



# IIT Madras

ONLINE DEGREE

**Computational Thinking**  
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**Applications of encapsulation, abstraction, class and object (Part 2)**

Professor Madhavan Mukund: So, we saw first how to do this, this object-oriented way, how to ask the station whether you can connect directly which it could do by just comparing these two lists of trains at the station without referring to that...

Professor G. Venkatesh: They need to ask the train anything.

Professor Madhavan Mukund: Ask anything about the trains.

Professor Madhavan Mukund: Then we said okay tell us...

Professor G. Venkatesh: Can go to a junction.

Professor Madhavan Mukund: Can we allow it to go through a junction. So, it was somewhat intelligent, either it looked for a direct train, or it looked for two trains for passing through the two stations, which had a common...

Professor G. Venkatesh: Common station.

Professor Madhavan Mukund: Common station on the correct day, in that day we also had a day restriction. Yeah, so we could ask for two lists of trains for the two stations, like we said, Jhansi and Kanpur. And then it will compare these two trains and see if there is a way of connecting.

Professor G. Venkatesh: Connecting, and it did find it.

Professor Madhavan Mukund: Fortunately found it now if we have not found it, then we are stuck.

Professor G. Venkatesh: Then we are stuck.

Professor Madhavan Mukund: Doing it that way.

Professor G. Venkatesh: We cannot do it one day.

Professor Madhavan Mukund: We cannot do it in one day, but also doing it that way, we have to go back and start all over again to look for a third station in between.

Professor G. Venkatesh: So, we may have to relax a little bit. So, you say let us say I relaxed the number of days to two days.

Professor Madhavan Mukund: And but then now, we have to be prepared for as many days as many trains as we need.

Professor G. Venkatesh: So, any number of trains, I do not care.

Professor Madhavan Mukund: So, I think we had done this sometime back, where we just did this systematic exploration. So, we started a station. We looked at the trains.

Professor G. Venkatesh: We said explore station.

Professor Madhavan Mukund: So, we explored the train to find out which station.

Professor G. Venkatesh: I remember what we said is that the thing called explore station.

Professor Madhavan Mukund: Yes.

Professor G. Venkatesh: Which explored all the trains in the station. Yes. And then that by calling explore train.

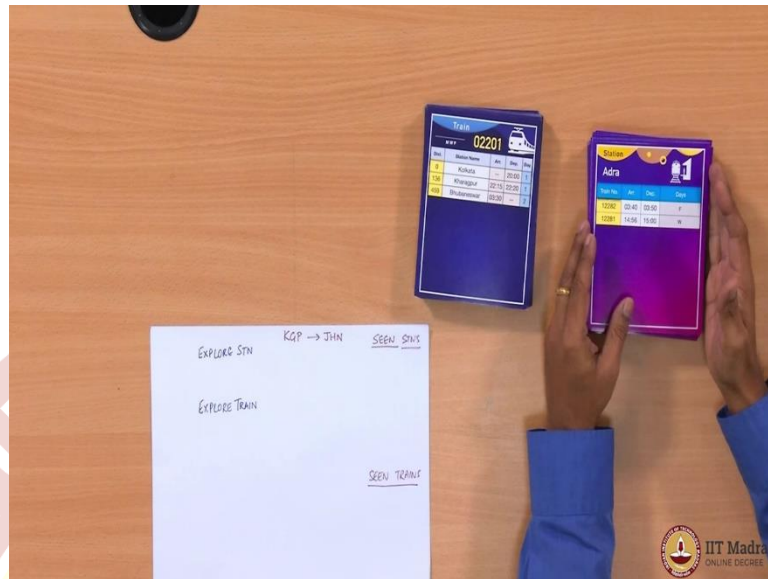
Professor Madhavan Mukund: And when we explore a train, it goes to the next station. And it explores that station.

Professor G. Venkatesh: So, train explore station called explore train, explore train called explore station and went back and forth like this. But we had to keep track. I mean, if you just leave it like that, it will just go into a loop. It will come to the train, will come to the station, same station and then this station will call the train, train call the station keep calling each other, you will have a loop.

Professor Madhavan Mukund: So, we had kept track of that. So, we had talked about the...

Professor G. Venkatesh: Keep track of the seen stations.

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Professor Madhavan Mukund: Yeah, the trains we had seen in (02:28)

Professor G. Venkatesh: Seen already.

Professor Madhavan Mukund: The stations we had seen and in station, we have to keep track of when we had started, so suppose if we had explored a station at say 1 o'clock in the afternoon. And then there is another train which reaches 10 o'clock in the morning.

Professor G. Venkatesh: You already seen a 1 o'clock.

Professor Madhavan Mukund: But we have to do the 10 to 1 part again. I mean, new fresh new.

Professor G. Venkatesh: So, all these keeping track business.

Professor Madhavan Mukund: We keep in track business.

Professor G. Venkatesh: What have you seen? Yeah, you have seen a station from some time to sometime, train from some time.

Professor Madhavan Mukund: Seen stations and we had seen trains. Now, we want to do this, I guess in a object oriented way.

Professor G. Venkatesh: So, firstly the first question, we ask asked this question, so I want to ask. I want to go from where... let us pick from stations.

Professor Madhavan Mukund: Kharagpur? Kharagpur to...

Professor G. Venkatesh: Jhansi It is...

Professor Madhavan Mukund: Kharagpur to Jhansi.

Professor G. Venkatesh: Kharagpur to Jhansi.

Professor Madhavan Mukund: So again, for us, we do not know anything about.

Professor G. Venkatesh: So, we asked this guy, we asked the station guy, said tell me how to go from Kharagpur to Jhansi? This guy will see a direct train, no train, he will say whether there is a way one of train.

Professor Madhavan Mukund: No, no no, he would not do all that. I think he will just explore, he will do this.

Professor G. Venkatesh: He will do recursion, will do this.

Professor Madhavan Mukund: How do we know? Why waste our time.

Professor G. Venkatesh: 3, 4 trains, 2 trains we do not know.

Professor Madhavan Mukund: If you do this, hopefully you will find a train because we are kind of doing it, exploring all these paths.

Professor G. Venkatesh: So, he is going to, so we are telling this box. Please tell me how to go from Kharagpur to...

Professor Madhavan Mukund: Jhansi.

Professor G. Venkatesh: So, you want to go Kharagpur to Jhansi. And you want to go in 2 days. So, if I leave today, I want to reach there by tomorrow. So, do I pick a day when I am going to leave or...

Professor Madhavan Mukund: Where is that, I do not care. You can leave any day provided you to reach a next day.

Professor G. Venkatesh: That is...

Professor Madhavan Mukund: I just do not want to sit in the train forever. But day, if you can reach me within 48 hours, I am happy. Not even 48 hours next day. I leave on a Tuesday I want to reach by Wednesday.

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Professor G. Venkatesh: All right, so I got the Kharagpur card. So, this guy is go and take the Kharagpur card. Jhansi when you reach Jhansi, you know, you are done. So, you are doing all the search starting in Kharagpur now. So, there are only luckily only two trains going out of Kharagpur.

So, he takes the Kharagpur card. In which means this is an object? So, it tells the Kharagpur object, to do something. What does he ask him to do? So, he says Kharagpur object take the trains each train that you have and explore it, but he is actually he is exploring Kharagpur. So, he is saying I am exploring Kharagpur he calls explore for Kharagpur. So, it is like box calls. So,

Professor Madhavan Mukund: So, we write down...

Professor G. Venkatesh: So, mark Kharagpur has visited.

Professor Madhavan Mukund: Who is marking?

Professor G. Venkatesh: This fellow is marking the entire yes marking.

Professor Madhavan Mukund: The station box station, station box is keeping the seen stations.

Professor G. Venkatesh: Only he can keep so we will keep, and then he will call.

Professor Madhavan Mukund: So, he will say that I the first was possible train.



Professor G. Venkatesh: But he will call the Kharagpur object and tell the Kharagpur object, explore yourself.

Professor Madhavan Mukund: Explore yourself starting at what...

Professor G. Venkatesh: I will have to give time.

Professor Madhavan Mukund: 01:15 or whatever it this is the first time I can leave Kharagpur.

Professor G. Venkatesh: Either 110 or 15 we can it does not really matter too much right now. So, we have the time when we started exploring Kharagpur. So, now what Kharagpur will say is. I have to know which train to take so let us take the first one.

Professor Madhavan Mukund: So, let me explore that train.

Professor G. Venkatesh: So, what he will do is he will call or he will not export you can just call explore train because that export train belongs to some train, so there is no train right now there is no train of yet.

Professor Madhavan Mukund: So, we will have to create a train for today.

Professor G. Venkatesh: So, first he has to do that interesting business of generating a train so he will go to 0 to 2 card which is a template again is a class, it turns in class.

Professor Madhavan Mukund: So, this is a Wednesday so let us assume we are doing it on a Wednesday.

Professor G. Venkatesh: So, you say give me a Wednesday train.

Professor Madhavan Mukund: So, let me write that here so we have explored Kharagpur on a Wednesday at 0115 and that so, this will now create a Wednesday train it will create a 02202 Wednesday object, it will create an object 022 Wednesday there is no Wednesday, Thursday Kharagpur is Wednesday. This starting on Tuesday Tuesday.

Professor G. Venkatesh: Will create a Tuesday object which reaches Kharagpur on Wednesday.

Professor G. Venkatesh: And then what does he say? He says explore tell this he tells this object which he has created, this object, it helps explore yourself.

Professor Madhavan Mukund: Explore yourself.

Professor G. Venkatesh: So, unlike saying explore, explore something else you are asking the guy to explore himself. So, the train this train, explore yourself means.

Professor Madhavan Mukund: So, first he will say I...

Professor G. Venkatesh: First he has to mark that that this.

Professor Madhavan Mukund: Presumably that has been done by the centre. So, this is being kept track of by the train's object the entire box.

Professor G. Venkatesh: That box that guy will basically keep track of the same trains. And then so he then he...

Professor Madhavan Mukund: Then next stop and he says...

Professor G. Venkatesh: What is explorer? This guy is explorer yourself, this object explore yourself. What does it doing?

Professor Madhavan Mukund: So, we will go to the next station on the list after Kharagpur.

Professor G. Venkatesh: Which is Kolkata.

Professor Madhavan Mukund: And it will say, now go back there and explore Kolkata.

Professor G. Venkatesh: Kolkata explore yourself. So, I recall Kolkata it will call the Kolkata object. There is only one object looking for us. It will tell the Kolkata object go explore yourself.

Professor Madhavan Mukund: On a Wednesday at 4:15.

Professor G. Venkatesh: On Wednesday at 4:15.

Professor Madhavan Mukund: So, we are looking for a new train which leaves from Kolkata on Wednesday at 4:15.

Professor G. Venkatesh: You moved one day already no we are on Wednesday only. 1:10 we have a left 1:10 early. We are on the same day. So, we got the whole of today.

Professor Madhavan Mukund: And tomorrow.

Professor G. Venkatesh: And we got all of tomorrow.

Professor Madhavan Mukund: So hopefully it will...

Professor G. Venkatesh:



Professor Madhavan Mukund: Hopefully we will make it, I think so. Now, we are looking for Wednesday trains.

Professor G. Venkatesh: So, Wednesday trains after 4:15 departure after 4:15 on Wednesday here there is on.

Professor Madhavan Mukund: So, then this will say, I need a 12262 train.

Professor G. Venkatesh: 12262 is departing Kolkata.

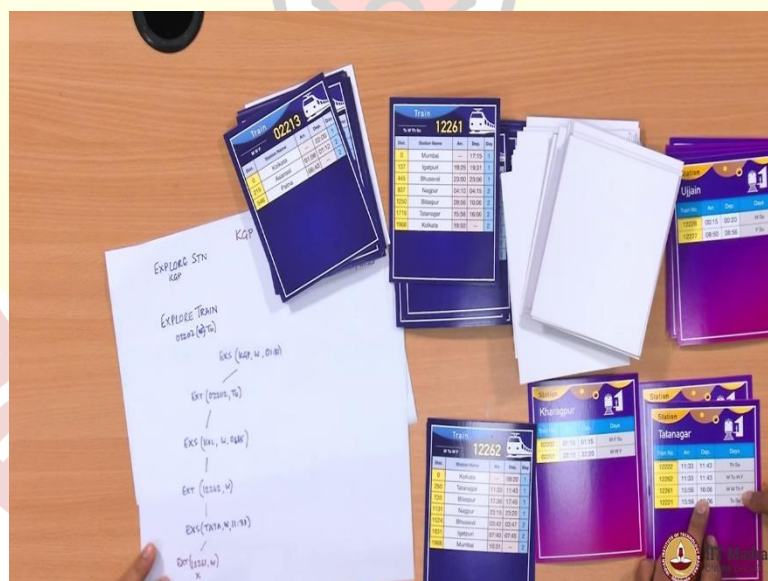
Professor Madhavan Mukund: On a Wednesday.

Professor G. Venkatesh: On a Wednesday. You would draw the graph I mean this Explore graph, whatever it is recursion graph.

Professor Madhavan Mukund: So, I will need another.

Professor G. Venkatesh: Because we have to keep track what they are calling when they are calling and all, so we can go back.

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Professor Madhavan Mukund: So, we started with explore station of KGP on a Wednesday day at.

Professor G. Venkatesh: 1:15.

Professor Madhavan Mukund: 1:10 is when technically the other thing we keep track of arrival. So, what this did was it generated an explore train of this 022 but it is on Tuesday and what this did was it gave us an explore station of Kolkata.

Professor G. Venkatesh: Kolkata.

Professor Madhavan Mukund: On a Wednesday at 04:15 is when we arrived. And now this has asked us to explore a new train which is...

Professor G. Venkatesh: Explore train 12262

Professor Madhavan Mukund: 12262 on a Wednesday.

Professor G. Venkatesh: On a Wednesday 8:20.

Professor Madhavan Mukund: 8:20 we do not have to bother, because that will finally reach the next station where...

Professor G. Venkatesh: So, 12262 we need.

Professor Madhavan Mukund: So, 12262 let us pull out from here.

Professor G. Venkatesh: So, 12262 now we are telling this. So, we have to first make this object.

Professor Madhavan Mukund: On Wednesday, we have make a comprehend.

Professor G. Venkatesh: We made a comprehend, we ask the class 12262 class make an object here the object. And then that object when I say train, we tell that object, please explore yourself.

Professor Madhavan Mukund: So, then it will say okay, I left Kolkata. The next station I could have got towards Tatanagar.

Professor G. Venkatesh: So, he will say explore Tatanagar.

Professor Madhavan Mukund: So, he will say explore station, Tatanagar, Tatanagar, Good card on Wednesdays at 11:33. And I have to mark it now saying that I saw Tatanagar

Professor G. Venkatesh: You have seen Tatanagar.

Professor Madhavan Mukund: At 11:33.

Professor G. Venkatesh: So, this Tatanagar, so Tatanagar is an object already says nothing further, you telling Tatanagar explore yourself.

Professor Madhavan Mukund: And so now Wednesday.

Professor G. Venkatesh: So, Wednesday, we are here 7:33 same train.

Professor Madhavan Mukund: And then we have one more train, which I could explore from there, which is 12261, which is actually the reverse of this train. So, it is probably not going to be very useful for us. So, we could explore it, but it is actually going backwards in the same route.

Professor G. Venkatesh: As going back... which is seen.

Professor Madhavan Mukund: Which we have seen, so there is nothing to do, so actually, if we ask it then it will I mean, we could go through that it will explore 12261 on a Wednesday, which will say explore Kolkata.

Professor G. Venkatesh: I will say Kolkata...

Professor Madhavan Mukund: We already seen after that time, and so I am come back so we can just skip that. So, I will just write it but we would not. So, this will do and explore, train 12261 on a Wednesday, which will just stop.

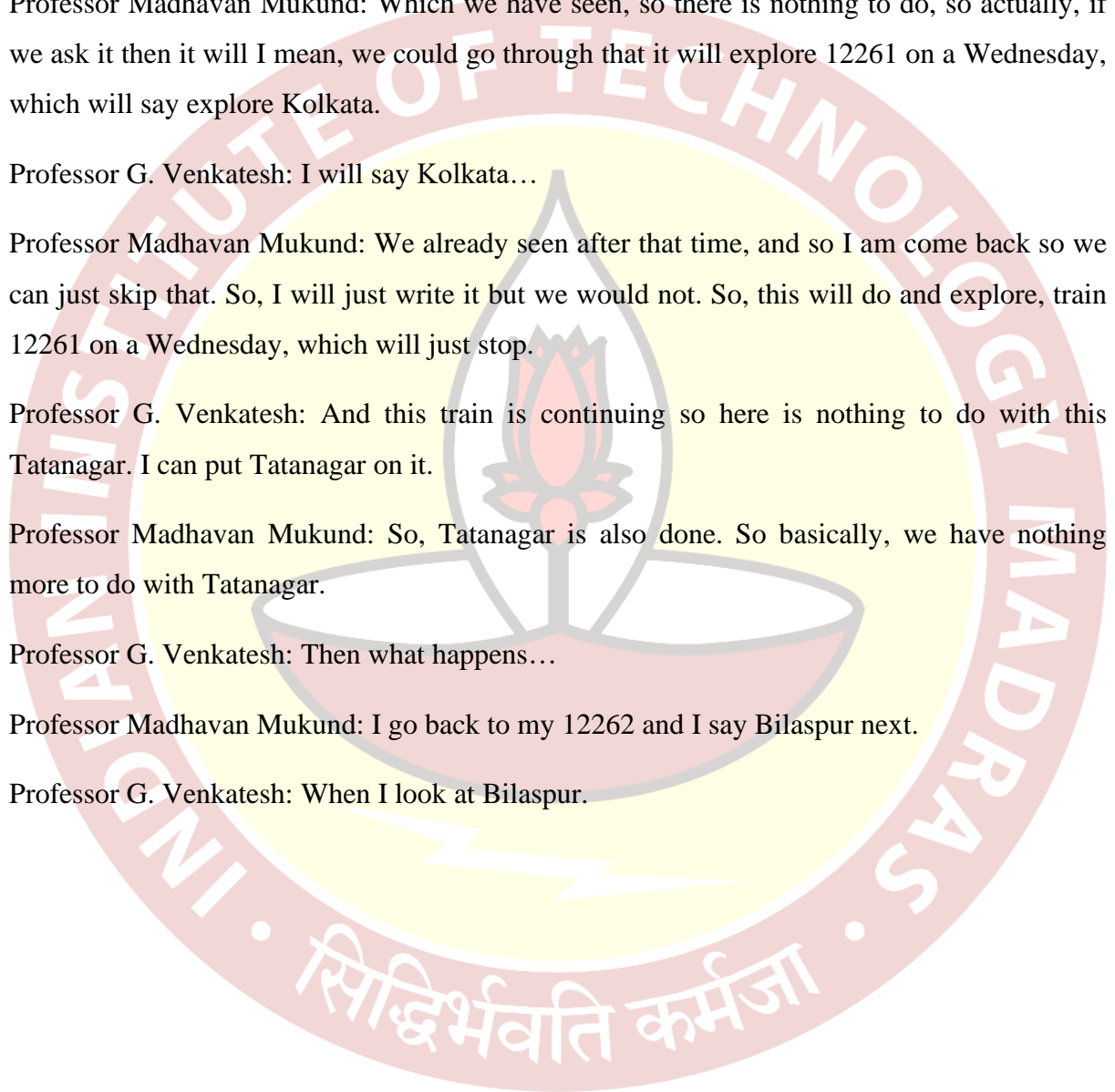
Professor G. Venkatesh: And this train is continuing so here is nothing to do with this Tatanagar. I can put Tatanagar on it.

Professor Madhavan Mukund: So, Tatanagar is also done. So basically, we have nothing more to do with Tatanagar.

Professor G. Venkatesh: Then what happens...

Professor Madhavan Mukund: I go back to my 12262 and I say Bilaspur next.

Professor G. Venkatesh: When I look at Bilaspur.



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Professor Madhavan Mukund: So, from here. I do an explore station of Bilaspur on a Wednesday, Wednesday at 17:36.

Professor G. Venkatesh: There is only okay there are two 17:36 that is this train.

Professor Madhavan Mukund: So, let me first write it down here. So, I have now visited Bilaspur on Wednesday at 17:36.

Professor G. Venkatesh: Now, I can continue this train.

Professor Madhavan Mukund: Oh, one thing I should remind you is that how did we know that we have seen Kolkata because the Kolkata information is kept by the station box.

Professor G. Venkatesh: Yes. He asked the station box.

Professor Madhavan Mukund: So, when this explore train said I want to explore Kolkata again. The station box told it No, you do not need to explore because I have already seen this thing. So, go back and see. So, that information is actually coming from there.

Professor G. Venkatesh: Station box.

Professor Madhavan Mukund: So, now what happens 1222.

Professor G. Venkatesh: Now, 1262 you are on the same train, you can continue of the train, or you can stay overnight, in Bilaspur hopefully you can stay overnight. Must be some relay. Something will be there right.

Professor Madhavan Mukund: 122261

Professor G. Venkatesh: And then catch the thing on Thursday.

Professor Madhavan Mukund: 122261, but that is again the same problem will be going backward.

Professor G. Venkatesh: So, we will ignore it.

Professor Madhavan Mukund: So, we will again, we can write it. But it is not going to take us anywhere. So, we can explore the train 122261 on Thursday.

Professor G. Venkatesh: But it is going backward.

Professor Madhavan Mukund: Again, it will go backwards to...

Professor G. Venkatesh: Kolkata. Tatanagar.

Professor Madhavan Mukund: And Tatanagar will say that, I have already seen that.

Professor G. Venkatesh: So, there is no point in doing that. So, there is nothing further to do

Professor Madhavan Mukund: 12222

Professor G. Venkatesh: Continue on the same train.

Professor Madhavan Mukund: No 12222 is also there.

Professor G. Venkatesh: Oh, I can get of here on Wednesday, and then wait. And wait, that is also is there.

Professor Madhavan Mukund: So, there is an...

Professor G. Venkatesh: whole day is gone 24 hours is gone.

Professor Madhavan Mukund: So, we have very little time to get from Bilaspur to wherever. But let us see where that 12222 takes place.

Professor G. Venkatesh: 12222 to is possible, theoretically possible. So, you should write.

Professor Madhavan Mukund: 12222 on a Thursday.

Professor G. Venkatesh: Thursday, and you have till midnight today to get somewhere get to Jhansi, I doubt you will get the Jhansi from the Bilaspur on 12222.

Professor Madhavan Mukund: 12222.

Professor G. Venkatesh: Nagpur, Bhusawal, Manmad down.



Professor Madhavan Mukund: So basically, it is going to go to Nagpur on the same day and then it is going to die. But we have to, in principle, look at that, well if you wanted to be really.

Professor G. Venkatesh: Pedantic.

Professor Madhavan Mukund: Pedantic about this, the will go to explore station. Nagpur Thursday at 23:15. So, we have here...

Professor G. Venkatesh: So, I have to take Nagpur. Explore station Nagpur you called.

Professor Madhavan Mukund: But we are going to now because we run out of time here. And then there will be no train after 23:15...

Professor G. Venkatesh: There is the last train.

Professor Madhavan Mukund: That is the last train.

Professor G. Venkatesh: So, pretend to Nagpur it said seen Nagpur.

Professor Madhavan Mukund: So, I have seen Nagpur at the end of my thing. So, I may come to Nagpur in the middle.

Professor G. Venkatesh: With a earlier day, with a earlier time.

Professor Madhavan Mukund: So, this 12222 goes back. So, now I am done with Bilaspur.

Professor G. Venkatesh: Bilaspur is done. So, I can put Bilaspur back. And now we come back to our train.

Professor Madhavan Mukund: Now, is the situation. So, this 1262 actually gets to Nagpur earlier, I could have got to Nagpur the same day, without having to wait till the next day on that train. So, now I take this and I explore Nagpur at 23:15 on a Wednesday, as opposed to.

Professor G. Venkatesh: One day earlier in fact...

Professor Madhavan Mukund: So, I could have...

Professor G. Venkatesh: I have to go back to the Nagpur.



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Professor Madhavan Mukund: So, now I will update this thing to say that I have seen it not on a Thursday 23:15. But on Wednesday itself 23:15. So, I go back to Nagpur and I asked what can I do on a Thursday.

Professor G. Venkatesh: What are the things I can do on a Thursday? Your Wednesday night to reach. So, Wednesday night to reach this train, so Wednesday night to reach this train you took. So, there is nothing to do on Wednesday. But Thursday.

Professor Madhavan Mukund: 122261.

Professor G. Venkatesh: There is this train 122261 going backwards.

Professor Madhavan Mukund: Going backwards going to hit Bilaspur. And so that is not going to work so...

Professor G. Venkatesh: we can throw it out. And then there is this is arrivals this is nothing. Then you can use this train 122290.

Professor Madhavan Mukund: This is on a Thursday at 8:40. Chances are you will not do much with it. But it is going in the wrong direction. 12290 is going away. But any way that does not have it. Next stop is going to be.

Professor G. Venkatesh: Next day. So again, that will.

Professor Madhavan Mukund: So, mark it as seen and then you get out. So, I actually have not been marking the trains very clear. So, it is a good thing we do this graph. So, after 02262 we saw 122262, which is what we are currently doing. And then we saw actually, we should

not have done this because we have seen it on different days, but Thursday. And now we also saw 12222 on a Thursday. And now what we are seeing is...

Professor G. Venkatesh: 12290

Professor Madhavan Mukund: 12290 also, on a Thursday, and that is also going to not take us anywhere because the next station on that is on the wrong day.

Professor G. Venkatesh: That is right. Then there is this train, which just said 02285 which is on Thursday. Again, 906 you have to look at it 02285.

Professor Madhavan Mukund: So, this would have worked except this wrong day. So, if I was allowing myself an extra day reach I could have reach Jhansi and going to reach Chennai on Friday.

Professor G. Venkatesh: How does it reach Jhansi by what...

Professor Madhavan Mukund: Bhopal and then Jhansi.

Professor G. Venkatesh: Good card.

Professor Madhavan Mukund: But anyway, technically that gets knocked off because I cannot take that one more step on the same day. So, this is...

Professor G. Venkatesh: For a near.

Professor Madhavan Mukund: We are very close, but Oh, so 02285 on Thursdays is also out. So, I have one more explore train here. 12285 on a Thursday, which is gone. Now, I think I need to, so I need to...

Professor G. Venkatesh: There is 1222 is there. 1222 we have already seen on Thursday. That is so that is. So, we are done with Nagpur.

Professor Madhavan Mukund: We are done with Nagpur.

Professor G. Venkatesh: So, now you have seen Nagpur from Wednesday. Hopefully we do not come back to Nagpur again. We will see. You still on this one train 12262, not finished exploring it. It is going towards Mumbai. Now, we come to Bhusawal on Thursday.

Professor Madhavan Mukund: So, now we have to explore Bhusawal on Thursday at 1003 42.

Professor G. Venkatesh: So, early morning we reached Bhusawal on Thursday. So, there is the train. And then there is another train here, which is in the night. You wait in Bhusawal till 11:06.

Professor Madhavan Mukund: 12261 that we have seen, so that is out.

Professor G. Venkatesh: So, that is the end of Bhusawal, nothing further Bhusawal. We cannot wait till the next morning because nothing can be done. So Bhusawal is over, then you go to Igatpuri.

Professor Madhavan Mukund: I am not going to be... chances are that we going wrong direction.

Professor G. Venkatesh: Completely going wrong direction, Igatpuri.

Professor Madhavan Mukund: Thursday at...

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Professor G. Venkatesh: Big junction Igatpuri.

Professor Madhavan Mukund: Thursday 0740, we reached.

Professor G. Venkatesh: which train is that.

Professor Madhavan Mukund: 12262, 12261 is gone.

Professor G. Venkatesh: we have seen it already. Then 12289, 12289 10:31.

Professor Madhavan Mukund: May actually be promising.

Professor G. Venkatesh: But it is Thursday.

Professor Madhavan Mukund: You do not have time.

Professor G. Venkatesh: And does it reaches, next office.

Professor Madhavan Mukund: 12289 is Igatpuri is going back to Bhusawal and then it is going to Nagpur, so now not very useful.

Professor G. Venkatesh: It is mark it as seen and we are done this so Igatpuri is no use. So, where are we now in our process?

Professor Madhavan Mukund: We are in Mumbai now.

Professor G. Venkatesh: here got a Mumbai. We are going to Jhansi and Mumbai. So, Mumbai how do we get to this train 12262 by Kolkata. So, Kharagpur to Kolkata. Kolkata we are going now to Mumbai.

Professor Madhavan Mukund: Does not...

Professor G. Venkatesh: Does not look like a look like the right direction. Mumbai has a lot of trains. When we reach Mumbai?

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Professor Madhavan Mukund: 10:30 on a Thursday.

Professor G. Venkatesh: search like anything. 10:30 on a Thursday. So, we have to look beyond 10:30. Thursday there is no train Thursday.

Professor Madhavan Mukund: 171512 so that we have seen is now 2261. So, that is a that is a already seen already seen train.

Professor G. Venkatesh: 8:15 12289. We have seen that. Want to do it now. So, then we come to 11:15 12227. 12227 no that is new.

Professor Madhavan Mukund: So, which have the trains we saw 12261 and 12289.

Professor G. Venkatesh: Now, you had this 122 but here are on Thursday at 11:15 in the night? Anybody want to do? We are just going to almost certainly it is did not know for the this.

Professor Madhavan Mukund: Too much. Too late.

Professor G. Venkatesh: Next train is next day. So, ruled out but we can mark it as seen and we are done with Mumbai.

Professor Madhavan Mukund: Yes. That was one...

Professor G. Venkatesh: You see in Mumbai from Thursday at some point in time. So, when you come back to Mumbai, we have already seen it from Thursday morning.

Professor Madhavan Mukund: So, this train is finally...

Professor G. Venkatesh: So, 12262 finally.

Professor Madhavan Mukund: This train is useless.

Professor G. Venkatesh: It did not get us to Jhansi.

Professor Madhavan Mukund: Nearly got us to Jhansi actually.

Professor G. Venkatesh: With a one day extra to go you can.

Professor Madhavan Mukund: If you are allowed me you know few more hours to reached to morning this morning something.

Professor Madhavan Mukund: three or four clock in the morning on Friday, I have reached. But did not allow me. So, we did not get to Jhansi in this time.

Professor G. Venkatesh: Now, what happens? Where do you go back now?



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Professor G. Venkatesh: Go back to Kolkata. And look at the next train.

Professor Madhavan Mukund: Next train after 12262

Professor G. Venkatesh: On a Wednesday.

Professor Madhavan Mukund: On a Wednesday? Yes.

Professor G. Venkatesh: So, we have one 02245.

Professor Madhavan Mukund: 02245 we should take these trains out 02245 this is going in really the wrong direction.

Professor G. Venkatesh: It is going to...

Professor Madhavan Mukund: It is going to Bhubaneswar, Vijayawada.

Professor G. Venkatesh: It is going to take time to examine. We shall skip it. Because it looks. Well strictly we should do it but yeah conserve time.

Professor Madhavan Mukund: So, let us see another train. We come back to this maybe.

Professor G. Venkatesh: you can come back to this later. Then comes 12259 which is leaving at 6:31.

Professor Madhavan Mukund: 12259 said more promising, this is more promising.

Professor G. Venkatesh: 12259.

Professor Madhavan Mukund: Wherever we are trying to go Kharagpur to Jhansi.



Professor G. Venkatesh: This is not going to Jhansi.

Professor Madhavan Mukund: No, it is going to Jhansi.

Professor G. Venkatesh: So, this we explore. This is taking a lot of time to explore. Now, we are at Kolkata at on Wednesday at 6:31. So, let us go back and we are exploring 12259 on Wednesday. So, we first create this 12259 object on Wednesday, and then ask it to explore itself. That is what we derive.

Professor Madhavan Mukund: So, what is the train next? Explore train 12259 leaving Wednesday on a Wednesday, so I first have to go back and watch this thing we have to come back to at some point if we need it. So, here we have now 12259 on a Wednesday.

Professor G. Venkatesh: Now, what this guy will do is at each station, he will get off and try.

Professor Madhavan Mukund: He will try.

Professor G. Venkatesh: Varanasi, Kanpur, Delhi, you already done Kanpur Jhansi.

Professor Madhavan Mukund: We have done Kanpur Jhansi and we can actually do Kanpur Jhansi in the same day. I think if we leave on a Tuesday, but this is on a Thursday, we do not know if we can do it on a Thursday, but...

Professor G. Venkatesh: It is normally again, it is same train can you check that what we did when we did it? 12259 there. So, let us see if we had stored it. The guy was smart enough to 12259. If we had stored this.

Professor Madhavan Mukund: And we can just check that 12270 is also available on that day. That was the connection. No See, 12270 was a train that we connected it to that is not there on a Thursday.

Professor G. Venkatesh: So, there will be no way to go to Jhansi.

Professor Madhavan Mukund: No, what about Delhi? Suppose we go to Delhi and change.

Professor G. Venkatesh: But you are too late. So, you are reaching on Thursday at 11:45.

Professor Madhavan Mukund: 11 45 so let us see. And supposing I...

Professor G. Venkatesh: So, strictly speaking, I have to try Darbar, Varanasi, Kanpur now that but as we have done it. Because that lot exploration.

Professor Madhavan Mukund: So, the logical place where we would get a train to go would be from Delhi I would think. So, assuming we have done all that.

Professor G. Venkatesh: we cut short cut short, we skipped one train, we skipped a few stations, because then we go same method.

Professor Madhavan Mukund: So, now we are exploring Delhi at 11:45 on a Thursday.

Professor G. Venkatesh: Thursday.

Professor Madhavan Mukund: So, we have to look at the Delhi station and see if there is something. So, we put this back, so we have kind of cheated a bit. And we are come down to...

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Professor G. Venkatesh: Here is Delhi 11:45.

Professor Madhavan Mukund: 11:45 is that right. So, after this on a Thursday, so there is 12:56 12282 it is not going ...

Professor G. Venkatesh: Strictly speaking, you have to actually again, we like to do all that Kanpur, Varanasi and all that stuff, explore, explore, explore and all that. But right now, we are short cutting it again.

Professor Madhavan Mukund: 12265 nothing more on Thursday 7:40 12260. This, this is going backwards. That is it.

Professor G. Venkatesh: That is it. So, Delhi is not very. So, it looks like if you had given me one more day, or I reached you at Jhansi at 3:45 in the morning.

Professor Madhavan Mukund: Let us see this thing will...

Professor G. Venkatesh: Sorry you will say and come back say I am not possible to find your root to say.

Professor Madhavan Mukund: So, this would have reached Vijayawada when this train that we did not explore could have reached at Vijayawada on Thursday morning at 4:25.

Professor G. Venkatesh: And then Vijayawada there is a way.

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Professor Madhavan Mukund: So, I think there... so there is a Chennai train which I have hopes for. So, this Chennai train over again crosses across to the next day. So again, I can reach on a Friday.

Professor G. Venkatesh: Friday at 5:30 you will reach.

Professor Madhavan Mukund: So, there are two different ways if you allow extra day to go but within 48 hours or within two calendar days.

Professor G. Venkatesh:

Professor Madhavan Mukund: It says not leaving on a Wednesday is not possible.

Professor Madhavan Mukund: But it explored I mean, it did a very desired exploration, station calling train calling, station calling trains calling. And the main thing was these same things are maintained by the respective.

Professor G. Venkatesh: respective classes. Yeah, respective.

Professor Madhavan Mukund: So, when I explore a station and the station box will tell me is has already been seen. Then I come back. When I explore a train and the train says I have already been seen, and it comes back. So, there is no so that information about which has been seen is kept within that box. And you just get the information about the next thing from the other box.

Professor G. Venkatesh: Very nice. I think it is good. It is really good.

