

Practical Assignment

Requirements:

This assignment is designed to test your experience with infrastructure as code (IaC) and Kubernetes.

In the assignment, you are asked to deliver a script with an IaC script (deployment manager, terraform, API via ruby, etc) that will perform the following

Tasks:

- Create a GCP project

The screenshot displays the Google Cloud Platform (GCP) console. The top navigation bar shows 'Google Cloud Platform' and the selected project 'lisa-gcp-cloud2'. A search bar is present on the right. The left sidebar contains navigation links for 'Overview', 'Metrics', 'Quotas', and 'Credentials'. The main content area shows the 'Overview' page for the 'lisa-gcp-cloud2' project, with a 'DISABLE API' button. A 'Select a project' dialog box is open, showing a search bar and a table of projects. The table has columns for 'Name' and 'ID'. The 'lisa-gcp-cloud2' project is listed with ID 'lisa-gcp-cloud2'. Below the dialog, the 'Kubernetes Engine' section is visible, showing a list of clusters. The 'Clusters' tab is selected, displaying a table with columns: 'Name', 'Location', 'Cluster size', 'Total cores', 'Total memory', 'Notifications', and 'Labels'. A single cluster named 'lbp' is listed with location 'us-east1', size '3', '3 vCPUs', and '11.25 GB'. A 'Connect' button is next to the cluster entry.

Name	Location	Cluster size	Total cores	Total memory	Notifications	Labels
lbp	us-east1	3	3 vCPUs	11.25 GB		

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Google Cloud Platform lisa-gcp-cloud2 Search results

Kubernetes Engine ← Clusters EDIT DELETE ADD NODE POOL DEPLOY CONNECT

Clusters

Workloads
Services & Ingress
Applications
Configuration
Storage
Object Browser

Marketplace

<1

Cluster

Master version: 1.15.11-gke.9
Endpoint: 35.196.152.119 [Show cluster certificate](#)
Client certificate: Disabled
Binary Authorization: Disabled
Kubernetes alpha features: Disabled
Current total size: 3
Region: us-east1
Node zones: us-east1-b, us-east1-c, us-east1-d
Network: lbp-network-7f43-network
Subnet: lbp-network-7f43-subnetwork-private
VPC-native (alias IP): Enabled
Pod address range: 10.4.16.0/20
Default maximum pods per node: 110
Service address range: 10.4.16.0/20
Intranode visibility: Disabled
Kubernetes Engine Monitoring: System and workload logging and monitoring
Private cluster: Enabled
VPC peering: gke-n165f48885b8e4778462-e1ec-249d-peer
Master address range: 10.5.0.0/28
Master authorized networks: all-for-testing (0.0.0.0/0)
Network policy: Enabled
NodeLocal DNSCache: Disabled
Legacy authorization: Disabled
Maintenance window: From 1:00 AM to 5:00 AM Daily
Cloud TPU: Disabled

● Create a custom network

VPC network ← VPC network details EDIT DELETE VPC NETWORK

VPC networks

External IP addresses
Firewall rules
Routes
VPC network peering
Shared VPC
Serverless VPC access
Packet mirroring

lbp-network-7f43-network

Subnet creation mode: Custom subnets
Dynamic routing mode: Regional
DNS server policy: None

Subnets Static internal IP addresses Firewall rules Routes VPC Network Peering Private service connection

Add subnet Flow logs

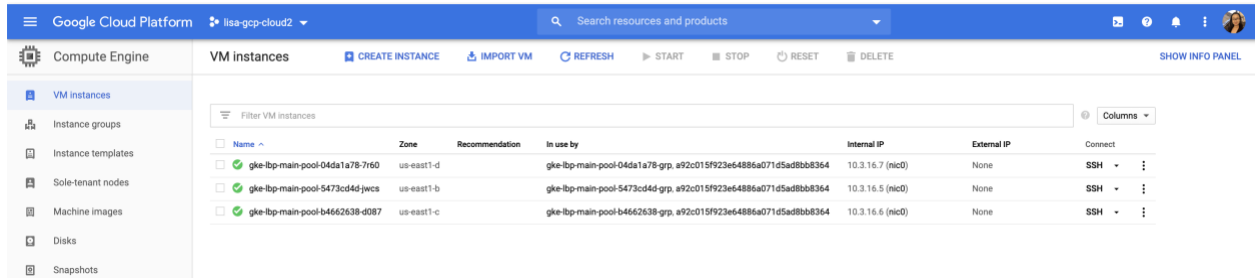
Name	Region	IP address ranges	Gateway	Private Google access	Flow logs
lbp-network-7f43-subnetwork-private	us-east1	10.3.16.0/20, 10.4.16.0/20	10.3.16.1	On	On
lbp-network-7f43-subnetwork-public	us-east1	10.3.0.0/20, 10.4.0.0/20	10.3.0.1	On	On

Equivalent REST

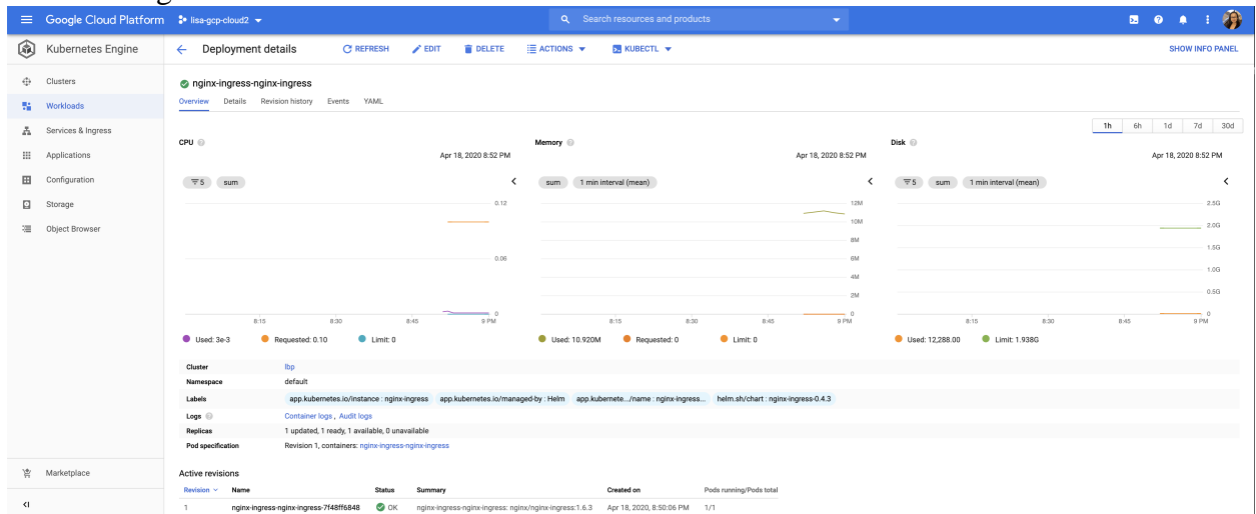
● Create a custom subnet (e.g: us-east1)

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● Create a regional GKE Cluster on 3 availability zones in the project that can be scaled up to 500 nodes. (By default, regional clusters will create nodes across 3 zones in a region.)



- Create a Kubernetes deployment on the GKE cluster created to deploy the official Nginx Docker image



- configure external HTTP(S) load balancer to publish the Nginx deployment
- Reference: <https://docs.nginx.com/nginx-ingress-controller/installation/installation-with-helm/>
- - setup HTTPS (TLS) between client and load balancer (a self-signed certificate is sufficient)

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```

bash-3.2#
bash-3.2# kubectl get nodes -o wide
NAME                                STATUS    ROLES    AGE   VERSION   INTERNAL-IP   EXTERNAL-IP   OS-IMAGE                                     KERNEL-VERSION   CONTAINER-RUNTIME
gke-lbp-main-pool-04da1a78-7r60     Ready    <none>   2m54s   v1.15.11-gke.9   10.3.16.7     10.3.16.7     Container-Optimized OS from Google         4.19.104+        docker://19.3.1
gke-lbp-main-pool-5473cd4d-jwcs     Ready    <none>   2m56s   v1.15.11-gke.9   10.3.16.5     10.3.16.5     Container-Optimized OS from Google         4.19.104+        docker://19.3.1
gke-lbp-main-pool-b4662638-d087     Ready    <none>   2m55s   v1.15.11-gke.9   10.3.16.6     10.3.16.6     Container-Optimized OS from Google         4.19.104+        docker://19.3.1
bash-3.2# kubectl get service
NAME                                TYPE               CLUSTER-IP   EXTERNAL-IP   PORT(S)                                     AGE
kubernetes                          ClusterIP         10.4.16.1     <none>        443/TCP                                    11m
nginx-ingress-nginx-ingress         LoadBalancer    10.4.23.186   34.73.174.252  80:31443/TCP,443:31389/TCP               5m57s
bash-3.2# kubectl get secret
NAME                                TYPE               DATA   AGE
default-token-dpr9b                kubernetes.io/service-account-token  3       11m
nginx-ingress-nginx-ingress-default-server-secret  Opaque                2       6m9s
nginx-ingress-nginx-ingress-token-kg26s          kubernetes.io/service-account-token  3       6m9s
sh.helm.release.v1.nginx-ingress.v1              helm.sh/release.v1      1       6m10s
bash-3.2#
bash-3.2#
bash-3.2#
bash-3.2# kubectl describe secret nginx-ingress-nginx-ingress-default-server-secret
Name:      nginx-ingress-nginx-ingress-default-server-secret
Namespace: default
Labels:    app.kubernetes.io/instance=nginx-ingress
           app.kubernetes.io/managed-by=Helm
           app.kubernetes.io/name=nginx-ingress-nginx-ingress
           helm.sh/chart=nginx-ingress-0.4.3
Annotations: <none>

Type: Opaque

Data
====
tls.key: 1679 bytes
tls.crt: 1013 bytes
bash-3.2#

```

-
- use a static IP address

Google Cloud Platform

lisa-gcp-cloud2

Search resources and products

VPC network

VPC networks

External IP addresses

Firewall rules

Routes

VPC network peering

Shared VPC

Serverless VPC access

Packet mirroring

External IP addresses

RESERVE STATIC ADDRESS

REFRESH

RELEASE STATIC ADDRESS

Filter table

<input type="checkbox"/>	Name	External Address	Region	Type	Version	In use by	Network Tier	Labels
<input type="checkbox"/>	nat-auto-ip-5014671-3-1587257340882002	104.196.196.159	us-east1	Static	IPv4	Router lbp-network-7f43-router	Premium	CHANGE
<input type="checkbox"/>	—	34.73.174.252	us-east1	Ephemeral	IPv4	Forwarding rule a92c015f923e64886a071d5ad8bb8364		

- script should accept the following variables (When you run #terrafrom plan and #terraform apply, please input project name, region name and cluster name)
 - GCP project name
 - GCP region name
 - GKE cluster name
- script should output the following attributes
 - Kubernetes API endpoint
 - curl http://localhost:8080/api/v1/namespaces/default/endpoints
 - the external IP that the nginx is exposed at.

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```

bash-3.2# kubectl get secret
NAME                                     TYPE                                     DATA  AGE
default-token-6c6bx                     kubernetes.io/service-account-token    3      15m
nginx-ingress-nginx-ingress-default-server-secret  Opaque                                2      9m37s
nginx-ingress-nginx-ingress-token-tg29l          kubernetes.io/service-account-token    3      9m37s
sh.helm.release.v1.nginx-ingress.v1             helm.sh/release.v1                     1      9m38s
bash-3.2# kubectl describe secret nginx-ingress-nginx-ingress-default-server-secret
Name:      nginx-ingress-nginx-ingress-default-server-secret
Namespace: default
Labels:    app.kubernetes.io/instance=nginx-ingress
           app.kubernetes.io/managed-by=Helm
           app.kubernetes.io/name=nginx-ingress-nginx-ingress
           helm.sh/chart=nginx-ingress-0.4.3
Annotations: <none>

Type: Opaque

Data
====
tls.crt: 1013 bytes
tls.key: 1679 bytes

```

Delivery:

- Copy your work into a zipped folder that is named QT_FirstName_Lastname.zip
- The folder should contain all your work and the documentation
- In the documentation explain what you did and how to run your code
- We are not going to test a running environment; just review the code you provide.

Note: If there some caveats or concerns about your approach please tell about them. Given the exercise, not all things can be perfect so we would love to hear your thoughts on how to make this production-ready if given time and resources.

IaaS – GCP Introduction

Step 0: Clone code

```

# git clone https://github.com/LIUBOPENG/GCP.git
# cd GCP

```

Or:

- # unzip QT_Bopeng_Liu.zip

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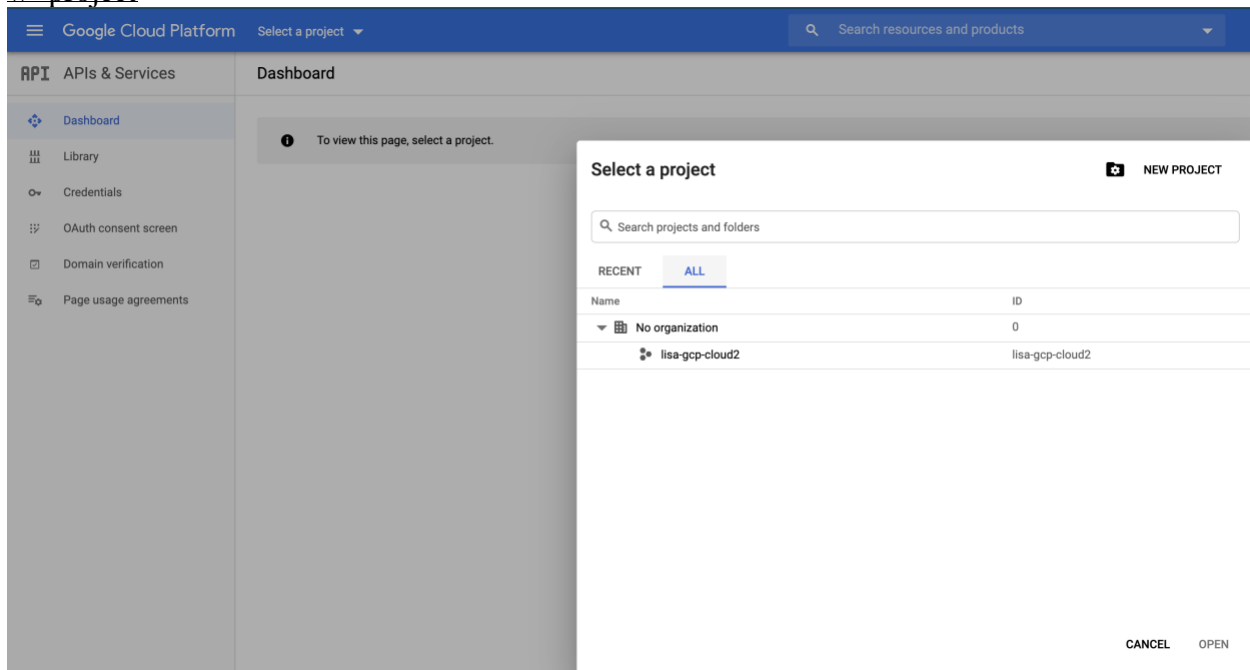
Step 1: Create project

All the steps are included in 001-create-project.sh

```
bash-3.2# vim 001-create-project.sh
bash-3.2# ./001-create-project.sh
Please input project ID:
lisa-gcp-cloud2
Project ID: lisa-gcp-cloud2
Create in progress for [https://cloudresourcemanager.googleapis.com/v1/projects/lisa-gcp-cloud2].
Waiting for [operations/cp.6327301690345238724] to finish...done.
Enabling service [cloudapis.googleapis.com] on project [lisa-gcp-cloud2]...
Operation "operations/acf.a6772f26-bd52-4d14-ac31-99a491e638bc" finished successfully.
bash-3.2#
```

Check new project name in the dashboard:

<https://console.cloud.google.com/projectselector2/apis/dashboard?authuser=1&supportedpurview=project>



Step2:
#gcloud init

```

bash-3.2# gcloud init
Welcome! This command will take you through the configuration of gcloud.

Settings from your current configuration [bopeng-liu] are:
core:
  account: mayerlbp@gmail.com
  disable_usage_reporting: 'True'
  project: lisa-bopeng-cloud

Pick configuration to use:
[1] Re-initialize this configuration [bopeng-liu] with new settings
[2] Create a new configuration
[3] Switch to and re-initialize existing configuration: [default]
[4] Switch to and re-initialize existing configuration: [lbp-cloud]
[5] Switch to and re-initialize existing configuration: [lisa-cloud]
Please enter your numeric choice: 2

Enter configuration name. Names start with a lower case letter and
contain only lower case letters a-z, digits 0-9, and hyphens '-': lisa-gcp-cloud2
Your current configuration has been set to: [lisa-gcp-cloud2]

You can skip diagnostics next time by using the following flag:
  gcloud init --skip-diagnostics

Network diagnostic detects and fixes local network connection issues.
Checking network connection...done.
Reachability Check passed.
Network diagnostic passed (1/1 checks passed).

Choose the account you would like to use to perform operations for
this configuration:
[1] mayerlbp@gmail.com
[2] Log in with a new account
Please enter your numeric choice: 2

Your browser has been opened to visit:
https://accounts.google.com/...

FX2F...type=code&client_id=36555940559.apps.googleusercontent.com...&https://www.googleapis.com/oauth2Fuserinfo.email=https://www.googleapis.com/
https://www.googleapis.com/oauth2Fcompute.googleapis.com/oauth2Faccounts.reauth

You are logged in as: [mayerlbp@gmail.com].

Pick cloud project to use:
[1] lisa-gcp-cloud2
[2] Create a new project
Please enter numeric choice or text value (must exactly match list
item): lisa-gcp-cloud2

Your current project has been set to: [lisa-gcp-cloud2].

Not setting default zone/region (this feature makes it easier to use
[gcloud compute] by setting an appropriate default value for the
--zone and --region flag).
See https://cloud.google.com/compute/docs/gcloud-compute section on how to set
default compute region and zone manually. If you would like [gcloud init] to be
able to do this for you the next time you run it, make sure the
Compute Engine API is enabled for your project on the
https://console.developers.google.com/apis page.

Your Google Cloud SDK is configured and ready to use!

* Commands that require authentication will use mayerlbp@gmail.com by default
* Commands will reference project 'lisa-gcp-cloud2' by default
Run 'gcloud help config' to learn how to change individual settings

This gcloud configuration is called [lisa-gcp-cloud2]. You can create additional configurations if you work with multiple accounts and/or projects.
Run 'gcloud topic configurations' to learn more.

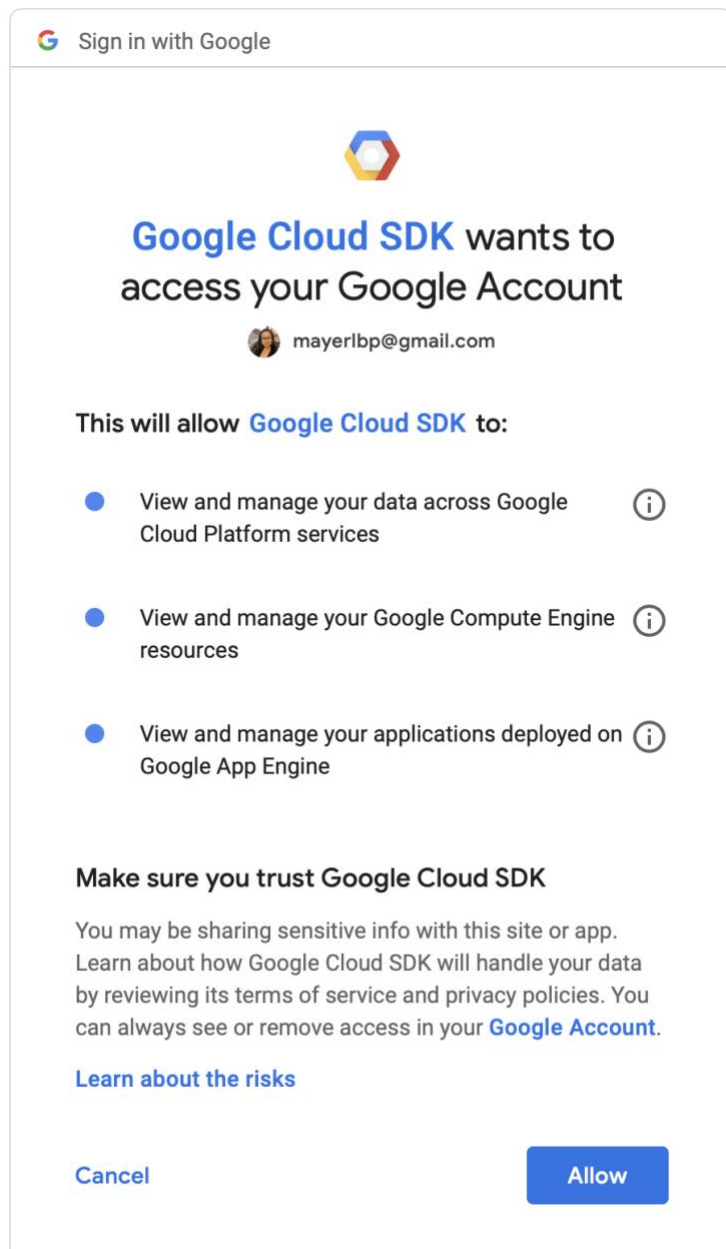
Some things to try next:

* Run 'gcloud --help' to see the Cloud Platform services you can interact with. And run 'gcloud help COMMAND' to get help on any gcloud command.
* Run 'gcloud topic --help' to learn about advanced features of the SDK like arg files and output formatting
bash-3.2#

```



Visit the URL in the above picture and give access to certain user.


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Step3: Enable advanced features

- Enable Kubernetes Engine API

 Google Cloud Platform  lisa-gcp-cloud2 ▾

 API Library




Kubernetes Engine API


Google

Builds and manages container-based applications, powered by the open source Kubernetes technology.

[ENABLE](#) [TRY THIS API ↗](#)

- Enable Cloud Resource Manager API

 API Library



Cloud Resource Manager API

Google

Creates, reads, and updates metadata for Google Cloud Platform resource containers.

[ENABLE](#) [TRY THIS API ↗](#)

Step 4: Create Credentials (Please run the following command and replace your username)

```
# gcloud iam service-accounts create lisa-gcp-cloud2
# gcloud projects add-iam-policy-binding lisa-gcp-cloud2 --member "serviceAccount:lisa-gcp-cloud2@lisa-gcp-cloud2.iam.gserviceaccount.com" --role "roles/owner"
# gcloud iam service-accounts keys create lisa-gcp-cloud2.json --iam-account lisa-gcp-cloud2@lisa-gcp-cloud2.iam.gserviceaccount.com
# export GOOGLE_APPLICATION_CREDENTIALS="/Users/mayerlbp/GCP-2/3/terraform-google-gke/lisa-gcp-cloud2.json"
```

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```

bash-3.2# gcloud iam service-accounts create lisa-gcp-cloud2
Created service account [lisa-gcp-cloud2].
bash-3.2# gcloud projects add-iam-policy-binding lisa-bopeng-cloud2 --member "serviceAccount:lisa-bopeng-cloud2@lisa-bopeng-cloud2.iam.gserviceaccount.com" --role "roles/owner"
ERROR: (gcloud.projects.add-iam-policy-binding) User [mayerlbp@gmail.com] does not have permission to access project [lisa-bopeng-cloud2:getIamPolicy] (or it may not exist): Th
ve permission
bash-3.2# gcloud projects add-iam-policy-binding lisa-bopeng-cloud2 --member "serviceAccount:lisa-gcp-cloud2@lisa-gcp-cloud2.iam.gserviceaccount.com" --role "roles/owner"
ERROR: (gcloud.projects.add-iam-policy-binding) User [mayerlbp@gmail.com] does not have permission to access project [lisa-bopeng-cloud2:getIamPolicy] (or it may not exist): Th
ve permission
bash-3.2# gcloud projects add-iam-policy-binding lisa-gcp-cloud2 --member "serviceAccount:lisa-gcp-cloud2@lisa-gcp-cloud2.iam.gserviceaccount.com" --role "roles/owner"
Updated IAM policy for project [lisa-gcp-cloud2].
bindings:
- members:
  - serviceAccount:service-41837938635@compute-system.iam.gserviceaccount.com
    role: roles/compute.serviceAgent
- members:
  - serviceAccount:service-41837938635@container-engine-robot.iam.gserviceaccount.com
    role: roles/container.serviceAgent
- members:
  - serviceAccount:41837938635-compute@developer.gserviceaccount.com
  - serviceAccount:41837938635@cloudservices.gserviceaccount.com
  - serviceAccount:service-41837938635@containerregistry.iam.gserviceaccount.com
    role: roles/editor
- members:
  - serviceAccount:lisa-gcp-cloud2@lisa-gcp-cloud2.iam.gserviceaccount.com
  - user:mayerlbp@gmail.com
    role: roles/owner
etag: BwWjmedH0ys=
version: 1
bash-3.2# █

```

Step 5: Input GKE name, region, project id when you run:

```

#terraform init
#terraform plan

```

```

# module.vpc_network.module.network_firewall.google_compute_firewall.public_allow_all_inbound will be created
+ resource "google_compute_firewall" "public_allow_all_inbound" {
  + creation_timestamp = (known after apply)
  + destination_ranges = (known after apply)
  + direction          = "INGRESS"
  + id                 = (known after apply)
  + name               = (known after apply)
  + network            = (known after apply)
  + priority           = 1000
  + project            = "lisa-gcp-cloud2"
  + self_link          = (known after apply)
  + source_ranges      = [
    + "0.0.0.0/0",
  ]
  + target_tags        = [
    + "public",
  ]

  + allow {
    + ports    = []
    + protocol = "all"
  }
}

Plan: 19 to add, 0 to change, 0 to destroy.

-----

Note: You didn't specify an "-out" parameter to save this plan, so Terraform
can't guarantee that exactly these actions will be performed if
"terraform apply" is subsequently run.

bash-3.2# █

```

Step 6: Input GKE name, region, project id when you run:

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#terraform apply

```
bash-3.2# ls -al
total 40
drwxr-xr-x  7 root  staff   224 18 Apr 20:24 .
drwxr-xr-x  3 root  staff    96 18 Apr 16:48 ..
drwxr-xr-x  4 root  staff   128 18 Apr 16:50 .terraform
-rwxr-xr-x  1 root  staff   127 18 Apr 20:21 001-create-project.sh
-rw-r--r--  1 root  staff 10328 18 Apr 16:50 main.tf
drwxr-xr-x  4 root  staff   128 18 Apr 16:48 modules
-rw-r--r--  1 root  staff  3145 18 Apr 18:01 variables.tf
bash-3.2#
bash-3.2# terraform init
Initializing modules...

Initializing the backend...

Initializing provider plugins...

The following providers do not have any version constraints in configuration,
so the latest version was installed.

To prevent automatic upgrades to new major versions that may contain breaking
changes, it is recommended to add version = "..." constraints to the
corresponding provider blocks in configuration, with the constraint strings
suggested below.

* provider.null: version = "~> 2.1"
* provider.random: version = "~> 2.2"
* provider.template: version = "~> 2.1"

Terraform has been successfully initialized!

You may now begin working with Terraform. Try running "terraform plan" to see
any changes that are required for your infrastructure. All Terraform commands
should now work.

If you ever set or change modules or backend configuration for Terraform,
rerun this command to reinitialize your working directory. If you forget, other
commands will detect it and remind you to do so if necessary.
bash-3.2#
```

Step 7: Set up Kubernetes Proxy:

#kubectl proxy &

```
bash-3.2# kubectl proxy &
[2] 28788
bash-3.2# Starting to serve on 127.0.0.1:8001
```

Step 8: Get endpoints of GKE:

#curl http://localhost:8001/api/v1/namespaces/default/endpoints

```

bash-3.2# curl http://localhost:8001/api/v1/namespaces/default/endpoints
{
  "kind": "EndpointsList",
  "apiVersion": "v1",
  "metadata": {
    "selfLink": "/api/v1/namespaces/default/endpoints",
    "resourceVersion": "7918"
  },
  "items": [
    {
      "metadata": {
        "name": "kubernetes",
        "namespace": "default",
        "selfLink": "/api/v1/namespaces/default/endpoints/kubernetes",
        "uid": "68da7b3c-172a-42f0-b31b-5ad34eb01c21",
        "resourceVersion": "147",
        "creationTimestamp": "2020-04-18T20:55:20Z"
      },
      "subsets": [
        {
          "addresses": [
            {
              "ip": "10.5.0.2"
            }
          ],
          "ports": [
            {
              "name": "https",
              "port": 443,
              "protocol": "TCP"
            }
          ]
        }
      ]
    }
  ],
  {
    "metadata": {
      "name": "nginx-ingress-nginx-ingress",
      "namespace": "default",
      "selfLink": "/api/v1/namespaces/default/endpoints/nginx-ingress-nginx-ingress",
      "uid": "27bf85d2-42dd-4ac1-b1e9-bdc1be5aa892",
      "resourceVersion": "4730",
      "creationTimestamp": "2020-04-18T21:01:19Z",
      "labels": {
        "app.kubernetes.io/instance": "nginx-ingress",
        "app.kubernetes.io/managed-by": "Helm",
        "app.kubernetes.io/name": "nginx-ingress-nginx-ingress",
        "helm.sh/chart": "nginx-ingress-0.4.3"
      }
    },
    "subsets": [
      {
        "addresses": [
          {
            "ip": "10.4.17.5",
            "nodeName": "gke-example-cluster-main-pool-e3bfb679-n08j",
            "targetRef": {
              "kind": "Pod",
              "namespace": "default",
              "name": "nginx-ingress-nginx-ingress-7f48ff6848-cvbfj",
              "uid": "1816e001-457b-461a-8eef-37179c61138a",
              "resourceVersion": "4204"
            }
          }
        ],
        "ports": [
          {
            "name": "http",
            "port": 80,
            "protocol": "TCP"
          },
          {
            "name": "https",
            "port": 443,
            "protocol": "TCP"
          }
        ]
      }
    ]
  }
]

```

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Step 8: Get the external IP of nginx is exposed at:

#kubectl get service

```
bash-3.2# kubectl get nodes -o wide
NAME                                STATUS    ROLES    AGE    VERSION    INTERNAL-IP    EXTERNAL-IP    OS-IMAGE                                KERNEL-VERSION    CONTAINER-RUNTIME
gke-lbp-main-pool-04da1a78-7r60     Ready    <none>    2m54s    v1.15.11-gke.9    10.3.16.7      10.3.16.7      Container-Optimized OS from Google    4.19.104+         docker://19.3.1
gke-lbp-main-pool-5473cd4d-jwcs     Ready    <none>    2m56s    v1.15.11-gke.9    10.3.16.5      10.3.16.5      Container-Optimized OS from Google    4.19.104+         docker://19.3.1
gke-lbp-main-pool-b4662638-d087     Ready    <none>    2m55s    v1.15.11-gke.9    10.3.16.6      10.3.16.6      Container-Optimized OS from Google    4.19.104+         docker://19.3.1
bash-3.2# kubectl get service
NAME                TYPE          CLUSTER-IP    EXTERNAL-IP    PORT(S)          AGE
kubernetes          ClusterIP     10.4.16.1     <none>         443/TCP          11m
nginx-ingress-nginx LoadBalancer  10.4.23.186   34.73.174.252  80:31443/TCP,443:31389/TCP 5m57s
bash-3.2# kubectl get secret
NAME                                TYPE          DATA    AGE
default-token-dpr9b                kubernetes.io/service-account-token  3        11m
nginx-ingress-nginx-ingress-default-server-secret  Opaque        2        6m9s
nginx-ingress-nginx-ingress-token-kg26s           kubernetes.io/service-account-token  3        6m9s
sh.helm.release.v1.nginx-ingress.v1               helm.sh/release.v1                    1        6m10s
bash-3.2#
bash-3.2#
bash-3.2#
bash-3.2# kubectl describe secret nginx-ingress-nginx-ingress-default-server-secret
Name:      nginx-ingress-nginx-ingress-default-server-secret
Namespace: default
Labels:    app.kubernetes.io/instance=nginx-ingress
           app.kubernetes.io/managed-by=Helm
           app.kubernetes.io/name=nginx-ingress-nginx-ingress
           helm.sh/chart=nginx-ingress-0.4.3
Annotations: <none>

Type: Opaque

Data
====
tls.key: 1679 bytes
tls.crt: 1013 bytes
bash-3.2#
```

The external IP of nginx service can be got by command:

#kubectl get service | grep nginx | awk '{print \$4}'

For example: (Test result in another GKE cluster, so IP is different)

```
bash-3.2# kubectl get service | grep nginx | awk '{print $4}'
35.237.232.18
```

Test result:

Nginx service works.



Welcome to nginx!

If you see this page, the nginx web server is successfully installed and working. Further configuration is required.

For online documentation and support please refer to nginx.org.
Commercial support is available at nginx.com.

Thank you for using nginx.

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