IIT Madras

ONLINE DEGREE

Computational Thinking
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Pseudocode for operation on the data collected in three prizes problem using lists

So, in the first lecture we saw how to introduce lists into our pseudocode notation. So, we have the square bracket notation to write a sequence of values and we had the foreach loop which allowed us to systematically examine the values in a list. So, now let us look at an example.

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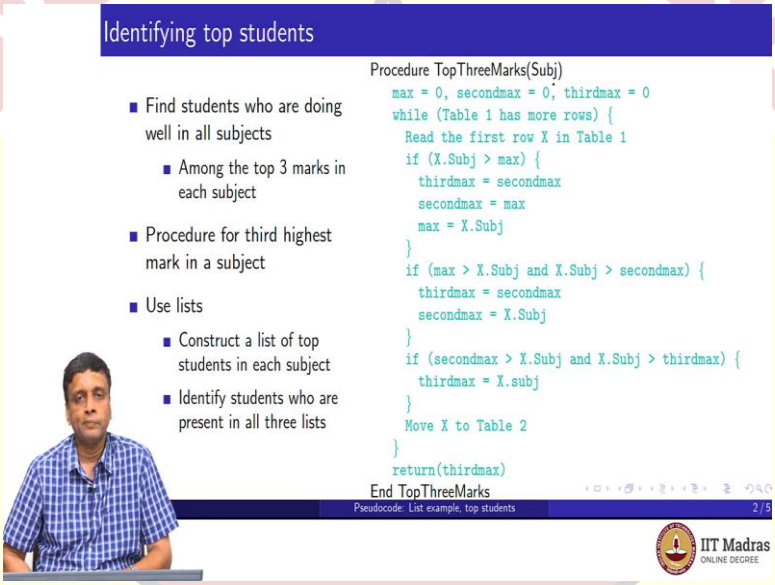

So, the example that we are going to look at is the one where we are trying to identify the top students in all subjects. So, we would as say that a student is a top student across all subjects say if that student has within the top 3 marks in each of them. So, in physics and in maths and in chemistry, the student has scored among the top three marks. So, we had already seen quite a while back when we discussed procedures, how to write a procedure for the top 3 marks in a subject, so we keep track of this maximum, second maximum and third maximum and then for each row in the table, or for each card in our dataset, we check the marks in this subject for that card and if that card, so we have basically 3 possibilities.

So, we have max, second max and third max. So, the new value that we see could be either bigger than max in which case everything gets shifted by 1 or it could be between max and second max, in which case only the second max gets shifted. Or it could be between second and third max in which case the third max gets replaced by this card. So, those are these 3 if

conditions so either it is bigger than the max in which case you shift the max down to second max and the second max down to third max and replace the max by this one.

Or if it is between max and second max, then you replace the third by the current second and make this the new second. Or if it is between second and third, then we leave max and second max as they are and we replace the third max by this. So, what this does is, it calculates the third highest, second highest and highest marks in each subject and finally it returns what we are really interested in is this cut off. So, it returns a single value which is the third highest mark in that subject. And this is parametrized by the subject name.

So, if we call it with physics, we get the physics marks, call it with mathematics, we get the mathematics marks and so on. So, now that we have this procedure, what we know is that the cut off is given by the procedure but we do not know how many students are there above this cut off?

So, any student who has got more than or equal to the third highest mark is considered to be a top student in that subject. So, this is where lists come in. So, we will take for each subject, we will take the list of students who are toppers in that subject by querying this procedure and then we will have to check whether there is a single student or how many students actually appear across all these 3 lists.

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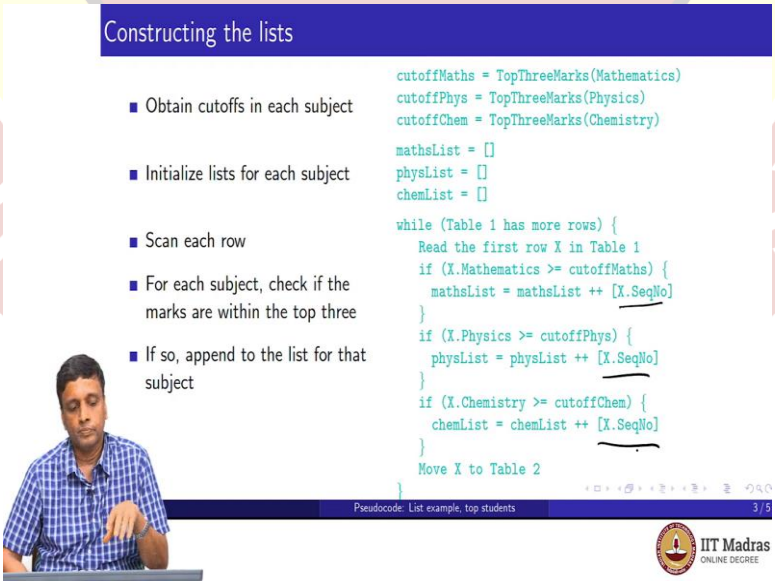

So, the first step is to identify what the cut off criterion is. So, this we get as we said by calling the procedure that we just saw. So, we look at this top 3 marks and we call it with mathematics, physics and chemistry and we get the corresponding values of the cut offs for

maths, physics and chemistry. Now, we want to construct these lists of students who are above the cut offs in all these 3 subjects. So, we have 3 lists, one for maths, one for physics, one for chemistry and we initialise each of them to be empty to begin with.

Now, we do one pass over the table again because we do not have these marks anywhere except in the table. So, we had done one pass in the table each time when we constructed these top 3 marks but now we have to look at each mark and decide whether that student qualifies as a top student. So, we look at each row in the table, then if the maths mark is above the maths cut off, then we will put this particular card into the maths list.

Similarly, if the physics mark is above the physics cut off, we will put it into the physics list and thirdly, if it is above the chemistry cut off, you will in this case. So, for each row that we process, we check each of these 3 criteria and in one shot by processing that row in one shot we know whether to add it to maths, physics and chemistry or not.

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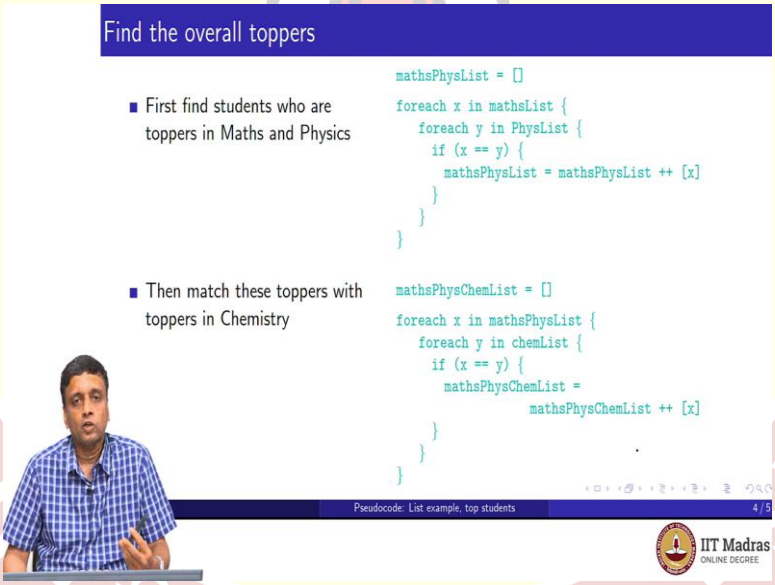

So, at the end of this we have these 3 lists. We have the physics, maths and chemistry and now we want to find out if some element is common to all 3. Now, in the first lecture we already looked at this idea of a nested loop to find out if some element is common to two lists. Remember that we looked at the students who were born in May and were from Chennai. So, we said if we have a list of students born in May and a list of students who are from Chennai, by doing a nested foreach we can check whether a sequence number appears in both lists.

So, we can do the same thing for maths and physics now. So, we want to find out all common elements between maths, physics and chemistry. So, if a student is a topper in maths, physics and chemistry obviously, the student is also a topper in just maths and physics. So, the first step is to just find out those who have topped maths and physics, both because unless they have topped both of maths and physics, they are not candidates to be a topper overall.

So, we first do this exact same nested loop that we did earlier. So, we start with this maths, physics list set to be empty and now for every student who we have put in the maths list, we check for every student who we have put in the physics list if they are the same or not and if we find that there is an x in the maths list which is equal to a y in the physics list, then we add that x to the mathsPhysics list. So, mathsPhysics list which we have created now is a list of toppers in both maths and physics.

And now, we take this list, so we now know those students who are toppers in 2 subjects and we want to check if they are also toppers in chemistry. So, now we do a nested iteration between mathsPhysics list and Chemistry list. So, mathsPhysics list is a list which we just created. Chemistry list is a list that we got by examining the cut off marks and again by doing this nested iteration, so in two nested iterations, basically, we have extracted the toppers across all 3 subjects.

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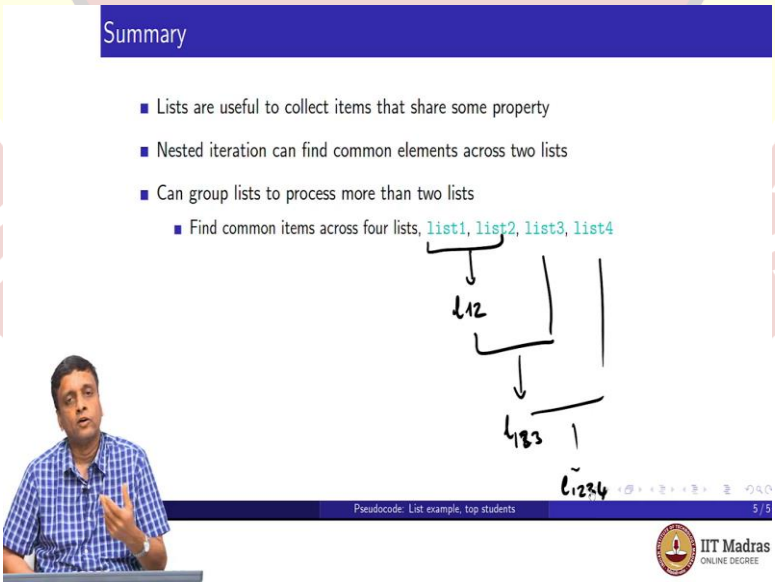

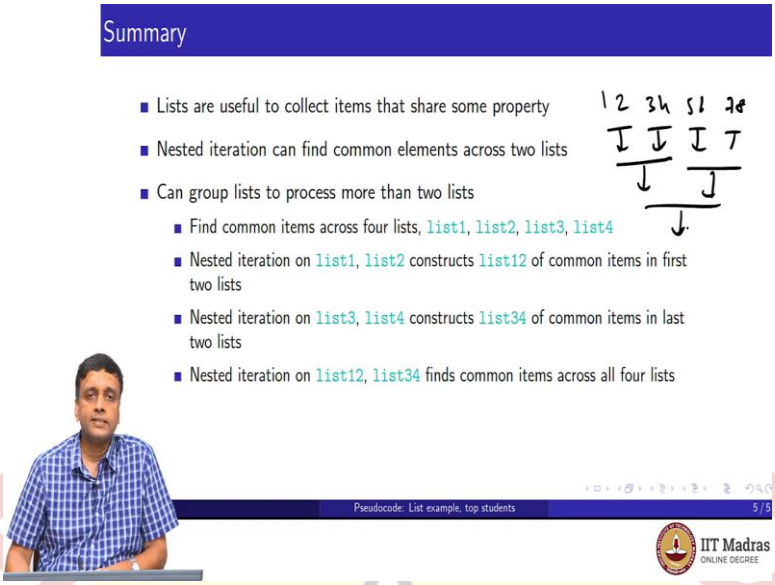

So, this example illustrates that we can use lists to collect items that share some property. So, in the first lecture we looked at people who have born in a month or who came from a particular place, here we are looking at people who have scored above a certain mark in a subject. And then, nested iteration repeatedly comes up as a useful way using this foreach operator to examine pairs of elements across two lists to identify those which are same or those which are different.

For example, you can also use the same thing and say is there an x in the first list which is not present in the second list. By minorly modifying the nested loop we can also find out elements which are only in one list but not in the other, but we were interested in finding out elements which were in both list. So, we can do a variety of things to compare elements in list using nested loops.

Then, we also saw that if you wanted to do this nested iteration for more than 2 lists of course, in principle you can do it for 3 lists at a time. You can do, you can take up every x, every y, every z and check if x is equal to y is equal to z and then put it in. But we can also do it more simply by doing a sequence of pair wise iterations. So, we saw it for 3. For example, supposing you had 4, so supposing you wanted to find out elements which are in list 1, list 2, list 3 and list 4.

Now, we could do it the way we did before which is that you could take for instance, those which are in list 1 and list 2 so you will get a pair like this. Then we can take this and get those which are in list 1, list 2, and list 3 and then we could do this and get to list 1, 2, 3 and 4. So, this is one way to extend what we did supposing we had a fourth subject biology, then we could have started with maths and physics, then taken those who have got top marks in

both maths and physics and then compare them with chemistry to find out if it is maths, physics and chemistry and finally take maths, physics and chemistry and also add biology and find out all four subjects. So, this is one way to do it.

A different way to do it is to group them like this. So, you first take list 1 and list 2 and now you separately take list 3 and list 4. So, now you have people who are toppers in the first 2 lists, people who are toppers in the last two lists and then you can merge the first two list and the last two list toppers to get 4.

So, in general if I have for example 8, this would be now interesting because for instance, I can first get this one, so each pair I can do, then I can get this pair and this pair and then finally I can do this pair. So, there are many different ways to do it, but essentially you can always break it down into a pair wise calculation if you want to. So, that summarises this example.