

Assignment 1, Cloud Computing

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Exercise 1: Understanding Cloud Computing Models

1. **Objective:** Explore different cloud computing models and understand their key differences.

2. **Steps:**

- Research the three primary cloud service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).

Answer:

Infrastructure-as-a-Service (IaaS): A set of raw IT resources offered to the user by the cloud service provider. They can be used to virtualise an infrastructure, or for resource-intensive projects — i.e. machine learning, big data, hosting, etc.

Platform-as-a-Service (PaaS): A platform that a provider offers to its customers via the internet. It enables teams — especially developers — to build applications and software on a solution without having to maintain it. Some applications support a wide variety of programming languages, which means they deliver more flexibility than an application hosted on a local infrastructure.

Software-as-a-Service (SaaS): This is the most popular cloud service. It is software that runs on a provider's infrastructure. The user pays for the license, but does not manage the data storage or physical hardware maintenance.

- Create a table comparing these models in terms of control, flexibility, and use cases.

Answer:

Model	Control Level	Flexibility	Use Cases
IaaS (Infrastructure as a Service)	High	High	Ideal for businesses that prefer to handle their own software applications, data management, middleware, and operating systems without worrying about the underlying hardware and networking infrastructure. This setup is typically used for creating virtual data centers, running complex software applications, and ensuring business continuity through disaster recovery solutions.
PaaS (Platform as a Service)	Medium	Medium	This solution is well-suited for developers aiming to create applications without managing the underlying infrastructure. It's typically used in various settings, such as development frameworks, analytics platforms, or business intelligence tools.

			Additionally, it plays a critical role in web hosting services, allowing developers to focus on building their solutions without the need to handle servers or other infrastructure components. It's a go-to choice when efficiency and scalability are priorities, making development faster and simpler
SaaS (Software as a Service)	Low	Low	Best for both end-users and businesses that want ready-to-go tools without the hassle of managing the backend. It's commonly used for things like email services, customer relationship management (CRM) systems, and collaboration tools. The appeal here is simplicity – you get a complete, functional product right out of the box, so there's no need to worry about servers, updates, or technical maintenance. It saves time and effort, letting users focus on their work instead of the tech behind it.

- Identify examples of services offered by Google Cloud Platform (GCP) under each model.

Answer:

Infrastructure as a Service (IaaS)

- Compute Engine: Virtual machines for running applications.
- Cloud Storage: Object storage for storing files of any size.
- Cloud SQL: Managed relational database service.
- Cloud Bigtable: NoSQL database for large-scale, high-performance applications.
- Virtual Private Cloud (VPC): Network infrastructure for creating private networks.

Platform as a Service (PaaS)

- App Engine: Fully managed platform for building and deploying scalable web applications.
- Cloud Functions: Serverless compute platform for executing code in response to events.
- Cloud Run: Serverless platform for running containerized applications.
- Cloud Dataflow: Fully managed service for data processing and analysis.

Software as a Service (SaaS)

- Google Workspace: Suite of productivity tools, including Gmail, Calendar, Docs, Sheets, and Slides.
- Google Cloud Search: Enterprise search service.
- Google Maps Platform: API for integrating maps and location-based services into applications.
- Google Analytics: Web analytics service.
- Google Marketing Platform: Suite of marketing tools, including AdWords, DoubleClick, and Analytics 360.

3. Questions:

- What are the main differences between IaaS, PaaS, and SaaS?

Answer:

Feature	IaaS	PaaS	SaaS
Control	High	Medium	Low
Management	Operating system, applications, data	Applications, data	None
Cost	Variable (based on usage)	Variable (based on usage)	Fixed subscription
Flexibility	High	Medium	Low
Time to market	Longer	Shorter	Fastest

- Which GCP services fall under each of these models?

Infrastructure as a Service (IaaS):

- Compute Engine: Virtual machines for running applications.
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Software as a Service (SaaS):

- Google Workspace: Suite of productivity tools, including Gmail, Calendar, Docs, Sheets, and Slides.
- Google Cloud Search: Enterprise search service.
- Google Maps Platform: API for integrating maps and location-based services into applications.
- Google Analytics: Web analytics service.
- Google Marketing Platform: Suite of marketing tools, including AdWords, DoubleClick, and Analytics 360.

Answer:

- Provide a real-world example where each cloud service model might be the most appropriate choice.

Answer:

IaaS	Google Cloud Platform (GCP): Used by many companies for infrastructure, including Kaspi.kz, Chocofood, TechOrda, Halyk Bank, Tengribank, Astana Hub, Ministry of Digital Development, Tengri News, Kazakhfilm, Nazarbayev University, and International Kazakh-Turkish University.
SaaS	Google Workspace: Used by many companies, including TechOrda, Halyk Bank, Tengribank, Astana Hub, Ministry of Digital Development, Tengri News, Kazakhfilm, Nazarbayev University, and International Kazakh-Turkish University. Google Maps API: Used by Chocofood. Google Analytics: Used by Chocofood, Tengri News, and potentially others.
PaaS	Google App Engine: Potentially used by companies for building and deploying web applications, though not explicitly mentioned in the examples. Cloud Functions: Could be used for serverless functions, but it's not directly mentioned.

Exercise 2: Exploring Google Cloud Platform's Core Services

1. **Objective:** Get acquainted with the core services provided by Google Cloud Platform.

2. Steps:

- Access the Google Cloud Console and navigate to the list of GCP services.

Answer:

All products

Explore products from Google Cloud and recommended partners at a glance

Management

- Control costs, establish identity and access management, and use APIs

Name	Description
APIs & Services	API management for cloud services
Billing	Assortment of billing and cost management tools
IAM & Admin	Resource access control
Google Cloud Setup	Set up and deploy a best-practice foundation
Admin for Gemini	Purchase and manage subscriptions in Google Cloud

Compute

- Run scalable virtual machines and containers

Name	Description
Compute Engine	VMs, GPUs, TPUs, disks
Kubernetes Engine	Managed Kubernetes / containers
VMware Engine	VMware as a service

- Explore and describe the purpose of the following core services:

- Compute Engine
- Google Kubernetes Engine (GKE)
- App Engine
- Cloud Storage
- BigQuery

Answer:

- Compute Engine - provides virtual machines (VMs) for running applications in the cloud.
- Google Kubernetes Engine (GKE)- a managed Kubernetes service for deploying, managing, and scaling containerized applications.
- App Engine- a fully managed platform for building and deploying scalable web applications.
- Cloud Storage- a highly scalable object storage solution for storing and retrieving data of any size.
- BigQuery- a fully managed, serverless data warehouse for large-scale data analysis and querying.

- For each service, identify a potential use case in a business scenario.

Answer:

Compute Engine	a financial institution can use Compute Engine to host a trading platform, allowing for scalable and reliable execution of trades.
Google Kubernetes Engine (GKE)	a bank can use GKE to deploy a microservices-based application for fraud detection, enabling faster and more efficient analysis of transaction data.
App Engine	a fintech startup can use App Engine to build a mobile payment

	application, leveraging its scalability and ease of development.
Cloud Storage	an insurance company can use Cloud Storage to store large volumes of customer data, including policy documents, claims information, and analytics results.
BigQuery	a hedge fund can use BigQuery to analyze vast datasets of financial market data, identify patterns, and make informed investment decisions.

3. Questions:

- What is the primary use case of Compute Engine?

Answer:

Compute Engine is primarily used to provide virtual machines (VMs) for running applications in the cloud.

- 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 many of the complex tasks involved in running and scaling containerized workloads. Some benefits: container orchestration, cluster management, integration with Google Cloud Platform.

- What advantages does Cloud Storage offer for data management?

Answer:

Cloud Storage provides a flexible, scalable, and secure solution for managing data in the cloud. Advantages of data management: scalability, durability, accessibility, cost-efficiency, encryption, security.

- Why would a business choose BigQuery for their data analysis needs?

Answer:

BigQuery is a powerful and efficient tool for businesses that need to analyze large datasets quickly and easily. Its scalability, performance, and integration capabilities make it a popular choice for data analysis and business intelligence applications.

Exercise 3: Creating and Managing Virtual Machines with Compute Engine

1. Objective: Learn how to create, manage, and interact with virtual machines (VMs) using Compute Engine.

2. Steps:

- In the Google Cloud Console, navigate to Compute Engine and create a new VM instance.

Answer:

The screenshot shows the Google Cloud Compute Instances page. At the top, there's a navigation bar with back, forward, and search icons. Below it is the Google Cloud logo and a dropdown for 'My First Project'. A search bar contains the placeholder 'Search (/) for resources, docs, products, and more'. To the right of the search bar are several icons: a magnifying glass for search, a gift box, a document, a refresh arrow, a question mark, and a help icon.

The main content area has a header 'VM instances' with sub-options 'CREATE INSTANCE', 'IMPORT VM', and 'REFRESH'. Below this is a navigation bar with tabs: 'INSTANCES' (selected), 'OBSERVABILITY', and 'INSTANCE SCHEDULES'. On the far right of this bar is a 'LEARN' button.

The 'VM instances' section lists one instance: 'instance-cloudcomp'. The table columns are: Status (green checkmark), Name (instance-cloudcomp), Zone (northamerica-northeast2-a), Recommendations, In use by, Internal IP (10.188.0.2 (nic0)), External IP (34.130.236.24 (nic0)), Connect (SSH dropdown), and a more options menu. A 'Filter' input field is above the table.

Below the table is a 'Related actions' section with six cards:

- 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.

- Configure the VM with specific parameters, such as the machine type, region, and operating system.

Answer:

The screenshot shows the Google Cloud Compute Instances Detail page for the VM 'instance-cloudcomp'. The top navigation bar is identical to the previous screenshot. The main content area has a header 'instance-clou...' with sub-options 'EDIT', 'RESET', 'CREATE MACHINE IMAGE', 'CREATE SIMILAR', and 'EQUIVALENT CODE'.

The main content area is divided into sections: 'DETAILS' (selected), 'OBSERVABILITY', 'OS INFO', and 'SCREENSHOT'. The 'Basic information' section contains the following details:

Name	instance-cloudcomp
Instance Id	4061836014704622120
Description	None
Type	Instance
Status	Running
Creation time	Sep 27, 2024, 7:44:27 PM UTC+05:00
Zone	northamerica-northeast2-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

Below this is a 'Machine configuration' section.

- Connect to the VM using SSH and install a basic web server (e.g., Apache or Nginx).

Answer:

```

Linux instance-cloudcomp 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.
zresulu23@instance-cloudcomp:~$ ls
zresulu23@instance-cloudcomp:~$ is
-bash: is: command not found
zresulu23@instance-cloudcomp:~$ cat /etc/issue

```

- Stop, start, and delete the VM through the console.

Answer:

Status	Name	Zone	Recommendations	In use by	Internal IP	External IP	Connect
<input checked="" type="checkbox"/>	instance-cloudcomp	northamerica-northeast2-a			10.188.0.2 (nic0)	34.130.236.24 (nic0)	SSH

The screenshot shows the Google Cloud Compute Engine Instances page. A single VM instance named "instance-cloudcomp" is listed. The instance is running in the "northamerica-northeast2-a" zone. Its internal IP is 10.188.0.2 (nic0) and its external IP is 34.130.236.24 (nic0). The "SSH" button is visible. Below the table, there's a section titled "Related actions" with links like "Explore Backup and DR", "View billing report", "Monitor VMs", "Explore VM logs", "Set up firewall rules", "Patch management", and "Load balance between VMs". A notification at the bottom says "VM instance started".

This screenshot is from the same Google Cloud Compute Engine Instances page as the first one, but it shows a delete operation. The "instance-cloudcomp" instance is selected, indicated by a green checkmark. A progress bar at the bottom says "Deleting instance-cloudcomp...". The rest of the interface is identical to the first screenshot.

3. Questions:

- What steps did you follow to create the VM?

Answer:

1. log in to the google cloud console
2. navigate to compute engine: select "vm instances"
3. create a vm instance: click the "create" button.
4. choose a vm name
5. select a zone
6. configure machine type

7. choose boot disk
8. configure networking
9. set firewall rules
10. create the vm

- o How did you connect to the VM, and what commands did you use to install the web server?

Answer:

use SSH (Secure Shell)

- o What happens to the VM and its data when it is stopped versus when it is deleted?

Answer:

differences when I stop and delete VM

Feature	Stopping	Deleting
Data Preservation	Yes	No
Billing	Paused	Stopped
Reversibility	Yes	No

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

1. **Objective:** Understand how to deploy and manage containerized applications using Google Kubernetes Engine.

2. Steps:

- o Create a simple Docker container for a web application.

Answer:

The screenshot shows the Google Cloud Platform interface for managing Kubernetes clusters. The URL in the address bar is `console.cloud.google.com/kubernetes/clusters/details/us-central1/cloudcomp-cluster-1/details?hl=ru&project=corded-bivouac-436214-u8`. The main content area displays the details for the cluster `cloudcomp-cluster-1`. The 'Cluster basics' section includes fields for Name (cloudcamp-cluster-1), Location type (Regional), Region (us-central1), Default node zones (us-central1-f, us-central1-a, us-central1-b, us-central1-c), Release channel (Regular channel), Version (1.30.3-gke.1969001), External endpoint (35.224.63.186), Internal endpoint (10.128.0.2), and Rollout sequence (To use rollout sequencing, register your cluster to a fleet). The 'Automation' section shows Maintenance window (Any time) and Maintenance exclusions (None).

- Push the container image to Google Container Registry (GCR).

Answer:

Google Cloud Search (My First Project) Search (Cluster basics)

cloudcomp-cluster-1

Cluster basics

Name	cloudcomp-cluster-1
Location type	Regional
Region	us-central1
Default node zones	us-central1-f us-central1-a us-central1-b us-central1-c
Release channel	Regular channel
Version	1.30.3-gke.1969001
External endpoint	35.224.63.186 Show cluster certificate
Internal endpoint	10.128.0.2 Show cluster certificate
Rollout sequence	To use rollout sequencing, register your cluster to a fleet

Automation

Maintenance window	Any time
Maintenance exclusions	None

- Create a GKE cluster in Google Cloud Console.

Answer:

Google Cloud Search (My First Project) Search (Cluster details)

cluster-1

Cluster details

Name	cluster-1
Location type	Regional
Region	us-central1
Default node zones	us-central1-f us-central1-a us-central1-b us-central1-c
Release channel	Regular channel
Version	1.30.3-gke.1969001
External endpoint	35.224.63.186 Show cluster certificate
Internal endpoint	10.128.0.2 Show cluster certificate
Rollout sequence	To use rollout sequencing, register your cluster to a fleet

- Deploy the containerized application to the GKE cluster.

Answer:

The screenshot shows the Google Cloud Platform interface for a deployment named 'cloudcomp-cluster-1'. In the 'EXPOSE' tab, there is a note: 'To let others access your deployment, expose it to create a service'. Below this, the 'DETAILS' tab is selected, showing the following configuration:

- Cluster:** cloudcomp-cluster-1
- Namespace:** default
- Created:** Sep 28, 2024, 10:38:52 AM
- Labels:** app: deployment-1
- Annotations:** autopilot.gke.io/resource-adjustment: {"input": {"containers": [{"name": "nginx-1"}]}, "output": {"containers": [{"limits": {"ephemeral-storage": "1Gi"}, "requests": {"cpu": "500m", "ephemeral-storage": "1Gi", "memory": "2Gi"}, "name": "nginx-1"}]}}, "modified": true, autopilot.gke.io/warden-version: 3.0.34, deployment.kubernetes.io/revision: 1
- Replicas:** 3 updated, 3 ready, 0 available, 3 unavailable
- Label selector:** app = deployment-1
- Update strategy:** Rolling update, Max unavailable: 25%, Max surge: 25%
- Min time ready before available:** 0 s
- Progress deadline:** 600 s
- Revision history limit:** 10

Below the main configuration, there is a section titled 'Autoscaling'.

- Expose the application to the internet and verify its accessibility.

Answer:

The screenshot shows the Google Cloud Platform interface for clusters. A cluster named 'cloudcomp-cluster-1' is selected. In the 'DETAILS' tab, the following configuration is shown:

- Name:** cloudcomp-cluster-1
- Location type:** Regional
- Region:** us-central1
- Default node zones:** us-central1-f, us-central1-a, us-central1-b, us-central1-c
- Release channel:** Regular channel

At the bottom, there is a 'CLOUD SHELL' terminal session for the project 'corded-bivouac-436214-u8'. The terminal output shows the user navigating through Cloud Shell, setting up credentials, and attempting to run 'gcloud' commands, which fail due to 'command not found'.

3. Questions:

- How did you create and push the Docker container to GCR?

Answer:

Create a Google Cloud account

Explore the console

Launch instances

- What steps were involved in setting up the GKE cluster?

Answer:

create a project

enable the kubernetes engine api

choose a zone

configure the cluster

create the cluster

- How did you verify that your application was successfully deployed and accessible?

Answer:

check logs: use `kubectl logs`.

access the application: use public ip or `kubectl port-forward`.

monitor metrics: use cloud monitoring.

check kubernetes status: use `kubectl get pods`.

test functionality: manually test your application.

Exercise 5: Storing and Accessing Data in Google Cloud Storage

1. **Objective:** Learn how to store, manage, and access data using Google Cloud Storage.

2. **Steps:**

- Create a new Cloud Storage bucket in the Google Cloud Console.

Answer:

- Upload various types of files (e.g., text, images, videos) to the bucket.

Answer:

- Set access permissions for the bucket and test public and private access to the files.

Answer:

- Use the Cloud Console to download, move, and delete files in the bucket.

Answer:

3. Questions:

- How do you create a Cloud Storage bucket, and what options are available during setup?

Answer:

log in to google cloud console
 navigate to cloud storage
 click "create bucket"
 name your bucket and choose a location
 set storage class, access control, and other options
 click "create"

- What are the differences between setting a bucket to public versus private?

Answer:

public for sharing, private for security

Feature	Public	Private
Visibility	Public	Private
Usage	Share data	Store sensitive data
Access Control	Basic	Strict

- How can you manage access permissions for individual files in a bucket?

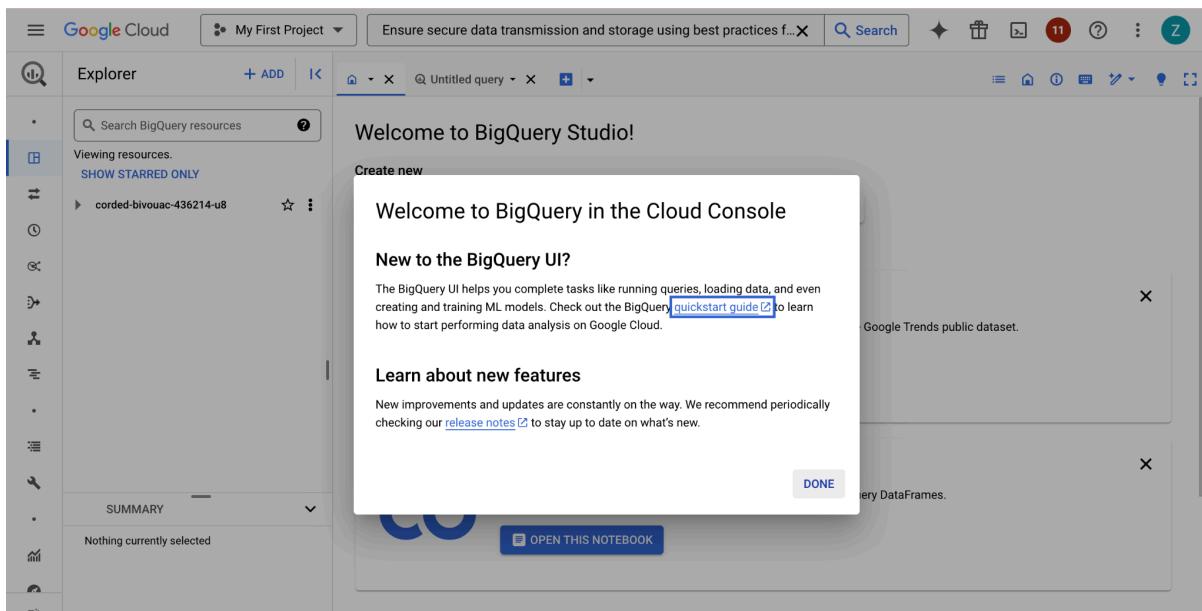
Answer: Set bucket-level permissions.

Exercise 6: Analyzing Data with BigQuery

1. **Objective:** Perform data analysis tasks using BigQuery.

2. **Steps:**

- Access BigQuery in the Google Cloud Console.



- Create a dataset and table by importing a sample dataset provided by Google.

Answer:

Table ID	corded-bivouac-436214-u8.1234cc.10
Created	Sep 28, 2024, 11:06:11 AM UTC+5
Last modified	Sep 28, 2024, 11:06:11 AM UTC+5
Table expiration	NEVER
Data location	US
Default collation	
Default rounding mode	ROUNDING_MODE_UNSPECIFIED
Case insensitive	false
Description	
Labels	
Primary key(s)	
Tags	

Storage info	
Number of rows	50
Total logical bytes	17.58 KB

- Write and execute SQL queries to perform basic data analysis, such as filtering, aggregation, and sorting.

Answer:

- Visualize the results using Google Data Studio or another visualization tool.

Answer:

3. Questions:

- What steps did you take to create a dataset and table in BigQuery?

Answer:

log in to the google cloud console

navigate to bigquery

create a dataset
name your dataset
choose a location
create the dataset
create a table
name your table
define the schema

- How did you write and execute SQL queries in BigQuery?

Answer:

through navigating to table explorer in BigQuery

-

Answer:

customer behaviour