Digital And The Everyday: From Codes To Cloud
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Lecture - 04
Socio-algorithmic processes & the Everyday-Part 02

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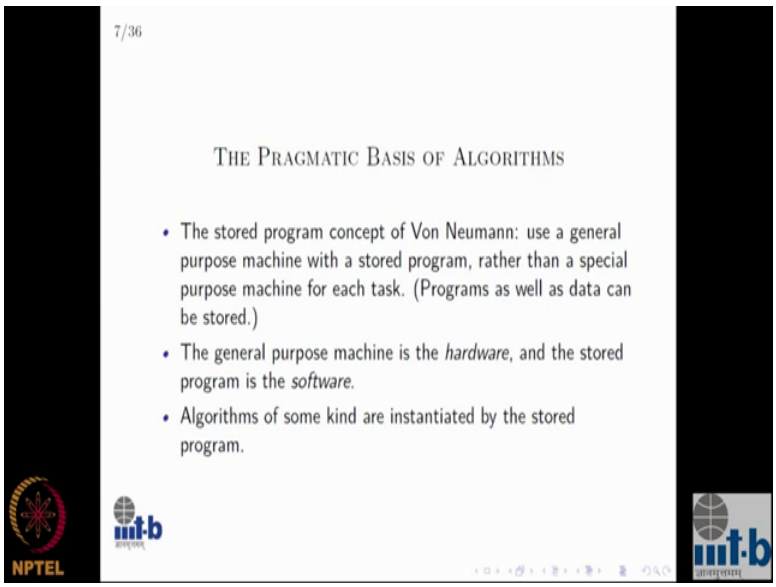

And algorithms of some kind are the instantiations of the stored program that is or they are instantiated by stored program that is what this is.

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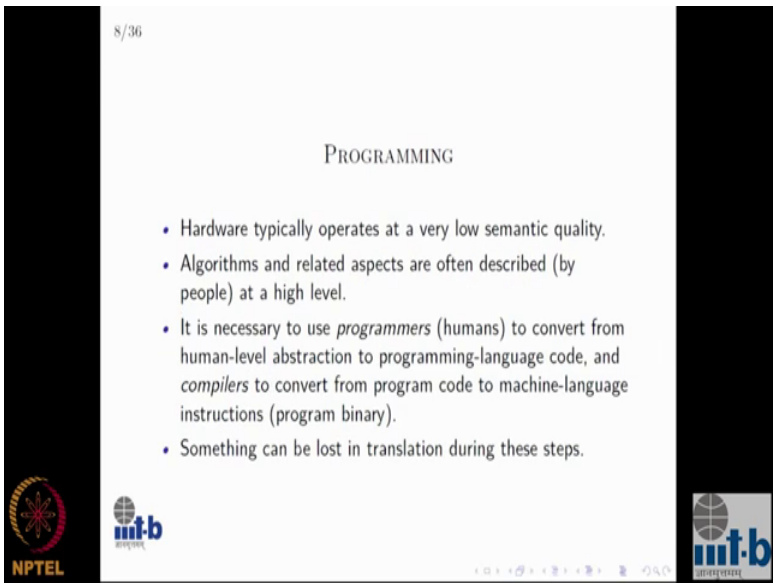

And one issue in this also is that hardware typically operates at very low semantic quality.

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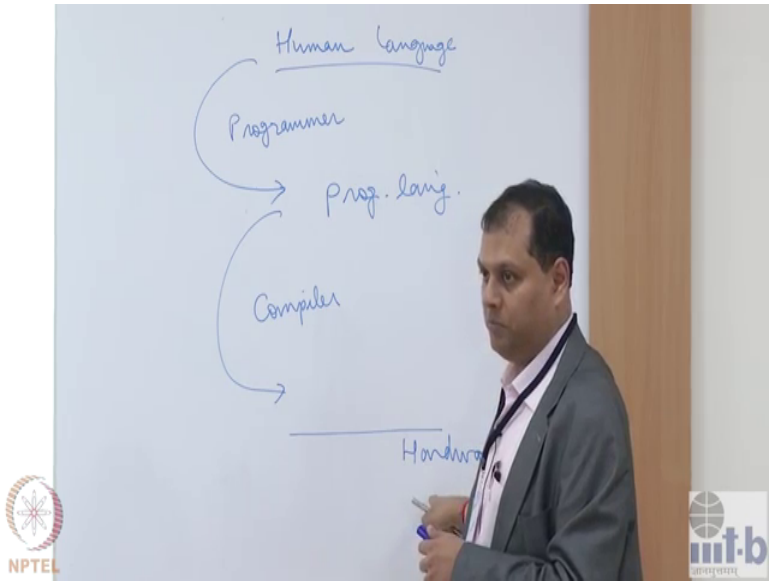

If I were to describe it in a very crude way, this would be your hardware which if you look at hardware instructions and I have, if you look at assembly language and similar things, those are very low semantic quality basically they operate at the level of somewhat very well trained dog, fetch, heal, run. So, you have some basic instructions of the hardware can directly understand. And then as human beings you have human language, which is much more semantically rich, we can use idioms. If I say that guy is real tiger, probably do not mean he is actually an wild animal who runs in a forest, I am using an idiom, I am using an metaphor, I am using some such constructions. So, human language is actually in that way.

So, there is a gap between what the hardware knows and what the human beings wants to say, and this is where programming actually comes in. So, in between these you will have some level which is this the programming language. And this task to convert from human language description to programming language is the job of a programmer, nowadays they call them developer or whatever that is what this is. And this task would be done by a complier to convert from the programming language to the machine language code.

And of course, if the programming language is more and more semantically rich, the job of the programmer becomes easier because it is closer and closer to the human level. Whereas the language is not that rich and it is close to machine language, it is actually very difficult for the programmer to write the code, because the programmer has to cover most of the distance, so that is what this is. So, programmers are almost always required because there is no system yet which can where no hardware itself can neither understand human being completely nor is there a compiler that can cover all these distance automatically that is why you almost always have human beings in this process somewhere in software development.

And unfortunately though we inspired by our best effort something can be lost in translation so what you get here may not be exactly what was described here. And then if the compiler is also not exactly write, then what is get what is processed and returned an output here may not be what was intended, so that does happen there are famous cases that we all know of where that has happened.

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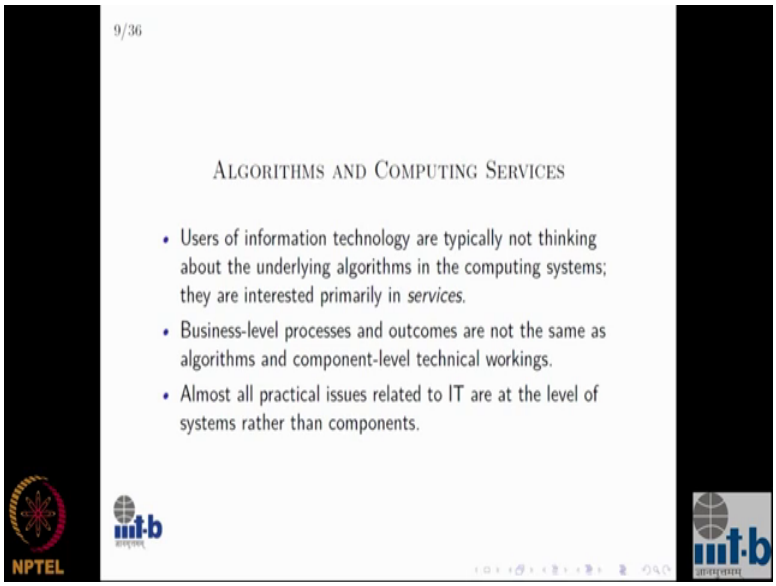

And one issue about this also is that users of IT systems are not typically think about thinking about underlying algorithms we all think about services we all think about things that effect us in our daily lives. And business-level outcomes and social outcomes are not the same as the algorithms and the component level workings, which is the world that I came from as a computer scientist. So, all the practical issues related to IT or at the

level of system rather than at the level of components and their technologies that is one of the issues we need to think about in this workshop also.

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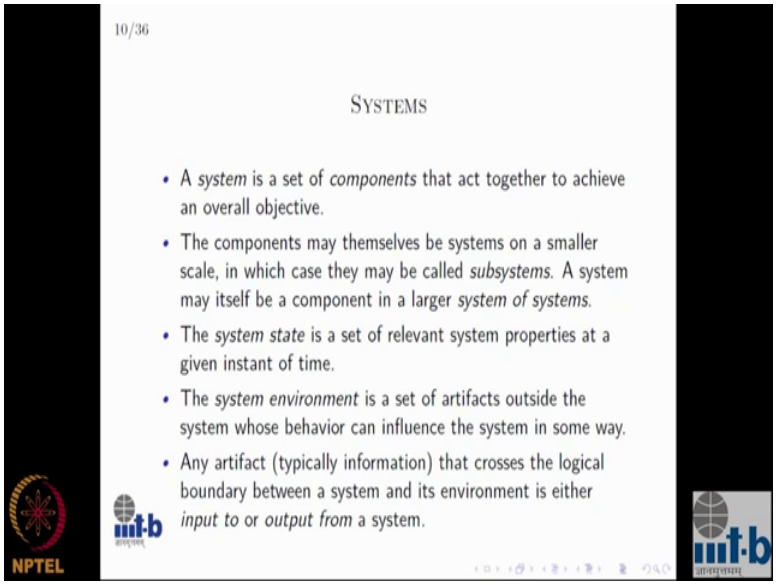

So, briefly to touch on what a system is I think you all implicitly understand this, but I will go over the classical meaning of this anyway. A system is the set of components that come together to achieve something overall objective. The system itself can have smaller sub systems inside it or it may be a part of larger system or system of systems. And once again simple example of this could be if you have a transportation system, you have different vehicles buses, cabs whatever which are components in that larger system, and then of course, each one of them can also be listed as a system on its own. A vehicle like a car will have its own components right. So, a system state is a set of relevant system properties that are given instance of time. And then the system environment is anything that outside the system which influences the system, where you have some influences typical information going this way or that.

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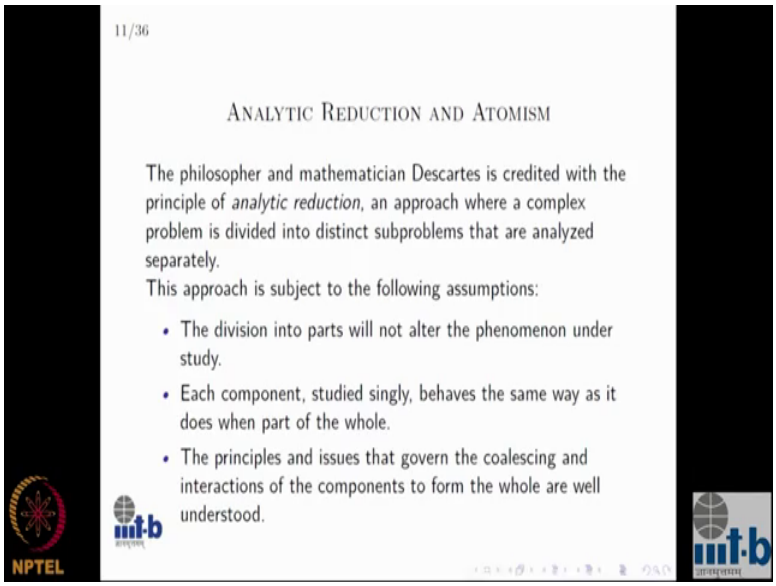

And then all this comes or it is traced back to the work of Descartes who was a very well known mathematician philosopher we all heard of the Cartesian plane and things like that right, they teaches that even in school. So, the principle of analytic reduction is that you have a complex problem that you do not fully understand all at once, then you describe that or divide that into various sub problems and then you work on each one separately that was the insight of Descartes. And then of course, this is subject to some assumptions you cannot do that will inlay; this only works if you have division where each part behaves a same way as it does when it is part of that whole system.

Some of us may have actually studied electronics at some point right or we may have heard or seen electronic devices and so on and you have you also seen that there are transistors and thyristors and God knows what else and they have some characteristics you can actually see how transistor behaves in an oscilloscope. You can give certain input voltage, output voltage, you can see how it the patters are and so on and why does that work, why does that matter because the implicit assumption is that a transistor behaves exactly the same way by itself as it does when it is part of a VLSI chip.

So, a transistor and a transistor circuit actually fulfills this property where you have analytic reduction and each component behaves exactly the same way by itself as it does when it is part of a whole. And then the principles that govern the coalescing of the system are also well understood. They are not just simultaneously thrown together they

are there is some system, there is some process or there is some structure behind it which I understand reasonably well that is when this whole thing work.

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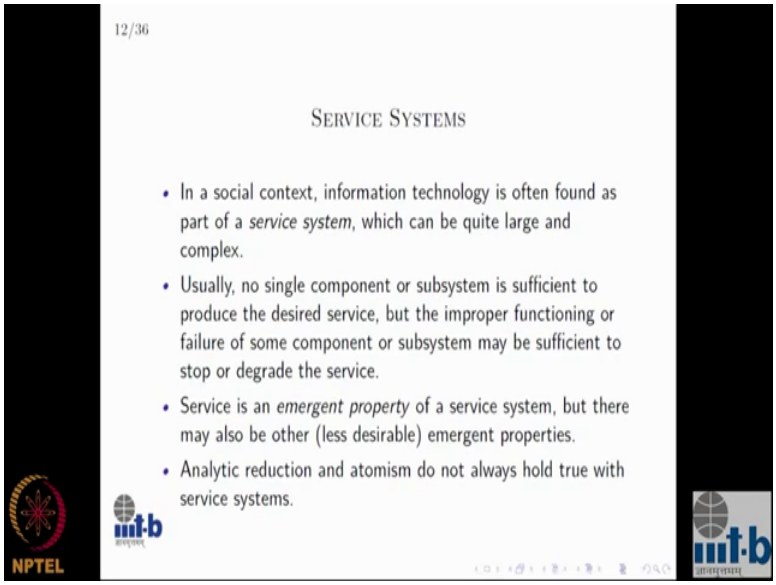

Now, this is all nice and good. In fact, in service systems, this may not exactly completely work out, because information technology is almost always found as a part of large service system. And no single component of a service system is can actually produce the desired service, but any failure of one component or one large part of the system will actually stop the service. And service is an emergent property of that system you know what an emergent property is an emergent property is something that actually bubbles up when the whole system comes together, but it is not a property of any one component of that system right. And this is the rub analytic and reduction atomism do not work in service system. Can you guess why not?

Student: because they cannot be generalized.

Ok, why not?

Student: because they (Refer Time: 07:03) and they cannot or as you said they working initially in the same way as (Refer Time: 07:16)

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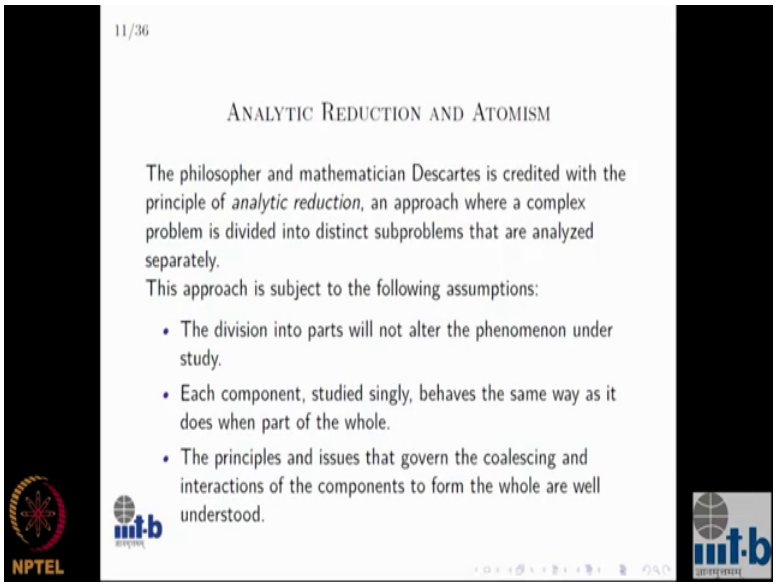

So, the concept here is yeah though each component studied singly behaves the same way as it does when the part of the whole, this is not typically true of a service system why is that.

Student: (Refer Time: 07:28)

Ok, what else? There was a remark that my good friend Bidisha made a little while ago which I do not know if you observed that is actually a very pertinent to this yes.

Student: (Refer Time: 07:44)

Any service system any system that produces the service like a transportation system is a service system. And the reason I am emphasizing systems instead of particular technologies or algorithm says that is the way human beings actually think that is the way society interacts with technology. We do not think really about the GCD algorithm and say GCD algorithm is something that is doing something for me, we actually use that in a very small context inside a larger system or at most inside a component. And our interactions socio technical interactions has Bidisha would say are at the level of systems not really at the end of individual pieces of code or whatever right.

So, anyway a service system this is the short answer I do not know want to spent too much time on this point is almost always going to include human beings in it. You cannot really have a service system, and I have looked even with all the AI and all the wonderful

advances in many other things that we have actually thought about, there is not really enough AI in the world or likely to be in the world where you can completely eliminate human beings.

Human beings are always going to be part of the mix in some way and human beings are famously not going to fulfill these criteria. A human being typically does not behave the same way always when they are by themselves or when they are part of a larger system that is very well known. There are very well known studies, there was a famous example somewhat groove some example that I am not going to where it leads to the phrase bystander syndrome, have you heard of that, bystander syndrome, what is that mean?

Student: It means things some other person is going to have.

Right. So, if a good natured person as I suppose most of us are, sees something happening and we are ourselves we are actually quite likely to want to help, and we are likely to actually do something helpful. But put a same person in a crowd of 500 people and let the same bad thing happen in front of all of them, no one person actually step forward and do anything.

And this actually came up once again going little bit more in detail in the 1970s there was a very famous incident in the US where a woman was brutally attacked in front of a lot of people, and no one did anything. And then that actually gave rise to lot of psychological studies and so on why did all these decent people not help when they saw something happening. So, then the theory is bystander syndrome where anyone of themselves would have actually tried to do something, but because there are so many of them they all thought somebody else will do it. If I step out and do something and I fail in some way and they all think I am a fool, some sense like a fear of public speaking also, anyway. So, the point is human beings do not behave the same way in all cases they are not like transistors, you cannot actually have a character requires for human being which is always the same right that is not going to work.

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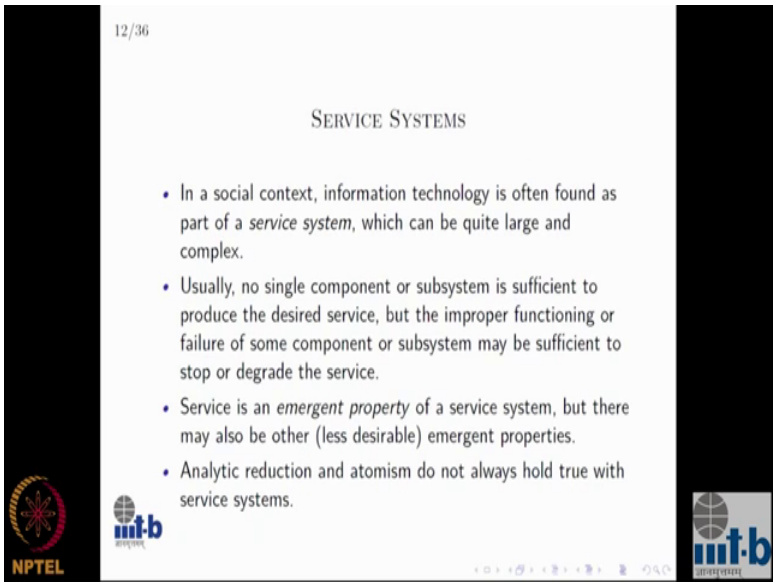

And because of that service system do not always have these nice characteristics that Descartes gave us.

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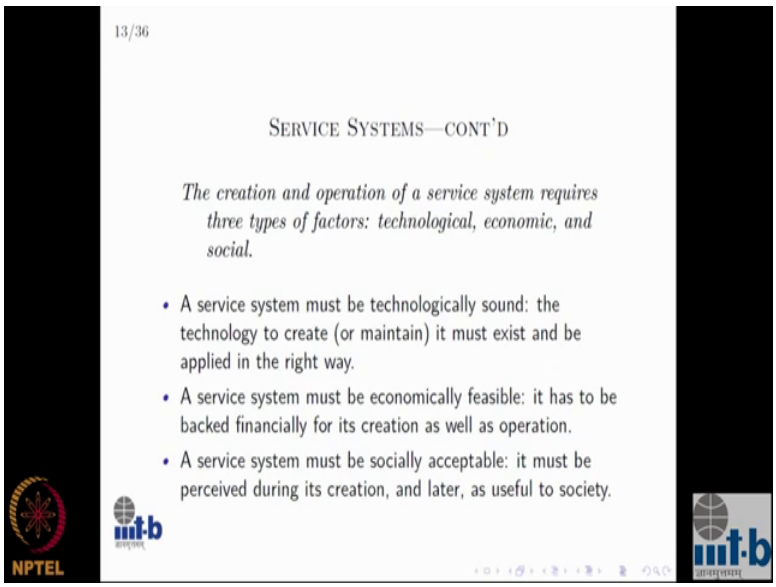

And once again this is in parallel with what Bidisha was saying earlier today where a service system require three types of factors in general. And this is not just service system it is true of service systems, but you can also have in for a rail road system or a bridge or metro that we is being constructed in Bangalore anything like that right. There are three kinds of factor technological, economical, social, and all of you must tick all of

these boxes, without that the system will not work. And what does mean is that the system must be technologically sound, you must already have the technology that you need to build that system and run that system right and it must be economically feasible otherwise it will not work, the money that it needs to generate will not available. And it must be socially acceptable.

Now, if there is going to be a system like dam which is going to flood all of Bangalore then you can aspect all of us in Bangalore will actually object to it. And there have being such cases in our country also right, there have being agitations in people who were disaffected or displaced they said no, this is scientifically sound or technologically sound or its also economically feasible, but socially acceptable, so because society as a whole is not going to accept certain things. So, this is also something to keep in mind and this is sort of a para concern over technology, it is not same as that technology itself, but you need to think about this also. It is not just thinking about the core technical issues you need to think about this in a different way.

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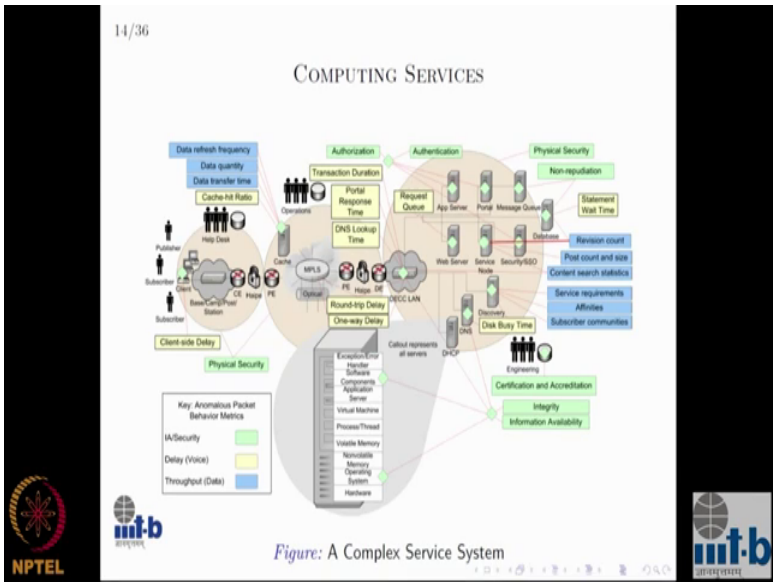

But that is it, this is an example of large computing service. Once again this is actually a lower level of abstraction that what really happens, but and I am not go going to what this says and so on, it does not even really matter. But the point is there are multiple administrative domains, each one of these circles is a different administrative domains, each one of them has different set of service requirements and technical issues.

Somebody who is at that level over there, it does not really understand what these people are doing, they may not even know each other's names. But then a consumer is actually dependent on the whole thing to work properly to make something happen.

A complex service system in the computing domain often looks like this. And what somebody like me as a theoretical computer scientist, so even an applied computer scientist would do is I would work on one of these boxes. I would say my work is actually improving this thing over here, which may not actually improve anyone's life, but that is good enough for me because I am a computer scientist, I do not really think about the social aspects right then that is really the problem. Because there are many people like me who actually have their minds in one small part of the box somewhere which does not really play very big role in the whole picture.

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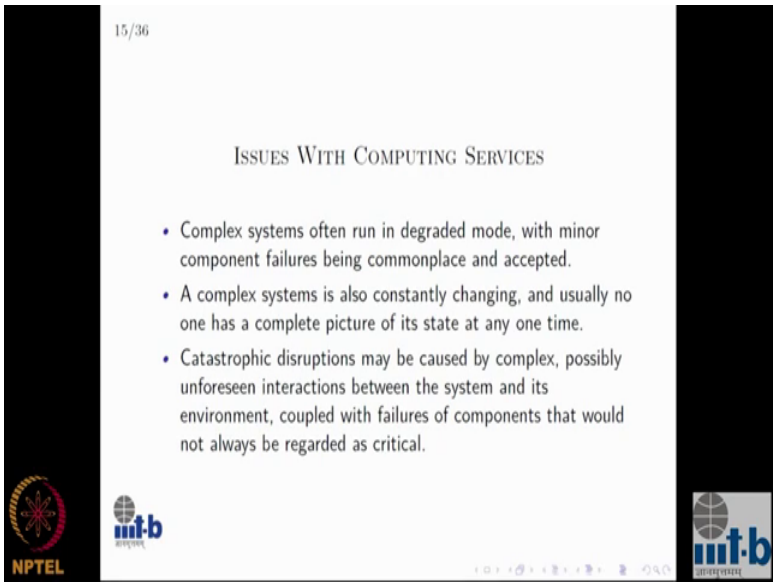

Now, in general with computing services, you have large systems, complex systems which often run in degraded mode. What do we mean by degraded mode? Well, think about this one building on this beautiful campus, do you think all the laptops or desktops or whatever kinds of machines here are always running that they are running right now. I am pretty sure they are not there is some machine here that is currently crashed or out of service or something wrong with it. So, if you have a large system that effect gets amplified, if you have a Boeing 747, you can never actually get up in the air, if you need

every light bulb on that blessed thing to be working all the time, there will always be something that actually degraded. And such failures are common place and accepted.

And complex systems are also constantly changing and nobody really understands how though understands its state at any one time. We do not really know what it is doing at given moment. And sometimes you have catastrophic disruptions and sometimes happening because they were certain interactions between failures that I did not really see that I did not really understand or foresee.

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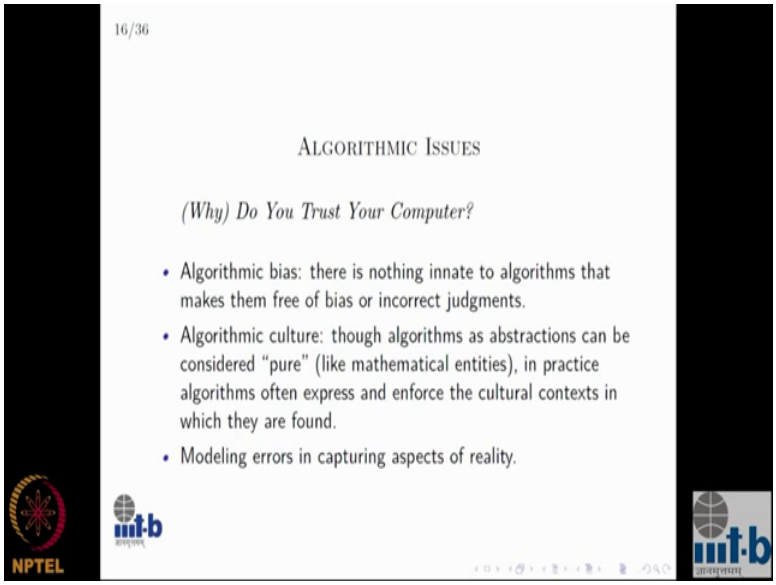

So, the next thing is to what extent we can actually understand or accept algorithms themselves. So, so far we have talked about systems, but now I will switch back to algorithms and talk about some of their issues although like I have just finished saying that does not really describe the whole experience that people have in a service system. So, algorithmic bias well it turns out there is nothing in it in algorithm that makes them free of bias or incorrect judgment that is something that we have to think about. And algorithms as abstractions are quite pure like the GCD algorithm. They is no culture to the GCD algorithm it does not actually care who you are as a person, it does not care about your background or your culture it will not discriminate against you, it is very pure in that sense, but that is not how it is in practice. Algorithms often express and enforce the culture of the people who created them and that matters also.

And last but not the least this is to some extent where I as a computer scientist would come in where we have modeling errors, where we are not really trying to do anything which is biased or cultural. But nonetheless we have actually found that in some cases we find that in some cases, your model does not really capture reality in the right way, and therefore, the algorithm that you base on that model will not do the right thing.

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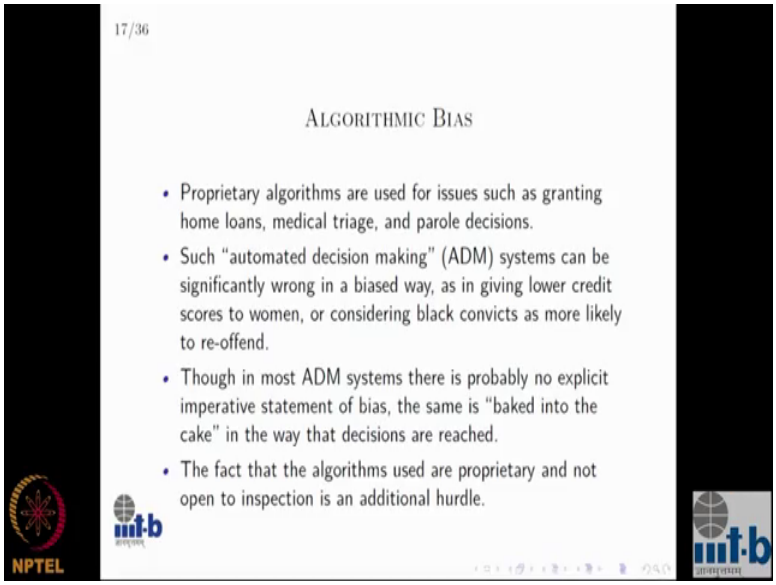

So, algorithmic bias well because nowadays once again I think have mentioned a while ago that one of the reasons for AI is that we do not have enough people to make all those judgment especially at the speed at which we want those judgment to be made. So, we have AI systems for things like home loan, medical triage and parole. Now, home loans we all understand anyone who actually gone through the process will never forget that. And you need to submit a lot of paper work, and then somehow the loan granting bank or agency will somehow decide what kind of loan you deserve and so on, and they have certain criteria based on that.

Medical triage applies in large hospitals and so on. So, if someone has broken thumb and somebody is having heart attack who should get cared first; now probably the guy who is having heart attack needs more urgent care than the guy who had thumb broken right. So, that is a triage where there is only one doctor, he can look at either the guy who has a thumb injury or he can look guy who has got heart attack. So, in such cases, you need to

have triage. If you have to have triage in larger scale, how to you make that happen. So, that also is something where algorithms are coming in.

And parole decision once again if a convict is up for parole as they say in the US right. So, somebody who has being convicted of a crime, they are currently incarcerated, but they are trying to reenter society, leave incarceration, so that can you actually give them parole or not give them parole. So, such decisions are also often algorithmic. And these are the so called ADM systems - automated decision system decision making system. And in some ways they are actually quite wrong in a biased way, because they often give lower credit scores to women and they often also are seem to consider black convicts as more likely to reoffend. So, blacks have a lower rate of getting parole using algorithmic systems than whites. And similarly women are less likely to get home loan than men.

Now, why did that happen? Now, an ADM system, once again being algorithmic should not actually has bias right. Algorithms do not really have bias in themselves, but nonetheless even if there is no imperative statement of biasing, oh, if this person is black deny their parole request; if this person is women deny her home loan, no. There will not any such imperative statement of bias, but nonetheless some biases are actually in built into the system because they are actually model based on the way human beings work, and they are actually repeating the same erroneous processes that human beings have, and in yes.

Student: (Refer Time: 18:24) eliminate this bias, because the data set or you know the data being feed to the system on which we know apply AI and basically make predictions or make judgments, so that will be based on the like previous data set previous data, so it is bound to you know create biases. Because we as humans the data we have created already creates biases.

Right and I will briefly allure to that, yes, you are making a very interesting point, yes, you are right. That in some cases the data we use will have biases in it and we do not have way to get away from that, but nonetheless we should acknowledge that this problem exists. Unlike what many people would say the man on the street of in many cases will believe that in IT system is some sense is pure, it is free of error, it is once again that is scientism at works. The government policy is often advocate, the use of IT in all context without really getting into the right or wrong of it. And we should be

mature enough to acknowledge that such a problem exists whether we can actually solve the problem shorter or not different question. Yes.

Student: I would just add into that that there is not just the need to acknowledge that the problem exists, but it has as a reinforcing effect right, it is you get locked into reinforcing the same societal like deep and structural prejudices and biases within society, but once it gets reflected in this system

Yeah, I do not know to I think that really is taking me well outside my game, and I do not know to what extend that once again those of who are you in the social sciences you can talk more about that. But to me the first step obviously is to understand and I come from I come at this from the algorithmic perspective I am not so much at home playing the game that you are. But I certainly think about this like a computer scientist and to me the first problem is to acknowledge that there is problem. This is not working well my algorithm is not doing what I wanted to do. Let us start from that. How do I make it better, how do I make it better in spite of biases in the data set next problem, we can work on that we can think about that.

Now, this is important also that there are algorithms that are set of proprietary like, the one that was part of that Huston judgment, where the school district was using against the teachers and the teachers sued. And there is also different problem here which I did not put on the slide were AI itself is not explainable where you do not really understand how neural network performs its job. We do not really understand how a deep learning system actually gives you the answer that it gives you. And in some cases, we are ok with that, but in many cases we should not be.

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And now in fact there is a new push at something which is now being called as XAI which stands for explainable AI. So, we do not just want AI, where the AI is giving some answer and asking me to blindly trust the answer, I actually want an explanation that I can understand on how the answer was arrived at. And a common well known machine learning example for this is that an AI system looked at treatments of people with pneumonia. And it found that people who have asthma seem to recover from pneumonia better than those who do not.

Now, you think that is why counter initiative how does asthma help cure pneumonia; it does not the fact is that when somebody has already asthma and contract pneumonia doctors tend to give them better care. They tend to consider them very high priorities, and they prioritize their care, and they take very good care of them, therefore, they have better recovery rates, but the AI will not really understand that. The AI simply finds the correlates and say someone with asthma recovers better from pneumonia which is an really nonsensical that is not really a proper conclusion.

So, if you can actually explain how your machine learning tool is working machine learning algorithm is working and so on, you will be better off. So, anyway that is the different thing and that also can lead to bias because if I do not understand how it is working then how do I know if it is biased it is just doing something and I am accepting

it. So, proprietary algorithms and explainable algorithms are both problematic in this context.

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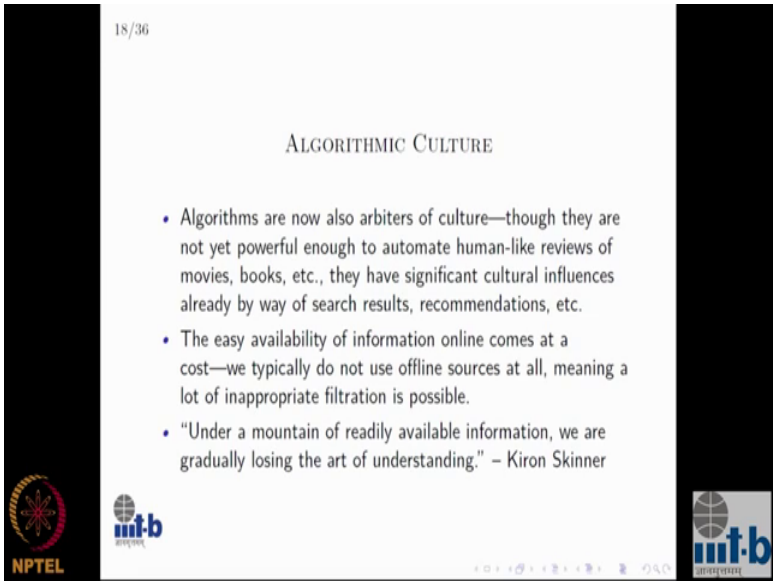

Now, this is the different issue also where algorithmic culture, where algorithms are also arbiters of culture in some senses now they are not cultural in the sense that the human beings are. Because we have not yet reached the point, where an algorithm can actually read a book and write a review or where it can watch a movie and then object to it or give it a rave review or whatever any such thing, only human beings can do that even now. But nonetheless because you have search results and recommendations and so on they do have significant cultural impact.

And a different problem is that nowadays when was the last time you actually went to physical library and pulled out a book from the book stacks and read it, hardly anyone does that anymore. The fact that we have so much knowledge available online is actually problematic to us because it can be filtered without your knowing. Somebody can decide you do not need to know about the certain opinion, somebody can decide that you do not need to read an author that they do not like. And thereby if keep you by the knowledge you otherwise get, because we do not use offline sources we can actually be subjected to a lot of inappropriate filtration and censorship. We do not end that of course, happen quite explicitly in China and other places, but it can happen everywhere, it not just china, we need to worried about it anywhere that we are.

And this also a problem there is a fairly well known quote this person is a professor at CMU, where she said that there is a lot of data available, but we are actually not processing it very well, because ultimately you have to understand it in your mind and that is not really happening very well. We are losing the art of understanding.

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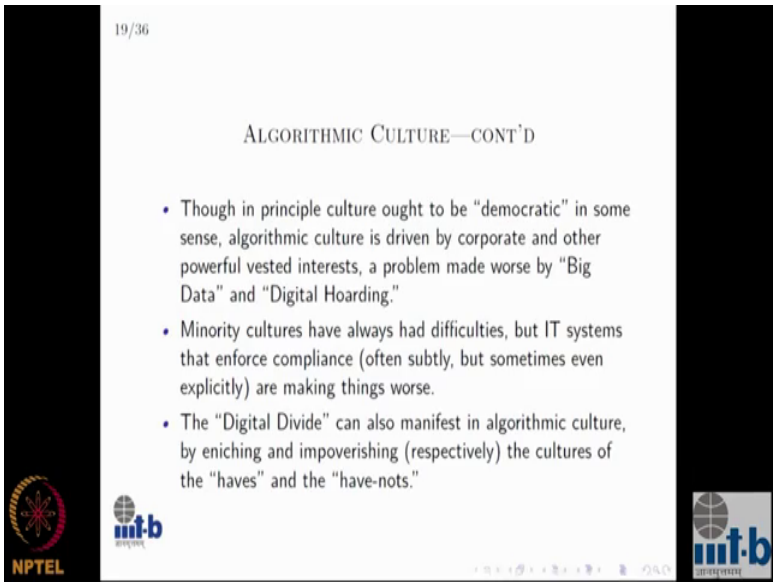

And culture ought to be democratic in some sense right, your culture and my culture we all have a vote and I get to express my culture, you get to express yours, but that is not really the way to it is, because algorithmic culture algorithmic recommendations and so on they are driven once again by corporate greed. They are not really democratic in any sense. And big data, well, big data what is the biggest problem with big data, big data is corporate data. Corporate entities hold all our data, they take your picture probably 20 times a day, and you do not get to see that pictures, they can actually see those pictures and they can infer certain things about you that you do not even think about.

For example, nowadays algorithms have gotten to the points were they can infer a person's sexual orientation, they can infer your moods, they can infer certain other things about you from very small nuances in your expressions right. So, and all that data is available not to you, but to somebody else, so that actually is a problem with big data. Digital hoarding same thing where they have data about you about other people, where they do not share it with anyone; they do not share it with me, if I am an academic and I

want to do something. But they will use it for their corporate purposes that is the problem also.

And minority cultures of course, have always have difficulties. If you speak a minority language in any society or at the state of Karnataka as a major language which is Kannada, but we also have several other languages. Some of which are gradually tending to lose their edge right and that happens everywhere in the world. English is the major language globally, Hindi is the major language nationally, Kannada is the major language in the state of Karnataka, but then you always have minority cultures in all of these context and they often gets suppressed. But in a very explicit way by IT systems and that is the problem.

And there is a phrase called the digital divide, this term called digital divide which I guess was a little more common back I would say around the year 2000, there was a very well known book written around that time. And this also happens in a algorithmic culture where there is a set of people also in our country right, we are all blessed and fortunate that we have access to all these wonderful IT resources, a lot of people close to us geographically close to us, do not have such access. So, their culture does not really gets expressed as much online as ours, so that is the digital divide. So, the cultures of the haves and the have not is get treated very differently, those who do not have access to IT resources their culture gets ignored in many cases, so that is how algorithmic culture exists.

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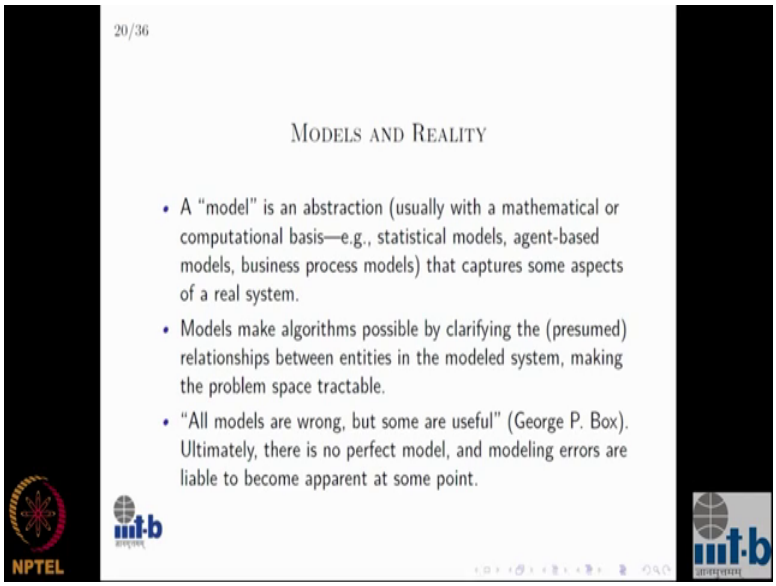

And this once again is probably closest to where I personally would get. The model is an abstraction with some mathematical or computational basis like agent based models and statistical models, where you try to capture some aspects of a real system. And that is because the real system horrendously complex, there is no way you can actually capture the entirety of the real system. You actually have a model that capture some essential aspect of real system. And then you make models, and then you work algorithms inside those models. You have algorithms that run on those models, and describe how the system would behave that is the kind of thing I would actually do.

And there is a very well known quote by a man called George P. Box. He is actually deceased now; he was a very well known American statistician. He said all models are wrong, but some are useful. What he meant by that is all models are wrong, because no model actually captures the entire system in its full glory, but some are useful. Because they gave you they give you some insight into how some aspects of the system will be. And the problem for us is that in some case this modeling errors are liable to become apparent. So, you have algorithms and you have models, even if there is nothing wrong in the algorithm itself, the modeling error will mean that in some case at some instance you will actually get some problematic conclusion, because the model does not match the reality.

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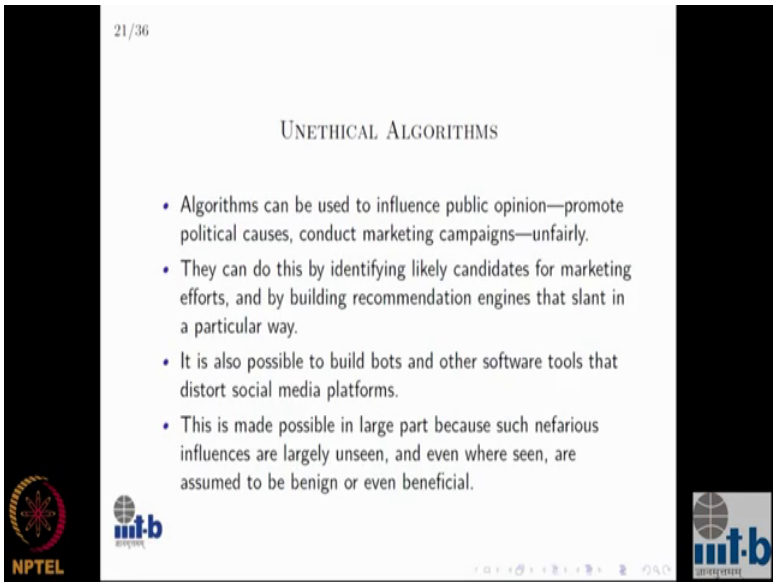

So, ethics also is big issue with algorithms. And sometimes they can be unethical that is because they can be used to influence public opinion, they can promote political causes, they can conduct marketing in a quite appropriate way. You can actually be the biased to world or against certain opinions because you are only exposed to certain view points about certain things. And machine learning and big data especially with the kind of data that big companies have about you can be used to do certain things in very good way. So, where they actually build recommendation engines which expose you in a very fine grained way, they actually know us much better than we realize.

And this is also problem that we have seen and in fact, this has a actually being point of some discussion in the media if you being following this. A lot of bots that you see on the twitter and so on lot of people suppose that people you see on twitter and facebook and are not really people at all, they are actually software agents, they are software bots. And on twitter I was actually quite surprised to learn about to couple of years ago you can actually buy followers did you know that?

Student: (Refer Time: 29:21)

There are actually companies whose business model I guess somewhat questionable where they will actually sell you a thousand follower for a hundred dollars so something. This actually quite cheap, they can get so many followers quite cheaply. I unfortunately not had the money, so I have not done that. So, you can buy a likes on facebook, you can

buy likes or retweets on twitter and so on also that actually distorts the social media platform, because if the platform is pure and its actually real people retweeting and sharing their opinions, we can respect that. Even if the opinions are something that we disagree with, they are ok.

But now what is happening is if a new movie is to be launched or if a new product like an auto mobile or any new phone or something is being launched, so then the company that is doing that will actually buy a lot of publicity on twitter in this way. They will actually have a lot of bots re tweeting this. So, they will have a lot of publicity that is actually fake, not really people who are actually doing this out of their own free will and that actually distorts social media quite a bit. And unfortunately I am sorry to say that the social media companies are quite happy apparently to go along with this charade, not good.

And such influences are mostly unseen they are at least unseen by common people. You and I can understand that if we actually put our mind to it, but actually most people who use facebook, who use twitter who do not really put much thought to it, they do not really understand what is happening here. And that also goes back to the fact that in most cases such things are assumed to be benign or beneficial, but they are not.

Student: (Refer Time: 30:56)

Hm.

Student: (Refer Time: 31:03)

An algorithm is not based on or model is not based on algorithm, but the point is ok. If I want there to be an algorithm, once again I think the gentlemen there asked for an example an algorithm while ago right. So, if you want to have an algorithmic perspective where you can actually build a tool that predicts an outcome like for an recommendation engine or if you want to predict the spread of a disease or if you want to predict how say a system will behave in reality when exposed to a certain kind of input, for that you need a model. And given the model and its properties you can then write the code or come up with the algorithm then predicts how that model is likely to behave under that input. And that tells you something about how the system in turn would behave under those conditions that is the way that it actually works.

Student: (Refer Time: 32:00)

Not quite, the parameters of the model, well to some extend yes, in some cases yes, you might be right. But the parameters of the model or the general structure the model will have a lot to say in terms of how good the algorithm turns out to be in its predictive powers, in its expressive ability, in terms of telling you how well the system exactly what the system in the real system will do. Ultimately, all this is meaningful if and only if helps you understand how are how the reality is. If it tells you something about the real system, for example, if I want understand how cyclone hitting Chennai will do something write, so obviously cannot arrange it and even if I could I would not, it is not possible first of all, and second is I do not want anything like it ever.

But if I want to build a model then I will actually think about what is the suitable model for this, and then I will run some algorithm on it and then figure out this shows these are the conclusions. Therefore, there are certain things which I can infer based on this. So, if the model itself is wrong then regardless of what the algorithm is that you choose to run on it, the conclusion will be questionable that is the point.

So, modeling errors are an independent point of question over and above what the algorithm is also doing. If the algorithm is wrong yes then you have a separate issue, but regardless of what the algorithm is the model itself is not capturing the system properly, is not capturing the reality in the right way, then you will not end up with the right answer that is the point.