Introduction to R Software
Prof. Shalabh
Department of Mathematics and Statistics
Indian Institute of Technology, Kanpur

Lecture - 42
More Examples of Programming

Welcome to the last lecture on this course Introduction to R Software. You may recall that in the earlier lecture, I had explain you something about the programming and I had taken one example in which I had tried to show you all the basic steps and then I tried my best to explain you that how the topics which you have learnt in the earlier lecture, can be used to create a program.

Now in this lecture, I am going to take 2 more examples and through which, I will try to give you some more idea about the programming. We are going to use only those syntax and commands which you have used earlier and the examples are very very common thing, but main thing what I would like to emphasize is that you have to understand how the program is being developed and how this our language is going to help us in writing the program.

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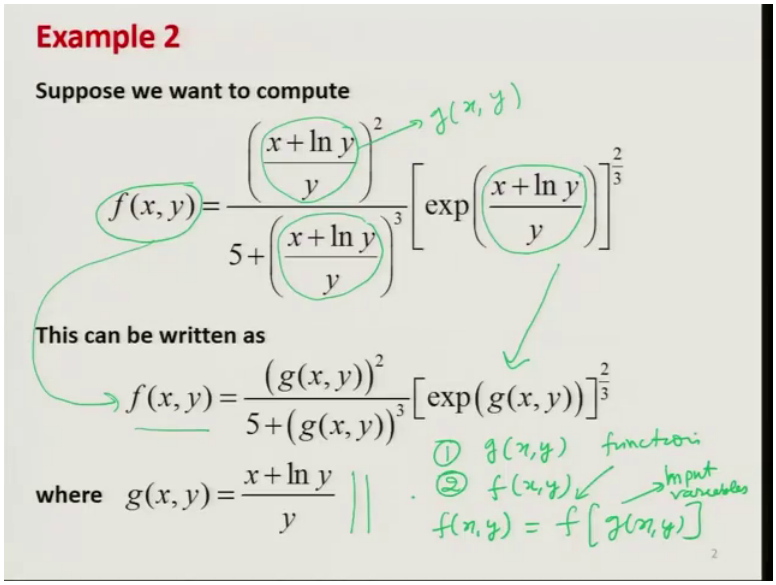

So, let us start with our lecture. So, suppose we consider this function f x, y; just try to have a look on the structure of this function and we want to compute it, you can see here that this function here x plus log of y upon y this is common here. So, the same function

f x, y here can be written as like this that I try to write down this function as say g x, y this is here. So, you can see here that the same thing can be written over here. Now my objective in this example is to show you that we had discussed earlier that whenever we are trying to define the input and output variables then the input variable can be a scalar can be a vector can be a matrix or even a function itself.

Here through this example, I would try to show you that the input variable can be a function and also I would like to show you that suppose you are dealing with a complicated program, then that program can be divided into several smaller programs and then they can be joint together or they can be called inside a function. So, if you try to see here, we are going to deal here with 2 functions one is g x, y and say another here is f x, y and you can see here that f of x, y; this is a function this is itself a function of say here g x, y; right. So, now, you can see here that if f is my here function then the input variable here is g x, y.

So, now I have an option that I try to develop here 2 programs one for g x, y and then second for f x, y and then this function has to be written in such a way such that this function f contains g x, y as its input variable.

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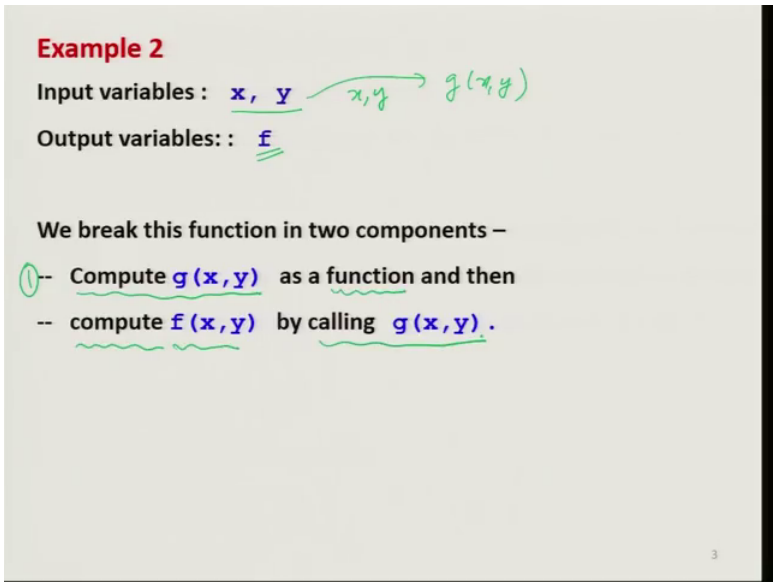

So, now, in this example, you can see here; here, we have 2 input variables x and here y. So, they can; obviously, be some data values and output variable here is f and this f is going to depend also on a function of x and y something like g x, y, but that is not

directly, but as in direct dependence. So, we try to break the entire function into 2 components in the first step we compute g x, y and this computation has to be done as a function and then we try to compute f x, y by calling the function g x, y. So, that is what we have to learn in this example.

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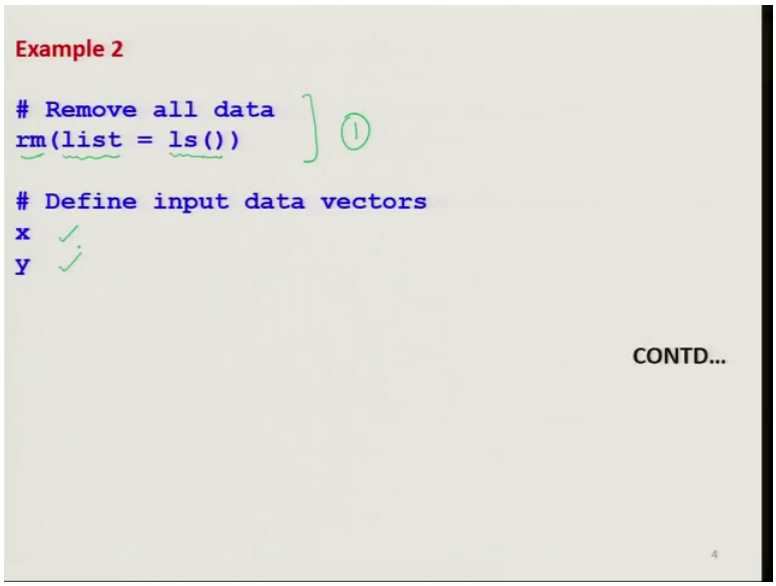

So, now we try to write down the program and I will go slow and I will try to write down all the steps whatever are needed. So, first step I would like to clear all my data set which is already contained in the R software for that I used the syntax here remove and then this is going to remove all the list inside this l s arguments in this particular way. After this, I have to define the input data vectors. For example, here this will take 2 values x and y whatever other values you want to give you can give it when we try to run the program.

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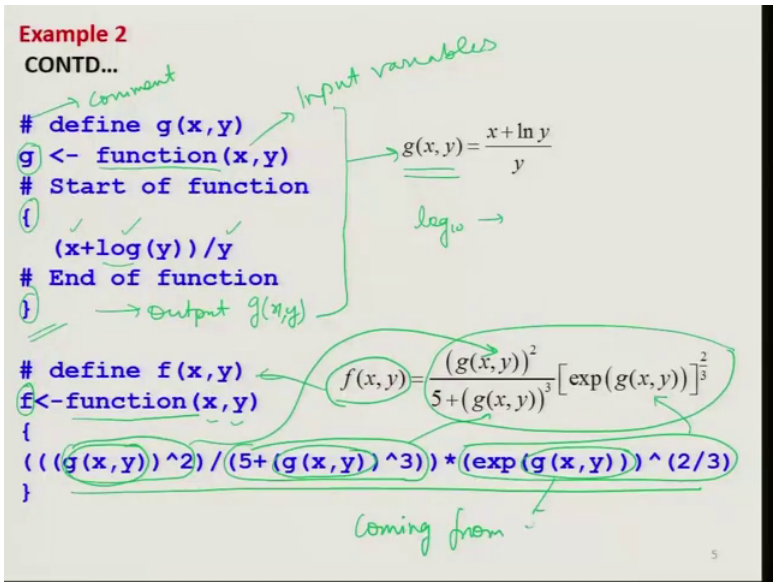

Now, I am writing here 2 parts used in the first part which is from here to here I am trying to write down a function to compute g x, y.

So, here this is my here comment because this will help me get around to remind me that I was trying to compute the function here g x, y and I tried to give this function a name which is more sensible that is here g and then I tried to define this function. So, I try to write down here function and that inside the argument, I try to write down here all the input variables separated by comma. And then I start writing the function, and all the syntax and commands they have to be written inside this curly bracket this and here this. So, you can see here in this case, it is pretty simple you are simply using here x plus log of y divided by y, here you have to be careful when you are trying to use the log function here. So, this is actually computing the natural log in case if you want to compute log of base 10, then you have a different command that you can see from the help menu all, right.

So, once it is computed here, then I am saying that now I am done and the function here is completed. Now this is going to give me an output for a given value of x and y as say g x, y. Now in the second step, I try to define the function f x, y. So, you can see here I tried to give it a name say here f and then I write down here function f of x, y and the same expression whatever is written over here, I can write down here that you can verify that is very very simple on the same logic; what we have done in the topic R as a

calculator. So, you can see here the g x, y whole square this is corresponding to this quantity 5 plus g x, y say whole cube this is corresponding to this factor and this exponential of this thing this is corresponding to this factor.

So, you can see here in this function f x, y, I am trying to call here g x, y directly, right, and this g x, y is coming from earlier function right which is where here you see.

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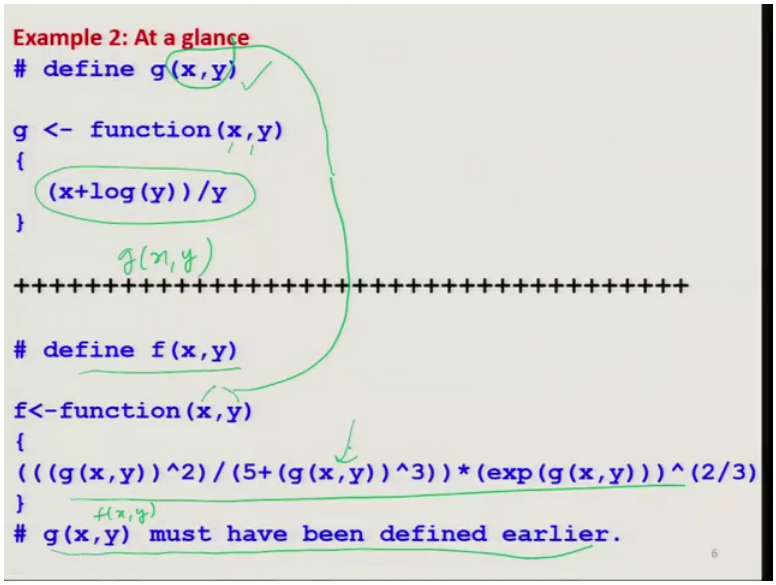

So, now, means I am just trying to write all this function at a simple glance so that I can explain you its functioning. So, first I have define here the function g x, y; I am trying to give here 2 inputs x and y and it is trying to compute the function g x, y and after that it is going to give me a and output of g x, y. Now I am trying to define here another function f x, y and then put variables are here again x and y and this x 1 x and y and this x and y; they are going to be the same and now I tried to write down this function and then I am just going to get here an outcome which is in the form of say here f of x, y.

What you need to keep in mind here is that you should define first the g x, y and then f x, y is if you do not define the g x, y earlier then this will not be coming over here in this function f x, y and then you will get in sort of error now I try to first show you the execution in say R.

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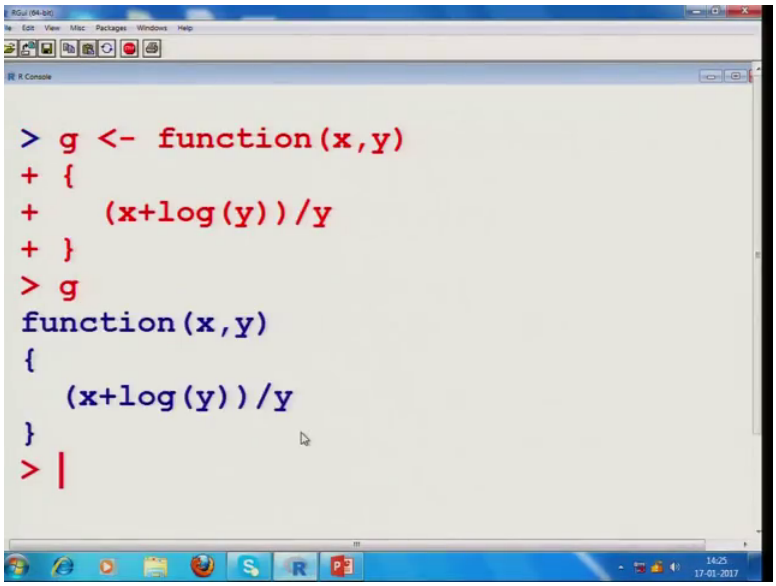

So, I can write down here in the R; you can see here; you can see here this is my here g function and similarly, I tried to copy here this function here f and I will try to write down here function here f you can see here this is my here f, right.

Now, I try to take here certain values; suppose, I try to take here the same values here say x equal to 10 and y equal to 20, suppose, I try to take here x equal to 10 and y is equal to 20. Now you see what I am going do here that there are 2 functions here g x, y and f x, y; right, but I am not computing here g x y, but I am simply going to compute here f of x, y; you see what happens over here you get the value of here f x, y this means that this f x, y when it was executing this happened like this. Now, what you can see here that whenever we are trying to execute this your program f x, y the control comes on the first line here and it finds here there is something called here g x y.

So, it goes from here to here and it computes the value of g x, y for the given value of x and y and after computation it comes back over here and it tried to substitute the value of g x, y here, here and say here and then the value is computed.

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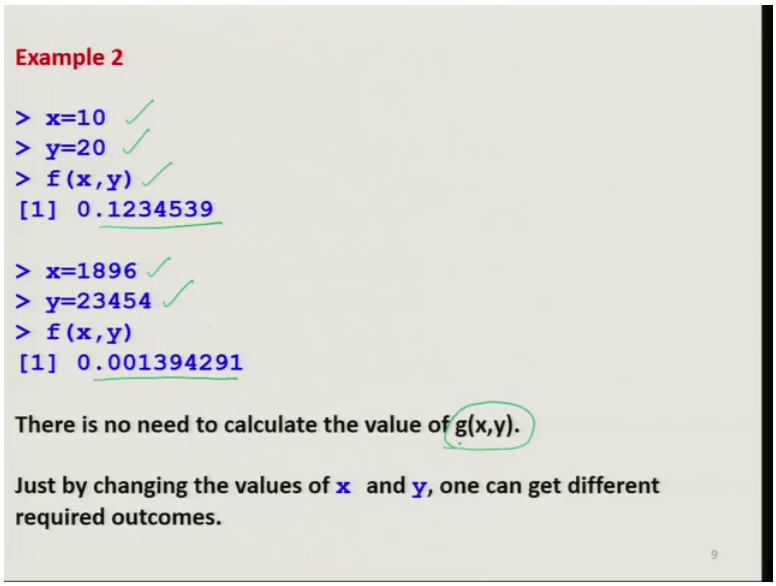

So, here is the screenshot of the function whatever I did here if the screenshot. So, if you try to see here; I tried to give here a value of x and y as 10 and 20 respectively and then I write it f x, y and I get here this outcome and similarly, if I try to choose anywhere value here x and y and then I get here different value. So, you can see here that in order to compute f x, y we need not to compute g x, y separately.

So, I am trying to call a function inside a function and just by changing the value of x and y I can get here different required outcomes. For example, we can give it a try.

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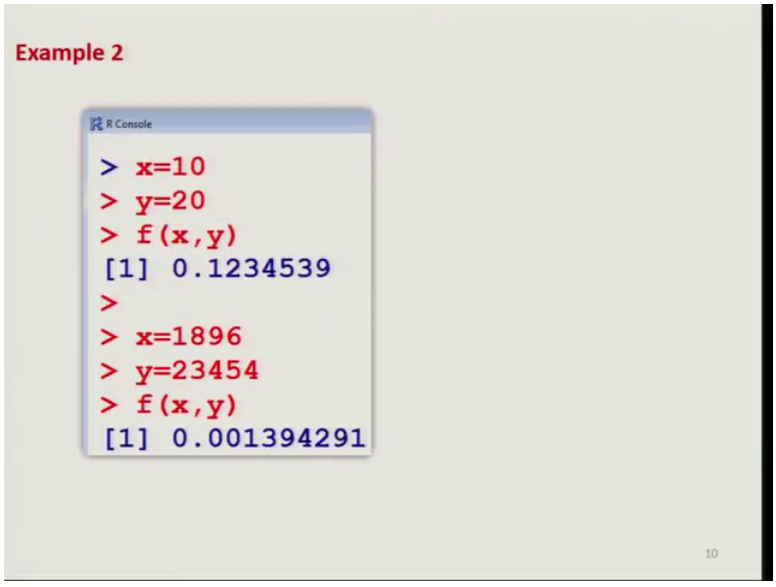

For example, if you want to have here x, y; for example, I can say here one 8 nine x equal to one 8 nine and y equal to 981 and you can get here this value directly, but then you have to keep in mind that the value of x and y they have to be given in the same order suppose was another value of here like this.

X equal to 981 and y equal to 98; I get here this value. So, you can see here this is how you can operate and run the function. So, here is the outcome the screenshot of the outcome and now try to take one more example.

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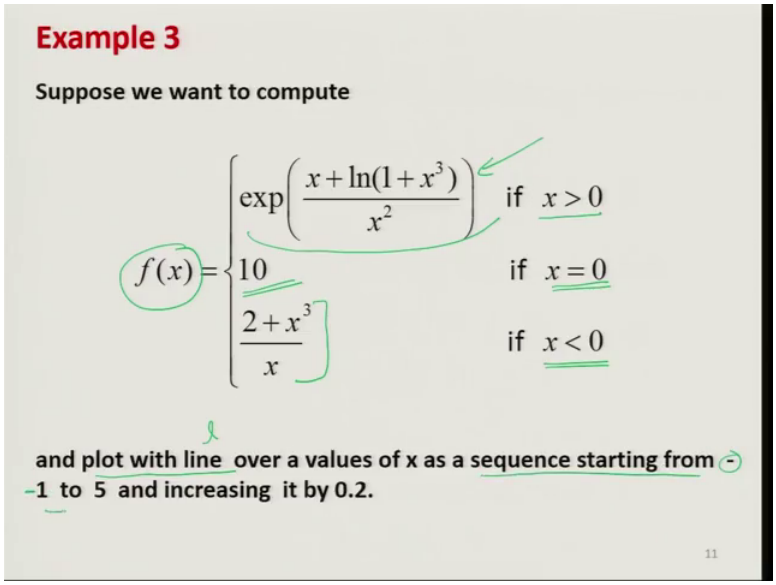

Is this example I want to compute the function f of x which has 3 possible values and this depends on the nature of here x in case if x is greater than 0, then the value is given by this expression and if the value is 0 x equal to 0, then the value of f x is given by 10 and in case if x is less than 0; that is negative then the value of f x is given by 2 plus x q upon x and we would also like to plot this function and for plotting, I would like to use the option of line which was given earlier by here plot l and this plotting has to be done where the values of x s are the sequence which is starting from here minus 1 well minus is coming here.

So, just be careful between from minus 1 to 5 and the sequence is increasing by an increment of 0.2.

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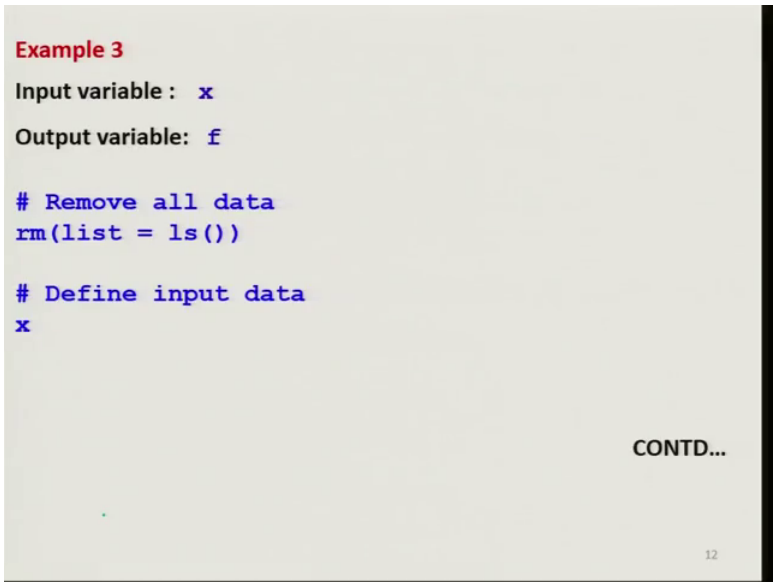

So, now we first try to define; what are my input and output variables. So, here you can see that there is only one input variable here x and there is only one output variable here f. Now, we start doing the programming. So, the first step I want to remove all the data that is stored inside the R software. So, that is my first step now in the second step I would try to define what is my input data whatever with the value that we can give when we try to execute the program.

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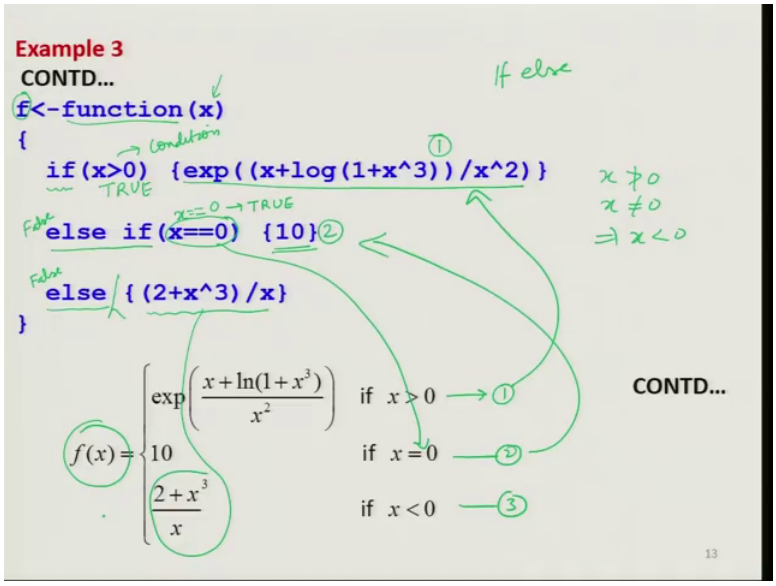

And now here I tried to write the program. So, I start here with a function and I give it here a name f and there is only one input data here x. So, I try to write it inside the argument.

Now, you can see in the function here f x this is got 3 components one 2 and here 3; that means, the function has to be computed based on the logical value of x whether it is greater than 0 smaller than 0 or say equal to 0. So, I try to use here the; if else statement if you remember we had done this thing. So, as a syntax since I have a 3 condition. So, I start here with here if and then I try to write down here the condition. And then the statement number here one this means if this condition is true then statement number one is going to be executed.

And suppose if this condition that x greater than 0 is false the control will come to second line and I try to write down here else if and then I try to check whether x is exactly equal to 0. And here I am trying to compute my second statement which is here and first statement here and this x equal to 0 that is related to here; here and in case if this condition is supposed true then this 2 is executed and suppose if this condition is false then the control come to the last statement, which is only here else because this is the last statement.

So, in case if x is not greater than 0; x is not equal to 0; that means; obviously, x is going to be smaller than 0 and in this case without writing here any condition, I can directly write down the function here. So, this function is here like this right. So, you can see here just in 3 lines using a logical operator and if else statement I can write down the entire program.

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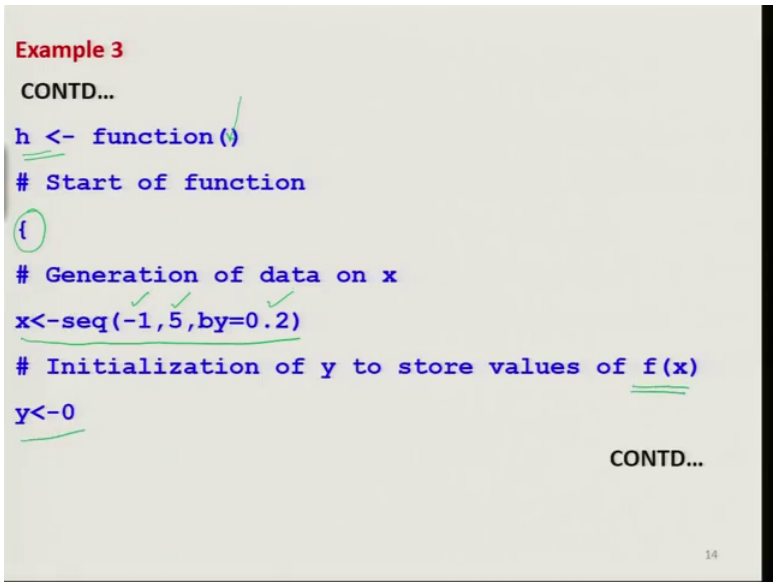

So, now, the next part of this function is how to write a program to plot the function. So, I tried to write here another function here h and which has no input variable because everything is predefined. So, what I try to do here that I try to write here another function h and I start this function here with this curly bracket.

First I need to generate the data which is given to us that this is a sequence starting from minus 1 to 5 and the sequence is increasing by 0.2 units. Now I need another variable to store the value of my function f x. So, for that I define here another variable here y and I say the initial value of y is 0.

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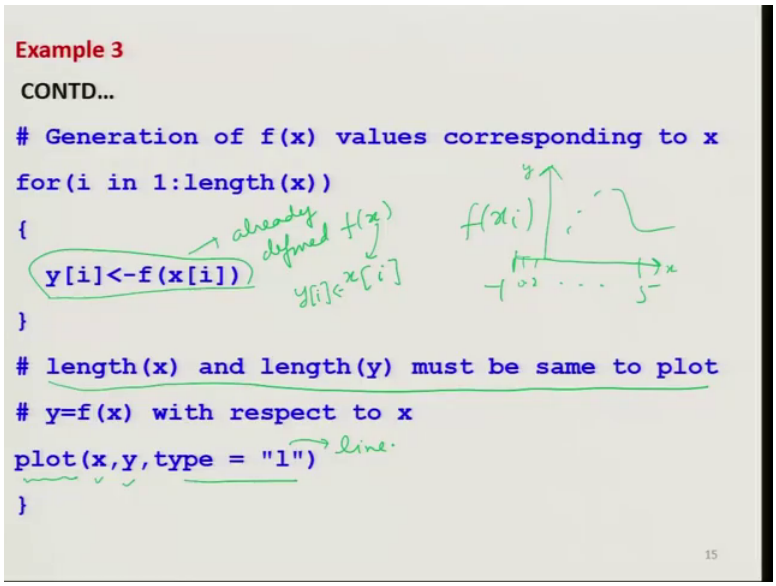

Now what I am going to do here that I have to generate the value of y based on f of x because what I want here that I want to have here the values of here x and here y. So, in order to plot something over here; I need 2 values x and y and that is what I am trying to generate here. So, the value of xs are given to us that they are starting from minus 1 to here 5 at an interval of 0.2 and so on.

Based on that I am trying to generate the value of say y i that is going to store the value of here f of x i. So, I try to say here y inside the bracket i is a function of f of x of i. So, you can see here that we already had defined we already defined f of x. Now what is going to happen this x is going to be replaced by here x of i and this value is going to be stored say in say here another variable here say y i. So, this is what is happening here one thing you have to keep in mind that the length of x and length of y must be the same otherwise you cannot plot the function, right.

Now, I have got here the value of x and I have got here the value of y. So, I can simply use my command here plot the data x, y and type here is line that is. So, I use here type equal to l; if you recall, we had discussed the plot function where I had given you different types of option and among them one was line. So, I try to write down this plot function and here I try to end the function right.

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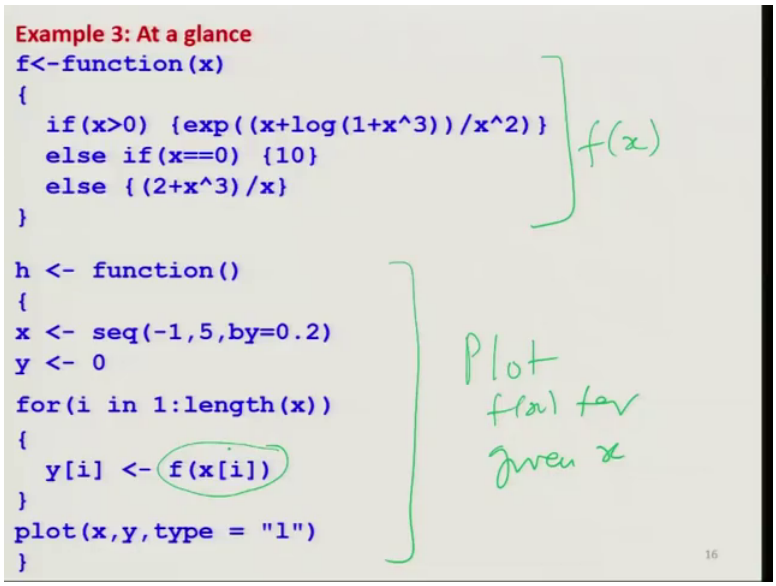

So, now, if you try to see the entire program at a glance; first of all, I am trying to write down here a function or a program for generating the value of f x and then I am trying to write here another program to plot f of x for given x.

So, you can see here that in this example also; I am using the function f of x as an input variable inside the function h x on the same lines that we did in the example number 2; right. So, you can see here that the program is not very lengthy now we try to execute it here. So, first I try to define here function here f the same thing you can also do on the R studio also, but that I already had showed you in the earlier lecture.

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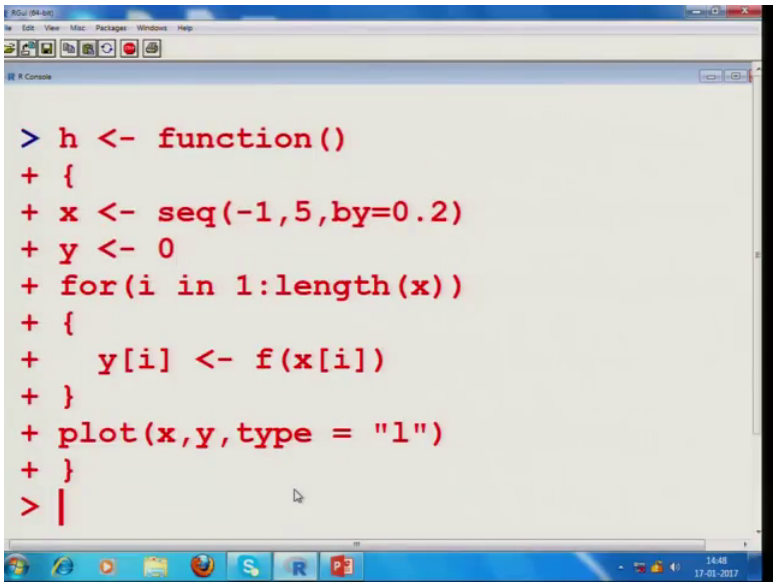

So, I am not showing you here that is pretty straightforward and then I try to do here function here for the plot.

You can see here this is the function for the plot now here I would like to show you several things first thing is this I would try to show you what is the value of here x when I try to give positive and negative values suppose, I give here the value plus 10.

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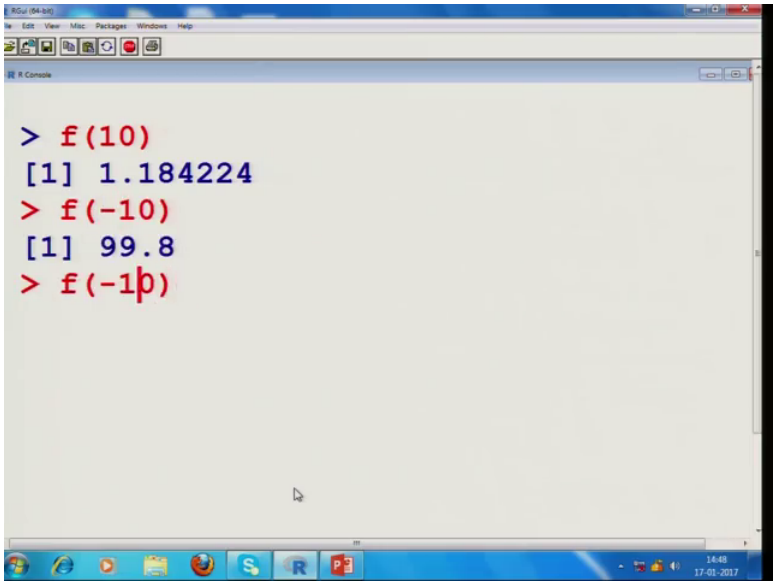

So, you can see here; this will come out to be like this and if I try to give here say this here minus 10 which is the negative value then the computation will be from the another

part and if I say here f at x equal to 0; you can see here this is only 10, right and similarly if you want to plot here the function h, then there is no input variable, but I simply have to h and arguments you can see here I get this type of graphic.

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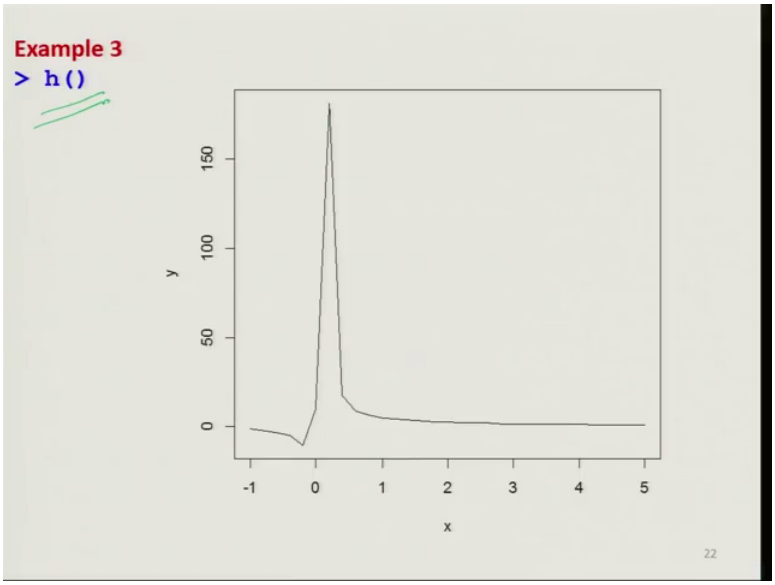

So, this means if you try to see here h function has already computed the function f of x for the given value of x in a sequence and based on that it is trying to create this graphic for the function f of x. So, let us now come back to our slide and let us try to see. So, you can see here this is the screenshot of the function f of x, then this is a screenshot of the function h of x and then these are the function f and h no shows that the same thing what we did earlier. And now if you try to see here; I have given here several values f of 1, 2, 3 positive value f of minus 1, 2, 3 negative values and f of 0 is equal to here 10 and similarly, here for positive value; 8 negative value 4 and f of 0 and you can see here this is the screenshot of the same outcome and then when I try to run the function here h then we get this type of graphic, right.

So, with this 2 example; I have again try to give you an idea that how to do the programming, but believe me we are going to and course, but this is not really the end of the story the story begins from here as I had said in the initial part of the lecture that I am going to teach you only the basic fundamentals and my idea is not at all that I can make you say expert in R programming in this course my modest approach was and my simple idea was to take out the fear from your heart for learning R.

At least you know now where to type a command how to find the command and how to execute it now you have to practice and the more you practice more you learn there are so many sources to help you out; so many books to help you out. So, try to fix an objective, try to take the help of different type of sources and try to write as many as programs possible the more you program you improve your programming skills which are essentially based on logic.

I remember that I used to ask my teacher that how to get this logic because he was always asking that whenever you want to write a program; first you have to give a logic and he was always giving me the same answer well you practice it you will develop it. As a student I never believed on him that how it is possible, but now you can believe on me, yes, it happens; more you practice; the more you solve; you develop a better logic.

So, I would stop here. And I wish all of you good luck for your exams, if you appear and otherwise good luck in learning the R Software. Goodbye.