

# **Virtualization with VirtualBox using CentOS!**

## **MINOR PROJECT REPORT**

*Submitted by*

**VIRENDER THAKUR (24MCC20054)**

*in partial fulfillment for the award of the degree of*

**Master of Computer Applications**

**Cloud Computing & DevOps**

In

University Institute of Computing



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**Chandigarh University**

**November 2024**



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## **BONAFIDE CERTIFICATE**

I certify that this project report, “**Virtualization with VirtualBox using CentOS!**” is the bona fide work of VIRENDER THAKUR, who did the project work under my/our supervision.

**SIGNATURE**

**Dr. Abdullah**

**HOD**

**UIC**

**SIGNATURE**

**Mr. Rishab Tomar**

**SUPERVISOR**

**UIC**

Submitted for the project viva voce examination held on **Nov 2024**

**INTERNAL EXAMINER**

**EXTERNAL EXAMINER**

## Declaration

I at this moment declare that the project report entitled “**Virtualization with VirtualBox using CentOS**” Submitted by me to the **University Institute of Computing, Chandigarh University, Gharuan**, in partial fulfillment of the requirement for the award of the degree “**Master of Computer Application- Cloud Computing & DevOps**” is a Bonafede project work carried out by me under the guidance of “**Mr. Rishab Tomar.**” I further declare that the work reported in this project has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.

**Project Guide:** Mr. Rishab Tomar

**HOD:** Dr. Abdullah

**Date:** November, 2024

**Submitted by:**

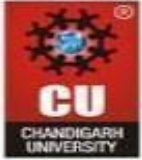
**Virender Thakur (24MCC20054)**

## **Certificate Of Originality**

This is to certify that the project report entitled “**Virtualization with VirtualBox using CentOS**” submitted by me in partial fulfillment of the requirements for the award of the Degree Master of Computer Application- Cloud Computing & DevOps (MCA CC & DevOps) is a bonafide record of the work carried out under my guidance and supervision at the University Institute of Computing of the Chandigarh University.

**Submitted by:**

Virender Thakur (24MCC20054)



## **Acknowledgment**

I take immense pleasure in thanking our HOD Dr. Abdullah for permitting me to carry out this project work. I wish to express my deep sense of gratitude to my Guide Mr. Rishab Tomar for his able guidance and useful suggestions, which helped me in completing the project work, in time. Words are inadequate in offering my thanks for his encouragement and cooperation in carrying out the project work. Finally, yet importantly, I would like to express my heartfelt thanks to my beloved parents and their blessings, and my friends & classmates for their help and wishes for the successful completion of this project.

**Date:** Nov, 2024

**Place:** University Institute of Computing, Chandigarh University **Submitted**

**by:**

Virender Thakur (24MCC20054)



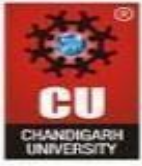
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## **Abstract –**

This document explores the implementation of CentOS virtualization using Oracle VirtualBox, a powerful and open-source virtualization software. CentOS, a community-driven distribution based on Red Hat Enterprise Linux (RHEL), serves as an ideal environment for learning, development, and testing. VirtualBox provides a flexible platform for creating, managing, and running multiple virtual machines on a single physical host. The virtualization of CentOS within VirtualBox allows users to harness the capabilities of this robust operating system without the need for dedicated hardware.

This abstract outlines the process of installing and configuring CentOS in a VirtualBox environment, emphasizing the significance of virtualization in modern computing. By leveraging VirtualBox's features, such as snapshot management, networking options, and resource allocation, users can effectively simulate various configurations and scenarios. The virtualization of CentOS fosters an experimental and safe environment for developers, system administrators, and students to gain practical experience with Linux-based systems, software development, and system administration tasks. Ultimately, this approach enhances learning outcomes and promotes the efficient use of computing resources, enabling users to explore the vast potential of virtualization technology.



## INTRODUCTION OF THE PROJECT

In today's technology-driven world, virtualization has become a cornerstone of efficient computing, allowing users to maximize their hardware resources while providing the flexibility to run multiple operating systems concurrently. CentOS, a popular Linux distribution derived from Red Hat Enterprise Linux (RHEL), is widely used for servers, development environments, and as a platform for learning Linux system administration. VirtualBox, an open-source virtualization solution developed by Oracle, offers a user-friendly interface and a robust feature set that enables users to create and manage virtual machines (VMs) on various host operating systems.

This introduction highlights the significance of utilizing CentOS within a VirtualBox environment. By employing virtualization, users can isolate different applications, experiment with software configurations, and test system setups without the risk of affecting the underlying host system. This approach is particularly beneficial for developers, system administrators, and students seeking to understand Linux environments and system management concepts.



# Technology used to develop the Project

## Operating System: CentOS

- CentOS serves as the primary operating system for the virtual machine, providing a stable and secure platform for server applications, development, and system administration tasks. Its compatibility with RHEL makes it an ideal choice for those looking to gain practical experience with enterprise-level Linux environments.

## Virtualization Software: Oracle VirtualBox

- Oracle VirtualBox is the virtualization software utilized to create and manage the CentOS virtual machine. Its open-source nature, cross-platform support, and rich feature set, including snapshot management, virtual networking, and hardware resource allocation, make it a popular choice for both beginners and experienced users.

# LITERATURE REVIEW

The literature on virtualization technologies and Linux-based operating systems, particularly CentOS, highlights the growing significance of these tools in modern computing environments. This review synthesizes key themes and findings from various sources, emphasizing the importance of virtualization and its applications in education, development, and enterprise solutions.

## 1. Virtualization Technology

- Virtualization has transformed the IT landscape by enabling the efficient utilization of hardware resources. According to Rosenblum and Ousterhout (2001), virtualization allows multiple operating systems to run concurrently on

a single physical machine, leading to reduced hardware costs and increased flexibility. This flexibility is essential for organizations that require rapid deployment and scalability, allowing them to adapt to changing business needs.

## **2. Benefits of Virtualization in Education**

- Virtualization plays a pivotal role in educational settings, providing students with hands-on experience in a safe environment. A study by Makhdoom et al. (2015) discusses how virtual labs can enhance learning outcomes in computer science and IT programs. By utilizing platforms like VirtualBox, students can experiment with different operating systems and configurations without the risks associated with physical hardware modifications. This approach fosters a deeper understanding of system administration, networking, and security concepts.

## **3. CentOS as a Learning Platform**

- CentOS is widely recognized as an ideal distribution for learning and development due to its stability and compatibility with enterprise environments. Wiles and Davis (2018) note that CentOS serves as a stepping stone for students and professionals to gain familiarity with Red Hat-based systems, making it a valuable asset in career development. The availability of comprehensive documentation and community support further enhances its appeal as a learning tool.

## **4. VirtualBox Features and Capabilities**

-

- 
- VirtualBox is lauded for its rich feature set, which includes snapshot management, virtual networking, and support for various guest operating systems. A review by Kearney et al. (2016) highlights how VirtualBox's user-friendly interface and cross-platform capabilities make it accessible for users at all skill levels. These features enable users to create isolated environments for testing software, running experiments, and simulating complex networks.

## **5. Challenges and Limitations**

- Despite its advantages, virtualization also presents challenges. Research by Sahu et al. (2020) identifies performance overhead and resource allocation as significant concerns when running multiple virtual machines on a single host. Additionally, the learning curve associated with mastering virtualization tools can be steep for beginners. However, these challenges can be mitigated through structured training and hands-on practice.

## **6. Future Trends in Virtualization**

- The evolution of virtualization technology continues to shape IT practices. As highlighted by Geng et al. (2021), trends such as containerization and serverless architectures are emerging, offering new ways to optimize resource utilization and streamline deployment. Understanding these trends is essential for users seeking to remain competitive in a rapidly changing technological landscape.

## Design Flow

The design flow for implementing CentOS virtualization in Oracle VirtualBox encompasses a series of structured steps, guiding users from the initial setup to the operational phase. Below is a detailed design flow outlining each stage of the process:

### 1. Project Planning

- **Define Objectives:** Determine the purpose of the virtualization project (e.g., learning, development, testing).
- **Identify Requirements:** Assess hardware specifications, software needs, and networking configurations.

### 2. Environment Preparation

- **Select Host Operating System:** Ensure that the host system (Linux, Windows, or macOS) meets VirtualBox requirements.
- **Download Software:**
  - **VirtualBox:** Download and install the latest version of Oracle VirtualBox.
  - **CentOS ISO:** Obtain the CentOS installation ISO file from the official website.

### 3. Virtual Machine Creation

- **Open VirtualBox:** Launch the VirtualBox application.
- **Create New VM:**
  - Click on **New** to start the VM creation wizard.
  - Enter VM Name, Type (Linux), and Version (CentOS or Red Hat).

- **Allocate Resources:**

- Assign RAM and CPU cores based on project requirements.
- Create and configure a virtual hard disk with sufficient storage (20 GB or more).

#### 4. VM Configuration

- **Adjust Settings:**

- **Storage:** Add the CentOS ISO file to the virtual optical drive.
- **Networking:** Configure network settings (NAT, Bridged Adapter) as per requirements.
- **System Options:** Enable virtualization features in the system settings (e.g., VT-x/AMD-V).

#### 5. Installation Process

- **Start the Virtual Machine:** Boot the VM from the CentOS ISO.
- **Follow Installation Prompts:**
  - Select language, keyboard layout, and installation destination.
  - Set up partitions (automatic or manual) based on needs.
  - Configure network settings and create user accounts.
- **Complete Installation:** Finalize the setup and reboot the virtual machine.

#### 6. Post-Installation Configuration

- **Remove ISO from Virtual Drive:** Detach the CentOS ISO from the VM to prevent boot issues.

- **Initial System Updates:** Use YUM or DNF to update the CentOS system and install essential packages.
- **Install Additional Software:** Set up any required applications or development tools based on the project's goals.

## 7. Networking and Connectivity Setup

- **Configure Network Interfaces:** Adjust network settings to enable internet access and communication with other devices.
- **Test Network Connections:** Verify connectivity through ping tests and browsing.

## 8. User Training and Documentation

- **Create Documentation:** Document the installation and configuration processes for future reference.
- **Training Users:** Provide training sessions for users on managing and using the CentOS VM effectively.

## 9. Maintenance and Monitoring

- **Regular Updates:** Schedule updates and maintenance for the CentOS system to ensure security and stability.
- **Monitor Performance:** Use monitoring tools to track system performance and resource usage.
- **Backup:** Implement a backup strategy for the VM and critical data.

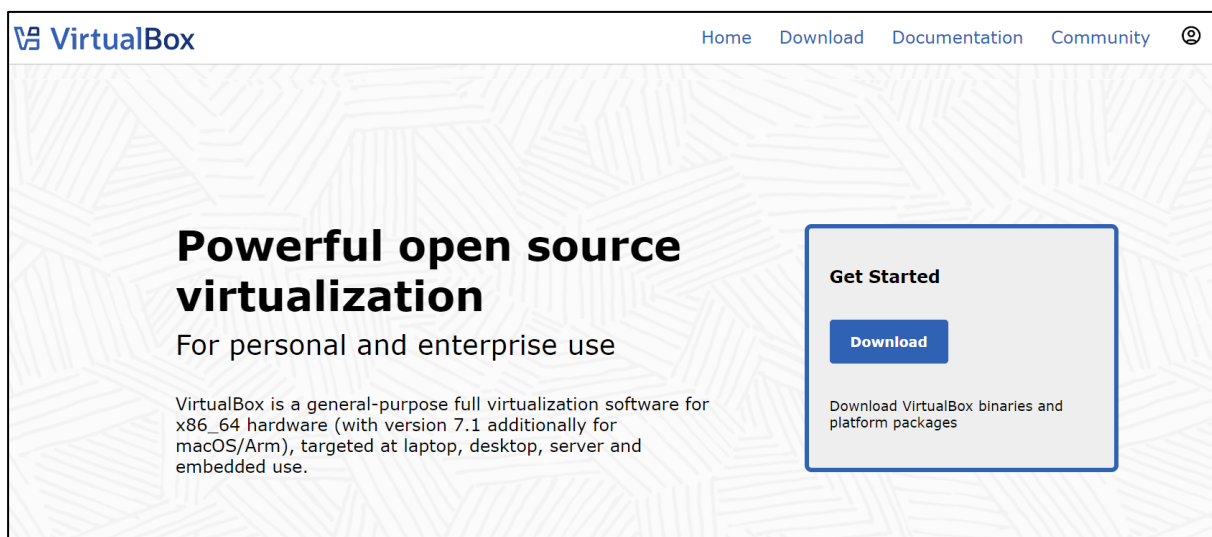
## Project Implementation --

### Ensure System Requirements:

- Make sure your host machine meets the necessary requirements for running VirtualBox and the CentOS virtual machine:
  - At least 8 GB of RAM (more recommended for better performance).
  - Sufficient disk space (minimum 20 GB for CentOS).
  - Virtualization support (Intel VT-x or AMD-V) enabled in BIOS/UEFI.

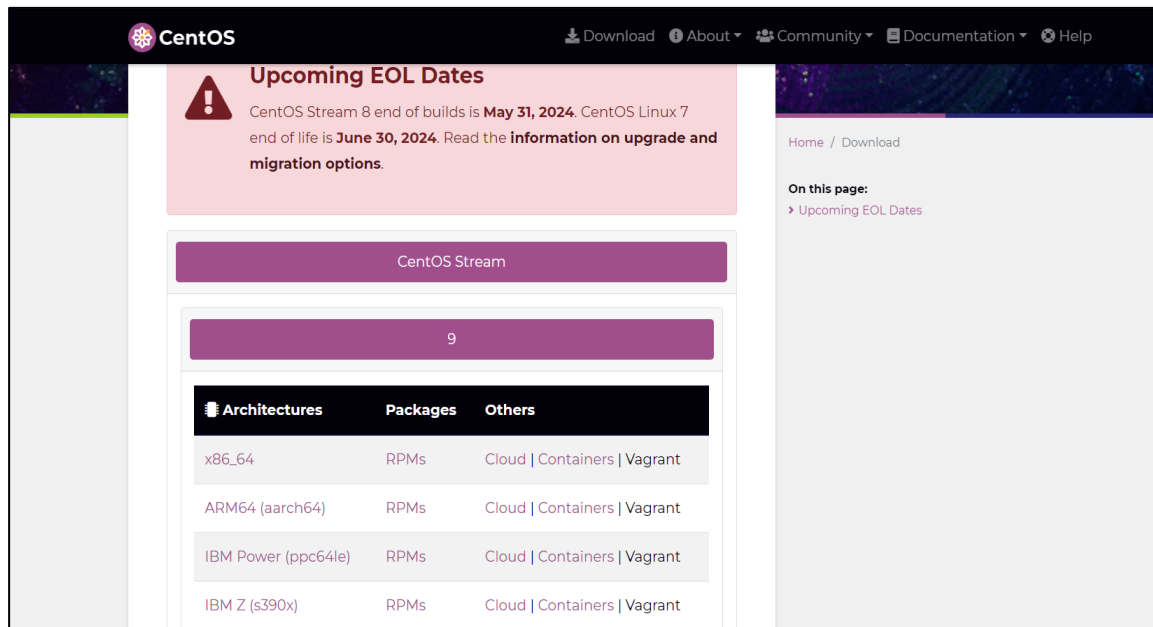
### Download Required Software:

- **Oracle VirtualBox:** Download from the [official website](#).



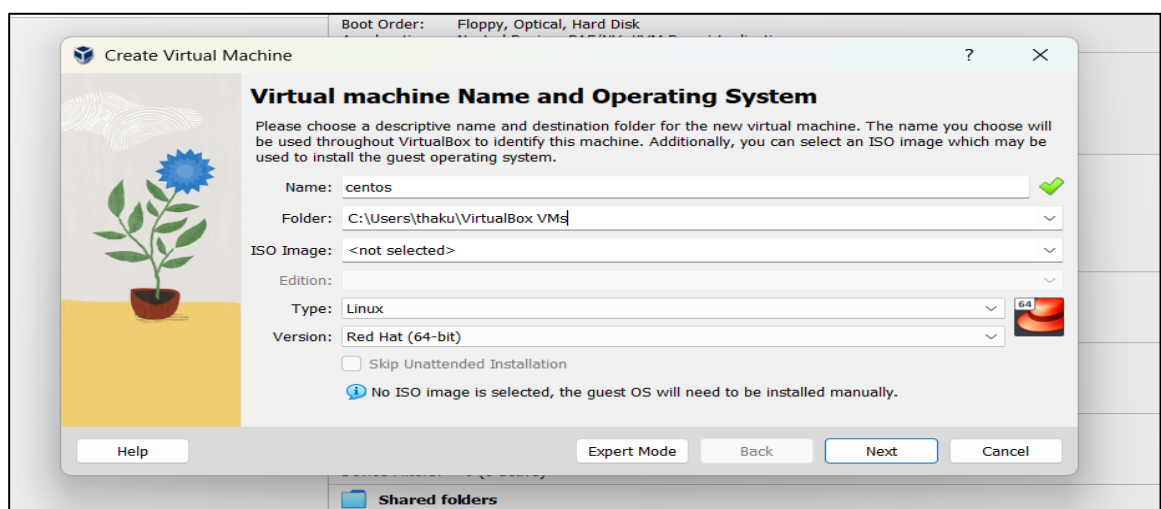
## Download Required Software:

**CentOS ISO:** Download the latest CentOS ISO from the CentOS website.



## Open VirtualBox:

Launch VirtualBox on your machine and click on the "New" button to create a new virtual machine.



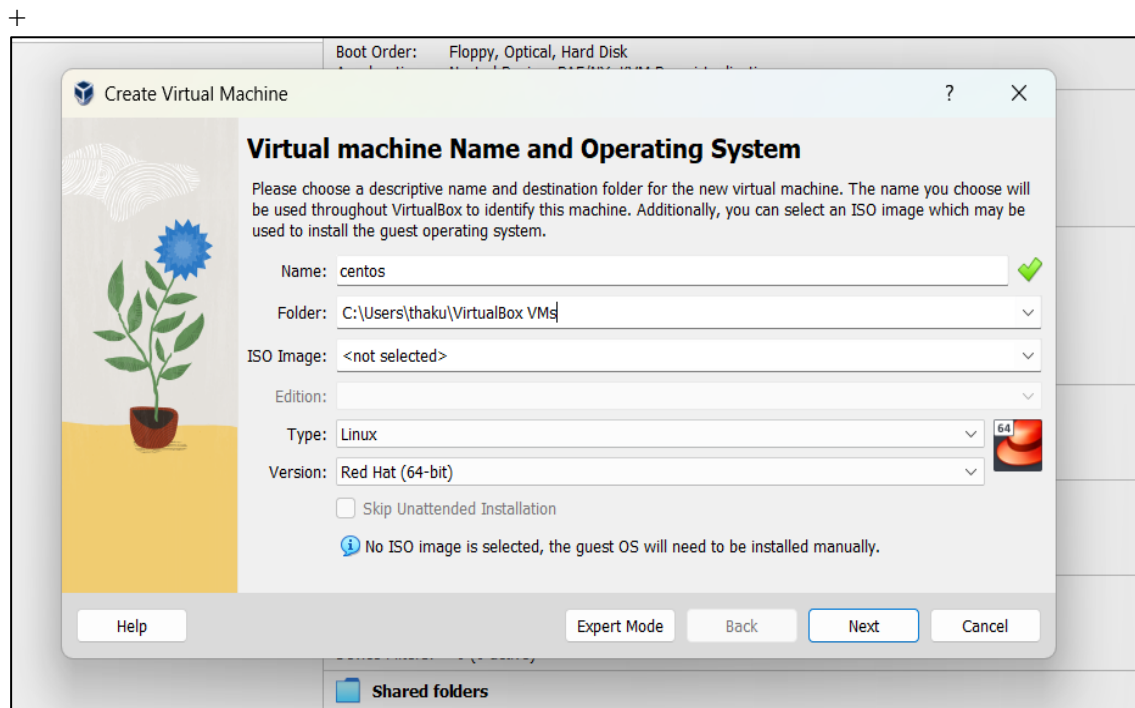


## Set Up the Virtual Machine:

**Name:** Enter a name for your VM (e.g., "CentOS VM").

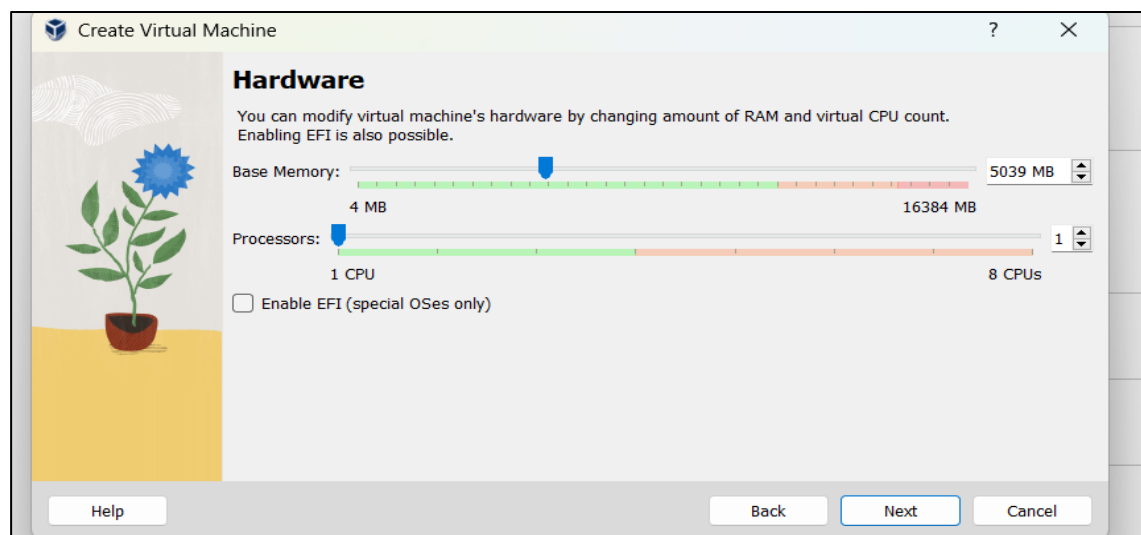
**Type:** Select **Linux**.

**Version:** Select **Red Hat (64-bit)** or the appropriate CentOS version if listed.



## Allocate Memory (RAM):

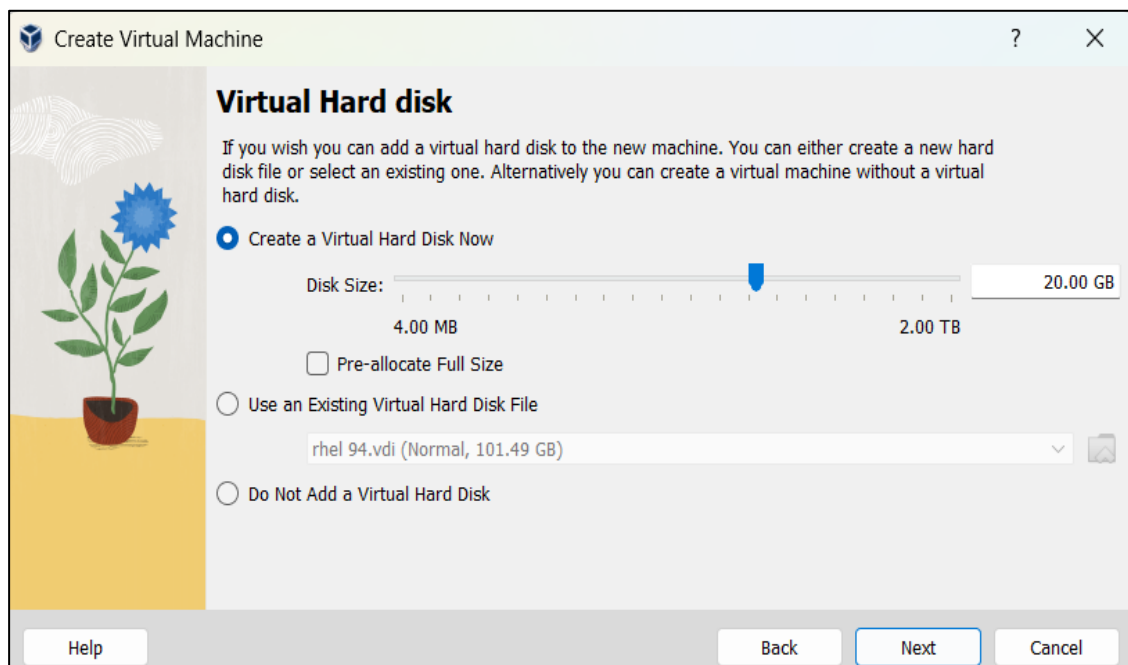
- Choose the amount of memory (RAM) for the VM. **2 GB (2048 MB)** is recommended, but you can adjust based on your system's resources.



### Create Virtual Hard Disk:

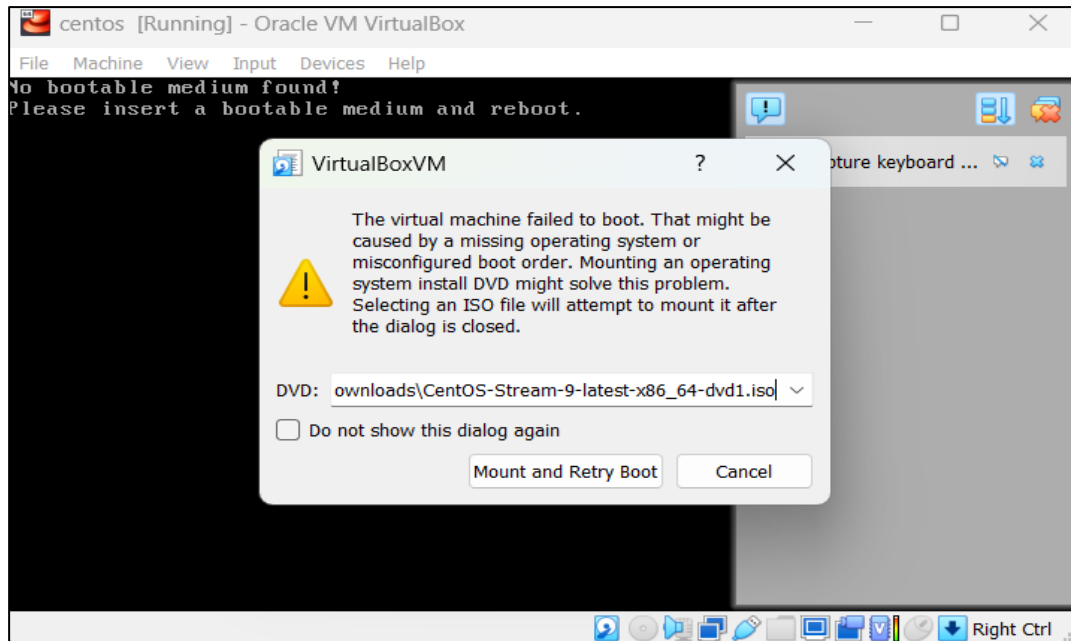
- Choose "**Create a virtual hard disk now**" and click **Create**.
- **Hard Disk File Type**: Select **VDI (VirtualBox Disk Image)**.
- **Storage**: Choose **Dynamically allocated** (recommended) or **Fixed size** based on your preference.
- **Size**: Allocate at least **20 GB** for the CentOS installation.

+



### Mount the CentOS ISO:

- Select your newly created VM and go to **Settings**.
- Go to **Storage > Empty** under the Controller: IDE section.
- Click the **Disk icon** next to "Optical Drive," choose **Choose a disk file**, and select the CentOS ISO you downloaded.

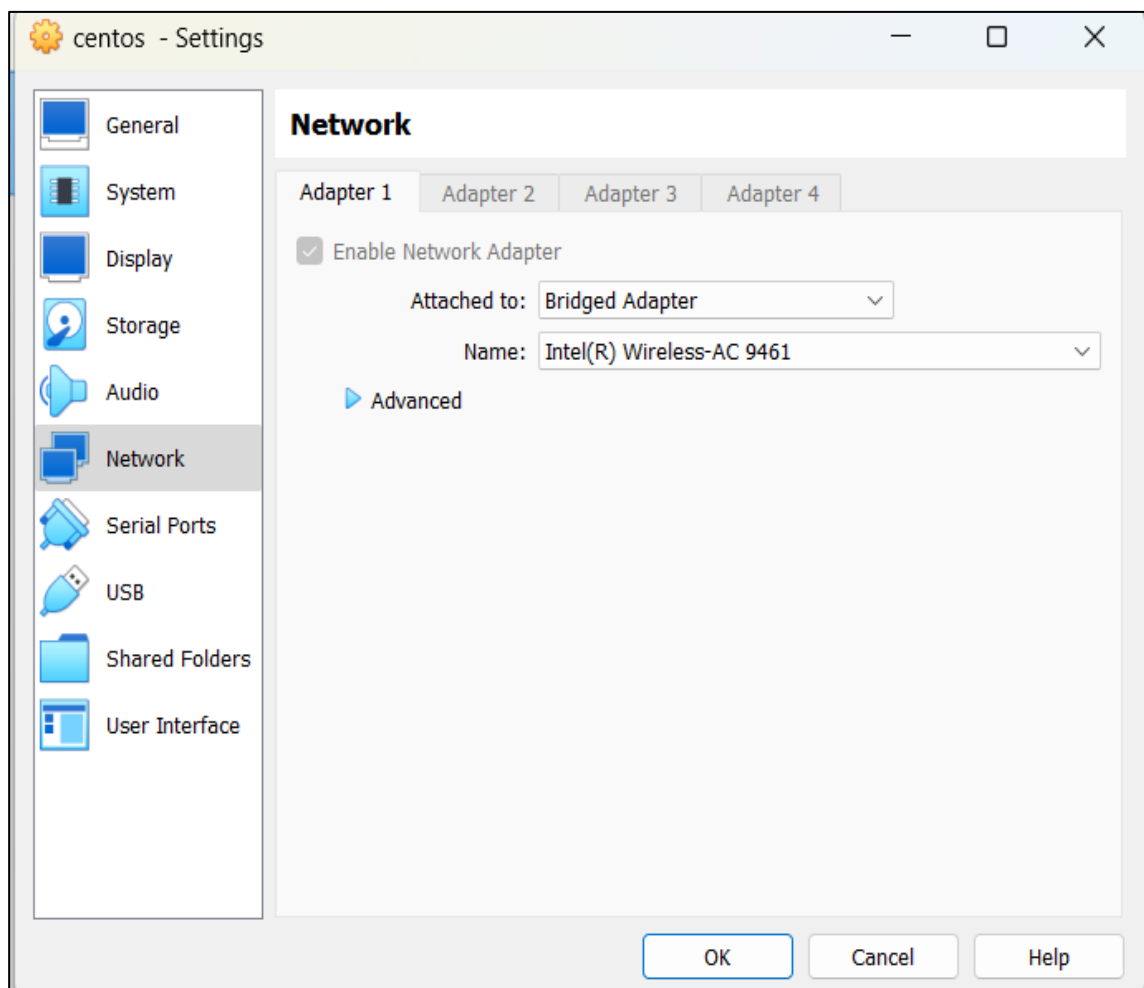


Click on mount and retry boot--

```
[ OK ] Started Show Plymouth Boot Screen.
[ OK ] Started Forward Password Requests to Plymouth Directory Watch.
[ OK ] Reached target Local Encrypted Volumes.
[ OK ] Reached target Path Units.
[ OK ] Started cancel waiting for multipath siblings of sda.
[ OK ] Finished Wait for udev To Complete Device Initialization.
       Starting Device-Mapper Multipath Device Controller...
[ OK ] Started Device-Mapper Multipath Device Controller.
[ OK ] Reached target Preparation for Local File Systems.
[ OK ] Reached target Local File Systems.
[ OK ] Reached target System Initialization.
[ OK ] Reached target Basic System.
[ OK ] Started cancel waiting for multipath siblings of sda.
[ OK ] Finished dracut initqueue hook.
[ OK ] Reached target Preparation for Remote File Systems.
[ OK ] Reached target Remote Encrypted Volumes.
[ OK ] Reached target Remote File Systems.
       Starting dracut pre-mount hook...
[ OK ] Finished dracut pre-mount hook.
[ OK ] Reached target Initrd Root File System.
       Starting Mountpoints Configured in the Real Root...
[ OK ] Finished Mountpoints Configured in the Real Root.
[ OK ] Reached target Initrd File Systems.
[ OK ] Reached target Initrd Default Target.
       Starting dracut mount hook...
[ OK ] Stopped Device-Mapper Multipath Device Controller...
[ OK ] Stopped Device-Mapper Multipath Device Controller.
[ OK ] Finished dracut mount hook.
       Starting dracut pre-pivot and cleanup hook...
```

### Network Configuration (Optional):

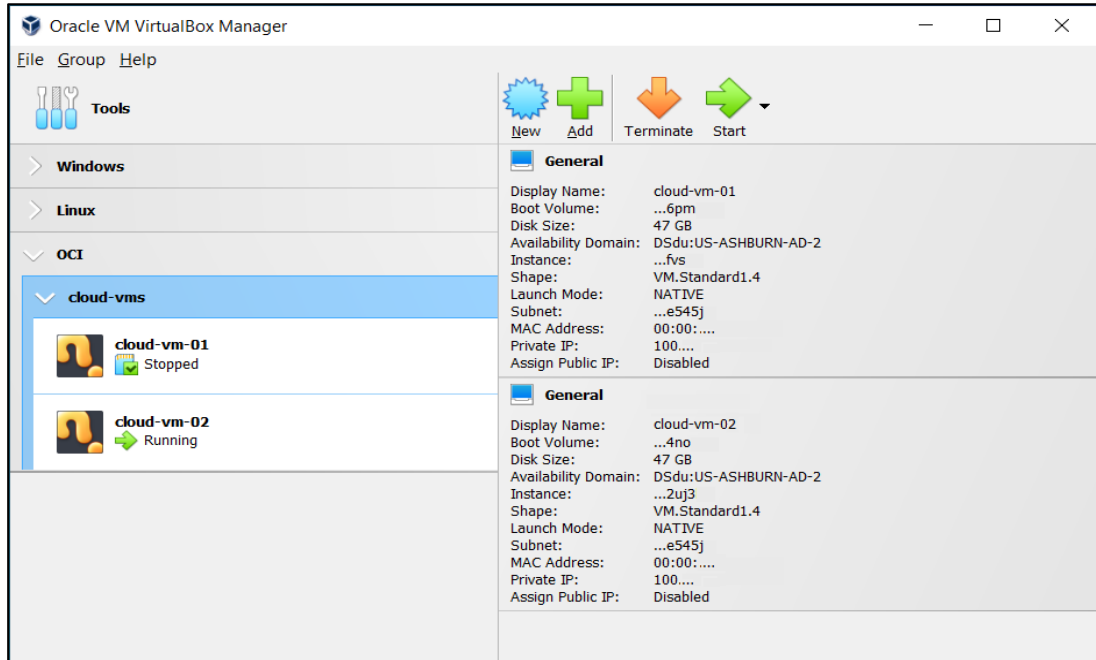
- In **Settings** > Network, you can select Bridged Adapter to allow the VM to access your local network directly. NAT is selected by default and works for most users.



Now can select Bridged Adapter to allow the VM to access your local network directly.

## Start the VM:

- Click **Start** to power on your VM. It will boot from the ISO.

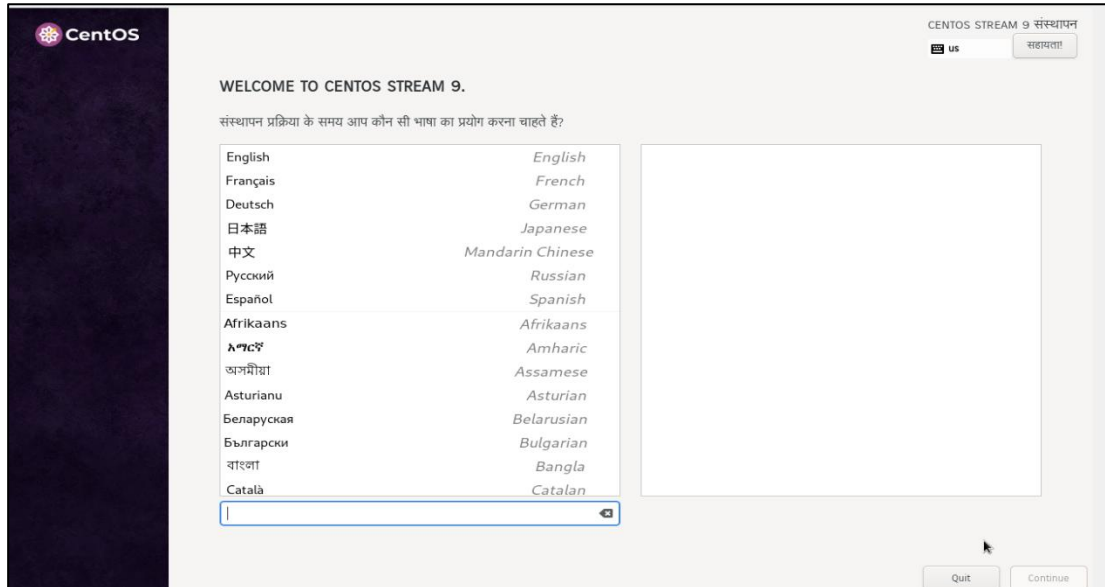


## Install CentOS:

- Once the CentOS installer boots, select **Install CentOS**.



Choose your **language** and **region**.



CentOS

CENTOS STREAM 9 संस्थापन

us सहायता!

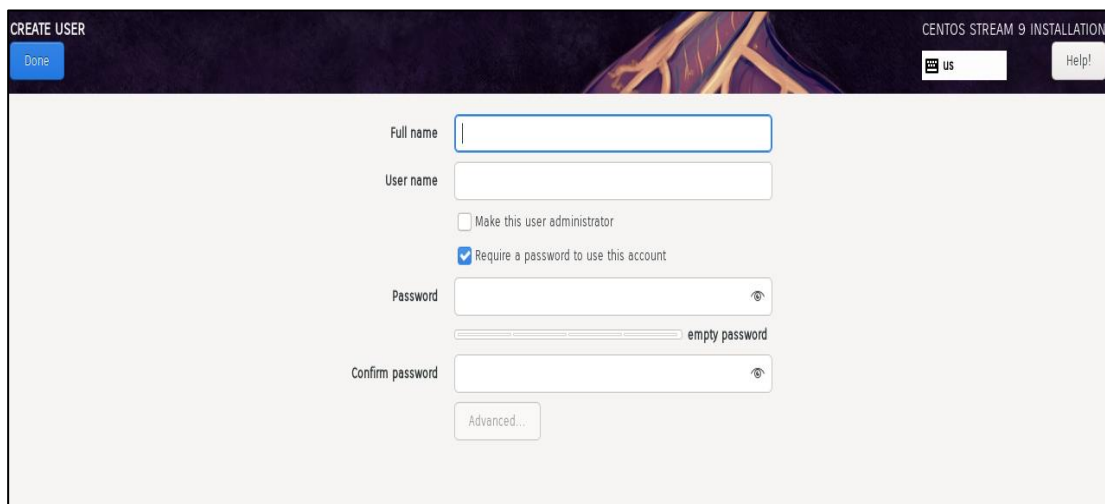
WELCOME TO CENTOS STREAM 9.

संस्थापन प्रक्रिया के समय आप कौन सी भाषा का प्रयोग करना चाहते हैं?

English	English
Français	French
Deutsch	German
日本語	Japanese
中文	Mandarin Chinese
Русский	Russian
Español	Spanish
Afrikaans	Afrikaans
አማርኛ	Amharic
অসমীয়া	Assamese
Asturianu	Asturian
Беларуская	Belarusian
Български	Bulgarian
বাংলা	Bangla
Català	Catalan

Quit Continue

Now create a user--



CREATE USER

Done

CENTOS STREAM 9 INSTALLATION

us Help!

Full name

User name

☐ Make this user administrator

☒ Require a password to use this account

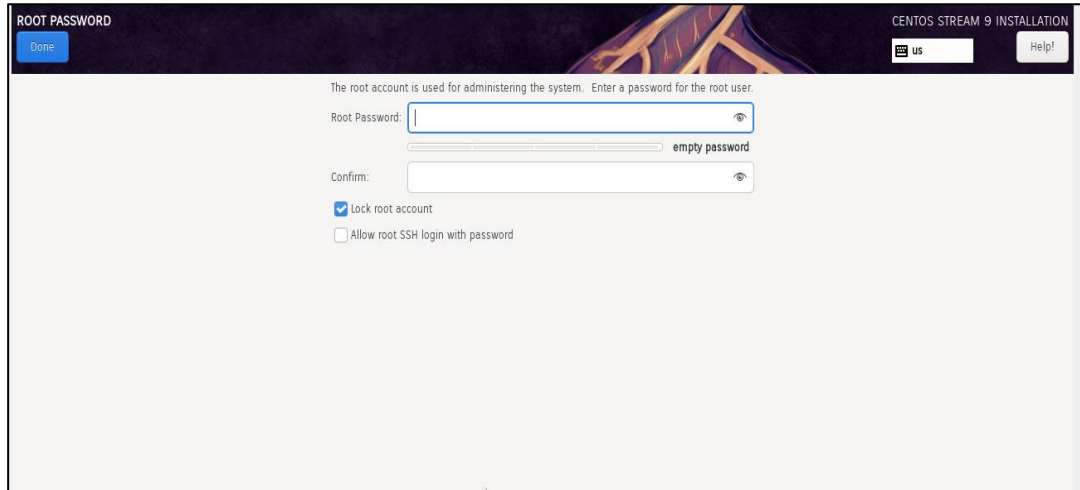
Password

empty password

Confirm password

Advanced...

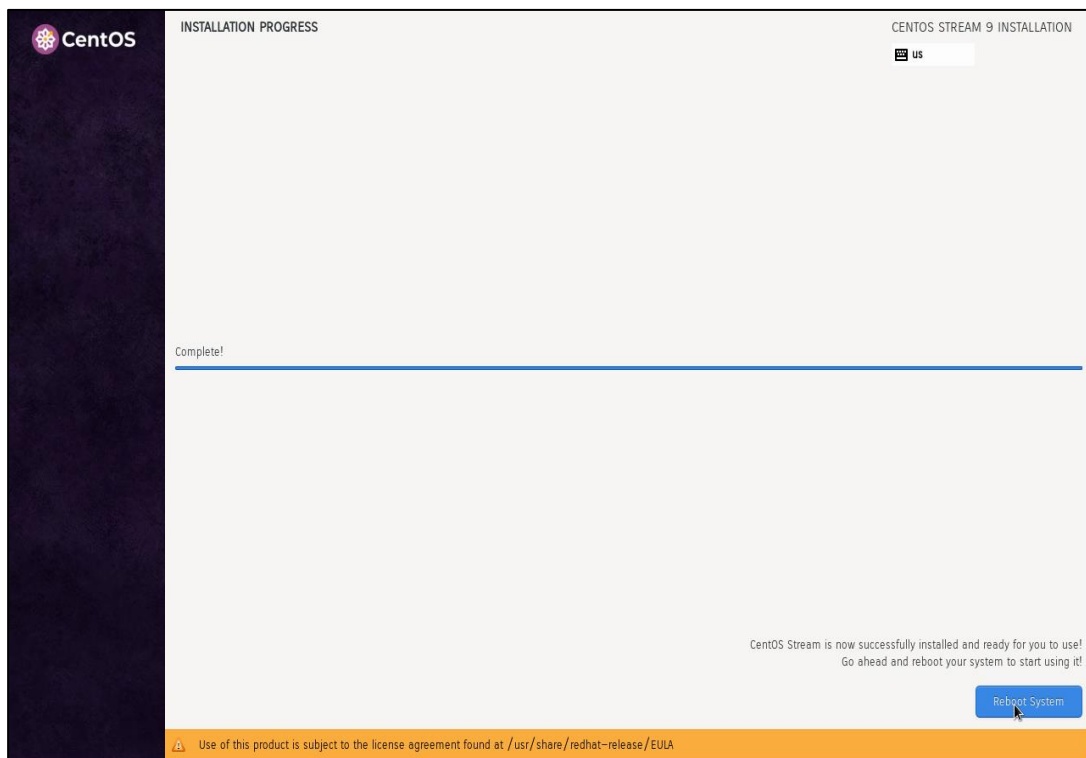
Set up **Root Password** and create a **user account**.



The screenshot shows the 'ROOT PASSWORD' screen during the CentOS Stream 9 installation. The title bar includes 'ROOT PASSWORD' and 'CENTOS STREAM 9 INSTALLATION'. A 'Done' button is in the top left, and a 'Help!' button is in the top right. The main text states: 'The root account is used for administering the system. Enter a password for the root user.' Below this, there are two password input fields. The first is labeled 'Root Password:' and the second is labeled 'Confirm:'. Both fields have eye icons to toggle visibility. Below the fields, there are two checkboxes: 'Lock root account' (checked) and 'Allow root SSH login with password' (unchecked). A progress bar at the bottom shows the installation progress.

### Complete Installation:

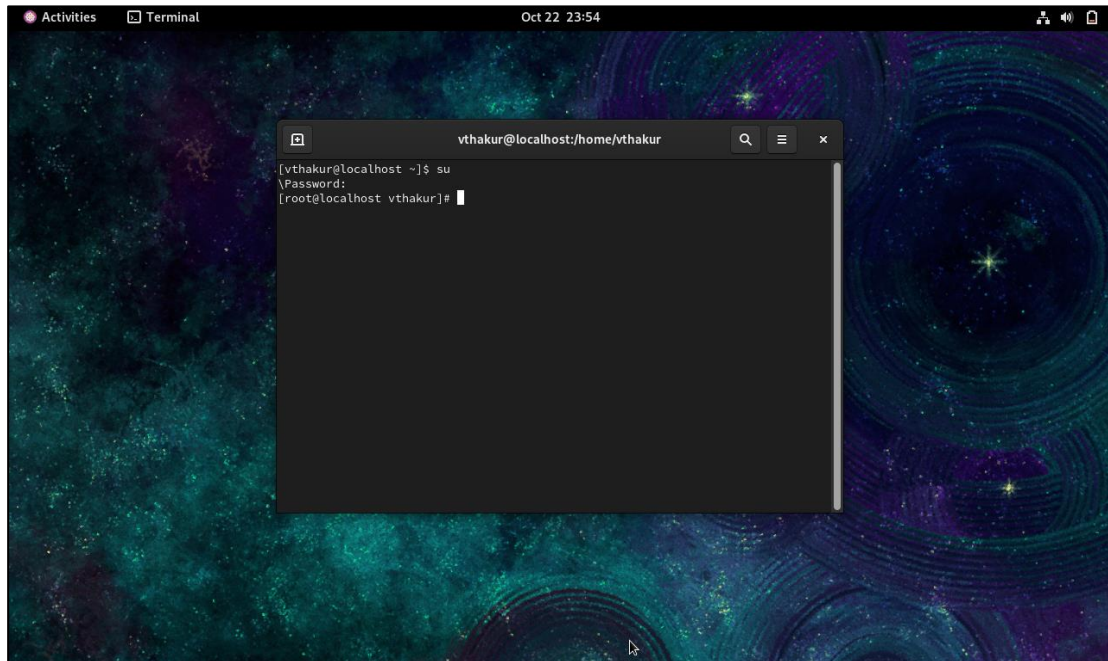
- Once the installation completes, remove the ISO from the virtual drive (go to **Devices** > **Optical Drives** > **Remove disk from virtual drive**).
- Reboot the VM.





## Post-Installation:

- Log in with your user credentials.



## Network Configuration

```
[root@localhost virenderthakur]# sudo ip link set enp0s3 up
[root@localhost virenderthakur]# ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 08:00:27:63:9e:b1 brd ff:ff:ff:ff:ff:ff
    inet 10.0.2.15/24 brd 10.0.2.255 scope global dynamic noprefixroute enp0s3
        valid_lft 81722sec preferred_lft 81722sec
    inet6 fe80::a00:27ff:fe63:9eb1/64 scope link noprefixroute
        valid_lft forever preferred_lft forever
[root@localhost virenderthakur]#
```



## **Conclusion—**

Installing CentOS in VirtualBox offers an efficient, flexible way to run a Linux environment within a virtualized setup, creating a fully functional development or testing environment isolated from the host machine. This project demonstrated the step-by-step process of setting up a virtual machine, from configuring basic system resources like memory and storage to mounting the CentOS ISO and completing the installation. With VirtualBox, users can allocate custom resources, select different network configurations, and test CentOS without making changes to the host system, which is especially valuable for users exploring CentOS, conducting software testing, or developing applications in a controlled environment.

The installation process involved setting up essential configurations such as user accounts and networking, making it a straightforward approach to introduce CentOS to new users or those who require an isolated Linux environment. Following installation, the VM proved highly responsive and capable of running standard software and services, simulating a real-world server or workstation setup. Post-installation steps, such as removing the ISO to prevent boot conflicts and performing system updates, ensured a stable and ready-to-use CentOS environment.