BAHIR DAR UNIVERSITY

BAHIR DAR INSTITUTE OF TECHNOLOGY

Faculty of computing

Department: Software Engineering

Course: Operating systems and system programming

Title: Installation of an operating system (macOS Ventura OS),why ,what and why virtualization and implementation of system call(gettimeofday())

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Table of contents

1.0 Introduction

Operating System (OS)

An operating system (OS) is the fundamental software that manages computer hardware and software resources. It acts as an intermediary between applications and the hardware.

It provides essential services like:

- Resource Management: Allocating CPU time, memory, and storage to different programs.

- Process Management: Creating, scheduling, and terminating processes (running programs).

- Memory Management: Managing the computer's memory (RAM) to ensure efficient and secure usage.

- File System Management: Organizing and storing files on storage devices.

- Input/Output (I/O) Management: Handling communication between the computer and peripheral devices (e.g., keyboards, mice, printers).

- User Interface (UI): Providing a way for users to interact with the computer (graphical or command-line).

Most of the time we Install operating systems on our devices. Why?

- The primary purpose of installing an operating system is to:

1. Enable Functionality: To make a computer system usable. Without an OS, a computer is just a collection of electronic components. The OS brings the hardware to life.

2. Provide a Platform: To create a foundation upon which applications can run. Applications are designed to work with a specific OS, so installing the OS is a prerequisite for running those applications.

3. Manage Resources: To efficiently manage the computer's resources (CPU, memory, storage) and ensure that applications can access those resources in a controlled and secure manner.

4. Offer a User Interface: To provide a way for users to interact with the computer, whether through a graphical user interface (GUI) or a command-line interface (CLI).

In essence, installing an OS transforms a collection of hardware into a functional, manageable, and interactive computing system. It's the foundation upon which all other software and activities are built.

From a list of operating systems now for this project I will focus on installation of **macOS Ventura operating system.**

1.1 The Historical Development of macOS Ventura

Background: The Evolution of macOS and Its Place in Apple's History

macOS, the operating system that powers Apple's desktop and laptop computers, has a long and storied history, evolving from its origins in NeXTSTEP to become a defining element of the Apple experience. This journey reflects Apple's commitment to innovation, user-centric design, and seamless integration of hardware and software.

- Return to Apple and the Birth of Mac OS X: In 1997, Apple acquired NeXT, bringing Steve Jobs back into the company and paving the way for the development of Mac OS X (later renamed macOS). Mac OS X was a revolutionary operating system that combined the user-friendly interface of the classic Mac OS with the robust Unix-based foundation of NeXTSTEP.

- Iterations and Refinements: Over the years, Apple has released numerous versions of Mac OS X/macOS, each building upon the previous one with new features, performance improvements, and design refinements. Key milestones include:

  - Mac OS X 10.0 (Cheetah): The initial release of Mac OS X in 2001, marking a significant departure from the classic Mac OS.

  - Mac OS X 10.4 (Tiger): Introduced Spotlight search, Dashboard widgets, and other notable features.

Motivation: The Driving Forces Behind macOS Ventura's Development

The development of macOS Ventura (version 13) was driven by a confluence of strategic goals and user-centric considerations. Apple aimed to address evolving user needs, leverage advancements in hardware capabilities, and maintain its competitive edge in the operating system landscape. Key motivations included:

- Enhancing Productivity and Workflow Efficiency: In today's fast-paced world, users demand tools that help them stay organized, focused, and productive. Apple sought to improve macOS Ventura's multitasking capabilities, window management features, and overall workflow efficiency.

- Optimizing Performance and Power Efficiency for Modern Mac Hardware: With the transition to Apple Silicon processors, Apple had the opportunity to optimize macOS Ventura for the unique capabilities of its custom-designed chips, delivering significant performance gains and improved battery life.

- Addressing User Feedback and Evolving User Needs: Apple actively listens to user feedback and continuously adapts its products to meet evolving user needs. macOS Ventura incorporated improvements and new features based on user input and emerging trends in computing.

2.0 Objectives

The Core Goals and Desired Outcomes of macOS Ventura

The primary objective of macOS Ventura is to deliver a more powerful, intuitive, secure, and seamlessly integrated computing experience for Apple users. This overarching goal translates into several specific objectives:

- Improving Multitasking and Window Management: Introduce innovative features like Stage Manager to help users stay organized, switch between tasks efficiently, and focus on their work.

- Enhancing Continuity and Cross-Device Integration: Further integrate macOS with other Apple devices, allowing users to seamlessly hand off tasks, share content, and collaborate on projects.

- Optimizing Performance and Power Efficiency: Leverage the capabilities of Apple Silicon processors to deliver significant performance gains and improved battery life.

- Strengthening Security and Privacy: Protect user data and privacy with the latest security technologies and features, such as passkeys and enhanced data encryption.

- Modernizing the User Interface: Redesign system settings, streamline user interactions, and adopt a more consistent and visually appealing design language.

3.0 Requirement

3.1 Hardware Requirements

1. Mac Compatibility (Critical):

- Importance: macOS Ventura will only install and function correctly on officially supported Mac models. Installing on an unsupported Mac can lead to severe instability, missing features, and potential hardware damage.

2. Processor:

- Importance: Ventura requires a 64-bit architecture.
- Requirement: 64-bit Intel processor *or* Apple Silicon (M1, M2, etc.). All Macs compatible with Ventura have this.

3. Memory (RAM):

- Importance: Sufficient RAM is essential for smooth performance.
- Minimum: 4 GB of RAM (but extremely limiting).

4. Storage Space:

Importance: You need enough space for the installer and the OS itself, plus room for virtual memory and general operation.

- Minimum: 35 GB of *available* storage.
- Recommended: 50 GB or more. Aim for even more (100GB+) if you plan to store large files or install many applications.

5. Display:

Importance: Ventura is designed for a variety of display resolutions.

Requirement: Built-in display or compatible external display. No strict minimum resolution, but 1280x800 or higher is recommended for a usable experience.

External Display Notes: Ensure compatibility and proper adapters (if needed) for external displays.

6. Internet Connection:

- Importance: Required for downloading the macOS Ventura installer from the Mac App Store.
- Requirement: Stable Wi-Fi or Ethernet connection. Broadband is highly recommended.

7. Graphics Card (GPU):

- Importance: The GPU renders images and videos.
- Requirement: Integrated or dedicated GPU compatible with macOS Ventura. All supported Macs have suitable graphics.
- How to Check:
- Apple menu ()> "About This Mac" > "Support" Tab > "Specifications" (opens a webpage).

3.2 Software Requirements

1. Existing macOS Version (Upgrade Path):

- Importance: You can usually upgrade directly from the previous three macOS versions.
- Supported Versions for Direct Upgrade:
- macOS Monterey (12.x)

- macOS Big Sur (11.x)

2. Apple ID:

- Importance: Needed to download Ventura from the Mac App Store and access services (iCloud, iMessage).
- Requirement: Valid Apple ID and password.

3. Backup Solution:

Importance: "Critical!" Back up your data before any major OS upgrade.

- Recommended:

Time Machine (built-in): Easiest for full system backups to an external drive.

Third-party: Carbon Copy Cloner, SuperDuper!, cloud backup services (Backblaze).

Storage: External drive or cloud**Compatibility** storage with enough space to hold your entire backup. At least as much free space as the used space on your Mac's internal drive.

4. Application Research:

Importance: Older applications might not be compatible with Ventura.

How to Check:

Visit the software vendor's website for each critical application.

Look for macOS Ventura compatibility statements.

Consider testing in a separate partition before upgrading your main system.

- **5. Antivirus Software:**

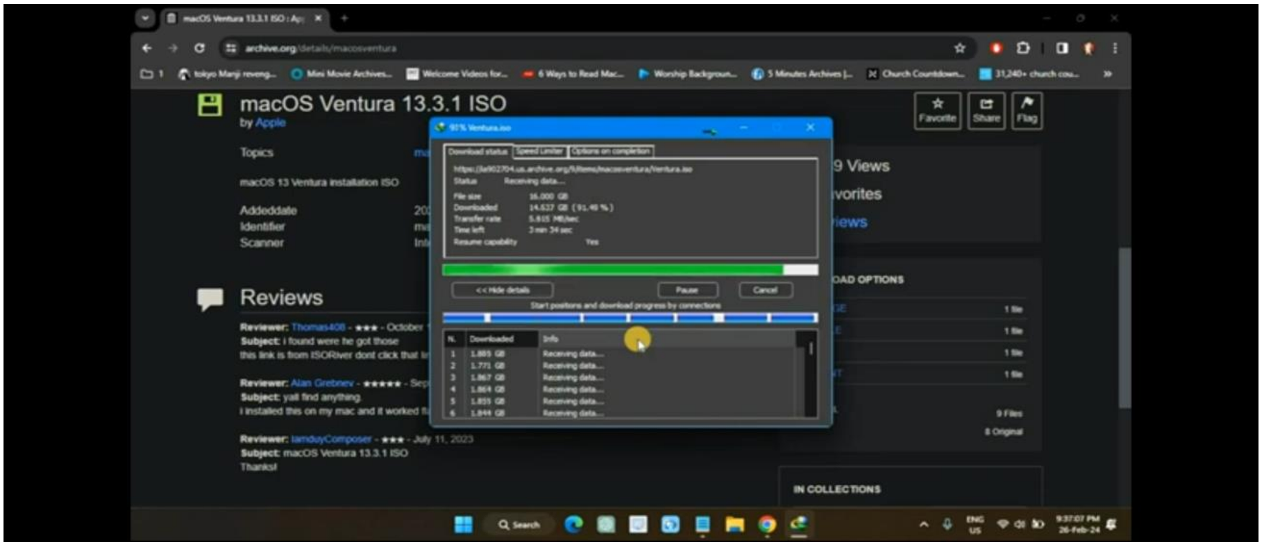
Importance: Can sometimes interfere with the installation process.

Recommendation: Temporarily disable antivirus software during the upgrade. Re-enable and update it afterward.

4.0 macOS Ventura Installation Steps:

Installation Steps:

1. Download the macOS Ventura IOS



91% Ventura.iso

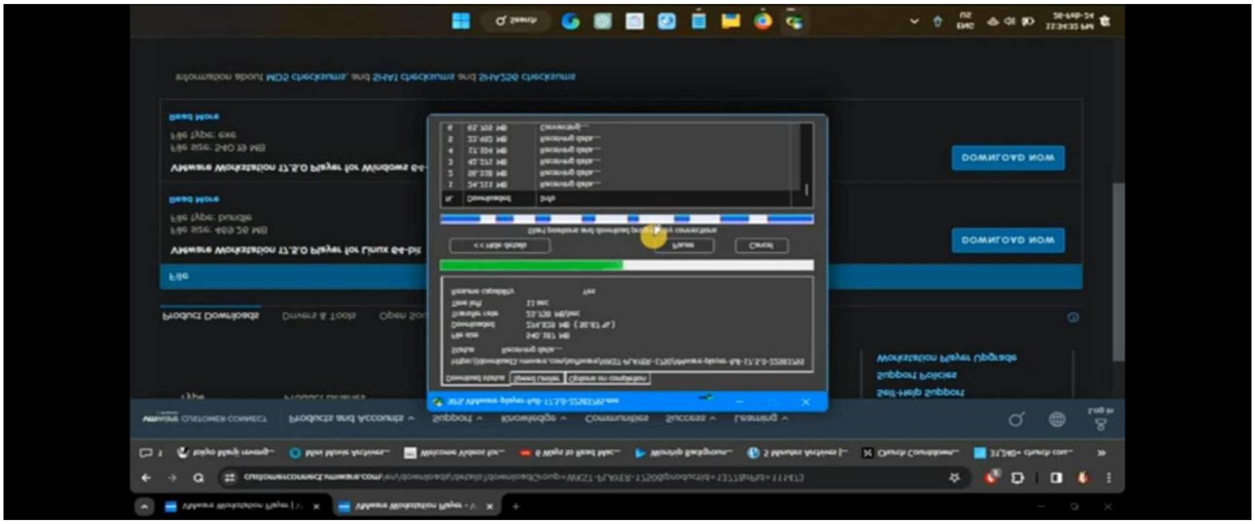
Download status | Speed Limiter | Options on completion

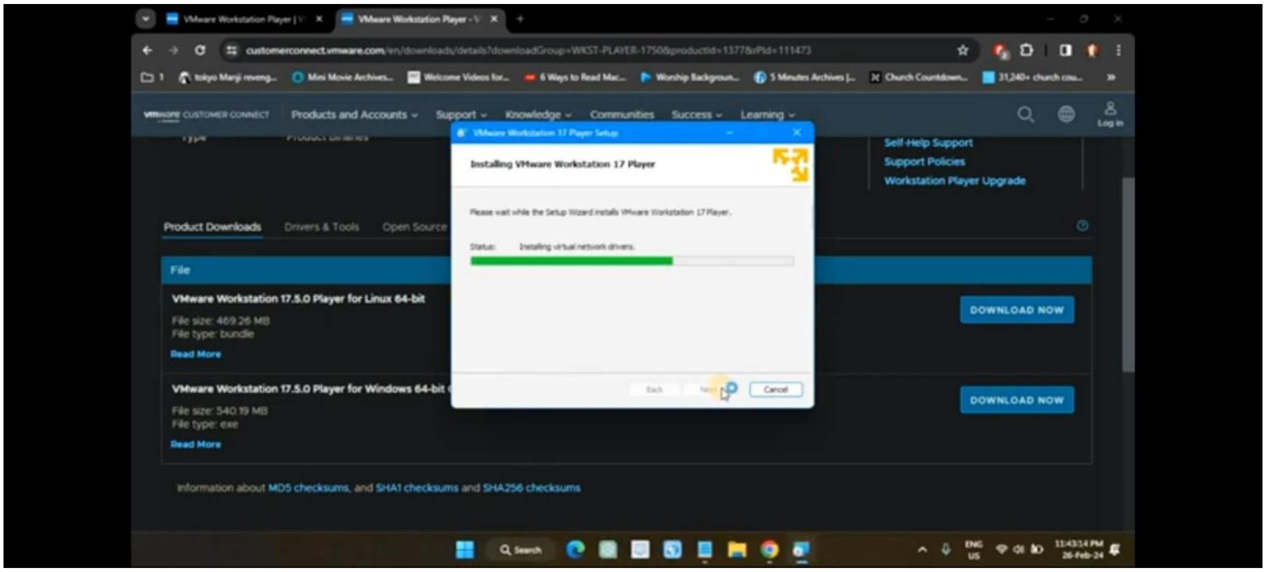
https://ia902704.us.archive.org/9/items/macosventura/Ventura.iso
Status Receiving data...
File size 16.000 GB
Downloaded 14.637 GB (91.48 %)
Transfer rate 5.815 MB/sec
Time left 3 min 34 sec
Resume capability Yes

Start positions and download progress by connections

N.	Downloaded	Info
1	1.885 GB	Receiving data...
2	1.771 GB	Receiving data...
3	1.867 GB	Receiving data...
4	1.864 GB	Receiving data...
5	1.855 GB	Receiving data...
6	1.844 GB	Receiving data...

2. Download and Install VMware workstation on player




customerconnect.vmware.com/en/downloads/details?downloadGroup=WKST-PLAYER-1750&productId=1377&rPId=111473
VMware Workstation 17 Player Setup
Back
Next
Cancel
Product Downloads
Drivers & Tools
Open Source
Self-Help Support
Support Policies
Workstation Player Upgrade
DOWNLOAD NOW
DOWNLOAD NOW

Installing VMware Workstation 17 Player

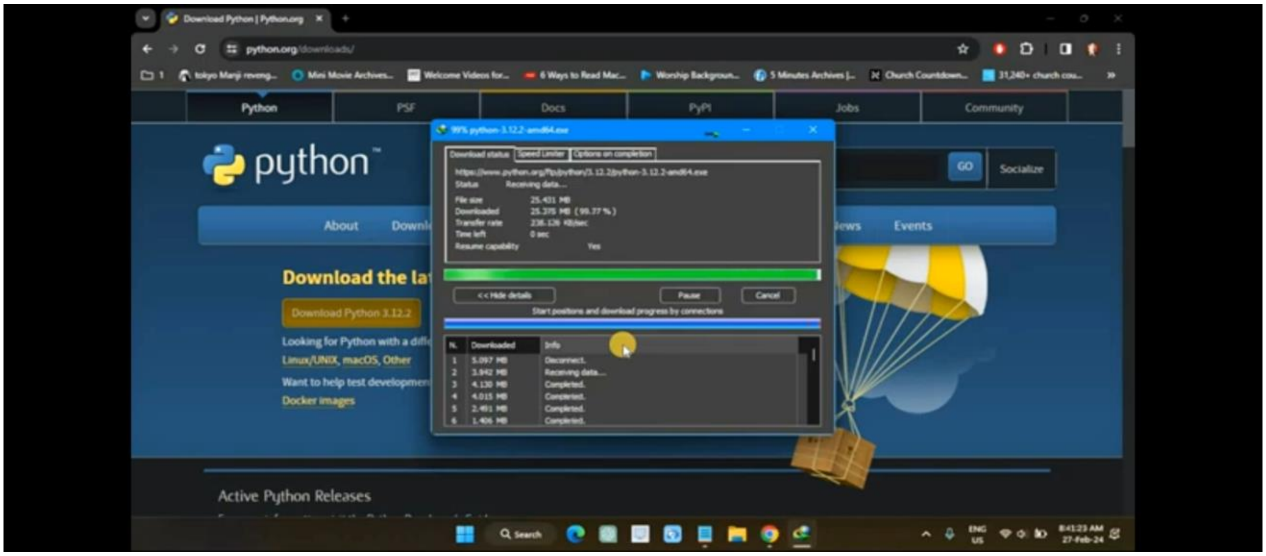
Please wait while the Setup Wizard installs VMware Workstation 17 Player.

Status: Installing virtual network drivers.

File	
VMware Workstation 17.5.0 Player for Linux 64-bit File size: 469.26 MB File type: bundle Read More	DOWNLOAD NOW
VMware Workstation 17.5.0 Player for Windows 64-bit File size: 540.19 MB File type: exe Read More	DOWNLOAD NOW

Information about MD5 checksums, and SHA1 checksums and SHA256 checksums

3. Download and install unlocker for VMware



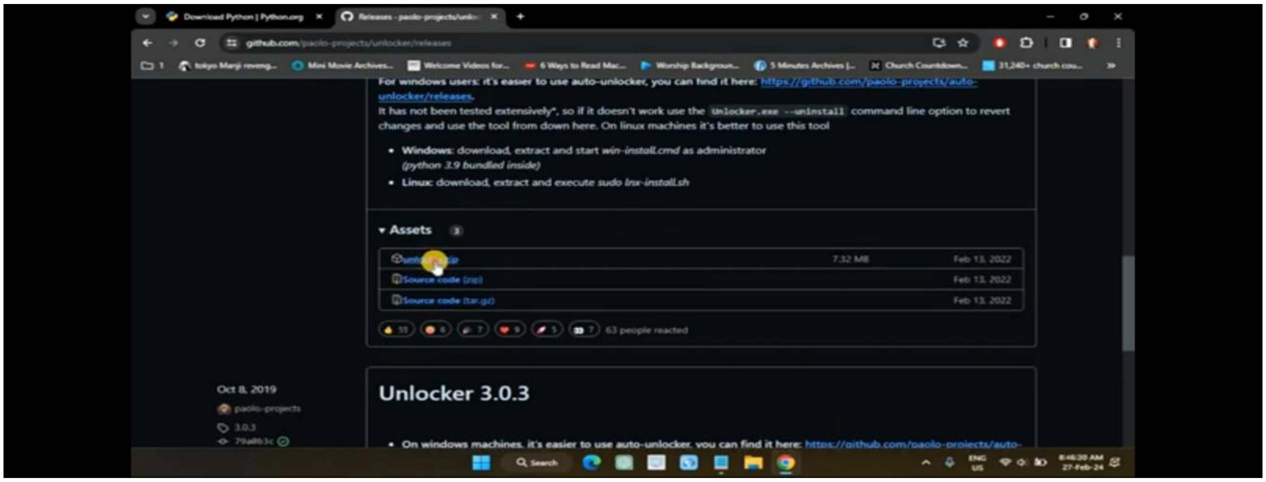
99% python-3.12.2-amd64.exe

https://www.python.org/ftp/python/3.12.2/python-3.12.2-amd64.exe

```
Status             Receiving data...
File size          25.431 MB
Downloaded         25.375 MB ( 99.77 % )
Transfer rate      236.126 KB/sec
Time left          0 sec
Resume capability           Yes
```

Start positions and download progress by connections

N.	Downloaded	Info
1	5.097 MB	Disconnect.
2	3.942 MB	Receiving data...
3	4.130 MB	Completed.
4	4.015 MB	Completed.
5	2.491 MB	Completed.
6	1.406 MB	Completed.


Releases - paolo-projects/unlocker
github.com/paolo-projects/unlocker/releases
Oct 8, 2019
paolo-projects
3.0.3
79a8b3c
63 people reacted

For windows users: it's easier to use auto-unlocker, you can find it here: https://github.com/paolo-projects/auto-unlocker/releases.
It has not been tested extensively*, so if it doesn't work use the `Unlocker.exe --uninstall` command line option to revert changes and use the tool from down here. On linux machines it's better to use this tool

- **Windows**: download, extract and start *win-install.cmd* as administrator *(python 3.9 bundled inside)*
- **Linux**: download, extract and execute *sudo lnx-install.sh*

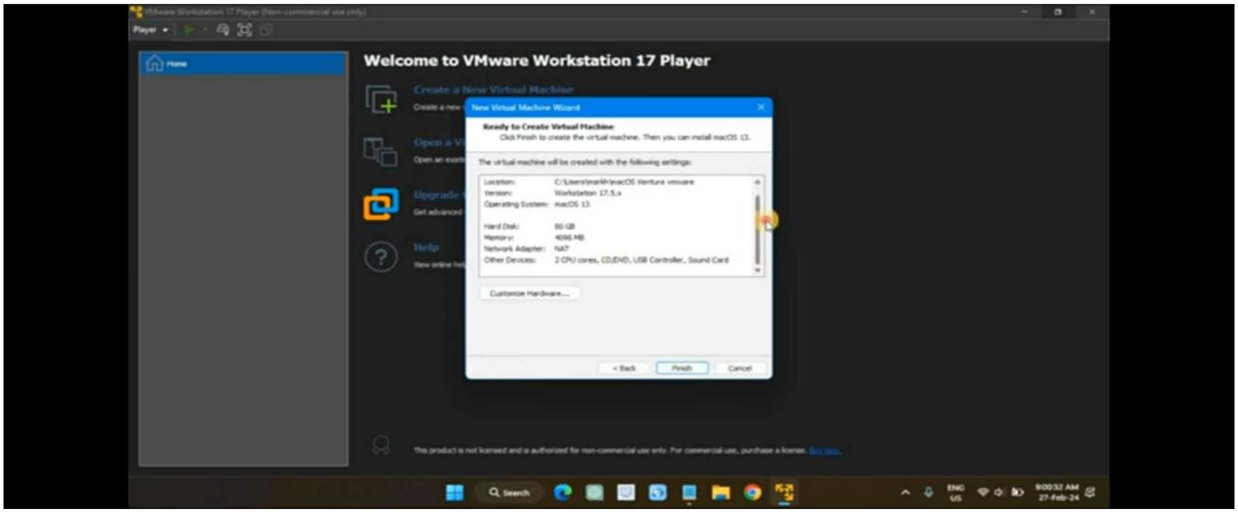
Assets 3

unlocker.zip	7.32 MB	Feb 13, 2022
Source code (zip)		Feb 13, 2022
Source code (tar.gz)		Feb 13, 2022

Unlocker 3.0.3

- On windows machines, it's easier to use auto-unlocker, you can find it here: https://github.com/paolo-projects/auto-

4. Create macOS Ventura virtual machine



Welcome to VMware Workstation 17 Player
Create a New Virtual Machine
Open a Vi
Upgrade
Help
New Virtual Machine Wizard
Customize Hardware...
< Back
Finish
Cancel

Ready to Create Virtual Machine

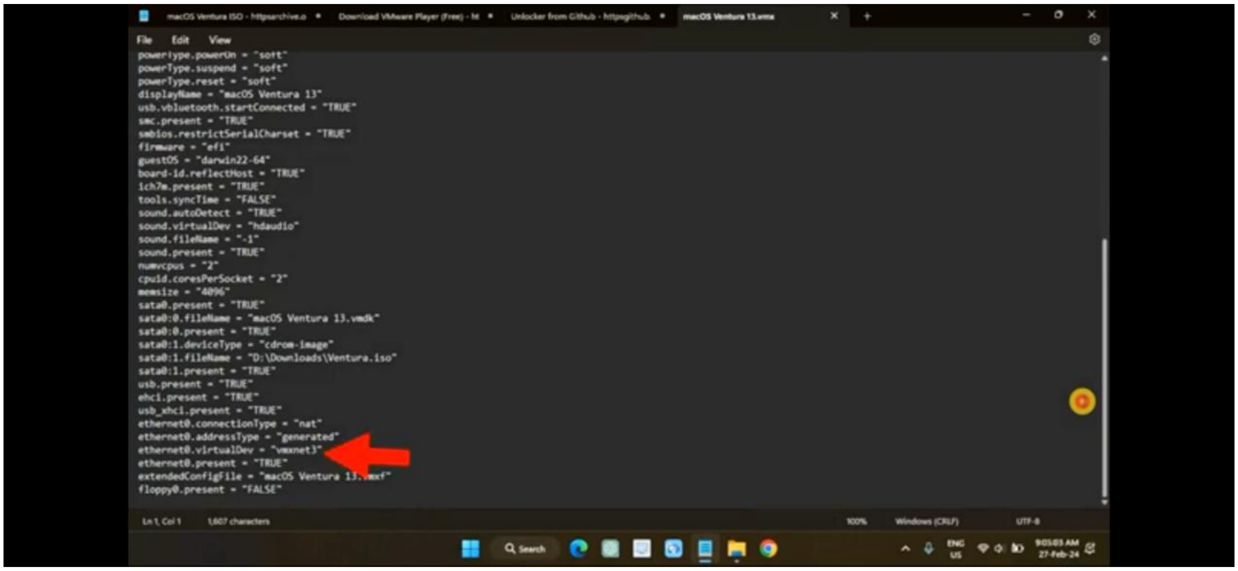
Click Finish to create the virtual machine. Then you can install macOS 13.

The virtual machine will be created with the following settings:

Location:	C:\Users\markh\macOS Ventura vmware
Version:	Workstation 17.5.x
Operating System:	macOS 13
Hard Disk:	80 GB
Memory:	4096 MB
Network Adapter:	NAT
Other Devices:	2 CPU cores, CD/DVD, USB Controller, Sound Card

This product is not licensed and is authorized for non-commercial use only. For commercial use, purchase a license.

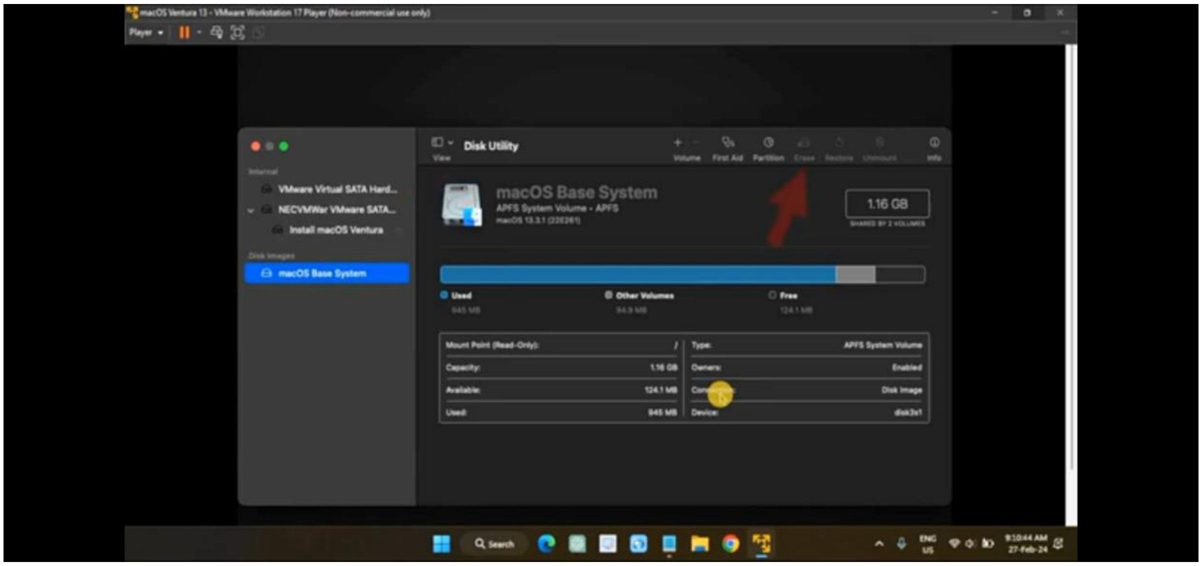
5. Modify the macOS Ventura.VMX file



macOS Ventura ISO - httpsarchive.o
Download VMware Player (Free) - ht
Unlocker from Github - httpsgithub
macOS Ventura 13.vmx
File
Edit
View
Ln 1, Col 1
1,607 characters
100%
Windows (CRLF)
UTF-8

```
powerType.powerOn = "soft"
powerType.suspend = "soft"
powerType.reset = "soft"
displayName = "macOS Ventura 13"
usb.vbluetooth.startConnected = "TRUE"
smc.present = "TRUE"
smbios.restrictSerialCharset = "TRUE"
firmware = "efi"
guestOS = "darwin22-64"
board-id.reflectHost = "TRUE"
ich7m.present = "TRUE"
tools.syncTime = "FALSE"
sound.autoDetect = "TRUE"
sound.virtualDev = "hdaudio"
sound.fileName = "-1"
sound.present = "TRUE"
numvcpus = "2"
cpuid.coresPerSocket = "2"
memsize = "4096"
sata0.present = "TRUE"
sata0:0.fileName = "macOS Ventura 13.vmdk"
sata0:0.present = "TRUE"
sata0:1.deviceType = "cdrom-image"
sata0:1.fileName = "D:\Downloads\Ventura.iso"
sata0:1.present = "TRUE"
usb.present = "TRUE"
ehci.present = "TRUE"
usb_xhci.present = "TRUE"
ethernet0.connectionType = "nat"
ethernet0.addressType = "generated"
ethernet0.virtualDev = "vmxnet3"
ethernet0.present = "TRUE"
extendedConfigFile = "macOS Ventura 13.vmxf"
floppy0.present = "FALSE"
```

6. Format the virtual hard drive for macOS Ventura



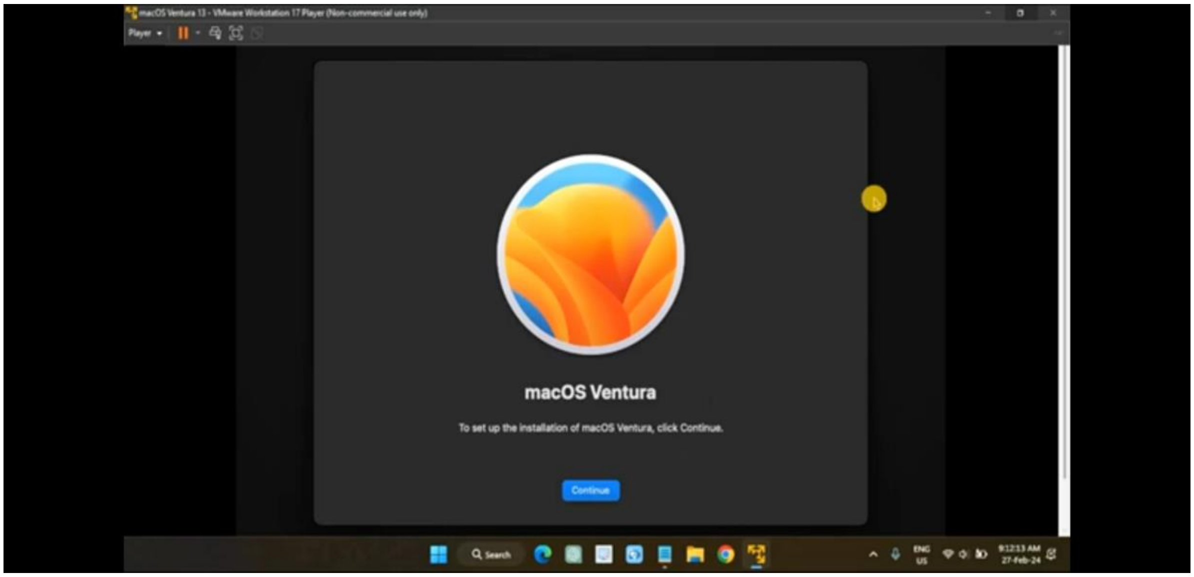
macOS Base System
APFS System Volume • APFS
macOS 13.3.1 (22E261)

1.16 GB
SHARED BY 2 VOLUMES

Used 945 MB
Other Volumes 94.9 MB
Free 124.1 MB

Mount Point (Read-Only):	/	Type:	APFS System Volume
Capacity:	1.16 GB	Owners:	Enabled
Available:	124.1 MB	Connection:	Disk Image
Used:	945 MB	Device:	disk3s1

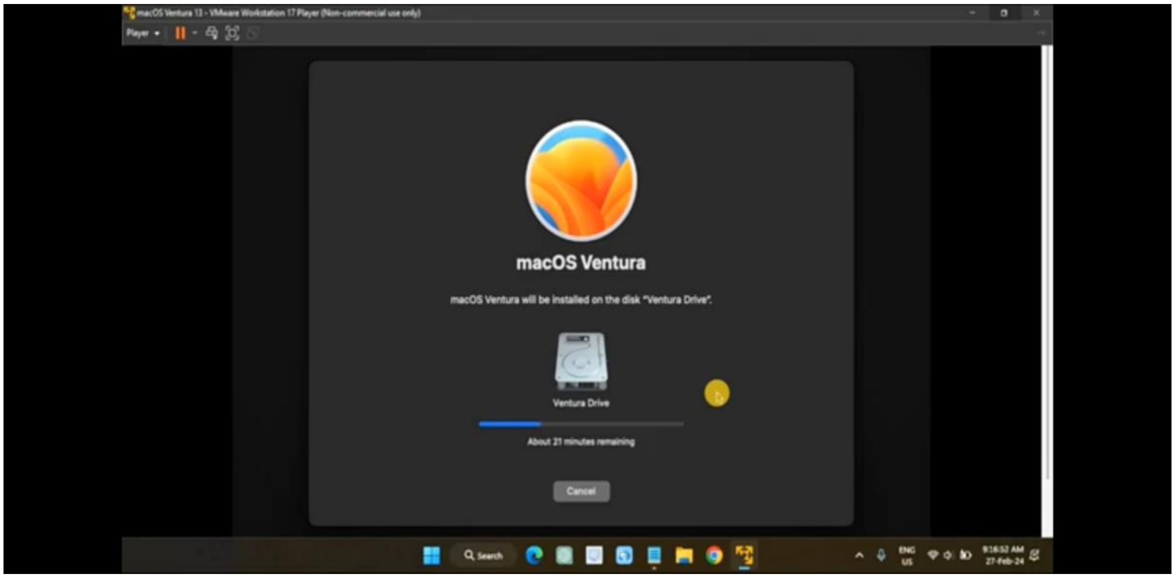
7.Finally   follow this below instruction to install macOS Ventura on VMware



macOS Ventura 13 - VMware Workstation 17 Player (Non-commercial use only)
Player
Search
ENG
US
9:12:53 AM
27-Feb-24

macOS Ventura

To set up the installation of macOS Ventura, click Continue.



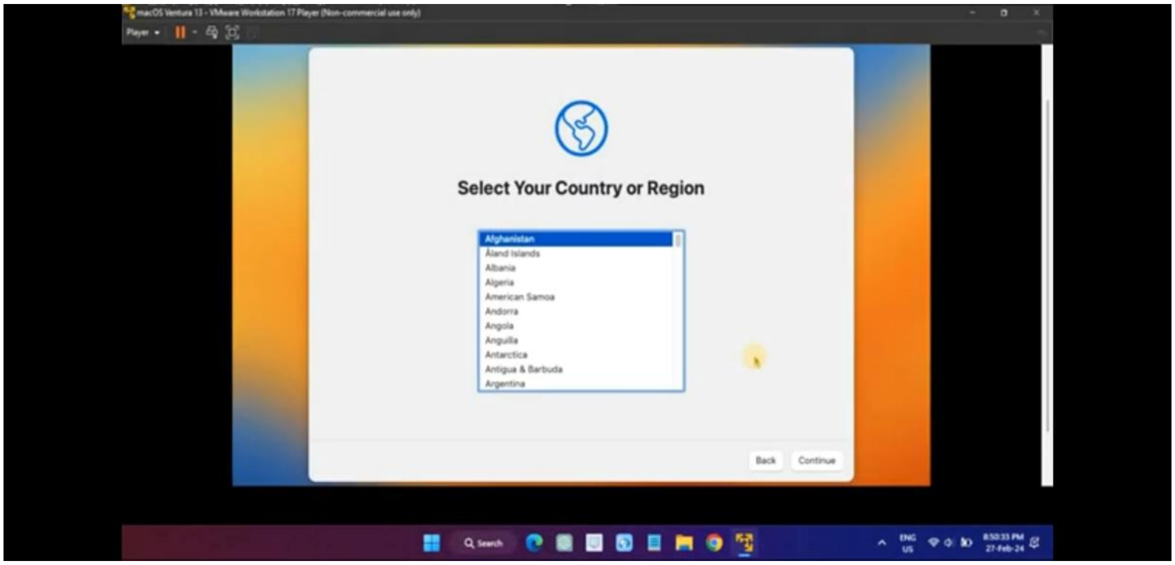
macOS Ventura 13 - VMware Workstation 17 Player (Non-commercial use only)

macOS Ventura

macOS Ventura will be installed on the disk "Ventura Drive".

Ventura Drive

About 21 minutes remaining



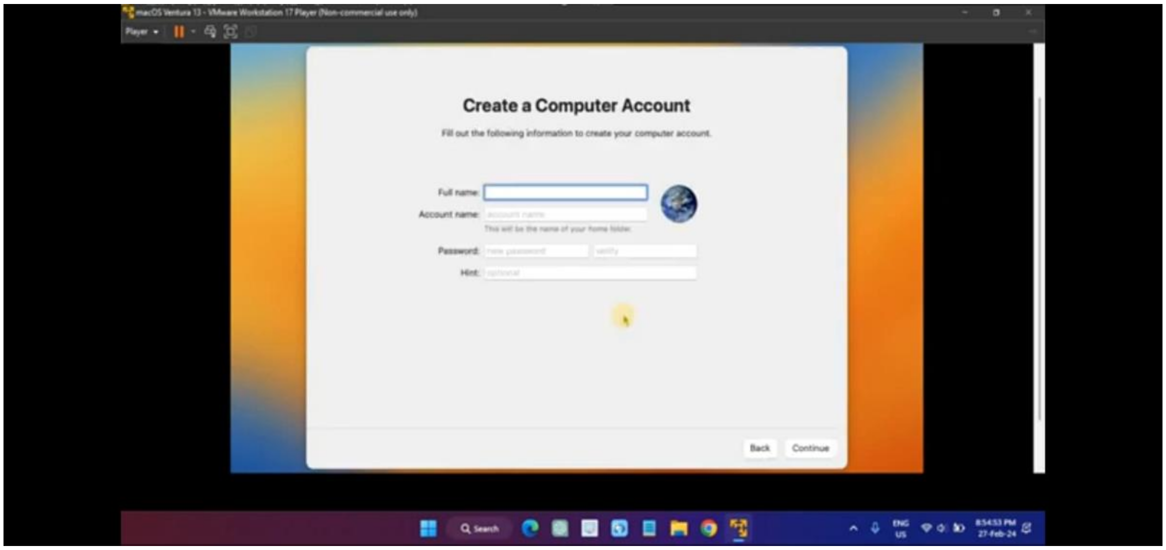
macOS Ventura 13 - VMware Workstation 17 Player (Non-commercial use only)

Select Your Country or Region

Afghanistan
Åland Islands
Albania
Algeria
American Samoa
Andorra
Angola
Anguilla
Antarctica
Antigua & Barbuda
Argentina

Then create a computer account:

- full name type "Mahlet Nigussie Alamneh"
- Username type "mahletnigussie"



macOS Ventura 13 - VMware Workstation 17 Player (Non-commercial use only)

Create a Computer Account

Fill out the following information to create your computer account.

Full name:

Account name: account name

This will be the name of your home folder.

Password: new password verify

Hint: optional

5.0 Issues(problem faced)

Problem

1. Be Alert and Observe Closely: Pay very close attention during each step of the installation. Note anything that seems out of the ordinary, unexpected, or that generates an error message. Don't dismiss anything as insignificant.

2. Capture Screenshots Immediately: The instant you encounter an error, warning, stalled progress bar, or any other unusual behavior, take a screenshot. Don't wait, as the error message might disappear.

•Installation progress bar stalled at 20% for over an hour.

Solution

- Verify the Downloaded Installer: The installer file might be corrupted during the download.

Check Date and Time Settings: Incorrect date and time settings can sometimes cause installer errors.

- Give it More Time (Patience): Sometimes, installations can take a very long time, especially on older Macs or with slow storage devices.

Check Disk Activity (If Possible): Try to gauge if there's any disk activity.

If I know how to use the Terminal in Recovery Mode (advanced users only), I might be able to use command-line tools to check disk activity.

6.0 macOS Ventura File System Support:

Here's a summary of how macOS Ventura handles various file systems:

APFS (Apple File System):

Support: Full read/write support.

Why: APFS is Apple's modern file system, designed for SSDs and flash storage. It's the default file system for macOS High Sierra (10.13) and later. APFS offers features like:

- Cloning: Quickly create copies of files and directories without using extra disk space (until the copies are modified).
- Snapshots: Point-in-time copies of the file system, useful for backups and restoring previous states.
- Encryption: Built-in support for encrypting the entire volume.
- Space Sharing: Multiple volumes can share the same physical storage, allowing for more efficient use of space.
- Crash Protection: Improved protection against data corruption in case of system crashes.

HFS+ (Hierarchical File System Plus, also known as macOS Extended):

- Support: Full read/write support.
- Why: HFS+ was the standard file system for macOS for many years before APFS. While APFS is now preferred, macOS Ventura still fully supports HFS+ for compatibility with older drives and systems. You might encounter HFS+ on older external hard drives.

FAT32 (File Allocation Table 32):

- Support: Full read/write support.
- Why: FAT32 is a very old file system that is widely compatible with many operating systems (Windows, macOS, Linux, etc.). It's often used for small removable storage devices like USB flash drives. However, FAT32 has significant limitations:
- Maximum File Size: It cannot handle files larger than 4GB.
- Maximum Volume Size: Volumes are limited to 2TB (in practice, often less).
- macOS Ventura supports FAT32 primarily for interoperability with older systems and devices.

• exFAT (Extended File Allocation Table):

- Support: Full read/write support.
- Why: exFAT is a modern version of FAT designed to overcome the limitations of FAT32. It supports much larger file sizes and volume sizes, making it suitable for large external hard drives and SD cards. It's also widely compatible with Windows and macOS, making it a good choice for drives you need to share between the two operating systems.
- macOS Ventura supports exFAT for seamless file sharing with Windows and other platforms, especially when dealing with large files.

NTFS (New Technology File System):

- Support: Read-only support by default.

- Why: NTFS is the standard file system for Windows. macOS Ventura can read files from NTFS-formatted drives, but it *cannot* write to them *natively*.
- Writing to NTFS: To gain write access to NTFS drives in macOS, you'll need to use third-party software. Popular options include:

ext4 (Fourth Extended Filesystem):

- Support: No native support. You will need third-party software to read or write.
- Why: ext4 is a journaling file system for Linux and is the widely used default file system.

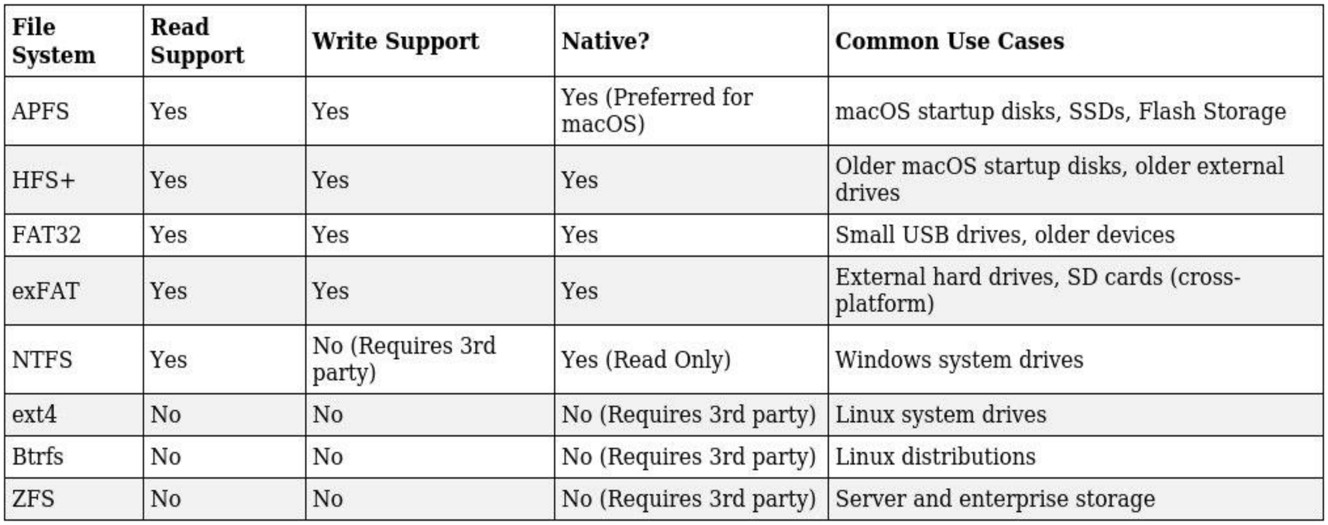
- **Btrfs (B-tree file system):**

- Support: No native support. You will need third-party software to read or write.
- Why: Btrfs is a modern copy-on-write file system for Linux.

- **ZFS (Zettabyte File System):**

- Support: No native support. You will need third-party software to read or write.
- Why: ZFS is a combined file system and logical volume manager designed by Sun Microsystems.

In Summary:



File System	Read Support	Write Support	Native?	Common Use Cases
APFS	Yes	Yes	Yes (Preferred for macOS)	macOS startup disks, SSDs, Flash Storage
HFS+	Yes	Yes	Yes	Older macOS startup disks, older external drives
FAT32	Yes	Yes	Yes	Small USB drives, older devices
exFAT	Yes	Yes	Yes	External hard drives, SD cards (cross-platform)
NTFS	Yes	No (Requires 3rd party)	Yes (Read Only)	Windows system drives
ext4	No	No	No (Requires 3rd party)	Linux system drives
Btrfs	No	No	No (Requires 3rd party)	Linux distributions
ZFS	No	No	No (Requires 3rd party)	Server and enterprise storage

Why Apple's Choices Matter:

- Performance: APFS is optimized for the type of storage used in modern Macs (SSDs and flash memory), resulting in faster performance and better efficiency.

- Security: APFS offers built-in encryption and other security features to protect your data.

- Compatibility: Apple provides native support for file systems that are widely used and important for interoperability with other operating systems (FAT32, exFAT).

- Control: By focusing on APFS and providing limited support for other file systems (like NTFS), Apple maintains greater control over the user experience and can ensure that macOS works reliably and securely.

When formatting external drives for use with a Mac, it's generally best to choose APFS (if the drive will only be used with macOS) or exFAT (if the drive will be shared with Windows)

7.0 Advantages and Disadvantages of macOS Ventura

7.1 Advantages

- Enhanced Multitasking with Stage Manager: Streamlines window management and improves focus on active tasks.

- Continuity Camera: Seamlessly uses your iPhone as a webcam, offering better image quality and features like Desk View.

- Improved System Apps: Significant updates to Mail, Messages, Safari, and other core apps, adding new features and improving usability.

- Passkeys: Enhanced security with passwordless login using Touch ID or Face ID.

- System Settings Redesign: A more streamlined and modern interface for system preferences, making it easier to find and adjust settings.

- Improved Spotlight Search: Faster and more comprehensive search results.

7.2 Disadvantages

- Stage Manager Learning Curve: The new Stage Manager feature may require some time to get used to.

- Compatibility Issues: Older software and hardware may not be fully compatible with macOS Ventura.

- Potential for Bugs: As with any major OS release, there may be some initial bugs and glitches.

- System Settings Redesign (Subjective): While many appreciate the redesigned System Settings, some users may find it takes time to adjust to the new layout.

- Limited Hardware Support: Some older Mac models are no longer supported, requiring users to upgrade their hardware to use Ventura.

8.0 Conclusion:

macOS Ventura is a solid update to Apple's desktop operating system, offering a range of new features, performance improvements, and enhanced security. The enhanced multitasking capabilities, Continuity Camera, and improved system apps make it a worthwhile upgrade for many users. However, it's important to be aware of potential compatibility issues and the learning curve associated with some of the new features.

9.0 Future Recommendations:

- Further Refine Stage Manager: Continue to improve the usability and customization options for Stage Manager to cater to a wider range of user workflows.
- Expand Hardware Support: Explore ways to extend support for older Mac models to reduce e-waste and allow more users to benefit from the latest features.
- Focus on Stability and Reliability: Prioritize stability and reliability in future updates to ensure a smooth and trouble-free user experience.
- Enhance Cross-Platform Compatibility: Continue to improve compatibility with Windows and Linux file systems to facilitate seamless file sharing.
- Address Privacy Concerns: Continue to strengthen privacy protections and provide users with more control over their data.

What is Virtualization?

Virtualization is the process of creating a software-based (or "virtual") representation of something physical. In the context of operating systems, it typically refers to creating virtual machines (VMs) that emulate the behavior of physical computers. Each VM can run its own operating system and applications, completely isolated from other VMs and the host system.

Why Use Virtualization?

Virtualization offers many benefits, including:

- Resource Optimization: Multiple VMs can run on a single physical server, maximizing hardware utilization and reducing costs.
- Isolation: VMs are isolated from each other, preventing conflicts and enhancing security. If one VM crashes, it doesn't affect the others.

- Flexibility and Scalability: VMs can be easily created, copied, moved, and scaled to meet changing demands.

- Testing and Development: Virtualization provides a safe environment for testing new software and configurations without risking the stability of the host system.

- Legacy Application Support: Run older operating systems and applications on a virtual machine, even if they are not compatible with the host OS.

- Disaster Recovery: VMs can be easily backed up and restored, making it easier to recover from system failures.

How Does Virtualization Work?

Virtualization is typically achieved using a hypervisor, which is a software layer that manages the VMs and abstracts the underlying hardware. There are two main types of hypervisors:

- Type 1 (Bare-Metal) Hypervisors: These hypervisors run directly on the hardware, without a host operating system. Examples include VMware ESXi, Citrix XenServer, and Microsoft Hyper-V Server. Type 1 hypervisors offer the best performance and resource utilization.

- Type 2 (Hosted) Hypervisors: These hypervisors run on top of an existing operating system (like Windows, macOS, or Linux). Examples include VMware Workstation, VMware Fusion, Oracle VirtualBox, and Parallels Desktop. Type 2 hypervisors are easier to set up and manage but typically have lower performance than Type 1 hypervisors.

Key Components:

- Virtual Machine (VM): A software-based emulation of a computer, with its own virtual CPU, memory, storage, and network interfaces.

- Hypervisor: The software that creates and manages VMs, allocating resources and isolating them from each other.

- Host Operating System: The operating system on which the hypervisor runs (for Type 2 hypervisors).

- Guest Operating System: The operating system running inside a virtual machine.

The Process:

1. The hypervisor creates virtual hardware for each VM.

2. The guest operating system is installed on the virtual hardware.

3. The hypervisor intercepts and translates requests from the guest OS to the physical hardware.

4. The hypervisor manages resource allocation, ensuring that each VM gets the resources it needs without interfering with other VMs.

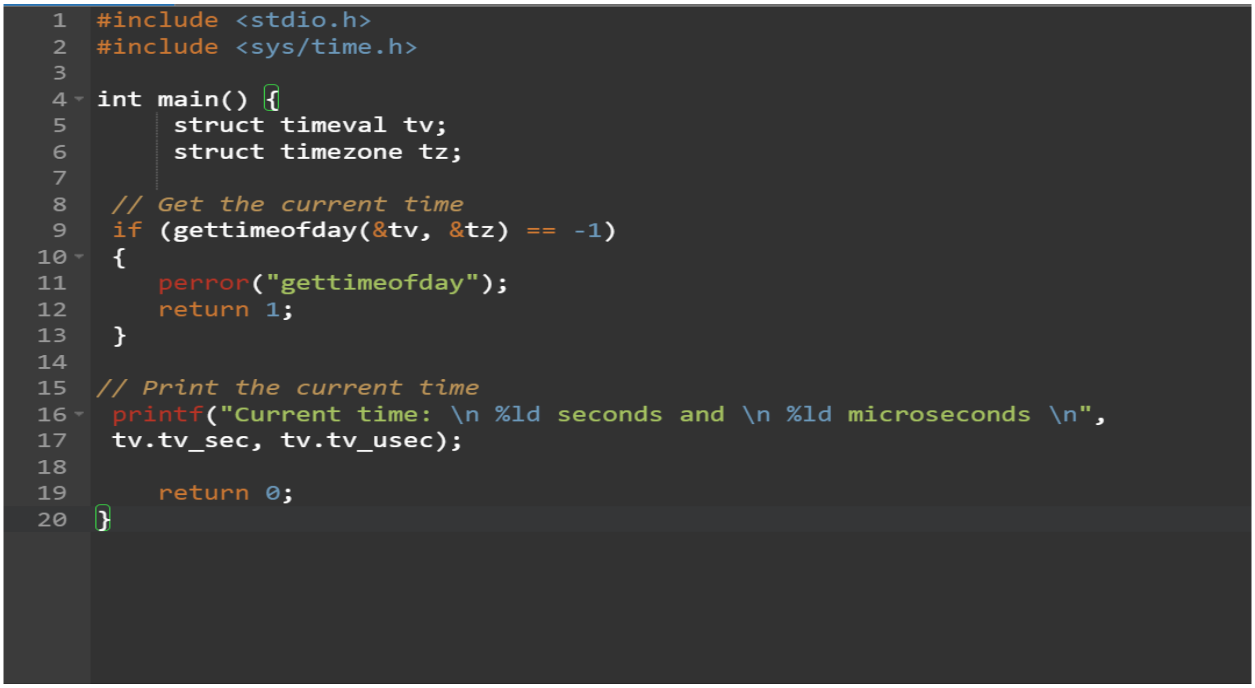
Virtualization has become a fundamental technology in modern computing, enabling greater efficiency, flexibility, and scalability in a wide range of environments, from data centers to desktop computers.

Implementation of gettimeofday() System Call:

The gettimeofday() system call is a fundamental part of many operating systems, providing a standardized way for user-level programs to obtain the current time with microsecond precision. gettimeofday() is to give applications a reliable and relatively precise way to measure time intervals and timestamp events.

Implementing the gettimeofday() system call involves adding a new system call to the operating system kernel that retrieves the current time and date. Below is a brief explanation of how to approach this task, assume I am working with a Unix-like operating system (e.g., Linux).

- The gettimeofday() function typically retrieves the current time and stores it in a structure that includes seconds and microseconds since the Epoch (January 1, 1970).



```c
#include <stdio.h>
#include <sys/time.h>

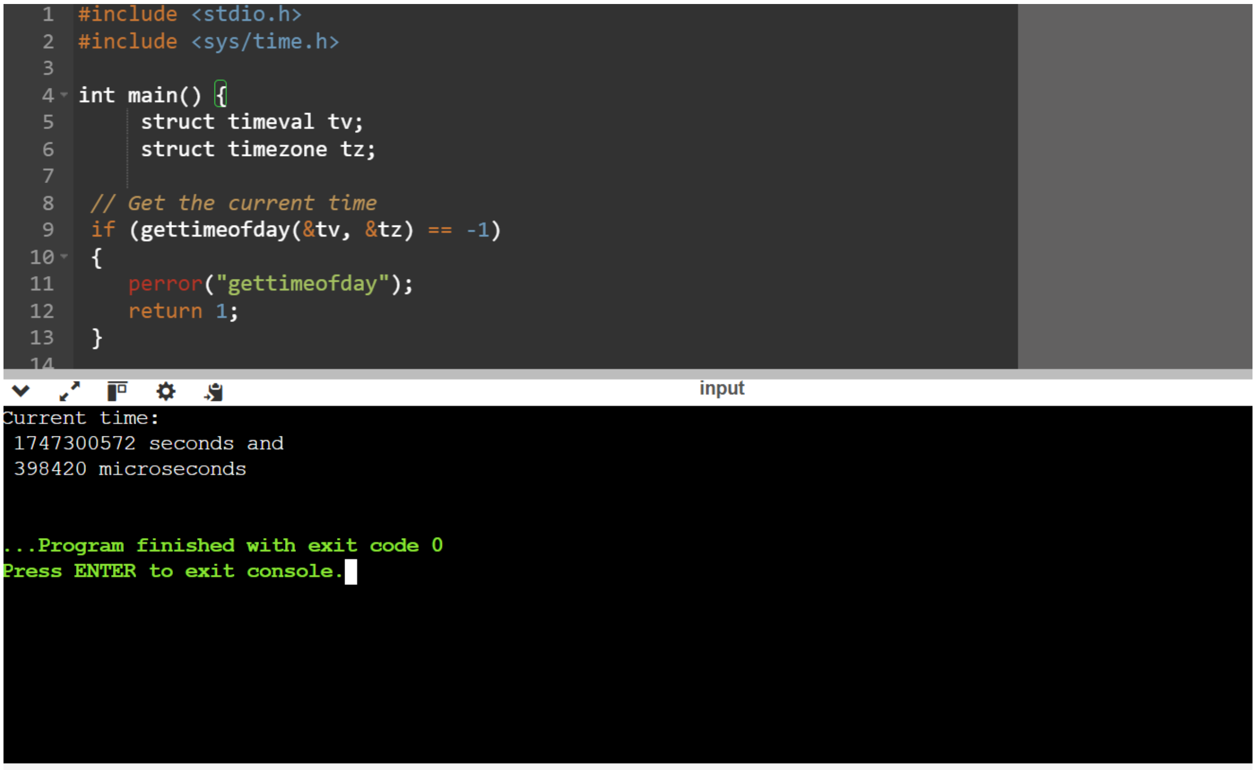
int main() {
     struct timeval tv;
     struct timezone tz;

 // Get the current time
 if (gettimeofday(&tv, &tz) == -1)
 {
    perror("gettimeofday");
    return 1;
 }

// Print the current time
 printf("Current time: \n %ld seconds and \n %ld microseconds \n",
 tv.tv_sec, tv.tv_usec);

    return 0;
}
```

Here is out put



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```

```
Current time:
 1747300572 seconds and
 398420 microseconds


...Program finished with exit code 0
Press ENTER to exit console.
```