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DEPARTMENT OF SOFTWARE ENGINEERING

OPERATING SYSTEM INDIVIDUAL

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SUBMISSION DATE :16/08/2017 E.C

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CALCULATE LINUX OPERATING SYSTEM

1. Introduction

1.1 Background: Virtualization has become an essential tool for software developers, system administrators, and general users. It allows running multiple operating systems concurrently on a single physical machine, improving resource utilization and providing a safe environment for testing and experimentation. Calculate Linux, a Gentoo-based distribution, offers a rolling-release model, optimized performance, and a focus on customization.

Calculate Linux is a highly customizable, source-based distribution that evolved from Gentoo Linux. It distinguishes itself through its commitment to speed, efficiency, and ease of deployment within both individual and organizational settings. Unlike binary-based distributions that provide pre-compiled packages, Calculate Linux leverages Portage, Gentoo's powerful package management system, which allows for fine-grained control over software compilation and optimization. This "build-from-source" approach enables Calculate Linux to be tailored precisely to the underlying hardware, resulting in enhanced performance and a reduced footprint. Furthermore, Calculate Linux prioritizes a rolling-release model, ensuring users have access to the latest software updates and security patches as soon as they become available, while maintaining a focus on stability through rigorous testing and quality assurance processes.

Calculate Linux is a Linux distribution optimized for fast deployment in an organization environment. It is based on the Gentoo Linux project and includes many preconfigured functions.

1.2 Motivation: This document provides a step-by-step guide on installing Calculate Linux in VMware Workstation. This approach allows users to experience Calculate Linux without dedicating a physical machine or altering their existing operating system. This guide caters to individuals wanting to explore Calculate Linux, test its features, or use it as a development environment within a controlled virtualized setting.

The driving force behind Calculate Linux lies in addressing the evolving needs of users who demand both power and flexibility without sacrificing usability. While Gentoo offers unparalleled customization, its complexity can be daunting for newcomers. Calculate Linux simplifies the Gentoo experience by providing:

- **Out-of-the-Box Functionality:** Pre-configured desktop environments (KDE, XFCE, MATE, etc.) and server editions (Calculate Directory Server, Calculate Linux Scratch) eliminate the need for extensive manual configuration, making it accessible to a broader audience.
- **Automated System Management:** Calculate Utilities, a suite of in-house tools, streamline common administrative tasks such as system updates, user management, and network configuration, reducing the learning curve and improving overall efficiency.
- **Simplified Deployment and Maintenance:** Designed with scalability and manageability in mind, Calculate Linux offers tools for creating custom ISO images and managing system configurations across

multiple machines, making it an ideal solution for organizations looking to standardize their Linux deployments.

- **Optimized Performance:** By leveraging Gentoo's build-from-source approach, Calculate Linux ensures that applications are compiled and optimized for the specific hardware on which they are running, resulting in a more responsive and resource-efficient system.
- **Commitment to Open Source:** Calculate Linux is a fully open-source project, built on a foundation of community collaboration and transparency. This ensures that users have access to a secure, reliable, and customizable operating system that is free from vendor lock-in.

In essence, Calculate Linux strives to bridge the gap between the power and flexibility of source-based distributions and the ease-of-use of binary-based systems, making it a compelling choice for users seeking a highly customizable, performant, and manageable Linux operating system.

2. Objectives

Make it Easy to Use:

- **Easy Setup:** To make it simple for anyone to install and get the system working, even if they are not Linux experts.
- **Quick to Get Going:** To provide tools that let you quickly set up Calculate Linux on many computers, like in a school or office.
- **Ready to Go:** To have the system come with common programs already installed, so you can start using it right away.

Let You Customize it Easily:

- **Change it Your Way:** To let you easily change the system to look and work how you want it.
- **Only What You Need:** To let you choose just the parts of the system you need, so it doesn't waste space.
- **Different Looks:** To offer different desktop styles (like KDE, Xfce, MATE) so you can pick the one you like best.

Make it Work Well and Be Secure:

- **Full System:** To provide a system that can do everything you need, whether you're using it at home or on a server.
- **Safe and Stable:** To keep the system secure and working well with regular updates.
- **Lots of Programs:** To have a big collection of programs you can easily install.
- **Free to Use and Share:** To be completely free and open-source, so anyone can use it, share it, and help make it better.

3. Historical Development

- **Early Days (Around 2002-2003): In-House Solution:** Calculate Linux began as an internal project within the Russian company "CIT" (Center of Information Technologies). The primary goal was to streamline the deployment and management of Gentoo Linux across the company's infrastructure. Gentoo's customizability was desired, but its manual installation process was too cumbersome.
- **Automation Focus:** The core focus during this phase was on automating the installation and configuration process. This led to the creation of the Calculate Utilities, which became a defining feature of the distribution. These utilities aimed to simplify tasks like system updates, network configuration, and user management.
- **2007: Public Debut:** Calculate Linux was officially released to the public as a free and open-source operating system in 2007. This marked a significant turning point, as it transitioned from an internal tool to a distribution available for anyone to use.
- **Development of Key Features:** Post-public release, the project focused on expanding its functionality and improving the user experience:
 - **Calculate Utilities Enhancement:** The Calculate Utilities continued to be refined and expanded, becoming more powerful and user-friendly.
 - **Calculate Directory Server (CDS):** CDS was developed to simplify the management of user accounts, network resources, and authentication, making Calculate Linux more suitable for server environments and enterprise deployments.
 - **Templates and Profiles:** The introduction of templates and profiles provided a mechanism for easily customizing and deploying system configurations across multiple machines.
- **Rolling Release Adoption:** Calculate Linux embraced a rolling release model, ensuring that users always have access to the latest software updates and features without the need for major version upgrades. This aligned with the Gentoo philosophy of providing a continually updated system.
- **Desktop Environment Diversification:** While initially focusing on KDE, Calculate Linux expanded to offer support for other popular desktop environments, including Xfce and MATE, catering to a wider range of user preferences and hardware capabilities.
- **Community Growth:** The project has fostered a community of users and developers, contributing to the ongoing development, testing, and support of the distribution.
- **Gentoo Foundation Support:** The project receives support from the Gentoo Foundation, reinforcing its commitment to open-source principles and collaboration within the Gentoo ecosystem.

4. Requirements

4.1 Hardware:

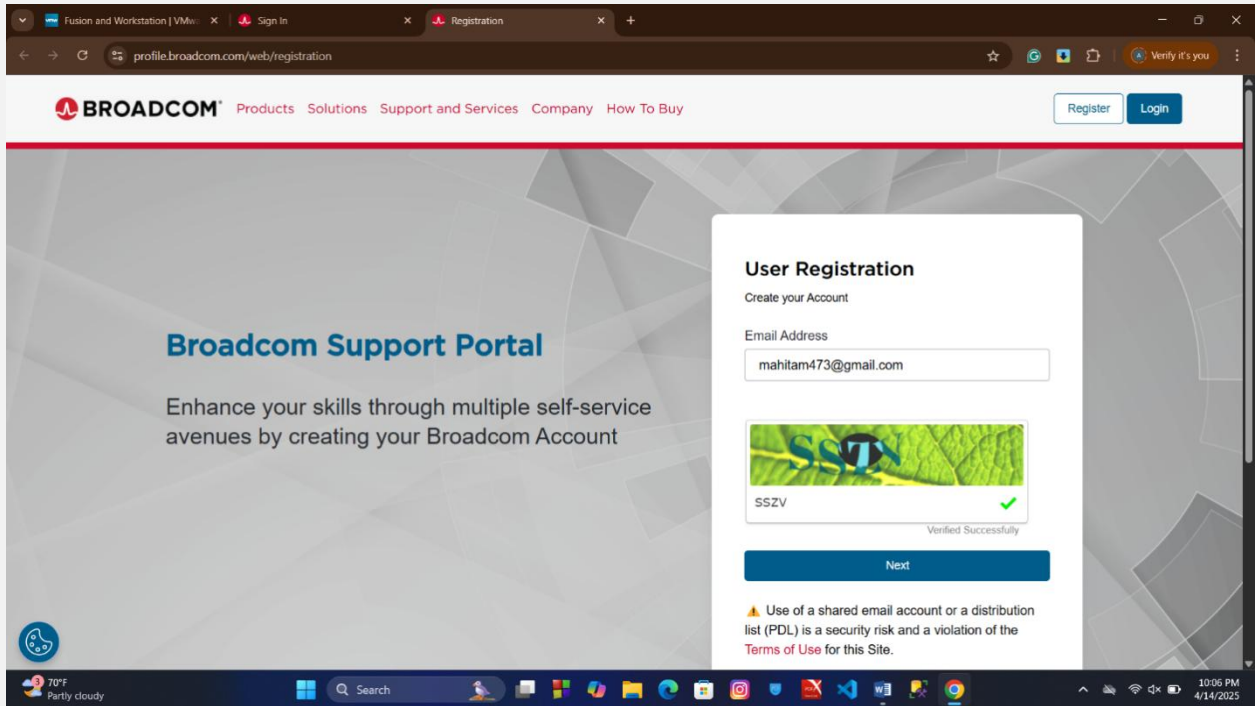
- * Processor: Intel Pentium 4 or AMD Athlon 64 processor (or equivalent x86-64 processor). A single-core processor might be sufficient for very basic use, but performance will be limited.
- * RAM: 512 MB of RAM. This is very minimal and only suitable for a text-based environment or a very lightweight desktop environment like Fluxbox or IceWM.
- * Storage: 10 GB of free disk space. This is the absolute minimum needed for the base system.
- * Graphics Card: A basic graphics card capable of displaying a graphical interface.
- * Network Adapter: A network adapter (Ethernet or Wi-Fi) if you need network connectivity.
- * Hard Disk Space: At least 20 GB of free disk space for the virtual machine. SSD highly recommended.
- * Internet Connection: Required for downloading the Calculate Linux ISO and VMware Workstation installer
- * Host Operating System: A supported host operating system (Windows 10/11, macOS, or Linux).

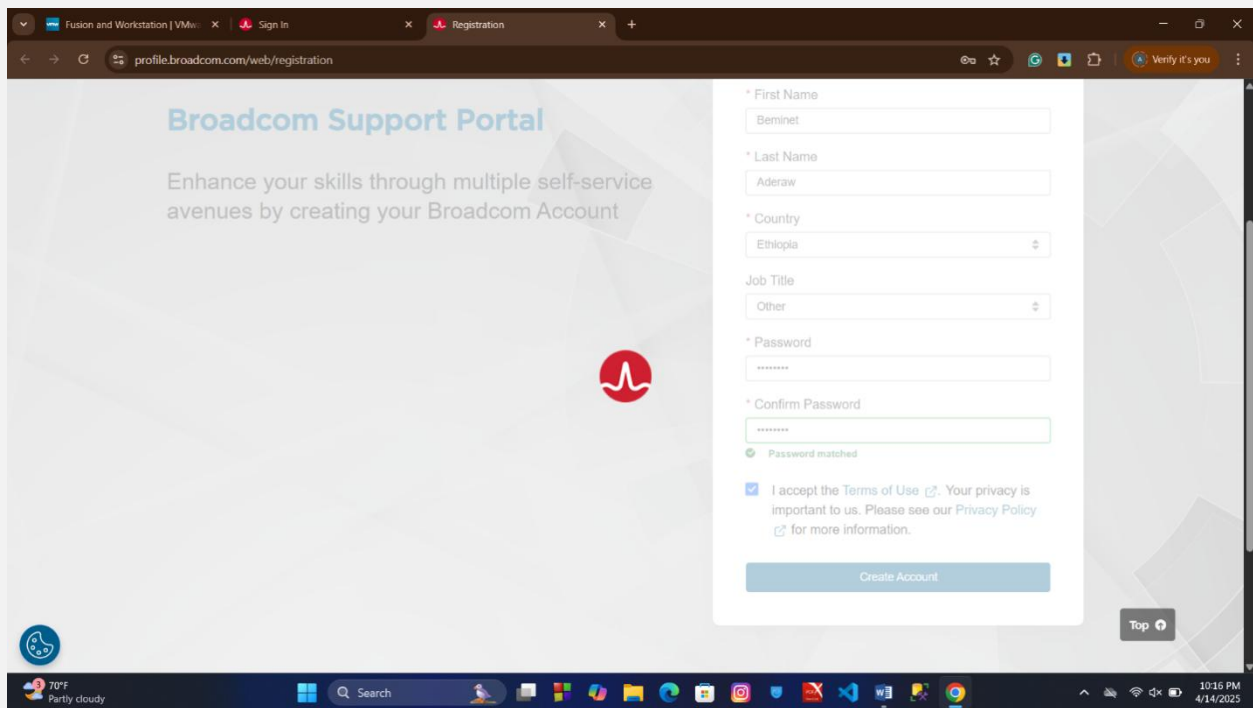
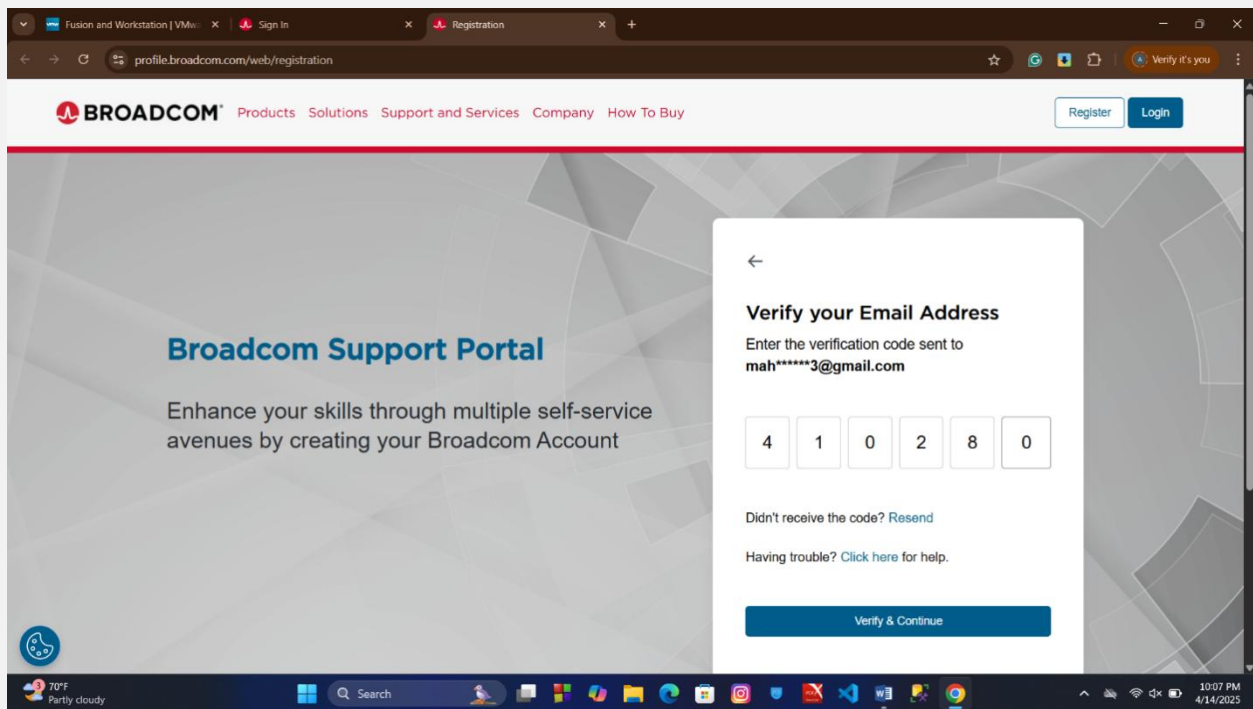
4.2 Software:

- * VMware Workstation: (Specify the version used: e.g., VMware Workstation 17 Pro)
- * Calculate Linux ISO Image: (Specify the version used and download link: e.g., Calculate Linux Desktop 23, [Download Link])

5. Installation Steps

1.Download VMware Workstation: Download the appropriate version of VMware Workstation for your host operating system from the VMware website.





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Workstation	17.x	Any	CVE-2024-22270	7.1	Important	17.5.2	None	None
Fusion	13.x	OS X	CVE-2024-22270	7.1	Important	13.5.2	None	None

4. References:

Fixed Version(s) and Release Notes:

Workstation Pro 17.5.2

Downloads and Documentation

<https://support.broadcom.com/group/ecx/productdownloads?subfamily=VMware%20Workstation%20Pro>
<https://docs.vmware.com/en/VMware-Workstation-Pro/17.5.2/m/vmware-workstation-1752-pro-release-notes/index.html>

Fusion 13.5.2

Downloads and Documentation

<https://support.broadcom.com/group/ecx/productdownloads?subfamily=VMware%20Fusion>
<https://docs.vmware.com/en/VMware-Fusion/13.5.2/m/vmware-fusion-1352-release-notes/index.html>

Mitre CVE Dictionary Links:

<https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2024-22267>
<https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2024-22268>
<https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2024-22269>
<https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2024-22270>

FIRST CVSSv3 Calculator:

CVE-2024-22267: <https://www.first.org/cvss/calculator/3.1#CVSS:3.1/AV:L/AC:L/PR:N/UI:N/S:C/C:H/I:A/H>

CVE-2024-22268: <https://www.first.org/cvss/calculator/3.1#CVSS:3.1/AV:L/AC:L/PR:N/UI:N/S:C/C:N/I:A/H>

CVE-2024-22269: <https://www.first.org/cvss/calculator/3.1#CVSS:3.1/AV:L/AC:L/PR:N/UI:N/S:C/C:H/I:A/N>

CVE-2024-22270: <https://www.first.org/cvss/calculator/3.1#CVSS:3.1/AV:L/AC:L/PR:N/UI:N/S:C/C:H/I:A/N>

5. Change Log:

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VMSA-2024-0010: VMware Workstation and Fusion updates address multiple security vulnerabilities (CVE-

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VMware Workstation Pro (For Windows) Release 17.6.3

File Name	Release Date	Last Updated	SHA2	MD5
VMware Workstation Pro for Windows VMware-workstation-full-17.6.3-24583834.exe(401.43 MB) Build Number: 24583834	Mar 04, 2025	Feb 24, 2025	d7c04b4dd1e6b1551693897d4805e99c45198a830c6381d9af8267b40906857b	de592b18a39513e3414f197ec1a4cb1c

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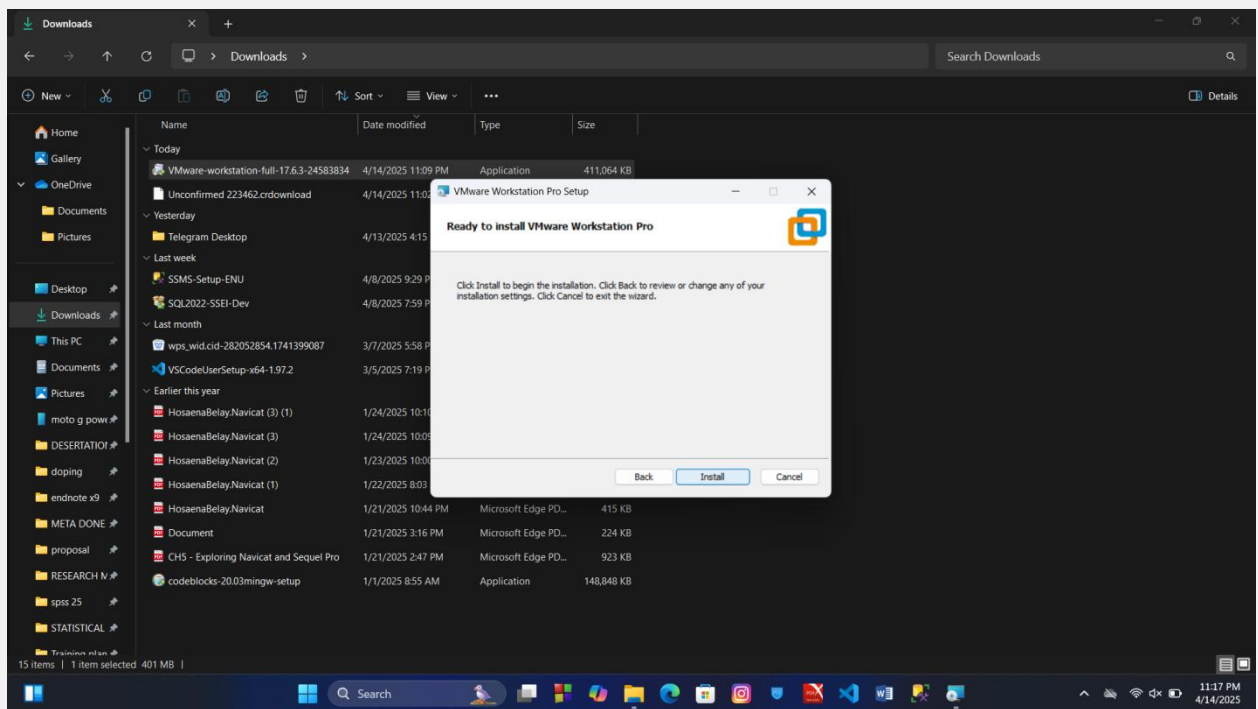
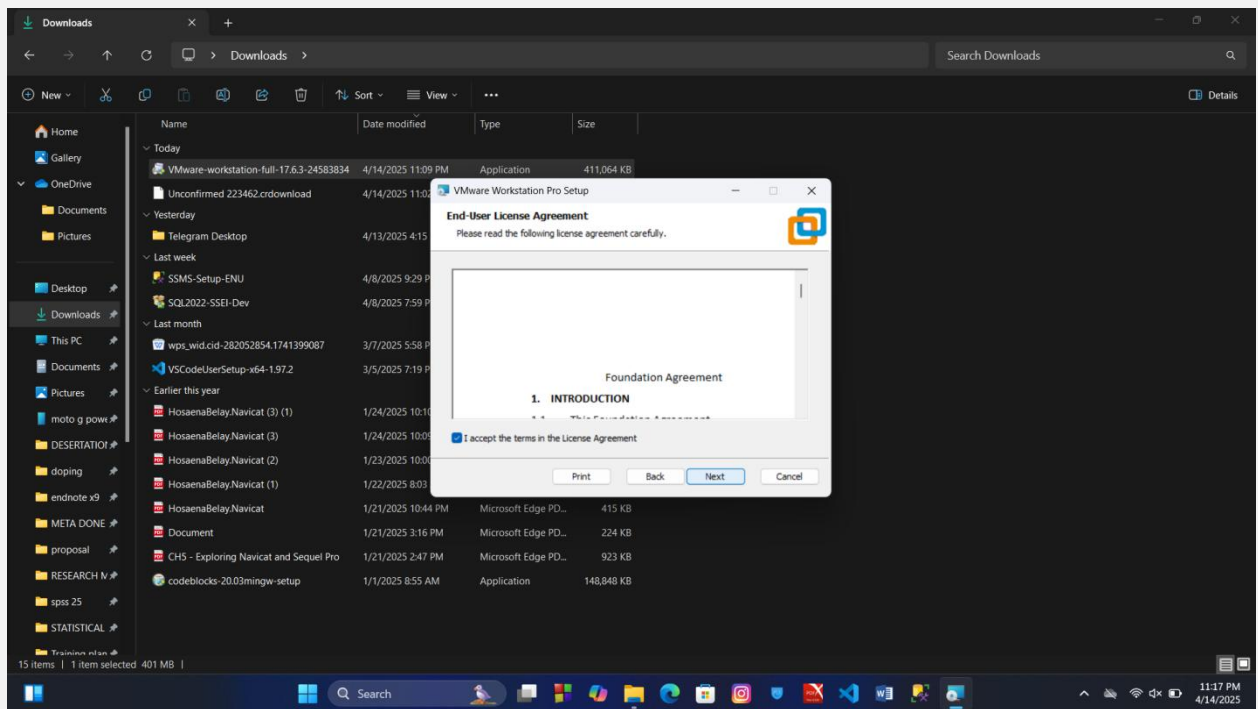
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2. Download Calculate Linux ISO: Download the Calculate Linux Desktop ISO image from the official Calculate Linux website .

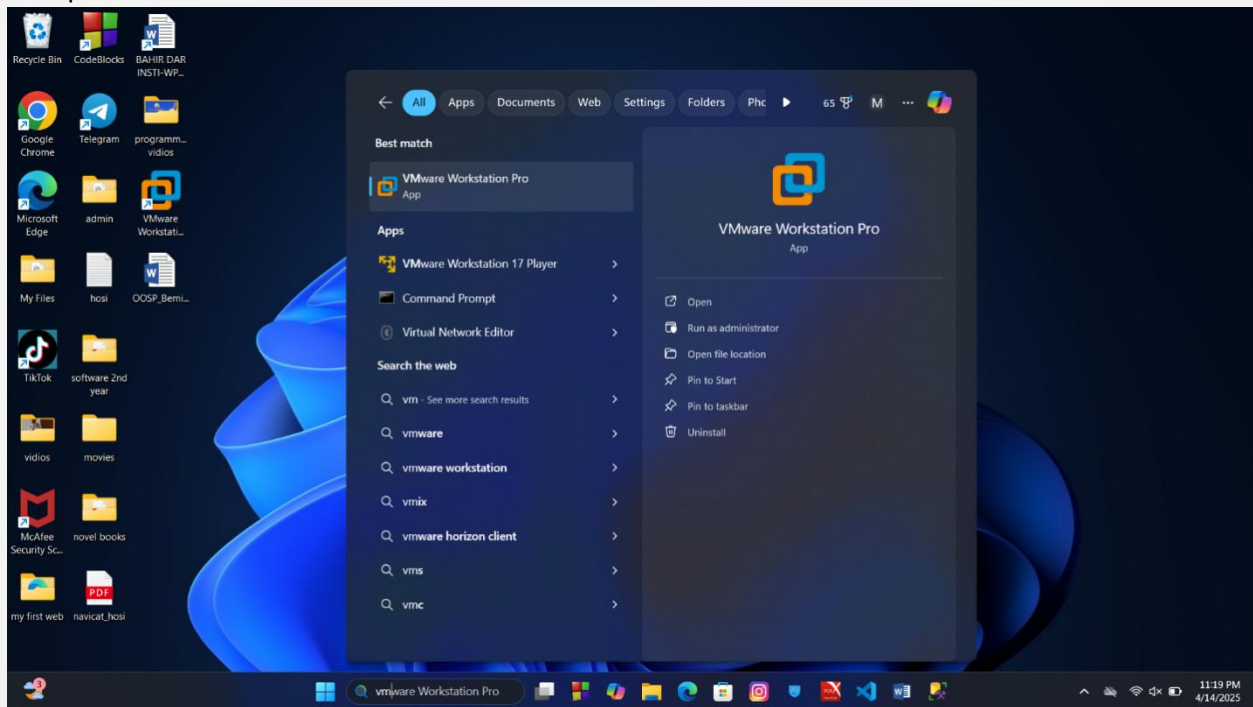
The screenshot displays a web browser window with the URL <http://gtlib.gatech.edu/pub/calculate/release/21/>. The page title is "Index of /pub/calculate/release/21". It lists various files for download, including ISO images and torrents. The file [cld-21-x86_64.iso](#) is highlighted, showing a size of 813 MB.

Below the browser window, a file manager window is open, showing the "Downloads" folder. The file [cld-21-x86_64.iso](#) is listed with a size of 813 MB. The file manager also shows other files like [cld-21-x86_64.list](#) and [cld-21-x86_64.iso](#).

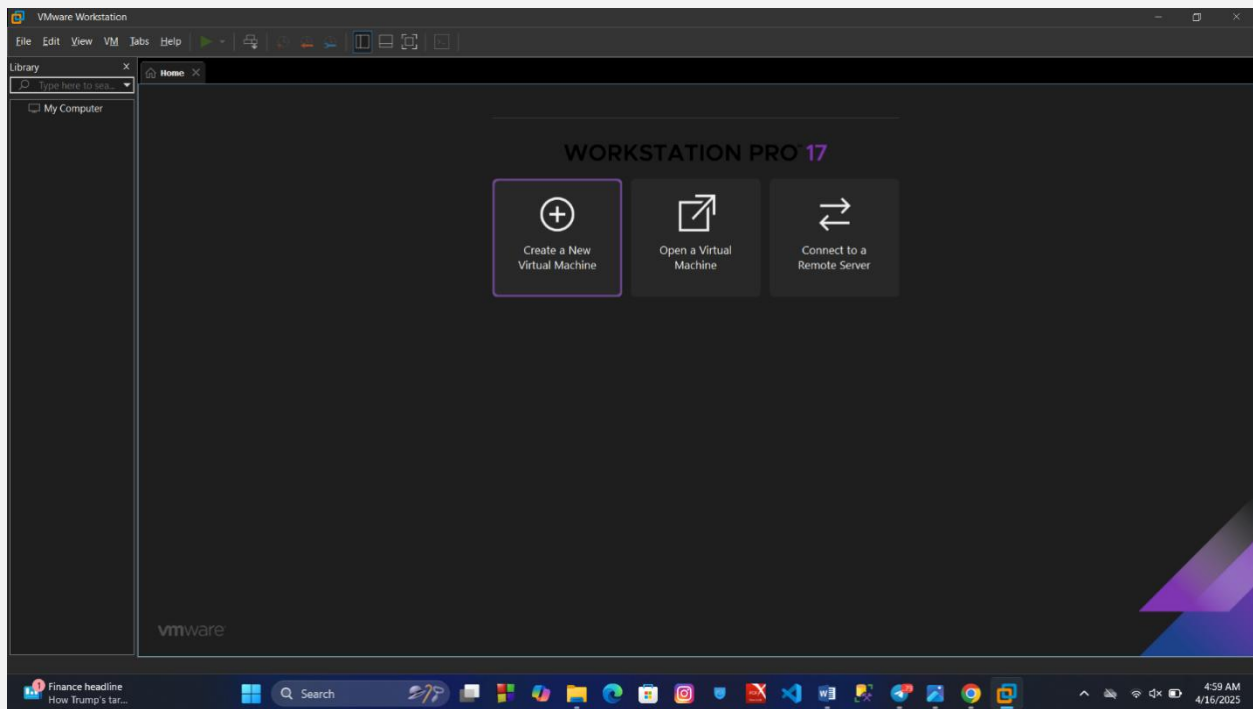
The taskbar at the bottom shows the system clock as 5:34 AM on 4/16/2025.

3. Create a New Virtual Machine in VMware Workstation:

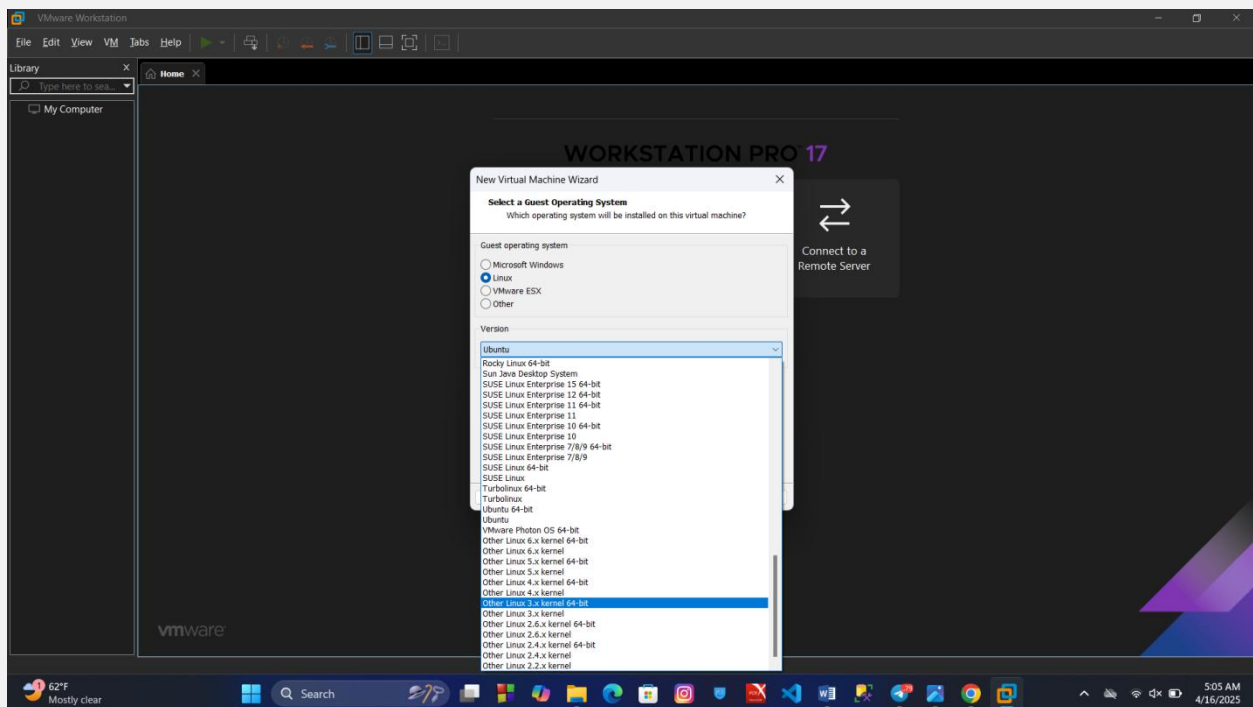
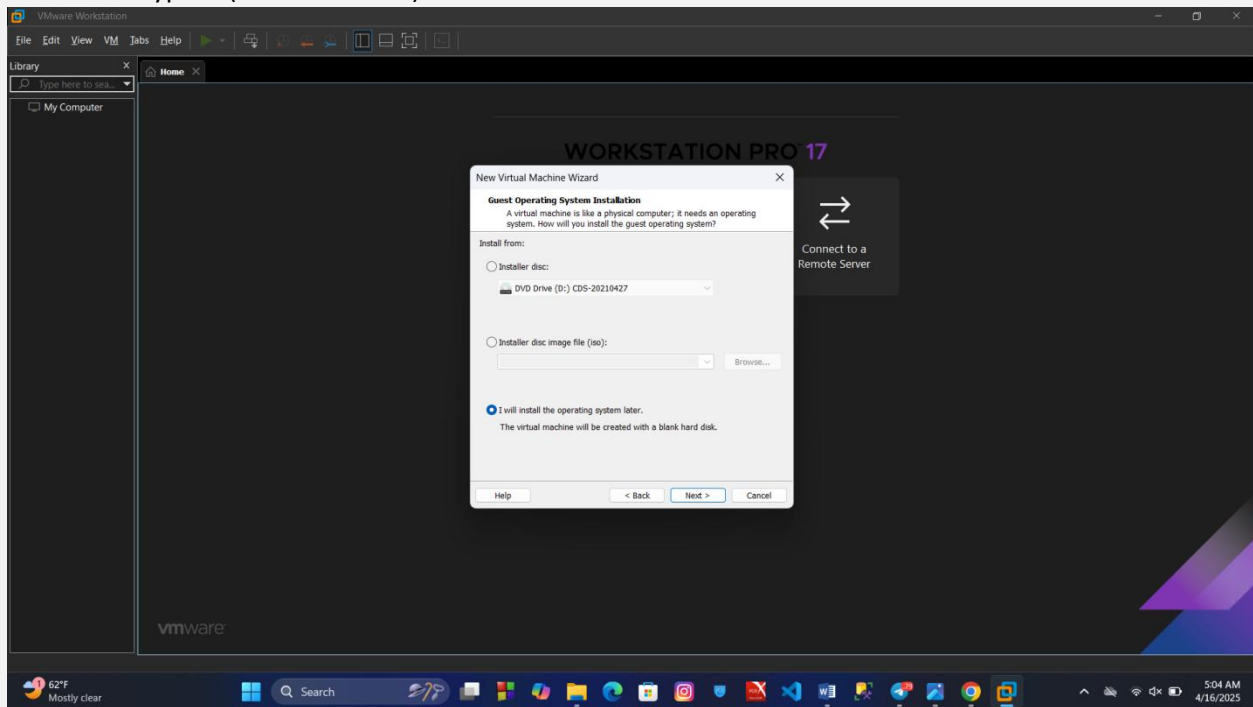
- Open VMware Workstation.

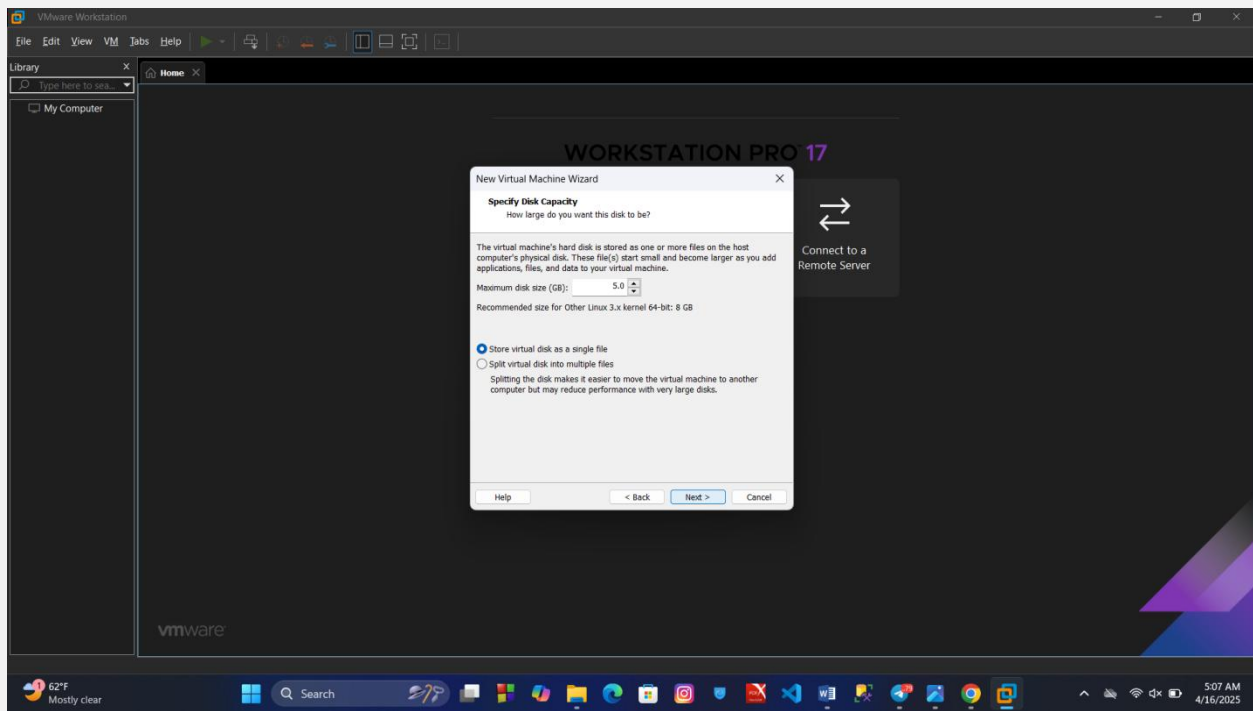


- Click "Create a New Virtual Machine."

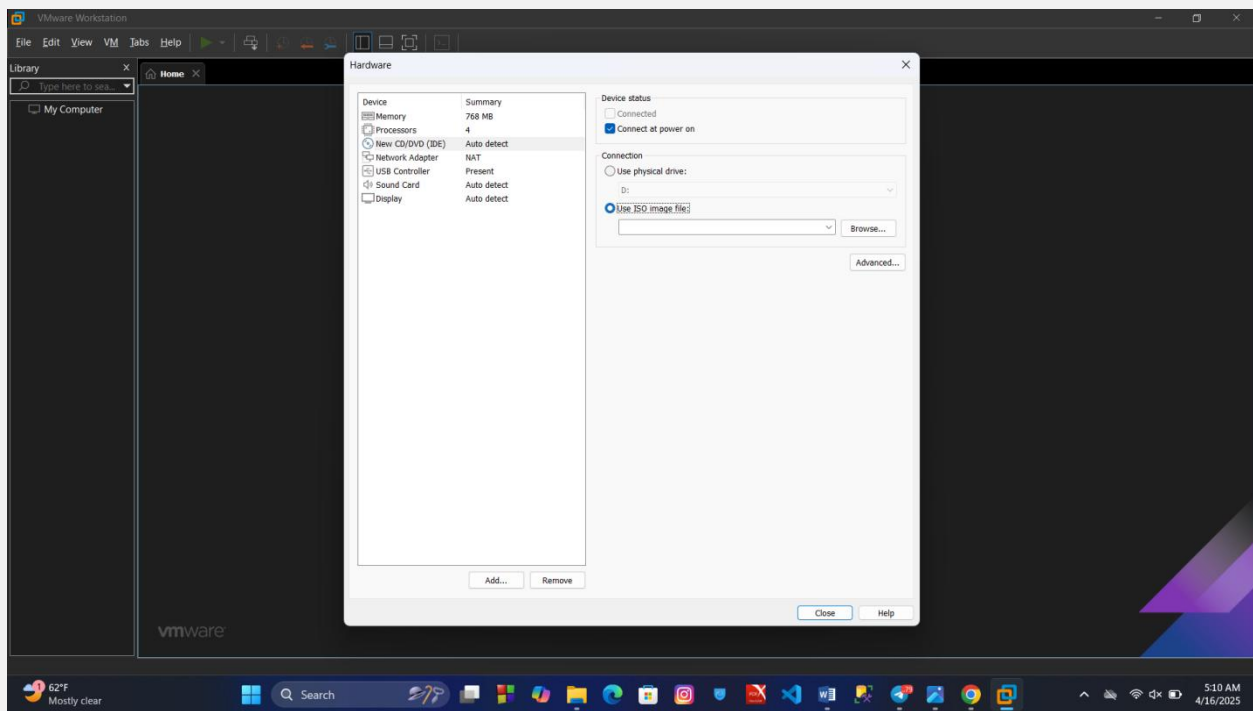


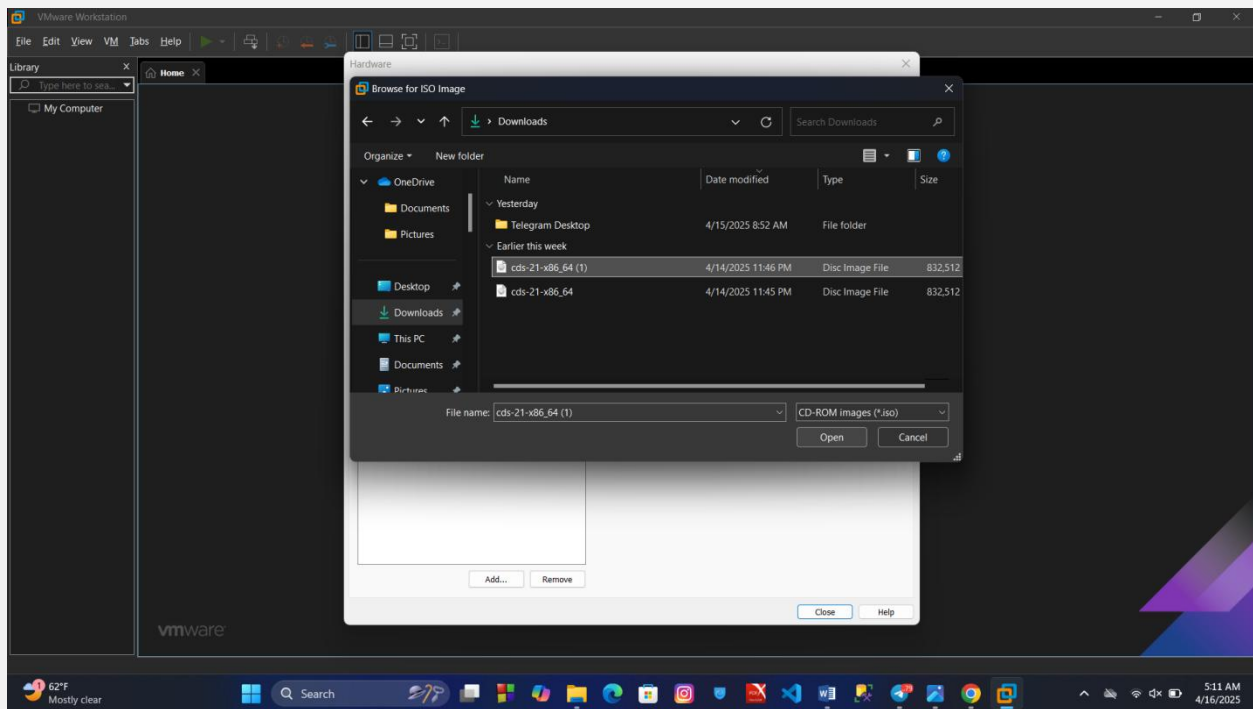
- Select "Typical (recommended)" and click "Next."



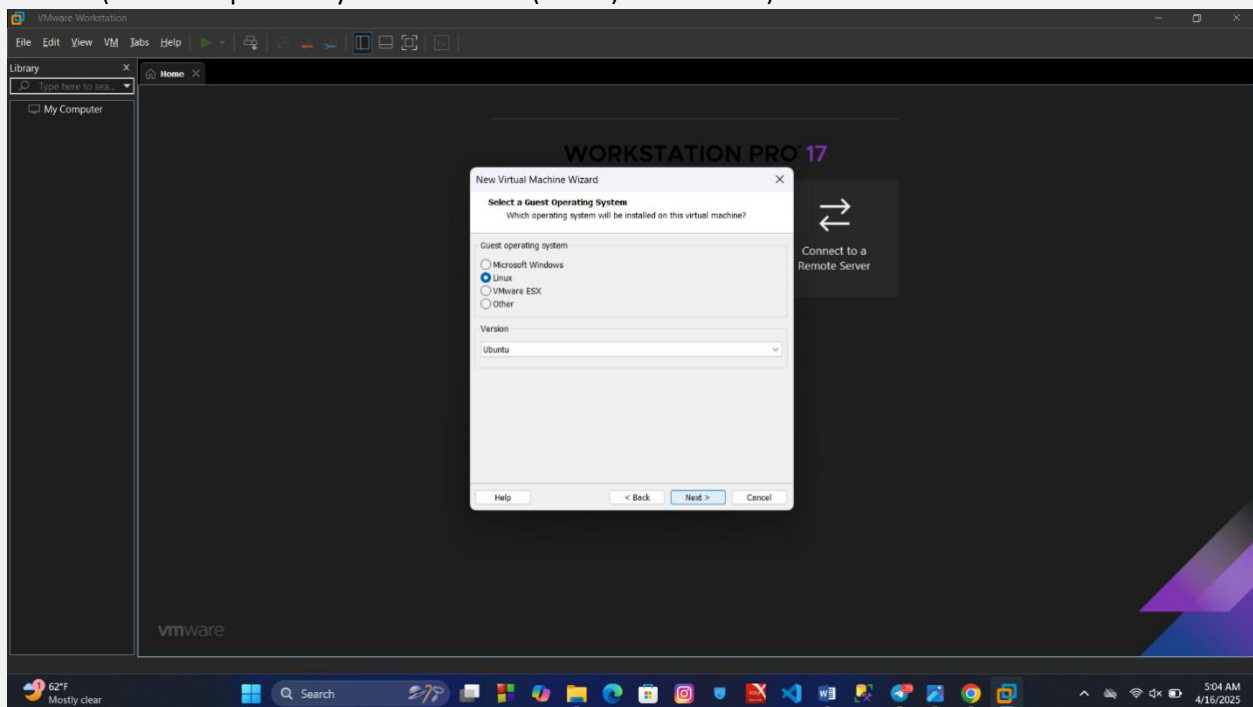


- Choose "Installer disc image file (ISO)" and browse to the downloaded Calculate Linux ISO image. Click "Next."



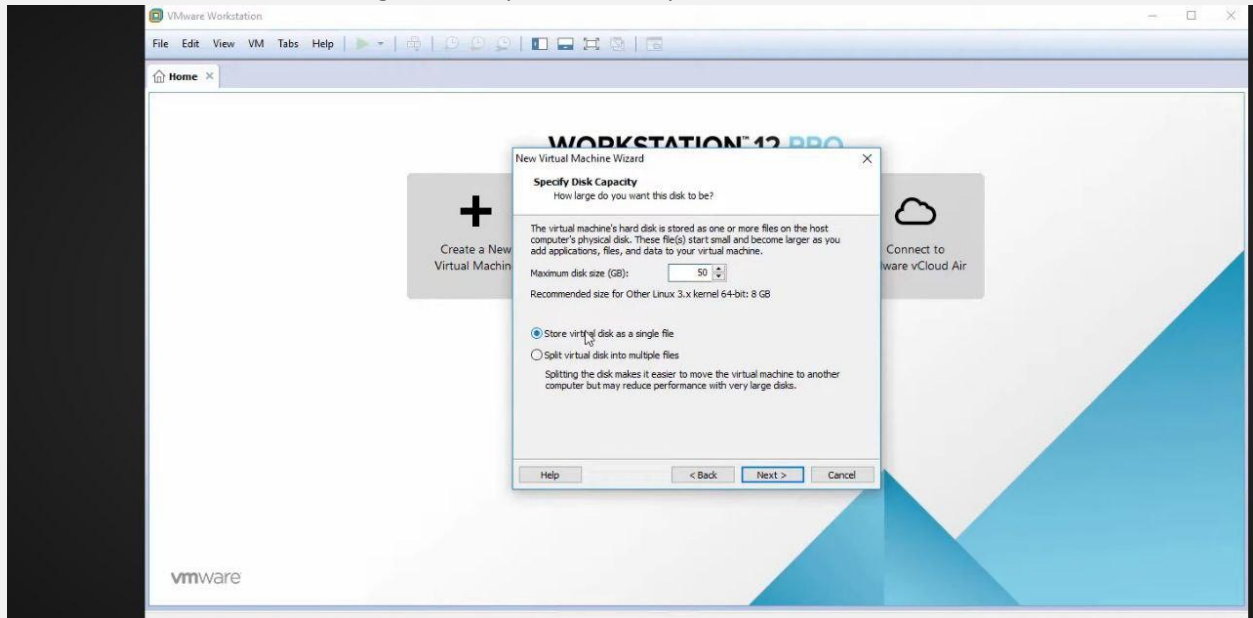


- Select "Linux" as the guest operating system and "Other Linux 5.x or later kernel 64-bit" as the version (or select specifically "Gentoo Linux (64-bit)" if available) then click "Next."

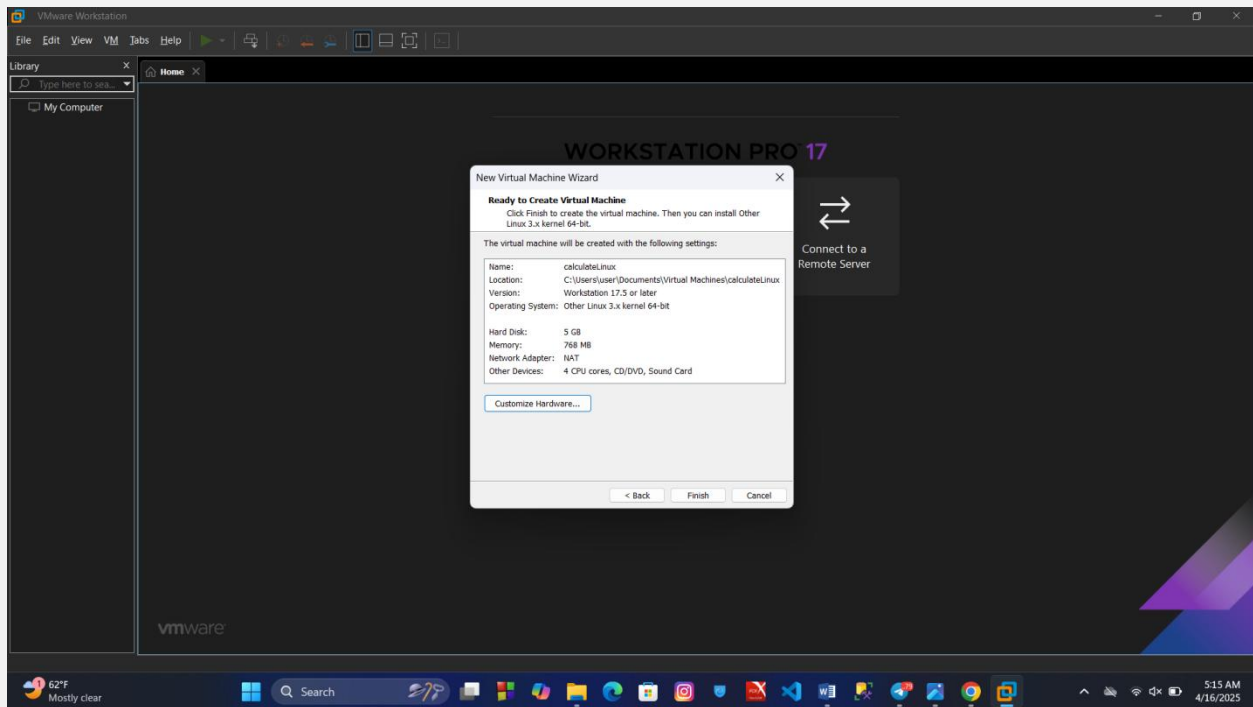


- Name the virtual machine (e.g., "Calculate Linux") and choose a location to store the virtual machine files. Click "Next."

- Specify the disk size. 20GB is a reasonable minimum, but adjust based on your needs. Choose whether to store the virtual disk as a single file or split into multiple files. Click "Next."

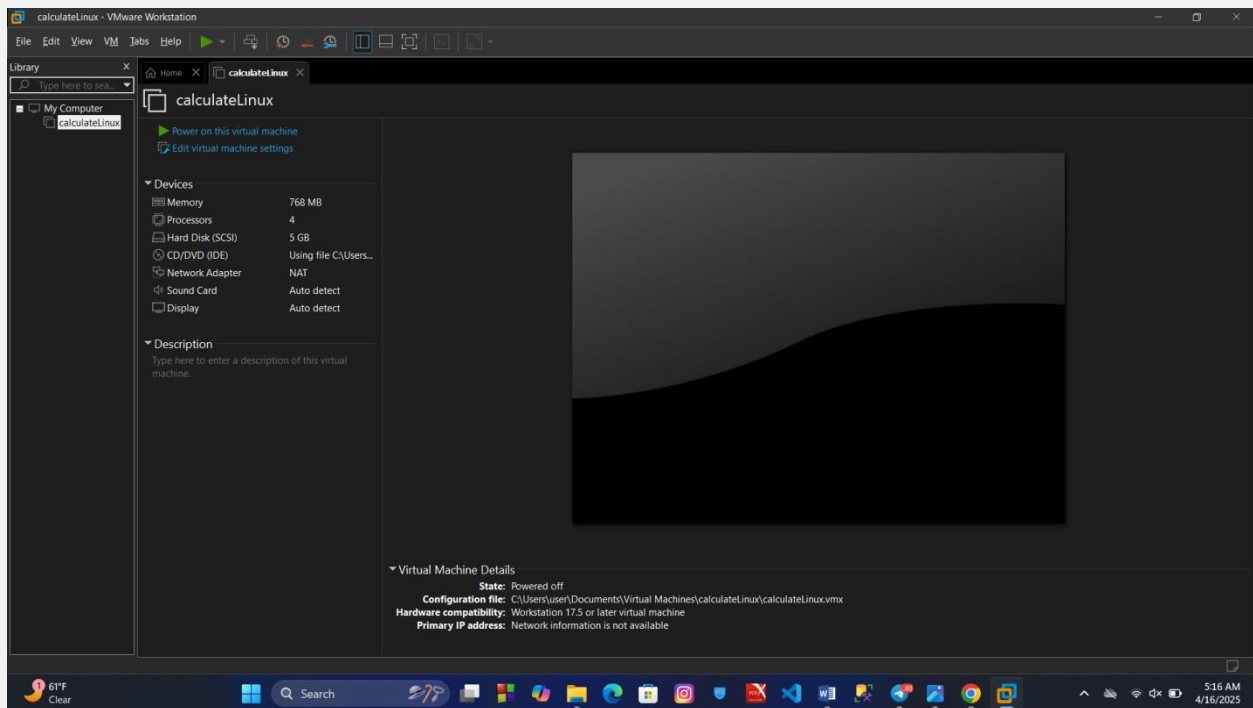


- Review the settings and click "Customize Hardware" to adjust RAM, network adapter, etc., if needed.
 - * Adjust RAM to 4GB or more.
 - * Ensure the Network Adapter is set to "NAT" (Network Address Translation) for internet access within the VM.
- Click "Finish."



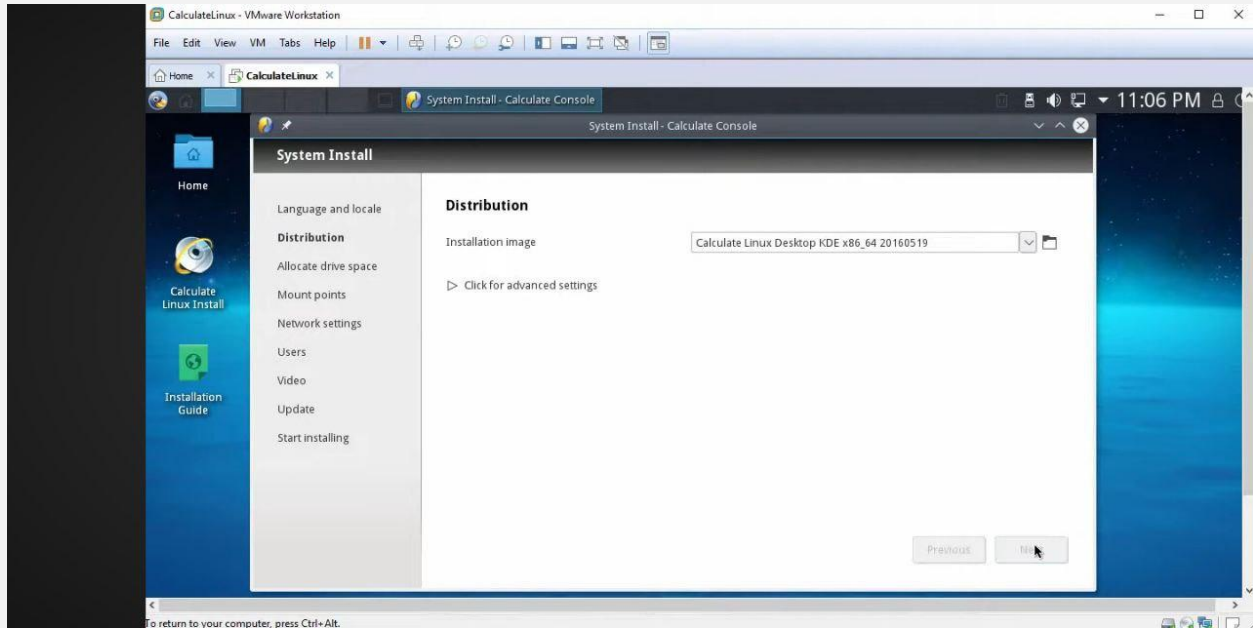
4. Start the Virtual Machine:

- Select the newly created virtual machine in VMware Workstation and click "Power on this virtual machine."

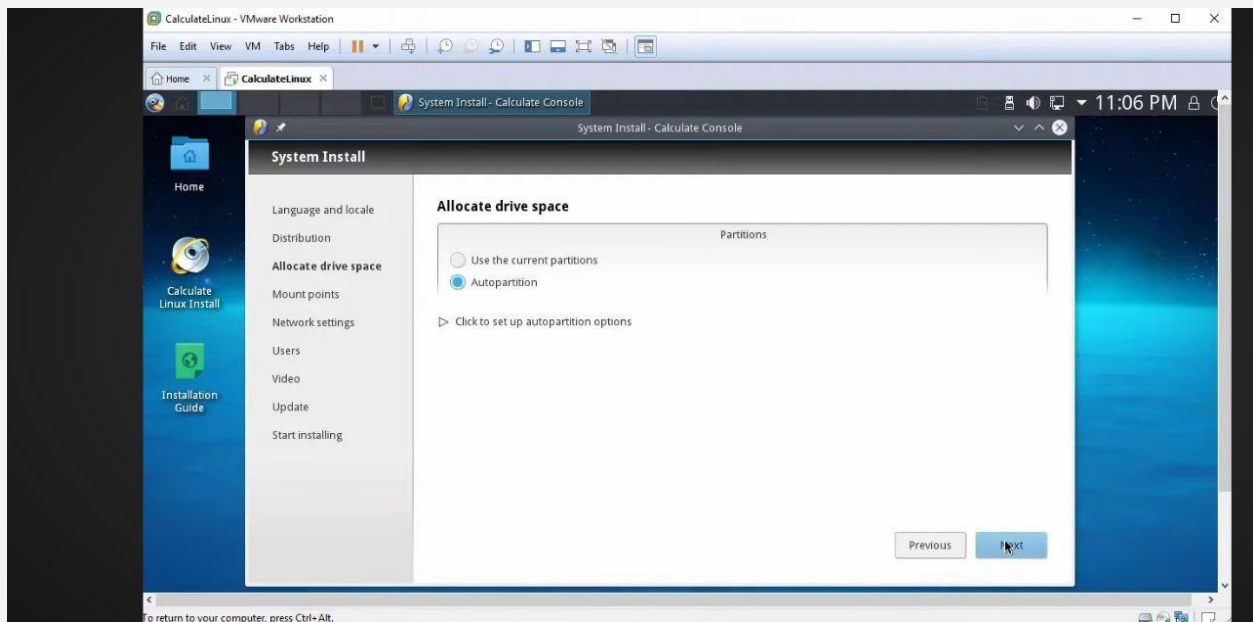


5. Install Calculate Linux:

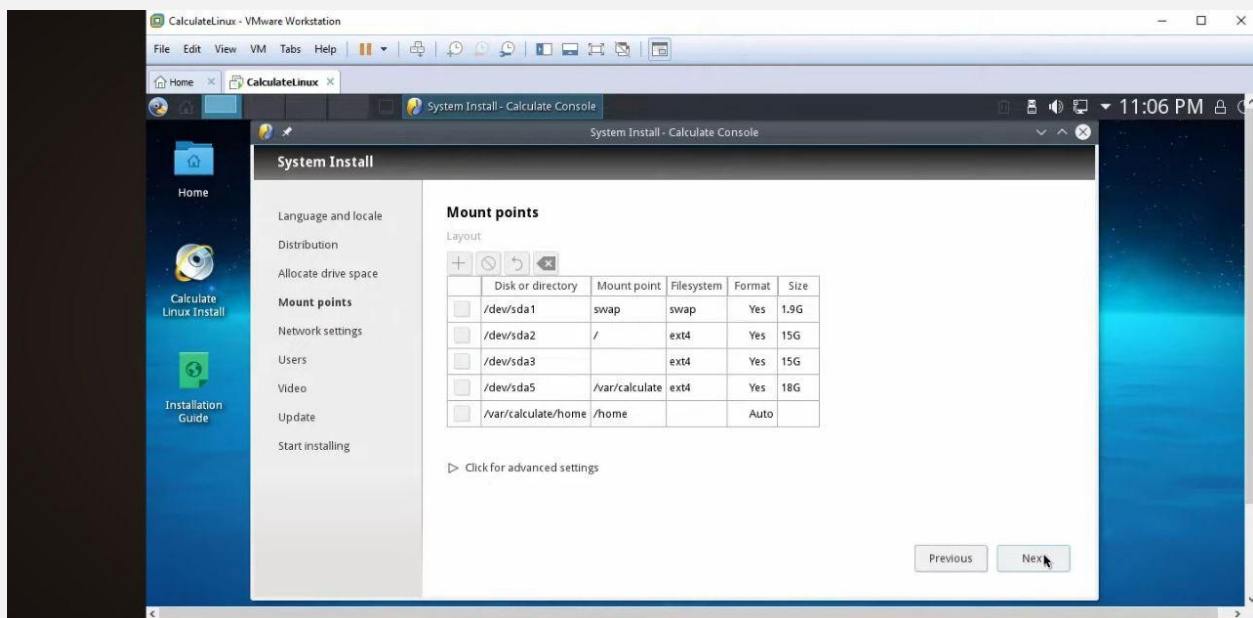
- The virtual machine will boot from the ISO image. Follow the on-screen instructions to begin the Calculate Linux installation.



- The exact installation process will depend on the Calculate Linux version and the chosen desktop environment. Generally, this involves:
 - * Setting the keyboard layout.
 - * Configuring the network connection (if not automatically configured).
 - * Partitioning the virtual hard drive. (Use a tool like cfdisk or a graphical partitioning tool if available. Create a root partition / and optionally a swap partition.)

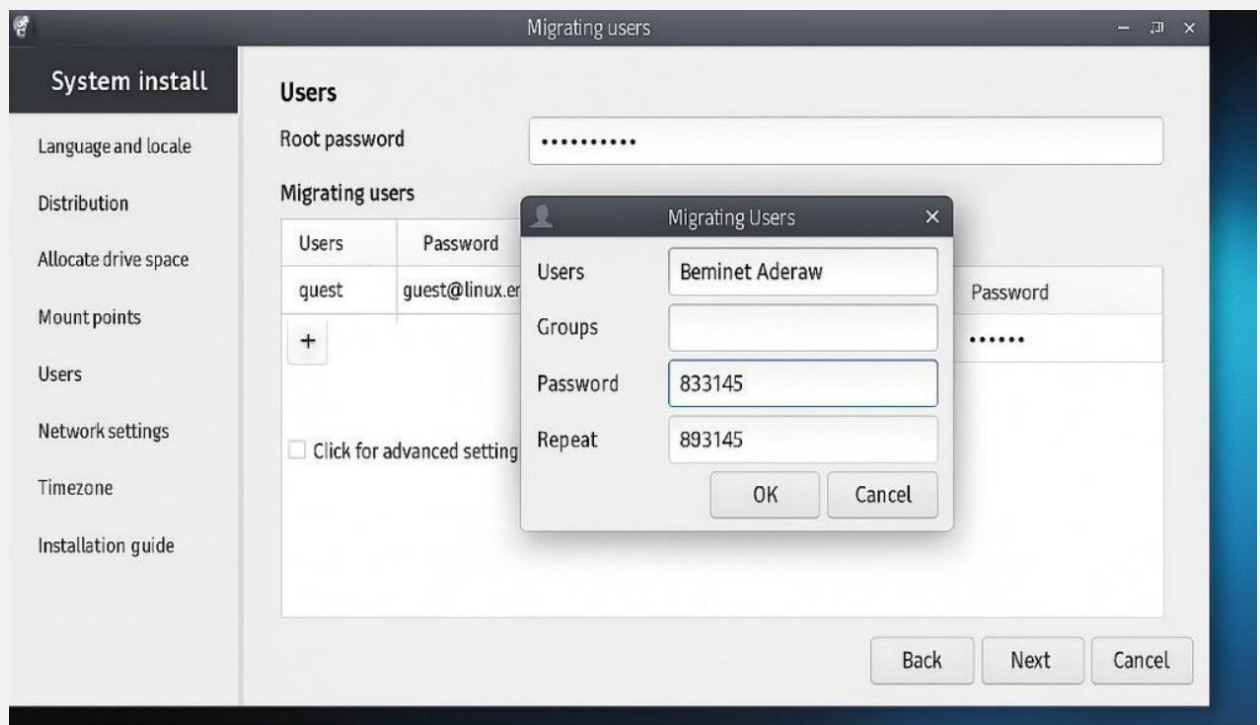
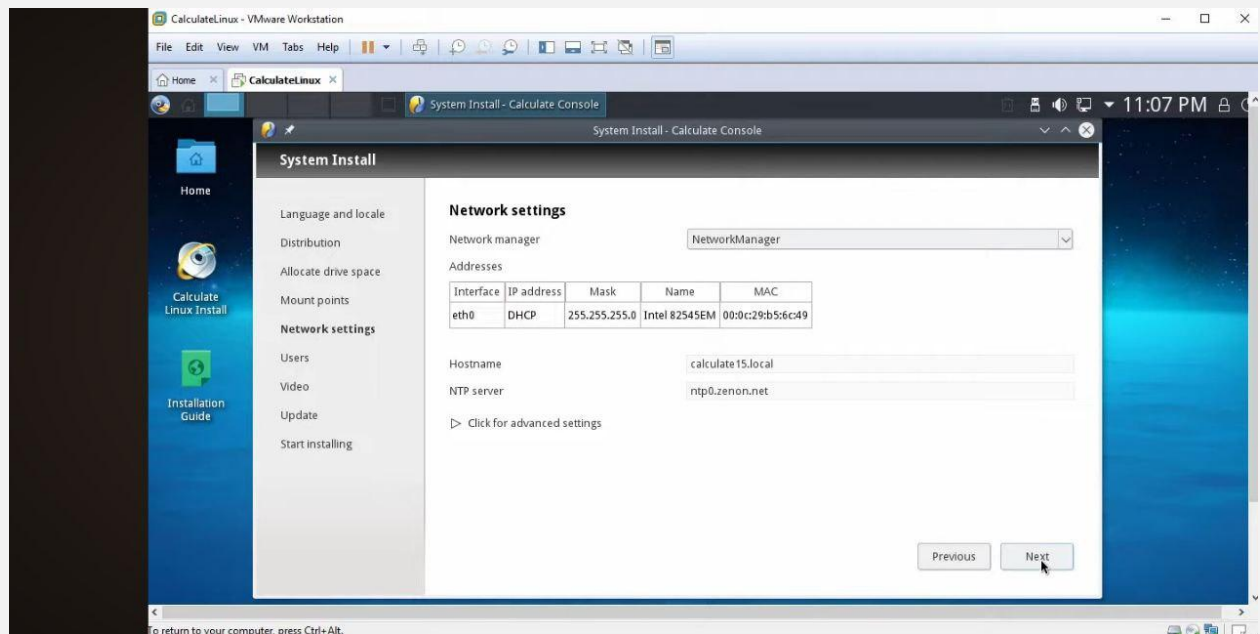


* Mounting the partitions.

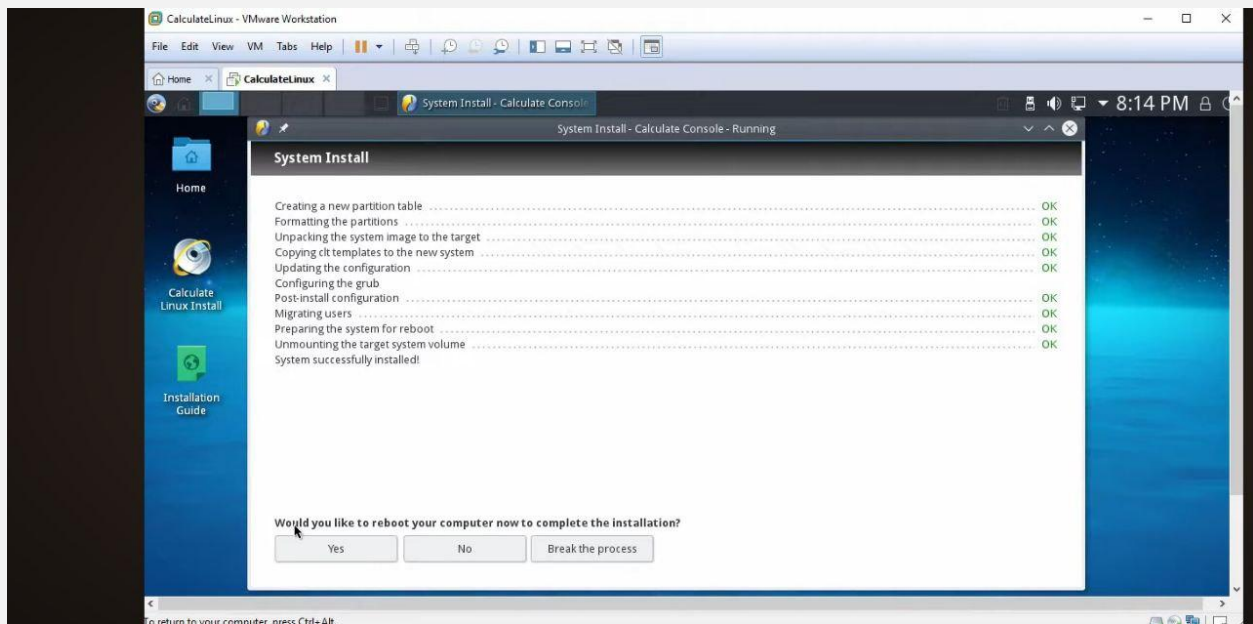
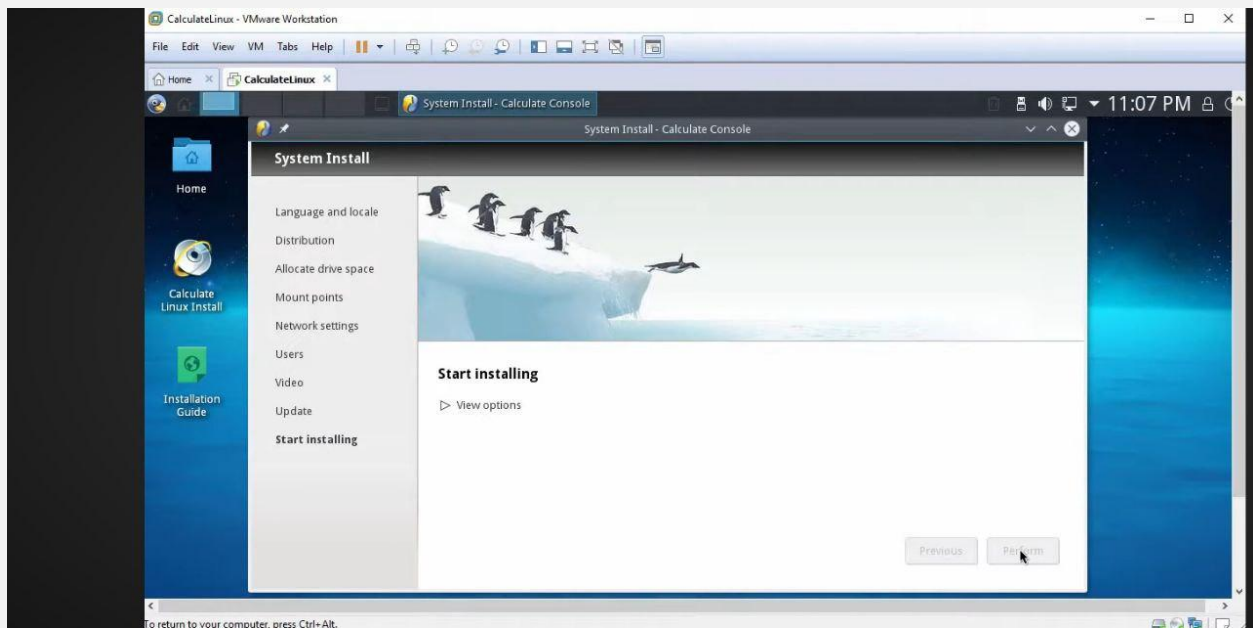


* Choosing the location to install the bootloader (GRUB or LILO)

* Configuring the system (hostname, time zone, users)



* Installing the base system.



- * Installing the bootloader.
- * Rebooting the system.

6. Install VMware Tools (Recommended): After the Calculate Linux installation is complete and you have logged in, install VMware Tools for improved performance and integration with the host operating system.

- In VMware Workstation, go to "VM" > "Install VMware Tools."

- Follow the on-screen instructions within the Calculate Linux virtual machine to mount the VMware Tools CD-ROM and install the tools. This typically involves extracting the VMware Tools archive to a temporary directory, running the installer script, and answering a series of questions.

6. Issues (Problems Faced):Any problems I encountered during the installation is :

In step 1 : Download corruption. The downloaded VMware Workstation installer might be corrupted, leading to installation errors.

In step 2 : Website unavailability. The Calculate Linux website may be temporarily unavailable, preventing the download

In step 3 : Insufficient Host Resources: If the hard disk is running out of space the VM creation may not proceed

In step 5 : Network Configuration Problems: The network adapter might not be automatically configured, preventing internet access within the virtual machine.

In step 6 : Incompatible Kernel: If the kernel is too old, the version may not be supported with the VM Tools installer.

7. Solutions:(solutions for the problems listed above)

- * Solution: Re-download the installer from the VMware website and verify its checksum (if provided).
- * Solution: Try downloading at a later time. Also confirm if your internet is working.
- * Solution: Free up space on your host computer's hard disk or select a location on a different drive with more space.
- * Solution: Manually configure the network settings within Calculate Linux. This might involve editing network configuration files or using a network management tool. If using DHCP does not work, use `cl-setup-network` with a static IP, netmask, gateway and DNS server.
- * Solution: Perform system updates and install the latest kernel and then install.

8. File System Support:

- **ext4 (Fourth Extended Filesystem):** This is the most commonly used and recommended file system for Calculate Linux, especially for the root partition (/) and home partition (/home).

Because:

- * **Mature and Stable:** ext4 is a well-established and thoroughly tested file system, making it very reliable.

- * **Good Performance:** It offers excellent performance for a wide range of workloads, suitable for both desktop and server use.

- * **Journaling:** It's a journaling file system, which means it maintains a log of changes before writing them to disk. This helps prevent data corruption in case of a system crash or power outage.

- * **Large File and Volume Support:** ext4 supports large file sizes and volume sizes, making it suitable for modern storage devices.

- * **Widely Supported:** It's supported by almost all Linux distributions, making it easy to move data and partitions between systems.

- **Btrfs (B-tree file system):** This is a modern file system gaining popularity, especially for its advanced features. Because:

- * **Copy-on-Write (CoW):** Btrfs uses a CoW mechanism, which means that when a file is modified, the changes are written to a new location on the disk, leaving the original file intact. This allows for easy snapshots and rollback.

- * **Snapshots:** Btrfs supports creating snapshots of the file system, which can be used to quickly restore the system to a previous state.

- * **Subvolumes:** It allows you to create subvolumes, which are like separate partitions within a single partition. This can be useful for organizing your data.

- * **Checksumming:** Btrfs uses checksumming to detect and correct data corruption.

- **XFS (Extended File System):** Another journaling file system known for its scalability and performance, often used in server environments.

Because:

- * **Scalability:** XFS is designed to handle very large files and volumes.

- * **Performance:** It offers excellent performance for large file I/O.

- * **Journaling:** Like ext4 and Btrfs, it's a journaling file system.

- * **Suitable for Servers:** Commonly used on servers and storage systems.

9. Advantages and Disadvantages:

9.1 Advantages of Calculate Linux:

- **Gentoo-based:** Offers high degree of customization and optimization.

- **Rolling Release:** Always up-to-date with the latest software.
- **Pre-built Templates:** Simplifies common tasks and configurations.
- **Good performance:** Well designed and stable.
- **Centralized Management (Server):** Easy to manage users and resources with CDS.
- **Easy to Install & Use:** User-friendly installer, pre-configured environment.

9.2 Disadvantages of Calculate Linux:

- **Gentoo Complexity:** Portage package manager can be difficult to learn.
 - **Smaller Community:** Less online support than major distros.
 - **Can Be Resource Intensive:** Compiling from source (Portage) takes time and power.
 - **Steeper Learning Curve:** Requires more Linux knowledge than some easier distros.
 - **Hardware Compatibility (Potential):** Might need extra tweaking for some hardware.
- * Can require more manual configuration, especially for advanced features.
- * Rolling-release model can sometimes lead to instability, although Calculate Linux aims to mitigate this through testing and quality assurance.

10. Conclusion:

Installing Calculate Linux in VMware Workstation provides a convenient and safe way to explore this powerful and customizable distribution. While the installation process involves several steps, following this guide should enable most users to successfully set up a Calculate Linux virtual machine. Understanding potential issues and solutions is crucial for a smooth installation experience.

Calculate Linux presents a compelling option for experienced Linux users seeking a highly customizable and perpetually up-to-date operating system; its Gentoo-based flexibility allows for fine-grained control and optimization, while its user-friendly utilities and modular design ease the initial setup and ongoing management; however, the inherent complexity of the Portage package management system and the relatively smaller community may pose challenges for newcomers, making it best suited for those comfortable with delving into the intricacies of Linux system administration.

11. Future Outlook / Recommendations:

- Explore different desktop environments available in Calculate Linux to find the one that best suits your needs.
- Experiment with Calculate Linux's customization features to tailor the system to your specific requirements.
- Investigate the use of Docker or other containerization technologies within the Calculate Linux virtual machine for further isolation and application management.
- Consider setting up a dual-boot environment to run Calculate Linux directly on your hardware for improved performance if you find it suits your needs.
- Automate more of the installation (using kickstart or other preseed/automated configuration methods).

12.Virtualization

12.1 What is Virtualization in modern operating system?

Virtualization is the technology that allows you to run multiple operating systems (or multiple instances of the same OS) on a single physical machine. Each OS runs inside a "virtual machine" (VM), which is essentially a software-defined computer. The VMs are isolated from each other and from the host operating system.

Virtualization in modern operating systems allows multiple virtual machines (VMs) to run on a single physical machine, each with its own operating system and applications.

Virtualization is the creation of a virtual (rather than actual) version of something, like a computer operating system, a server, a storage device, or a network resource. In simpler terms, it's the technology that lets you run one or more operating systems on the same physical piece of hardware, at the same time. It's like having multiple computers inside one physical computer.

Virtualization is technology that you can use to create virtual representations of servers, storage, networks and other physical machines.

12.2 Why Use Virtualization in modern operating system?

- Resource Optimization: Consolidate multiple physical servers onto fewer machines, reducing hardware costs, power consumption, and cooling expenses.
- Flexibility and Agility: Quickly create, deploy, and move VMs to respond to changing business needs.

- **Testing and Development:** Create isolated environments for testing software, trying out new operating systems, or reproducing bugs without affecting the host system.
- **Disaster Recovery:** Easily back up and restore entire VMs, allowing for quick recovery from failures.
- **Security:** VMs provide isolation, which can improve security by limiting the impact of malware or other security breaches.
- **Legacy Application Support:** Run older applications that are not compatible with modern operating systems inside a VM running the required legacy OS.

12.3.How Does Virtualization Work?

Virtualization is achieved through a combination of hardware and software techniques:

- **Hypervisor (Virtual Machine Monitor - VMM):** This is the core component of virtualization. It's a software layer that sits between the hardware and the VMs. The hypervisor manages the VMs, allocates resources (CPU, memory, storage, network), and provides a virtualized hardware environment for each VM. There are two main types of hypervisors:
 - **Type 1 (Bare-Metal):** Runs directly on the hardware (e.g., VMware ESXi, Citrix XenServer). These are typically used in server environments.
 - **Type 2 (Hosted):** Runs on top of an existing operating system (e.g., VMware Workstation, VirtualBox). These are typically used on desktop computers.
- **Hardware Virtualization Support:** Modern CPUs (Intel VT-x and AMD-V) provide hardware-assisted virtualization, which improves the performance and efficiency of virtualization. This allows the hypervisor to more efficiently manage the VMs.
- **Virtual Hardware:** The hypervisor presents each VM with a virtualized set of hardware resources, including a virtual CPU, virtual memory, virtual disk, virtual network adapter, etc. The VM believes it's running on real hardware, but it's actually running on a software-defined environment.
- **virtual machines:** VMs are virtual instance of computer system, each with its own operating system and applications. They can run the same physical hardware as the host operating system.

In simple terms, the hypervisor creates a simulated hardware environment for each VM, allowing them to run independently on the same physical machine. Hardware virtualization features in modern CPUs make this process more efficient and performant. This allows users to maximize utilization of physical resources, improve flexibility, and enhance security.