Individual Assessment Coversheet

To be attached to the front of the assessment.

Campus: Pretoria

Faculty: Information Technology

Module Code: ITVAAO-B12

Group: Group 1

Lecturer's Name: Ms. Mutheiwana. F.

Student Full Name: Kelebogile Nanikie Mathebula

Student Number: [redacted]

Indicate	Yes	No
Plagiarism report attached	✓	

Declaration:

I declare that this assessment is my own original work except for source material explicitly acknowledged. I also declare that this assessment or any other of my original work related to it has not been previously, or is not being simultaneously, submitted for this or any other course. I am aware of the AI policy and acknowledge that I have not used any AI technology to generate or manipulate data, other than as permitted by the assessment instructions. I also declare that I am aware of the Institution's policy and regulations on honesty in academic work as set out in the Conditions of Enrolment, and of the disciplinary guidelines applicable to breaches of such policy and regulations.

Signature: KNP MATHEBULA	**Date** 9/06/2025

Lecturer's Comments:

Marks Awarded: %

Signature	**Date**

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Proposal for Server Virtualisation using Oracle VirtualBox

Prepared by: KNP Limited

Submitted to: DataSecure Ltd.

Date: 13/06/2025

Abstract:

DataSecure Ltd. Currently operates 10 physical servers that support critical business applications, including Customer Relationship Management (CRM), database management (e.g. Database Server **(**SQL Server and PostgreSQL instance**)**), cybersecurity tools, and backup systems. This infrastructure, while functional, is challenged by high maintenance costs, underutilised resources, scalability issues, and complex security management.

Therefore:

KNP Limited proposes a virtualisation strategy using Oracle VirtualBox, a robust, cross-platform, open-source virtualisation solution. Our proposal outlines a phased approach to integrate or unite your existing infrastructure, significantly reducing overheads while increasing flexibility and operational efficiency. A proof-of-concept (PoC) which basically demonstrates or shows the viability of our proposal, the PoC will use VirtualBox to demonstrate the effectiveness of our solution prior to full-scale deployment.

Figure 1: VirtualBox Logo

Our Objectives

- We will first reduce or lessen hardware and energy costs through server consolidation.
- We will secondly improve flexibility and scalability for future application deployments.
- We will thirdly optimise or better hardware resource utilisation.

- ❖ We will fourthly enhance disaster recovery preparedness.
- ❖ We will lastly simplify security and compliance through centralised management.

Those are our 5 goals that we as KNP Limited aim to achieve, they will help our team to track the progress of what we will be doing for your organization, therefore according to your struggles this is what we are going to produce for your organization.

Proposed Solution: Virtualization with Oracle VirtualBox

Why VirtualBox?

Oracle VirtualBox is what we believe or rather know will work for you since it is a lightweight, open-source virtualisation platform.

Server Consolidation Plan

We propose migrating or moving physical servers into VirtualBox-hosted virtual machines (VMs), which will be hosted on 2-3 high-performance workstations or servers.

Proof of Concept (PoC)

We propose a 3-4-week PoC to virtualise two critical systems (e.g. the CRM system and file server) on Oracle VirtualBox running on existing or newly supplied hardware.

Project Timeline

This is an estimate of how long the project might take

Phase	Duration
Planning & Infrastructure Assessment	1 week
PoC Deployment	2-3 weeks
Evaluation & Final Report	1 week
Full Migration	4-6 weeks

Cost Estimate

We do not have a specific cost of the whole project but using the Oracle VirtualBox will be cost effective and will reduce your company's costs, that is because the Oracle VirtualBox is free of charge. Costs will only relate to labour, support, training, and optional hardware purchasing which is a big upside for now and your company's costs in the long run.

Prepared by: Kelebogile Nanikie Mathebula

KNP Limited: EDUV7934480@vossie.net

Question 1

1.1 Investigate leading virtualization platforms, including VMware vSphere, Microsoft Hyper-V, and Oracle VirtualBox.

➢ VMware vSphere

VMware vSphere is a virtualized platform developed by VMware that allows organizations to create and manage virtualized IT environments. It's essentially a suite of products that enables the virtualization of hardware resources, such as servers, allowing multiple operating systems to run simultaneously on a single physical machine. vSphere includes components like ESXi (the hypervisor), vCenter Server (for management), and other tools.

vSphere allows organizations to consolidate multiple physical servers into fewer virtual machines, improving efficiency and resource utilization.

The core of vSphere is ESXi, a bare-metal hypervisor that directly runs on the hardware, creating a foundation for virtual machines. vCenter Server is the management console.

vSphere offers numerous benefits, including improved resource utilization, reduced hardware costs, easier management, and the ability to run various operating systems and applications on the same hardware.

Advantages:

- Scalability as well as enterprise-grade performance.
- Robust management tools (vCenter, vMotion, DRS, HA).
- High compatibility with hardware and software.
- It has advanced features like fault tolerance, distributed resource scheduling.

Disadvantages:

- It is quite expensive in terms of licensing and support costs.
- It requires compatible hardware (HCL compliance).
- It has complex setup and management for quite small environments.

Key Specifications:

- **Management tools:** vCenter Server
- **Backup Integration:** Extensive third-party support
- **Live Migration:** Yes (vMotion)
- **Supported OS:** Windows, Linux, macOS (limited), Solaris
- **Clustering/HA:** Yes

It is vey ideal to be used by large enterprises, datacentres, and organizations that need high availability and performance.

➢ Microsoft Hyper-V

Microsoft Hyper-V is a virtualization technology that allows users to create and run multiple virtual machines (VMs) on a single physical server. It provides a software layer called a hypervisor that sits between the physical hardware and the virtual operating systems, enabling them to share resources and operate independently.

Hypervisor is a software layer that manages the virtual machines and interacts with the physical hardware.

Each virtual machine runs a complete operating system, just like a physical machine, but on a virtual environment.

Hyper-V allows VMs to share resources like CPU, memory, and storage, optimizing resource utilization.

Hyper-V can be used for various purposes like testing different operating systems, running legacy applications, and consolidating or merging server workloads.

Hyper-V Replica makes copies of virtual machines with the intention to store them in another physical location, making it easy for you to restore the virtual machine from the copy.

In terms of backing up, Hyper-V offers two types of backups, one which uses saved states and the other will use Volume Shadow Copy Service (VSS).

Hyper-V is available as a server role for x64 versions of Windows Server and as a feature that can be enabled on Windows 10 and 11.

Advantages:

- It is free with Windows Server/Pro licences.
- There is live migration, replication, and clustering available.
- It has solid performance on Windows based VMs.
- It offers good integration with Microsoft ecosystem (e.g. System Centre, Active Directory).
- Automation is made easier by Hyper-V Manager and PowerShell.

Disadvantages:

- It has limited guest OS support compared to VMware.
- The GUI management can feel less intuitive.
- There are fewer advanced features in standalone/free versions.

Key Specifications:

- **Management tools:** Hyper-V Manager, System Centre VMM.
- **Live Migration:** Yes.
- **Backup Integration:** Strong within Windows ecosystem.
- **Supported OS:** Windows, Linux (limited versions), FreeBSD.
- **Clustering/HA:** Yes (via Failover Clustering).

It also has a virtual switch for advanced networking. In terms of its use case, it is best for organizations that are already invested in the Microsoft ecosystem, or those seeking a lower-cost enterprise-grade solution.

➢ Oracle VirtualBox

VirtualBox is a free and open-source, Type-2 hypervisor developed by Oracle. It runs on top of a host OS like Windows, macOS, or Linux and is aimed at desktop and developer use cases.

Advantages:

- ❖ It is very easy to install and use.
- ❖ Used on cross platforms (Windows, Linux, macOS, Solaris hosts).
- ❖ It is completely free and open-source.
- ❖ It also has snapshots and cloning features.
- ❖ It is good for desktop/lab testing.

Disadvantages:

- ❖ It is not suitable for production enterprise environments.
- ❖ Has no built-in clustering or HA.
- ❖ Has no native live migration.
- ❖ It has limited performance and scalability.

Key Specifications:

- ❖ **Management tools:** GUI or CLI
- ❖ **Clustering/HA:** No
- ❖ **Backup integration:** Manual or script-based
- ❖ **Live Migration:** No
- ❖ **Supported OS:** Wide range (Windows, Linux, macOS, BSD, Solaris)

It also has features like seamless mode and shared clipboard between host and guest, snapshot and cloning support, basic networking options (NAT, Bridged, Host-only), and command-line interface and extensibility. In terms of it's use case, it is ideal for individual users, developers, and educational purposes.

1.2 Compare their performance, security features, scalability, and licensing costs.

Performance:

Feature	VMware vSphere	Microsoft Hyper-V	Oracle VirtualBox
Virtualisation Type	Type 1 (bare-metal)	Type 1 (integrated into Windows)	Type 2 (it runs on top of OS)
Overhead	Very low	Low, but it is slightly higher than vSphere in benchmarks	Higher, due to host OS dependency
Hardware Utilization	Outstanding with features like DRS, NUMA support.	Good, it does will especially in Windows Environments.	Lower utilization, it lacks optimization for multi-core.
Best Use Case	Datacentres, Large Enterprises	Windows ecosystem	Development, testing.

In essence VMware vSphere has the best performance.

Security:

Feature	VMware vSphere	Microsoft Hyper-V	Oracle VirtualBox
Secure boot & VM encryption	VM encryption, Secure boot, it also has TPM integrated in it	Secure boot, it has TPM support, including shielded VMs	Has no native encryption as well as no TPM support.
Isolation & Sandboxing	Strong, it has vSphere Security Hardening	Good, especially with shielded VMs	It has basic isolation making it weak, due to host OS dependence
Patch Management	It has vSphere Lifecycle Manager	It comes with Windows Update integration.	Manual

Audit & Logging	It is advanced with syslog as well as vRealize Log insight	It is integrated with Windows Event Logs	Basic logging

TPM: (Trusted Platform Module)

In this case VMware vSphere and Hyper-V offer better security, with vSphere having a slight edge in breadth and flexibility.

Scalability:

Feature	VMware vSphere	Microsoft Hyper-V	Oracle VirtualBox
Host Physical CPUs	Up to 768 CPUs (vSphere 8)	Up to 512 logical processors	It is limited by host OS, and it's because it's not designed for scale
RAM per Host	Up to 24 TB	Up to 24 TB	Limited (typically under 256 GB)
VMs per Host	1024	1024	100, it is not enterprise supported
VMs per Cluster	It has 96 hosts per cluster	64 nodes per cluster	It has no Cluster support
Management Scalability	Outstanding with vCenter and vRealize automation	Good with System centre	It is not made/ designed for centralized management

VMware vSphere is in the lead in terms of scalability, followed by Hyper-V.

Licensing costs:

Feature	VMware vSphere	Microsoft Hyper-V	Oracle VirtualBox
Base Software	Paid (ESXi free limited edition)	Free with Windows (Standard/Datacentre)	Free and open-source
Management Tools	vCenter is paid	System Centre is paid	Free
Support	It has enterprise	Microsoft support options (they are	Community support,

	support subscriptions.	included with Windows)	Oracle VirtualBox offers limited paid support.

VirtualBox wins for users who are cost-conscious. Hyper-V is cost effective in Windows environments, and VMware vSphere is quite expensive but has a lot of features for large enterprises.

1.3 Recommend the most suitable platform for DataSecure Ltd. Based on their operational needs and budget constraints.

I recommend Oracle VirtualBox and that is because it is **cost effective and free** which supports the company's budget constraints, it has no licensing costs, secondly VirtualBox is **lightweight and easy to deploy** making it perfect for DataSecure Ltd. Since they are a small sized business which is not ready to invest in large-scale-enterprise platforms due to their budget issues. Thirdly, it **supports multiple operating systems** like Windows, Linux, BSD etc., it also enables running multiple VMs on fewer physical machines, maximising CPU, RAM, and storage utilization.

Oracle VirtualBox has **snapshot and cloning features** which make disaster recovery and system rollback easy and reliable. It also offers **enhanced security through isolation**, which reduces the impact of potential breaches.

Therefore, Oracle VirtualBox meets both the operational and financial goals, making it the most practical and sustainable virtualisation platform for DataSecure Ltd. (Dash, 2013)

1.4 Explain how virtualization optimises resource utilisation by enabling multiple virtual machines (VMs) to share CPU, RAM, and storage.

Instead of each physical server running a single workload, virtualisation enables a single server to run multiple isolated VM environments, each with its own operating system. This consolidation improves efficiency and reduces hardware costs by maximizing the use of existing resources.

Multiple VMs can share the CPU's processing power. The VirtualBox manages the allocation of CPU time to each VM which ensures that each VM receives the resources it needs without interfering with others.

Similar to CPU the Ram can be shared among VMs. VirtualBox allocates memory to each VM as needed, dynamically adjusting the allocation based

on demand. VMs can share access to a common storage pool, VirtualBox provides each with the necessary storage capacity, allowing for efficient data management.

Therefore, there will be increased efficiency, where by virtualisation enables better utilization of hardware resources, reducing wasted capacity and improving overall system efficiency not only that, there will also be reduced hardware costs, by running multiple VMs on a single physical server, organizations can reduce the number of servers they need, leading to significant cost savings on hardware, electricity and physical space. Improved flexibility and agility will also be a produce since VMs will easily be moved, created, and scaled up or down, providing flexibility in deploying and managing applications as well as enhanced management and automation where virtualisation will simplify server management, making it way easier to back up and restore as well as manage VMs.

1.5 Demonstrate how virtualization enhances disaster recovery through features like snapshots, failover clustering, and automated backups.

Oracle VirtualBox will enhance disaster recovery through virtualisation features like snapshots, failover clustering, and automated backups enabling DataSecure Ltd. to quickly recover from system failures.

Snapshots allow capturing the state of a virtual machine for easy rollback, failover clustering ensures seamless migration to a secondary site, and automated backups protect data integrity.

VirtualBox snapshots capture the complete state of a virtual machine (including the operating system, installed applications, and data) at a specific point in time, snapshots also allow for testing without fear of damaging the production environment. In case of a system failure a user can quickly restore the virtual machine to its previous state which was healthy.

In a failover cluster, virtual machines can be migrated from a failed host to a healthy host in the cluster to minimize downtime as well as disruptions, Oracle VirtualBox can then be used in conjunction with failover clustering technologies, this is to ensure continuous operation during possible hardware failures.

In terms of automated backups, VirtualBox can be integrated with backup solutions to automatically create backups of virtual machines and their associated data, the backups can then be saved on external storage or they can be replicated to a remote site, providing a secure offsite copy of important data. (Portnoy, 2012)

1.6 Provide an in-depth cost-benefit analysis, including savings on hardware, energy, and administrative overhead.

NB: This is a hypothetical estimate of the costs.

Current Costs (Without Oracle VirtualBox)

Expense Category	Estimate per Annum	Notes
Hardware Maintenance	R230 000	R13 000 per server yearly
Electricity and cooling	R100 000	The 10 physical servers present
Physical Space Rental	R85 000	Server room rent or it could be the data centre costs
Admin Overhead	R99 000	Time as well as salary for IT staff for their physical maintenance
Total:	**R514 000**	

Costs (With Oracle VirtualBox)

Expense Category	Estimate per Annum	Notes
Hardware Maintenance	R44 000	R18 000 per server
Electricity and cooling	R26 000	There will be lower power or electricity usage
VirtualBox Licensing	R0	Free
Admin Overhead	R30 000	It is for more efficient admin tasks
Total:	**R100 000**	

The total Annual saving will be R414 000 (R514 000(current)-R100 000(VirtualBox)).

1.7 Discuss potential cybersecurity improvements, such as isolated virtual environments of high-risk applications.

Oracle VirtualBox can be enhanced for cybersecurity through the use of isolated virtual environments, especially for high-risk applications. This means creating separate virtual machines for sensitive tasks, limiting their interaction with the host and other VMs and implementing robust security measures within those VMs.

In terms of applications dealing with sensitive data or critical systems, isolating them in their own VMs can significantly reduce the attack surface. If it happens that some sort of corruption takes place, the damage is contained within that VM which minimizes the impact on other parts of the system.

Within the isolated VMs there can be additional security measures put in place or implemented, such as firewalls, intrusion detection systems as well as strong password policies.

Benefits of isolation include **reduced attack surface** that is because when sensitive applications are isolated the overall attack surface is reduced, making it harder for attackers to compromise their entire system, secondly there is **containment of compromises** in the sense that if a vulnerability is exploited in one VM, the damage is contained to that VM which prevents it from spreading to other parts of the system. Thirdly there will be **testing and development** whereby isolated environments are ideal for testing new software or experimenting with security tools without any of those affecting other systems. (Anderson, 2014)

Question 2

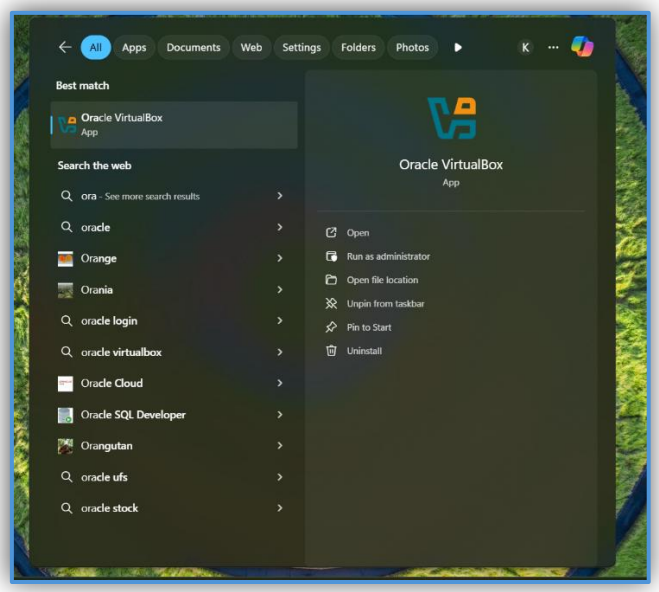
2.1 Set up a virtualised environment using the chosen platform.

The chosen Platform is Oracle VirtualBox, pictures of the whole process are attached below:

2.2 Create at least two virtual machines running different workloads.

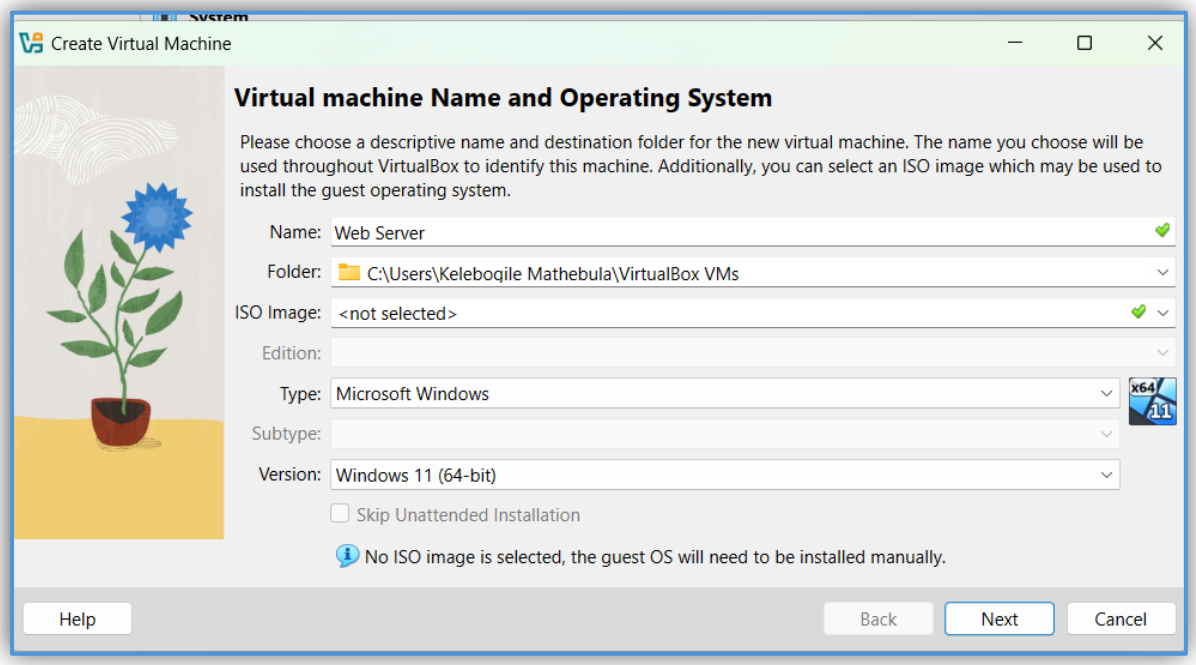
These are the steps that I took when creating two virtual machines, it is the same process for both the virtual machines that being the reason as to why I did not show the process for both the virtual machines but I showed both of the virtual machines signing in stage.

Step 1: I started of by searching for the app that I will be using which is Oracle VirtualBox

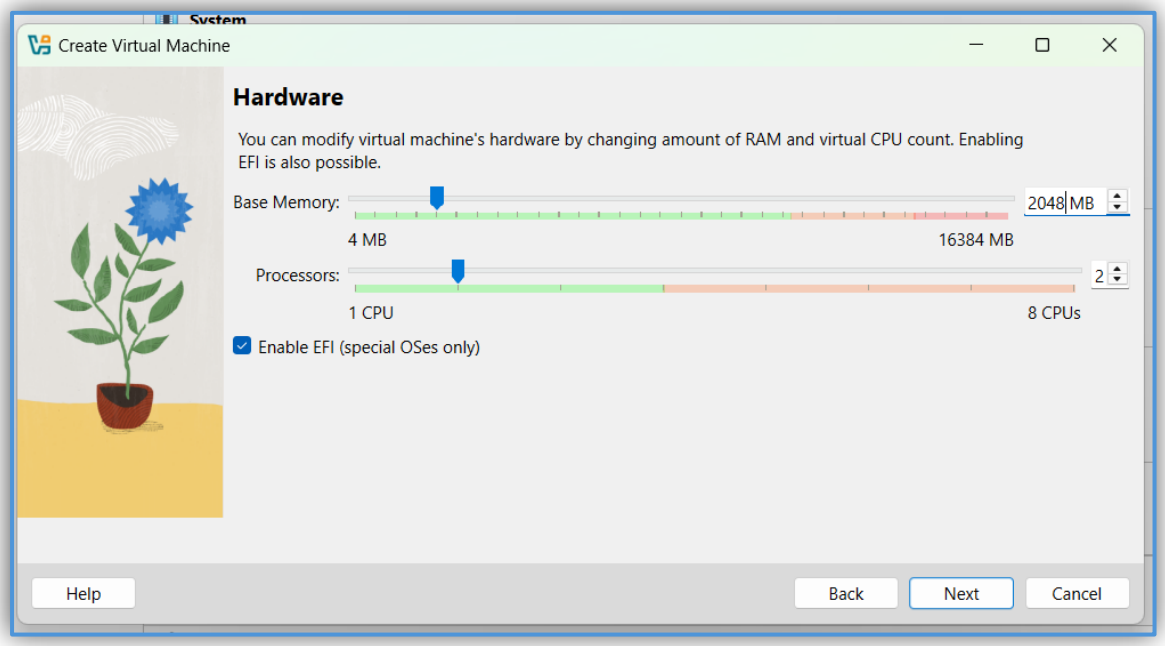


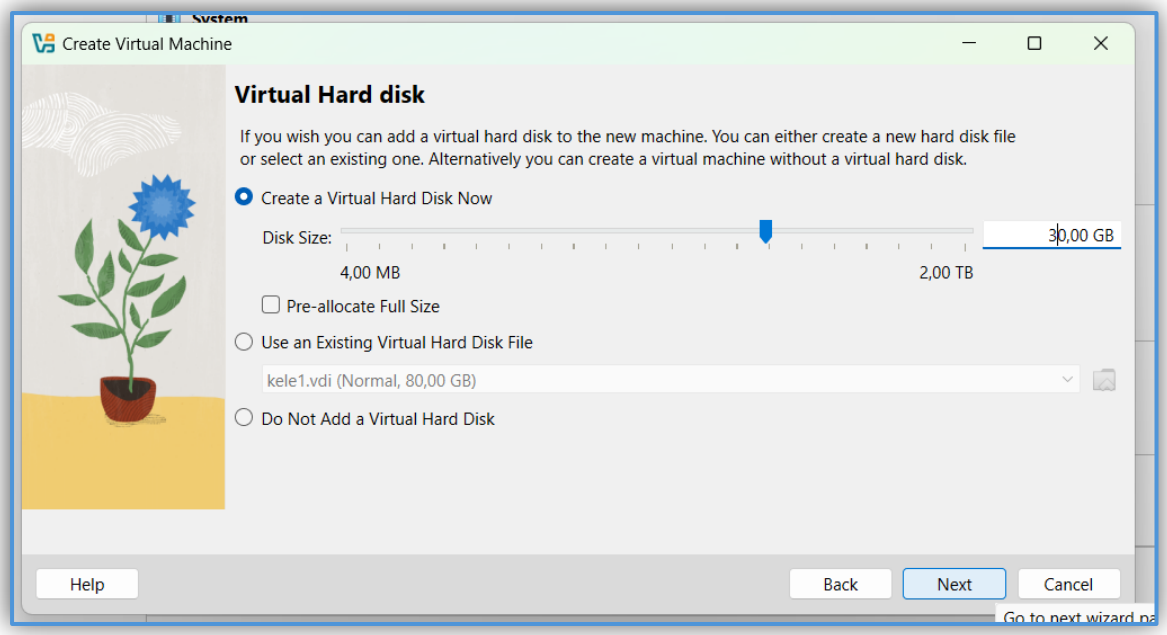
Step 2: I opened the app, at the top middle there were options for me, the options being-new, add, settings, discard and start. I then went on to select new, the following image is what appears after clicking new. I then filled in the following:

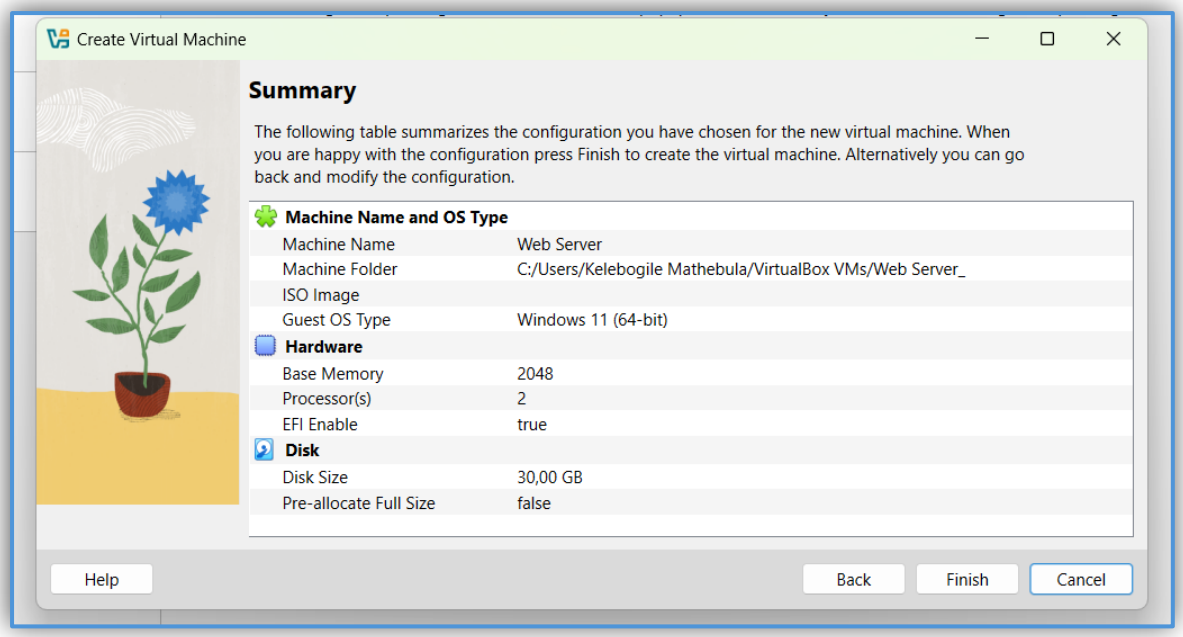
NB: I left out the ISO file/image



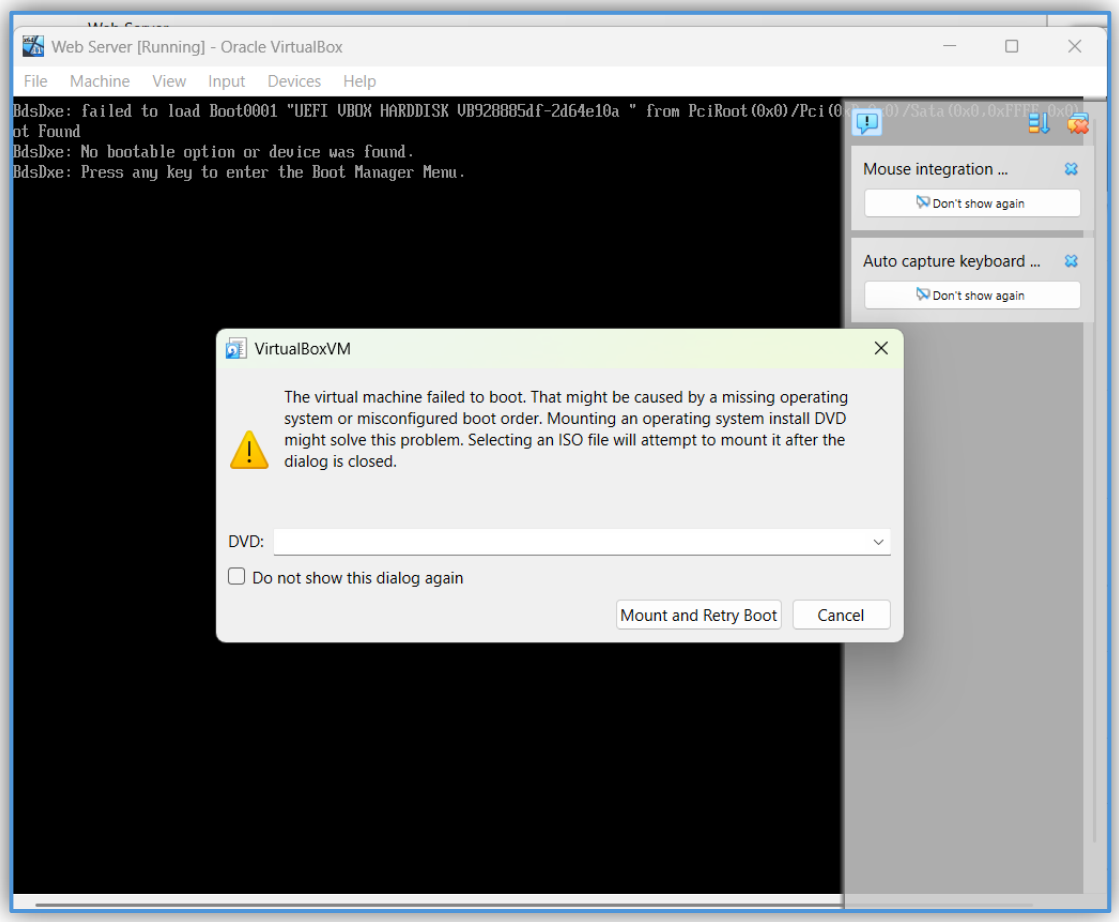
Step 3: I then continued filling in the required information, the next 3 images are what I filled in and are in order.

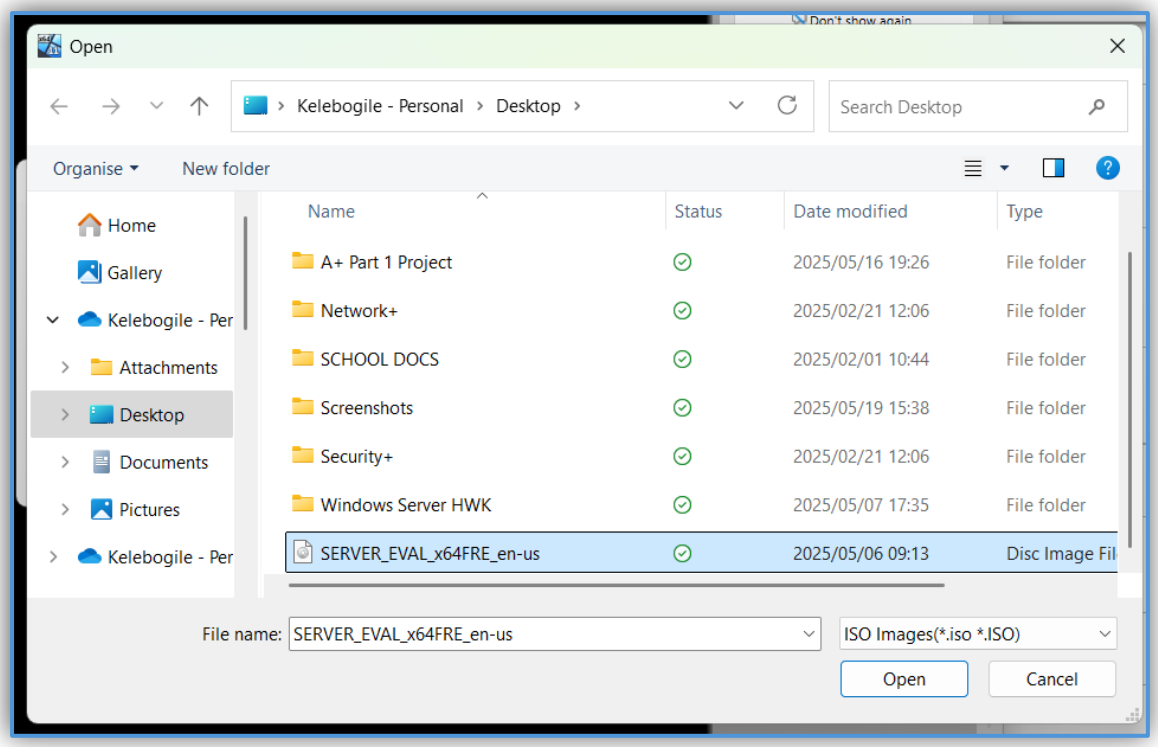


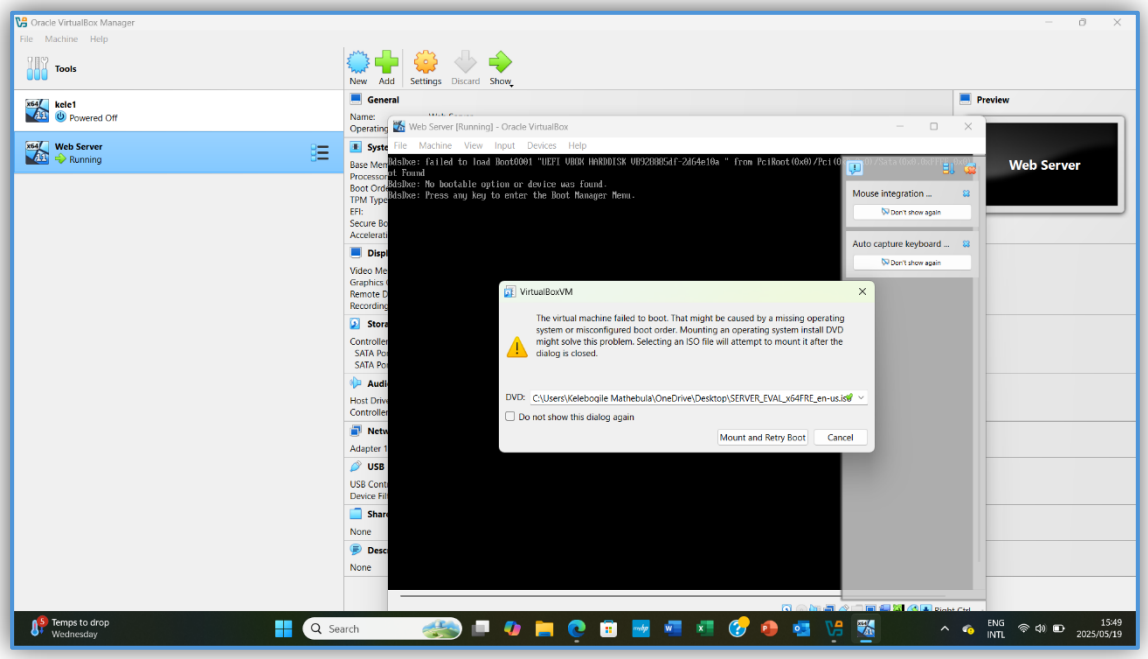




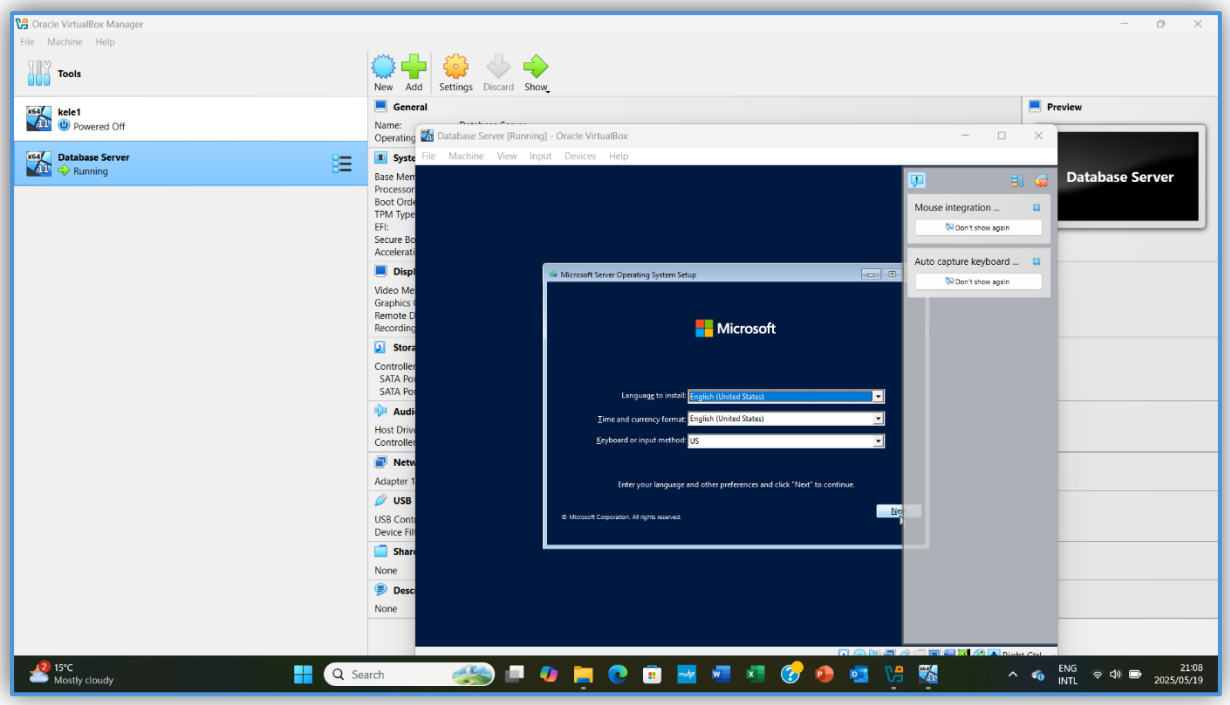
Step 4: After pressing finish the virtual machine will run, then a pop up will appear, that is where I inserted my ISO file/image. I then pressed mount and Retry boot.







Step 5: After mounting and retrying boot the VM will continue running, you will be required to choose desktop experience as the second step then I thirdly accepted the license agreement, fourth step is to choose the custom Microsoft Server Operating System Setup then install everything.


Oracle VirtualBox Manager
File Machine Help
Tools
kele1
Powered Off
Database Server
Running
New Add Settings Discard Show
General
Preview
Database Server
Database Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Mouse integration ...
Don't show again
Auto capture keyboard ...
Don't show again
Microsoft Server Operating System Setup
Microsoft
Language to install: English (United States)
Time and currency format: English (United States)
Keyboard or input method: US
Enter your language and other preferences and click "Next" to continue.
© Microsoft Corporation. All rights reserved.
15°C
Mostly cloudy
Search
ENG
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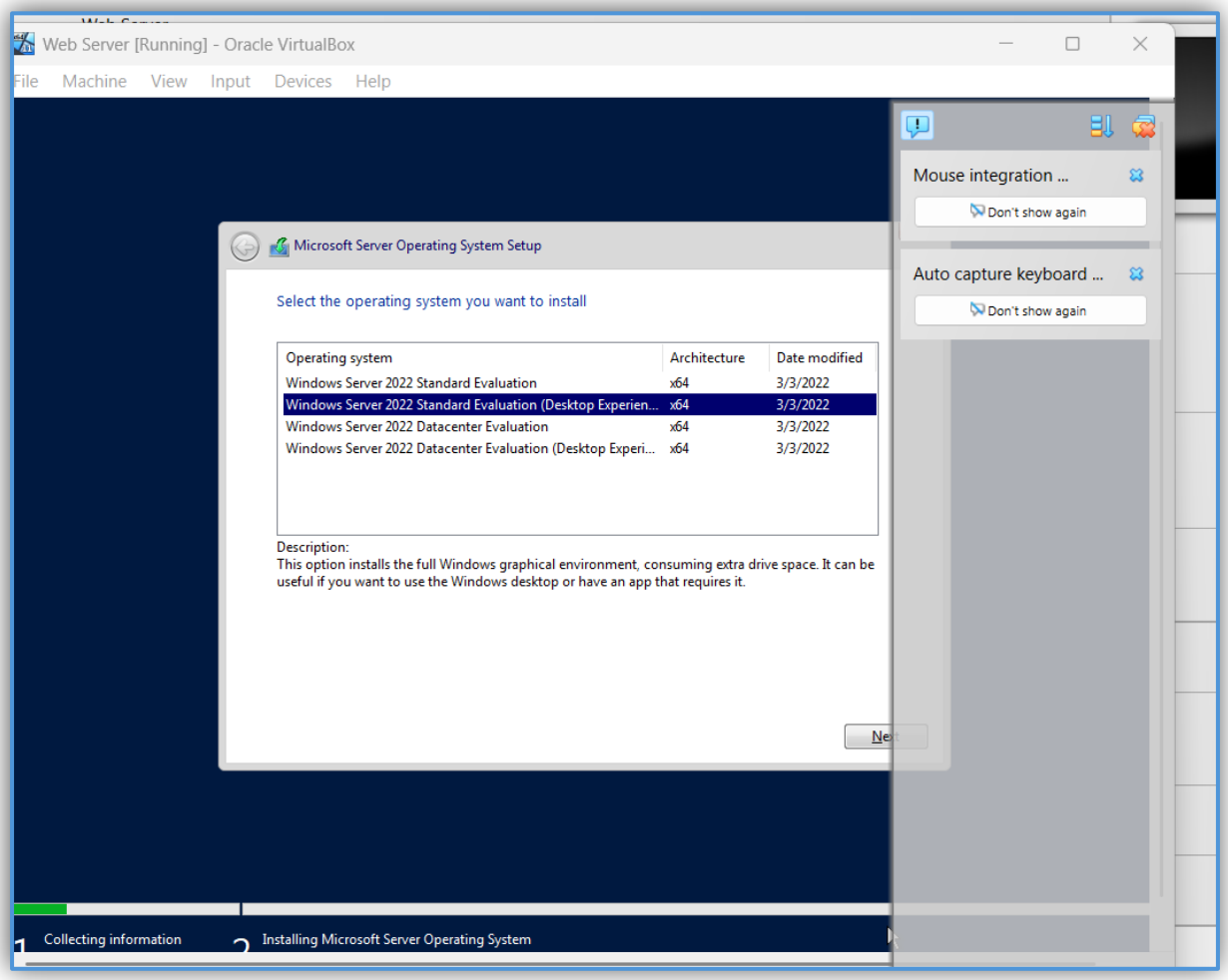
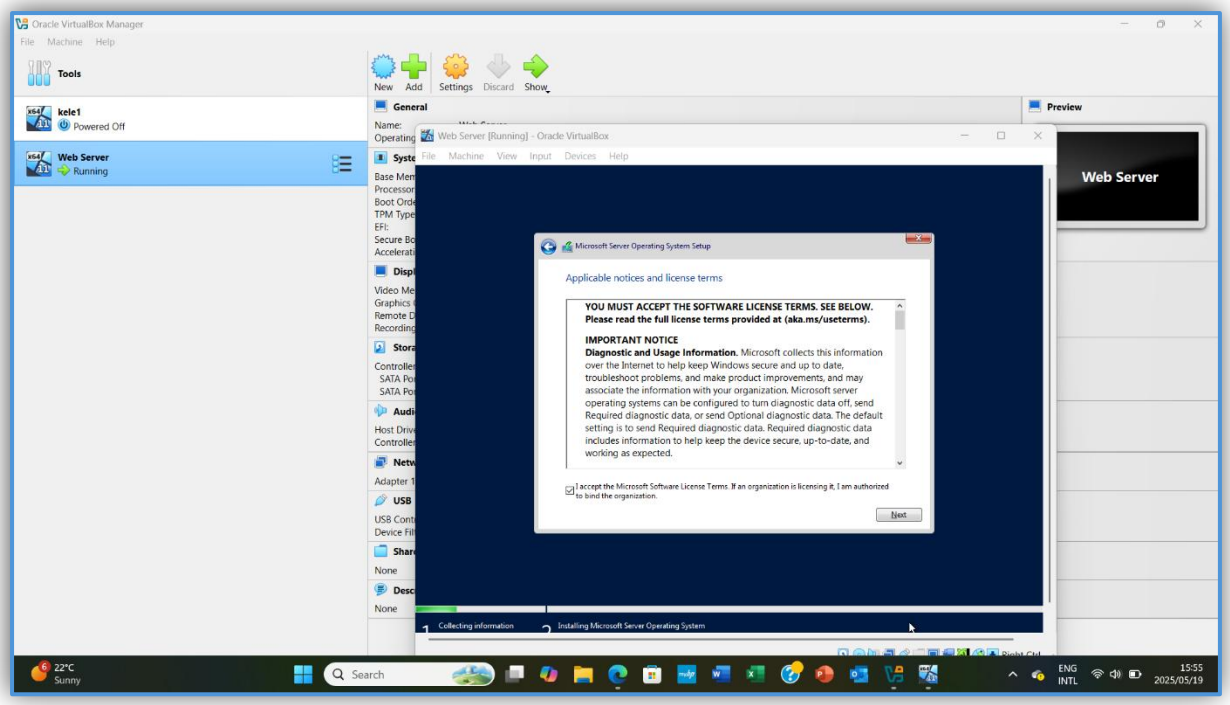
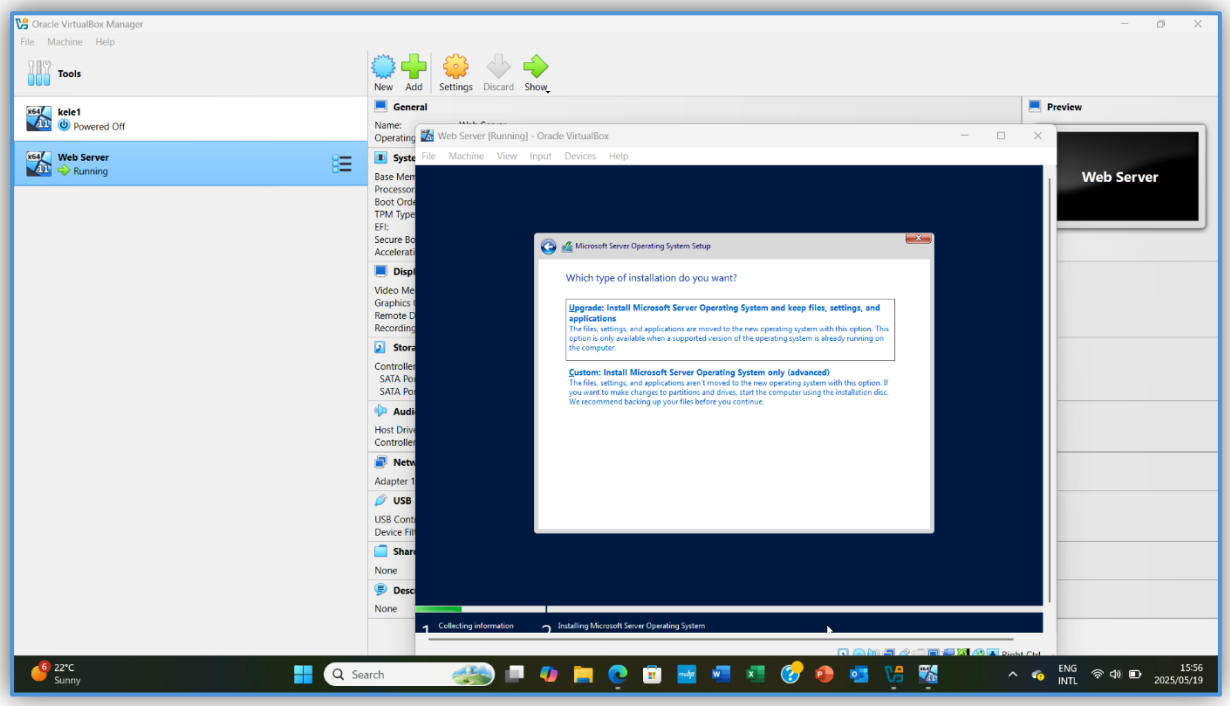
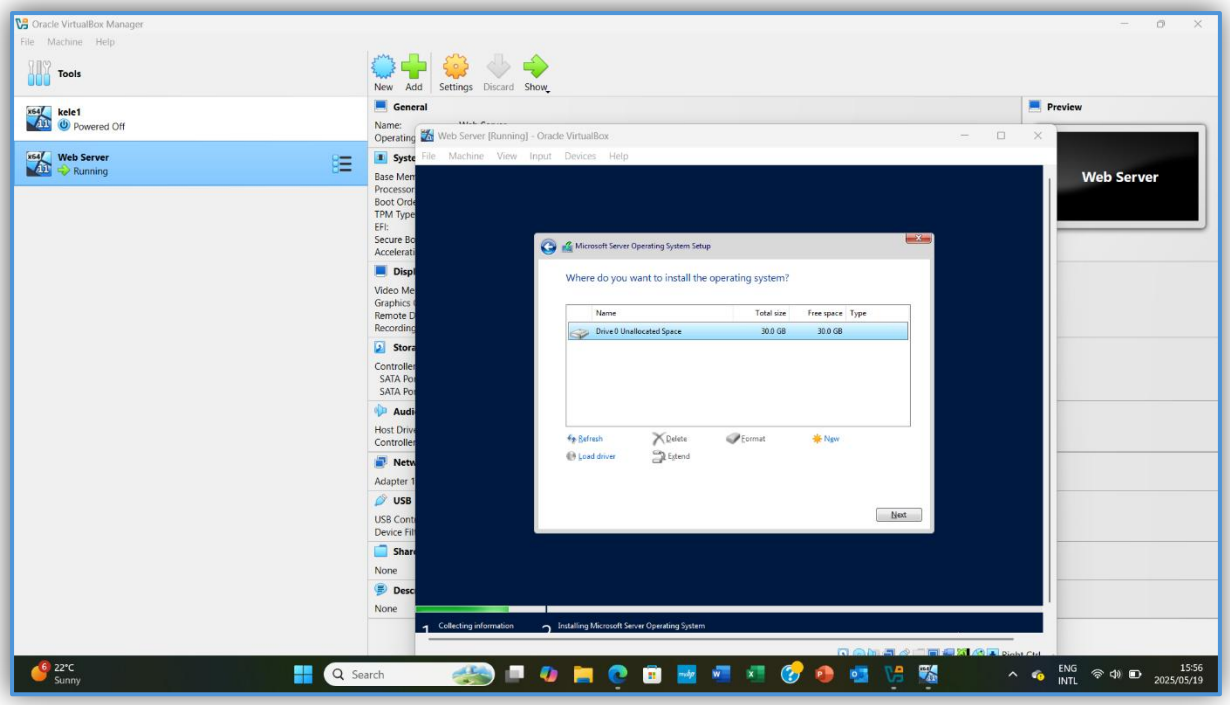
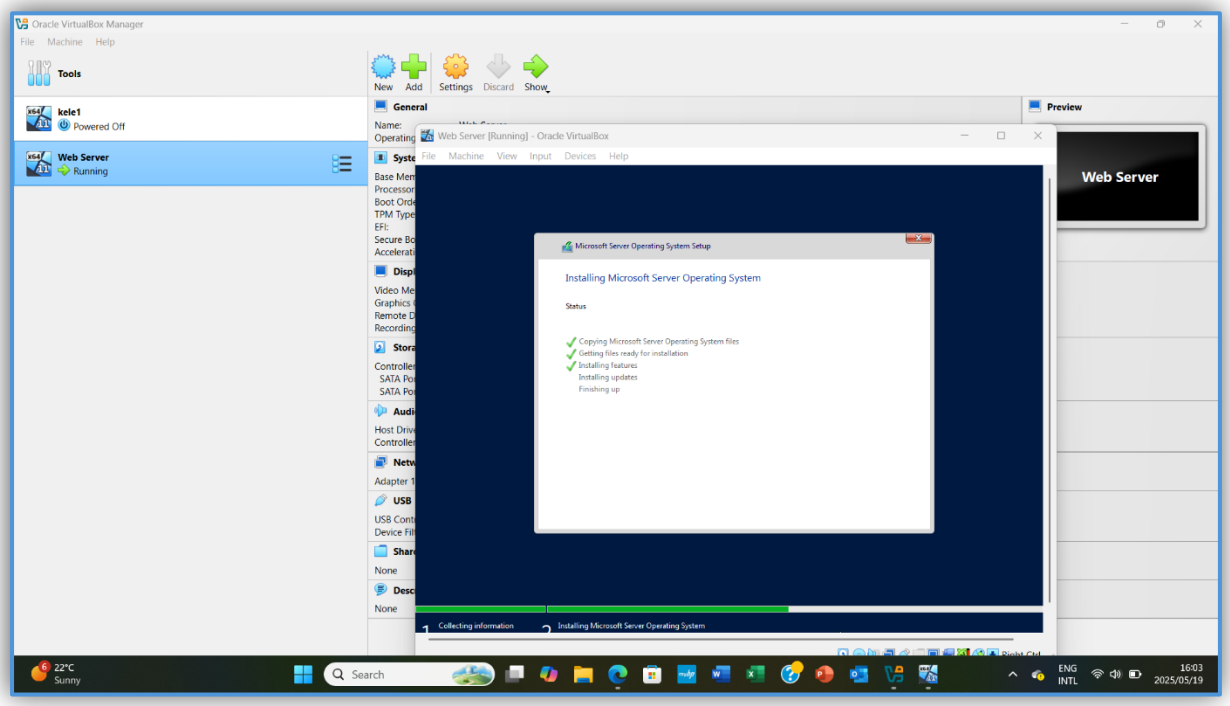
21:08
2025/05/19


Web Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Mouse integration ...
Don't show again
Auto capture keyboard ...
Don't show again
Microsoft Server Operating System Setup
Select the operating system you want to install
Operating system
Architecture
Date modified
Windows Server 2022 Standard Evaluation
x64
3/3/2022
Windows Server 2022 Standard Evaluation (Desktop Experien...
x64
3/3/2022
Windows Server 2022 Datacenter Evaluation
x64
3/3/2022
Windows Server 2022 Datacenter Evaluation (Desktop Experi...
x64
3/3/2022
Description:
This option installs the full Windows graphical environment, consuming extra drive space. It can be useful if you want to use the Windows desktop or have an app that requires it.
Next
1 Collecting information
2 Installing Microsoft Server Operating System


Oracle VirtualBox Manager
File Machine Help
Tools
New Add Settings Discard Show
kele1
Powered Off
Web Server
Running
General
Preview
Web Server
Web Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Microsoft Server Operating System Setup
Applicable notices and license terms
YOU MUST ACCEPT THE SOFTWARE LICENSE TERMS. SEE BELOW.
Please read the full license terms provided at (aka.ms/useterms).
IMPORTANT NOTICE
Diagnostic and Usage Information. Microsoft collects this information over the Internet to help keep Windows secure and up to date, troubleshoot problems, and make product improvements, and may associate the information with your organization. Microsoft server operating systems can be configured to turn diagnostic data off, send Required diagnostic data, or send Optional diagnostic data. The default setting is to send Required diagnostic data. Required diagnostic data includes information to help keep the device secure, up-to-date, and working as expected.
I accept the Microsoft Software License Terms. If an organization is licensing it, I am authorized to bind the organization.
Next
Collecting information
Installing Microsoft Server Operating System
22°C Sunny
Search
ENG INTL
15:55 2025/05/19


Oracle VirtualBox Manager
File Machine Help
Tools
New Add Settings Discard Show
kele1
Powered Off
Web Server
Running
General
Preview
Web Server
Web Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Microsoft Server Operating System Setup
Which type of installation do you want?
Upgrade: Install Microsoft Server Operating System and keep files, settings, and applications
The files, settings, and applications are moved to the new operating system with this option. This option is only available when a supported version of the operating system is already running on the computer.
Custom: Install Microsoft Server Operating System only (advanced)
The files, settings, and applications aren't moved to the new operating system with this option. If you want to make changes to partitions and drives, start the computer using the installation disc. We recommend backing up your files before you continue.
Collecting information
Installing Microsoft Server Operating System
22°C Sunny
Search
ENG INTL
15:56 2025/05/19

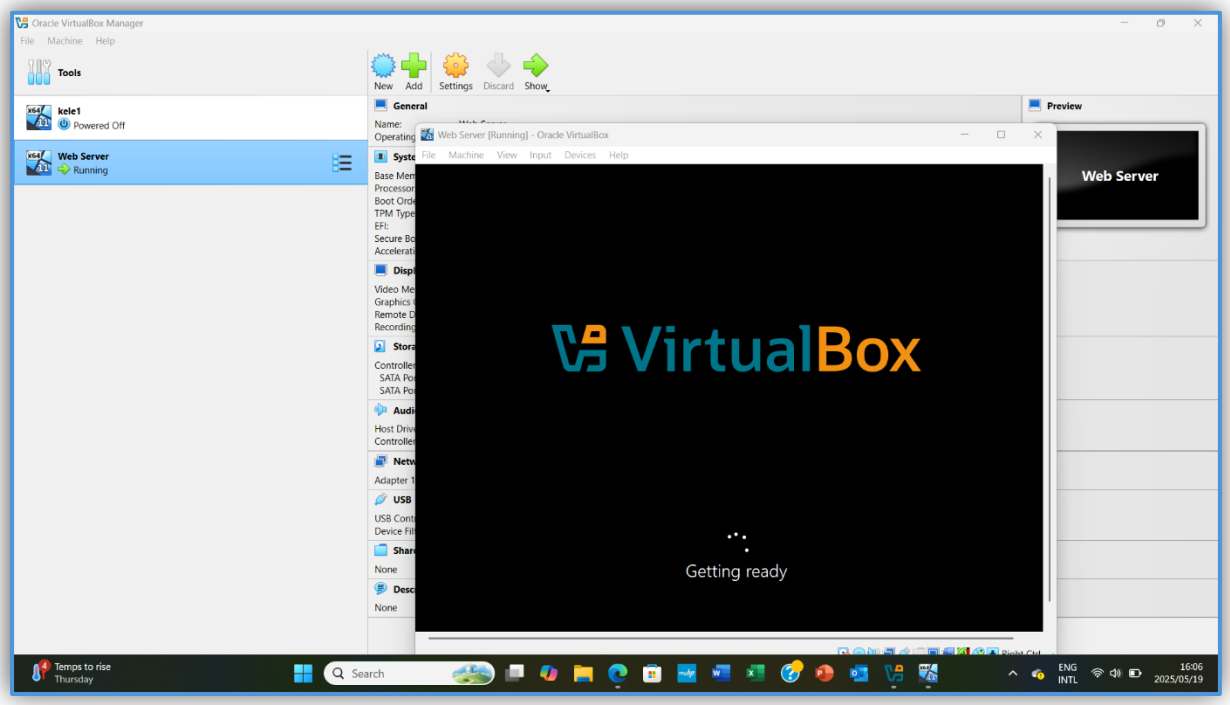


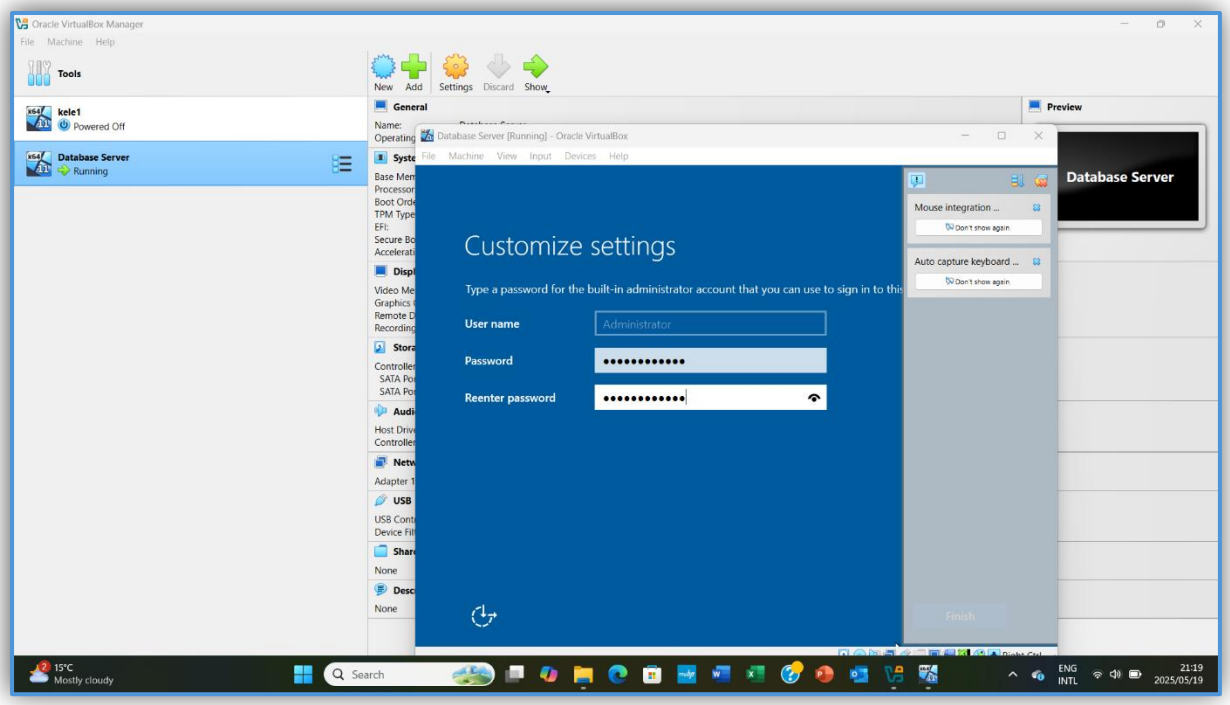


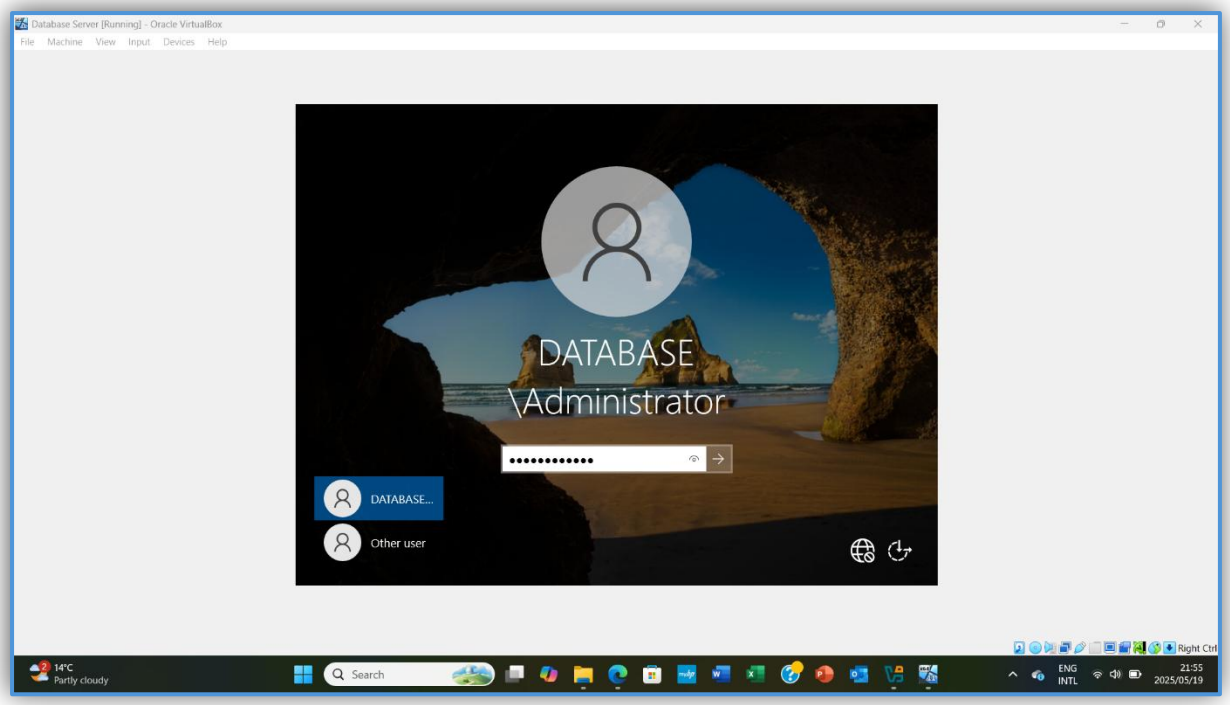
NB: For the first step of step 5 I used an image capture from the Database Server since the process was the same for both the Web Server and the Database Server.

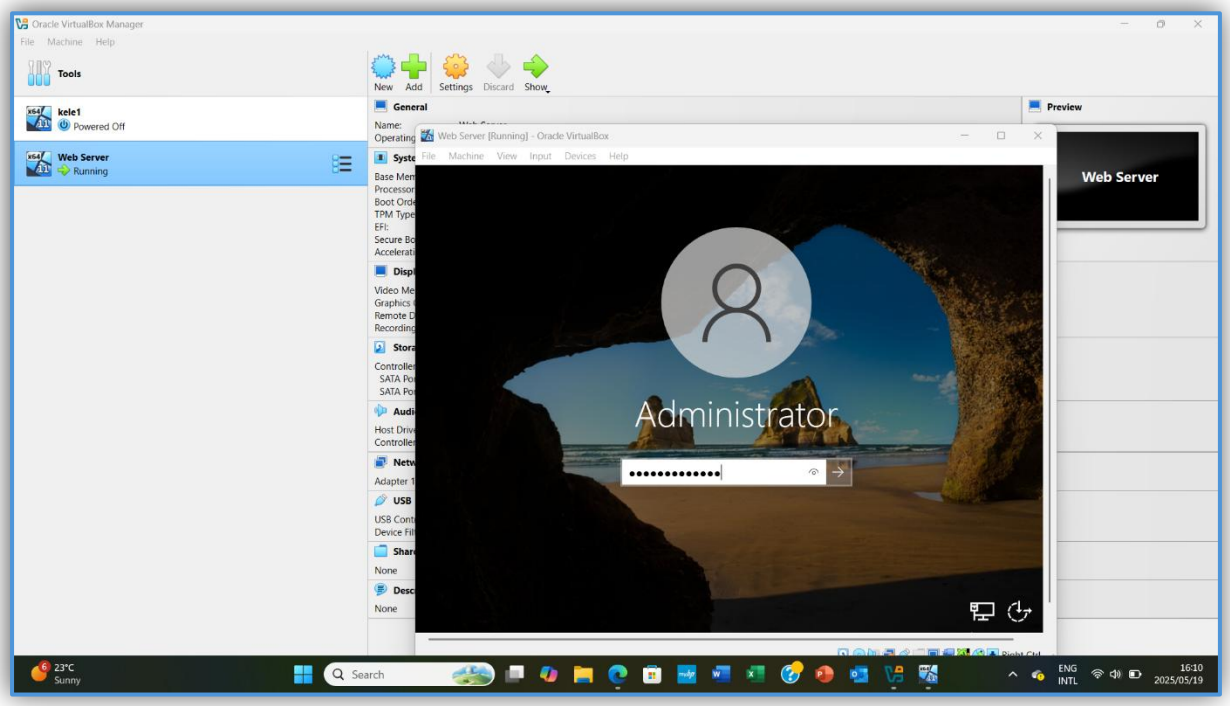
Step 6: The process of setting up the two virtual machines is now complete and the VM will run, I then set my administrator password which finally leads to the sign in page.

NB: I used images from the Database Server and the Web Server since it's the same process, it's also proof that I did the same for each server.



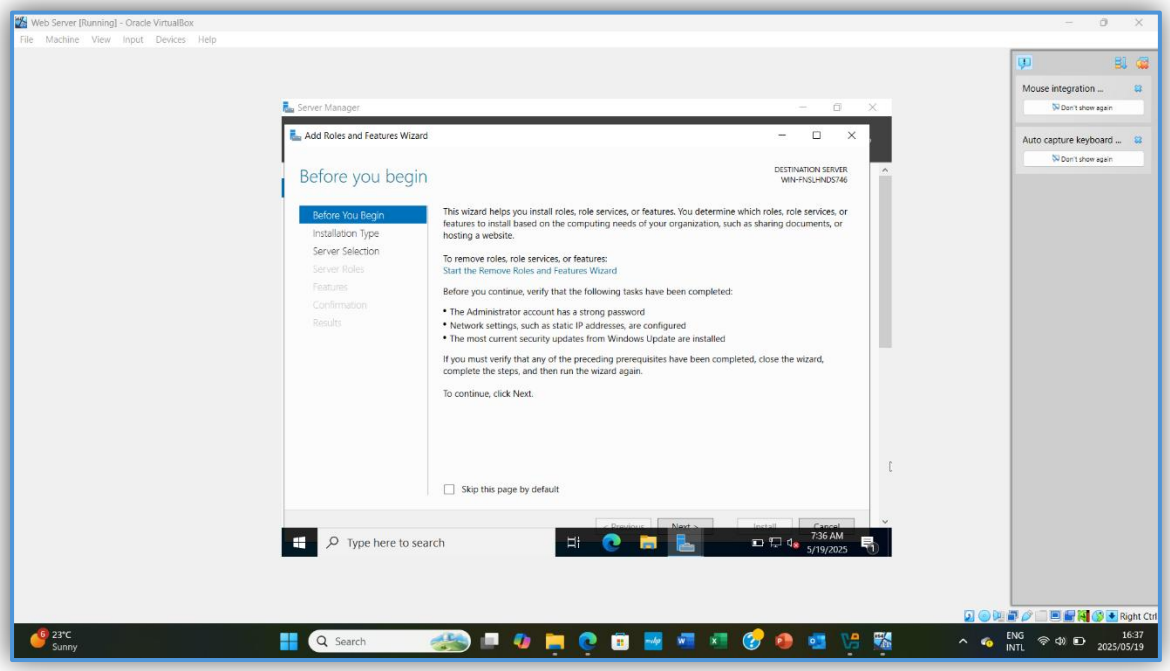


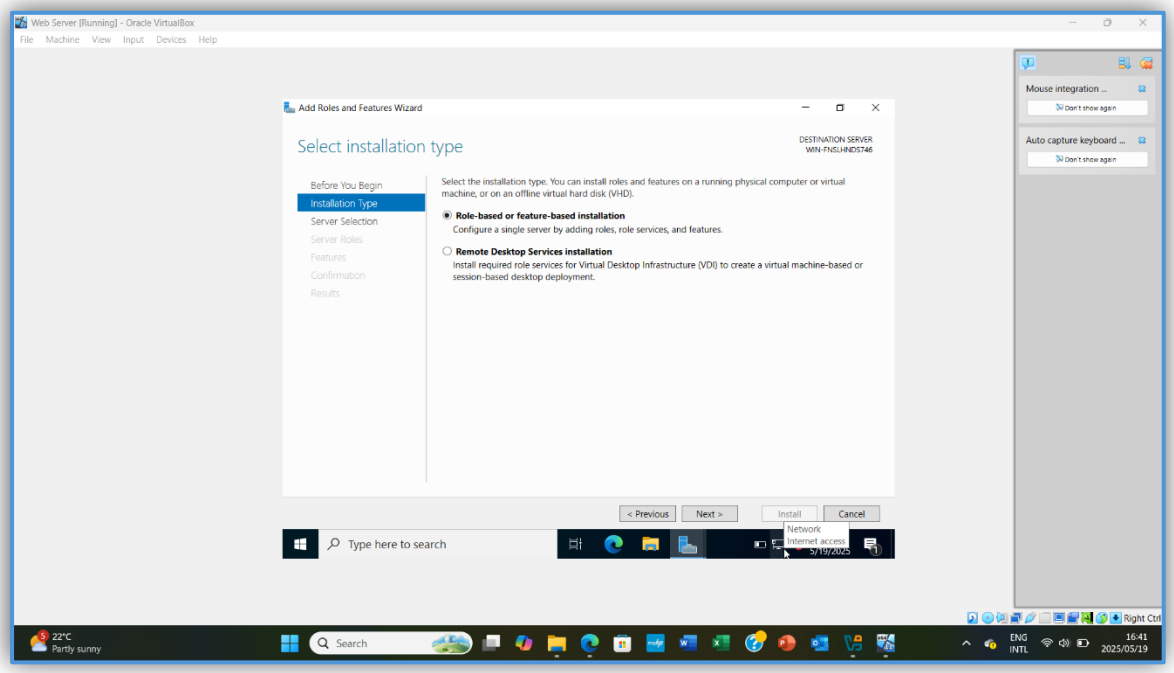

Database Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
DATABASE
\Administrator
DATABASE...
Other user
Right Ctrl
14°C
Partly cloudy
Search
ENG
INTL
21:55
2025/05/19

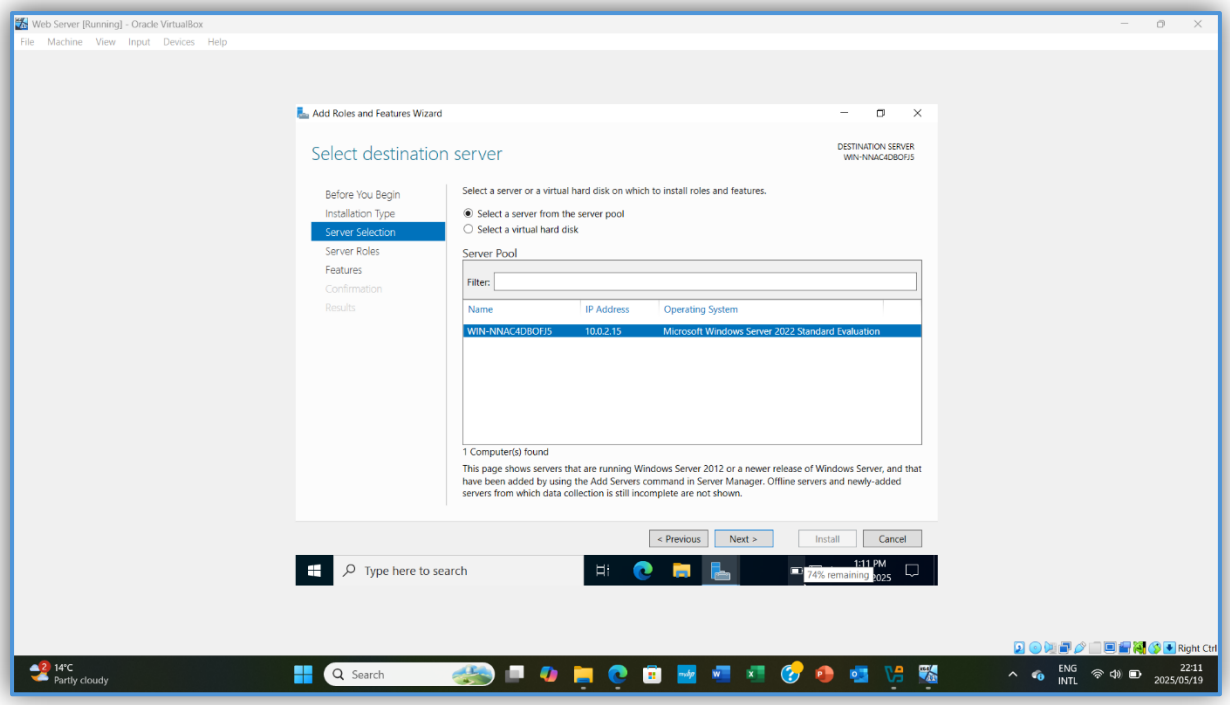

Oracle VirtualBox Manager
File Machine Help
Tools
kele1
Powered Off
Web Server
Running
New Add Settings Discard Show
General
Preview
Web Server
Web Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Administrator
23°C
Sunny
Search
ENG
INTL
16:10
2025/05/19

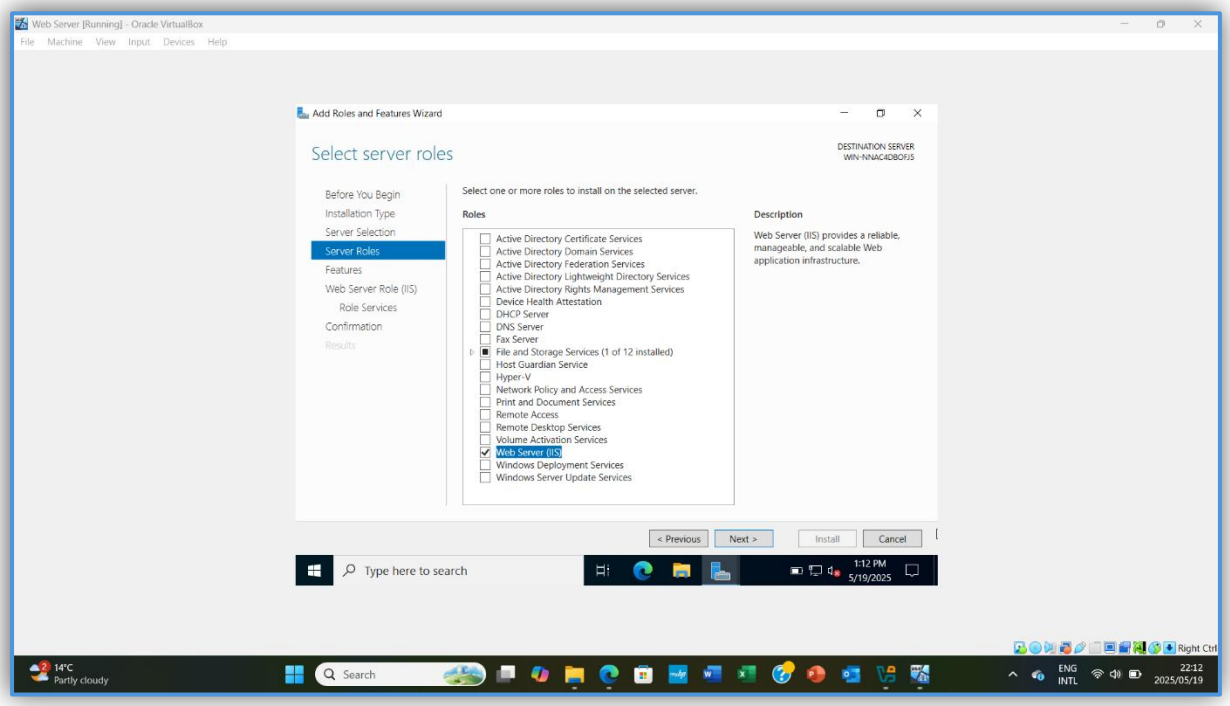
This is where I assigned different workloads, for the Web Server I added a Web Server role and feature and for the Database Server I made it run Domain services.

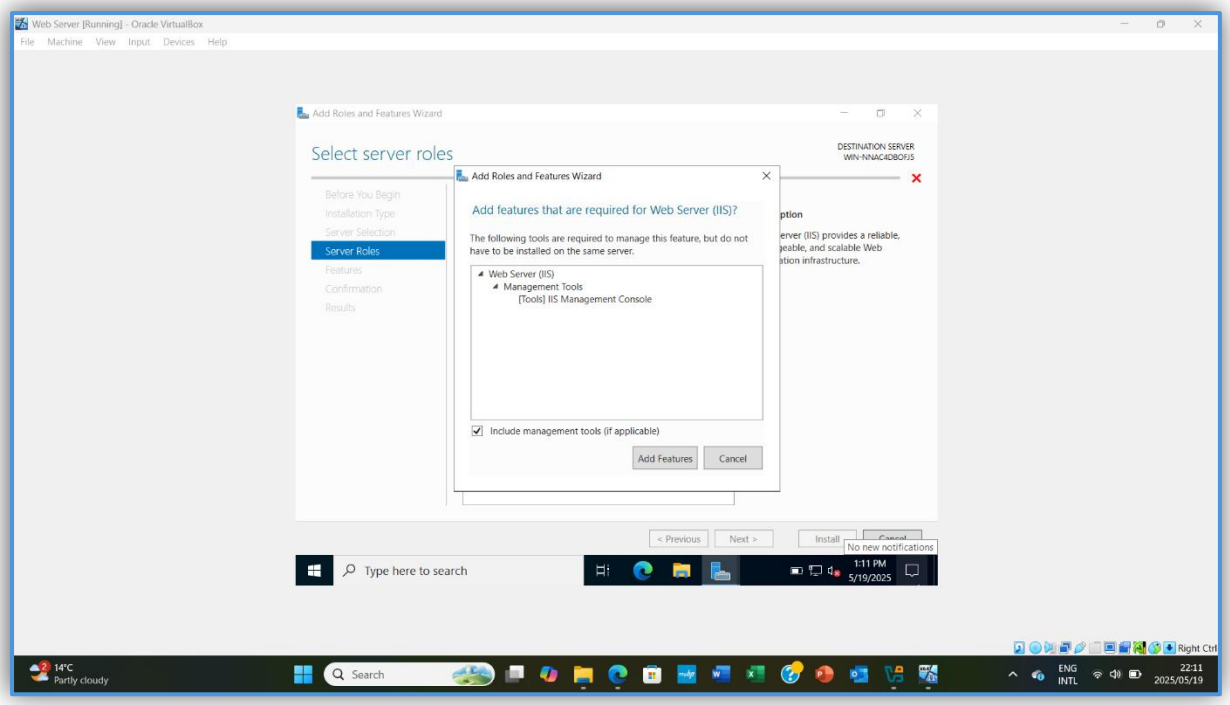
Web Server

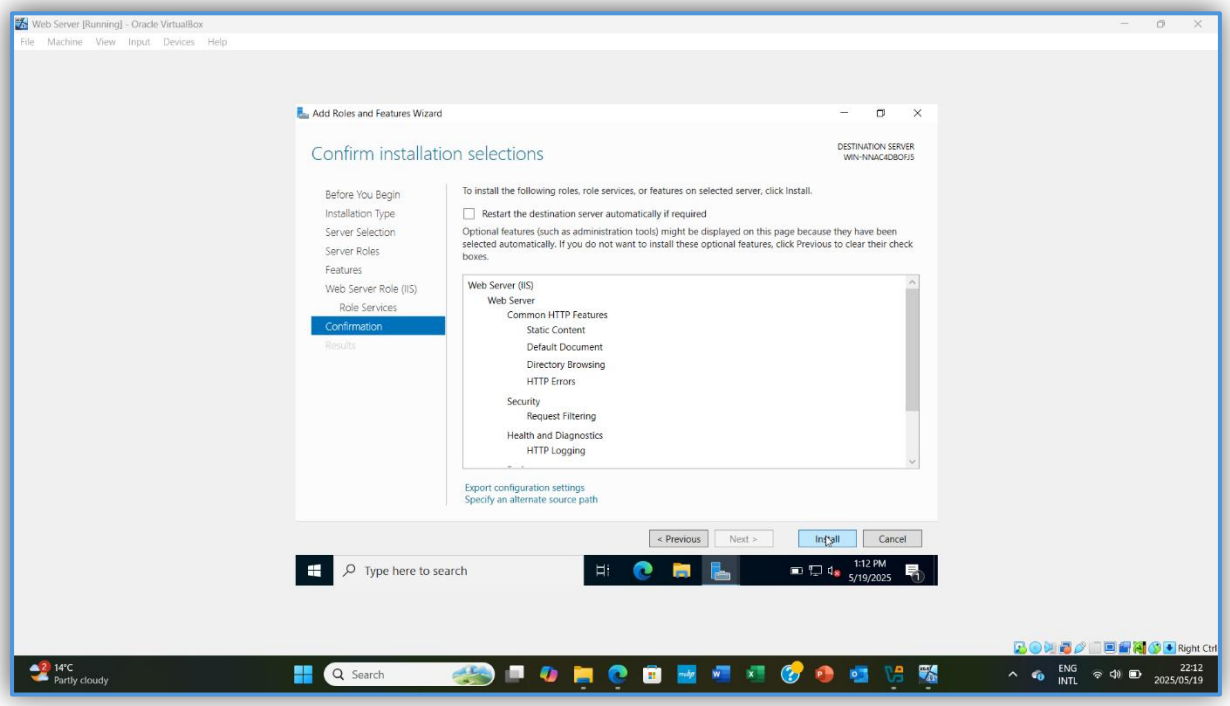


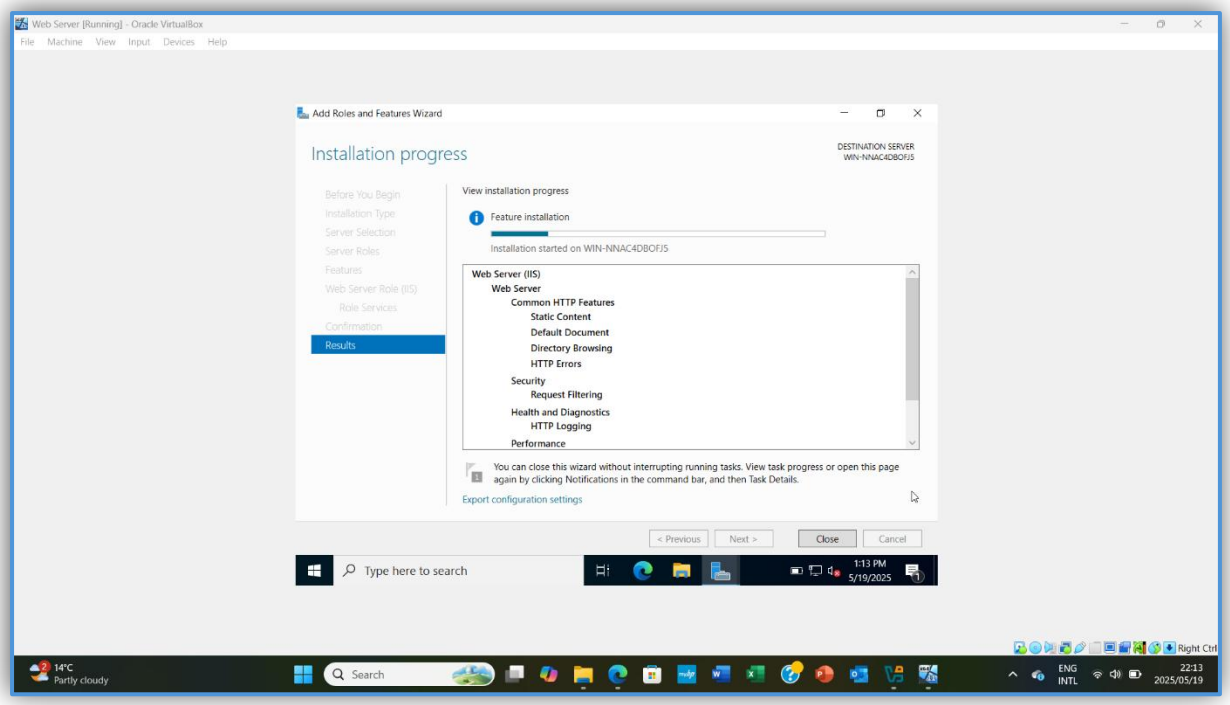



Web Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Add Roles and Features Wizard
Select destination server
DESTINATION SERVER
WIN-NNAC4DBOFJ5
Before You Begin
Installation Type
Server Selection
Server Roles
Features
Confirmation
Results
Select a server or a virtual hard disk on which to install roles and features.
Select a server from the server pool
Select a virtual hard disk
Server Pool
Filter:
Name
IP Address
Operating System
WIN-NNAC4DBOFJ5
10.0.2.15
Microsoft Windows Server 2022 Standard Evaluation
1 Computer(s) found
This page shows servers that are running Windows Server 2012 or a newer release of Windows Server, and that have been added by using the Add Servers command in Server Manager. Offline servers and newly-added servers from which data collection is still incomplete are not shown.
< Previous
Next >
Install
Cancel
Type here to search
1:11 PM
74% remaining
Right Ctrl
14°C
Partly cloudy
Search
ENG
INTL
22:11
2025/05/19

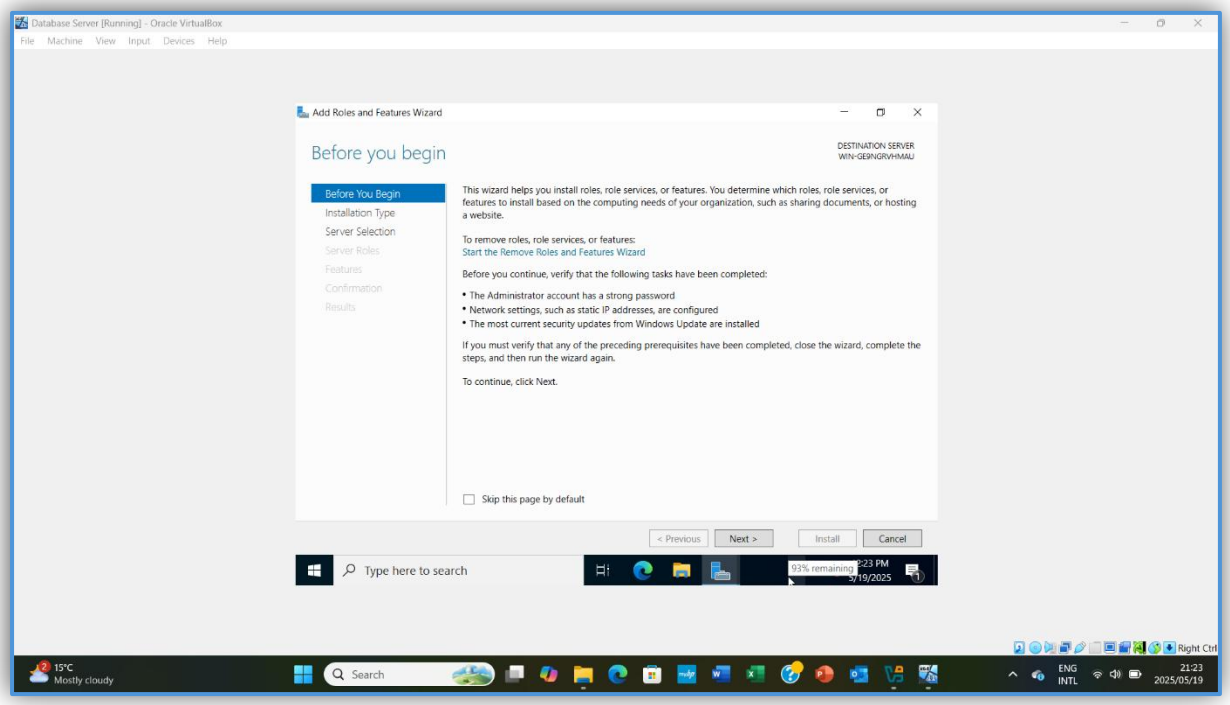

Web Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Add Roles and Features Wizard
Select server roles
DESTINATION SERVER
WIN-NNAC4DBOFJ5
Before You Begin
Installation Type
Server Selection
Server Roles
Features
Web Server Role (IIS)
Role Services
Confirmation
Results
Select one or more roles to install on the selected server.
Roles
Active Directory Certificate Services
Active Directory Domain Services
Active Directory Federation Services
Active Directory Lightweight Directory Services
Active Directory Rights Management Services
Device Health Attestation
DHCP Server
DNS Server
Fax Server
File and Storage Services (1 of 12 installed)
Host Guardian Service
Hyper-V
Network Policy and Access Services
Print and Document Services
Remote Access
Remote Desktop Services
Volume Activation Services
Web Server (IIS)
Windows Deployment Services
Windows Server Update Services
Description
Web Server (IIS) provides a reliable, manageable, and scalable Web application infrastructure.
< Previous
Next >
Install
Cancel
Type here to search
1:12 PM
5/19/2025
Right Ctrl
14°C
Partly cloudy
Search
ENG
INTL
22:12
2025/05/19

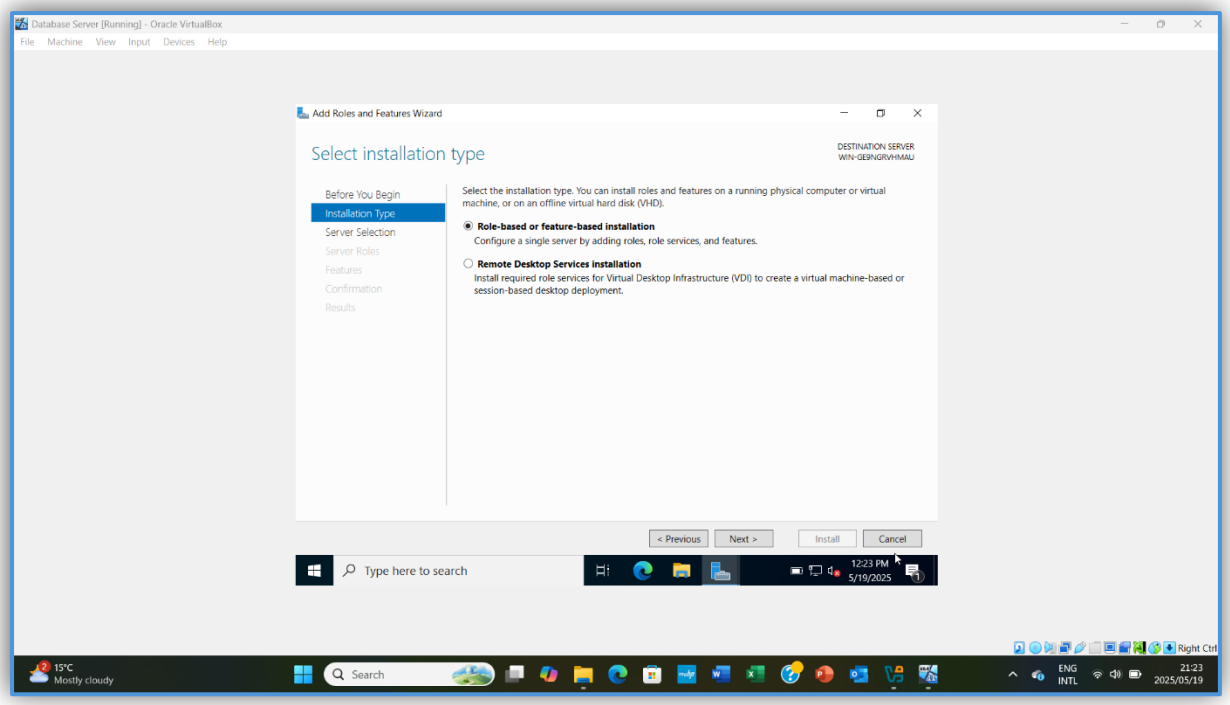

Web Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Add Roles and Features Wizard
Select server roles
DESTINATION SERVER
WIN-NNAC4DBOFJS
Before You Begin
Installation Type
Server Selection
Server Roles
Features
Confirmation
Results
Add Roles and Features Wizard
Add features that are required for Web Server (IIS)?
The following tools are required to manage this feature, but do not have to be installed on the same server.
Web Server (IIS)
Management Tools
[Tools] IIS Management Console
Include management tools (if applicable)
Add Features
Cancel
< Previous
Next >
Install
Cancel
No new notifications
Type here to search
1:11 PM
5/19/2025
Right Ctrl
14°C
Partly cloudy
Search
ENG
INTL
22:11
2025/05/19

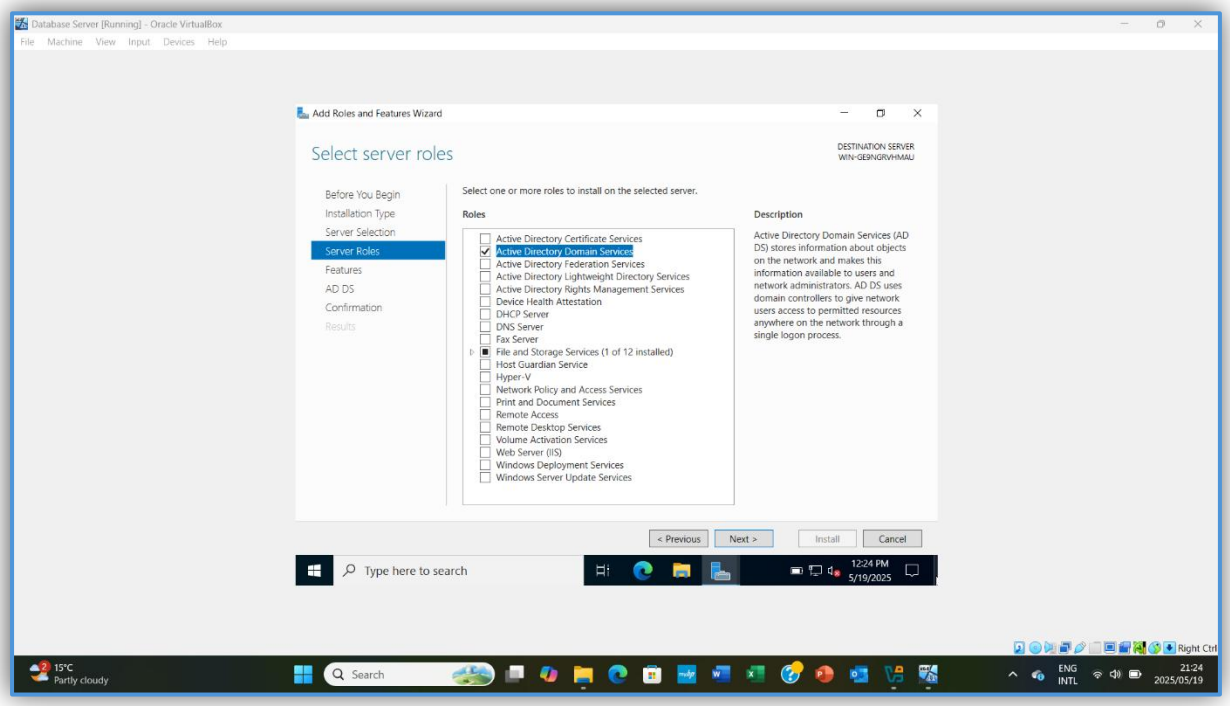

Web Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Add Roles and Features Wizard
Confirm installation selections
DESTINATION SERVER
WIN-NNAC4DBOFJS
Before You Begin
Installation Type
Server Selection
Server Roles
Features
Web Server Role (IIS)
Role Services
Confirmation
Results
To install the following roles, role services, or features on selected server, click Install.
Restart the destination server automatically if required
Optional features (such as administration tools) might be displayed on this page because they have been selected automatically. If you do not want to install these optional features, click Previous to clear their check boxes.
Web Server (IIS)
Web Server
Common HTTP Features
Static Content
Default Document
Directory Browsing
HTTP Errors
Security
Request Filtering
Health and Diagnostics
HTTP Logging
Export configuration settings
Specify an alternate source path
< Previous
Next >
Install
Cancel
Type here to search
1:12 PM
5/19/2025
Right Ctrl
14°C
Partly cloudy
Search
ENG
INTL
22:12
2025/05/19

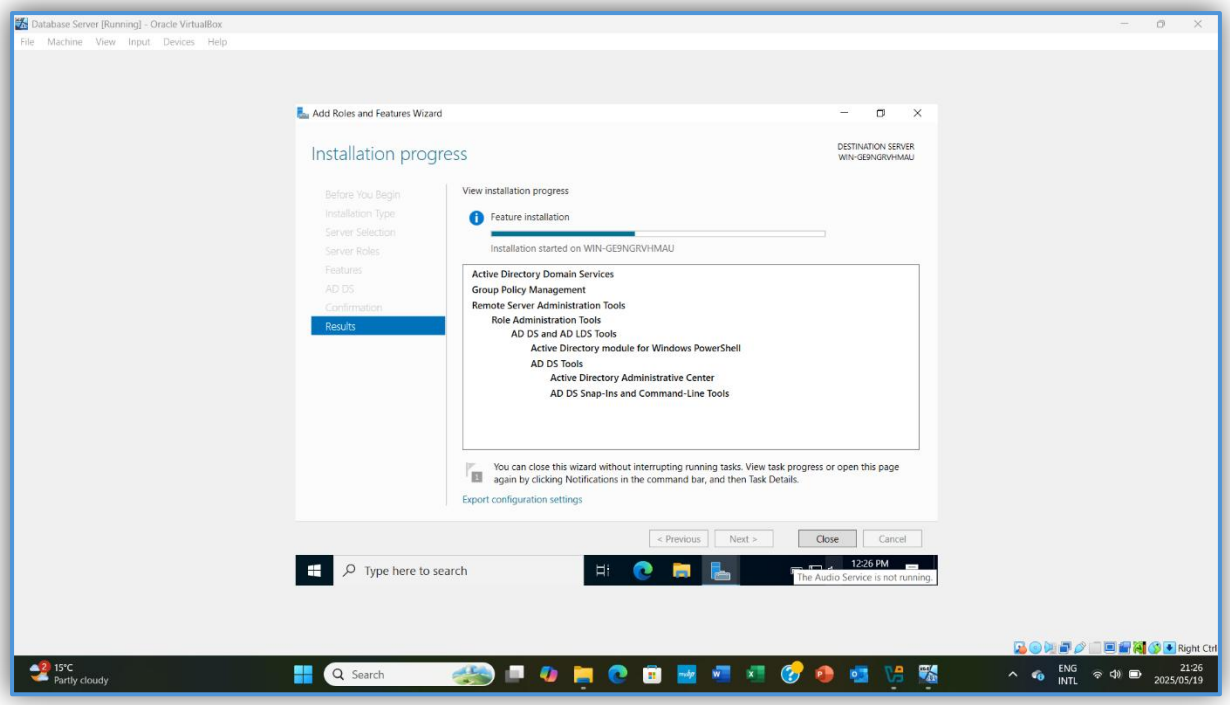


Database Server

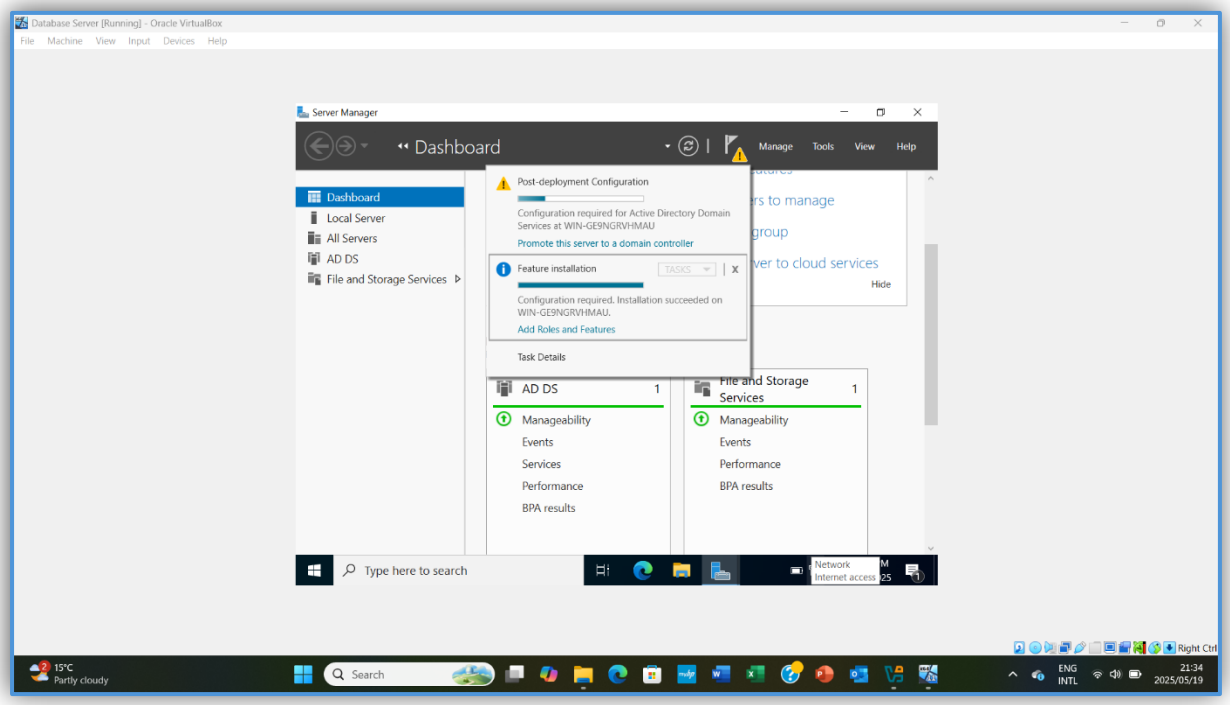


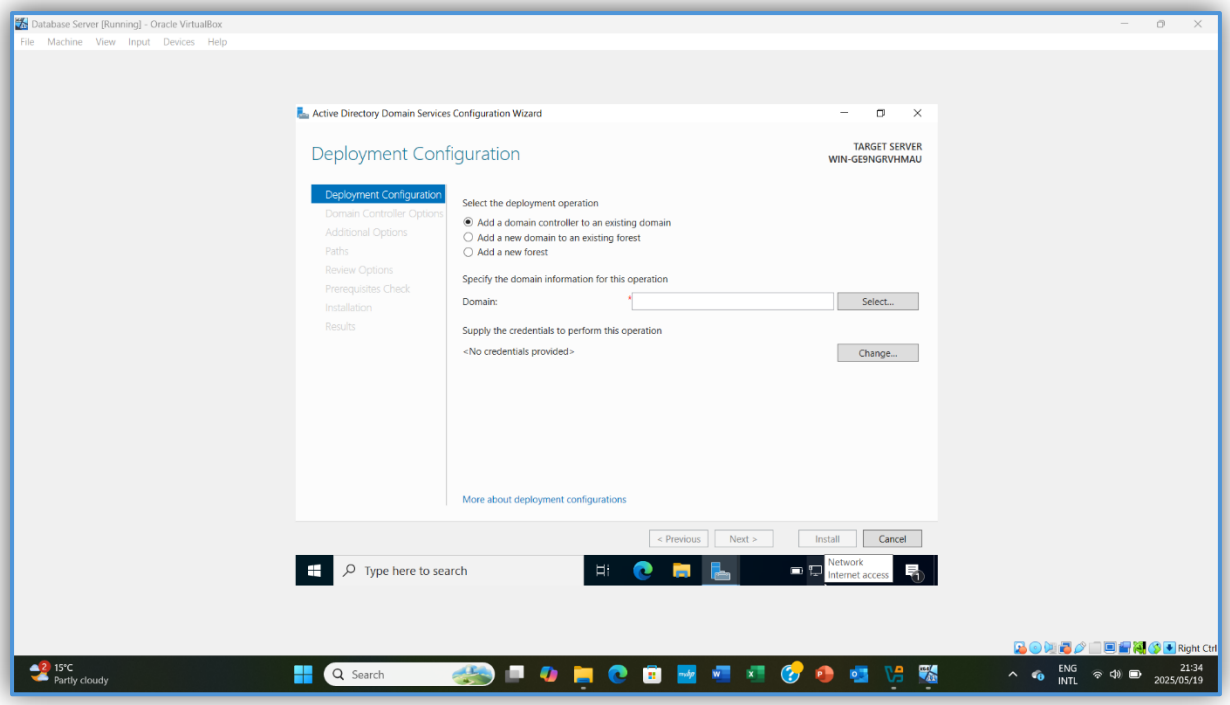

Database Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Add Roles and Features Wizard
Select installation type
DESTINATION SERVER
WIN-GE9NGRVHMAU
Before You Begin
Installation Type
Server Selection
Server Roles
Features
Confirmation
Results
Select the installation type. You can install roles and features on a running physical computer or virtual machine, or on an offline virtual hard disk (VHD).
Role-based or feature-based installation
Configure a single server by adding roles, role services, and features.
Remote Desktop Services installation
Install required role services for Virtual Desktop Infrastructure (VDI) to create a virtual machine-based or session-based desktop deployment.
< Previous
Next >
Install
Cancel
Type here to search
12:23 PM
5/19/2025
15°C
Mostly cloudy
Search
ENG
INTL
21:23
2025/05/19
Right Ctrl

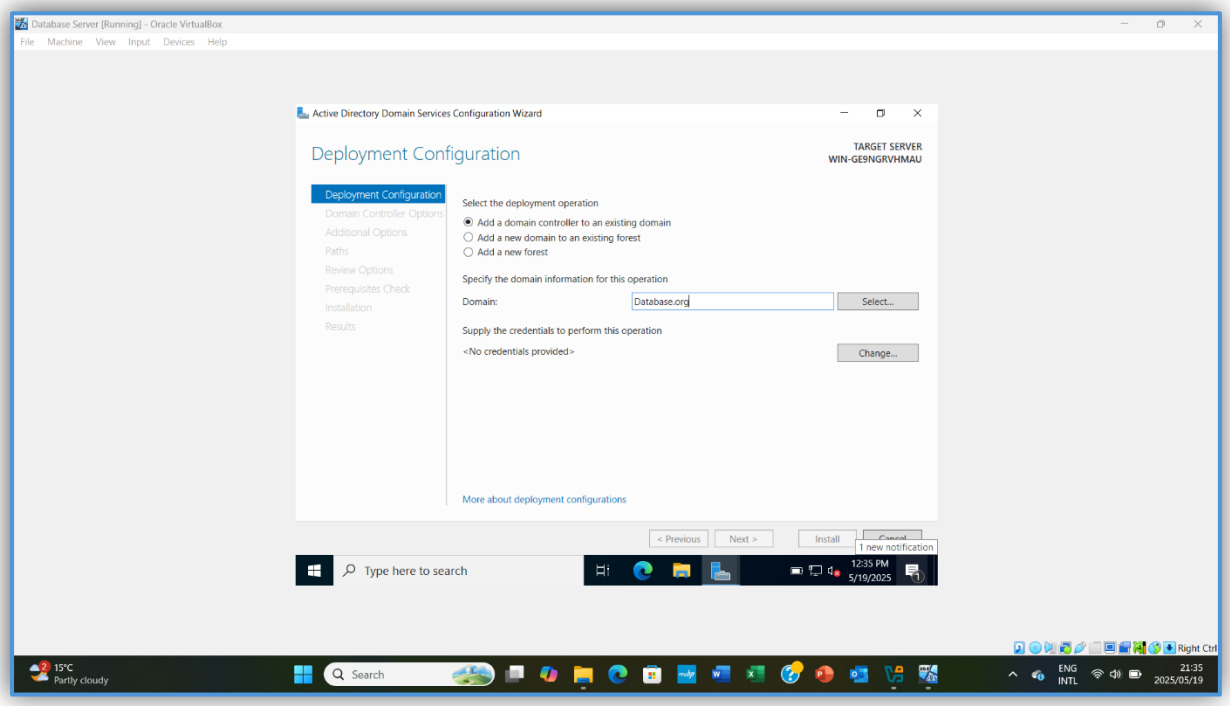

Database Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Add Roles and Features Wizard
Select server roles
DESTINATION SERVER
WIN-GE9NGRVHMAU
Before You Begin
Installation Type
Server Selection
Server Roles
Features
AD DS
Confirmation
Results
Select one or more roles to install on the selected server.
Roles
Active Directory Certificate Services
Active Directory Domain Services
Active Directory Federation Services
Active Directory Lightweight Directory Services
Active Directory Rights Management Services
Device Health Attestation
DHCP Server
DNS Server
Fax Server
File and Storage Services (1 of 12 installed)
Host Guardian Service
Hyper-V
Network Policy and Access Services
Print and Document Services
Remote Access
Remote Desktop Services
Volume Activation Services
Web Server (IIS)
Windows Deployment Services
Windows Server Update Services
Description
Active Directory Domain Services (AD DS) stores information about objects on the network and makes this information available to users and network administrators. AD DS uses domain controllers to give network users access to permitted resources anywhere on the network through a single logon process.
< Previous
Next >
Install
Cancel
Type here to search
12:24 PM
5/19/2025
15°C
Partly cloudy
Search
ENG
INTL
21:24
2025/05/19
Right Ctrl

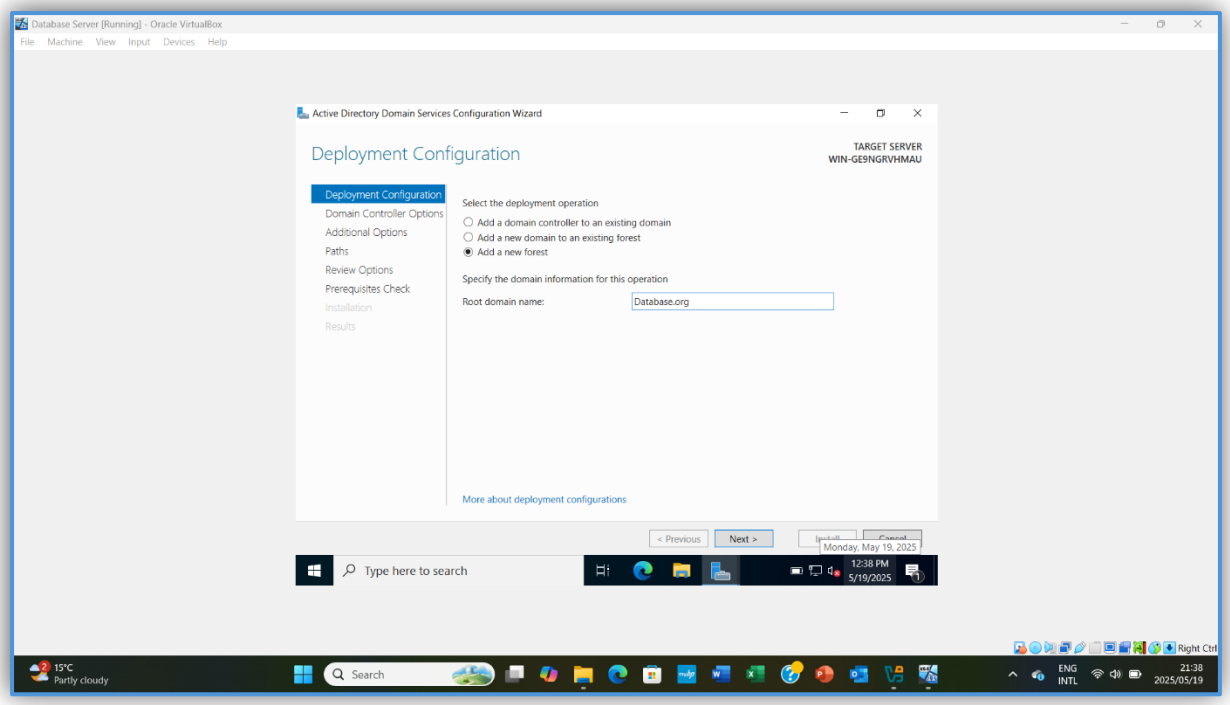


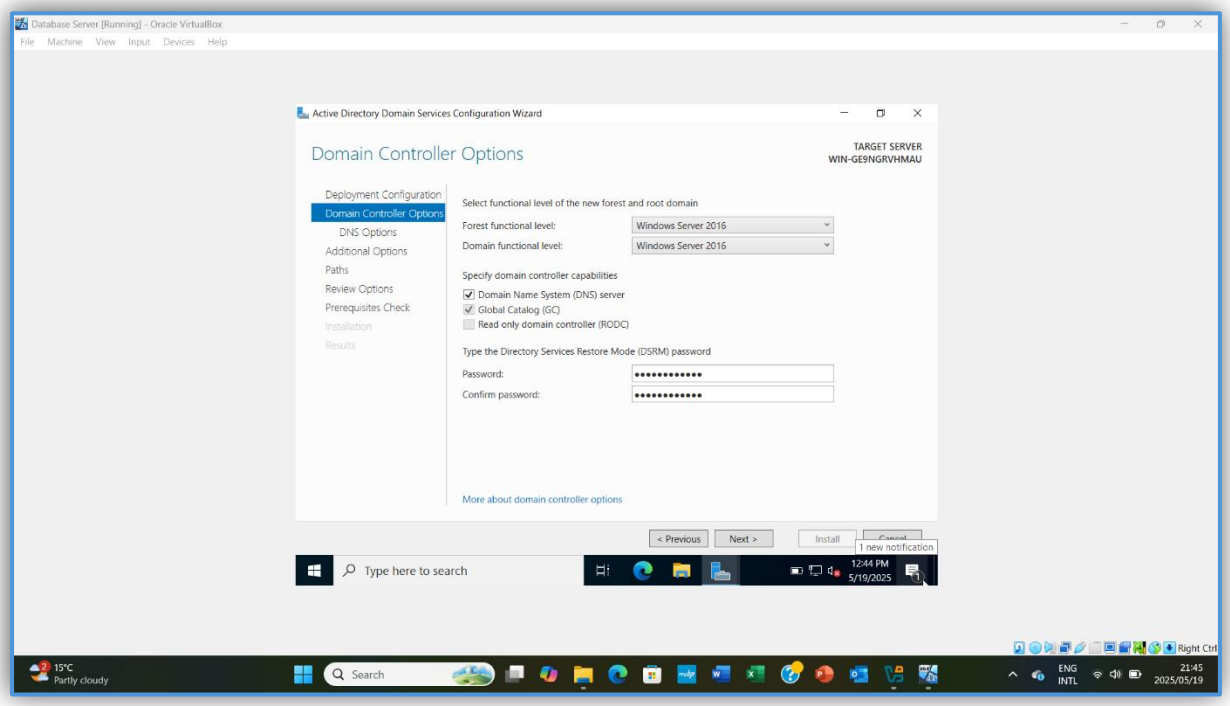
This is when I activated the Active Directory Domain Services

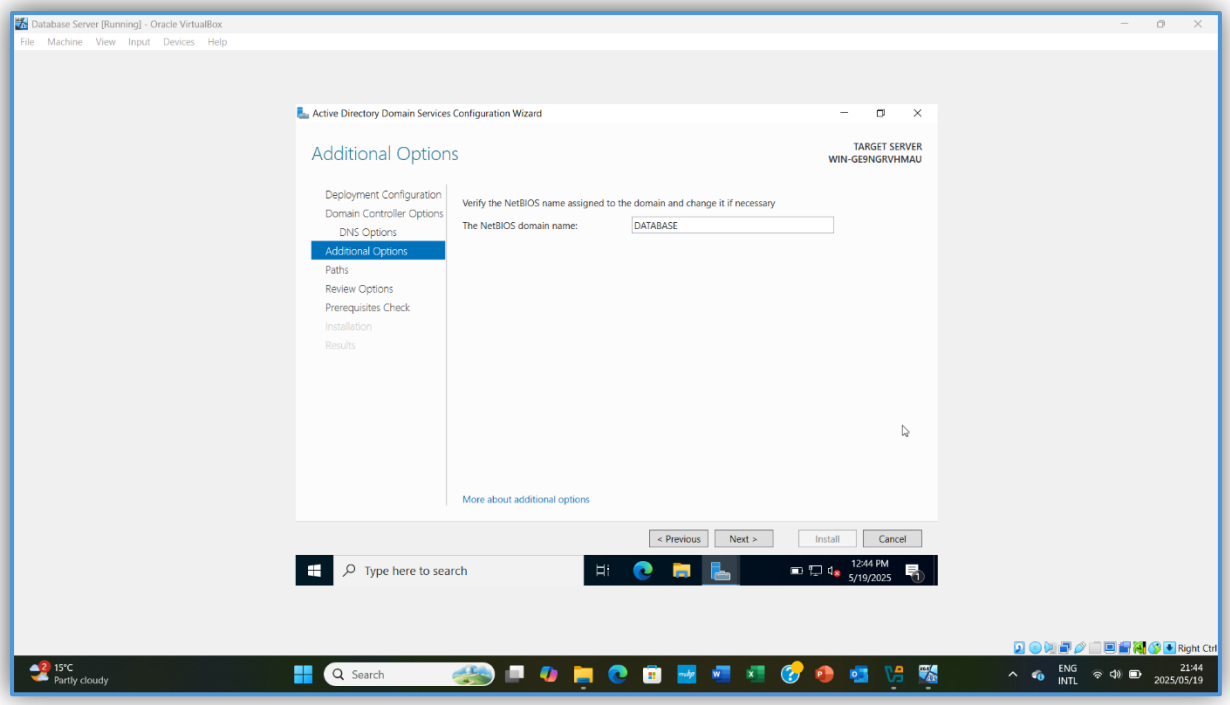


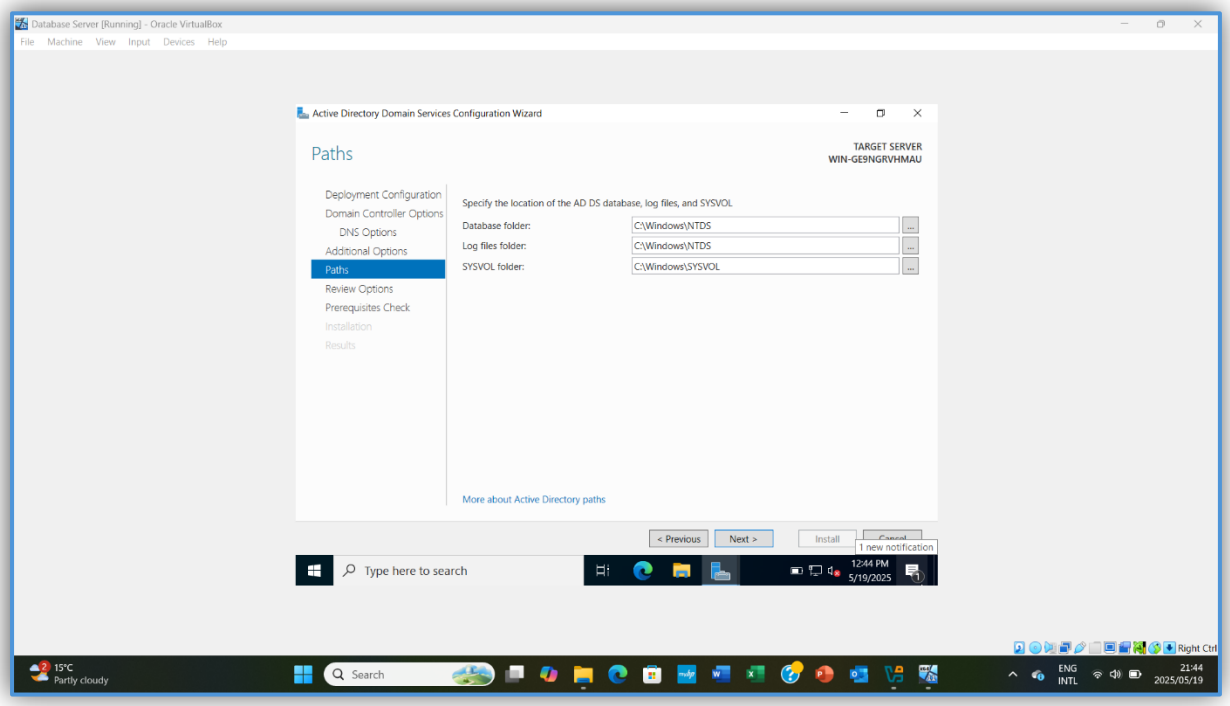

Database Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Active Directory Domain Services Configuration Wizard
Deployment Configuration
TARGET SERVER
WIN-GE9NGRVHMAU
Deployment Configuration
Domain Controller Options
Additional Options
Paths
Review Options
Prerequisites Check
Installation
Results
Select the deployment operation
Add a domain controller to an existing domain
Add a new domain to an existing forest
Add a new forest
Specify the domain information for this operation
Domain:
Select...
Supply the credentials to perform this operation
<No credentials provided>
Change...
More about deployment configurations
< Previous
Next >
Install
Cancel
Type here to search
Network
Internet access
15°C
Partly cloudy
Search
ENG
INTL
21:34
2025/05/19
Right Ctrl

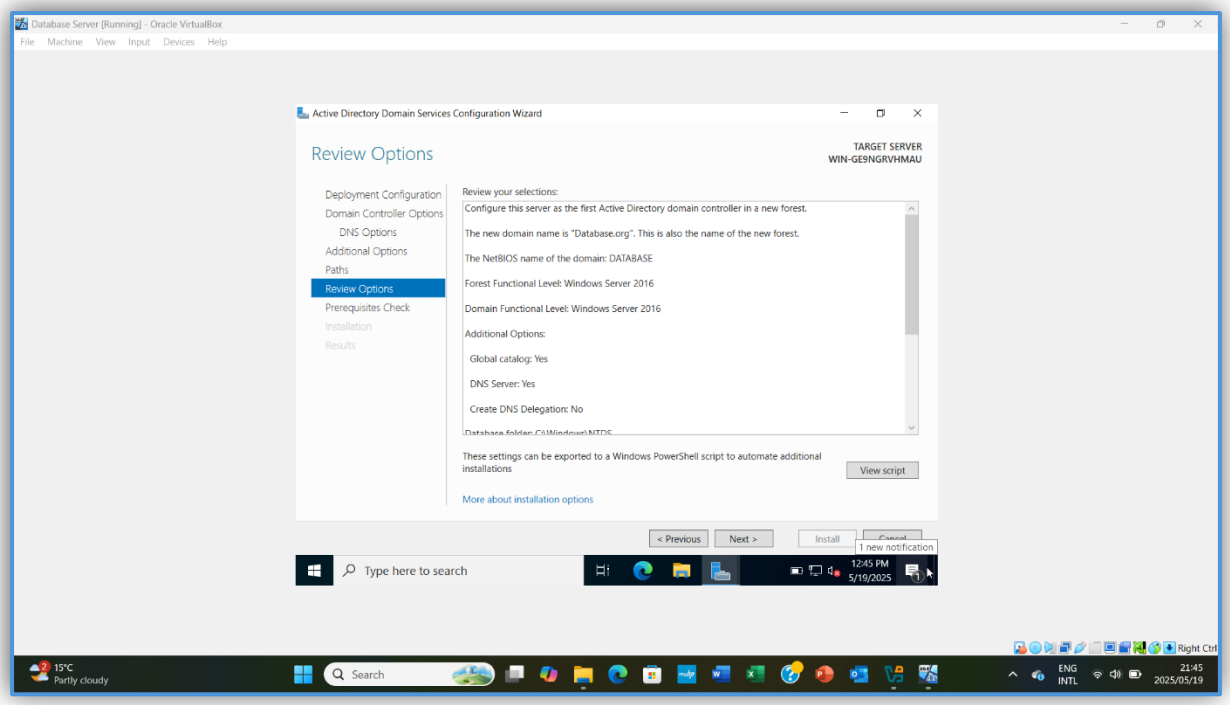

Database Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Active Directory Domain Services Configuration Wizard
Deployment Configuration
TARGET SERVER
WIN-GE9NGRVHMAU
Deployment Configuration
Domain Controller Options
Additional Options
Paths
Review Options
Prerequisites Check
Installation
Results
Select the deployment operation
Add a domain controller to an existing domain
Add a new domain to an existing forest
Add a new forest
Specify the domain information for this operation
Domain:
Database.org
Select...
Supply the credentials to perform this operation
<No credentials provided>
Change...
More about deployment configurations
< Previous
Next >
Install
1 new notification
Type here to search
12:35 PM
5/19/2025
15°C
Partly cloudy
Search
ENG
INTL
21:35
2025/05/19
Right Ctrl

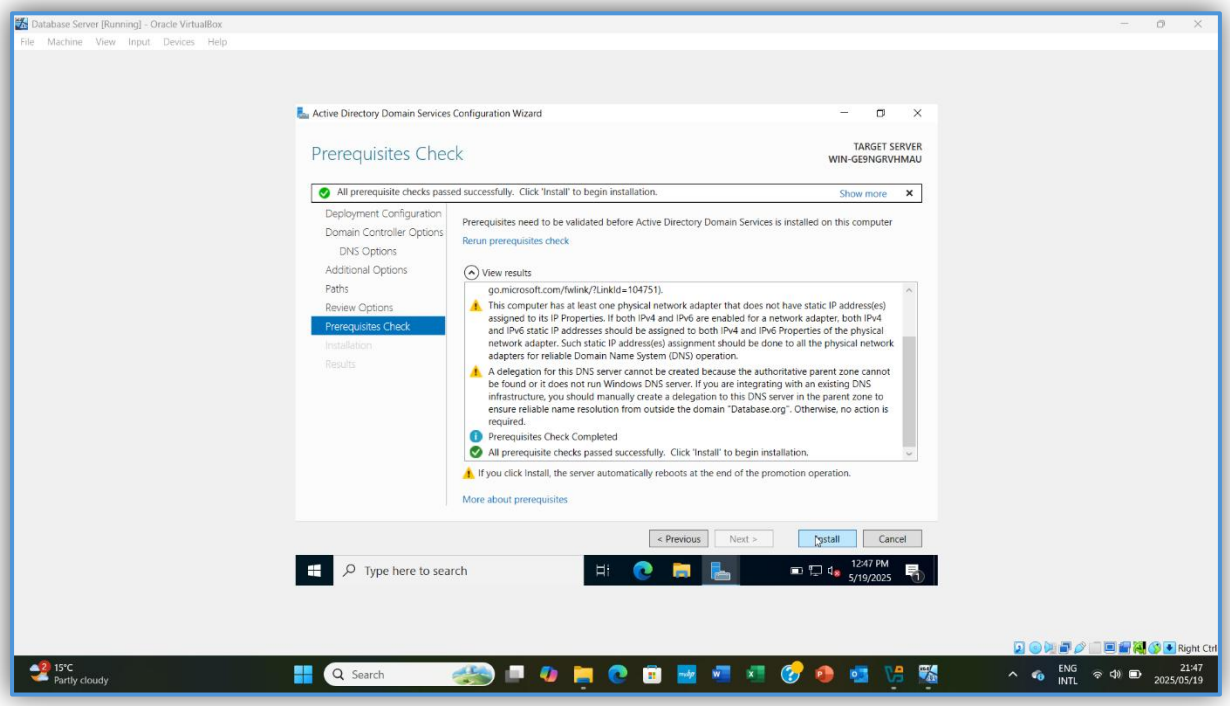

Database Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Active Directory Domain Services Configuration Wizard
Deployment Configuration
TARGET SERVER
WIN-GE9NGRVHMAU
Deployment Configuration
Domain Controller Options
Additional Options
Paths
Review Options
Prerequisites Check
Installation
Results
Select the deployment operation
Add a domain controller to an existing domain
Add a new domain to an existing forest
Add a new forest
Specify the domain information for this operation
Root domain name:
Database.org
More about deployment configurations
< Previous
Next >
Monday, May 19, 2025
12:38 PM
5/19/2025
Type here to search
15°C
Partly cloudy
Search
ENG
INTL
21:38
2025/05/19
Right Ctrl


Database Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Active Directory Domain Services Configuration Wizard
Domain Controller Options
TARGET SERVER
WIN-GE9NGRVHMAU
Deployment Configuration
Domain Controller Options
DNS Options
Additional Options
Paths
Review Options
Prerequisites Check
Installation
Results
Select functional level of the new forest and root domain
Forest functional level:
Windows Server 2016
Domain functional level:
Windows Server 2016
Specify domain controller capabilities
Domain Name System (DNS) server
Global Catalog (GC)
Read only domain controller (RODC)
Type the Directory Services Restore Mode (DSRM) password
Password:
Confirm password:
More about domain controller options
< Previous
Next >
Install
1 new notification
12:44 PM
5/19/2025
Type here to search
15°C
Partly cloudy
Search
ENG
INTL
21:45
2025/05/19
Right Ctrl

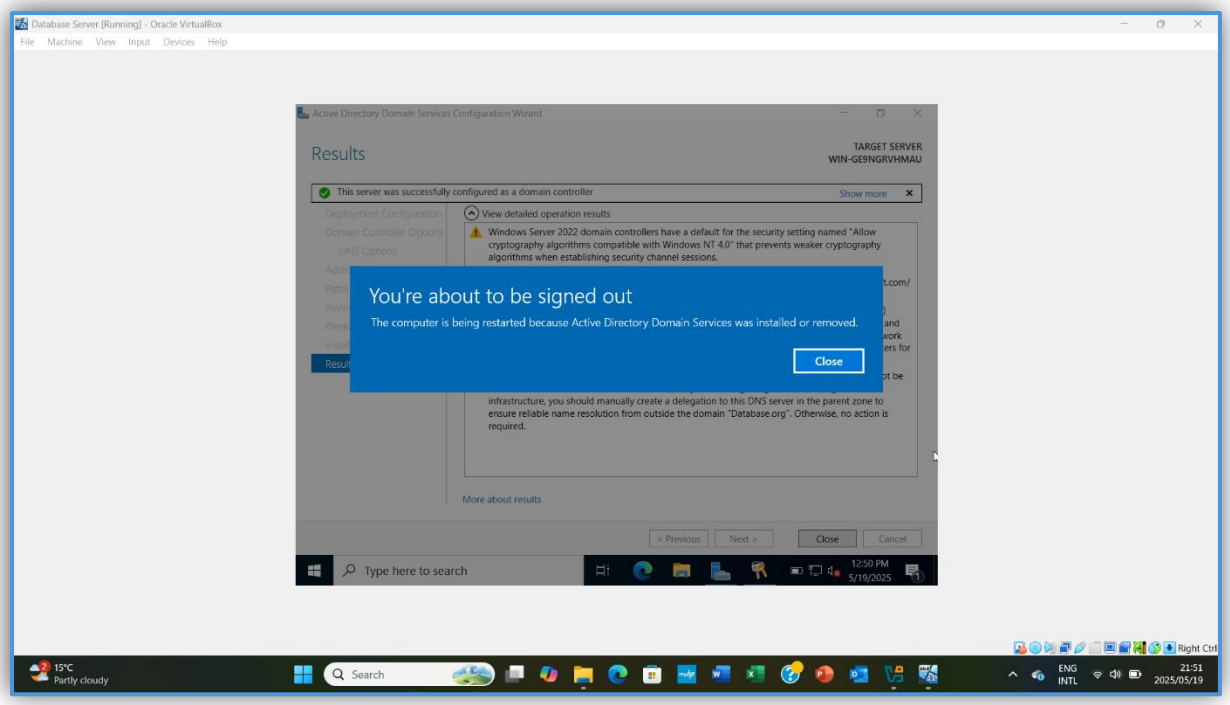

Database Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Active Directory Domain Services Configuration Wizard
Additional Options
TARGET SERVER
WIN-GE9NGRVHMAU
Deployment Configuration
Domain Controller Options
DNS Options
Additional Options
Paths
Review Options
Prerequisites Check
Installation
Results
Verify the NetBIOS name assigned to the domain and change it if necessary
The NetBIOS domain name:
DATABASE
More about additional options
< Previous
Next >
Install
Cancel
Type here to search
12:44 PM
5/19/2025
Right Ctrl
15°C
Partly cloudy
Search
ENG
INTL
21:44
2025/05/19

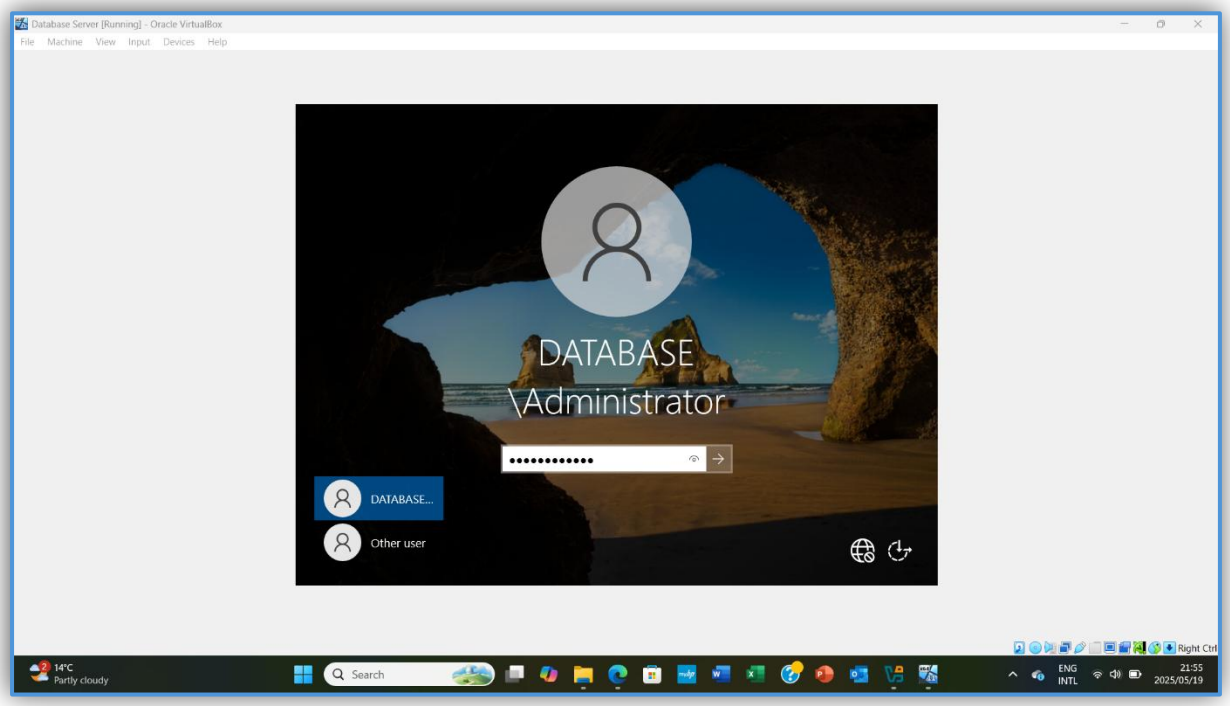

Database Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Active Directory Domain Services Configuration Wizard
Paths
TARGET SERVER
WIN-GE9NGRVHMAU
Deployment Configuration
Domain Controller Options
DNS Options
Additional Options
Paths
Review Options
Prerequisites Check
Installation
Results
Specify the location of the AD DS database, log files, and SYSVOL
Database folder:
C:\Windows\NTDS
Log files folder:
C:\Windows\NTDS
SYSVOL folder:
C:\Windows\SYSVOL
More about Active Directory paths
< Previous
Next >
Install
1 new notification
Type here to search
12:44 PM
5/19/2025
Right Ctrl
15°C
Partly cloudy
Search
ENG
INTL
21:44
2025/05/19

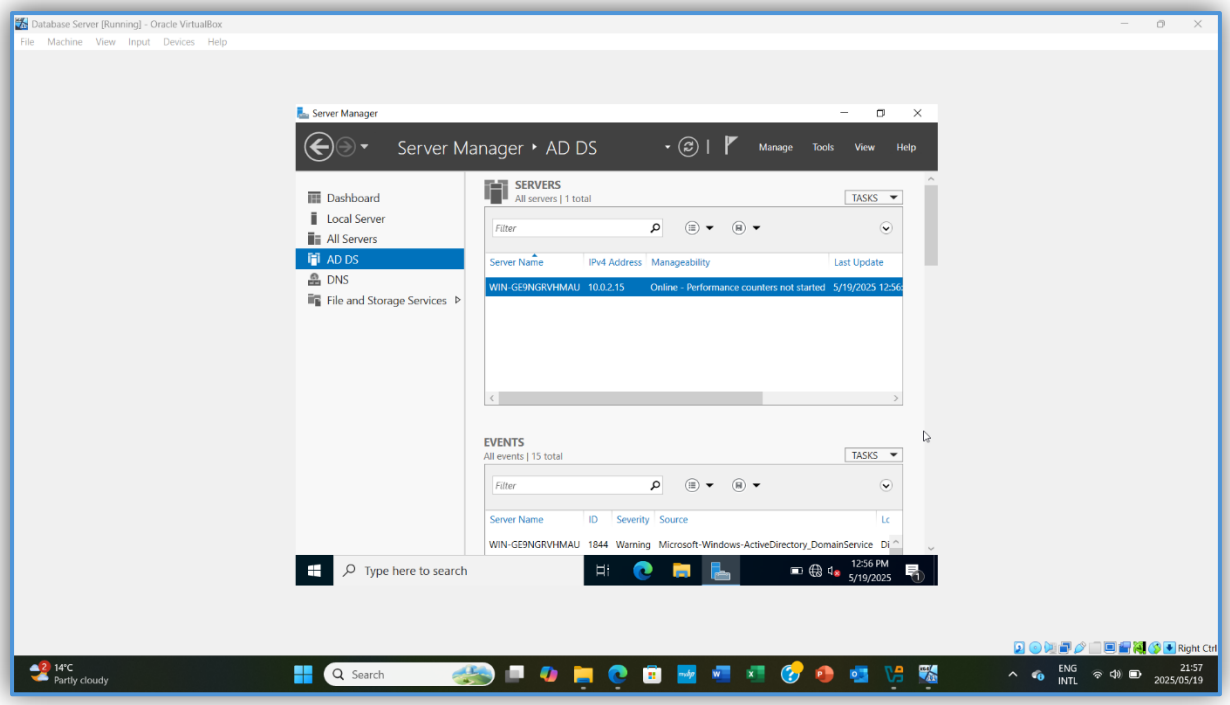




After the installation process I got a pop up that says that I'm about to be signed out, I then signed in again after it restarted.


Database Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Active Directory Domain Services Configuration Wizard
Results
TARGET SERVER
WIN-GE9NGRVHMAU
This server was successfully configured as a domain controller
Show more
View detailed operation results
Windows Server 2022 domain controllers have a default for the security setting named "Allow cryptography algorithms compatible with Windows NT 4.0" that prevents weaker cryptography algorithms when establishing security channel sessions.
You're about to be signed out
The computer is being restarted because Active Directory Domain Services was installed or removed.
Close
infrastructure, you should manually create a delegation to this DNS server in the parent zone to ensure reliable name resolution from outside the domain "Database.org". Otherwise, no action is required.
More about results
< Previous
Next >
Close
Cancel
Type here to search
12:50 PM
5/19/2025
15°C
Partly cloudy
Search
ENG
INTL
21:51
2025/05/19
Right Ctrl


Database Server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
DATABASE
\Administrator
DATABASE...
Other user
14°C
Partly cloudy
Search
ENG
INTL
21:55
2025/05/19
Right Ctrl

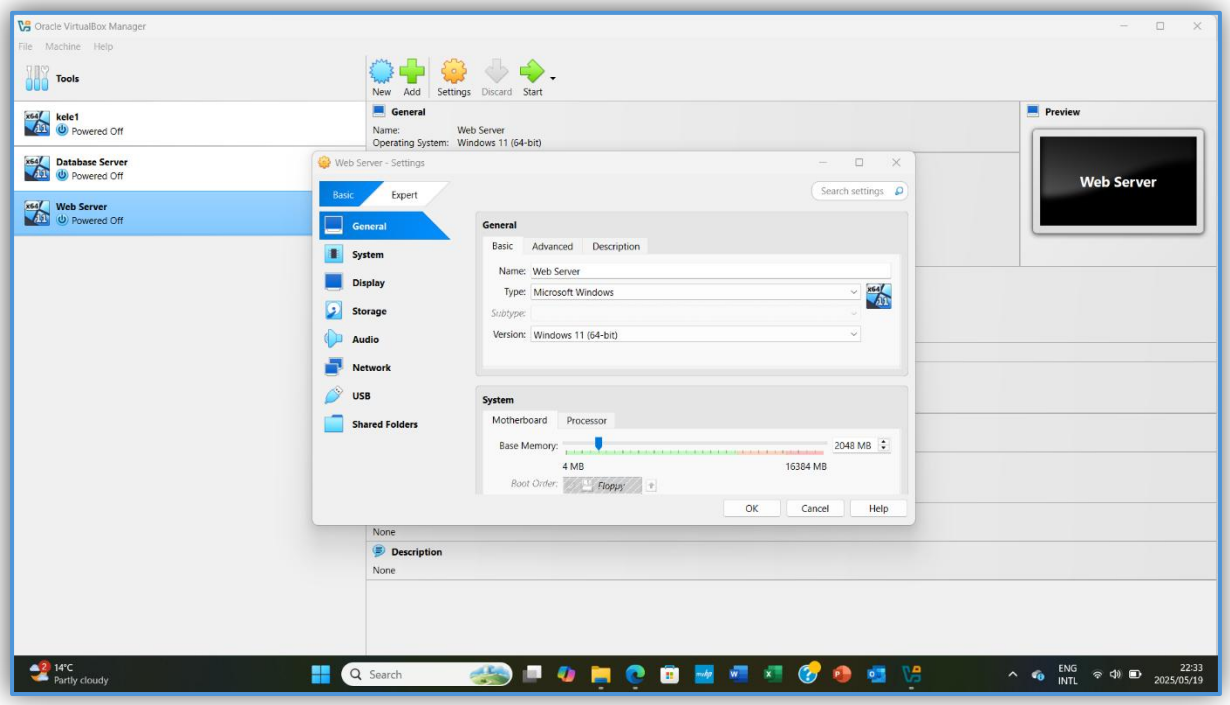


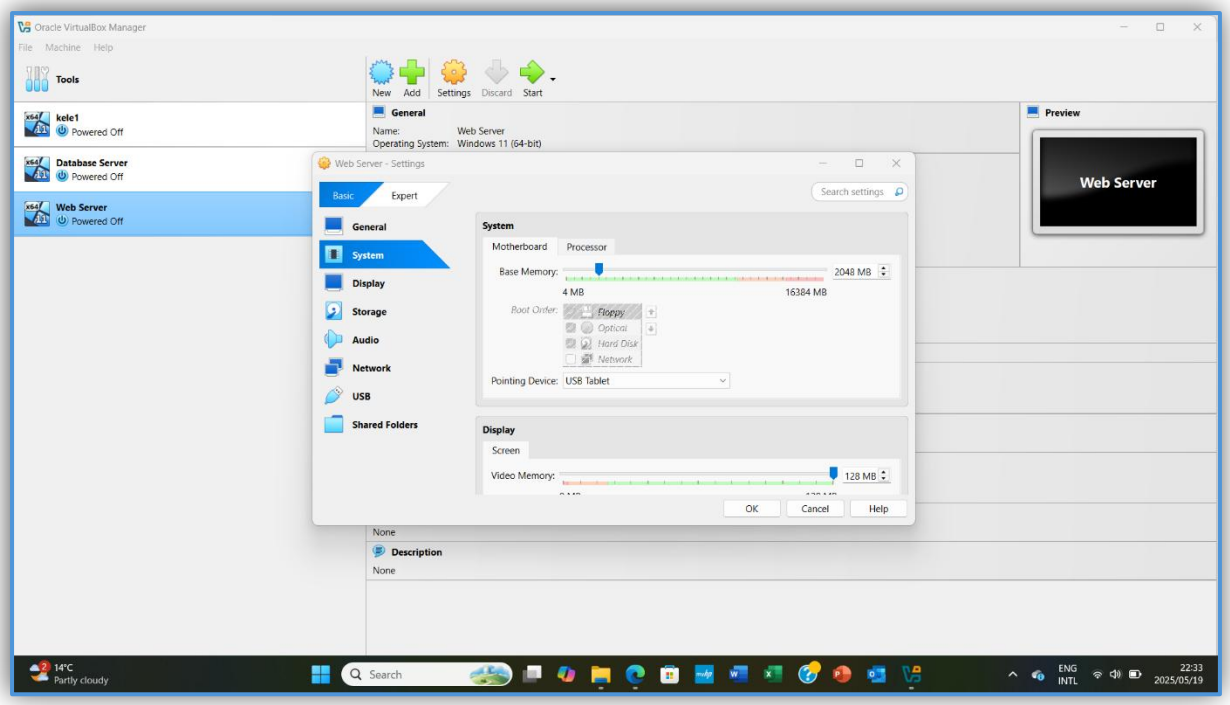
2.3 Simulate critical real-world scenarios, including:

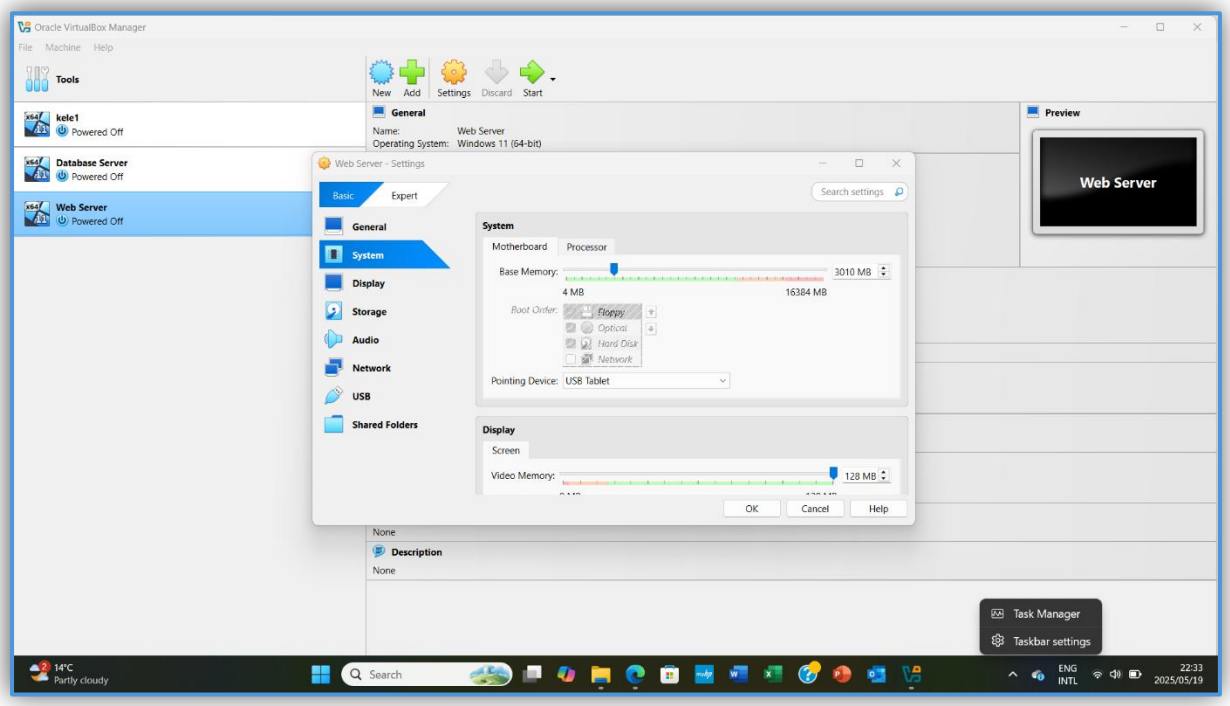
- ❖ Dynamic resource allocation.

Step 7: This is where I allocated more (base) memory space on the VMs.

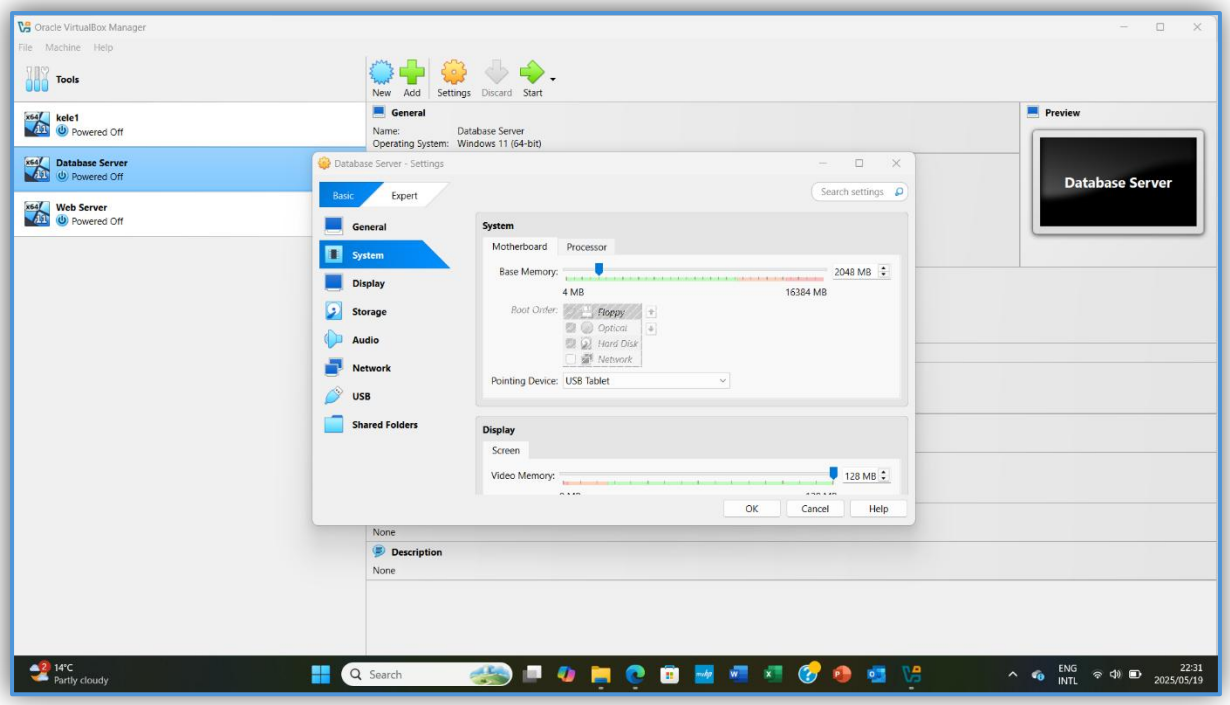
Web Server

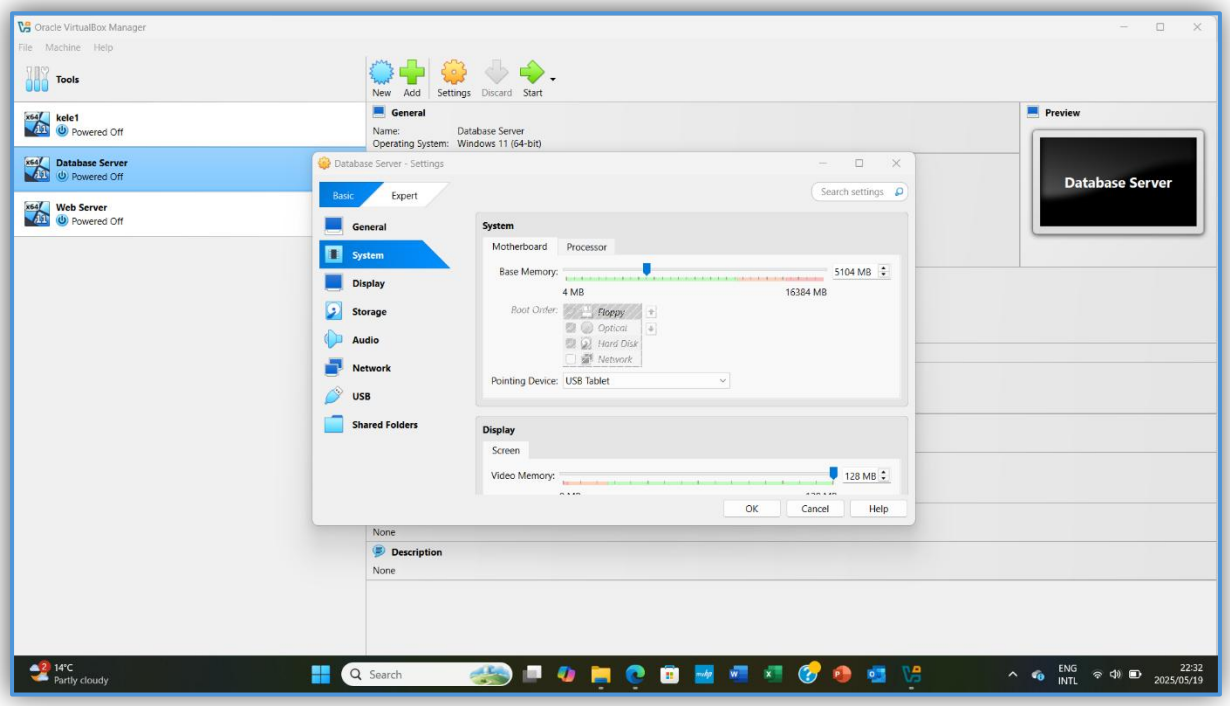






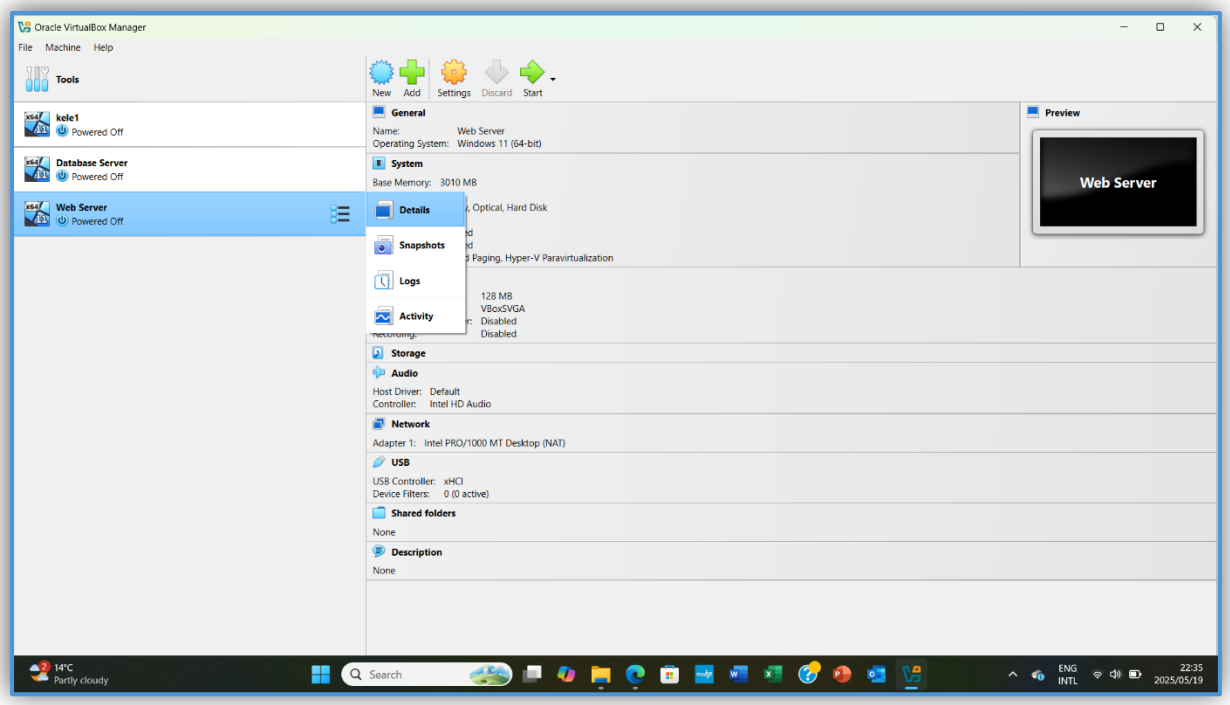
Database Server

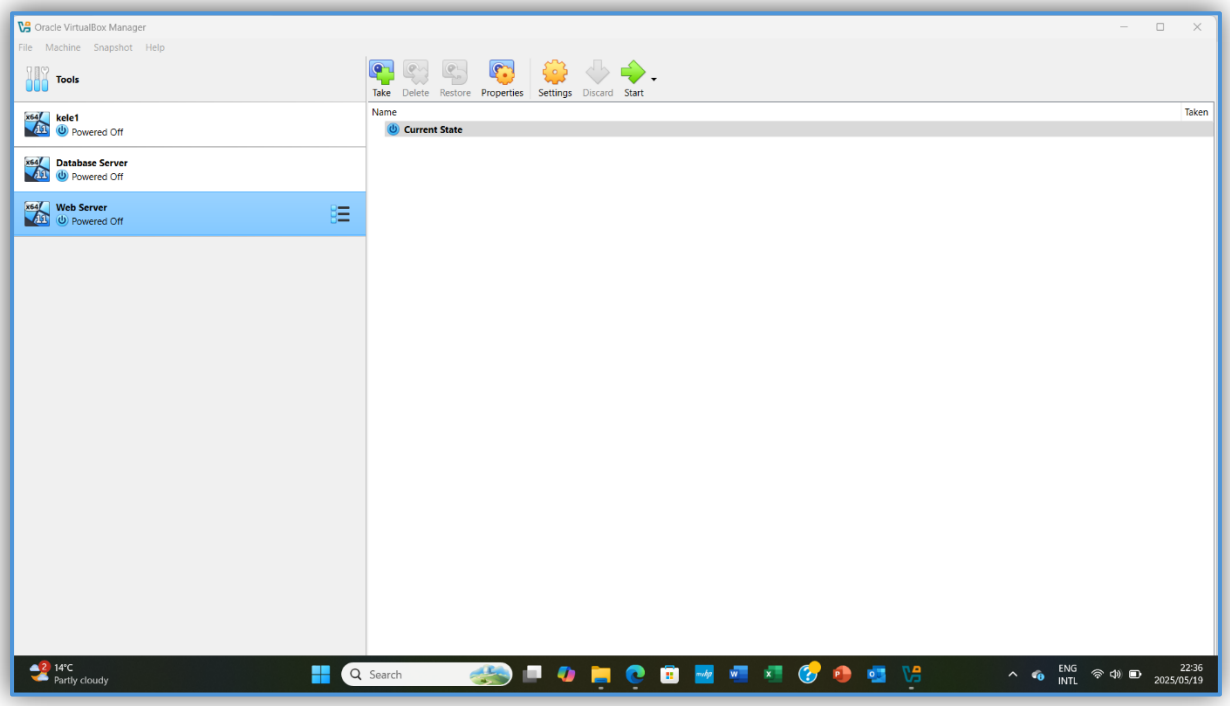


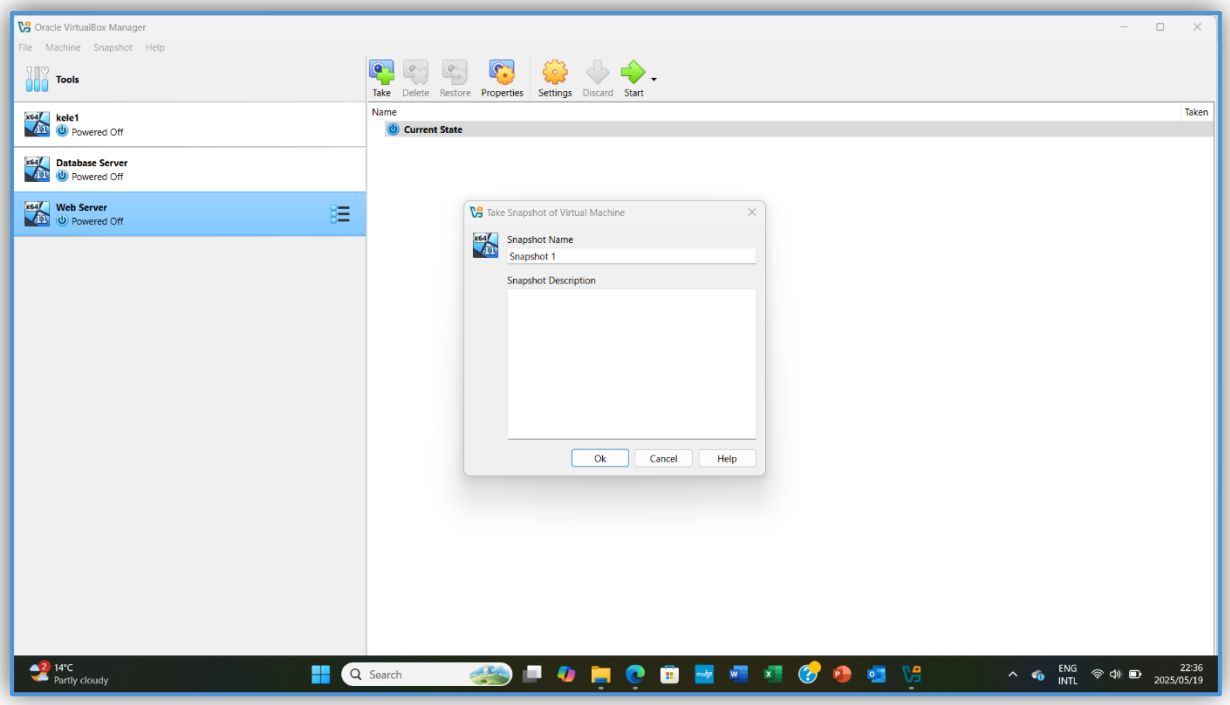


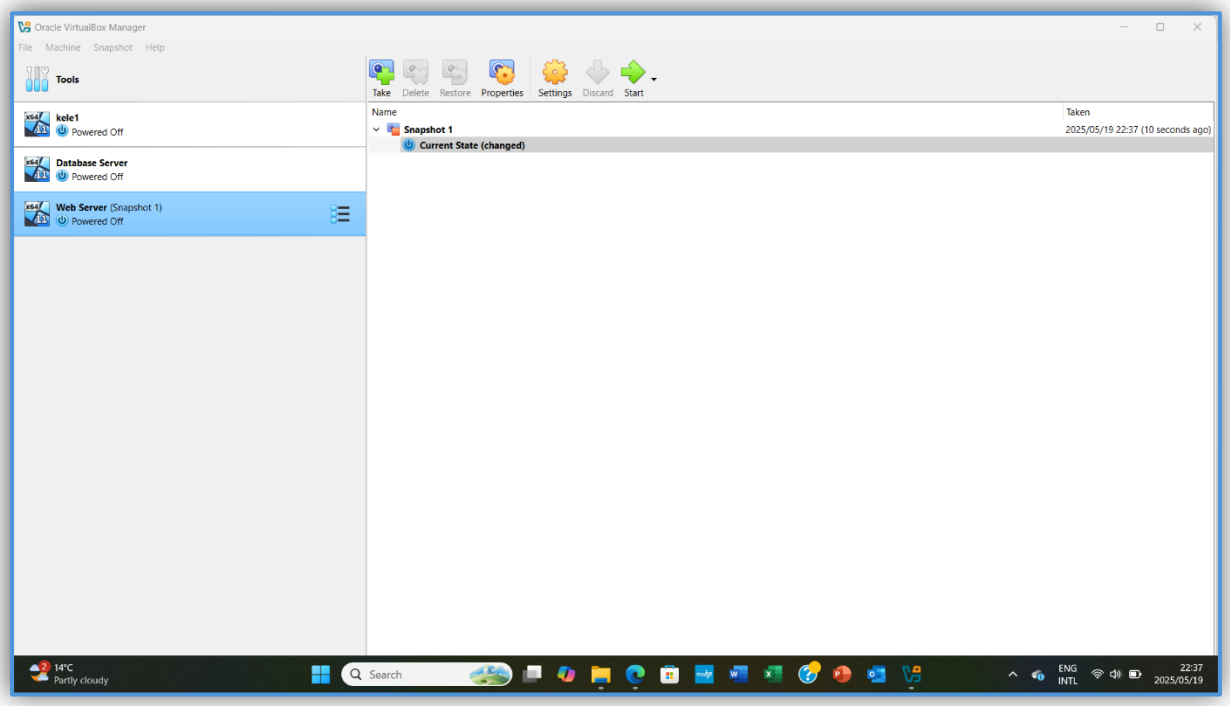
- ❖ Backup and disaster recovery testing using snapshots and restoration procedures.

Step 8: I added the snapshots on one VM which is the Web Server.

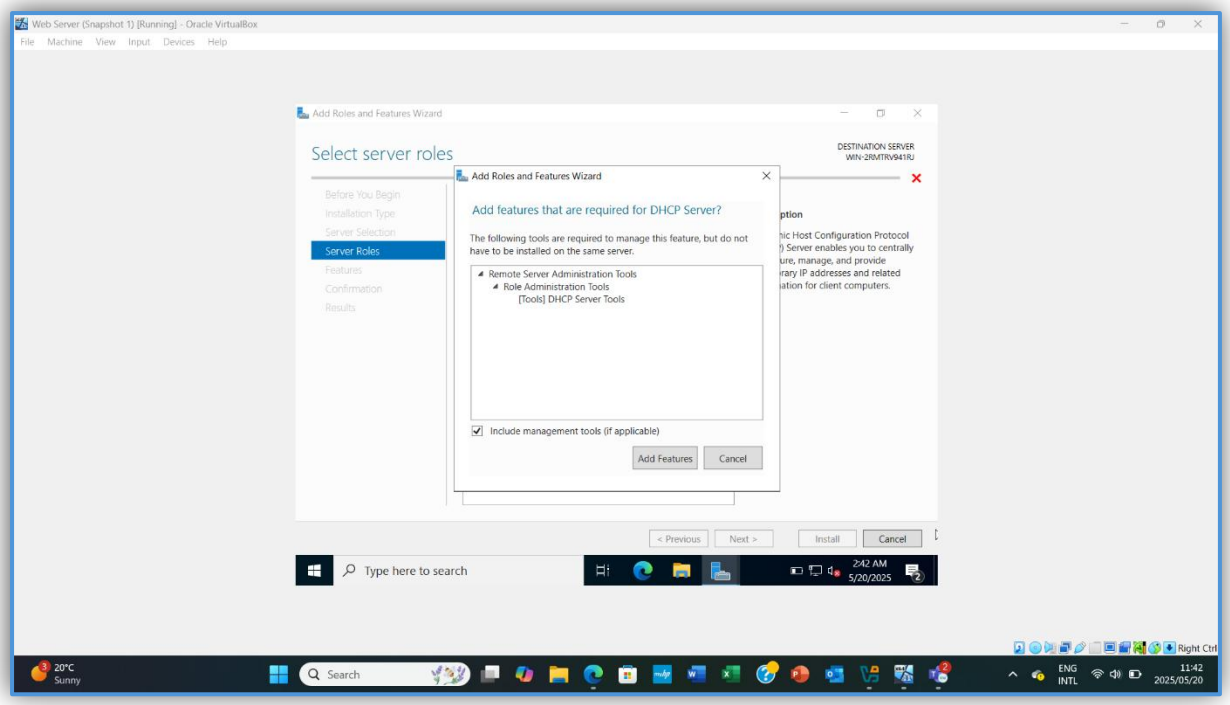

Oracle VirtualBox Manager
File Machine Help
Tools
kele1
Powered Off
Database Server
Powered Off
Web Server
Powered Off
New Add Settings Discard Start
General
Name: Web Server
Operating System: Windows 11 (64-bit)
System
Base Memory: 3010 MB
Details
Snapshots
Logs
Activity
Preview
Web Server
Storage
Audio
Host Driver: Default
Controller: Intel HD Audio
Network
Adapter 1: Intel PRO/1000 MT Desktop (NAT)
USB
USB Controller: xHCI
Device Filters: 0 (0 active)
Shared folders
None
Description
None
14°C
Partly cloudy
Search
ENG
INTL
22:35
2025/05/19

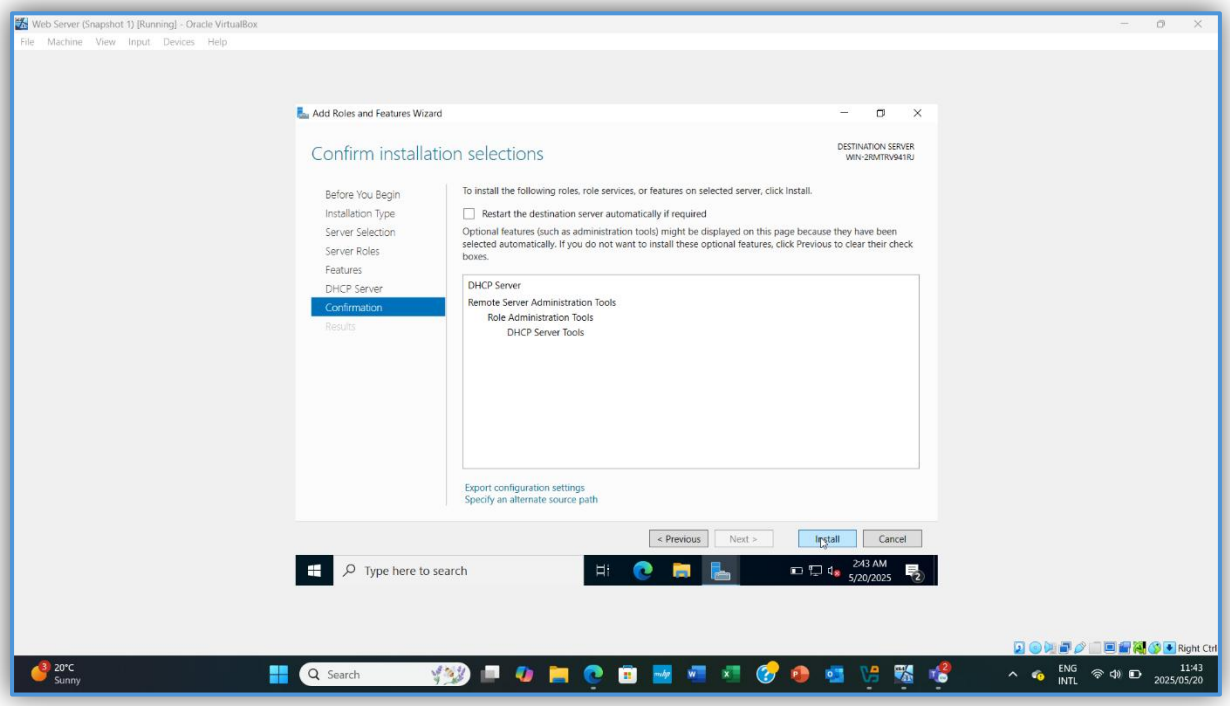

Oracle VirtualBox Manager
File Machine Snapshot Help
Tools
kele1
Powered Off
Database Server
Powered Off
Web Server
Powered Off
Take Delete Restore Properties Settings Discard Start
Name
Taken
Current State
14°C
Partly cloudy
Search
ENG
INTL
22:36
2025/05/19

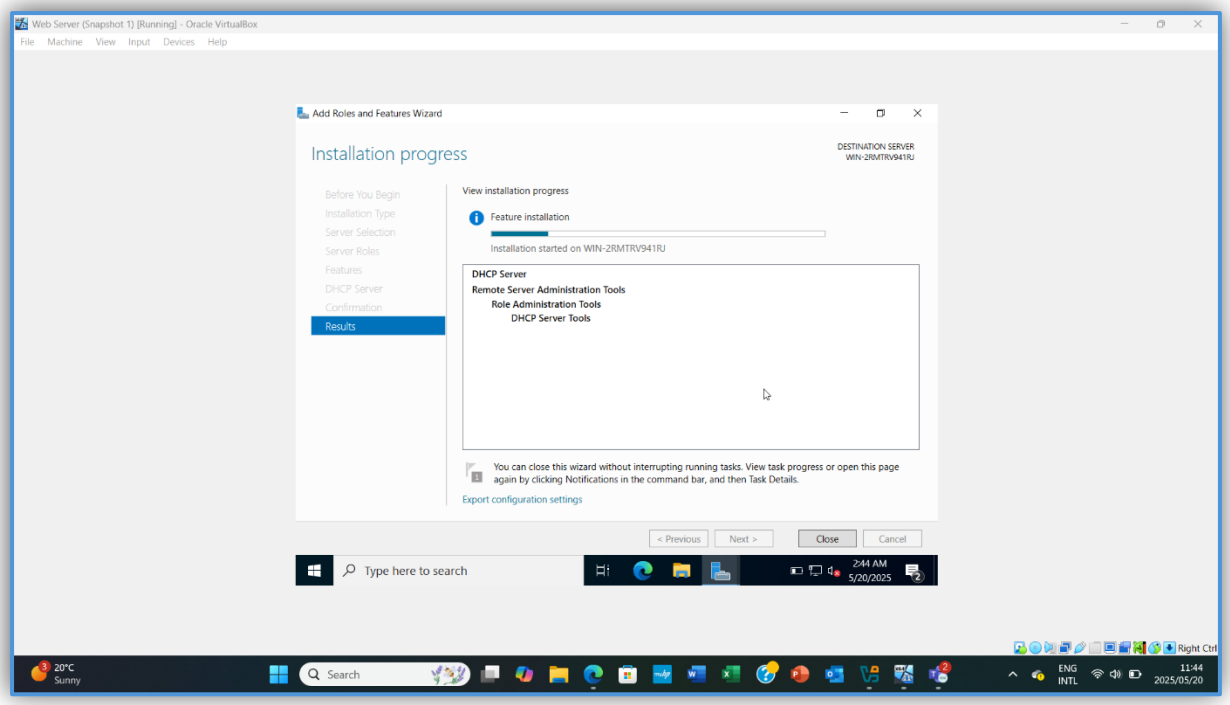




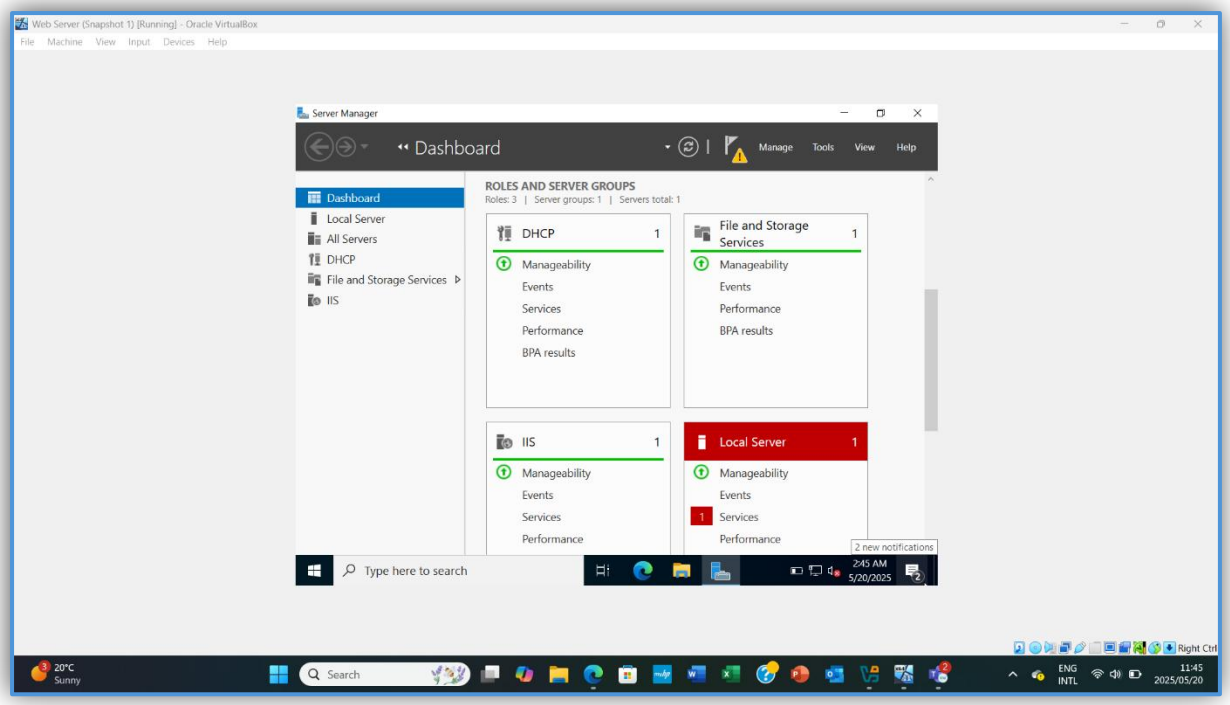
After adding my snapshot, I then put it to the test by adding another role and feature so that I can revert/restore everything back to its previous stage by using the snapshot.

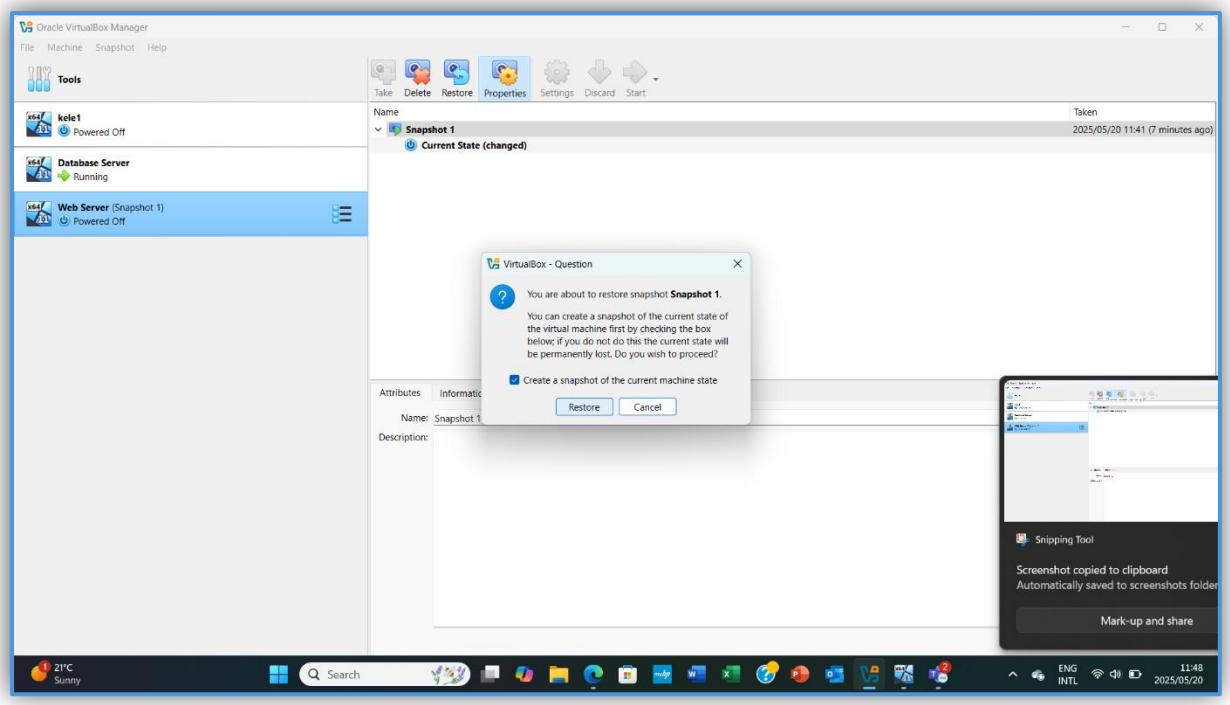

Web Server (Snapshot 1) [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Add Roles and Features Wizard
Select server roles
DESTINATION SERVER
WIN-2RMTRV941RJ
Add Roles and Features Wizard
Add features that are required for DHCP Server?
The following tools are required to manage this feature, but do not have to be installed on the same server.
Remote Server Administration Tools
Role Administration Tools
[Tools] DHCP Server Tools
Include management tools (if applicable)
Add Features
Cancel
Before You Begin
Installation Type
Server Selection
Server Roles
Features
Confirmation
Results
< Previous
Next >
Install
Cancel
Type here to search
2:42 AM
5/20/2025
20°C
Sunny
Search
ENG
INTL
11:42
2025/05/20
Right Ctrl


Web Server (Snapshot 1) [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Add Roles and Features Wizard
Confirm installation selections
DESTINATION SERVER
WIN-2RMTRV941RJ
Before You Begin
Installation Type
Server Selection
Server Roles
Features
DHCP Server
Confirmation
Results
To install the following roles, role services, or features on selected server, click Install.
Restart the destination server automatically if required
Optional features (such as administration tools) might be displayed on this page because they have been selected automatically. If you do not want to install these optional features, click Previous to clear their check boxes.
DHCP Server
Remote Server Administration Tools
Role Administration Tools
DHCP Server Tools
Export configuration settings
Specify an alternate source path
< Previous
Next >
Install
Cancel
Type here to search
2:43 AM
5/20/2025
20°C
Sunny
Search
ENG
INTL
11:43
2025/05/20
Right Ctrl

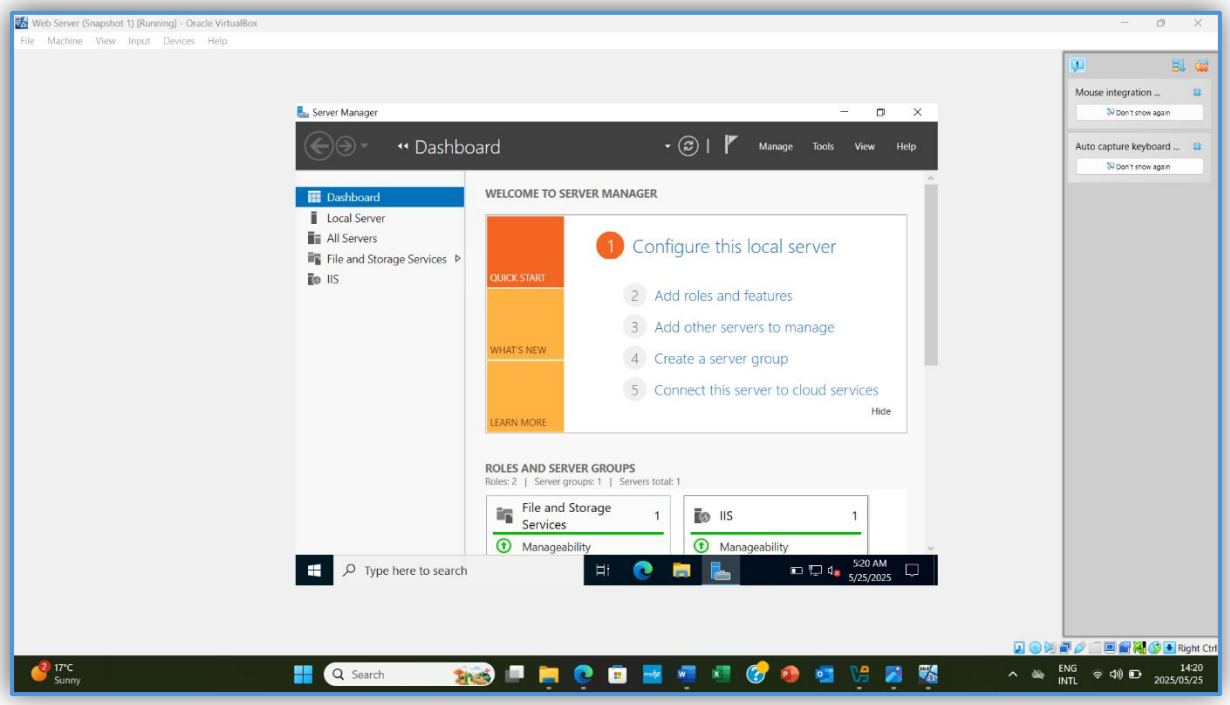


The DHCP role is now added, I then restored the VM previous state using the snapshot



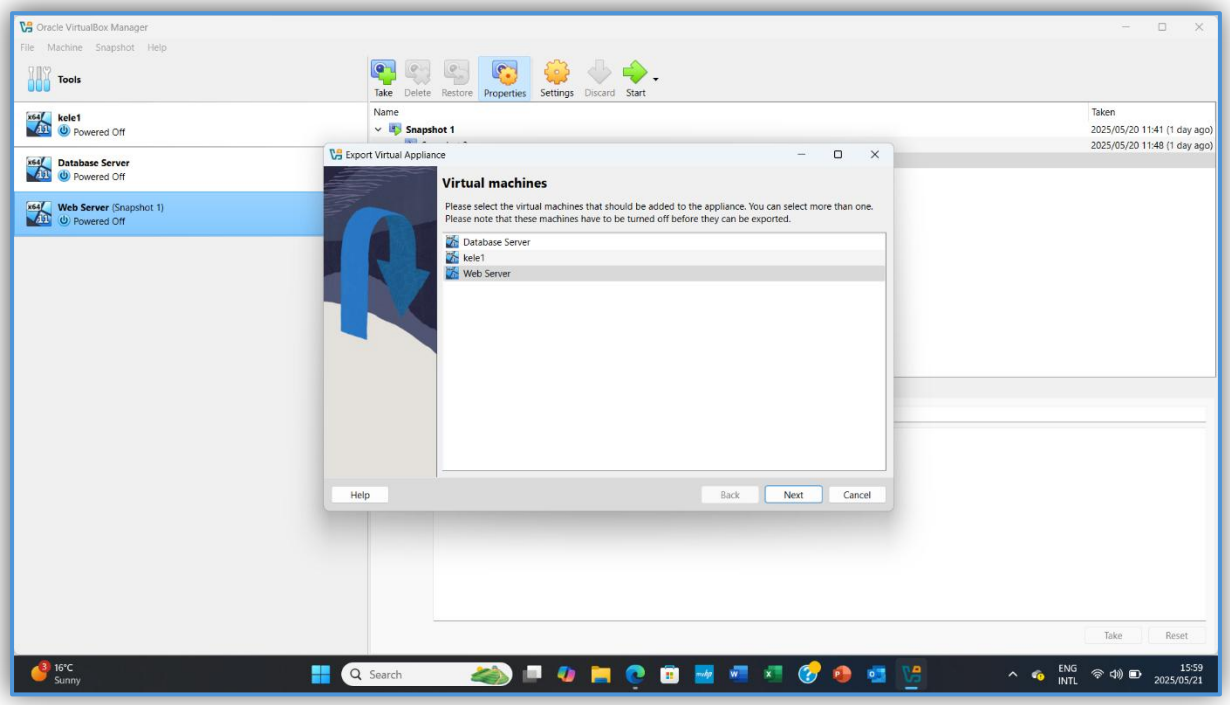


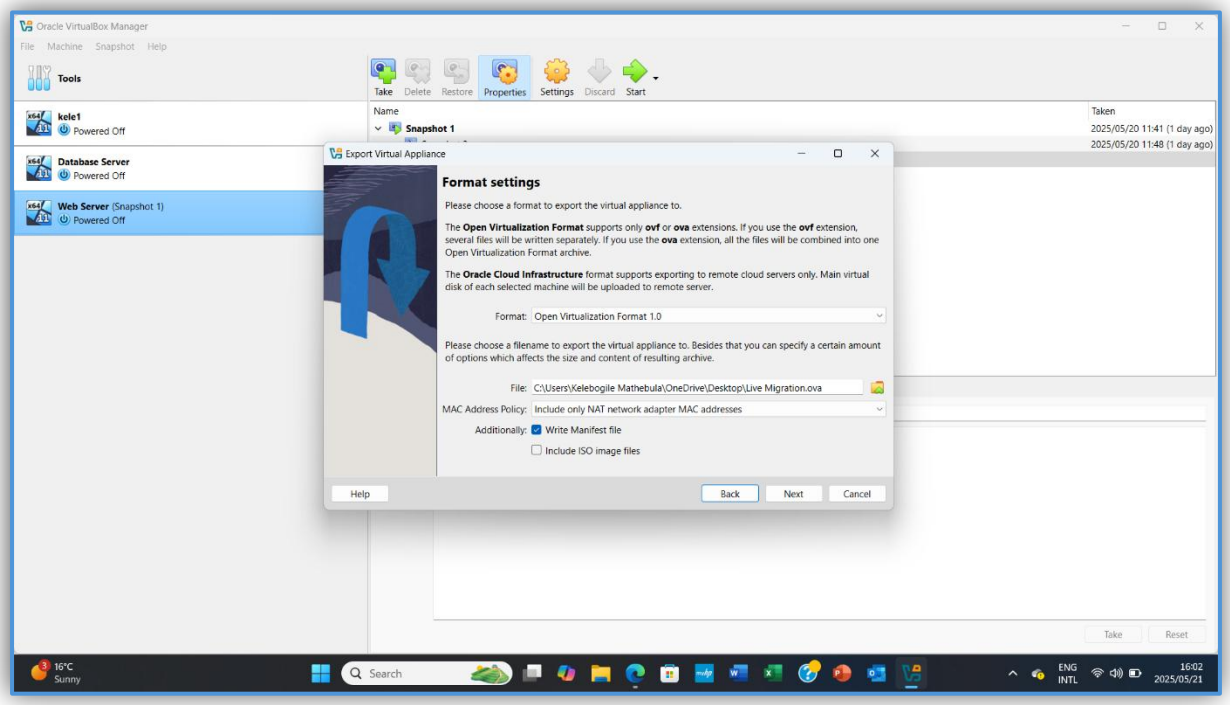
The VM then went to its previous state before the DHCP was added.

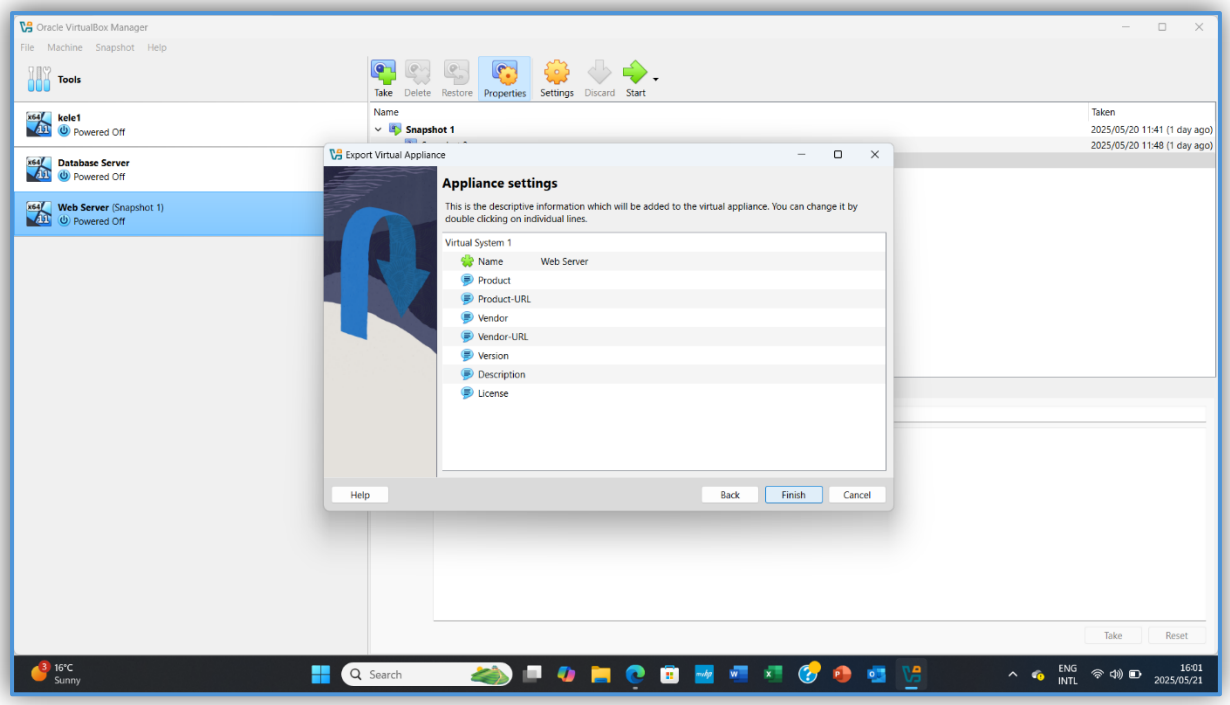


- Live migration of virtual machines to demonstrate system uptime improvement.

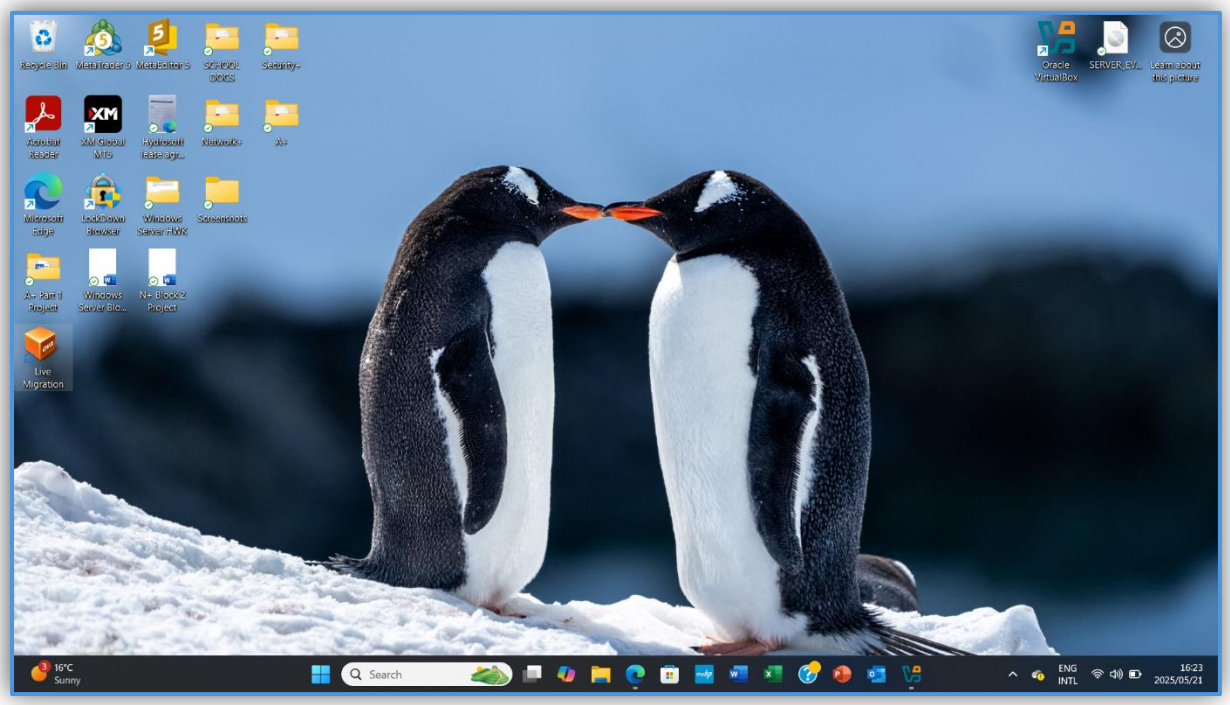
Step 9: I migrated Wed Server, VirtualBox does not support live migration but it can perform a cold migration, which simulates the concept of live migration. I exported Web Server and then Imported it back into VirtualBox on another VirtualBox host.



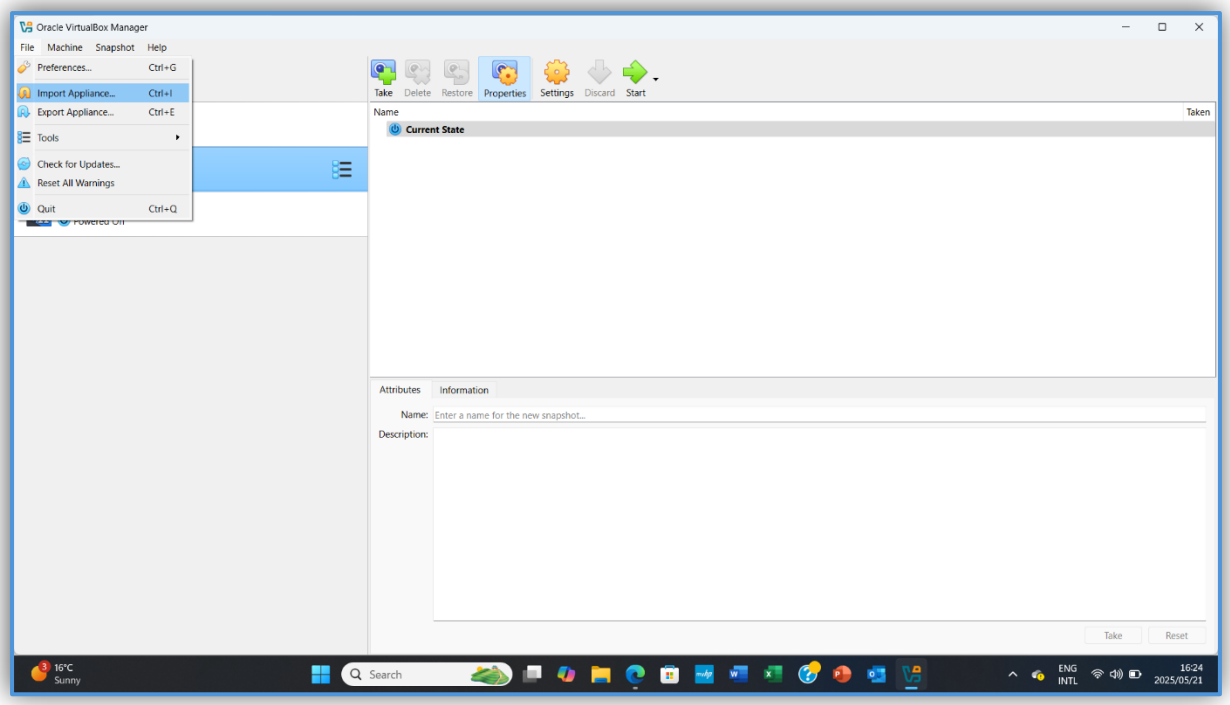


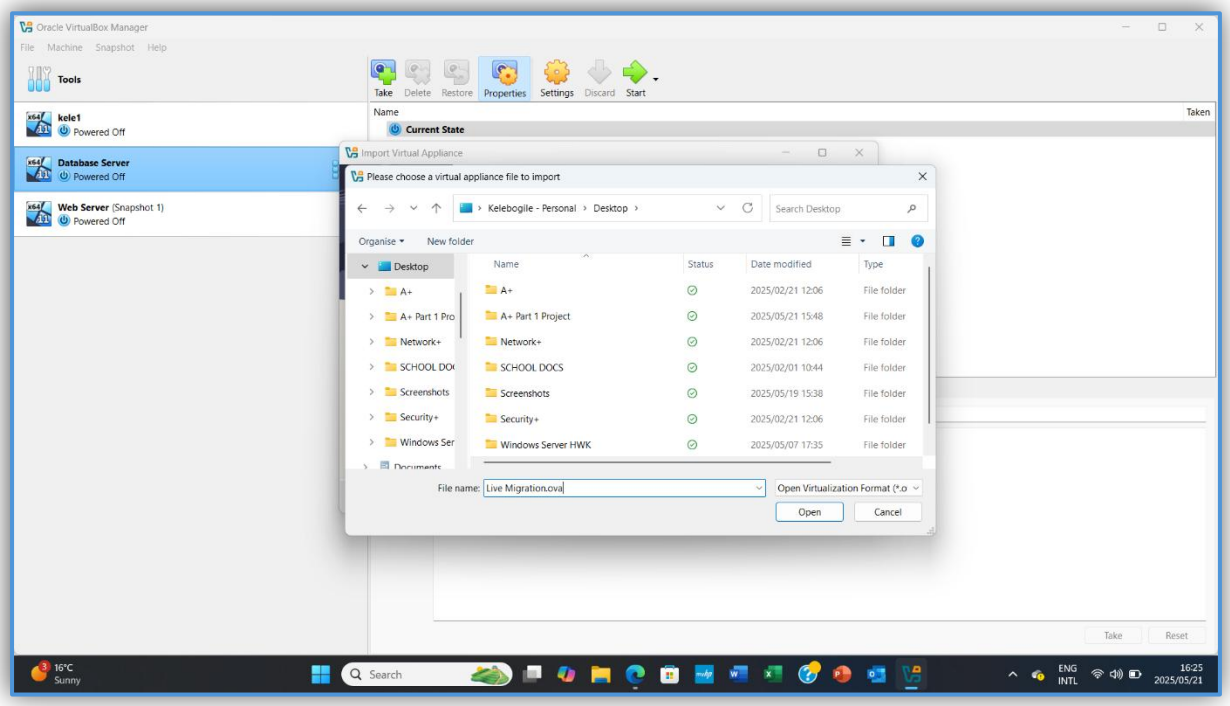


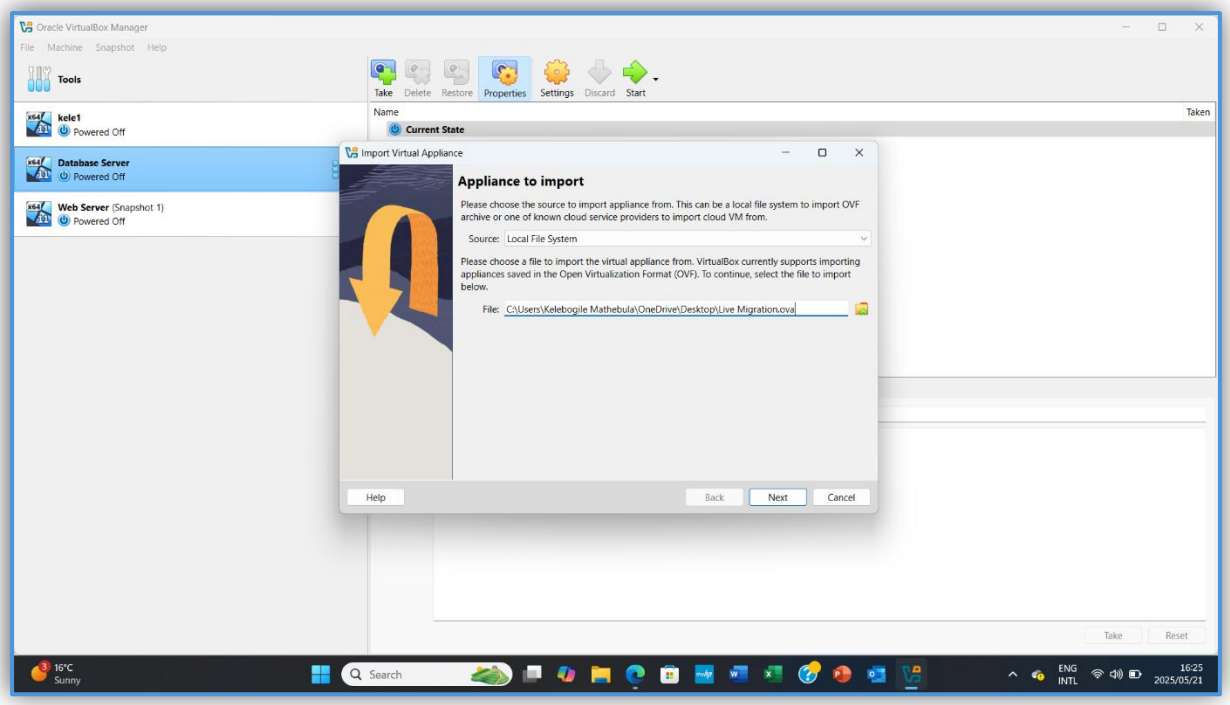
After the export process the live migration icon appeared on my desktop.

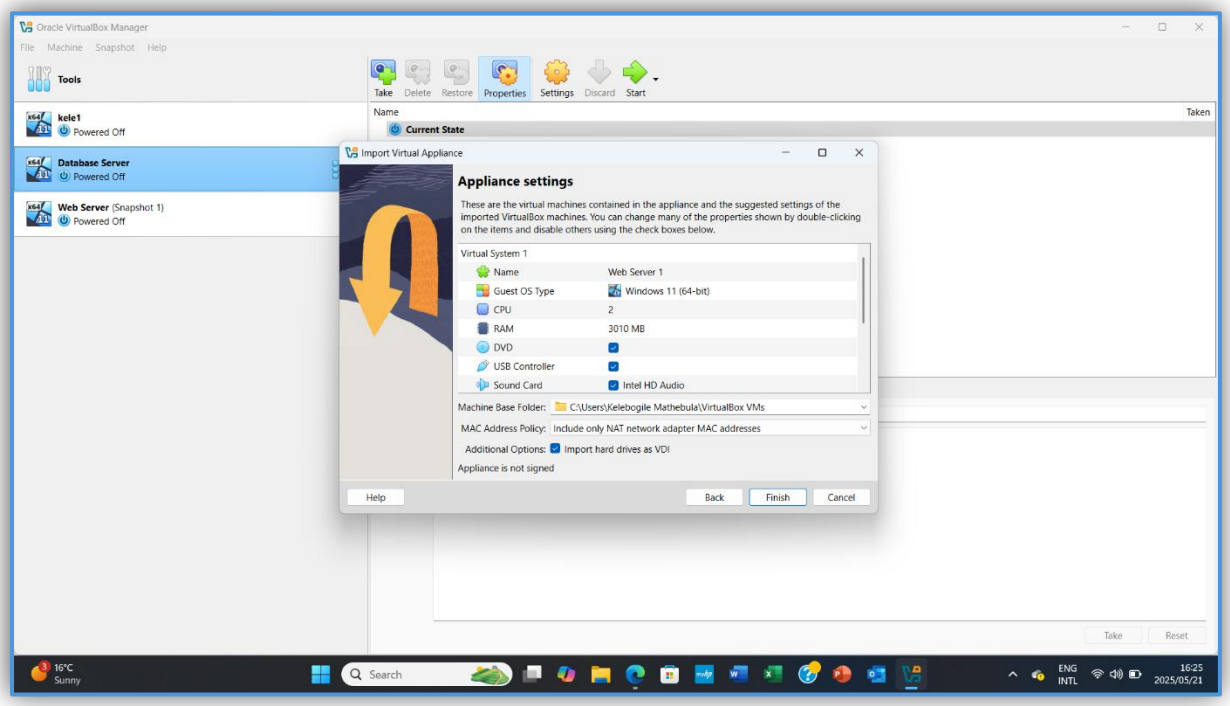


After noticing the icon, I then imported the migration onto an existing VirtualBox host and a duplicate of the Web Server appeared.

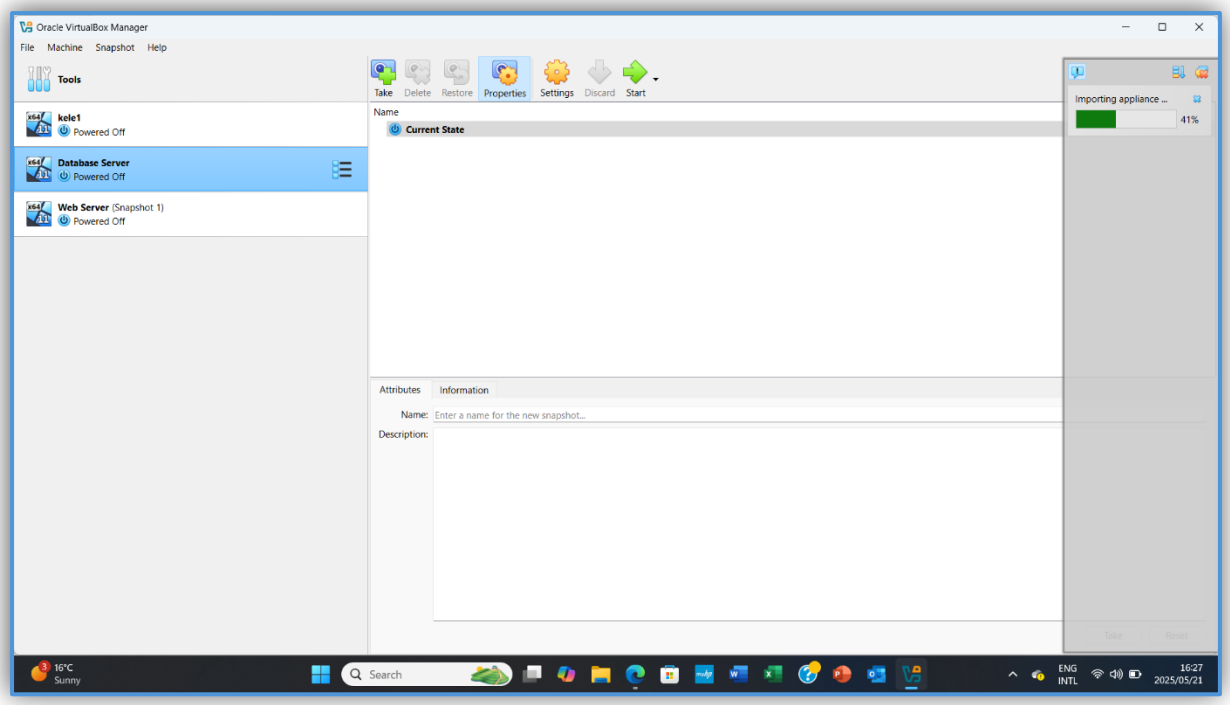

Oracle VirtualBox Manager
File Machine Snapshot Help
Preferences... Ctrl+G
Import Appliance... Ctrl+I
Export Appliance... Ctrl+E
Tools
Check for Updates...
Reset All Warnings
Quit Ctrl+Q
Take Delete Restore Properties Settings Discard Start
Name Taken
Current State
Attributes Information
Name: Enter a name for the new snapshot...
Description:
Take Reset
16°C Sunny
Search
ENG INTL
16:24 2025/05/21

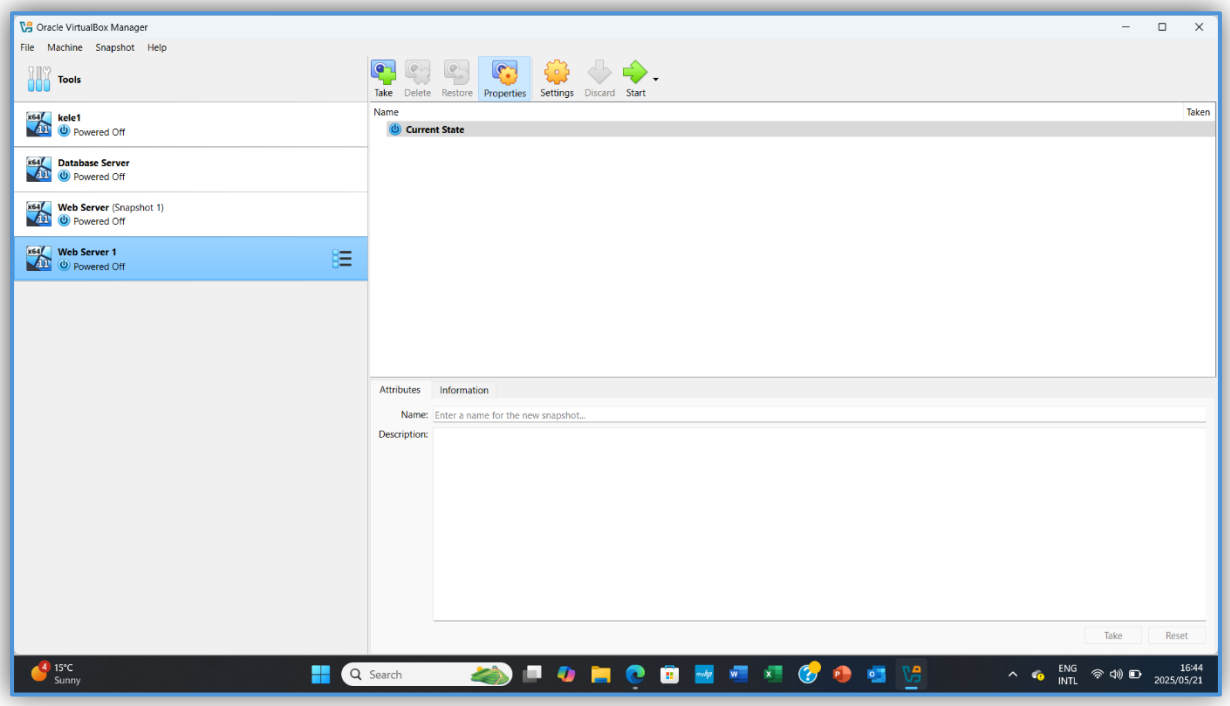

Oracle VirtualBox Manager
File Machine Snapshot Help
Tools
kele1 Powered Off
Database Server Powered Off
Web Server (Snapshot 1) Powered Off
Take Delete Restore Properties Settings Discard Start
Name Taken
Current State
Import Virtual Appliance
Please choose a virtual appliance file to import
Kelebogile - Personal › Desktop ›
Search Desktop
Organise New folder
Desktop
Name Status Date modified Type
A+ 2025/02/21 12:06 File folder
A+ Part 1 Project 2025/05/21 15:48 File folder
Network+ 2025/02/21 12:06 File folder
SCHOOL DOCS 2025/02/01 10:44 File folder
Screenshots 2025/05/19 15:38 File folder
Security+ 2025/02/21 12:06 File folder
Windows Server HWK 2025/05/07 17:35 File folder
File name: Live Migration.ova
Open Virtualization Format (*.o
Open Cancel
Take Reset
16°C Sunny
Search
ENG INTL
16:25 2025/05/21





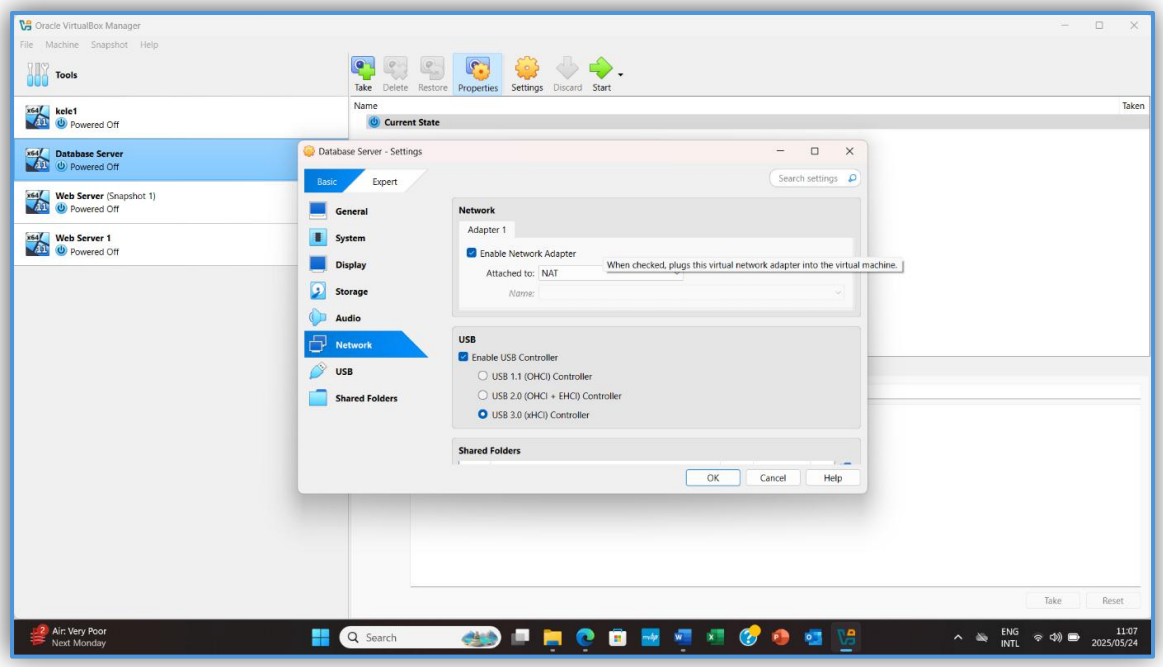
After pressing finish the import will run then a duplicate of Web Server will appear.

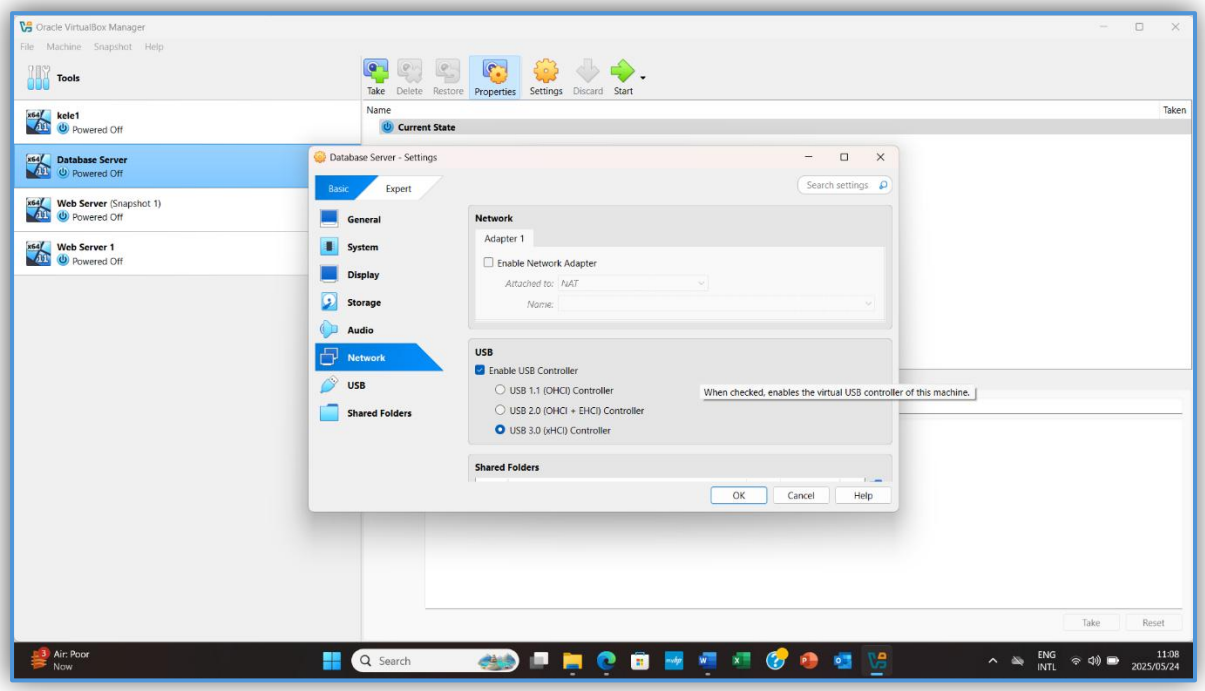

Oracle VirtualBox Manager
File Machine Snapshot Help
Tools
kele1
Powered Off
Database Server
Powered Off
Web Server (Snapshot 1)
Powered Off
Take Delete Restore Properties Settings Discard Start
Name
Current State
Importing appliance ...
41%
Attributes Information
Name: Enter a name for the new snapshot...
Description:
16°C
Sunny
Search
ENG
INTL
16:27
2025/05/21


Oracle VirtualBox Manager
File Machine Snapshot Help
Tools
kele1
Powered Off
Database Server
Powered Off
Web Server (Snapshot 1)
Powered Off
Web Server 1
Powered Off
Take Delete Restore Properties Settings Discard Start
Name
Taken
Current State
Attributes Information
Name: Enter a name for the new snapshot...
Description:
Take
Reset
15°C
Sunny
Search
ENG
INTL
16:44
2025/05/21

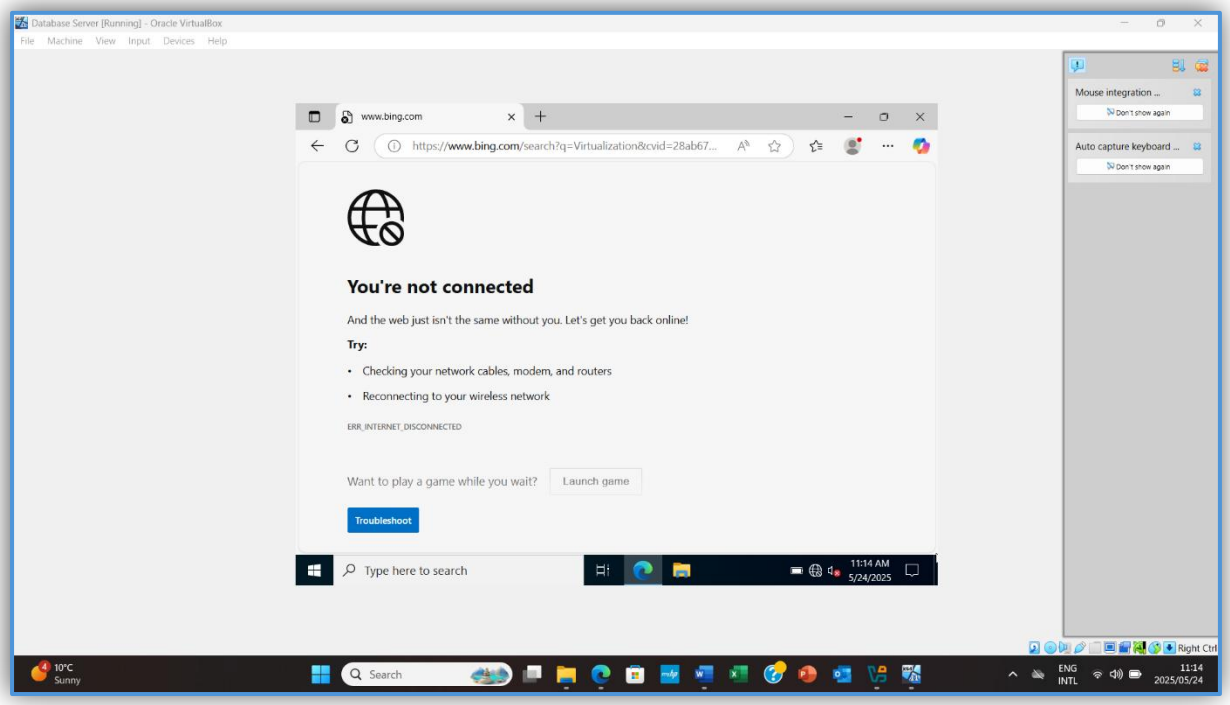
- ❖ Security testing, such as isolating one compromised VM without affecting others.

Step 10: This is where I disabled the Network adapter, the network adapter is normally disabled when that specific VM is corrupted and we don't want it to corrupt the other VMs, so I disabled the Database Server Network adapter. I first checked if it was enabled.





I then started the machine and tried to look up virtualization to see whether the VM is still connected to the internet or not.



Question 3

3.1 Document a step-by-step implementation plan for migrating DataSecure Ltd.'s servers to a virtualised environment.

Step 1: Assessment as well as Planning

The first thing is to perform a detailed audit of all the 10 physical servers (look at the hardware specks, the OS, and the applications) in use at DataSecure Ltd., secondly we would have to identify applications that can be virtualised and group them based on their usage as well as their compatibility, the third task would be to start implementing Oracle VirtualBox since it is the Virtualisation solution because it is open-source, free and well-supported. We will lastly define key goals so that we can reduce physical servers, optimize resource usage, and increase scalability.

Step 2: Infrastructure Preparation

We will buy or repurpose 2 to 3 high performance host machines with at least 64-128 GB RAM, Multi-core CPUs for example AMD Ryzen Threadripper, SSD storage and reliable cooling fans, RAID-configured NAS for shared backups. We will then lastly install Oracle VirtualBox as well as any extension that might be needed.

Step 3: Create and configure the VMs

We will create base virtual machines with the required operation system which will depend on DataSecure Ltd., after the install we will pre-install necessary services as part of templates as well as the necessary roles and features after all that we will enable and configure VirtualBox features like snapshots, shared folders, and virtual networking like NAT.

Step 4: Phased Migration

The migration services will begin in a low-risk order-**1**. File and document storage systems, **2**. Backup and disaster recovery, **3.** CRM, **4**. Database servers, **5**. Web and application server, **6**. Email server (Microsoft Exchange), **7**. Cybersecurity systems. After each service migration we will start testing everything thoroughly, monitoring the performance and then documenting the configuration.

Step 5: Backup and Recovery Setup

We schedule daily VM snapshots via VirtualBox, export VMs weekly to external storage for extra safety and support as well as implement disaster recovery drills.

Step 6: Staff Training

The IT staff or personnel will be trained in VirtualBox usage as well as maintenance, they will also prepare or be responsible for troubleshooting guides and procedures for routine tasks.

3.2 Include a risk assessment addressing potential challenges (e.g., software compatibility, initial setup costs)

Risk	Impact	Likelihood	Mitigation Strategy
Software Compatibility	High	Medium	Before migration make sure to test critical applications.
Initial Hardware Costs	Medium	High	Reduce the use of open-source software
Backup Failures	High	Low	Make sure that there are automated backups and conduct regular recovery drills.
Security Configuration Errors	Medium	Medium	Make sure that you use hardened OS setting templates and centralize your patch management
Performance Deterioration	High	Medium	Allocate resources properly, make use of SSDs as well as robust CPUs.
Skill Gap Among Staff	Medium	Medium	Make sure your staff gets regular formal training on VirtualBox.

3.3 Provide a detailed cost-benefit breakdown comparing current physical server expenses with projected virtualisation costs.

NB: This is an estimate

Category	Physical Servers	Virtualised Environment
Hardware Maintenance	R 230,000 (R23,000 per server)	R22,000 (shared virtual hosts)
Power and Colling	R50,000	R13,000
Training and Staff	R50,000	R13, 000 (includes initial upskilling)
Downtime Costs	R39,000	R22,000
Hosting	R70,000	R18,000
Software Licensing	R60,000	R0(free)
Backup and Recovery Tools	R15,000	R12,000

Totals:

- **Current costs:** R514,000 per year
- **Projected Virtualised costs:** R100,000 per year

Estimated Annual Savings: R414,000

3.4 Present the proposal and proof-of-concept demonstration in a technical report and live presentation.

The PowerPoint presentation is individually done.

Bibliography

Bibliography

Anderson, R. (2014). *Student experiential learning of cyber security through virtualization*. CA USA: National University.

Dash, P. (2013). *Getting Started on oracle vm virtualbox*. Brimingham: Pack Publishing.

Portnoy, M. (2012). *Virtualization essentials*. Indiana: John Wiley & Sons.

AI Decleration

I carefully read the assignment instructions, and the extent to which AI may be used for the assignment.
I used the following AI system(s)/tool(s): I made use of none
I used it for the following: I made use of none
If I quoted or paraphrased an AI output, I have referenced the relevant tool, version, and the date I used the tool.
I still consider this work my own. (i.e., I have not outsourced the final product, or significant portions of it, to AI tools/systems).
If required, I can defend my argument/perspective, explain my choices and approach, and can show that I am knowledgeable about the details of my work.