

Assignment No:2

Problem Definition: Implementation of Virtualization in Cloud Computing to Learn Virtualization Basics, Benefits of Virtualization in Cloud using Open Source Operating System.

Objectives: 1. To learn Virtualization basics.
2. To implement basic OS Virtualization using VMWare.

Software Requirements: Ubuntu 18.04, VmWare station

Hardware Requirements: Pentium IV system with latest configuration

Theory:

A] What is Virtualization in Cloud Computing?

Virtualization is the "creation of a virtual (rather than actual) version of something, such as a server, a desktop, a storage device, an operating system or network resources". In other words, Virtualization is a technique, which allows sharing a single physical instance of a resource or an application among multiple customers and organizations. It does by assigning a logical name to a physical storage and providing a pointer to that physical resource when demanded.

B] Types of Virtualization:

1. Hardware Virtualization.

When the virtual machine software or virtual machine manager (VMM) is directly installed on the hardware system is known as hardware virtualization. The main job of hypervisor is to control and monitoring the processor, memory and other hardware resources. After virtualization of hardware system we can install different operating system on it and run different applications on those OS.

Usage: Hardware virtualization is mainly done for the server platforms, because controlling virtual machines is much easier than controlling a physical server.

2. Operating system Virtualization.

When the virtual machine software or virtual machine manager (VMM) is installed on the Host operating system instead of directly on the hardware system is known as operating system virtualization.

Usage: Operating System Virtualization is mainly used for testing the applications on different platforms of OS.

3. Server Virtualization.

When the virtual machine software or virtual machine manager (VMM) is directly installed on the Server system is known as server virtualization.

Usage: Server virtualization is done because a single physical server can be divided into multiple servers on the demand basis and for balancing the load.

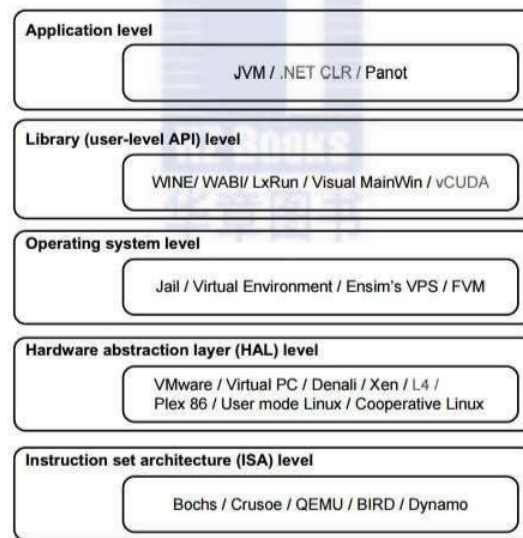
4. Storage Virtualization.

Storage virtualization is the process of grouping the physical storage from multiple network storage devices so that it looks like a single storage device. Storage virtualization is also

implemented by using software applications.

Usage: Storage virtualization is mainly done for back-up and recovery purposes.

C] Levels of Virtualization:



1. Instruction Set Architecture Level

At the ISA level, virtualization is performed by emulating a given ISA by the ISA of the host machine. For example, MIPS binary code can run on an x86-based host machine with the help of ISA emulation. With this approach, it is possible to run a large amount of legacy binary code written for various processors on any given new hardware host machine.

2. Hardware Abstraction Level

Hardware-level virtualization is performed right on top of the bare hardware. On the one hand, this approach generates a virtual hardware environment for a VM. On the other hand, the process manages the underlying hardware through virtualization. The idea is to virtualize a computer's resources, such as its processors, memory, and I/O devices. The intention is to upgrade the hardware utilization rate by multiple users concurrently.

3. Operating System Level

This refers to an abstraction layer between traditional OS and user applications. OS-level virtualization creates isolated containers on a single physical server and the OS instances to utilize the hardware and software in data centers. OS-level virtualization is commonly used in creating virtual hosting environments to allocate hardware resources among a large number of mutually distrusting users.

4. Library Support Level

Most applications use APIs exported by user-level libraries rather than using lengthy system calls by the OS. Since most systems provide well-documented APIs, such an interface becomes another candidate for virtualization. The software tool WINE has implemented this approach to support Windows applications on top of UNIX hosts. Another example is the vCUDA which allows applications executing within VMs to leverage GPU hardware acceleration.

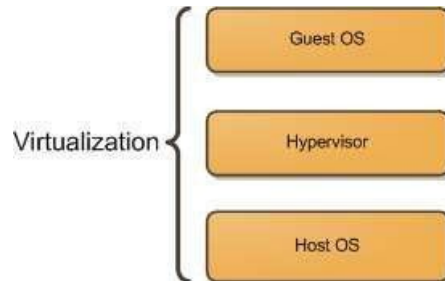
5. User-Application Level

Virtualization at the application level virtualizes an application as a VM. On a traditional OS, an application often runs as a process. Therefore, application-level virtualization is also

known as process-level virtualization. Any program written in the HLL and compiled for this VM will be able to run on it. The Microsoft .NET CLR and Java Virtual Machine (JVM) are two good examples of this class of VM.

D] Virtualization

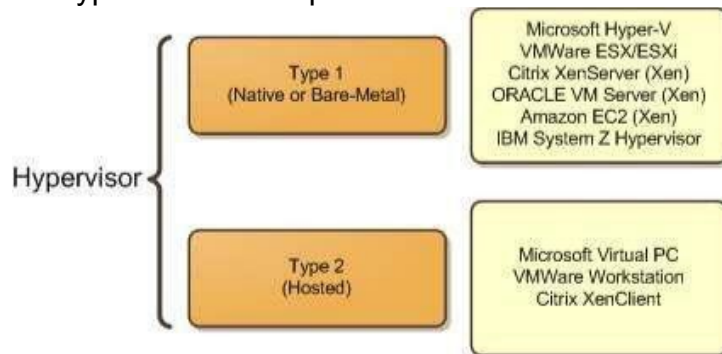
Virtualization is not a new concept, but its complexity has been growing, and a number of new paradigms are rising. Let's consider three very simple concepts regarding virtualization: the host operating system, the hypervisor, and the guest operating system.



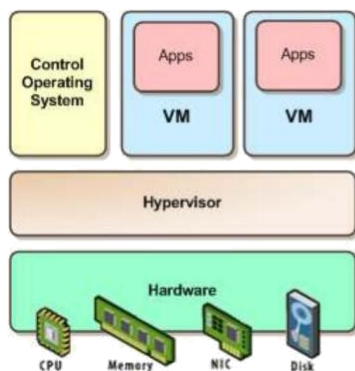
The host operating system provides a host to one or more virtual machines (or partitions) and shares physical resources with them. It's where the virtualization product or the partitioning product is installed. The guest operating system is the operating system installed inside a virtual machine (or a partition). In a virtualization solution the guest OS can be completely different from the host OS. In a partitioning solution the guest OS must be identical to the host OS.

A hypervisor, also called a virtual machine manager (VMM), is a program that allows multiple operating systems to share a single hardware host. Each operating system appears to have the host's processor, memory, and other resources all to itself. The task of this hypervisor is to handle resource and memory allocation for the virtual machines, ensuring they cannot disrupt each other, in addition to providing interfaces for higher level administration and monitoring tools.

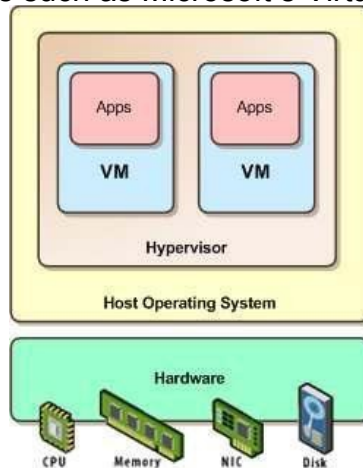
There are two types of hypervisors as depicted below:



Type 1 hypervisors, also known as baremetal, are software systems that run directly on the host's hardware as a hardware control and guest operating system monitor. Baremetal virtualization is the current enterprise data center leader. VMware ESX is easily the market leader in enterprise virtualization at the moment, and it utilizes bare metal virtualization architecture. What is immediately apparent about this architecture, is the lack of an existing OS; the hypervisor sits directly on top of the hardware, hence the term "baremetal virtualization". The reason so many data centers implement baremetal products, such as ESX, Xen, and HyperV, is because of the speed it provides due to the decreased overhead from the OS that hosted virtualization uses.

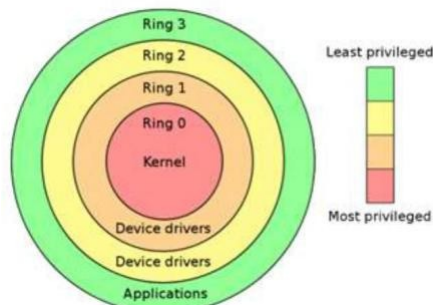


Type 2 hypervisors, also known as hosted, are software applications running within a conventional operating system environment. This type of hypervisor is typically used in client side virtualization solutions such as Microsoft's Virtual PC, and VMWare.



The Protection Rings

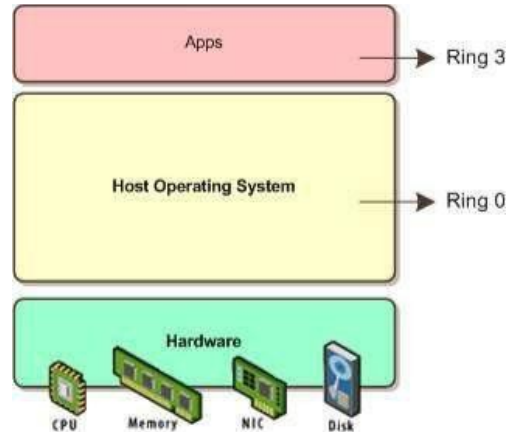
Another important concept is the protection rings. x86 CPUs provide a range of protection levels, also known as rings, in which code can execute. Ring 0 has the highest level privilege and is where the operating system kernel normally runs. Code executing in Ring 0 is said to be running in system space, kernel mode or supervisor mode. All other code, such as applications running on the operating system, operate in less privileged rings, typically Ring 3.



The hypervisor runs directly on the hardware of the host system in ring 0. Clearly, with the hypervisor occupying ring 0 of the CPU, the kernels for any guest operating systems running on the system must run in less privileged CPU rings. Unfortunately, most operating system kernels are written explicitly to run in ring 0, for the simple reason that they need to perform tasks that are only

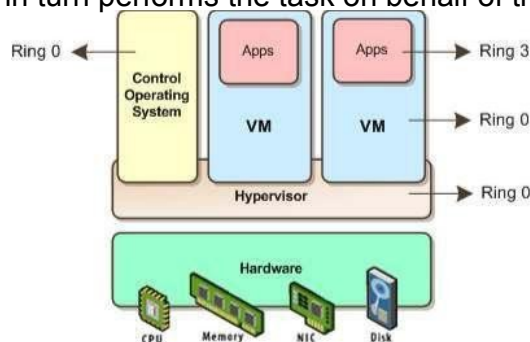
available in that ring, such as the ability to execute privileged CPU instructions and directly manipulate memory.

The AMDV and IntelVT CPUs use a new privilege level called Ring 1 for the VMM to reside, allowing for better performance as the VMM no longer needs to fool the Guest OS that it is running in Ring 0. This is not a virtualization scenario; it's here solely for comparison purposes. Here we see that the OS sits directly above the hardware executing in the ring 0.



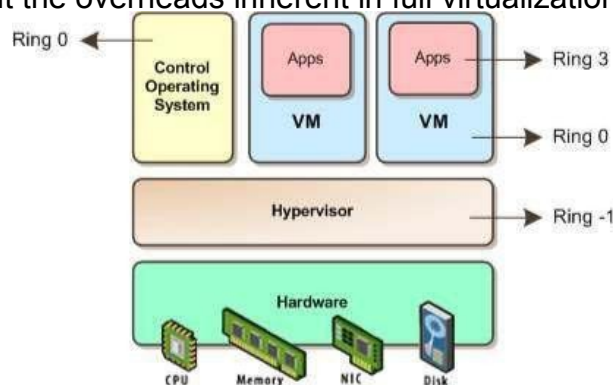
Paravirtualization

Under paravirtualization, the kernel of the guest operating system is modified specifically to run on the hypervisor. This typically involves replacing any privileged operations that will only run in ring 0 of the CPU with calls to the hypervisor (known as hypercalls). The hypervisor in turn performs the task on behalf of the guest kernel.



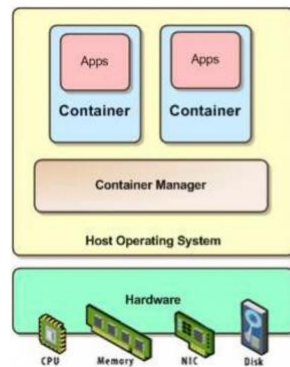
Full Virtualization with Hardware Assist

Hardware virtualization leverages virtualization features built into the latest generations of CPUs from both Intel and AMD. These technologies, known as Intel VT and AMDV, respectively, provide extensions necessary to run unmodified guest virtual machines without the overheads inherent in full virtualization CPU emulation.



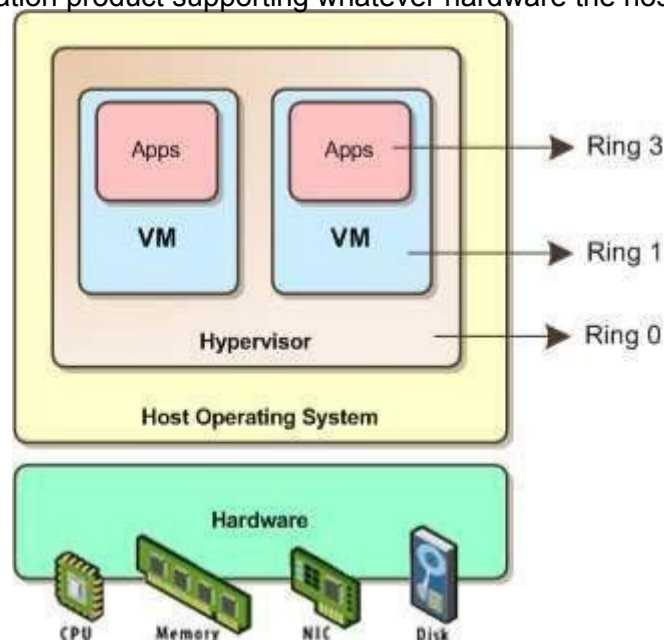
OS virtualization

Compared with hypervisor based virtualization, container based virtualization offers a completely different approach to virtualization. Instead of virtualizing with a system in which there is a complete operating system installation, container based virtualization isolates containers work from within a single OS. The most well-known products that use OS virtualization are Parallels Virtuozzo and Solaris Containers. This virtualization architecture has many benefits, speedy performance being the foremost. Another benefit is reduced disk space requirements. Many containers can use the same files, resulting in lowered disk space requirements.



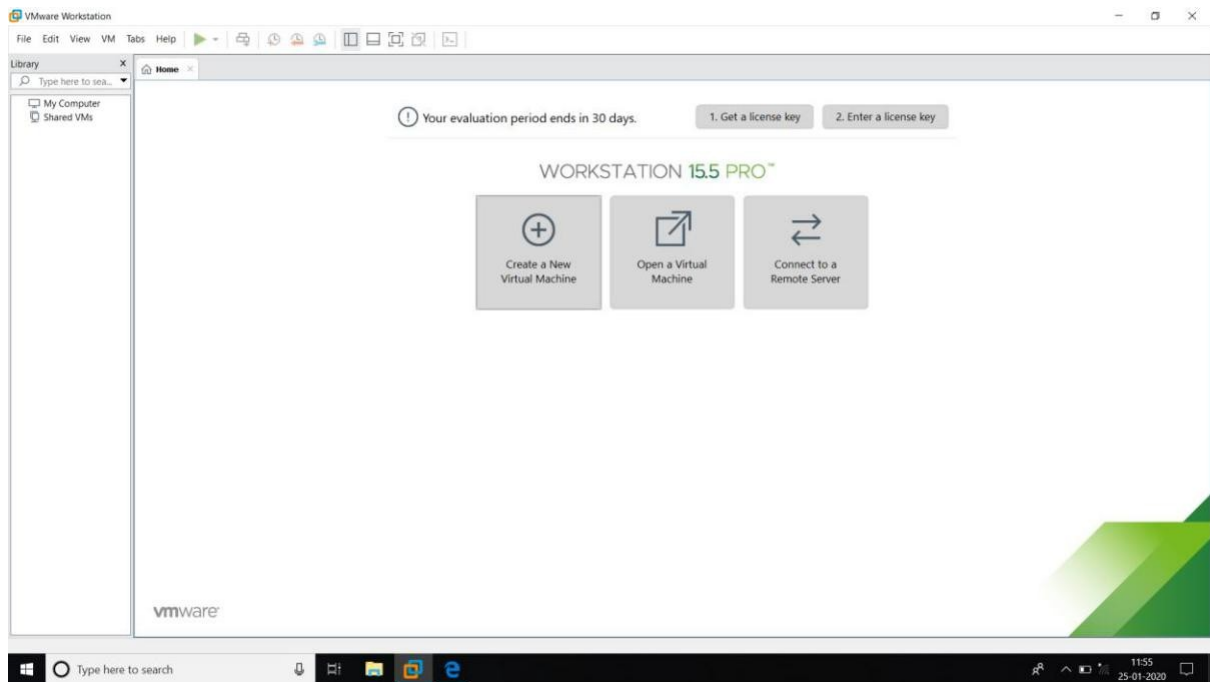
Hosted virtualization

This is the type of virtualization with which most users are familiar with. All of the desktop virtualization products, such as VMware Workstation, VMware Fusion, and Parallels Desktop for the Mac, and Microsoft Virtual PC implement hosted virtualization architecture. There are many benefits to this type of virtualization. Users can install a virtualization product onto their desktop just as any other application, and continue to use their desktop OS. Hosted virtualization products also take advantage of the host OS's device drivers, resulting in the virtualization product supporting whatever hardware the host does.

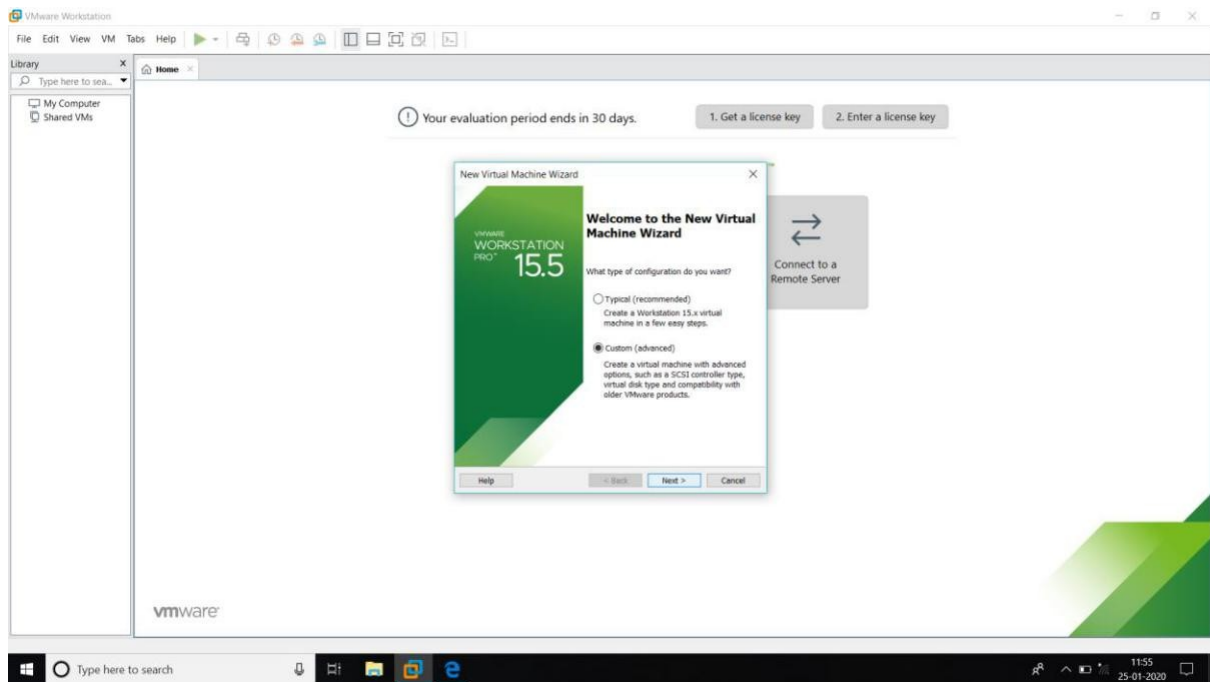


Conclusion: We learnt Virtualization and implementation using different applications and tools called as hypervisors, basic OS virtualization using Vmware.

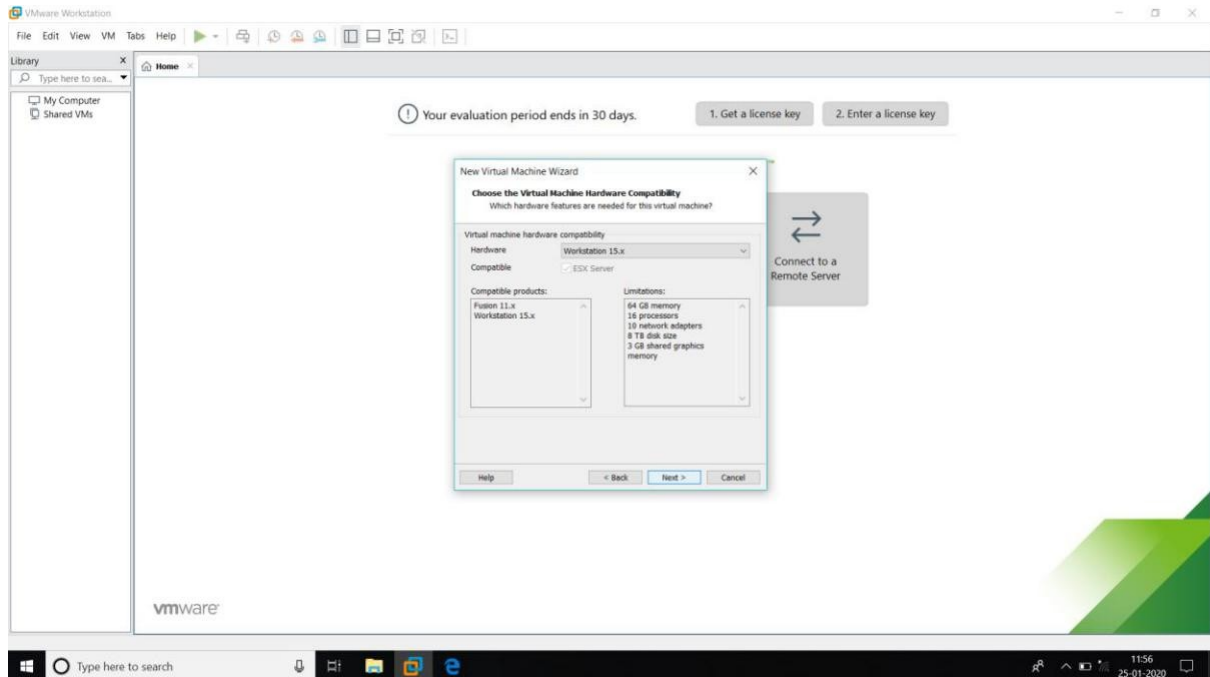
1) Click on create new virtual machine.



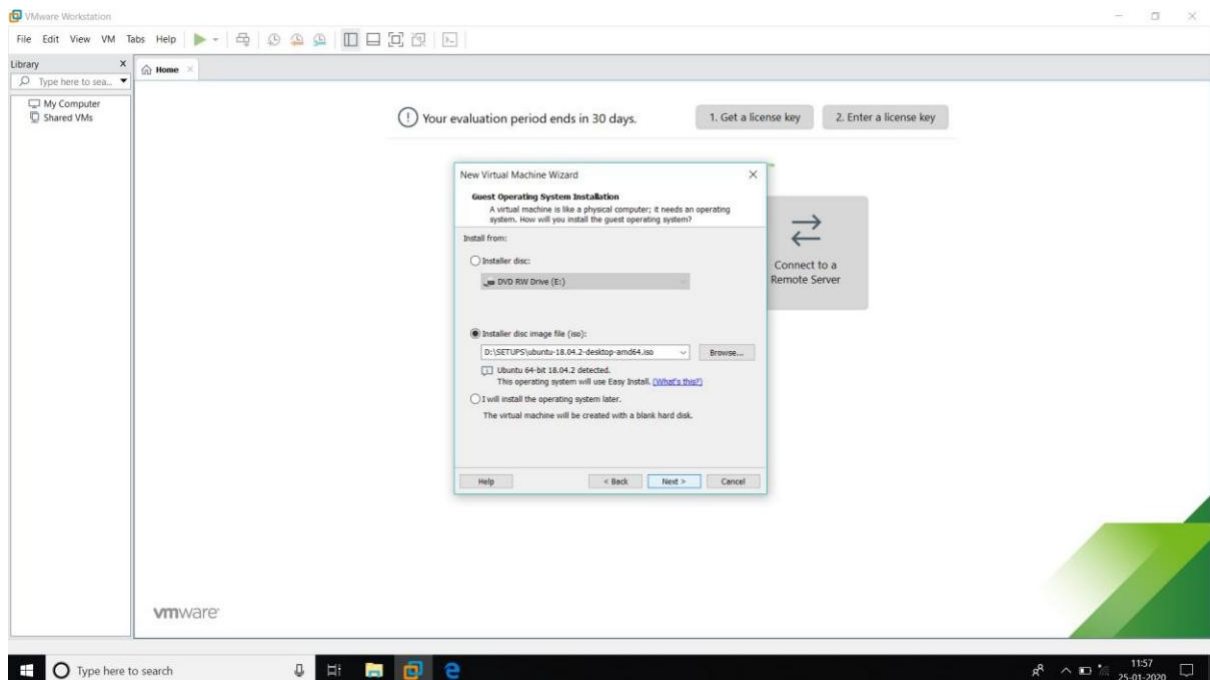
2) In welcome window, choose custom option and click next button.

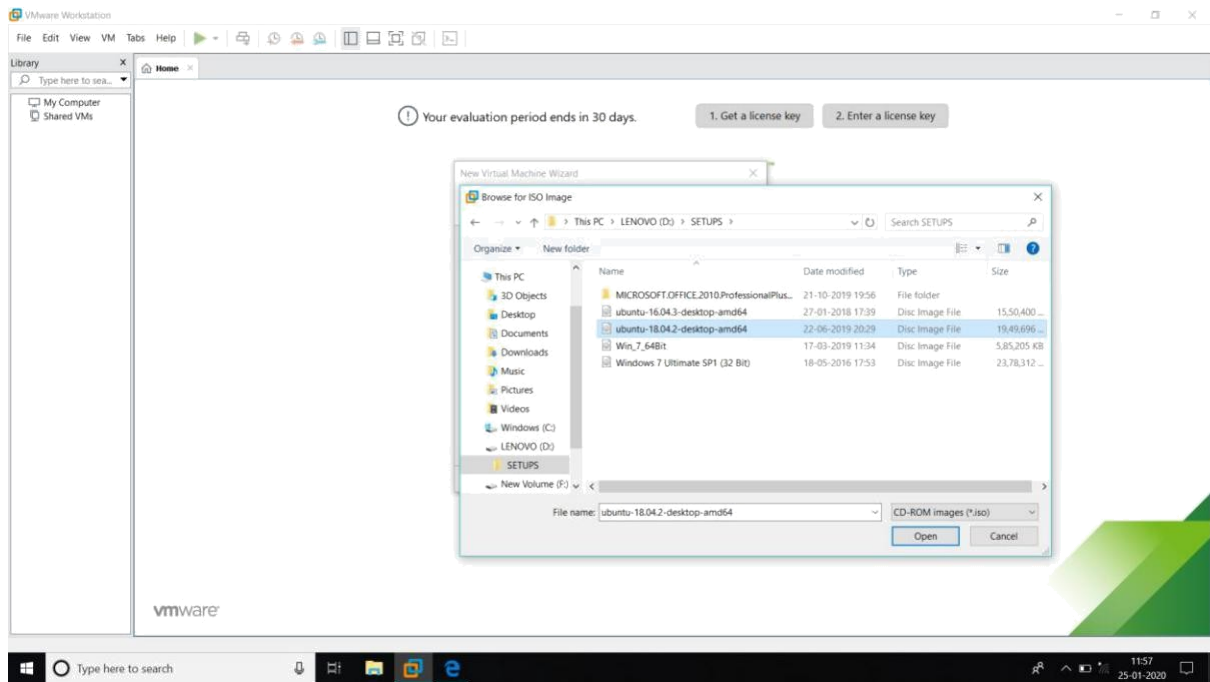


3) In choose the virtual machine hardware compatibility window, click on the next button.

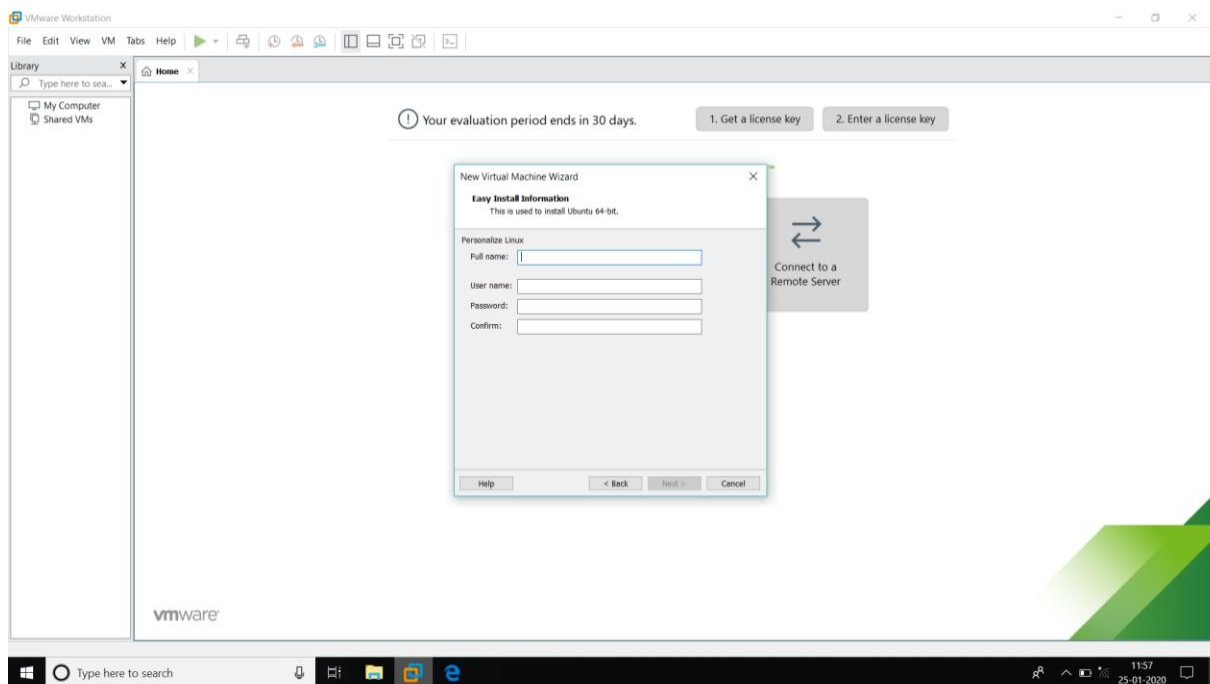


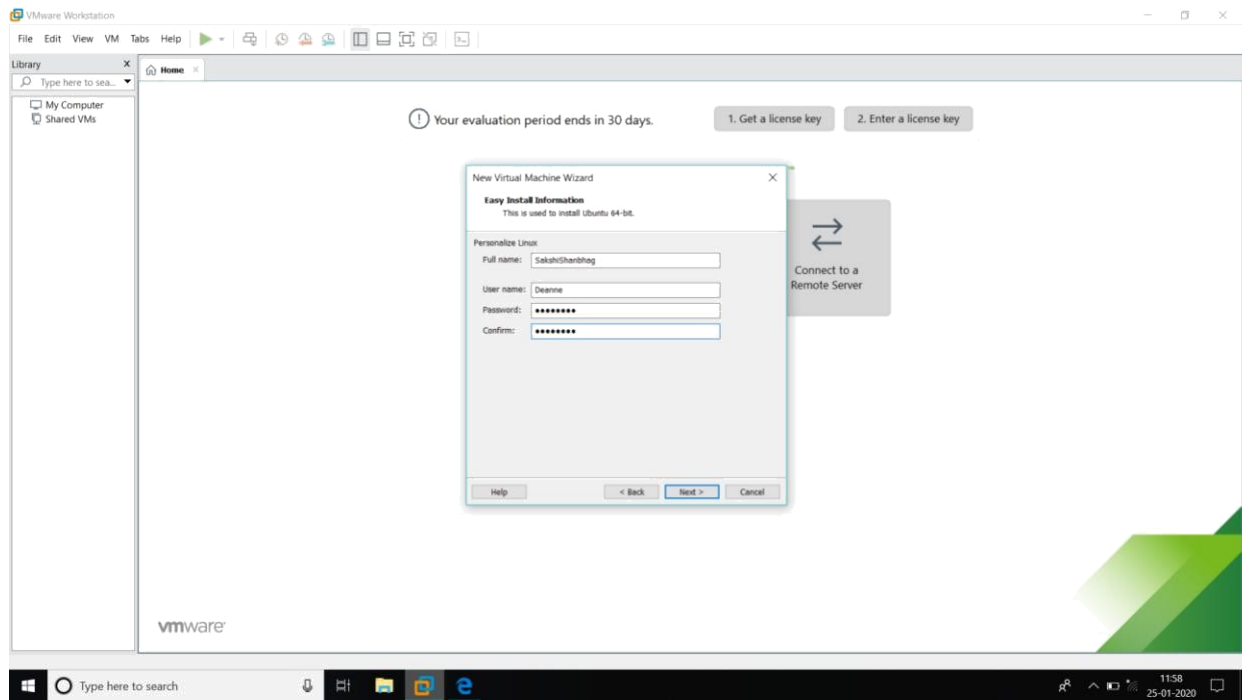
4) In the Guest operating system window, choose installer disc image file(iso) option and iso image file from the disk or any drive. I have put the iso file of ubuntu in D: drive. So browse your iso image and click on next button.



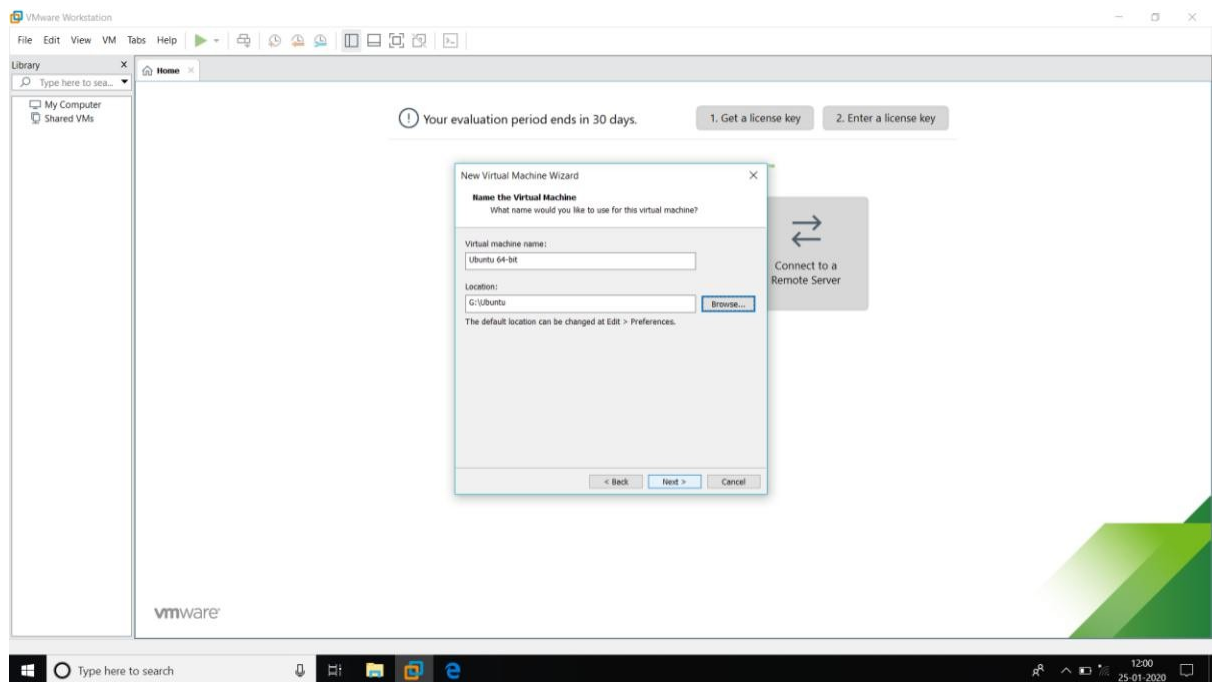


5) In the easy install information window, provide full name, username, password and confirm password then click on next button.

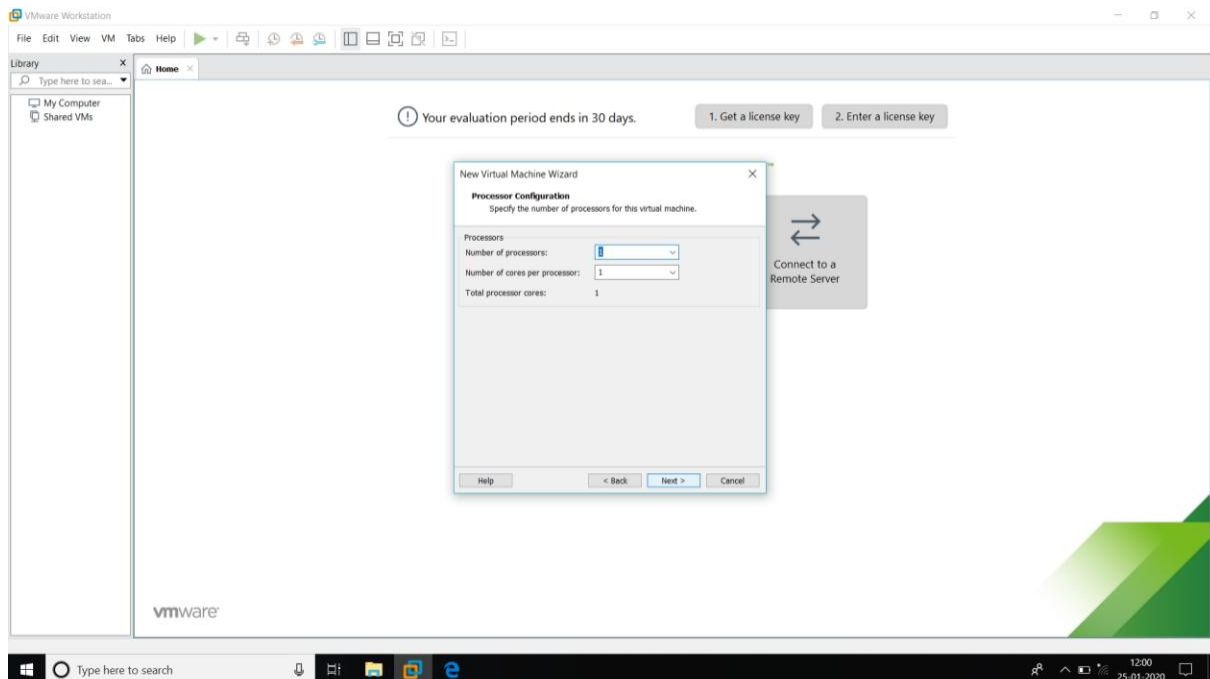




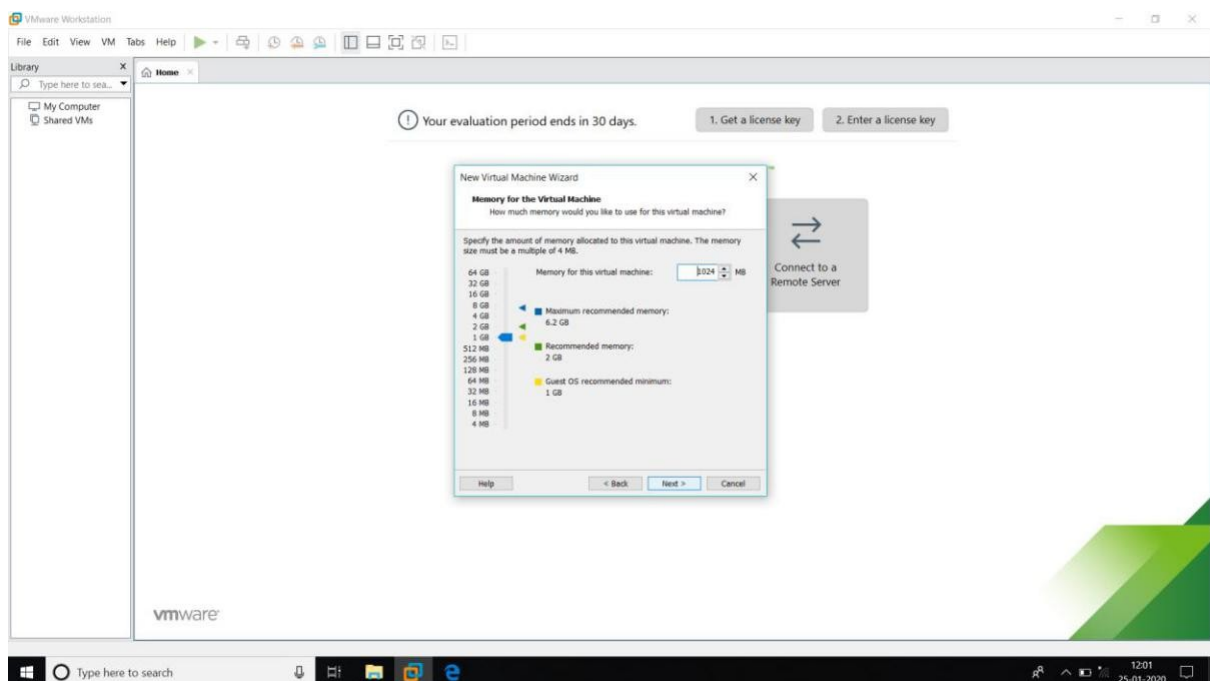
6) Set the path for Virtual Machine.



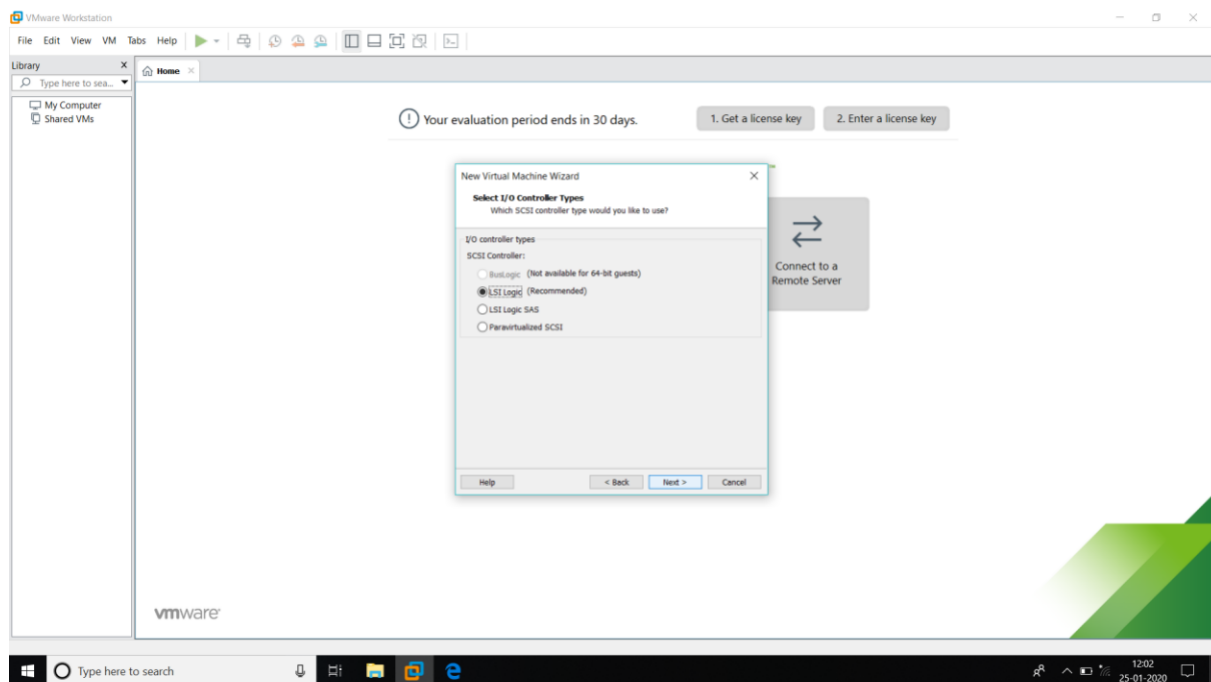
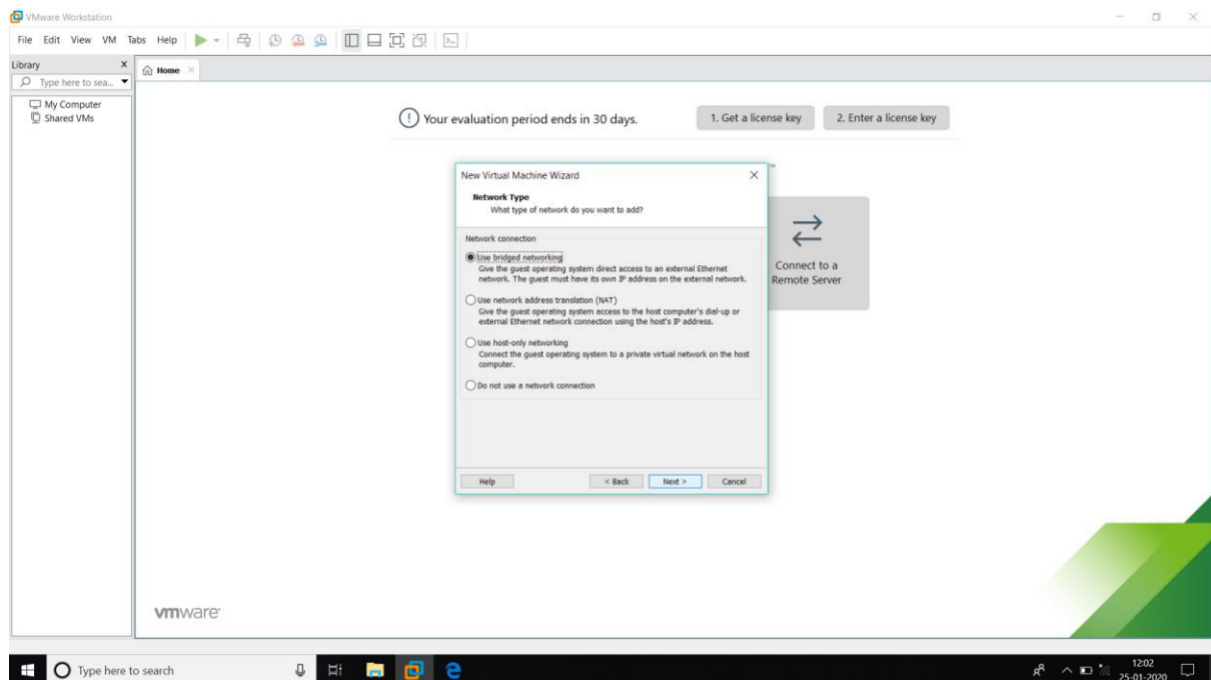
- 7) In the processor configuration information, you can select number of processors, number of processor per core. If you don't want to change the default settings, click on next only.



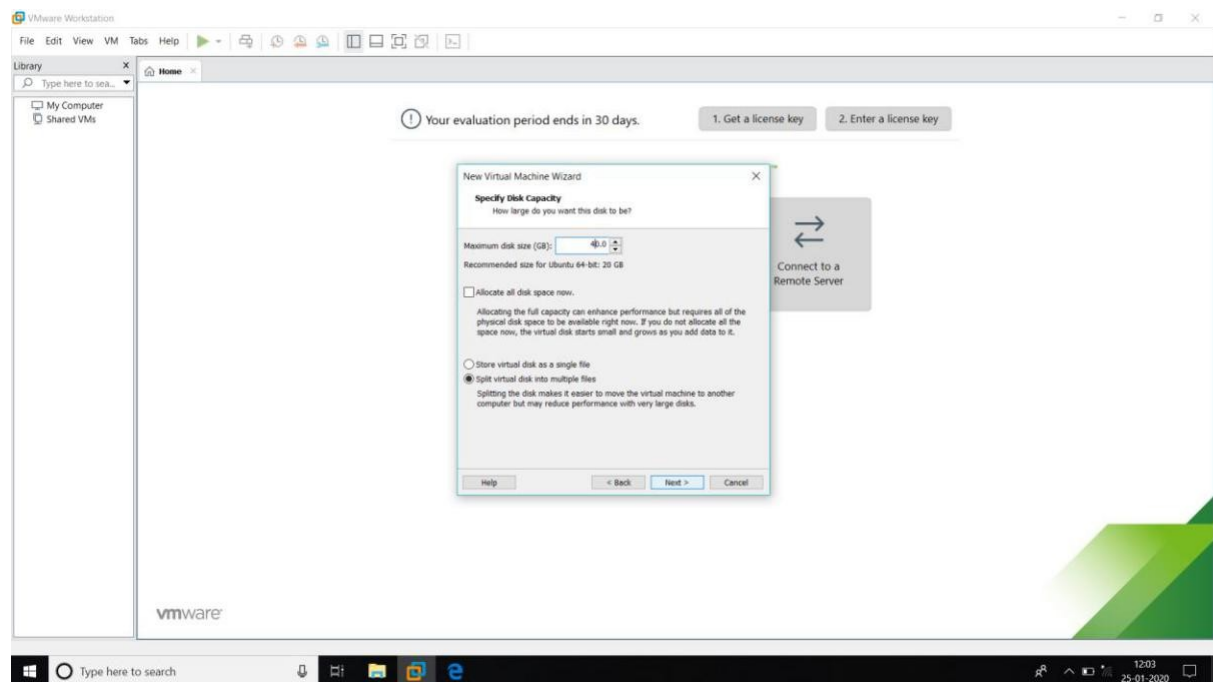
- 8) In the memory of the virtual machine window, you can set the memory limit. Click on the next button.



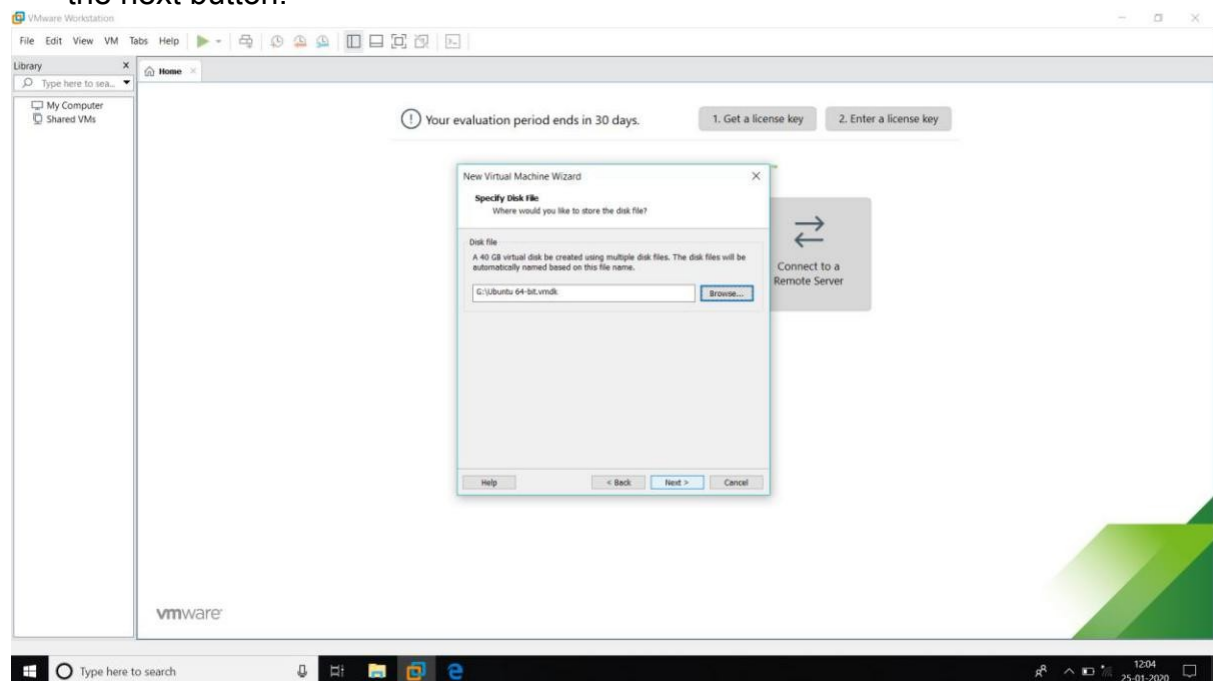
9) Make Necessary Configurations



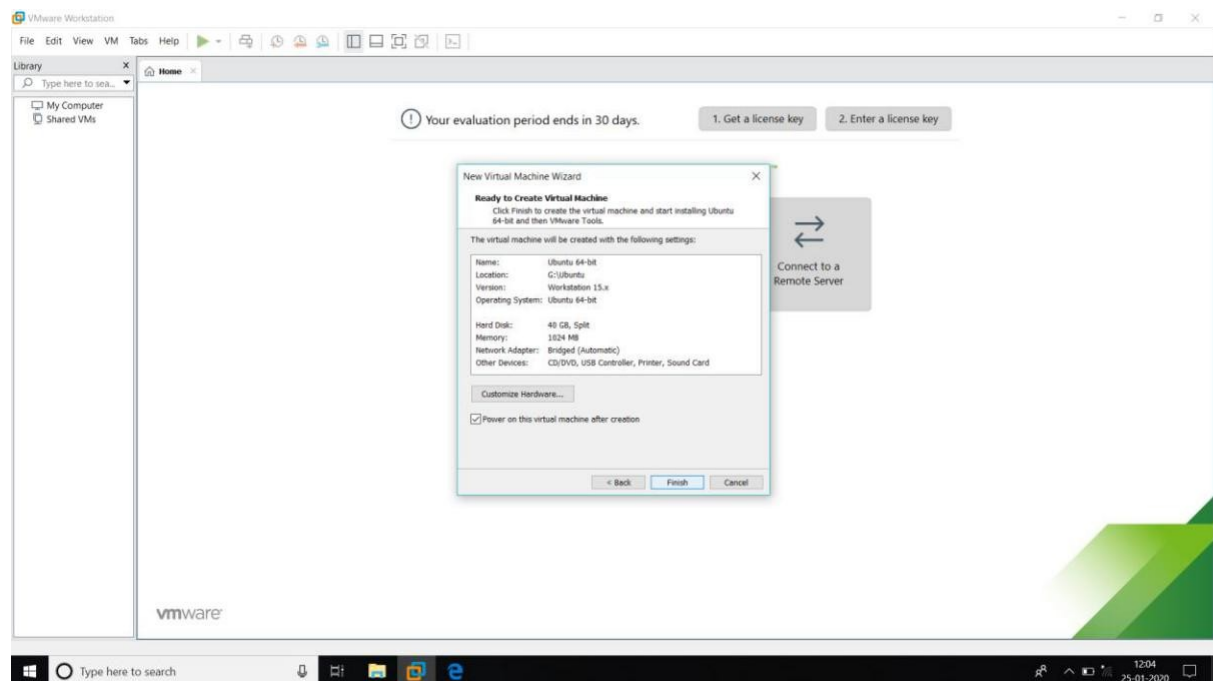
10) In the specify disk capacity window, you can set the disk size. Click on the next button.



11) In the specify disk file window, you can specify the disk file then click on the next button.



12) In the ready to create virtual machine window, click on the finish button.



13) Now you will see vmware screen then ubuntu screen.

