Computational Mathematics with Sagemath
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Lecture – 05
Tuple, Sets and Dictionaries in Python

Welcome to the 4th lecture on Computational Mathematics with Sagemath. In the last lecture, we looked at how to define a list in python and how to apply various methods on a list. We also looked at how to take any slice of a list.

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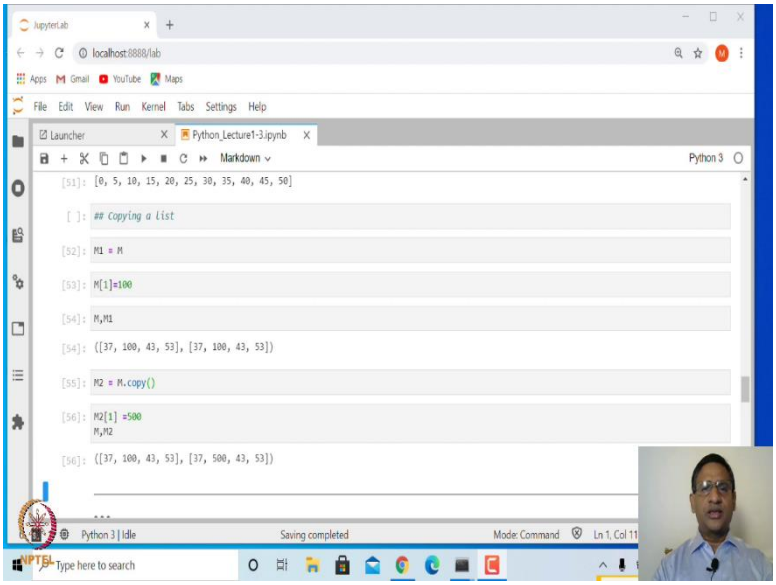

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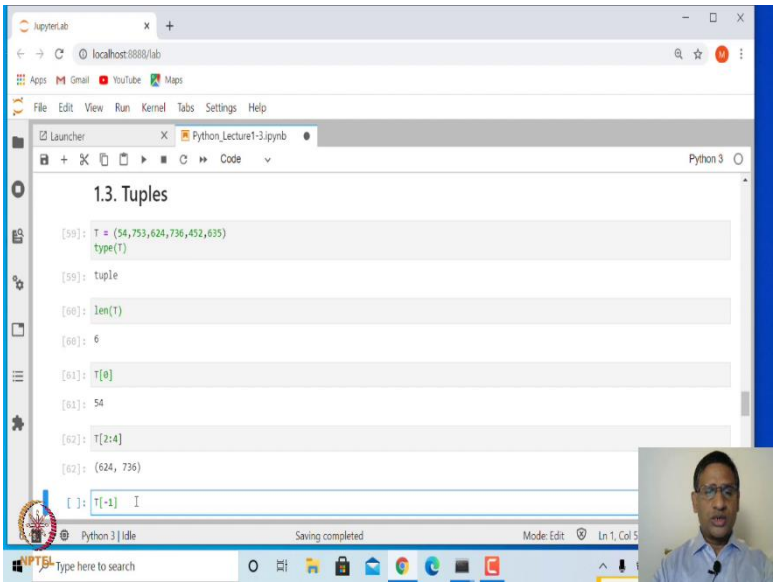

Now, let us define another data structure type which is called a tuple. We defined list by writing its elements in a square bracket. Now, instead of square bracket, if you write round bracket, then it is a tuple and there is a difference between list and tuple.

So, let us see, if I define T is equal to round bracket 54, 753, 624, 736 and 452, if you want you can add some other element.

Now, if I say what is type of capital T, then it is says it is a tuple. So, square bracket and round bracket have different meaning. Square brackets we have used for creating a list, round bracket we have used for giving argument of a function, combining things together and this is the third use, which is to create a tuple.

Again you can find out length of this tuple and in this case, it is 6. There are 6 entries in this tuple. You can you find out what is the first entry in this tuple again using the similar command or you can write the index in square bracket.

You can find out, let us say T 2 colon 4. So, T 2 colon 4 will be 2 comma 3. So, this will give me 3rd entry and 4th entry. You can try to find out, for example, if I say T of minus 1, then it gives you the last entry.

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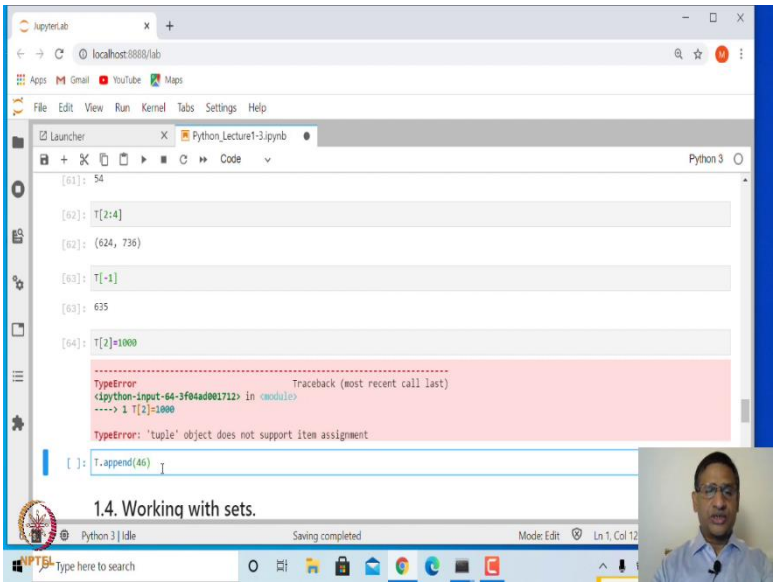

So, again here the indexing of tuple is very similar to indexing of a list. You can take any slice of tuple. However in case you want to change, let us say third entry 3rd entry which is 624. If I want to say, T of 2 is equal to let us say something like 1000 then it does not allow me to do. So, what does it say? It says a tuple object does not support item assignment. That was the case with a list, whereas tuple entries you cannot reassign. That is a difference between list and tuple.

Tuple actually is a un-mutable data type whereas, list is a mutable data type. That is, one difference. You can try whether you can apply some other functions or methods that you did on lists. If I say T dot append and let us say append something like 46, again it is not allowing.

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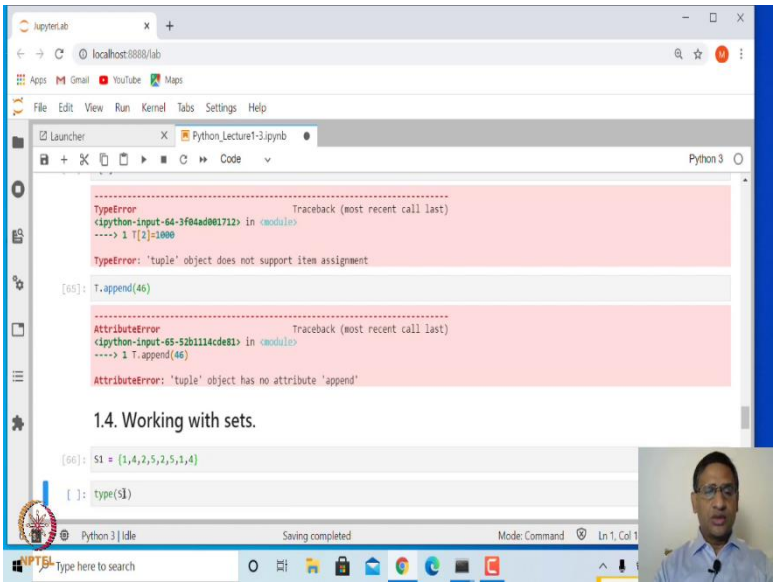

Again it says that the tuple object has no attribute called append. So, many methods that you were able to apply on a list are not available in tuples. But one of the biggest difference between tuple and list is that the entries of a tuple cannot be changed, whereas entries of list can be changed.

So, wherever we require to have a data and you do not want its entry to be changed, then you can create using tuple. We will also see later on that vectors can be defined as a tuple.

Now let us say you can also create sets in python and you can do various operations on sets. How do we create a set? For, creating a set, you just write its entries inside curly braces. Off course, when you create a set, set will have entries which cannot be repeated.

So, even though I have typed here 1, and again 1 is appearing. Similarly 2 is appearing twice. Bu actually these repetitions will not be there.

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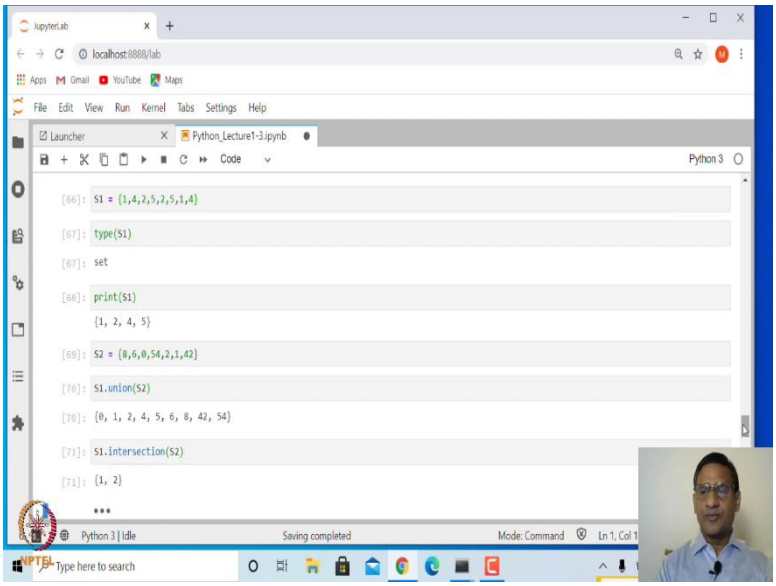

If I say now what is type of S, then it is a set and if I ask it to print for example, print S1, this gives you only 1, 4, 1, 2, 4, 5. 1 is not repeated, 2 is also not repeated as this is a set.

Now you can have another set. For example, S2 equal to 8, 6, 0, 54, 2, 1 etc. Then you can find out intersection of S1 and S2, union of S1 and S2 and various set theoretic operations. So, for example, if I say S1 dot union S2, it will give me union of these two sets. If I say S1 dot intersection S2, it will give me intersection of S1 and S2.

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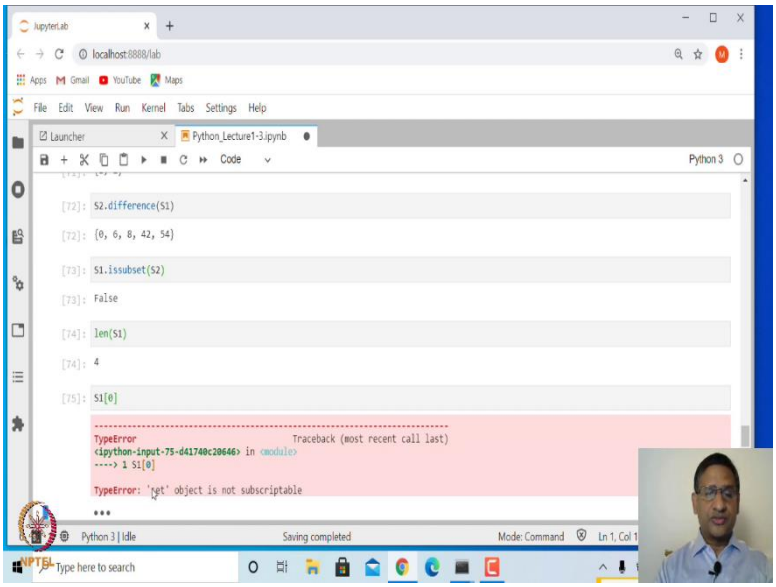

If I say S2 dot difference S1, it will take S2 minus S1. This is a set theoretic difference. From S2, you replace or remove all the entries or elements of S1. You will get S2 minus S1.

You can also explore various other operation. You can check whether S1 is a subset of S2. You can also create power set, you can look at superset, all these things you can explore.

For example, you can also find length of S1, you can find out first entry of S1, in this case, it is not allowed. What it says is, set object is not sub scriptable. So, first entry of a set cannot be accessed by this list command.

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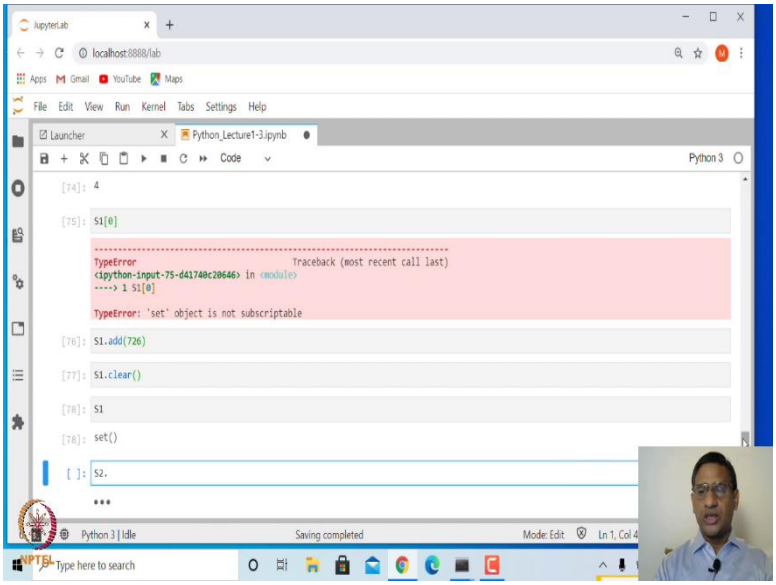

Next you can also add an element, you can clear all the entries of a list. Now if I say what is S1, it has become a an empty set. You can apply various other methods.

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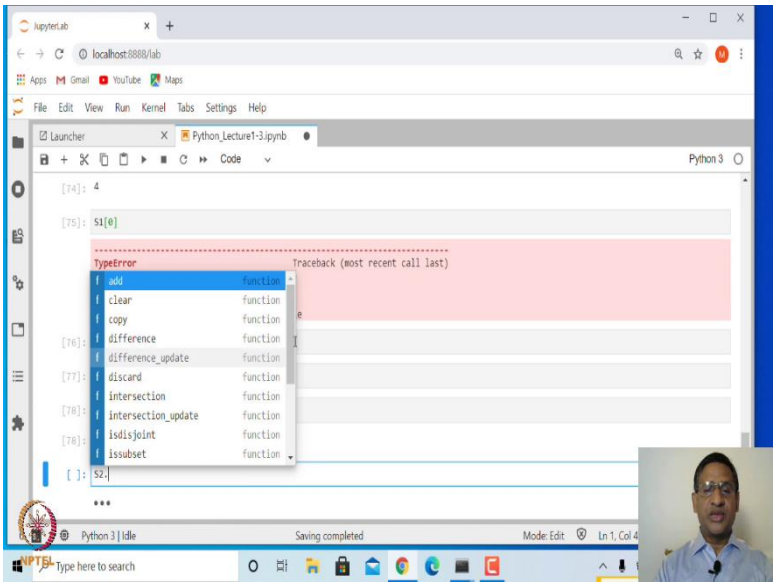

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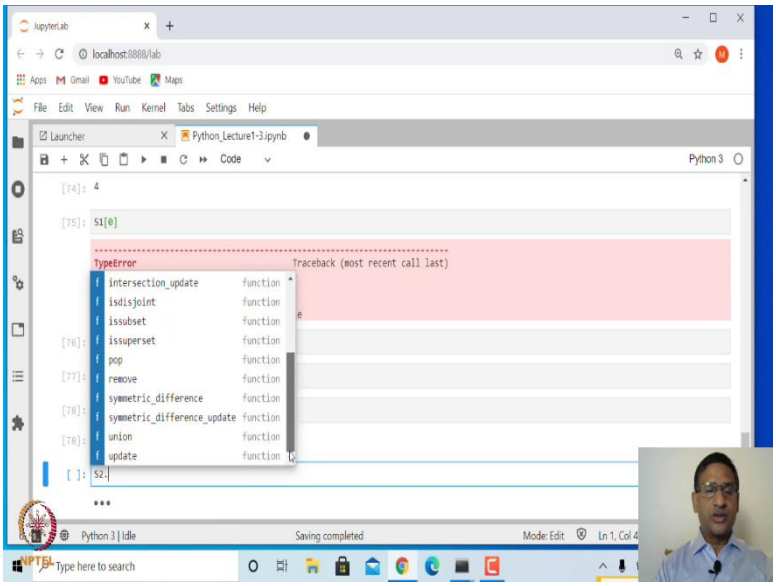

So, again what you can do is, you can say S2 dot and then press tab, you can see here many methods are available on a set. You can again explore all these functions, methods and then see how you can make use of these things.

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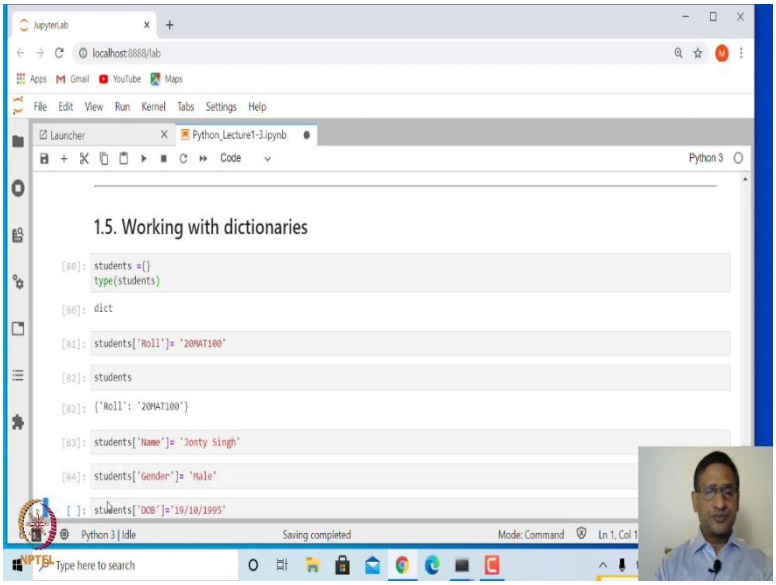

Let us define another very important data structure which is called dictionary. The dictionary will also be defined by writing its entries inside curly braces. So, for example, let us create an empty dictionary students. So, if I ask for what is type of students, then it will say it is a dict meant for dictionary. Dictionary is a very important data structure in python.

When you have created a list for example, then its entries are indexed by integer starting from 0, first entry has index 0, the second entry has index 1 and so on. Whereas dictionary can have index which can be anything, it can be integer, it can be any name, it can be anything actually.

Especially when you have large data set, then defining that data as a dictionary is very handy and very useful. In fact, nowadays for data analysis, dictionary is used very frequently. Now, let us see how we can add more entries in this students dictionary. We can say students, in the square bracket write roll and the roll number is let us say 20MAT100.

Now let us create or add a cell here and say what is students. Then you see here now student has one entry that is indexed by roll. Similarly let us try to add some more thing here. Let me also add name to this. The student name is, let us say, Jonty Singh, student gender is male and student date of birth is 19/10/1995.

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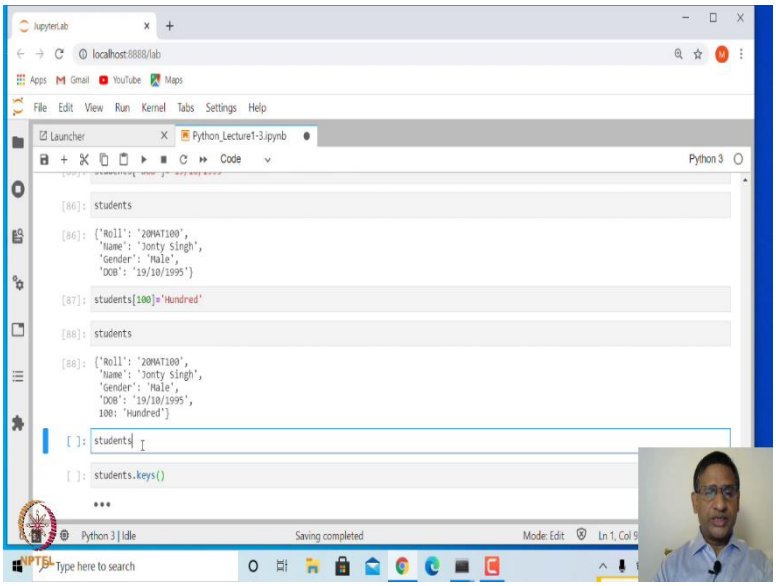

Now, if you ask what is students, then inside curly brackets you can see how it is given? It has roll colon , the value then name colon, the value etc. This roll, name, gender, date of birth are actually called keys and these are the values. Let us add one more entry to this. This time I am giving the key as integer 100 and its value is Hundred

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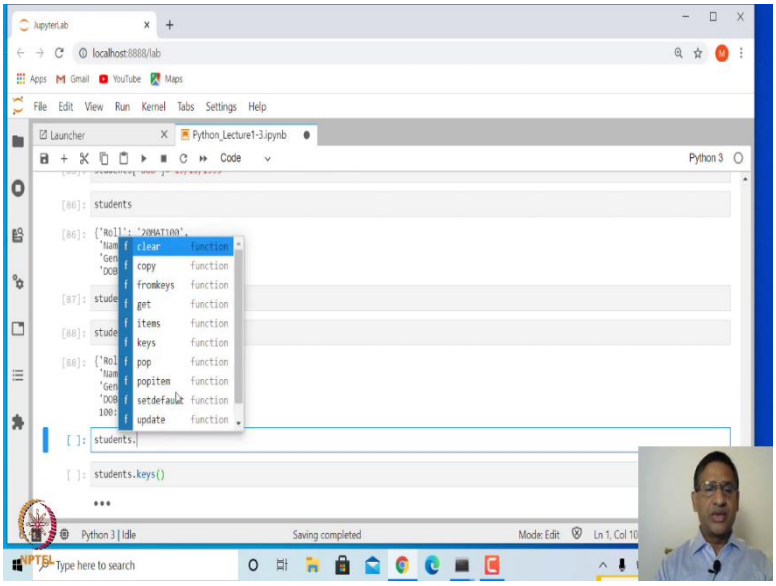

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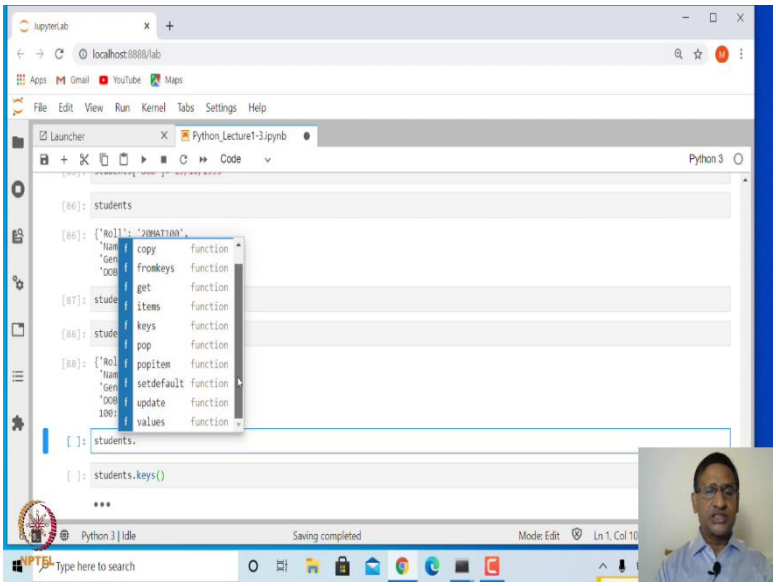

You can look at what are keys to students using students dot keys. Again you can look at students dot and then press tab to see all the methods that you can apply on this students dictionary. I encourage you to explore these methods.

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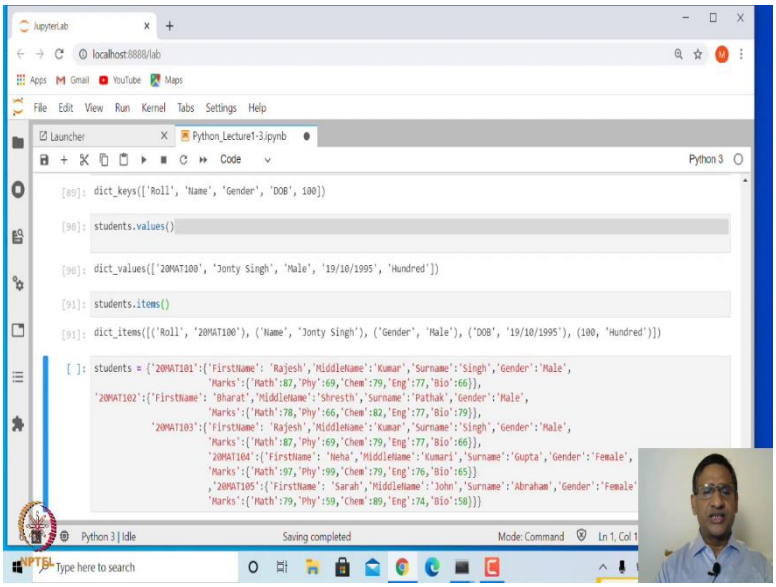

You can access what are the keys of this students by students dot keys, and it says, the keys are their roll name, gender, date of birth and this 100 is actually a number here, whereas other things are string variables.

Similarly, you can ask for students dot values and in this case the values are 20MAT100, Hundred, Jonty Singh, male and so on.

You can also look at students dot items and in this case, it will give you key value pair as a tuple. So, one can actually think of dictionary as a list of keys and values pair or tuple. That is how you can describe dictionary. It is a list of tuples and the first entry of each tuple in this case is the key and the second entry is value. You can even have an nested dictionary, that is, you can have a dictionary inside a dictionary right.

For example, I have created a dictionary called students and its keys are roll numbers and the values are again a dictionary, where you have first name, you have middle name, you have surname and you also have gender, then you have a marks and the marks value is again a dictionary. The marks are marks in maths, marks in Physics, marks in Chemistry, English, Biology. You are creating this as a nested dictionary. This is how you can create a nested dictionary. In particular you can have any data as a dictionary.

For example, you can have books in a library defined as dictionary or you can have employees data in a bank as a dictionary. It is very convenient data type. Later on we will its use also see, how handy it is especially when you want to get some information from data.

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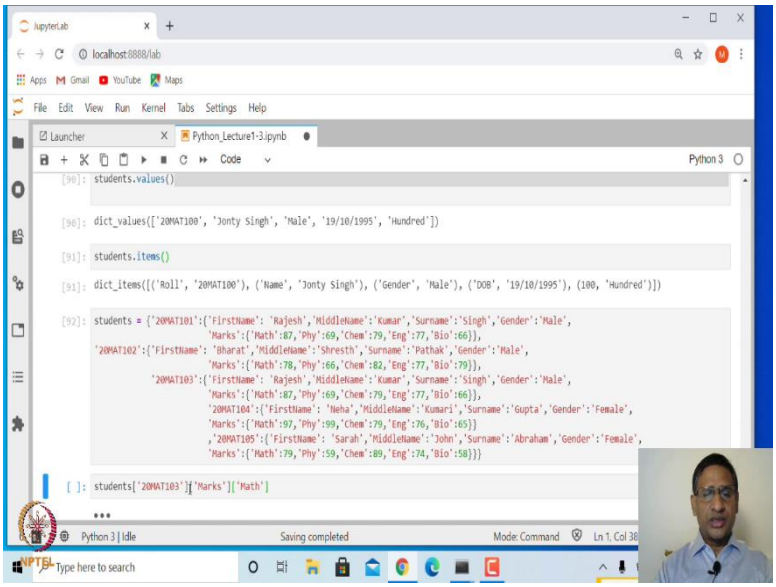
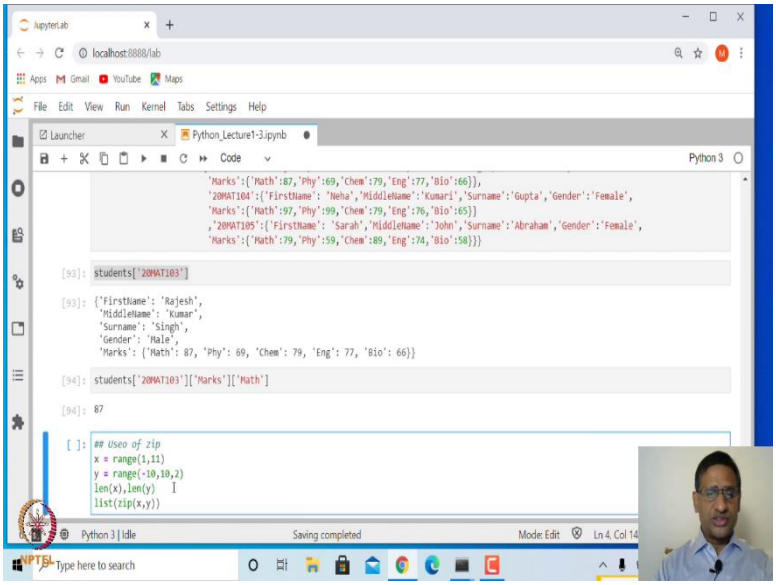


Now let us use students[‘20MAT103’]. So, that is a roll number of the students and let us see what it is values? The value is the name of the student, first name is Rajesh, middle name is

Kumar and surname is Singh, its gender is male and that these are the marks (Refer Slide Time: 14:42)



Now suppose we want to find out what are marks in math of this student. So, we can simply we can simply say this, students[‘20MAT103’][‘Marks’][‘Maths’]. So, we will get the marks in math as 87, that is what you can see here math mark is 87. Of course, there is a in-built order in which the entries will appear when you ask it to print a dictionary.

We will not get into too many details on this dictionary, later on we will come back to this and may be when we do looping etc, we will see how we can extract some information's from a dictionary type of data.

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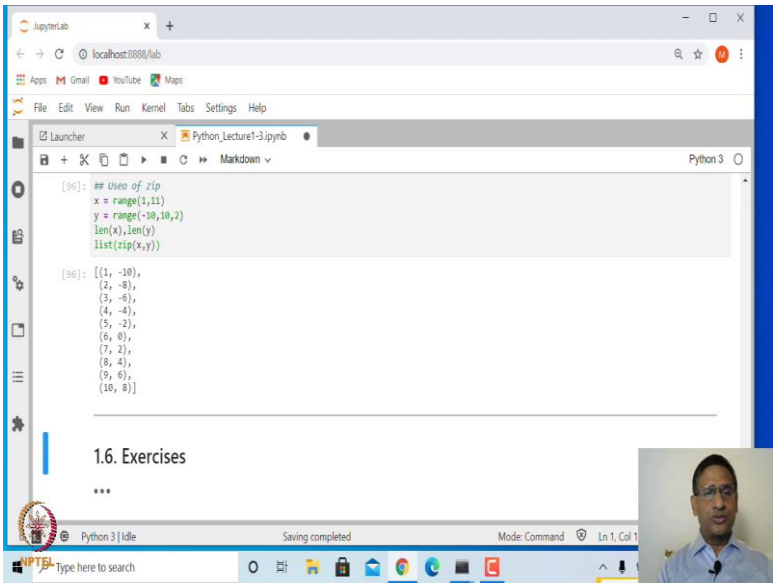

Another important function that you can use is zip. Suppose you want to create, let us say x, y coordinates or x, y, z coordinates, then we can make use of zip. So, for example, you have a data x which is range 1 comma 11.

So, it will be a list 1, 2, 3 up to 10 and y is a range from minus 10 to 10 with a step length of 2. So, it will be minus 10, then minus 8, minus 6 and so on. You can check, what are the lengths of x and y. Both are of length 10. When I say zip x comma y and convert this into a list and then what do you see here? This is a list of ordered pairs. It has created for example, set of x y coordinates of 10 points in a plane. This is also very important function that we will make use of this later on. Especially when you want to plot set of points, you want to do various competitions with list of points in the plane or in the space, this will be very handy.

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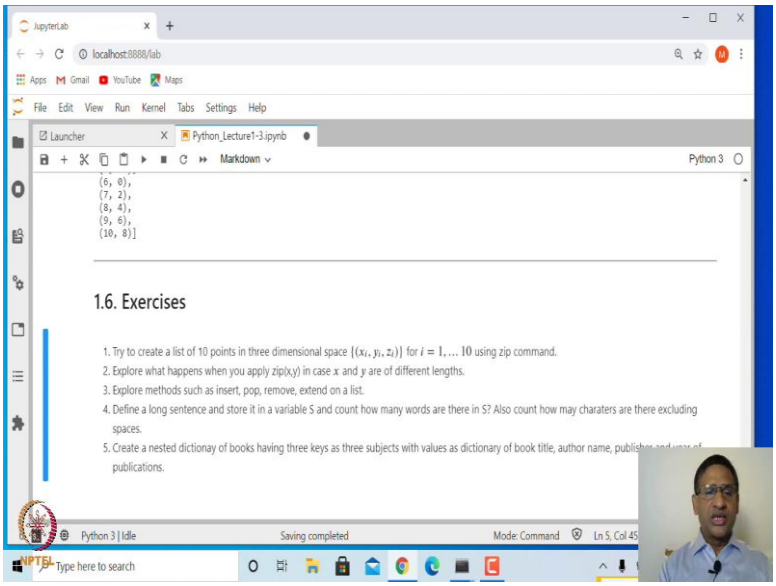

Next let me just give you few exercises. These are simple exercises, but one thing you should try to do, we have dealt with lists, tuples, dictionaries, and sets. So, you can explore all the methods that you can apply on these built-in data structures, so that you will be comfortable. You should also take help on each of the methods that you are exploring.

So, let me give you some simple exercises. For example, the first exercise is, try to create a list of 10 points in three dimensional space, call it as xi, yi zi, i going from 1 to 10 using zip command, so it is very simple. Explore what happens when you apply zip in case an x and y are of different lengths. We have applied zip to x and y where x and y are of the same length. In this case, it was 10. Now you can explore methods such as insert, pop, remove, extend on a list. So, create a list and try to explore these functions. You can define a very long sentence, store it in some variables let us say capital S. You can also try to count how many words are there and you can count how many characters are there, you can even count how many, for example vowels are there. All these things are also possible.

The last one is it create a dictionary of books having three keys in three subjects. So, it is a dictionary of books in three subjects; let us say math, physics, chemistry and then the values is again a dictionary which contains the book title, author's name, publisher and the year of publication. This is a nested list nested dictionary.

So, I will see you in the next class. So, thank you very much.