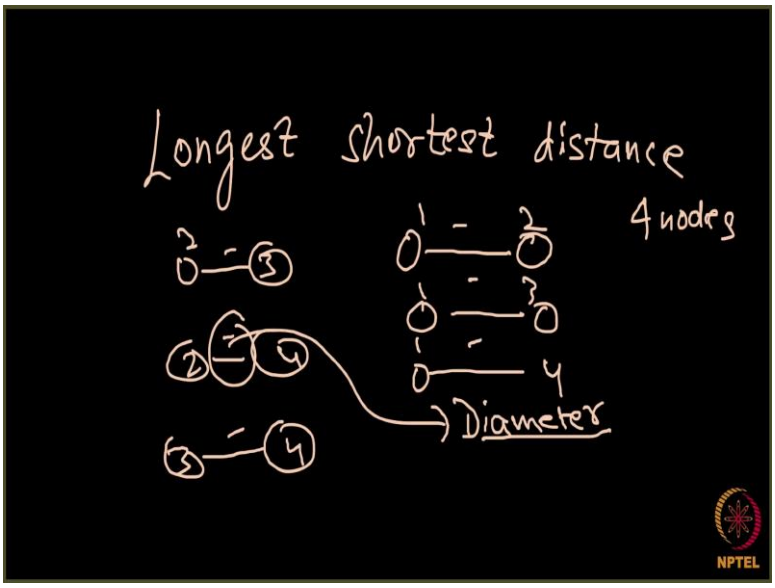

Diameter of a network is nothing but the longest, shortest, distance; longest shortest distance. So, you take every possible pair of nodes in the network, you find the distance between them distance between them. So, let us say there are some 4 nodes in this network. So, you take 1, 2, 1 3, 1 4 and then and then you can take 2 3, 2 4 and then you have 3 4. And you look at their distance right the shortest distance between these two nodes and the maximum over here is your diameter.

So, we have discussed it previously, I will not going to the details of this.

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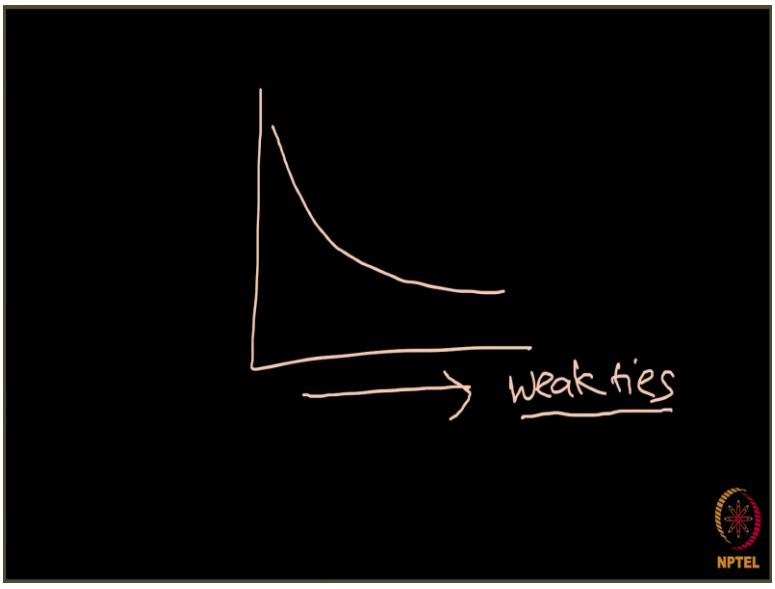

So, overall the first part of this programming screencast is going to deal with when we make a small world network as we increase the number of extra edges; as we increase the number of weak ties or the short range or the long range contacts how is this diameter going to reduce.