

# Assignment 1. Cloud Computing

## Temirzhanov Meiram Sopy

### Exercise 1: Understanding Cloud Computing Models

#### **Infrastructure as a Service (IaaS)**

IaaS allows users to utilize computing resources such as servers, storage, and virtualization. The provider is responsible for maintaining the hardware, while users manage their software, including the operating system, databases, and applications.

#### **Platform as a Service (PaaS)**

PaaS supplies the necessary tools and environment for developing, testing, and deploying applications. The cloud provider manages the underlying infrastructure, encompassing both hardware and software components.

#### **Software as a Service (SaaS)**

SaaS delivers fully functional software applications that users can access via the internet. The cloud provider oversees all aspects of these applications.

**In IaaS, users have the highest level of control, managing their operating systems and applications while the provider maintains the physical servers and hardware. PaaS simplifies the process by managing most of the infrastructure, allowing users to concentrate on developing and running their applications without concerns about the backend. SaaS entails the provider managing everything, from infrastructure to software.**

*Which GCP services fall under each of these models?*

IaaS - Cloud Storage, Compute Engine

PaaS - Cloud SQL, App Engine

SaaS - BigQuery, Workspace

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

#### **IaaS - Google Cloud Storage**

For example, we have a media company. So we need to store and retrieve a large amount of unstructured data, such as photos and videos.

And Google Cloud Storage is a fine scalable decision, as the data grows everyday, and would be good for media files, backups, and logs. It gives users control over how data is stored and organized, can be accessed from everywhere and supports various storage Classes.

#### **PaaS - Google Cloud SQL**

For instance, we have an e-commerce app and we need a relational db to store data on orders, user information and so on.

Google Cloud SQL is a satisfactory option for managing databases in the cloud because it's easy to use, can grow with your needs, and works well with other Google Cloud services. Also, it supports databases like MySQL, PostgreSQL, making it flexible for different apps. It

means businesses can move their current databases to the cloud or create new ones using the database they prefer.

### **SaaS - Google BigQuery**

As an example, a healthcare company wants to analyze patient data from multiple sources, such as electronic devices, lab results, and insurance claims. And they need to identify trends in patient outcomes and improve treatment.

BigQuery can be a good decision because of serverless architecture, so the team can be more focused on analysis rather than system maintenance. Also, it is a good option for running complex queries in order to analyze data. And can be easily integrated with Visualization tools.

## **Exercise 2: Exploring Google Cloud Platform's Core Services**

*What is the primary use case of Compute Engine?*

Google Compute Engine is primarily utilized for running virtual machines in the cloud. It's suitable for hosting websites, running applications, and executing computing tasks such as machine learning.

*How does Google Kubernetes Engine (GKE) simplify the management of containerized applications?*

GKE automates various tasks, including scaling applications in response to increased traffic. It handles monitoring, setup, and scaling efficiently.

*What advantages does Cloud Storage offer for data management?*

Cloud Storage supports a wide range of data types, from images to datasets. It is also scalable and dependable, with data replication options available.

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

BigQuery is ideal for businesses that need to analyze large volumes of data. It executes complex queries quickly, making it effective for generating reports.

## **Exercise 3: Creating and Managing Virtual Machines with Compute Engine**

**Steps:**

- 1. Create instance**

**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.

[CREATE INSTANCE](#) [TAKE THE QUICKSTART](#)

## 2. Edit configurations

**Machine configuration**

Machine types for common workloads, optimized for cost and flexibility

Series	Description	vCPUs	Memory	Platform
C4	Consistently high performance	2 - 192	4 - 1,488 GB	Intel Emerald Rapids
N4	Flexible & cost-optimized	2 - 80	4 - 640 GB	Intel Emerald Rapids
C3	Consistently high performance	4 - 192	8 - 1,536 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 & performance	2 - 128	2 - 864 GB	Intel Cascade and Ice Lake
N2D	Balanced price & 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 & performance	0.25 - 96	0.6 - 624 GB	Intel Skylake

**Machine type**  
Choose a machine type with preset amounts of vCPUs and memory that suit most workloads. Or, you can create a custom machine for your workload's particular needs. [Learn more](#)

[PRESET](#) [CUSTOM](#)

e2-medium (2 vCPU, 1 core, 4 GB memory)

**VCPU** **Memory**

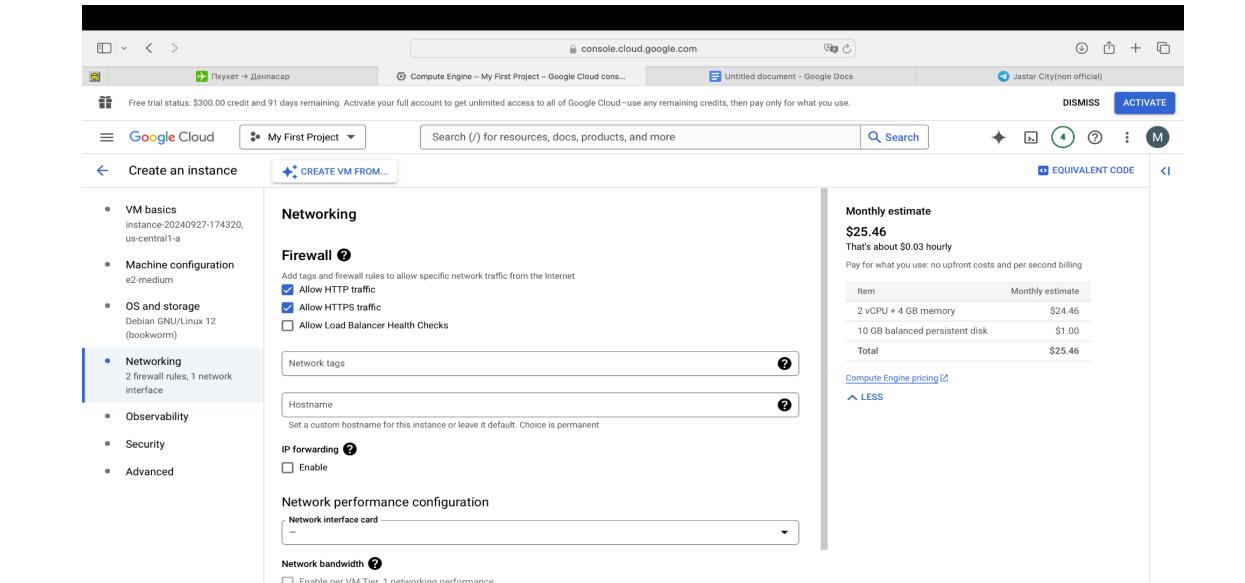
[CREATE](#) [CANCEL](#) [EQUIVALENT CODE](#)

**Monthly estimate**  
**\$25.46**  
That's about \$0.03 hourly  
Pay for what you use: no upfront costs and per second billing

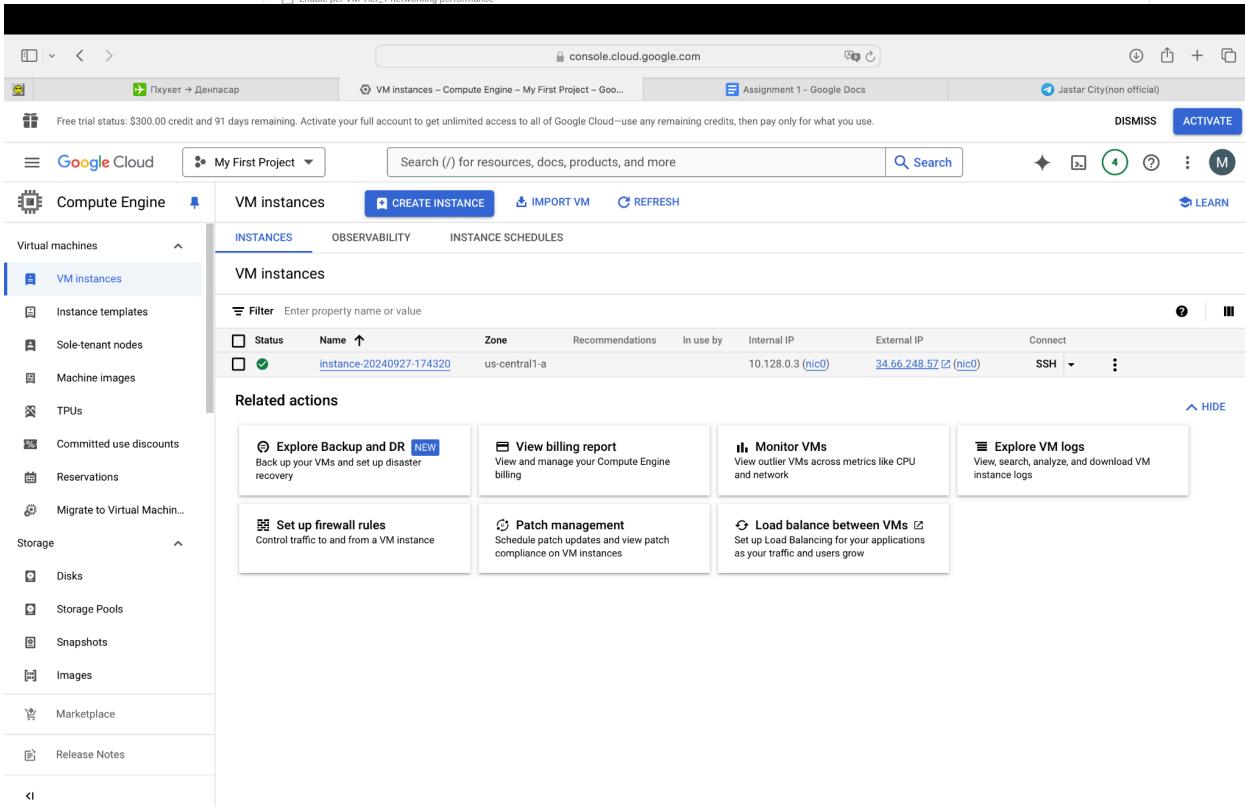
Item	Monthly estimate
2 vCPU + 4 GB memory	\$24.46
10 GB balanced persistent disk	\$1.00
Total	\$25.46

[Compute Engine pricing](#) [LESS](#)

### 3. Allow HTTP/HTTPS traffic



The screenshot shows the Google Cloud Compute Engine interface for creating a new VM instance. In the 'Networking' section, under 'Firewall', the 'Allow HTTP traffic' and 'Allow HTTPS traffic' checkboxes are selected. The 'Monthly estimate' sidebar indicates a cost of \$25.46 per month. The 'VM instances' list on the left shows one existing instance named 'instance-20240927-174320'. The main interface displays the instance details and its status as running.



The screenshot shows the Google Cloud Compute Engine interface for managing VM instances. The 'VM instances' list shows the single instance 'instance-20240927-174320' with its details: Zone (us-central1-a), Internal IP (10.128.0.3), External IP (34.66.248.57), and Connect (SSH). The sidebar on the left provides navigation links for Compute Engine services like Instance templates, Sole-tenant nodes, Machine images, TPU, Committed use discounts, Reservations, Migrate to Virtual Machine, Storage, Disks, Storage Pools, Snapshots, Images, Marketplace, and Release Notes.

### 4. Go to SSH and instal Apache server

```

Linux instance-20240927-174320 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.

mairam@mirrhanov:~$ sudo apt install apache2 -y
Reading package lists... done
Building dependency tree... done
Reading state information... done
The following additional packages will be installed:
apache2-bin apache2-utils libapr1 libaprutil1 libaprutil1-dbd-sqlite3 libaprutil1-ldap libjansson4 liblua5.3-0 ssl-cert
Suggested packages:
apache2-doc apache2-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 0 not upgraded.
Need to get 8,468 kB of additional disk space.
After this operation, 8,468 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 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 [8.8 kB]
Get:6 https://deb.debian.org/debian bookworm/main amd64 libjansson4 amd64 2.14-2 [40.8 kB]
Get:7 https://deb.debian.org/debian bookworm/main amd64 liblua5.3-0 amd64 5.3.6-2 [123 kB]
Get:8 https://deb.debian.org/debian bookworm/main amd64 apache2-bin amd64 2.4.62-1-deb12u1 [1385 kB]
Get:9 https://deb.debian.org/debian bookworm/main amd64 apache2-data all 2.4.62-1-deb12u1 [160 kB]
Get:10 https://deb.debian.org/debian bookworm/main amd64 apache2-utils amd64 2.4.62-1-deb12u1 [210 kB]
Get:11 https://deb.debian.org/debian bookworm/main amd64 apache2 amd64 2.4.62-1-deb12u1 [223 kB]
Get:12 https://deb.debian.org/debian bookworm/main amd64 ssl-cert all 1.1.2 [21.1 kB]
Fetched 2378 in 0s (5368 kB/s)
Preconfiguring packages...
Selecting previously unselected package libapr1:amd64.
(Reading database ... 6988 files and directories currently installed.)
Preparing to unpack .../00-libapr1_1.7.2-3_amd64.deb ...
Unpacking libapr1:amd64 (1.7.2-3) ...
Selecting previously unselected package libaprutil1:amd64.
Preparing to unpack .../01-libaprutil1_1.6.3-1_amd64.deb ...
Unpacking libaprutil1:amd64 (1.6.3-1) ...
Selecting previously unselected package libaprutil1-dbd-sqlite3:amd64.
Preparing to unpack .../02-libaprutil1-dbd-sqlite3_1.6.3-1_amd64.deb ...
Unpacking libaprutil1-dbd-sqlite3:amd64 (1.6.3-1) ...
Selecting previously unselected package libaprutil1-ldap:amd64.
Preparing to unpack .../03-libaprutil1-ldap_1.6.3-1_amd64.deb ...
Unpacking libaprutil1-ldap:amd64 (1.6.3-1) ...
Selecting previous: libapr1:amd64.
Preparing to unpack .../04-libjansson4_2.14-2_amd64.deb ...
Unpacking libjansson4_2.14-2_amd64.deb ...
Selecting previous: libaprutil1-ldap:amd64.
Preparing to unpack .../05-liblua5.3-0_5.3.6-2_amd64.deb ...
Unpacking liblua5.3-0_5.3.6-2_amd64.deb ...
Selecting previous: libaprutil1-ldap:amd64.
Preparing to unpack .../06-apache2_2.4.62-1-deb12u1_all.deb ...
Unpacking apache2_2.4.62-1-deb12u1_all (2.4.62-1-deb12u1) ...
Selecting previous: libaprutil1-ldap:amd64.
Preparing to unpack .../07-apache2-bin_2.4.62-1-deb12u1_amd64.deb ...
Unpacking apache2-bin_2.4.62-1-deb12u1_amd64 (2.4.62-1-deb12u1) ...
Selecting previous: libaprutil1-ldap:amd64.
Preparing to unpack .../08-apache2-data_2.4.62-1-deb12u1_all.deb ...
Unpacking apache2-data_2.4.62-1-deb12u1_all (2.4.62-1-deb12u1) ...
Selecting previous: libaprutil1-ldap:amd64.
Preparing to unpack .../09-apache2-utils_2.4.62-1-deb12u1_amd64.deb ...
Unpacking apache2-utils_2.4.62-1-deb12u1_amd64 (2.4.62-1-deb12u1) ...
Selecting previous: libaprutil1-ldap:amd64.
Preparing to unpack .../10-apache2_2.4.62-1-deb12u1_amd64.deb ...
Unpacking apache2_2.4.62-1-deb12u1_amd64 (2.4.62-1-deb12u1) ...
Selecting previous: libaprutil1-ldap:amd64.
Preparing to unpack .../11-ssl-cert_1.1.2_all.deb ...
Unpacking ssl-cert_1.1.2_all (1.1.2) ...
Setting up libapr1:amd64 (1.7.2-3) ...
Setting up libaprutil1:amd64 (1.6.3-1) ...
Setting up libaprutil1-dbd-sqlite3:amd64 (1.6.3-1) ...
Setting up libaprutil1-ldap:amd64 (1.6.3-1) ...
Setting up libjansson4 (2.14-2) ...
Setting up liblua5.3-0_5.3.6-2_amd64 (5.3.6-2) ...
Setting up apache2-bin (2.4.62-1-deb12u1) ...
Setting up apache2-data (2.4.62-1-deb12u1) ...
Setting up apache2-utils (2.4.62-1-deb12u1) ...
Setting up apache2 (2.4.62-1-deb12u1) ...
Setting up ssl-cert (1.1.2) ...

```

## Here I can stop, start or delete my VM

The screenshot shows the Google Cloud Platform interface for managing VM instances. The main navigation bar includes links for Google Cloud, My First Project, Assignment 1 - Google Docs, ChatGPT, and a user profile icon. The main content area is titled "VM instances" under the "Compute Engine" section. A sidebar on the left provides navigation for Virtual machines, Storage, Committed use discounts, Reservations, Migrate to Virtual Machine, Marketplace, and Release Notes. The main table displays one VM instance:

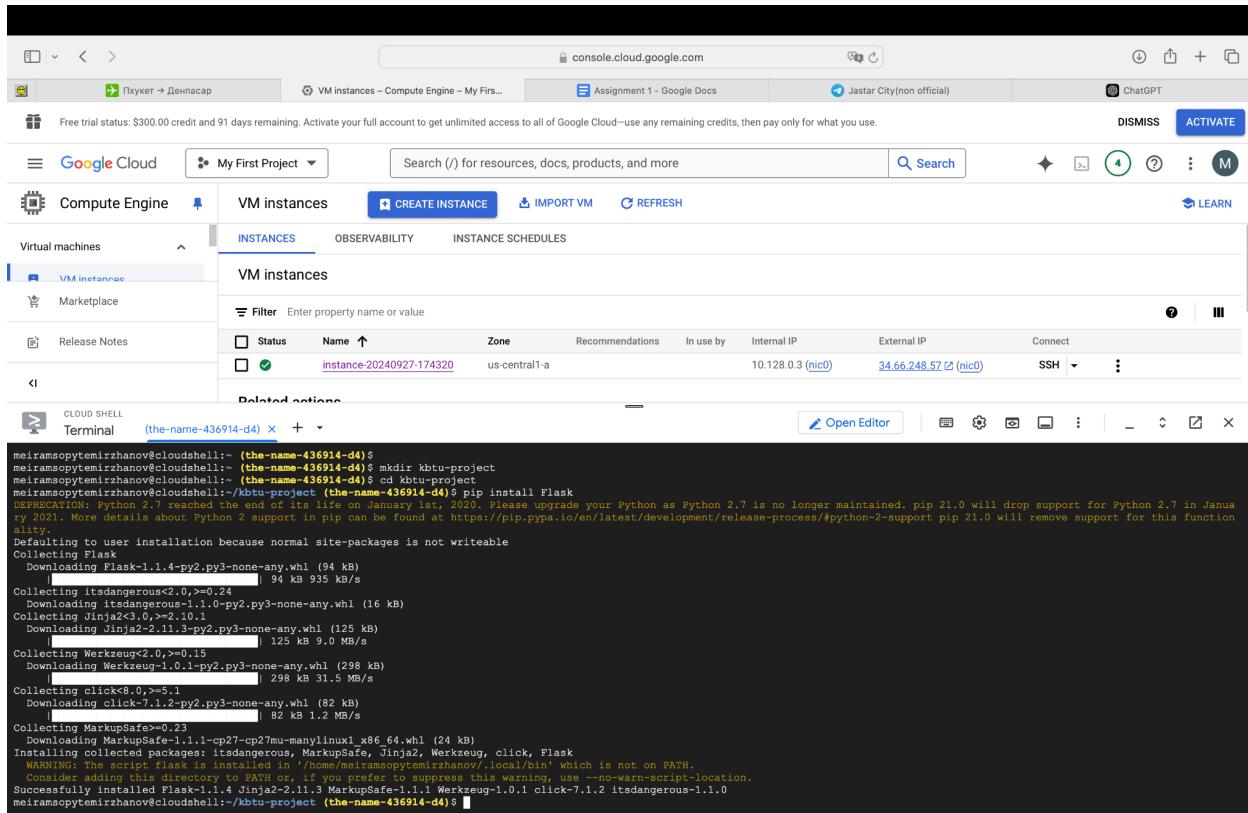
Status	Name	Zone	Recommendations	In use by	Internal IP	External IP	Connect
<input checked="" type="checkbox"/>	instance-20240927-174320	us-central1-a			10.128.0.3 (nic0)	34.66.248.57 (nic0)	SSH

Below the table, there are "Related actions" buttons for various VM management tasks like Explore Backup and DR, View billing report, Monitor VMs, Explore VM logs, Set up firewall rules, Patch management, and Load balance between VMs.

**Answer for the question: When a VM is stopped, you won't be charged for CPU usage, but you will still incur charges for the boot disk. The resources remain accessible. However, if the VM is deleted, the boot disk and all associated resources will be removed and will no longer be available, unless you've created a snapshot.**

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

### Installed flask

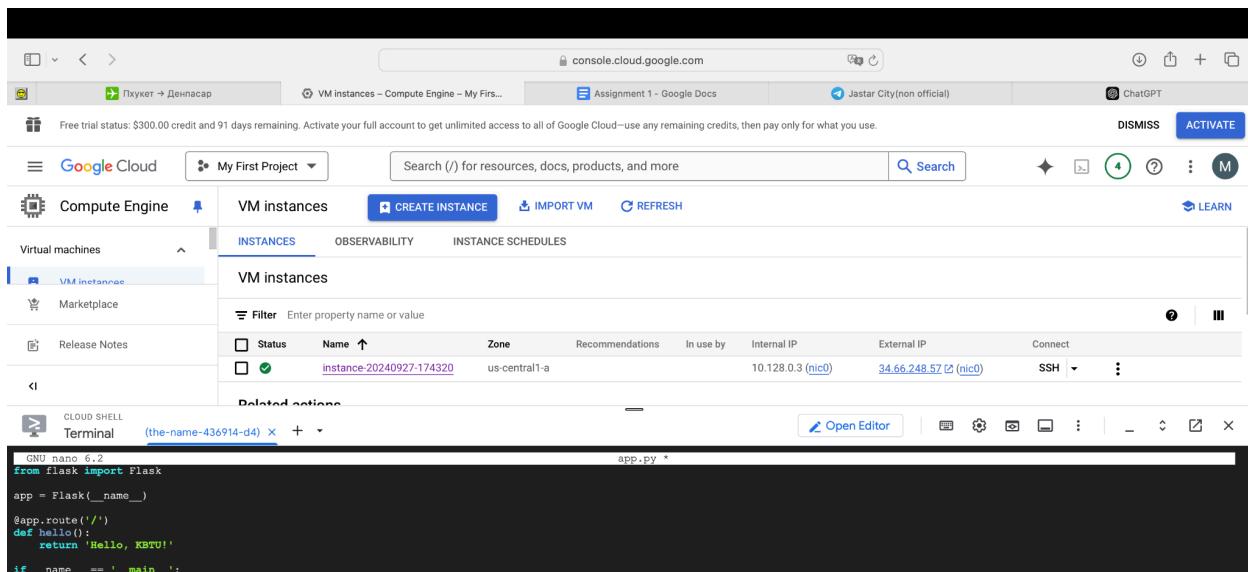


```

meiramsopystemirzhanov@cloudshell:~ (the-name-436914-d4)$ meiramsopystemirzhanov@cloudshell:~ (the-name-436914-d4)$ mkdir kbtu-project
meiramsopystemirzhanov@cloudshell:~ (the-name-436914-d4)$ cd kbtu-project
meiramsopystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ pip install Flask
DEPRECATION: Python 2.7 will reach the end of its life on January 1st, 2020. Please upgrade your Python as Python 2.7 is no longer maintained. pip 21.0 will drop support for Python 2.7 in January 2021. More details about Python 2 support in pip can be found at https://pip.pypa.io/en/latest/development/release-process/#python-2-support pip 21.0 will remove support for this functionality.
Defaulting to user installation because normal site-packages is not writable
Collecting Flask
  Downloading Flask-1.1.4-py2.py3-none-any.whl (94 kB)
Collecting itsdangerous<2.0,>=0.24
  Downloading itsdangerous-1.1.0-py2.py3-none-any.whl (16 kB)
Collecting Jinja2<3.0,>=2.10.1
  Downloading Jinja2-2.11.3-py2.py3-none-any.whl (125 kB)
Collecting Werkzeug<2.0,>=0.15
  Downloading Werkzeug-1.0.1-py2.py3-none-any.whl (298 kB)
Collecting click<8.0,>=5.1
  Downloading click-7.1.2-py2.py3-none-any.whl (82 kB)
Collecting MarkupSafe<0.23
  Downloading MarkupSafe-1.1.1-cp27-cp27mu-manylinux1_x86_64.whl (24 kB)
Installing collected packages: itsdangerous, MarkupSafe, Jinja2, Werkzeug, click, Flask
WARNING: The script flask is installed in '/home/meiramsopystemirzhanov/local/bin' which is not on PATH.
Consider adding this directory to PATH or, if you prefer to suppress this warning, use --no-warn-script-location.
Successfully installed Flask-1.1.4 Jinja2-2.11.3 MarkupSafe-1.1.1 Werkzeug-1.0.1 click-7.1.2 itsdangerous-1.1.0
meiramsopystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$

```

### Created app.py

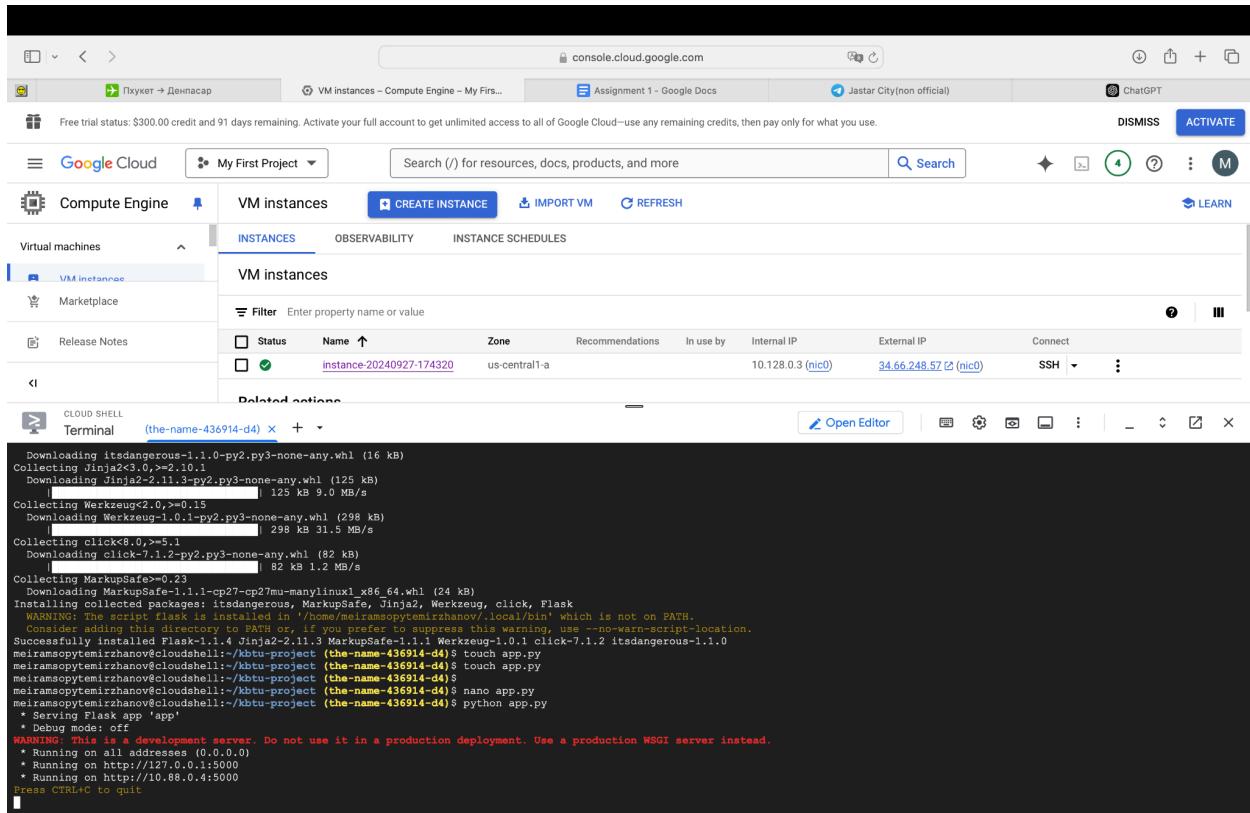


```

GNU nano 6.2
from flask import Flask
app = Flask(__name__)
@app.route('/')
def hello():
    return 'Hello, KBTU!'
if __name__ == '__main__':
    app.run()

```

## Started python app in localhost:5000



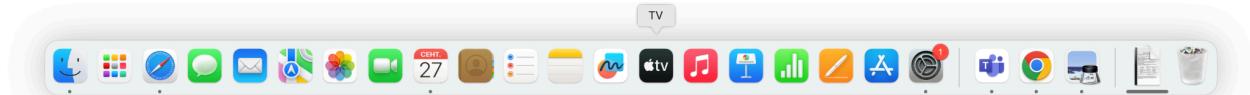
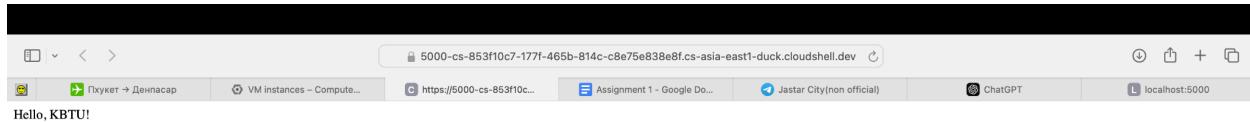
The screenshot shows the Google Cloud Platform Compute Engine VM instances page. A single VM instance is listed:

Status	Name	Zone	Recommendations	In use by	Internal IP	External IP	Connect
Green checkmark	instance-20240927-174320	us-central1-a			10.128.0.3 (nic0)	34.66.248.57 (nic0)	SSH

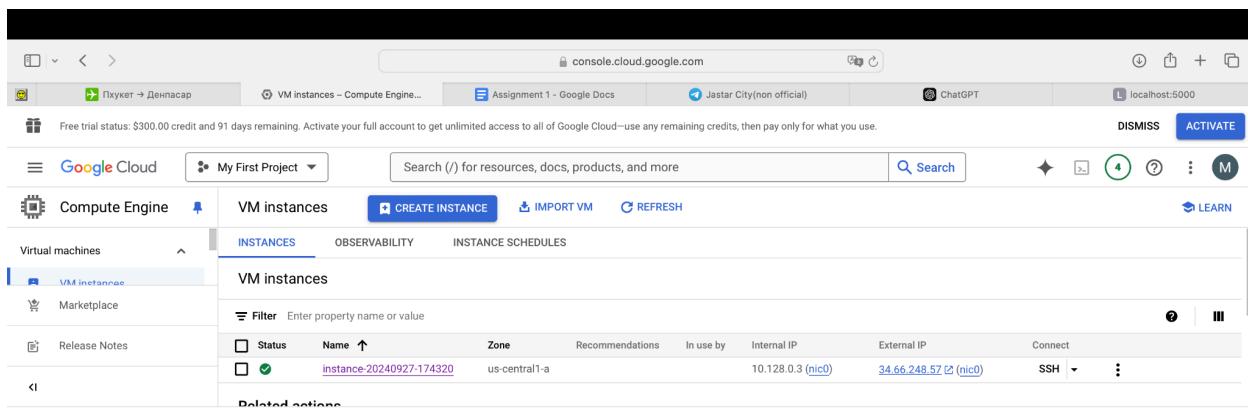
Below the table, a terminal window titled '(the-name-436914-d4)' is open, showing the output of a pip install command for a Flask application:

```
Downloading itsdangerous==1.1.0-py2.py3-none-any.whl (16 kB)
Collecting Jinja2<3.0,>=2.10.1
  Downloading Jinja2-2.11.3-py2.py3-none-any.whl (125 kB) 125 kB 9.0 MB/s
Collecting Werkzeug<2.0,>=0.15
  Downloading Werkzeug-2.0.1-py2.py3-none-any.whl (298 kB) 298 kB 31.5 MB/s
Collecting click<8.0,>=5.1
  Downloading click-7.1.2-py2.py3-none-any.whl (82 kB) 82 kB 1.2 MB/s
Collecting MarkupSafe<0.23
  Downloading MarkupSafe-1.1.1-cp27-cp27mu-manylinux1_x86_64.whl (24 kB)
Installing collected packages: itsdangerous, MarkupSafe, Jinja2, Werkzeug, click, Flask
WARNING: The script flask is installed in '/home/meirasmopytenirzhanov/.local/bin/' which is not on PATH.
Consider adding this directory to PATH or, if you prefer to suppress this warning, use --no-warn-script-location.
Successfully installed Flask-2.1.1 Jinja2-2.11.3 MarkupSafe-1.1.1 Werkzeug-1.0.1 click-7.1.2 itsdangerous-1.1.0
meirasmopytenirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ touch app.py
meirasmopytenirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ touch app.py
meirasmopytenirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ nano app.py
meirasmopytenirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ nano app.py
* Serving Flask app 'app'
* Debug mode: off
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
* Running on all addresses (0.0.0.0)
* Running on http://127.0.0.1:5000
* Running on http://10.88.0.4:5000
Press CTRL+C to quit
```

Here is how it looks like :)



## Created Dockerfile



The screenshot shows the Google Cloud Platform Compute Engine VM instances page. A single VM instance is listed with the name 'instance-20240927-174320' in the us-central1-a zone. Its internal IP is 10.128.0.3 (nic0) and its external IP is 34.66.248.57 (nic0). The SSH status is shown as 'SSH'. Below the table, there are 'Related actions' and a 'CLOUD SHELL' section.

**Dockerfile Content:**

```
GNU nano 6.2
# Use the official Python image
FROM python:3.9

# Set the working directory
WORKDIR /usr/src/app

# Copy requirements.txt and install dependencies
COPY requirements.txt .
RUN pip install --no-cache-dir -r requirements.txt

# Copy the rest of the application files
COPY .

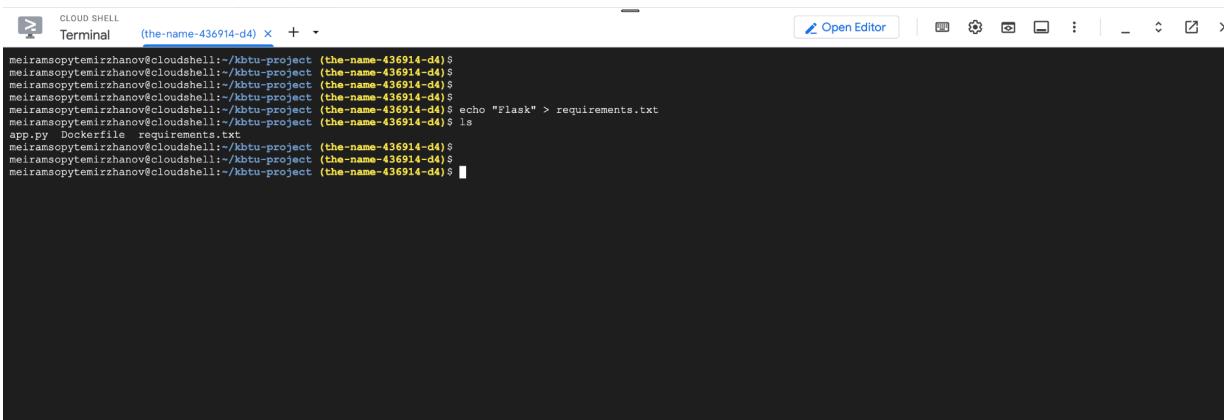
# Expose the port the app runs on
EXPOSE 5000

# Command to run the app
CMD ["python", "app.py"]
```

**Terminal Navigation:**

- Help
- Write Out
- Where Is
- Cut
- Paste
- Execute
- Justify
- Location [Read 18 lines]
- Go To Line
- Undo
- Redo
- Set Mark
- To Bracket
- Copy
- Where Was
- Previous
- Next
- Back
- Forward

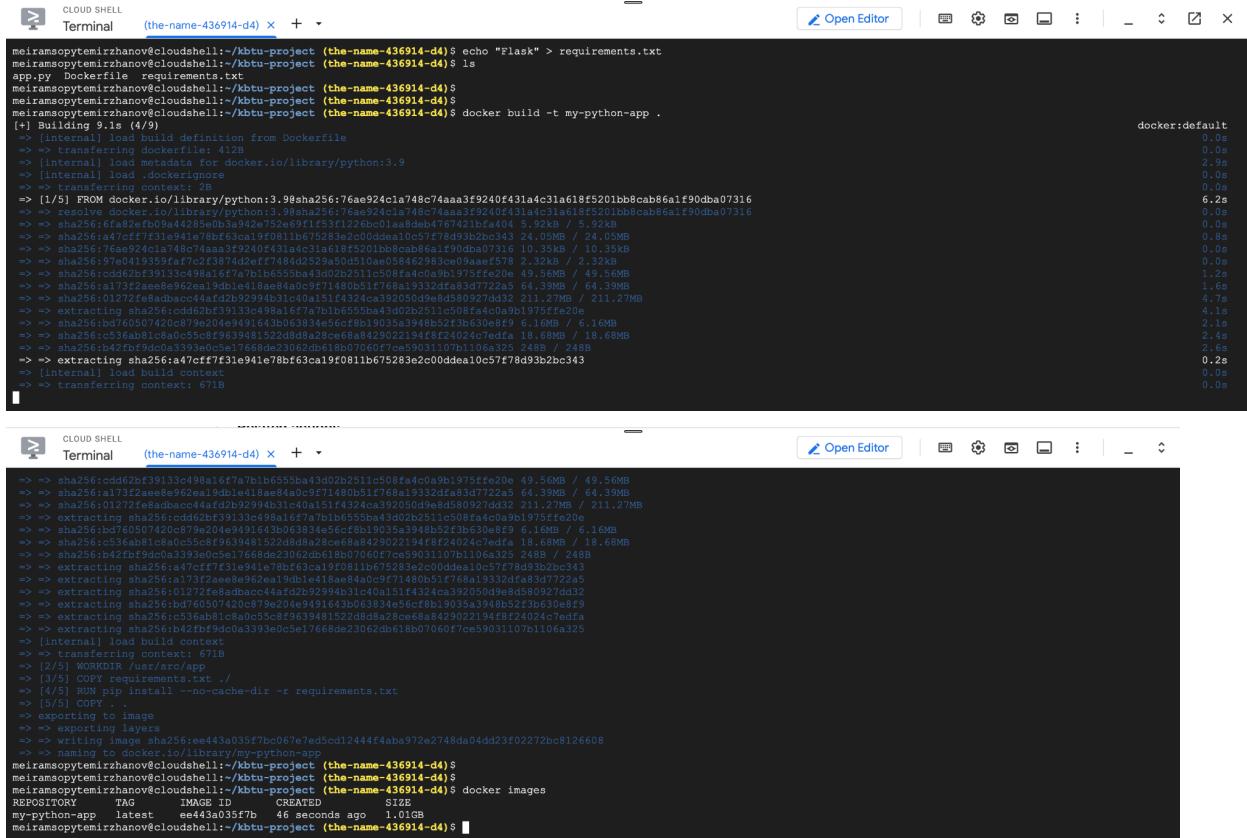
## Added requirements.txt for dependencies



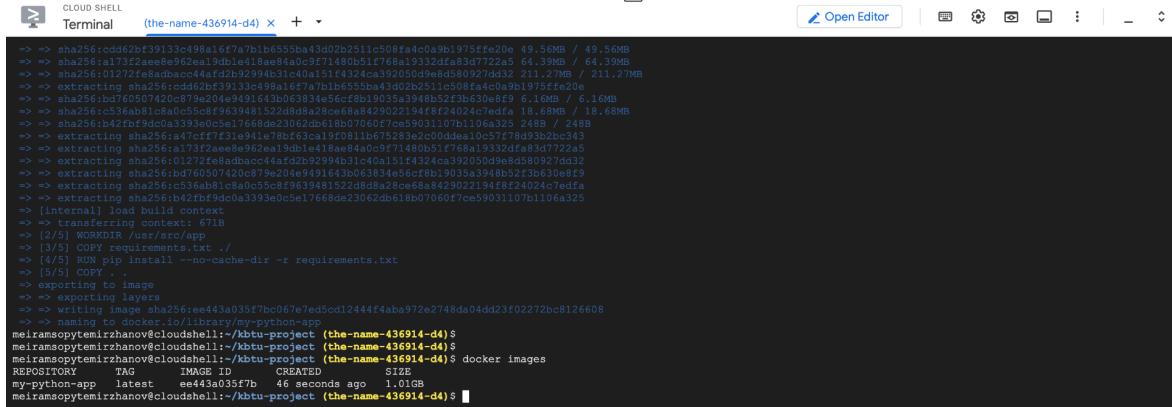
The screenshot shows a terminal session on a KUbuntu system. The user is in their home directory (~) and creates a new file named 'requirements.txt'. They then add the line 'echo "Flask" > requirements.txt' and save the file. The terminal shows the command history and the contents of the requirements.txt file.

```
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ echo "Flask" > requirements.txt
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ ls
app.py Dockerfile requirements.txt
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$
```

## Build docker image from Dockerfile and start docker app

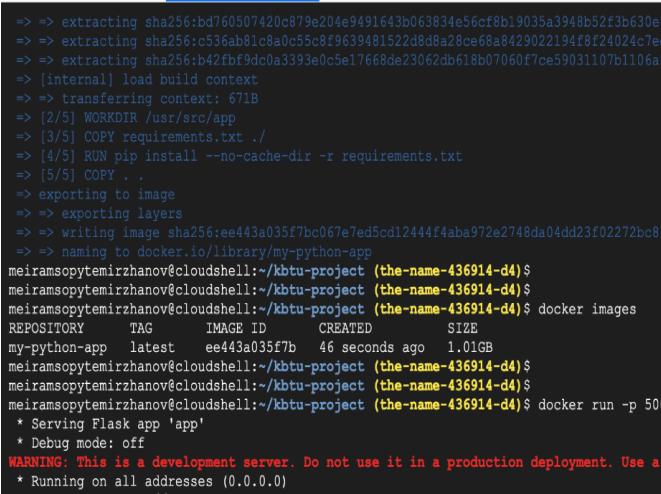


```
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ echo "Flask" > requirements.txt
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ ls
app.py Dockerfile requirements.txt
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ docker build -t my-python-app .
[+] Building 9.1s (4/9)
=> [internal] load build definition from Dockerfile
=> => transferring dockerfile: 41B
=> [internal] load metadata for docker.io/library/python:3.9
=> [internal] load build context
=> => transferring context: 2B
=> [1/5] FROM docker.io/library/python:3.9@sha256:76ae924c1a748c74aaa3f9240f431a4c3la618fs20lbb8cab86a1f90dba07316
=> => resolve docker.io/library/python:3.9@sha256:76ae924c1a748c74aaa3f9240f431a4c3la618fs20lbb8cab86a1f90dba07316
=> => sha256:6fa82efb09a42485e0b3a9269f53cf226bc0laa8eb4767421bfa404 5.92kB / 5.92kB
=> => sha256:6a47cf7f3le41e78bf639e19p01lb675283e200da1057f8d9302ba3c43 24.05MB / 24.05MB
=> => sha256:67ea924c1a748c74aaa3f9240f431a4c3la618fs20lbb8cab86a1f90dba07316 10.35kB / 10.35kB
=> => sha256:67ea924c1a748c74aaa3f9240f431a4c3la618fs20lbb8cab86a1f90dba07316 2.34kB / 2.34kB
=> => sha256:67ea924c1a748c74aaa3f9240f431a4c3la618fs20lbb8cab86a1f90dba07316 5.65MB / 5.65MB
=> => sha256:67ea924c1a748c74aaa3f9240f431a4c3la618fs20lbb8cab86a1f90dba07316 64.39MB / 64.39MB
=> => sha256:67ea924c1a748c74aaa3f9240f431a4c3la618fs20lbb8cab86a1f90dba07316 211.27MB / 211.27MB
=> => extracting sha256:6fa82efb09a42485e0b3a9269f53cf226bc0laa8eb4767421bfa404
=> => sha256:bd760507420e879e204e9491643bd6383ae56cf8b19035a3948b52f3b630e8f9 6.16MB / 6.16MB
=> => sha256:536ab1c8a05c8e9639481522d8d8a28ce8a842902194f8f24204c7edfa 18.68MB / 18.68MB
=> => sha256:642fbff9dc0a3393e0c5e17668de23062db618b07060f7ce59031107b1106a325 248B / 248B
=> => extracting sha256:6772fe8dbacc44af2d92994a31c0a151f4324ca3205d9e0d580927d32 211.27MB
=> => [internal] load build context
=> => transferring context: 671B
```



```
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ ls
app.py Dockerfile requirements.txt
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ docker images
REPOSITORY TAG IMAGE ID CREATED SIZE
my-python-app latest ee443a035fb7b106a325
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$
```

So, Docker container is running the app, but it's serving on port inside the container



```
=> => extracting sha256:bd760507420e879e204e9491643bd6383ae56cf8b19035a3948b52f3b630e8f9
=> => extracting sha256:536ab1c8a05c8e9639481522d8d8a28ce8a842902194f8f24204c7edfa
=> => extracting sha256:642fbff9dc0a3393e0c5e17668de23062db618b07060f7ce59031107b1106a325
=> [internal] load build context
=> => transferring context: 671B
=> [2/5] WORKDIR /usr/src/app
=> [3/5] COPY requirements.txt .
=> [4/5] RUN pip install --no-cache-dir -r requirements.txt
=> [5/5] COPY . .
=> exporting to image
=> => exporting layers
=> => writing image sha256:ee443a035f7bc067e7ed5cd12444f4aba972e2748da04dd23f02272bc8126608
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ docker images
REPOSITORY TAG IMAGE ID CREATED SIZE
my-python-app latest ee443a035f7b 46 seconds ago 1.01GB
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ docker run -p 5000:5000 my-python-app
 * Serving Flask app 'app'
 * Debug mode: off
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
 * Running on all addresses (0.0.0.0)
 * Running on http://127.0.0.1:5000
 * Running on http://172.17.0.2:5000
Press CTRL+C to quit
```

## Pushed the tagged image to Google Container Registry:

```
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ gcloud projects list
PROJECT_ID: gen-lang-client-0983140921
NAME: Generative Language Client
PROJECT_NUMBER: 975414315873

PROJECT_ID: the-name-436914-d4
NAME: My First Project
PROJECT_NUMBER: 757493291491
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ docker tag my-python-app gcr.io/the-name-436914-d4/my-python-app
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ docker push gcr.io/the-name-436914-d4/my-python-app
Using default tag: latest
The push refers to repository [gcr.io/the-name-436914-d4/my-python-app]
bf57710a7093: Pushed
883bc29db439: Pushed
34748fa18f74: Pushed
78a5eba617fc: Pushed
5026504e37c5: Layer already exists
a7939b3dd13: Layer already exists
22ec93acf2d9: Layer already exists
2bce433c3a29: Layer already exists
f91dc7a486d9: Layer already exists
3e14a6961052: Layer already exists
d50132f2fe78: Layer already exists
latest: digest: sha256:b51c55259d8d580d5caf83f67fc7be65c72e9db8b6db78723695619e2e751b size: 2628
meiramsoptemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$
```

## Create kubernetes cluster

The screenshot shows the Google Cloud Platform interface with the following details:

- Autopilot Cluster Creation:** A modal window titled "Create an Autopilot cluster" is open. It includes sections for "Cluster basics", "Fleet registration", "Networking", "Advanced settings", and "Review and create".
  - Cluster basics:** Describes creating an Autopilot cluster by specifying a name and region. It lists benefits like automated node provisioning, scaling, and maintenance.
  - Name:** The input field contains "meiram-cluster-1".
  - Region:** The dropdown menu shows "us-central1".
  - Next Step:** "NEXT: FLEET REGISTRATION".
  - Buttons:** "CREATE", "CANCEL", "RESET SETTINGS".
- Cloud Shell Terminal:** Below the modal, a terminal window shows the command "gcloud projects list" and its output, confirming the project setup.
- Right Sidebar:** Titled "Get started with GKE", it provides links to "GKE overview", "Create a cluster and deploy workload", "Explore the cluster and workload", "Configure a cluster and workload for staging", and "Update and deploy from an IDE".

## Setting up VM to use the GKE cluster

The screenshot shows two instances of the Google Cloud Platform web interface. Both instances are navigating to the 'Clusters' page under the 'Kubernetes Engine' section. The top instance shows the 'Cluster basics' details for 'meiram-cluster-1'. The bottom instance shows a terminal window where a deployment configuration file is being edited.

**Cluster basics (Top Instance):**

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

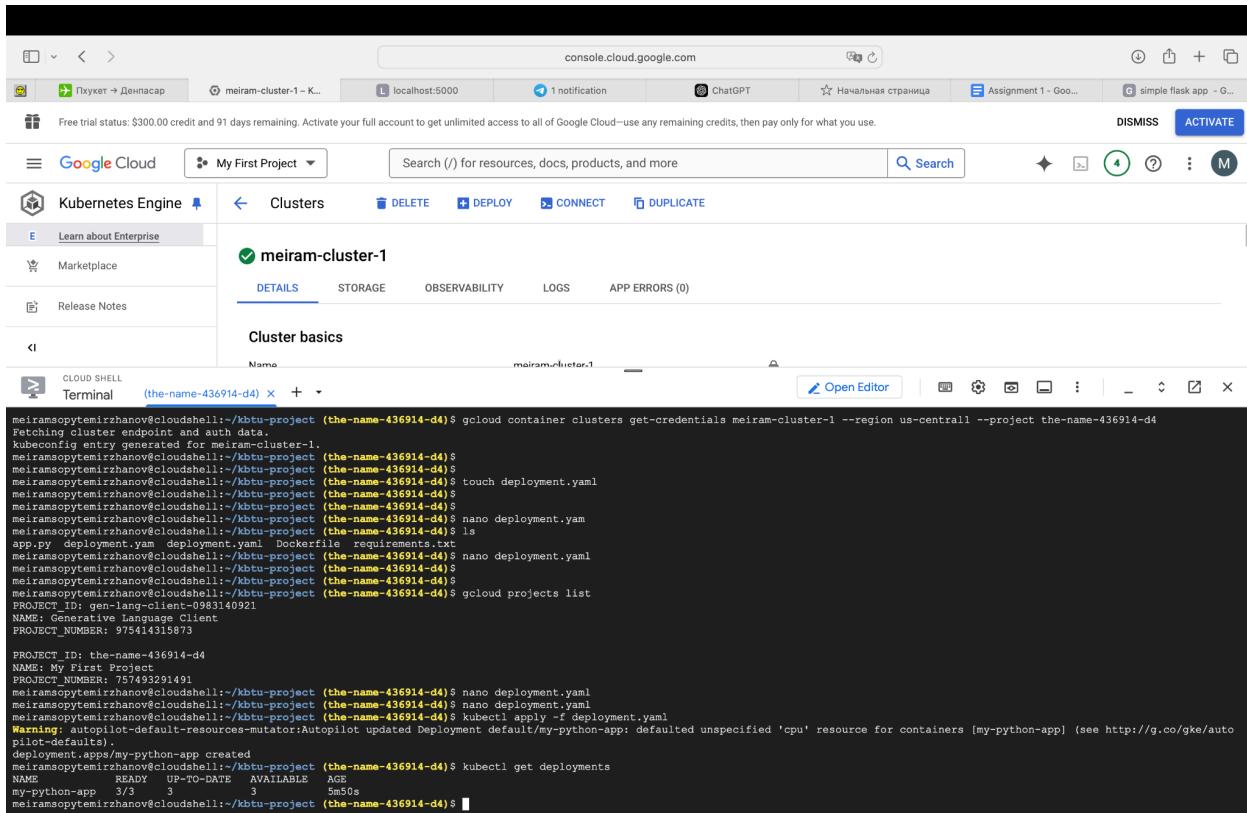
**Terminal (Bottom Instance):**

```
meiramaptyemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ gcloud container clusters get-credentials meiram-cluster-1 --region us-central1 --project the-name-436914-d4
Fetching cluster endpoint and auth data.
kubeconfig entry generated for meiram-cluster-1.
meiramaptyemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramaptyemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramaptyemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$
```

**File Content (Bottom Instance Terminal):**

```
app.py deployment.yaml deployment.yami Dockerfile requirements.txt
GNU nano 6.2
apiVersion: apps/v1
kind: Deployment
metadata:
  name: my-python-app
spec:
  replicas: 3
  selector:
    matchLabels:
      app: my-python-app
  template:
    metadata:
      labels:
        app: my-python-app
    spec:
      containers:
        - name: my-python-app
          image: gcr.io/the-name-436914-d4/my-python-app
          ports:
            - containerPort: 5000
```

## Deployed the Containerized Application to the GKE Cluster

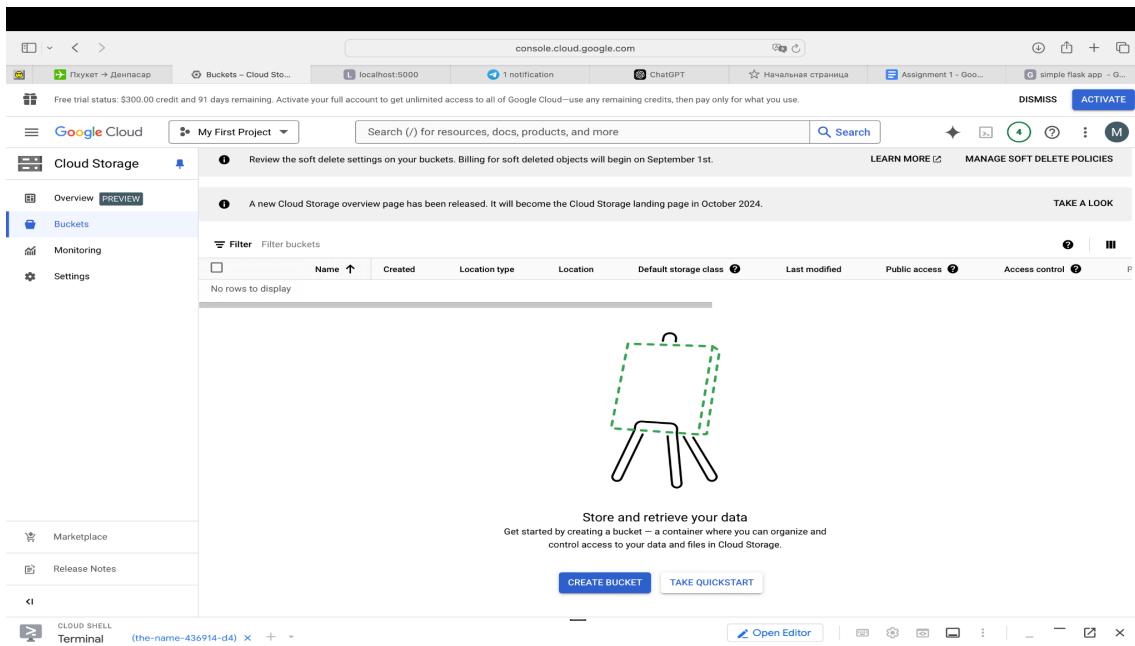


```
meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ gcloud container clusters get-credentials meiram-cluster-1 --region us-central1 --project the-name-436914-d4
Fetching cluster endpoint and auth data.
kubeconfig entry generated for meiram-cluster-1.
meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ touch deployment.yaml
meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ nano deployment.yaml
meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ ls
app.py deployment.yaml Dockerfile requirements.txt
meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ nano deployment.yaml
meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ gcloud projects list
PROJECT ID: gen-lang-client-09814091
NAME: Generative Language Client
PROJECT_NUMBER: 975414315873

PROJECT ID: the-name-436914-d4
NAME: My First Project
PROJECT NUMBER: 757493291401
meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ nano deployment.yaml
meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ nano deployment.yaml
meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ kubectl apply -f deployment.yaml
Warning: autopilot-default-resources-mutator:Autopilot updated Deployment default/my-python-app: defaulted unspecified 'cpu' resource for containers [my-python-app] (see http://g.co/gke/autopilot-defaults).
deployment.apps/my-python-app created
meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$ kubectl get deployments
NAME          READY   UP-TO-DATE   AVAILABLE   AGE
my-python-app  3/3     3           3           5m0s
meiramsystemirzhanov@cloudshell:~/kbtu-project (the-name-436914-d4)$
```

**Answer: How did you verify that your application was successfully deployed and accessible?**  
kubectl get deployments

## Exercise 5: Storing and Accessing Data in Google Cloud Storage



**Get Started**

- Name: meiram-bucket

**Choose where to store your data**

- Location: us (multiple regions in United States)
- Location type: Multi-region

**Choose a storage class for your data**

A storage class sets costs for storage, retrieval, and operations, with minimal differences in uptime. Choose if you want objects to be managed automatically or specify a default storage class based on how long you plan to store your data and your workload or use case. [Learn more](#)

- Autoclass** Automatically transitions each object to Standard or Nearline class based on object-level activity, to optimize for cost and latency. Recommended if usage frequency may be unpredictable. Can be changed to a default class at any time. [Pricing details](#)
- Set a default class** Applies to all objects in your bucket unless you manually modify the class per object or set object lifecycle rules. Best when your usage is highly predictable.
- Standard** Best for short-term storage and frequently accessed data
- Nearline** Best for backups and data accessed less than once a month
- Coldline** Best for disaster recovery and data accessed less than once a quarter
- Archive** Best for long-term digital preservation of data accessed less than once a year

**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**

## Uploaded test file to the bucket

**meiram-bucket**

Location	Storage class	Public access	Protection
us (multiple regions in United States)	Standard	Not public	Soft Delete

**OBJECTS** CONFIGURATION PERMISSIONS PROTECTION LIFECYCLE OBSERVABILITY INVENTORY REPORTS OPERATIONS

Buckets > meiram-bucket

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	Encryption	Obj
kbtu-folder/	—	Folder	—	—	—	—	—	—	—

1 file successfully uploaded

Uploads and My First Project operations

Снимок экрана 2024-09-28 в 00.00.02.png

## Exercise 6: Analyzing Data with BigQuery

Welcome to BigQuery Studio!

Create new:

- SQL QUERY
- PYTHON NOTEBOOK
- DATA CANVAS
- WORKFLOW

Try with sample data:

Try the Google Trends Demo Query

This simple query generates the top search terms in the US from the Google Trends public dataset.

OPEN THIS QUERY

VIEW DATASET

Try the Colab Demo Notebook

This notebook walks you through their basics and showcases BigQuery DataFrames.

OPEN THIS NOTEBOOK

Add your own data

Job history: 1 file successfully uploaded

Uploads and My First Project operations: Чимок экрана 2024-09-28 00.00.02.png

### Example patents view dataset

Search BigQuery resources: View Dataset

Found 2 results.

SEARCH ALL PROJECTS

- non\_inventor\_applicant\_201908
- otherreference
- otherreference\_201708
- otherreference\_201908
- patent**
- patent\_201708
- patent\_201908
- patent\_assignee
- patent\_assignee\_201708
- patent\_assignee\_201908
- patent\_contractawardnumber

SHOW MORE

SUMMARY

patent

patents-public-data.patentsview

Last modified: Feb 20, 2022, 8:35:15 AM UTC+6

Data location: US

Description:

Labels:

Table type: table

SCHEMA

Field name	Type	Mode	Key	Collation	Default Value	Policy Tags	Description
<input type="checkbox"/> id	STRING	NULLABLE	-	-	-	-	-
<input type="checkbox"/> type	STRING	NULLABLE	-	-	-	-	-
<input type="checkbox"/> number	STRING	NULLABLE	-	-	-	-	-
<input type="checkbox"/> country	STRING	NULLABLE	-	-	-	-	-
<input type="checkbox"/> date	STRING	NULLABLE	-	-	-	-	-
<input type="checkbox"/> abstract	STRING	NULLABLE	-	-	-	-	-
<input type="checkbox"/> title	STRING	NULLABLE	-	-	-	-	-
<input type="checkbox"/> kind	STRING	NULLABLE	-	-	-	-	-
<input type="checkbox"/> num_claims	INTEGER	NULLABLE	-	-	-	-	-
<input type="checkbox"/> filename	STRING	NULLABLE	-	-	-	-	-
<input type="checkbox"/> withdrawn	INTEGER	NULLABLE	-	-	-	-	-

EDIT SCHEMA

VIEW ROW ACCESS POLICIES

Job history

console.cloud.google.com

DISMISS ACTIVATE

Google Cloud My First Project Search (/) for resources, docs, products, and more

Untitled query RUN SAVE DOWNLOAD SHARE SCHEDULE OPEN IN MORE Query completed.

Free trial status: \$300.00 credit and 91 days remaining. Activate your full account to get unlimited access to all of Google Cloud—use any remaining credits, then pay only for what you use.

Untitled query \*Untitled query \*Untitled query

1 SELECT \* FROM `patents-public-data.patentsview.patent` LIMIT 1000

Query results

Row	id	type	number	country	date
1	10325988	utility	10325988	US	2019-06-18
2	10326857	utility	10326857	US	2019-06-18
3	10327286	utility	10327286	US	2019-06-18

Job history

REFRESH

Explorer + ADD

Search BigQuery resources View Dataset

Found 2 results.

SEARCH ALL PROJECTS

- the-name-436914-d4
  - Queries
  - Notebooks
  - Data canvases
    - Untitled data canvases
    - Shared data canvases
      - Untitled canvas
    - Data preparations
    - Workflows
    - External connections
  - patents-public-data
    - patentsview

SUMMARY

Nothing currently selected

console.cloud.google.com

DISMISS ACTIVATE

Google Cloud My First Project Search (/) for resources, docs, products, and more

Untitled query RUN SAVE DOWNLOAD SHARE SCHEDULE OPEN IN MORE Query completed.

Free trial status: \$300.00 credit and 91 days remaining. Activate your full account to get unlimited access to all of Google Cloud—use any remaining credits, then pay only for what you use.

Untitled query \*Untitled query \*Untitled query

1 SELECT AVG(withdrawn) as avg\_withdrawn FROM `patents-public-data.patentsview.patent` LIMIT 10

Query results

Row	avg_withdrawn
1	0.001664700481...

Job history

REFRESH

Explorer + ADD

Search BigQuery resources View Dataset

Found 2 results.

SEARCH ALL PROJECTS

- non\_inventor\_applicant\_201708
- non\_inventor\_applicant\_201908
- otherreference
- otherreference\_201708
- otherreference\_201908
- patent
- patent\_201708
- patent\_201908
- patent\_assignee
- patent\_assignee\_201708
- patent\_assignee\_201908
- patent\_contractawardnumber

SUMMARY

Nothing currently selected

console.cloud.google.com

Free trial status: \$300.00 credit and 91 days remaining. Activate your full account to get unlimited access to all of Google Cloud—use any remaining credits, then pay only for what you use.

DISMISS ACTIVATE

Google Cloud My First Project Search (/) for resources, docs, products, and more

Untitled query RUN SAVE DOWNLOAD SHARE SCHEDULE OPEN IN MORE

1 SELECT \* FROM `patents-public-data.patentsview.patent` WHERE withdrawn > 0.0001

Query results

Row	id	type	number	country	date
1	5704877	utility	5704877	US	1998-01-06
2	7574373	utility	7574373	US	2009-08-11

Results per page: 50 1 - 50 of 13160

Job history

console.cloud.google.com

Free trial status: \$300.00 credit and 91 days remaining. Activate your full account to get unlimited access to all of Google Cloud—use any remaining credits, then pay only for what you use.

DISMISS ACTIVATE

Google Cloud My First Project Search (/) for resources, docs, products, and more

Untitled query RUN SAVE DOWNLOAD SHARE SCHEDULE OPEN IN MORE

1 SELECT \* FROM `patents-public-data.patentsview.patent` ORDER BY id LIMIT 10

Query results

num\_claims, withdrawn by id

Chart configuration

Chart type: Bar

Dimension (x-axis): id

Measures (y-axis): num\_claims and withdrawn

Select up to 5 measures

id	num_claims	withdrawn
10000000	22	1
10000001	14	0
10000002	12	0
10000003	8	0
10000004	5	0
10000005	4	0
10000006	10	0
10000007	25	1
10000008	14	0
10000009	22	0

Job history