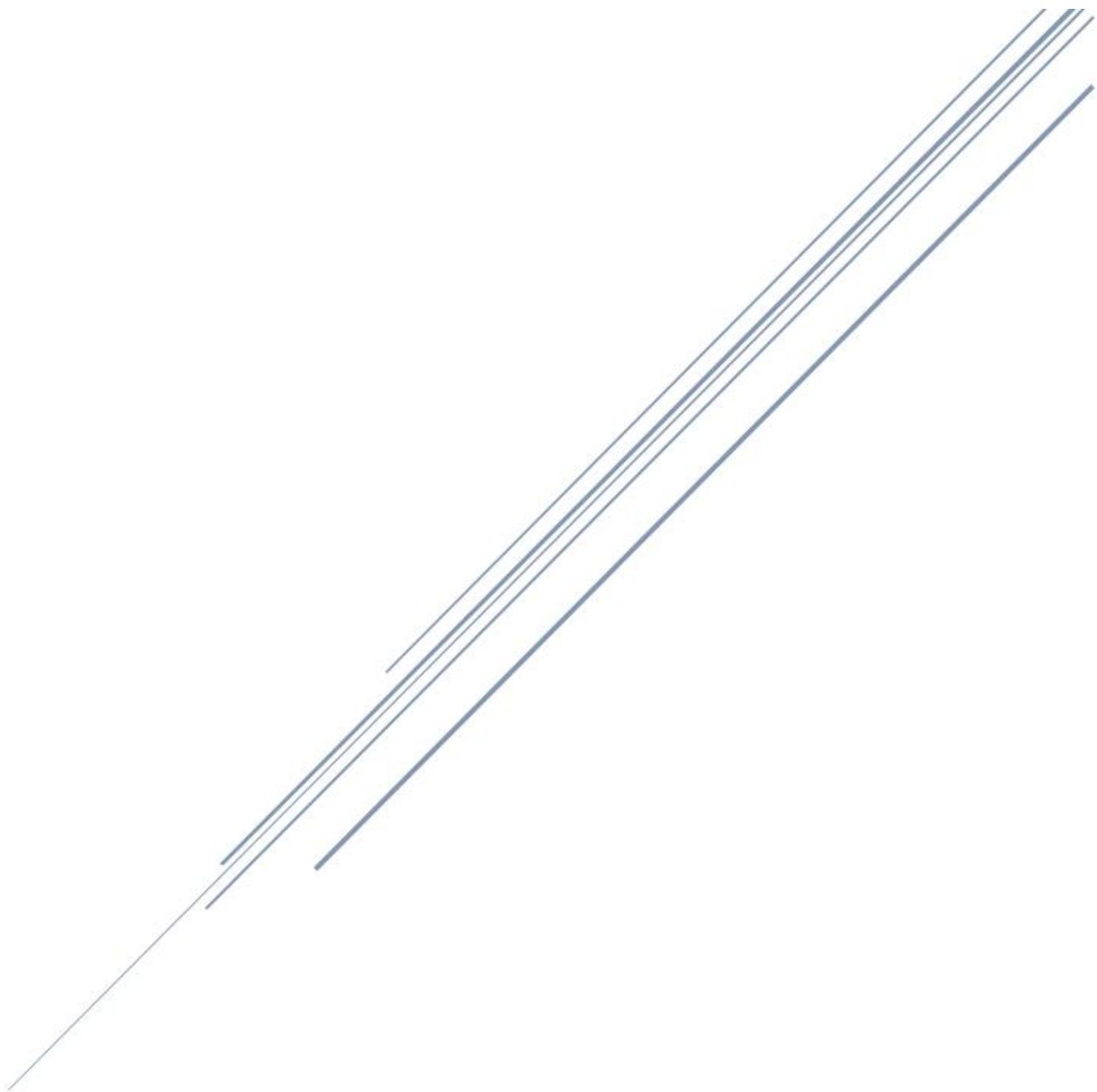
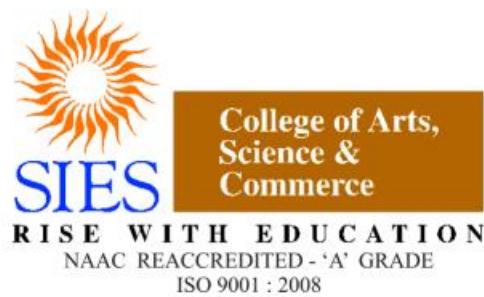


TCS2324055 SAGAR SWAPNIL PAWAR

*CLOUD COMPUTING  
JOURNAL PRACTICAL FILE*





**S.I.E.S College of Arts, Science and Commerce**  
**Sion(W), Mumbai - 400 022.**

**CERTIFICATE**

This is to certify that Mr. / Miss. Sagar Swapnil Pawar Roll No. **TCS2324055** Has successfully completed the necessary course of experiments in the subject of **Cloud Computing** during the academic year **2023 - 2024** complying with the requirements of University of Mumbai, for the course of T.Y. BSc. Computer Science [Semester-6]

Prof In.Charge

Prof. MAYA NAIR

Examination Date:  
Examiner's Signature & Date:

Head of the Department

Prof. Manoj Singh

College Seal

And

Date

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6	Perform the following in google cloud: a. A “Hello world “ website on IIS- Create an IIS web server VM using Compute Engine in b. A “Hello World” website on Apache. Create an Apache web server on a Linux VM c. Transfer files to Windows VMs d. Transfer files to Linux VMs e. Back up a VM's persistent disk f. Configure periodic backups with a snapshot schedule g. Restore a boot disk from a snapshot h. Restore a persistent disk from a snapshot	23 28 32 35 37 39 42 46	
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## **1. Study of Cloud Computing & Architecture(Theory)**

**Ans:-**

Cloud computing is a technology that allows users to access computing resources such as servers, storage, databases, networking, software, and analytics over the internet ("the cloud") on a pay-as-you-go basis. Cloud computing offers several benefits, including scalability, flexibility, cost-efficiency, and reduced management overhead.

The architecture of cloud computing typically consists of several layers:

1. Infrastructure as a Service (IaaS): This is the foundational layer of cloud computing, providing virtualized computing resources over the internet. Users can rent virtual machines, storage, and networking resources on-demand. Examples of IaaS providers include Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP).
2. Platform as a Service (PaaS): PaaS provides a platform allowing customers to develop, run, and manage applications without the complexity of building and maintaining the underlying infrastructure. PaaS offerings include development tools, middleware, databases, and other application services. Popular PaaS providers include Heroku, Google App Engine, and Microsoft Azure App Service.
3. Software as a Service (SaaS): SaaS delivers software applications over the internet on a subscription basis. Users access these applications through a web browser or API without needing to install or manage any software locally. Examples of SaaS applications include Salesforce, Google Workspace, and Microsoft Office 365.

Cloud computing architectures can also be categorized based on deployment models:

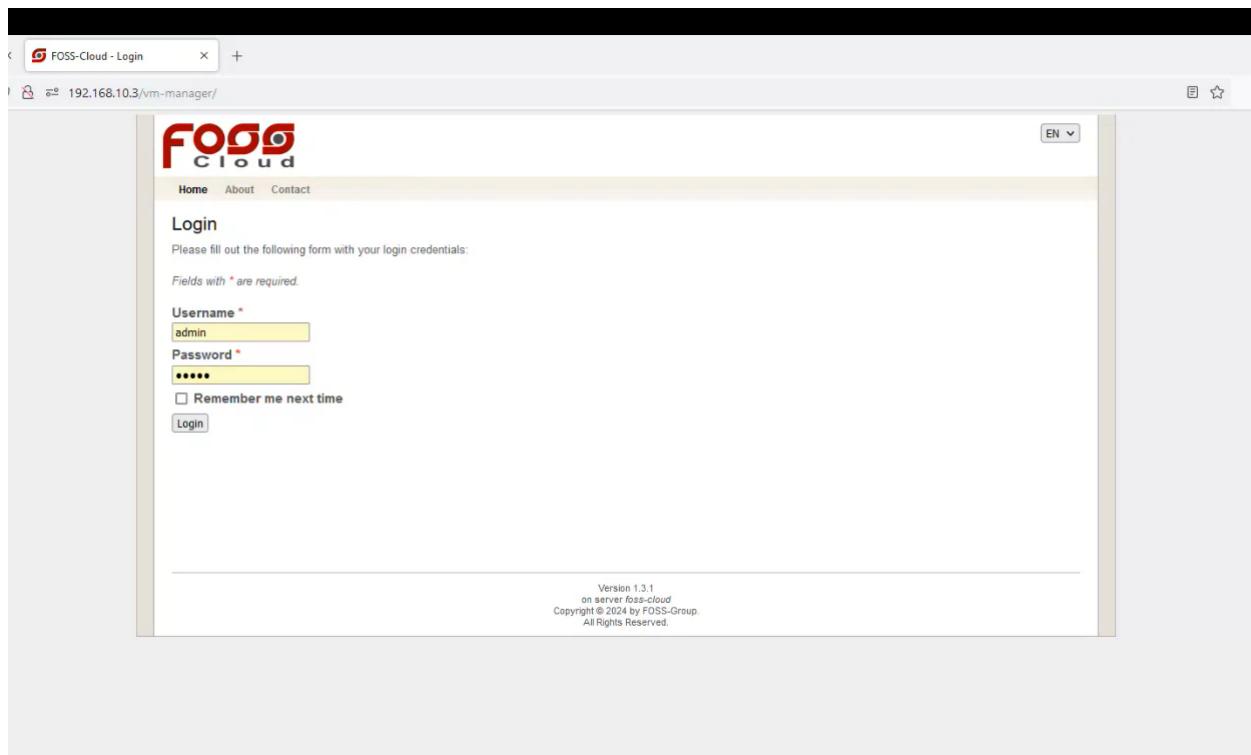
1. Public Cloud: Resources are owned and operated by third-party cloud service providers, and services are delivered over the public internet. Public clouds offer scalability and cost-effectiveness but may have security and compliance concerns.
2. Private Cloud: Infrastructure and services are provisioned for a single organization and are either located on-premises or hosted by a third-party provider. Private clouds offer greater control, security, and customization but may require higher upfront investment.
3. Hybrid Cloud: Combines elements of public and private clouds, allowing data and applications to be shared between them. Hybrid clouds provide flexibility, allowing organizations to leverage the benefits of both public and private clouds while addressing data sovereignty and regulatory requirements.
4. Multi-Cloud: Involves using services from multiple cloud providers to avoid vendor lock-in, increase redundancy, and optimize performance and cost. Multi-cloud architectures require careful management of resources across different providers.

There are numerous online resources, courses, certifications, and academic programs available for studying cloud computing and architecture, offered by providers such as AWS, Microsoft, Google Cloud, and various educational institutions. Additionally, hands-on experience through practical projects and experimentation with cloud platforms can greatly enhance your understanding of cloud computing concepts and technologies.

## 2. Study and implementation of Infrastructure as a Service(FOSS Cloud)

FOSS-Cloud (FOSS-Cloud software and hardware) is an integrated and redundant server infrastructure to provide virtualization- and cloud-services, Windows or Linux based SaaS-, Terminal Server-, Virtual Desktop Infrastructure (VDI) or virtual server environments

Open FOSS CLOUD on the LOCAL Server and LOGIN using admin username & Password

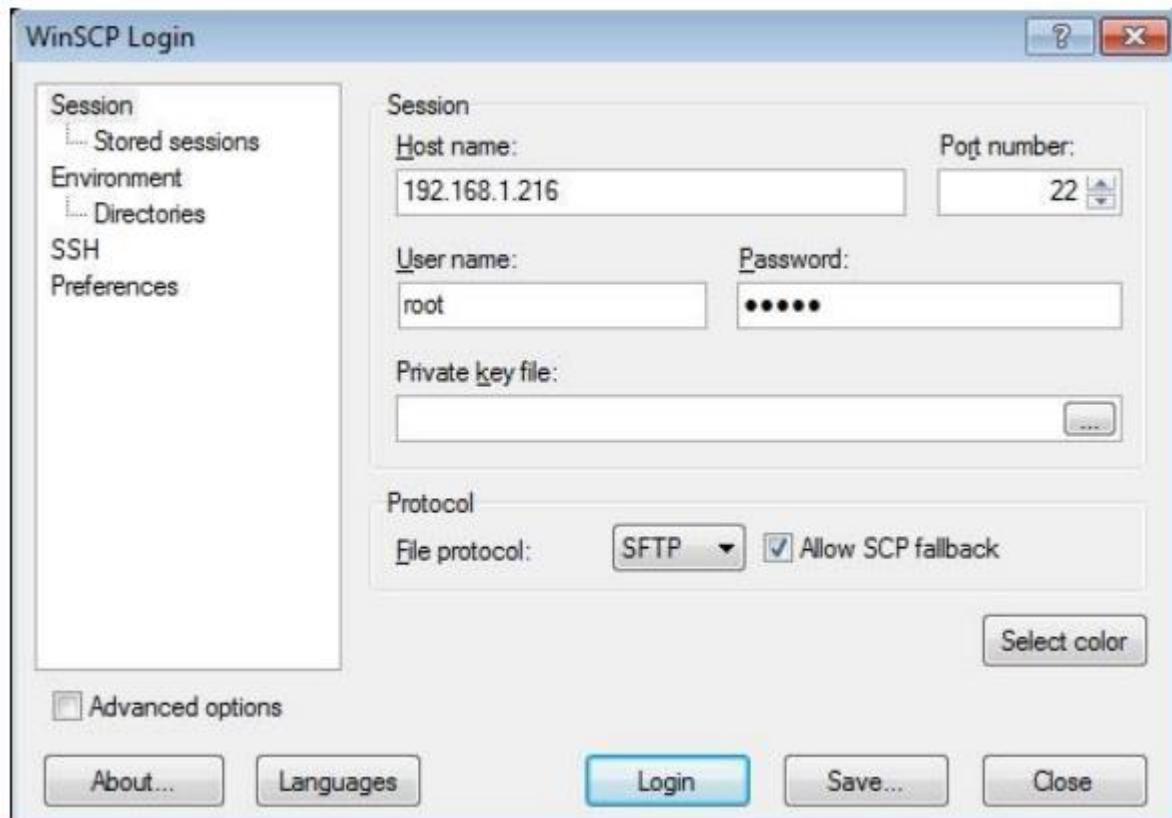


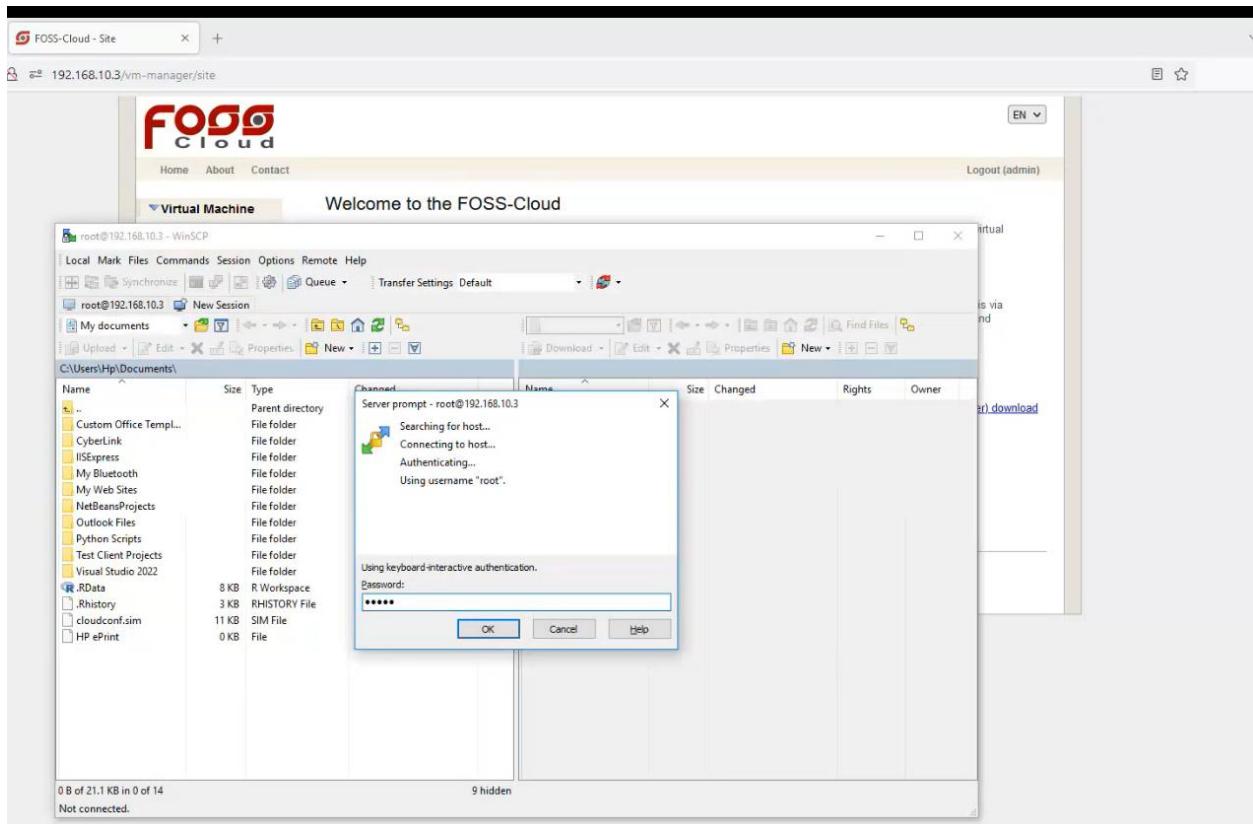
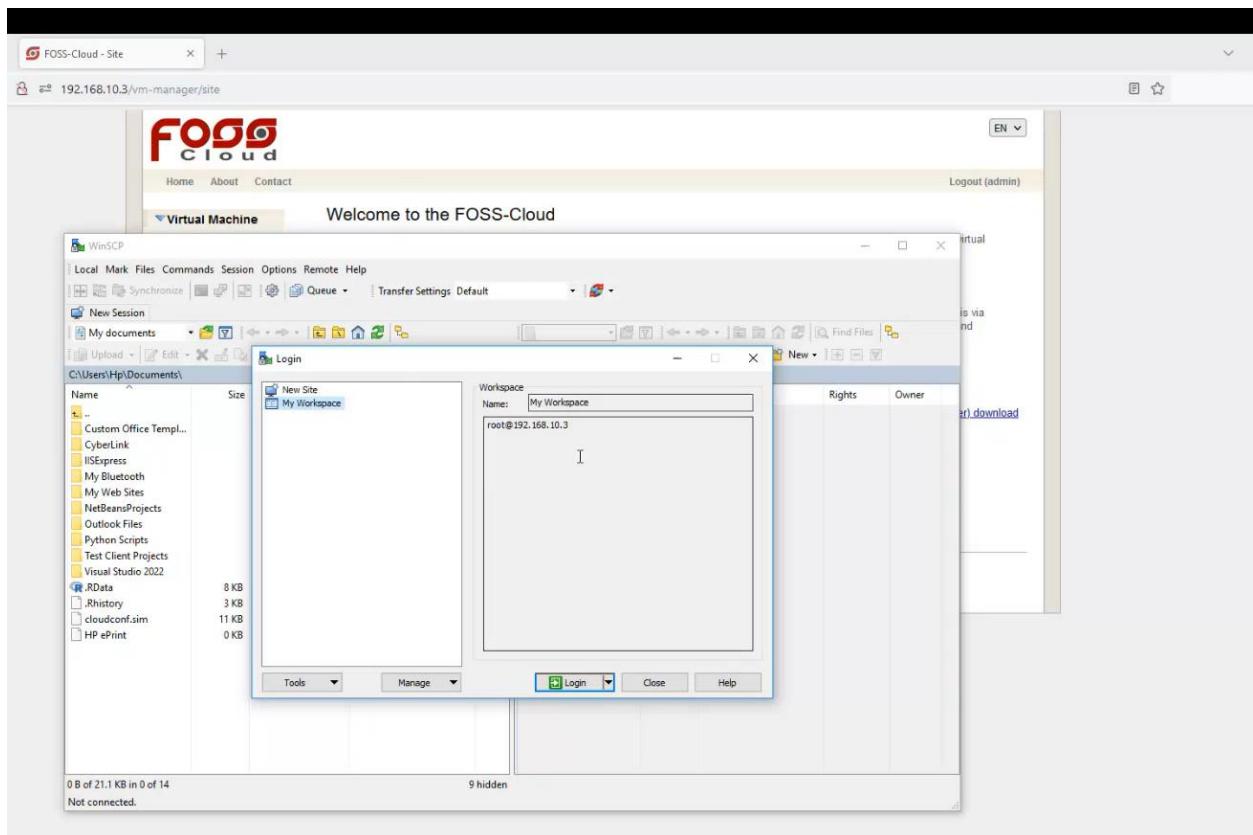
Local Windows computer with WinSCP installed (Download WinSCP)

- You've downloaded a ISO-File to your computer. This example is done with: ubuntu-11.04-desktop-i386.iso

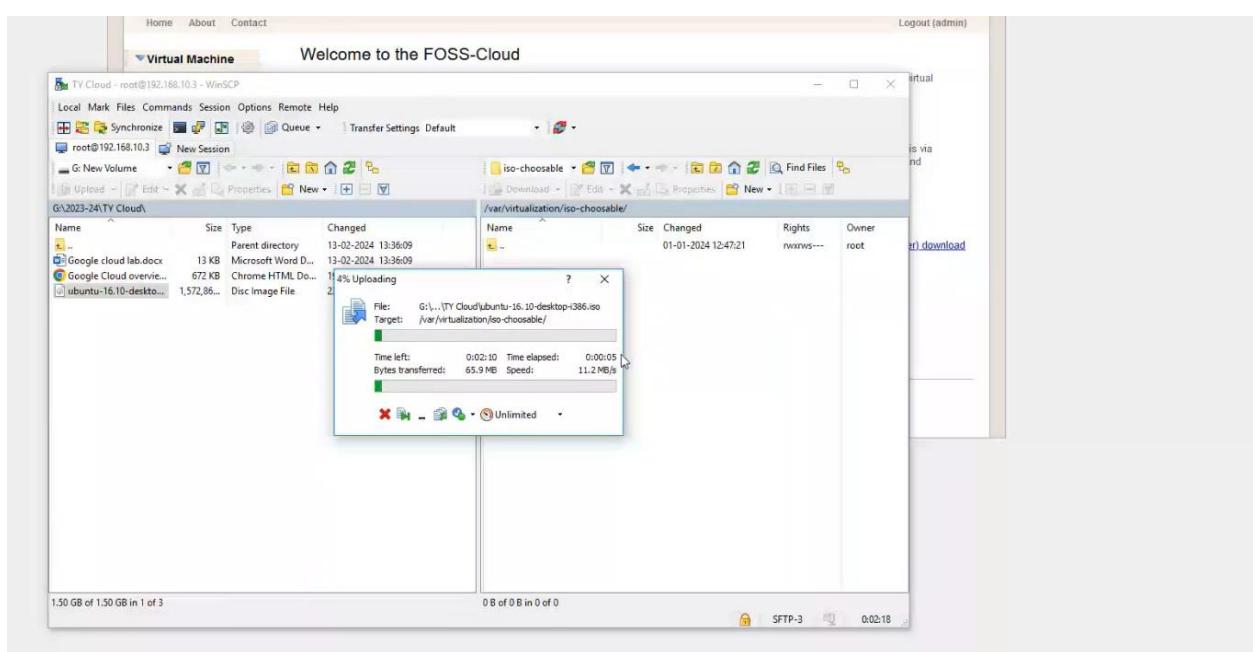
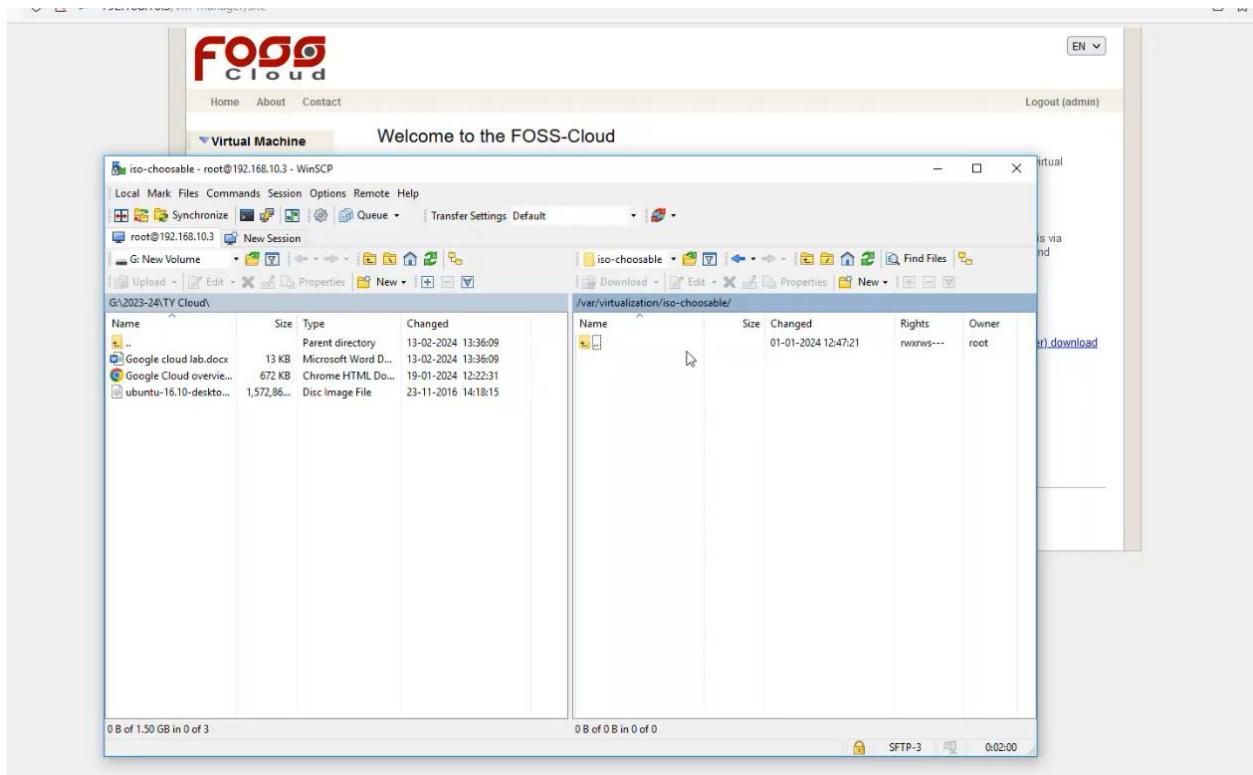
- The IP-address of the FOSS-Cloud Node. This example is done with: 192.168.1.216
- Run WinSCP and establish a connection to the FOSS-Cloud Node:  
username: root password: admin

Connect to FOSS CLOUD Node





On the guest machine change to the '/var/virtualization/iso-choosable' direcotry. On the host, change to the directory the ISO-file is located:



Back to FOSS CLOUD

Create a Profile

What's new with Firefox - Mozilla Firefox FOSS-Cloud - Create VmProfile +

192.168.10.3/vm-manager/vmProfile/create.html

**FOSS Cloud**

Logout (admin)

**Create VM Profile**

Fields with \* are required.

**Step I**  
Please select a profile first

**BaseProfile**

- linux
  - default
  - i686
    - multi
    - de-DE
    - de-AT
    - de-CH
    - en-US
    - en-GB
    - fr-CH
    - fr-FR
    - it-CH
    - it-IT
  - x86\_64
- Ubuntu
  - UbuntuVM
  - ubuntu123
  - UbuntuM
  - Ubuntu2
  - ubuntu7537
  - Ubuntu2324
  - Ubuntu555
  - UbuntuByRam
  - Ubuntu\_AkShree
  - Ubuntu
  - MyUbuntu
  - Ubuntu1
  - Ubuntu7616
  - Ubuntu89
  - soniya
  - UbuntuBySangi
  - windows

**Step II**  
Overwrite the default values if necessary!

**Isofile \***  
ubuntu-16.10-desktop-096.iso

**Name \***  
Linux1

**Description \***  
Linux OS

**Memory \***  
128 MB 128 GB 2.25 GB

**Volume Capacity \***  
16 GB 2349.0B 31 GB

**CPU \***  
1

**Clock Offset \***  
utc

**Create**

FOSS-Cloud - VmProfile

192.168.10.3/vm-manager/vmProfile/index.html?copyaction=10350

**FOSS Cloud**

Logout (admin)

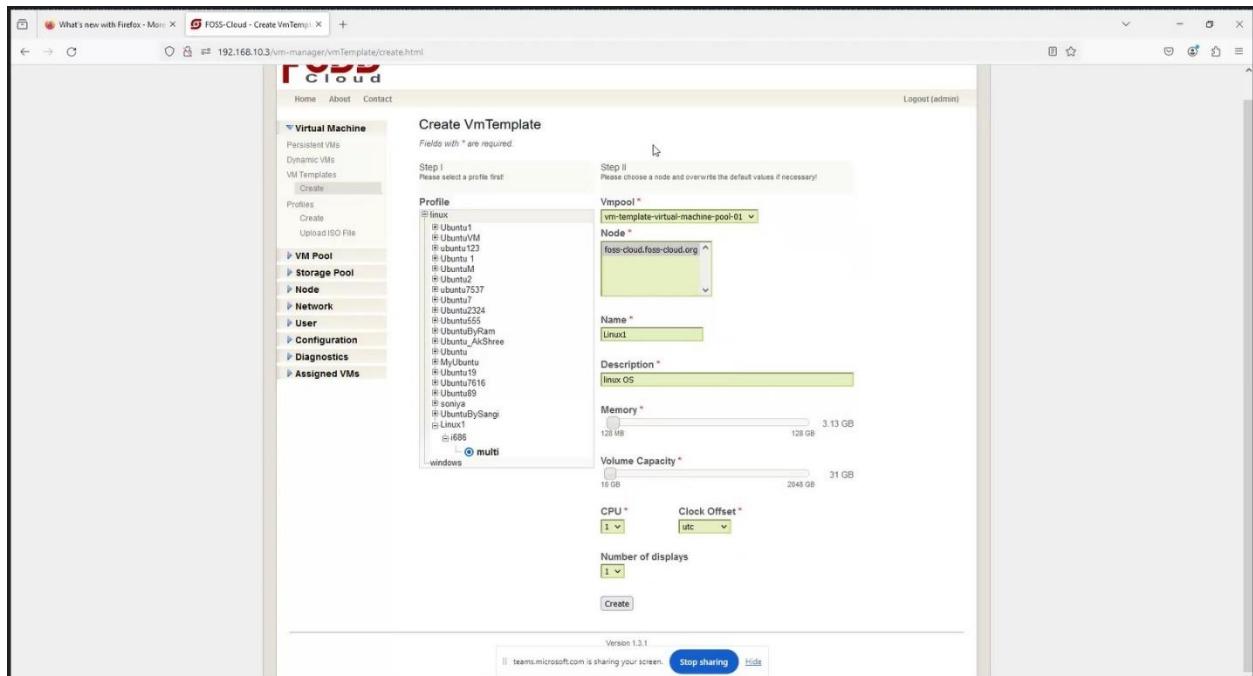
**Manage VMProfiles**

No.	Name	Architecture	Language	Description	Action
11	UbuntuByRam	linux / i686	multi	This is the UbuntuByRam VM-Profil	
12	Ubuntu_AkShree	linux / i686	multi	VM with Ubuntu OS	
13	Ubuntu	linux / i686	multi	This is the Ubuntu VM-Profile subre	
14	MyUbuntu	linux / x86_64	multi	This is my virtual machine	
15	Ubuntu19	linux / i686	multi	Ubuntu OS	
16	Ubuntu7616	linux / i686	multi	Ubuntu OS	
17	Ubuntu89	linux / i686	multi	Ubuntu OS	
18	soniya	linux / i686	multi	VM with Ubuntu OS	
19	UbuntuBySangi	linux / i686	multi	VM with Ubuntu OS	
20	Linux1	linux / i686	multi	linux OS	

Page 2 of 2 10

Version 1.3.1  
on server foss-cloud  
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## Create VM Template



Manage VM Templates And Start the VM

168.10.3/vm-manager/vmTemplate/index.html

**Manage VM Templates**

Vm Pool **vm-template-virtual-machine-pool-01**

No.	DisplayName	Status	Run Action	Memory	Node	Action
11	Ubuntu89	stopped	→ ↳ ✎	---	foss-cloud.foss-cloud.org	
12	soniva	stopped	→ ↳ ✎	---	foss-cloud.foss-cloud.org	
13	UbuntuBySang	stopped	→ ↳ ✎	---	foss-cloud.foss-cloud.org	
14	Linux1	stopped	→ ↳ ✎	---	foss-cloud.foss-cloud.org	

start VM

Page 2 of 2 Refresh 10

Version 1.3.1  
on server foss-cloud  
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12.168.10.3/vm-manager/vmTemplate/index.html

**Manage VM Templates**

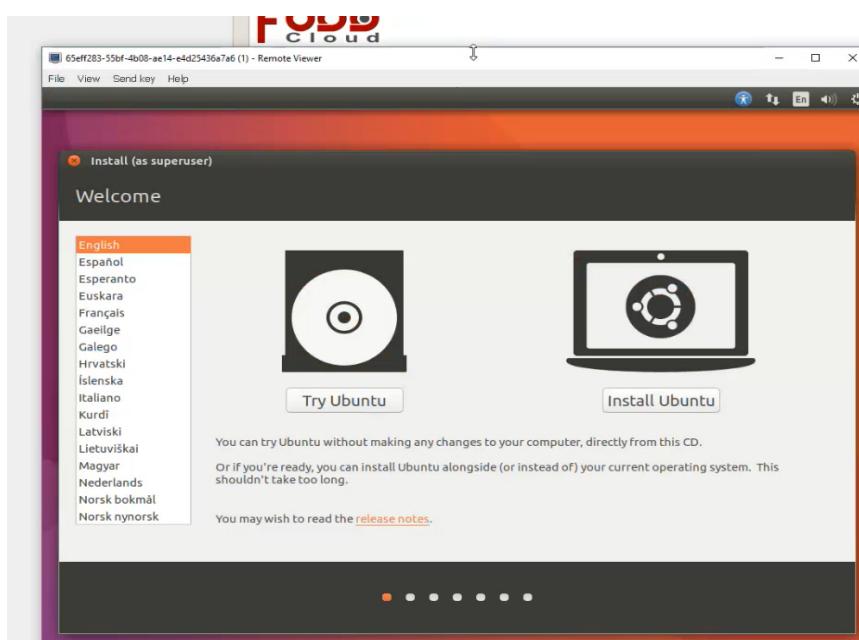
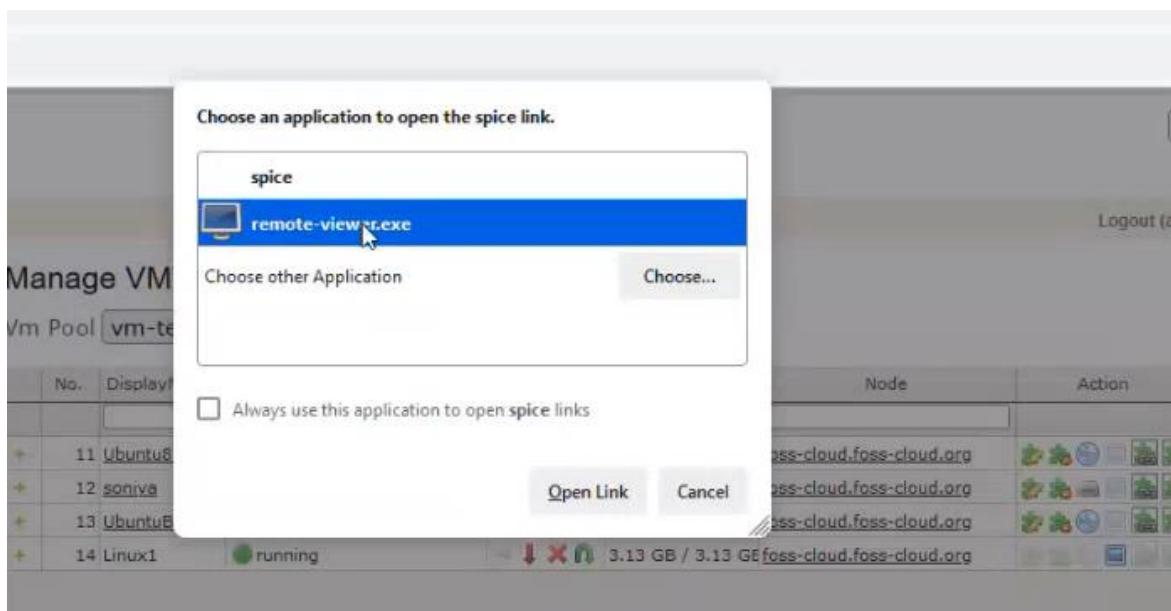
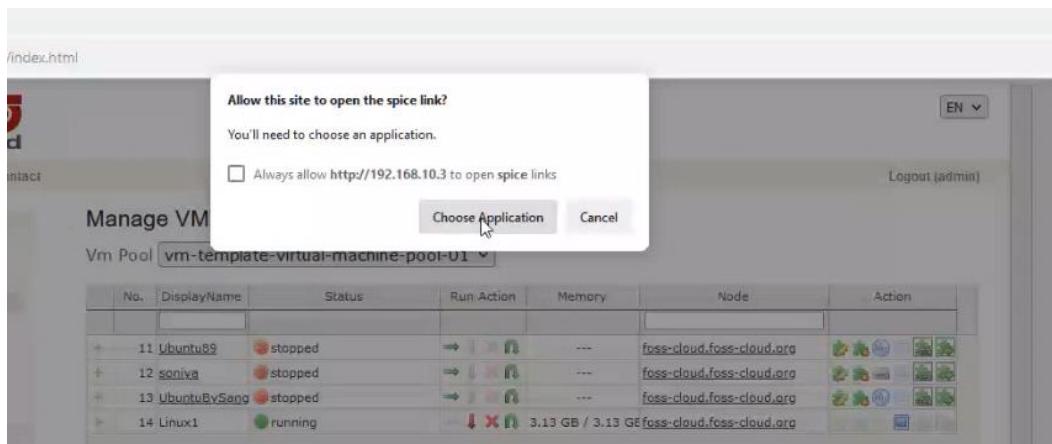
Vm Pool **vm-template-virtual-machine-pool-01**

No.	DisplayName	Status	Run Action	Memory	Node	Action
11	Ubuntu89	stopped	→ ↳ ✎	---	foss-cloud.foss-cloud.org	
12	soniva	stopped	→ ↳ ✎	---	foss-cloud.foss-cloud.org	
13	UbuntuBySang	stopped	→ ↳ ✎	---	foss-cloud.foss-cloud.org	
14	Linux1	running	stop ↴ ✎	3.13 GB / 3.13 GE	foss-cloud.foss-cloud.org	

use VM Template

Page 2 of 2 Refresh 10

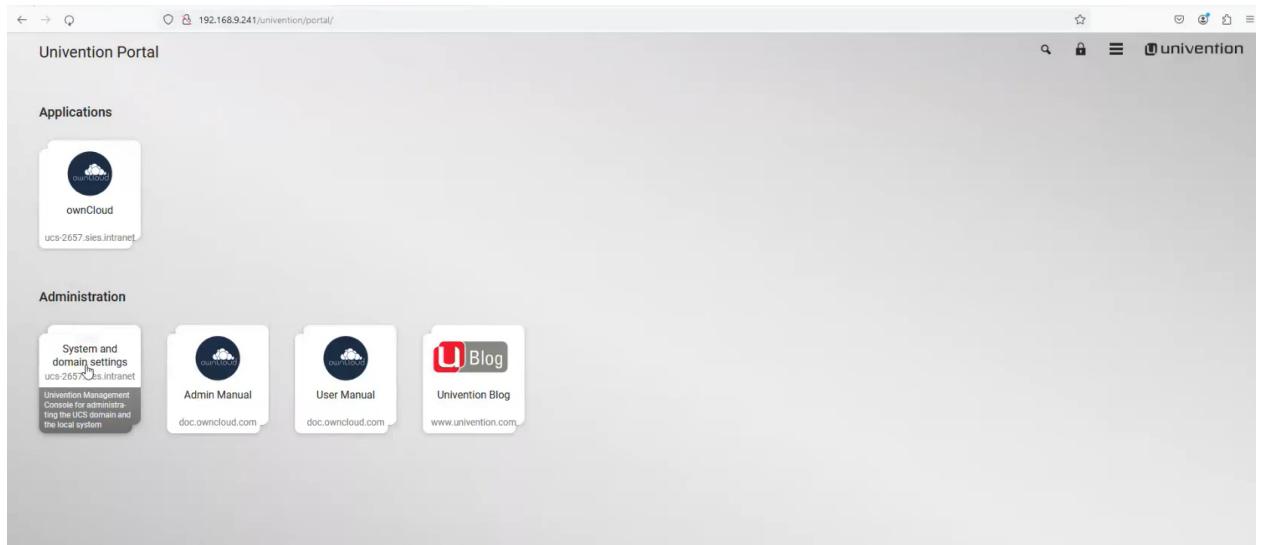
Version 1.3.1  
on server foss-cloud  
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### 3. Study and implementation of Storage as a Service (Own Cloud)

Go to the OwnCloud IP address

Click on System and Domain Settings



Login using Administrator & admin@123 as username & password

A screenshot of a web browser displaying the 'Univention Login' page at the URL login/?location=%2Funivention%2Fmanagement%2F&lang=en-US. The page title is 'Login at sies.intranet'. It features a central login form with a green 'UCS' logo at the top. The form has fields for 'Administrator' (containing the text 'Administrator') and a password (containing a series of dots). Below the form is a 'LOGIN' button with a hand cursor icon. At the bottom of the page, there is a red warning message: 'This network connection is not encrypted. Click here for an HTTPS connection.' followed by a link 'How do I login?'.

## Click on Create New Users & Add new Users

The screenshot shows the univention management interface with the 'Users' module selected. The top navigation bar includes tabs for 'FOSS-Cloud - VmTemplate', 'ucs-2657.sies.intranet - Univen...', and a '+' button. The main header bar shows the URL '192.168.9.241/univention/management/#category=users'. The top menu bar includes icons for search, notifications, and user management, along with the 'univention' logo.

The interface features a grid of icons and links:

- Favorites (blue circle)
- Users (yellow circle, highlighted)
- Devices (orange circle)
- Domain (blue circle, cursor hovering over it)
- System (purple circle)
- Software (green circle)
- Installed Applications (dark green circle)

Below the icons are four cards:

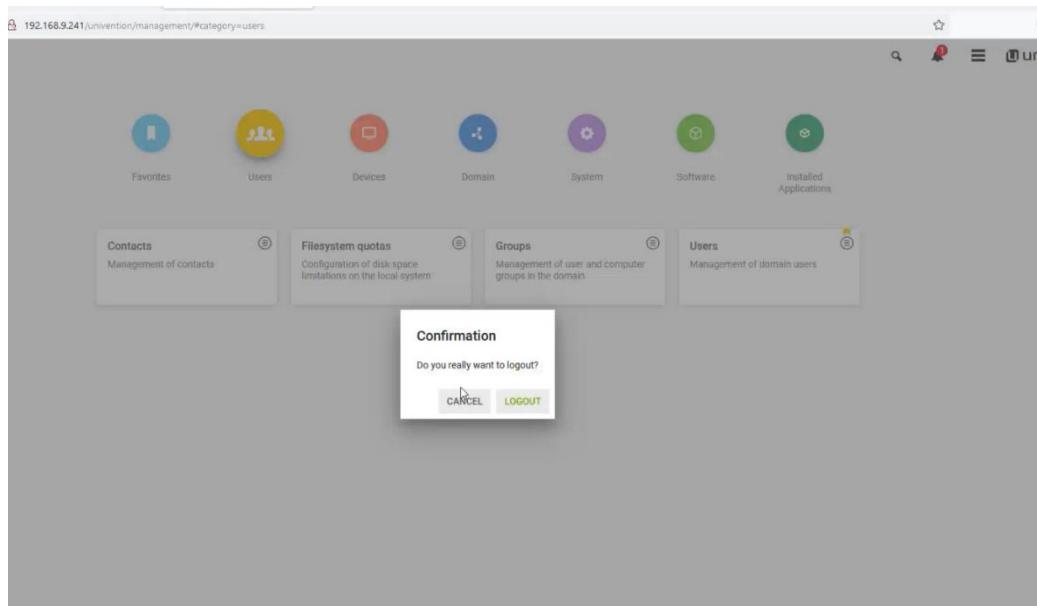
- Contacts**: Management of contacts
- Filesystem quotas**: Configuration of disk space limitations on the local system
- Groups**: Management of user and computer groups in the domain
- Users**: Management of domain users (highlighted with a yellow border)

The 'Users' card is expanded, showing a list of users:

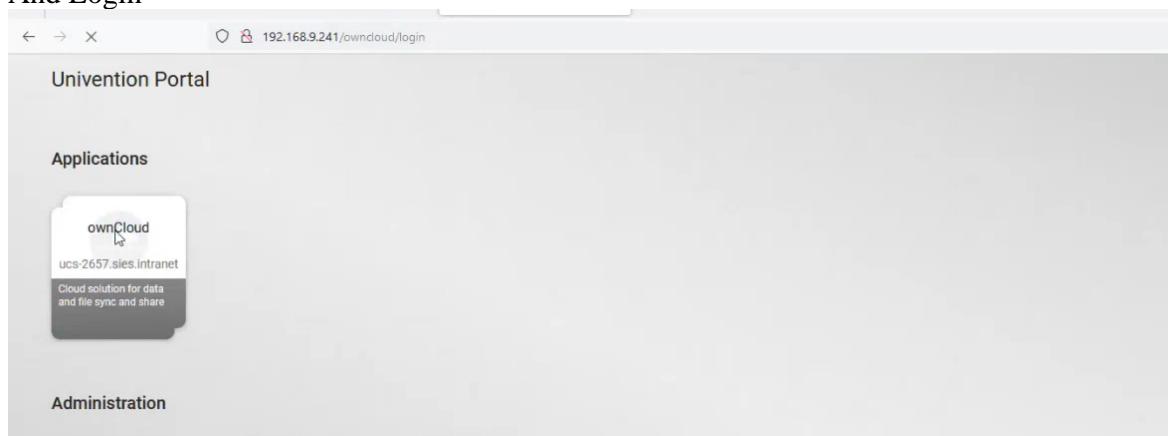
Name	Path
abc	intranet.sies:/users
Administrator	intranet.sies:/users
ak_nadar	intranet.sies:/users
Bhola	intranet.sies:/users
Blessingraj	intranet.sies:/users
cloudcc	intranet.sies:/users
Donotdelete	intranet.sies:/users
gudu1121	intranet.sies:/users

At the bottom right of the list, there is a 'CLOSE' button.

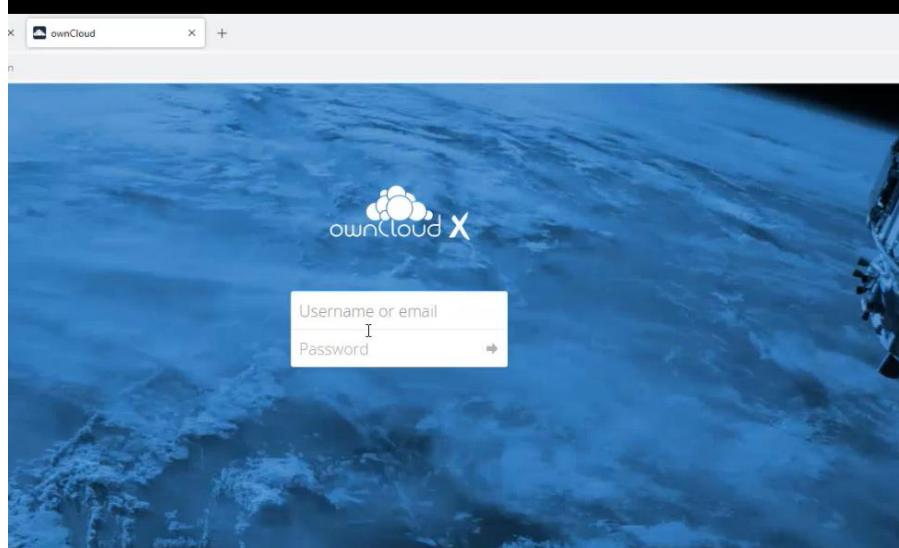
Then Logout



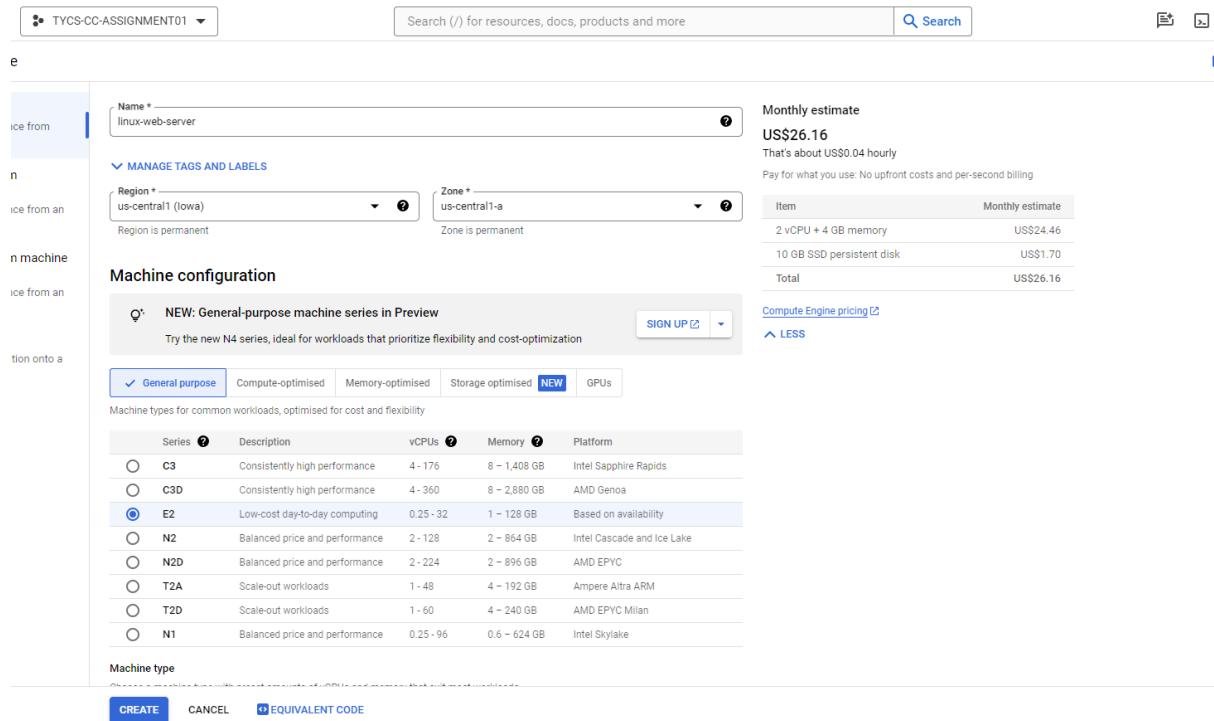
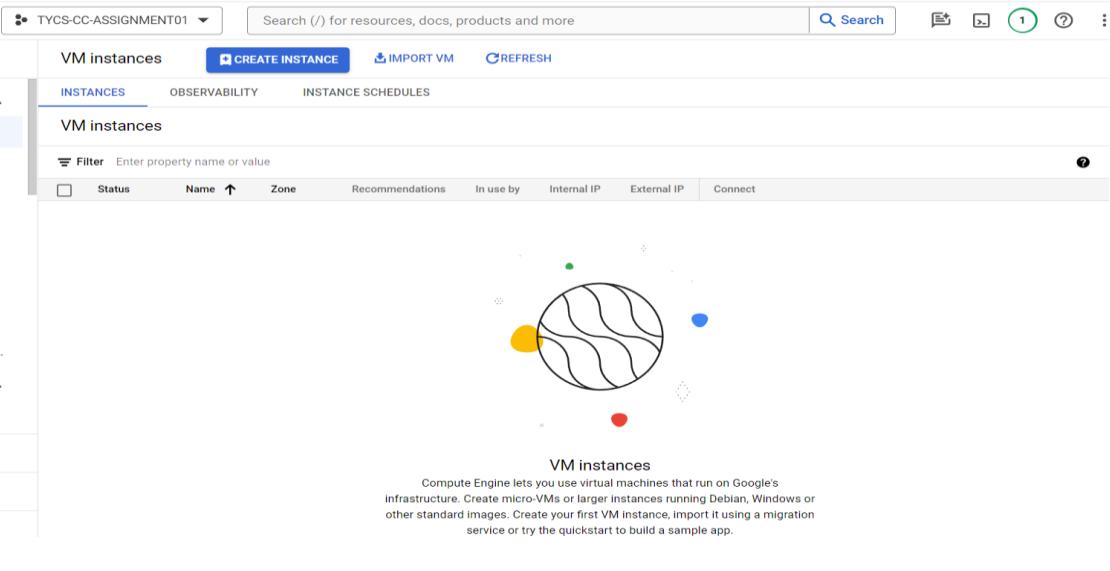
Click on OwnCloud application  
And Login



using the Created User Credentials



## 4. Google cloud Linux VM creation



## Boot disk

X

Select an image or snapshot to create a boot disk, or attach an existing disk. Can't find what you're looking for? Explore hundreds of VM solutions in [Marketplace](#)

PUBLIC IMAGES

CUSTOM IMAGES

SNAPSHOTS

ARCHIVE SNAPSHOTS

EXISTING DISKS

Operating system

Debian

Version \*

Debian GNU/Linux 12 (bookworm)

x86\_64, amd64 built on 20240213

Boot disk type \*

SSD persistent disk

[COMPARE DISK TYPES](#)

Size (GB) \*

10

Provision between 10 and 65536 GB

[▼ SHOW ADVANCED CONFIGURATION](#)

[SELECT](#)

CANCEL

## Confidential VM service [?](#)

 Confidential Computing is disabled on this VM instance

[ENABLE](#)

## Container [?](#)

Deploy a container image to this VM instance

[DEPLOY CONTAINER](#)

## Boot disk [?](#)

Name	linux-web-server
Type	New SSD persistent disk
Size	10 GB
Licence type <a href="#">?</a>	Free
Image	 Debian GNU/Linux 12 (bookworm)

[CHANGE](#)

## Identity and API access ?

### Service accounts ?

Service account

Compute Engine default service account

Requires the Service Account User role (`roles/iam.serviceAccountUser`) to be set for users who want to access VMs with this service account. [Learn more](#) ?

### Access scopes ?

- Allow default access
- Allow full access to all Cloud APIs
- Set access for each API

## Firewall ?

Add tags and firewall rules to allow specific network traffic from the Internet

Allow HTTP traffic

Allow HTTPS traffic

Allow load balancer health checks

## Observability – Ops Agent ?

Monitor your system through collection of logs and key metrics.

Install Ops Agent for monitoring and logging

## Advanced options

Networking, disks, security, management, sole-tenancy

**CREATE**

CANCEL

EQUIVALENT CODE

VM instances								<span style="color: #0070C0;">?</span>	LEARN	
INSTANCES		OBSERVABILITY		INSTANCE SCHEDULES						
VM instances										
Filter	Enter property name or value <th>Status</th> <th>Name</th> <th>Zone</th> <th>Recommendations</th> <th>In use by</th> <th>Internal IP</th> <th>External IP</th> <th>Connect</th> <th></th>	Status	Name	Zone	Recommendations	In use by	Internal IP	External IP	Connect	
<input type="checkbox"/>	<span style="color: green;">✓</span>	iis-web-server	us-central1-a				10.128.0.2 (nic0)	34.69.149.244 (nic0)	RDP	⋮
<input type="checkbox"/>	<span style="color: green;">✓</span>	linux-web-server	us-central1-a				10.128.0.3 (nic0)	35.184.221.76 (nic0)	SSH	⋮
<input type="checkbox"/>	<span style="color: green;">✓</span>	web-server	us-central1-a				10.128.0.5 (nic0)	35.184.137.247 (nic0)	RDP	⋮
Related actions										
<span style="color: #0070C0;">?</span> <a href="#">Explore Backup and DR</a> <span style="color: #0070C0;">NEW</span> Back up your VMs and set up disaster recovery			<span style="color: #0070C0;">?</span> <a href="#">View billing report</a> View and manage your Compute Engine billing			<span style="color: #0070C0;">?</span> <a href="#">Monitor VMs</a> View outlier VMs across metrics like CPU and network			<span style="color: #0070C0;">?</span> <a href="#">Explore VM logs</a> View, search, analyse and download VM instance logs	
<span style="color: #0070C0;">?</span> <a href="#">Set up firewall rules</a> Control traffic to and from a VM instance			<span style="color: #0070C0;">?</span> <a href="#">Patch management</a> Schedule patch updates and view patch compliance on VM instances			<span style="color: #0070C0;">?</span> <a href="#">Load balance between VMs</a> Set up load balancing for your applications as your traffic and users grow				

## 5. Google cloud Windows VM creation

Google Cloud

New Project

You have 12 projects remaining in your quota. Request an increase or delete projects. [Learn more](#)

[MANAGE QUOTAS](#)

Project name \*  ?

Project ID: tycs-cc-assignment01. It cannot be changed later. [EDIT](#)

Location \*  [BROWSE](#)

Parent organisation or folder

[CREATE](#) [CANCEL](#)

Google Cloud TYCS-CC-ASSIGNMENT01

Product details

 Compute Engine API

[Google Enterprise API](#)

Compute Engine API

[ENABLE](#) [TRY THIS API](#)

TYCS-CC-ASSIGNMENT01 Search (/) for resources, docs, products and more [Search](#)

VM instances [CREATE INSTANCE](#) [IMPORT VM](#) [REFRESH](#)

INSTANCES OBSERVABILITY INSTANCE SCHEDULES

VM instances

Filter Enter property name or value

Status	Name	Zone	Recommendations	In use by	Internal IP	External IP	Connect
--------	------	------	-----------------	-----------	-------------	-------------	---------

VM instances

Compute Engine lets you use virtual machines that run on Google's infrastructure. Create micro-VMs or larger instances running Debian, Windows or other standard images. Create your first VM instance, import it using a migration service or try the quickstart to build a sample app.

TYCS-CC-ASSIGNMENT01

Search (/) for resources, docs, products and more

Search

Name \* iis-web-server

Manage Tags and Labels

Region \* us-central1 (Iowa)

Zone \* us-central1-a

Machine configuration

NEW: General-purpose machine series in Preview

Try the new N4 series, ideal for workloads that prioritize flexibility and cost-optimization

SIGN UP

General purpose Compute-optimised Memory-optimised Storage optimised NEW GPUs

Series	Description	vCPUs	Memory	Platform
C3	Consistently high performance	4 - 176	8 - 1,408 GB	Intel Sapphire Rapids
C3D	Consistently high performance	4 - 360	8 - 2,880 GB	AMD Genoa
<b>E2</b>	Low-cost day-to-day computing	0.25 - 32	1 - 128 GB	Based on availability
N2	Balanced price and performance	2 - 128	2 - 864 GB	Intel Cascade and Ice Lake
N2D	Balanced price and performance	2 - 224	2 - 896 GB	AMD EPYC
T2A	Scale-out workloads	1 - 48	4 - 192 GB	Ampere Altra ARM
T2D	Scale-out workloads	1 - 60	4 - 240 GB	AMD EPYC Milan
N1	Balanced price and performance	0.25 - 96	0.6 - 624 GB	Intel Skylake

Machine type

CREATE CANCEL EQUIVALENT CODE

Confidential VM service

Confidential Computing is disabled on this VM instance

ENABLE

Container

Deploy a container image to this VM instance

DEPLOY CONTAINER

Boot disk

Name	iis-web-server
Type	New SSD persistent disk
Size	50 GB
Licence type	PAYG (Pay as you go)
Image	Windows Server 2019 Datacenter

If you are using Windows and intend to run additional Microsoft software, please fill in the [Licence verification form](#)

Learn more about Microsoft licence mobility requirements

CHANGE

Boot disk

Select an image or snapshot to create a boot disk, or attach an existing disk. Can't find what you're looking for? Explore hundreds of VM solutions in [Marketplace](#)

PUBLIC IMAGES	CUSTOM IMAGES	SNAPSHOTS	ARCHIVE SNAPSHOTS	EXISTING DISKS
---------------	---------------	-----------	-------------------	----------------

Operating system — Windows Server

Version \* — Windows Server 2019 Datacenter

x86/64, Server with Desktop Experience, x64 built on 20240214

Boot disk type \* — SSD persistent disk

[COMPARE DISK TYPES](#)

Size (GB) \* — 50

Provision between 50 and 65536 GB

[SHOW ADVANCED CONFIGURATION](#)

**SELECT** CANCEL

## Identity and API access [?](#)

### Service accounts [?](#)

Service account — Compute Engine default service account

Requires the Service Account User role (`roles/iam.serviceAccountUser`) to be set for users who want to access VMs with this service account. [Learn more](#)

### Access scopes [?](#)

- Allow default access
- Allow full access to all Cloud APIs
- Set access for each API

## Firewall [?](#)

Add tags and firewall rules to allow specific network traffic from the Internet

- Allow HTTP traffic
- Allow HTTPS traffic
- Allow load balancer health checks

## Observability – Ops Agent [?](#)

Monitor your system through collection of logs and key metrics.

- Install Ops Agent for monitoring and logging

## Advanced options

Networking, disks, security, management, sole-tenancy

**CREATE** CANCEL [EQUIVALENT CODE](#)

TYCS-CC-ASSIGNMENT01  Search (/) for resources, docs, products and more

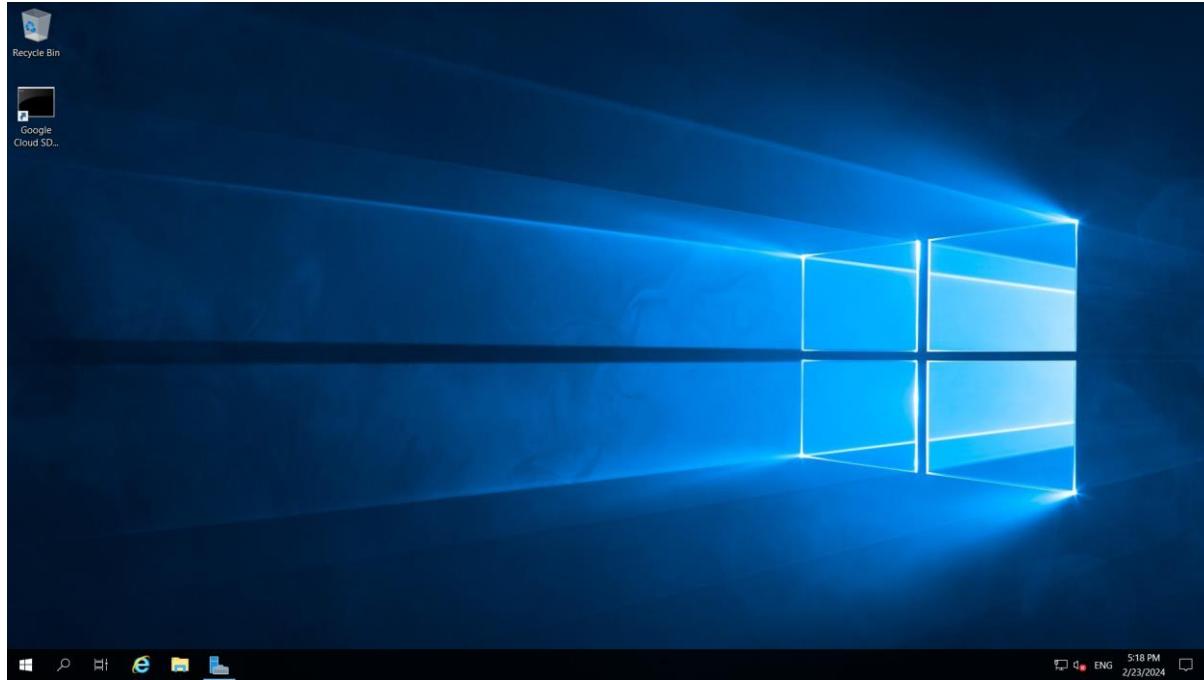
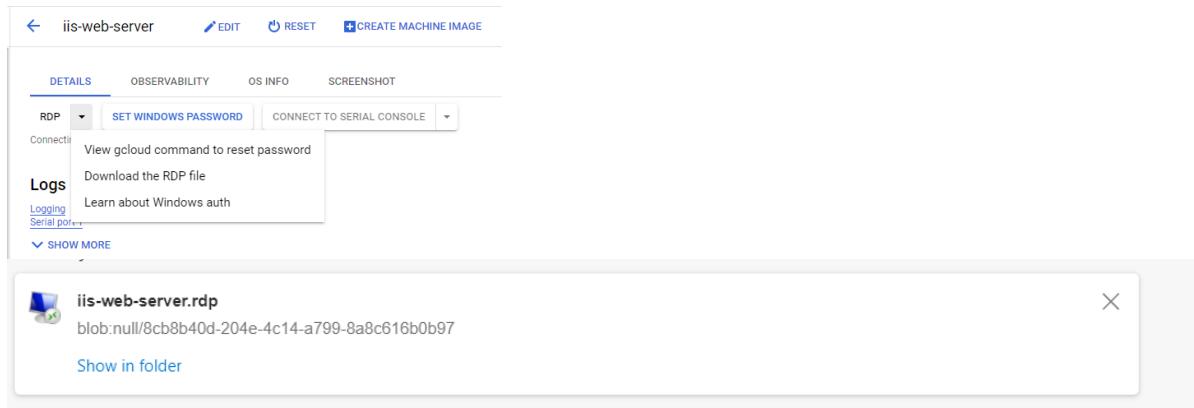
[INSTANCES](#) [OBSERVABILITY](#) [INSTANCE SCHEDULES](#)

**VM instances**

Filter Enter property name or value

Status	Name ↑	Zone	Recommendations	In use by	Internal IP	External IP	Connect
<input checked="" type="checkbox"/>	iis-web-server	us-central1-a			10.128.0.2 (nic0)	34.69.149.244 (nic0)	RDP

[Related actions](#)



## 6. Perform the following in google cloud:

1. A “Hello world” website on IIS-Create an IIS web server VM using

The screenshot shows the Google Cloud Platform interface. At the top, there's a navigation bar with the Google Cloud logo, a search icon, and other account-related icons. Below it, a "New Project" section displays a quota warning: "You have 12 projects remaining in your quota. Request an increase or delete projects." with a "MANAGE QUOTAS" link. The "Project name" field is filled with "TYCS-CC-ASSIGNMENT01". Below the project name, the "Project ID" is listed as "tycs-cc-assignment01" with an "EDIT" link. The "Location" dropdown is set to "No organisation" with a "BROWSE" button. Under "Parent organisation or folder", there are "CREATE" and "CANCEL" buttons. The main content area shows the "Product details" for the "Compute Engine API". It includes a blue square icon, the title "Compute Engine API", a subtitle "Google Enterprise API", and a "Compute Engine API" description. There are "ENABLE" and "TRY THIS API" buttons. Below this, the "VM instances" page is shown. It has a header with "VM instances", "CREATE INSTANCE", "IMPORT VM", and "REFRESH" buttons. The "INSTANCES" tab is selected. A table header includes columns for "Status", "Name", "Zone", "Recommendations", "In use by", "Internal IP", "External IP", and "Connect". The table body contains a single row with a yellow circular icon, a globe icon, and a red circular icon. A "Filter" input field is present. At the bottom, there's a "VM instances" section with a brief description of Compute Engine.

TYCS-CC-ASSIGNMENT01

Search (/) for resources, docs, products and more

**Name \*** iis-web-server

**Region \*** us-central1 (Iowa)

**Zone \*** us-central1-a

**Machine configuration**

**NEW: General-purpose machine series in Preview**

Try the new N4 series, ideal for workloads that prioritize flexibility and cost-optimization

**SIGN UP**

**General purpose** (selected), Compute-optimised, Memory-optimised, Storage optimised, NEW, GPUs

Series	Description	vCPUs	Memory	Platform
C3	Consistently high performance	4 - 176	8 - 1,408 GB	Intel Sapphire Rapids
C3D	Consistently high performance	4 - 360	8 - 2,880 GB	AMD Genoa
E2	Low-cost day-to-day computing	0.25 - 32	1 - 128 GB	Based on availability
N2	Balanced price and performance	2 - 128	2 - 864 GB	Intel Cascade and Ice Lake
N2D	Balanced price and performance	2 - 224	2 - 896 GB	AMD EPYC
T2A	Scale-out workloads	1 - 48	4 - 192 GB	Ampere Altra ARM
T2D	Scale-out workloads	1 - 60	4 - 240 GB	AMD EPYC Milan
N1	Balanced price and performance	0.25 - 96	0.6 - 624 GB	Intel Skylake

**Machine type**

**CREATE**, **CANCEL**, **EQUIVALENT CODE**

**Confidential VM service**

Confidential Computing is disabled on this VM instance

**ENABLE**

**Container**

Deploy a container image to this VM instance

**DEPLOY CONTAINER**

**Boot disk**

Name	iis-web-server
Type	New SSD persistent disk
Size	50 GB
Licence type	PAYG (Pay as you go)
Image	Windows Server 2019 Datacenter

If you are using Windows and intend to run additional Microsoft software, please fill in the [Licence verification form](#)

[Learn more](#) about Microsoft licence mobility requirements

**CHANGE**

Boot disk

Select an image or snapshot to create a boot disk, or attach an existing disk. Can't find what you're looking for? Explore hundreds of VM solutions in [Marketplace](#)

PUBLIC IMAGES	CUSTOM IMAGES	SNAPSHOTS	ARCHIVE SNAPSHOTS	EXISTING DISKS
---------------	---------------	-----------	-------------------	----------------

Operating system — Windows Server

Version \* — Windows Server 2019 Datacenter

x86/64, Server with Desktop Experience, x64 built on 20240214

Boot disk type \* — SSD persistent disk

[COMPARE DISK TYPES](#)

Size (GB) \* — 50

Provision between 50 and 65536 GB

[SHOW ADVANCED CONFIGURATION](#)

**SELECT** CANCEL

## Identity and API access [?](#)

### Service accounts [?](#)

Service account — Compute Engine default service account

Requires the Service Account User role (`roles/iam.serviceAccountUser`) to be set for users who want to access VMs with this service account. [Learn more](#)

### Access scopes [?](#)

- Allow default access
- Allow full access to all Cloud APIs
- Set access for each API

## Firewall [?](#)

Add tags and firewall rules to allow specific network traffic from the Internet

- Allow HTTP traffic
- Allow HTTPS traffic
- Allow load balancer health checks

## Observability – Ops Agent [?](#)

Monitor your system through collection of logs and key metrics.

- Install Ops Agent for monitoring and logging

## Advanced options

Networking, disks, security, management, sole-tenancy

**CREATE** CANCEL [EQUIVALENT CODE](#)

TYCS-CC-ASSIGNMENT01  Search (/) for resources, docs, products and more

VM instances

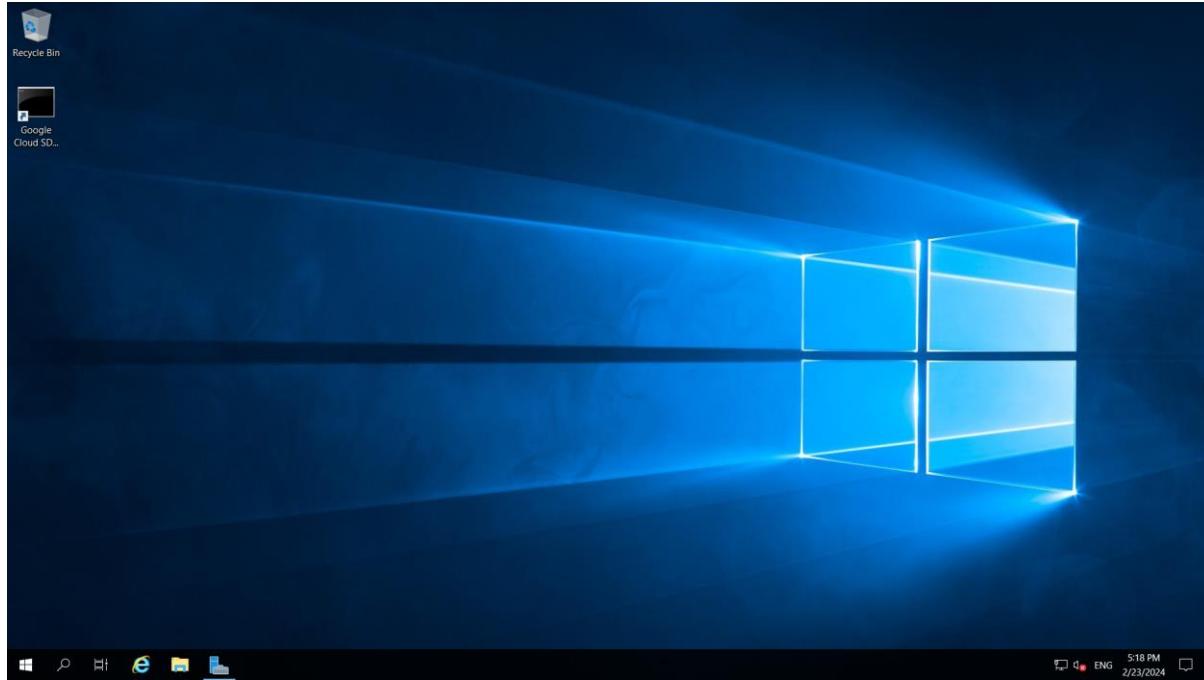
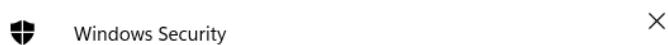
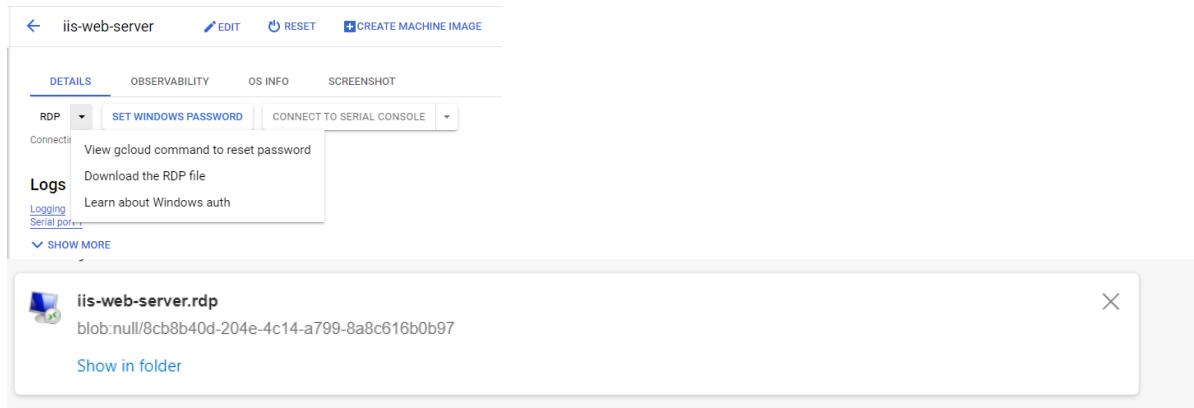
INSTANCES OBSERVABILITY INSTANCE SCHEDULES

VM instances

Filter Enter property name or value

Status	Name ↑	Zone	Recommendations	In use by	Internal IP	External IP	Connect
<input checked="" type="checkbox"/>	iis-web-server	us-central1-a			10.128.0.2 (nic0)	34.69.149.244 (nic0)	RDP

This instance is running. [Related actions](#)



The image shows two overlapping Command Prompt windows on a Windows desktop. The top window is titled 'Command Prompt' and displays the Windows version information: Microsoft Windows [Version 10.0.17763.5458] (c) 2018 Microsoft Corporation. All rights reserved. The bottom window is titled 'Administrator: PowerShell 7 (x64)' and displays a PowerShell upgrade message: A new PowerShell stable release is available: v7.4.1 Upgrade now, or check out the release page at: https://aka.ms/PowerShell-Release?tag=v7.4.1. It also shows the command PS C:\Users\sagarpawar> add-windowsfeature web-server -includeallsubfeature and the progress Start Installation... [24%].

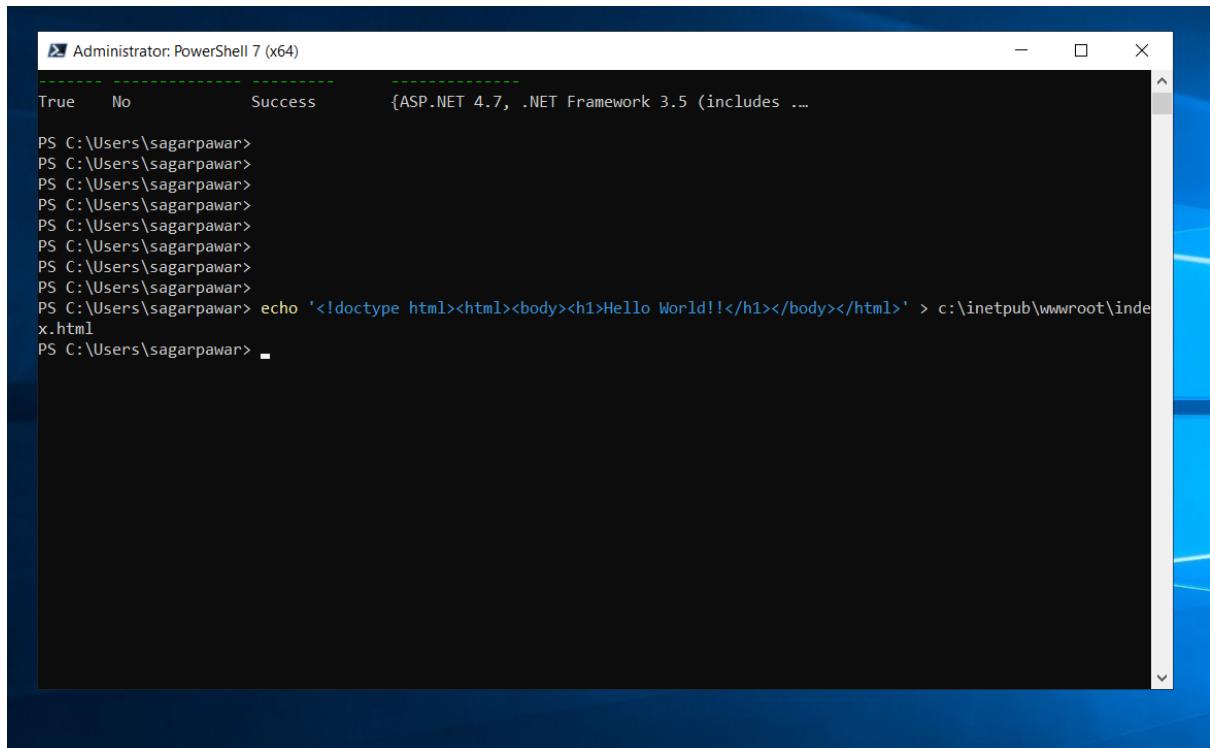
```
Microsoft Windows [Version 10.0.17763.5458]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\sagarpawar>

Administrator: PowerShell 7 (x64)
PowerShell 7.3.11

A new PowerShell stable release is available: v7.4.1
Upgrade now, or check out the release page at:
https://aka.ms/PowerShell-Release?tag=v7.4.1

PS C:\Users\sagarpawar> add-windowsfeature web-server -includeallsubfeature
Start Installation... [24%]
```



A screenshot of an Administrator PowerShell window titled "Administrator: PowerShell 7 (x64)". The window shows the command PS C:\Users\sagarpawar> echo '<!doctype html><html><body><h1>Hello World!!</h1></body></html>' > c:\inetpub\wwwroot\index.html being run, which creates an index.html file in the C:\inetpub\wwwroot directory. The output "True" and "Success" are displayed at the top.



Hello World!!

2. A “Hello World” website on Apache. Create an Apache web server on a Linux VM

TYCS-CC-ASSIGNMENT01

Search (/) for resources, docs, products and more

Name \* linux-web-server

Region \* us-central1 (Iowa)

Zone \* us-central1-a

Machine configuration

General purpose Compute-optimised Memory-optimised Storage optimised NEW GPUs

Series	Description	vCPUs	Memory	Platform
C3	Consistently high performance	4 - 176	8 - 1,408 GB	Intel Sapphire Rapids
C3D	Consistently high performance	4 - 360	8 - 2,880 GB	AMD Genoa
E2	Low-cost day-to-day computing	0.25 - 32	1 - 128 GB	Based on availability
N2	Balanced price and performance	2 - 128	2 - 864 GB	Intel Cascade and Ice Lake
N2D	Balanced price and performance	2 - 224	2 - 896 GB	AMD EPYC
T2A	Scale-out workloads	1 - 48	4 - 192 GB	Ampere Altra ARM
T2D	Scale-out workloads	1 - 60	4 - 240 GB	AMD EPYC Milan
N1	Balanced price and performance	0.25 - 96	0.6 - 624 GB	Intel Skylake

Machine type

**CREATE** CANCEL EQUIVALENT CODE

## Boot disk



Select an image or snapshot to create a boot disk, or attach an existing disk. Can't find what you're looking for? Explore hundreds of VM solutions in [Marketplace](#)

PUBLIC IMAGES CUSTOM IMAGES SNAPSHOTS ARCHIVE SNAPSHOTS EXISTING DISKS

Operating system  
Debian

Version \*  
Debian GNU/Linux 12 (bookworm)

x86/64, amd64 built on 20240213

Boot disk type \*  
SSD persistent disk

COMPARE DISK TYPES

Size (GB) \*  
10

Provision between 10 and 65536 GB

SHOW ADVANCED CONFIGURATION

**SELECT** CANCEL

## Confidential VM service ?

Info Confidential Computing is disabled on this VM instance

[ENABLE](#)

## Container ?

Deploy a container image to this VM instance

[DEPLOY CONTAINER](#)

## Boot disk ?

Name	linux-web-server
Type	New SSD persistent disk
Size	10 GB
Licence type <span>?</span>	Free
Image	 Debian GNU/Linux 12 (bookworm)

[CHANGE](#)

## Identity and API access ?

### Service accounts ?

Service account

Compute Engine default service account



Requires the Service Account User role (roles/iam.serviceAccountUser) to be set for users who want to access VMs with this service account. [Learn more](#) 

### Access scopes ?

- Allow default access
- Allow full access to all Cloud APIs
- Set access for each API

## Firewall ?

Add tags and firewall rules to allow specific network traffic from the Internet

- Allow HTTP traffic
- Allow HTTPS traffic
- Allow load balancer health checks

## Observability – Ops Agent ?

Monitor your system through collection of logs and key metrics.

- [Install Ops Agent for monitoring and logging](#)

## Advanced options

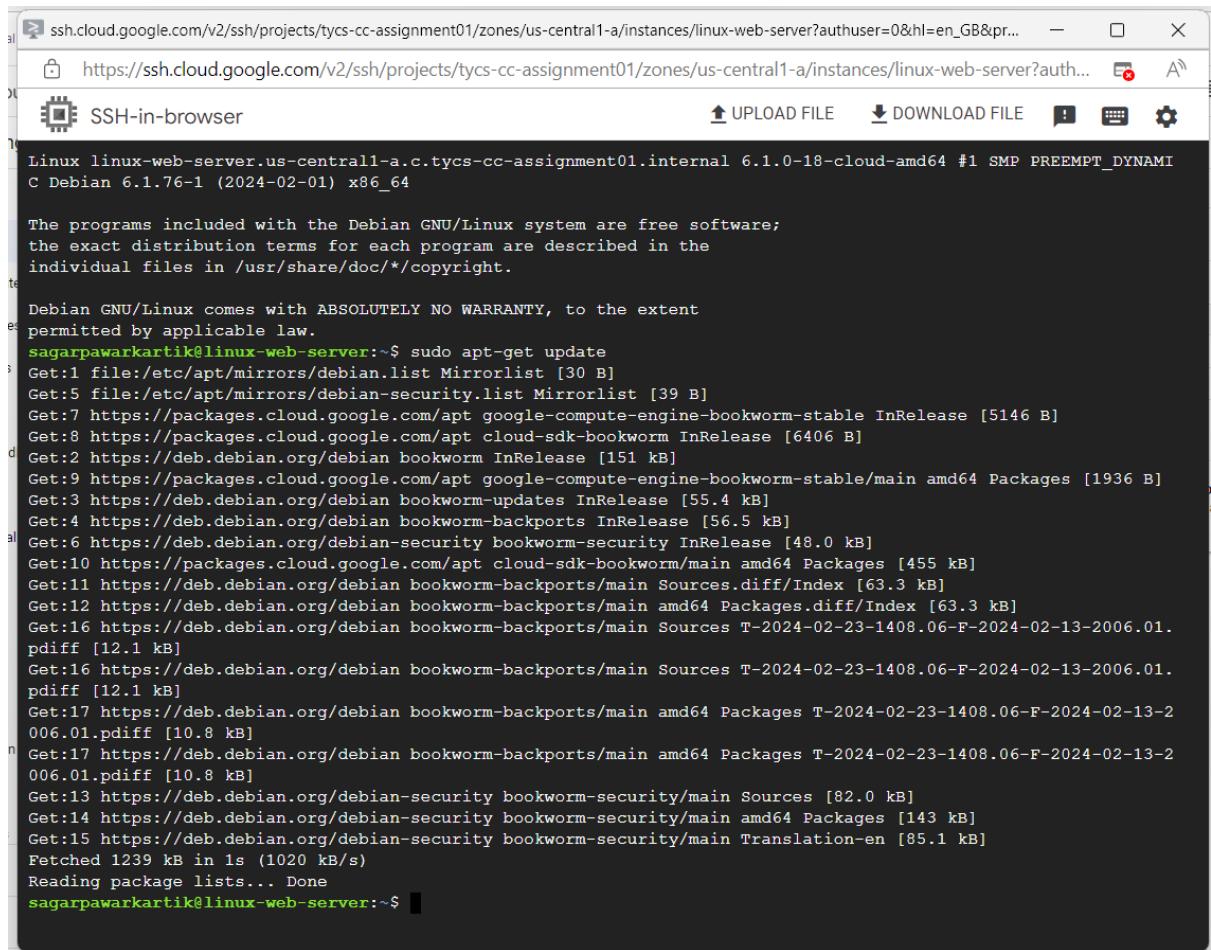
Networking, disks, security, management, sole-tenancy



[CREATE](#)

[CANCEL](#)

 [EQUIVALENT CODE](#)

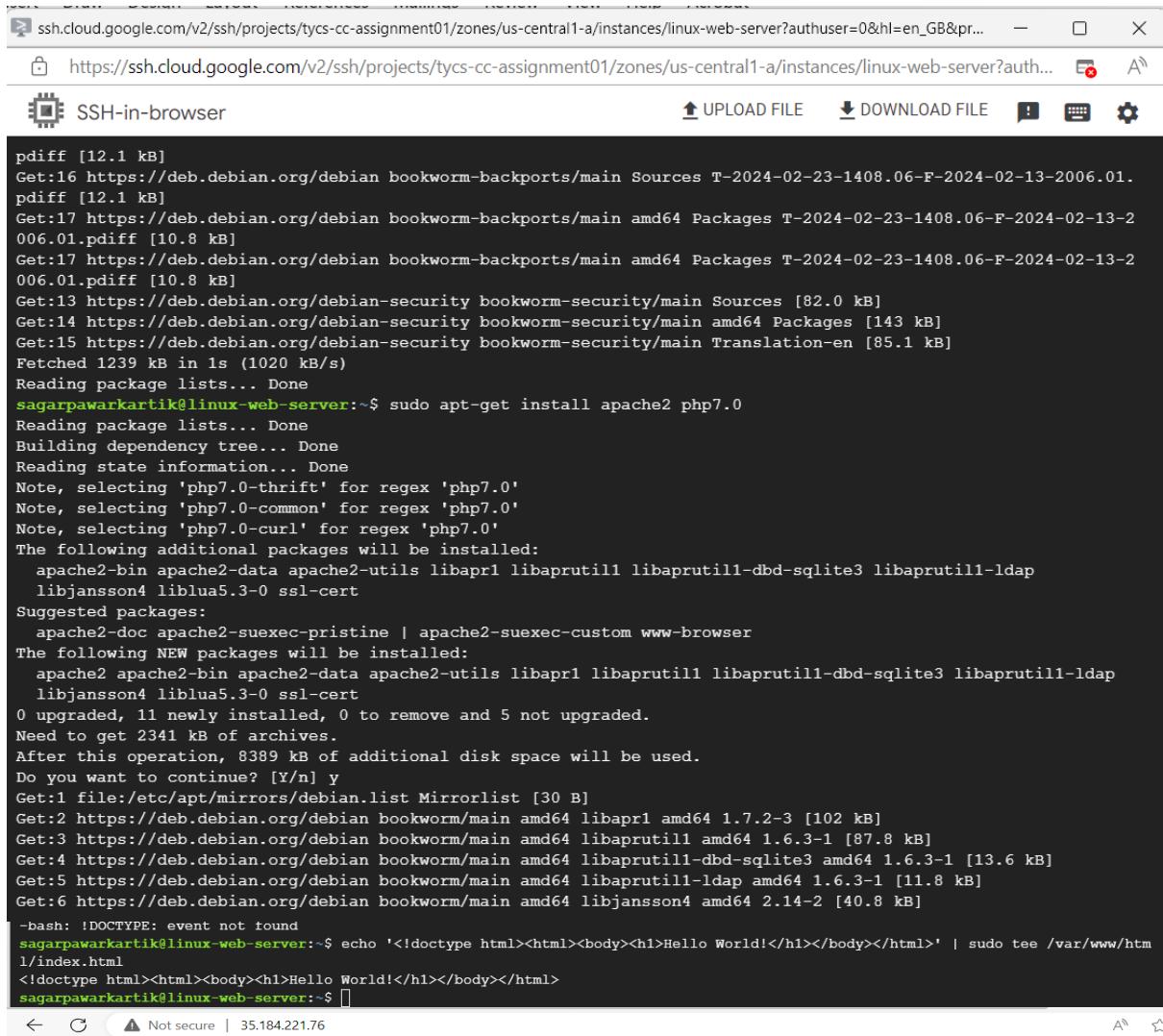


The screenshot shows a terminal window titled "SSH-in-browser" running on a Debian system. The terminal output is as follows:

```
ssh.cloud.google.com/v2/ssh/projects/tycs-cc-assignment01/zones/us-central1-a/instances/linux-web-server?authuser=0&hl=en_GB&pr...
https://ssh.cloud.google.com/v2/ssh/projects/tycs-cc-assignment01/zones/us-central1-a/instances/linux-web-server?auth...
SSH-in-browser
 UPLOAD FILE DOWNLOAD FILE
Linux linux-web-server.us-central1-a.c.tycs-cc-assignment01.internal 6.1.0-18-cloud-amd64 #1 SMP PREEMPT_DYNAMIC
c Debian 6.1.76-1 (2024-02-01) x86_64

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
sagarpawarkartik@linux-web-server:~$ sudo apt-get update
Get:1 file:/etc/apt/mirrors/debian.list Mirrorlist [30 B]
Get:5 file:/etc/apt/mirrors/debian-security.list Mirrorlist [39 B]
Get:7 https://packages.cloud.google.com/apt google-compute-engine-bookworm-stable InRelease [5146 B]
Get:8 https://packages.cloud.google.com/apt cloud-sdk-bookworm InRelease [6406 B]
Get:2 https://deb.debian.org/debian bookworm InRelease [151 kB]
Get:9 https://packages.cloud.google.com/apt google-compute-engine-bookworm-stable/main amd64 Packages [1936 B]
Get:3 https://deb.debian.org/debian bookworm-updates InRelease [55.4 kB]
Get:4 https://deb.debian.org/debian bookworm-backports InRelease [56.5 kB]
Get:6 https://deb.debian.org/debian-security bookworm-security InRelease [48.0 kB]
Get:10 https://packages.cloud.google.com/apt cloud-sdk-bookworm/main amd64 Packages [455 kB]
Get:11 https://deb.debian.org/debian bookworm-backports/main Sources.diff/Index [63.3 kB]
Get:12 https://deb.debian.org/debian bookworm-backports/main amd64 Packages.diff/Index [63.3 kB]
Get:16 https://deb.debian.org/debian bookworm-backports/main Sources T-2024-02-23-1408.06-F-2024-02-13-2006.01.
pdiff [12.1 kB]
Get:16 https://deb.debian.org/debian bookworm-backports/main Sources T-2024-02-23-1408.06-F-2024-02-13-2006.01.
pdiff [12.1 kB]
Get:17 https://deb.debian.org/debian bookworm-backports/main amd64 Packages T-2024-02-23-1408.06-F-2024-02-13-2
006.01.pdiff [10.8 kB]
Get:17 https://deb.debian.org/debian bookworm-backports/main amd64 Packages T-2024-02-23-1408.06-F-2024-02-13-2
006.01.pdiff [10.8 kB]
Get:13 https://deb.debian.org/debian-security bookworm-security/main Sources [82.0 kB]
Get:14 https://deb.debian.org/debian-security bookworm-security/main amd64 Packages [143 kB]
Get:15 https://deb.debian.org/debian-security bookworm-security/main Translation-en [85.1 kB]
Fetched 1239 kB in 1s (1020 kB/s)
Reading package lists... Done
sagarpawarkartik@linux-web-server:~$
```



```
pdiff [12.1 kB]
Get:16 https://deb.debian.org/debian bookworm-backports/main Sources T-2024-02-23-1408.06-F-2024-02-13-2006.01.
pdiff [12.1 kB]
Get:17 https://deb.debian.org/debian bookworm-backports/main amd64 Packages T-2024-02-23-1408.06-F-2024-02-13-2
006.01.pdiff [10.8 kB]
Get:17 https://deb.debian.org/debian bookworm-backports/main amd64 Packages T-2024-02-23-1408.06-F-2024-02-13-2
006.01.pdiff [10.8 kB]
Get:13 https://deb.debian.org/debian-security bookworm-security/main Sources [82.0 kB]
Get:14 https://deb.debian.org/debian-security bookworm-security/main amd64 Packages [143 kB]
Get:15 https://deb.debian.org/debian-security bookworm-security/main Translation-en [85.1 kB]
Fetched 1239 kB in 1s (1020 kB/s)
Reading package lists... Done
sagarpawarkartik@linux-web-server:~$ sudo apt-get install apache2 php7.0
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Note, selecting 'php7.0-thrift' for regex 'php7.0'
Note, selecting 'php7.0-common' for regex 'php7.0'
Note, selecting 'php7.0-curl' for regex 'php7.0'
The following additional packages will be installed:
  apache2-bin apache2-data apache2-utils libapr1 libaprutil1 libaprutil1-dbd-sqlite3 libaprutil1-ldap
  libjansson4 liblua5.3-0 ssl-cert
Suggested packages:
  apache2-doc apache2-suexec-pristine | apache2-suexec-custom www-browser
The following NEW packages will be installed:
  apache2 apache2-bin apache2-data apache2-utils libapr1 libaprutil1 libaprutil1-dbd-sqlite3 libaprutil1-ldap
  libjansson4 liblua5.3-0 ssl-cert
0 upgraded, 11 newly installed, 0 to remove and 5 not upgraded.
Need to get 2341 kB of archives.
After this operation, 8389 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 file:/etc/apt/mirrors/debian.list Mirrorlist [30 B]
Get:2 https://deb.debian.org/debian bookworm/main amd64 libapr1 amd64 1.7.2-3 [102 kB]
Get:3 https://deb.debian.org/debian bookworm/main amd64 libaprutil1 amd64 1.6.3-1 [87.8 kB]
Get:4 https://deb.debian.org/debian bookworm/main amd64 libaprutil1-dbd-sqlite3 amd64 1.6.3-1 [13.6 kB]
Get:5 https://deb.debian.org/debian bookworm/main amd64 libaprutil1-ldap amd64 1.6.3-1 [11.8 kB]
Get:6 https://deb.debian.org/debian bookworm/main amd64 libjansson4 amd64 2.14-2 [40.8 kB]
-bash: !DOCTYPE: event not found
sagarpawarkartik@linux-web-server:~$ echo '<!doctype html><html><body><h1>Hello World!</h1></body></html>' | sudo tee /var/www/html/index.html
<!doctype html><html><body><h1>Hello World!</h1></body></html>
sagarpawarkartik@linux-web-server:~$
```

**Hello World!**

### 3. Transfer files to Windows VMs

Google Cloud | TYCS-CC-ASSIGNMENT01 | Bucket | Search | Refresh | Help

**Buckets** CREATE REFRESH

Beginning on 29 April 2024, at-scale policy analysis and advanced IAM recommendation capabilities will require Security Command Centre Premium. Learn more ↗

**Transfer** New Power near real-time analytics and replication with event-driven transfers You can now capture changes faster at your Google Cloud Storage and Amazon S3 sources via event-driven transfers, enabling you to act on your data in near real-time. To get started, create a transfer job with a Pub/Sub- or AWS SQS-based event stream configured to send event notifications when objects are created or updated. CREATE TRANSFER JOB LEARN MORE ↗

**Security** View security recommendations Improve security by applying security recommendations to your buckets. The security insights column in the table describes which buckets have excess permissions. VIEW IN TABLE LEARN MORE ↗

Filter Buckets Name ↑ Created Location type Location Default storage class Last modified Public access Access control Protection Bucket retention Lifecycle rules

No rows to display

Marketplace Release notes

**Create a Bucket**

**Name your bucket** Pick a globally unique, permanent name. [Naming guidelines](#) ↗ windows-files-tycs-cc-assignment01 Tip: Don't include any sensitive information

**LABELS (OPTIONAL)**

**CONTINUE**

**Good to know**

**Location pricing** Storage rates vary depending on the storage class of your data and location of your bucket. [Pricing details](#) ↗ Current configuration: Multi-region / Standard

Item	Cost
us (multiple regions in United States)	\$0.026 per GB/month
With default replication	\$0.020 per GB written

**ESTIMATE YOUR MONTHLY COST**

**CREATE** CANCEL

Buckets + CREATE ⌂ REFRESH

Beginning on 29 April 2024, at-scale policy analysis and advanced IAM recommendation capabilities will require Security Command Centre Premium. [Learn more](#) ↗ DISMISS

**Transfer** New Power near real-time analytics and replication with event-driven transfers You can now capture changes faster at your Google Cloud Storage and Amazon S3 sources via event-driven transfers, enabling you to act on your data in near real-time. To get started, create a transfer job with a Pub/Sub- or AWS SQS-based event stream configured to send event notifications when objects are created or updated. CREATE TRANSFER JOB LEARN MORE ↗

**Security** View security recommendations Improve security by applying security recommendations to your buckets. The security insights column in the table describes which buckets have excess permissions. VIEW IN TABLE LEARN MORE ↗

Filter Buckets

Name	Public access	Access control	Protection	Bucket retention	Lifecycle rules	Tags	Encryption	Security insights
windows-files-tycs-cc-assignment01	public	Uniform	None	None	None	—	Google-managed	—

[Bucket details](#) [REFRESH](#) [LEARN](#)

### windows-files-tycs-cc-assignment01

Location	Storage class	Public access	Protection
us (multiple regions in United States)	Standard	Not public	None

[OBJECTS](#) [CONFIGURATION](#) [PERMISSION](#) [PROTECTION](#) [LIFECYCLE](#) [OBSERVABILITY](#) [INVENTORY REPORTS](#)

Buckets > windows-files-tycs-cc-assignment01 [Edit](#)

[UPLOAD FILES](#) [UPLOAD FOLDER](#) [CREATE FOLDER](#) [TRANSFER DATA](#) [MANAGE HOLDS](#) [EDIT RETENTION](#) [DOWNLOAD](#) [DELETE](#)

Filter by name prefix only [Filter](#) Filter objects and folders [Show deleted data](#)

<input type="checkbox"/> Name	Size	Type	Created	Storage class	Last modified	Public access	Version history	Encryption	Object ret.
<a href="#">Malware Analysis presentation.txt</a>	6.8 KB	text/plain	24 Feb 2024, 10:29:08	Standard	24 Feb 2024, 10:29:08	Not public	-	Google-managed	-

[VM instances](#) [CREATE INSTANCE](#) [IMPORT VM](#) [REFRESH](#) [LEARN](#)

[INSTANCES](#) [OBSERVABILITY](#) [INSTANCE SCHEDULES](#)

### VM instances

[Filter](#) Enter property name or value

<input type="checkbox"/> Status	Name	Zone	Recommendations	In use by	Internal IP	External IP	Connect
<input type="checkbox"/>	<a href="#">iis-web-server</a>	us-central1-a			10.128.0.2 (nic0)	34.69.149.244 (nic0)	RDP
<input type="checkbox"/>	<a href="#">linux-web-server</a>	us-central1-a			10.128.0.3 (nic0)	35.184.221.76 (nic0)	SSH
<input type="checkbox"/>	<a href="#">web-server</a>	us-central1-a			10.128.0.5 (nic0)	35.184.137.247 (nic0)	RDP

[Related actions](#) [HIDE](#)

[Explore Backup and DR](#) NEW  
Back up your VMs and set up disaster recovery

[View billing report](#)  
View and manage your Compute Engine billing

[Monitor VMs](#)  
View outlier VMs across metrics like CPU and network

[Explore VM logs](#)  
View, search, analyse and download VM instance logs

[Set up firewall rules](#)  
Control traffic to and from a VM instance

[Patch management](#)  
Schedule patch updates and view patch compliance on VM instances

[Load balance between VMs](#)  
Set up load balancing for your applications as your traffic and users grow

 Windows Security X

### Enter your credentials

These credentials will be used to connect to 35.184.137.247.

sagarpawarkartik

Remember me

[More choices](#)

[OK](#) [Cancel](#)

**Welcome**

You're working in **TYCS-CC-ASSIGNMENT01**

Project number: 94965986794    Project ID: tycs-cc-assignment01

[Dashboard](#) [Recommendations](#)

[Create a VM](#) [Run a query in BigQuery](#) [Create a GKE cluster](#) [Create a storage bucket](#)

**Quick access**

<a href="#">API APIs and services</a>	<a href="#">IAM and admin</a>	<a href="#">Billing</a>	<a href="#">Compute Engine</a>
<a href="#">Cloud Storage</a>	<a href="#">BigQuery</a>	<a href="#">VPC network</a>	<a href="#">Kubernetes engine</a>

Types Of Malware Analysis:-Static Analysis: Static analysis involves examining the malware without executing it. Analysts analyze the malware's code, file structure, metadata, and other attributes to identify suspicious or malicious characteristics. Techniques such as disassembling, decompiling, and examining the file's signature are used in static analysis.

Dynamic Analysis: Dynamic analysis involves executing the malware in a controlled environment, such as a virtual machine or sandbox, to observe its behavior. Analysts monitor system calls, network traffic, file system changes, and other interactions initiated by the malware to understand its capabilities and behavior.

Behavioral Analysis: Behavioral analysis focuses on understanding the malware's actions and impact on the infected system. Analysts observe how the malware interacts with system processes, modifies system settings, communicates with external servers (command-and-control servers), and performs malicious activities such as data exfiltration or encryption.

Code Reversing: Code reversing, also known as reverse engineering, involves decompiling the malware's code into a higher-level programming language to understand its logic and functionality. This helps analysts identify vulnerabilities, extract encryption keys, uncover hidden functionalities, and develop countermeasures.

Memory Analysis: Memory analysis involves examining the system's memory (RAM) to identify malware artifacts, such as injected processes, malicious DLLs, or rootkit hooks. Memory analysis techniques help uncover stealthy malware that may evade traditional detection methods.

Malware Classification: Malware analysis also involves classifying malware into different categories based on its characteristics, behavior, and propagation methods. Common malware categories include viruses, worms, Trojans, ransomware, spyware, adware, and rootkits.

\*\*\*\*\*

Here's how the Netcat Trojan typically works:

Infection Vector: The Netcat Trojan is typically distributed through various attack vectors such as phishing emails, malicious websites, or compromised software downloads. Once executed on a victim's system, the Netcat Trojan may disguise itself as a benign-looking file or process to evade detection.

Backdoor Installation: Upon execution, the Netcat Trojan installs a backdoor component on the victim's system. This backdoor facilitates remote access and control by the attacker, allowing them to execute commands, upload/download files, and manipulate system settings.

Command-and-Control (C2) Communication: The Netcat Trojan establishes communication with a remote command-and-control (C2) server controlled by the attacker. This enables the attacker to issue commands to the compromised system and receive responses, effectively controlling the system remotely.

Data Exfiltration: In addition to remote control capabilities, the Netcat Trojan may also be designed to exfiltrate sensitive data from the compromised system. This could include user credentials, financial information, intellectual property, or other valuable data, which can be used for further malicious activities or sold on the black market.

Persistence Mechanisms: To maintain persistence on the infected system and evade detection/removal, the Netcat Trojan may employ various persistence mechanisms such as creating registry keys, modifying startup settings, or installing itself as a hidden process or service.

Evasion Techniques: To avoid detection by antivirus software and security mechanisms, the Netcat Trojan may utilize evasion techniques such as obfuscation, encryption, or polymorphism. These techniques make it challenging for security tools to detect and analyze the malicious payload effectively.

Exploitation of Vulnerabilities: In some cases, the Netcat Trojan may exploit known vulnerabilities in the target system's software or configuration to gain initial access. This could involve exploiting unpatched software, weak passwords, misconfigured services, or other security weaknesses.

Overall, the Netcat Trojan represents a significant threat to cybersecurity as it provides attackers with a means to compromise systems, steal sensitive information, and potentially cause widespread damage. Detection and mitigation of Netcat Trojan infections require a multi-layered approach, including robust endpoint security measures, network monitoring, user education, and timely software patching. Additionally, malware analysts and security professionals continuously monitor and analyze emerging threats to develop effective countermeasures and protect against evolving attack techniques.

\*\*\*\*\*

## 4.Transfer files to Linux VMs

VM instances CREATE INSTANCE IMPORT VM REFRESH LEARN

**INSTANCES** OBSERVABILITY INSTANCE SCHEDULES

VM instances

**Filter** Enter property name or value

<input type="checkbox"/>	Status	Name <span>↑</span>	Zone	Recommendations	In use by	Internal IP	External IP	Connect
<input type="checkbox"/>	✓	l1s-web-server	us-central1-a			10.128.0.2 (nic0)	34.69.149.244 (nic0)	RDP <span>▼</span> <span>⋮</span>
<input type="checkbox"/>	✓	linux-web-server	us-central1-a			10.128.0.3 (nic0)	35.184.221.76 (nic0)	SSH <span>▼</span> <span>⋮</span>
<input type="checkbox"/>	✓	web-server	us-central1-a			10.128.0.5 (nic0)	35.184.137.247 (nic0)	RDP <span>▼</span> <span>⋮</span>

Related actions HIDE

Explore Backup and DR NEW  
Back up your VMs and set up disaster recovery

View billing report  
View and manage your Compute Engine billing

Monitor VMs  
View outlier VMs across metrics like CPU and network

Explore VM logs  
View, search, analyse and download VM instance logs

Set up firewall rules  
Control traffic to and from a VM instance

Patch management  
Schedule patch updates and view patch compliance on VM instances

Load balance between VMs  
Set up load balancing for your applications as your traffic and users grow

### Cloud Shell Editor

Cloud Shell (tycs-cc-assignment01) X + ▾

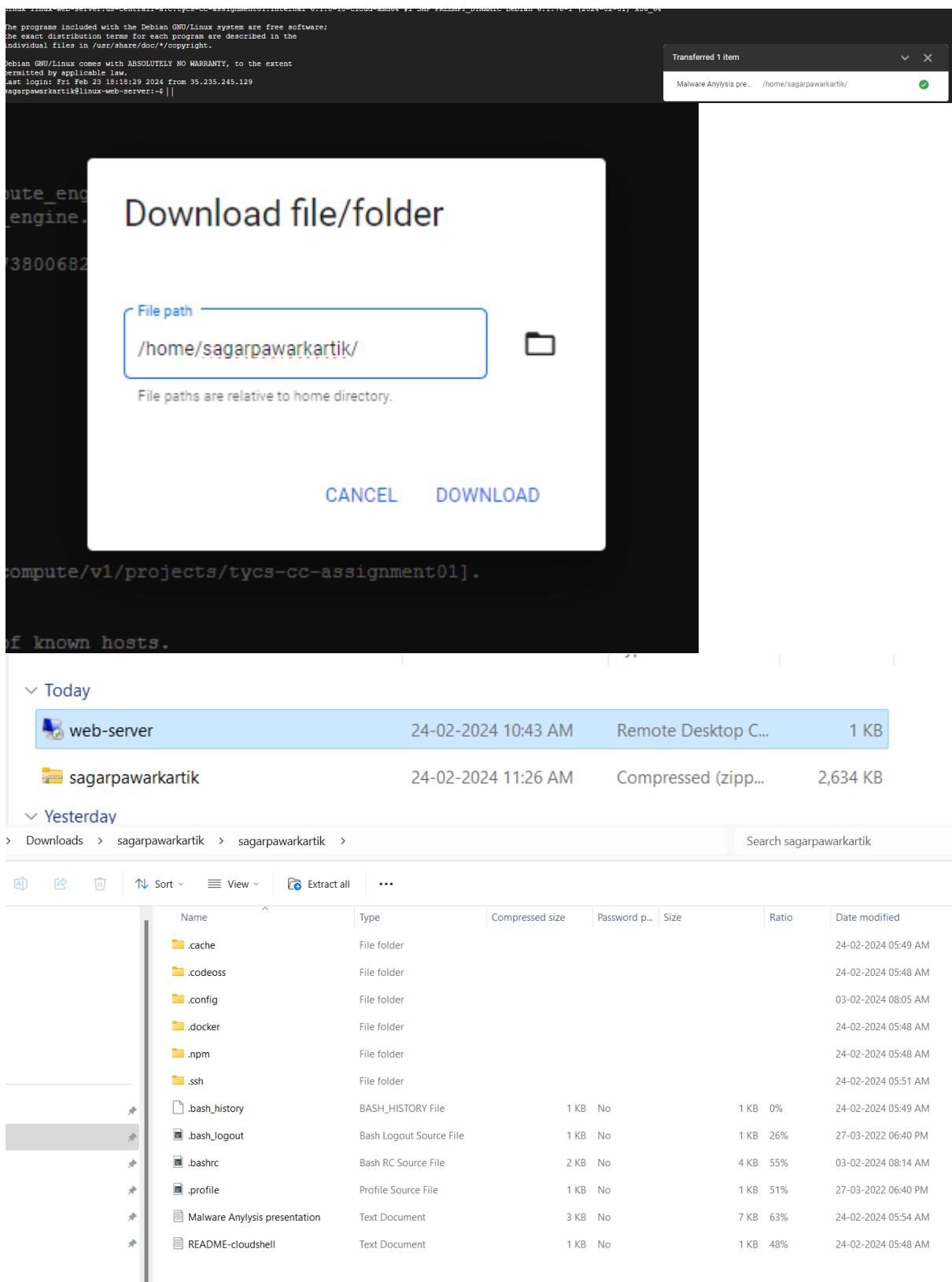
i Terminal tabs have been recovered from an existing session.

```
Welcome to Cloud Shell! Type "help" to get started.
Your Cloud Platform project in this session is set to tycs-cc-assignment01.
Use "gcloud config set project [PROJECT_ID]" to change to a different project.
sagarpawarkartik@cloudshell:~ (tycs-cc-assignment01) $
```

```
sagarpawarkartik@cloudshell:~ (tycs-cc-assignment01)$ gcloud compute ssh linux-web-server --zone=us-central1-a
WARNING: The private SSH key file for gcloud does not exist.
WARNING: The public SSH key file for gcloud does not exist.
WARNING: You do not have an SSH key for gcloud.
WARNING: SSH keygen will be executed to generate a key.
This tool needs to create the directory [/home/sagarpawarkartik/.ssh] before being able to generate SSH keys.

Do you want to continue (Y/n)? y

Generating public/private rsa key pair.
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Passphrases do not match. Try again.
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/sagarpawarkartik/.ssh/google_compute_engine
Your public key has been saved in /home/sagarpawarkartik/.ssh/google_compute_engine.pub
The key fingerprint is:
SHA256:E9IqlvjEKKLVR3WnlxAuHUXu9iYrzIu4BpRK2UoZjY sagarpawarkartik@cs-1028173800682-default
The key's randomart image is:
+---[RSA 3072]---+
|       o      |
| . . . +      |
|oE+ . + =     |
|+=... + O o    |
|o . o * S     |
|.* o . o .    |
|Bo=.o o       |
|=+o+. +       |
|+o+++.+=     |
+---[SHA256]---+
Updating project ssh metadata...working.Updated [https://www.googleapis.com/compute/v1/projects/tycs-cc-assignment01].
Updating project ssh metadata...done.
Waiting for SSH key to propagate.
```



## 5. Back up a VM's persistent disk

VM instances CREATE INSTANCE IMPORT VM REFRESH LEARN

**INSTANCES** OBSERVABILITY INSTANCE SCHEDULES

VM instances

**Filter** Enter property name or value

Status	Name	Zone	Recommendations	In use by	Internal IP	External IP	Connect
✓	iis-web-server	us-central1-a			10.128.0.2 (nic0)	34.69.149.244 (nic0)	RDP ▾
✓	linux-web-server	us-central1-a			10.128.0.3 (nic0)	35.184.221.76 (nic0)	SSH ▾
✓	web-server	us-central1-a			10.128.0.5 (nic0)	35.184.137.247 (nic0)	RDP ▾

Related actions HIDE

Explore Backup and DR NEW  
Back up your VMs and set up disaster recovery

View billing report  
View and manage your Compute Engine billing

Monitor VMs  
View outlier VMs across metrics like CPU and network

Explore VM logs  
View, search, analyse and download VM instance logs

Set up firewall rules  
Control traffic to and from a VM instance

Patch management  
Schedule patch updates and view patch compliance on VM instances

Load balance between VMs  
Set up load balancing for your applications as your traffic and users grow

◀ linux-web-serv... EDIT RESET CREATE MACHINE IMAGE CREATE SIMILAR START/RESUME STOP SUSPEND DELETE OPERATIONS

**DETAILS** OBSERVABILITY OS INFO SCREENSHOT

**Network interfaces**

Name	Network	Subnetwork	Primary internal IP address	Alias IP ranges	IP stack type	External IP address	Network interface
nic0	default	default	10.128.0.3		IPv4	35.184.221.76 (Ephemeral)	Premises

**Storage**

**Boot disk**

Name	Image	Interface type	Size (GB)	Device name	Type	Architecture	Encryption	Mode	W
linux-web-server	debian-12-bookworm-v20240213	SCSI	10	linux-web-server	SSD persistent	x86/64	Google-managed	Boot, read/write	Deleted

◀ Manage disk CREATE INSTANCE CREATE SNAPSHOT CREATE IMAGE CLONE DISK CREATE SECONDARY DISK EDIT DELETE

**linux-web-server**

**DETAILS** MONITORING

**Properties**

Type	SSD persistent disk
Size	10 GB
Architecture	x86/64
Zone	us-central1-a
Labels	None
In use by	linux-web-server
Snapshot schedule	None
Source image	debian-12-bookworm-v20240213
Encryption type	Google-managed
Consistency group	None

EQUIVALENT REST

[Create a snapshot](#)

Snapshots are backups of persistent disks. They're commonly used to recover, transfer or make data accessible to other resources in your project. [Learn more](#)

Name \*  Name is permanent

Description

Snapshot source type \*  Disk

Source disk \*  linux-web-server

Type \*

- Snapshot  
Standard backup and disaster recovery; stored in a separate location to your disk
- Instant snapshot  
Rapid restoration; stored in the same location as your disk
- Archive snapshot  
Long-term storage for infrequently accessed data; stored in a separate location to your disk

Location ?  
There may be a network transfer fee if you choose to store this snapshot in a location other than the source disk. [Learn more](#)

- Multi-regional
- Regional

Select location  us (multiple regions in United States)

Labels ?

[CREATE](#) [CANCEL](#) [EQUIVALENT CODE](#)

### Archive snapshots

[CREATE SNAPSHOT](#) [CREATE SNAPSHOT SCHEDULE](#) [REFRESH](#) [DELETE](#) [HIDE INFO PANEL](#) [LEARN](#)

Use archive snapshots for long-term data backup at a lower cost than standard snapshots for scenarios such as compliance, audits and long-term disaster recovery. [Learn more](#)

Archive snapshots																							
<a href="#">SNAPSHOTS</a>		<a href="#">ARCHIVE SNAPSHOTS</a>		<a href="#">INSTANT SNAPSHOTS</a>		<a href="#">PREVIEW</a>																	
<a href="#">SNAPSHOT SCHEDULES</a>																							
<input type="checkbox"/> Filter Enter property name or value																							
<table border="1"> <thead> <tr> <th>Status</th> <th>Name</th> <th>Location</th> <th>Snapshot size</th> <th>Creation time</th> <th>Creation type</th> <th>Source disk</th> <th>Source instant snapshot</th> </tr> </thead> <tbody> <tr> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/> boot-disk-snapshot-tycs-cc-assignment01</td> <td>us</td> <td>656.93 MB</td> <td>Feb 24, 2024, 11:37:33 am UTC+05:30</td> <td>Manual</td> <td>linux-web-server</td> <td></td> </tr> </tbody> </table>								Status	Name	Location	Snapshot size	Creation time	Creation type	Source disk	Source instant snapshot	<input type="checkbox"/>	<input checked="" type="checkbox"/> boot-disk-snapshot-tycs-cc-assignment01	us	656.93 MB	Feb 24, 2024, 11:37:33 am UTC+05:30	Manual	linux-web-server	
Status	Name	Location	Snapshot size	Creation time	Creation type	Source disk	Source instant snapshot																
<input type="checkbox"/>	<input checked="" type="checkbox"/> boot-disk-snapshot-tycs-cc-assignment01	us	656.93 MB	Feb 24, 2024, 11:37:33 am UTC+05:30	Manual	linux-web-server																	

Select an archive snapshot

[PERMISSIONS](#) [LABELS](#)

Please select at least one resource.

Successfully created snapshot boot-disk-snapshot-tycs-cc-assignment01. [X](#)

## 6. Configure periodic backups with a snapshot schedule

TYCS-CC-ASSIGNMENT01 ▾

Search (/) for resources, docs, products and more

LEARN

VM instances CREATE INSTANCE IMPORT VM REFRESH

INSTANCES OBSERVABILITY INSTANCE SCHEDULES

VM instances

Filter Enter property name or value

Status	Name	Zone	Recommendations	In use by	Internal IP	External IP	Connect
<input type="checkbox"/>	lls-web-server	us-central1-a			10.128.0.2 (nic0)		RDP
<input type="checkbox"/>	linux-web-server	us-central1-a			10.128.0.3 (nic0)	25.184.221.76 (nic0)	SSH
<input type="checkbox"/>	web-server	us-central1-a			10.128.0.5 (nic0)		RDP

Related actions HIDE

Explore Backup and DR   
Back up your VMs and set up disaster recovery

View billing report  
View and manage your Compute Engine billing

Monitor VMs  
View outlier VMs across metrics like CPU and network

Explore VM logs  
View, search, analyse and download VM instance logs

Set up firewall rules  
Control traffic to and from a VM instance

Patch management  
Schedule patch updates and view patch compliance on VM instances

Load balance between VMs   
Set up load balancing for your applications as your traffic and users grow

Manage disk CREATE INSTANCE CREATE SNAPSHOT CREATE IMAGE CLONE DISK CREATE SECONDARY DISK EDIT DELETE

### linux-web-server

DETAILS MONITORING

#### Properties

Type	SSD persistent disk
Size	10 GB
Architecture	x86/64
Zone	us-central1-a
Labels	None
In use by	<a href="#">linux-web-server</a>
Snapshot schedule	None
Source image	debian-12-bookworm-v20240213
Encryption type	Google-managed
Consistency group	None

[EQUIVALENT REST](#)

In credit. Don't worry – you won't be charged if you run out of credit. [Learn more](#)

TYCS-CC-ASSIGNMENT01 Search (/) for resources, docs, products and more

[CREATE INSTANCE](#) [CREATE SNAPSHOT](#) [CREATE IMAGE](#) [CLONE DISK](#)

**linux-web-server**

**Properties**

Size \* 10 GB [?](#)  
Provision between 10 and 65,536 GB

**Snapshot schedule**

Select or create a snapshot schedule [Filter Type to filter](#)  
There are no schedules in us-central1  
[CREATE A SCHEDULE](#)

**Labels**

[+ ADD LABEL](#)

Type	SSD persistent disk
Architecture	x86/64
Zone	us-central1-a
In use by	<a href="#">linux-web-server</a>
Source image	debian-12-bookworm-v20240213
Encryption type	Google-managed

**Schedule options**

Schedule frequency: Daily  
Start time (UTC): 00:00-01:00  
Auto-delete snapshots after: 14 days

**Deletion rule**

After you delete the disk that uses this schedule:  
 Keep snapshots

**Create a schedule**

Name \* boot-disk-snapshot-schedule-tycs-cc-assignment01  
Lowercase letters, numbers, hyphens allowed

Description

**Schedule location**

Choose where to use this schedule. You can only attach a snapshot schedule to a persistent disk in this region.

Region: us-central1 [?](#)

**Snapshot storage location**

Choose where to store snapshots generated by this schedule. Location can affect availability and networking costs. [Learn more](#)

Multi-regional  
 Regional  
Select location: us (multiple regions in United States)

**CREATE** **CANCEL**

TYCS-CC-ASSIGNMENT01 Search (/) for resources, docs, products and more [Search](#)

[CREATE INSTANCE](#) [CREATE SNAPSHOT](#) [CREATE IMAGE](#) [CLONE DISK](#) [CREATE SECONDARY DISK](#) [EDIT](#) [DELETE](#)

**linux-web-server**

**Properties**

Size \* 10 GB [?](#)  
Provision between 10 and 65,536 GB

**Snapshot schedule**

Select or create a snapshot schedule: boot-disk-snapshot-schedule-tycs-cc-assignment01  
Every day, starts between 00:00 and 01:00, Storage location: us (United States)

**Consistency group**

Select or create a consistency group

**Labels**

[+ ADD LABEL](#)

Type	SSD persistent disk
Architecture	x86/64
Zone	us-central1-a
In use by	<a href="#">linux-web-server</a>
Source image	debian-12-bookworm-v20240213
Encryption type	Google-managed

**CREATE** **CANCEL**

TYCS-CC-ASSIGNMENT01

Search (/) for resources, docs, products and more

1

Manage disk

CREATE INSTANCE CREATE SNAPSHOT CREATE IMAGE CLONE DISK CREATE SECONDARY DISK EDIT DELETE OPERATIONS

linux-web-server

DETAILS MONITORING

**Properties**

Type	SSD persistent disk
Size	10 GB
Architecture	x86/64
Zone	us-central1-a
Labels	None
In use by	linux-web-server
Snapshot schedule	boot-disk-snapshot-schedule-tycs-cc-assignment01
Source image	debian-12-bookworm-v20240213
Encryption type	Google-managed
Consistency group	None

EQUIVALENT REST

Successfully updated disk linux-web-server.

## 7. Restore a boot disk from a snapshot

TYCS-CC-ASSIGNMENT01

Search (/) for resources, docs, products and more

**VM instances**

**CREATE INSTANCE** **IMPORT VM** **REFRESH** **LEARN**

**INSTANCES** **OBSERVABILITY** **INSTANCE SCHEDULES**

**VM instances**

**Filter** Enter property name or value

Status	Name <b>↑</b>	Zone	Recommendations	In use by	Internal IP	External IP	Connect
<input type="checkbox"/>	lis-web-server	us-central1-a			10.128.0.2 (nic0)		RDP <b>▼</b> <b>⋮</b>
<input type="checkbox"/>	linux-web-server	us-central1-a			10.128.0.3 (nic0)	25.184.221.76 (nic0)	SSH <b>▼</b> <b>⋮</b>
<input type="checkbox"/>	web-server	us-central1-a			10.128.0.5 (nic0)		RDP <b>▼</b> <b>⋮</b>

**Related actions**

- Explore Backup and DR** **NEW**  
Back up your VMs and set up disaster recovery
- View billing report**  
View and manage your Compute Engine billing
- Monitor VMs**  
View outlier VMs across metrics like CPU and network
- Explore VM logs**  
View, search, analyse and download VM instance logs
- Set up firewall rules**  
Control traffic to and from a VM instance
- Patch management**  
Schedule patch updates and view patch compliance on VM instances
- Load balance between VMs**  
Set up load balancing for your applications as your traffic and users grow

**HIDE**

**linux-web-serv...** **EDIT** **RESET** **CREATE MACHINE IMAGE** **CREATE SIMILAR** **START/RESUME** **STOP** **SUSPEND** **DELETE** **...**

**DETAILS** **OBSERVABILITY** **OS INFO** **SCREENSHOT**

**SSH** **CONNECT TO SERIAL CONSOLE**

Connecting to serial ports is disabled **?**

### Logs

**Logging**  
Serial port 1 (console)

**SHOW MORE**

### Basic information

Name	linux-web-server
Instance ID	869440351817261507
Description	None
Type	Instance
Status	<b>Running</b>
Creation time	Feb 23, 2024, 11:38:46 pm UTC+05:30
Zone	us-central1-a
Instance template	None
In use by	None
Reservations	Automatically choose
Labels	None
Tags <b>?</b>	—
Deletion protection	Disabled
Confidential VM service <b>?</b>	Disabled
Preserved state size	0 GB

### Machine configuration

Machine type	e2-medium
CPU platform	Intel Broadwell

[◀](#) linux-web-serv... [EDIT](#) [RESET](#) [CREATE MACHINE IMAGE](#) [CREATE SIMILAR](#) [START/RESUME](#) [STOP](#) [SUSPEND](#) [DELETE](#) [OPERATION](#)

[o previous page](#)

[DETAILS](#) [OBSERVABILITY](#) [OS INFO](#) [SCREENSHOT](#)

SSH [CONNECT TO SERIAL CONSOLE](#)

Connecting to serial ports is disabled [?](#)

## Logs

Logging  
Serial port 1 (console)

[▼ SHOW MORE](#)

## Basic information

Name	linux-web-server
Instance ID	869440351817261507
Description	None
Type	Instance
Status	<span>Stopped</span>
Creation time	Feb 23, 2024, 11:38:46 pm UTC+05:30
Zone	us-central1-a
Instance template	None
In use by	None
Reservations	Automatically choose
Labels	None
Tags <a href="#">?</a>	<a href="#">-</a>
Deletion protection	Disabled
Confidential VM service <a href="#">?</a>	Disabled
Preserved state size	0 GB

## Machine configuration

Machine type	e2-medium
CPU platform	Unknown CPU Platform

VM instance stopped [X](#)

[◀](#) Edit linux-web-server instance

default default (10.128.0.0/20) [▼](#)

[ADD A NETWORK INTERFACE](#)

### Firewalls

- Allow HTTP traffic
- Allow HTTPS traffic
- Allow Load Balancer Health checks

### Network tags

Network tags [?](#)

http-server [×](#)

## Storage

### Boot disk

No disk selected. You can add a new disk or attach an existing disk.

[CONFIGURE BOOT DISK](#)

### Additional disks

[+ ADD NEW DISK](#)

[+ ATTACH EXISTING DISK](#)

Don't worry – you won't be charged if you run out of credit. [Learn more](#)

TYCS-CC-ASSIGNMENT01 ▾ Search (/)

← Edit linux-web-server instance

default default (10.128.0.0/20)

ADD A NETWORK INTERFACE

Firewalls

Allow HTTP traffic  
 Allow HTTPS traffic  
 Allow Load Balancer Health checks

Network tags

Network tags  http-server

**Storage**

**Boot disk**

No disk selected. You can add a new disk or attach an existing disk.

[CONFIGURE BOOT DISK](#)

**Additional disks**

[+ ADD NEW DISK](#) [+ ATTACH EXISTING DISK](#)

**Local disks**

None

**Security and access**

Shielded VM [?](#)

Select a shielded image to use shielded VM features.

[SAVE](#) [CANCEL](#)

## Boot disk

Select an image or snapshot to create a boot disk, or attach an existing disk. Can't find what you're looking for? Explore hundreds of VM solutions in [Marketplace](#)

[PUBLIC IMAGES](#) [CUSTOM IMAGES](#) [SNAPSHOTS](#) [ARCHIVE SNAPSHOTS](#) [EXISTING DISKS](#)

Operating system [Debian](#)

Version \* [Debian GNU/Linux 12 \(bookworm\)](#)

x86\_64, amd64 built on 20240213

Name \*  [?](#)

Name is permanent

Boot disk type \* [Balanced persistent disk](#)

[COMPARE DISK TYPES](#)

Size (GB) \*

Provision between 10 and 65536 GB

[SHOW ADVANCED CONFIGURATION](#)

[SELECT](#) [CANCEL](#)

## ✓ linux-web-server

DETAILS MONITORING

### Properties

Type	SSD persistent disk
Size <small>?</small>	10 GB
Architecture	x86/64
Zone	us-central1-a
Labels	None
In use by	None
Snapshot schedule	<a href="#">boot-disk-snapshot-schedule-tycs-cc-assignment01</a>
Source image	debian-12-bookworm-v20240213
Encryption type	Google-managed
Consistency group	None

### EQUIVALENT REST

Disks									
<a href="#">CREATE DISK</a> <a href="#">REFRESH</a> <a href="#">DELETE</a>									
<a href="#">Filter</a> Enter property name or value									
	Status	Name <a href="#">↑</a>	Type	Size	Architecture	Zone(s)	In use by	Snapshot schedule	Actions
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<a href="#">iis-web-server</a>	SSD persistent disk	50 GB	x86/64	us-central1-a	<a href="#">iis-web</a>	None	<a href="#">⋮</a>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<a href="#">linux-web-server</a>	SSD persistent disk	10 GB	x86/64	us-central1-a		<a href="#">boot-disk-snapshot-schedule-tycs-cc-assignment01</a>	<a href="#">⋮</a>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<a href="#">new-boot-disk-tycs-cc-assignment01</a>	Balanced persistent disk	10 GB	x86/64	us-central1-a	<a href="#">linux-w</a>	None	<a href="#">⋮</a>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<a href="#">web-server</a>	Balanced persistent disk	50 GB	x86/64	us-central1-a	<a href="#">web-se</a>	None	<a href="#">⋮</a>

## 8. Restore a persistent disk from a snapshot

linux-web-serv... EDIT RESET CREATE MACHINE IMAGE CREATE SIMILAR START/RESUME STOP SUSPEND DELETE OPERATION

o previous page DETAILS OBSERVABILITY OS INFO SCREENSHOT

SSH CONNECT TO SERIAL CONSOLE Connecting to serial ports is disabled ?

### Logs

Logging Serial port 1 (console)

SHOW MORE

### Basic information

Name	linux-web-server
Instance ID	869440351817261507
Description	None
Type	Instance
Status	Stopped
Creation time	Feb 23, 2024, 11:38:46 pm UTC+05:30
Zone	us-central1-a
Instance template	None
In use by	None
Reservations	Automatically choose
Labels	None
Tags ?	-
Deletion protection	Disabled
Confidential VM service ?	Disabled
Preserved state size	0 GB

### Machine configuration

Machine type e2-medium CPU platform Unknown CPU Platform

VM instance stopped

0 in credit. Don't worry – you won't be charged if you run out of credit. [Learn more](#)

TYCS-CC-ASSIGNMENT01 Search (/) for resources, docs, products and more

Edit linux-web-server instance

**Disk**

Name	new-boot-disk-tycs-cc-assignment01
Image	debian-12-bookworm-v20240213
Size	10 GB
Interface type	SCSI
Type	Balanced persistent disk
Encryption type	Google-managed
Mode	Boot, read/write
Snapshot schedule	None

**Deletion rule**  
When deleting instance  
 Keep disk  
 Delete disk

**Device name ?**  
Used to reference the device for mounting or resizing.  
 Device name: linux-web-server  
 Custom

**DETACH BOOT DISK**

**Additional disks**

+ ADD NEW DISK + ATTACH EXISTING DISK

**Local disks**  
None

**Security and access**

**Encryption**  
Data is encrypted automatically. Select an encryption key management solution.

**SAVE CANCEL**

Add new disk

Name \* new-persistent-disk-tycs-cc-assignment01  
Name is permanent

Description

**Source**  
Create a blank disk, apply a bootable disk image or restore a snapshot of another disk in this project.  
 Disk source type \* Archive snapshot  
 Source archive snapshot \* boot-disk-snapshot-tycs-cc-assignment01

**Disk settings**  
 Disk type \* Balanced persistent disk

COMPARE DISK TYPES

Size \* 10 GB

Provision between 10 and 65,536 GB

**Snapshot schedule (Recommended)**  
Use snapshot schedules to automate disk backups. [Learn more](#)  
 Select a snapshot schedule

**Consistency group**  
Ensure that the asynchronous replication of data is aligned across multiple disks in the same region. [Learn more](#)  
 Select a consistency group

**Encryption**  
Data is encrypted automatically. Select an encryption key management solution.

**SAVE CANCEL**

## Additional disks

New disk new-persistent-disk-tycs-cc-assignment01, Blank, 10 GB edit X

+ ADD NEW DISK + ATTACH EXISTING DISK

## Local disks

None

## Security and access

\* SAVING CANCEL

### Local disks

None

### Additional disks

Name	↑	Image	Interface type	Size (GB)	Device name	Type	Architecture	Encryption	Mode
new-persistent-disk-tycs-cc-assignment01	—	—	SCSI	10	new-persistent-disk-tycs-cc-assignment01	Balanced persistent disk	x86/64	Google-managed	Read/write

## 7. Write a program for web feed.

**Code:-**

```
<h3><b>Choose category: </b></h3>

<form method="post" id="myform">

<select name="rssurl" required>

<option value="">Select</option>

<option value="http://timesofindia.indiatimes.com/rssfeeds/-2128672765.cms">Science</option>

<option value="https://timesofindia.indiatimes.com/rssfeeds/65857041.cms">Astrology</option>
```

```
<option  
value="http://timesofindia.indiatimes.com/rssfeeds/66949542.cms">Tech</  
option>  
  
</select>  
  
<input type="submit" value="Load"/>  
  
</form>  
  
<?php  
  
if(isset($_POST['rssurl']))  
  
{  
  
echo '<h1> Search Result for RSS url: '.$_POST['rssurl'].'</h1>';  
  
$rssurl=$_POST['rssurl'];  
  
$rss=new DOMDocument();  
  
$rss->load($rssurl);  
  
$feed=array();  
  
foreach($rss->getElementsByTagName('item')as $node)  
  
{  
  
$item=array('title'=>$node->getElementsByTagName('title')->item(0)->nodeValue, 'desc'=>$node->getElementsByTagName('description')->item(0)->nodeValue, 'link'=>$node->getElementsByTagName('link')->item(0)->nodeValue, 'date'=>$node->getElementsByTagName('pubDate')->item(0)->nodeValue);  
  
array_push($feed,$item);  
  
}  
  
$limit=5;  
  
for($x=0;$x<$limit;$x++)  
  
{
```

```

$title=str_replace('&','&',$feed[$x]['title']);

$link=$feed[$x]['link'];

$description=$feed[$x]['desc'];

$date=date('I F d,Y',strtotime($feed[$x]['date']));

echo '<p><strong><a href="'.$link.'"'
title="'.$title.'">'.$title.'</a></strong><br>';

echo '<p>'.$description.'</p>';

echo '<small><em>Posted on '.$date.'</em></small>';

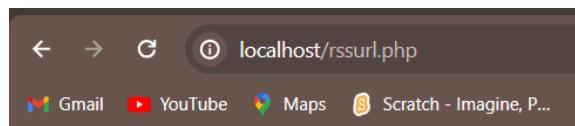
}

}

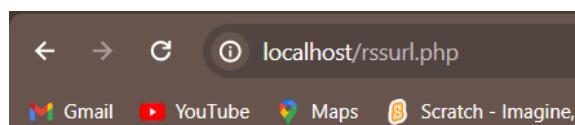
?>

```

### **Output:-**

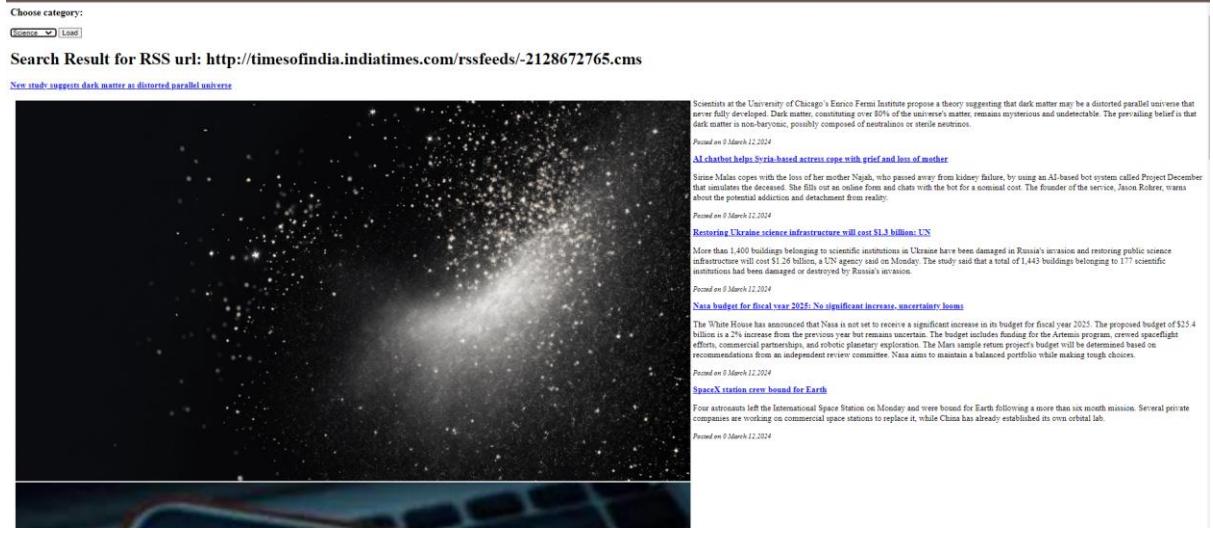
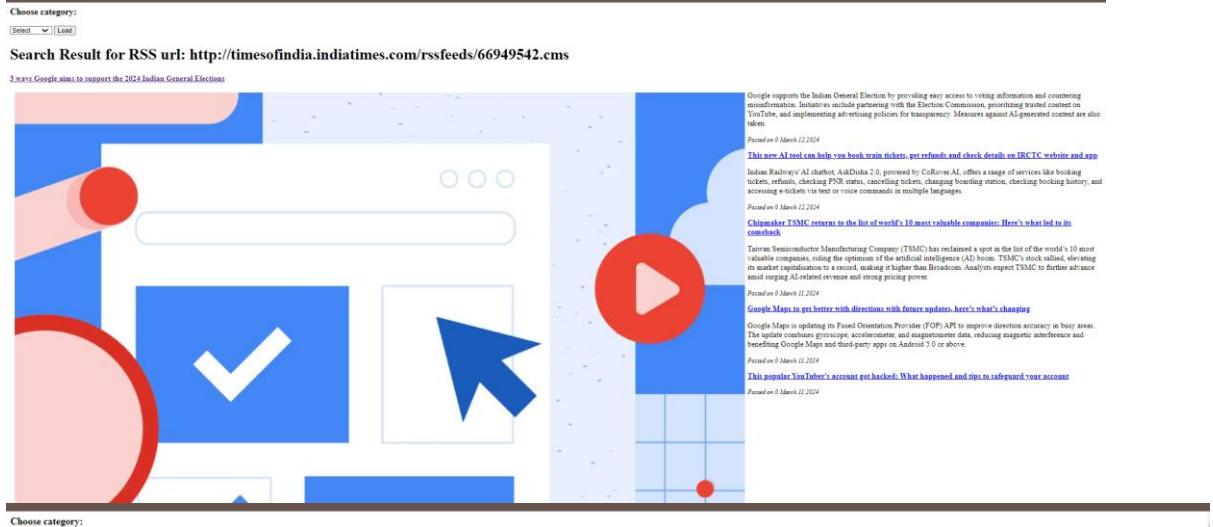


**Choose category:**



**Choose category:**

Select  
Science  
Astrology  
Tech



## **8. Case study on Amazon EC2/Microsoft Azure/Google Cloud Platform (Research paper analysis)**

**Title:** Leveraging Google Cloud Platform for Scalable Healthcare Data Analytics: A Case Study

### **Abstract:**

This research paper presents a case study on the utilization of Google Cloud Platform (GCP) for building a scalable healthcare data analytics system. The study focuses on addressing the challenges faced by healthcare organizations in managing and analyzing large volumes of diverse healthcare data while ensuring compliance with data privacy regulations. Leveraging GCP's suite of services, including BigQuery, Cloud Storage, and machine learning tools, the case study demonstrates how healthcare institutions can harness the power of cloud computing to derive actionable insights from their data, improve patient outcomes, and drive innovation in healthcare delivery.

### **Introduction:**

Healthcare organizations are grappling with the exponential growth of healthcare data generated from electronic health records (EHRs), medical imaging, wearable devices, and genomic sequencing. Analyzing this vast amount of data holds the potential to improve patient care, personalize treatments, and accelerate medical research. However, traditional on-premises infrastructure often lacks the scalability, agility, and cost-effectiveness required to process and analyze such massive datasets. Cloud computing platforms like Google Cloud offer a compelling solution to address these challenges.

### **Case Study Overview:**

A large regional healthcare system, consisting of multiple hospitals, clinics, and research facilities, embarked on a digital transformation journey to enhance its data analytics capabilities and drive innovation in healthcare delivery. The organization sought to leverage the scalability and advanced analytics capabilities of Google Cloud Platform to streamline data management, perform predictive analytics, and improve patient outcomes.

### **Challenges:**

1. Scalability: The healthcare system needed a scalable infrastructure capable of handling petabytes of structured and unstructured data generated from diverse sources.
2. Data Integration: Integrating data from disparate sources, including EHRs, medical devices, and administrative systems, posed a significant challenge.
3. Security and Compliance: Compliance with healthcare regulations such as HIPAA (Health Insurance Portability and Accountability Act) was paramount to ensure patient data privacy and security.
4. Analytics Capabilities: The organization required advanced analytics tools to derive actionable insights from the data, including predictive modeling, cohort analysis, and population health management.

### **Solution:**

The healthcare system adopted Google Cloud Platform as its cloud computing infrastructure and implemented the following solutions:

1. Data Ingestion and Storage: Utilizing Google Cloud Storage for secure and scalable storage of healthcare data, including EHRs, medical images, and sensor data. Data pipelines were built using Google Cloud Dataflow to ingest, transform, and load data into BigQuery for analysis.

2. Advanced Analytics with BigQuery: Leveraging BigQuery, Google's serverless, highly scalable data warehouse, for performing ad-hoc SQL queries, data exploration, and predictive analytics. BigQuery ML was employed to build machine learning models for predicting patient outcomes, identifying at-risk populations, and optimizing treatment protocols.
3. Secure and Compliant Environment: Implementing robust security controls and encryption mechanisms to protect sensitive healthcare data stored on Google Cloud Platform. Compliance with HIPAA regulations was ensured through comprehensive auditing, access controls, and data encryption practices.
4. Machine Learning and AI: Harnessing Google Cloud's machine learning tools, including TensorFlow and AI Platform, for developing predictive models, image analysis algorithms, and natural language processing (NLP) applications. These models were deployed to automate tasks such as image classification, diagnosis prediction, and clinical documentation.

**Results:**

The adoption of Google Cloud Platform enabled the healthcare system to achieve the following outcomes:

1. Scalability and Performance: The organization experienced significant improvements in data processing speed and scalability, allowing for real-time analysis of large healthcare datasets.
2. Actionable Insights: Advanced analytics capabilities provided valuable insights into patient populations, disease trends, and treatment efficacy, enabling clinicians to make informed decisions and personalize patient care.
3. Cost Savings: By leveraging Google Cloud's pay-as-you-go pricing model and serverless computing services, the organization optimized its infrastructure costs and reduced the total cost of ownership compared to on-premises solutions.
4. Innovation and Collaboration: Google Cloud's ecosystem of tools and services fostered innovation and collaboration among researchers, clinicians, and data scientists, leading to breakthroughs in medical research and healthcare delivery.

**Conclusion:**

This case study demonstrates how healthcare organizations can leverage Google Cloud Platform to overcome the challenges associated with managing and analyzing large volumes of healthcare data. By harnessing the scalability, security, and advanced analytics capabilities of GCP, healthcare institutions can unlock the full potential of their data to improve patient outcomes, drive innovation, and transform the delivery of healthcare services.