Performed by: Aisha Ait

Exercise 1: Understanding Cloud Computing Models

1.1. Main Differences Between IaaS, PaaS, and SaaS:

	IaaS	***PaaS***	***SaaS***
Definition	Provides virtualized computing resources over the internet.	Provides a platform allowing developers to build, run, and manage applications without worrying about the infrastructure.	Delivers fully functional software applications over the internet, managed by the provider.
I manage	Applications, data, runtime, middleware, and OS.	Applications and data.	Usage and configuration of the software.
Vendor manages	Virtualization, servers, storage, networking.	Runtime, middleware, OS, virtualization, servers, storage, networking.	Everything else (applications, data, runtime, middleware, OS, etc.).
Use case	For organizations needing full control over their IT infrastructure and scalability while avoiding physical hardware management.	For development teams needing to focus on coding and application logic without managing the underlying infrastructure.	For end-users who need access to software applications without worrying about installation, infrastructure, or maintenance.
Example	Hosting websites or applications where you want flexibility in choosing your OS, installing applications, and configuring security.	Developing web applications or APIs where you don't want to handle server setup, patching, and maintenance.	Using a CRM or an email service like Gmail where the entire software environment is managed by the vendor.

1.2. GCP Services for Each Model:

IaaS (Infrastructure as a Service):
- **Google Compute Engine**: Virtual machines and infrastructure management.
- **Cloud Storage:** Object storage for any data size
- **Google Kubernetes Engine (GKE):** Managed Kubernetes for containerized workloads.

PaaS (Platform as a Service):
- **App Engine:** Platform for building scalable web apps and mobile backends.
- **Cloud Functions:** Event-driven serverless functions for running code in response to events.
- **Cloud Run:** Fully managed platform for deploying containerized applications.

SaaS (Software as a Service):
- **Google Workspace**: Suite of productivity tools including Gmail, Docs, Sheets, and Drive.
- **Google Cloud Identity**: Manage users and groups with single sign-on (SSO) and identity management.
- **BigQuery**: Serverless, highly scalable data warehouse for analytics.

1.3. Real-World Examples for Each Model:
- **IaaS**:
  A startup developing a custom e-commerce platform may choose **Google Compute Engine** for flexibility

to configure their own OS, software stack, and database system. This model allows them full control over the infrastructure, which is critical during rapid scaling.

- **PaaS**:
  A development team creating a new mobile app might choose **Google App Engine** to handle the backend and web services. The team can focus solely on developing the app while the platform manages scaling, patching, and infrastructure needs automatically.
- **SaaS**:
  A marketing team might use **Google Workspace** (Gmail, Google Drive) for daily productivity tasks. They benefit from easy access to email, documents, and collaboration tools without needing to worry about installation, security, or updates.

Exercise 2: Exploring Google Cloud Platform's Core Services

Explore and Describe the Core Services:

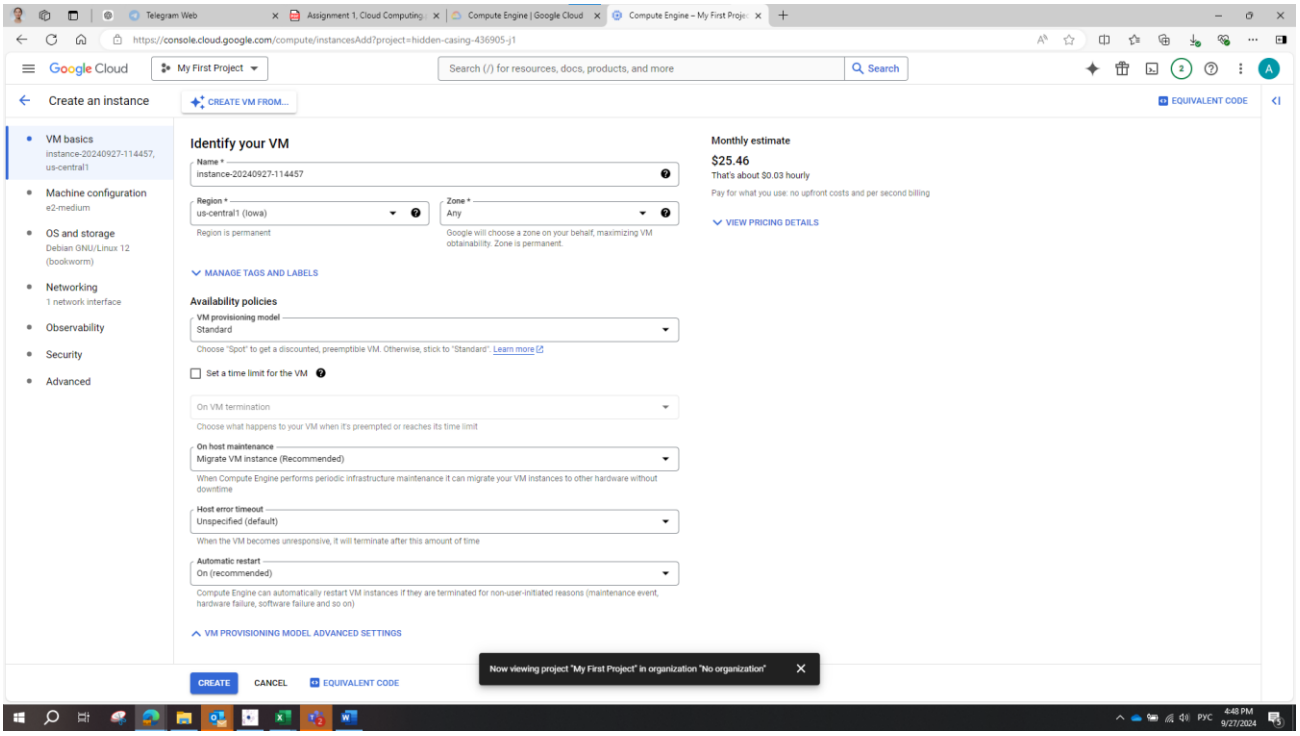
	Compute Engine	Google Kubernetes Engine (GKE)	App Engine	Cloud Storage	BigQuery
Purpose	Provides virtual machines (VMs) that run on Google's infrastructure. It allows users to deploy scalable VMs, customize them with their preferred operating systems, and manage workloads in a flexible manner.	A managed Kubernetes service that simplifies the deployment, scaling, and management of containerized applications. GKE automatically handles cluster provisioning, scaling, and updates.	A fully managed platform for developing and hosting web applications. It abstracts away the underlying infrastructure, letting developers focus on writing code without worrying about server management.	An object storage service designed for storing and retrieving any amount of data at any time. It's highly durable and scalable, making it ideal for storing unstructured data like images, videos, and backups.	A fully managed, serverless data warehouse designed for fast SQL queries and large-scale data analytics. It allows businesses to analyze massive datasets using the power of Google's infrastructure.
Use Case	A business running a web application that needs complete control over its OS, network configurations, and resources could use Compute Engine to set up highly available and scalable VMs.	A company developing microservices-based applications can use GKE to orchestrate and manage containers, ensuring high availability, automatic scaling, and simplified deployment.	A startup developing a web or mobile application can use App Engine to deploy the app quickly and scale automatically, without needing to manage infrastructure.	A media company can use Cloud Storage to store large volumes of video content, allowing them to easily scale storage needs and access data from anywhere.	An e-commerce company can use BigQuery to analyze customer purchase data, identifying trends and generating insights that drive marketing strategies and business decisions.

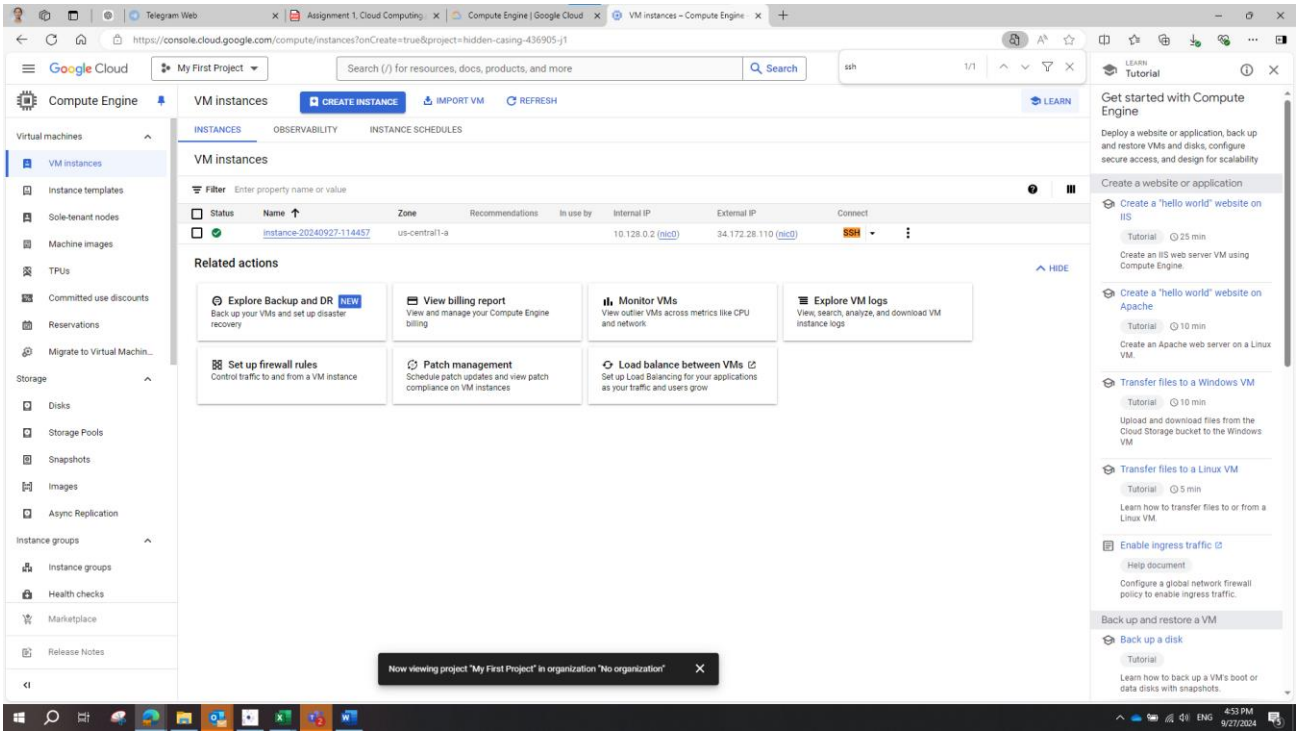
Questions:

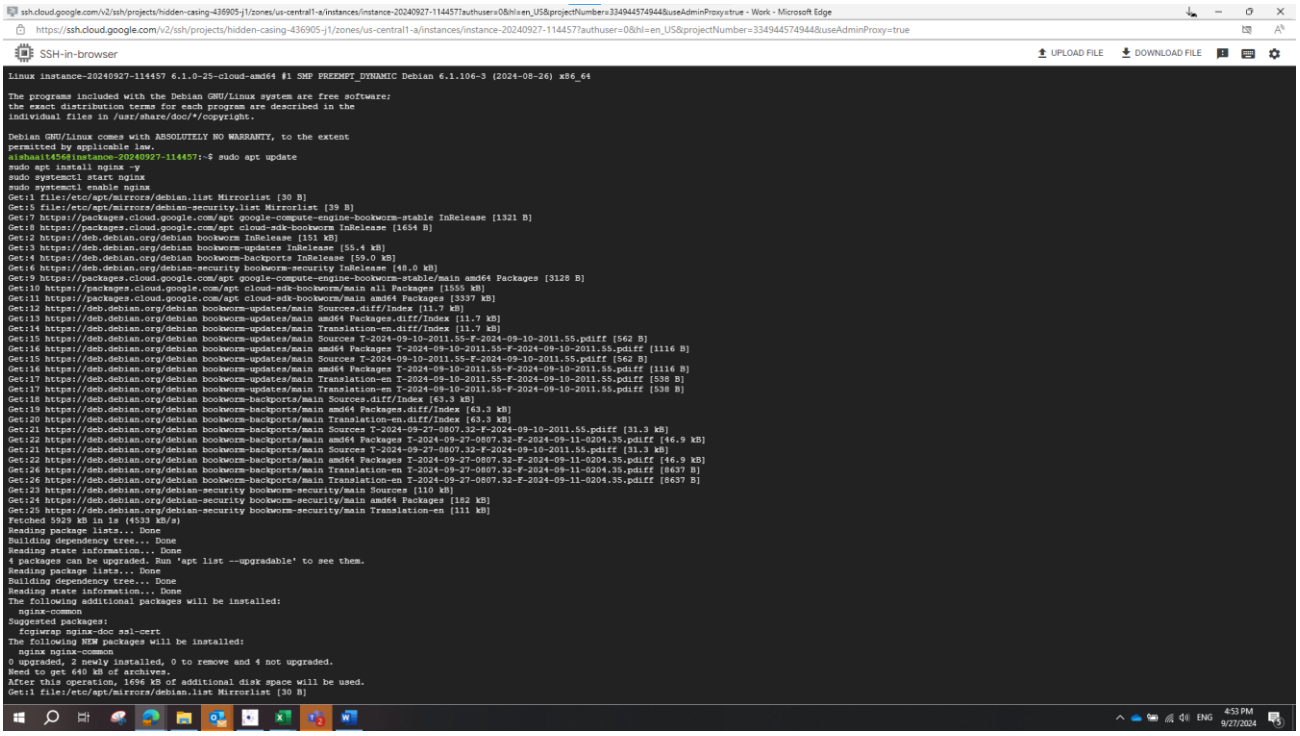
1. **What is the primary use case of Compute Engine?**
    - **Answer**: The primary use case of **Compute Engine** is to run customizable virtual machines (VMs) on Google Cloud's infrastructure, providing businesses with flexibility and full control over their operating systems, applications, and network configurations. It's ideal for running applications that require specific environments or large-scale workloads like web hosting or enterprise applications.
2. **How does Google Kubernetes Engine (GKE) simplify the management of containerized applications?**
    - **Answer**: **Google Kubernetes Engine (GKE)** simplifies the management of containerized applications by automating the deployment, scaling, and operations of containers. It offers managed Kubernetes clusters that handle provisioning, updates, scaling, and monitoring. This enables businesses to focus on building applications without worrying about infrastructure, orchestration, or scaling complexities.
3. **What advantages does Cloud Storage offer for data management?**
    - **Answer**: **Cloud Storage** offers several advantages for data management:
        - **Scalability**: Automatically scales to store virtually unlimited amounts of data.
        - **Durability**: Highly reliable, with multiple redundancy options across regions.
        - **Accessibility**: Data can be accessed globally with high performance.
        - **Security**: Provides strong encryption for data at rest and in transit.
        - **Cost-effectiveness**: Different storage classes (e.g., Standard, Nearline, Coldline) provide cost options based on access frequency and retention.
        - **Use Case**: Businesses can use Cloud Storage for data archiving, backups, and serving static website content.
4. **Why would a business choose BigQuery for their data analysis needs?**
    - **Answer**: A business would choose **BigQuery** for data analysis due to its ability to handle large-scale data with fast SQL querying capabilities. It's serverless, so there's no need to manage infrastructure, and it can analyze terabytes to petabytes of data quickly. Its integration with other GCP services and built-in machine learning tools makes it ideal for businesses looking to derive insights from massive datasets with minimal setup and operational overhead.

Exercise 3: Creating and Managing Virtual Machines with Compute Engine

Step 1:


Create an instance
CREATE VM FROM...
EQUIVALENT CODE
VM basics
instance-20240927-114457, us-central1
Machine configuration
e2-medium
OS and storage
Debian GNU/Linux 12 (bookworm)
Networking
1 network interface
Observability
Security
Advanced
Identify your VM
Name *
instance-20240927-114457
Region *
us-central1 (Iowa)
Region is permanent
Zone *
Any
Google will choose a zone on your behalf, maximizing VM obtainability. Zone is permanent.
MANAGE TAGS AND LABELS
Availability policies
VM provisioning model
Standard
Choose "Spot" to get a discounted, preemptible VM. Otherwise, stick to "Standard". Learn more
Set a time limit for the VM
On VM termination
Choose what happens to your VM when it's preempted or reaches its time limit
On host maintenance
Migrate VM instance (Recommended)
When Compute Engine performs periodic infrastructure maintenance it can migrate your VM instances to other hardware without downtime
Host error timeout
Unspecified (default)
When the VM becomes unresponsive, it will terminate after this amount of time
Automatic restart
On (recommended)
Compute Engine can automatically restart VM instances if they are terminated for non-user-initiated reasons (maintenance event, hardware failure, software failure and so on)
VM PROVISIONING MODEL ADVANCED SETTINGS
Monthly estimate
$25.46
That's about $0.03 hourly
Pay for what you use: no upfront costs and per second billing
VIEW PRICING DETAILS
CREATE
CANCEL
EQUIVALENT CODE
Now viewing project "My First Project" in organization "No organization"


Compute Engine
VM instances
CREATE INSTANCE
IMPORT VM
REFRESH
LEARN
INSTANCES
OBSERVABILITY
INSTANCE SCHEDULES
Virtual machines
VM instances
Instance templates
Sole-tenant nodes
Machine images
TPUs
Committed use discounts
Reservations
Migrate to Virtual Machin...
Storage
Disks
Storage Pools
Snapshots
Images
Async Replication
Instance groups
Instance groups
Health checks
Marketplace
Release Notes
Filter Enter property name or value
Status
Name
Zone
Recommendations
In use by
Internal IP
External IP
Connect
instance-20240927-114457
us-central1-a
10.128.0.2 (nic0)
34.172.28.110 (nic0)
SSH
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, analyze, 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
Tutorial
Get started with Compute Engine
Deploy a website or application, back up and restore VMs and disks, configure secure access, and design for scalability
Create a website or application
Create a "hello world" website on IIS
Tutorial 25 min
Create an IIS web server VM using Compute Engine.
Create a "hello world" website on Apache
Tutorial 10 min
Create an Apache web server on a Linux VM.
Transfer files to a Windows VM
Tutorial 10 min
Upload and download files from the Cloud Storage bucket to the Windows VM
Transfer files to a Linux VM
Tutorial 5 min
Learn how to transfer files to or from a Linux VM.
Enable ingress traffic
Help document
Configure a global network firewall policy to enable ingress traffic.
Back up and restore a VM
Back up a disk
Tutorial
Learn how to back up a VM's boot or data disks with snapshots.
Now viewing project "My First Project" in organization "No organization"


ssh.cloud.google.com/v2/ssh/projects/hidden-casing-436905-j1/zones/us-central1-a/instances/instance-20240927-114457?authuser=0&hl=en_US&projectNumber=334944574944&useAdminProxy=true - Work - Microsoft Edge
SSH-in-browser
UPLOAD FILE
DOWNLOAD FILE
Linux instance-20240927-114457 6.1.0-25-cloud-amd64 #1 SMP PREEMPT_DYNAMIC Debian 6.1.106-3 (2024-08-26) 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.
aishaa1456@instance-20240927-114457:~$ sudo apt update
sudo apt install nginx -y
sudo systemctl start nginx
sudo systemctl enable nginx
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 [1321 B]
Get:8 https://packages.cloud.google.com/apt cloud-sdk-bookworm InRelease [1654 B]
Get:2 https://deb.debian.org/debian bookworm InRelease [151 kB]
Get:3 https://deb.debian.org/debian bookworm-updates InRelease [55.4 kB]
Get:4 https://deb.debian.org/debian bookworm-backports InRelease [59.0 kB]
Get:6 https://deb.debian.org/debian-security bookworm-security InRelease [48.0 kB]
Get:9 https://packages.cloud.google.com/apt google-compute-engine-bookworm-stable/main amd64 Packages [3128 B]
Get:10 https://packages.cloud.google.com/apt cloud-sdk-bookworm/main all Packages [1555 kB]
Get:11 https://packages.cloud.google.com/apt cloud-sdk-bookworm/main amd64 Packages [3337 kB]
Get:12 https://deb.debian.org/debian bookworm-updates/main Sources.diff/Index [11.7 kB]
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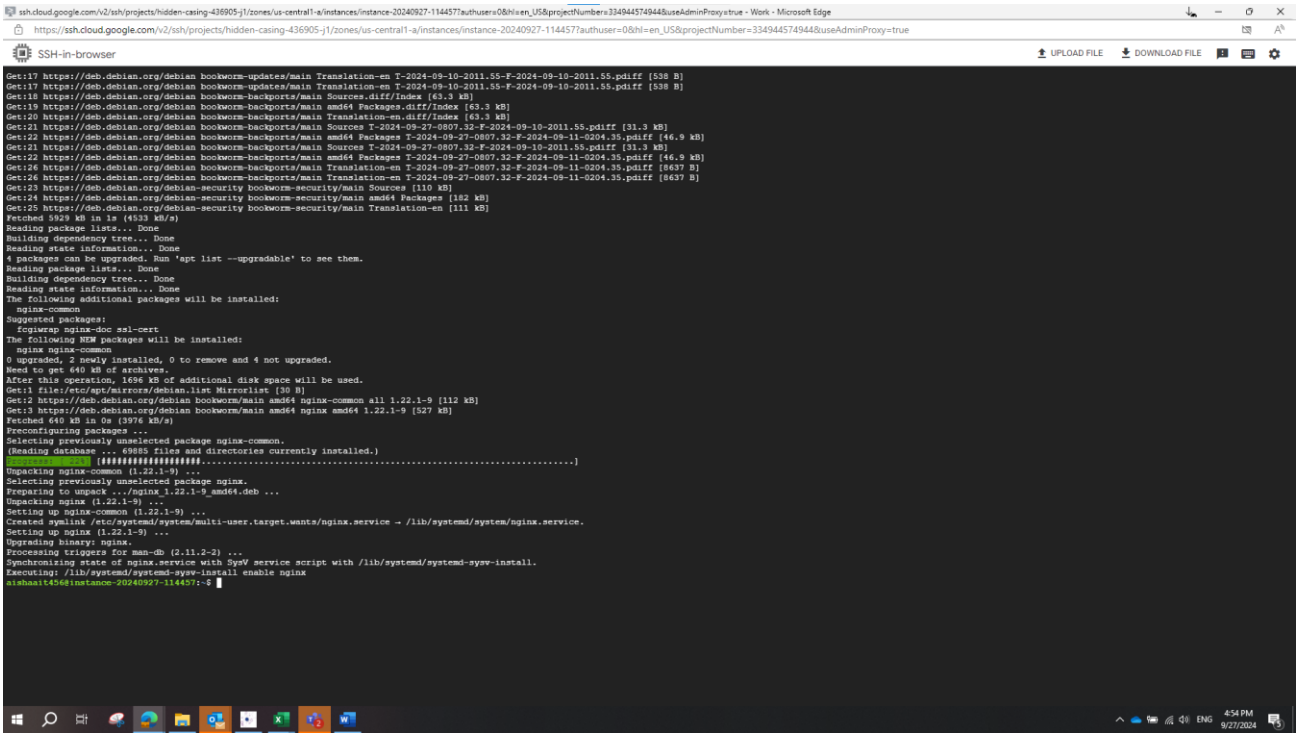
Get:23 https://deb.debian.org/debian-security bookworm-security/main Sources [110 kB]
Get:24 https://deb.debian.org/debian-security bookworm-security/main amd64 Packages [182 kB]
Get:25 https://deb.debian.org/debian-security bookworm-security/main Translation-en [111 kB]
Fetched 5929 kB in 1s (4533 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
4 packages can be upgraded. Run 'apt list --upgradable' to see them.
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
nginx-common
Suggested packages:
fcgiwrap nginx-doc ssl-cert
The following NEW packages will be installed:
nginx nginx-common
0 upgraded, 2 newly installed, 0 to remove and 4 not upgraded.
Need to get 640 kB of archives.
After this operation, 1696 kB of additional disk space will be used.
Get:1 file:/etc/apt/mirrors/debian.list Mirrorlist [30 B]
ENG
4:53 PM
9/27/2024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SSH-in-browser
UPLOAD FILE
DOWNLOAD FILE
Get:17 https://deb.debian.org/debian bookworm-updates/main Translation-en T-2024-09-10-2011.55-F-2024-09-10-2011.55.pdiff [538 B]
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Get:26 https://deb.debian.org/debian bookworm-backports/main Translation-en T-2024-09-27-0807.32-F-2024-09-11-0204.35.pdiff [8637 B]
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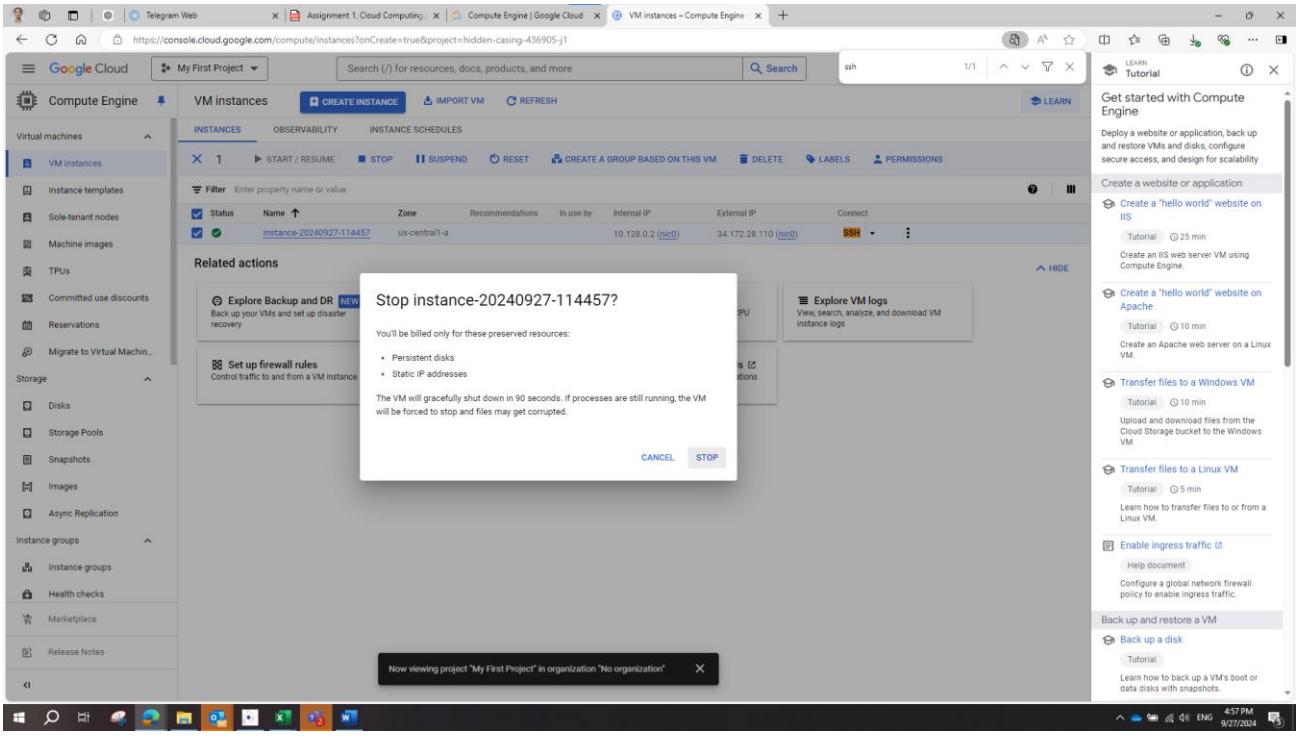
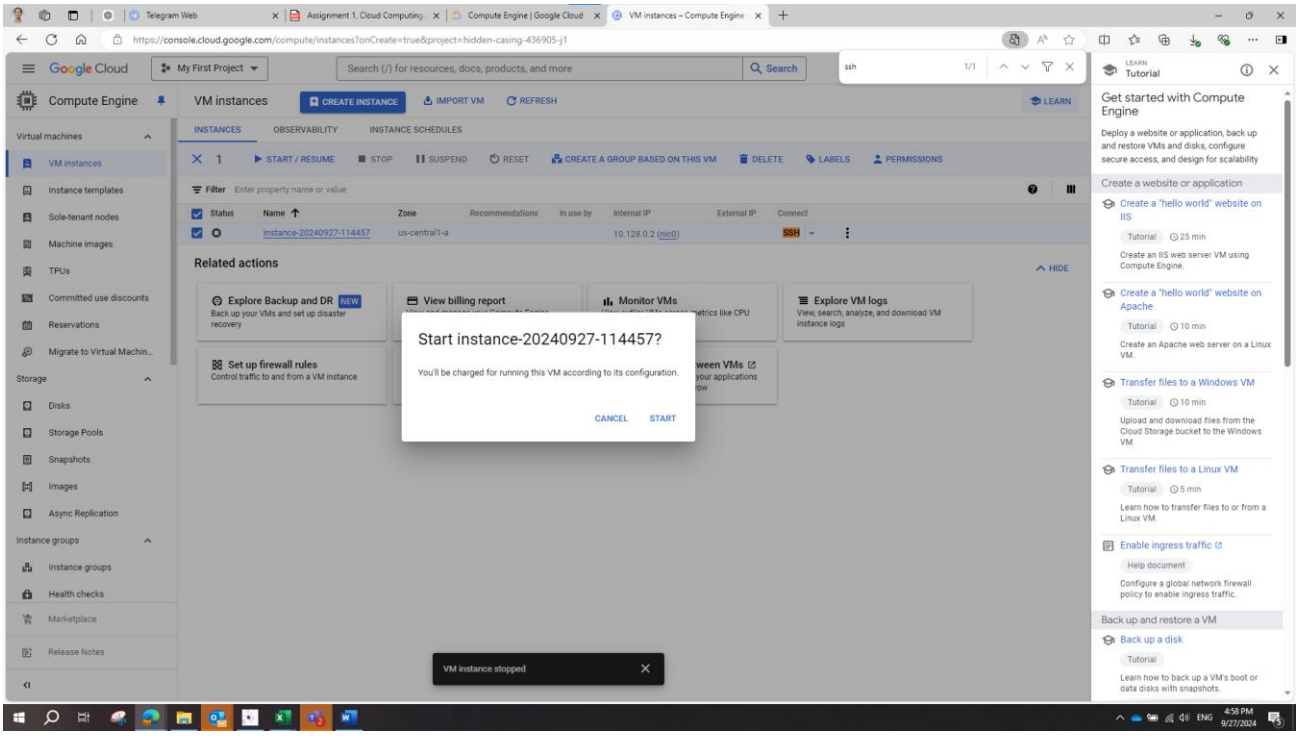
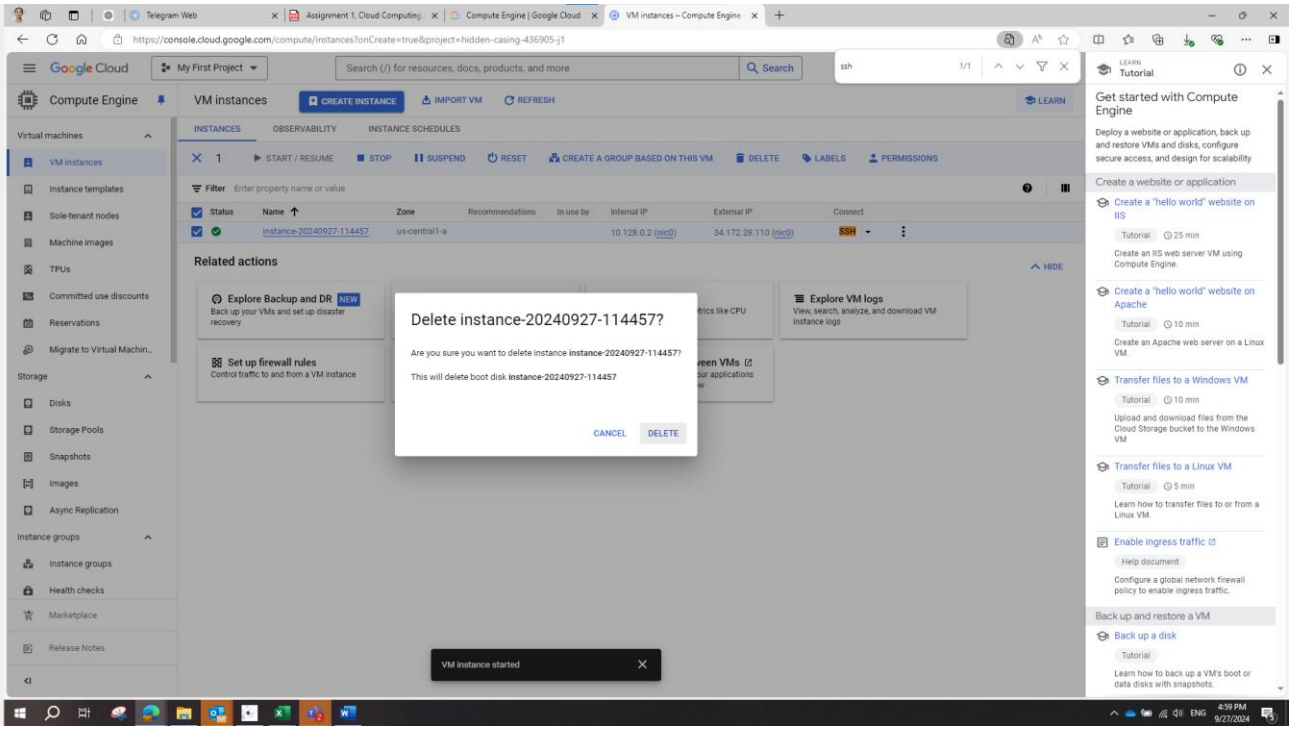
Get:23 https://deb.debian.org/debian-security bookworm-security/main Sources [110 kB]
Get:24 https://deb.debian.org/debian-security bookworm-security/main amd64 Packages [182 kB]
Get:25 https://deb.debian.org/debian-security bookworm-security/main Translation-en [111 kB]
Fetched 5929 kB in 1s (4533 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
4 packages can be upgraded. Run 'apt list --upgradable' to see them.
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
nginx-common
Suggested packages:
fcgiwrap nginx-doc ssl-cert
The following NEW packages will be installed:
nginx nginx-common
0 upgraded, 2 newly installed, 0 to remove and 4 not upgraded.
Need to get 640 kB of archives.
After this operation, 1696 kB of additional disk space will be used.
Get:1 file:/etc/apt/mirrors/debian.list Mirrorlist [30 B]
Get:2 https://deb.debian.org/debian bookworm/main amd64 nginx-common all 1.22.1-9 [112 kB]
Get:3 https://deb.debian.org/debian bookworm/main amd64 nginx amd64 1.22.1-9 [527 kB]
Fetched 640 kB in 0s (3976 kB/s)
Preconfiguring packages ...
Selecting previously unselected package nginx-common.
(Reading database ... 69885 files and directories currently installed.)
Unpacking nginx-common (1.22.1-9) ...
Selecting previously unselected package nginx.
Preparing to unpack .../nginx_1.22.1-9_amd64.deb ...
Unpacking nginx (1.22.1-9) ...
Setting up nginx-common (1.22.1-9) ...
Created symlink /etc/systemd/system/multi-user.target.wants/nginx.service → /lib/systemd/system/nginx.service.
Setting up nginx (1.22.1-9) ...
Upgrading binary: nginx.
Processing triggers for man-db (2.11.2-2) ...
Synchronizing state of nginx.service with SysV service script with /lib/systemd/systemd-sysv-install.
Executing: /lib/systemd/systemd-sysv-install enable nginx
aishaa1456@instance-20240927-114457:~$
ENG
4:54 PM
9/27/2024


Stop instance-20240927-114457?
You'll be billed only for these preserved resources:
Persistent disks
Static IP addresses
The VM will gracefully shut down in 90 seconds. If processes are still running, the VM will be forced to stop and files may get corrupted.
CANCEL
STOP
Now viewing project "My First Project" in organization "No organization"


Start instance-20240927-114457?
You'll be charged for running this VM according to its configuration.
CANCEL
START
VM instance stopped



Questions:

1. **What steps did you follow to create the VM?**
   - Navigated to **Compute Engine** > **VM instances**, clicked **Create Instance**, configured the machine type, region.
2. **How did you connect to the VM, and what commands did you use to install the web server?**
   - Connected via SSH from the console and installed Nginx with the following commands:

```
sudo apt update
sudo apt install nginx -y
sudo systemctl start nginx
sudo systemctl enable nginx
```

3. **What happens to the VM and its data when it is stopped versus when it is deleted?**

- **Stopped**: VM shuts down, but data remains on the persistent disk.
- **Deleted**: VM and its data are permanently removed unless persistent disks are retained.

Exercise 4: Deploying a Containerized Application on Google Kubernetes Engine (GKE)

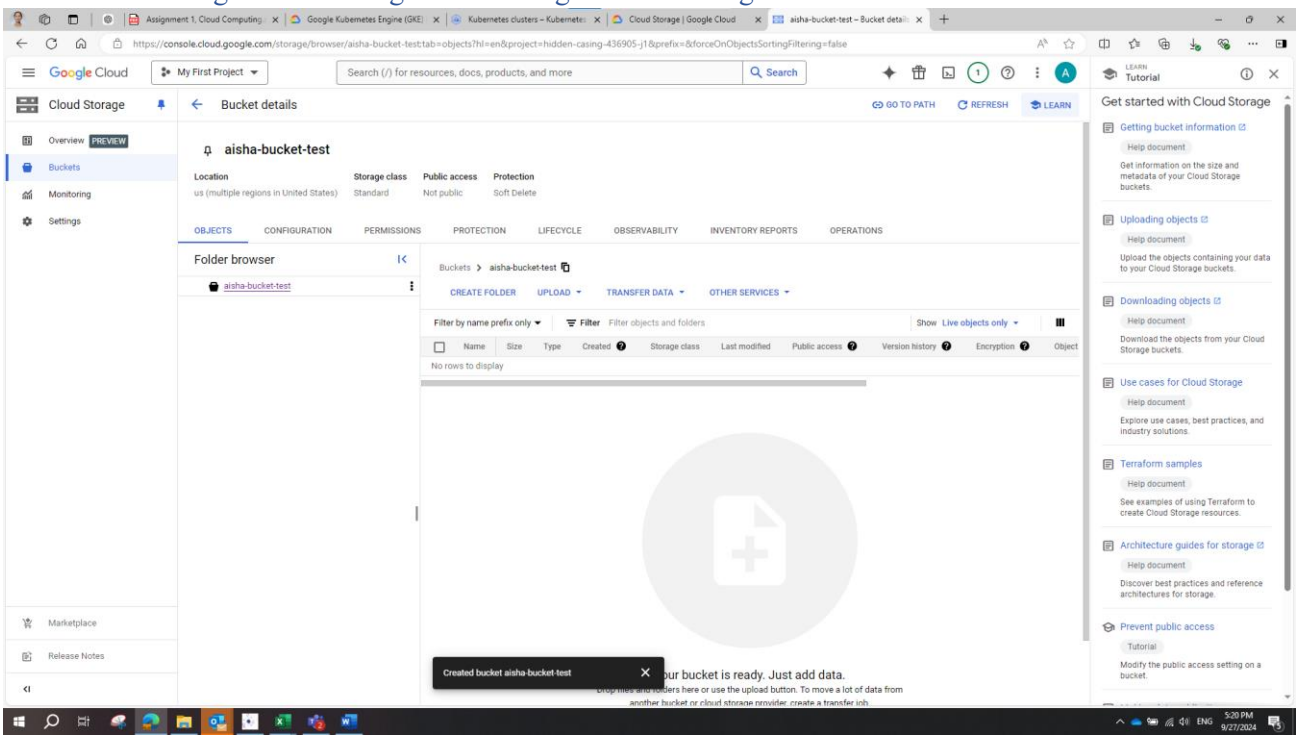
Questions:

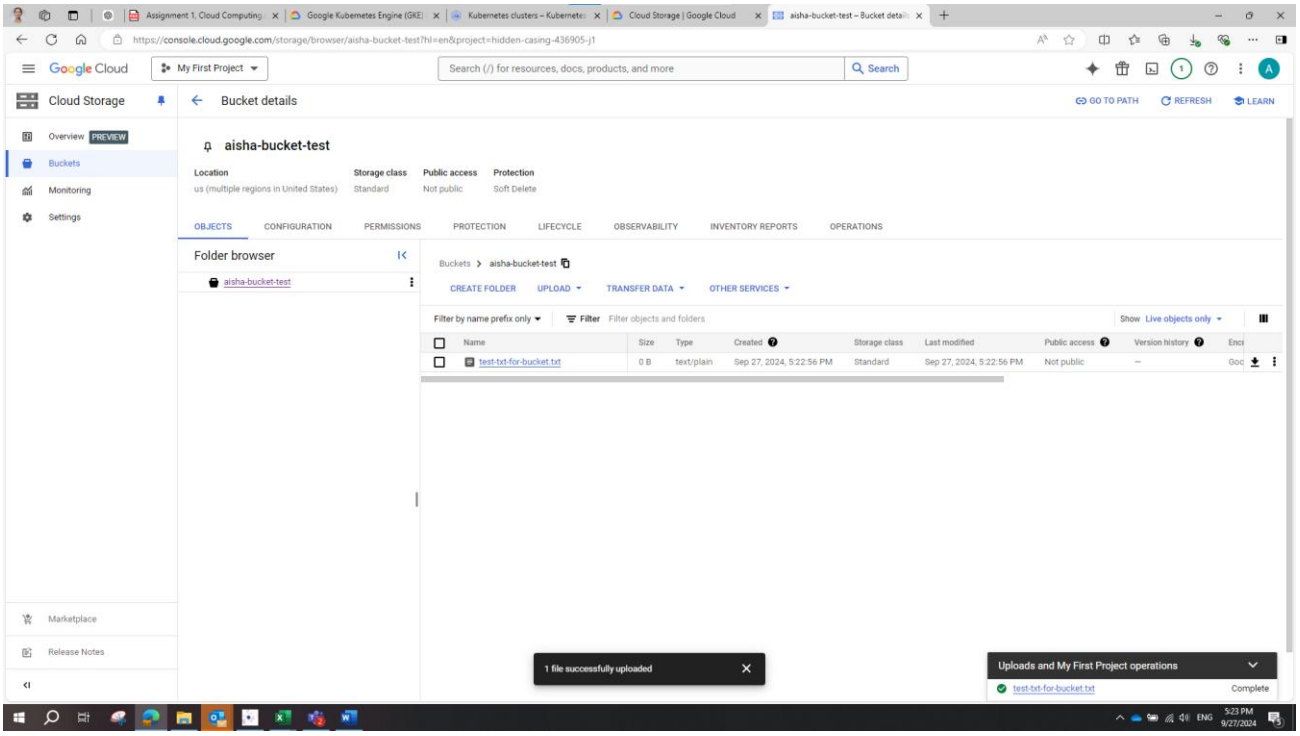
- **How did you create and push the Docker container to GCR?**
  - Provide the steps you followed to build the Docker image locally and push it to Google Container Registry using commands like docker build, docker tag, and docker push.
- **What steps were involved in setting up the GKE cluster?**

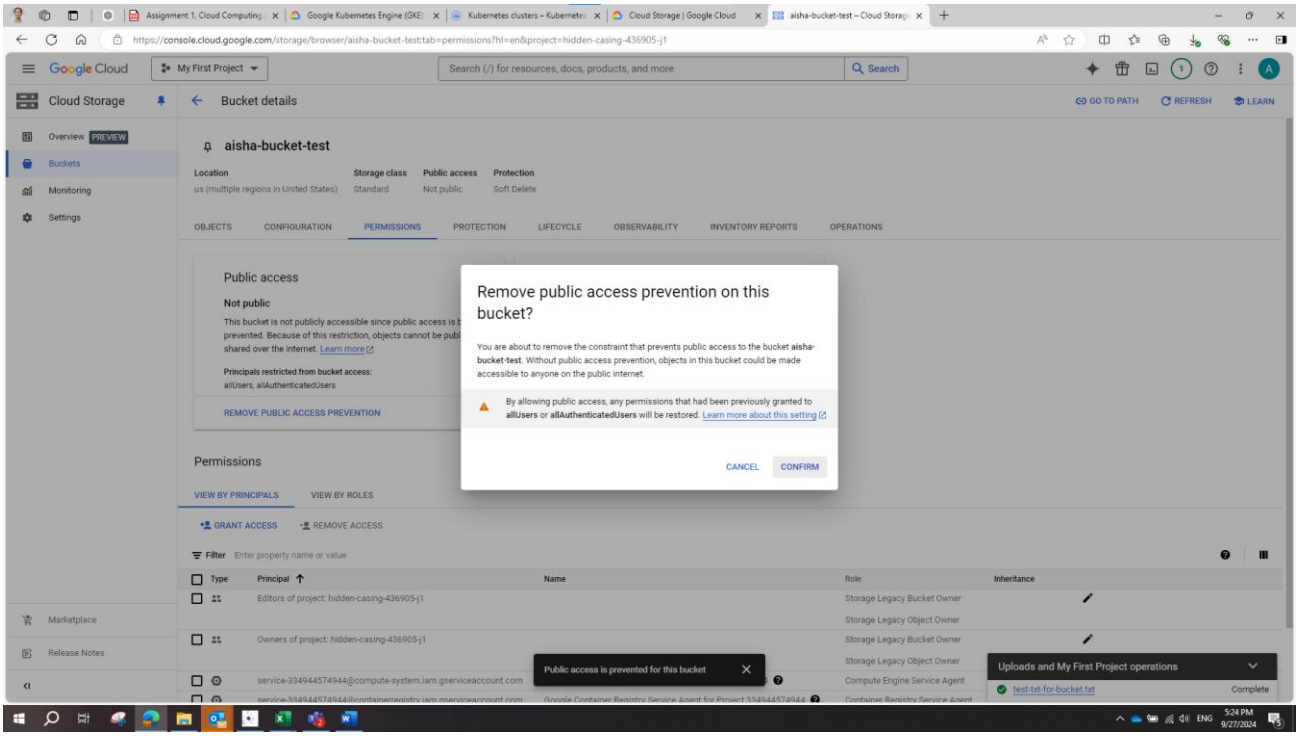
- Detail the process of creating the GKE cluster in the Cloud Console, specifying parameters like the region, node configuration, and any other relevant settings.

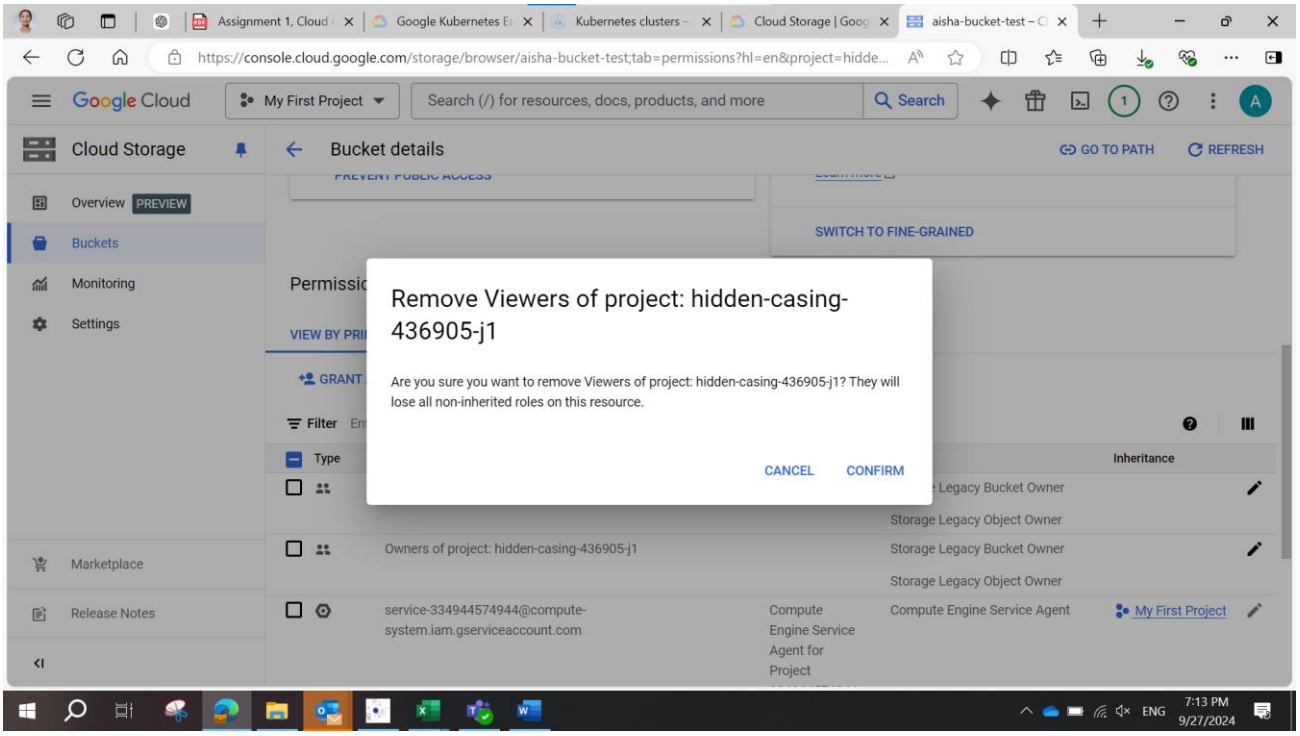
- **How did you verify that your application was successfully deployed and accessible?**
  - Describe the steps you took to expose the Kubernetes service (e.g., using kubectl expose), obtain the external IP, and access the web application through the browser to confirm deployment success.

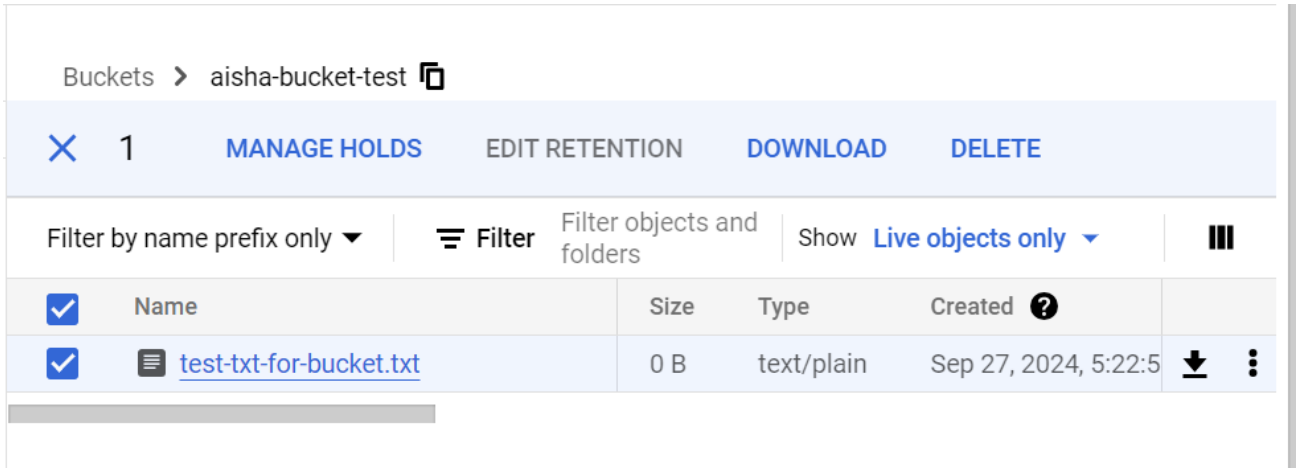
Exercise 5: Storing and Accessing Data in Google Cloud Storage




Google Cloud
My First Project
Search (/) for resources, docs, products, and more
Search
Cloud Storage
Bucket details
GO TO PATH
REFRESH
LEARN
Overview
PREVIEW
Buckets
Monitoring
Settings
aisha-bucket-test
Location
us (multiple regions in United States)
Storage class
Standard
Public access
Not public
Protection
Soft Delete
OBJECTS
CONFIGURATION
PERMISSIONS
PROTECTION
LIFECYCLE
OBSERVABILITY
INVENTORY REPORTS
OPERATIONS
Folder browser
aisha-bucket-test
Buckets > aisha-bucket-test
CREATE FOLDER
UPLOAD
TRANSFER DATA
OTHER SERVICES
Filter by name prefix only
Filter
Filter objects and folders
Show
Live objects only
Name
Size
Type
Created
Storage class
Last modified
Public access
Version history
test-txt-for-bucket.txt
0 B
text/plain
Sep 27, 2024, 5:22:56 PM
Standard
Sep 27, 2024, 5:22:56 PM
Not public
1 file successfully uploaded
Uploads and My First Project operations
test-txt-for-bucket.txt
Complete
Marketplace
Release Notes
5:23 PM
9/27/2024


Google Cloud
My First Project
Search (/) for resources, docs, products, and more
Search
Cloud Storage
Bucket details
GO TO PATH
REFRESH
LEARN
Overview
PREVIEW
Buckets
Monitoring
Settings
aisha-bucket-test
Location
us (multiple regions in United States)
Storage class
Standard
Public access
Not public
Protection
Soft Delete
OBJECTS
CONFIGURATION
PERMISSIONS
PROTECTION
LIFECYCLE
OBSERVABILITY
INVENTORY REPORTS
OPERATIONS
Public access
Not public
This bucket is not publicly accessible since public access is
prevented. Because of this restriction, objects cannot be publ
shared over the internet. Learn more
Principals restricted from bucket access:
allUsers, allAuthenticatedUsers
REMOVE PUBLIC ACCESS PREVENTION
Remove public access prevention on this bucket?
You are about to remove the constraint that prevents public access to the bucket aisha-bucket-test. Without public access prevention, objects in this bucket could be made accessible to anyone on the public internet.
By allowing public access, any permissions that had been previously granted to allUsers or allAuthenticatedUsers will be restored. Learn more about this setting
CANCEL
CONFIRM
Permissions
VIEW BY PRINCIPALS
VIEW BY ROLES
GRANT ACCESS
REMOVE ACCESS
Filter
Enter property name or value
Type
Principal
Name
Role
Inheritance
Editors of project: hidden-casing-436905-j1
Storage Legacy Bucket Owner
Storage Legacy Object Owner
Owners of project: hidden-casing-436905-j1
Storage Legacy Bucket Owner
Storage Legacy Object Owner
service-334944574944@compute-system.iam.gserviceaccount.com
Compute Engine Service Agent
Public access is prevented for this bucket
Uploads and My First Project operations
test-txt-for-bucket.txt
Complete
Marketplace
Release Notes
5:24 PM
9/27/2024



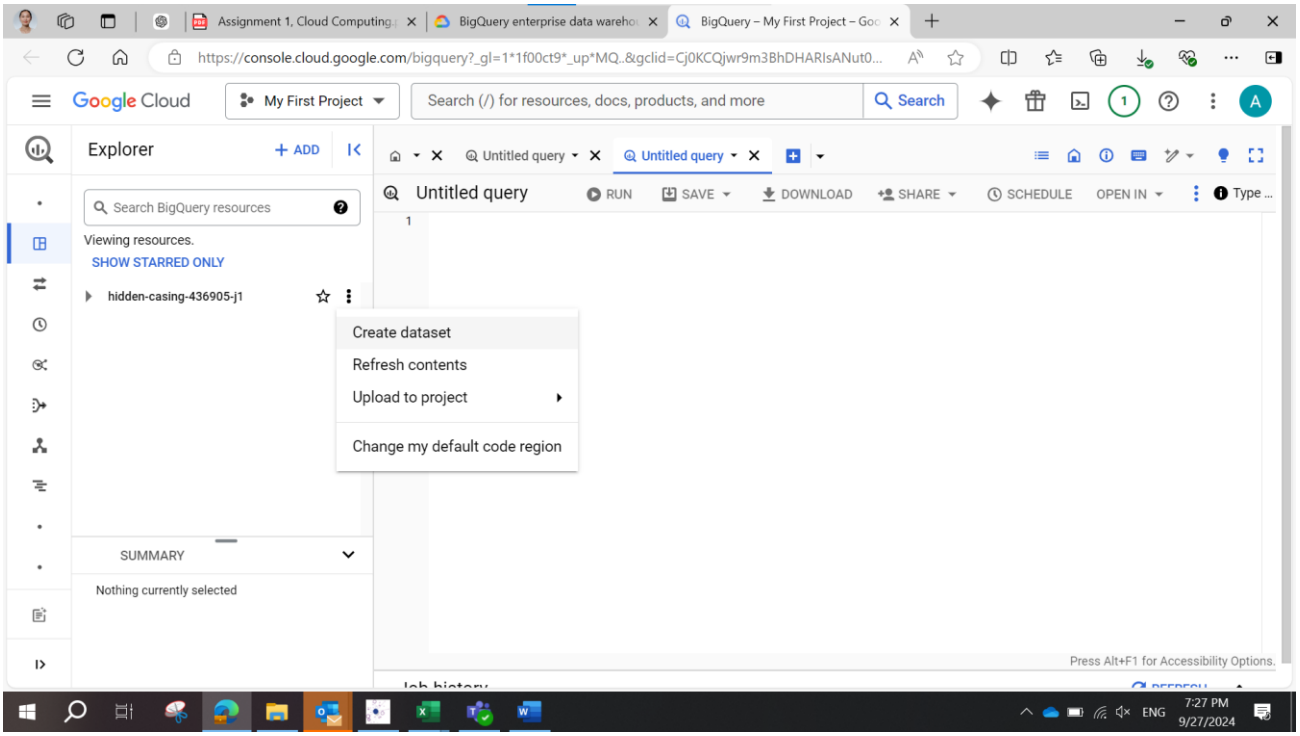


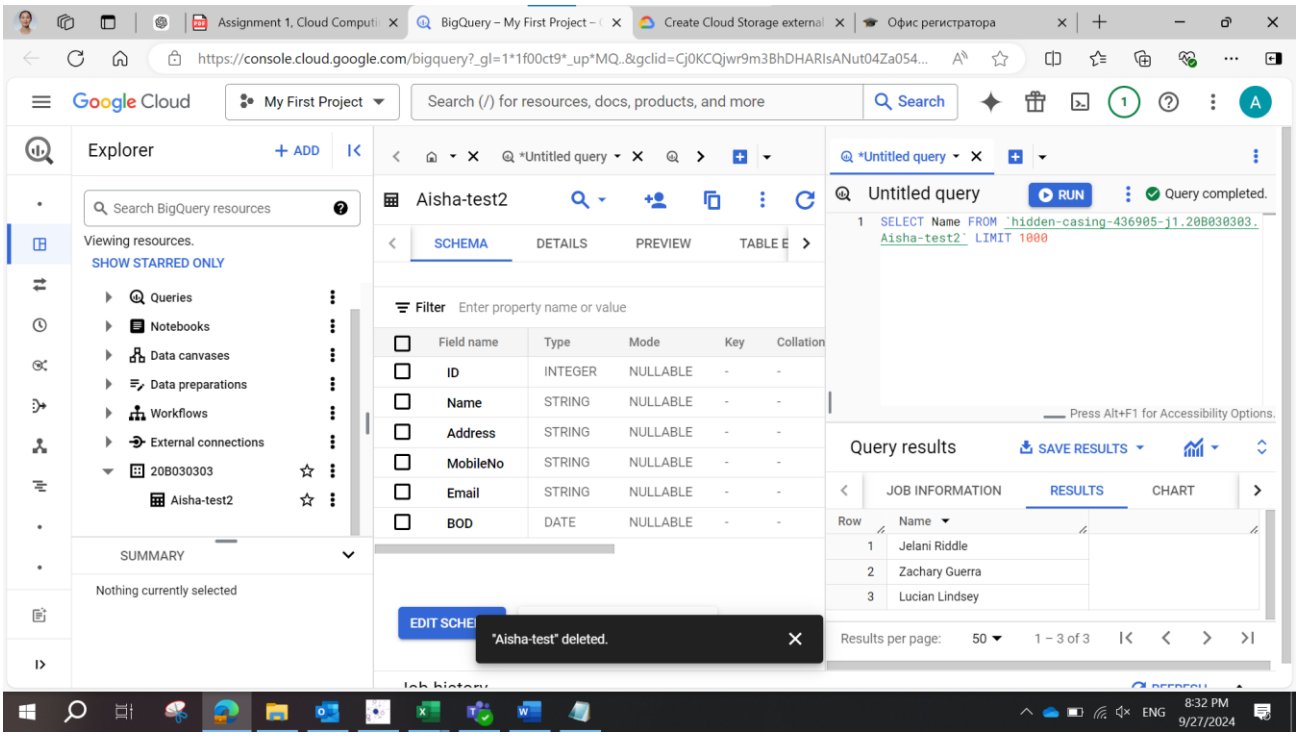
Questions:

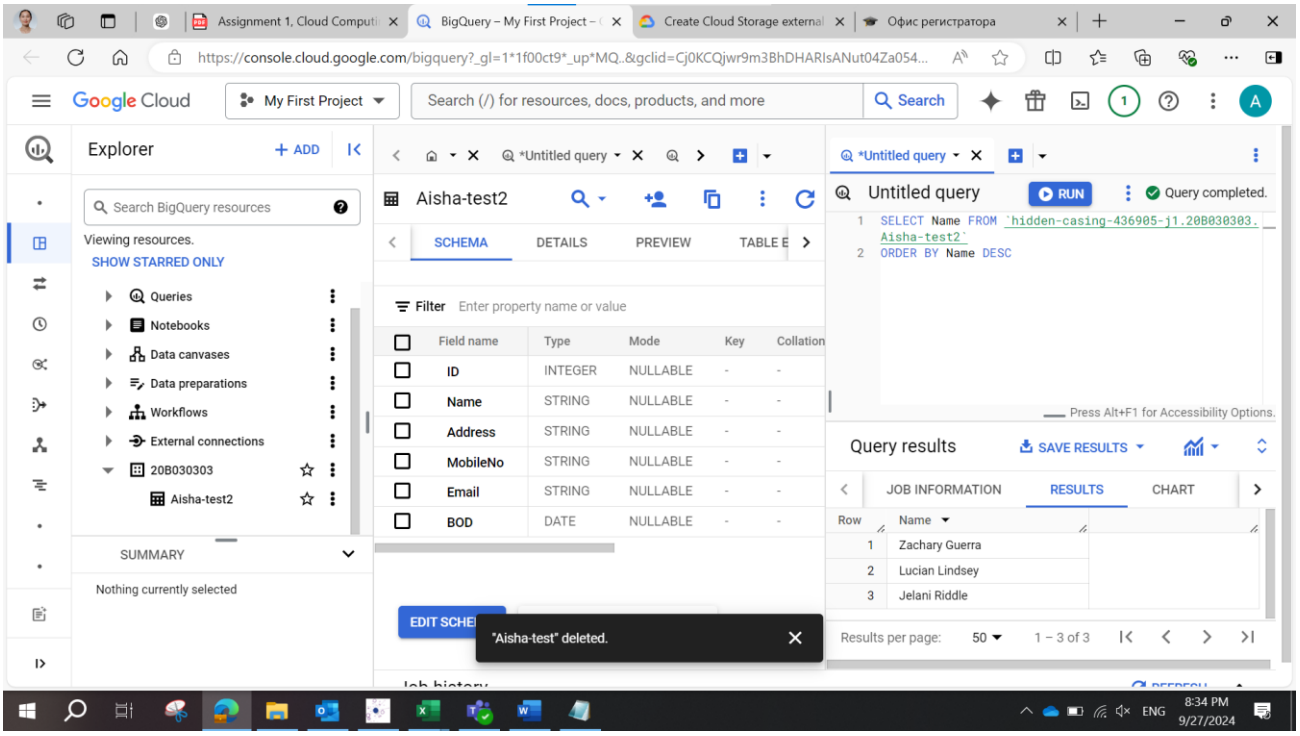
1. **How do you create a Cloud Storage bucket, and what options are available during setup?**
   - You can create a bucket by navigating to **Storage** in the Google Cloud Console and clicking **Create Bucket**. Setup options include:
     - **Bucket name**: Must be globally unique.
     - **Region**: Where your bucket will be stored (multi-region, single-region).
     - **Storage class**: Determines cost and data access (e.g., Standard, Nearline).
     - **Access control**: Uniform (bucket-level control) or Fine-grained (individual file control).
2. **What are the differences between setting a bucket to public versus private?**
   - **Public**: Anyone with the public URL can access files in the bucket without authentication. This is useful for sharing assets like images or videos publicly.
   - **Private**: Only users with specific permissions (IAM roles) can access files. This is important for sensitive data or controlled access.
3. **How can you manage access permissions for individual files in a bucket?**

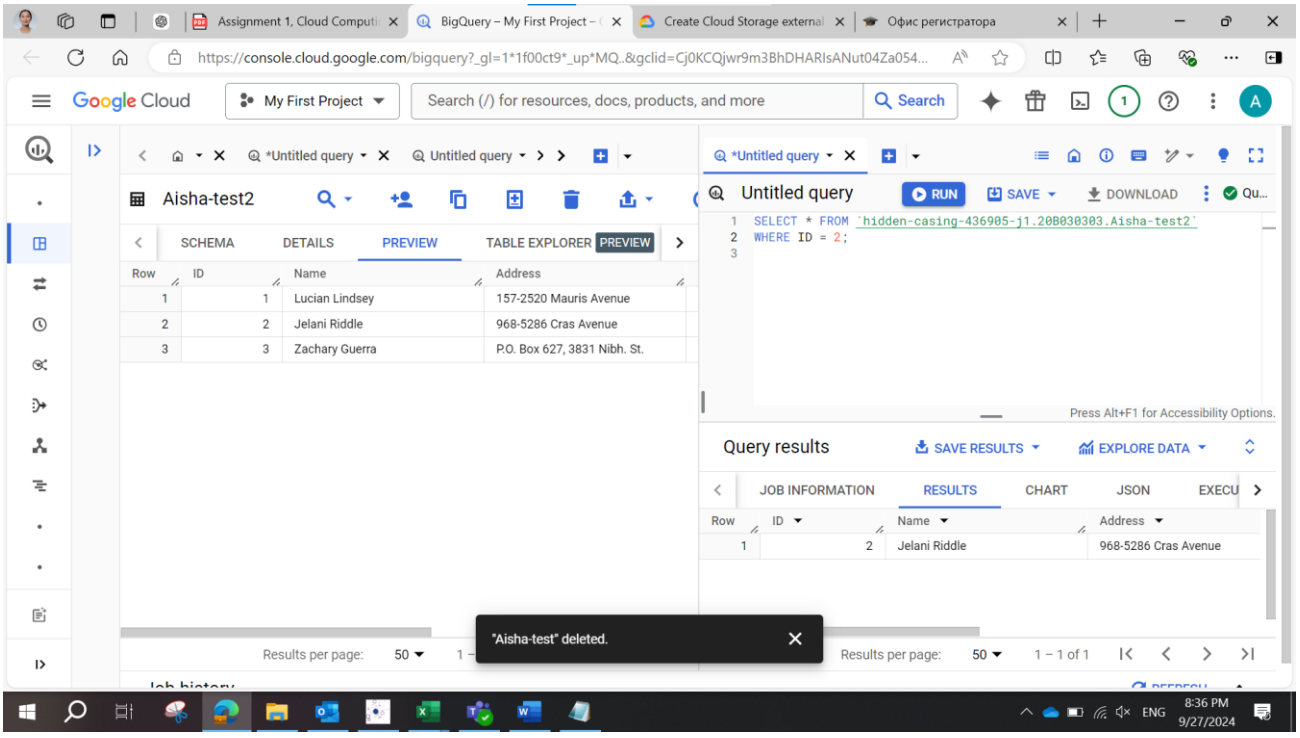
- With **Fine-grained access**, you can manage individual file permissions by going to the file's settings in the **Permissions** tab and adding/removing specific IAM roles or setting public/private access for that specific file. You can also apply access policies using signed URLs for temporary access.

Exercise 6: Analyzing Data with BigQuery









Questions:

1. **What steps did you take to create a dataset and table in BigQuery?**
   - I navigated to **BigQuery** in the Google Cloud Console, clicked on **Create Dataset**, named it, and set the region. Then, I created a table by importing a sample dataset from **Google Cloud Storage** or **Sample Tables**.
2. **How did you write and execute SQL queries in BigQuery?**

- I used the **BigQuery Editor** to write SQL queries like SELECT, WHERE, GROUP BY, and ORDER BY for filtering, aggregating, and sorting data. After writing the query, I clicked **Run** to execute it and review the results.

3. **What insights were you able to derive from the data analysis?**
   - The analysis provided insights such as:
     - Data distribution through aggregation queries.
     - Identified key trends or outliers based on filtering and sorting.
     - Summarized information, like the frequency of specific values in columns or overall patterns.