

✓ indicates that a section was completed but did not request any screenshots or written answers.

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# I. Lab 7.1a: Terraform AWS Guestbook

## 1. Terraform



## 2. Setup

- In AWS cloud shell, install yum-utils, add the hashicorp repo, and install terraform. Make a directory for your terraform deployment and cd in.

## 3. Initial Configuration

- Examine and copy over the main.tf file contents from the lab.

## 4. Launching Configuration

- init, plan, and apply the terraform configuration. Show the output of the apply command.  
**I can't complete this task due to what looks like a permissions misconfiguration for my aws account. I do not have control over this permission as far as I can tell. I'm moving on to the next lab for now.**

```
Enter a value: yes

aws_instance.guestbook: Creating...

Error: creating EC2 Instance: OptInRequired: In order to use this AWS Marketplace product you need to accept terms and subscribe. To do so please visit https://aws.amazon.com/marketplace/pp?sku=a8jygnf4hjutohctm41o2z18 status code: 401, request id: b25f2182-1c13-4e03-8cfd-09a34890ce36

with aws_instance.guestbook,
  on main.tf line 7, in resource "aws_instance" "guestbook":
   7: resource "aws_instance" "guestbook" {

[cloudshell~user@ip-10-6-163-252 tf]$
```

 **Ubuntu 20.04 LTS - Focal**

Continue to Configuration

You must first review and accept terms.

User: arn:aws:sts::217663952189:assumed-role/voclabs/user2812445=amminer@pdx.edu is not authorized to perform: aws-marketplace:Subscribe on resource: \* because no identity-based policy allows the aws-marketplace:Subscribe action

[< Product Detail](#) [Subscribe](#)

## Subscribe to this software

To create a subscription, review the pricing information and accept the terms for this software.

### Terms and Conditions

### Canonical Group Limited Offer

By subscribing to this software, you agree to the pricing terms and the seller's [End User License Agreement \(EULA\)](#). You also agree and acknowledge that AWS may, on your behalf, share information about this transaction (including your payment terms) with the respective seller, reseller or underlying provider, as applicable, in accordance with the [AWS Privacy Notice](#). AWS will issue invoices and collect payments from you on behalf of the seller through your AWS account. Your use of AWS services is subject to the [AWS Customer Agreement](#) or other agreement with AWS governing

Accept  
Terms

## 5. Adding Network Access

- todo

## 6. Adding ssh access

- todo

## 7. Adding the guestbook application

- todo

## 8. View the guestbook

- todo

## 9. Clean up

- todo

# II. Lab 7.1g: Terraform GCP Guestbook

## 1. Terraform



## 2. Setup



## 3. Initial Configuration

- Copy the main.tf code. Substitute in the fmi and your project name.

## 4. Launching Configuration

- Init, plan and apply. Show the VM's IP addresses in the CE web console.

Google Cloud cloud-Miner-amminer  [Search](#) 6

---

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

---

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

---

VM instances

**Filter**

<input type="checkbox"/>	Status	Name	Zone	Recommendations	Internal IP	External IP	Network	Connect	
<input type="checkbox"/>		<a href="#">course-vm</a>	us-west1-b		10.138.0.2 <a href="#">(nic0)</a>		<a href="#">default</a>	SSH	
<input type="checkbox"/>		<a href="#">course-vm-usw1a</a>	us-west1-a		10.138.0.8 <a href="#">(nic0)</a>		<a href="#">default</a>	SSH	
<input type="checkbox"/>		<a href="#">tf-lab-vm</a>	us-west1-b		10.138.0.16 <a href="#">(nic0)</a>		<a href="#">default</a>	SSH	

## 5. Adding an external IP Address

- Copy the code in from the lab to add an external IP to the machine. Plan. Apply. Show the output.

```
Changes to Outputs:
+ ip = (known after apply)

Do you want to perform these actions?
Terraform will perform the actions described above.
Only 'yes' will be accepted to approve.

Enter a value: yes

google_compute_address.static: Creating...
google_compute_address.static: Still creating... [10s elapsed]
google_compute_address.static: Creation complete after 11s [id=projects/cloud-miner-amminer/regions/us-west1/addresses/ipv4-address]
google_compute_instance.default: Modifying... [id=projects/cloud-miner-amminer/zones/us-west1-b/instances/tf-lab-vm]
google_compute_instance.default: Still modifying... [id=projects/cloud-miner-amminer/zones/us-west1-b/instances/tf-lab-vm, 10s elapsed]
google_compute_instance.default: Modifications complete after 11s [id=projects/cloud-miner-amminer/zones/us-west1-b/instances/tf-lab-vm]

Apply complete! Resources: 1 added, 1 changed, 0 destroyed.

Outputs:

ip = "35.233.236.40"
amminer@cloudshell:~/tf (cloud-miner-amminer)$
```

- Visit the Compute Engine web console and refresh it to see that the IP address has been bound to the VM. Take a screenshot that includes the VM's IP addresses.

Google Cloud

cloud-miner-amminer

Search (/) for resources,...

Search

6

VM instances

CREATE INSTANCE

IMPORT VM

REFRESH

LEARN

Filter

Enter property name or value

<input type="checkbox"/>	Status	Name ↑	Zone	Recommendations	Internal IP	External IP	Network	Connect	
<input type="checkbox"/>		<a href="#">course-vm</a>	us-west1-b		10.138.0.2 ( <a href="#">nic0</a> )		<a href="#">default</a>	SSH	<div><div></div><div></div></div>
<input type="checkbox"/>		<a href="#">course-vm-usw1a</a>	us-west1-a		10.138.0.8 ( <a href="#">nic0</a> )		<a href="#">default</a>	SSH	<div><div></div><div></div></div>
<input type="checkbox"/>		<a href="#">tf-lab-vm</a>	us-west1-b		10.138.0.16 ( <a href="#">nic0</a> )	35.233.236.40 ( <a href="#">nic0</a> )	<a href="#">default</a>	SSH	<div><div></div><div></div></div>

## 6. Adding ssh access

- Create ssh keys for the cloud console and add the key file to the terraform config. ssh in from cloud shell and show the successful log in.

**I can't access the machine. Any attempt I make to ssh in eventually times out.**

**Google cloud's GUI says I'm being blocked by the machine's firewall but there's a rule in place to allow ssh. When I look at the VM details in CE I see that the ssh keys were copied over successfully but I still can't log in. It appears to be some kind of backend issue with google cloud. Moving on to the next lab for now.**

The screenshot shows the Google Cloud Platform console with a list of VM instances. The instances are:

Status	Name	Zone	Internal IP	External IP	Network	Connection
Running	course-vm	us-west1-b	10.138.0.2 (nic0)		default	SSH
Running	course-vm-usw1a	us-west1-a	10.138.0.8 (nic0)		default	SSH
Running	tf-lab-vm	us-west1-b	10.138.0.16 (nic0)	35.233.236.40 (nic0)	default	SSH

Below the table, a terminal window is open, showing the output of a Terraform command. The output indicates that the VM instance 'tf-lab-vm' has been successfully created and its IP address is 35.233.236.40. The terminal also shows the command to SSH into the VM:

```
amminer@cloudshell:~/tf (cloud-miner-amminer)$ ssh 35.233.236.40 -v
```

The terminal output shows the SSH connection attempt, including the SSH version, the remote host information, and the connection status. The connection timed out, and the terminal shows the error message:

```
ssh: connect to host 35.233.236.40 port 22: Connection timed out
```

Overlaid on the terminal is a dialog box titled "Connection via Cloud Identity-Aware Proxy Failed". The dialog box contains the following information:

- Code: 4003
- Reason: failed to connect to backend
- Connection to VM is blocked by firewall.
- Please ensure that:
  - VM has a [firewall rule](#) that allows TCP Ingress traffic from the IP range 35.235.240.0/20, port: 22
- You may be able to connect without using the Cloud Identity-Aware Proxy.
- Buttons: Retry, Retry without Cloud Identity-Aware Proxy, Troubleshoot

## 7. Adding the guestbook application

todo

## 8. View the Guestbook

todo

## 9. Clean up

todo



### III. Lab 7.2g: Kubernetes Guestbook

#### 1. Kubernetes



#### 2. Setup



#### 3. Assigning Privileges



#### 4. Create Kubernetes Cluster

- What is the name of the Instance Template dynamically generated to create the two nodes (VMs)?

**gke-guestbook-default-pool-357f161d**

Google Cloud cloud-Miner-amminer Search (/) for resources, docs, products, and more

Instance temp... [CREATE INSTANCE TEMPLATE](#) [REFRESH](#) [CREATE VM](#) [CREATE](#)

Instance templates are saved VM configurations used to create identical VMs, either individually or as part of managed instance groups. [Learn more](#)

<input type="checkbox"/>	Name ↑	Machine type	Image	Disk type	Location ?	Actions
<input type="checkbox"/>	<a href="#">gke-guestbook-default-pool-357f161d</a>	e2-medium	gke-1273-gke100-cos-105-17412-101-24-c-pre	Balanced persistent disk	global	⋮

- What is the name of the Instance Group dynamically generated that the two nodes belong to?

**gke-guestbook-default-pool-357f161d-grp**

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Instance groups CREATE INSTANCE GROUP REFRESH DELETE LEARN

Instance groups are collections of VM instances that use load balancing and automated services, like autoscaling and autohealing. [Learn more](#)

Filter Enter property name or value

Status	Name ↑	Instances	Template	Group type	Creation time	Recommendation	Autoscaling	Zone	In Use By
<input checked="" type="checkbox"/>	<a href="#">gke-guestbook-default-pool-357f161d-grp</a>	2	<a href="#">gke-guestbook-default-pool-357f161d</a>	Managed	Nov 12, 2023, 3:32:34 PM UTC-08:00		No configuration	us-west1-b	<a href="#">guestbook</a>

- What are the names of the two nodes?  
**gke-guestbook-default-pool-357f161d-2c1n and gke-guestbook-default-pool-357f161d-p7gz**

Google Cloud cloud-Miner-amminer Search (/) for resources, docs, products, and more

VM instances CREATE INSTANCE IMPORT VM REFRESH

INSTANCES OBSERVABILITY INSTANCE SCHEDULES

VM instances

Filter Enter property name or value

Status	Name ↑	Zone	Recommendations	Internal IP	External IP	Network	Connect
<input type="checkbox"/>	<a href="#">course-vm</a>	us-west1-b		10.138.0.2 (nic0)		<a href="#">default</a>	SSH
<input type="checkbox"/>	<a href="#">course-vm-usw1a</a>	us-west1-a		10.138.0.8 (nic0)		<a href="#">default</a>	SSH
<input checked="" type="checkbox"/>	<a href="#">gke-guestbook-default-pool-357f161d-2c1n</a>	us-west1-b		10.138.0.19 (nic0)	35.199.159.174 (nic0)	<a href="#">default</a>	SSH
<input checked="" type="checkbox"/>	<a href="#">gke-guestbook-default-pool-357f161d-p7gz</a>	us-west1-b		10.138.0.18 (nic0)	34.145.75.201 (nic0)	<a href="#">default</a>	SSH
<input checked="" type="checkbox"/>	<a href="#">tf-lab-vm</a>	us-west1-b		10.138.0.16 (nic0)	35.233.236.40 (nic0)	<a href="#">default</a>	SSH

Related actions

## 5. Prepare a container image

- Visit the Artifact Registry UI and navigate to its container images section. Show the container image created

Google Cloud cloud-Miner-amminer Search (/) for re... Search

Images DELETE

Container Registry is deprecated. After May 15, 2024, Artifact Registry will host images for the gcr.io domain in projects without previous Container Registry usage. [Learn more](#)

**gcp\_gb**

gcr.io > cloud-miner-amminer > gcp\_gb

Filter Enter property name or value

Name	Tags	Virtual Size	Created	Uploaded
<a href="#">26e0cf8d3541</a>	latest	1.1 GB	15 minutes ago	11 minutes ago

## 6. kubernetes.yaml

- Copy over the kubernetes configuration yaml, editing in your project ID. ✓

## 7. Deploy the configuration

- Obtain credentials from the cluster:

```
gcloud container clusters get-credentials guestbook --zone  
us-west1-b
```

Then deploy the configuration on the cluster.

```
kubectl create -f kubernetes.yaml
```

Note that the configuration file is portable and can run on any other cloud provider, locally, etc. Get the status of the pods running in the cluster.

```
kubectl get pods
```

Take a screenshot of the output of the following command when all 3 replicas reach a "Running" state.

**When I did this in the order the lab instructs, it appeared to run successfully but failed to bring up my pods. When I did it manually they failed at the container image pull stage. I inverted the order of the declarations so that the Service is specified at the top of the file and the ReplicationController at the bottom. This worked.**

```
amminer@cloudshell:~ (cloud-miner-amminer)$ kubectl create -f kubernetes.yaml  
replicationcontroller/guestbook-replicas created  
amminer@cloudshell:~ (cloud-miner-amminer)$ kubernetes get pods  
bash: kubernetes: command not found  
amminer@cloudshell:~ (cloud-miner-amminer)$ ^Ckubectl create -f kubernetes.yaml  
amminer@cloudshell:~ (cloud-miner-amminer)$ kubectl get pods  
NAME                READY   STATUS             RESTARTS   AGE  
guestbook-replicas-khdjf 0/1     ContainerCreating   0          35s  
guestbook-replicas-pz2ps 0/1     ContainerCreating   0          35s  
guestbook-replicas-vrws9 0/1     ContainerCreating   0          35s  
amminer@cloudshell:~ (cloud-miner-amminer)$ kubectl get pods  
NAME                READY   STATUS    RESTARTS   AGE  
guestbook-replicas-khdjf 1/1     Running   0          2m20s  
guestbook-replicas-pz2ps 1/1     Running   0          2m20s  
guestbook-replicas-vrws9 1/1     Running   0          2m20s  
amminer@cloudshell:~ (cloud-miner-amminer)$
```

- Then, find the service that is exported from the deployment.

```
kubectl get services
```

Take a screenshot of listing services with LoadBalancer indicating an external IP address that is ready for access.

```
amminer@cloudshell:~ (cloud-miner-amminer)$ kubectl get services  
NAME          TYPE          CLUSTER-IP    EXTERNAL-IP    PORT(S)          AGE  
guestbook-lb  LoadBalancer 10.20.12.144   35.197.40.21   80:31133/TCP     17m  
kubernetes    ClusterIP      10.20.0.1     <none>         443/TCP          106m  
amminer@cloudshell:~ (cloud-miner-amminer)$
```

## 8. view the guestbook

- Bring the guestbook up at its external IP and sign it "Hello Kubernetes!".



## Guestbook

**Sign [here](#)**

### Entries

**Amelia <amminer@pdx.edu>  
signed on 2023-11-13 01:26:36.732318+00:00  
Hello Kubernetes!**

---

**Amelia <amminer@pdx.edu>  
signed on 2023-10-30 01:05:00.939198+00:00  
Hello Cloud Shell!**

---

**Amelia <amminer@pdx.edu>  
signed on 2023-10-29 17:39:21.049839+00:00  
Hello Datastore**

---

**Amelia <amminer@pdx.edu>  
signed on 2023-11-03 00:43:25.874230+00:00**

- View the resources kubernetes has deployed across your cloud project:
  - Take a screenshot of the managed guestbook pods and the service being exposed:

The screenshot shows the Google Cloud console interface for a project named 'cloud-Miner-amminer'. The main section is titled 'Replication Co...'. Below this, there are two sections: 'Managed pods' and 'Exposing services'.

**Managed pods**

Name	Status	Restarts	Created on ↑
<a href="#">guestbook-replicas-vrws9</a>	✓ Running	0	Nov 12, 2023, 5:18:38 PM
<a href="#">guestbook-replicas-pz2ps</a>	✓ Running	0	Nov 12, 2023, 5:18:38 PM
<a href="#">guestbook-replicas-khdjf</a>	✓ Running	0	Nov 12, 2023, 5:18:38 PM

**Exposing services** ⓘ

Name ↑	Type	Endpoints
<a href="#">guestbook-lb</a>	Load balancer	<a href="#">35.197.40.21:80</a>

- Take a screenshot of the load balancer and its details:

The screenshot shows the Google Cloud console interface for a project named 'cloud-Miner-amminer'. The main section is titled 'Service details' for the 'guestbook' service. Below this, there are several sections: 'Cluster', 'Namespace', 'Labels', 'Logs', 'Type', 'External endpoints', 'Load Balancer', and 'Serving pods'.

**Cluster** [guestbook](#)

**Namespace** default

**Labels** [app: guestbook](#) [tier: frontend](#)

**Logs** [Service logs](#)

**Type** LoadBalancer

**External endpoints** [35.197.40.21:80](#)

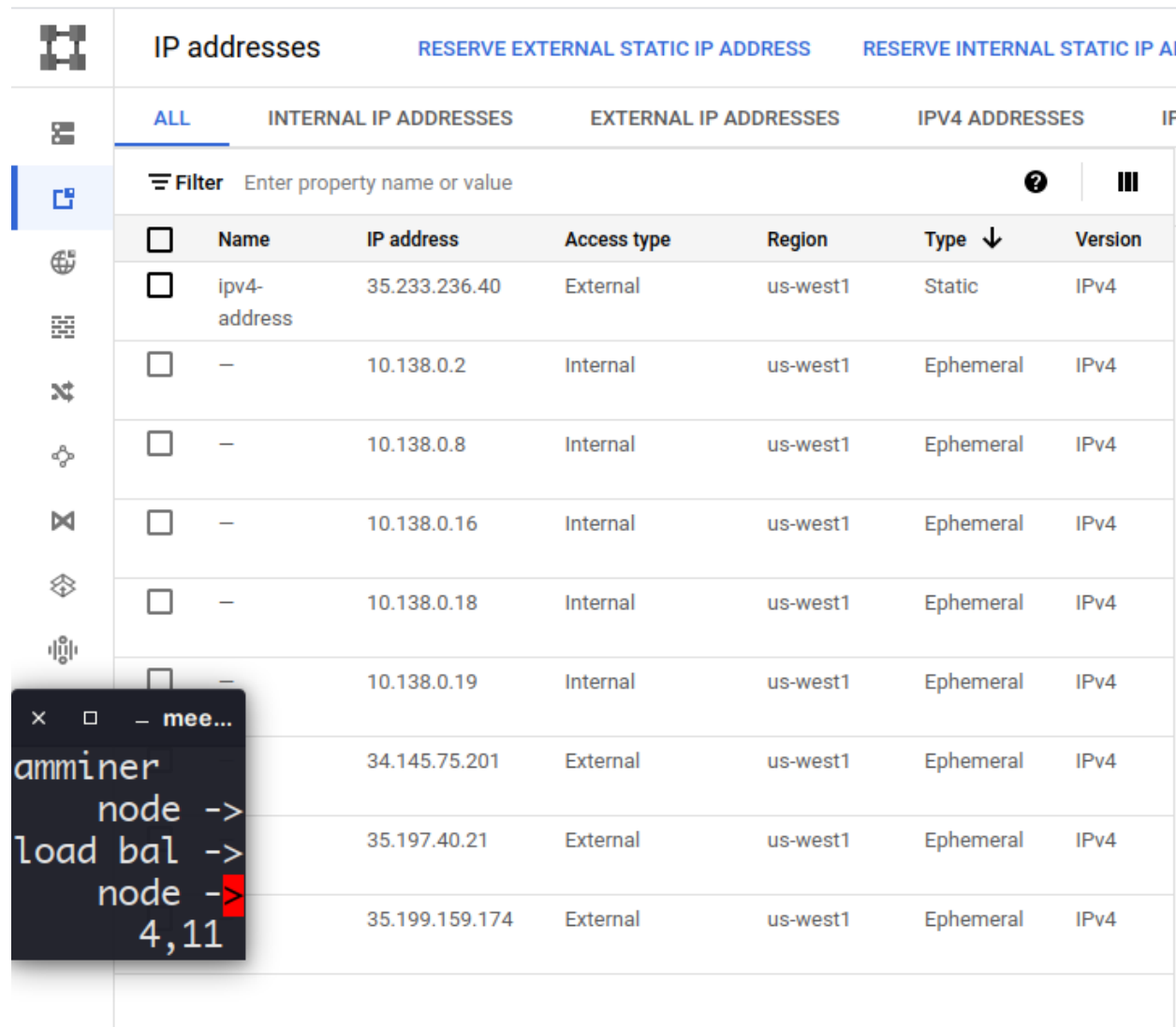
**Load Balancer**

Cluster IP	10.20.12.144
Load balancer IP	35.197.40.21
Load balancer	<a href="#">acdec0e1dfb84e0c9137e3a7eaaec44</a>

**Serving pods**

Name	Status	Endpoints	Restarts	Created on ↑
<a href="#">guestbook-replicas-vrws9</a>	✓ Running	10.16.0.9	0	Nov 12, 2023, 5:18:38 PM
<a href="#">guestbook-replicas-pz2ps</a>	✓ Running	10.16.0.10	0	Nov 12, 2023, 5:18:38 PM
<a href="#">guestbook-replicas-khdjf</a>	✓ Running	10.16.1.15	0	Nov 12, 2023, 5:18:38 PM

- Take a screenshot of the addresses allocated and indicate the ones associated with nodes versus the load balancer.



The screenshot shows the Google Cloud Platform 'IP addresses' page. The table lists various IP addresses, including static and ephemeral ones. A terminal window is overlaid on the table, showing commands to identify IP addresses associated with nodes and the load balancer.

	IP addresses	RESERVE EXTERNAL STATIC IP ADDRESS	RESERVE INTERNAL STATIC IP ADDRESS
	ALL	INTERNAL IP ADDRESSES	EXTERNAL IP ADDRESSES
	IPv4 ADDRESSES		
Filter	Enter property name or value		
	Name	IP address	Access type
	Region	Type	Version
	ipv4-address	35.233.236.40	External
	us-west1	Static	IPv4
	10.138.0.2	Internal	us-west1
	Ephemeral	IPv4	
	10.138.0.8	Internal	us-west1
	Ephemeral	IPv4	
	10.138.0.16	Internal	us-west1
	Ephemeral	IPv4	
	10.138.0.18	Internal	us-west1
	Ephemeral	IPv4	
	10.138.0.19	Internal	us-west1
	Ephemeral	IPv4	
	34.145.75.201	External	us-west1
	Ephemeral	IPv4	
	35.197.40.21	External	us-west1
	Ephemeral	IPv4	
	35.199.159.174	External	us-west1
	Ephemeral	IPv4	

```
mee...
amminer
node ->
load bal ->
node ->
4,11
```

## 9. delete workload and service

```
kubectl delete -f kubernetes.yaml
gcloud container images delete
gcr.io/${GOOGLE_CLOUD_PROJECT}/gcp_gb
```



## 10. CI/CD build automation

- Run:

```
GOOGLE_CLOUD_PROJECT_NUMBER=$(gcloud projects describe  
$GOOGLE_CLOUD_PROJECT --format="value(projectNumber)")
```

```
echo $GOOGLE_CLOUD_PROJECT_NUMBER
```

```
gcloud projects add-iam-policy-binding ${GOOGLE_CLOUD_PROJECT}  
--member  
serviceAccount:${GOOGLE_CLOUD_PROJECT_NUMBER}@cloudbuild.gservice  
account.com --role=roles/container.developer
```



## 11. Configure build automation

- In cloud shell create cloudbuild.yaml from the code in the lab.

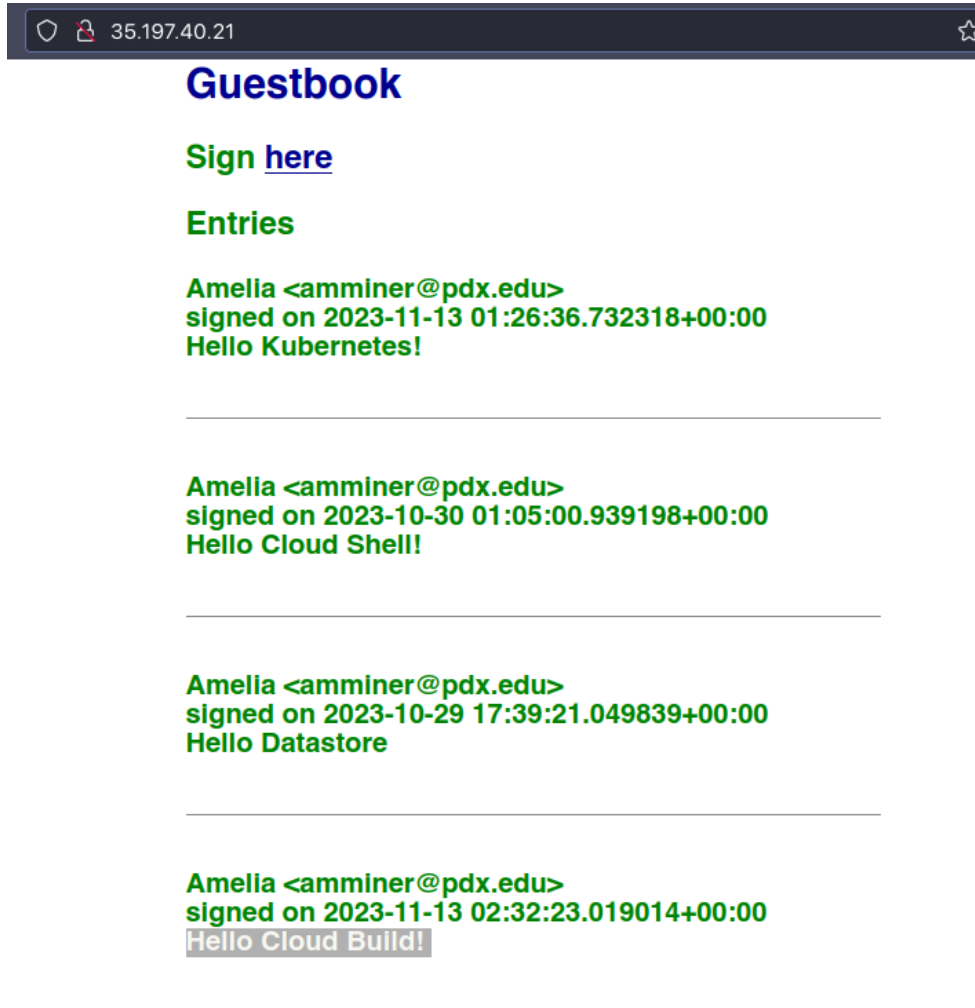


## 12. Deploy and view application

- Build and deploy the app:

```
gcloud builds submit --config=cloudbuild.yaml
```

Visit the load balancer and sign the guest book “Hello Cloud Build!”.



## 13. Clean up

- `kubectl delete -f kubernetes.yaml`
- `gcloud container images delete gcr.io/${GOOGLE_CLOUD_PROJECT}/gcp_gb`





## IV. Lab 7.3g: APIs (Slack, Knowledge Graph)

### 1. Slack and Knowledge Graph Integration

We're setting up a slack command /kg to query google's knowledge graph API on demand via a cloud function. The slack client sends a payload + token to the cloud function's trigger endpoint. The function verifies the token and sends a request to the knowledge graph API + an API key.

- `git clone`  
`https://github.com/GoogleCloudPlatform/python-docs-samples.git`
- `cd python-docs-samples/functions/slack/`



### 2. Code

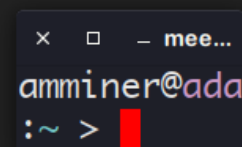
- Does Google provide a Python package specifically for accessing the Knowledge Graph API?

**No. Google provides the `googleapiclient.discovery` module as a generic interface to all of their backend APIs. It uses parameters to its `build` function to determine which API to instantiate.**

### 3. Code

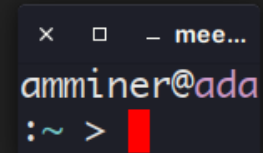
- Show the source line that constructs the query we wish to send to the Knowledge Graph API.

```
81
82     return message
83
84
85 # [END functions_slack_format]
86
87
88 # [START functions_slack_request]
89 def make_search_request(query):
90     req = kgsearch.entities().search(query=query, limit=1)
91     res = req.execute()
92     return format_slack_message(query, res)
93
94
95 # [END functions_slack_request]
96
97
98 # [START functions_slack_search]
99 @functions_framework.http
100 def kg_search(request):
```



- Show the source line that then executes the query and saves the response. What is the name of the method that sends the query to the Knowledge Graph API?  
**the `execute` method of the knowledge graph search query object, whose name is `req` in the program, sends the query to the API.**

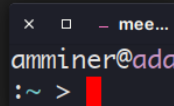
```
82     return message
83
84
85 # [END functions_slack_format]
86
87
88 # [START functions_slack_request]
89 def make_search_request(query):
90     req = kgsearch.entities().search(query=query, limit=1)
91     res = req.execute()
92     return format_slack_message(query, res)
93
94
95 # [END functions_slack_request]
96
97
98 # [START functions_slack_search]
99 @functions.framework.http
```



- What is the Python data type that is used to represent the formatted message?

**A dictionary.**

```
42 # [START functions_slack_format]
43 def format_slack_message(query, response):
44     entity = None
45     if (
46         response
47         and response.get("itemListElement") is not None
48         and len(response["itemListElement"]) > 0
49     ):
50         entity = response["itemListElement"][0]["result"]
51
52     message = {
53         "response_type": "in_channel",
54         "text": f"Query: {query}",
55         "attachments": [],
56     }
57
58     attachment = {}
59     if entity:
60         name = entity.get("name", "")
61         description = entity.get("description", "")
62         detailed_desc = entity.get("detailedDescription", {})
63         url = detailed_desc.get("url")
64         article = detailed_desc.get("articleBody")
65         image_url = entity.get("image", {}).get("contentUrl")
66
67         attachment["color"] = "#3367d6"
68         if name and description:
69             attachment["title"] = "{}: {}".format(entity["name"], entity["description"])
70         elif name:
71             attachment["title"] = name
72         if url:
73             attachment["title_link"] = url
74         if article:
75             attachment["text"] = article
76         if image_url:
77             attachment["image_url"] = image_url
78     else:
79         attachment["text"] = "No results match your query."
80     message["attachments"].append(attachment)
81
82     return message
83
84
85 # [END functions_slack_format]
86
87
88 # [START functions_slack_request]
89 def make_search_request(query):
90     req = kgsearch.entities().search(query=query, limit=1)
91     res = req.execute()
92     return format_slack_message(query, res)
93
94
95 # [END functions_slack_request]
96
```



- What are the three main attributes of the formatted message passed back to Slack?  
**response\_type, text, and attachments... see above.**

## 4. Knowledge Graph Setup

- Enable the KG API and issue an API key.

```
gcloud services enable kgsearch.googleapis.com
gcloud alpha services api-keys create \
  --display-name="KG API Key" \
  --api-target=service=kgsearch.googleapis.com
```



## 5. Create a Slack Workspace

- Also create a slack app and associate it with your workspace. Obtain the slack app's signing secret: basic info -> app credentials -> show. Keep this page up.



## 6. Configure and Deploy

- in Cloud Shell, deploy the code substituting your kg key and slack secret. Note the URL of the function endpoint.



**[https://us-central1-cloud-miner-amminer.cloudfunctions.net/kg\\_search](https://us-central1-cloud-miner-amminer.cloudfunctions.net/kg_search)**

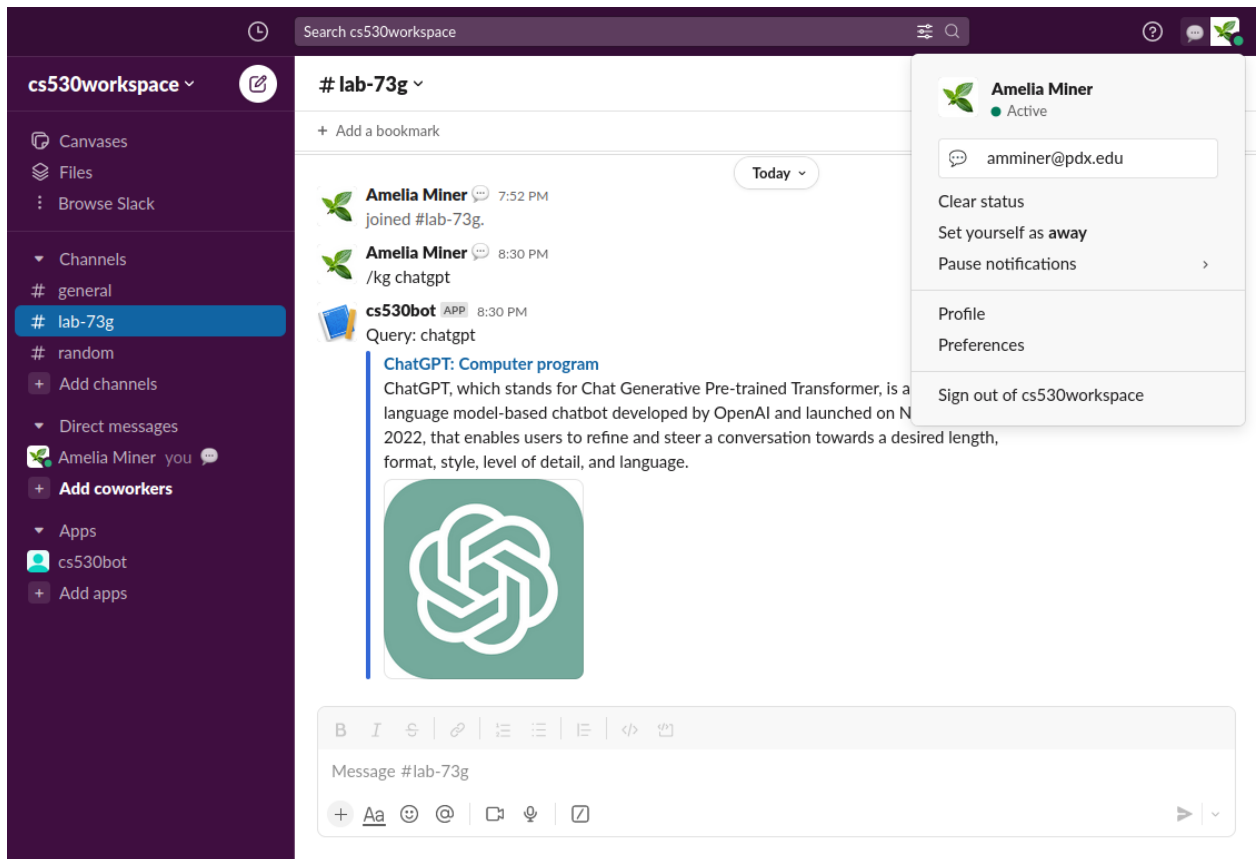
## 7. Create Slack Command

- Create the /kg command and connect it to the above endpoint. Install the app on your workspace.



## 8. Test the command

- Run the command `/kg chatgpt` in your workspace.



- Visit Cloud Shell and examine the logs for the function. Delete the function.



## V. Lab 7.4g: ML APIs