

# MLOps Deliverables

For MLOps Workflow we are using

1. Github for Code Tracking
2. MLFlow for Model Versioning, Development and Tracking
3. Google Cloud Services for Model Deployment, CI/CD Pipeline and Performance Tracking and Trigger Management.

## MLFlow Screenshots

More information about MLFlow- <https://mlflow.org/>

Model Artifacts Files can be tracked and found here - <https://github.com/aryan-jadon/CMPE-297-Project/tree/main/notebooks/mlruns>

mlflow 2.0.1 Experiments Models GitHub Docs

**Experiments** ⊕ 📄

Search Experiments

☒ Default ✎ 🗑

☐ experiment\_few\_shot ✎ 🗑

**Default** 📄 Share

Track machine learning training runs in experiments. [Learn more](#) ×

Experiment ID: 0 Artifact Location: file:///Users/aryanjadon/Desktop/Assignments/Project-Special-Topics/notebooks/mlruns/0



































> Description [Edit](#)

🔄 Refresh 🔍 metrics.rmse < 1 and params.model = "tree" ⓘ Sort: ↓ Created ▾ State: Active ▾ Started during: All time ▾ ⬇ Download Columns ▾

Showing 1 matching run

<input type="checkbox"/>	Run Name	↓ Created	Duration	Source	Models	
<input type="checkbox"/>	gentle-koi-50	🟢 5 minutes ago	3.1min	ipykerne...	sklearn	⊕

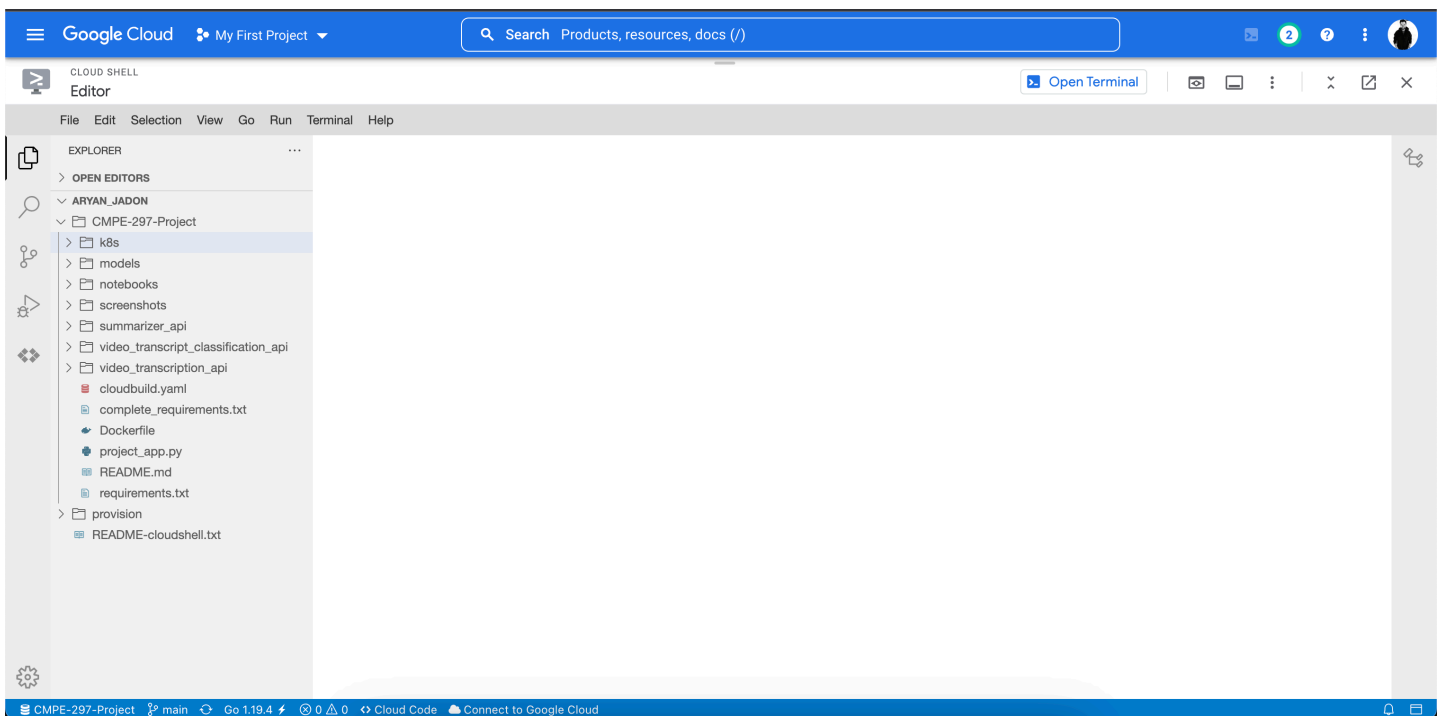
Load more

- ▼  mlruns
  -  .trash
  - ▼  0
    - ▼  ed5eaef9ba18498a97d6d94b25a5ae29
      - ▼  artifacts
        - >  model
          -  estimator.html
          -  training\_confusion\_matrix.png
      - ▼  metrics
        -  training\_accuracy\_score
        -  training\_f1\_score
        -  training\_log\_loss
        -  training\_precision\_score
        -  training\_recall\_score
        -  training\_roc\_auc\_score
        -  training\_score
      - ▼  params
        -  C
        -  class\_weight
        -  dual
        -  fit\_intercept
        -  intercept\_scaling
        -  l1\_ratio
        -  max\_iter
        -  multi\_class
        -  n\_jobs
        -  penalty
        -  random\_state
        -  solver
        -  tol
        -  verbose
        -  warm\_start
      - >  tags
      -  meta.yaml

# Google Cloud Screenshots

## Initial Cloning of Github Repo in Google Cloud

```
aryan_jadon@cloudshell:~ (resonant-tract-371623)$ git clone "https://github.com/aryan-jadon/CMPE-297-Project"
Cloning into 'CMPE-297-Project'...
remote: Enumerating objects: 389, done.
remote: Counting objects: 100% (105/105), done.
remote: Compressing objects: 100% (64/64), done.
remote: Total 389 (delta 37), reused 105 (delta 37), pack-reused 284
Receiving objects: 100% (389/389), 127.15 MiB | 26.48 MiB/s, done.
Resolving deltas: 100% (114/114), done.
Updating files: 100% (414/414), done.
aryan_jadon@cloudshell:~ (resonant-tract-371623)$ ls
CMPE-297-Project  provision  README-cloudshell.txt
aryan_jadon@cloudshell:~ (resonant-tract-371623)$
```



## Spinning Cluster

```
aryan_jadon@cloudshell:~ (resonant-tract-371623)$ gcloud container clusters create project-kube --zone "us-west1-b" --machine-type "n1-standard-1" --num-nodes "1"
Default change: IPC-native is the default node during cluster creation for versions greater than 1.21.0-gke.1500. To create advanced routes based clusters, please pass the "--no-enable-ip-alias" flag
Default change: During creation of nodepools or autoscaling configuration changes for cluster versions greater than 1.24.1-gke.800 a default location policy is applied. For Spot and PVM it defaults to ANY, and for all other VM kinds a BALANCED policy is used. To change the default values use the "--location-policy" flag.
Note: Your Pod address range (--cluster-ip-range) can accommodate at most 1008 nodes.
Creating cluster project-kube in us-west1-b... Cluster is being health-checked (master is healthy)...done.
Created https://console.cloud.google.com/project/resonant-tract-371623/zones/us-west1-b/clusters/project-kube.
To inspect the contents of your cluster, go to: https://console.cloud.google.com/kubernetes/workload/_gcloud/us-west1-b/project-kube?project=resonant-tract-371623
Logging entry generated for project-kube.
```

```
NAME: project-kube
LOCATION: us-west1-b
MASTER_VERSION: 1.24.5-gke.400
MASTER_IP: 104.19.115.104
MACHINE_TYPE: n1-standard-1
NODE_VERSION: 1.24.5-gke.600
NUM_NODES: 1
STATUS: RUNNING
aryan_jadon@cloudshell:~ (resonant-tract-371623)$
```

# Google Cloud Build

```
Step #2: -rw-r--r-- 1 root root 2303 Dec 15 05:00 README.md
Step #2: -rw-r--r-- 1 root root 510 Dec 15 04:28 cloudbuild.yaml
Step #2: -rw-r--r-- 1 root root 1540 Dec 15 05:00 complete_requirements.txt
Step #2: drwxr-xr-x 2 root root 4096 Dec 15 06:17 k8s
Step #2: drwxr-xr-x 4 root root 4096 Dec 15 06:17 models
Step #2: drwxr-xr-x 3 root root 4096 Dec 15 06:17 notebooks
Step #2: -rw-r--r-- 1 root root 5942 Dec 15 06:12 project_app.py
Step #2: -rw-r--r-- 1 root root 65 Dec 15 05:00 requirements.txt
Step #2: drwxr-xr-x 2 root root 4096 Dec 15 06:17 screenshots
Step #2: drwxr-xr-x 5 root root 4096 Dec 15 06:17 summarizer_api
Step #2: drwxr-xr-x 4 root root 4096 Dec 15 06:17 video_transcript_classification_api
Step #2: drwxr-xr-x 5 root root 4096 Dec 15 06:17 video_transcription_api
Step #2: total 70528
Step #2: drwxr-xr-x 4 root root 4096 Dec 15 06:17 .
Step #2: drwxr-xr-x 10 root root 4096 Dec 15 06:17 ..
Step #2: -rw-r--r-- 1 root root 70116213 Dec 15 05:07 Few_Shot_Classifier_Model.pkl
Step #2: drwxr-xr-x 2 root root 4096 Dec 15 06:17 assets
Step #2: -rw-r--r-- 1 root root 6617 Dec 15 05:07 keras_metadata.pb
Step #2: -rw-r--r-- 1 root root 2074332 Dec 15 05:07 saved_model.pb
Step #2: drwxr-xr-x 2 root root 4096 Dec 15 06:17 variables
Finished Step #2
Starting Step #3
Step #3: Already have image (with digest): gcr.io/cloud-builders/gke-deploy
Step #3: Preparing deployment.
Step #3: Configuration files to be used: [{"kind": "Deployment", "name": "specialtopicsproject"} {"kind": "Service", "name": "videoclassifier"}]
Step #3: Saving suggested configuration files to "output/suggested"
Step #3:
Step #3: Expanding configuration files.
Step #3: Saving expanded configuration files to "output/expanded"
Step #3: Finished preparing deployment.
Step #3:
Step #3: Applying deployment.
Step #3: Getting access to cluster "project-kube" in "us-west1-b".
Step #3: Configuration files to be used: [{"kind": "Deployment", "name": "specialtopicsproject"} {"kind": "Service", "name": "videoclassifier"}]
Step #3: Applying configuration files to cluster.
Step #3: W1215 06:24:25.325491 40 gcp.go:120] WARNING: the gcp auth plugin is deprecated in v1.22+, unavailable in v1.25+; use gcloud instead.
Step #3: To learn more, consult https://cloud.google.com/blog/products/containers-kubernetes/kubect1-auth-changes-in-gke
Step #3: W1215 06:24:26.942160 61 gcp.go:120] WARNING: the gcp auth plugin is deprecated in v1.22+, unavailable in v1.25+; use gcloud instead.
Step #3: To learn more, consult https://cloud.google.com/blog/products/containers-kubernetes/kubect1-auth-changes-in-gke
Step #3:
Step #3: Waiting for deployed objects to be ready with timeout of 5m0s
Step #3: Deployed object with kind "Service" and name "videoclassifier" is ready after 900ms
```

Google Cloud

My First Project

Search Products, resources, docs (/)

Kubernetes Engine

Workloads

Services & Ingress

Applications

Secrets & ConfigMaps

Storage

Object Browser

Migrate to Containers

Backup for GKE

Security Posture

Config & Policy

Config

Marketplace

Release Notes

Services & Ingress

REFRESH

CREATE INGRESS

DELETE

HELP ASSISTANT

LEARN

Cluster

Namespace

RESET

SAVE

SERVICES

INGRESS

Services are sets of Pods with a network endpoint that can be used for discovery and load balancing. Ingresses are collections of rules for routing external HTTP(S) traffic to Services.

Filter Is system object: False Filter services and ingresses

	Name	Status	Type	Endpoints	Pods	Namespace	Clusters
	videoclassifier	OK	External load balancer	34.168.103.198:80	0/2	default	project-kube

Google Cloud

My First Project

Search Products, resources, docs (/)

2

?

Kubernetes Engine

Deployment d...

REFRESH

EDIT

DELETE

ACTIONS

SHOW INFO PANEL

OPERATIONS

HELP ASSISTANT

LEARN

OVERVIEW

DETAILS

REVISION HISTORY

EVENTS

LOGS

YAML

1 hour

6 hours

12 hours

1 day

2 days

4 days

7 days

14 days

30 days

Custom

CPU

Memory

Disk

1

1B

1

No data is available for the selected time frame.

UTC-8 9:20 PM 9:30 PM 9:40 PM 9:50 PM 10:00 PM 0

UTC-8 9:20 PM 9:30 PM 9:40 PM 9:50 PM 10:00 PM 0

UTC-8 9:20 PM 9:30 PM 9:40 PM 9:50 PM 10:00 PM 0

Cluster

project-kube

Namespace

default

Labels

app.kubernetes.io/m...: gcp-cloud-build-de...

Logs

Container logs, Audit logs

Replicas

2 updated, 2 ready, 0 available, 2 unavailable

Pod specification

Revision 1, containers: cv-app

Horizontal Pod Autoscaler

Not configured

CONFIGURE

Vertical Pod Autoscaler

Not configured

CONFIGURE

Google Cloud

My First Project

Search Products, resources, docs (/)

2

?

Kubernetes Engine

Services & Ingress

REFRESH

CREATE INGRESS

DELETE

HELP ASSISTANT

LEARN

SERVICES

INGRESS

Services are sets of Pods with a network endpoint that can be used for discovery and load balancing. Ingresses are collections of rules for routing external HTTP(S) traffic to Services.

Filter

Is system object: False

Filter services and ingresses

X

?

Name

Status

Type

Endpoints

Pods

Namespace

Clusters

videoclassifier

OK

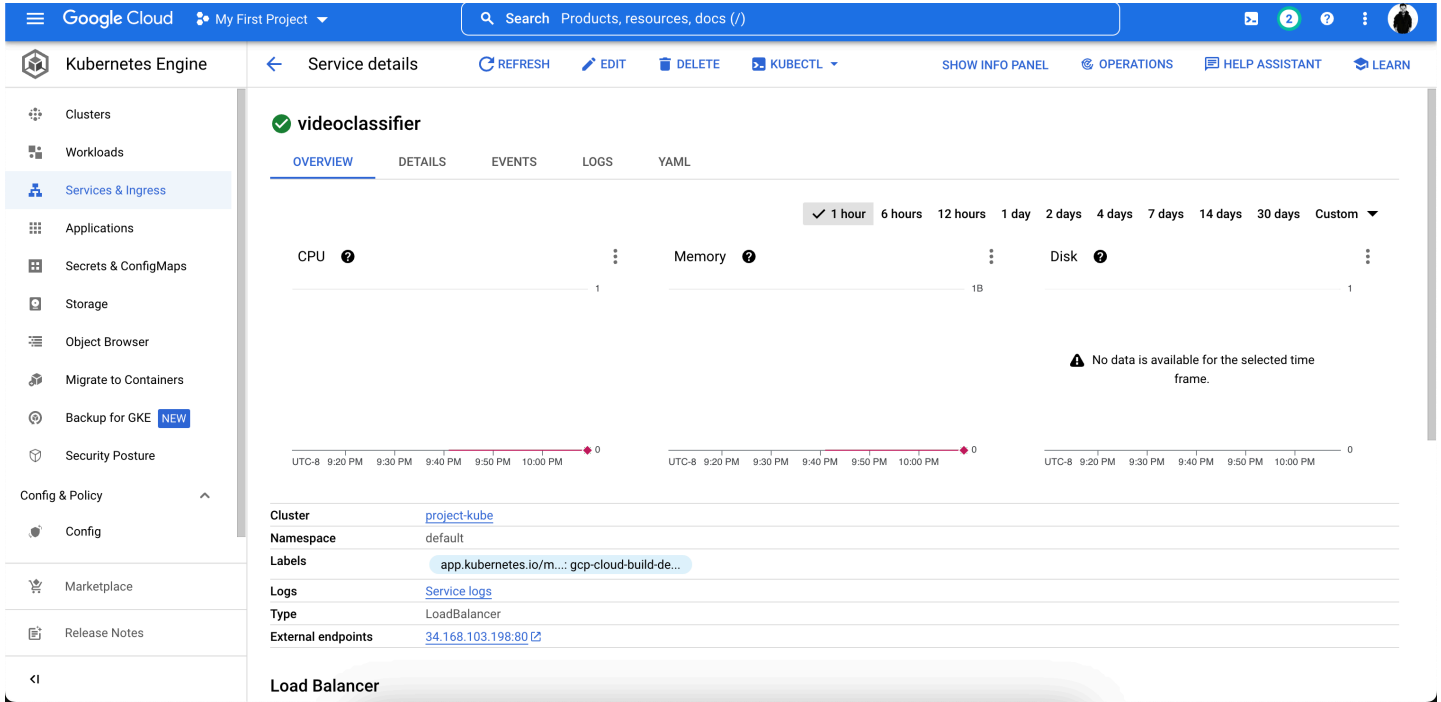
External load balancer

34.168.103.198.80

0/2

default

project-kube



## Container Registry

Google Cloud My First Project Search conta

Container Registry

Repositories

My First Project

Filter Enter property name or value

Name	Hostname	Visibility
<a href="#">webapp</a>	gcr.io	Private

Google CloudMy First Project

Searchconta

Container Registry

Images

DELETED

webapp

gcr.io > resonant-tract-371623 > webapp

Filter Enter property name or value

	Name	Tags	Virtual Size	Created	Uploaded	
<input type="checkbox"/>	83a23e660a49	v1	1.6 GB	12 minutes ago	8 minutes ago	
<input type="checkbox"/>	ac693f8fd4ea		1.6 GB	43 minutes ago	39 minutes ago	
<input type="checkbox"/>	fde94fd60487		1.6 GB	57 minutes ago	52 minutes ago	
<input type="checkbox"/>	e5e687e582c0		1.6 GB	1 hour ago	1 hour ago	
<input type="checkbox"/>	680939b03640		1.6 GB	1 hour ago	1 hour ago	
<input type="checkbox"/>	8c9f70a450f2		1.5 GB	1 hour ago	1 hour ago	

Marketplace

Release Notes

# CI/CD Pipeline Setup

Google CloudMy First Project

SearchProducts, resources, docs (/)

Cloud Build

TriggersMANAGE REPOSITORIES

Regionglobal (non-regional)

Filter Enter property name or value

Name	Description	Repository	Event	Build configuration	Status
------	-------------	------------	-------	---------------------	--------

No triggers found in your project. Automatically start a build whenever you make changes to your repository in response to other events. Learn more

Connect repository

Region: global

With the Google Cloud Build GitHub application, you can connect your repositories to your Google Cloud project and start using Cloud Build.

Select repository

Create a trigger (optional)

Your aryan-jadon/CMPE-297-Project repository is connected.

Cloud Build can automate builds in response to events that happen in your connected repositories. You can set up a trigger on your own or have a sample trigger created for you with the following values:

Name	Description	Event	Build configuration
sample-trigger	Invokes a build every time code is pushed to any branch	Push to branch	Autodetected

You can change the configuration of any trigger after it's created.

CREATE A TRIGGER

CREATE SAMPLE TRIGGER

DONE

Google Cloud

My First Project

Search Products, resources, docs (/)

2

Cloud Build

Triggers

+ CREATE TRIGGER

CONNECT REPOSITORY

MANAGE REPOSITORIES

LEARN

Dashboard

History

Triggers

Settings

Release Notes

Region

global (non-regional)

Filter

Enter property name or value

Name	Description	Repository	Event	Build configuration	Status	
MLOPS-Trigger	-	arian-jadon/CMPE-297-Project	Push to branch	Autodetected	Enabled	RUN

'MLOPS-Trigger' has been created on arian-jadon/CMPE-297-Project

## CI/CD Triggers with Git Commits

Google Cloud

My First Project

Search Products, resources, docs (/)

2

Cloud Build

Build history

STOP STREAMING BUILDS

LEARN

Dashboard

History

Triggers

Settings

Region

global (non-regional)

Filter

Enter property name or value

Status	Build	Source	Ref	Commit	Trigger Name	Created	Duration	
	d89d77cc	arian-jadon/CMPE-297-Project	main	410d0a8	MLOPS-Trigger	12/14/22, 10:39 PM	44 sec	



Google Cloud

My First Project

Search clou

Cloud Build

Build details

CANCEL

COPY URL

LEARN

Dashboard

History

Triggers

Settings

Release Notes

<1

Running: d89d77cc

Started on Dec 14, 2022, 10:39:16 PM

Trigger

Source

Branch

Commit

MLOPS-Trigger

aryan-jadon/CMPE-297-Project

main

410d0a8

Steps

Duration

Build Summary

4 Steps

00:03:03

0: gcr.io/cloud-builders/docker

build -t gcr.io/resonant-tract-371623/w...

-

1: gcr.io/cloud-builders/docker

push gcr.io/resonant-tract-371623/web...

-

2: gcr.io/cloud-builders/gcloud

bash -c echo "Docker Container Built" ls...

-

3: gcr.io/cloud-builders/gke-deploy

run --filename=k8s/ --location=us-west...

-

BUILD LOG

EXECUTION DETAILS

☐ Wrap lines

☐ Show newest entries first

EXPAND

VIEW RAW

1 Already have image (with digest): gcr.io/cloud-builders/docker

2 Sending build context to Docker daemon 334.6MB

3 Step 1/8 : FROM python:3.9-slim

4 3.9-slim: Pulling from library/python

5 025c56f98b67: Pulling fs layer

6 778656c04542: Pulling fs layer

7 25eb27f3c3a8: Pulling fs layer

8 834522e4ba91: Pulling fs layer

9 22d848066944: Pulling fs layer

10 834522e4ba91: Waiting

11 22d848066944: Waiting

12 778656c04542: Verifying Checksum

13 778656c04542: Download complete

14 834522e4ba91: Verifying Checksum

15 834522e4ba91: Download complete

16 25eb27f3c3a8: Verifying Checksum

17 25eb27f3c3a8: Download complete

18 22d848066944: Verifying Checksum

19 22d848066944: Download complete

20 025c56f98b67: Verifying Checksum

21 025c56f98b67: Download complete

22 025c56f98b67: Pull complete

23 778656c04542: Pull complete

24 25eb27f3c3a8: Pull complete

25 834522e4ba91: Pull complete

26 22d848066944: Pull complete

27 Digest: sha256:c8efd5af04f039d2cd484670f0d38a379c001cc8a10980ee1c9cfc78a2c1e007

28 Status: Downloaded newer image for python:3.9-slim