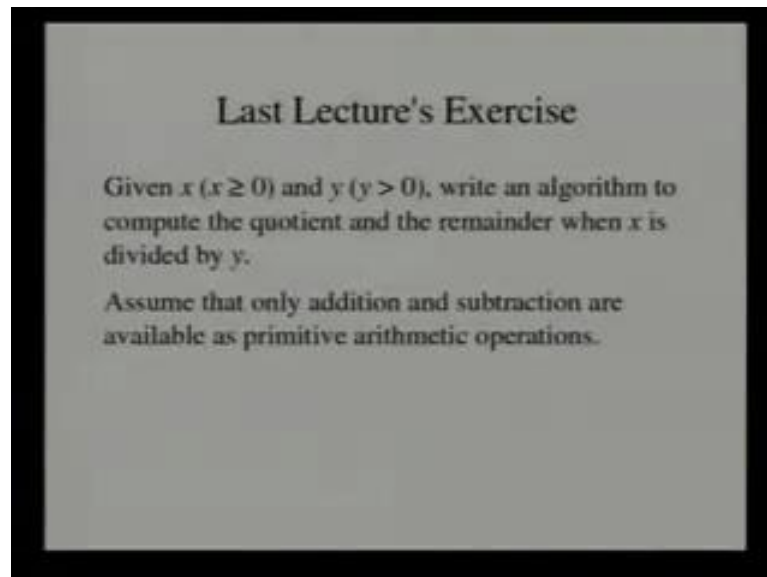**Introduction to Problem Solving and Programming**
Prof. Deepak Gupta

Department of Computer Science Engineering

Indian Institute of Technology, Kanpur

Lecture – 2

Welcome back in the last lecture we have talked about the notion of an algorithm and I showed you how to write an algorithm for a simple problem indeed to compute the factorial of the given number. In this lecture, I try to familiarize you with the basic use of the computer. So, you can start working with the computer right away, and whatever we learn in the class you can put that to practical use.

(Refer Slide Time: 01:04)

Last Lecture's Exercise

Given x ($x \geq 0$) and y ($y > 0$), write an algorithm to compute the quotient and the remainder when x is divided by y.

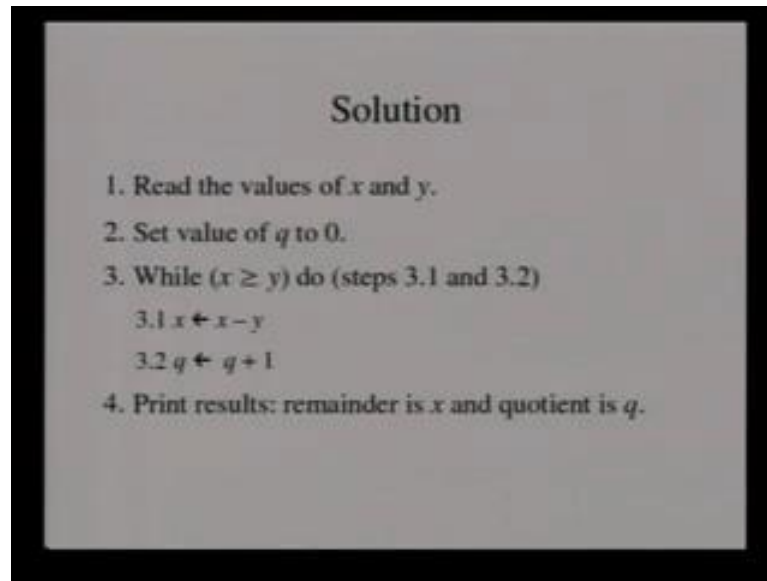Assume that only addition and subtraction are available as primitive arithmetic operations.

But before we start with the today's lecture, let me once again talk a little bit about last lectures exercise. To recall last lectures exercise was to compute the quotient and remainder when x is divided by y, assuming that only addition and subtraction are available as the primitive arithmetic operations.
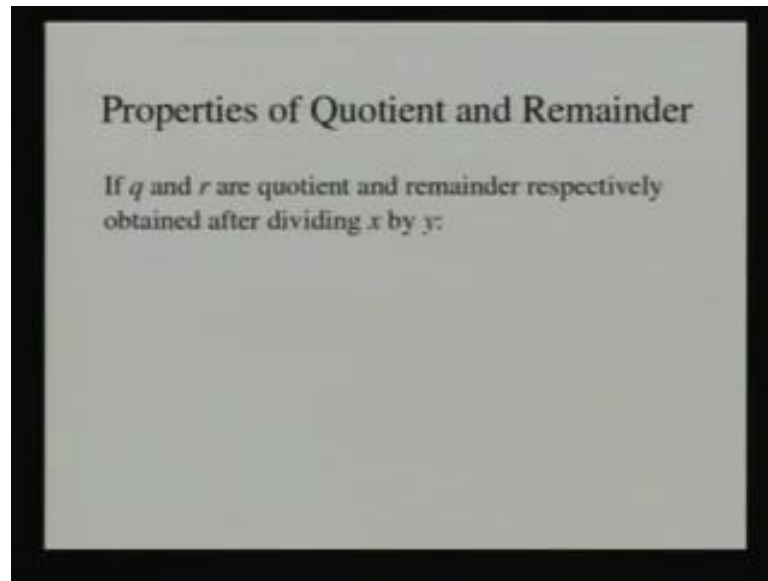
So, how do we go about doing that, well we need to use the properties of the quotient and remainder. And as you know if q and r are quotient and remainder respectively obtained after dividing x by y, then these two properties are satisfied that q times y plus r is equal to x and. Secondly, r is less than y. So, how do we use this properties to come up with an algorithm to compute q and r given x and y, well the idea is pretty simple. We keep subtracting y is on x repetitively, till the end of the number which is smaller than y; and once you do that then the final number that we left that is nothing but the remainder or that we looking for and what is the quotient the quotient is number of times that we have subtracted y from x.

(Refer Slide Time: 02:01)

Solution

1. Read the values of x and y.
2. Set value of q to 0.
3. While $(x \geq y)$ do (steps 3.1 and 3.2)
   3.1 $x \leftarrow x - y$
   3.2 $q \leftarrow q + 1$
4. Print results: remainder is x and quotient is q.

So here is the solution to this problem. So, as before we read the value x and y and the variable q is going to be denote the quotient which will essentially count the number of times that we are going to subtract y from x till x becomes less than y. So, we initialize the value of q to zero, and as long as x is greater than or equal to y, if we form these two steps. And in each step we subtract y from x, sp x becomes x minus y note that you have change the notations like at least from the last lecture and we are now using more concise notation. The left arrow here indicates an assignment which means that the value of the variable x has been changed, the left hand side of the arrow denotes the variable whose value has been changed and the right hand side denotes the new value that the variable is going to have.

So, this statement three point 1 should be rather, x assigned x minus y and which means that the new value of x is set to the old value of x minus the value of y. And similarly since we have subtracted y from x 1, we have 1 to q; remember the q counts the number of times that we subtract y from x. And finally, after some time syntax is decreasing in every step, ultimately x will become x and y; and at that time, we stop executing step number three and we come to step four which is to print the result. The remainder is x remember that every time we are subtracted y from x we have stored the result back in x. So, finally, x becomes less than y, and it is the remainder, and the quotient of course, the number of times subtracted y from x which is nothing but q.

Editing Completed
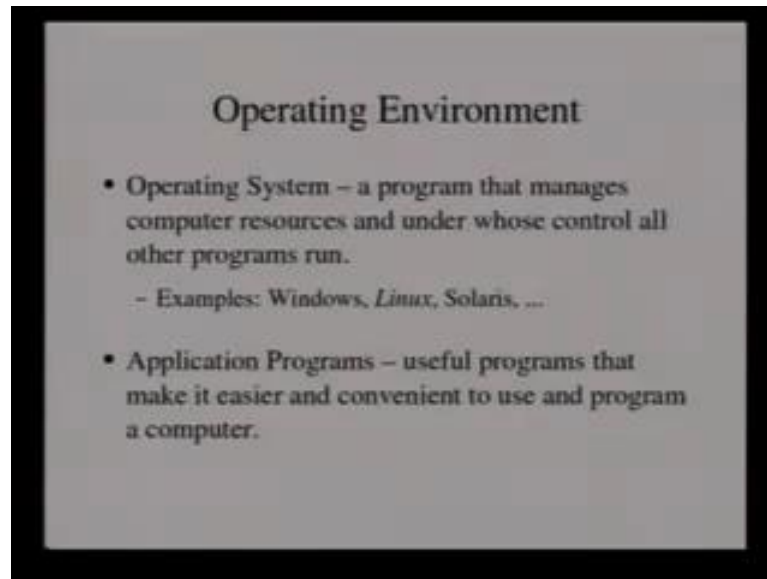
So, coming back to today's lecture. As I said today, I will familiarize you with the basic working and use of a computer, so that we can start using the computer to write programs and to execute to programs. In this lecture series, we will be using the Linux operating environment there are several operating system available for computers you might have heard of for example, windows Linux and Solaris etcetera. Now bedding environment actually consists of an operating system and number of application program an operating system is the program that manages the computer resources and all application program run under the control of the software.

So, I said there are several operating system like Windows, Linux and Solaris. We will be using Linux for all demonstrations in this particular lecture series. Application programs are useful programs that make a easier and convenient for us to use and program a computer we will see a number of application program and see how to use them.

Let me first introduce you to the various part of the computer this is what is known as the CPU box which containing the brain of the computer memory and so on will be talking in little bit more detail about what this contain this is the key board which you can see contain key is for various thing. So, that to which we can type information to the computer and this is what is known as the mouse this computer is like different from what you will probably seeing your lap this is a laptop computer another thing that you would find in lap will be monitor attached to the computer to this computer is connected to this monitor is attached we can see the output of the computer here.

So, let us first familiarize ourselves with the key board this what the keyboard looks like. As you can see the main area of the keyboard as keys corresponding to the various English alphabets, and then we have the number keys at the top using these English alphabet keys. Of course, you can type whatever English word you like note that these keys can be used to type lower case as well as the upper case, English character. If I have to type, let us type the small g and if I have to type capital g I have to first press shift key like this keep it press and then press the g key and then release the shift key. This is the control key the control key is used to type special characters. For example, sometimes we might ask you to type control c what; that means, is press control press c and then release both of them 1 by one.

This is the caps lock key and if you press this then what this means is that whichever English characters you now type will now appear in upper case instead of in lower case. And if we press it again, the caps lock mode is now switched off. These are the number keys on top of the number we also have certain special symbols printed on the keys. So, if I just press these keys directly then the number 5 will appear where as if I want to get the character percent then again I have to press shift and then press this keys and then release them 1 by 1.

This is the backspace key this is also very important key if you want to erase something that you have typed previously perhaps incorrectly and we just press this and whatever we have typed is erased. This is an another important keys is a called as enter key usually most of the time we type line of text we have to then press enter to say that we whatever we are typing now will appear on the next line. The rest of the keys are not very important at the time being we will talk about them whenever we need to.

And this is the mouse, and if I move this around you can see this result arrow moving on the screen this little arrow is called the pointer. And using this mouse I can move this pointer anywhere that I like also in this mouse you can see this two buttons which are called as the left button and the right button. Most of the time the left button will be use where as occasionally right button might be used. So let us not start using the computer the first screen that you are seeing over here is what is known as the login screen. So, here we are suppose to identify ourselves to the system and this identification consists of the two part.

(Refer Slide Time: 09:08)
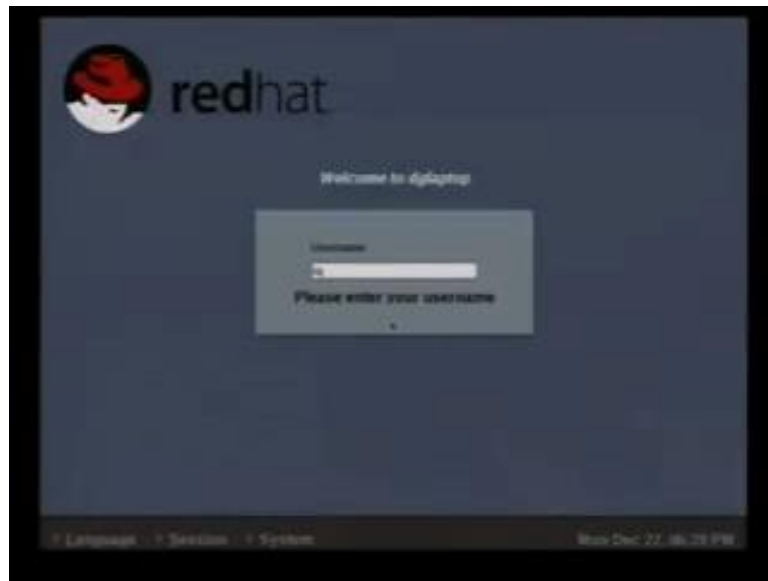
The first part is the user name which is assigned to us by the system administrator of the computer my login name or the user name if you see on the computer. So, I move the mouse and make the pointer appear in this small window where I am suppose type the user name I click here with the left button. So, that my whatever I type on the keyboard now will go here and i type my user name which is dg and after doing that I have to press enter now the computer is requesting me for the pass word this password is the secret combination of characters that I alone and suppose to know.

(Refer Slide Time: 09:24)
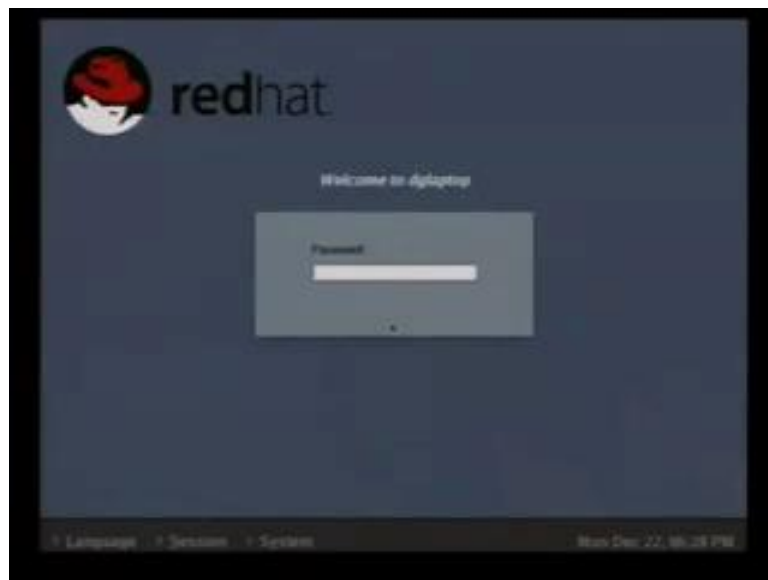
And if I type the sequence of character correctly then the computer will ensure that it is indeed the user dg who is trying to use the computer and if I type the password incorrectly.
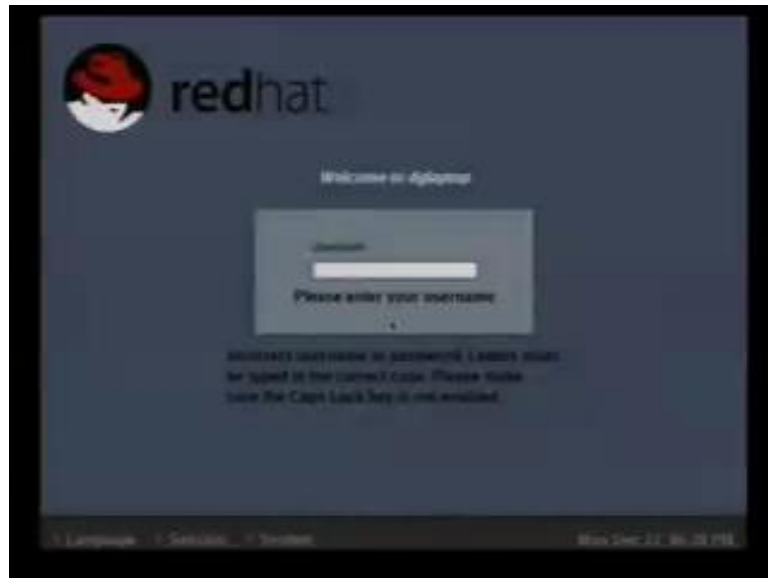
Let me type some arbitrary pass word. So, we can see it says that the user name or the password is in correct. Let me now correctly log in my user name again is dg this, what I am typing now is my secret password, and you can notice that the password is not appearing on the screen. And this for object reason that if somebody was watching over your shoulder your password should not be revealed. So, after typing my password 1 second I just press the enter key and the computer is now logging in. And this is the initial screen you are going to see once this login process is complete this is what we get this entire area is what is known as a desktop. So, think of as that desktop
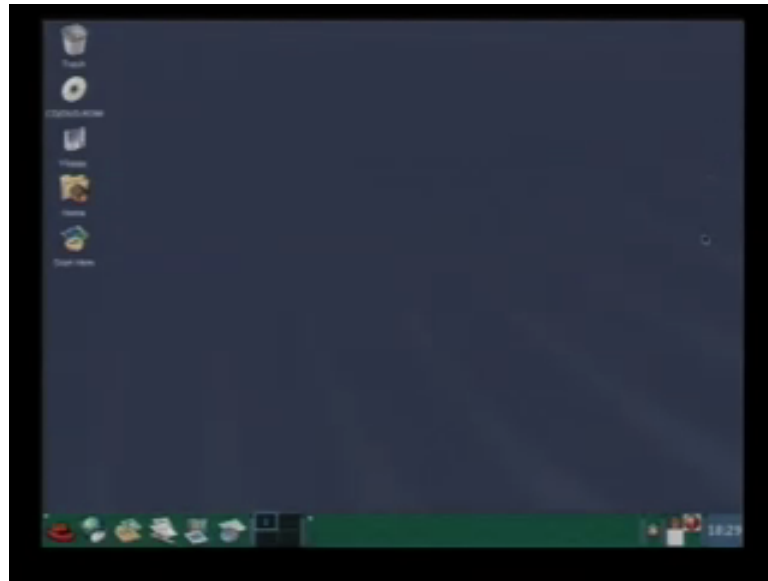
On your physical desk on which you can place some pieces of paper we do not have any pieces of paper on this desktop yet. But we will soon have them these little pictures are called as icon and these are shortcut to starting some useful applications. So, let us start the applications program running. So, for example, lets first get the calculator program let me start another program we can actually run more than 1 program at the same time.

So, let us start the game of chess. So, think of these two what are known as windows as the pieces of paper on your desk and just like on your desk you can move these windows

around on your desk and you can choose which paper should be on the top and so on. So, for example, we now want the chess window to be on top all we have to do is take the pointer to the title bar this is the title bar of this window and at the top and click the left most button here. So, the chess window now comes into the top.

Similarly, if I now want the calculator window on the top, this is what I have to do I can move these windows around just like moving paper around on my real desk. If I want to move this calculator little bit to the right what I need to do is to take my pointer again o the title bar of this window, press the left mouse button and keep it press like this. And now moved the mouse while holding the left mouse button down and when the window is in the desired position I just relieved the mouse button and the window has free scale and I can do a similar thing with this chess window.

For example, I can also change the sizes of this windows in most cases. For example if I want to make this calculator window a little bigger I bring my pointer to the edge of this window and as you can see the pointer shake has changed here. And now I again press the left mouse button keep it press and move the mouse like this and you can see the calculator window becoming larger and smaller. And other thing, we can do with these windows is to minimize them; that means, putting them away still we really need to use them again. So, to see this small button in the title bar for minimization of this window.

If you just click the left mouse button here then this window has been minimized and you can see that it has come here, and if you just clicked this again is come back similarly we can minimize this. . So, in terms of really desk you can choose to put away some of the papers that we actually need to use them also many of these applications will find things like these which are menu button. So, if you click your mouse button on any of these you will see menu of actions that you can choose from for example, this research the game of chess or this using this manual you can choose whether the machine plays white or the machine plays black. Now, the machine has playing the white and we are using the mouse. Again to make our move in the game of chess next important concept that we need to understand is that of files and directories. This is very fundamental to a computer because any piece of information that you wish to store in a computer is stored in a file.

(Refer Slide Time: 14:08)
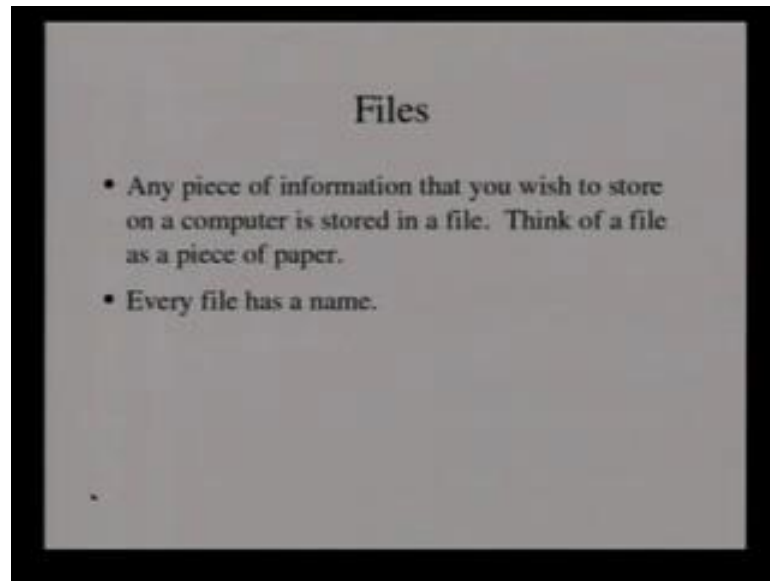
And every file has a name. So, you can think of a file as being a piece of paper and which you can write something and using programs you can create files and put whatever content that you want to place in those files these programs are called text editor using this programs we can also change the contents of the particular file. So, see the use of the text editor, let us see later on today.

(Refer Slide Time: 14:33)
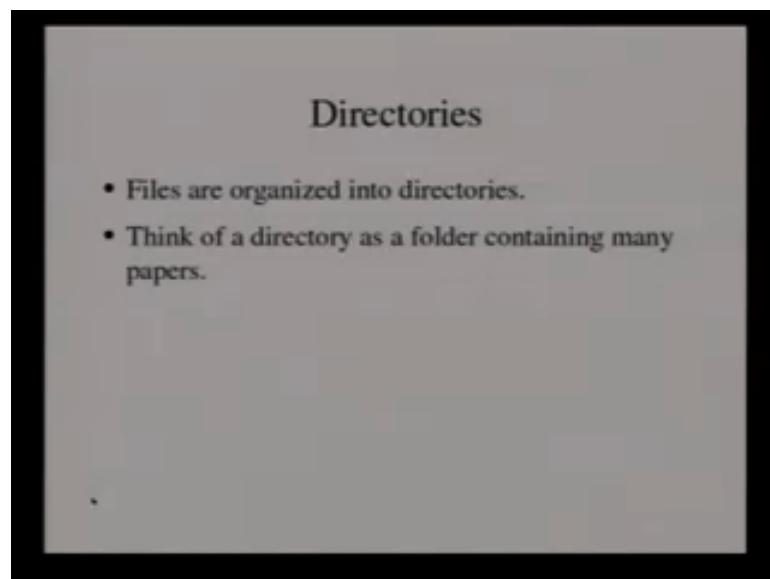
Directories also a very important concept to understand files are organized into directories. So, you can think of directory as a folder in which you can place several

papers. The only difference there from normal physical folders is that it is very common to actually place folders inside folders. So, you have a hierarchical directory structure very high directory in which you have some files and some sub directories which also may contain some other files and then some more sub directories and so on so forth.

(Refer Slide Time: 15:18)
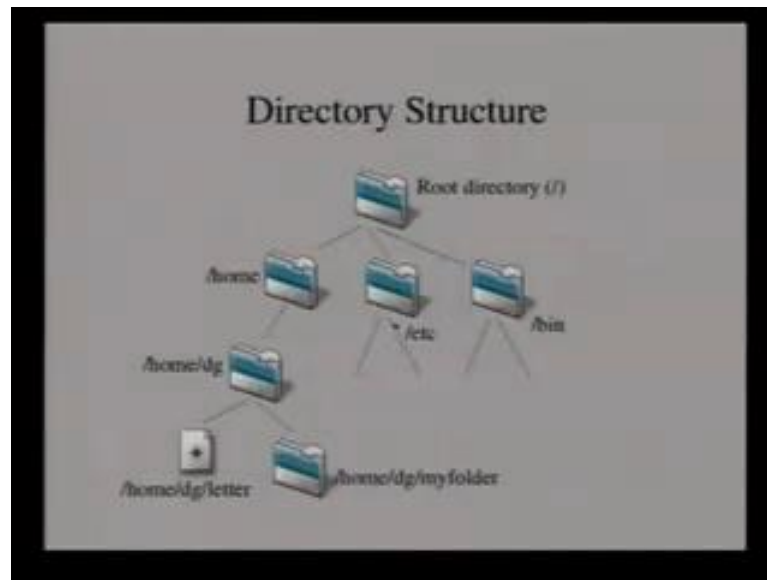
So, let us look at a typical directory structure in the Linux machine all these things are folders this folder is called the root directory this is special directory because this is the hierarchy of files begin everything else is contained directly or indirectly within this root directory. So, this example within this root directory there are three sub directories or sub folders within the same folders, which are called home acc and bin the name of the root directory. You can see is always slash this is the slash character and the names of these folder are then slash home slash etc slash bin and this slash in the beginning of the name signifies that this folder contains within the slash folder which of course, the root directory.

This folder home in this example contains yet another folder which is called dg, and therefore, the complete path starting from the root directory to this folder is slash home slash dg. So, this slash character separates the various components of the part and the path is nothing but the sequence of names of folder within which using which the folder or file can be access. And in this example, this particular folder contains a coil which is called the letter and therefore, the path to the file is slash home slash dg plus letter and

another folder which is called my folder. And therefore, the path this folder is slash home slash dg slash my folder and in this entire directory searches every user is assigned part of the directory searches with this you c can create your own file this is called the user home directory.

(Refer Slide Time: 17:07)
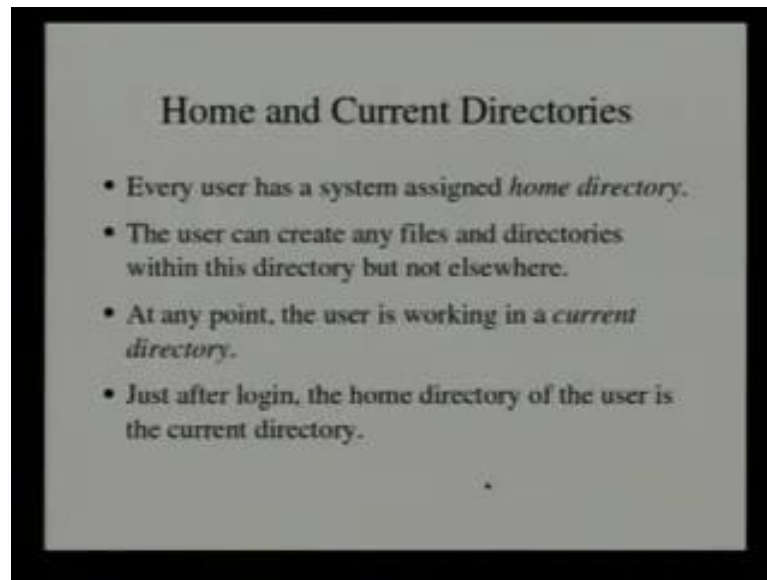
So, every user has system assigned home directory and the user can create any files or directories within this directory, but not as there in the previous picture this directory is the home directory of the user dg. And within this I can create any files and sub folders that I wish to create. So, this part of the directory tree belongs to me in some time and at any point in time well the user is working in some current directory and we can actually change what directories we are working in at any given point in time.

Thus after we log in the home directory is also current directory just after the log in the current directory is nothing, but the users home directory. So, in my particular example just after I login the current directory would be slash home slash dg and as I show you let us see later on. We can easily change what the current directory is and therefore, it is useful to able to refer the file not just with the reference to the entire part starting from the root directory, but also it is convenient to refer to file by their relative part starting from the current directory. It absolute path is unique unique to file and it is the full path starting with slash perhaps the relative path is the path that file relative to the current directory.

And this is changed depending on what the user current directory at that particular moment happens to be. So, for the same file, where the relative path and the different depending on the current directory and we will see some example very soon and within the part there are these two special component called dot and dot dot which refer to the current directory.

(Refer Slide Time: 18:57)

Relative and Absolute Paths

- Absolute path – full path starting with /.
    - A file has a unique absolute path.
- Relative path – path relative to the current directory.
    - For the same file, the relative path may be different depending on the current directory.
- Use . to refer to the current directory and .. to refer to the parent directory of the current directory.
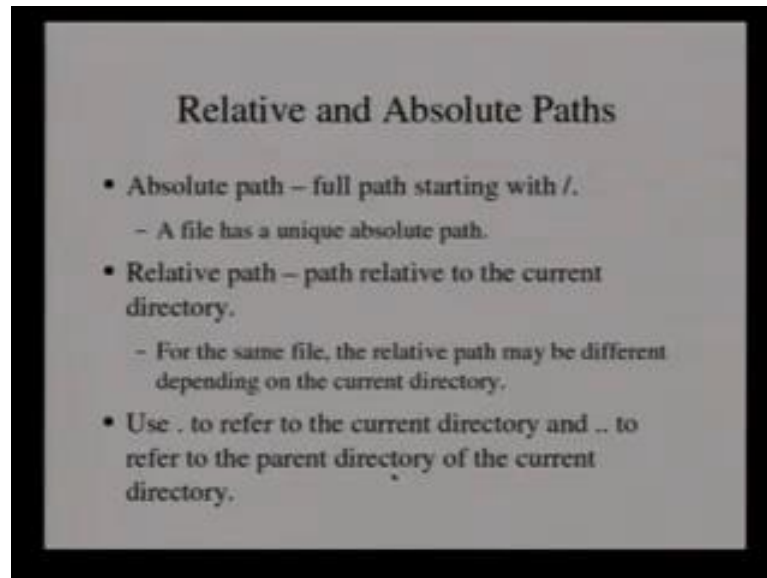
And the parent directory of the current directory in the directory tree respectively. So, let us see some example. So, this is the same directory set up as before we are assuming in this example that slash home slash dg is assigned as the come directory in the computer

(Refer Slide Time: 19:16)
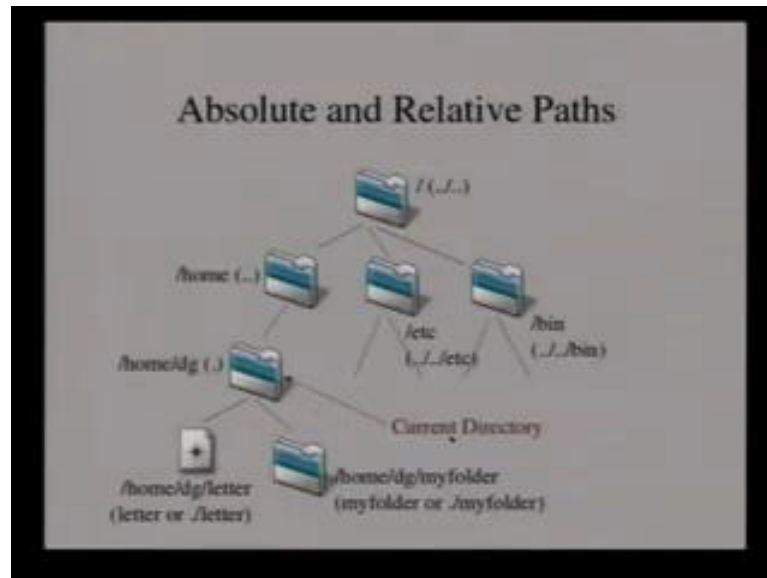
Here is also the current directory at this particular point in time. So, these path in the bracket are the relative path relative to the current directory slash home slash dg. So, the path for the current directory itself, the relative path would be the dot as I said dot is used to refer to the current directory itself and the relative path for this directory namely slash home would be dot dot. Because as I said dot dot is used to be refer to the parent directory of the current directory. And similarly the relative path for the root directory would be dot dot slash dot dot, because it is the parent of the parent of the current directory. And similarly now the etc directory this particular folder can be referred also as dot dot slash dot dot slash etc because this is within the root directory which has its relative path dot dot slash dot dot and therefore, the relative path of.
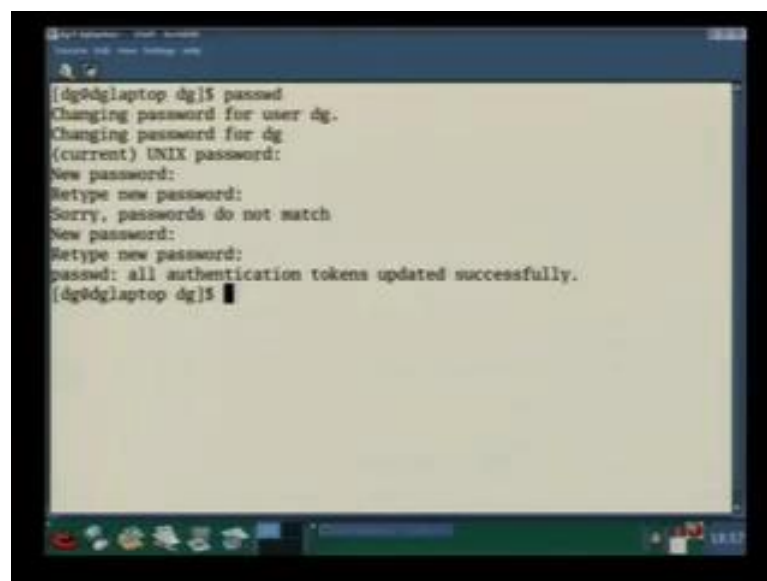
This folder becomes dot dot slash dot dot slash etc and if we look at these two files and folder in my own home directory the relative path for this and actual path for this particular file remember this slash home slash dg slash letter. So, the relative path is become either just letter or dot slash letter because remember again that dot is used to refer to the current directory. We do not need to use actually dot here just an letter if you do that then because this part is not starting with the slash it is assumed to be refer to the it is assumed to be a relative path.

And similarly relative path to this folder would be either my folder or dot slash my folder. Let us now look at some unique comments that we will find helpful to b in the

files and directories for doing that we need to first start the unique command window this is how I started on this computer it may be a little different on your own machine in the lab. So, in the menu go to system tools and within this sub menu click a terminal note that every time I clicking this left mouse button. So, this brings up the command window in which I can type command.

First command that we are going to see is very important that is the command to change your password you change your password the command is simply password, it will ask you for the current password. In order to ensure that this is not somebody who is using your terminal while you are went for tea and 1 can correctly given the correct unique password it asks for the new password. So, let me type some new password I have to type it again to ensure that I haven't made any mistake. So, I get some mistake that time let me try it again.

(Refer Slide Time: 22:22)

So the password has changed successfully having done that lets try out our new password. So, let us first logout of the system tell the system that no longer you are using it then log in again. So, for doing that lets first close this command window and to close any window we just need to click with the left mouse button on this cross which appears in the title bar of the every window. So, logout will use this menu which we had used earlier if I click here and there is the log out option. So, click on this it asking me to confirm that I really wished to log out. So, I click here and the system has logged me out.

And as you can see now we are again back to the login screen and this time when we log in we have to use the new password. So, this time I typed new password and we have successfully logged in.

So, let us start the command window once again system tools terminal we have the command window back first command that we will look at is called pwd command, which stands pwd stands for print working directory and this shows what our current directory is. So, instead of logging in the current directory is same as the user home directory since my home directory is slash home slash dg that my current directory as well and this is what the output of the pwd command is note that after typing the command I have to press the enter.

Let now see some more commands using the cd command we can change the directory and after separated with the blank we have to specify which directory we need to go to and here we have to give the path of the directory which can be either an absolute path or a relative path.
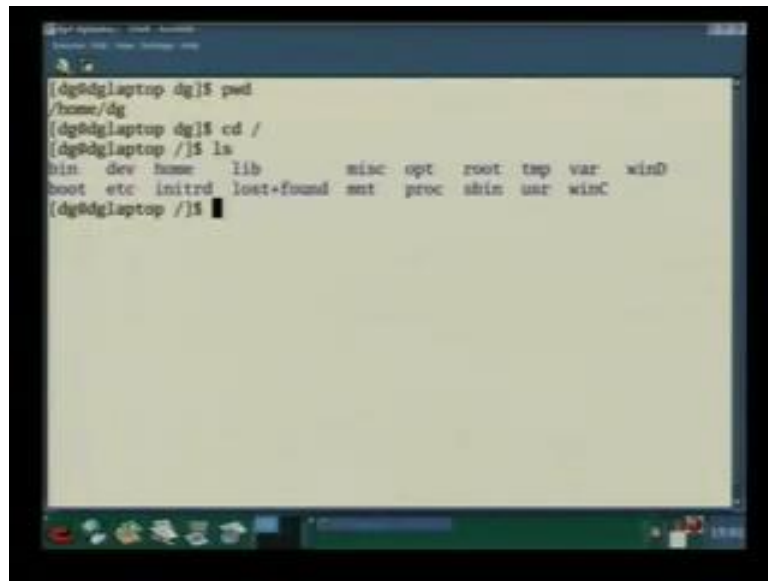
(Refer Slide Time: 24:27)

Let us just go to the root directory which means that I can use the absolute path slash and now we have gone to the root directory the next command that I am going to show is the ls command ls stands for directory listing. So, this shows the list of size present in the current directory. So, the current directory remember it is a root directory and these are the files order exists in the root directory.
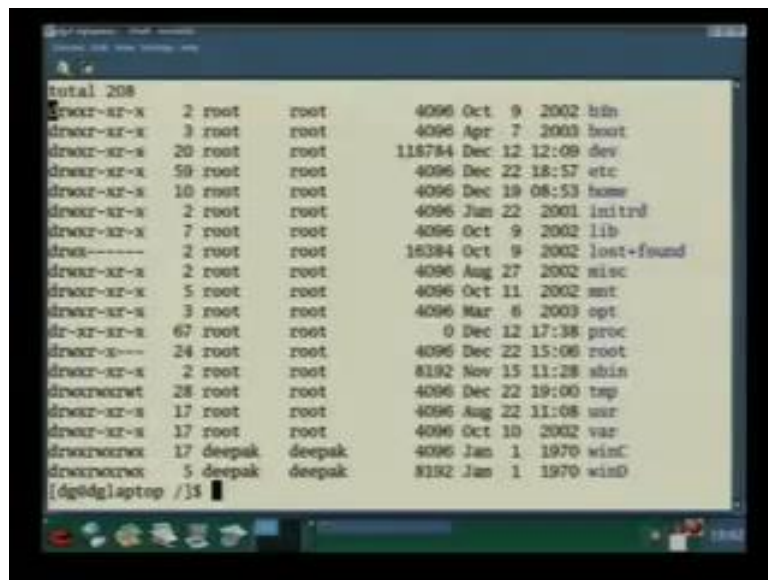
(Refer Slide Time: 24:47)

You want to see more details about these we will use ls minus l command note that ls the word ls and minus l is separated by a blank. We type enter again and we see more details about each of these. Let us look at some of these details closely the first character for each line says whether this is a directory or a regular file.

(Refer Slide Time: 25:15)

So, this bin is a type of directory because the first character is c and as a matter of fact in this particular directory in the root directory all the sub files are the actually directories. So, lets try pwd again pwd again shows us slash as the current directory because they

changed into that now if of course, we use the name of the directory and this gives the date which is last modified. Let me now go back to our home directory which always take me to the home directory. So, pwd here shows home slash dg again.

Let us try some ls minus l command here the ls minus command here shows that within the directory slash home slash dg. There is a directory called desktop because there is d here and there is a file called phd dot txt this gives the date at which this file was last modified and this gives the number of character present in the file we can see what this file contain by using the cat command. So, again for the cat command I have to give a argument to the command the path to the file and since the file phd dot txt happens to be in the current directory we can directly use the relative path with would be simply phd dot txt.

(Refer Slide Time: 26:46)

And this is what are the content of the file phd dot txt ok. Lets now use a text editor to create a new text file and see how we can change the content of an existing text file or creating a new text file. So, 1 of the text editors programs available in the linux is called vi editor and as on option to this as an argument to this command I have to give the file name that I want to create. So, let me name the new file we are going to create as try dot txt. So, the command is here I get blank try dot txt and this is the text editor window knock and I can type here.

So, for example, I have typed this in a new text file that we are creating. If I now want the next word to appear on the next line all that we have to do is press enter and as you can see this blinking cursor has come to the next line whatever I type here will now go on the next line. If I want edit something if I have made a mistake in what I just typed I can of course, use the back space key to erase what I have just done and if I want to change something in text written long time back I. For example, if I want to change this a with the then what I can do is take the pointer here click here. Just after the a the cursor has now come here now press backspace and start typing the new text that I want to enter.

We can also do more interesting thing for example, we can create we can tag regions of the text and to meet them and mark for example, if you want to delete the word text here of course, I could take the cursor here and press backspace four times to delete the entire word. But I could also select these entire word and to select these I have to first bring the cursor just before this word and then to select this word. I will do is press the left mouse button keep it press and drag it to little bit towards right till the entire word is selected or whatever text I want to select has been highlighted.

Now, once the word text file has been highlighted I can press backspace. So, the entire two words will go away and I can replace it with something else. For example, letter or they could do more interesting thing such as if I want to make it copy of this sentence I can select this entire sentence like these and then use the copy command there is a short cut to the copy command on this menu this lecture is like on for copying. So, when I say copy the selected text is copied it does not appear anywhere in the screen, but if I now paste it now whatever has been copied will appear wherever the cursor happens to be. So, this is the icon for the paste if I press it this is what I get.
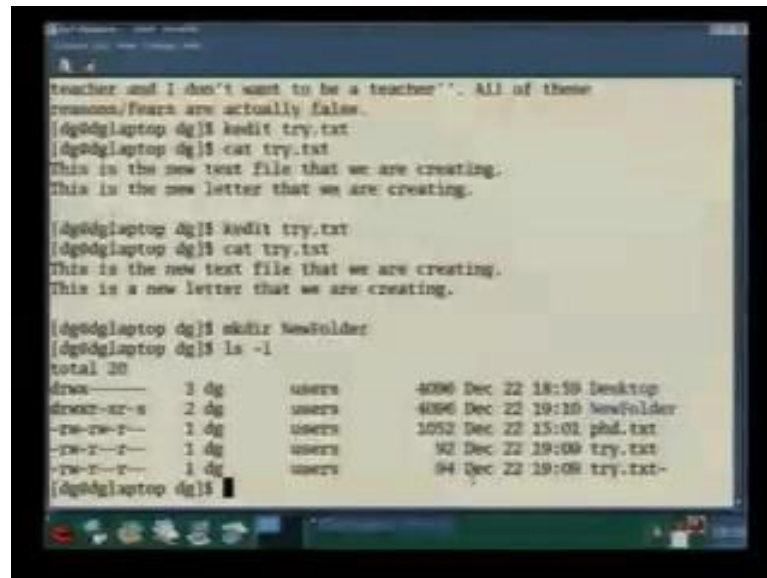
Let me now change this little bit again suppose you want to interchange the order of these two line what we need to do well let me first select this and then instead of copying this entire line I will cut this entire line using this scissor like picture over here. So, I cut this. So, this disappears and it has also been copied in some internal place now if I bring my cursor here I can also use the arrow keys to move the cursor around as we just saw. So, I create blank line here and if I paste now then the original selection that we have cut appears over here.

Now, we would after typically creating contents of file once you certified with the contents you typically want to save the file what saving means is that. So, far what we have been doing in the size of window has not actually been written to the file on the system. So, we wanted to be actually written to the file on the system we have to first save the content of a editor window to the file and to save the file all you need to do is to click this small copy disc like image and this file has been written you can see here wrote try dot text.

Now, you can close this editor window and try to see what contents has been written in this file. So, using the old commands cat you can see the contents of the file this is this is the new text file that we are creating this is the new letter we are creating this is precisely what we have entered in the the text file. You can see using this editor program we can create whatever text document that you want to create and in particular we will see that is the program is also a text document and we will use the same program to to actually write new programs that we develop for ourselves.

Let also now try to add it an existing file again. So, let us added this file try dot txt once again and as you can see the whole sentences has come back I can now change whatever I like to make whatever changes I like to make here it close this window and the changes have taken effect ok. Another thing you would like to do is to organize our files that we create into folder and therefore, we need to able to create new folder and the command to do that is mkdir. So, I can create new folder within this current directory itself. So, using this command mkdir I want to create a new folder whose name will be new folder.

And now if I look at the directory content you can see that the new folder has been created I can now change directory into this folder. And if I want I can create some files ls shows nothing here because there are no no files in this folder yet at in use the editor command has before to create some files here. We can also make more copies of an existing file and to do that we have to use the cp command cp stands for copy. And this time you have to give two arguments the first argument is the part of the file. So, the existing file which we want to copy somewhere else.

So, let us copy the try dot txt file that we just created and then since it is in the parent directory of the current directory we remember that the current directory is slash home slash dg slash new folder where as the file that we created was slash home slash dg. So, the relative path of this file would be dot dot slash try dot txt and the second argument is where we want to copy this.
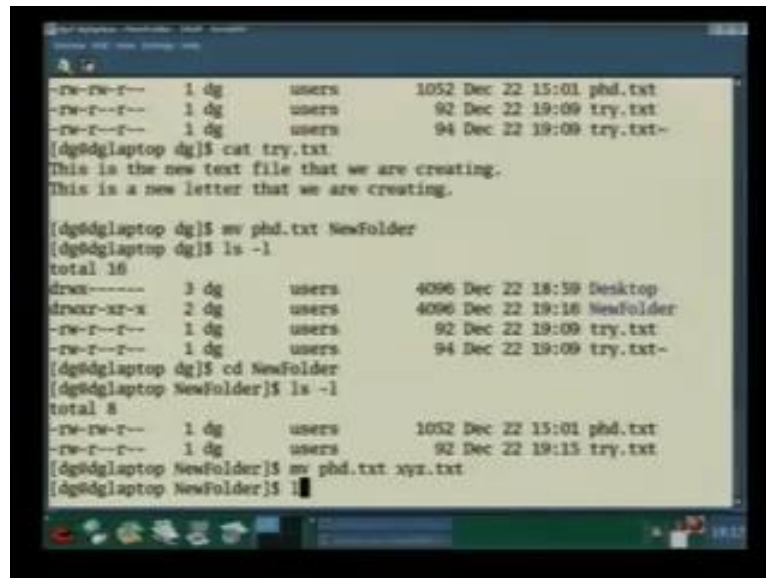
(Refer Slide Time: 34:44)

So, we want to copy this is in the current directory and to refer to that we can just use dot as I said earlier and this copies this file to the current directory lets have a look using the ls minus l command. So, you can see in the directory new folder there is a file try dot txt and the content are the same as what were in the original try dot txt and in the parent directory which is my home directory also there is a file try dot txt with the same content.

We can also move files to from 1 place to another for example, if we want to move the file php dot txt to the new folder that we just created we use a proper similar to what we use or copying files. But this time you see mv command stands for move you can use it to move the file to another directory and we can also use it to assign a different name to an existing file. So, suppose we move it to the new folder as you can see the file is no longer in this folder and if we go to new folder the file has appeared here.

We can also use the move command to actually change the name of the file. So, if I use this command the name of the file is changed to xyz dot txt. Here is the summary of the unix commands we have seen today passwd command is used to change the passwd the ls command is used to list the files in a directory. The cd command is used to change the current directory the pwd command is use to print the current directory or the working directory. The cat command is used to display the contents of the file the kedit command is used to create or edit contents of a file. The cp command is used to copy a file and the mv command is used to move a file.

So, in today's lecture we have familiarize ourselves about using a computer the notions of files and directories how to create files and directories to edit files and so on and so forth. And an exercise for today please try out the things that we have seen today in the lecture in your lab or at home using your own computer. So, the next time onwards, we will actually start writing some programs.