Social Networks
Prof. S. R. S. Iyengar
Department of Computer Science
Indian Institute of Technology, Ropar

Rich Get Richer Phenomenon – 2
Lecture - 131
Simple Branching Process for Modeling Epidemics (Continued)

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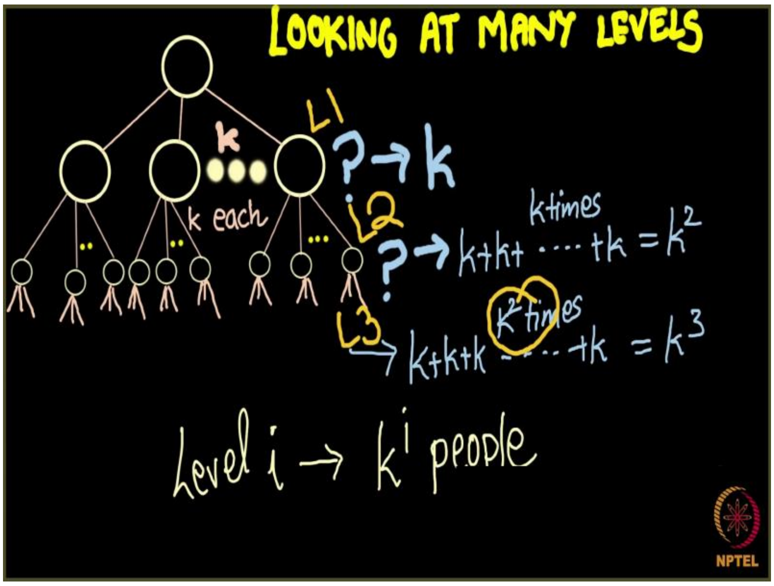

Now, what we are going to do is, we are going to look at more levels, many levels. How do we, what do I mean by looking at many levels? So till now we have looked at if there was one person who is infected and this person has some children how the disease is going to spread in this case according to what is the number of children this person has and how is the pathogen, what is the contagiousness of the pathogen we have looked at that in terms of probability.

Now, what I am going to do is, we are going to look at this network in terms of many level. So this is the first node here and let us say this node here has got k children k children and each of these k children is again having some k children each of these children has these k children and so on. Each of these k children are again having some k children; what do you think? So let us call this particular level to be level 1 so this is your level 1.

So, what do you think are the number of people present at level 1 and we know it very clearly this is k because our node here it is having k people? So the number of people at this level are going to be k people now what do you think is the number of people at the second level. So this is our level 2 so what is the number of people here at level 2 so a little bit of maths tells us what is the number of people. So in the previous level we were having k people and each of these k people have k children.

So, how many people here we have; k + k + k k times which is equal to k^2 similarly let us look at level 3. So how many people will be the here at level 3 so at level 2 we were having here at level 2 we were having k square people and each of these k^2 people now are having k children. Hence at level 3 we have how many people k + k + k k^2 times because each of these k^2 people are having k children each.

So, we get an answer k^3 so on and so forth so if I ask you the question what is the number of people at level i; so what it will be at level 1 we had k people k^1 at level 2 we had k^2 people; at level 3 we had k^3. Similarly, at level i we are going to have k^i people. So, we have looked that how the different levels how do the number of people increase; what we want to do next is.

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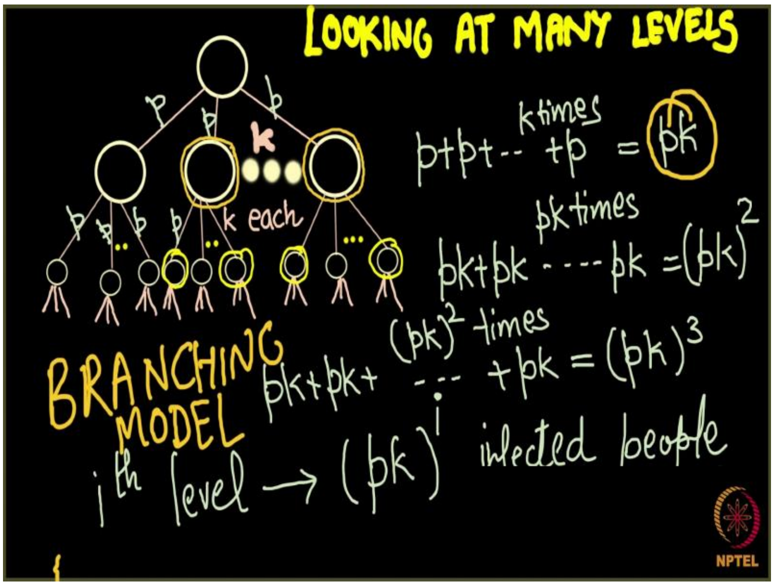

Let us look at how the contingence spreads over here and again looking at many levels and here we have a node. So this node is here having k children each of these k children is again having k children and each of those is again having k children.

The probability of infection here is p; I know that there are k people at this level, but what are we interested in now is out of these k people on an expected on an average how many people are infected here. And we know the answer right so if there is a person here and he has k neighbors each of the edge each of the edge has a probability p of infecting. So we have looked at it previously that there are going to be p + p + p k times, that is on an average p * k people are going to be infected at this level.

What about the next level how many people are now going to be infected the next level; can you pause this video for 2 minutes and then try to figure it out by your own and then you can resume the video. Now here I am having p * k number of infected people let us say these are those infected people; so, one is here, one is here, so here are p * k number of infected people. What happens next? This person here how many people is it going to infect in the next level again the question is the same.

One node is infected here. And this node is having k neighbors each of the neighbors gets infected with probability p as before on an average it creates p * k number of infected people. Similarly, this node here creates p * k number of infected people and how many such nodes are there p * k such nodes are there. So how many people get infected at this level is p * k + p * k + p * k times which is $p * k^2$. What happens at the third level is again similar.

So, let us say these are those these people are those pk^2 number of people who are infected. So now, on the next level how many people will be infected? So each of these guys over here will infect on an average p * k number of people so in the next iteration p k + p k + p k and there are p^2 people so we add it $p * k^2$ times and we get $p * k^3$. So in the third level $p * k^3$ number of people gets infected.

Similarly, what happens at the ith level is $p * k^i$ people get infected. I think it is clear now so in this tree kind of a network at ith level we have how many people we have k^i people. And then if we talk about the number of infected people there are $p * k^i$ number of infected people. This is all about the basic epidemic modeling and this model which we have discussed about this is known as the branching model. So, this model it is known as the branching model.

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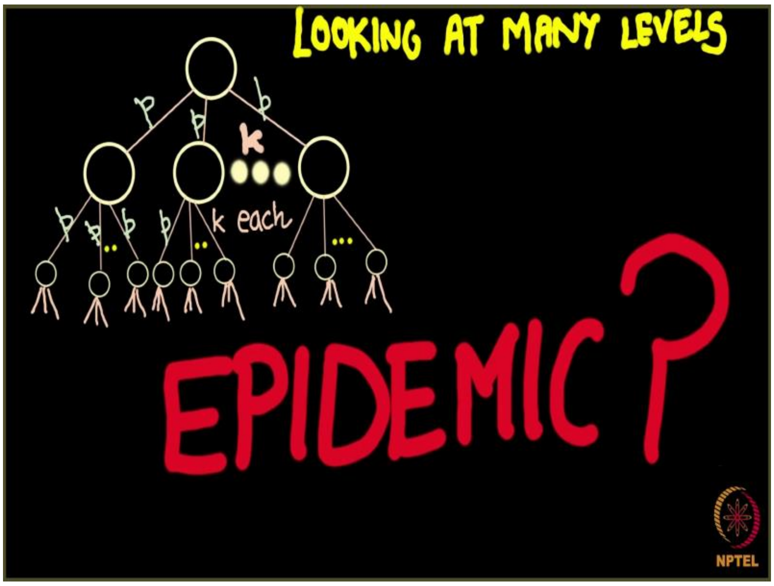

We have looked that this example; always keep this example in your mind so one person having k children each of these having k children and then we looked at the branching model here we found out the expected number of people infected at the ith iteration is p * k^i. What I said in the beginning, why are we studying these why are we studying this contagion, how does a contagion spread? And the answer was to understand whether something goes epidemic or not.

When will I say something has become epidemic on this network shown over here I go I keep going down in this network keep going down in this network and when I go lot of down let us say through some infinite level and I see a person infected here. I can say that this disease has become an epidemic. If it was not to become an epidemic it would have died somewhere here, but this disease starts from here infect these people, infect some of the people at this level we keeps we keep going down and it even infect some of these people at too much bottom or let us say at the infinite level.

Then I say that this disease has become an epidemic now from all the information I have given you that there are some probability p and number of neighbors k p * k^i people infected at the ith level. Can you tell me whether this disease is going to be an epidemic or not? So based on the values of p and k can you comment about whether contagion is going to be epidemic or not. Is it even possible to say it and the answer is yes and in next lecture we see how do we do that? How just by looking at the value of p the probability and k, the number of children every node has, we can comment about whether this contagion is going to become an epidemic or not.