So, we saw an introduction to datasets, importance of crunching datasets and thankfully as I said we are in era where lot of datasets are available when we can try to make sense out of it. But there are times when we may have to not worry so much about data sets to unravel some mysteries of networks in general. I am going to teach you right now in the forth coming few lectures on how one can actually keep a side data sets and look at graphs in general and make sense out of it.

So, what will do is will revisit or age old puzzle which we have been talking from a long time of how does a graph become connected, why is it that almost always a graph is connected in the real world. Given a class room of 100 people as friendships start happening when will you observe the graph becoming connected, will it at all become connected, what if there is a bunch of people this side a bunch of people this side such that nobody knows each other across where friendships only happen within, what do I mean by this? By this I mean following.

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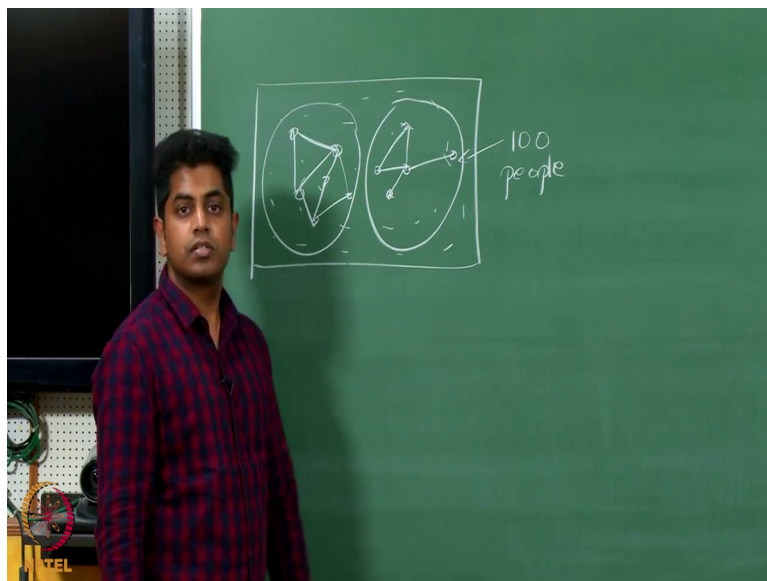
Assume this is my class room and a class room full of some let us say 100 people, let me call this 100 people and you look at the friendships between them some random friendships like this friends with him, friends with him, friends with him etcetera. Will you see a bunch of people this side a bunch of people this side where connections are only within, there are no connections across can this even happen? Let me give you an intuition.

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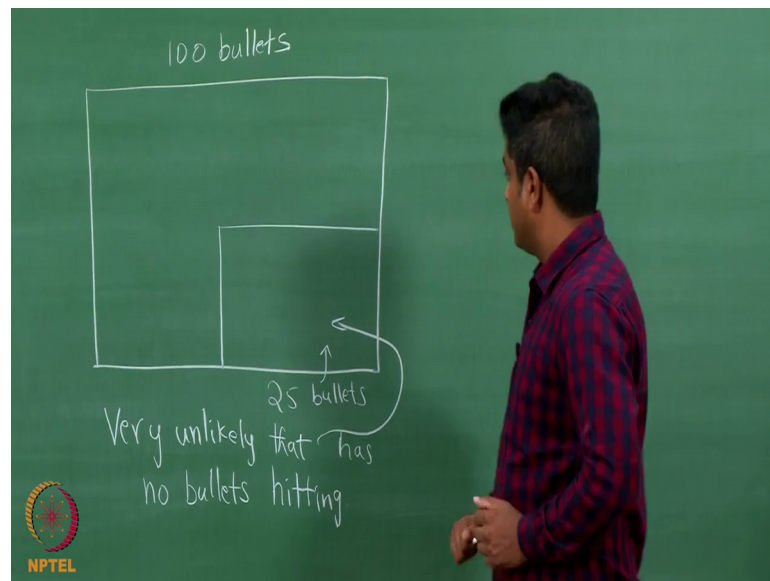


By looking at a similar example look at this assume I am giving you a shooting target by a shooting target I mean I will give you a gun and ask you to shoot within this square only within this is rectangle only you can go on shooting as many bullets as you want right, but then I will give you one quadrant of this rectangle let us say this is one-fourth of the total rectangle correct, in this one-fourth of this rectangle small rectangle your bullet will definitely fall unless you aim really well you are a great archer, you may not throw your arrows only in a particular place.

The assumption here is that you are shooting uniformly random your blind folded and simply shooting and all your bullets assuming here coming within this rectangle I will ask you how many bullets came here, let us say you shoot 100 bullets, how many of those bullets came and fell here? If you are shooting uniformly it random is not it very obvious that this captures one-fourth the total area. So, one-fourth the bullet should come and fall here right. If you are shooting 100 bullets 25 bullets should fall inside can it. So,

happen its very straight forward and intuition for all of us can it. So, happen that none of the 100 bullets fell inside this and all of them fell outside this, let me remind you, you are not shooting it with any intend you are uniformly at random shooting at it, your blind folded you cannot see where to shoot you just hold a rifle and keep shooting. It is very unlikely that no bullets come inside.

Let me write that down very unlikely that this place has no bullets at all, no bullets hitting is not this very unlikely, it is very unlikely correct. Now, if you have this intuition I am going to ask you a question on this it is exactly the same as this observation, what do I mean by that?

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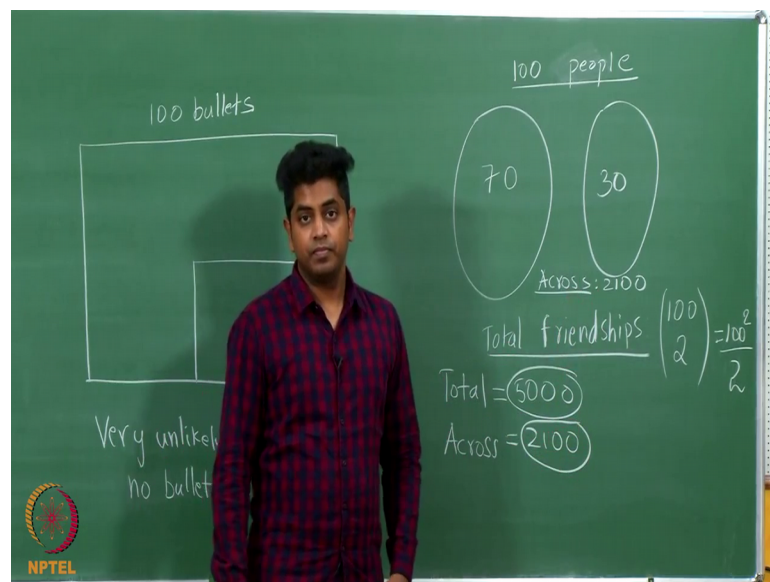


If I take 100 friends, 100 people they are not friends 100 people - let me say 70 people are this side, 30 people are this side totally there are 100 people, total possible friendships, total possible friendships is clearly 100 choose to as you all know 100 choose to which is roughly 100 square by 2, 100 square by 2, it is actually 100 into 99 by 2 for you know from day one I have been writing it as square by 2 because 99 can be seen as 100 its almost all close to 100. So, there total number of friends which is 100 square by 2 which we all know is 5000 these are the total possible friendships out of which there are some friendships within, within there are some friendships across. Let me see how many friendships are across, across friendships are simply 70 into 30 - 2100

right. What do I mean by this? Let us take a pause and understand what I have done. So, far total possible friendships are 5000, but the friendships across are 2100 in number.

What I am saying? Here is the situation where there was a possibility for people to make 5000 something friendships and every single friendship that they choose did not fall into this, did not fall into the across friendship, there were so many possible ways in which they could have had an across friendship they did not, all of them fell within only this is very unlikely.

The intuition is this do you see this is roughly half of this, this is roughly half of this. There are let us say twenty balls in a basket 10 black, 10 white you pick some balls from this basket all of them are black, you are picking them uniformly it random and all of them are black is this even possible, it is not possible, it is not impossible it is improper. So, I repeat if you take a bunch of 100 people and look at friendships it is very unlikely that there are no friendships across because a whole lot of possibilities for that to happen and you are saying none of this possibilities happened.

So, what did I just say? Let me connect the analogy properly when you start putting a lot of edges it is as good as you choosing the edges out of 5000 edges it choosing some edges, half the edges are between and when you are choosing none of these edges are chosen, half the edges are across between you choose not to touch even one of them and you are picking the edges look at the analogy I gave you of the basket and balls. There is a basket full of balls half of them are black half of them are white, you blind fold yourself and then pick and you see there all the balls that you are picking are all black. It is unlikely when you are blind folded you should pick uniformly it random white as to come somewhere. So, the black balls all the balls here or all the edges here, the white balls are the edges across and the black balls are the edges within. Edges across are roughly half the total number of edges, black balls are half the total number of balls, white balls is half the total number of balls, but you when you are picking you are only picking black balls you are not picking white balls and your blind folded look this is very unlikely.

And I am just using argument to say this is very unlikely that you have two components most of them are out of 5000 half of them are across and you are not choosing even one of them right. Same thing here one-fourth of the place is this part and all your bullets are

not falling here its falling out side this only that is unlikely some bullets should fall here, some balls should be white, some edge should be across that is the intuition correct. When you create a graph you cannot see two compartments like this when you have sufficiently many edges by sufficient many edges I mean when you pick one ball it can so happen that it is black only. Second ball can be black only when you pick some 50 balls all of them being black is very unlikely. So, when you put a lot of edges all these edges being within this only is very unlikely.