Social Networks
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The Small World Effect
Lecture - 144
Milgram's Experiments

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So, back in 1967, a scientist by name Milgram took a bold step to try executing this experiment of finding out whether the friendship network in the world is connected at all. If you take two people let us say P_1 and P_2 in the world, are they connected through several people in between or is the world of friendship networks disconnected? So, he took a bold step and conducted a very neat experiment.

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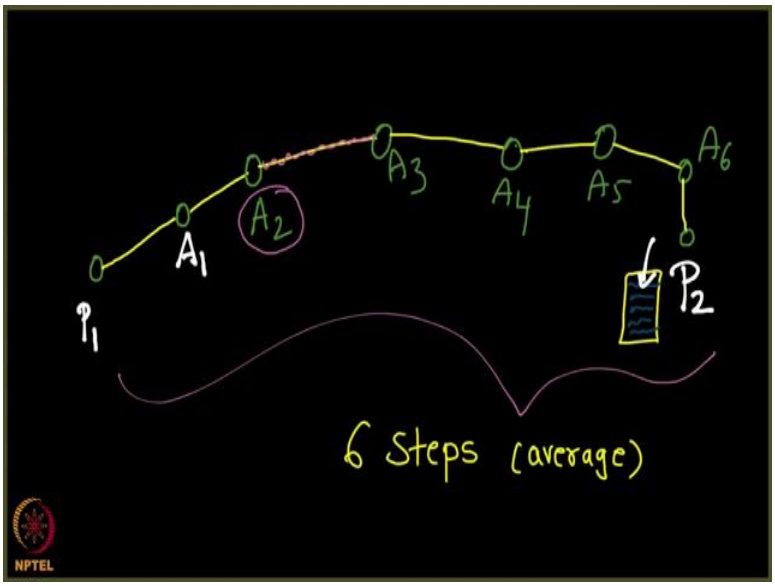

All that he did was he choose a person P_1 and gave a letter to this person P_1 had a letter which the which with this person P_1 was supposed to pass this on to a person P_2 in some other part of the world. And P_1 and P_2; obviously, did not know each other's. They were pick uniformly at random let us say.

And P_1 was supposed to deliver this letter to P_2; now given that P_1 did not know P_2. Now there is another rule here the address of P_2 is specified in the letter, but P_1 cannot post it to P_2 directly. He cannot post it to be directly, instead he is asked to pass it on to someone whom he might know who might in tern know P_2 or he may not know P_2. All that P_1 should do is pass it on to some other persons let us say A_1 whom P_1 might know, whom P_1 suspects that this A_1 might know P_2 and this A_1 should then pass it on to P_2. Again, the same story, he may not know P_2. So, what she does is he chooses someone. This particular A_1 chooses someone exactly the way P_1 did and sends this letter to A2 asking him to pass this letter to the destination which is P_2.

This goes on and on; this goes on and on, he might suspect that it might indeed take a reverse direction and it might reach somewhere else. Now can this happen. I do not think this can happen because when A_2 tried giving the letter to A_3. He gave it in such a way that he chooses A_3 in such a way that A_3 was someone who sort of was close to P_2 if not new P_2 personally, was locationally region wise close to P_2.

If you remember the previous example, people passed on the letter to the next person they knew who might possibly be closer to P_2 then what they are. So, this reversal thing may not happen mostly does not happen right. So, what does A_3 do here? A_3 intern sends it to another friend of his namely A_4 and A_4 sends it to some other friends let us say A_5 and A_5 sends it to some other friend namely A_6 and A_6 might know P_2 and A_6 will send it to P_2.

Milgram observe that surprisingly most of the letters that he sent they started with of course, the source like this and then reached the destination. In this entire thing happened in 6 steps on an average. I repeat these 6 steps are on an average and Milgram observed this, and he published this article in a magazine called psychology today and this magazine did; then this article did attract a whole lot of attention back then.

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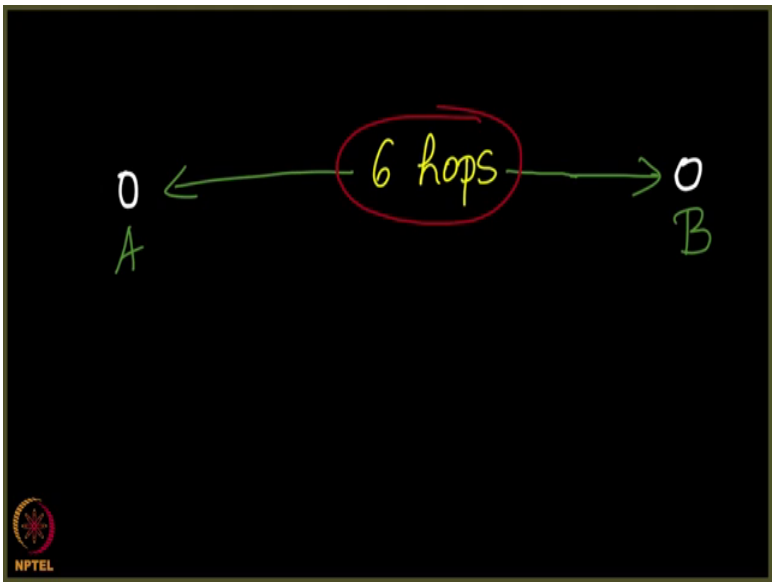

And people did not believe that this was true that any two people in the world are simply separated by a mere 6 hops. By 6 hops I mean with 6 friends, they can always connect any two people; absolutely any two people can be connected. Pick any person A another person another person B, you will observe that there are 6 people separating them and again as I told you, this is on an average 6 hops. And Milgram did this daring experiment and published these results. Now, what was this to say? What is this obvious or is it counter intuitive ok?

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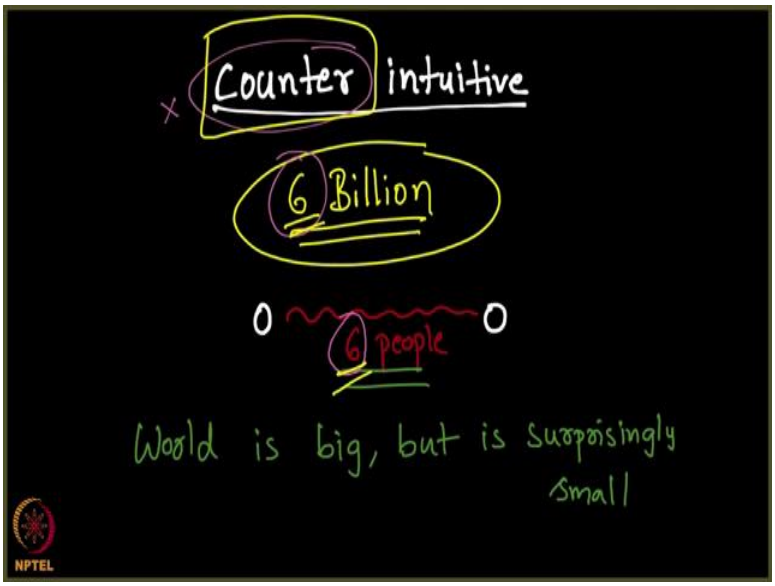

It is indeed counter intuitive, why is it counter intuitive? Let us see the counter intuitive part first. This is counter intuitive because the world as you know has roughly it say what is the best what you know, the population of world is more than 6 billion people. Out of this 6 billion people all that we are saying is any 2 people are connected by just 6 hops that is unbelievable right. Just 6 people separate each other. That is unbelievable because this looks like two huge a number and this looks like too small a number right.

So, what is happening here? We this is the counter intuitive part of it. The world is big the world is big, but it is surprisingly, but is surprisingly small as well at the same time; surprisingly small by small we mean of course, the world is big because it is 6 billion people. But then the world is small because it is 6 people who separate any two people right. So, if you want to know someone in the world, it is not difficult for you can indeed know them through a friend's friend' s friend' s friend's friend right. Let us see why it is actually not counter intuitive? It is not so counter intuitive. In fact, let us see what is behind this idea, how exactly this happens.

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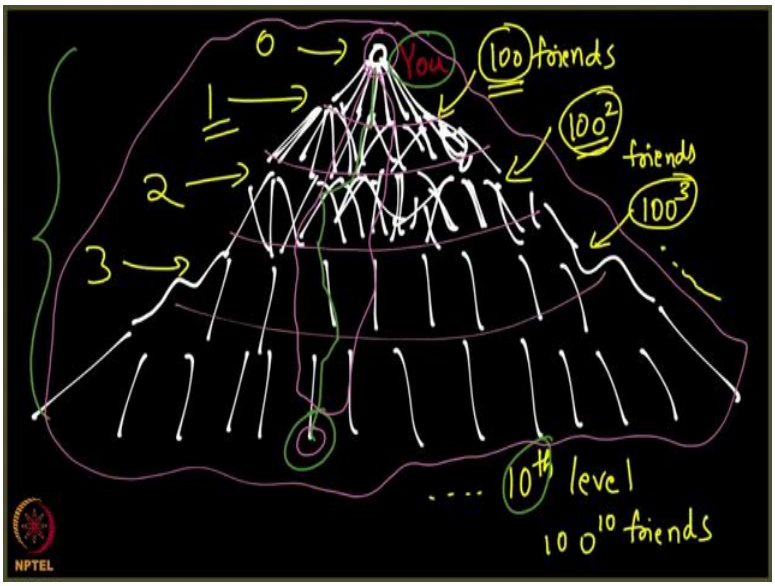

So, assume this is you and you have some say 100 friends. So, you have some say 100 friends and then each one of your friends they intern have 100 friends each, 100 friends each, 100 friends each so on. As you node the next step when each person has 100 friends, it turns out to be 100 into 100 which is 10,000 friends. And as this keeps going on and on so, each of your 10.000 friends will have 100 friends each and so on and so forth right. It each level has so, what is the number of friends at this level. It is what was the number of friends the second level, let me try writing it square instead, 100 square friends.

The next level will be the 100 square each one of them will have 100 friends. So, it will be 100 cube and so on. Let us say at the 10th level like this at the 10th level, you will have 100. So, as you can see this let us call this level 1, let us call this level 1. So, level 1 has 100 friends, level 2 has 200 100^2 friends, level 3 has 100^3 friends and so on; 10th level you have 100^{10} friends that is a huge number.

And as you can see, if you want someone from let us say that this person, you want know someone in the world right you can should just sort of slight down the slope of people. And the height of this as you know as I told you, 10th level is simply 10 hops down. So, you a for people will know every single person in the world in this in a span of this let us say, 10 steps down right. It is not counter intuitive 10 is a small number as you can see

right. This here sort of grows exponentially. It comes down exponentially right. So, that is the reason why you will be exhausting the entire world's population.

If you look at your friends, your friend's friends, your friend's friends and so on. So, we saw that it is indeed counter intuitive given that it is 6 billion, but any 2 people are separated by 6 hops said Milgram right; Milgram said this and this is indeed counter intuitive. But when we see it properly in a different lens, we observed that is not all that counter intuitive. It is indeed sort of obvious.