in this lecture we will be studying about virtual machines and we will be seeing what virtual machines are and what is the idea behind the concept of virtual machines so it says that the fundamental idea behind a virtual machine is to abstract the hardware of a single computer like the CPU memory disk drives network interface cards and so forth into several different execution environments thereby creating the illusion that each separate execution environment is running its own private computer alright so here we have a long definition now let us try to break this definition down and try to understand what this virtual machines actually means so here it says the fundamental idea is to abstract the hardware of a single computer so we have a single computer on which it has its Hardware resources like the CPU the memory the disk drives the network interface cards and so on so we are going to abstract the hardware of this single computer into several different execution environments and hence what happens we create the illusion that each separate execution environment is running its own private computer so we take the Hardware of a single computer and we give it to several different execution environments and we create an illusion to that execution environment that they are running their own private computer so that is what we mean by virtual machines so the term virtual what does it mean it means that it is not physically real but we try to make it look like it is something physically real so these days you must have come across virtual reality which is a very popular and common topic that is going on will you even have your virtual reality headsets in which what happens when you wear this virtual reality headsets and when you watch some video you feel like you are physically in that video or you feel like it is physically happening around you but in real it is not actually physically

happening but you are getting an illusion that it is physically happening so in the same way in case of operating systems this virtual machines also does something like that what it does is that it creates the illusion that each separate execution environment is running its own private computer while in reality it is not in reality we are just on one computer having just the resources and hardware of that particular computer but we are creating an environment or an illusion that these different execution environments are running their own separate computers all right now let's take a diagram to understand this in a more detailed way so here I have the diagram of two system models one is a non virtual machine which is this one diagram number a and another one is a virtual machine which is diagram number B so here in a non virtual machine this is a normal system that we have the normal system model where we have the hardware on top of which we have the kernel and then we have the processes which is doing its own task now in case of a virtual machine which is this one what we have is we have the hardware over here the base hardware which belongs to the physical machine and then on top of that we have a virtual machine implementation which allows us to have virtual machines of this form so on top of this virtual machine implementation we have implemented three virtual machines virtual machine one virtual machine two and virtual machine 3 and for these individual virtual machines they have their own kernel or they have their own separate operating system installed on top of this virtual machines and they are running their own processes so virtual machine one has this kernel version version two has this kernel and virtual machine 3 has this kernel and these kernels belongs to these separate virtual machines and they are not the same so this is how a virtual machine implementation looks like so we see that

in reality we are just having one physical Hardware but on top of that by having this virtual machine implementation we are able to have three different kind of execution environments for this particular example that we have taken here so let's say that you are having your hardware here in your physical system and on your system you are having Windows operating system installed let's say that you are having your main Windows operating system installed then using this virtual machine implementation or using the virtual machine software you have created three virtual machines virtual machine 1 2 & 3 & our virtual machine 1 let's say that you have installed Linux Mint operating system and on virtual machine 2 you have installed another distribution of Ubuntu operating system and in virtual machine 3 also you have installed let's say fedora or some other Ubuntu distribution operating system so we see that at the base we are having this Hardware on which we have the Windows operating system and by the help of this virtual machines you have installed 3 operating systems on your computer now for a particular operating system let's say that here you are having Linux Mint for this lensman it looks like or it feels like it is running its own private computer so it doesn't have to know that it is a virtual machine or what it is it just feels like it is running its own private computer and so is the same for the other two operating system that you have installed over here so we are creating an illusion that each separate execution environment is running its own private computer so that is the main fundamental idea behind a virtual machine implementation now let's take a deeper look at the implementation of the virtual machine system now we know that there are two modes of operation that we have already studied about before which is a user mode and kernel mode now we need to find out how does a virtual

machine actually run so does it run in user mode or the kernel mode so first of all the virtual machines software that runs in kernel mode the virtual machine software which allows the implementation of virtual machine that is the base operating system that you have so that one
it runs in kernel mode but the virtual machine itself it runs in the user mode the virtual machine itself means these virtual machines that we have over here they run in DES
user mode and when I talk about kernel mode and user mode over here I'm talking about the real or the physical kernel mode and user mode that we have in this system all right so the virtual machine software which is the operating system itself on which you are installing these virtual machines that runs in kernel mode but the virtual machine itself that means these virtual machines VM one VM to VM three they run in the user mode of the physical system now the question is that here we have this virtual machine with its own kernel and processes and we have already said that virtual machine runs in such a way that that execution environment is operating its own private computer so if this is in the illusion that it is operating its own private computer it also needs to have a user mode and kernel mode for its operation now how does that work I already said that the virtual machine itself runs in the physical user mode of the main system but if this itself is one complete system that we are talking about that also needs to have its own user mode and kernel mode now how does that work
so just as the physical machine has two modes however so much the virtual machine the virtual machine must also have its own user mode and kernel mode so consequently we must have a virtual user mode and a virtual kernel mode so the virtual machine also will have its own user mode and kernel mode which we call the virtual user mode and the

virtual kernel mode and both of which runs in a physical user mode so this is very important because I already told you that the virtual machine itself it runs in the user mode the virtual machine itself is running in the main physical user mode of the system now inside this we are having the virtual user mode and virtual kernel mode but keep in mind that the virtual machine itself is running in the physical user mode so this virtual user mode and virtual kernel mode that we had inside this runs in the physical user mode so that is
how the virtual machine is implemented now this virtual machine has many benefits like protection of resources as we don't have to share the resources with each other so all the resources of one virtual machine is completely isolated from the other virtual machines so you may be thinking here we are having only one Hardware so if they are not shared then how will they be used so the answer to this is that for each virtual machine there will be a particular area of the disk that will be assigned to that particular virtual machine so we call it a mini disk so a mini disk is created from the entire disk that we have and each disk will be assigned to the particular virtual machines that we have and then they are assigned to those particular virtual machines and they are isolated from each other
so that is how the base Hardware is shared between the virtual machines but the resources that each virtual machine uses are completely protected or completely isolated from each other so those are some of the benefits of using virtual machines now if you want to try this you can also try it in your system for example you can download software's like VMware or VirtualBox which allows you to install the virtual machine in your system and on that VirtualBox or VMware that you download you can install different kind of operating systems and

you can check it out so let's say that for example you are having Windows operating system installed in your system and after installing that VirtualBox or VMware or whatever virtual machine software that you are using you can install another operating system using that software let's say Linux Mint so you maybe will be able to install that on top of the VirtualBox that you have installed so you will be able to use your Windows and you can also on your VirtualBox and switch to the next operating system which you have installed so that is something you can try out and if you want to see the demonstration of how it is done leave a link in the comment section I'll be showing it to you in another video if there are enough requests all right so I hope that was clear to you that was about virtual machines the fundamental idea behind virtual machines and its implementation so I hope this lecture was clear to you
thank you for watching and see you in the next one
[Applause]
[Music]