IIT Madras

ONLINE DEGREE

Programming in Python
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Theoretical Introduction to Recursion

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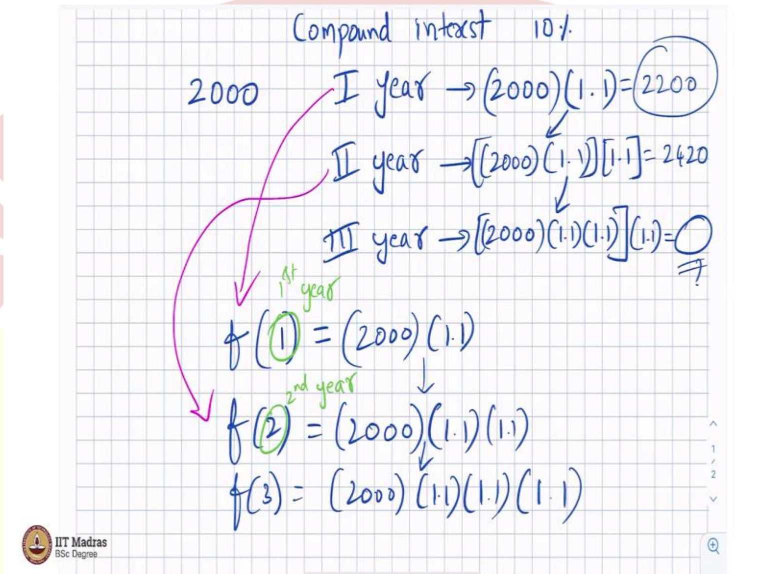

Let us consider the example of compound interest, something that was a little difficult for us to understand. In our primary school days, at least I found it difficult to understand. I still do not know the formula for compound interest, it is some P into 1 plus R to the power of T, P into 1 plus R by 100, whole, to the power of T or something like that.

Anyways, I am not going to bore you with the formula for compound interest. Of course, it is not boring, it is interesting. But then let us see some basic aspects of compound interest. Alright, so assuming you have 2,000 rupees, and at the end of first year, it compounds, at the end of second year, again, that gets compounded third year, that again gets compounded. Let us assume this is a 10 percent interest.

Easy way to see this is at the end of last year, your 2,000 becomes 2,000 times 10 percent. The easy way to calculate it is like this. So, this will be equal to how much 2,200 If I am not wrong. 2,000 added 10 percent so a good way to write that is this, as you know so all I am trying to say here is, this is 1 plus 10 by 100, that I have directly written it as 1.1, that is a easy thing on the mind to write it like that. Fine.

So, because I like writing it that way I am forcing you all to think that way, I am sorry. Sorry for imposing that on your people. So, what is at the end of second year, whatever you had, at the end of the first year? Whatever that money was 10 percent of that gets compounded. It is 1.1 times your 2,200. What is that? If I am not wrong, it is 2,420 you can calculate and see. And at the end of third year, it is simply this 2,000 into 1.1 into 1.1, whatever that was, at the end of first year, second year, rather.

At the end of second year, whatever you had and that thing gets compounded, which is times 1.1, whatever this is. So, it is 2,420 times 1.1. Whatever answer you get you write it here, but then that is not what I am here for. I am not calculating the final answer, but I would like to see that here you have a function f. At the end of first year, it gives you this much, 2,000 into 1.1. At the end of second year, let me call that f of 2, instead of 1, I will say if f 1 instead of 2 and say f of 2 and so on.

So, f of 2 will be whatever you had, as f of 1, which is at the end of one year, this stands for year, as you can see we use, I am just using some other ink. So, that this stands for end of first year. Similarly, end of second year and so on. The language of let us say mathematical functions, this is simply so much into whatever was here into 1.1 of this. So, f of 3 is equal to 2,000 into 1.1 into 1.1, whatever that was at the end of second year, times 1.1. This is all you mean by compound interest, as simple as that. And this leads to that formula whatever I was telling you. P into 1 plus R to the power of 100. P into 1 plus R by 100 whole to the power of T, I hope I am right there.

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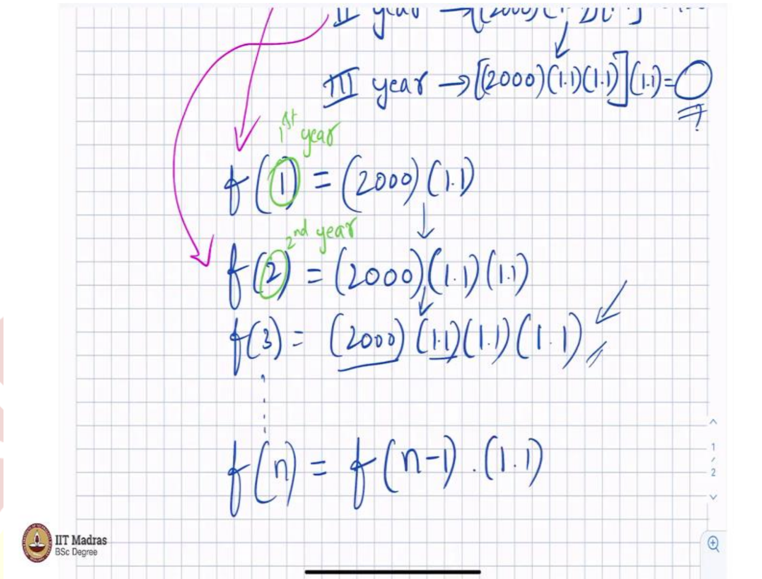

So, the formula of component in fact, you can derive it here as you can see, the years are getting multiplied here. P into 1 plus R by 100. R is 10, 10 by 100 whole to the power of T is the time 3 anyways, that is not important for us, we go on like this. Do you observe something f of n is equal to in English what does this mean? At the end of n years n whatever n is, what is the amount that you will get? It is simply your 2,000 times 1.1 times 1.1 times 1.1 sometimes, I do not want to write it like this. For different reasons, I would like to be a little stylish and I will say, whatever you will get at the end of n years is whatever you get at the end of n minus 1 years, times 1.1.

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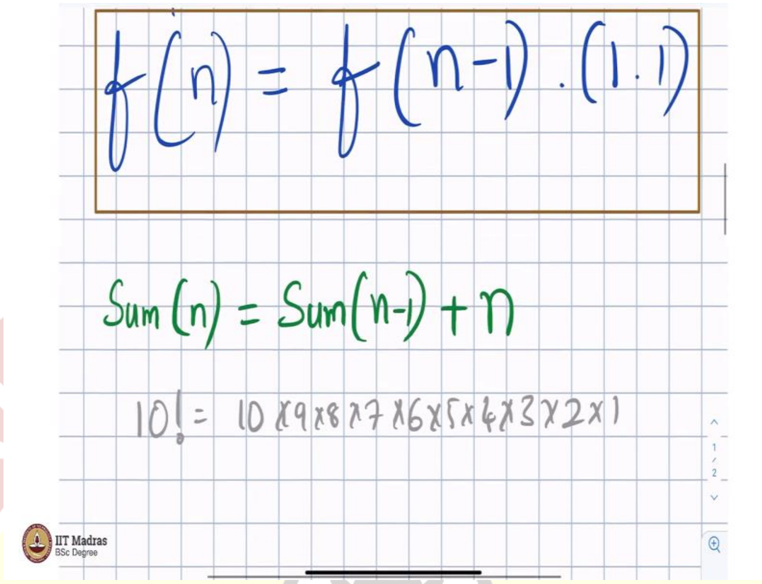

Pause for a minute, stare at the screen, stare at this properly for a minute. Let me box this for a reason that is very important and also interesting. Again, so f of n is equal to f of n minus 1 times 1.1. This is multiplication and this is decimal 1.1 do not get confused. So, to tell you what f is, I am using f. So, to tell you how to compute f of n, I will ask you, you compute and give me what is f of n minus 1, and I will multiply 1.1 to it. So, there are many instances, you very will encounter things like this. I will give you another instance. What is the sum of n numbers? Some of n numbers is sum of n minus 1 numbers, plus the number n.

Now, if you are finding this, not so easy, on your mind, do not worry at all this is total common sense. So, when we write it like this, it becomes very complicated. As I keep saying, mathematical statements are common sense complicated that is all. Once you see the common sense part of it, it becomes very clear to. Sum of n equals some of n minus 1 plus n. Similarly, if you know what is factorial, what is factorial 10 factorial equals 10 into 9 into 8 into 7 into 6 into 5 into 4 into 3 into 2 into 1, that is what you mean by 10 factorial.

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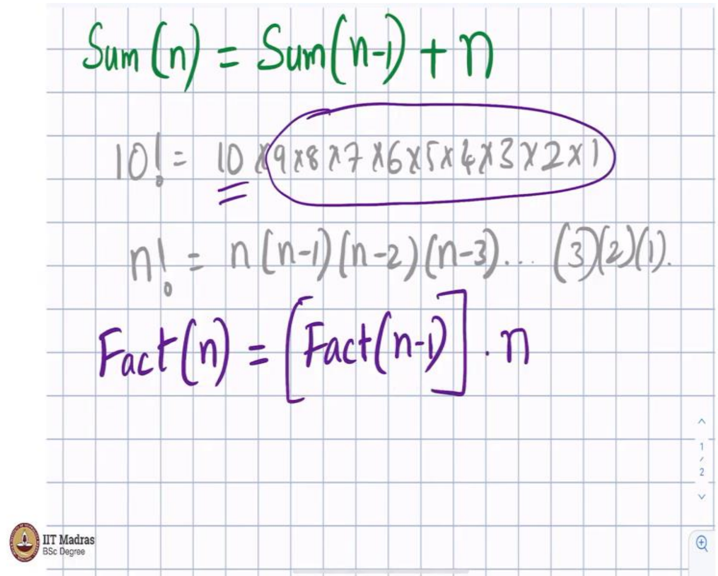

So, what do you mean by n factorial in general, it is n into n minus 1 into n minus 2, the same thing. The concept of this 10 factorial, I am writing it as n factorial. So, if you have not seen this, do not worry, you can always look up or do not break your head much about factorials. It is not important, at least at this point of time, n minus 3, so on up to again, whatever 3 into 2 into 1 at the end, this is what you mean by factorial.

But let me write this neatly, maybe with the different ink. Factorial of a number n is factorial of a number 1 less and see what is happening factorial n is 10 factorial is nine factorial, you see this entire thing 9 factorial times 10. It can be seen like that, you see, so factor of n is factor of n minus 1 times this entire thing times, what is it times n. You can specify you can define a function by using the same function.

Please make a note of these three things. This is one boxed thing and the next box thing would be this for me, sum of n numbers and then let us say factorial.

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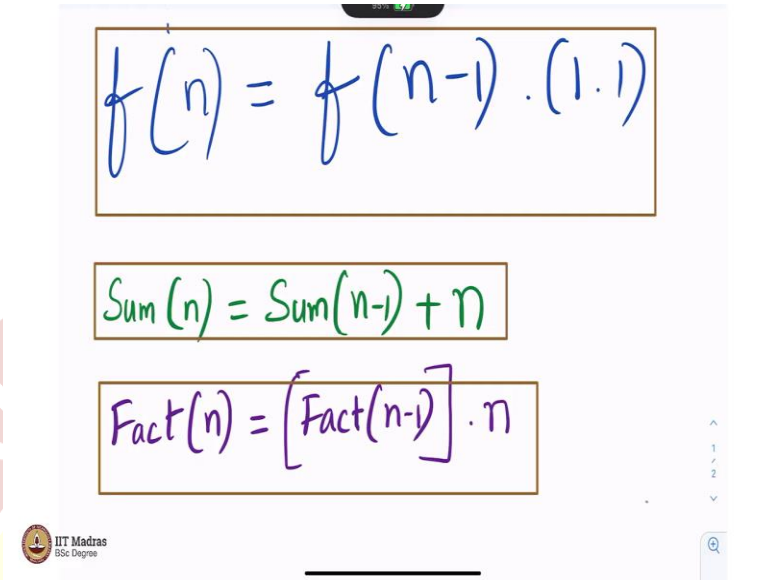

I would like to take these three things. And so just for the sake of clarity, let me remove the other parts quickly and let me retain the three stuff here. So as you can see, in one page, I am showing these two things. Look at it let me remove the gridlines so that it is clear to you people. So, let us take a deeper dive into what has this to do with our programming. Learning, we are learning Python. What does we have even saw what are functions this week. What has this to do with what we have shown you so far in the past few lectures.

So, let me go ahead and code in my next video, and try to tell you what am I after? Why did I explain this concept to you? What has this to do with programming using functions, you have functions here to point to be noted is to define a function, you can use another function the same function you can use here. Function sometimes can be defined by itself, perfect. So, let us now go ahead and then try to see what has this to do with programming.