STD Session 2

**Karthik C:** [00:00:00] I am fine.

Yeah, Yeah. I got. Yeah. Yeah. Yeah. Yeah. Do you want to sit in front? Like I want to sit here. [00:01:00] Not bad. Haru. What an idiot. In the house, bro. A man carries so many photographers, everyone is going to look for him all over again. Hey, do you have sheets? No. I have multiple sheets. Why do you need sheets when you are a shit?

Good question. I'm going to need to ask myself. I was going to say your mother, but that wouldn't look good. How is your sister? Sharma. Is anyone sitting here? Where are you sitting alone? Where is your team? There is no place here. Who is your team? Go back. Take a chair and sit next to your team. Why? Why? Why?

Why are you running away? No one is coming here. Harib bhai, [00:02:00] no one is coming here. What? No one is coming here. Who? Who?

You tell me, I'm on your team. No, no. Why don't you come here? Where? Here. You come here. Keep my bag there. Sexy, bro. Sexy cut. Sir, look up. No, no, no. Oh, man. It's not online. Yes, it's still online. Bro. Get lost. Oh, sir. Sorry.

I pay for that. Why should I pay for that?

What if [00:03:00] he doesn't? I'm not going to do that. I shall stay in the sun. Sir, cancel the online. I protest. Sir, no online is acceptable. Bro, don't go online. I'm not coming. Go. No, he'll come online. Online? Yeah, B5 Basics. Who said? He'll teach below and he'll use. How do you know that? Because that sir who was teaching B5 Basics stopped teaching.

He left, uh He left the subject. He left the subject? Yeah. Left then he If he left then you should give them online notes. Their teacher left notes. Look, bro. It's a skill issue, bro. B5, B6 is a bit dumb. Yeah. I don't get it, bro. It's here, it's here. It's offline. Hey! It's all online, bro. You idiot. You're lying.

What did he say? He's lying. He's lying. I don't know, bro. I'll have [00:04:00] to check. Why are you lying, bro? I feel like dying. You gave me a headache. I feel like dying right now. We'll go now. I performed a quicksort album for 1000 inputs in a second. For 20 inputs, I performed this much. I put a thousand inputs, bro.

Now, where am I from? One guy says, enter, enter, enter, enter. Another guy says, enter, enter, enter, enter. Another guy says, enter, enter, enter, enter. I've sorted it. Bro, you have to read and read out from the file. Hmm? You have to read and read out from the file. I'll have to type it in the file, right? No. With open text dot Where will the content come from in the file?

I'll have

How many of you have trouble with the teams? Most of you are 30 people are able to accept. So what is the issue? You're not able to create a [00:05:00] Microsoft calling with your mail id. There's a new problem actually. See what you do, what some of you are able to do. How is that? Office 365, sir. Microsoft, they will need to have that license, is it?

Sir, Office 365. Sir, for me it says I'm not part of the organization if I, if I log in through another account. Personal ID is not accepted. Personal ID, you cannot. I need to know your roll number. Institute of Humanities is not allowing to create Microsoft account, sir. Maybe I think, uh Saying the organization does not allow.

Saying the organization does not allow creating Microsoft account. I don't know what went wrong. You can find, if we do Office 365, otherwise we will have to go to Google Classroom. Google Classroom, the problem is, it's a bit, uh, unstructured, right? Teams is a bit more structured. But most of your roll numbers I can manually add, but unless you have a Microsoft account, through your Institute by LED, your roll number will not be reflected.

Right? [00:06:00] Unless you have a Microsoft account, linked to your roll number, right, I cannot, because if I look for your roll number also, it's not showing. Right? Some of you are manually able to add. Vaishnavi is here. One student, I added her manually. You mailed me actually. There is one Vaishnavi. Yes, you are Vaishnavi?

Varshini. Varshini. Is it Varshini or Vaishnavi? Okay. Can you check your phone? I just now uploaded your, you only asked. Who else mailed me? I got three mails from students. What is your name? Yes. So, you guys are not able to find your own number. Yeah. So, you have a Microsoft login, ah? No? How come your, your own number is not working?

Okay, I'll find out, right? So, if it doesn't work, we'll switch to Google Classroom. Sir, we'll make it work. So, students, listen. [00:07:00] Right? So far, we've had about six hours, right? Assignments, right? All of you have formed groups. Teams of 4 or 5, we had this discussion last week itself, right? 6, 7, 6. 7, I do not want, right?

7 is too much, right? 7 I said in the worst case, right? 7 the problem is all of you will club, 2 guys will work, right? Other 4 will be resting. I do not want that. Right? Let us restrict to 4 or 5. Okay. How many of you are yet to, yet to form groups? 6, sir. See that is, right? Your next assignment is that. It is a graded assignment.

Talk to your friends, right? Your own friends form groups are four or five. Preferably if the problem statement is very difficult, maybe I allow six. If you take a very tough problem statement, okay, what is the constraint I gave you? When choosing a problem statement, it has to be relevant. India specific, right?

It has to be relevant. India specific. That is the guys. I still here. . I'll throw it out, right? [00:08:00] So this week onwards, I'm gonna take physical utterance. Also, the TA will be going around. You will be taking utterance, right, start at the end of the class also, okay. Some of you are running away and coming, skipping the second hour and coming back in third hour, right, that I have noticed, okay.

So, got it. So, the problem statement selection has to be, right, whatever you pick, domain I gave you the freedom, right, can be anything, right. Pick anything, anything of your choice, healthcare, waste management, renewable energy, can be anything, does not matter, but the problem statement has to be. Specific to Indian context, it is something you can associate, you can understand, right.

So, that is the key thing, ok. So, please pick something, right. If it is not good, right, TA's and myself will go through once you submit, we will review, we will suggest, say change this topic or maybe I will suggest, maybe we will pivot. What is pivoting? Maybe with the idea you are starting, maybe something a bit more realistic, I will ask you [00:09:00] to move, right,

ok. So, first thing is the important thing is the group formation, right, because from now onwards, right, because I am having trouble with the teams, right, so I will give you time, okay. Maybe one week's time I will give you to submit the previous assignment, we will sort out this, uh, group issue by tomorrow, right, and talk to our CS team also, right.

So, I will figure out a solution. If I am not able to figure out a solution, we will move over to Google platforms, okay. I do not prefer that. It is a bit more cumbersome compared to Teams. Teams is much more easier, right. It helps me clearly track, when did you submit, if it is a late submission, it will, Microsoft has got a nice implementation.

Ok. So first thing is the group formation, ok, ideally 4 to 5, ok, classes about 160, right, so let us keep about 25 teams, right, that is my aim, 25 to 30 teams, not more than that and not fewer also, right, that way it becomes problematic also. [00:10:00] And we spoke about collective problem discovery. What is collective problem discovery?

Let us say five of you are in the team. Five different students will have five different problem statements, right? You need to negotiate, talk to your friends, right? And then come to one or two good problem statements, right? Of course, there will be dispute, right? You may not agree. So you have to know how to resolve the conflict, right?

So that is collective problem discovery. From this week onwards, I will be covering on system theory. I have not gotten more into system theory. This week, I will be touching upon quite serious system theory concepts, right. So, let me close this and open the PDF for some reason.[00:11:00]

Okay, again a recap of what I was telling you last week, right. From deep reflection, right, into your own everyday experiences I want you to identify, right. Problems that that has personally bothered you, issues that, that you are passionate about, right, where you want to change the status quo, right. So we saw this, right, where to, why

this is happening, okay. We'll manage.

Okay, right, so. [00:12:00] Sir, how do I help you? Is there anybody who is having trouble picking a problem statement? May be let me take one or two. Raise your hands. Sir, I really have trouble. He is like half hand is going up. You have trouble? Yeah, stand up. What is your name? Jesvin. Jesvin. Jesvin, you have trouble picking a problem statement?

Who are your team members? We are all sitting together, okay. All five of you no idea? I wrote it in last week's. Somewhat difficult, ok, right. So, I will give you a simple example, ok, how to sit on the, right. The problem is actually finding a problem, right. A problem that is well defined is half the solution, right, understand that.

I gave you a simple solution for you to pick a problem. What did I ask you to do? From the time you wake up, right, keep a notebook right by your, by your bedside. You start noting, ok. So, [00:13:00] I will give you probably a week more time, ok. I am sure half the class, right, even though we are not being frank about it, I know at your stage you will find it difficult to find good problem statements, right.

But I will give you a week's more time. I want you to be sincere, right. Good problem statements, right, if you identify will fetch extra marks, original problem, original ideas. How to pick this? So, you first you simply identify, do not worry about solution at all. Do not worry about the tools. You just document every single problem you faced right, I gave you an example right last week, same thing we said right, couple of examples I will tell you.

There was, there was one guy right he was very, there I carrying too many things, I have to carry a scale, protractor, so many things No sir, Listen sirs, listen, Indian Law does not give going. This was his problem, right? So, I have to carry a bunch of Measuring tools, right. I have to have a protractor, scale, blah, [00:14:00] blah, blah, pencil.

So, he started with this, ok. They were iterating for a complete semester. Finally, what they did? They came up with one device, right, which is, which is a scale, which is a measuring device, right, built in protractor. Of course, they had an electronic implementation, ok. There are couple of, right, microcontrollers involved, right.

Sir, did they actually make it? Extremely compact, right. Did they make it? Yes, they made it. 6th semester, right? They are 3rd year students, they made it. Okay, you can actually measure, kept a roller. Have you seen this? Guys will be slowly moving a roller, right? That is a odometer, O D O M E T, yeah, right? So, this guy made a chota odometer.

What did he use for this thing, for the wheel? So, he 3D printed it. All of you know 3D printing? Yes, sir. Most of you are familiar, right? What are the 3 buzzwords today? A M L and? 3D printing. 3D printing, right. These are the things that are actually changing, right. That is bringing about a lot of [00:15:00] change.

Okay. How many of you have never come across 3D printing? Raise your hands. Sir, I have never heard of it. How many of you physically seen a 3D printer? Sir, we had a class. We had, last semester we had DML lab. We have design manufacturing lab. Super. Okay. So, you know, right, you know to make a model, slice, 3D print.

Does it talk to you formally? Formally? I mean. Just, just the printing process. Printing process. Okay. Okay. Basically, you know FDM, fusion deposition, right, FDM you know, right. So, the reason why I am talking about this is, right, reason why you have to understand 3D printing, guys, if I see you one more time, I will ask you to leave.

So the reason why I am talking about 3D printing is, end of the day, this is running a, some sort of a software, right, so I am pressing buttons, correct. So, how did this come into being, just ask that question, ok. How did this come into being? I am here, I am here, If I did not have this, what will will have to go there.

I have to physically go there. I have to make one of my TAs [00:16:00] sit and say, next, right. Sometimes I will say, he will go front, right, back, there is a miscommunication, right. So that creates a need. Necessity is the mother of invention. There is a necessity, right. What about your projector? Before projector, have you seen the OHP sheets?

The overhead projector, school, right, your teacher might have used, right, take a transparent So, I have to write down all this, right, then project it. Have you seen those projectors? Yeah, yeah, yeah. Right, I do not know how many of you are familiar with that. So, before your LCD projectors, right, this is a sophisticated technology, right.

So, you have a display this big and that too it shows in color, high definition. Imagine, right, if I have to present, if I just add this, if I started with this. Let us look at the evolution. I told you to watch a series. How many of you remember the name of the series?

Huh? No. I didn't tell you. [00:17:00] I don't know how many of you made a note of it. He didn't tell us. He didn't tell us. You cannot say no. I will once again tell you. Okay? He would have told us. No. I would have noted him down. No. He didn't tell you. No, he didn't tell us. Did I not tell you this? No, sir. No, sir. Okay.

It's actually my first slide. Yeah, yeah, you did not, I will write it down, yes, write that down, write that down, okay. What I want you to do is, this is a compulsory watching for the course. Okay, I will ask you, end semester I will ask you questions from this series. There are 18 episodes. Damn sir, so many. So what's the genre?

It's too long. It's like watching a movie, man. What's the genre? Is it about machines? It's all about photocopiers, office equipment, vacuum cleaners, all your watch, everything, everyday objects. Right? Okay, so [00:18:00] machines don't think, right? So you need to understand. For instance, right? Let's talk about telephone.

How did it evolve? Let us talk about a fax machine. How did fax machine evolve, right? How did communication evolve, right? You might think, okay, I am a CS engineer, why should I bother with this? Is that the question you are having? End of the day, please understand, right? First class itself I made, I made it very clear.

You are not just coding. If you are a coder, you will be jobless. End of the day, you have to work on a piece of code that will run on some sort of a IOT device or some sort of a device like this. This is running some sort of a code. This has got a microcontroller inside. When you press, right? Something is happening, it is talking to a receiver there, all that is happening, right.

So you writing a piece of code is not just a piece of code, right. Remember last week I gave you the example of a nuclear reactor, yes or no, you remember that example, right. So coding is not just, right, today increasingly, right. All of you know about autopilot, have you ever heard of autopilot, [00:19:00] what is an autopilot.

So you have a plane, pretty much a plane can fly itself today. Not today, 20 years back. A plane you put it in autopilot, tell it where to go, it will actually, it knows to go. What is the pilot doing then? He is just supervising. It is like ADAS, right? All the cars has level 2 automation today. You press a button, adaptive cruise control, I just sit there, right?

If the car ahead of me speeds up, my car speeds up. If that breaks, mine breaks up, right? That is like level 2 automation. Right. So, any code that you write, end of the day, we are increasingly moving towards interconnected devices, right. Now, they are talking about this, Elon Musk is talking about now, having a car with no steering.

We just go, right, say, it takes you wherever you want to go, right. So, do not think of yourself as just, you know, people who write piece of code, that, understand that code will run some sort of a device. I will, I will give you another example. All of you know about ventilator problem in [00:20:00] COVID. Thank you.

Everybody understood that, right? There was a severe shortage. Every ventilator has got a very sophisticated piece of code to do what, right? If I have to put you on ventilator or if you have to put me on ventilator, our lung volume is very different, right? It has to measure, right, what is the SpO2 in your blood, right?

What is your lung capacity, right? What is your physical condition now and suitably put positive ventilation, right? For each of you, it differs. So, it needs a Yes or no? What is the number one killer, Cardiac disease, right? Lot of people have Thanks for having me. Right, you have stents, yes or no? Lot of, uh, your own grandparents you might have heard, right?

They went there, they have a coronary vessel that is [00:21:00] blocked, right? You have to put a stent, right? Image guidance, right? It is done under continuous fluoroscopy, which means some doctor is there sitting, steering, and then he has to precisely place this here. How does he know where to do it? It is all pakka image processing.

End of the day, it is a 3D problem. Again it boils down. If you do that, it is all linear algebra, right? It all boils, rotate all the day. So, I will put it this way. Mechanical EC is the physical body. CS is the soul that animates the body. You understand? That is the way I look at it. Right? If the soul leaves the body, what happens?

Body dies. Body dies. Right? Understand the importance of your role. There is nothing without us. Many times, right? I will give you a classic example. NASA center over, right? Two teams. There is a team in Europe. Many of you know about this story. There is a team in US, team in Europe. They are working on different parts of the probe.

They are sending it to I think Saturn or Jupiter, [00:22:00] right? It misses the target not by a few hundred kilometers, several hundred thousand miles. How can they get it so wrong? The trajectory, what it is supposed to go, it missed it not by a small margin, by a massive margin. How did this happen? They do not know, right.

They launch an investigation. They lost 200, 300 million dollars, right. They launch a rocket into space. It did not do what it is supposed to do, right. Whole mission failed. And then they go back to the drawing board. They are pulling their hair. What did we do wrong? Everything is pakka. Finally, it came down to, you know what?

Units. U. S. guys are using inch, pounds, all the imperial units. Europeans are using SI units. What happens? What else was there? Calculation in SI unit, these guys were doing it in, what Americans call freedom units. Finally, what happened. That is where, they did not know, talk to each other. At that level they messed up.

This is well documented. You can go on Google, read about this. You understand. [00:23:00] So, coding is that important. Do not, again, the reason I keep repeating is, this is Infosys, cognizant, code and then come back home. My sister is a She works in IT, right. She works in IT, she works for, right, one big MNC. Now, that company is a client of a medical device manufacturer, Medtronic.

So, what is Medtronic? Anyone of you have heard of Medtronic? So, Medtronic is the one who built the pacemaker. You have heard of pacemaker? Right. Again, pacemaker is a very sophisticated device. Your, your heart knows Medtronic. It is involuntary, right? You are not controlling it. It knows when to beat, how, if I walk, speeds up, if I sit down, it slows down, right?

When the natural pacing goes bad, right, there are, there is a natural rhythm, right? There are certain feedback loops, right, that is inherently there. When that fails, what your heart will do is, [00:24:00] if not, get up, stand up, stand up, stand up, stand up. I am asking you man, yeah, stand up please, yeah, yeah, what were you laughing about?

Oh, like, looping, yeah, so. Uh? Looping, I just thought of the programming loop also. But why are you laughing about this? I do not understand. Momentary, sir, I do not mean it, sorry. Right, you do not have to say sorry man, see, what is the first thing I told you in first class? Right? I treat you as a mature adult.

If you all are well behaved, all of you show up on time, I do not have to waste his time, three hours, right? He should be doing research, I am pestering him. Right. He is physically going to take attendance. Is it a, is it a good thing to do? Right. Last one. Right. Is it a good thing to do? No. Right. So let us behave like responsible adults.

Adults. Right. Let us go back to what I was talking about. Look at the natural pacing. Right. If the heart loses the natural pacing, what happens? Right. It will do this. [00:25:00] Right. It is called arrhythmia. Ok. Now, you have to. It is a medical condition, right? You need external help, right? So you have to put a device called a pacemaker.

The natural pacing, what is pacing? If you do jogging, you will be familiar with this term, right? Pacing is, right, how fast or slow you are running, you are jogging, right? That is pace. I am not able to keep up pace with you, right? This is the English phrase we say, right? So the natural pacing goes bad. What do you do?

You have to put a external. So, he wrote this in his book which is a, which he wrote in his book, he wrote it in his book. look at the oxygen level, so many things, okay, and then uses that and then it sets your thing right, right, that is why I said. See as the importance is it is the soul that animates the [00:26:00] mechanical system, the electrical and the mechanical system.

Please don't take your job. Likely people will die if you make a mistake. Right? Understand that. Right? So I use a lot of cad, CAD program. You understand? So cad, I can actually make a 3D modern and measure. So what is it? It's all computational work, right? In 3D space. If the program gives me wrong dimensions, what will happen, right?

It is something as simple as that. Right, look at round off errors, right, if you know, I mean you guys, I do not know if you will be taught numerical methods. Is it there in your course work? Because you need to understand how computers handle, handles numbers. Computers do not handle numbers, they may be handle, handle numbers.

The spacing, however fine you, you may go, right, 10 power minus 12, 10 power minus 16, right, you can go like nanometer, picometer scale. Even if you go at that scale, right, computers will not space numbers uniformly. Right. Because of that, there are lot of errors, it will accumulate. Okay. [00:27:00] This is not very prevalent, right, in case of day to day things.

But when you are talking about astronomy, right, where you need to keep very precise time, you need correction methods, right. So again, right, that is why I keep insisting.

Okay. So, we were talking about again, identifying problem statements, right. So, One easy thing I said is you please document, ok. I will give you couple of examples, right. One is this multi, multi, uh, feature device, right. It can do measurement, use it as a scale, protractor, whatever, right. That is one thing, you get it.

Another thing, ok. Another guy said, sir, when I am walking, my feet are getting sweaty, ok. Then I said why don't you go, and then. So, I will just, you know, I will [00:28:00] just, I mean, look at this. So, I will just, I will All of that. Tesla. So they took a idea. This guy, right? He has made so many inventions, right? So he has an invention called a Tesla valve.

Okay? It's a special kind of valve. So actually we took that, put it in the shoe, right? So they worked on this and made a shoe that actually whenever I take a step, it'll pump out. It's like a fan that doesn't need a battery. Nice problem, right? Nice problem statement. It didn't work exactly how we wanted, but they gave it a shot.

So, this is the second example. Third example I will go in very great detail. I have another case study that I will talk about, right, termite identification, right. That is a fantastic work done by one of your seniors, right, that I will touch upon that as well. You understand, right? [00:29:00] Now, bad problem statements, right, few examples I will give you again and again.

Typically people will go to traffic. Sir, we will put a camera. And then we will put a thermal imaging camera, ok. Then what? Now you go check out the pricing of your, for a single signal, right? Government spends like lakh. These are just lights, right? First time I, I mean, I heard this, I was surprised. How can this be this expensive?

Why? It is standing there out in the sunlight and rain throughout the year, so it has to be varied again. So the seals, the quality of wires they use, light, it is all industrial grade, so it costs lot of money. Right. If you have to put all these fancy cameras, sensors and all that, what happens? You cannot afford it.

It might solve the problem. Right? If you go to Annanagar, right, centre of city, they are the main junction, they have put couple of cameras. Government spent like 20, 30 lakhs only for that one signal. Completely automated. Do image [00:30:00] recognition. How many of you are from, from Hyderabad, right? Anyone from Hyderabad, right?

There if you go, right, it will take a photo, right? You will get a SMS right away, right? You made a violation, you will get a message. The website, the website will get. Website also you can go pay the fine, right? Chennai also they have implemented the same system, right? So the point I am trying to emphasize is you can throw technology at the problem.

You can throw all the technology at the problem. But the question you have to ask is, okay, the question you have to ask is, Is it viable? Is it viable? Is it something you can do with your skill set. I will give you an example. If I have to ask you, can you make a pen that will write upside down? Can you do that?

Take your pen, will it write upside down? No. Right, he is saying take a pencil. What else can you do? There is a pen called space pen. You can buy it. [00:31:00] There is a pen called space pen, because you As I wanted astronauts to use this when writing. What is your name? Aditya? Adi? Aditya. Adi, I can call you Adi. Yeah.

Right? So, right? So, I will give you marks for that. What is your roll number, Adi? B1023. CS20, 23, right? Yeah. 23? B1023. 10? 23. 23, right? So, what is simple solution, right? If you have to write upside down, NASA spent millions of dollars on this pen, read about it, space pen. Why did NASA think of Adi solution?

Pencil is what, 2 rupees? The nib can go and hurt something. The nib can break and like hurt equipments and destroy. Short circuiting, right? Lead, right? Your graphite is conductive, that is one problem. Debris. Right? Debris. The [00:32:00] second problem is? So, that is the reason NASA does not use that. So, in that scenario, ok, it is warranted.

Now, this pen supposedly can write underwater, right? That is the claim. You can go to the website. Each pen is 4000 rupees, 5000 you can buy it actually. You can write upside down, put it underwater, right? That is the claim. Sir, what do you mean by write upside down? If I put the board here, can I write? How How long this will write?

For one line.

You can use a felt pen to some level it will work right, but after that all the ink will start running down, it will stop writing right. So, now guys listen, the point I am trying to emphasize is right, you can have a complicated solution like a space pen, what I want you to work on is something like a pencil.

Sir, I have an idea. Yeah. We can have nibs on both sides, we will write [00:33:00] We will write on this side until it goes to other side and then we can go to the other side and write that. Sir, the point is reliability. I am going to talk about quality, ok. So, what is your name? Badresh. So, Badresh is, ok. Badresh is a quick thinker.

He is saying, Sir, I will put nicks on both sides. I will keep rotating. This is what you are saying. I will write, rotate. That is a bit inconvenient, right, because imagine somebody is giving you instructions. Sir, but in what location are we going to do this, in space? See, the reason I said upside down is in space there is no gravity, right?

So ink will not flow, okay. What they finally did was put a pressurized canister, okay, put pressurized canister so that pushes ink out, they are using that to write, right? So he is a quick thinker, he is like, Badri is like, okay, let me just keep spinning the pen, let me That is what you mean. That will work, to some level it will work, yes, right.

But the problem is, right, sustained. See, qualities, you [00:34:00] should deliver your function in a sustained manner. I will talk about it in the upcoming slide. What is quality? This product, quality is bad man, means what? Right now, I am using the laser pointer, after tomorrow it breaks down, what happens?

Functionality is gone. Functional over a period of time, at that desired level. It is giving me a service at a desired level. Over a period of time, I am able to get it. That is what quality is about, right? In a very proper, formal way, we have to put it. That is quality. Your solution, right, solves the problem in a, in, in some sense, but quality is not there.

Reliability is not there, right? More than quality, I would say reliability is not there, right? The sustained level of performance over a period of time is absent. So, it is not in it. So, for a mission, mission critical performance, right. What is the difference between product development that you may do as an engineer and something what ISRO does?

The stakes are very high there. You cannot fail. [00:35:00] So, they will have the, the model itself. Whatever I am teaching you, many of it is not applicable to an organization like ISRO. Why? There the goal is clear. Here what I am telling you, go pick the problem. I am asking you go pick the problem. Anything. They are, they're saying, no, we have to go to Mars.

We have to go to right , we have to go to this particular location. It's well defined and this is the budget, this is the timeframe. This is your job, this is your job, this is your job. It's all well put properly de marketed. Right. In this case freely. Right. I'm asking you to explore it freely. Understood.

Right. Fine. So identifying problem itself, right? If you have the right mindset, it's not that difficult. Okay. If you want, let us say, ok, typically, right, CA students what they will do is, I will develop an app, sir. Ok, you write an app, nothing wrong in writing an app, but do not write an app for the sake of writing an app, ok.

One guy made an app. You know what he did? I will call an [00:36:00] ambulance. Open the app, there is one red button. You press the red button and it dials what? 1 0 8. 1 0 8. I can, I might have still taken 1 0 8, I can dial, right. Why need, I have to put an app, that will open. Please do not do such thing, right. This was three years back, right.

So, once he is, literally the students, this is what they first, and then later on I asked them to go back and change it, they changed it, right. Please do not come up with such, guys stop talking, right. So, please do not, I am not telling you to, see this is painful, right, to see such solutions, right. Literally that is what they have done.

One big red button, press, right. What if my internet is off? Right, mobile connectivity is terrible, right. So, not an app for everything, you cannot have an app for everything, right. And do not throw technology, do not bring in quad copters, that is again, right. I do not know what is the fascination with quad copters.

Today everything needs to have a quad copter, it needs to have everything. You understand? Again, do not force AI and ML [00:37:00] if there is no need for it. What do I mean by that? Guys, what, what is the discussion going on there? Last guy, stand up. See, it actually throws my focus if I am looking at you. What were you talking to him, man?

What is that? You ask me, I am teaching you. Sit down. Right? What is a quadcopter? Right? Have you seen these overhead shots? Drone. Right, your drones. You know, you know a drone, right? Have you heard of a drone? So, drone is a quadcopter. Helicopter is a single rotor thing. Quadcopter has got four such rotors. We call it a quadcopter, right?

So, So, your drone, right, every problem has to have a drone. Last week, right, I was, uh, handling the other batch. There was one student, she came and said, I am going to work on women's safety. I am going to put a quadcopter and put a camera on this. It is going to follow me. It is like a guardian, right, which means, no, what she did not understand was, I am not blaming her, which means she has never [00:38:00] been near a drone, right.

Marriages have you seen, right. It is very famous, right? These days marriages, they fly these drones, right? And they take all these fancy shots. If it goes above you, have you seen the air flow? It is like a fan, ceiling fan. And how long can the thing fly? May be an hour, right? Most of the quadcopters are made by a Chinese company called DJI, right?

That can fly for an hour, hour and a half if you go for the best model, right? And it makes a ton of noise. It will make a ton of noise, right? Do you really want that? And if there is a glitch, right, sometimes, right, sometimes, see I work a lot with these drones, that is why I am telling you, ok. I have experience in building lot of this.

They are very unreliable, extremely unreliable. I will never trust the software, right. You will, 99 percent of the time it will work, but there is that 1 percent, when it fails, if it hits your face, imagine, some spinning thing, right, can cause serious damage, right. Why do you want to do that? So, ultimately, right.

The idea was, she wanted a camera that will [00:39:00] go with her. So the suggestion I made to her was, you already have a camera with you, put it, let the camera face outside. Will that not solve the problem? It is going to work with you, right, if you want that solution. If you have to go take that solution where you have a camera looking forward, recording, right, transmitting however you want it, it is already there.

Why do you a quadcopter that costs like 3 4 lakhs, right, it needs to be connected to internet, right, and who is going to steer it, it needs to have autonomy. And that is going to be even more expensive and it is going to be unreliable, right. So, take solutions that are simple. Got it? You have to focus on solutions that are very simple, that are very pragmatic.

What is pragmatic? What is pragmatic? Very realistic. Yes, right, very realistic, right. What is your roll number? 1 0 12, right. So, right, very, that is, that [00:40:00] can be done today, right. I do not need to do extreme development, right. So, your solutions have to be pragmatic, right. Right. They have to be realistic. There is something called pie in the sky idea.

What is pie in the sky idea? Any idea? Pie in the sky? Idea is like, is like the squad top idea, right? It's going to follow me around, right. Be my guardian. Right. That sort of an idea. Right? So simple thing, if you don't know martial arts, what do you carry? You carry a pepper spray. Right? Right. Even if I know martial arts, if four people come, I'm finished.

Let's not know. Again, I'll give you another bad idea. Okay. Every year at least one or two teams will come up with this idea every year, right? Okay. I can, I can bet on the idea. Again, women's safety, right? What, what generally, right, students will do is, we are going to make a smart band, right? And the smart band is internet connected, okay?

And if there is a danger, we have to press a button on the smart band. Now, what is the thing, what is this thing going to [00:41:00] do? Uh, basically, yeah. Right? And then you see, even if it works, who is it going to call? Okay, let us say it calls the local police station. You are 10 minutes away. So, when is the help going to arrive?

You are going to arrive late, 15, 20 minutes later. You need help now. You understand, right? So, when you pick, right, please understand the nuances of all this, right? That is what I talk about pragmatism, right? How is this going to help me, right? I can, might as well have a quick dial on my phone, right? I can literally map my power button, right?

Double, double press, it is going to call, right, whoever I trust. You understand? So, please do not come up with these sort of ideas. The reason I am spending time, right, I do not want you to repeat this. Got it? Another thing, right? CS students, you will be interested in supply chain logistics. Have you heard of supply chain?

Any idea? I will give you a typical, typical example, ok. This student team again, uh, I think it is a mix of CS and EC, [00:42:00] ok. What they did, ok, they wanted to make farming more profitable, ok. So, they said we will write an app that will aggregate, which means if you are selling a seed, right, you will come, you will say I am growing this crop, whatever, corn, right, whatever, bhajana, whatever, right.

So, I am making this crop. I will put it here. And the problem is, right, what is the fundamental problem in farming? Government has the data, ok. The problem is storage, ok. Most of the food that we produce, ok, goes bad because of bad storage. Cats will eat it, right. There is no proper humidity control. Certain foods are perishable.

They are not properly stored. This is the fundamental problem in Indian agriculture economy, right. Can you do something there? Not much, right. Ok. So, that is a difficult problem. It is an engineering problem. It is a difficult problem. Again, when I pointed out, when I went back and then said, government is already doing all this [00:43:00] data collection.

You go to the local, right, wherever you sell, right, that guy has got all the data. You do not have to sit and write, reinvent the app. Do not do it. Do not do it as an academic exercise. That is another important thing, right. When you are writing an app, please refrain from writing these things. Please bring some new ideas.

Now, you can ask, what can a new user, everything I am saying, you are saying bad. Yes or no? Yes, Ali. Yes, sir. Each and everything I am saying, you are saying. This is all I can think of, sir. What can I think of new? Yes or no? Correct? So, that is where you have to go back and read that book. What is that book I said?

Lateral thinking. Lateral thinking. Right? Lateral thinking. The reason why I ask you to read it, ok, you can look at, look at it from a different dimension, ok. Same app writing, ok, I will give you Lateral thinking. Again, the students try to do it, right. They were not fully successful. Some, some level they were able to do.

I will give you an example, ok. Again, do not [00:44:00] put some small, chota change to it and present it as an idea, right. I am giving you an idea. All of you have got a phone, right. It has got all the hardware. It has got all the hardware, ok, fine. One simple thing, right. So, we, I, I sent students to local, uh, visual impact, couple of centers are here in Chennai, right.

Students went there. I said, you go talk to people. So, Students, when they interacted, they visited couple of orphanages, couple of, uh, visually impaired, right, centers, that is, there are, designed to help these people, right, run by the government, private, right, different places they went. They came back with, with a summary.

What does the summary say? I was under the impression, people typically will have trouble walking, actually which is not a problem, right. Again, I went back, spoke to couple of, right, visually challenged people, they said, I can actually navigate, it is not a problem. [00:45:00] Do it 5, 10 times. I know how, how, how many number of steps I have to take.

When to turn left, when to turn right, I can commit to memory. It is actually not that difficult, ok, which I thought is a difficult thing. What that fellow told me, the most difficult problem is actually reading name plates of buses. I do not know. Train, I do not know where this train is heading. Is it going to beach or is it going to Tambaram?

I do not know, right. I cannot read signs. Can you do something for that? So, I said, write an app. Take care everyone. Put it there, let it turn on the camera, do the image processing, right. You have a light version of open CL, right, open CV, right. Take open CV, right. That is the lighter version of that. They try.

Again, the problem is reliability, right. If the lightning is bad, again, the blind guy does not know whether he is pointing this way or this way. Sign may be here, right. When that fellow is pointing at the sign, it was properly saying. But I do not even know where to point it, right. That is a fundamental problem that we could not [00:46:00] solve.

You understand? Can you solve this? Sir, sound. No, no, you are not following me. See, there is a signage here, okay. Exit, there is supposed to be exit sign here, okay. There is a fire, it is supposed to say, you go to movie theatres, you will have exit sign here, right, a guy running. That you can see, I can see. A blind person, how will they know?

If it says here, then it can say exit is here. You can inform, right, you can do whatever. Get the idea? Sir, if we have, if he has a camera all around, it can tell which direction he has to go. So, you are talking about the omnidirectional camera, which is a. This is a very, guys I, I hear some murmur. You are talking about a omnidirectional camera.

See even a single camera, try taking a video, video of your phone. Take your phone, turn on, turn on video mode. Ten minutes it will heat up like anything. Image processing is a luxury, please understand. This is the single camera. What you are saying, I need at least two. Ricoh, is a Japanese [00:47:00] brand, which will, which will, basically you can buy that camera, Ricoh Theta, right.

Hit a button, it will give you 360 view. Yeah, you can do that. But what about the hardware? I am trying to use, uh, existing hardware, right? I do not want to spend another 30, 000, 40, 000, right? That is the Israeli company that makes glasses, right? I think cost around 50, 000, 60, 000, right? That has got a onboard processor, everything, right?

What we want is a simple, cheap solution. Can you build it for 5, 000? That is what I want, right? That is what we want. That is the basic solution we are looking for. Can you make it for 10, 000? Or what can you make? That reasonably solves the problem, not at all the time, at a basic level. I am going to show you a couple of examples, ok.

Sir, but this is a very fundamental problem for a lot of people. It is a very complex problem. It is a complex problem, ok. You take one thing, ok. Let me break it down. Actually, if you go to, there is even an RBI app. Can you just make an [00:48:00] app that will help them read the note, what is the denomination of the note?

Yes. It is. Not necessary. It is not needed. It is, there are apps written like that is what I am saying. You can go at that level, right. One common problem, right, I said cooking. They can actually cut carrots. Guys, guys, anything you ask me. Sir, we can use braille for that. If it is science. Not for that, but for the denomination at least.

Denomination, how many banknotes come with braille? See, there are practical problems. So, students understand. Wake up your friend, he is sleeping. Last bench is two of them are sleeping. Wash your face and come man. I do not know. I just ask it. Wash your face and come. I just ask it. I do not know. Why not have a brain?

What he is suggesting? Lifts have brain actually. Lift buttocks have got brain. Every lift has got a brain. Why, why not? Why not, why not, you have [00:49:00] cache tended, why does it not have break? Does it already not have, like, there is like signs at the corner. Right, so recent notes RBI has got some, some, somewhere you can drop one and find out, it is there.

What about the older notes? Why do not you, why, why does it not have break per se, what, what is basically saying? When it will actually add thickness to the notes. Hmm. One thing. Oh. But basically some texture sort of thing that will help them, that company, I think newer notes that they have, they do have something in one niche you can wrap your finger.

Right? That tells you the denomination that they've already made. But brain specifically, I'm not a specific, you understand? Right. It's got its own limitations, what I'm saying. Right. Coming back to what I was saying. Right. So if you want to address Right. These sort of problems, these are difficult. What you Yeah.

I was talking about, right. The blind person. Right. So I. Specifically, you know the problem that fellow told me is like, I can cook, I do not even know if the stove is on or off, I do not know if something is hot or cold, I have to go touch it, once after it burns only I will know. You understand? For a blind person, [00:50:00] right, you know water is boiling, oil is hot, that fellow can actually put his hand into that.

That is what prevents them. Does it have the solution? No, extremely difficult. To solve that is extremely difficult, right. So, you have to see where can you pose, right. This is what I am saying. Please do self reflection, right. Problems that personally bother you, issues that you are passionate about. Why?

Anything that you are passionate about? Blue shirt. Yes, what is your name? Daniel. Daniel, is there any problem you are passionate about? Sir, I wish I can. I want to work on this. Identifying snakes in the backyard. Identifying snakes in the backyard. Is that, is that your passion? I am talking like. It is not a problem.

I face that issue. In my backyard, there have been a lot of snakes. Okay. So, once I get into the back end, I feel a bit happy and I feel a bit scared of going. Okay, where are you from? Chennai. Chennai, which area are you from? Ponmar sir, near Tambaram. Tambaram, okay, okay, [00:51:00] that little bit forest area, okay, okay.

No, what I mean is, right, not your fears. Deep down where you want to solve some sort of a problem. Guys, I hear somebody murmuring. Some deep down value.

You have anything like that? Nothing like that yet, sir. Nothing like that yet? I have to think about it. Then you have to think about it, that is why you have to do deep reflection. Yes, your name? Yeah, you have any, anything that you, that you are pondering about, like you want to solve all the time. Guys, last, last row, last warning.

Ok, see that is a problem you cannot solve, that is an administrative issue. Sir. Ok. Sir, like, uh, whenever it's too cold, you want to sit on the fence. Whenever it's not cold, you want to sit on the fence. Okay. Probably depending on, depending on the temperature, the fan speed can be regulated. Okay? Not something [00:52:00] that I'm passionate about, but okay.

This is reasonable problem at hand. What you saying, right? Guys? Listen. Okay. Technically something like this is fine, not an excellent problem, but you are on the right track. What he's saying is, okay, AC is running. Sometimes I would like the ceiling to be on. I want it to be automatic. If I feel too cold, it should slow down.

If I feel a bit hot, it has to speed up. Is that what you are saying? Yeah. Right? So, in that case, right, I might need maybe a differential sensor, some sort of a microcontroller that talks to and then speed control of the fan, a little bit of code that runs that, that is fine. Something like this is okay.

Not the best problem, but it is okay. Good starting point. Right? Anything else? Guys? Last bench, last again. Yes. Can you stand up? Yes. Any, any problem you are passionate about? Attendance, sir. Why are you passionate about attendance?

See, when I say passionate, right, [00:53:00] something you cannot sleep. Okay, sit down. I will tell you. I will tell you what I am passionate about, right? Right? So, guys, listen. See, I worked a lot with medical devices, okay? So, one such problem. Guys, I hear a In the past. So, I work a lot with medical devices, one such problem that I constantly, right, I myself am a patient, multiple times, any of you have taken endoscopy, right, you have taken, have you, you are not sure, okay, he himself is not sure, okay, this is the problem, guys listen.

I will tell you what I am passionate about, right. Couple of problems, many of which you may not, you do not have the background to understand, this you can understand, okay. What is endoscopy? Let us say, somebody has got, for whatever reason, and let us say that person has got ulcer. How do you know that fellow has got ulcer?

You cannot take a x ray, it will not show up on x ray. [00:54:00] You have to take a? Endoscopy. Right, you have to, you have to do an endoscopy. What is scope? You have to put a camera into your? How do you do that? You take a long tube, flexible tube, put a camera at the tip or have some sort of fiber optic channel, put the camera at the outside, literally put it into your mouth.

Imagine putting a water hose through your, you understand how painful it is. They will ask you to swallow. Can you swallow a water pipe, flexible pipe? It'll be this thick, about 15 centimeters, right? It's a horrible thing. Okay? You to swallow about 15 feet. They'll push it in. They'll do local sedation.

They'll, they'll spray something, which means you can't feel if you just right pinch, you can't feel, feel your own throat, right? They desensitize. This is not, testing is done, endoscope is done. What is the alternative? Right? There are alternatives. Very expensive. There is something called right opu. [00:55:00] So, they made something called pill cam.

What is pill? Swallow it. Pill is a drug, you take a tablet. So, they made a whole system size of a drug. Problem is it cost a lakh, one lakh rupees. This test cost about two thousand rupees. Not everybody can use that. You take water, put the pill, just swallow it as it is going. It is literally a cell phone with a camera.

It is taking pictures as it is going through. So, solution is there very expensive, right. So, I am working on lot of techniques, ok, different ways, right, of how to solve this problem. So, that is the problem I am passionate about. You understand, when I say passionate, I cannot solve it tomorrow. It will take me next 10 years, probably my entire life, right.

There are, there may be somebody who is passionate about, right, people in biotechnology, I have some of my friends, they are passionate about solving cancer. Can I find a drug [00:56:00] for, that will cure cancer, right. So, you need to have something like that. If you do not have, please find one, right. If you do not have, please find one.

Reason is, right, that will give you a direction, that will give you, right, your attitude, right. Your attitude determines your altitude, right, we say, right. So, that is the thing, you understand. So, I have spent about one hour, right, talking about, right. How do you choose a problem, what is expected, what is not expected, let us not go back to that, right.

What a red color button calling police, that app I do not want, if at all you are writing an app, please come up with some original idea, need not be ground breaking, I am not expecting any ground breaking idea, where app writing you can do it in a day or two, yes or no? Yes or no? You can do an app, app development in a day, right, not that difficult, but that should take you.

Some problem discovery, right. Start with something, right, coming to a domain, define [00:57:00] a problem, work on it for the entire semester. As you get more data, right, you yourself will, you talk to the stakeholders. What do you, what do I mean by talking to the stakeholders? Uses. Not only the uses, stake means, stakeholder means anybody who has a stake in the system.

I will give you an example. Who are the stakeholders of this educational institution? Not just users, students, faculty, administrative staff, right, housekeeping staff, everybody has got a stake, right, in the proper running of the institute, right? Anybody who has a stake, a risk, stake is risk, right, in economic terms, right, I have a stake in the outcome, which means there is a risk I have it, you understand?

Right? So, you need to talk to stakeholders, really explore, right? It will be a difficult journey. Remember, the FFA, I was talking about fuzzy front end. You will not get answers immediately. I am going, I am asking you to step outside your comfort zone, spend time, explore. You will fail. Nine out of ten times you will fail.

Why? [00:58:00] I am asking you to do what is called a source of knowledge, ok. I will put it in a different way. When was the last time, other than Instagram, , when was the last time you actually made a contribution to internet? When I say contribution, you uploaded something that will be of useful to somebody. Can somebody raise their hand?

Yes. What did you do? Ready? What did you do? Mm-Hmm? . I asked answer a tech question about some guys. Okay. At some level, yes, I'll agree. Anything else? Anything else, Cora? Somebody I can say I write on Cora. Anything else? Yes. Review on a hotel. Review on a hotel, okay. Again, similar lines. Github, anybody has uploaded your own custom code, right?

This solves this problem. Nobody on the internet has solved it. I have solved it. Is there anybody there? Stackoverflow, have you uploaded your own piece of code? I asked for an issue, I mean, I put [00:59:00] up an issue, but I did not do a full request. Right. So, the point is, it is very difficult to do that. So, like, my guru used to say, Karthik, you will only download, you will never upload.

This is what he meant, sir. This is actually what he meant. It is actually difficult to upload. It is very difficult to upload. Try making something new and, it is not easy. It is painful, right. I want you to do something of value, upload something to GitHub, something to Stack Overflow, right. Create your own repository, put your, your name, put your name, your logo, say, uploaded by a student from so and so institute.

And the world should use it. You understand? Oftentimes what happens, if I want a code, I go to GitHub, it is there. What are you want? It is already there. Unfortunately, mostly it will be some Europeans, some American, right? Typically, they are the ones who upload. Why? They are passionate about their problems, right?

If you get that passion, if you develop that sense, you will keep the inner fire burning. right. [01:00:00] And you, you will start making things, okay. As students right, the important point that I want to emphasize, right, in this course is do not look at yourself as a recipient of knowledge. I am here, okay, Gradient is this way, water is flowing this way, no, that is to some degree true.

But, you are also a source of knowledge creation. I repeat student you can also create something new. You are also a source of knowledge creation. How is that possible, sir? How is this possible? How can I do it? Right? Anything you do in a small scale, right? In a very small scale, right? We spoke with a blind problem, right?

How do we solve that? You may not have all the answers, you may have, right? There is a guy, okay, I'll give you an example. Okay? The project actually failed, but I'll give you an example. Back in 2002 or three, I don't remember the exact time, right? I was your age at the time, right? So there was a. I think he is a MIT professor.

Yeah, right. I forgot his name. There is a MIT [01:01:00] professor. His idea was one laptop per child program. Have you heard of this? Have you heard of it? How many of you have heard of it? Ok, right. So, let me quickly touch upon this. This guy's passion, right, that MIT professor's passion was make technology accessible to everybody.

So, in his mind, right, what is he thinking? Ok. Internet is growing, right. It is a 2000, right, 2000 to 2003, that time. What is he is doing? He is pitching his idea to an international forum saying give me money. I want to make a laptop for 200 dollars. That, that time it was impossible to make a laptop for 200 dollars.

I want to make it rugged. If I throw it on the ground, it should not break. Why? I am going to give it to children in Africa and India in developing economies and it will connect to internet, right. This was his passion. So, he went about making a, read about it, right. It will look like a toy actually. He made a very rugged laptop Right, but it failed for various reasons, right?

That's a case that if you're interested, go please. There are a lot of [01:02:00] videos on YouTube that has documented this in great detail. Okay? It's called One Laptop Per Cell Program. Now this, right? He failed ultimately, right? The process idea, it didn't take off, but right. The process of him doing actually developed a knowledge base.

That's it. If anybody else wants to do this, please don't do this. You understand? It is not all his work went in vain, right. He was the first one to approach this problem with a solution. What he felt is the solution, right. I will give you two reasons why it failed. First thing, he just gave a laptop to all the children and said, use it.

What will I know? I do not know anything. In his mind, he was thinking, oh, if you give a laptop, people will start learning coding. They will go to the web, start reading on their own. No, they need guidance. Who is going to guide them? The teachers. They are also not educated enough. So, ultimately, right, they ended up giving laptops to everybody, right, millions of dollars they spent, [01:03:00] right, philanthropic money, right, social cost, they tried, ultimately, culturally he did not think about how different cultures perceive.

If you go to the west, if you go to Europe, right, if you find some 15 year old guy, pretty much you give them the materials, they will learn on their own. Their culture is set up like that, right. They are more independent. They will take risk. That is in their culture. He comes from that idea. Right, he, he just extrapolated and then said, ok, I give this to kids in Africa, they will do the same thing.

It is an assumption he made and it failed very badly, you understand. But that documented, right, how not to go about any future program if it, if it had to do, what not to do, that created a safe database. Even a failed project is a good source of knowledge, you understand, right. Even if you fail, the experience of you doing, next time what will you do?

Right, next time what will you do? Think about different patches. You will, you will think about it like, okay, I failed this way. [01:04:00] Heuristics, all of you know what heuristics, right? What do you do? Look at the past and say, oh, I failed this way. Let me not try that. Let me try something else. Right, the more you fail, the more methods, the more robust you will become.

Yes or no? It is like writing a piece of code, right? Once you find a bug, you are like, okay, I should never write it like this. Fine, that registers. Sometimes, have you ever spent like hours trying to find a bug in a piece of code? Has it ever happened to you? So, 3, 4 hours you will be like I cannot find.

Then finally, it strikes like oh man I made a small mistake here, what happens? You will never make that mistake ever again, right. It is a painful way, but that is the best way if you ask, right. You understand, right. So, look at yourself as a source of knowledge creation, right. Do not look at yourself as okay, I will just absorb information, put it on my notebook and go.

That is not the point of this, right. So you go explore, use different principles as I said. Read the book, apply the principles that the book teaches you, textbook [01:05:00] of creativity, right. Watch these videos, ok. It is, each video is about 20, 25 minutes long, not that long. Do not watch it in a single sitting, watch each video, may be one video per day, before you go to sleep, may be when you are taking dinner, right, put it on your phone, laptop, just watch it.

He will go, right, specific example I remember, right, he will talk about Xerox, how do Xerox machines work. He will go to the history of how do you make a photocopy. Similarly watches, right? What is the first watch that has been made? Any idea? Sundial. Sundial, right? You start with the sundial, water clock, you have a candle clock.

He will go through the step by step, right? What is time? How do you measure it? What are all different methodologies people have used, understood? Right? So, it is about an hour. I will give you like ten minutes break. Come back, right? Time on my watch is 3. Let us take a break, [01:06:00] right. So I will, I will go in detail, right.

We will discuss more methods.

I don't know if you can see it, but it's, it's, it's, it's, it's, it's, it's, it's, it's, it's,[01:07:00]

What are you doing? What are you doing? Give me some money, I'll give a laptop to a kid. There's too much water coming out. That kid is new. Let's go somewhere else. Let's go. We'll go to the laboratory, right? I can't seem to find it. It's not coming down either. I checked yesterday. No, last night. Yeah, last night.

It wasn't coming yesterday afternoon. Maybe they shut off the water supply here at the hostel. No, it's not coming down. Yeah, it's not coming down. It wasn't coming down yesterday afternoon. Oh, Oh, Oh, Oh, Oh, [01:08:00] Oh,

I don't have a problem. I have a solution. You have to learn. Otherwise you will fall down. I tried once. I am at home. Look, I didn't learn it, so I don't know it. It's really good, you know? Look, if there's a speed trigger, it'll explode. The roller, the four wheel one. If there's a hole, it'll explode. That's why they say there's a problem.

Look, there's a pressure sensor. Pressure sensor. What's that? Pressure sensor. That's why they say there's a problem.[01:09:00] [01:10:00]

I don't know, that's why I don't know. I know 1st year, 2nd year, 3rd year, 4th year. I know 1st year, 2nd year, 3rd year, 4th year. No, I don't even know your batch. You're welcome, Jacksepticeye. Why? Maybe he's a 2nd year student. Not a 1st year student. He's a CS22 student. Yes. What's the time? 4 more minutes. 4 more minutes.

5 more minutes. 6 more minutes. 2 more minutes. I'm sorry. He has five more. I misread it, but you can measure it [01:11:00] when using. It's not a problem, I can go. You can go. I won't fall, I promise. I remember, Arjun. I remember it well. But I'm a bit afraid. I'll be late. What? Yeah? Nearby.

See, Uh, If it's just like this, If it's just like this, then it'll work. But if it's like this, then it's a bit scary. But if it's just like this, if someone tells you, if it's like this, then it'll work. If your life depends on it, then it's fine. It's easy. It's a fact. Yes, [01:12:00] brother.[01:13:00]

Me.

You [01:14:00] know,

it's so cold. I know, right? I'm dying. Wait, you are not. Your hands are warm. You asked him. Bro, I went there and came here. I will see you all in a bit. Bro, this is a problem. We find a solution to the problem. Yeah, he told off. Self justification. Please, who's coming out of your team? Come on, let's make a new team.

Seriously, you're going out of the team? She just said, what the hell to you. Disrespect. Disrespect. Do you think I care? You should be sorry for yourself. Such damn shit. You should be sorry for yourself. Who else is coming? No one. There are six of you, right? [01:15:00] Yeah. So? Six is five. Five. Six is five. Hey, it's nothing.

We'll take a good problem. Yeah, we'll get a good problem. Just like you. Let's see. You are a problem. Shut up. We'll take her. Keep it there. Yeah. See, I don't know. You talk to the team lead. Who is the team lead? What? Me? What? No, no. He is the team lead. You said he's the team lead. What? Yeah. Yeah. All that I want to do is play music.

All I need is music. See, because everyone rejected me. Okay. Yeah, no, no. Guarantee. Music club, also. Music club will apply for you. Obviously. Coordinate is key. See. He's too good. He's too good. He's too good. That, [01:16:00] okay. There's an.

Right, in any language. Right, you understand. So, the point is, How do you How do you What are you doing here? Anurag Sharma, which team are you in? Huh? I'm in no team, bro. No team? Sahitya Shankar He prefers to be naughty. He prefers to be naughty. Just like that. Bro, for some reason you resemble that guy. No.

No. No. Yes. Yes. In my eyes. I think there was a straight guy. In my eyes. Huh? Bakchoz. [01:17:00] He is also Bakchoz. He is also Bakchoz. He was, I am more Bakchoz. You are better than him. You remind me of him. He was better than gaya. I am Bakchoz. So what? He doesn't want to experience life, I want to experience life. So what Tenci?

He was like, I have done everything in my life. I'm like, I want to do it.

So whenever I asked him to do something, he, he gone from there. He has gone from here to here. You are starting. That's the difference. No. Okay. You can never, you can never reach an end. No. You can never reach an angle. He was like, I don't want to do, I already done everything. The thing is that gay has fun.

He challenges himself with anything. If you tell him that you can't do something, the next day, he'll do it and show you. He was so talented, you know, that he, uh, he, he has no struggle, you know. He's like, studying, coding. Bro has [01:18:00] no, no struggle, actually. Guitar, Pocky. He's a prodigy. Right. Go on, bro. Students, listen.

Listen. If that's the case, then The TAs are late, sir. The TAs are late. It's so small, man.

And that is also a problem. The battery fell. AC is a problem, man. Yeah, bro, hey. Bhadresh. You can just Put down, turn down the AC, increase the AC, instead of attaching a fan, temperature sensor, increase the AC. Turn down the AC. Yeah, you can do that. No, he's telling for general use. But some people need ventilation.

Right? During the break, uh, I had a couple of interactions with a few of your friends, right? So I'll tell you, right? What's your name? The first, uh, ID card guy. Yes, what's your name? [01:19:00] Yes. Right? Bye. Ananda. Amit. Amit, Amit, right. So, Amit has this idea, ok. This problem is impersonation, right. This guy is going with his friend's car, right, showing the security.

Sometimes the security misses. He lets him go. How do I prevent this? By the way, by the way, Do, we can't, don't prevent. Cancel, Amit. Cancel. Guys, listen. Okay, he's, he's talking about an e ID card. What's an e ID card? You can give your phone now. Guys, listen. Biometric, biometric. Right, see, now, off the bat, You can give your phone now.

What you are tending to do is, right, somebody right away said okay, have a E concept. Somebody is saying biometric, right. I can go on [01:20:00] listing a couple of other solutions. The point is, right, this eminent solution was, right, he was talking about, right, I will put a camera, I will look at the I. D. card, I will look at your face, I will compare.

Lot of work, right? Computational. It's a lot of work. Uh, again, that's RFID. Okay. That's RFID, right? That's the third solution, right? I'll come to that. The point is, right, don't jump when you see a problem, what are, what are the problem you're working on? Don't jump to a solution. List down what is called you have to do.

Very important, right? There's a word for it. It's called literature survey. Okay, first thing, okay, you have to do a literature survey. What is literature survey? What is there in literature, right? I am not the only one facing this problem. Somebody throughout history has been facing this problem, right? How have they solved it?[01:21:00]

You understand? How have they solved it, right? So, for instance, okay, Bank of, Reserve Bank of India, right? There are a lot of counterfeit currency. What do they do? Let us make our own note. No, they look currency from all around the world. What is France doing? What is Germany doing? What is America doing? How are they making it, making it difficult to counterfeit?

Have you ever taken a photograph of a, have you tried to Xerox a 100 rupee note? What will you get? The latest machine will actually not even let you do that, right? So it is built at that level. So the machine does not even let you print it actually. Right. That is the level to which they have worked.

Right. That is one solution. If people are taking Xerox, now they have built in intelligence into the Xerox machine that will let you not photocopy a currency. Why would you want to photocopy a currency? No reason. Is there a valid reason? No. So, let us ban it. [01:22:00] Right. That is one solution. That is one solution.

Second solution is they have lot of implementation inside, right, lot of technology built in. Some fine print, so small, even if you bypass the photocopiers restriction. Let's say you figure out a way, it's still photocopies, right? So when you take a copy, the copy and the original, there will be a difference, which can be easily picked up, understand the paper, right?

So the point I'm trying to make is when you look at solutions based, don't jump to solutions. Look at what people have done. Go back and read these three. That is what I mean by pedagogy. Go back and read history, right? What are all the different options that are there? Because once you see that, you will not go and reinvent the wheel.

What is reinventing the wheel? I am walking, oh my god, my feet are paining. What will you do? I have a car, I can take a car. I have a bike, I can take a bicycle, whatever. Will you go, uh, let me figure out what shape works, works best. Will I start with the square, [01:23:00] hexagon, pentagon, will I do that, right? So that is what is called reinventing the wheel.

Don't reinvent the wheel, right? If you don't have to reinvent the wheel, you have to go read history. What is there? How is the problem being solved today? And what are the gaps? That is the important thing. E card biometric, ok. Somebody said RFID, ok, ok. What is the cost? This is what I mean by different dimensions, ok.

Every solution has got a dimension, right. Cost is one dimension, ok. What is, how technology intensive is it, right, right? Maintenance, right. How easy or how hard is it to maintain? Right, these are different dimensions, right. So, make a table, make a huge table, it is called a Puck's matrix. There are, there are methods to actually compare different solutions, right.

One thing is called Puck's matrix,[01:24:00]

ok. So, you give weightage. I have to choose one solution, right. Sometimes it is easy, just by, right, comparison you can say, ha, we will go with this. RFID is best. Why? Cheapest, reasonably foolproof. And technology is not that intensive. Adoption is very easy, right. I can do that, but sometimes it is not that straightforward.

You will have two solutions, you will not know which one to pick. Then you have to have some quantitative means of processing. So what do you do? You create a matrix, write down the methods, write down different cost, technology adoption, reliability, quantity, right, so on and so forth, foolproofness, right.

You have different dimensions, start putting, okay. For this, okay, let me quickly write it down so you can understand, right.

What I think is like, we just need, but if we take like institute ID card, [01:25:00] okay, we need that to move out of the campus if we want to go out of the institute, so if we like have a PDF or something like, there is some digital representation, okay, right, cost is on a scale of one to ten very cheap, maybe let me give two, right, biometric needs lot of infrastructure, okay, or if you put it six or seven, okay, RFID.

Similarly, compared to biometric, r of n is little bit cheaper. Let me give it 5. You understand? Next dimension, right? Reliability,

ok. First, e card, how reliable is it? 10. Right? 10 out of 10. On a scale of 1 to 10, right? So, how do you decide this? You discuss with your friends. Sir, it is not reliable. That is, you discuss, you debate. No, no, no. I am not even going to put a number. What I am saying is, among your team members, you discuss. You come to a consensus.

So, this is the, the value that is generated. So, this [01:26:00] what is the value? It is the value of the x, which we will call the first one. So, this is the x that you are involving in the value of this value. So, you see this is the value. So, this is the value. So, I am enclosing this. What I will do is, I will take this and divide by this.

So, I will get 2 minus 3 into 6 is equal to 0. So, I am dividing into 6 into 6. So, this is a 3. So, this is a 3. So, what is this 3? This 3 is a 3. So, this would be 3. with.

What will happen? We will argue and you will become stronger in your belief, I will become stronger in my belief, right. So, repeat after me. All of you, guys who are drooping in the last row, raise. So, do not, do not, something like that. Sit straight, sit, sit, sit direct, right. So, if I can stand for three hours, I am, I mean, I can at least, right, hope you will sit, sit straight, right.

So, guys, listen, right. What, what is the last guy doing? Right. Right. Right. What are you [01:27:00] looking at, man? Is it your phone you are looking at? Do you have an earphone on your hand? See, if

you are cheating me, you are not cheating me, you are cheating yourself, right? It is impossible for me to keep track of every person, right? I try to look as much as possible when I am taking, taking class, right? So, so behave as adults, right? So, what I was saying, right? So, repeat after me. The point is. The point is.

What? What is right? What is right? What is right? Not. Not. Who is right? Who is right? Let us say it again. The point is. The point is. What is right? What is right? Not who is right? Not who is right? She is having a debate with me. I am having a debate with her. Ok. The point of the discussion has to be. Let me eliminate all the reasons I am right.

You list down all the reasons you are right. Let us compare as neutral [01:28:00] observers. I have one idea. Let me put it down. You have your ideas? Put it down. Ok. Now, let us objectively, analytically assess as a third person and then see, ok, this, do you agree my point has this merit? Yes. Or, I think your point has merit this way.

That is a healthy decision. You understand? I am not questioning. I am right. If I get into that mode, what will I do? I will try to substantiate. I will try to make sure whatever I say is right. That is fine. You will never have a proper discussion that way, right. You will not get to the proper solution that way, right.

Many big companies have been destroyed because of ego. Some guy will come, Boeing, right. Look at what is happening to Boeing. Boeing was bought, Boeing bought a company called Douglas Aerospace, ok, 20 years back. Slowly the management, right, Boeing was run by engineers, ok, very reliable company, ok. If Boeing made an airplane, absolutely reliable, right.[01:29:00]

Last 20 years, right, They took over another company, the management guys, right, who, who are engineers, right.

So the point is, right, it was run by engineers who went into management, right. People actually designed parts of the plane, right, who wrote scores for the plane, right. They got into management, right. So which means they understand risk, they understand reliability. What slowly happened, all these guys who have, who had no experience in actually plane development, but who are only.

Theoretical knowledge, they came in slowly they pushed in cost they said airbus is selling we have to sell it at a lower cost, they were pushing. Our share market price is not going up push, push what happened they started cutting corners right lot of the safe, what are called standard operating procedures SOP's they are called they started violating.

You have good practices right when you code right. Yes or no? You can [01:30:00] write, anybody can write a code, that is not the point. The point is how elegant is your code, yes or no? Is it self explanatory? If I read his code, right, if I read, if he is writing a piece of code, guys, I hear some murmur, right, if I am looking through it, I should be able to follow, right, if he has, has he properly commented, why is he declaring this variable?

You understand, right? And I can also, right, if I am, for instance, I will give you an example. If I am maintaining a database of health records of, So, I can write a code like that also or I can explicitly say age, declare a variable as age, declare, write specifically, write that self explanatory, yes or no, right.

So, these are called, what are called good practices. So, Boeing slowly, because it was costing money, good practices take time, right. [01:31:00] They said do not do this, do not do this, cut cost, cut cost. What happened? It is starting eating it to the reliability of the product. Ultimately now, we are facing lot of lawsuits right, two planes crashed right, Boeing is under investigation right, so FAA they have a body there, US they are investigating the thing, because Boeing is a defense contractor in US right, defenses are privatized right, because Boeing is a defense contractor, it is a private company.

Right. The government is showing them some leniency. Otherwise they, they would've been bankrupt longer because all the practices you understand. So the point is, right. Again, the reason I'm giving all these examples is what is right. Don't have this ego like I am. Right? No. Ask what is right? Right. This is the problem we have at hand.

What I feel objectively what you feel objectively, let's come to an agreement, right? If you approach it in that sense. Sometimes if you have disagreement, go back and read, read more literature, [01:32:00] right. If you disagree, you say, you will say, no, no, no, it will, I, I, I will not, even if I take this stand also, you have to have proper information.

If you do not have that, again you will argue, right. Even if you do not have, if you set aside the ego also, still you will be arguing based on incomplete information, right. So, that is the point I am trying to say, right. Before you jump to a solution, please do a literature survey. So, I want you to actually go, when you present a problem, when you present a solution, the preceding solution, before the solution, I want you to talk about all the different methods and exhaustive survey, right, as much as possible, right.

Now, what do I mean by literature? Not just Googling. For instance, if you are talking, if you are working on, let us say, right, visually impact, better go talk to somebody who is visually impacted. Better go meet somebody in person, right, get their feedback. It will change your view. It changed my view, right.

I told you, right, I thought for them [01:33:00] navigation is the biggest thing. No, right, cooking I never even thought, ok. Somebody touching a vessel, is it hot or not? I did not think. I have vision. I can never think like a blind person. Yes or no? Or what should I do? I should blind, blind fold myself and? Empathy, last class we spoke about empathy, right.

I have to make myself blind in some way, blindfold and then start cooking. Then I will start understanding the pain, right. So you talk to the stakeholders, whatever your problem. If you are working on a agricultural solution, right, right, please go talk to them, right. At least few of them, two or three of them, so you have some context.

Otherwise, you will be talking some solution, right, which has no context anywhere. Got it? Right? Stakeholder analysis is extremely important. This course I, what did we say? Four phases of design we said. We have, I will stop at conceptual design. What is conceptual design? I will not ask you what microcontroller you are going to use, what language are you going to program in.

I do not want [01:34:00] it. What I do want is, give me a broad overview. Sir, this is the problem, these are the solutions, I am picking this solution and these are the gaps. What are gaps? Where do these solutions fail? All these solutions, right? Sir, this has got this pitfall. RFID I can have reasonably cheap, reasonably reliable, right?

Works most of the time, most of the time does not fail, but I can swap my friend's card for mine, mine for his. How do I stop that, right? You can have any solution, right? Point is, that is the one problem. That is the gap. Do not jump to a solution, right? Do not jump to a solution, right? Tell me the gap, right?

That can be another dimension. Where does it fail or what does it not fulfill, right? Let that down. So if you put it in a matrix form, it makes it very easy to see, right? Or this are, this fails, [01:35:00] right? I will teach you something called a discovery metrics, right? We'll cover it in the next class step by step, right?

It's a huge thing you have to construct, right? So you take your problem statement because if you don't choose a problem statement, by next week, you cannot do the next assignment. You understand? Why? Only if you have a problem, you can apply the methods I am going to teach you. Understand? I have not even gone into the methods.

Right? Fine. Let us continue. There are boundaries. What are boundaries? Boundaries are constraints. What is the constraint I am setting? Right? Issues should be relevant to the context. This already we have discussed in detail. Restricted to industries. Important thing. Okay? Restricted to industries in manufacturing sector.

Okay.

medical devices, transportation can be anything. Okay? Not an exhaustive one list, but representative list, right? Possible to grapple with your current knowledge base and some switch. [01:36:00] Very important. This is what I was talking about, right? Some guy again said, Sarah, I'll make a HoloLens. All of you. Part of Microsoft HoloLens, right?

Some of you might have heard, right? Don't pick such problems. Why? Do you have the skills to make it? You may not have, but your current knowledge base, whatever you know, some stretch, which means what? Next two months, three months, can you learn something and with that can you build on that? That is the important thing.

You understand? Sir, I do not know this. I do not know the scripting. If I just go spend a week or a month on this, I can learn. That is a stretch. This is your comfort zone. Little bit I can, I am able to go and then use that to solve the problem. That is the point. Right? I do not want you to go,

right, got it? So the point is that, right, [01:37:00] you have to use your current knowledge base, guys I hear some talking, you have to use your current knowledge base with some stretch, right, something which you can learn a little bit more and use that knowledge to attack the problem. And potential for technology enabled solution, ok, not policy prescription, last week itself I said.

Things like corruption, bad infrastructure. Water not coming in hostel. Water not coming in hostel is a administrative issue. That is not much you can do about it, right. So, and cyber physical and affordable solutions, right. So, this is something I want you to keep in mind, right. Let me repeat. I want you to pick a domain, team of five, preferably less, right.

India specific, socially relevant problem, right. And with your current skill sets, you I am not giving you the entire thing, but it is a little bit of a stretch. Where can you work? The list I have given here, right? And it should not be a policy preservation. What is that? You have to make [01:38:00] stricter laws. You have to fine people, right?

I don't want that, ok.

This specifically, right? I already spent lot of time doing this right now, right? Or are you sitting in your, in groups of your batch, or are you scattered all over the place? Scattered. You are scattered? Scattered, then we cannot do this, right, then I leave it as an assignment. Right? So, as a group, discuss and identify the common problem of interest, right, the various faces of the problem, right.

So, this, as I said earlier, right, you see different dimensions, right, do not start with one problem, have like a list, 5 or 10, 5 of you will, who want to work in 5 different areas, right? Find some common intersection, right? Go from there, right? Make a start now on complete research over the week, right? So you can go to what is the library?[01:39:00]

What is digital library? Use journals. What do I mean by journals? some random blog post, show that as a reference, right. Any literature you cite has to be peer reviewed. What is peer reviewed? What is peer reviewed? See, often students will bring some random journal, ok. There are good journals and there are terrible journals also.

There are bad journals. What I want you to refer to are well established journals, ok. So, if you want to find whether a journal is good or not. What is a journal? You guys know what a journal is? I will give you an example. ACM. Association for Computer Missionary, right, for CSK, right. What they do is, right, IEEE have you heard?

No. ASME have you heard? Yes. SAE have you heard? Yes. Society of Automotive Engineers, American Society for Mechanical Engineers, IEEE is what, Institution of Electrical and Electronic Engineers. These are all professional bodies, ok. Similarly, [01:40:00] for you guys, I think it is ACM, ok, ACM Digital Library, just google you will get it.

You will have lot of journals in that, right. There are good journals under that, there are bad journals also, ok. So, typically depending on the problem you choose, right, you will find papers from different organizations, different publishers, ok, Elsevier, Science Direct, right, SAGE, ASME, IEEE, Explore, can be anywhere.

What I want you to do is find couple of journals, right, that talk about solutions, right. If you propose a solution, especially something like this RFID. It is a well studied topic, okay. There will be papers concerning this. How do I find this? Right? You can go to a place like Google Scholar. Have you used it?

Google Scholar, Microsoft Academia, right? Use, right, these tools, right? That is what eLibrary means. Go, find papers, find journals, and how do I know, sir, how do I know whether [01:41:00] this journal is good or not? How do I know that?

Okay, you go to this website. I will give you a name of a website. Okay, you go to this website, put the

journal's name in this. Okay, once you put in a journal's name, right, I think I can give you a demo actually. This is connected to the internet.

You are restricting yourself to classroom mode.

Okay. Unfortunately, it is not that. Finally, they switched off the AC. Go to this website and [01:42:00] find out. Off, off. They switched off the AC. Okay. Once you go there, Okay. I will give you an example. Okay. Let us say, I want to make a small change to a blood glucose monitor. Have you seen those devices? Take a drop of blood.

Put it in the device. It shows you what is the sugar. Damn. I want to know more about it. I want to know how that sensor works, okay. I can go to a journal like KSME, Journal of Medical Devices.

Just one example, there are 40, journals are there, okay,

okay. Let us say I come across this journal, okay, and it has got couple of articles, it says, this is how you build up. glucose monitor, this is how a sensor works, all that information it has. [01:43:00] How do you know if the journal is good? Just take the name of this journal, put it in the website, right, it will show you all the data, ok.

It will show you data, it will not tell you whether it is good or bad, you have to make a judgment, ok. It gives you a ranking system, Q1, Q2, Q3, Q4, means quartile. Q4 generally is quartile, ok. That would be a better way of doing this. So, we are going to call this as data integer. Because I took a metric and I took a function, I did a data pilot and I did a data transfer.

And I took a function. So, I am taking this as a function, I am taking this as a data report. And I am taking this as a function for a particular data. If I take data as a function, nothing happens, because I am taking the function for my data. So, if I take data as a function, that data, if I take data as a function, then I am going Okay, not great.

If it is in Q 1, it must be a good journal. You understand? Right? So, the reason is, how do I trust the information? You understand? [01:44:00] Understand? No information is 100 percent correct. You understand? Veritasium, how many of you follow Veritasium? Some of you follow? Right? That guy has got a video, he posted 5 years back.

He has posted a video All published research is wrong and he is not wrong. I agree with it. Ok. It takes lot of expertise. Even if you go to a Q 1 journal, right, there will be mistakes. Right? There will be mistakes. No information is 100 percent fool proof. Please understand. Ok. But the point is we have to start somewhere if we cannot keep questioning everything.

Right? We have to start somewhere. So chances are the information here is reasonably accurate. Ok. Okay, because why? What is a journal, right? I write a, I work on a sensor, I do testing, I submit it, somebody who is a domain expert, 3 4 people, they will be questioning me, how did you do this? How did you do this experiment?

What sensor did you use? How did [01:45:00] you design the experimental procedure? All these questions they will ask me, I have to answer. If I do not answer, they will not let me publish, you understand, right? So, it is called a peer review. Somebody who is a peer, my peer, Somebody who is also working in medical devices, but who has got much more experience than me.

Somebody who is 50 years old, 60 years old, right, they will look at me and ask questions. Similarly, when that guy is publishing, sometimes it will come to me. I will question them. How did you do this? How did you do this? Right? They have to convince me. You understand? So, it is called peer review. People who are expert in the domain will review your work.

Then you say that it does not impair, but it requires having a proper translation, okay. There is a, there is a, let us say, there is a, it is er, dictation, right, which any fact has to be [01:46:00] given. do bad work also, that is also possible. I am lucky, you understand, right? So, that is what e library is all about, right?

Google scholar and other reliable sources. When I say reliable, something like this, right? So data gathering is important. Without good data, as CS engineers, if you do not have good database, data set, what happens? First problem in, right, right, with any, making any model is you need data. Second thing is what?

You need to process that data, weed out all the bad data, that is the most painful thing. Getting data itself is difficult. On top of that, what should I do with that data? I should filter out, I should process that data, right? So that is what I am asking you to do manually, yourself, right? You cannot depend on an algorithm to do this, right?

Next, after research, each group member should prepare a two to three page summary as understood by themselves, right? Ensure there is [01:47:00] no duplication of topic, content should be structured in a logical manner. So, what we will do is we will either have a summary material, or a special, or a timeline either timeline.

Let us have the base material, I will take, I cannot take everything in class. I will take some of it, and I will talk about it in class. So, for clear. Can, somebody give me a summary, I will give you 2 marks. Whatever I have taught so far. So, far we have spent like 6 plus another 1, 7 hours I have spent. Can anybody, can I have a volunteer, I will give you 2 minutes.

Summary of whatever I have taught you so far, in your own words. So, I am going to give you two marks, you do not have to be correct, you can just tell me what you know, anyone? Come on guys, I am giving you two free marks man, what is so difficult about it? I do not know how to point at somebody, anyone? The guy is sleeping wake him up, what happened man?

Amit, what is wrong Amit? Uh, tired? [01:48:00] See, this is like, uh, generally post lunch is what I get classes. It is my blessing or however I have to take it. is difficult to engage students, especially over 3 hours, it is not easy, but I am doing my best. Guys, come on. Let us have a quick summary. Otherwise, if I summarize two marks, you are just throwing down the train.

Nobody wants it? Okay, finally, yeah. Just coherently, right, whatever we covered from the start till now, you tell, tell us, in your own words. Louder, louder, what is, I mean, I forgot your name. Ditya. Ditya, yes. Sir, you said that, uh. Do not say you said that, right. You say, see give it like a reported speech. So, we have learnt the following in the course so far.

They are, start like that. You understand? That is how I want you to present it. We have learned the following. Louder, that guy, the last guy should be able to hear you. [01:49:00] We have learned the following in the course, Uh, we should give more importance to facts. Okay. Rather than our own, keep our ego aside. Okay, that is what, no, start from the first, or if you want to go ultra also, it is okay.

First class, what did we cover? Very first slide, do you remember? Yes, sir. Uh. Thank you. We learn

to have specific and. Socially relevant, not viable, socially relevant. Socially relevant. Then? 50 percent of the solution is solved if we define the problem. Ok. It should be economically feasible. Ok. What should be economically feasible? Problem. Problem, the

solution. Sorry, sorry. Ok. Then? [01:50:00] Complex technology should not be. I am not saying complex technology should not be used. Right, generally right. You pick something which you can handle. That's all. I'm saying. Something which you can handle. Then should be used. Okay? Beautiful. Okay. The problem should be looked at from perspectives.

Okay? So that you may have to run. So I used to have word for those other people who are all stakeholders. Stakeholders. Stakeholders, right? You have stakeholders, talk to the stakeholders, then

collect. Okay. You may have to step out of your comfort zone for that. Okay. When, uh, if there is a debate between two people. Okay. The facts, uh, the correctness of the facts should be. The question is what is right, not who is right. Right, let us put it that way. Then, no, you get, come to the [01:51:00] subject. You are talking general principles I taught you.

As far as systems thinking principles goes, right. Anything else you remember? Remember I showed you a car. You, So, saw image of a car, last week, n cap, safety rating, stated need, unstated need. Do you remember? Then.

Any other principal? Important thing, you have not mentioned, FFE, fuzzy front end,

right and I taught another structure, FBS structure, function behavior structure. I will come back to this, at least, this you remember? Fuzzy front end, no? You remember the term, but you do not remember what it means. Yeah, okay, you can sit down. What is your number? I, 1, 0, 3, 2. I, 1, 0, 3, 2. 32. Okay, I [01:52:00] will give you two marks.

Okay, fine. Guys, anybody tell me what FFE is? One mark. Anyone? What is, what does fuzzy front end mean? I already, I already have given you a mark, right? Yeah, so let, let's give the opportunity to someone else. Any one from this side? I am getting no participation from this side. Any one? Yes? Sir, we are trying to define a problem.

We are getting so many ideas like how we make it, what we will make, will it succeed. So, the ideas you think are the fuzzy front end. Not the ideas that you think, okay. The process, there is no linear progression, okay. Correct? What is your number? What is your name? Priyank, okay, right. So, Priyank, more or less correct, but not exactly.

Guys, listen, FFE is [01:53:00] very, solution, right, work on a concept for the solution, keep progressing in that order. There is a linear progression, right. Fuzzy front end, right, does not have that. You will start, you will roam so many places until you hit the top. The, right, generally you have the bulk moment, right?

What is that? You, you know this solution is going to work, right? Until you get there. Once you get there, then the progression is linear. You understand? I will give you, I mean there is an image, right? Anyway, I will talk about it, right? In the upcoming slides, it is there anyway. So when you start, you do not know where to start.

So you are all over the place. You are talking to stakeholders. You are reading literature, you are, you are coming up with a concept and then you are sending it to me. I am criticizing, you are going back, right. This exercise you are doing. So you are doing it, there is no clear path. So this is termed as fuzzy front end, got [01:54:00] it, right.

So we looked at that, then we looked at latent needs, then we looked at different dimensions of a problem, right. Let us continue understanding, right. So I taught you last week one very important thing. You have science, science, some principle. For instance, if I supply current to a piezo crystal, what, what will the crystal do?

It will vibrate, it will vibrate, ok, fine. This is one scientific principle. Now using this, I make a, some sort of technology, means what? I have made a crystal oscillator, right, it is a component, ok, ok. I have this, I have a crystal oscillator. Now this, I am going to turn it into a product. Now here comes the problem.

I have a crystal oscillator, what can I do with this? If I supply current, it will vibrate. And this crystal oscillator vibrates at a very precise frequency, [01:55:00] 22 kilohertz.

Right? I know this. And I have made one component. What do I do with this? I do not know. You understand? Rather, right? If I ask the question, I know, I need to know time, okay. Let us go 200 years back. I need to know time, okay, which means everybody had a pocket watch. It is a mechanical watch. You have to wind up, okay.

Now somebody comes up and says pocket watch's accuracy is terrible. Let us have an electronic equivalent. I have come across a crystal oscillator which keeps very precise thing. We can somehow use this technology.

So, it is going from science, technology, product, society, ok, typically. What we are saying is society in this case, right, you have a business opportunity. [01:56:00] And, which basically links to user needs that leads to a technical problem that leads to a scientific principle, right? So So, if you wear a watch, if you have a watch at all, smart watch does not matter what you have, it, how do you, how does it know what one second is?

Can you tell me what is one second? Can you count exactly every second? 1, 2, 3, where is the reference for this? I am randomly saying. How does your watch know what is a second? Have you ever thought of it? It needs what is called a reference. What is a reference? What length of elapsed time is a second? You understand?

It is a basic question. How, I do not know, right? My watch hand will move every minute provided it has got a reference and I do not have a reference. But I do know if piezo crystal of a certain dimension and apply a certain electric potential, it will vibrate at [01:57:00] this frequency. What is frequency?

Oscillations per second. Beautiful. Now we have a, ok, now, now I have a reference for a second. If I count 22 kilo hertz, 22000, if I apply a potential and if I simply put a counter, right, I know this crystal will vibrate at this frequency provided this electric potential. That is a scientific principle, right.

Now, Since I know this, right, I can do a counting of this and that gives me measure of a second. Now, you have basis for all modern clocks. How beautiful is this, right? So, you understand. Of its own, a scientific principle is useless. It is useless. I have to find a way to take that scientific principle to some, address some technical problem, some, something that the user wants.

You understand? Then, you take that and you sell it as a product to the society. Got it? [01:58:00] So, how it has to be is, guys, somebody's alarm is on, right. So, you go from society, product, technology, science. Always remember this example if you want. You understand, if I simply write a piece of C code, what will I do with it?

Now, I, I write the C code that can do counting. Right. That will be counting. Now you have use for that, right? So look at this, right? So every box here, you have to explore for your solution, right? What is the social economic issue? This is what I'm asking you to find. What is the problem? India specific social relevant problem here, right?

Which means there is a business opportunity that I can make a product to. It's like just like making this pointer. Every time I have to walk, I have to have somebody who's gonna help me. So, I want to have something that will help me do that, right. So, that is a, [01:59:00] that is a issue I am having and that is also a business opportunity.

What is my need? Is that need unstated? Now, think about before the advent of this, which means what? I do not even know this is a viable solution, you understand. Now, it is obvious somebody has made it. Now, what will I do? It is unstated. I need it. I need it. But, I do not know what form it is going to be. So, somebody, right, they thought, ok, you do not have to walk, I will give you a remote in your hand, press it, it will change, you understand.

So, that is the unstated. Often, solutions, right, it will be multidisciplinary, it will be a technology driven problem. Why, why is this multidisciplinary? If you have to make this, I need a mechanical guy who will make the casing, who will make all the components. I need an electrical guy who will understand the electronics, who will understand Create the antenna, transmission, right, other transmission, uh, framework that is required.

I need a CS guy, right, who will actually do the coding for this. So you need [02:00:00] participation of not one engineer, you need hundreds of search engineers for a simple presenter. Please understand this. Right? And when I press this, imagine, second floor, some other faculty, if I press here, if the presentation there changes, what happens?

So this has to be uniquely mapped to my receiver. So some form of encoding is required. Encoding of its own is useless. You understand? I have a stream of data, I am sending packets of data, 1 I am sending, right. If I just send it, it is broadcasting, right, radio waves will go like a spear. So, it means ground floor somebody is making a presentation, whenever I am changing, presentation will change, whenever they are changing, presentation here will change.

How is that not happening? There is, it is called cross talk. How do I prevent cross talk? I am encrypting this data. That receiver is getting data from my cell phone, right, multiple sources, but it knows to only listen to this. How did that happen? They have to decode it, right? Every information it is getting, it is [02:01:00] decoding and it is looking for some signature.

Ok, not my, this is not my master, so it will ignore the data. You understand? Me making a simple press, this, so much goes on behind the screen. Please try to appreciate that. A single press of a button, right, when you think about it, how fascinating it is, right? It is broadcasting for like 10, 20 meters, right?

Imagine a spear. That is, it is radiating that information. Any receiver within that will take that information. And if it is mapped to that, it is decoding that information and it is taking the required action, right. So, you understand this slide clearly. Now, this slide makes sense specifically. Now, imagine, if I give you the slide, will it, will it make any sense if you miss the class?

Nothing, right. You will look at this slide, you will be like, what is this, right. But when you attend the class, right, when you listen to this, it is much more easier, right. So, you look at the slide. solution, solution at the component level, right. So, here we stopped here, in this course. We do not go to detail design, right.

[02:02:00] You do not go to detail design in this course. In this course, have to focus on phase one and phase two. I will give you the slides for the lecture two. I will speak about phase one and phase two. Phase two stops at concept level, not at detail design. Phase three, phase four. Phase four will talk about mass manufacturing, making thousands of this, ten thousands of this, right.

We do not want to go there. Understood clear? Everybody is fine? let me proceed. So, I gave you two case studies, right, so far, right. Let us take a, another case study done by one of your own seniors, ok. What this student did, right? So, the problem that she tried to solve was this. You take a furniture, right.

You have seen all these termites everywhere. You go to the old buildings, right, you will find termites on all the doors, yes or no? Now, the problem is, by that time you realize, right, oh, I have got a termite issue. So, So, which means the termite has eaten half the door it would have eaten, right. So, by the time you realize there is a [02:03:00] problem, it is already too advanced.

The infiltration, right, it has infestated so badly, right, your door is almost, the termite would have eaten most of it. So, which means earlier detection is important, yes or no? Now, the problem is how do I detect earlier? There may be termite in this, but I do not see any signs of termite infestation, right.

I only will not. or maybe six months or one year later. The point is if there are one or two termites that are infesting me, that are eating through the wood, I need to find a way to detect it. Fine? This is the problem statement she had. Is it socially relevant? Is it India specific? again, it ticks both the boxes.

So, she went on to work on that. Now, she did not know what to do. She identified that, in third semester, only in the sixth semester she had a working solution, you understand. So, I will just give you a quick summary. So, she explored multiple methods when I say she, I mean her entire team, right, they explored multiple methods and then they went and [02:04:00] looked at biology.

The student team was ECE mostly, ECE and CS engineers, right. So, they went and read biology. Why biology? How do termites interact? How do they behave? You understand? So, they understood, they had to go back and understand termite psychology. So, if a termite is going and if it is agitated, it will bang its head.

If you agitate a termite, it will bang its head. It is a principle that they discovered, ok. How did they discover? Literature survey. You have to go and read. That is why I said please go read, understand context. Once they read this, they, they understood You can actually excite a termite. If you send in a certain amplitude, right, if you go and knock on, knock on the wood at a specific frequency and amplitude, the termite, if it hears it, it will think one of its friends is calling, so it will bang itself.

You understand? You are [02:05:00] cheating the termite basically. Ok. So, she took a piece of crystal, right, put a specific amplitude, right, some testing and all they did, right, went to old fence block, put it on a couple of those that are termites, right, some testing also they did. So, they created excitation tuk tuk tuk.

So, termite thought ok, oh our friends are calling, they are responding tuk tuk tuk. That response again gets transmitted back to the door. If there is a response, you get a spike, which you can measure with another piezo. Beautiful idea. What, what are all the things that they used? They used an Arduino. All of you know an Arduino, right?

It is a microcontroller. All of you know piezo, right? That is it, man, and lots and lots of code. That is it. So, I think she had two, two PSOs, Arduino, one 3D printed tupper. That is it. This is what I mean by stepping out of your comfort zone. [02:06:00] Your knowledge base with a stretch. What is stretch? Some of them are CS engineers, right?

They did not know how, what is a PSO, how to connect, right? All those things, right? Of course, PSO you cannot directly plug to know, you need a driver, you need a PSO driver. So they had to go and learn, look at the data sheet of a PSO this potential, this is how you send in a stream of data, that makes the crystal vibrate.

Once this picks up, you put it on a op amp, then connect it on Arduino, it works. Just 5 6 components, spent about couple of months on this project, they had a working model. Understood? That is why we put specifically this example. Got the idea? Right? So, the reason, right, so they picked a problem that is India specific, socially relevant that has got now this is a viable solution, you understand, right.

These are the kind of things I want you to do, right. I am not saying pick a, pick this, pick anything and it, you should be able to [02:07:00] find, right, approach and solve a problem on your own with help of course, right. We are, we are here to help you, right. You can always approach me, you understand, right. So, this is how you navigate this problem, got it.

Any questions? Okay. I hope everybody is clear, right, right. So, you will have difficulty, it will be painful actually. I know that, right. Often I get a complaint saying that system seeking is the difficult course I have done in my entire state. I have, I have come, I have students who have come and told me this.

One such student told me that. Your senior Adarsh, sorry for mentioning you, he is a fourth year student, ok. He sat through my, unfortunately, he was the first batch I taught here, right. He is again re attending the class. Why is he, why are you doing it Adarsh? Can you please tell the crowd? Why, why is he sitting through the, I, I did not ask him.

I have been there like how, I have bunked 8 out of 11 classes. See. You have like 11 sessions, ok. [02:08:00] But you do not know how important it is until and unless you start attending the interviews and everything, they will ask you like, it is not directly, but then indirectly you will need to know systems thinking.

That is how it will be and even now I work under him for developing a project, so you will need to have that kind of an interaction and attitude, right. We have our MDes student, right? He has got additional duty. Why are you here, Dhanraj? See I am not advertising for the course, right? Because if I say, your own senior, right, he is an electrical engineer, okay?

He need not come here. See, I will tell you, you have two breaks, right? I know you people bunk in the first one and come back in the second one. We have done that. And it is very easy to get proxy also. See there is a difference right, I did do, I bunged it, I told you right, I bunged 8 out of 8 sessions and then now I have to do it again.

It is not like I have failed in this course right, so I need to learn this, this is not like, people do not tell you this. People do not tell you that, right. [02:09:00] Yes Adarsh, thank, thank you very much. Anything you want to say? Yeah, sure sir. Yeah, yeah, go ahead, yeah. See, people learn data structures, I have done that.

Yes. I am, I am an electronics engineer, but then I have to.

So, I know you people can bunk everything, just learn DSA, crack interviews, do that, but then eventually to be a good engineer, you need to learn all these stuff. People are not going to tell you that, eventually the interviewer will also test you for this. They will test you for that, right. One very important thing, thanks Adarsh, right, one very important thing, right.

I told about industry readiness, right. No, no. See. We spoke about industry readiness, right? That industry readiness, you will not be ready if you do not prepare, right? This course is called the Front End Design in University of Michigan, ok. I reached out to one of my students, he is senior, two years senior to him, ok.

I will invite him, if possible I will put him on a conference call because if I tell you, [02:10:00] you may, you may or may not, you may not be fully convinced. He will be like, I do not know, right? But, right, I can tell you. People who have graduated, who are in industry, I will call them, right. If possible, I will put them on a conference call, you can talk to them, okay, our own students.

And, right, I hope at least, right, you will understand the importance of this course. This is not like, right, all the design spine courses we are trying to tell you, right. It is a little bit off, right. It does not have a standard template, right. It is not like quiz one, quiz two, right. That is not the point.

That is not the point. My point is to change your perspective, right. It is to widen and then say, hey, take a step back, man. Look at, you are looking at a tree from this perspective. Look at the side, right. Look at the back of the tree. Now you see a different tree. Yes. You understand. Once you develop that attitude, your problem solving approach will change.

You will not jump to solutions. In fact, you will actually slow down. I tell my student, right, my PhD scholar is that. He will quickly answer. [02:11:00] I tell him is I do not want quick answers. What I want is a well thought out answer. You take a minute. If I ask you a question, think about it. Rather I will appreciate students who are actually not quick to answer, right.

You take in the question, ok, easy. And then sometimes they will even ask for clarification. This is what I understood. Is that what you meant? All the more better, you understand. Speed is not what we are looking for here. People who are fast, right, certain areas being fast helps. But this is not a mental arithmetic game, right?

It is not like JEE exam you are writing. It does not matter whether I solve it in one hour, two hours, right? Important teaching of the book. Lateral thinking. How many of you are reading the book? Textbook of creativity? Oh my god, not even one? How many of you bought the book? You bought the book? Or at least have a pirated copy, soft copy, PDF?

Nobody, yeah? You have a copy? Pirated copy, na? Does not matter. No problem. Read, read a text [02:12:00] book of creativity, did I not tell you? No. No? Text book of creativity. Okay, right. So note down, a text book of creativity, lateral thinking, Edward de Bono, I told you, right? Lateral thinking and text book of creativity are the same book.

Because this guy got greedy, okay. Ten years back, there was one book. Now he has split that book into two, three parts and then he is selling it as three separate books, okay. So, get the red one, right, that is a text book of creativity, red color book. If you find the old book, it's even better. One guy will be standing upside down, actually, lateral thinking, right, if you can find that book, right.

That's out of print ten years back. I used to have a copy gave it to my friend, that fella never returned it. So I don't have that to show you, right? Even, I have a newer copy with me, right? So, please read that book. It's something you have to put it in practice. Is the problem statements clear? How to pick a problem statement, is that clear?

Spend a week, right? You will [02:13:00] eventually change your problem statement, some of you, ok. Why? As you explore, you will realize, ok, sir, I recently found a work, sir. They have actually solved it better than what I could do. Fine. Take something else. Or you continue working on it, pivot it, maybe have a slight variation of that.

You understand? That is what I will tell you. Understood? Fine. Let us proceed. Why is this not working? Yeah, right. Guys, very important. I want your undivided attention. This slide is very important. You have to understand this because I am going to build up on top of this slide in the coming lectures, okay.

So there is a new word called landscape. What is landscape? Right, physical landscape, right. This landscape looks beautiful, right. There are a lot of trees, mountains. Yes or no? Now, we have a term called product process landscape. What is this product process landscape, right? Learn all these terms, right? Let us start with function.[02:14:00]

What is the function of this pointer? To change the What, what does it do? To change slides, to point at, right, to point at screen. It needs what is called the purpose. If a product does not have a purpose, it will be obsolete. I repeat, function means What is the purpose of the product? What is it used for?

What does it do? Cell phone, what is the purpose? It doesn't have one purpose, it has multiple, right? Right? It's a portable computer, it's your messaging device, it's your camera, it's everything. Right? So function for a cell phone is many. What is its purpose? It's a pocket computer, you can say, right? During my time, we had something called Newton, Isaac Newton, right?

Have you heard of Newton? There was a device called, my dream is to somehow, you know, I used to ask my uncle, he was, he was abroad, can you buy me a Newton, right, very expensive, right, 30, 40, 000 rupees, he is like, no man, it is too expensive, right. So it [02:15:00] is called personal digital assistant, PDA, okay, Google it, right.

So I am talking 2000, 20 years back, 25 years back, right. So personal digital assistant, which means, who is my digital assistant, right. So it's a with a screen, with a calendar. It had a touch screen actually, right? I've used it. Right. So you take a pointer and then write, you write on that. You can put a reminder, right?

You can do all this. Now your phone does it, all this, and it has no sim, nothing. It doesn't talk anywhere. It, you just carry it in your pocket. If calendar, if there is a meeting scheduled, it'll ring or. That is your, what is the job of a personal assistant? Sir, you have a meeting now. You understand? That is all it did, right?

It is called Newton, right? Then I had something called the Casio Data Bank.

What is [02:16:00] Casio Data Bank? Ok,

again it is a, it had a keyboard with a two line display. You can put your friend's name, address, it is like a digital visiting card. You can store all the information. That is it. That is all it did and it had a calculator. I still have one. It is no longer working. It is like a digital diary. Yes, it is a digital diary.

Right? Not a diary per se. You cannot make too many notes. It is more of a digital sort of a, what to say, organizer sort of thing. Right? So, that is what it did. Now, what is its function? Function of a PDA. Play the role of a digital assistant. Play the role of your assistant. What is the function of a data pack?

It is to store all the address. What does your phone do? Both. Your phone does, for your phone it is one of the many functions it does. You understand, right? So understand, that is function. Form. Form is actually, right, we looked at form [02:17:00] as in design, vadivam, right, Tamil we call it vadivam and then Hindi, what is the Hindi word for design?

Abhikalpana. Abhikalpana. Abhi? Abhikalpana. Abhikalpana. Okay, see, oh no, somebody said some other word last class. Bana. Uh? Bana is verb. Okay, Ana is, well, I'm talking about the noun, right? So when I say, uh, this design looks good, man means what? It's shape, it's texture, it's color, it's feel, right? That's what all this story, aesthetics, shape, size, aesthetics.

Yes. What is genre? What is genre? Where have you heard this word? G And Songs. Songs, songs. right. Mostly music. Music. How come music is coming here? Okay. What we are looking at is. Domain. Huh? Context. Domain. Not only context. Domain. Product. When I say product, do not only think of hardware products. Think of?

Think of? [02:18:00] Services. Services. Right. Software also. So, there is product, there is, there is product, there is service, there is product service system. Software as a service, SOS, software as a, SAS, software as a service, there is a concept in IT industry, right. What is software as a service? It will give you the platform, it will let, it will let you deploy your app, you just need to give it to your data, that is it.

Right. It will do everything for you. One of the thing, it is much more than that, software as a service is much more than that, right. So, when you talk about form, do not only think of physical products, think of software, think of your IRCTC website, right. That is also a service. That is a software service.

I can do bookings online. Think of your SBI app, you know app, right? So, what is the genre, what is the form of SBI app? Right, we will answer that. Right? Structure, what is structure? Typically, you know the English meaning of the word structure. Structure means what? There are multiple [02:19:00] components, how are they connected to each other?

So, in a generalized sense, ok, you have a Follow with me carefully, I will build on, build on top of this in coming classes. So,

I will talk about network, right, network theory little bit we will touch. You have got multiple nodes and these nodes are connected in different ways, you understand. So, this constitutes a structure. There are multiple subsystems, it is like this. Cells make tissue, a collection of cells is tissue.

Collection of tissue makes your organ, collection of organ makes your whole body, it is that simple, right. So, structure when I say, you have to ask at what level, sir. Macroscopic level, you are talking organ, ok. Now, I am zooming in, ok, organ level. Now, I am zooming in further, tissue level. Now, I am zooming in further.

Now, I am having cells. I am zooming in further. Now, a cell itself is a structure. It has got mitochondria, right, or your DNA, all the things. [02:20:00] If you keep zooming in, what happens? You will end with atomic level, right. So, when I say structure, it is part relations. There are parts, there are nodes, multiple such nodes, and each have their own relationship.

And understand, relationships can be on or off. So, if, if there is a link here, sometimes it can be on, sometimes it can be off, that is also possible. How is this possible sir? Now, this is not talking to that. When I press a button, it will talk to that. So, whenever I am pressing a button, it is talking to it to conserve battery, right.

So, your part relationships constitutes the structure. Next thing, content. Content means what? You are eating a dosa, what is content in a dosa? You have dosa batter, right. You have dal, urad dal, whatever dal, right. It is ground, right. So, There is, there is salt, right? That is the content. You take coffee, milk, coffee powder, sugar, right?

That is the content, what is physically. For a service, what is content? [02:21:00] Anyone? For a service, what will be content? Here, information, right? For a service, information is the content, right? Medium, what is medium? How you interact? How I interact? Medium is a bit tricky actually. For physical products, guys listen, for physical products, you do not need a medium.

I will explain in the next slide. Reason being, a piece of code is what? It is just a set of instructions, yes or no? It needs something to run, you need a hardware, physical thing, that will implement those instructions, yes or no? I will give you an example, okay. Have you heard of a device called, okay, you may not have heard, just read about it, C U R T A, Google this later, it is a pocket calculator, it is called, what we call as a mechanical calculator.

[02:22:00] Okay, did she come back? I thought she was sick. What happened to her? One girl left in the middle. Okay, maybe she did not do well. Okay, right. So, there is something called karta. What is karta? Right? Internet unfortunately does not work, right? So, you can do addition, you can do multiplication, you can division by rotating a few screws actually.

How is this possible, sir? How is this possible? Calculator means I have always punched buttons, that shows me value. Charles Babbage made dash. Calculator. Analytical engine, mechanical calculator, right. What is a mechanical, have you ever looked at it? Go, please Google it, please Google it. So, reason I am telling you this is, your algorithm on those will be just a sequence of, right, arrangement of gears actually.[02:23:00]

How do you code? How was the Apollo computers? Apollo 11 program, how many of you know Apollo 11 program? You are all right? You are okay? Apollo 11 program, how many of you know about Apollo 11 man? Nobody has heard of it? You know about the moon mission? Yeah, that is Apollo 11. Yeah, that is Apollo 11, exactly.

Right, you know how they used to program computers for Apollo 11, any idea? Okay, I will tell you. I will tell you how painful it is.

So, you have a, You have a magnetic ring. Guys, listen. You have to understand technology without understanding history, right? Because you are saying zeros and ones, right? Okay. What does it mean? It means so many things in so many contexts. Let us look at context of memory. How do you program something, okay?

You have a ring, which is what is called ferrous, okay, ferritic, okay. And you have a coil. This is called a toroidal coil. You have a copper coil, okay. Okay. [02:24:00] I said an electric pulse. Magnetic field. This has exactly, right, this is magnetized. So now this is magnetized. If you measure the magnetism, right amplitude, magnetism, it will be like this.

So it is magnetized. If it is magnetized means it is 1. If it is not magnetized means it is 0. Every bit was a physical ring. Can you imagine that, how big that memory will be? 1 KB will be the size of this room, you understand? Do you appreciate that? Which means what? The programmers who did programming of the upper low 11, were the best programmers who have ever lived.

Look at this lady, ok. I wish I had internet man. She had 500 pages of. Yes, she will be standing and she will have. Her height level of. Yes, we have seen that picture, right? I am happy, right. Please Google that, right. You put, right, I know, I forgot her name, Sarah something, [02:25:00] right. So, she would, she will be standing, the code she wrote will be like up to her head, ok.

Now, the point is, these codes have to be optimized. Why? You are programming at the binary level, you understand. You are writing it, what, machine codes, again hex. If you go to binary, it will be 0 0 1 1, it will be crazy, right. And during programming, if some, some, some programmer, right, the actual one doing the Instead of zero, if they put one, what happens?

A gone, the whole machine is, you understand how painful it is. You understand how painful it is. There are people who have sat, they have like punch the cards, literally. Uh, one. Okay. measure. Yeah, it is one. Okay. Next. Zero. Okay, don't charge it. Next you understand this is how painful storing was. Now what do you do?

4K. It comes, can you, can you process somebody who's arrived at that time? If they are here, they'll be like. What the hell, right? You [02:26:00] understand the context, right? Because why? I can little bit appreciate why? Because I used to use, last class I told you, floppy of 1. 38 MB. MB for me is a big memory even today, right?

I do not know how you treat MB. Maybe the way you see terabytes, I will say, I will see megabytes, right? For me, MB, 1 MB of big memory man, right? I am used to 512 MB, right? The pen drive, first pen drive I bought, they still have it, still works. That is 17 years old. I still have a transcendent, right? It still works, extremely slow.

Extremely slow. 512 MB, big memory, right? You understand, right? Zeros and ones, this is how they programmed it, okay? Why am I talking about this? For an algorithm, whatever you are writing, it is just a concept on a piece of paper. It can be an electric charge in case of your phone or it can be a magnetic charge on a ring.

It can be anything. It can be a cam on a multiple gear box, you talk about a mechanical calculator, sine of 45. [02:27:00] You have to put sine, 45 and you have to rotate and it will run numbers and you sine of 45 is, got it? Now can you appreciate? So software services needs, it needs a medium. So your Ola app for instance, your Uber app, Zomato app, it is what?

It is just a idea, concept or algorithm. Needs a physical thing to run on. So that physical thing is called a? Medium. Medium. Got it? So, what is process? Banana, right? What you are saying? The process of making, right? The process of writing a piece of code. The process of composing music. Now, is this clear?

This is the important thing in product process landscape. And we have something called behavior. What is behavior? Okay? All of you are here, nicely air conditioned room, right? Reasonably silent. And you have a teacher who is teaching you. Imagine I take you, same [02:28:00] teacher, same students, I put you below that tree.

Will you learn? Same teacher, same students, they are sitting behind that tree, right? If I have a people tree, right, if you all go sit under that and say, I am teaching the same lecture, no presentation, no pointer, I am having this board, I am teaching you the, teaching you same, I am no one teaching you. Will you understand?

Yes sir. Yes sir. But will it have this impact? Yes sir. Does it matter? No, no, no, no. You cannot say it does not matter. This is the important thing I am talking about. It is called emergent behavior. What is emergent behavior? I may be the same, the students may be the same, the teacher may be the same, but the context, right, that is the important thing, physical, economic, social, environment context, that will impact how the behavior comes out to be, okay.

You understand, I repeat. The emergent behavior, right, is contingent upon multiple factors. I can have the same [02:29:00] inputs and have completely different output. In other words, I buy a Ferrari, can I drive? Right? Or I take a Tata Nano, go to Europe, go to Germany, U Bahn. Can I do that? Deutsche Bahn or whatever they are, forward, whatever the road is called.

There is no speed limit. You can drive how fast you want. Autobahn, right? I go to Autobahn. Nano will go probably 80, 90. What is the point? So, the emergent behavior is different, right? You understand? So, that impacts quality. What is quality? Performance, usability, intelligence, sustainability. Reliability, beginning of the class I told you.

A desired performance over a period of time in a sustained fashion, right? Can I give the same output, right? For instance, I buy this phone, right? My phone is there. Today I am making a phone call. I can hear it clearly. 10 days later I make a phone call. Is it at the same level? The quality is made. That is what we call the function.

Whatever function it [02:30:00] is doing, is it delivering that function at a sustained level over a period of time? That is what we call as reliability. Got it? So if it declines, we say it is not reliable man. It is terrible. You understand? This is fine. So the key takeaway is behavior emerges from the pattern that integrates multiple dimensions.

So, this emergent behavior I am talking about is dependent on a lot of factors, lot of dimensions, right. So, couple of examples we saw. Let us look at one more thing, classic example, another example I gave you last week. Same biryani you are having in some hotel here, go to Taj Coromandel and have. I give you the exact same biryani, ok.

It is literally, will you not say it is more tasty in Taj Coromandel, yes or no? I give you the exact same thing, no difference. Huh? Huh? Because we paid more for it. Not only you paid more for it. No, I told you right. The context is different. [02:31:00] Writing is different, right? The table is there somebody who's coming and like standing next to you, sir, but they don't understand why that's changing.

The taste your perceived taste will change. It'll not change the taste. Your perception, it impacts your perception. You understand? It is the same food. You'll give an nine out of 10. You'll give a nine out of 10 there because I've changed the context, right? You'll do it. Now, you are biased. If I do a blind study, what is called a blind study, if I just take you, yes sir, this is definitely better, sir.

They have a better cook. Then later on, if I tell you, no man, it is the same damn cook, right, but I put you in a different setting. Or rather, if I cook it in Taj Corral and give it here, you will say, this is horrible, man. That is also likely, right. So, this is fine. Let us quickly spend the next few minutes going through this.

Here you can watch from the pattern. Right. So, here I have put car, cola and music. What are all the different, guys listen, different elements. Students listen, it is very important, right? [02:32:00] Different elements of product design, right? Context or environment, what is the context or environment for a car? It is, where is it running?

What is the condition of the road, right? User segment, right, so on and so forth, right? What is the personal purpose of a car or the function of a car, right, for personal transportation? And when I say purpose, overall purpose is that, but if you look at it internally, what are the sub functions? It is the uh, transcript of.

It is the a, b, c, d, e, f, g, r, k, i, j, s, h, u, v, l, m, n, e, f, g, d, e, f, r, g, l, m, n, n, s. what is physically there. Steel, aluminum, plastic, right rubber, right [02:33:00] glass, so on and so forth. Medium, not applicable. Why? The car itself is a physical thing. It does not need a medium for it to work. Process is very important. What is lean manufacturing?

Lean means what? This guy is very lean man made water. If I say I am very lean means what? I am very thin. Is being thin a good thing or a bad thing? Depends on context. It depends on the context. Depends on the context. Good thing. He has learnt to repeat. And, it is very important. It depends on the context.

But, mostly being lean or in other words, right, thinking, and processing is very, What are we talking about? Process of making a car. The process of building a car. If it's lean, means what it needs minimal resources. That means what? It's very good. Actually. I want it right. In software, we have a name. It's called Agile.

E is here. Agile. What is agile man? Agile, uh, product, uh, software development. If it takes a hundred developers, right. If I can do it with 50 developers without hampering the output quality, that is also there. [02:34:00] Not like Boeing, okay. Now I will, uh, just, uh, put it under, under the rug. Don't do this. Right? You don't sacrifice on the quality, but you have other systems in place.

How can I do this, sir? How can hund, fifty people do the work of hundreds? So you modularize. What is modular, modularization? See, my time, if you wanted a code, there was no Stack Overflow, there was no GitHub. What do you do? I have to literally know the algorithm in my head. Have you, just try this. Gauss elimination, all of you know.

Can you write your own code in whatever language? I want you to write your own code. I will give you a 4 by 4 matrix, do Gauss elimination and tell me like 4 values I want you to find. Can you do that? How many of you can do that? Please do that. Challenge yourself. If you cannot do this, you are unemployable.

This is exactly what industry readiness means. If I give you a 4 by 4 matrix, if I tell you use Gauss elimination. Or use some sort of decomposition. You understand what decomposition is? Can you decomposition? You, you, [02:35:00] you been taught right linear algebra? Can you write it on your own, your own algorithm? I can go to github, you can go to github.

Let us say there is a solar flap. We go to dark ages. Everything is dead. We have to start developing from scratch. What do you do? You understand, right? So my time, you cannot go refer. You have to sit and do this. Break your head and write your own algorithm, which means your own thing. The point I am trying to do, is right?

This takes time. If I am thinking of algorithm for everything, I am going to spend a lot of time solving it. If the code is modularized, and if it is sitting somewhere, all I have to do is what? Use. Integrate. Take that, take this, connect. Will it work? Yeah, it works. All I have to do is manage the Today's software engineers are doing this.

Look at what it is saying. Software, modules, components, database, GUI, hardware, cloud, etc. You only do [02:36:00] integration. In the truest sense, right, nobody actually sits and actually writes a new algorithm. I have not seen any software engineers. There are lakhs and lakhs of software engineers, right. So many of my friends are in the industry.

I do not know one guy. who actually sits and bangs his head and actually writes a original algorithm. I don't know of anyone. The people who do are people who are actually in academia trying to come up with the new algorithms that are more computationally efficient. That is how nVidia came with CUDA.

Before CUDA, right, there was no parallelization. Everything was done sequentially. Your clock will run, every, every other fellow has to stand in a queue. It will execute, Okay, next fellow. It will execute next fellow. That is how your computer, right, CPU was used to process. Anyway, I came up with this. very different idea ok.

Guys, last bench I see some activity right. So, QEDA what happen? Instead of having a strong process and I will make a [02:37:00] weak process and I will make multiple such process there, let me paralyze, QEDA course all of you know right. So, different approach right that is AJ process. Now, you understand AJ right, it is not that I am doing a terrible job I am still doing as good as a job with minimal resources.

So, let us go. Behavior, what is behavior? Car, what, what it is do? Performance, what is the pickup? If you want to go fast, you need a good road, right? Is it comfortable? What is the mileage, pollution, noise, right? So, for a physical product, is this clear? Let me go to a software product, Ola app, right? What is the context?

Location, where am I using the app, right? Network strength, signal strength, so on and so forth. What is the purpose of Ola app? Don't say to book a car. Look at the word. It's written there. Just in time mobility. What is just in time mobility? To book a car, I can always call fast track, right? I can make a phone call to fast track and say, send me a car.

Sir, I'll send you a car in the next one hour. There is a car [02:38:00] that comes from middle of the city. Ola, Ola is I want it now. Just in time. Jit, right? It's a Japanese term, jit. I want it now. I want a car in the next five minutes, right? So that lets you do that. That is its purpose. Right, so register, find location, vehicle, compare cost, et cetera, form.

What is the form? It is the application, right? What is the structure we just saw, right? The technical architecture, software modules, components, database, etc. Et cetera. Content. What is inside, right? What is it I am? Where am I booking it from? What is my bank balance? What is my credit card number? All that information, right?

Next medium. You need, of course a phone to run this software. So your medium is your phone. And the back end architecture, right, your back end software technologies, right, your database, so on and so forth, process we just saw in detail, behavior. What is the user experience? How quickly am I getting? Is it easy to use?

Can my grandmother use it? Those are the questions I am asking, right? That is the behavior. Let us [02:39:00] look at music, again a service. What is the context, right, auditorium, the acoustics, seating, air conditioning, so on and so forth. What is the purpose? Mostly entertainment and to calm your mind, some, some uses, form, what is the form of music, right?

There are different forms, right? Classic, rock, right? This we say the genre, right, the type of music and the structure, what is structure? This is important, right? Structure for a Ola app is the software module, how they are connected, how they talk to each other. For a music, what is structure? You just sing a song.

Beats and raga. No, no. Notes. The different raga, the different scales. Why not beats? Different notes. B, it is tempo, how it is, how, you understand, yeah, that will more like a, uh, uh, come to the genre. Classical music will play slowly, jazz will play slowly, rock will be bit more sped up, you understand. What I am saying is, how are the, what are the different [02:40:00] constituents of the service or product in question and how do those elements talk to each other, understand, that is the question I am asking.

So, the question is different arrangement of notes. A, B, C, D, E, A, C, B, D, E, right, you can change them, right, all the different permutations and combinations. That is the structure. Content, what is the words, lyrics that the artist is using? Medium, right, you need a violin, guitar, keyboard, something to play the music on or you need, right, a music player, right.

Process, actual process, right, the process of singing, right, composing. Behavior, what is the emotion? Emotion. Right, behavior, you are playing music on your phone, you are playing your music on your laptop, you are playing your music on a stereo system. Same music but emergent behavior, right, what I was talking in the previous thing, this is very important.

Depending on the context, right, even if I give the same ingredients, it is going to be different, right, the emergent behavior, the different [02:41:00] elements combined and the effect I see is going to be influenced, that is what I am saying, fine, okay. So, another very important thing, right. So, innovation, design and systems, right, these are extensively used across different disciplines, right, and in a variety of ways, ok.

What I want you to do is, right, since there is only 15 minutes, I have a few more slides to cover, I will leave it as an assignment to you, right. I want you to write in your own words, what is innovation, what is design and what is system. I will leave it as an assignment for you, ok. Let us go to system C, ok.

Guys, listen. Sir, what are the three words? Design, innovation, design and system. System. And let me tell you why, what is the intersection here, oops, let us see why. Intersection, you are [02:42:00] going to join here as the point of intersection, not going to join

You are just going to type in the n. T. T. S. S. A. A. A. A. S. S. S. right. So, if you work. Transcript argument, is that correct? Yes ma'am. Yeah, okay, okay. How is this what are the letters, what is written here? Summary? Summary. Yeah, okay. So this is, this is, this is the fraternity, I got that [02:43:00] right? So now you can do the, you can do the work that you can write.

So you can do the work. You can write the work. Summary, summary, that is for sharing. Yes ma'am. Summary, summary, yes ma'am. So, what we are doing, we are doing this is for the sake of understanding what a test is. So, we have to do three more exercises and then we have to be able to, it is a challenge to do all the exercises.

So, this is a challenge to do a test, we can do it in a test environment right. So There are multiple phases to it. Let us look at it, right. You have to understand what is called reductionist thinking. What is reductionism? Reduction means what? Reducing. What does it mean? I will give you a classic example, ok.

What is a classic example, sir? [02:44:00] Take global warming. Why is global warming there, man? If I ask you this question, why is there global warming? A. C. A. C. A. C. Overuse of AC. What causes global warming? Overuse of air conditioners. Huh? Air conditioners. He is saying overuse of air conditioners. CO2 na? We say greenhouse gases.

Yes or no? All of you know this, right? Yeah. What causes global warming? CO2. So, what we have said?

More CO2, more global warming. Okay? This is reductionism. Why is this reductionism? You have not factored in, you have reduced. A complex phenomena like global warming, many factors participate. For instance, let us logically think this through. Sun is here, earth is here, earth average temperature is 15 degree centigrade.

So, sun is constantly shining. Now, [02:45:00] if the solar output goes up, what happens? This temperature will go up. If the distance between the sun and the earth, if that increases or reduces, what happens? Temperature will go up. So you see there are a lot of factors other than C do. See the output from sun is not constant.

It is constantly changing slightly, not by a large margin, but it does change. It's not like a light bulb, right? This is constantly giving 40 watts of uh uh, or not 40 or a hundred s of light, right? It is constant. I can control this sun is what, right? It is giving, but it is a variable. You understand? That can cause a change in global warming as, or no, it can.

But, we are never told that, right. The distance between the sun, that changes. There are other things like CO2. For instance, there is a volcano, volcano erupts in Hawaii. That puts out lot of, lot of, uh, what do you say, not so, they call it, uh, [02:46:00] particles. That, that changes the heat penetration. That affects global warming.

You understand? So, there are actually, uh, thousands and thousands of factors that cause, that affect, not say Has a role to play in global warming, I am not able to process it. Right. So what I'm doing, I'm asking the question, what is the most dominant contributing factor? So I'm listing them down and saying, CO2 80% or 70% of all that cost by CO2, I will blame it on that.

And I will simply say, global warming is cost based. C. You understand? So we, we do blame what we can control though, correcter. But there are things beyond your control also. No, see, I am not getting into the argument of whether this theory is right or not. All I am saying is, this concept of taking one factor and associating it because of one phenomena is what is called reductionist thinking.

That is all I am saying, right. This can be applied anywhere. [02:47:00] One classical example I am giving, right. So, this is limited and narrow disciplinary view. Why is it disciplinary? I am telling you one thing, right. I am not taking, right, the astrophysics, the other heat input. There are many other disciplines. I am simply ignoring them, right.

So the problem of reductionist thinking, this is one problem. What is the second problem? The CHA challenge of integrating disciplinary concepts in cour ability, which is what I showing here. What is insurability? Incompatibility? Can you make a philosopher understand science or can you make a scientist understand philosophy?

This is actually a philosophical question. You think about this, right? You what are all some of are here, right? You will get a and M tech. You'll get a B Tech. B BTech. Dual. Yeah. All dual. What about BTech? Right? BTech. Okay. Ali, right. Ali will walk out with the B Tech, uh, [02:48:00] will walk out with the BTech at Mtech tomorrow.

Ali decides, okay, let me get an mtech. Okay. Spends another two years. He gets an mtech. So that sort of technology, master of technology, what should be the next degree you get? PC. PC is what they've named it. Think about it Logically. Masters in technology. Huh?

Master, Grandmaster, if we logically think, no, no, no, I am trying to emphasize a point here. Bachelor. Bachelor of Technology, Master of Technology, Grandmaster should have been the title, logically thinking. What have they named it? Doctor. Doctor. Doctor. Doctor. Doctor. Doctor. Doctor of Technology, PST. There is no concurrence right?

Why is it named like this? This is what I was thinking. I asked my teacher, he gave me some, uh, and then I, after, right, ten years, I think I have found the answer. I will tell you why, ok. Why is it defined as [02:49:00] philosophy? Why is philosophy important? I used to think philosophy is a useless subject, right. What has got philosophy got to do with anything?

It is useless. No. Philosophy is what drives your thinking. That is what makes you propel. I will tell you why. What is my philosophy? What is my Indian philosophy? Ok, if my philosophy is I have to safeguard my ecology, I have to safeguard my culture, my language, my customs, then the economic system that I will set up will be in line with that.

What is my philosophy? I want to compete with China. My philosophy I want to compete with the West. Then what am I setting up? That is why the degree is named as Doctor of Philosophy. Philosophically you, you have crossed the level where you have mastered a, What is the question? You asked, yes sir.

Technology is subject at, at the master's level. But beyond that, you can keep mastering. There is no limit to mastering right. You can, there is no grand master. You, there is no, you can just keep learning. But the point is right, if you start, you, it changes your perspective right, it changes your belief system.[02:50:00]

It makes you question everything. If you tell me a piece of research. Sir, if you eat this, you will get cancer. Then, my next question is, what country, what is the age group, what did they eat, how long did they eat, what was the control? These are the questions. I will ask you. I will not accept any result you show me.

You understand? So, now the problem is you bring in a guy like this and you bring in a scientist, you bring in a social, somebody who is specialist in sociology, you bring in a somebody who is economics. How do you make them agree? Let us take a car manufacturer. Let us take Ford, okay. Marketing guy will come and say, sir, this is what the customer will want after two years because if I start making a car now, design process will take me two years, right?

So, this is what they will want. Okay, you start building a website. Okay, IRCDC website, they want to revamp. Okay, it take us one year, sir. Income tax website, they took like, Infosys spent like one and half or two years on that. Right? Why would it take that long? That is how long it takes, right, to make it robust.

Now, after two [02:51:00] years, the whole paradigm of how do you make a website might have changed. Now, this will come obsolete. Uh, it is a dated interface, man. Yes or no? Now, different people from different disciplines will be arguing, will not be agreeing. In other words, they will have incompatibility in working together.

This is what the problem is, interdisciplinary approach to problem solving. How do we solve this? That is the central question. You understand? That is why I started with the question, what is right, not who is right, right? Next thing, dealing with socio technical problems in search of a common language, right?

I will talk about it in this slide, right? Another five minutes, I will wrap up. Look at this, what is called fundamentals, right? Have you heard of this unified grand theory? Has any of you familiar with this idea? So, one theory, it is like a Big Bang Theory, you can explain the universe, you can explain. What about unified grand theory?

Can you explain psychology with unified grand theory, I mean with Big Bang Theory? No. Can you explain medicine with that? No. So, can [02:52:00] I have one theory that explains everything? Explains art, explains science, explains economics, everything, right? That is what is called the insert of a common language, right?

So, how can we do that is what we are going to look at here, right? So, you have a problem situation at hand. What is the problem situation? You have a scientific situation. What is scientific situation? Water flow, water is flowing, right, fluid dynamics, ok. And then I understand that I am looking at vehicle traffic.

Now I am having an insight, oh, water flow, vehicle flow, looks very similar. This is, I have an insight, ok. Next I am thinking deeply about this. I am having a concept mode, right. I am having multiple factors, right, that influences fluid, water flow and factors that Vehicle flow what I am seeing, are there any parallels I can try, right?

I have a set of variables here, I have a set of elements here, right? Can I just draw parallels? Can I compare, can I have a one to one mapping, right? All of you have [02:53:00] learnt set theory, right? I have one group here, one group here, multiple elements, can I map these elements? That is the question I am asking.

Next, I am doing more rigorous formulation. much more rigorous formulation on both the areas, ok. And then if I can get to that level it is called isomorphism. In other words, right, I have a scientific model that describes vehicle traffic as well as, right, the flow of water, right. So, you have, you have to use certain principles, right, deduction.

Right? Write down. This you will forget. So write down. Deduction, induction, abduction. Right? Abduction is this process of analogy. What is abduction? What is analogy? Right? What is analogy? Right? Establish. Time is money, if I say. Time and money, I am comparing. So that is an analogy. Is time and money the same?

No. No, [02:54:00] but? Both are valuable. Time is valuable, money is valuable. Dude, you are wasting your time. You are wasting your money. So, time is one. Right? So, that is an analogy. So, that comparison is called abduction. You understand? I am comparing something somewhere, somewhere else something is there. I am comparing these two.

Right? It is called analogy. Right? Next thing. Right? So, deduction. What is deduction? Deduction is first principles to specifics. What is first principles, right? So I am having a model, I am going this way, right? Induction is specific to generalization. So I have a specific situation at hand. Can I have a unified grand theory, right?

That is induction. And, right, generally, right, deduction is very useful in engineering, right? Induction is very useful in social sciences. And abduction, right, that is very useful in design. Why? [02:55:00] Why is abduction very useful in design? Because I am comparing something which is already there, I am comparing that with something which is in a different field, but I am trying to see is there one is to one mapping, right?

If I have a model for fluid dynamics, different molecules of water that is flowing, can I treat every vehicle as a different molecule, which means why I can design a better traffic signal, traffic flow system, you understand? So, that is what we are looking at, fine. So, this is like the basis for system theory, it starts here, right.

So, it all evolved from an area called cybernetics, right. What is cybernetics? How many of you have seen the movie Terminator, Arnold Schwarzenegger? Now this, hands up. No one has seen. Not everybody has seen? You know Arnold Schwarzenegger? Yes. He is a robot. Yes sir. So, it is man and machine, right, right. No one saw it.

So, [02:56:00] cybernetics is all about that, right. You have got robotics, you have got communication, you have got all these fancy technology. Where did this all come from? This all came from world wars, ok. It all came from, it is a offshoot of both the world war 1 and 2, right. U. S. wanted a lead, Germany wanted a lead, Japan wanted a lead, they were doing whatever.

So, in U. S., all these systems theory, complexity science, right, people from different disciplines, right, the department of defense, right, there is something called the Manhattan Project, right. This Oppenheimer took a movie, what is that movie called? Openheimer. Openheimer. Movies called Openheimer. Movies called Openheimer?

Yeah. I, my memory is very bad man. Right? So, that guy, right, scientist, he, they built a bomb, atomic bomb, just read the different disciplines people they moved in. They created a complete town with everything and then they brought in the best people, one brown, everybody, all the best scientists, right, who fled Germany, right, they took them, best scientist of US, NASA, they put in all the best [02:57:00] scientists together.

People with different backgrounds, they made incom, incommensurability, incompatibility compatible. The government made them, forced them to work together, solve the problem. So all this came from your systems thinking, whatever I am talking now, came from an offshoot of that, right. You, you, you have the years here, it evolved over time.

Your computer science basis itself evolves from there. All the theory that you are reading, right, bringing in, wow, most of CS is actually mathematics if you actually. Yes or no, right? All the theories you read all comes from mathematics actually. No application. Mathematicians like to solve problems. Just syntax.

Right? Now there is a much more disciplined and streamlined way of doing things. And this we take and apply, right? So science, technology, product, society. Always remember that. It should be ulta. Society, product, technology, Sorry, society, uh, society, product, technology and science. Science. Right? Right. So, it is what is called the demand driven pull, the system has to pull, which means somebody is asking, I have [02:58:00] this problem, can you give me a solution, can you solve this.

So, you as an engineer, oh, I can make a product for this, there is a business opportunity, remember that slide. Once you have a business opportunity, you ask, what technology can I use? Oh, for me to use this technology, I need to understand this science, it is that simple. You follow this, right? So, you understand this, This is the overall summary of systems theory, if you actually see, if you look at this, this is the overall, words I give you.

Next week onwards, I will focus on methods, how to do discovery, how to do diagnosis, how do you derive, right? You have this product process landscape, right? You have something called morphology chart, right? How do I make a new thing? This is a remote, I have another remote, how do I build something new, right?

We will look at different methods that people, right, people use, Philips. Right. Gives us some up with some fantastic methods. Motors, right? We'll go back. hp IBM, right? All these companies, they have their own systems, right? So we talk about all that in the upcoming classes. So you have. [02:59:00] Teams, I'll try to resolve, otherwise I'll send you off.

Right? Okay. Let me just have something. I think so. Isomorphism. Isomorphic jobs, I remember. What does that have to do with this? I don't understand. Different way of thinking. Sandy, what? Where are you going? Oi, oi, oi, oi, oi. Get that now. Bharat Darshan K. What happened? for providing your message. I will get my pen back.

It's unlocked. Down, down. I'll ask him if he can put it on. Other people can use it. I'll ask him if he can put it on. Good that he didn't put it on the head. He hates it. No, [03:00:00] I absolutely love this thing. Why? Epic. Amazing. Um, Um, Anuragi Pink, yeah. Sure.

No problem,

so very

today. This guy is animating Jeevan. Yeah, Jeevan was my bro.[03:01:00]

Classical, there's something should be there. No, should not be there. It should be there because.

Without beats also you can't have music. Without beats also you can't have music. Without beats also you can't have music. It's old practice. Look at this man. We are taking a picture of this Krishnadingam here. Cute, it's so cute. It looks good bro. It looks amazing. Why you are Vamshi but not Vamhi? Why you are Haridandan?

Why you are Haridandan? Not Harini. Yeah, [03:02:00] why are you not Harini? I am male. Why are you male? Why are you male and not female? Because I have Y chromosome. Why do you have Y chromosome? Ask your dad. I didn't ask. Why did you ask your dad? Bhaiyesh! Bhaiyesh, listen to me. Bhai, listen to me. Yeah, I'll see. I'll see.

What? Q. Okay. See, some people think the ball is H05. Who?

What, bro? You're smiling. What? Everyone is sending me this picture, man. What a baddie. What a baddie. Oh, that's C A R T A. C A C U R T A, bro. Kurta. Ah, kurta. Iron Man is Kurta on. What a baddie. What a baddie. Manamela. Feather. Velchukka. Baddie. You're a baddie now. Batrish is a baddie. [03:03:00] Batrish, are you going at 7 o'clock?

Where? Jeevan. Jeevan Singh. If he invites me, I'll go. Yeah, same. But he told me yesterday that he's going to call me. What's in the mess? What's in the mess? Sweetcorn. Let's go. Priyansh. Peri, peri, peri, peri, peri. And what does it come? For parts, ringtone, no? No, no, my cousin brother also has the ringtone. Nice.

I need to use the restroom man, that's why I went outside. Okay, come we'll go to the restroom together. Suss. Stalls. Do you watch Vsauce? Vsauce? Hello there, Vsauce. Hello Michael, Vsauce. Bodybuilder. Brand. Yeah, bodybuilder. Dude, I remember watching a [03:04:00] video of Vsauce related to Not a video, a series. You know, you know a series.

What series? Like, how people's brains work. Like, they conduct experiments. Social experiments and all. Nice, you should watch. What else? Ah, man. I'm loving this design course. I have a feeling we'll work well in this. I have a feeling this course will be good. We'll see. Hopefully. I don't expect it. People are tired, bro.

After second semester. People are tired. Huh? People are tired after second semester. Why? See, they just want some time off.

Time off? Yeah, from this side. Such people will be here. They are [03:05:00] here. I mean, I don't think you would know before it's such that this goes for such that's how you do it. No, no. This one is amazing. No, I'm telling you. You think it sucks, huh? No, I don't. No, no, I mean, it's fine if you think that way. No, I'm just telling that.

I mean, it's fine if you think that way. No, I don't think like that. I don't think like that. But you, you, you just feel like it should have been better if it was one course or something. No, no, I don't think anything like that. See, it's fine if you think that way. It's just starting, I don't know if it's starting.

No, I'm not saying it's starting. Ah, so you're not generalizing. I'm not generalizing, yeah. It's always specific. You have to be specific. Context specific. See, design is bad, no? What did you decide is bad? Which course is bad? What part of the course is bad? What part? Yeah, what small part is bad? So you need to See, whenever you hate design, you have to be deeper.

Why you hate what you hate? What structure means? Is it atomic structure or what structure? [03:06:00] It's not coming up. Overcome, she'll come. I'll go eat cheese man. I'll eat veg man. Okay, then I'll eat veg man. Hey, what is the time? 5. Today I need to I have esports. matrix package. Oh, fuck. Don't worry, I'll send you the code.

Okay, thanks. I have to do that I finished it. You add comments and make it different. Oh, really? You finished it? When? Today? No, no, no. I finished I finished determinant fully. Like, complete, uh Complete Inverse you did, huh? Inverse I'm going to finish. Cofactor, I need to write cofactor logic. If I write that O away.

Obviously. Obviously. Obviously. Oh, Parodic madam. Yeah, Parodic. If I'm done with that, then I'll just write main function. I'll just write main function. And then I'll send it to you. Okay. You rename. Right so, right. So, okay. Okay, right. Okay, so, I failed some of you guys in the course. Please don't feel bad. Who [03:07:00] says that?

That day he told in cafeteria. Really? Yeah, he came to us and said some of you guys might have gotten some less grades. Okay, so, don't feel bad. Don't feel bad. I don't think

so. I don't think so. He'll be like, ah, Badresh. But, but, you are local CR. Local, local CR. But you're going home, yaar. Hi, Rohan. Roshan. Rohan. Roshan. Rohan Joshi. Oh, it's Rohan Joshi. Roshan Joshi. Not Roshan. Roshan Joshi. Joshi Joshi is like a family name. Yeah. Joshi, Singh, Kumar. Huh? No, Joshi usually comes in the other half of the name.

Yeah, even Kumar comes. Gulshan Kumar. [03:08:00] Kumar is not a family name. Bansh Singh. Kumar is like very generic even in Tamil. That's what, family name only, no? Basically. Like it's like an initial. No, no, no, no, no. Yeah. Then Kumar is the initial, no? No, no, no. It's the last name. No. First name is Praveen. Praveen Kumar's dad is not, not Kumar.

Might not be, might not be. Damn, they give salad, ah? Super, ah? I didn't know that. Sunky. But I won't eat. Why? Because I like my food.

Drink.

I paid you 35 that day. I paid. You paid for me. You paid for me. You pay for me. This. Bhaiya, 2 veg maggi, [03:09:00] 2 coffee. Rupees 30, received on phone pay. 2 coffee. Uh, two coffee, two Weg Maggie

84.

Coffee and. Give it to me. Tell me, is he taking anything? I went for dinner. Which one? [03:10:00] I went with Ritik. No I went with Ritik. After coming back from campus, Ritik left.

It's a very simple, you have to add five numbers to get the targets. That's it. Yeah, that's it. Last period. Yeah, yeah. Simple but, uh. I used five moves. It worked. Five loops, huh? I do. Me too. There, there must be a simpler way. Yeah, there must be a simpler way. I thought it. What, what, what? Look at that. Yeah.

Chameleon, chameleon. So cute. Chaisa ready. He thinks it's angry. Bro, he thinks it's angry.

Oh, it's so big. That's what she said. [03:11:00] Imagine it going up and down. No, no, no, no, no. You're acting like a dinosaur. Yeah, bro. I was saying. Where did he go? I'm deleting, bro. Why? Color change is fun. Why would you? You feel threatened? We are Krimli. This is Khada, no threat. Badrash is Khatra. Satraya is Khatra bro.

Satraya is Khatra, right. Bro, bro, look. That's okay. Meow. Meow? Ha ha ha.