NPTEL

NPTEL ONLINE CERTIFICATION COURSE

Discrete Mathematics
Graph Theory - 1

Directed, weighted and multi graphs

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Look at this graph of friendship,
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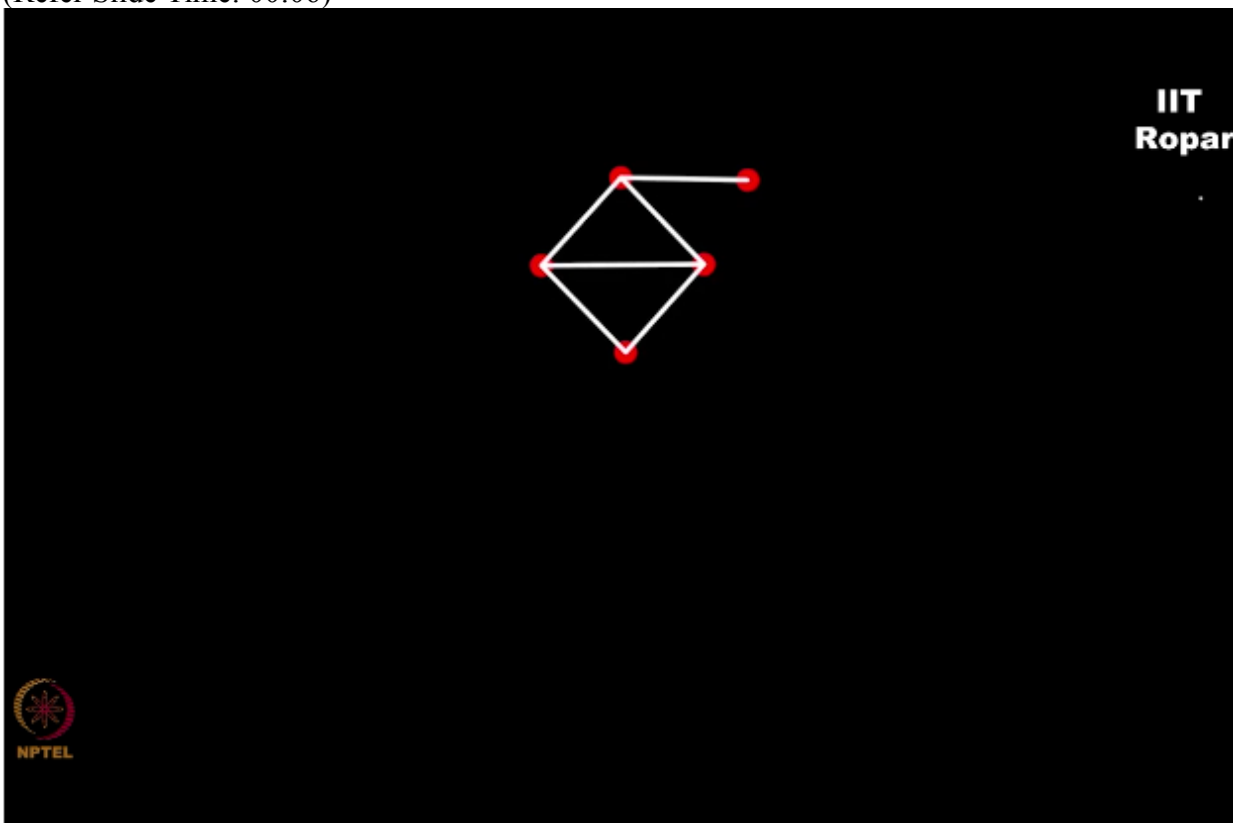

generally when we speak about friendships it is always mutual, I cannot be your friend and you cannot be, it cannot so happen that I'm your friend, but you're not my friend you see, so friendships are always mutual, what if I wrote the friendship network, it will be what is called an undirected graph,
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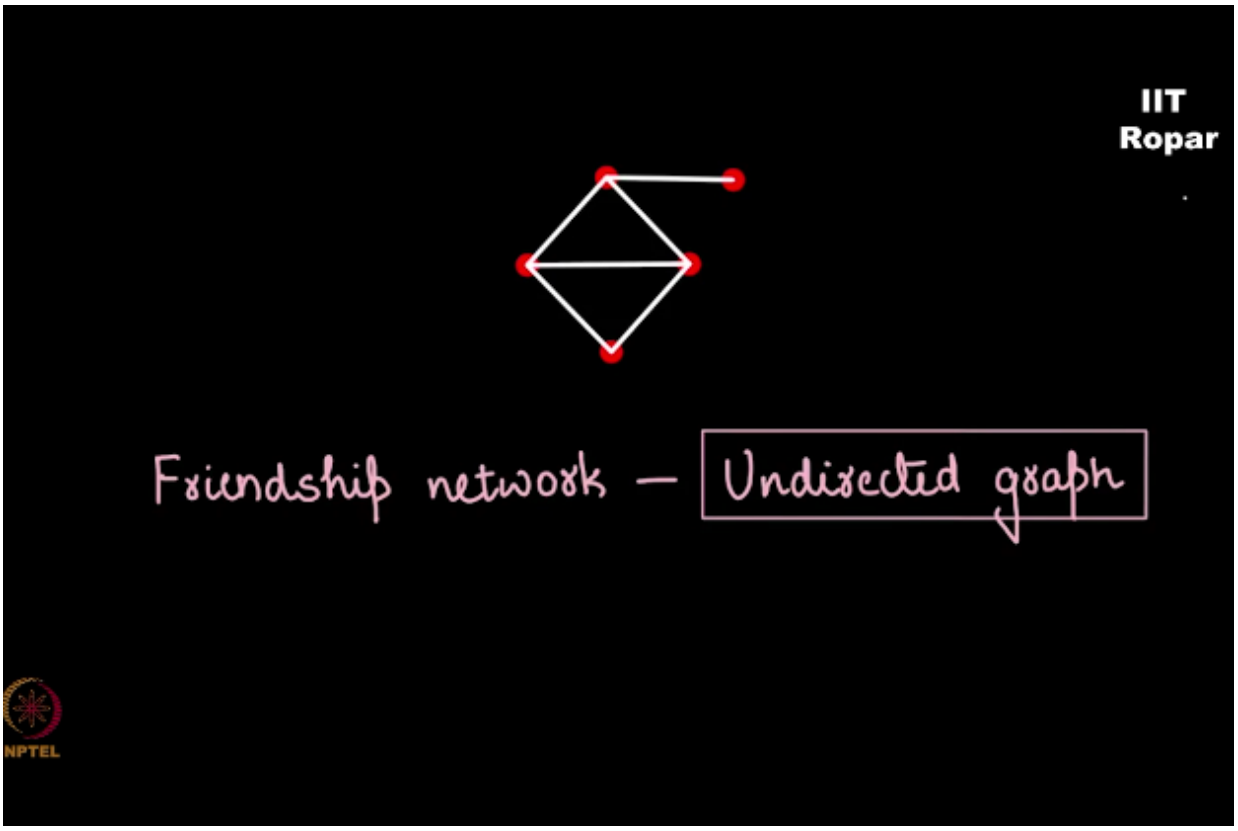

if I put a line between the nodes A and B

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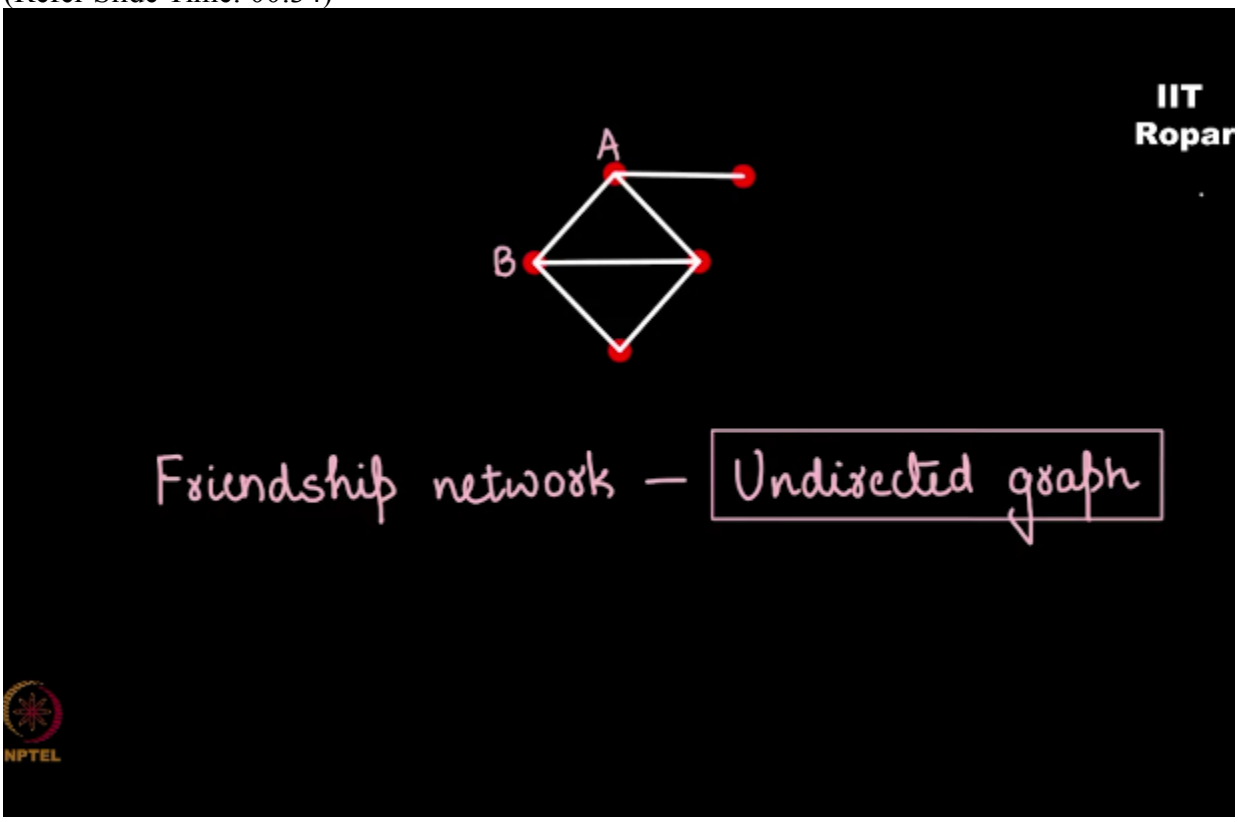

that edge represents that A knows B, and B knows A, but look at this example, in a classroom of 100 people, some people like some people, some people may not like some people, if I represent this liking by an edge, A likes B, but B may not like A, correct, such a graph is called a directed graph,
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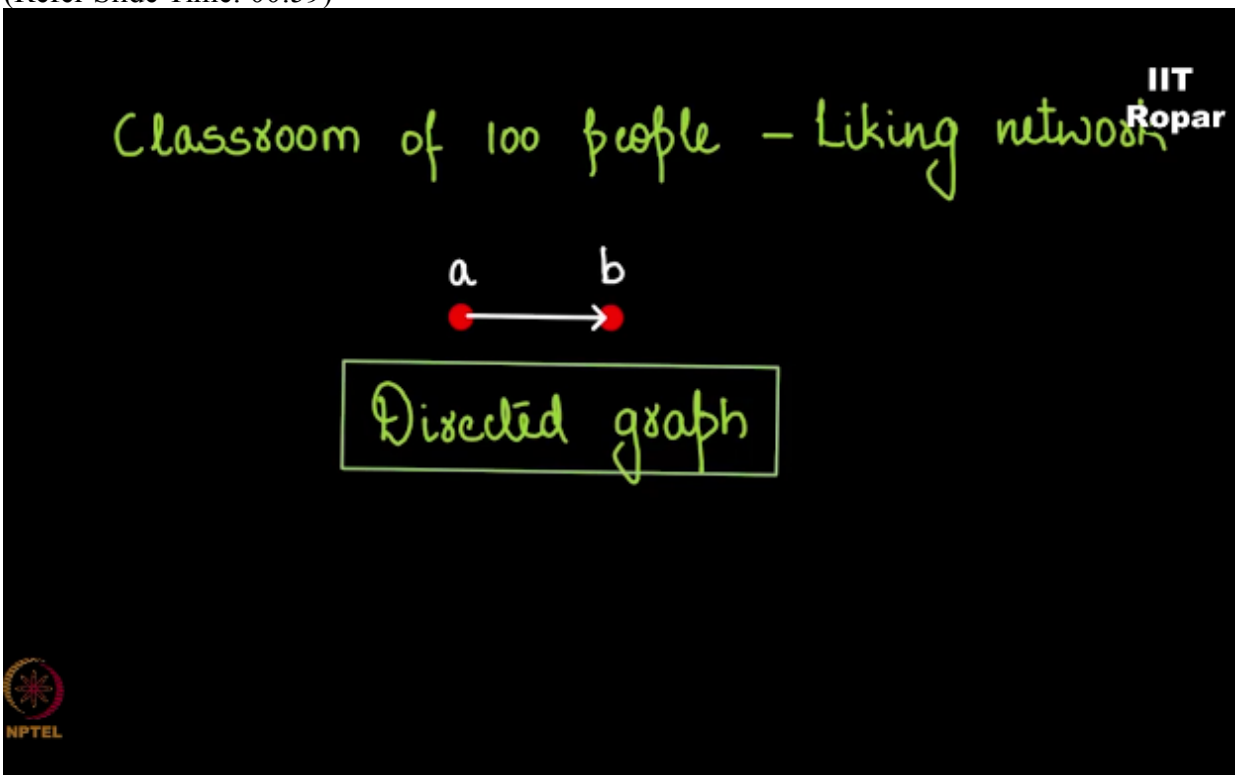

because given A and B if you simply put a line it doesn't denote who likes whom, you should explicitly specify that A likes B, there is an arrow starting from A and going to B, this is called a directed graph.

So in its representation what we do is we ensure that in the edge set that we define we precisely write without any ambiguity within brackets A, B, which is in fact different from B, A,
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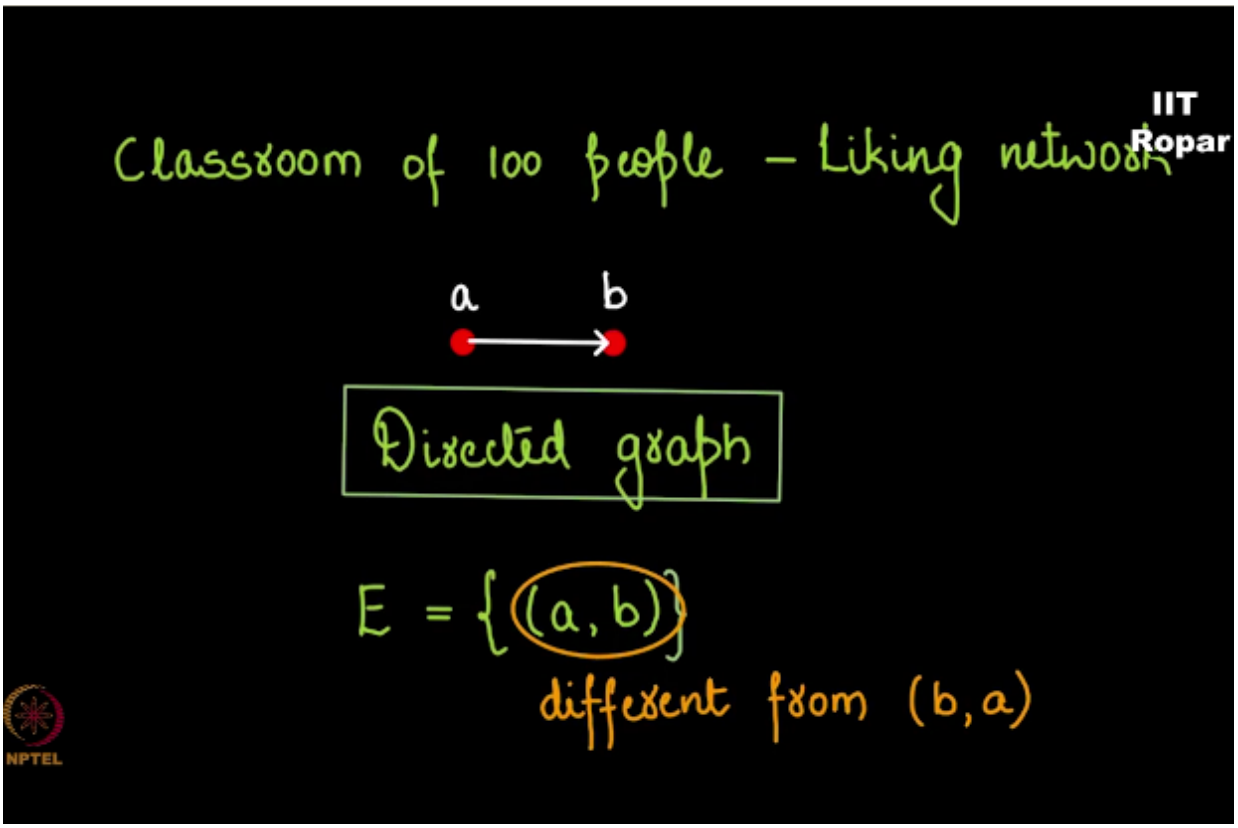

so if A, B belongs to E it means that there is a directed edge from A to B, imagine I took all possible locations of India and then I put a edge, if there is a direct highway connecting two cities,

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by that I mean I should not be passing through another city to reach this destination city, what do you observe? Probably between 2 nodes there could be more than one edge, you see, so far we have been talking about a situation where in a graph there is an edge or, there is no edge, so here is an example where you can possibly have more than one edge in case of road networks, such a graph is called a multi graph, the word multi there represents there could be multiple edges, and not necessarily one edge.

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Look at this example, I have this network of people who have had a telephone conversation with each other, whenever a person calls another person in his lifetime I put an edge,

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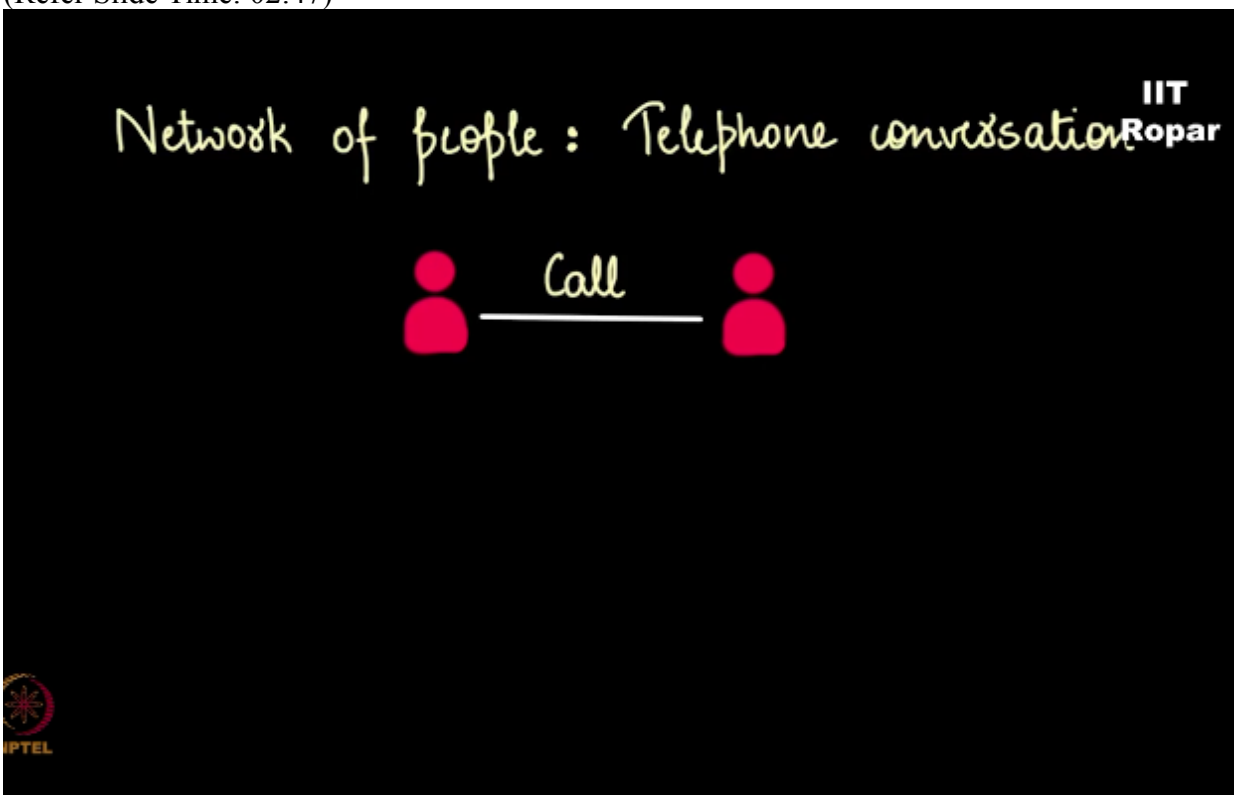

I don't just put an edge, I also write down that total time duration of their talking so far, which means if you have called me, and we both are spoken for half an hour then I'll put 30 minutes on the edge, the next day if we speak for one and the half hours I'll put 2 hours on this edge,
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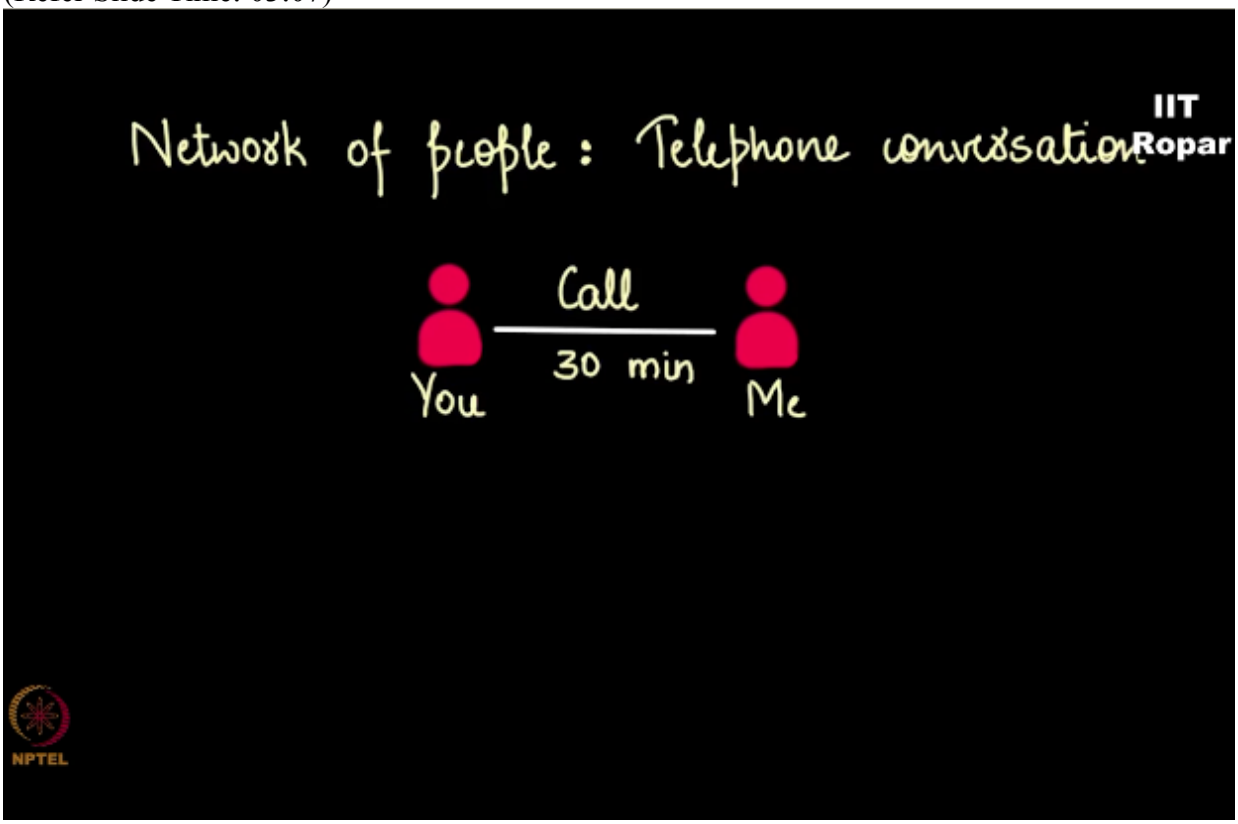

and I keep adding and then I keep accumulating this added number and then put that as the weight of our friendship, so given 100 people in the classroom what I do is I join an edge between 2 people whenever they execute a telephonic conversation and then I add up the amount of time that they have spent on phone, you see not everybody calls everyone in a classroom, right, although most of them will call each other, there could be situation where a person A may not even know a person B,
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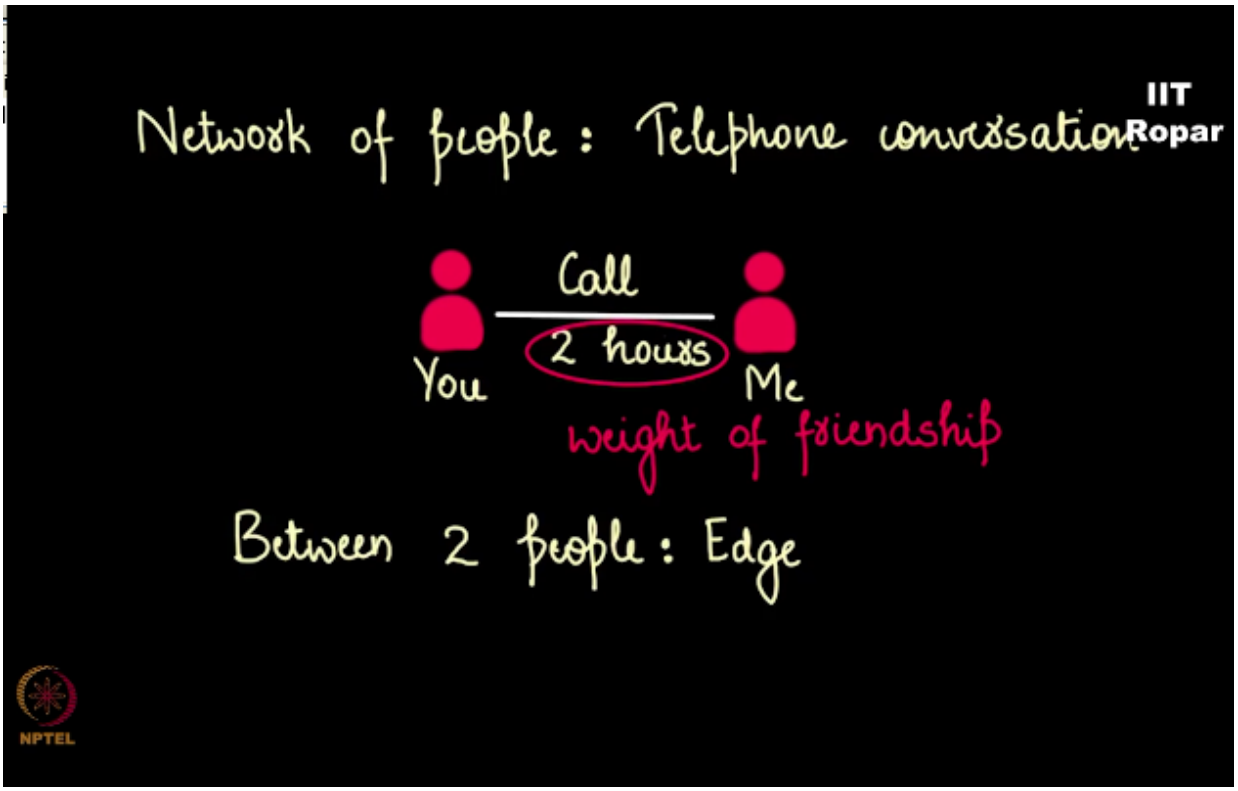

let along calling, right, so such a graph where you don't just put an edge but you also put a value for this relationship, right, in this case the relationship value was simply the amount of phone call duration, right, this is called a weighted graph,

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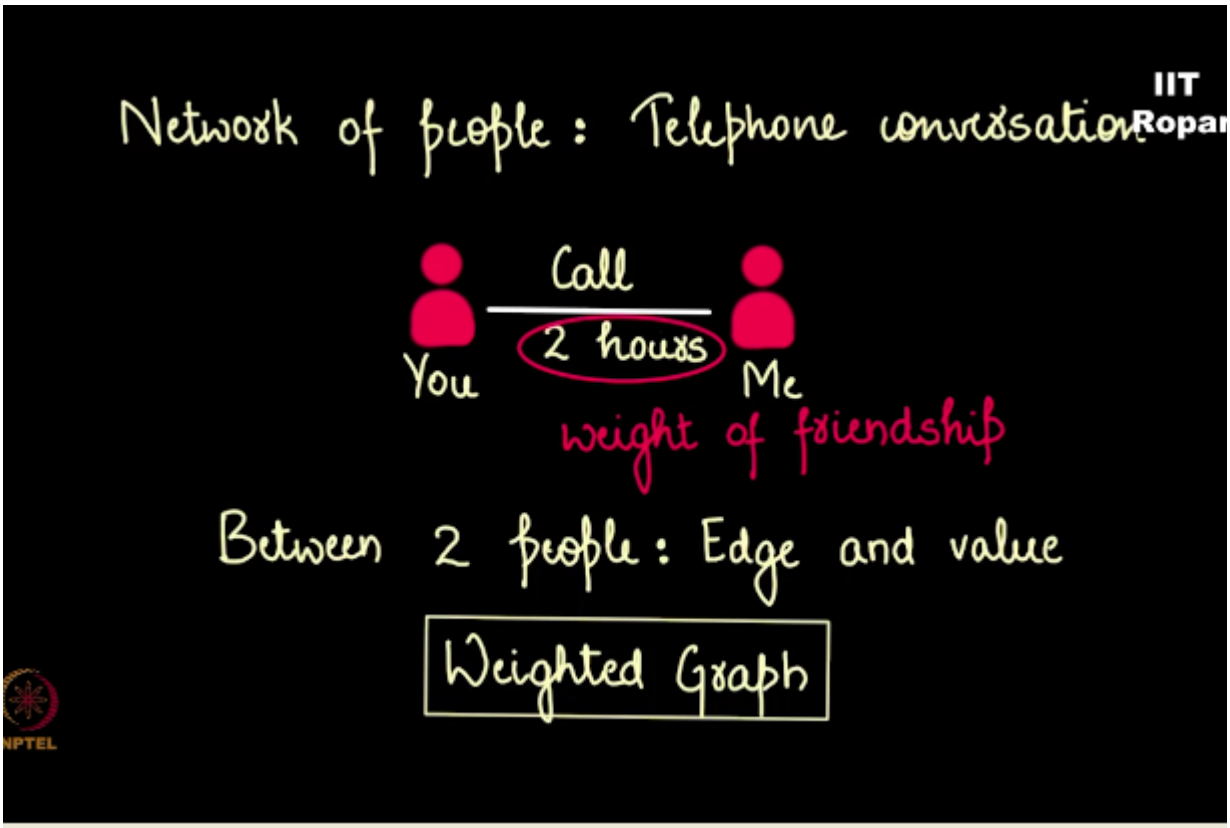

a graph where edges are not just put but you also put a value on top of the edge which denotes the intensity of the relationship that is called a weighted graph or a weighted network.