STD Session 9

**Karthik C:** [00:00:00] On a broad level, what is the intent of this? We are talking about non detail design. We are talking about conceptual design, right? And overall, what is called the bird's eye view, right? Where is Patil? Sir, sir. Okay, okay. Why did you change your place? No, sir. Before you could occupy, they occupied, sir. What is this, man?

Okay. Right? On a broad level, right? So, what is the intent of this course? What we are telling you is, we are talking about non detail design. You always show up late.

Right? So, on a broad level, we said, please pick a India specific socially relevant problem which all of you have done. Next thing is, we said, construct a discovery matrix, which all of you have done. Then, we said, look, now we are going to look at discoveries over diagnosis, right? What is the tool that so far we have seen?

Snack analysis. [00:01:00] Snack analysis, right? Who is the stakeholder? What are their needs? What are the things that can change, alterables and within what constraint they should be, correct? This is something we saw. Next I said hierarchy, right? I have a set of objectives. In order to fulfill those objectives, right, I have to change an alterable, right?

I asked you to write down, right? All of you have submitted the assignment? Deadline is over, right? Right? By changing this alterable, Right? Within this constraint, right? What is the keyword I taught you? Influence, right? Remember that? So you write down a set of objectives like this. Then now, today we look at what is called a little bit of network theory at the top, right?

Properties of complex network, right? Uh, concept of diameter which I have already touched a little bit, right? Things like core, decore, click, right? Few properties, network properties, something with C, right? Okay. So, what did we say? [00:02:00] Okay, so, right, what is a network and what is a system, right? Let me clearly give formal definition.

System has to have what? Needs. Yes, it has to have, it has to have a boundary. It can be a virtual boundary in case of a computer system. Right. Or it can be a physical boundary like this classroom. Now, what is a network then? When, when does it, we say local area network, right? LAN, right? Why do we use the word network?

Why do not we say local area system? It is connected to the internet or something. No, I am saying local area network. It is connected to the internet which does not. I can even disconnect it. Still I would call it local area network, LAN. LAN is still, it will work great. Okay. Then I can draw a boundary and then, uh, I can call it a system.

[00:03:00] You see, if I actually, right, if you think about it, right, it is actually how I define. Please understand that. It is all human defined, right? It is all we define this, right? So the key difference between a system and a network is, or in other words, what we call system of systems. Why, why is there a system of system within your compute you take?

You are on mobile phone, you take, right? So if you take your mobile phone, right? There is a microcontroller, there's a processor, right? There's a chip, there's a GPU, you've got the power management circuit, right? So you've got the radio communication chip, right? Systems ownership, right? All these are there and these talk to each other, or no, what did I say?

Any system has still have notes and relationships, correct? So all these are notes and they talk to each other. So your phone itself can be considered as a system. What is the boundary of the system? You can define, correct. So, it is all again how much I am zooming in or zooming out. Got it? So, [00:04:00] now this is a system.

Your phone itself can be viewed as a system, right? In that sense your computer can be viewed as a system. We say na, system, turn on the system. We use that word, right, probably without even giving much thought. But your PC, your personal computer itself is a system. Right? You can define a boundary, physical boundary, diversal boundary, so on and so forth.

But, when do I go to the concept of a network is, right, when I have many such systems, a computer is one system, there is one system in the admin block, right, when you, right, apply for anything online, right, or when you send a mail, it is what we call a system of systems. There are many such systems that talk to each other, that are interconnected with each other.

So, in that sense, The concept of network takes some center stage. You following that, Badri? No. So, now it doesn't make sense to say, I have this boundary, right? It's crossing. Because, where will I put the boundary? It disappears, right? I'll give you one or two examples also. So, [00:05:00] the key thing to understand is, you can look at something as a network or as a system.

It is how you look at it, because it is how you are defining it, right? So As to reiterate system has to have a boundary, network does not have, it does not have a well defined boundary it's blurred. So when we have many such systems right, that are interconnected, we call it a local area network and then such networks are connected between different geographies we call it a wide area network and then global networks we call it a internet.

Where is the centre of the internet? Who maintains the internet? Who maintains WWF, that worldwide web? Any idea? Who is the owner of the internet? Have you ever asked this question? Who owns the internet? Internet came, came from DARPA, right? All of you might have read about DARPA, right? The US, they had the defense.

They wanted to actually have quick communication during, after World War. After the field of cybernetics took over, right? Science of control and communication, I said, right? Communication, when it took over, [00:06:00] all these systems, they started talking to each other. Okay? Now, So, let us look at the broad way. So if you see there are multiple systems which can communicate with each other.

Older days if you, if I have to send a message, right, have you seen there are vacuum tubes in hospitals, have you seen that? You just have to write something, roll and if you just put it, it will get sucked and it will travel. How many of you have seen this system? Not many? Okay. Some hospitals even today use this system.

For instance, I have to send a, doctor signs a prescription and he has to send it to the pharmacy. What does he do? He will simply sign the prescription, roll it, there is a tube, and he has to push a button, where should it go? Because you have valves that direct how the piece of prescription, piece of paper has to travel, right?

So, That has to be routed. So you press a button, [00:07:00] that will end up at the pharmacy. Right? Why? Physically, I don't have to give it to a person. Right? That fellow need not walk and give. Right? He can just keep pushing and it will go. Now this is like a node talking to another node. Right? Physically. He is writing something and sending a piece of information.

Same thing virtually. What do we do? Right. You send in packets of information, right? So the concept of network takes at the stage, right, when we have multiple such systems that talk to each other. Now the question you can ask is, sir, where is the central node? If I have to shut down internet, what should I do?

You can ask this question. Let us say, or, for somebody, right, who do what is called vulnerability analysis. What is a vulnerability? Right? If I do something, right, if I do, if I, I have to know what is the weakest link, why? Thank you. Okay. What is the simplest thing they can do? Attack the machines. Critical infrastructure right?

A ton of your, what will, how will you buy anything? Just [00:08:00] imagine the chaos it will happen. Your UPA goes down for one hour, that is all. It does not need to be shut down for an extended period of time. Right? That is it. You cannot do any financial transaction, everything will, you can, you can bring a country to its knees.

Right. Now, if some foreign power wants to attack, let us say our own UPS system. So, government will always look at what are called vulnerability. Where should I focus? How should I strengthen? Right. And I should have it as spread out as possible. What is called redundancy? When you build a system, you build a redundancy.

How do you, how do you take backup of your system? You guys do, how many of you do some sort of a backup of your data? Raise your hands all the way. Very few hands, right? Now, the thing is, right? You are at a stage where it's not critical. What do you back up, Badri? Maybe personal photographs? Yeah, documents.

Huh? Documents. Documents, right? Maybe your certificate? Yeah, yeah, all of it. Mostly your scanned copy of your certificate, right? Now the thing, okay? Where do you back it up? Uh, either [00:09:00] drive or I have a hard disk. Hard disk. Hard disk crashes, what do you do? I have it in drive. You have it in drive. See, he's very confident.

That's it. So, I will give you the data. What will you do? Possible. I have to pay, sir. You have to pay, right? Now see, now, where is all of our institute's data, hosted most of our data? Google Drive. You pay for it, ok. Tomorrow, US is a friendly nation. Ok, think about this. Suddenly there is some sort of a confrontation, right.

So, that is why organizations like ISRO, DRDO, they will not use Google Drive. They will not use any private thing. They will have their own Data centers. Data centers. Why? Because I need to hold the control. Right. Suddenly, if there is a suddenly us says, okay, we are going to put a sanction on Russia. You have to support us.

And I will say, we are nonaligned. Right? We are not going to neither support nor accept. Let us step aside. You deal with it. They, if they armed this and say, if you don't do it, I will make sure you do it. Okay. So they can do [00:10:00] extortion, right? They have, they always do it right. So now what? As a country, right?

Okay. For some civilian data. Okay. If it is like some plans for your, uh, Chandrahan mission, next mission you keep, what, what will you do? Right? So the point I am trying to emphasize is vulnerability study. So which means in my network, you understand, right, some nodes are more important than others. Right?

The point I am trying to emphasize is what is called the concept of centrality. What is the central node? Already we have discussed in previous classes also. If I touch that, everything else will be affected in a good way or a bad way. You understand? Similarly, if you take biology as a system, if there is some, some particular organ, if that gets affected, your entire, right, it will shut down your whole system.

What is that organ? Is it your heart? Is it your kidney? Is it your brain? Brain. Right? People, brain dead people will be there alive for 10 years, 15 years. Right? [00:11:00] Right? You can put a ventilator. Heart. Okay. Right? Somebody says heart. Which is vital, right? But you understand, right Soul again, it's relative. If you see, if you're upset, if you have to be conscious, you'll say a brain, brain dead.

People are soulless, right? So understand what, and there's another thing called, because the reason is I'm giving you some back. It doesn't go this in your mind because it use, that's little bit, not too much. Little bit, okay? Just to multiplication, because when I go there, whatever I say will make more sense.

All this is clear, right? Now, why is this, why am I teaching you this? Okay sir, network theory is fine. How is this applicable to what we are doing? So, in your discovery matrix, right, if you look at it, there will be some stakeholders who will play a central importance. There will be certain alterables, certain constraints or certain objectives which are more important than, in a hierarchical position.

I told you to sort by most important, [00:12:00] least important, right? If I, if I influence one, it will affect every other. Think, what is that? For instance, let, let's take the mobile phone example. Should we, which is most critical? There are multiple subsystems, which node is most critical? We have had this discussion.

In my view, I would claim battery because if a ton of battery, the whole thing dies. Right. In my view, somebody might argue otherwise. Right? So battery is important. Crucial, right? It is. It is what powers the whole form, right? No, I would argue that is the central thing. If it touch that. So now. Let me flip the coin.

Okay. Okay. Battery is important. Okay. If I have to improve the battery life, okay, let me ask this question. What should I do? If I have to improve the battery life, understand? Pay close attention to what I am saying. If I have to improve the usable time, I am not even saying battery. I am saying if I have to extend the Efficiency.

Increase efficiency. What can I do? Increase efficiency. He is saying increase efficiency. Efficiency of what? Processor. Processor. Okay, [00:13:00] then? Optimize usage of apps. Like the Ah, background apps. So you can, so broadly what you are saying is touch both hardware and software. Correct, ah? Right. I can have that argument.

Somebody can say put a mortar battery. How big a battery can I put? Right, there is a limit to how big a battery I can carry. So that is given. So, that conventionally if you go, go back five years, right, five years back, 5 to What is this? This is, if you look for the process time, all the other things that are not important here, but they are important in the process time.

But the second thing I want to make sure that you are paying attention to, these are small numbers. These are just numbers. So, I just want to show you the, how do we do that. It is written to run on that. Now, if Apple comes out and say, this is my software and this is my hardware, [00:14:00] I have very fine granular control on both, which means I can touch the software and the hardware.

I can play with both, which means I can put a much smaller battery and still make the phone last longer. Right? That is their idea. Google does not have that luxury. Why? But didn't they buy Android? Isn't Android there? Android, see, it is there, man. See, you understand. Google doesn't have, Google doesn't build hardware, you understand.

See, my, predominantly Android is used by most manufacturers. The question is, that software is optimized to run on every hardware, which means it'll be suboptimal. That is the point I'm trying to make. You understand? It is not that Google does not know what to do. Okay? It is knowing what to do and being able to move in that direction.

But still, but still Android gives the flexibility for the, for any company to, uh, fix it to their Exactly. What you are saying is Open source. Modularity. It is [00:15:00] modular enough, right? The problem with that is, because I'm providing that ability to, uh, meld it, right? Gel itself to a particular, any hardware.

The problem is what happens, right? The problem is you end up actually making some suboptimal decisions, right? See, this may run a MediaTek processor or it may have a Snapdragon processor or it may have some, something else. Yes or no? Yeah. Right, which means what? It has to run on everything. And how can you build a software that can run on different hardware and be exceptionally good in everything?

Not possible. You cannot do that. Very good. So, so, now slowly, slowly, slowly, slowly, slowly, they have also learnt, right? Ok. And then there is an adaptive element, right. They are built in, right, adaptive algorithms, right. And then it is almost, right, not exactly, almost as good as APT Right. APT. It has gotten to a point where that is there.

Why am I telling you this, right, so when you talk about the concept of centrality the important thing is, where should I focus my energy, because what are we [00:16:00] asking you to do? Innovate, now. Little bit, innovate. Now, where should I innovate, sir, right, what are my customer requirements and these Right. We have this Smartphone is one term that most design has used.

Google this term. Peak Smartphone. What is Peak Smartphone? Last 5 years you see, I can buy it from anyone. It looks exactly the same. The performance is I mean, you pay 20, 000 to any manufacturer. He's going to give you practically more or less the same phone. Little bit of, right, in terms of the colour may be different.

In terms of form may be different. But in terms of functionalities, you see, every phone is more or less the same. Why? Bye. How many words you will write? 6. You will write 6 in this case, but you will not write 7. How many words will you write? 6. 7 in this case? 7. 7 in this case? 0. [00:17:00] 7 in this case? 7. Bye. There is a guy called Edward Abbey.

He says, change for the sake of change is not a good change. Is the ideology of the cancer cell. So, what is cancer? Cancer is uncontrolled cell division. It is mutation. Ok. So, if I have cell division, what? You grow. In fact, your cell has to divide for you to grow. Right? Old cells die, new cells divide and then takes up, it regenerates.

That was lovely. If it goes out of control, that's cancerous. So, to break the monotony, yes. But then, uh, we need disruption to create new things, right? Now the question is, how do you bring, wake up your friend, right, sit direct, guys, sit direct. Right, just sit direct. Now this monotony, you have to break, right.

I agree with it, but Hot, hot, is different from how you come, come at it. What the question that I'm asking is, what is your problem? You're using your phone. What is your problem with this phone? [00:18:00] Huh? It's too slow. Can't run games smoothly. Ah, bigger screen. My real estate is small, sir. Display is small.

Display is small. Okay, then. Any, any problem that you face with your phone? What is the problem that you face with your phone? Game becomes too short. What do you mean by portable? Portable? Huh? It's not portable. It heats up, okay? Then? Sir, it gets hot. Then? Majorly battery and Processing power is not enough.

Okay? Then? Exactly for what? You see, slow processor is a bit ambiguous, actually. You have to be more smart. Specific, why do you say it? This small cold drop. Okay.

Okay. Multitasking is slow. Maybe that way you have to be a bit more refined right then, huh?

Okay. It's talking about durability. Okay. You have all this, right? I can go on asking this question, right? With this, what? What I call a big phone, right? If I ask this right, foldable came just [00:19:00] to address this. How would I get to foldable if nobody saw a foldable phone? What will you do? Simply increase the screen size.

How big a phone can I hold? See, I will tell you. There was something called tablet. All of you know tablet, right? I still remember. 2007, 8 we used to have tablets. You know the size of the tablet? 7 inches. 7 inches, exactly. Today's phone comes up with 6. 9 which is almost the size of a tablet. So, I've had tablets, old tablets, I mean, 15 years back.

Which is the size of your standard phone today. Sir, there are something called phablets also. I was exactly about to come there, ok. So they had something called a phone which is like 4 inch, 4, 4 and a half inches. And then you had a tablet which is 7 inches. So Samsek came up and said, I will give you a phone which is almost as big as a tablet.

So he called it phablet, P H A B L E T, phablet, right. I am surprised you know the term, right. It went out of fashion, right, that, that trend died. But now what has happened? The new phablet became the new [00:20:00] standard for your phones, right? I hate carrying a huge phone, right? I really hate that, right? Now the question is, we have to innovate, right?

Where should I touch? Right? What is the important central node in my complete system? That's the question I'm asking. From a software point, let's ask this question. What can I touch? If I touch something in the software, it will radicalize the whole Can you think of anything? Okay. Sir, this aspect, this feature of the software, if I tweak a little bit, it will revolutionize the way how we use the phone.

Right? Apart from efficiency, we spoke about efficiency, usability, user experience, all that, that is also okay. Then, right? Think about it. Right? So, it is not easy, right? It is not apparent, right? It is not apparent, but somebody points at and say, right? You have something called, what is called software controlled radio, [00:21:00] okay, software controlled radio.

Your radio used to be a hardware and now software, you still need a hardware but not a dedicated hardware. You can have a minimal hardware and most of the activity will be done by the software. This is a very powerful thinking. Why should the hardware do everything and let the software do it? Right? It is called software controlled radio.

So that is how your phones are able to shrink down. Okay. Right. Read about these things, right? How did they come up with these concepts? Is they use all these systems principles, right? So far clear right Now let's quickly jump into complex networks, right? And what are the right, just look at these two screen.

That's kinda something has happened, right? So, so far what, what are the things you know from discovery metrics? You know, out degree, total degree. What is out degree? How many other nodes? It's one node. So you can see, I am trying to, I am trying to find out, I am trying to [00:22:00] figure out what is the, what is the, what is the, what is the, what is the, what is the, what is the clearly define a boundary, right.

The concept of system itself collapses beyond a certain level. So you talk about the, what is called the network, right? So real world has elements, nodes and relationships. What are nodes? Each system is a node in an internet, correct? Which is the central node? There are certain important nodes, right? If I turn off the, right, then whichever is connected downstream of that network will collapse.

There is no clear boundary, right? What is inside and outside? It is no longer clear, right? So pre COVID, right? So, We are actually in pre covid now. It's actually post covid, right? But what is the thing you have triple, what is the point of the education system? What are the purpose, skill development, certification, placement, right?

Three things we can put, we can put the three purpose, [00:23:00] right? Why does a institution like this exist? And then you've got trade faculty, students, right? Multiple stakeholders have put their relationships right? Uh, on and off relationships have put, and I put a boundary here, and there are multiple homes, two or three.

Home support. If there are 2000 students, there'll be 2000 households, right? Yes. Right. So you can have a very clear boundary, yes or no. This is clear now what happened after, right? What is a home, right? Before I jump there, right? What is a hope? What is the purpose of a home? Last class, I asked this question, right?

So you can list down right, which is most familiar to you, where your access to wifi, where you've lived the longest, where your friends and family are living. Where you are completely yourself. Yes or no. All of you give an option you want to go home right, immediately you will jump on, go home right, you will go right.

Why? Because you can be completely yourself. Here there is a constraints somebody is watching you they say, sit down, stand up right. All these restrictions is not being [00:24:00] imposed at your home, right, where you do not have to do any work, right, my father and mother will take care of me, my grandma will take care of me, right, where you have created a significant memory, right, you grew up in that place.

Right where you develop your cultural identity, where you're surrounded by a community of like-minded people or no, so this is what we call a home. Now, what has happened after, uh, right, this boundary? Now, what has happened? See, in Covid time, you are in school, right? How did you study Boundary internet with, with the phone, right?

Some of, some of you may not even have a proper computer, right? You're watching videos through a phone. Phone. Now what has happened? You are here now, this education system. Now it is ambiguous. You draw the boundary. All 2000 homes got got in you to play him also. And there is a guy selling something on the street that's a distraction.

Your brother or sister comes distracts you. You have a dog, probably a pet that comes and distracts you. Right? So many other thing. Now [00:25:00] that's where, you know, in 2020, right? Ministry of Education went back and said. So many things have changed, not because of Corona, right? Anyway, uh, Ministry was at work before that, right?

So they came up with something called New Education Policy. That's called NEP 2020. Introduced in the year 2020, so they called it, right? So you see, NEP's objective is this. Producing, engaged, productive and contributing citizens for building an equitable, inclusive and plural society. This is all the objective, broad objective, right?

Very generalist objective of NEP. Education policy, what is the point of education? This is what is given in NEP 2020 document to do this. I can do it anyway. You can even be homeschooled. Correct? And still do all this, right? Build a citizen who's productive. Build a citizen who's contributing, right? All this is also possible, so they had a revisit.

Now in this, if I see the concept of what is called, the system breaks down and you get [00:26:00] into the concept of network, right? In during, right? During the Corona Pandemic. Right? So if you see, can this be viewed what is called education network, right? So can then student, can they do on their own, right? What is the meaning of each student certification, right?

But we have survived right back to the whole model. But with this model survey, it'll slowly morph. It'll definitely morph, no doubt, right? I told you this model is how old, how old is this model? I told you this all came from. Ian model, right? Read about how many have you read about the Ian model, right?

This sort of student sitting on one faculty coming and talking. It's not almost like a hundred years old. Not all than that, right? After World War, right? People used to go stand in line. You want OB workers, right? So it comes from all this, right? So definitely there will be a change. Okay. Now let's get some basic understanding, little bit insight into networks and its properties.

So. What do you see here? [00:27:00] Lot of nodes, no. Is every dot indicates a every.here that you see here indicates a node. You see there are a lot of clusters. What is a cluster grouping, right? These four nodes are former cluster. These two other four, four nos, former cluster, so on and so forth, right? So on and so forth, right?

So if you look at multiple industries, six industries I listed here comes late, okay? And you know. How many friends do you have, Badri? All of them are my friends. On a daily basis, on a daily basis, how many people do you interact with? Three, four. Three, four. Okay, that is reasonable. How many of you do you interact with?

Two. Two, three, right? That is, even though you are here, if I ask this guy, somebody who sits all the way there is like, I have hardly ever spoken to him, sir. Yes or no? He is in your class studying for four years together. Yes or no? Okay. So. So, what this says is, right, this is important in a network, right?

Why is this [00:28:00] important in a network? Look at this node. There are two friends, they only talk to each other, that's it. This is often not the case, right? Occasionally you do, right? So, this is how aircraft industry operates, right? There are a lot of vendors. Who is a vendor? Okay, I'll give you a, maybe, service industry, I'll give you an example.

Let's take DCS. I'm going to talk about DCS. Some of the case studies from TCS. TCS, what is TCS? Consultancy. Not a consultancy service. What do they do? Consulting. Consultancy means what? Uh, product. Okay, how TCS started is, I told you, remember the old example I gave you? We laid a fiber optic cable, blah blah blah, that story you remember, right?

All of you remember? Yeah. Now after they laid, okay, Okay. TCS, Government of India promoted, okay, service sector first. What is the role of making software, right? There are a lot of people, right? Software people are there who can write codes, right. Can you also somehow, right, Indian government is giving a request.

[00:29:00] American government is also looking for places where they can actually get labor for almost next to nothing, okay. So TCS initially started as a company with 10 to 15 projects, that's it. What are these projects, sir? What is a project? Simple. I have lot of industries. What are those industries? Tourism is one industry.

Health care is one industry. Right? Then there are essential services. What are essential services? Somebody, they have a police department. They make a phone call. They say, my whatever, right? I have this emergency. Can you help me out? Right? So what are called essential services? So there are lot of industries that operate.

Right? I just bought a laptop. It broke down. right? So, these sort of requirements they have internally. There are people there in US who address that. Slowly, what has happened? They are starting to outsource all the right? Wash your face and come man. Too tired. [00:30:00] Right. I always am given after lunch, post lunch and that's my unfortunate thing and subject is also sometimes dry.

I'm doing my best to make it interesting. Yes, Badri? Is it boring? No, sir. Okay. I'm actually doing my best. If you want to go, wash your face and come. It's okay. Right? Right. Understand, how did all these IT companies started? Because you have to have a good understanding of this. So, few, at least few things, because my sister is in IT industry.

So, I sit and say, what the hell Doing. Right. They sit with that. I have my friends, right? I go, show me what you do. Right? Just to get some insight. So typically what happens is let's take a customer like Citibank, right? This is a Citibank as a customer, right? I don't know if they still do, at least they used to do, okay?

So Citibank, what do they do? They have a huge database of all their customers, correct? Who are the customers? Customers who may be doing a doctor, an engineer, right? Or daily labor? Anybody. Now, what does do? They have to somehow increase their profit, right? Which means they have to sell you a product. [00:31:00] What is a product for a bank loan?

Loan loan? You can give loan, but not everybody will take loan all the time. So smaller loan. So you give credit cards, okay. Credit card is also a loan, right? So it's, it's more than a different, it's a different product. One, what they call, they call it that product, right? Credit card product. Now, if I give this credit card, how do I convince battery to take a credit card?

He's a very considerative guy. Sir, I get 50, 000. 48, 000 I'll spend, uh, 2, 000 I'll spend. Remaining 48, 000 I'll keep it in bank. He's just keeping it in bank, okay? He's not spending money. I should encourage Badri to spend money. How do I encourage him? Ice cream. Huh? Ice cream. First I should have product to sell to Badri.

Hey, here, nice phone you have. Buy this phone. Buy this car. Right? Here, go on a nice cruise. I should give him some products. Fine? Now he's still like, no. So, I have to encourage him, right? So, I give him products. Next thing is, okay, let us say he is [00:32:00] interested, right? He says, sir, two hours every day I have to take bus train.

I wish I had my own car, but I cannot afford a car. Okay, so I say, okay, monthly you get 50, 000. How much a car cost, basic car, 5 lakhs. So, if you save up for ten months, you can pay me actually. What I will do, I will give you the car today. Right? I look at your credit history. What is called credit history?

What is credit history? Is this guy, is he responsible? Or somebody who spends, buys and then spends all the money? I don't want that guy. I do want that guy. I will sell him a smaller product. But, somebody who is a responsible spender is a big fish for me. Ok. So, this is our bank things, right? It might sound a little bit funny.

This is our bank things, right? So, I will give him a credit card, right? And I will charge him an interest. Ok. Okay, I'll give you, uh, file copies piece, but you have to pay me 30,000 extra because I'm giving you today, right? So battery will gimme 5.3 bucks or he'll pay an MI, right? This, who is that battery?

I don't know. My customer base. I have two like customers. How do I find this guy? He is [00:33:00] there. He is somebody in my, these are the doctors I have to identify, right? So I have a credit history.

So this is one project where you have to do a survey of a customer. So TCS took, Citibank's thing, right, understand this, initially how they were operating is they took and then said, what do you want? Database management. This is my customer. He paid his interest. Write the software, which will track that.

Build me a software platform for this. Or, I already have a software platform. It needs periodic maintenance. Get me five engineers who will literally listen to what I say, build it and give it back to me. Understood? This is clear? This is how all our IT companies started. OMR, you find a lot of companies, this is how they started.

I'm talking banking. Healthcare, let me give you another example in healthcare. Healthcare, Let us take Metronic, right? [00:34:00] Metronic again has got all the health records of Jones, Jane, right, all the people, right? These are my customers and these are the ailments they have. This fellow, uh, right, this John had a valve replacement 10 years back.

His replacement is due, right? You have to send him a message and say, Mr. John, if you do not replace the valve in the next two years, you will probably die. Go visit the hospital. I have to send him a message. I have to automatically send a message. You understand? Remember, remember this. Right. So, this is how they started.

Pure, like brute work. I will give you set of requirements, a database of my customer. Maintain. First he started with deployment. It is deployed, you maintain it. What is maintenance? Suddenly, right, let us say this is the case scenario, right. Somebody who is 17 may, system will have a limit. Right. Somebody who does not have the, US they have something called social security somebody who doesn't have a social security number.

So, [00:35:00] you have to go back, right, edit the code, change, provide an additional drop menu. Right, this is called maintaining. Right, you have to add some very small thing. Right, that is like a mundane work, right? But somebody has to go edit in the program, right, which line to edit, right? So, this is maintaining a code, right?

Code crashes. Y2K, what happened? Right, you know about the Y2K problem? Right, systems are not designed to handle the transition. Right, somebody has to go manually update all the data. So it'll conform to that new system. So this is at a basic level, it is how industry started. Now, over time, what is happening?

What is happening is, okay, this is thinking we are doing all these basic things. Can I just give the city back an idea and say, dude, I'm looking at your data for the last 10 years, right? I think if you do this, your profit will go up. Now what happens? You're evaluating. , right now you're actually doing consultancy earlier.

You are not doing consultancy. It is [00:36:00] just software services. Even though you call me right now, what is it I do? I'm looking at, I've got 5 million of your customers. I've done an analysis. I say you are giving two credit cuts, right? And if you maybe make a variation of those, right? You get Amazon Pay, right?

Buy from, you can only buy from Amazon predominantly. So I'll give you a customized uh, ICSA Amazon pay credit card to you. So these things will give you an idea. City bank will say, see most of these customers, this subset, not everybody will buy from this particular website, you give some half a percent, one percent extra offer, right?

And I can convince them to go to your bank. You understand? How did ICSA suddenly? Somebody from ICSA will be thinking or somebody, ICSA may be contacting Infosys or TCSA saying we want to grow a customer base. How do we do it? So they'll say, okay, let us give us your data analyst, right? And then say they may also be doing it for Amazon also.

So there is one guy looking at data of Amazon, [00:37:00] data of ICC, and then he says, okay, I have a friend in ICSA. Right? Come here. See, I do cancel. I do maintain the backend of Amazon flip card down. So I know, I know you. I will not talk to standard Charter HSBC. I'll not go to, I'm coming to you, I'll give you a special offer.

I will give you, I will convince Amazon, okay, I will tell him, if I give you, you give me, now you give me a bargaining chip, then ICICI will think, okay, Amazon has got probably 5 crore customers. Beautiful. If I get 5 percent of that, that is 50, right, 5 lakh people, right. So let me just do, let me just go, let, I will give you an offer.

ICICI bank manager agrees. Then they go talk to, okay. Right? Amazon. Amazon actually is like, okay, good idea. Right? So you do concept. This is how, right? All these new products, how, how do this come? Just somebody sitting in doing this data, now you're doing proper concept. Now what do you need? You need somebody, data analyst.

You have this job. Now that's the job of this fellow's job is to, and then how do you analyze data? Not manually [00:38:00] sorting through Excel sheets, right? You'll have trends, patterns, right? Uh, like today, now you have this influencer trend, all the that I don't follow very much, right? But. Historically speaking, this is how it goes.

Understood. This is fine. Now, this means networking. What is networking? At a base level? There's a human element. Is there somebody there connecting to people? Right. There is a product. Now, if you look at this way for an aircraft industry is a possible network. Look at this, right? Some guy here sitting here, right?

Doesn't talk to this guy at all. Can innovation happen in this space? No. Look at the next thing. Chemical industry, similar. Medical supplier, similar. Highly fragmented. This is called fragmentation. Your base is fragmented. It is in chunks. Data fragmentation. What is data fragmentation? Defragmentation. Have you heard of this word?

Defrag. What is defragging your hard disk? Right? Are you [00:39:00] interested? How many of you want to know about data fragmentation? Nobody? Only last bench I see a few hands go up. Okay. Right, quickly, two minutes, I will give you a summary. What is this fragmentation, sir? How do we defrag? And is it relevant today, this software?

Right? It is called So, all of you have studied some, some sort of memory? Memory What sort of memory?

Primary, secondary No, I am talking about, yeah, volatile, non volatile. Forget what we are using. Let us assume we have a magnetic storage, ok? If I have So, let us say this is a word file, let us say this is a word file, I am writing a word file, after what I decide, I decide to delete this, okay, now memory is used, right.

Now, I write another word [00:40:00] file, there are only 3 bits, but I need 4 bits, what will happen? It will, see, it has to write here, right? This is where free space is. Now I do some other edit and what happens is these two bits have to be taken out. Do you understand? Next file, now what will happen? Where will, where will the computer, OS has to decide where do I put this data?

Ah, free space is here, here. Now what happens to the free space? It becomes fragmented. So physically in the hard disk, right, during, even now we have a hard disk. This means physically, this cluster and this cluster are separated. You understand? Right? In a hard disk, how do you store data? In sectors, right?

All of you know this, right? So, in a hard disk, how do you store information? That is CD. No, it is spindle. Hard, hard drive. Right? This is how it is. Oh. Right? So, here you write 101, right? Which means, [00:41:00] if I, if I delete this bit, Then if the head is here, right, your head is reading here, it has to, this has to rotate, spin, read the data here and over time what will happen?

This fragmentation will only get worse, right, as you are using the computer more and more. That is why when you buy a brand new computer, if it only has a hard disk, physically the head has to move. And if the data is fragmented, how will it, how will this keep track of that this data is here, this here? It has to put a, some sort of a index, right?

Part of this file is sitting here, which means it has to use another bit. You understand? I am heavily simplifying, but this is the overall idea. Everybody follow this? So, your data will get fragmented and this itself will lead to lot of clustering actually. Now if you have to access one file, one file is in pieces.

If you have to play MP3 music, part of it is here, part of it is there. Right? So periodically what the hard disk will do is, the operating system, If the computer is idle, it will say, oh, I have empty [00:42:00] space here, let me move this entire data here. Right? It has to do this. That's not a fork, right? Physically it has to read, delete, write, and if it messes up, your data is gone.

So it has to create, it has to have some sort of redundancy, right? All this, your Microsoft Windows, right? Every operating system has got a built in defragment. It will say defrag now. My days, right? XP days. Sometimes every once in three months I will run. It will run for the entire night. Why? How much data it has to physically read, write, read, write.

It has to keep swapping. It is a lot of work for the operating system. Got it? So periodically you have to defrag the hard disk. Now why are we talking about this? Now, today, what are we using? We are using solid state, right? This is no longer a problem. Why? Because I am not physically moving anything. So, I can read a data from any point.

What is happening? I can instantly access [00:43:00] any bit any time. So, it does not matter if my data is fragmented or not. You understand? Right? Now, what has happened? Earlier, I have to have a software solution to a physical problem because I am moving. Right? How do I manage this? Whenever the computer is idle, I have to defrag it.

Now, I have changed the physical media itself such that I can access any bit any time. Instantly because I can do that. Fragmentation is no longer a problem. Understood. Now what? What has happened? So somebody who is innovating, right? Hard disk. If I say, if you're writing software, right, what will you do, sir?

I will make it more optimum. Right? Okay, sir, I've got a new algorithm. Sir, how much can you do? What are you, what is the throttling here? What is central? The heart risk is the problem. That physical moving, right? That's the problem. If I get rid of that thing, then my data speed will go up. So there is [00:44:00] only so much, you can only do so much in software, right?

I need to do something in the hardware. You reach a point. Now what has happened? You transition. I still remember the first time I bought a computer with a solid state drive. It was like, it's like switching from, uh, Maruti to Ferrari. It was crazy. 5 second boot up. I just booted Windows 7. It is like ready to go.

I could not believe, right? I installed the operating system. I said, dude, what is this? This is crazy. I don't believe this. Right? Now, I cannot stand it. If you give me a computer with a hard disk, I mean, I am going mad actually. Any click, right? This runs a hard disk, this computer. That's it. So slow. You understand this?

So, if you have to innovate, you have to ask these questions. Right? Where should I touch? If you are simply banging your head on software and saying, problem. If you are only banging your head on hardware, it's a problem. It's a Blend of multiple things. That's all I'm trying to tell you. You understand, you cannot only do software solutions.

You cannot only do hardware solutions. You should understand the system you want here. This is gray box modeling. What is gray box modeling? Just at the conceptual [00:45:00] level I'm saying, but if I give you a physical artist, can you go or do anything? No. But you understand enough at the surface level, at the conceptual level, what is the technology?

What is the limitation? What can you do about it? Got it. Fine. Let us go further. Right? Now, this is fragmentation. So, innovation will not usually happen. Right? Or if it happens, it will be restricted to a cluster. Somebody may be exceptional here in this cluster. It will not percolate into other nodes. Why they are not connected?

Look at computer and office equipment. Which is the central node here? Very difficult to say somewhere here. Right? And then look at communication equipment. 366 North are here. Look at motor vehicle, automotive industry. Everything is connected. And you see that's a cluster here. High densely connected note.

Any system that they bring in here, everybody will learn. If Hyundai Day does, right? They say, this is how we do the design process. This is how we keep file management. All their [00:46:00] suppliers have to, they will follow good practices, what is called GMP, good manufacturing practices, right? A tier one supplier does it, tier two, tier three, all the way to the last level, they will follow.

Why? Because they, people from here will move there. They'll talk to them, interact with them. Say, dude, why are you using this? I'm using this in a company. Change it. Or, we long got it of this. We bought this new software. Use this all. We have this new hardware. Use this. You understand? Right. So in a world, right, this is, this represents real world, but there are also networks like this also.

Got it clear? Right? This is something key for you to understand. The point I am trying to make is, right? Sometimes, right? I will be talking to students, right? I will be talking to her and say, do you know this, uh, this student? Yeah, I have never spoken to that fellow. That fellow is doing the same thing as what you are working on.

We will go talk to him. Right? That is what happens even if you do not talk to your own friends.

Right? [00:47:00] Now, let us talk about banking. Sir, why banking sir? Because I have to talk about the concept of centrality. What is centrality? This represents, everything represents a country. Ok. Each location, right? And then these big circles represent the continent. Ok. If you see, UK is the financial hub for European system.

All the international transactions, financial thing goes through UK. And we will discuss what is it called? What is it called? What does it mean when you put together a formula? When you put together a formula What is it called, when you put together a formula? What is it called? I know, I know. I know, I know nothing.

They're separating. They're saying we have too much differe. He say he can block us, can simply stop the payment. [00:48:00] Okay? Because I own the system. I control my node is central to world finance, right? I build the system because I want to have the on off switch. If China doesn't listen, I will turn it off. We doesn't listen and turn it off.

I can put embargo, I can put up, I can put some tar on you, right? I can threaten you. What is China doing? They are slowly trying to decouple, so they are forming their own cluster. But they also want to become some, some centrality in Hong Kong. That is why they took over Hong Kong. They want to, slowly, why do they want to take over Taiwan also?

All the semi continental giants are in Taiwan. So, they want to completely, once the, if they take over Taiwan, right, nobody can touch China. Right? That is what they are trying to do. Right? So, understand this concept of centrality. Okay? Now, here, right, this story I already have, I have started, I gave you like a lot of preview into how TCS started, right?

you I will use this slide to show you how to write contracts in global banking industries. Multiple examples I gave, right? Like this slide exemplifies that, right? You have [00:49:00] these central loads, right? This is one central load, this is central. If you touch this, it will have shock wave going through the entire system, and this was done by your students, right?

Three, four years old, right? Just before COVID, right, we asked students to work on multiple problems, and then they, just, I mean, I'll give you the slide, you can go through it. So, here you have a lot of points of intervention, like in a phone, like a battery, right, they have listed down multiple things. So, let us quickly come to, you guys want a break?

Yes sir. Okay, go for a break.

So fucking cold and fucking steep here. What a fucking piece of garbage. Go on. Go on, that's it. I need to sleep. You can't sleep. He'll always be calling Bhadri, Bhadri only. [00:50:00] You can't sleep. No, bro, ask, I'm asking him to go one death. Moora. What? Move on that side. Going out? Why? Why? No. Move on that side. Let him go in.

You have to go in now. No, I'm going to sleep. He's saying you want to go. I'll sit here only, bro. I'll sleep. Oh, for Rao? Yeah. Move to there. I'm going out. How do you sleep? Good night. Daily we give a sign as we report to school.

Adibaba and the 40 Thieves. Bye. Adibaba? [00:51:00] Yeah.

Ended up. Our thing. We were texting the whole time. Class. She was also saying that you're resisting now. So the spicy part of the thing is now. First two months though. Two, three months, we'll keep texting. Then you'll see. I'll be like, welcome to the club, man. The fights will start. Who says they haven't started?

They've already started, yeah. How many months is it? Two already. Huh? Two? Now[00:52:00]

three. Okay. Dating. Hey, Yadinesh! Yeah, we have. I asked him already, he's in my team. What is wrong with you? What's wrong with you? Why are you, why are you pulling people from my team? My team? My team. My team. I asked him. You are in which team now? I don't know. What's your problem? I asked him the minute sir told in class.

Hey, Bendel. The minute he was sitting, sitting next to me, I told Parth will do. So, I said Parth. Stone, paper, scissors, whoever wins, Parth is in their team. Okay. Now, stone. Three points. Three points. Three points. Three points. Three points. Three points. Three points. Three points. Three points. Three points. He's fighting for that guy who's not going to do anything.

Stone. Paper. Scissor. Stone. Paper. Scissor. Stone. Paper. Scissor. Stone. Paper. Scissor. [00:53:00] Stone. Paper. Scissor. Stone. Paper. Scissor. I know you cheated. I know you cheated. I won't do anything in my team. I'm seriously not doing anything. You should also join our team. What's the difference? Hey, Sandy. Let him be in the team.

The more the merrier. See, I called Parth. Parth called you. I'll do it alone. Why are you doing it alone? The more the merrier. Yeah, do a loan. Give R& A. We'll study up. Even Bhadresh told me to do a loan. Bhadresh is doing a loan. Hey Sandy, listen. I'll do only two or three. Or I'll leave with three. No, no, no.

I'll do it alone, bro. I'm done with people of 5, [00:54:00] 6, 7. Oh my God. No. Design drama is enough. D. A. drama. Design drama is enough. Only 2 or 3. That's it. That's it. Alright, you. I am okay with it. You guys sit here and tell me. Cooking work. What were you doing yesterday? Yesterday, what were you doing? Yesterday, what were you doing?

What were you doing yesterday? Near, uh, Skybridge. Hey, always he'll do that. What is his question? What were you doing? I was studying. It might happen with his girlfriend. Why do you care? I was walking. He was standing alone. What were you doing? What was I doing? What were you doing? Nothing. Camera, the title, what was he doing?

The kitchen, that's what he was doing. No, what was he doing?[00:55:00]

How.

Happened in March. What happened that day? You were shouting. Because of the class. What? Yeah, yeah. You didn't understand what it was? You said something about her waiting for, her waiting for Gym, that's it. Yeah.

Ask you the same question.

Okay. What is the final conclusion? Tell me a conclusion. Parth [00:56:00] is doing a lot. Parth is doing a lot. You're also doing a lot. Yeah, I'm also doing a lot. Parth, how will you do it alone? Parth is doing a lot.

I'm doing better. Okay, I'm doing better. I'm doing better. There's a confusion. You're doing with him. Fine. I'll write co pilot code and I'll send it to you. You send me Claude AI code. What is this, bro? You're looking at the chat GPT. We'll see whose is better. We'll compile and send it. And building culture.

Think of the future. No, we have to submit it on Monday. Tomorrow! It's not Tuesday. [00:57:00] What you're submitting? Team name and what is the domain or some problem statement. Listen, think about this. Better

put an extra

dm. I DM . Most the people put an people calling it ID dm. What is the D? Put an extra I.

Kandy, IIT Kandy guys, IIT near V. I. T, that's also better, IIT near V. I. T, Institute of National Importance, Institute of Local Unimportance, V. I. T, V. I. T Chennai also does not have a reputation, and you are saying near V. I. T Chennai, what to, what to people, they are like near V. I. T, yeah, okay, okay. [00:58:00] If you tell out of guy, triplet, he won't know.

Do I need to know to Kanchipuram? Hey, the person who are here will know triplet. They'll only listen to Kanchipuram, they won't listen triplet. Ah, they won't listen triplet, they'll listen only to Kanchipuram. Just say, we are Kandigai triplet. Okay. Nine 90. Reply to, oh, shit.

See that. Melakottaiyur, Vengadamangalam, Rathinamangalam, Yeah, Rathinamangalam, Yeah, there's something with K also. Keerampakkam. Keerapakkam. Keerapakkam. Keerapakkam also is there. See, four things you can say. Oh, time's not up. Yes, let's go. Hey, Sandy, Sandy, Sandy. Aiyo, wait bro, [00:59:00] one second. Listen, listen. Hey!

Fuck you, Asad. Come to water parlor. We'll make you Ministry of Tell him, class. You! My name, work everything, come work parlor. Hey! We'll make you Ministry of He did that much time. I've got a good idea. I've got a good idea. Uh, what's that? Snake and a lady. Snake and a lady just came in and said I'm going to find out.

No. Oh shit, he needs us. I've got a good idea. Yeah, I have a good idea. I've got a good idea. I actually have a good idea. Yeah! Night canteen. Nothing not like that bill. The bill already proposed and got signed by president. None of the bills are passing again in the youth parliament. What's the use? Make a new bill.

Make a new bill. No, you can't do that. Remove the extra I from AAATDF. You can't make a new bill. Pass the bill, bro. Let the arguments go. First you need to You [01:00:00] have to argue the existing bill. If it doesn't have the majority, then you vote for that. You can't directly take a new bill. See, the bill has already been passed in the Parliament.

What are you going to do by talking about it again? Even if we don't talk about it, a new bill will be passed. Do you know Tamil? Do you know Tamil? Yes.

Aiyo, I need to complete this. You don't know how to read? Tamil? Yeah. Yeah, I know. Aiyo, it's in Marathi. Don't think too much. Okay. I love you too. Aiyo, aiyo, aiyo.

I'll go and tell it to somebody. I'll tell it to somebody. Who do you want him to be? [01:01:00] I don't know. We'll see. We'll see. I didn't want to come here. It's a little heavy. What are you wearing? It's called a mask. I have a cold. They want me to affect you. I have a cold too. I'm wearing a mask and still I'm wearing a mask and still I'm telling Ramesh, why did you come to class?

You'll make two people sick. I'm wearing a mask and I'm not touching people. I'm still having a problem. You can hear my voice being different. By who has fever? I have cold. Who did you get it from?

Uh, no man. I'm the source. You, he is the source. What did you guys do? I'm seeing him after four days. Yeah, I was Three months ago? Three months. He was in the music room. He was in the music room while I was outside playing with the cat. I was also [01:02:00] playing I was playing with the cat, he was playing Okay.

I was also playing with the cat. No, actually, I was in the music room one night. Actual cat. Okay, I said something. If he jumps from here, will he stay alive? Yes, he will stay alive. Jump from there. How will he go there?

Hey, bro. God. If he descends upon Earth, will he survive? Joe? It is so cold. I'll call you later. Call me later, sir. Sadanga? Thank you, sir. He didn't give snack. He didn't give snack? Yeah, he didn't give. He didn't give. He's telling, just go and He didn't give snack analysis. He's telling like, I told to sort this out, again out, again out.

He's telling to, to, to [01:03:00] sort the needs of people using these constraints, using these alternatives. Ah, that's what we didn't do. I think he'll give this. That's snack analysis. We didn't have snack analysis assignment. No, he'll give it. Ah, no. He said that I gave. You guys have finished it. You guys have submitted assignment now.

No, we didn't. His exact statement was, you did this. You already submitted assignment now. Why are we waiting here? He started.

He was hallucinating me. That's what happens when you fall and hallucinate. And what about you? Why are you hollering at the door? You want to sit there? Why? It's very warm over there. Why? Because you're thinking about her? It's a German brand. I think, I don't know if the company is still around. You guys are struggling, huh?

I'm, I'm waiting. [01:04:00] Today I'll post it.

As it is. So, students, listen. Let's continue the class. Hi. Good morning. Alright? Quickly. Guys, wake up. Make your neighbors sit, sit, sit straight. Good morning. You want to sit there or you want to sit here? Uh, you sit there. You want to sit there only? Please. I need my tab then. Guys, sit straight. Don't touch.

No, watch it. Sit straight. Watch it. Sit straight. Sit straight. Sit straight. Abish, sit straight. He's getting better. Are you sitting straight? You look like you're answering our questions. So, let us listen, right. So, we have been talking about, right, networks. Guys, listen. We have been [01:05:00] talking about networks, right.

What we have seen so far is the concept of centrality, only one principle, right. We have two or three more. I will talk about power law, right, scale free networks. Guys, listen, I still hear some murmuring. Guys, if I see you, I will ask you to leave, right. Let us not do that. So, There is something called semantics.

What is semantics, sir? Logic. Yes? Huh? Logic, huh? Semantics mean logic? The way of writing. Huh? Hey, that, not that semantics. Was this word introduced in sociology? Semantics. Can somebody tell me what does it mean? Logos semantics. Sign up. Visual representation. So, Please listen, right? Let me just go back. If I say the word volcano, what comes to your [01:06:00] mind?

Volcano. Volcano of course comes to your mind, but association. Lava. Lava. Okay. Then? Mountain. Mountain. Okay. Eruption. Eruption. Eruption. Okay. Then? Smoke. Yes, I am getting more answers from this side. Smoke. Lava cake. Mountain. Okay. Something else. Heat. Yes, heat. Erection. Erection. What? What? Erectile dysfunction.

Vesivus. Vesivus. Vesivus. Okay. Fine. Now? Right? Hawaii also will come, right? Active volcanoes, where are they? Right? I don't know, Mount Fuji erupts, right? Hawaii, you have active volcanoes, right? Now, let's go to the next word. Somebody said heat. If you think of heat, what comes to your mind? Stove. Stove. Huh?

Stove. Stove, stove, stove. [01:07:00] Stove, okay, stove. Stove. Fire, okay, fire, okay, stove, fire, then? Thermodynamics. Ah, thermodynamics, okay, thermodynamics. Huh? Huh? Sun, okay, sun, fire, sun, okay. AC, okay. AC? High fever. Huh? High fever, okay. Let us take that. So where did we go from volcano to high fever, we have ended up? Okay.

High fever, what comes to your mind? Medicine, Croatian. Okay, medicine, thermometer. Dolo. Dolo, 650, okay then. You go to a doctor, okay? Medical leave, okay, it's not a leave, okay? Fever means what, man? When you get fever, how do you feel, how do you feel? Tired. You feel pain, right? It's pain. So, you see. We got from volcano [01:08:00] to pain.

Somebody said thermodynamics also. If you have gone down there, I would have gone somewhere also. Right? So that is what this slide actually summarizes. Right? You start with volcano, somebody said explosion, mountain, lava, right, fire, right, fire burn, pain and ache. Right? So you can actually, somebody said, right, Vesuvius, Mount Vesuvius.

Right? Here I put Hawaii, water, pool, poolside, ache. Right. Explosion, pop, sound, ear, hearing, right? So you can go from volcano to egg, right, in multiple paths, correct? Randomly if I ask, right, eventually I can actually write this down, if I keep asking this question again and again. If we took every single, somebody said, mountain, lava, fire, ash, heat, right, literally whatever, at least first level, you guys told me exactly, second level also, right?

Now the question is, guys listen, now we are talking about 10 door theory. What is the shortest path? 1, 2, 3, 4. Look [01:09:00] at this, 1, 2, 3, 4, 5. Look at this, 1, 2, 3, 4, 5. Right? So, what is the shortest path if I count? Right? There are few, there are few short paths. And what is the, what is the number of jumps I have to make?

Four. So, where is this important? Last week I gave another example. Why is this important? The number of jumps that I have to make in a, in a network? Why is it important? I have fewer such connections. I need fewer connections. Is good sir? Huh? Huh? And giving us an example, I gave you any online interaction, right?

Any teleconferencing. If I'm doing online meet, what is it? I want less latency, right? So we said. So, what is the limit? What is the limit? What is the ultimate limit there? Communication medium, what is the ultimate limit? Speed [01:10:00] of light, I cannot communicate faster than the speed of light, right? That is like the basic principle, which means I need to have the shortest cable if I have to, right?

Now, if I am here, somebody is in New York, that distance is there, right? You cannot do anything about it. And even if the speed of light at circumference is 40, 000 kilometers roughly. So if I look at my, if I look at my time, okay, if I look at my time, if I look at my Longest butt. Would it [01:11:00] be beneficial for any engineering system to have a long path.

Does it even make sense? Anyone?

Yes, can you guys think of something? I can think of this network, actually it makes sense to put as many nodes as possible. Can you think of one application, only one? Anything is fine. Computing networks is beneficial to have multiple nodes.

Any idea? Right? So, okay. I will give you some physical examples. In US, right, stock market trading was done. By people. What is stock market trading? Let us say, it. Right. I, uh, sell oranges. Okay. I'm selling some, some produce, orange, apple, something I'm selling, which means my stock is listed. Okay. [01:12:00] Now I want to actually sell my shares.

Okay. Which means there'll be brokers. One fellow will say, okay, this is winter. No, most people won't take orange juice now. Right. It's winter, right? Yeah. When will uh, juice.

So, what will happen? Company, my, actually my need will go down now. So, during March April, what happens? Everybody wants orange juice flavor, right? You want ice cream, juice, right? Concentrate, all that. So, something like orange or anything related to this space, the share price will go up. It is seasonal.

Summer, it will go up. Ice cream also, right? Something, now I am making 6. 50. What happens? Rain season. So now a lot of people will buy. So my share actually, this is also seasonal, right? So what am I trying to tell you is, okay, who will gimme the best price? Okay? This broker will say, okay, , some pharma, right?

Let's say, I don't know, right? Some pharma is there. [01:13:00] Okay? Let's say pharma. Okay? My SHA is six 50. Someone will say, I'll pay six 60. I'll pay six 70. Physically they have two. They'll bargain it. Six 70 done here. Thank maisha. This is a painful exercise. Please go back to YouTube and say stock market, New York stock market 1980s.

People will be fighting each other. It will be like a, it is the worst thing you can see, right? People will be fighting each other. One guy will be standing with a note, right? People will be jumping. They will say, 700. They will say 750, right? This guy will be, uh, sold, 720. He will write down on a piece of paper.

This is how they were doing trading, right? Physically people are there fighting with each other and over a month they will be fighting, okay? A lot of films are also there, right? Just go watch. Now, the important thing is, the important thing is, right, this was done like this. Slowly, what happened?

Computerization happened, right? You automated this process. Now, they reached a point where the automation was so quick, the [01:14:00] PC could not handle the load. So, what do you do? See the automated, which means you no longer need people. Computer was doing the trading. Right? It was setting the price, right? I can set the price.

Orange juice or apple juice, Rolo 650, okay. Maximum I am willing to pay is 300 rupees, one share. Sun Pharma, that is the limit. I, and then I go over, do my work. So algorithm is running. So stock market is going up, 290, 300, it will buy. Oh, this fellow wanted to buy. It went above 300, I can sit. Right. If it goes above this, don't buy.

If it goes below this set, I can set actually Right. All failing. I can do that today. I can do that. Right. This was not the case.

Okay. I put

so Right. I'm losing my, uh, we'll deal with [01:15:00] him at the end of the class. Yeah. Right. So, right. If I'm doing training right. I can do it manually or I can automate it, right? I can set this done, do the training. Now the thing is, once you automate it, everybody has anonymous done, right? Uh, everybody has done this, right?

I've done. Now the problem is computers are sending a lot of data. The server is not able to handle it, right? What do you do, sir? Build a bigger server. What are possible I've done in terms of computation? I cannot, I cannot make any, any. So, what New York Stock Exchange did, right? It is one of the craziest thing I have seen.

This story, please go to YouTube. They took extra fiber optic cable and added it to the existing network to slow down the communication. They took like some 2 or 3 kilometers length of fiber optic cable. They connected it between the exchange and the stock market. So, it will be a millisecond slower, not like that.

That's slow. It will, it will, it will delay by a [01:16:00] millisecond. Ok? Physically, they added a extra length of cable. Just by a few milliseconds. Mmm. You got it? Right? Just so, just to slow down by just enough so the computer can, can handle it. Right? This is a very odd example, right? That I've come across where actually you will induce latency for benefit because this real time training causes problems.

Now, the question I'm asking is, right, Not just the length of the connection between the Lord where I add more notes. Where would you need this example? Any answers. Tell your example. Any answers

that quality book, so I'm talking about not delaying. Also, please understand. I just gave you the example of the stock market, right? Dr. Booking. What does it do? It actually sometimes 9, 15, 8. I'll log in and give. Tetherblock it'll sign me out. By the time I sign in, the ticket would be over, right? It happens to most of us, right?

So earlier, I used to choomba do some dummy click. Choomba click [01:17:00] something and then the website will hang at Tetherblock, right? Because it's not able to take the load, everybody blocks it, right? Now that is, just inducing a latency, what I'm asking is, add more nodes to the benefit, not just latency. Ok, think about this.

There is a bus that runs from Tamparup to Kandihe. Does it make two sense fewer stops and more stops, right? So in such a scenario, you want to serve as many customers as possible, so you would actually add more nodes. So don't just think, right? Network theory means, okay, uh, my, my, my sales said, right then you sell.

No. Really depends on what is it I want to do. That is why I said in engineering there is no right NorAm, there is no absolute good or absolute bad. You have to ask, what is the context? What is it you want? What is it you want? Right? Maybe you want more notes. Or maybe you want fewer notes. Really depends on the task at hand.

What is it I want to do? [01:18:00] This you understood? This is fine? Let's move on.

Okay. So, a few terms. Right? Anything in yellow I have already covered in class. Right? Degree. Guys, listen. Degree I degree out. Degree. Degree distribution. We are supposed to. All this we've seen now new thing, right? We have learned the concept of ity. I've been talking about it for the last one hour, and then you have something called click.

What is this? Click, sir. Let's say there are four rows. If on fours are connected, it's called a click, right? Add out of it. So you can ask this question, right? How many different influences does an entity receive in degree? How many other entities does it influence out of degree? Do some nodes in a network play an important role in connecting the whole network?

That is what we call centrality. How tightly are the, are the entities nodes grouped together? [01:19:00] Right? That is what is called end click, right? There are three nodes, four nodes, all are connected. Each in turn are connected to everything else, right? If you, if that is the case, you call it end click. And click right.

How long does the communication take between node take shortest path and the maximum path length between nodes, right? Two examples we saw I start in the previous, right? I did cover this. Okay, so there are these, right? In a real world, right? You saw, right? I showed you for aircraft industry, right? I showed you.

For automobile industry, it's simply not possible for a human being to sit, turn, and connect. There are these softwares. That are readily available. Right? R is quite famous, right? They're popular. You can even check out this website. Okay. In a complex project, right? So this is, I borrowed this from, uh, , his practical work.

You see, how can you even make sense of this? What he has done, his [01:20:00] project work at this, he has, right? He has taken, and then he is collected. If you ask me what is the central, no, I don't know. By visually I am not able to see, right? So, you have to have something called, what is called? Clustering coefficient.

Right, you need to have some measures. Right, what is that measure? I take any random node, and then I count how many other nodes are there at first level, at second level. I will give some weightage, I will say 1. If there are more than 10, I will give weightage 1. This has got 8, so I will give 0. 7. So, I will give a coefficient.

Let us call it clustering coefficient. So, once I start doing that, right, then I can list down and say what is the most important to least important node.

Ok. Right. Look at this. Right. This is already at the beginning of the class I spoke about this. Right. So, this is specifically with regard to any IT industry. Ok. Right. Initially when [01:21:00] this started, right, 93 India opens, right, you have, Just two department. One is called sales. Another thing is called delivery Sales will be sitting in USA delivery is there in India, either above bang, right?

They're, they're wherever they are. And then you have a, there is a team, there are three, there are two teams actually. Client management team and project dynamics team. And you have the environment slowly. What happens? I told you when TC started, it was a collection of projects, 10 to 15 projects, right?

That's how they started, right? Slowly. What happens when the project grows? You need to build more teams, right? The problem is when you want to build more teams, you have to hire manpower, right? Which means it's a big problem, actually. Actually, it's easier to run a small organization. When the organization grows, you need to have a system.

Now, what is the system? Okay. How many people do we need? How many people do we have? There are also people constantly quitting the job also, right? If somebody quits, right, before I came here, right? Whenever I used to [01:22:00] work. Sorry, I have forgotten the link. See, I went through this process, you know, three months notice period.

Three months they said three months notice period. Why? Suddenly if I leave, I reported to whatever project or whatever work I am doing, if I left, what would happen? Got it? Right? So, you need to plan that. This is called manpower planning. You have human resources, right? So, you have manpower planning getting added, right?

So, environment becomes planning process and external disturbances right and slowly what happens to client management, client relationship, project scoping this is called knowledge management. What is this project scoping? Okay. You give me a project, sometimes what will happen is, right, what is scoping, what is scope of a project, what is scope of this course.

Some I stop somewhere, right, I say this is beyond the scope of this work. Right? Network theory itself is a huge book if you, actually it will be like this big. If you go to proper computer science, right, it is a massive subject. Am I going there? No. All I am doing is, I The scope, I will limit it to whatever is needed for what we want.

What is the objective, right? That is called product scoping. Then you have something [01:23:00] called quality service people management, right? Planning process all. And now you see now it becomes lot more complicated. Right? Now you have requirements of management, right? IT alignment architecture, right? So you have what is called patterns of distinctive patterns and attract.

What does it mean as an industry, right? What DCS or any organization for that matter. Okay. The question they'll ask is today, what happened? Physical currency to digital currency, right? Or rather, I should not call it digital currency. How do you do transaction right now? After 10 years? Okay, let's say, or after, let's say a hundred years.

Okay. 10 years. I don't know if it's possible. After a hundred years, let's say, India slowly grows. Okay. We are already the largest in terms of population. Let's say we reach a place where, let's say, you have, I don't know, 200 crore people. U. S. has collapsed, let's say, to 10 crore people. [01:24:00] Right? Other European nations have shrunk.

China is also big. Okay? Now, in terms of population, let's say India is the largest. Now India might say, okay, even though I am begging my currency, now I say, I've got enough financial muscle to say, my currency will be standard. We can say that, if it is that state. And then let's say we are magnanimous. We say, Let us not have, we will have one world currency, we will say rupee will be used by every citizen of planet earth.

If we come to that state, what will happen to the financial model, right? There is no exchange, concept of exchange, correct? Now if we reach that model, I do not know what will happen, I am just speculating. Some other country, let us say China can take over also, then we can refuse that, I do not know, right?

Right? What happens is, If I am in a banking sector, guys, I see somebody talking, if I am in a banking sector, right, I need to be able to forecast these changes, right, instead of doing banking, right, doing the same [01:25:00] thing over and over again. Unless I see this, I cannot do, right, project management, project, I cannot address to the needs of the future.

It is actually, I told you, right, effects over time are difficult to predict. Only those industries that can actually slowly, right, look at, What is, what is the thing tomorrow in 10 years time? What is going to be that? If you can see that, you are a millionaire, you are a billionaire. If you can see that far, that far into the future.

Right? You got the idea, right? So projects, project management, right? Looking at what is called building client relationship, right? I need to be able to go help my client and say open new doors for them. Okay, sir, so far, uh, this is the way it's going. Future trajectory, right? We see, right. The concept of money itself will go right, they will value something else, right?

There are alternate theories like water based economy, which are country has the most, water will be valued most. There is a proposal like that. Why? [01:26:00] What is the valuable resource? Which country has the most? Right? Will be valued more. Like this, there are alternate models. And if you can actually predict, if you can actually look, this is, I am talking 100 years into the future.

Ok, sir. Let us not think that far ahead. Next 5 years, what will happen? Next 5 years, what will happen? Sir, digital penetration, everybody has, everybody has got a mobile phone in India. Ok. Health services will grow. So, online consultation, right? Let us say psychiatric consultation. People are like, too much, they are bombarded with information.

Psychological health is getting bad. So, in 5 years time, there will be a requirement of lot of online therapy. Let us say, if I can tell, and let us say, my client happens to be in this space. You say, you build a platform that will provide, right? It is not, it is there today, but in a big way, next 5 years, why?

I am saying, right? People are getting frustrated. So much stress, right? I can see a trend or people start eating more healthy. Lot of [01:27:00] diseases, cardio diseases there. Cancer is on the rise, right? People look for organic produce. Why don't you start training? Why don't you start focusing on this? ITC. I just go tell ITC.

Just assure. Assure the customer. Assure my customer he is willing to pay 500 piece. He'll pay for one k of rice. But if you can assure him right? So, these sort of predictions, right, that, as a control, I mean, you look at this, uh, what is this, uh, they have this IA for monolithic, KP for, no, no, wait, give me a second, McKinsey.

You are aware of McKinsey, right? What do they do?

Huh? What did you say? Louder, louder, I can ban. Frozen footer. McKinsey, McKinsey. I am talking about consultants. Give me an example.

Okay, JP Morgan, okay, you are getting close. What, what is JP Morgan? Goldman Sachs, okay.[01:28:00]

Lehman Brothers, right. He does not want down. Asset management, okay, you are getting close. What is asset management? Banking. Banking, he says all these are related. Okay. Let us say I am a high network, HNI, high network, high net, net worth individual. Okay, I have like, I have 100 I don't know what to do with it.

I don't know what to keep it in FD. Right? I'm not happy with it. Guys, listen. So, I will go to a company like, like, you just said, right? Goldman Sachs and say, I need consultation. How do I grow my, uh, wealth? I want to make it 200 crores in the next 5 years, 10 years. They say, invest here, here, here, here, here.

Right? If this assessment also collapses, this will grow. Right? That sort of consultancy they'll do. Right? They'll say, sir, I'm selling chocolate. Calgary is selling chocolates. Right? We want to increase our market share by 2 percent. What should we do? Okay. Now you address children, you say healthy chocolate, you say.

Maybe. Right? But chocolate is [01:29:00] sugar. How do I sell it? Okay. Right? Now, uh, let us see. Right? What else can be done? You understand? Right? These are the sort of things they'll do. Right? You understand little bit of this? Right? What is important is, right? I'll slowly get through. Uh, again, look at this. Right? So, this is, uh, what did you do in college?

You just took, and what this says is, I will just summarize this slide for you, right? There is something called TCS Ion, Ion platform. What is this? This is like your, have you heard of it? Have you used it? Huh? Right? Is it good? No, somebody says no, wait. Huh? Louder, louder. Why is it bad? Security is. Security is why.

Why would you say it's a bad thing? It's irritating. I understand it's irritating. But why is it a bad thing? You can't see [01:30:00] it? See. Exactly. See the very strict which I was about to say, he says it's bad. See it's designed to be Right? It's designed, right? It went through a lot of changes, right? Right, it went through a lot of changes.

Now guys understand, how did this come about? Right? This is a new product, right? Right? So, talent acquisition, right? They are finding it very difficult, right? Sir, Tamil Nadu alone there are 700 plus colleges. Andhra, there are 800, 900 colleges. Right? Andhra, Telangana put together. India, there are 1000, 10, 000, 20, 000 colleges.

How can I physically visit? It's impossible for me, right? No. I can only visit here own institutions. I can go to I right and then say fine, but what if higher one? Right? What if if some small college somewhere in some four corner? Yeah, guys, listen, some, some, some remote corner of India somewhere, right?

Category in it's a Kim. There is [01:31:00] one guy. Exceptional inte. I don't want to miss that guy. I want him on my board. My team. How do I get that guy right? These are the question, right? Somebody in talent manager is asking. So what do they do? Let us build the platform, right? Whatever you are complaining about.

And then make it, right? So I cannot cheat, make it, right? He said security side, right? The whole point is not to cheat, right? I want to get the best possible talent. So if you cheat now, the whole point, point is defeated. You think about as a product of, see, whatever you are complaining, now you switch the shoes and then you see, how did this guy, he has to predict what this fellow will do.

They will put a camera, they will see what you are looking. Yes or no. Right? Every possible scenario you have to imagine, right? You have to build. Now, how do I innovate in that space, right? Which is the important role. If I just model it as a network, right? So, you have right colleges, right? You have knowledge sharing, you have students, right?

Performance of employees, placement, faculty development, right? Competition, IT, right? Co curricular activities of [01:32:00] students, right? It is going back and forth. Right? So, here. If I Actually look at what is called Vantage. I told you right? Point seven, right? You can give some metrics different on how dense state is collected.

You'll actually say, okay, this has got 0.39, very weak strategic capability that you get that inference after you do all this network analysis, right? You look at different notes and see, this is where we can actually give a product, give a service, and you can actually build something, right? That's what this rate is all about.

Okay? Now. There are networks. So far we saw centrality, clique, right, all that. Now, there are different types of network. What is different types of network, right? One is, one thing is, this is random, sir. It is all random network, right, which is done by the work of Erdos and Rennie, ok. There is something called Albert, right, they proposed.

There is something called power law. There is also another network called Watts, ok. Now, when you ask the question network, you have to [01:33:00] ask whether it is natural or whether it is social. Okay. Social network is different. How humans interact. Why? Any given student here will have more than 2 3 friends. Is there anybody who will say I have only one friend?

No, right? Each of you are at any given time, right? Psychiatrist say at any given point of time your limit, they say limit, somewhere around 150 people. You cannot constantly stay in touch for more than 150. Human brain cannot do that. Okay. That is like the upper limit. Lower limit easily, right? Five to ten people on a daily basis will interact easily, right?

You go to the mess fellow, right? Somebody gives you food, you talk to the security guard, you come and meet the faculty in class, right? Anyway, you're forced to do that, right? So, all that is there. That is social. There is something called a natural network. What is natural network? You're not forced to Not just human, other things that occur naturally.

Okay, I'll give you examples. [01:34:00] Okay. Right. So, guys listen. This is the easy principle. Right. Listen, another half an hour I will let you go. Okay. We will not have 4, 4. 15 I will let you go. Guys, listen, I should not have said that, but you should listen, little math I'm bringing, so I want your attention, that's why I just went wrong, right?

Guys, listen, it's easy, okay? Guys, just five minutes, I'll quickly finish the next three slides, just listen, So what is this? Every, every yellow dot represents a node, right? Now, n represents the number of nodes. P is the probability, okay? Probability of, guys listen, I still hear a lot of murmuring. So I repeat, [01:35:00] n represents the number of nodes, right?

P represents the probability of any node to be connected to any other node. That's the probability, okay? K is the, K is the So, I will just write this as a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a, a Next I slightly increase the probability from zero to 0.09.

What happens to k? K becomes one right 0.09. Eight to 12 Approximately one. Right now, guys, listen, what happens except this fellows, can you see this? What are we saying? Average degree, which means it's average. There may be one or two, which is, which is an outlet which [01:36:00] is not gonna affect anywhere else. So we say when property likely have slowly have ramped up the norm.

Anyway, in the first, the first step, the word is collection, collection. is getting weaker. Yeah, slowly. Okay. Right? So probability is 0.

K is 0, right? Slowly, I increase it to 0. 05, 0. 045. Now, you say average degree is half, right? Some nodes are not connected at all. And, what is the size of the largest component? Largest component is only 1. It is not connected anywhere else, right? [01:37:00] Here, 1, 2, 3, 4, 5. Ok? And, What is the diameter of the largest component?

1, 2, 3, 4. Number of connections. Number of hops I have to make, right? That's 4. Average path length, right? That becomes 2. Now, guys, listen. If I see somebody, I'll throw you out. Right? So, next what happens? This already we saw, right? My average number of nodes becomes 1. Connections becomes 1. What happens? You see the size of the largest component, right?

It becomes 11. And from 5, C. Slowly, all I am doing is changing the probability. In other words, something like LinkedIn, why is this important? I will tell you. Look at any, any websites like Instagram, Facebook, LinkedIn. This is very important. Why is it important? Number of nodes remains the same. You understand?

My users are, they have saturated. Facebook has its saturation, right? 2 billion users, I don't know, 2, 2. 5 billion users. Users. [01:38:00] I can't bring in any more people. India. India is there. India, , China is banned, right? Most of, uh, India, north America is there. That way I find new customers, all I can do is connect more people, okay?

That is a limit. So they know. Please understand, they don't, they know they don't have infinite growth. That is why they're talking about, you know, introducing a premium, right? Some, some way of, you know, not just depending on advertising. The problem with all this, right, all these sort of software. In its infancy, it was good.

Uber was good. Ola was good. Facebook was good. LinkedIn was good. LinkedIn, there is a premium that you have to pay. Why? There is no free lunch, right? Somehow, Google had data. We compare about Google infancy and privacy and all that. But, he is giving you so much information for free. How will he run a service, right?

Hmm. Every employee Google gets paid what? One quarter, 1.5. Somebody sitting in California who's paying for it? It's their assets. Look at their revenue stream. Guys. [01:39:00] Look at their revenue stream, right? Which means, why am I talking about this? Right? For, for a company, like anything that's involved in social network, okay, what should they touch?

Okay. They have to increase the probability of two people connecting, which means they have to do everything possible to make sure you, you meet different, different people. YouTube algorithm. How do I increase engagement they say, no? How do I increase, I have to first understand, ok, what is it you like? You only like very few things.

So, ok, let me slowly find out the probability of you liking something relevant. Right? So, when I increase the probability, what happens to the average number of links, right? It went from 0, 0. 5, 1. And then, see here, So, this is what is called a small world. What is a small world? Every node is connected to every other node, right?

So, look at the, look at the size of the largest component, 1, 5, it becomes suddenly 11, going from this to this. Ok. All these models, these social networking companies, they will have. [01:40:00] They will know the trend. They can see when will their business fail. That also Facebook knows. Right? Because Facebook has pretty much reached somewhere.

I think it has reached here. I think it is. Ok. There is no room for further growth. You can't increase any more people. Everybody knows everyone else, right? Which means what should I do? That's the question he is asking. That is trying all this meta words, all this stuff he is talking, na? Right? Because once you run off this, you run out of ideas, right?

You hit, hit, peak. So what happens to the largest component, right? One, five, it goes and then see, saturates. Largest component, see from here I can go anywhere except here. That's why it's 11. Okay. If I go to 12, I can go from any node to any node instantly. Can you see that? Here if I go, if I have to go from here to here, I have to go here, here, here, here, here, right arm start, ok.

Now, you understand. But here, I can go from any node to any node instantly, right? So this observation, [01:41:00] right, just increasing the probability, if we plot it like a graph, right? Percentage of nodes in the largest component industry. What happens? Hardly anything. Then it follows out of a S curve. If you look at the diameter, it increases.

Then there is a sudden prop. Why? Because if you have to go from one place to another node, right? I have to travel a lot to get to another node. If I increase the collections more, what happens? Diameter actually strings to one, right? That's what you see. Diameter strings. Like, no, sorry, let's start one, right?

I can instantly go from. So, if k is less than 1, small isolated clusters, small diameter, short path length, this is one observation. If k is equal to 1, a giant component appears, right, this, this huge pipe that you see, right? Diameter peaks, path lengths are high actually. If I have to travel, I have to really travel a long distance.

If k is greater than 1, almost all loads are connected, diameter shrinks, path length shortens. This is clear? [01:42:00] Very easy principle, right? This is something you have to be aware. Okay. Random graphs. Okay. So, what is, uh, Erdos and Rényi, right? What they say is, if connection between people can be modeled as a random graph, then we know, given minimum, you know more than one, one friend you will have.

Okay. What he is saying is, right, what they are saying is, right, we live in a small world where, within a few links, we are connected to anyone. It is like saying, I know Donald Trump. Do I know Donald Trump? No. Right? Or I am saying, I know Tim Cook. Do I know Tim Cook? No. I know somebody. That somebody is somebody's, uh, friend who works for Apple.

That fellow is, you know, some, uh, P. F. Tim Cook. That fellow knows Tim Cook. See, so they say, between five to six hops or links, you can actually connect to anybody in the world. So, they did a lot of study and they came to this number six. Okay? So, So, we will go there, we will get there in the next [01:43:00] slide. So, they say, they said average path length between any two connected load follows natural log of n to natural log of k.

Right? So, this guy, ok, Stanley Milgram, he performs an experiment. Guys, listen, it is an interesting experiment, this fellow makes. What he, what he did is, he said, you It's a very poor state in US, right? Northern part of US. You don't get to hear about it because not much economic activity. It's a cold place, na?

You can't do much. So it's there in, towards the north, towards east coast, right? Somewhere in the middle, northern side. And then he says, random people, he's picking random people from Nebraska and he tells them, he says there is a stockbroker in Boston, right? Close to New York. Which is in the far east. You send a letter.

Okay. Under one condition. Okay. This is, people in, uh, Nebraska, which is like northern part of US, [01:44:00] right, all the west. From there, over like, I think, 2, 000, 3, 000, 4, 000 kilometers away. And this experiment was done when? 1967. No internet, no phone itself was not that prevalent. Okay. Which means, nobody knew nobody.

This was at that time. Almost impossible to reach out to anyone. Right? So. So. So you could only send it to somebody whom you know as a primary contact. So if I know this guy, I say, hey, give it to the friend in Boston, man, here. I don't know anyone in Boston. Okay. My doctor knows somebody in Boston. He gives it to him.

Then doctor says, okay, I know this guy in Boston. Let me give it to him. That fellow says, I don't know this stockbroker, but I do know somebody who works in, uh, right? Somebody closer. He gives it to them. He says, oh, I am his milkman. I know this guy. He goes to him. Okay. That's it. Like this, it's a crazy story, not story day, it's an experiment.

Physically, did this, right? And after that it says among the letters that that found the target. Not everything reached. [01:45:00] Not everything reached. That's the important thing, right? Some it just went and then randomly never found its place. But among those that went, the average number of links was six. Right?

So based on this, they also took a film, right? You can watch this film, right? It's called Six Days of Operation. Okay. Okay. So, what's, this fellow, he did a model, right? People you know aren't randomly chosen, right? And he says, uh, this researcher says, people tend to know those who are two links away. And real world exhibits a lot of clustering.

What is this clustering, sir? You don't talk to a lot of people, but you stick to a bunch of friends. You go to mess, who do you call? Some XY, no? Okay. You will, you will, these three will go as a cluster, these fellows will go as, right? If you see Badri, he will always hang around with a bunch of people. Yes or no?

So that is what is clustering behavior, right? That is a good thing or a bad thing [01:46:00] also? Badri is a whore. So, you can do what is called, right? Badri is a whore. What is called alpha modeling and beta modeling, okay? What is this alpha and beta modeling we did, right? Don't worry. Learn English for free www.

engvid. com Uh, I will not, uh, ask you these things in exam, just for awareness I am covering. Somebody may be like, okay, is it flying over your head or is it fine? Flying over head, ah? Who said that? So far what I said is easy, man. This, if you say difficult, I can understand. The previous, is it flying over the head?

No, right? What did I say, right? Or, let me, let me just skip this. It's okay if you don't know this. But you should understand this one. How many of you did not follow this? This slide is the important slide. Raise your hand. Okay, fine. He's at least, admission is fine. Admission is good. He cannot be the only one who did not understand.

He's brave enough now. How many of you did not follow this? Raise your hand. No, I did not. Huh? [01:47:00] No, it's okay. It is better to be thought of as a fool and ask a question than to remain quiet. And then be a fool forever. I always will ask questions. People will tell me what a tongue fair. But after that, some support, like, thank you Doc.

We were you.

My math teacher hated me. Okay? That mean she always hated me because I will say, ma'am, please repeat. I'm not following. I'm very slow. Mathematically, I was a very slow learner. Why? I'm slow, right? That's how I'm so, I used to stop my teacher. Now, Harford joke, it's a fact. I will keep watching. Half of the class will not follow.

At least that one part. It will happen to you also. And I, often I will end up getting the right bullet. And every friend will come to me and say, There is a, Ashwin is there in my class. He is a brainy fellow. He, he, you don't, you don't have to teach him. Because why? He goes to a tuition. Previous day he will learn from his teacher and come to class.

Say, ma'am, ma'am, I understand. I understand. Right? Right? I, I could not afford [01:48:00] an extra, extra tuition. So I go to the class. And then what happens? Often I don't follow what is being taught in class. So he's like, oh man, I, right. I know there are bunch of other students, right, who have similar difficulty. So generally, right, you ask a question, even if it's a stupid question.

It's okay. You can only ask a question as long as you are a student. Okay? See, often, right? Sometimes. Last question. Okay. You wanna hear a story? Where's your answer now? Okay. See I do little bit of consultancy work. What is consultancy work? Sometimes I get to work with, guys listen, even slowly you are not listening, but it is relevant to what we are discussing here.

Sometimes when, when I go for consultation, right, I have to work out something, right, some, some calculations, something of some sort. Recently, right, the most recent one. [01:49:00] It is for a lift manufacturer. We have Johnson lifts, right? Like that one manufacturer came to me and said, sir, there is a axle from which the lift hangs.

We have been building this for so long. We want to make it smaller, right, to save some cost. How small can we get it? So I said, yeah, I know all the calculations, but I really do not know how low I can go. But what I will do is, right, There are what is called ASTM standards, right? I know you are not following that.

Okay. But at least based on that I can tell you how low you can go. You can still go smaller than that. I cannot guarantee. Because ASTM says, if you want to go below that, the designer has to take the responsibility. I don't want to take responsibility. Okay. So I will stick to the code, right? I will work out.

Code is like this big. Code has got some 2, 000 pages, right? You don't have to go through all 2, you have to understand most of it, right? [01:50:00] So, I just went to couple of months, right? Then walked out and then gave them set. You can easily, easily, right? I am convinced you can go. Easily, you can shave off, right?

This much you can shave off. No problem. Okay. Provided, the steel quality, you have to meet this. The codes clearly says that. Okay. Sometimes, right? It is a scary feeling for me. Why? Somebody's life or death, I am signing with my name. Right. Yes or no? Right. Sometimes consultancy, right? Sometimes, uh, medical devices, right?

They call me, they put me, uh, they, see, sometimes they call me as a reviewer, right? I have to go review somebody's work, say, yeah, this is good. They will ask me as, as, as, uh, a teacher from an academic institution, I have to go sign. What if something is wrong? Based on what I understand, I'm signing. What if somebody may die, actually?

Right? That's a liability. So that's a serious thing. So if you are a practicing engineer and understand, okay, at least my, what is called exposure, [01:51:00] right? This is not that great. I can always say, see, you may not. Right? I can put a hundred different clause if I'm building a bridge or if you're writing a code, let's say, what is the assurance you are writing a guys, listen, you are asked to writes, okay.

Or modify OS for a medical device. Let's say that's a. Devices that will monitor your heart condition, which is going to sit in a hospital, GE. You find a job at GE and then you have to write a piece of code. That runs. And that code can never crash. It can never crash. Because if it crashes, somebody will die.

Will you take the legal risk saying, I can be jailed if my code fails? How many of you will be willing to do that?

You are willing to take that risk, that much faith in your

Yes.

Yeah. You'll write, somebody is [01:52:00] doing it. Please understand. Somebody is doing it right. So why am I bringing this long story? Why did I tell you all this long story? You can make a mistake till the moment you get a certificate from here. And then we certify, what's your name? Anish. Anish. So Anish is a student sir, sorry, made a mistake, fine.

I cannot say that. A practicing engineer cannot say that, right? What is called a chartered engineer? Civil engineers, they have a chartered engineer. It's a chartered engineer means highly respected. If he signs and a bridge collapses, he can be jailed. In ancient Rome, right, if a builder builds, he can be jailed.

Somebody dies, they'll come, kill his family, entire family. This was the rule. Roman Emperor had this rule. If you build a building, if the building collapses, if people die, the Emperor will call, kill this entire family. What will you do? Now look at the consequence, which means, okay, my family will die. It's not that I die, my family will die, so I will do everything possible, so no [01:53:00] building collapse.

Right? Please understand, right? This, I don't know, is this emphasized to you? This is very important, right? Okay. Not all of you will go to critical, critical things, right? But some of you will end up critical things, right? See, I used to work with systems, right? Sometimes, right? Guys, listen. Right? Another, another, uh, history, story.

Right? There is a tube. My first design edit was a tube that carries, right? Can you touch 150 degree centigrade? What is 150 degree Celsius? See this? It is a lot of pressure. Let us see how we can get out of this problem. 1st of all, we have to make the tube that will carry 10 parts of pressure hot air at 150 with the oil mixed.

If [01:54:00] that thing explodes, what will happen to you? One is pressure, 10 bar. Your cycle, entire tube is something like 3 bar. You've seen the entire tube blow up, thump, right? Imagine 3 times that, 10 bar, and oil at 150 is circulating inside that, right? That's the very first project I did as a practicing engineer at 22.

You understand? First time, right? Of course, my boss is there, my manager is there, right? All of them cross checked, right? It's not that they let me do that. Finally, they asked me to sign the document. I was like, sir, I'm not sure. They said, Karthik, you did everything right? Yes, sir, but, uh, I just saw this thing closed.

Will you hold me responsible? Yeah, I will hold you responsible. I will not sign, sir. Then, I cannot pay you this month. This is your work. So, I said, sir, will you protect me if something goes wrong? He didn't follow product you signed, then he signed. Then they said, you go stand near it. They said, I'm too scared, sir.

Right. It took me a [01:55:00] couple of years right after I did for like a couple of years. Then I became comfortable with it, right? I knew, okay, this has to be this thick. This rubber has to be made this thick. This man has to be this thing. You have to tighten up to this specification. You have to use this gasket, blah, blah, blah, blah.

Understood. Fine. You have to build that ability slowly, little by level. Right? Why am I telling you all this tangent story, recently? Anything you write might end up some day in a critical setting. Chargeability can't write a code. It cannot take. It is stealing code, na? It is pulling from multiple repositories.

So it will say, no waiver. Waiver. I am not responsible for any damages. Right, they'll put, na? Usually for subjective documents, they'll say, right? Like that it can give a disclaimer. You, can you give a disclaimer? No. As an engineer you cannot do that. Right. I understand that. Right. So just to the [01:56:00] subtle thing is right.

Please understand you're not just writing a piece of code, right? You are giving a soul. I've told you mechanical engineers build a body who, who animates it? Software engineers. Please understand. Right. Some, sometimes I also have to play the role of a software engineers. I have to make sure, right, right.

The US. Life, you have to breathe life into it. Okay. So, now you tell me, how many of you don't follow this? He has already said. Come on, man. Nobody wants to admit? Can I, can I read? Quickly revisit this? No? Let me quickly revisit this. I don't know that. I'm sure some of them are there. No? If I call you in private and say, Yes, sir.

Right? Right? So, So what I'm saying is, right? [01:57:00] Guys, Yes, sir. Yes, sir. So, we say B is probability, N is the number of nodes, multiply these two, you will get K. Right, I repeat, B is the probability of any node to be connected to any other node. Guys, listen. This I, of course, I will ask this in exam, right. So, B is the, nothing is explained in the slide.

If you do not listen, if you go back after a month, you will forget this. I am repeating again. B is the probability of any node to be connected to any other node. K. k is the number of nodes. multiply these two you will get the average number of connections. K. Yes?

You cannot have. Ok, he's asking a good question. Right. I will go back to your J D syllabus. Please wait. Sir? How can it be a, half a connection? Right? So in fiber optic, right, I do remember, right, the, the wrong one [01:58:00] and all.

4. 5 percent, yes. In this, do you think, the proportion of the two terms are the same? No, the probability is varying. Because, your K, is always dependent on this term. Both are varying. I still didn't get his question. Got it? You can have X1 constant and make it proportional. Very simple.

No. Is it clear? So slowly, guys, listen slowly as I increase the probability, little by little, see, these are some random values. These are some random values. Okay? You can put anything here, right? When property zero, K zero, because nothing is connected, connected to you, don't have any loans talking to [01:59:00] any other loan.

What is the largest property itself, right? One next. When it's likely increase it, right, it becomes 0.5, right? What happens to the largest component, right? There are five nodes that are connected together, so size of the largest component increases. Next, as they increase it further, what happens is. Most of the nodes are connected and you are the largest diameter C Levi.

Right? Next, when I increase it further, right, if I make it one right, it becomes exponential, right? Which means you enter the concept of small world, right? Graphically plotting this, right? So when K is less than one, right? You have small isolated clusters. When K is equal one, a giant component computer, right?

Then finally, after you. Increase it further, right? You have the path length. That's shorter. Okay, so the six degrees of the operation, we saw what this says is right, right. This, [02:00:00] okay? Okay. Skip this, right? This alpha model, what it says is right mutual friends as a fraction of the total friends, right? You know somebody, what is the propensity, right?

What is the propensity, right? What is the possibility of those two guys, your friend? But I, I, I, I, F is non, non reliable. So, I will be a non reliable one. So, this zone will be a non reliable one. So, I will be of, of, of, of, of course, of course I will on. In this space you have what is called the small world network.

Right? So on and so forth. Right? Similar story, when beta is 0, people know their neighbors, but if I have to [02:01:00] go, guys listen, right? I know my neighbor, but if I have to go, the diameter is huge. Clustered, but not small world. Right? If beta is 0. 125, right, people know their neighbors and a few distant people.

Right? I can actually have the path length actually, right? I can actually Shorter if Peter is one. Similarly, right? People know others at random, not clustered, but you end up with a very small world,

right? So power law quickly explain what this sources, right? What does this mean? There are few nodes, right, that have a lot of connections and there are a lot of notes that have very few connections. I repeat what this power law says, right? What is the degree, number of edges distribution over a graph for real world graphs?

Many real world networks exhibit a power law distribution, right? What this says is, there are few nodes of the entire network I have, there are very few [02:02:00] nodes which will have a lot of connections and most of the nodes will have few connections. This stands to reason, right? Let us see some examples, right?

So, if you see hyperlinks, certain pages, right, there are lot of pages, certain pages will have lot of. Right, it will be collected to many other places, right? Co starring in movies if you see, If you find one hero, you'll always find, somebody co starring with him, somebody who know him very well, right? And co authorship of physicist, what is physicist?

I'll talk about my own thing. I write papers, I know couple of my friends, I will always keep writing those same people, right? Neuro scientist, you can keep going, with all these examples, okay, so this also, I Follows this, lock this, uh, age old attach, right? The rich gets which are right. Power distribution of no distribution arise as if the number of Norths grow and if this condition is made.

Okay, is not [02:03:00] guys one important thing, right? I'm going to talk about Japan. What is the, why are I, why are you talking about Japan, sir? Okay. Japan is, guys, listen this important thing. Okay. Network theory we are talking, right? So, one important principle our network theory. Why am I talking about Japan, right?

Look at this. Guys, I still need some murmur. Sixty hertz, you see this line? Okay. That line separates, it is a virtual line. This side, one side of Japan uses fifty hertz. You One side of Japan uses 60 hertz Japan. How then did a single country end up like this? Because why US uses 60 hertz. Okay. I think it was G after World War, right?

Listen, what did us do to Japan? They bombed with them right after they bombed them. What they us is always the world police. [02:04:00] Okay? What they did, okay, we have to be in control, so we want you now, we will actually help people. They did something called. Let us start with 5. 9, 6. 9, 7. 1, 0. 7, 6. 3, 0. 9, 0. 5, 0. 5, 0. 2.

Um, now, what is the frequency that you are going to give? The Marshall Plan, read about the Marshall Plan, something called Marshall Plan where they send people, money, everything. So as part of the Marshall Plan what General Electric was asked to do is, because they have found, let us rebuild the power system of Japan.

Which means, it is a US manufacturer, what is their frequency? 60 Hertz. 60 Hertz means, what is, what are they going to export? Their machinery. So, whichever parts of Japan they end up giving, it was. Forced to take 60 hertz and which are part of Japan had, they are also a local Mitsubishi Toshiba. Right. They also are in power business.

They, because their infrastructure was intact or for whatever reason, right. They remained or they continued building equipment. 50 hertz. Now what has happened, part of Japan is at 60 hertz. Part of Japan is at 50 hertz. Okay. [02:05:00] Sir, what is the problem? Just frequency know. It's a, it's a, it's a big headache.

Why? This fan is designed to run at 50 hetz. This project was designed to run at 50 hertz. Right. But some phone charges you, you see slash report. Have you seen, I mean, almost all charges say that 50 slash 60. So it is universal, no problem. But most motors, if you see it, is designed for a particular frequency, okay?

These days, electronics, right? They are flexible, right? The problem is right. Some Medtronics are very sensitive. So if I buy some equipment here and if I buy some equipment here. It has to be compatible with that grid. That is one headache. I will tell you the bigger headache. What is the bigger headache?

The bigger headache is, there is a power plant here. There is a power plant here. That power plant is running at 50 hertz. This power plant is running at 60 hertz. Now if I have to exchange power, I have to do frequency conversion. It is not a straight [02:06:00] forward process. It is a very lossy process. To this day Japan is doing it.

Okay. You see frequency converter here. Wherever you see this round, right where you Google it, you get right. So why their I grid is one grade. Please understand everything is connected to everything else. It's a very weird scenario. I didn't cover this in class as a exception. I put here, every power plant is connected to every other power plant, every, it's called the grid, right?

Complete grid. Why do we have a grid? Namely, there is a power station. There are a lot of dead ends with the thermal power plant in Neyvali in Tamil Nadu. Kalpakkam we have a nuclear power plant. Right? If you go to southern part, Kanyakumari you go, they have lot of windmills, solar power plant is there.

All this is let's say if it is only connected to Tamil Nadu. Ok? Tamil Nadu also supplies to Karnataka, right, I mean, Andhra, right, Kerala also. There are also windmills in Kerala feeding Tamil Nadu also. If each are clustered, Each are cluster. Let's say power plant in [02:07:00] camera only serves in camera. Power plant in camera only serve problem is if the power plant goes down, what happens?

That region, entire region, you'll not get power. Okay? But if everything is connected to everything else, okay, is gone, sir. Big or apartment that is concept 400. Megawatts got dead. But what I can do. I still can get power from my neighboring state, but problem is I can run at a reduced capacity. I'll say factory shut down.

I will say ac CU shut down. You forgot us. You send a mail. What is the mail? They say elevators will not run. Or maybe they'll only run elevators. AC will not run. Only fans and lights will run, will run a diesel generator. Right? So you can run at a reduced capacity if you have a anti grid connector that is called redundancy.

Okay. Now the thing here is, this is a very weird scenario, right? I don't even know how people even model this, right? Where everything is connected, everything is talking to [02:08:00] each other, but the communication itself is different. Because if I generate power, right, here in Tokyo, if I were to send it to Hokkaido, which is in northern part of Japan, right, I have to do a frequency conversion, right?

And similarly, any power that they generate after me, I have So, I have to convert it here. Now the biggest headache is what is called grid balancing. What is grid balancing? This conversion amount, how much of this power I should convert. Let us say one guy turns on a light bulb here, I have to modulate the power.

One guy turns on an air conditioner here, I have to modulate the power. And in real time you see how messed up this will be, right. This is the only country I know of where they have a grid which actually runs in two separate frequencies. To this day they cannot change it. Why? Because they[02:09:00]

So this is a very special case where they had to actually compromise because they got help from the U. S., right? They are stuck with two different standards and to this day this is how this entire, their power grid is running like this, a rare case. Right? So, look at this. Thanks to system biology, we now have a clear picture of complex diseases.

What does this mean? Right? There is something called a human, uh, genome project. Have you heard of it? Yes. During Obama time, back I think 2008, right? It's a very, computationally very expensive exercise. Why? What you, what they tried, they have not completely cracked it. For instance, what causes cancer? Sir, tobacco cancer causes cancer.

Carcinogenic substances, what are these carcinogenic substances? Causes cancer. Sunlight u will it? Cause you can, you can attribute, but not everybody gets it. Some people smoke, they're fine their entire life. Correct. But some people don't even smoke. They get cancer. What is the correlation? Right? So it is a highly complex [02:10:00] interaction of uh, if you go to system systems biology, which is what I've written here, right?

If you actually go to this page, right? Molecular biology. You will have a lot of, they will have like thousand parameters that is influencing, right, which causes a, and there will be one thing, and there will be a sequence of events, right. If, if you go to California, they will say diesel vehicles are banned in California.

You cannot drive a diesel vehicle there. They say diesel vehicle is known to the state of California as a carcinogen. We use diesel engine all the time here. If you take a bus, you will be smelling diesel. I can say for 100 percent sure it might get cancer. That is the entire state of California has banned this.

They say it will give me cancer. They have banned it. Right? So who is correct? We are also fine there. Right? So if you have to know this interaction, this pathway, this molecular pathway, right? This is what they use. What are these molecular pathways? This chemical at this environment for this person with this gene sequence, right, [02:11:00] might again probability, I cannot say for 100 percent sure, might get cancelled.

Cell under these circumstances. So you try to avoid it. You understand? So still, even now, right? Drug discovery, right? They make new molecules that has to selectively go, only destroy cancer cell. You should not destroy your normal cell, which means, again, you have to know what is called signal pathways. How do you turn off one particular gene?

Turn something on. You understand? Right? Read about. It's a, it's a, it's a crazy drug. Discovery is a crazy area that all this network theory, right, is widely used. So network theory is no limit, right? You can look at supply. Logistics, supply chain, right, for instance, okay. You order a pencil on Amazon. It comes to you next day, right?

The moment you order, right, even the time of the day, the supplier that you buy it from, I got a pencil from Assam and I was like, what the hell? I ordered a HP pencil, why is he sending me from, I don't understand their thinking at all, right? We talk about carbon footprint, all that, right? Why is he [02:12:00] sending me a pencil all the way from Assam?

Like local shop, I can go buy, right? I just bought, right Because there's price was good during . I said, okay, let me buy some 10 cents. I got a book and he is sending me from all the way from ASAM comes from asam. Like makes no sense to me, but they have some logic to it. I don't know if any of you don't let me know.

I don't know. What is the thinking. 3000 kilometers away. They're shipping something. It's taking so much of diesel, they have to burn and it's giving me a good deal on it. I do not understand that logic, right? I cannot, I mean I am not able to, I have spoken to people who work for Amazon, they also do not know, right?

Or it is a mess up of the algorithm, I do not know, right? You understand, right? In logistics, this is huge, right? You book Uber, I just make a booking here, now, I want a car now, just in time. There is a car here, there is a car near that, uh, police quarters, there is a car there, three cars are there, which should come to me.

One nearer. Right? Not the nearest one, not always. Bye. Right? It will look at the, ah, these [02:13:00] algorithms are hidden. I, I just did two lot of things. The actual thing what overages we do not know. You simply, you would think nearest one. It is not just that. It looks at my history, your history, and it has got some complicated logic.

Right? And then it sends out of three. If they have, let us say I am in the middle of the city. Twenty, sometimes I will see twenty cars around my home. Which one will come? Randomly something it will pick up. Right? And that fellow will cancel. And then, right? It goes through some, uh, It's like, uh, you play this game, right?

Russian roller coaster. Sometimes it will go 5 kilometers away. 5 kilometers away, exactly. Exactly. I see a car here. Sir, is it, is it probably dependent on, uh, how often, uh, where the driver often goes? I don't know. They give some, like, cluster coefficient, they give some weightage. Some weightage they have, right?

And you end up with this scenario. Half an hour you'll be sitting and that fellow will come, right, from somewhere far away. I didn't see it. You pay me 100 rupees, I spend 70 rupees on decent domain. Today I'm running at a loss. Often, right, drivers, that's how they say. Not [02:14:00] this fine, right? So, application of network theory, you can talk about any network, right?

Any network, logistics, your, your own body, right? Different, different, uh, millions of you. If you don't talk in, if you don't talk in Canada, he'll ask. The point is, Yeah. Keep in mind there is no ultimate good or bad. Sometimes you try to minimize the length. Like in the first example I told you, you're trying to maximize the length.

Sometimes you'll hop between these two words. Like that, positive and negative feedback, I told you, na? Sometimes you need positive feedback to destabilize and then you need negative feedback to stabilize. So, I will post next two assignments on all the class notes. Any questions or we will call it quits.

Mahesh just retain that guy. Mahesh where [02:15:00] are you? Just retain that guy. The trouble maker. Right. Okay, guys. Attendance. Thank you, sir. Attendance. What attendance? Attendance.

Uh, uh, uh, uh, uh, uh, uh, uh, uh, [02:16:00] uh, uh, uh, uh, uh, uh, uh, uh, uh, uh, uh, uh, uh, uh,

What happened? It's [02:17:00] fifty six. What happened? Attendance means you have to sit down, it seems. Sheesh! I'll set that at the ringtone. You call me, okay?[02:18:00]

Do we have team number? We just have team, right?

Uh.[02:19:00]

They played with it. That's it. They did this. Did this. That's what we have done. No, utterances take time. Sir, Sir, Sir, Sir, Sir, Sir, Sir. Sir karthicks are behind. That's why you started the video. What happened? That was very rude. What happened? What did he do? What did he do? What did he do? What did Bharat Raj do?

What did Bharat Raj do? Come on. It's here. It's here! [02:20:00] It's here! Eric Mee ah. Eric Mee ah. Mee ah. Hey! Sir, also you can just call roll numbers, you can just call roll numbers, right? Then just report on where everything is. There is an issue is there, right? I'm just saying, sir.

Idiot, idiot. Why are you writing the wrong numbers? I don't know, I don't get it. What are you going to write? I don't know. We will write, no. Start writing for his No, no. See if he write, he has to check the paper and then he has to test it's pain for him. What is Ally? Mother? What is Ali? [02:21:00] Ally is like, it's a rude way of.

Addressing someone. What is the meaning? It's bitch. Why do you not know that? It's not Bitch,

I told you already. I told

what the fuck is wrong with? What happened?[02:22:00]

Daniel, Daniel, Daniel. Daniel, Daniel, Daniel. Tell him to ask for numbers on the mic. Tell him to be smart for once in his life. Tell him to be smart for once in his life.

I am telling three is enough. One for this row, one for this row, one for that row. This row requires two because it's kind of double that. One can go from that side, one can go from this side for the same row. Admin close. Five 30 academics. Close 5, 5 30. You mean academics? Office, [02:23:00] admin, academics office.

Close at five.

He said, Noah, what a dumb guy.

No, I don't. Yes, sir. Cheese. Cheese, cheese. What is this photo for? Attendance, huh? Attendance, yeah, attendance. Damn, that's Wait, what? Wait, what? He's taking a photo, he's going to put attendance with them. How does he know that? He knows! Bro, face recognition, bro. I have that. CNN model. No, I look great, I think.

You, you look okay. No da, it's just facial recognition. It doesn't look up [02:24:00] to date. It's the most ridiculous thing I've seen. Tell your father not to do it.

Basically, free attendance. Full attendance only. He'll just take a photo for testing purposes.[02:25:00]

Yeah. Yeah, you can. His forehead.

What's his name? Olajide? Olajide? Olajide Orianke something. What's the case actually? I don't know what the case is. His name is Reje or something. Reje [02:26:00] Ola Tunga. No, Olajide. Olajide. What? What did he say?

Someone who, who would be interested? Are you interested in joining us? Join us? Join this year. Next year I think. You can ask someone else. I'm really not interested.[02:27:00] [02:28:00] [02:29:00]

Come to daddy, come to daddy.

Yeah, what happened? Oh, yeah.

Damn, it's sharp. Oh, yeah.

Hey, it looks red. It's a flying car. What happened to its leg? Check its leg, no? Wait. Wait. No, it's fine. I don't think so. It just got tanned, yeah.[02:30:00]

Yeah. Or it got burnt or something. Hello. Hello. Hello. Hello. I, I think it got burnt. The only thing is, the only reason is the thing like this, you know. The fur, the fur is gone. How? How did that happen? Send a picture in the group. Send, send, send. How did? The leaves are so sharp. Yeah, the leaves are like [02:31:00] penetrating through the clothes.

I saw, I heard things. Take it, take it. What do you want? What is it? EMI. This, this um, this girl, no. This girl, this guy. This girl is very, ouch. Don't scratch yourself, what the fuck are you doing. What is wrong with you. It's better than licking its balls. I was literally licking its balls. Hold on, hold on, hold on, hold on.

Easy, easy, easy, wait, wait, wait. Eyo, now there's milk in your ear. I told you to wait, wait, wait. No, no patience on the ear.

Hey, chill. Come here. No, no, no, no, no. Hey, wait. What? You know automatic Telugu? Just one minute. What? I'm giving you a [02:32:00] way to wait your turn. No patience only. I'll give you, you wait. You wait for a minute. You wait. Wait, I'm sorry. I'm sorry only. Come here. Hey Badresh, see, it's like something happened. Wait, it got scratched.

What? How? What the hell is this? It's bleeding, bro. Hi. Hi. I see rat. Shut up. Rat. Rat. No, no, no, it peed. It peed. It peed. It peed. It's red. Oh, I see. It's red. Red. What's up, bro? Where are [02:33:00] you going?