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BAHIR DAR INSTITUTE OF TECHNOLOGY
FACULTY OF COMPUTING
DEPARTMENT OF SOFTWARE ENGINEERING**

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History of Fedora OS

The history of Fedora OS goes back to the beginnings of the 2000s when one of the leading enterprises in Linux, Red Hat Inc, strategically decided to split its Linux offering into two branches, proprietary and community supported derivatives. A commercial version known as Red Hat Enterprise Linux (RHEL) for businesses was released alongside a community version that was called Fedora. Previously Red Hat, Inc used to provide a single distribution, Red Hat which was subsequently renamed as Red Hat Linux, owing to its burgeoning popularity-s-tered owing to its unmatched support and reliability CSV, trendset in IT industry, and multitude reasons. But c early 2003, Red Hat Inc was confronted by challenges of offering enterprise support alongside rapid development and innovation.

In November 2003, Fedora was introduced as a part of the Red Hat Community with the release of its first version called Yarrow and subsequently prefixed with core 1. The term 'Core' denotes controlled by Red Hat engineers subset Core packages, which until then were maintained by Red Hat extras separately managed by the community also corresponding contributions community managed. This was the model until fedora 7, released in May 2007. Moonshine consolidated extras and core repository into single unit system, eliminated core designation; metamorphosed MP pioneered C and escalated community driven development.

Fedora always planned to be a bleeding edge distribution highlighting the most recent innovations in open-source software. It acted as a testbed for functionalities that were to be incorporated later into RHEL. Innovations like SELinux (Security-Enhanced Linux), System (which replaced the traditional init system), and even Wayland (a new Display Server Protocol) were all implemented and tried out in Fedora long before other distributions adopted them.

Fedora has grown its scope way beyond a simple desktop operating system over the years. It created multiple editions to meet the requirements of different users:

Fedora Workstation – A desktop OS tailored to developers and general users.

Fedora Server – A system tailored as a server and data center powerhouse.

Fedora Silverblue – An optimized version of an immutable desktop for containers.

Fedora IoT - A minimal and more secure version for Internet of Things devices.

As with other distros, Fedora is run by maintainers and governed by the community of users and developers known as the Fedora Project, with Red Hat functioning as the main sponsor. According to the project, decisions are made in a fully open and democratic manner, guided by their foundational philosophies: 'Freedom', 'Friends', 'Features', and 'First' which encapsulates the ethos of collaboration and innovation within the open source domain.

Fedora became known for integrating the newest releases of GNOME, supporting new hardware and advanced file systems like Btrfs alongside secure boot technologies. Its predictable releases every six months have driven many other distributions, solidifying its place as one of the most respected and cutting edge Linux platforms.

Introduction

Fedora OS, as the Fedora Project develops it and Red Hat sponsors it, distributes cutting-edge Linux so as to provide a community-driven, open-source OS. It serves in the role of the upstream source when it comes to Red Hat Enterprise Linux integrating revolutionary technologies that maintain both stability and also reliability. Fedora has been positioned as just a testing ground for all new features. Enterprise-grade systems incorporate these items after. Fedora is known because of its rapid release cycle that delivers new versions approximately each six months, ensuring users have access to features, advancements in Linux ecosystem.

Fedora OS dedicates itself to innovation, collaborates together, and stays flexible in accordance with its motivation. Developers as well as users actively contribute to its evolution, encouraging an energetic community. Fedora is suitable with desktop systems, servers, IoT devices, and for containerized applications. It serves several diverse use cases. Its emphasis that is on security, as well as on performance, and also on user experience endears it to Linux enthusiasts, and system administrators, including developers. Furthermore, Fedora installation lets users explore Linux systems so they can improve command-line skills, and also deepen system-level operations and development understanding.

Objective

- To deliver a solid, reliable and secure operating system that demonstrates the current state of the art of Linux technology

Fedora aims to be leading edge on features, and that is largely achieved by shipping the most recent stable features from the upstream project for that feature. This means they will adopt things like systemd, Wayland, PipeWire, and Btrfs long before other distributions. It is a testbed for new features in the Linux kernel, for example, to find hardware-related issues early; or to test out the latest GNOME release without putting other subsystems in unstable conditions.

While Fedora adopts the latest technology, the release also strives to remain well balanced in the cutting edge versus stable spectrum. The development and testing stages are divided into: Alpha, Beta and Final Release Candidate stages for the sake of letting contributors and testers to find bugs and fix them. The end product is, therefore, a system that not only demonstrates the latest amenities but at the same time performs reliably for both personal as well as professional use.

The security of users and their data is a primary concern. Advanced security tools and frameworks, such as SELinux (Security-Enhanced Linux) and firewalld, are included in Fedora. Automatic updates are performed regularly and applied willingly, which is fairly easy to do because Fedora has a policy of using secure defaults. Users are encouraged to follow best practices as outlined in the Fedora Security Guide.

- To foster a collaborative open-source community for ongoing development and upgrades. ·

Fedora is more than a distribution; it is a community. The Fedora Project operates an open development model. This means that everything we do and decide is done and decided in a transparent and collaborative manner. Anyone can contribute, whether it is with code, documentation, translations, artwork, or testing. This kind of inclusiveness makes Fedora a hotbed of innovation and a superproductive turning point for the kinds of diversity you find in open-source software.

The governance of the project is managed by the Fedora Council, the Engineering Steering Committee (FESCo), and the Mindshare Committee. All of these entities make decisions and hold meetings that are accessible to the public; this allows the community to have a direct hand in the governance of Fedora and to work more closely with all of its many contributors toward common objectives.

Fedora's development infrastructure comprises several vital channels that encourage and enable user feedback. Bugzilla, the Pagure platform (which is Git-based), and various mailing lists provide ample opportunities for contributors to maintain effective communication. Fedora's community engages in a plethora of activities that promote an active and lively atmosphere. These include hackathons, Fedora Test Days, and attending conferences like Flock.

- To provide flexibility to enable a variety of use case support like desktops, servers, IoT, containers, etc.

Fedora's modular architecture lets it serve all kinds of users and environments. It doesn't matter whether the user is a developer working on a laptop, a sysadmin managing a fleet of servers, or a company deploying cloud-native applications in containers; Fedora has an edition that caters precisely to their needs.

Each edition fine-tunes itself for its respective use case:

- ✓ Fedora Workstation polishes up a GNOME desktop, befriends quite a developer environment, and supports many programming languages and tools now.
- ✓ Fedora Server offers role-based server deployments and a Cockpit web management interface along with secure configurations.
- ✓ Fedora IoT does include support for OTA Over-The-Air updates in addition to lightweight containers. It has optimization for small devices.

For containers, Fedora CoreOS provides an automatic OS. It is minimal as well as ideal for Kubernetes and distributed systems.

Fedora standardization is allowed for users as well as organizations through this flexibility after the underlying ecosystem benefits.

- To be a learning platform where users can learn technical and command line skills

Fedora for being open as well as transparent makes it ideal for one to learn and experiment. Students, developers, and IT professionals prefer it since it has scripting capabilities, development environments, and command-line tools preloaded.

Users can explore and learn more about Linux internals that include file system structures systemd services shell scripting package management via DNF and user permission models. Guides and tutorials can be found through Fedora's thorough documentation in addition to wiki pages for both beginners and advanced users.

Since Fedora avoids proprietary software and stresses FOSS tools, learners experience open tools for use across other Linux distributions and Unix-like systems. Fedora becomes more than only an OS. It is also a platform for building practical Linux skills for IT as well as DevOps.

➤ To serve as a sandbox for Red Hat Enterprise Linux

Fedora plays such a critical role since it innovates upstream for Red Hat Enterprise Linux (RHEL). Technologies have to be first tested within Fedora. They are then refined and stabilized prior to integration into RHEL. Innovations are ensured for enterprise software via this upstream-first model after being thoroughly vetted and community-tested.

Fedora first tested and introduced many RHEL features like systemd, the Anaconda installer, and also the move from iptables to firewalld. Red Hat is provided a pipeline of proven features ready for enterprise deployment since Fedora remains cutting-edge using this relationship.

Because it serves this dual purpose—Fedora innovates as well as RHEL hardens enterprises—the project benefits both communities. For Fedora users, there is quick access to features that are the latest. However, RHEL customers do in fact receive software that is stable and supported.

➤ To support rapid innovation with short release cycles and frequent updates

Fedora follows a six-month release cadence that ensures the operating system evolves alongside upstream developments and encourages adoption of new features. For users and for developers with regular access to updated software, Fedora becomes predictable using this time-based model.

Each release has support lasting about 13 months. Users are able to follow the latest release or they can skip just one version and still have support. Helpful for developers as well as testers, this short lifecycle helps Fedora incorporate quickly new packages, kernel versions, and software stacks.

It has a package manager called DNF, support for Flatpak, and updates to keep users up to date without a need for a OS re-installation. This update model also means that the system stays secure and performant with little-to-no manual maintenance required.

- To ensure compliance with free and open-source software(FOSS) standard

Fedora is committed to the software principles which happen to be free as well as open-source. It includes software only in the event that such software complies with the licensing guidelines of Fedora based on licenses that are approved open-source. Proprietary software is absent from Fedora initially. It omits also drivers and codecs.

Fedora is free and open source. It contains only packages that are compliant with Fedora's licensing guidelines, which are among the most open of all Linux distributors. In other words: Fedora does not ship proprietary software, drivers, or codecs out of the box.

Although as a downside, users might have to manually install some third party stuff (like media codecs), this further solidifies Fedora's commitment to the open and ethical distribution of software. Fedora also offers tips on how to legally and responsibly rent such software elsewhere if required.

- To enable easy customization and scalability for various environment

It also works with sophisticated configuration and deployment systems, which is why Fedora makes a great platform for customization and ultimate scaling. For system administrators, you can use Kickstart files to automate installations, and manage packages through DNF or other package-management tools such as Ansible.

This favorable aspect of Fedora renders it appropriate for numerous types of environments, from development systems that are on a smaller scale, to large-scale data centers and cloud setups. It is in full accord with current deployment practices, such as Infrastructure as Code (IaC), container orchestration systems like Kubernetes and Podman, and CI/CD pipelines. Fedora's modular repositories and support for Software Collections (SCLs) further enhance scalability. They enable users to install multiple versions of the same software package for compatibility or testing purposes. This empowers organizations to build tailored solutions while relying on Fedora's strong foundations.

Requirements

❖ Hardware:

First, you need a 64bit, dual core processor to run Fedora, period. That means the machine needs to run on a 64-bit architecture (x86_64) which is already commonplace in laptops and desktops. You'll also be able to make use of any Intel Core i3, AMD Ryzen 3, or superior CPU. For users who want to install Fedora on a virtual machine (such as VirtualBox or VMware) the system hardware virtualization must be activated (intel VT-x or AMD-V) at the BIOS.

Fedora's memory demands are not as severe as some other modern operating systems, but they are not trivial either. The minimum requirement is 4 GB, but that is barely enough to get it installed and moving. For a pleasant and smooth experience, especially with that RAM-hungry graphical environment called GNOME, 8 GB is strongly recommended. Virtualizing Fedora is another matter altogether. A virtual

instance needs to be provisioned with at least 2 GB and preferably 4 GB of RAM if the host system is to maintain any semblance of normal operating behavior.

Fedora requires a minimum of 20 GB of unoccupied disk space for its installation. This amount suffices for the system's base components, set-aside packages, and a modicum of updates. In point of fact, though, you should provision at least 40 GB of space if you don't want to run into obstacles or delays during the installation of the software packages that make Fedora usable for your personal or developmental work. To put it another way, 40 GB of space is optimal. Finally, using a solid-state drive instead of a traditional hard disk will yield significantly better performance in all respects.

A display resolution of 1024×768 pixels minimum is needed to display the desktop and system installer properly. For a better user experience as well as control over the workspace, higher resolutions are recommended and present, especially on monitors that are newer.

❖ Software:

Installing Fedora on a virtual machine requires virtualization software. This can be something like Oracle VirtualBox or VMware Workstation/Player. Such platforms provide the user with a full computer environment (virtually, of course) that allows one to install an operating system like Fedora and try it out in a safe manner—safe, in that it doesn't affect the computer's real, or "host", operating system in any way. (At least, that's the idea. If you want to know more about the safety of virtual machines, try [this link](#).) Anyway, if you want to try Fedora in this manner, you need a virtual machine. To get a virtual machine, you need to have virtualization software. To install Fedora in this way and have it work well, you really ought to use the most up-to-date version of that virtualization software.

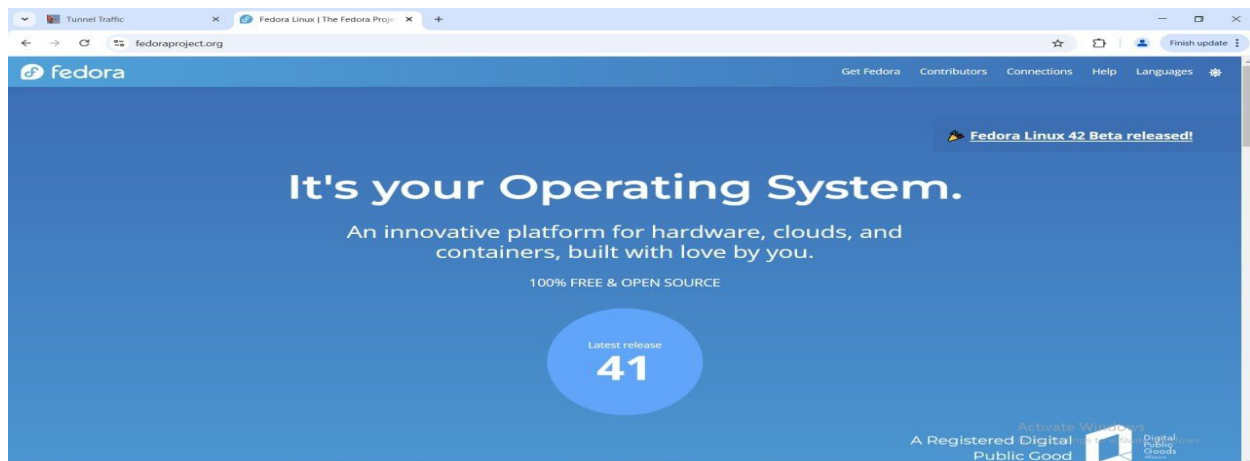
Another important software component is the installation media that the Fedora ISO file becomes. The Fedora Project official website offers downloads. This does include the ISO image. Fedora offers multiple editions, including Fedora Workstation (targeted at general users, as well as developers with a graphical interface), Fedora Server (intended for network infrastructure, along with services), and other specialized spins such as Fedora IoT and Fedora CoreOS. Patrons must pick the version suiting their wants. Once downloaded, the ISO file must be mounted as a virtual optical disk within the virtualization software to start the installation process.

Summary of Requirements	
Hardware	software
Cpu: 2-core 64-bit processor	virtualBox/VMware workstation
RAM: minimum 4GB	ISO file of the os to install
Disk : 20 GB free space	

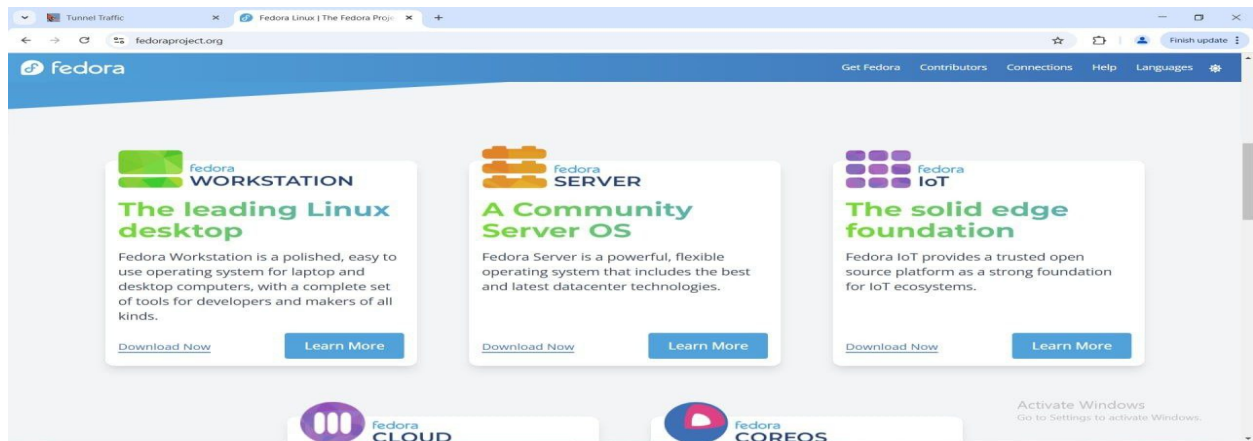
Installation

- ❖ To download and install fedora linux 41 on vmware workstation

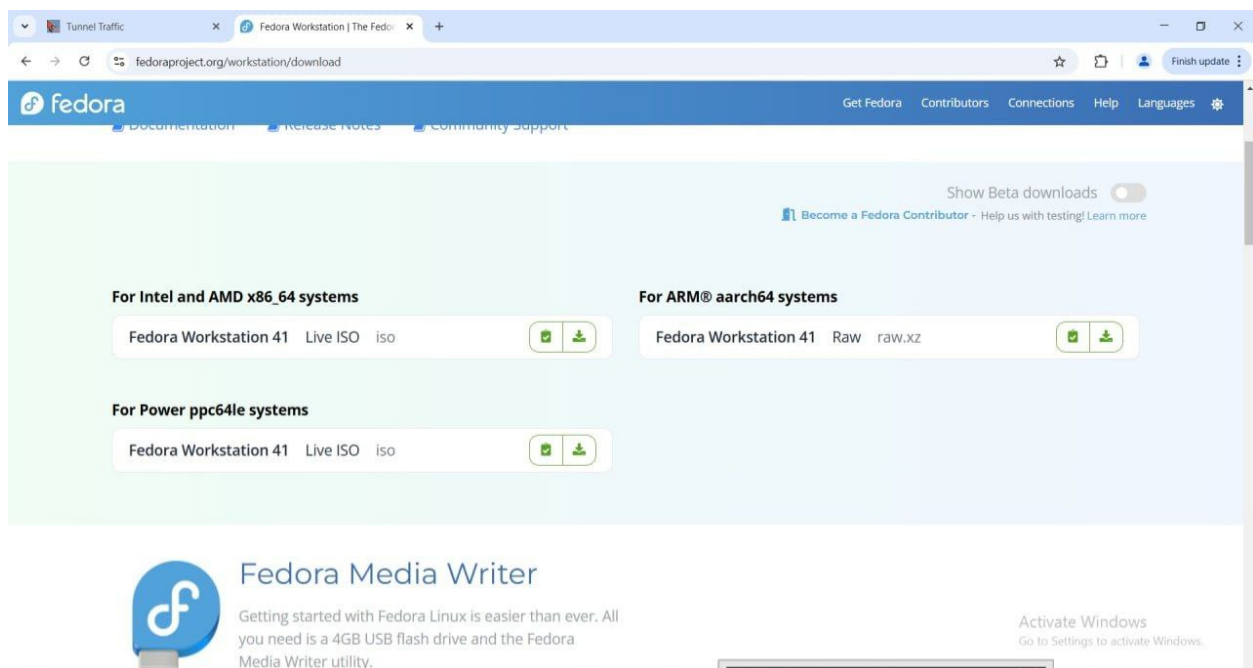
Step1: GO fedora official website (fedoraproject.org) and Then click on the latest release 41



Step2: In fedora workstation click the download now button



Step3: select the For Intel and AMD x86_64 system iso file and click the download button



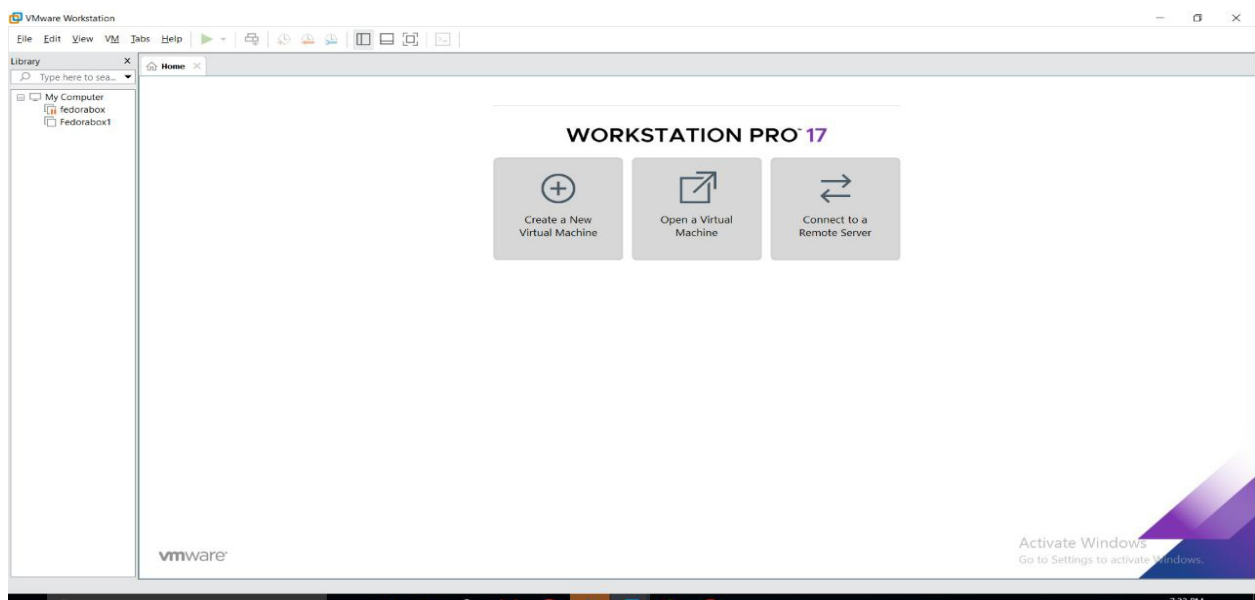
Step4: After download is completed then if you install VMware workstation, open it otherwise it installs it first

Purpose:

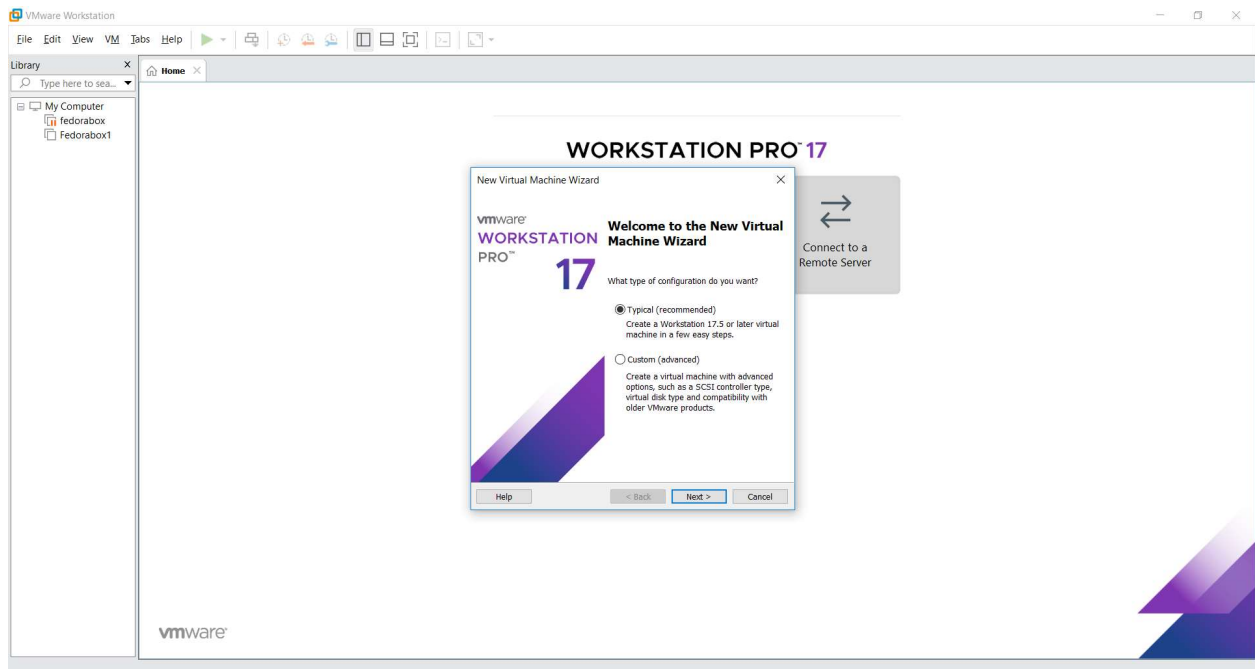
- **Learning & Testing in a Safe Environment:** You could try out various operating systems (like Fedora, Ubuntu, Windows) without putting your host system at risk your main OS won't be affected by mistakes - delete and recreate the virtual machine.
- **OS & App Compatibility Testing:** It is beneficial for software developers to test applications on different OS environments. Handy for testing legacy systems or different OS versions simultaneously
- **Resource Isolation:** Each virtual machine can be allocated a specific amount of CPU, RAM, and storage. Keeps your experiments isolated and controlled.

Etc...

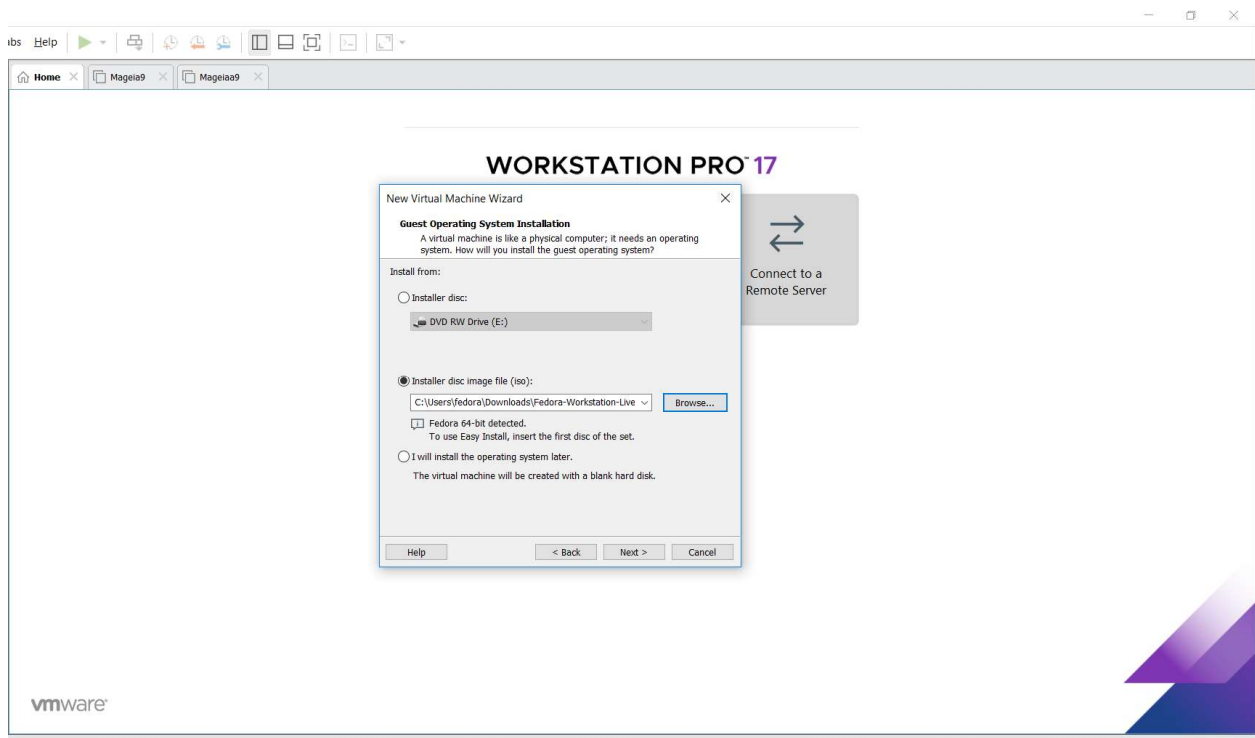
- Go to home and create a new virtual machine



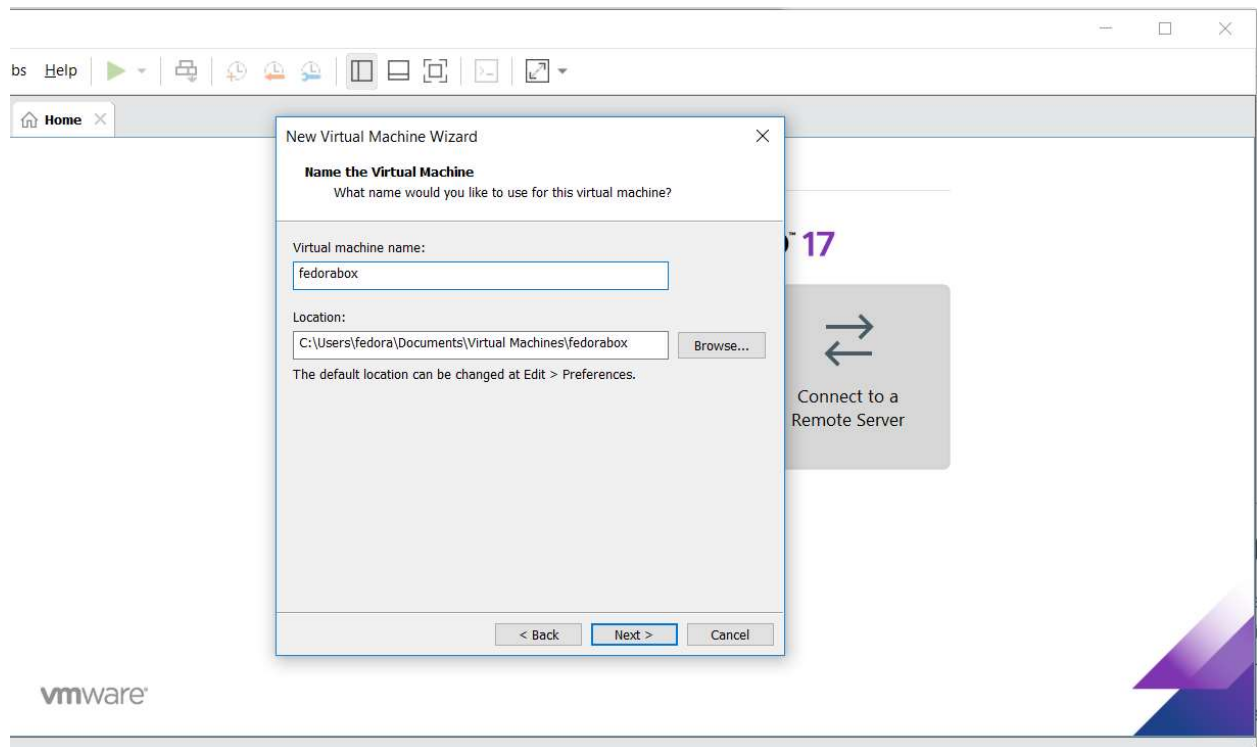
Step5: turn on the typical (recommended) and then click the next button



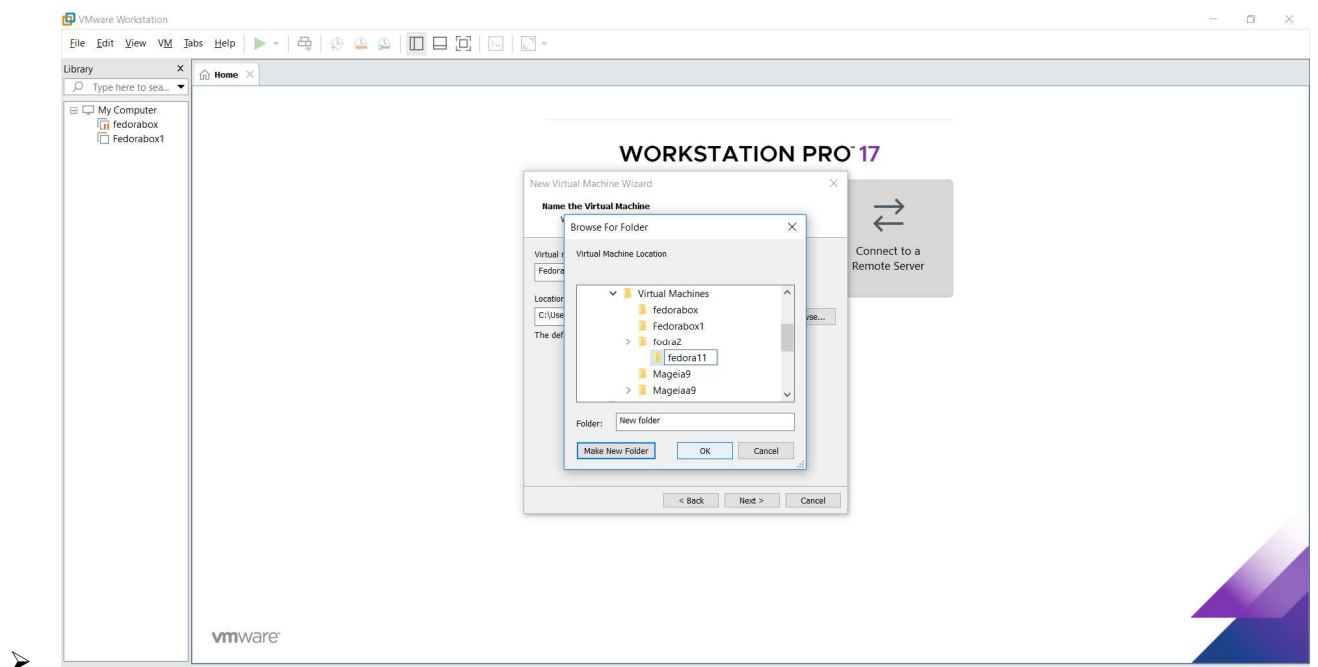
Step6: To select the downloaded iso file (click on browse then set the downloaded iso file click on open then click on next)



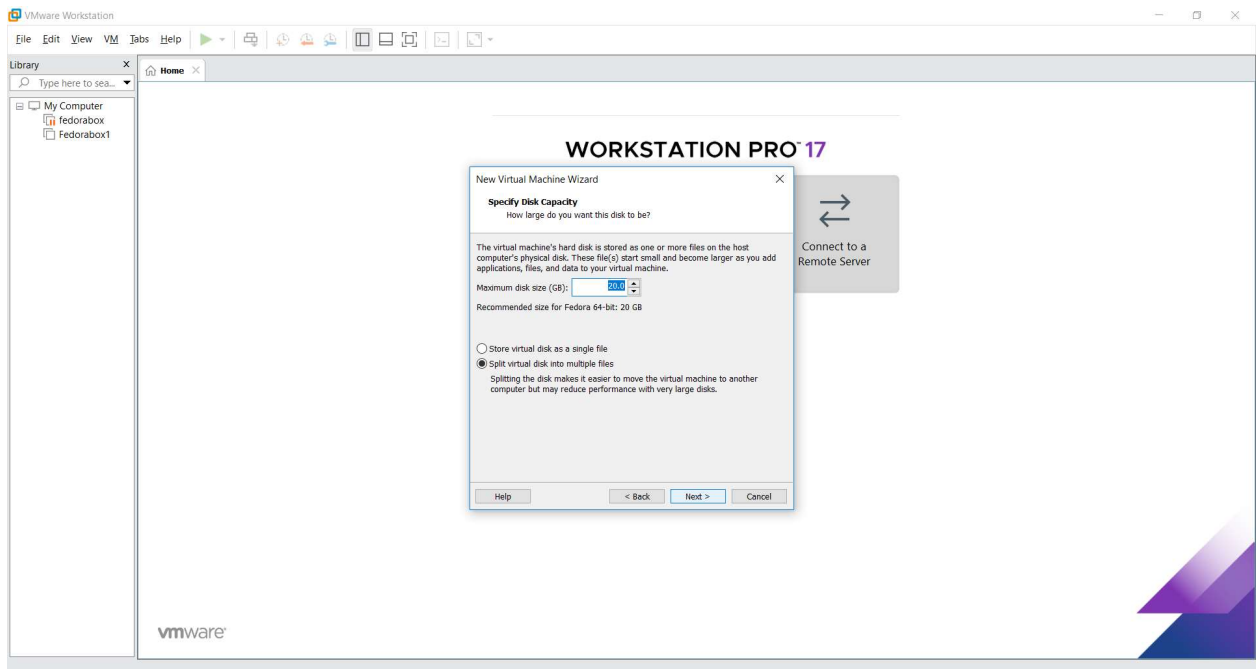
Step7: provide name in the virtual machine name



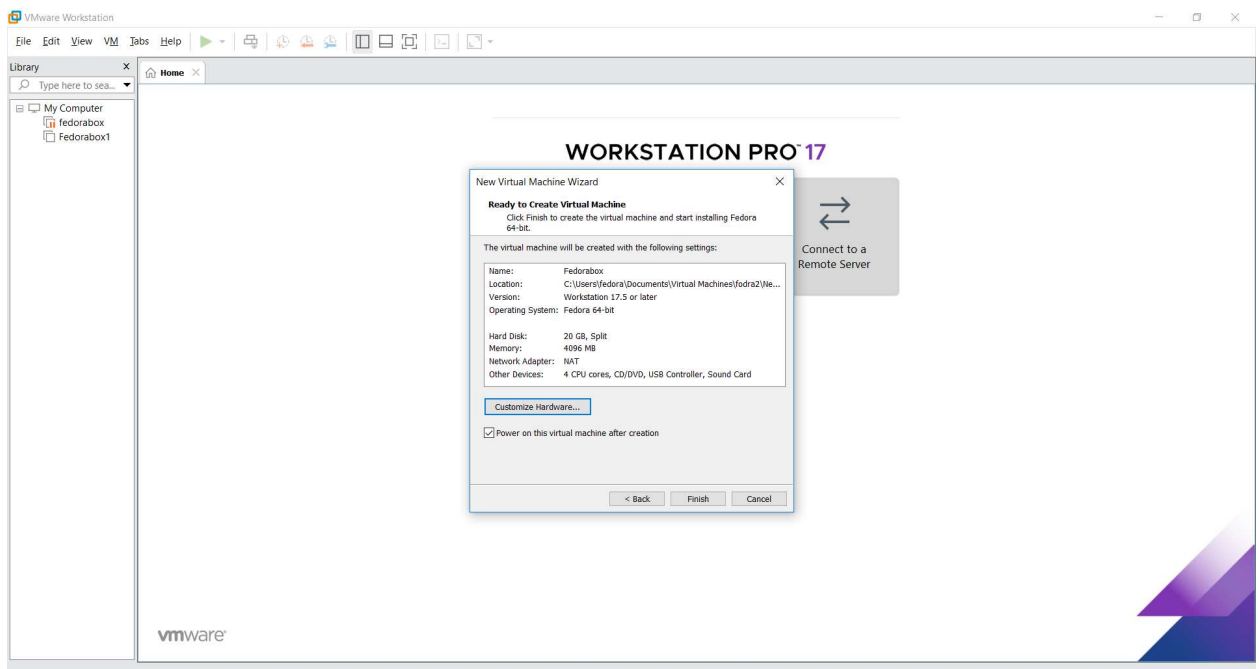
- Select the path to store virtual machine file and folders click on browse then select the path



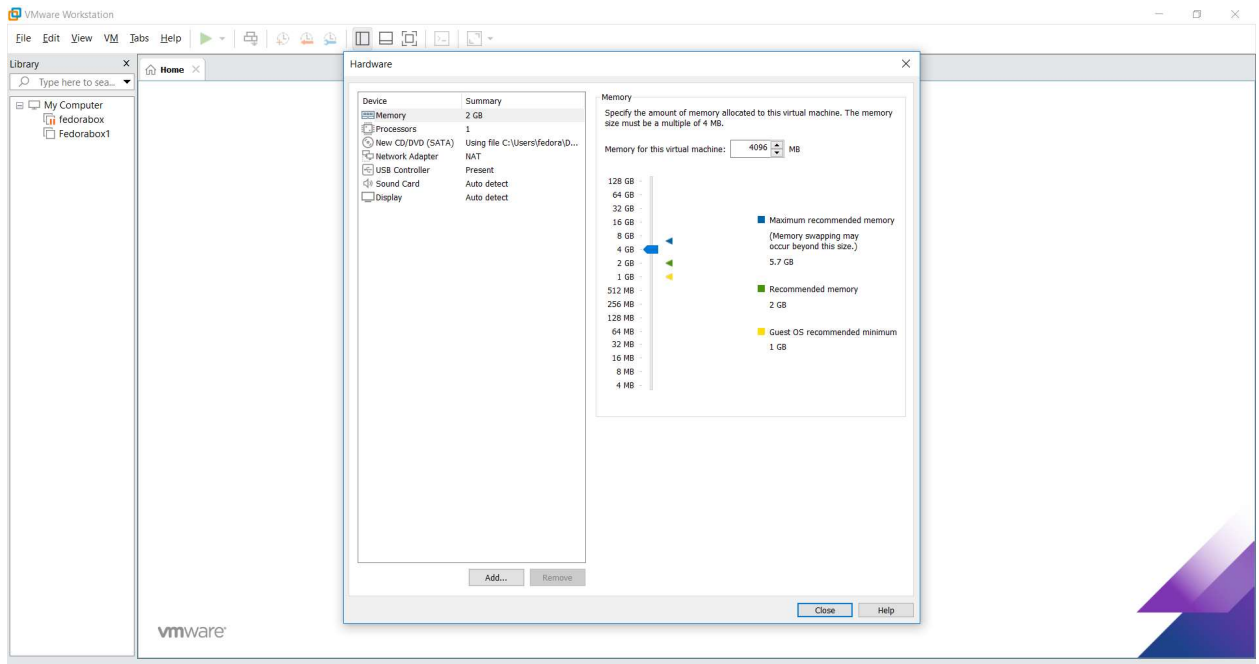
Step8: click on next



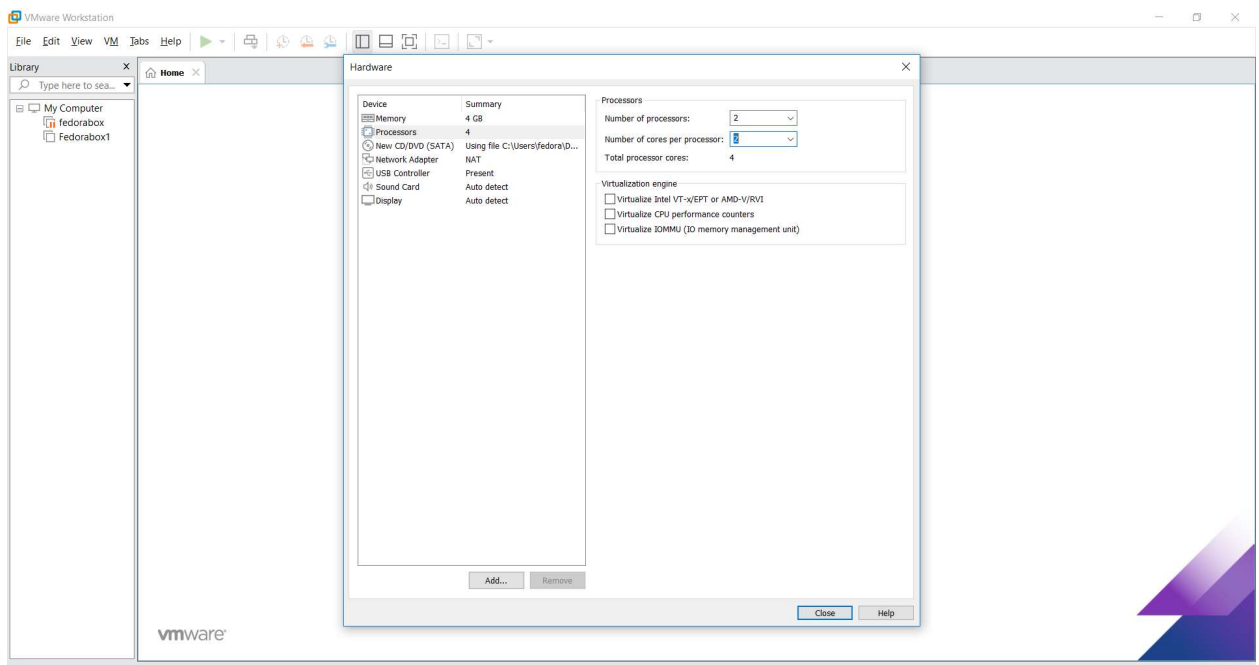
Step9: click on customize hardware



- add the memory a little bit (4GB memory)

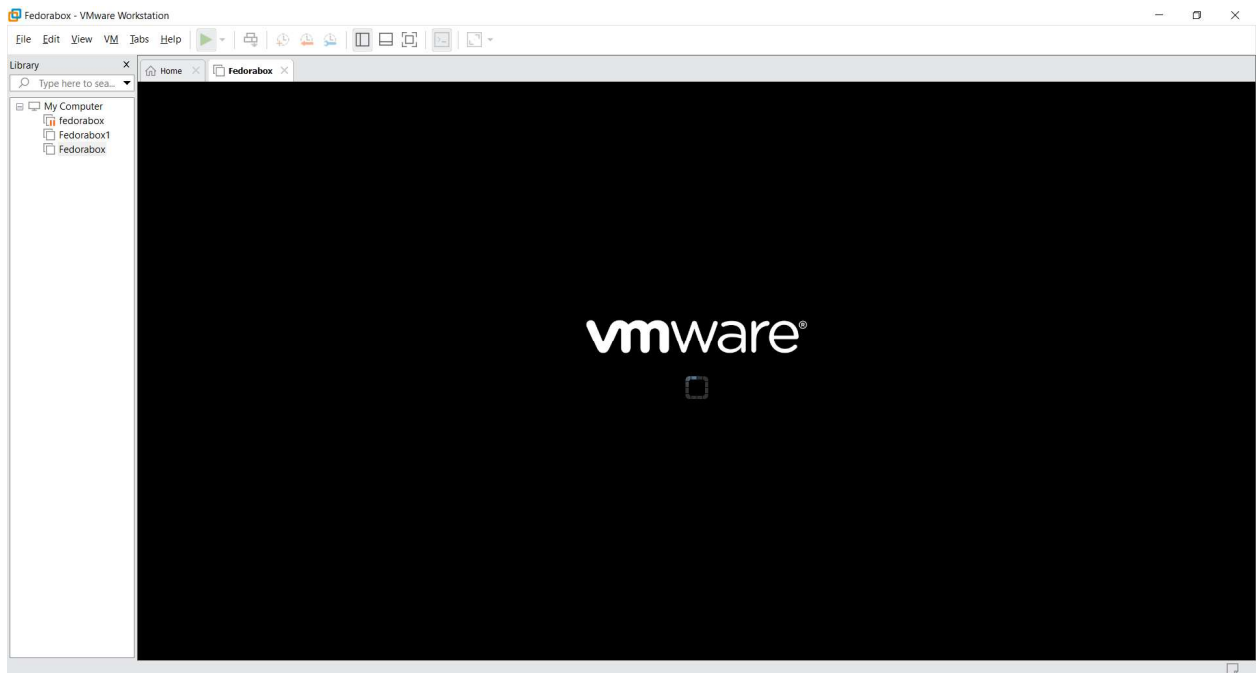


- allocate CPU (give to two for number of processors and number of core per processor) and click on close

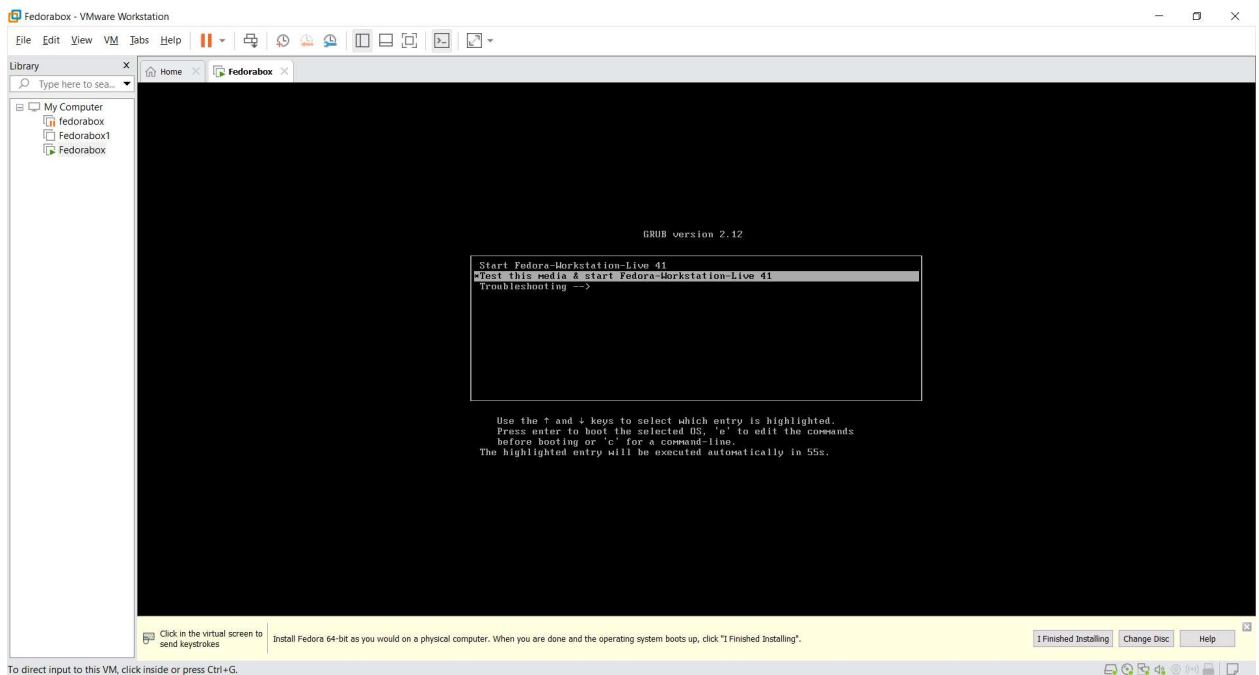


After the customization is done click on the finish button

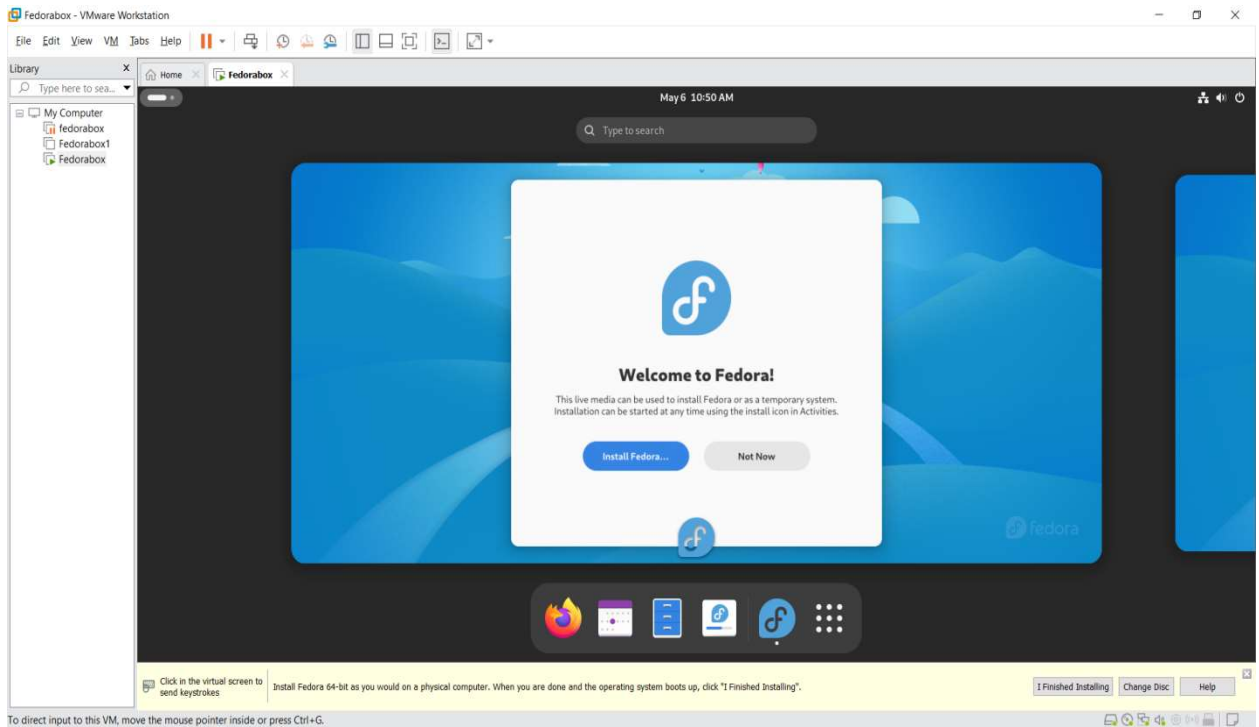
Step10: the installation process begin



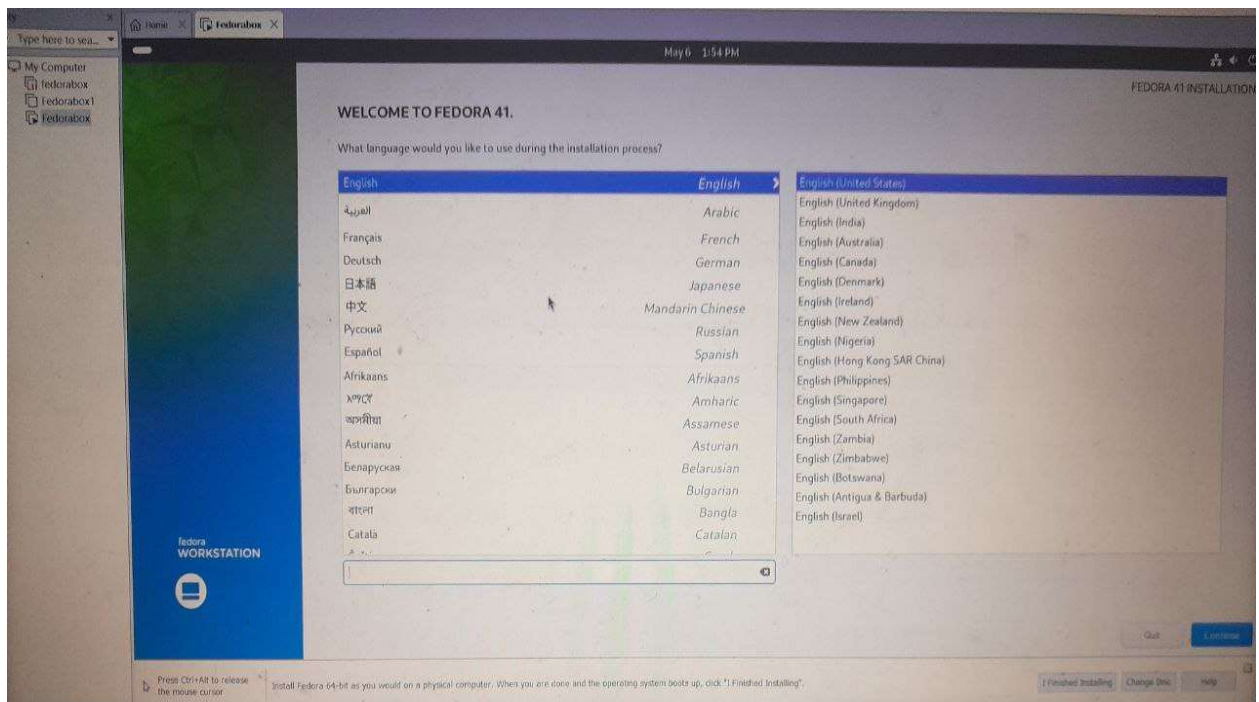
Step11: click inside the screen and move up to first one (Fedoras – Workstation-Live 41)



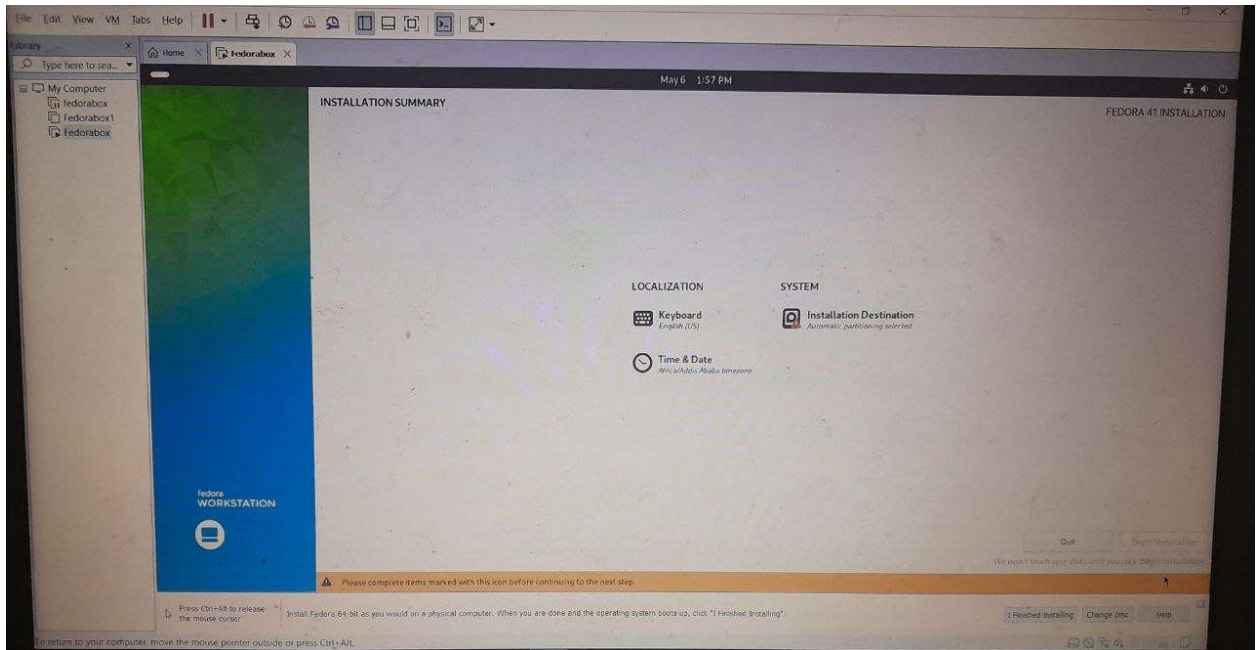
Step12: click the install fedora icon



Step13: choose language and then click continue



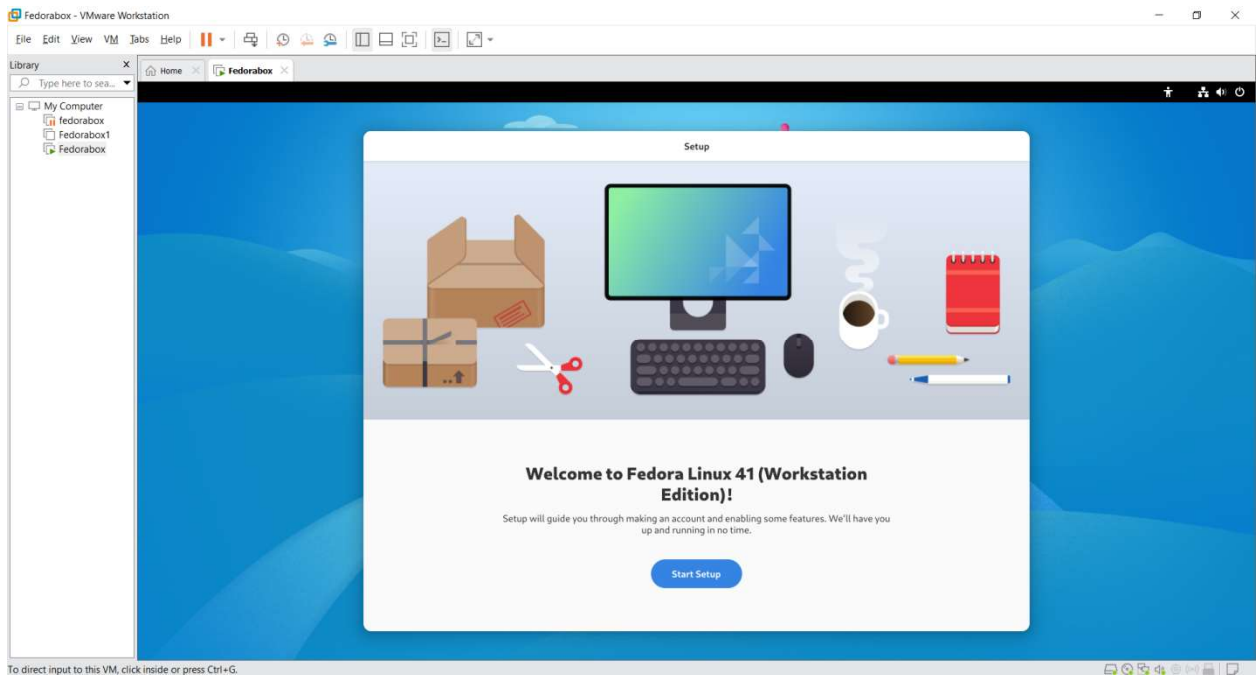
Step14: click on begin installation at bottom



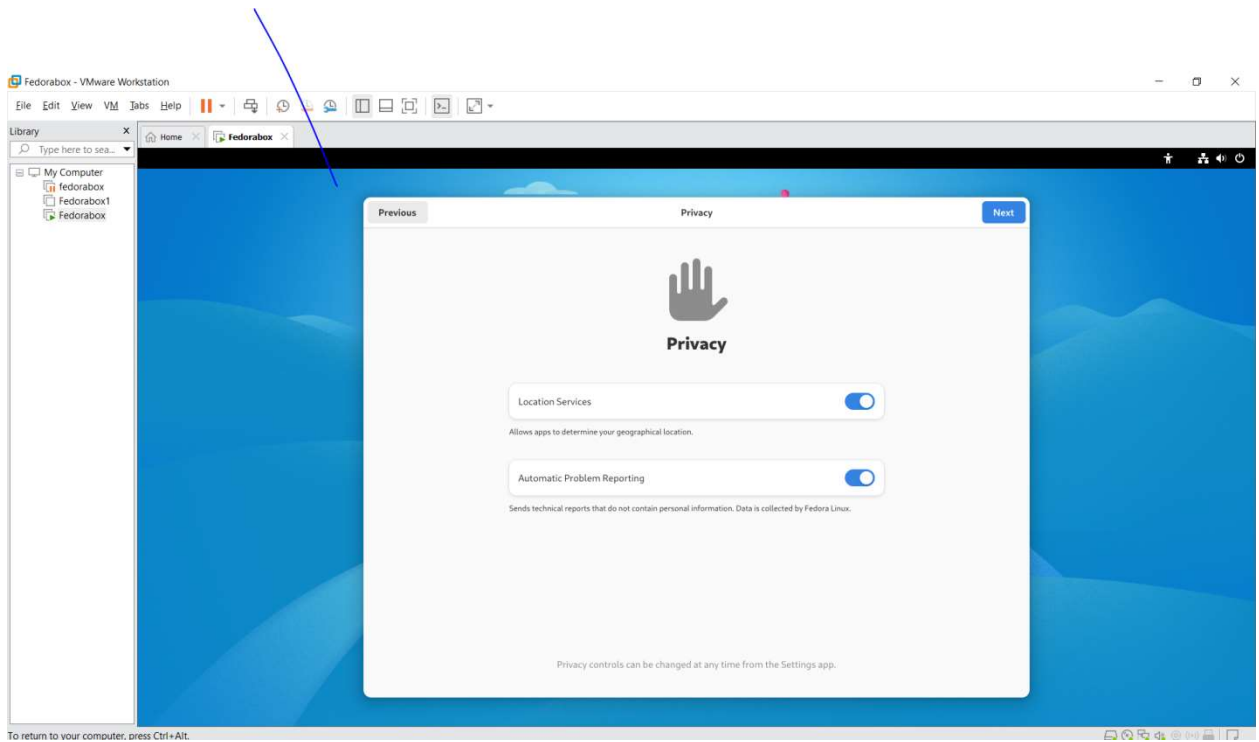
Step15: installation process start. After the installation is completed then click on finish installation icon



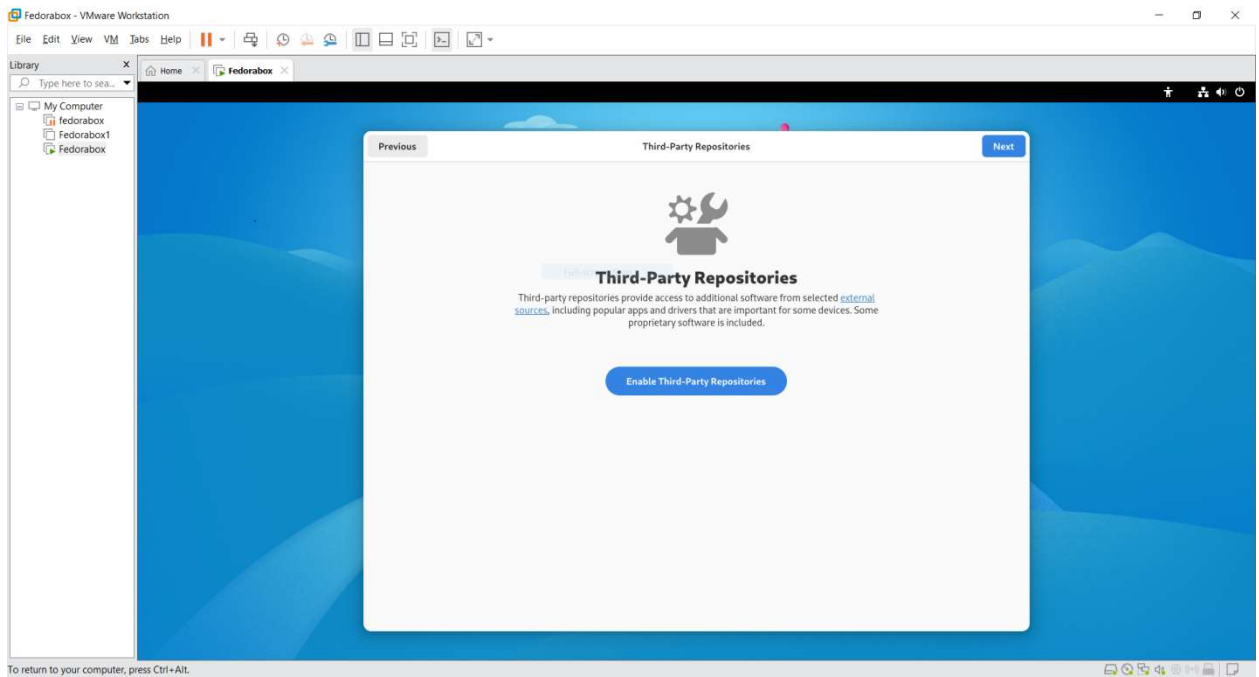
Step16: After completed installation process restart it and start setup



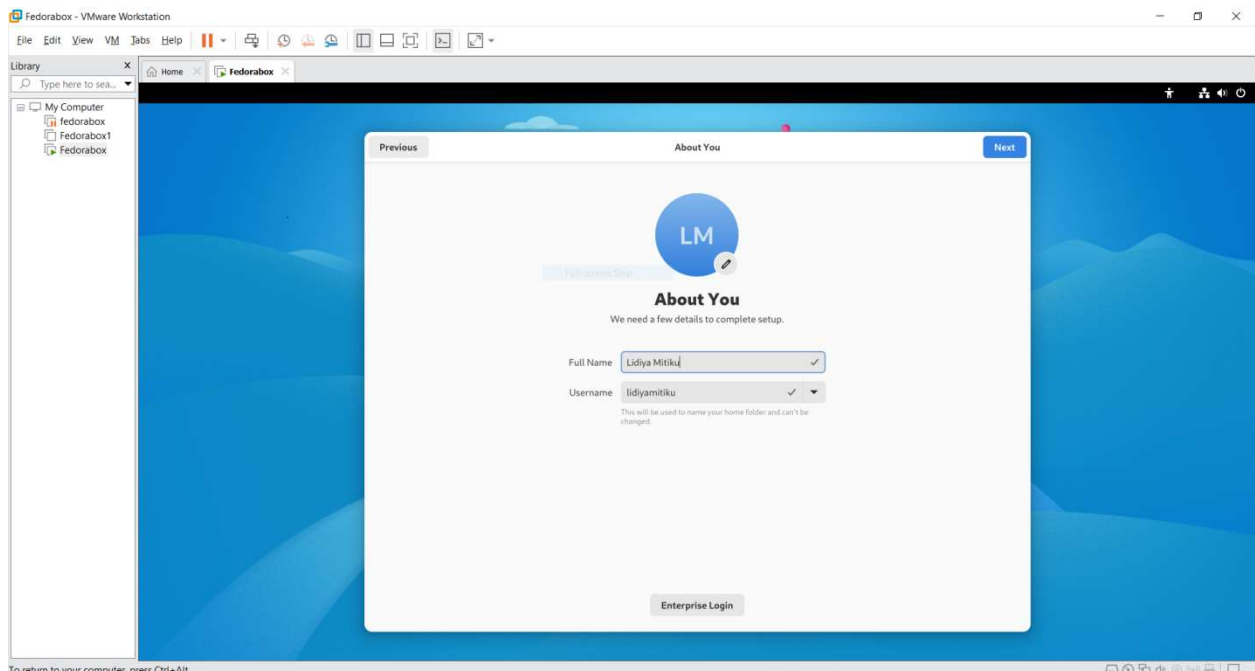
- click on next



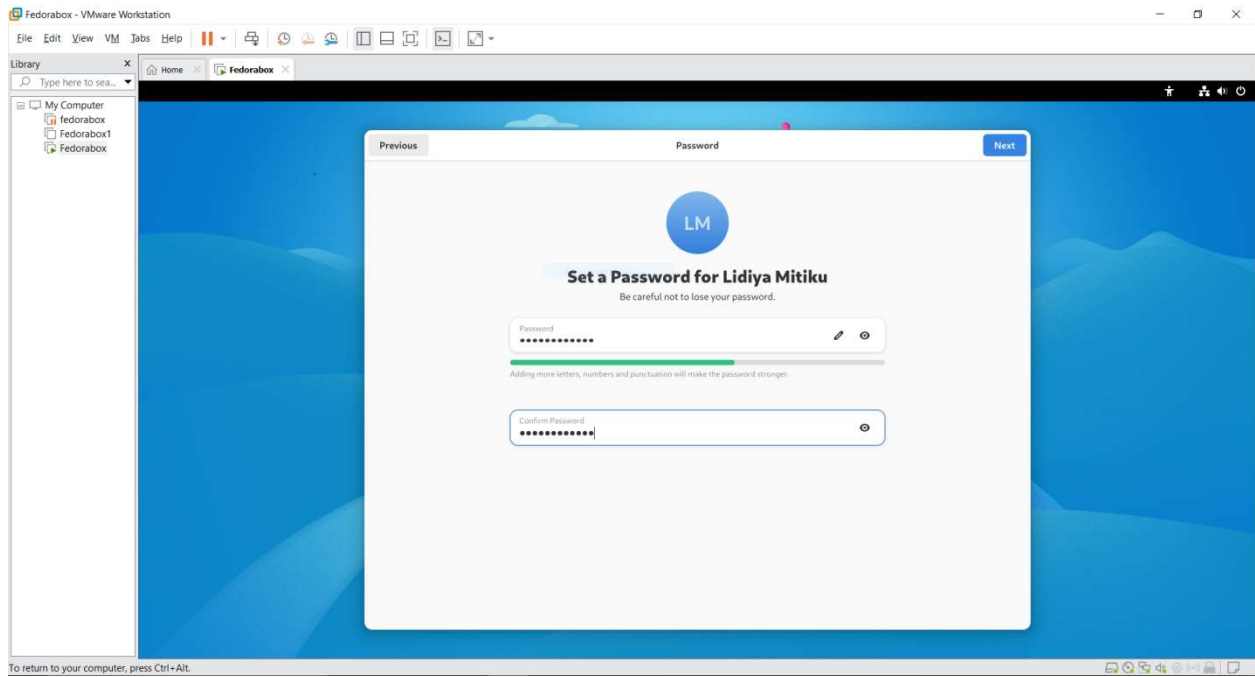
- click on next



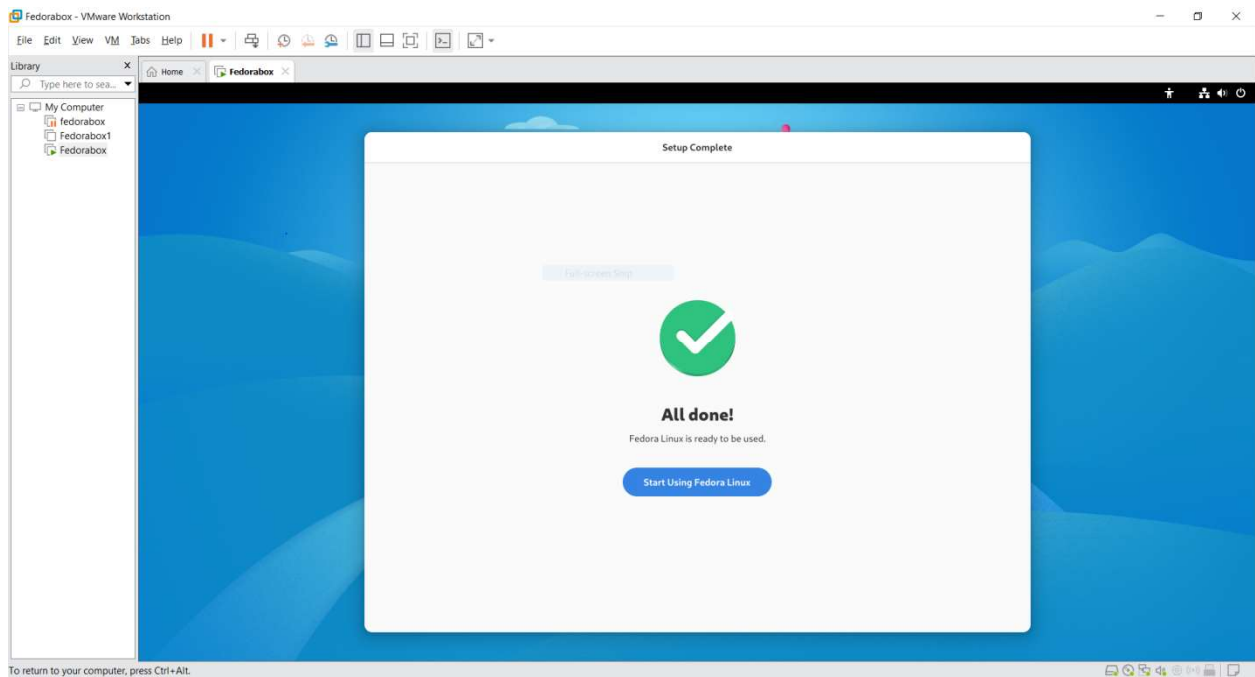
Step17: Create a user account with full name and click on next



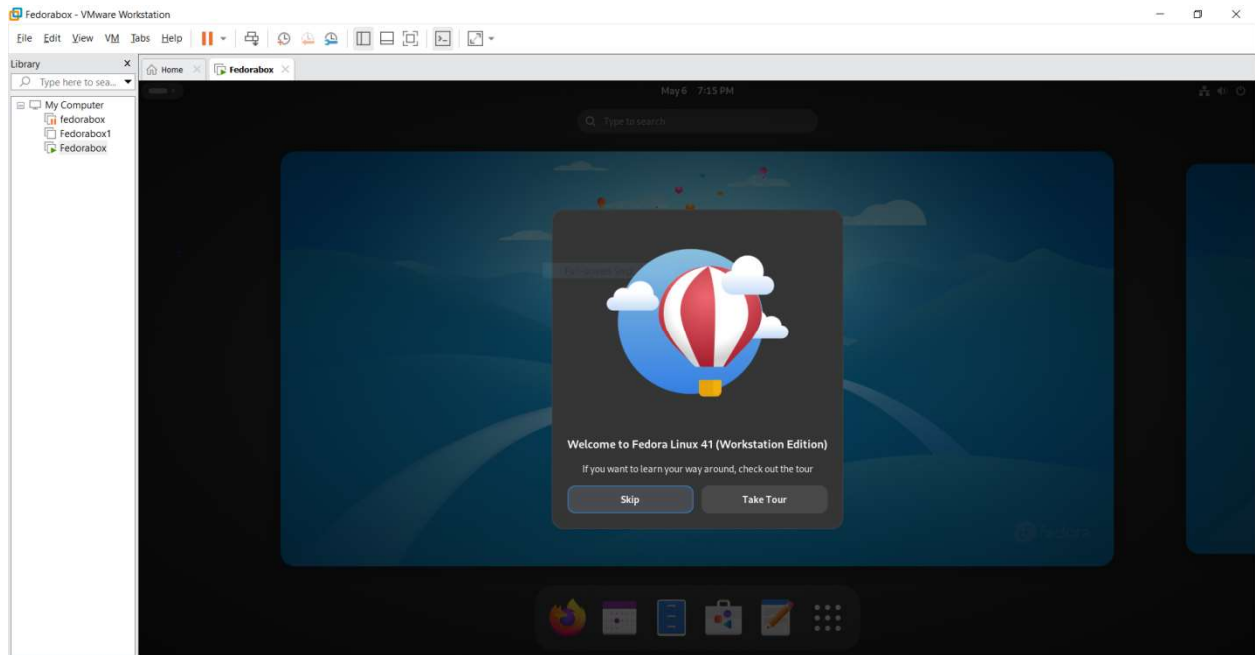
Step18: set password and click on next



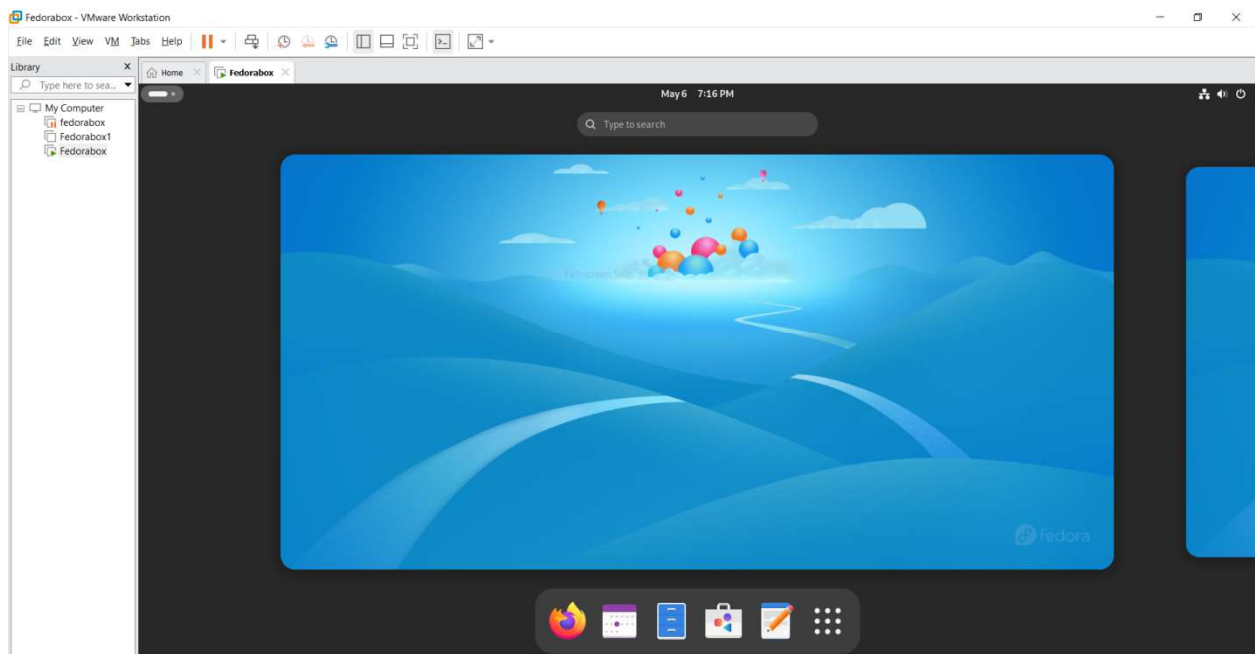
Step19: click start using fedora Linux



Step20: click on skip



Then get



Issues

Fedora OS Installation and Usage: - Fedora OS Installation in Virtualized Environment: It is sometimes the case that technical glitches arise when one tries to install and use the Fedora operating system, especially in virtualized environments such as VirtualBox or VMware. When this happens, it is often because of one or more of three foundational problems: hardware configuration, resource limitations, or software compatibility. You must understand these problems if you are to ensure the smooth deployment and effective use of the Fedora operating system

- a. If virtualization is not enabled, Fedora installation could freeze

One of the problems I often hear new Fedora users facing, is that their system completely freezes, or becomes dead slow during the boot or setup process. This is a common issue when your machine's BIOS/UEFI has virtualization technology (Intel VT-x / AMD-V) disabled. Because Fedora is not working properly on a virtual system without enablement of your virtual parts, the missing option can stop the whole installation.

- b. Poor performance due to insufficient memory or disk

Users have expressed slowness or lag of Fedora when they run Fedora on a virtual machine. This typically comes when you have not given enough RAM or number of CPUs to the virtual machine. Fedora, especially Workstation with GNOME, need a fair amount of resources to operate well. It can take long memory or even CPU when installed on low-end phones, causing your phone to be sluggish, the application is not responding or even a crash.

- c. Problems related to connectivity of network

The Fedora virtual machine is frequently without network access. Many a users face the issue that fedora can't connect to the internet or with other devices. This problem is often caused by poorly configured virtual network

adapters and/or virtualization software that has not been correctly configured. If the adapter is not configured correctly, Fedora may not recognize it, or may not initialize the virtual network interface correctly, and you will lose the network connection.

d. Virtual hardware version compatibility errors

Fedora may as well have troubles with compatibility with the virtual hardware. Where the Fedora will not boot or displays error because the VM hardware is older and does not support some functions which the new Fedora release is based on. Incompatibility between Fedora and virtualization software can sometimes cause performance obstacles or make installation impossible.

Solution

In order to solve the aforementioned problems, a number of practical solutions can be employed. These solutions require the user to adjust BIOS configurations, allocate relevant system resources, configure network adapters, and ensure compatibility of all software components involved in the boot process. Implementing these solutions results in a more stable and efficient environment in which to run Fedora.

i. Enable Virtualization in BIOS

To resolve installation freezing problems, users should activate virtualization support on the computers they use to host virtual machines. This means enabling it in the BIOS or UEFI settings, which normally involves restarting the computer and entering one of those firmware-level interfaces. Look for options with names like "Intel Virtualization Technology (VT-x)" or "AMD-V," depending on your processor type. Fedora can then run properly in its virtual machine, which should eliminate the freeze during startup.

ii. Preallocate more memory and CPU cores

To boost the performance of Fedora, one must allocate additional resources to the virtual machine. Users should ensure that they assign no less than 2 GB of RAM (4 GB or more is preferred) and at least two CPU cores in the settings for virtual machine management. This allocation guarantees that Fedora has sufficient memory and processing power to manage not only its various desktop environments but also the kind of productive multitasking for which its users seem to require no slowdown in governing the virtual machine.

iii. Enable Adapter for networking in Virtual Box as "Bridged"

Restoring network connectivity requires that users verify the settings for the network adapter in the virtual machine. In VirtualBox, for example, setting the adapter to "Bridged Adapter" lets Fedora receive its IP address from the same network that the host system is on, thereby allowing it to access the Internet and communicate with other devices with much less hassle. (Using "NAT" instead of "Bridged Adapter," for instance, still gives Fedora limited access to the Internet, but at the cost of not being able to communicate with other devices on the same network.)

iv. Compatibility Check of VMware/VirtualBox versions with Fedora

To prevent compatibility problems, users need to confirm that their version of virtualization software (VirtualBox or VMware) is up to date and supports the particular Fedora release they wish to try. Because Fedora tends to be fairly avant-garde in the Linux world, it is not uncommon for a Fedora release to be using a Linux kernel or some core system tools that have been built to take advantage of features not supported by older virtual machine software. Using such software thus risks turning a fundamental aspect of the virtual machine (its kernel) into a compatibility time bomb.

Filesystem Support

Fedora primarily uses ext4, but also supports Btrfs, XFS, and others.

- Ext4: is an improved version of Ext3 and Ext2 with better performance, reliability and support for large files and filesystems. Fedora includes full native support for Ext4 in both the kernel and user space tools. The default filesystem for /boot and sometimes root(/) if not using Btrfs. They are secure, fast and well-supported
 - pros:
 - stable and well-tested
 - excellent performance
 - wide compatibility
 - great tools support
 - cons:
 - no built-in compression or deduplication
 - unlike Btrfs, limited snapshot capability

The reason for support in Fedora:

- **Maturity and Stability:** Ext4 has been the default filesystem for numerous Linux distributions for over ten years, including earlier versions of Fedora, demonstrating its reliability through extensive testing.
 - **Backward Compatibility:** It is fully compatible with Ext2 and Ext3, which facilitates easy upgrades and seamless data migration.
 - **Low Overhead:** The absence of complex features such as Copy-on-Write (CoW) or compression results in a lightweight and efficient filesystem, making it suitable for everyday use.
 - **Widespread Tool Support:** Ext4 is supported by nearly all Linux tools, rescue systems, and installers, ensuring broad compatibility and ease of use.
-
- **Btrfs:** is the default filesystem used by Fedora Workstation. Btrfs has two key advantages for users using the default filesystem configuration:
 1. Transparent compression means that data stored on disk uses less space

2. System reinstallation while preserving user data can be supported, while avoiding the issue of volumes running out of space. This is due to the fact that Btrfs subvolumes are not limited to a static predefined size.

Btrfs also provides a range of other features, such as snapshotting and online shrinking, which can be useful for those who want to use them, and can potentially be the basis of future user-facing features.

The reason for support in fedora:

- **Advanced Features:** Btrfs comes with powerful capabilities like native snapshots, compression, subvolumes, and checksumming, making it an excellent choice for both desktop users and developers.
 - **System Rollbacks:** With Btrfs, Fedora Workstation users can easily roll back updates or system changes using tools like Snapper, ensuring a smooth recovery process.
 - **Efficient Storage:** The built-in compression (using zstd) and dynamic subvolumes help save space and enhance data organization, making storage management more efficient.
 - **Future-Oriented:** Actively developed and maintained, Btrfs is considered the modern Linux filesystem for those seeking greater flexibility and improved data safety
- XFS: is mature, enterprise-grade filesystem idea for large-scale fedora deployments, especially in server, storage arrays and high-performance applications. While it lacks some desktop-oriented feature like compression and snapshots, it shines in speed, robustness and scalability.

The reason for support in fedora:

- **Scalability:** XFS supports very large files and filesystems, making it ideal for enterprise, server, and data center environments.

- Performance: Optimized for large I/O operations and parallel access—especially useful for databases and large multimedia files.
- Enterprise Proven: XFS is the default in Red Hat Enterprise Linux (RHEL), which Fedora often leads. This ensures compatibility and upstream development.
- Advanced Management Tools: Includes support for quotas, online growth, and xfsdump/xfsrestore tools for backup.

Comparison

feature	XFS	Ext4	Btrfs
snapshots	no	no	yes
compression	no	no	Yes(zstd)
Best use	Large file	general	desktop
shrinking	no	yes	yes
Online resize	Yes(grow)	yes	yes

Advantage

❖ Fedora is 100% free

As you know, using Windows and macOS will cost you a fortune. Their constant updates and license renewal traps you in a never-ending loop of paying and not seeing a significant difference. But Fedora is not like that. First of all, anyone who desires to have a new and useful operating system can download and install Fedora operating system with ease. Also, without having to pay a single penny, ever! So, if you are eager to learn unlimitedly and own a storage drive, Fedora has a lot to offer.

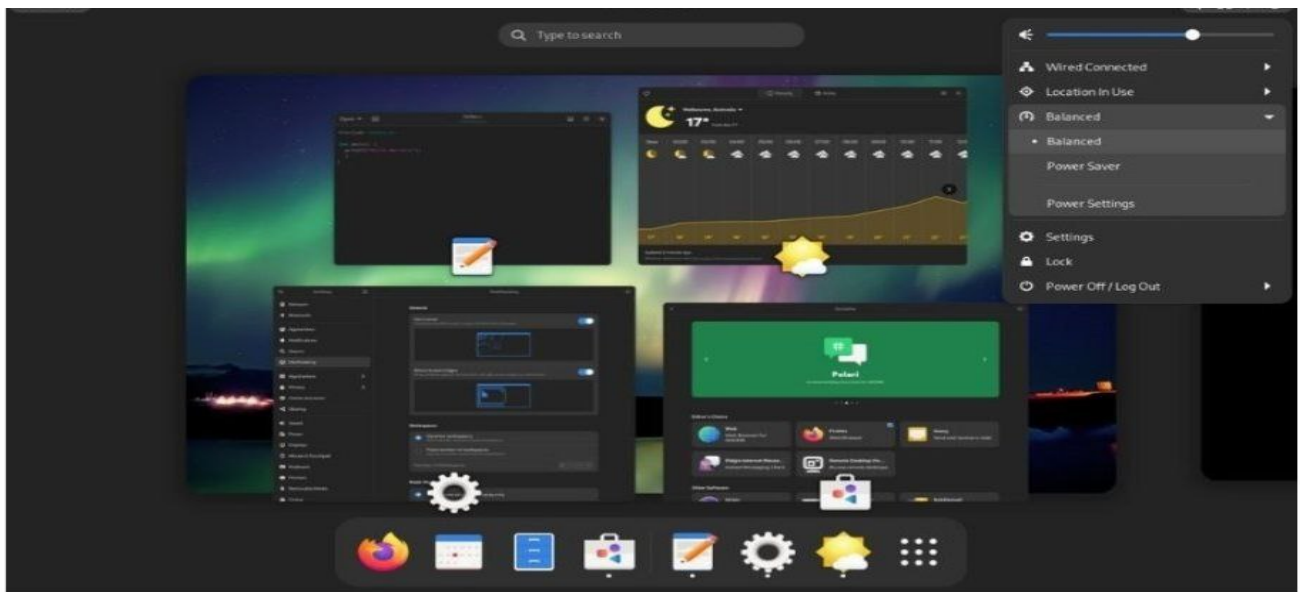
❖ It's simple

I was wondering if Fedora Linux is good for beginners. Well, the answer is simple. I mean SIMPLE!

Although it has a completely new environment compared to Windows and macOS, it won't take much time to learn and get used to it. Especially if you are a beginner, you might wander around for hours, not knowing what to do.

However, the hard part will pass in the first day or two. Once you know its appealing UI, you can see how efficiently you can work with Fedora's desktop and features.

❖ It has great accessibility



Every app you can ever think of is available for Fedora OS. So, unlike macOS, you can access anything you want using this operating system. You may not find every app you want on the store.

However, don't worry. Even if the app wasn't available on Fedora's software center, you could always find it on its official page. For example, chrome is not listed on Fedora's store, but you can download it from chrome's web page.

❖ It has a high-security environment

What is Fedora Linux good for? EVERYTHING. Moreover, it's secure, even more secure than other OS. But how can that be?

By now, you know that Fedora is an open-source OS; plus, it's free to use. It all means that many developers are working on it simultaneously. So, they add features, troubleshoot their problems, and solve bugs with every passing second. That's why it has a more reliable nature than macOS and Windows.

Nevertheless, being freely accessible to thousands of developers doesn't mean it's immune to viruses and malware. It's just less prone to cyberattacks.

❖ **It is less hardware-consuming**

During our research, we came up with a crucial question: How many resources does Fedora consume compared to the latest version of Windows? Here's what we found:

- Fedora OS consumes 1GB of RAM, while Windows 11 needs at least 2.4GB to operate smoothly.
- You should have at least 64GB of storage to Download and install Windows 11. With Fedora, it takes only 20GB of storage.

As you can see, Fedora is lighter than Windows. However, it doesn't mean you can use it on old hardware. You can run more apps at the same time on it without facing any disturbance signals. But it best operates on new and fresh systems.

❖ **Suitable for Virtualization and Containers**

Fedora works smoothly in VirtualBox, VMware, and other virtual environments.

Disadvantage

- ❖ It's quite new and has the latest features. How is that a drawback? Well, you know what comes with new features? Instability and many things that won't work properly. Every new feature needs to be tested and updated from time to time to achieve a stable and somewhat flawless state. So, you need to have patience with Fedora's features.
- ❖ It's not usable on old hardware. With new technologies come new demands. So, you can't expect Fedora to work properly on old computer systems. You need to buy brand-new hardware to get it to work as needed.
- ❖ It requires a long time for preparation. Of course, it isn't all that speedy an operating system to work with. So, our initial piece of advice to individuals who yearn to enjoy a distinctive Fedora experience is possess patience.
- ❖ It has a dedicated server. This means you cannot use any other real - time servers to work on Fedora. Sometimes, the boundless options we offer require some truly dedicated resources, right?

Conclusion

Fedora OS is powerful, flexible, secure, and particularly fit for contemporary computing environments. Its open source property, together with the support from Red Hat, allows users to access the latest advances in technologies through Fedora without compromising on system innovation and stability. Developers, system administrators and students wishing to interact with the world of Linux and get practical experience with system operations greatly benefit from this. Fedora also stands out due to its strong focus on security, low resource consumption, hardware virtualization, and resource efficiency making it ideal for personal and educational purposes.

Although there are some drawbacks like difficulty in navigating the UI for beginners, lack of compatibility with old hardware, these difficulties are significantly outweighed by the advantages. Overall, Fedora shines as an optimal platform for open source OS learning, experimentation, and professional development with its unmatched reliability.

Future Outlook / Recommendations

Fedora OS is anticipated to remain a leading-edge Linux distribution, consistently offering innovative features and enhancements. The forthcoming versions of Fedora should pay particular attention to the following areas: User Experience Hardware Compatibility System Performance Stability Simplicity of Setup/Installation Despite Fedora's commitment to 'bleeding edge' technologies, these recommendations are aimed at ensuring that Fedora remains a relevant and usable distribution for a diverse array of setups, including those found in academic environments. These recommendations were jointly written by members of the Fedora Community and do not necessarily reflect the views of any one individual or group. All in all, the sustained engagement of the community, along with the support of Red Hat, guarantees continue to be a dynamic element in the open - source world. It will be both a proving ground for experimental software and a seedbed for the development of robust, reliable systems that are good enough to serve as the backbone for enterprises.

I.

❖ What is Virtualization?

It allows a single physical machine to host multiple virtual machines (VMS), each with its own OS and applications. These VMs operate independently and behave like different physical machines. The virtualization is managed by a software layer called a hypervisor that allocates system resources (CPU, memory, storage, etc) to each VM

❖ Why Use Virtualization?

Virtualization provides several benefits in modern computing:

- **Resource Efficiency:** It helps better usage of hardware resources by enabling many operators to run on a single physical machine.
- **Cost Saving:** Minimizes multiple physical servers, conserving energy, maintenance, and hardware expenditures.
- **Testing and Development:** Developers can test an application across multiple operating systems without owning separate devices.
- **Isolation and Security:** Each VM is separated from others; therefore, problems in one VM will not affect the others.
- **Disaster Recovery and Flexibility:** These are easy to back up, move, or restore.

❖ How Does It Work?

Hypervisor (for example, VMware, Virtual Box , KVM) is placed between the hardware and the operating systems. It allows several operating systems to share the same physical hardware. There are two types of hypervisors

- **Type 1 (Bare Metal):** Runs directly on hardware (e.g., VMware ESXi, Microsoft Hyper-V).
- **Type 2 (Hosted):** Runs on top of a host OS (e.g., VirtualBox, VMware Workstation).

Each VM has its own virtual hardware (CPU, RAM, disk, etc.) , and the hypervisor allows communication between VMs and the physical machine . Modern CPUs also have virtualization support (for example, Intel VT - x, AMD - V), which enhances VM performance and stability.

II.

Implement System Calls

The system call `sbrk ()` is used for changing the size of the data segment of a program. It either increases or decreases the size of the heap space during the runtime of the program. This is a low - level memory management function, and it is still used in some place by some people. It is used in this example program to create a simple operating system procedure for allocating and deallocating memory.

Objective: To create a simple C program that manually allocates and deallocates memory using the `sbrk()` system call.

Code Example:

```
#include <stdio.h>
#include <unistd.h>
#include <string.h>

int main() {
    void *initial_brk, *new_brk;
    int increment = 1024; // Allocate 1 KB

    // Get current end of data segment
    initial_brk = sbrk(0);
    printf("Initial program break: %p\n", initial_brk);

    // Increase data segment size
    new_brk = sbrk(increment);
    if (new_brk == (void *)-1) {
        perror("sbrk increment failed");
        return 1;
    }

    printf("Program break after increment: %p\n", sbrk(0));
```

```

        // Use the new memory
        char *allocated = (char *)new_brk;
        strcpy(allocated, "Hello from heap!");
        printf("Stored string: %s\n", allocated);

        // Decrease data segment size
        if (sbrk(-increment) == (void *)-1) {
            perror("sbrk decrement failed");
            return 1;
        }

        printf("Program break after decrement: %p\n", sbrk(0));

        return 0;
    }

```

Compilation and Execution in Fedora Terminal

Open your terminal and run the following commands:

```

gcc -o sbrk_example sbrk_example.c
./sbrk_example

```

Expected Output Example

```

Initial program break: 0x556d3f404000
Program break after increment: 0x556d3f404400
Stored string: Hello from heap!
Program break after decrement: 0x556d3f404000

```