INDIAN INSTITUTE OF TECHNOLOGY MADRAS

सिद्धिर्भवति कर्मजा

IIT Madras

ONLINE DEGREE

Programming in Python
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Online Degree Programme
Pandas Series, DataFrame and more

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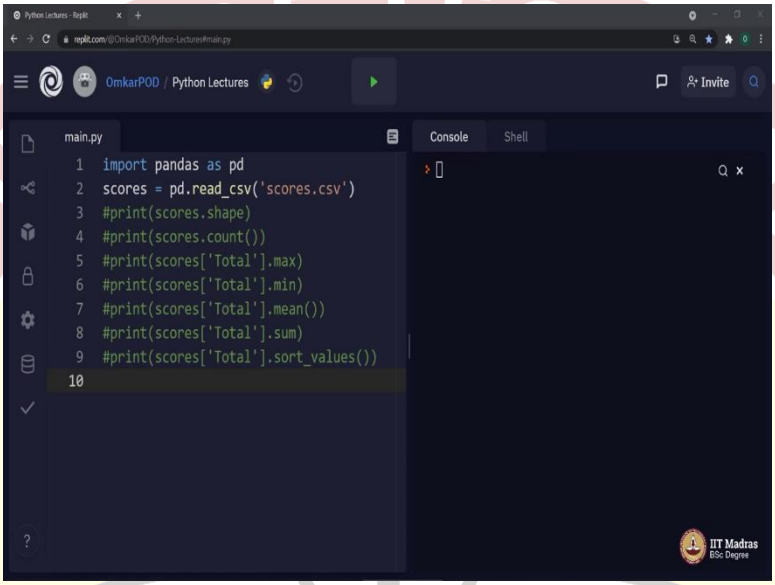

Hello, python students. In last lecture, we started with Pandas. We saw how to input this external library called Pandas. Then we saw how to read a CSV file, and then, we continued our discussion with some Pandas' features like shape, count, maximum, minimum, average sum and even sorting of values of a specific column from the given table.

But during that lecture, we never talked about any specific details related to pandas. In this lecture, we will see some key features of pandas like series, data frame, and then we will continue with some more examples, which are little bit more complicated than what we saw earlier.

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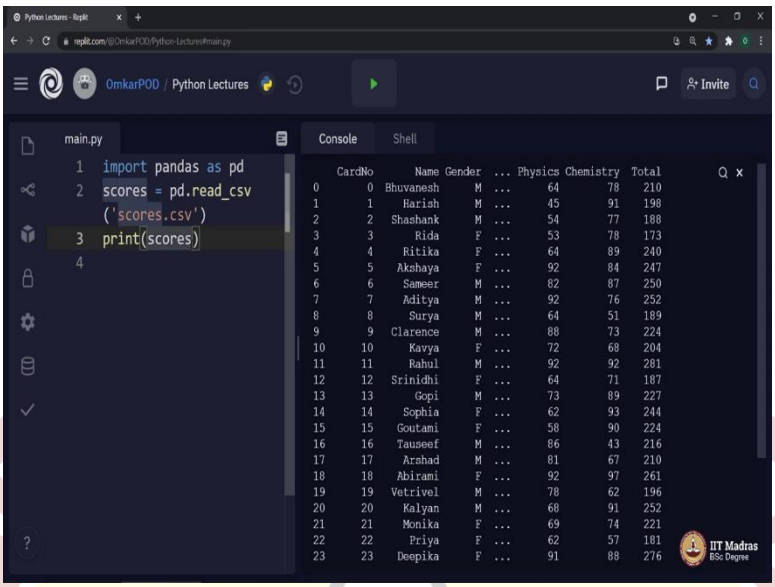

Let us start with data frame, print scores. We all know what this particular variable holds with respect to pandas. It stores the entire CSV file in the form of a table. And with respect to Pandas, this particular table is referred as data frame, which means data frame is nothing but a two-dimensional data structure, which is used to store tabular data. We can check the same thing by printing type of scores.

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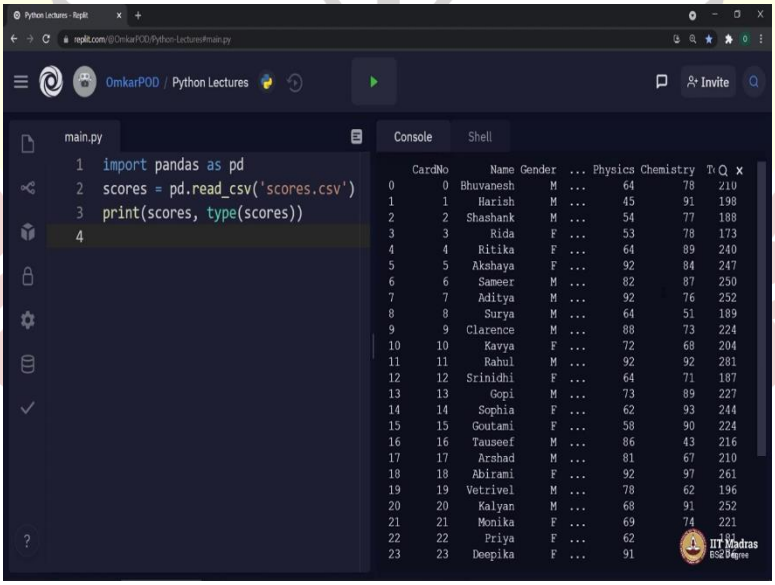

As I explained, it says data frame is, this entire table is referred as data frame, then the question is, what should we call to a specific column in this table. Any specific column from the data frame is referred as series in Pandas. Let us verify that.

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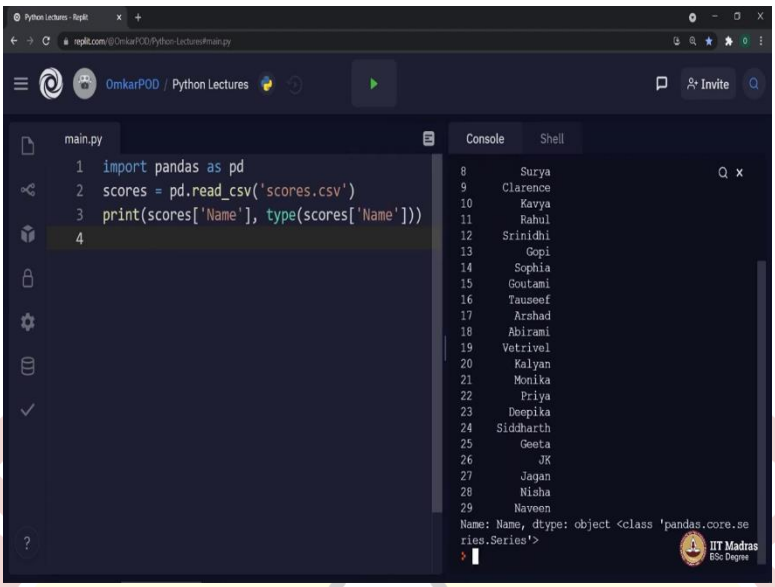

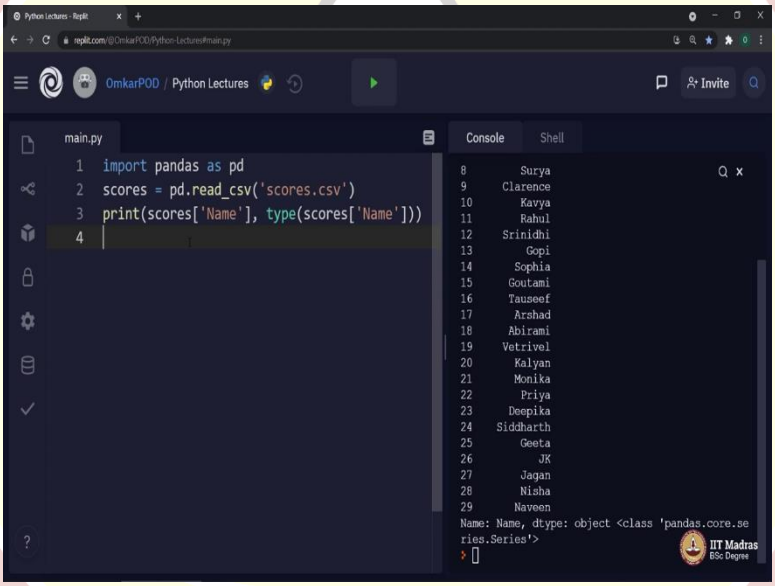

Scores of name, type of scores of name, it will print a specific column from the data frame, which is name, and the type is series. This particular variable, which stores the output of read underscore CSV is referred as data frame and it is a two-dimensional entity just like a table. Whereas, any specific column from that table or from the data frame is referred as series, which means series is an one-dimensional entity.

Now, as we know what is series and data frame in Pandas, now, let us try to execute few more examples, which we found very difficult when we were studying these in computational thinking course.

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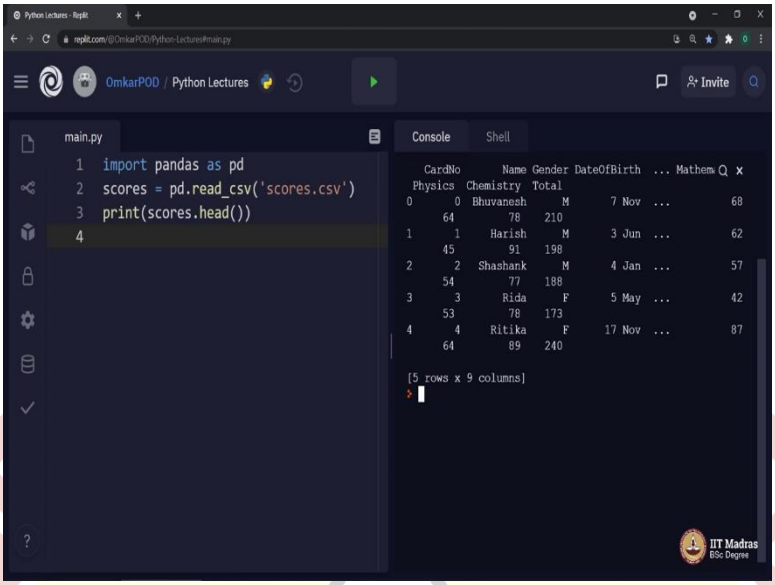

Consider this particular line print scores. Whenever we try to print the entire data frame, it displays all the rows from the given data frame. In the case of scores data set, we have only 30 entries. Therefore, it was easy to print the entire data frame as output. But what if the input data set is much more larger than the score's dataset, then it is not possible to go through all those rows manually.

And sometimes, we may prefer to look at only few sample rows from the given data set. And the way to access these sample rows is using a function called head, scores dot head. This particular function will print only top five rows from the given data set, as in the data frame. As you can see, it is printing index from 0 to 4.

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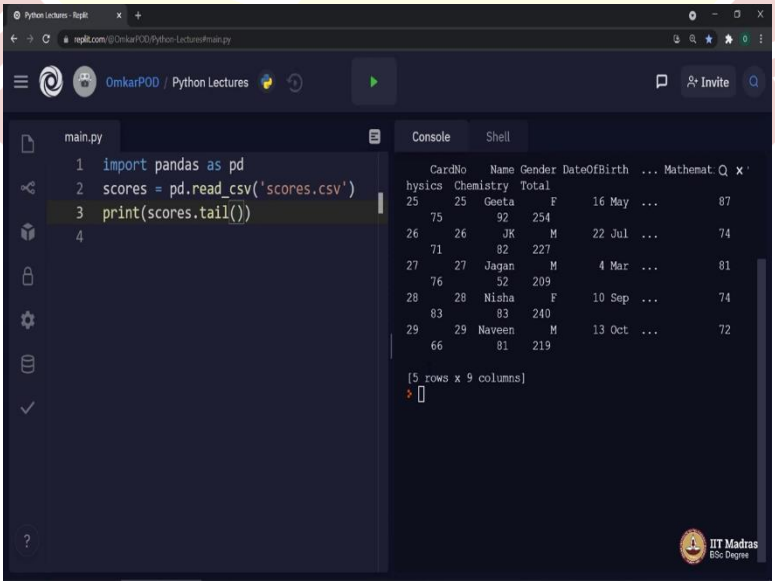

Similarly, in order to print the last five rows from the data frame, the function is tail. It will print last five rows from the data frame that is index from 25 to 29.

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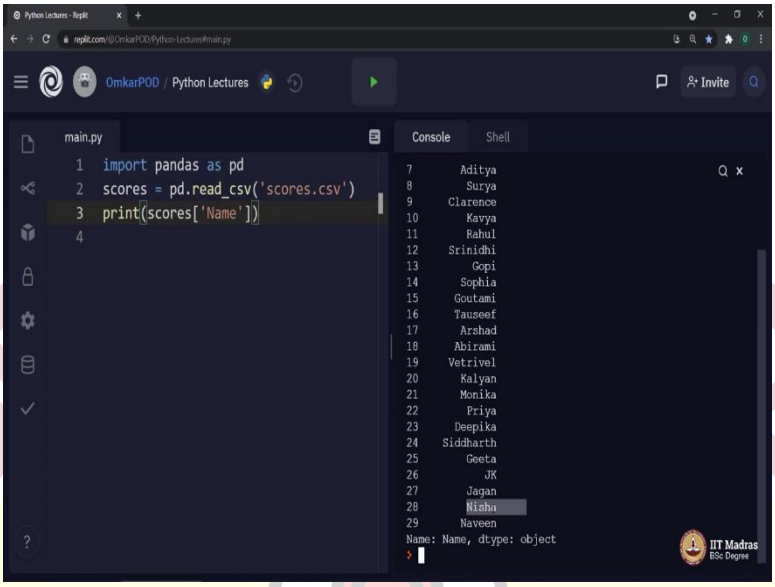

Earlier we saw something like scores of name, and we all know this will print a series from the data frame. This is fine, but what if I want to print all the details of a specific student based on his or her name, which means, what if I want to print the entire details of student Nisha? So, the question is, can we do that using Pandas, because earlier we saw Pandas help us access data column wise. But in this case, I want the entire row which belongs to this student, Nisha.

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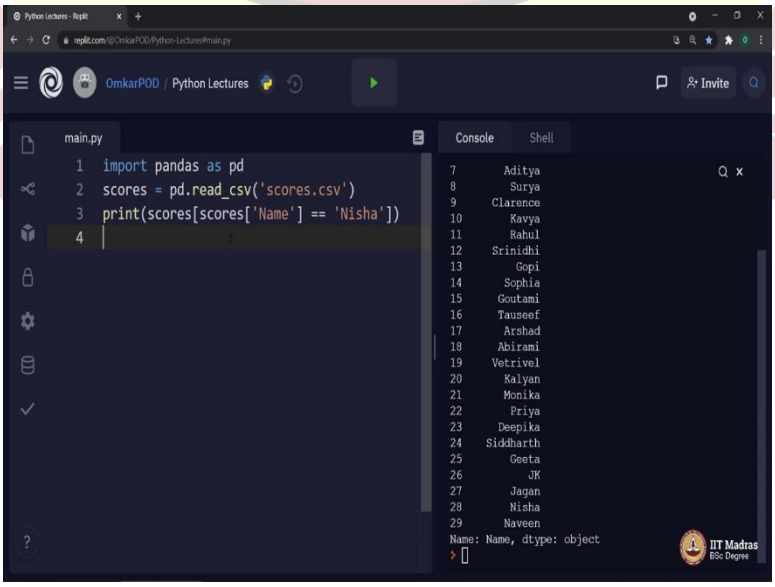

Let us say can we do something like that. And the way to do this is scores of name equal equal to Nisha, and this condition should be executed on the given data frame. Hence, we should have something like this. It says, access the data frame name scores, but make sure, within that data frames name series, the value should be Nisha. Let us execute and see, whether we are getting the expected output or not.

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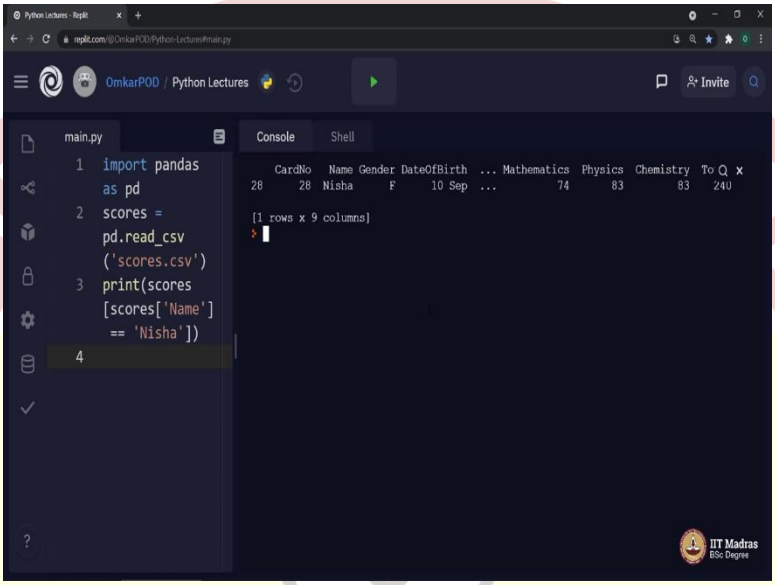

As you can see, we are getting all the details of this student Nisha. Card number, name, gender, date of birth, and so on till the total. Pandas does not restrict us from reading data column wise, it is capable of reading data, either by column or even by a row.

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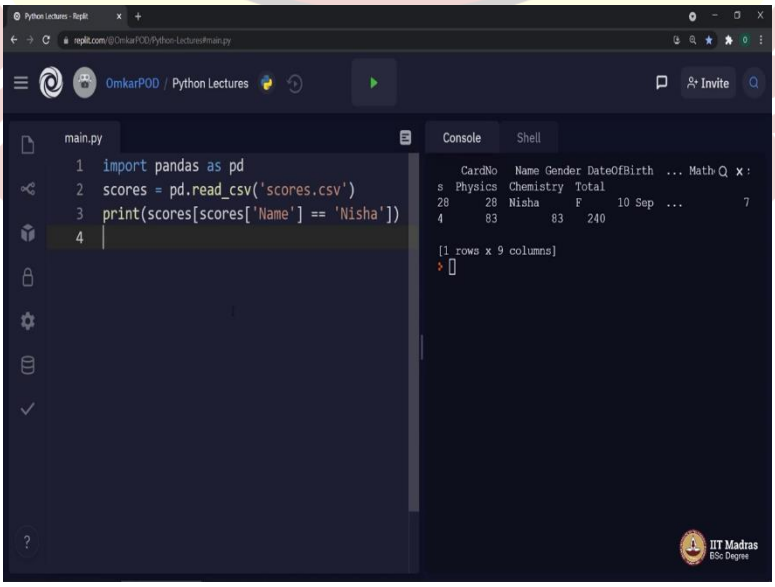

Alright, this is related to one particular student. What if I want to find marks of a topper boy, and marks of a topper girl? That means, I want to find topper marks based on their gender. Now, that seems little bit complicated as compared to whatever examples we saw so far. It may appear very complicated, and you might think this may require lot of execution and complicated python code, but actually, it is once again very easy with respect to Pandas.

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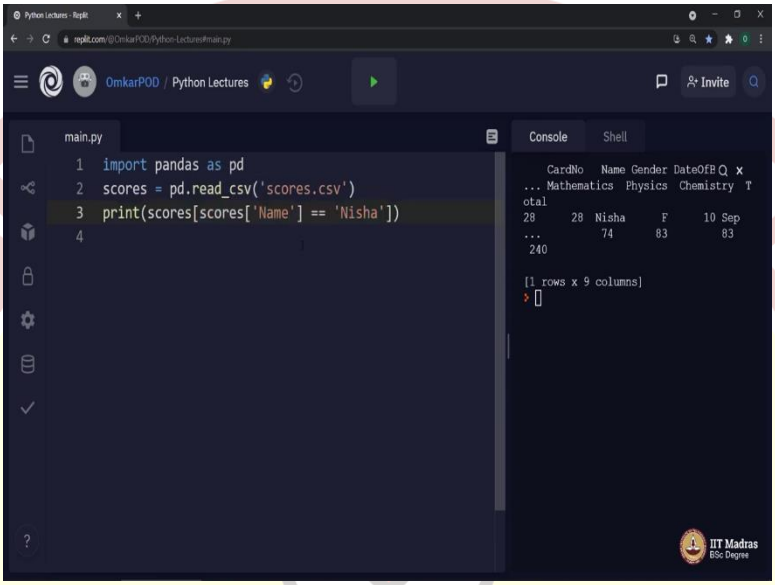

Let us see how that is done. We already know this is how we can write a condition on the data frame. Now the condition is based on gender. Let us say first, I want to find a topper from boys. This will give us all the data where gender is M. Let us see what happens if we try to print something like this.

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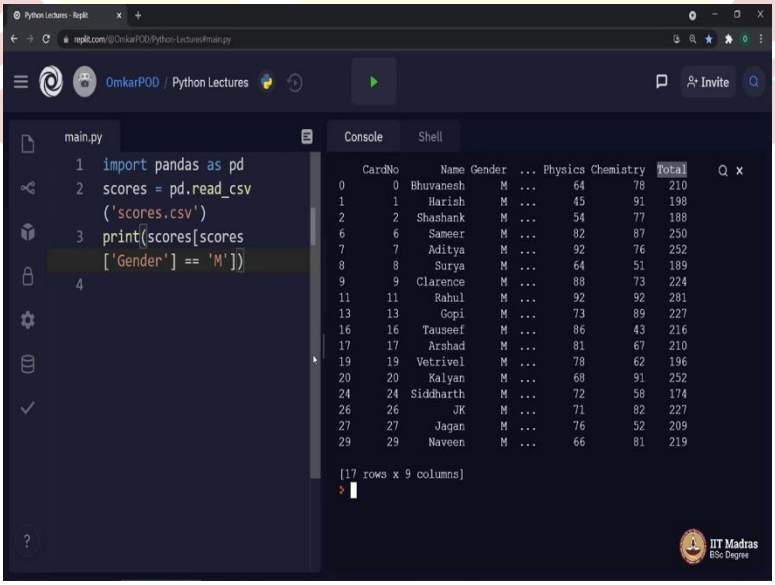

It prints the entire data where gender is M. Alright, with this, we were able to apply first level of filter. Next, we want only column, which is total. How to do that? Same just like this. So, this particular highlighted part gave us the entire details. And now we are telling computer from all these details, which is nothing but a data frame give us only one specific column, which is a Panda's series total. Let us try that.

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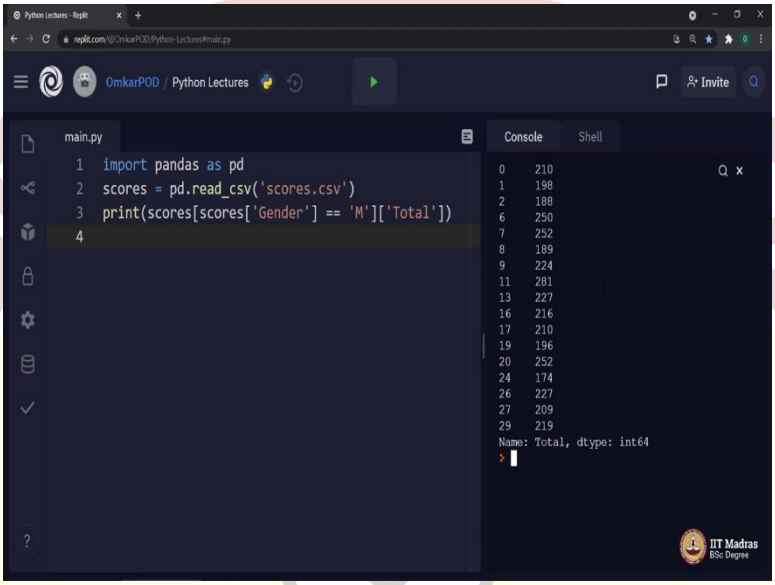

Alright, we achieved the next step. Now, as per our original statement, we want a topper from this particular list, and how to get maximum out of something. Correct, we have seen that earlier dot max. Let us execute.

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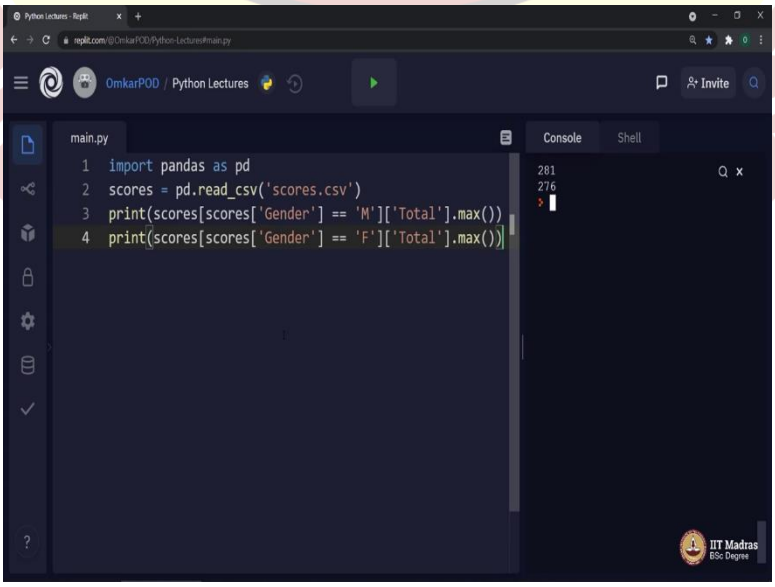

And answer is, 281. Similar line can be executed by modifying a gender parameter over here. Now, we got 281 as a topper for boys and 276 as a topper for girls. Once again, we were able to do this in just four lines of python code. Do you remember how complicated it was earlier when we did this in computational thinking or even when we were reading this data from a dictionary or from a file using file handling operations. Alright, so far, this is going good but now can we try something even more complicated than this?

For example, something like dividing all the students based on their marks into four different categories. If you remember, we did something similar in order to award grades to individual students. Let us say based on physics marks, we want to categorize students into four categories.

Students with physics marks higher than 85 will be the first category. second category, marks between 70 to 85, third category, marks between 60 to 70, and the fourth category, marks less than 60. We will give Grade A to first category students, then Grade B to second category students and so on.

We have done similar exercise earlier, but now, we will not stop there, we will go a step beyond. We will find out how many students are there in each category, which means, how many students got A grade, how many students got B grade, and so on for all four grades. Let us try to write that particular code.

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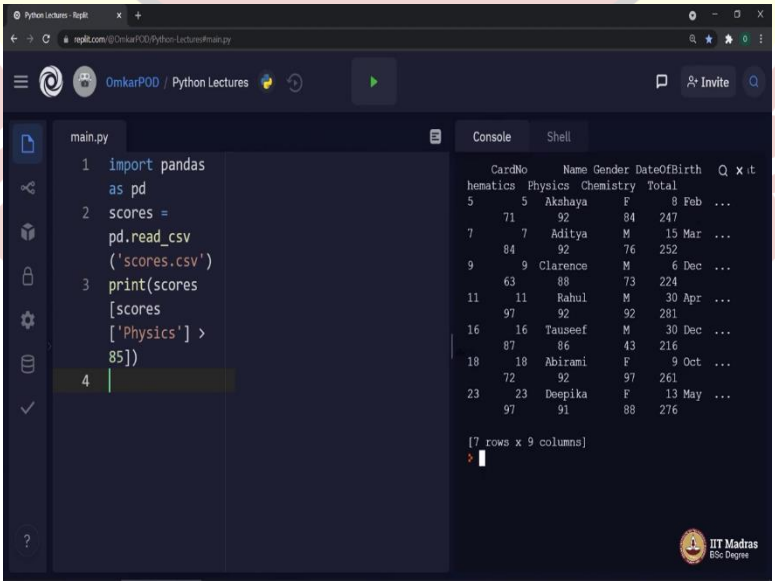

Now, look at this. This is very simple. On top of scores data frame, we are saying scores of physics greater than 85. That means, now all the students who scored more than 85 marks in

physics should be our output. Let us try it. As you can see, 92, 92, 88, 92, 86, 92, 91 all above 85. All these students fall under A grade. Let us move to second category.

As we said, the second category should be the students between 70 to 85. We can always write something like greater than 70, and then the entire condition with less than 85 or something similar. But with respect to Pandas, we do not even have to do all those things. Panda provides us a method called as between. This particular method will give us the required data between 70 and 85. Let us execute this.

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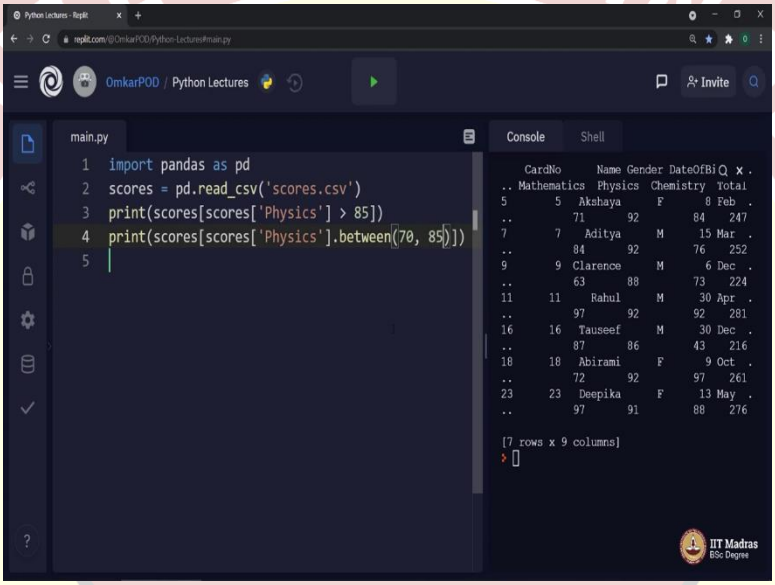

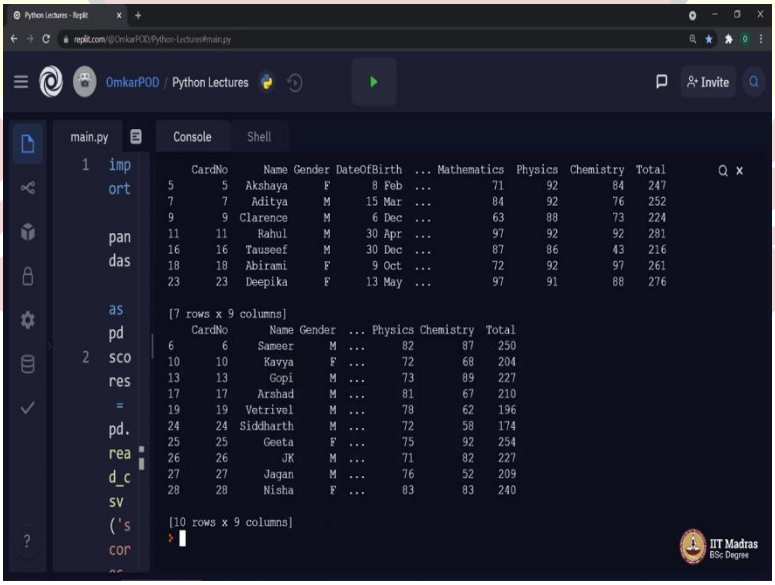

As you can see, first we got all above 85. And now students who are in between 70 and 85 with respect to physics marks. Now, let us write python code for remaining two categories as

well. Third category, physics marks between 60 to 70 and fourth category physics marks less than 60. Let us execute.

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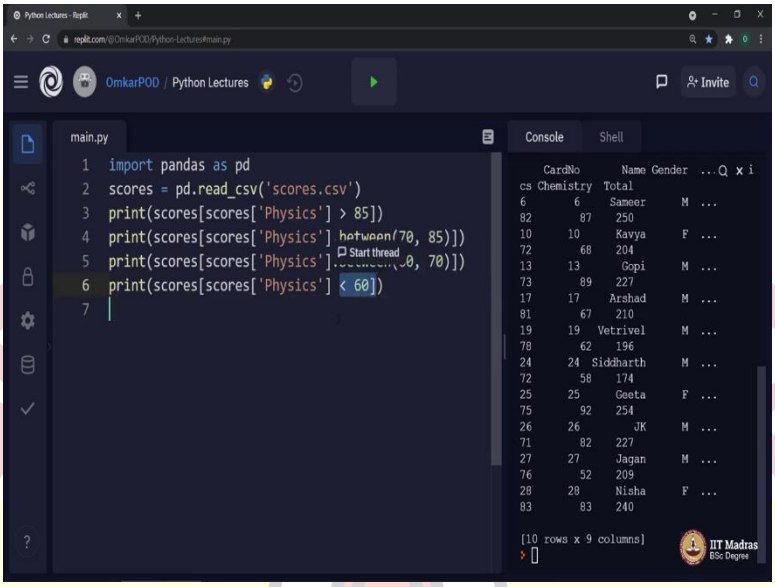

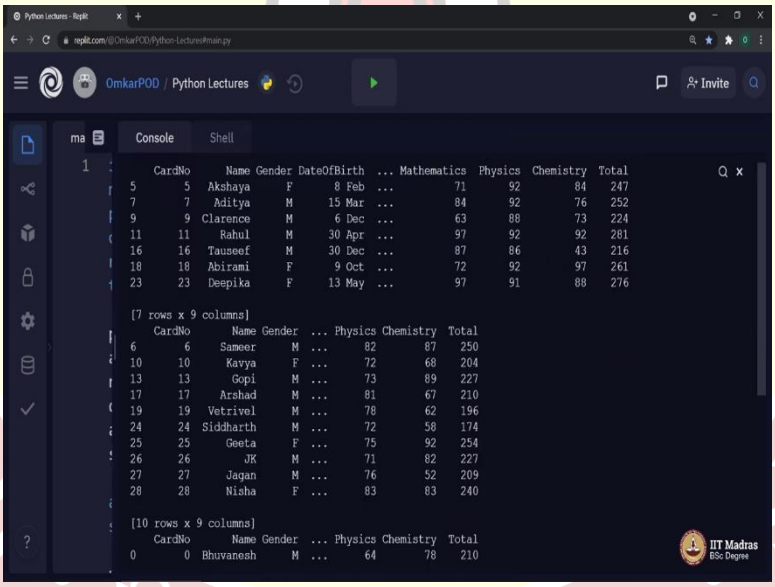

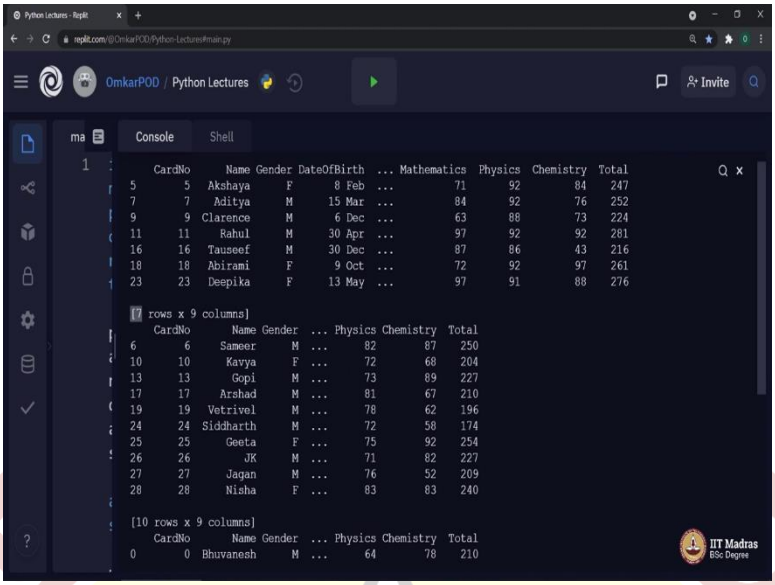

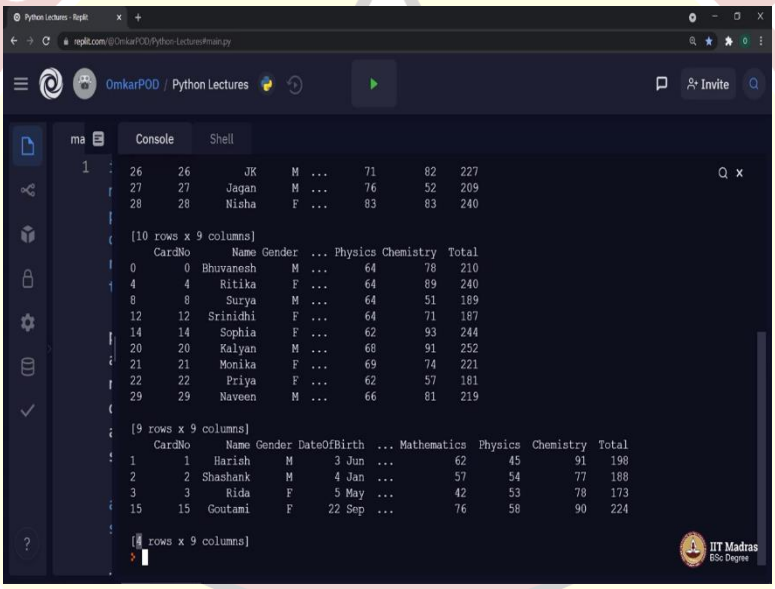

As you can see, first, above 85, 7 students, then 70 to 85, 10 students, then 60 to 70, 9 students, and below 60 we have 4 students. If you add these numbers, we should get 30. This is what we started with. But then we said we will not stop here, we will get the exact counts as in the exact number of students in all these categories, which means the final output should print only these four numbers 7, 10, 9, and 4.

Now, the question is how to do that? How to extract these specific numbers from this entire data, which is being displayed over here. And we already know the answer. We have studied something called as shape in our previous lecture.

If you remember, shape displays a tuple, with two values, number of rows comma number of columns. In this case, we want number of rows, which is at the zeroth index in that tuple.

This should work so, this dot shape of 0 should give us that number. First observe the code, then we will execute it.

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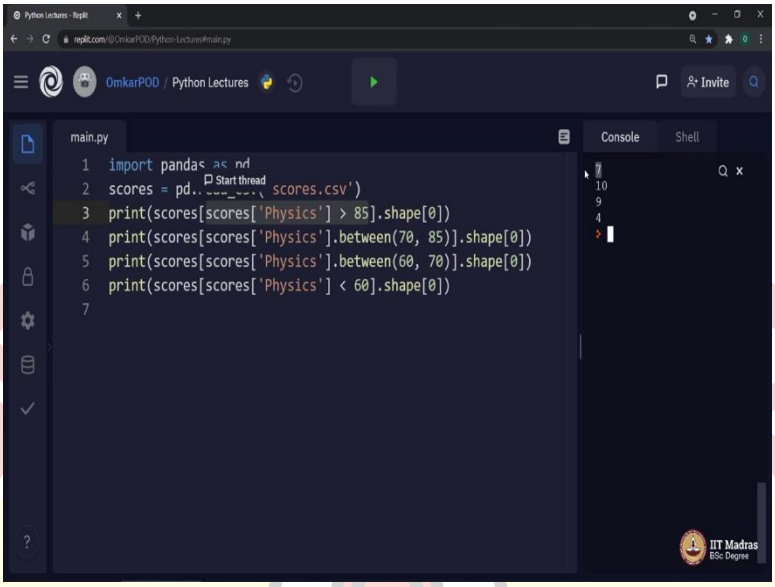

Says 7, 10, 9, 4, as expected. Once again, very simple. Now, let us increase the complexity by one more step. So far, we are checking only one condition like this. And when we require two conditions, we use this particular way between function. This was possible because both conditions were based on the same series, which is physics marks. What if these conditions are based on two different columns as a two different Panda's series, then what should we do?

Let us consider this example. Scores of physics greater than 85 is fine, but what if I want to know a gender wise split even in this, which means the students above 85 are 7, that is known to us. But now, I want to know how many are male students and how many are female students, which means, now we have to add one more condition, which is based on a different column, which is gender. So how to write these two conditions using two different Panda's series.

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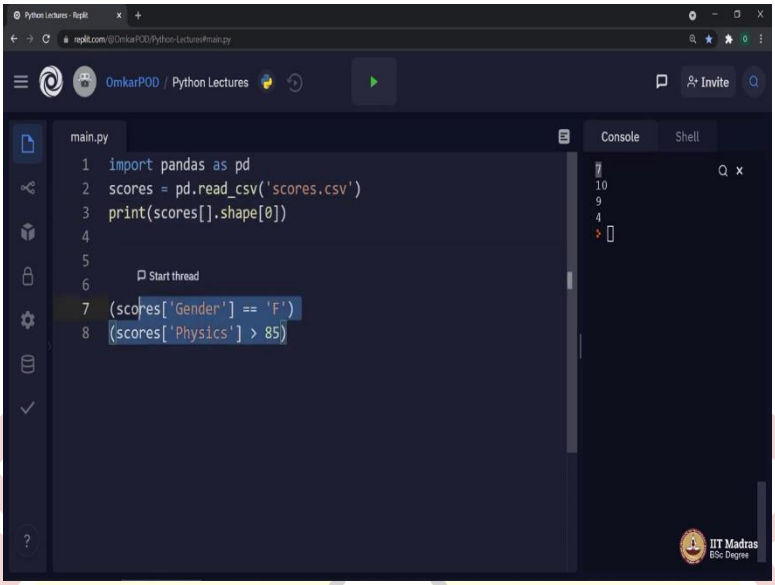

Let us try that. First, let us remove this. Alright, first, let us extract this condition from here. This was our condition. Now, the second condition which we are trying to write, which says scores of gender is equal equal to, let us say female. Now, somehow, we have to add both these conditions inside this square bracket, then only this particular data frame will be filtered based on both these conditions. Let us see how to do that.

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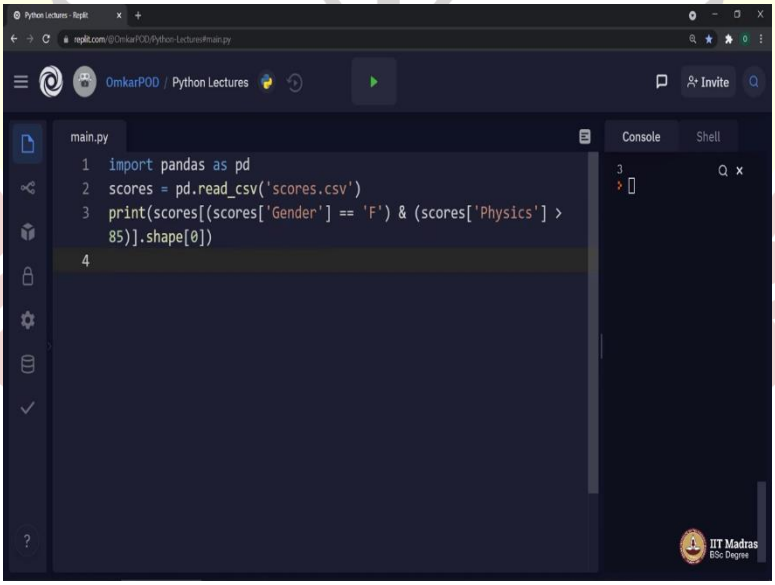

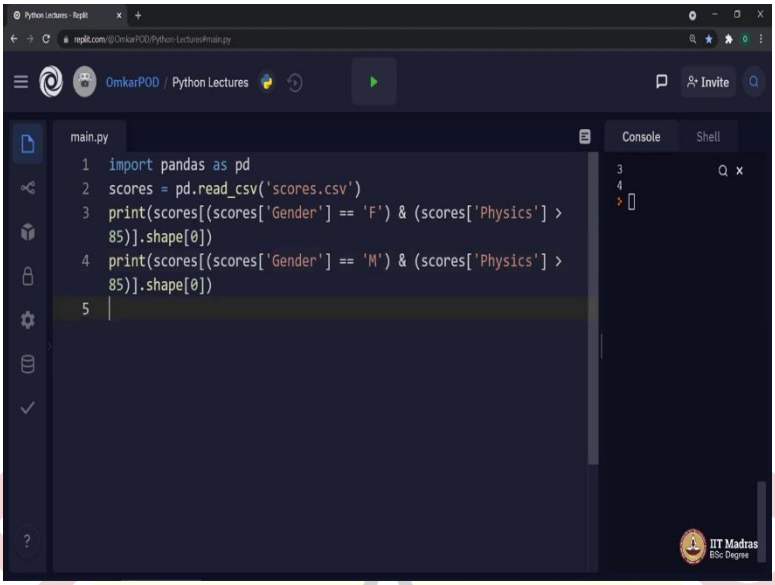

First, let us move this one from there to here and then the second one, as well. Now, we have first condition, followed by a second condition, and we want something like AND operator in between. Before you jump to a conclusion, let me tell you Pandas do not support our regular python AND operator. Instead, it has its own AND operator, and the symbol used is this ampersand sign, like this.

Look at this particular code. First condition scores of gender is equal equal to female and scores of physics greater than 85. When both these conditions are satisfied, on top of the given data frame, then we will get some number of rows, and we are counting the shape of the data frame and extracting the zeroth index from the tuple.

I understand this might be a bit complicated in the first glance. So maybe just pause this video, try to analyze this line number three, and then you can continue. Let us execute this code, the answer is 3. If we can print the same line by modified parameter M, we should get exactly 3 and 4.

If you remember, the original number was 7, which is now split into two, 3 and 4. Are we going to stop here? Of course, not. Let us add one more level of complexity into this code. Why should we do all these things only for physics marks? I want counts of all the students above 85 in all three subjects and based on their genders. That means, we have to execute this particular line of Physics, Chemistry and mathematics, with F. And then once again, with physics, chemistry and mathematics with M. Which means, now we want total, 3 into 2, 6 print statements. But we are programmers, we do not repeat same line six times, what we do, we write a loop.

So, let us declare one list subject is equal to mathematics, physics, and chemistry. And these two lines should be executed for every entry in this list. Hence, for every subject in subject list we should execute these two lines. And now, instead of this subject parameter, we should use this variable sub. Let us try this code.

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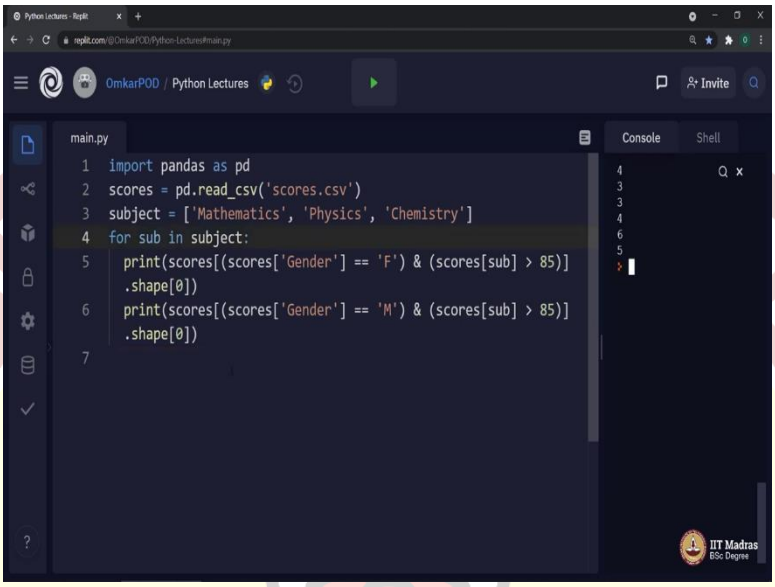

This is working without any error, but this looks like some random numbers. Let us write one print statement. Above 85 in sub. Now let us try it.

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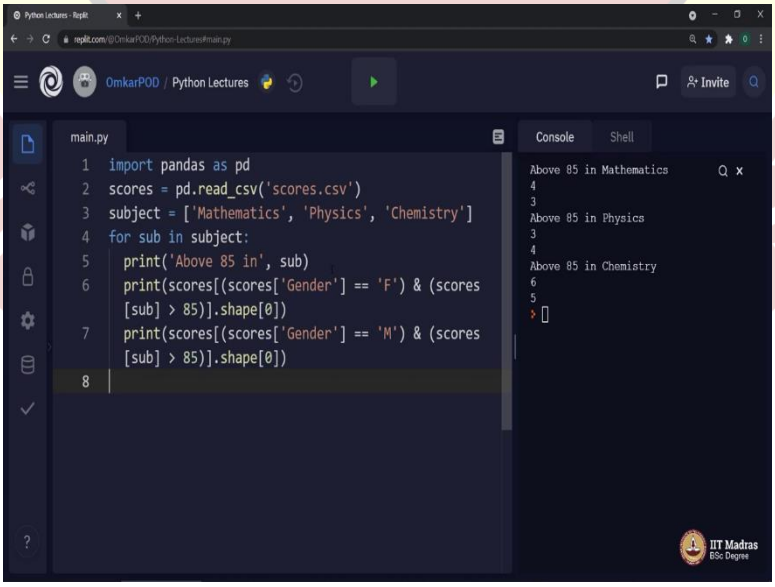

Above 85 in mathematics 4, 3. Now we know first is female, second is male. So, 4 girls, 3 boys; above 85 in physics, 3 girls, 4 boys; above 85 in chemistry, 6 girls, 5 boys. This is regarding all the students who are about 85, which means we are focusing only on small

fraction of students. But most of the times, teachers are more interested in knowing how many students are scoring above average or how many students are scoring below average.

Now, how to do that? Is it too complicated? Of course not. We have to make very small change in this particular code. First, we have to find average marks for individual subjects. We already know how to do that. Scores of subject dot mean. This is a mathematical mean, which will give us the average of the given subject. Now, this variable avg will hold the average of a subject. We simply have to replace 85 with average, and then this print statement above average. Let us execute.

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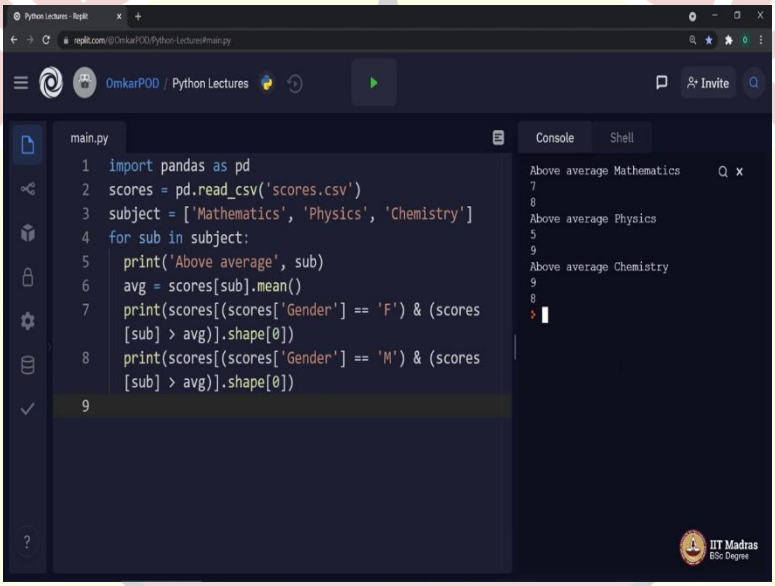

Above Average mathematics, 7, 8; above average physics 5, 9; above average chemistry, 9, 8. I believe all these numbers are accurate, but if you doubt, you can always go back to our scores dataset and check it manually, and then tell me how difficult that was as compared to this code.

Once again, now you must be thinking is that all we can do with Pandas? And once again the answer is of course not. This is only the basic things, which you can do with Pandas. So before closing this lecture, let us introduce one more feature of Pandas called as groupby.

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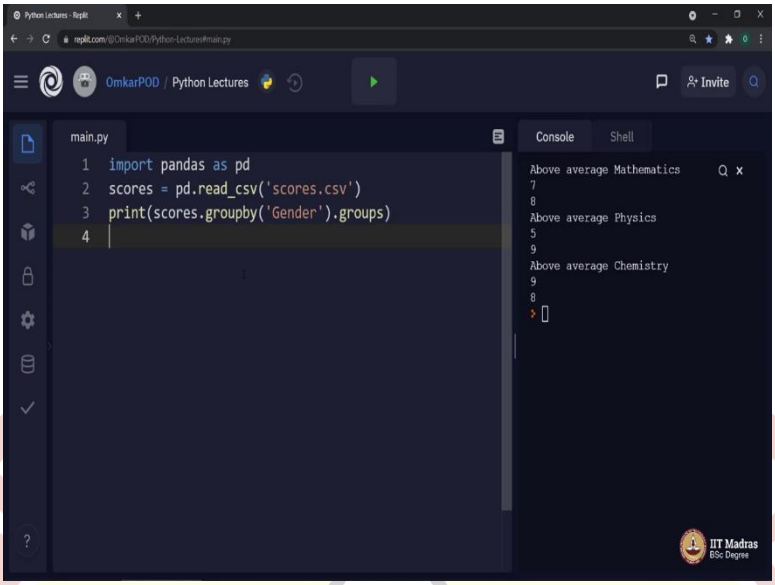

Observe this particular line, print scores, which is this data frame dot groupby is a function to which we have passed one parameter which is nothing but a column heading and then we are saying dot groups. Let us first execute this code and then I will try to explain what is happening over here.

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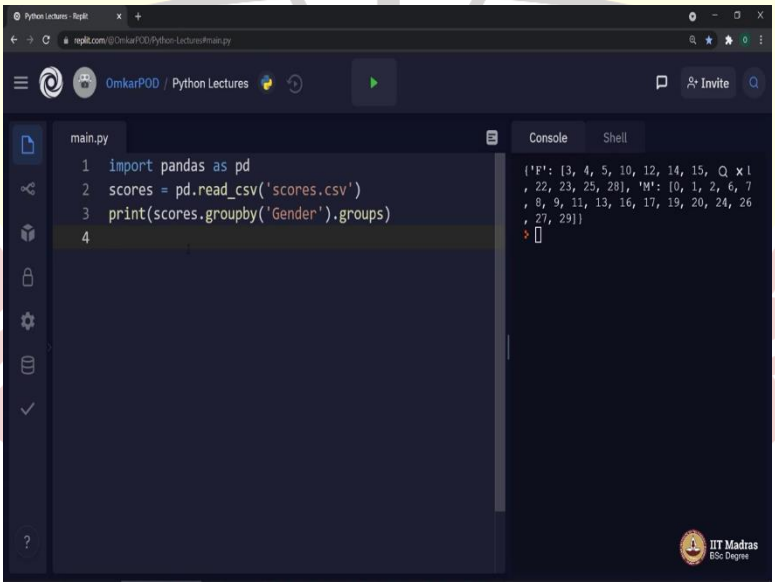

Observe this output it is printing a dictionary of lists. F is a key in the dictionary and as a value we have a list of some numbers. Then second key is M. And again, a list of numbers. Can you guess what these numbers are representing over here? Correct, all these numbers represent the card numbers, where gender is F, and this second list represents all those card

numbers where gender is M, which means, using this particular groupby gender dot groups returns a dictionary where every key is an unique value from this column gender.

As we know, our gender column has only two values hence, we are seeing two keys F and M, and the entire data available in data frame is clubbed together against these keys on the basis of their index values.

You might think this is fine. It is printing a list of card numbers of all male students, all female students and so on, but what is the use of all this? Where can we use this? And the answer is, this groupby feature of Pandas comes very handy when we try to divide our data into bills. I hope you remember billing concept from computational thinking. If you remember, in our previous example, we had to print the same statement twice. Let me quickly go back to the previous code.

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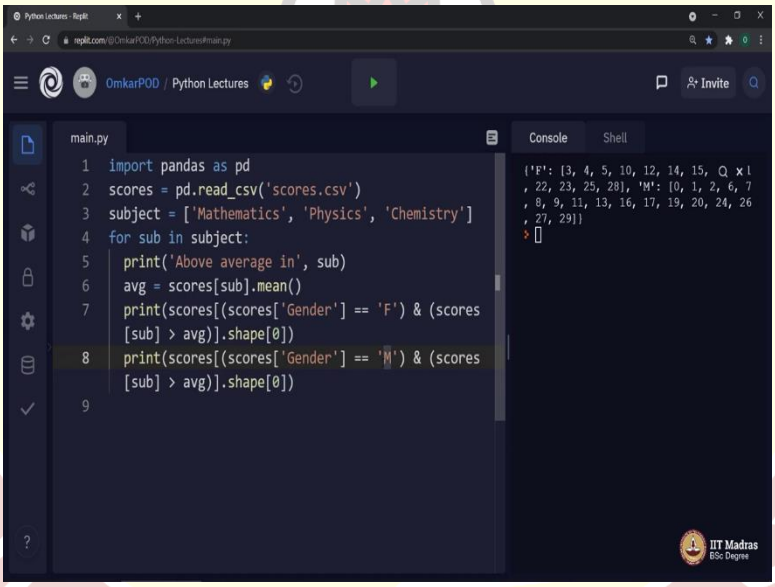

Here we are printing the same print statement twice, one for F once for M. And if you remember, when I added these subjects, I said we are programmers, we do not repeat same thing twice, we use loops. But writing a loop to iterate over only two values is not a good idea. And this is the place where we can use that particular feature, which we saw just now, which is groupby. Let me modify this code first, then I will try to explain how it works.

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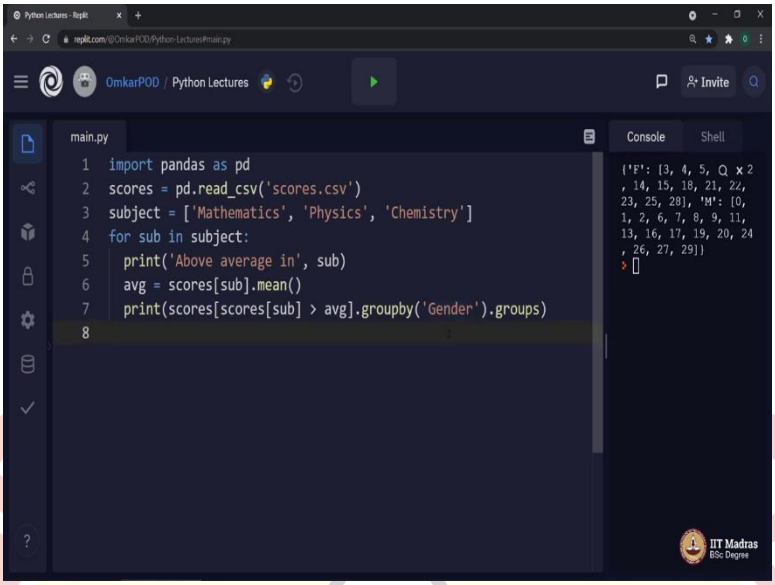
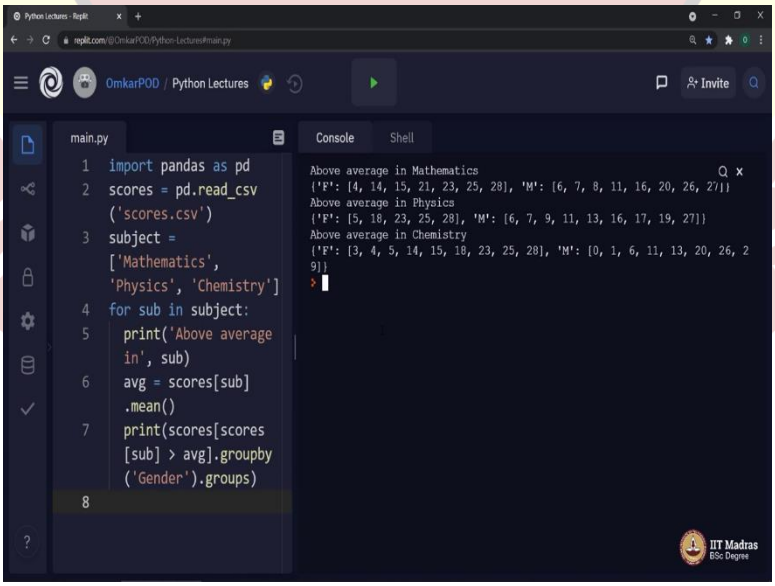


Look at the scores line number 7. First, we are saying scores of subject greater than average, that is the only condition we have. If the value is above average then we are collecting that entire data frame. And then, on top of that entire data frame we are using this groupby function which will be applied using this particular column gender. And at the end dot groups, which will print all the possible groups with respect to this column in form of a dictionary of lists. Let us execute.

(Refer Slide Time: 28:38)



Observe this output. Above the average in mathematics, F, these many students; M, these many students, then physics F and M; chemistry F and M. In this case, we are not just getting

the number we are also getting their card numbers or their index values, which are even more useful in order to refer a particular student.

This is the place where we will stop with respect to Pandas in this course. But let me give you one very important instruction. Whatever we have seen so far with respect to python Pandas is just the tip of the iceberg. We have not seen the entire functionality of Pandas, because in this particular course, whatever we have seen so far is more than sufficient.

As you go ahead with the rest of the courses, at a diploma level or at a degree level you will learn many more features of Pandas whenever they are required. So do not break your head over other features, which you might come across while reading Pandas' documentation. Whatever we have covered in these two lectures based on Pandas is more than sufficient for this particular course. Thank you for watching this lecture. Happy learning.