IIT Madras

ONLINE DEGREE

Computational Thinking
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Concept of encapsulation and object

Professor Madhavan Mukund: So, I was wondering actually about these procedures that we have being writing, these different things to find out facts about the data. So, it seems a little odd that we just keep writing these procedures as and when we need then, but actually we are only going to use a given procedure like if we want to give 3 prices, this procedure only makes sense for instance, for this course dataset, we cannot award top 3 prices for example for the shops or for trains.

So, it seems a bit odd that we have these procedures and then we kind of have no direct connection. If we look at a procedure in some sense we do not have a way of identifying clearly what data it is suppose to work on, what dataset in our cards, which cards are going to be using this procedure and which card…

Professor. G. Venkatesh: The other is that I think procedures in general, in real life they do not mean much, they are subservient. So, but we see data objects lying all around us, we do not see procedures lying around.

Professor. Madhavan Mukund: Exactly, when we have some data, then we do some operations on it to get some information.

Professor. G. Venkatesh: For we will see a procedure, if at all we see any procedure, it will probably be packaged with some data.

Professor. Madhavan Mukund: Yeah. So, there will be some context, some setting in which the procedure, so they would not just be…

Professor. G. Venkatesh: So, we might have a television buy a television, then it comes in a box, nice box and we open it, take out the television, usually it is, nowadays the television is more complicated, but again there is this manual. So, you open the manual and it tells you this is the switch, that switch this switch, so many connectors in the back and all that, so what to connect where, how to power it up, what to do, how to set it up, how to set up with your Wi-Fi or some other thing, today everything…

Professor. Madhavan Mukund: Correct.

Professor. G. Venkatesh: So, how to set up all that, so all that is written in the manual.

Professor. Madhavan Mukund: Instruction manual.

Professor. G. Venkatesh: But that thing is inside the box with the television.

Professor. Madhavan Mukund: Correct. No point in saying..

Professor. G. Venkatesh: It is not that you go and buy a manual separately.

Professor. Madhavan Mukund: manual separately.

Professor. G. Venkatesh: Then you figure out which did not apply to or something. It is not like that.

Professor. Madhavan Mukund: Correct. Correct. So, I think, so there is some mismatch I think the way we have been looking at it….

Professor. G. Venkatesh: if something…

Professor. Madhavan Mukund: I think we need to somehow connect these two.

Professor. G. Venkatesh: Connect the two and also I mean the other thing is that when you said that the procedure is related to some data, we also saw that procedure need some data outside it.

Professor. Madhavan Mukund: Correct.

Professor. G. Venkatesh: Some of the data is inside the procedure like when you keep a count of something, it is inside the procedure we keep count and then we keep updating it or something like that. But some of the data is outside, sideeffects or whatever we call it, they are outside the procedure, we are acting on the cards which are outside.

In fact there maybe two procedures, one procedure may call another procedure, both of them may work on the cards and then this may return something. So, we have to know which procedures shares what data with what other procedure and what impact it has, what side effects it has. Now, right now it is messy, we are not keeping track of all that. So, there must be some better way of organising these procedures.

Professor. Madhavan Mukund: So, I think like that box you said like the TV box, so we can think of our, so we buy a set of marks cards for instance and when it is sold to us, it is sold to us along with some procedures, somethings that we can get out of this.

Professor. G. Venkatesh: Pre-packaged.

Professor. Madhavan Mukund: It is pre-packaged and maybe there is a way to add things, so customize it.

Professor. G. Venkatesh: See right now the procedure itself, who is doing the procedure here?

Professor. Madhavan Mukund: Yeah. It is not yet clear. We are executing the procedure.

Professor. G. Venkatesh: But who is we? Suppose I give it to the students, student is doing, then what? So, it is not very clear who is the owner of this procedure, right?

Professor. Madhavan Mukund: Yes.

Professor. G. Venkatesh: So, now what you are saying is that the marks card will come with some procedures and those procedures belong to a mark card.

Professor. Madhavan Mukund: Sort of, so it is like you have an app on a phone, so you, is there some buttons you can press and it will do something with the dataset inside and….

Professor. G. Venkatesh: Okay.

Professor. Madhavan Mukund: But maybe you can customize the app, you can add a button, you can move it around, but the ultimately, everything is inside the box.

Professor. G. Venkatesh: Inside.

Professor. Madhavan Mukund: Inside, you do not have a clear idea of, you know what it is supposed to do, its told, if you press this and this will happen like supposing you are keeping track of say some calendar or something, you can add an entry and you can set it to give you an alarm when the time goes off. All these things you can do but you are not really keeping track of how it maintains what is this information and how it remember.

Professor. G. Venkatesh: So, procedure if it is inside some object, if it is sitting inside the thing which on which it is working, what is it, what is it mean, you have this, so let us say mark card, you are saying the procedure is attached to the marks cards, not outside, inside.

Professor. Madhavan Mukund: Inside.

Professor. G. Venkatesh: So, if it is inside the …

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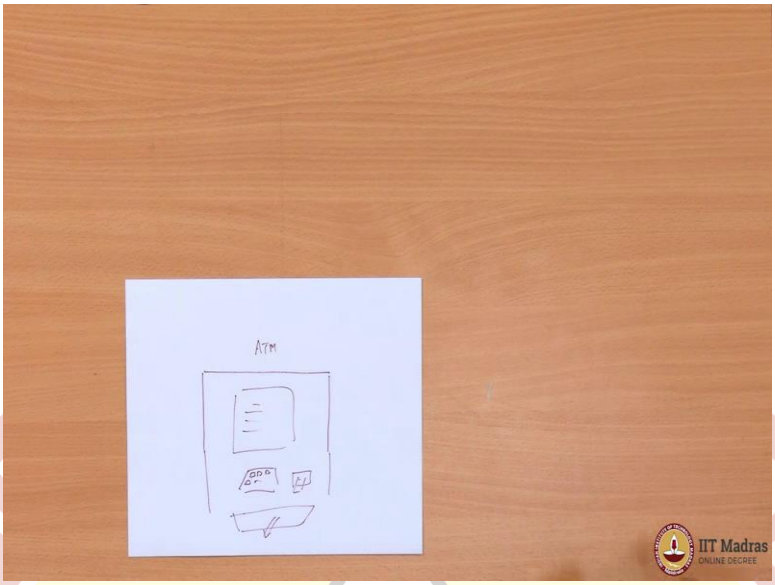

Professor. Madhavan Mukund: So, inside, I mean I would see you think of this ATM like thing. So, you have an ATM. Okay. What do you see, you see a display on which it can tell you some information.

Professor. G. Venkatesh: Okay.

Professor. Madhavan Mukund: Then you will typically have some panel here where you can press some buttons and then you have this slot here where you can put in your card and then you have some slot here which can give you money. So, in this way you can think of this whole thing as some box….

Professor. G. Venkatesh: Box.

Professor. Madhavan Mukund: In which you can interact with it by pressing these cards. Occasionally you might want to give it some information which you can push in through a slot and then it has to give you something back. If it cannot display it, if it has something else, so you have these different ways in which you can interact with this.

Professor. G. Venkatesh: interact with this.

Professor. Madhavan Mukund: But you can also ask it to do something because it will give you a menu or it will say do you want to withdraw money, you want to check your balance. So, you can press that button.

Professor. G. Venkatesh: So, ATM in a sense has, it is packaged in a way that it controls what it accepts from you and what it gives you?

Professor. Madhavan Mukund: Yes.

Professor. G. Venkatesh: Interfaces are…

Professor. Madhavan Mukund: Yeah. So, this is a very sort of rigid kind of thing where we do not have flexibility but what we are saying is in a similar way supposing we are able to add buttons to it…

Professor. G. Venkatesh: I presume that ATM also some guy writes a software, he can change it?

Professor. Madhavan Mukund: Yeah, he can change it, we cannot change it.

Professor. G. Venkatesh: we cannot change it.

Professor. Madhavan Mukund: So, but if we are designing the cards and we want tomorrow to add, change 3 prices to 5 prices or we want to change the criteria or something, we have the flexibility to change that, but it will remain…

Professor. G. Venkatesh: attached to that.

Professor. Madhavan Mukund: within the cards, so the next person who comes will see the same thing.

Professor. G. Venkatesh: So, he can just take the same thing.

Professor. Madhavan Mukund: So, he can just take the card deck along with all its procedures.

Professor. G. Venkatesh: Yes.

Professor. Madhavan Mukund: And he can modify the procedures.

Professor. G. Venkatesh: Yeah. If he given permission to. And then he can give that modified thing to somebody else, they can work out.

Professor. Madhavan Mukund: But the whole thing is that the procedures and the cards will go together as a unit, so there will be no doubt as to.

Professor. G. Venkatesh: So, in this case if the let us say marks cards or procedures sitting inside it, not outside, inside it, then if it is inside it, then you have to have just like the ATM we are telling the ATM, you have to tell the marks cards to do something?

Professor. Madhavan Mukund: Exactly. So, like you press the button, so it will give you an option what you want me to do? Do you want to do banking? Typically, it is what an ATM does, you have what services do you want?

Professor. G. Venkatesh: Right.

Professor. Madhavan Mukund: And then you press a button, and then it offers you some more choices. So, similarly here you will have a menu saying what do you want me to do? So, I want you to tell me top 3 physics marks. So, he will say okay, here are the top 3 physics marks. Maybe as it said it could have an option to change itself, I want to add a new data card, say new student has come, maybe that is also possible.

Professor. G. Venkatesh: Just like an…

Professor. Madhavan Mukund: Like a card I can feed in some information. So, I have to change the….

Professor. G. Venkatesh: Data inside…

Professor. Madhavan Mukund: Inside possibly if it allows me to.

Professor. G. Venkatesh: And the fellow from outside cannot see inside what is going on!?

Professor. Madhavan Mukund: Yeah. So, for instance, we saw..

Professor. G. Venkatesh: Just like that.

Professor. Madhavan Mukund: We saw that there may be different ways to find out the maximum maybe you already keep it arranged, so it is the top card, maybe you have to search through the whole thing. We have no idea whether it is doing this or that.

Professor. G. Venkatesh: It will just found out the top 3 physics marks and get it. When you ask it just gives it.

Professor. Madhavan Mukund: Maybe it knows that this is a popular question, so it just keeps a written down somewhere so that it instantly give you the answer.

Professor. G. Venkatesh: Or it keeps it sorted.

Professor. Madhavan Mukund: Yeah. Or it keeps it sorted so it always knows.

Professor. G. Venkatesh: When you ask 3 or 5, it will take the top 3, top 5 whatever it is.

Professor. Madhavan Mukund: So, it does not have to search instant. So, we really do not.

Professor. G. Venkatesh: Or it may have done nothing, then it may have to do the whole thing from beginning.

Professor. Madhavan Mukund: Yeah.

Professor. G. Venkatesh: But as far as from outside we are seeing,…

Professor. Madhavan Mukund: So, we may get to know because it takes a long time, but that also it could fool us, it might pretend it is doing a lot of work and tell us the answer and actually it knew the answer already.

Professor. G. Venkatesh: we do not care really.

Professor. Madhavan Mukund: Actually we do not care, right now we do not care. We are interested in getting the answer that we want. We are at the moment not to bother about how much time it takes and whether it is, I mean of course, reasonable time it should be doing it and the reasonable time, but we are not going to be overly I mean these things do not take so long that, we will see the difference very obviously. So, I think so long as it tells us correctly what we expected to do,…

Professor. G. Venkatesh: So, take this thing suppose we ask this marks card dataset. Take that out.

Professor. Madhavan Mukund: Okay. So, let us take.

Professor. G. Venkatesh: Now, this is an object except that this object, this creature is in a box presume.

Professor. Madhavan Mukund: Yeah. So, we cannot look at the inside.

Professor. G. Venkatesh: look inside.

Professor. Madhavan Mukund: So, we cannot look at the individual cards.

Professor. G. Venkatesh: We cannot see it.

Professor. Madhavan Mukund: If you want to see a card, for example, we might know there are 30 cards numbered 0 to 29. So, maybe we can say tell me the total of card number 17 or who is the name of card number 5 or something? But we cannot directly lift the cards the way we have been doing, that is not available to us anymore.

Professor. G. Venkatesh: The procedure is inside.

Professor. Madhavan Mukund: Yeah. Somebody inside when little…

Professor. G. Venkatesh: So, we are inside.

Professor. Madhavan Mukund: Yeah.

Professor. G. Venkatesh: So, we are the procedure inside.

Professor. Madhavan Mukund: So, we are, we have been acting like this little creatures sitting inside the box who are moving this cards around.

Professor. G. Venkatesh: Moving the cards around. So, somebody inside will do all the work, some ant move around and do all that and then he will return the answer.

Professor. Madhavan Mukund: Yeah.

Professor. G. Venkatesh: So, suppose I say give me 3 physics, the top 3 physics marks.

Professor. Madhavan Mukund: Yeah. Correct.

Professor. G. Venkatesh: Now, what does it mean, I mean this guy first has to accept that instruction.

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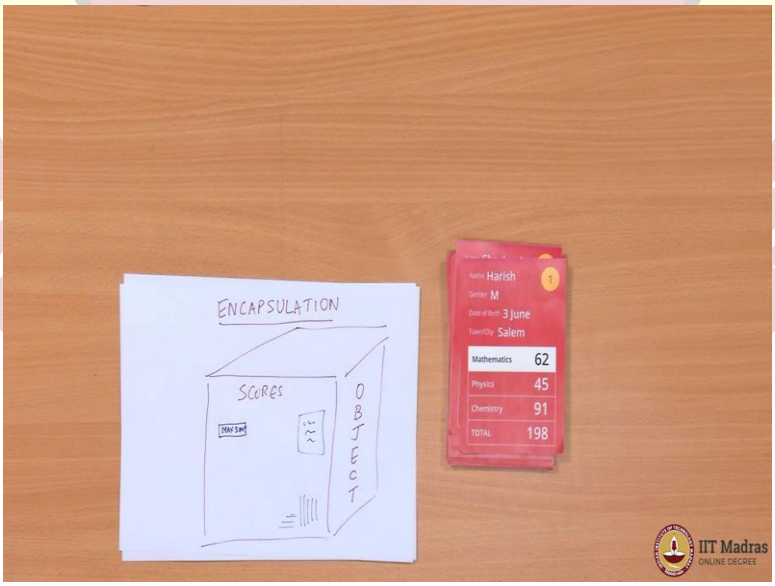

Professor. Madhavan Mukund: Yeah. So, we have this box.

Professor. G. Venkatesh: We have to be able to tell this fellow.

Professor. Madhavan Mukund: Yeah. So, we have this like the picture that this ATM. Now we have this scores box and somewhere inside this scores box these cards are lying around in some stack or some…

Professor. G. Venkatesh: Somewhere he is keeping it. We cannot see it.

Professor. Madhavan Mukund: We do not know whether he keeps it vertically, horizontally nothing.

Professor. G. Venkatesh: idea 1, pile 2, pile 3 do not know.

Professor. Madhavan Mukund: Now here they will be some kind of questions that we can ask. They will be button which says max 3 physics or something. So, we can press that button.

Professor. G. Venkatesh: Okay.

Professor. Madhavan Mukund: And then somewhere here…

Professor. G. Venkatesh: Hopefully we should be able to parametrise.

Professor. Madhavan Mukund: Yeah. That we can figure out later on but basically we could have say again 3 or 5 whether

Professor. G. Venkatesh: Physics can be in chemistry.

Professor. Madhavan Mukund: So, like in this ATM, you could say I want to find out maximum, it will say how many you want to press the button, which subject you want you press in the screen.

Professor. G. Venkatesh: Right.

Professor. Madhavan Mukund: So, these kind of things. So, parameters you can always pass through something and then it will do some…

Professor. G. Venkatesh: what all it does.

Professor. Madhavan Mukund: Yeah, some processing on this.

Professor. G. Venkatesh: What does it give back?

Professor. Madhavan Mukund: So, It will give you back…

Professor. G. Venkatesh: It will give you cards?

Professor. Madhavan Mukund: It would not give the cards, it will give you the numbers or the names or whatever you agree is the correct answer to give back to you.

Professor. G. Venkatesh: But the thing is the list, 3 is list.

Professor. Madhavan Mukund: It will give you a list of some form, it will display the list in some form which we agree on in advance how it should display, so that is part of this. So, this we have talked about these procedures having this contract. This contract includes the form in which it gives you the answers back.

Professor. G. Venkatesh: answer back.

Professor. Madhavan Mukund: So, otherwise it is a black box.

Professor. G. Venkatesh: So, right now again we are thinking about us.

Professor. Madhavan Mukund: Yeah.

Professor. G. Venkatesh: as you or me as human beings talking to a box. But the guy who is asking this box can be a another box?

Professor. Madhavan Mukund: Absolutely. Yes.

Professor. G. Venkatesh: So, one box can ask another box?

Professor. Madhavan Mukund: Yes. One box can ask another box.

Professor. G. Venkatesh: So, the box can ask itself also?

Professor. Madhavan Mukund: Yeah, it could ask itself also. Correct. So, for instance, say you could have the box could internally be able to parametrise, get the top 3 marks of any subject. So, it might have its own procedure inside which does that. So, when you ask that box to get the top 3 marks or the top k marks in subject S. So, when you say k is 3 and subject is physics, then it will call itself its own internal guy with those parameters and it will give you back the answer. So, it is like…

Professor. G. Venkatesh: So, box can call itself, the box can call another box, we can also call the box which you say….

Professor. Madhavan Mukund: Yeah. So, even when we call the box, effectively it is like we write some procedure which calls them, we do not call the box from…

Professor. G. Venkatesh: We will write a procedure.

Professor. Madhavan Mukund: So, finally everything is …

Professor. G. Venkatesh: Only one procedure….

Professor. Madhavan Mukund: One procedure is… So, there is some main context from which we call the box.

Professor. G. Venkatesh: So, that big procedure, one main procedure. Hopefully, everything else is boxes, one main procedure, this guy calls boxes one after the other and the boxes in turn may call each other, call itself, do whatever it may say and finally it spits out the answer, it comes out somehow. It is interesting method, is there a name for this method, I mean this business of packaging it nicely like this in a box and making it.

Professor. Madhavan Mukund: So, basically you are putting it inside like this time capsule kind of thing, so everything is there, so you time capsule you send out something into outer space which is supposed to represent all of..

Professor. G. Venkatesh: all the world.

Professor. Madhavan Mukund: world's civilization so that somebody could look at it and then say, oh, this is what world is.

Professor. G. Venkatesh: This is how the world look like.

Professor. Madhavan Mukund: This people look like this culture in this far away planet.

Professor. G. Venkatesh: Yeah.

Professor. Madhavan Mukund: So, same way this is like a capsule, so these are capsule which consist of…

Professor. G. Venkatesh: capsule of everything whatever you need about the cards.

Professor. Madhavan Mukund: Yeah. It has all the information, all the data about the cards and it has all the

Professor. G. Venkatesh: all that you want to do.

Professor. Madhavan Mukund: all the procedures that you can use to operate on the data. So, everything is there, so this is basically encapsulation, you putting things, you are putting thing into…

Professor. G. Venkatesh: This is encapsulation. Capsule. So, you got it from the word capsule.

Professor. Madhavan Mukund: capsule.

Professor. G. Venkatesh: Encapsulation.

Professor. Madhavan Mukund: So, we will call it encapsulation. Encapsulation.

Professor. G. Venkatesh: Encapsulation basically means that we are putting things..

Professor. Madhavan Mukund: putting everything into one box.

Professor. G. Venkatesh: Putting the cards as well as its putting the data as well as the procedures all together.

Professor. Madhavan Mukund: Together into a unit so that they are tied to each other in a fairly tight way. So the data knows what can be done to it and the procedures know what they are operating on and as you said they can share information that they are partially computed and keep it so that they do not have to do it again and so on.

Professor. G. Venkatesh: So, these objects is we are creating objects I mean this is related also to object oriented or something?

Professor. Madhavan Mukund: Yes.

Professor. G. Venkatesh: So, we will keep saying object oriented…

Professor. Madhavan Mukund: So, we can think of this, so these all thing is an object.

Professor. G. Venkatesh: So, this is same thing is it, object oriented and encapsulation are they same?

Professor. Madhavan Mukund: Well, I guess they are related obviously. So, encapsulation is more I guess abstract idea that you have in some data and procedures together and concretely you call such a unit. So, an object is like a concrete unit of this thing. So, this is an object, then if you take the shopping cards that will be another object and so on and each of these has got an encapsulated set of data and procedures.

Professor. G. Venkatesh: So, if strictly speaking this one card is also an object, right?

Professor. Madhavan Mukund: Yes. So, it is an object consisting an object. Yes, we could think of…

Professor. G. Venkatesh: We could think of one card because it is got inside it. So, just take this one card, so we got basically, this is a student profile. And then there are some marks of course, right now we have only listed marks, 3 marks, it could have more marks.

Professor. Madhavan Mukund: It could be more subjects.

Professor. G. Venkatesh: You could have many years, you could have look at the marks and twelfth standard, you could look at his marks in eleventh standard, tenth standard like that. Chronologically you could look, the profile will not change.

Professor. Madhavan Mukund: Profile will not change.

Professor. G. Venkatesh: Some part of it can keep.

Professor. Madhavan Mukund: Yeah.

Professor. G. Venkatesh: So, there should be some way of organising this object itself in a much more interesting way. Then you have the collection of these objects which basically makes up this card deck which is a set of all the objects which are together because they are in the same classroom or something.

Professor. Madhavan Mukund: Yes.

Professor. G. Venkatesh: That is why they are together. But then principle this also is an object. So, everything can be converted on object or what?

Professor. Madhavan Mukund: Well, generally things which have some structure I mean you will not like to think of a number as an object. For an example.

Professor. G. Venkatesh: 3, June 30.

Professor. Madhavan Mukund: Or count, supposing we are keeping track of count.

Professor. G. Venkatesh: Count? Count is not an object.

Professor. Madhavan Mukund: Count is not very interesting object, it can only tell us what is count and you can add 1 to it and subtract 1 from it.

Professor. G. Venkatesh: So, it has to have some reasonable amount of structure like this card itself has some structure so it makes sense.

Professor. Madhavan Mukund: Yeah. And something which we can do some interesting operations we can do. Like for example things that we can do with this is we can add up for

instance supposing we did not have the total if we could ask you or you can say find the total of the top 2 of the three subjects or which is the minimum subjects.

Professor. G. Venkatesh: Which subject you are doing best at.

Professor. Madhavan Mukund: Yeah. Which subject is best, which subject is worst, all these questions we can ask. So, these are all interesting questions, whereas if you just had 1 number like storing count or something like that, or max.

Professor. G. Venkatesh: So, in some sense after some level of complexity which means that once the object has become sufficiently interesting that there are enough procedures to be applied to it. At this point in time it starts making sense to…

Professor. Madhavan Mukund: Think of it as an object.

Professor. G. Venkatesh: Think of it as an object and put, but you can do too many objects then meaningless it becomes.

Professor. Madhavan Mukund: Yeah. It becomes meaningless so but even here. So, we have to make conscious decision do you want to…

Professor. G. Venkatesh: whether to think of doing or not.

Professor. Madhavan Mukund: Whether to think of one card as an object is more interesting or a stack of cards as an object is more interesting. It depends on how we are going to use it.

Professor. G. Venkatesh: Yeah.

Professor. Madhavan Mukund: So, when we are asking questions like top 3 prices and these kind of things it makes sense to think of the whole stack as an object.

Professor. G. Venkatesh: As an object, not one card.

Professor. Madhavan Mukund: Not one card, but maybe in some other context for instance in the shop, shopping bill.

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Professor. Madhavan Mukund: We can look at the shopping bill for instance. So, here if we look at these card, so now of course we can, we also have this idea here that they are separated into these different types of shops. So, we can decide whether we want to think of the shop as one shop.

Professor. G. Venkatesh: It will be a better object as a unit.

Professor. Madhavan Mukund: so, then we can…

Professor. G. Venkatesh: took other shopping bill.

Professor. Madhavan Mukund: so, we can

Professor. G. Venkatesh: is owned by actually it is owned by two people, shopping bill, it is owned by the customer, customer keeps a copy, shops keeps a copy.

Professor. Madhavan Mukund: So,… And the bill itself actually is a record of transactions in two people, it is not like here there is essentially one persons….

Professor. G. Venkatesh: So, here the natural object is the whole bunch of cards, we could also think of one student as a card, but the whole bunch is a much more natural object. There is a very little use for one card actually.

Professor. Madhavan Mukund: Yeah.

Professor. G. Venkatesh: in that sense to break it into an object. But here there is something in between the whole deck.

Professor. Madhavan Mukund: Yeah. So, there these collections which are grouped either by so what would object here…

Professor. G. Venkatesh: customer, interesting object might be a shop.

Professor. Madhavan Mukund: a shop could be an interesting object. So, we want all the bills of SV Stores together and we can …

Professor. G. Venkatesh: So, SV Stores is an object. So, we ask SV Stores, hey SV Stores…

Professor. Madhavan Mukund: what item do you sell the most?

Professor. G. Venkatesh: What items did you sell the most?

Professor. Madhavan Mukund: Yeah.

Professor. G. Venkatesh: How will you do that?

Professor. Madhavan Mukund: So, it will have to go through all its bills and then keep track of all the items it has sold and keep counting for the same item if he sold it multiple times, it will keep either the value or the count whatever we decide by most and then it will tell us.

Professor. G. Venkatesh: It will tell us, okay I sold let us say.

Professor. Madhavan Mukund: so many units of ..

Professor. G. Venkatesh: milk or something. Okay. Whatever it is ..

Professor. Madhavan Mukund: Now it will be milk.

Professor. G. Venkatesh: I sold milk the most, SV Stores will say. You could ask the same question to Sun General, hey Sun General tell me.

Professor. Madhavan Mukund: Yeah exactly.

Professor. G. Venkatesh: What did you sell the most?

Professor. Madhavan Mukund: Yeah.

Professor. G. Venkatesh: That guy might say apparel or something.

Professor. Madhavan Mukund: Okay. So, here it becomes like a procedure where we have I mean internally procedure will ask, so it is there is a big box which has all these cards and it has these smaller objects inside.

Professor. G. Venkatesh: But the thing is you can have shops, so shop is an object. So, you can have so in this you have 3 objects, 3 shops. Customer can also be object.

Professor. Madhavan Mukund: Yes. I will tell you how we can organise it by say Amit so Amit has shopped in these 3 things. So, we can put all the Amit's bills together and ask Amit what item do you buy the most? Or which shop due you…

Professor. G. Venkatesh: So, the bill is there, so the bill has to be there, both have to have?

Professor. Madhavan Mukund: Yes.

Professor. G. Venkatesh: Both because they need the bill. They receive the bill somewhere else this guy can…

Professor. Madhavan Mukund: So, this is a little bit like we talked earlier about this indexing. So, we have the bills are there…

Professor. G. Venkatesh: bills are there.

Professor. Madhavan Mukund: So, I can refer to it through the shop. So, the shop has a copy of its bills.

Professor. G. Venkatesh: So, how does it look, I mean can we draw diagram of these objects how they look. You have 3 shops and maybe I know 10 or 12 customers are there, I do not know how many customers are there.

Professor. Madhavan Mukund: Yeah. So, there I think the quite a few customers. So, what I would say is that…

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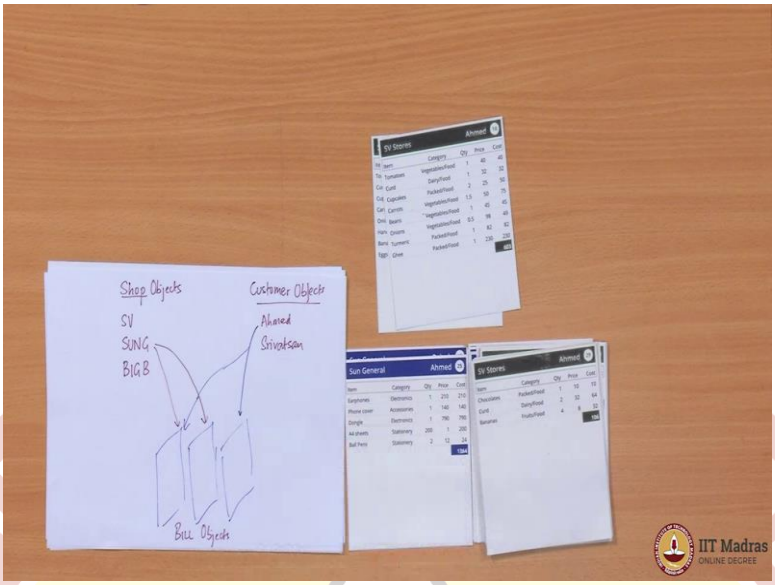

Professor. Madhavan Mukund: at the bottom you have, so you have these actual shopping bills which are there.

Professor. G. Venkatesh: Okay. And that we can put in a box.

Professor. Madhavan Mukund: Then we put that in a box and then we will have this SV Stores, Sun General and Big Bazaar, is it?

Professor. G. Venkatesh: Big Bazaar. These are 3 boxes of their own.

Professor. Madhavan Mukund: So, these are 3…

Professor. G. Venkatesh: So, these are 3 objects,

Professor. Madhavan Mukund: 3 objects.

Professor. G. Venkatesh: Here shop objects, write here shop objects.

Professor. Madhavan Mukund: Shop objects

Professor. G. Venkatesh: and this is the bill object or whatever it is I do and know.

Professor. Madhavan Mukund: So, these are the bill object or something. This is holding all the bills. And then we have one more thing which is the customer object and here again you have for each customer like Ahmed and all that you have one, each of them have one box.

Professor. G. Venkatesh: Now you can ask Ahmed, presumably you can ask Ahmed, right?

Professor. Madhavan Mukund: Yeah.

Professor. G. Venkatesh: Previously you were not thinking it like that? Now I can go and ask Ahmed, hey Ahmed tell me…

Professor. Madhavan Mukund: Yeah. So, Ahmed will have somehow he will. So he will know which of these..

Professor. G. Venkatesh: bills belong to him.

Professor. Madhavan Mukund: bills belong to him. So, you will be pointing to a collection of these bills.

Professor. G. Venkatesh: So, he will have these bills, access to these bills.

Professor. Madhavan Mukund: Access to these bills and the same way Sun General…

Professor. G. Venkatesh: And we do not need to know how he has access to bill, we do not care.

Professor. Madhavan Mukund: Sun General might have access to some bills and there will be some bills, so this is bills, so this is access belongs to Sun General and to Ahmed, so this is a bill where Ahmed has shop at Sun General.

Professor. G. Venkatesh: So, you can ask Ahmed, Ahmed tell me what item you brought the most?

Professor. Madhavan Mukund: Correct. So, it will, he will go through his bills…

Professor. G. Venkatesh: he will go through his bills..

Professor. Madhavan Mukund: and do this…

Professor. G. Venkatesh: whatever Ahmed he will do whatever he keep track of all the items how much of it he brought.

Professor. Madhavan Mukund: and he will tell us.

Professor. G. Venkatesh: Find out the maximum of that and he will return back to us something which says which item and how much of it he brought. Then I can ask the same question to Sun General, hey Sun General which item you sold the most?

Professor. Madhavan Mukund: Correct.

Professor. G. Venkatesh: Then he will do something and he will come back and say, Ahmed it looks like you are shopping only in Sun General because both the answers came out the same. It could be?

Professor. Madhavan Mukund: Correct.

Professor. G. Venkatesh: So, that, so it is interesting way of looking at it because earlier we are not looking like this. This makes it really very intuitive because we naturally we that is how we do in real life, we, when we want to do something we go ask somebody.

Professor. Madhavan Mukund: Who has the information to give us some summary or some…

Professor. G. Venkatesh: and he may do something, he may in turn ask a few, he may not know the answer.

Professor. Madhavan Mukund: Correct.

Professor. G. Venkatesh: He may ask somebody or he may say, let me search for it, he may have something in his book or somewhere he may have stored it, he will search, he will do something, I do not know what he does, but the result is that he will come back and tell me this is it, this is what you should do, it will give me advice whatever it is. So, this is a very natural way and so this what do you call it, object (orient) encapsulation?

Professor. Madhavan Mukund: Yeah. So, encapsulation and these objects and then, so we have programming with respect to these objects. So, everything that we do is kind of…

Professor. G. Venkatesh: So, this encapsulation seems to make things much more closer to real life.

Professor. Madhavan Mukund: Yeah.

Professor. G. Venkatesh: Then what we had done earlier where he had some..

Professor. Madhavan Mukund: So, there we had procedures on one side which were kind of…

Professor. G. Venkatesh: Goes like creatures

Professor. Madhavan Mukund: Then you feed them data even though the procedures themselves were very somewhat picky about what data they would use. So, there was no direct connection, now we are saying that the data is connected directly to the procedure.

Professor. G. Venkatesh: So, very I mean the key thing about this I think the most interesting thing about this is that the data that the procedure needs to have access to is very well defined now because either he has it inside or if he does not like in Ahmed here, if he does not have it inside, he has a specific contract with another object through some well defined interface to get whatever data he needs to do his work, is not it?

Professor. Madhavan Mukund: Correct.

Professor. G. Venkatesh: So, similarly Sun General, the object basically has its own contract with bill objects to get whatever it needs to do its work. So, that the access to the data that the object needs that part of it is extremely well defined now, unlike what was there.

Professor. Madhavan Mukund: And under control, you can decide where what information you give, what information you don't give.

Professor. G. Venkatesh: So that way it is much better organised and also the way of asking objects to do things for us and the objects talking to each other and asking things about each other makes it very close to real life.

Professor. Madhavan Mukund: Yeah.

Professor. G. Venkatesh: So, this method of organising things seems much better but we have to try a real example I think then only it becomes more fun.

Professor. Madhavan Mukund: Yeah.

Professor. G. Venkatesh: But, this looks very definitely appealing, much more appealing than what we have tried so far.

Professor. Madhavan Mukund: So, let us try and do something after this with one of our earlier examples.

Professor. G. Venkatesh: sure.