Deploy, Scale, and Update Your Website on Google Kubernetes Engine

GSP663

Google Cloud Self-Paced Labs

Overview

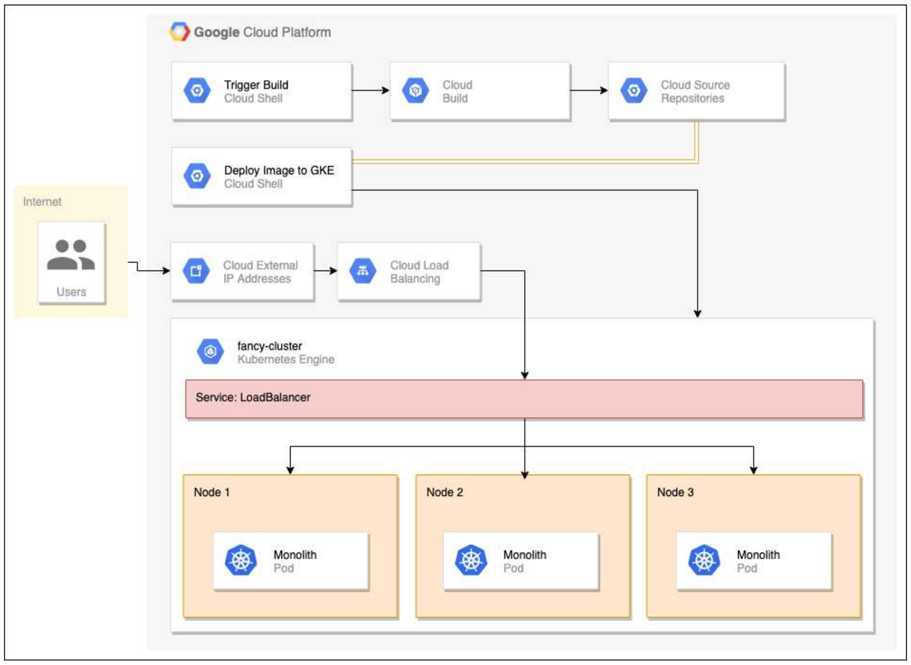
Running websites and applications is hard. Things go wrong when they shouldn't, servers crash, increase in demand causes more resources to be utilized, and making changes without downtime is complicated and stressful. Imagine if there was a tool that could help you do all this and even allow you to automate it. With Kubernetes, all of this is not only possible, it's easy!

In this lab you will assume the role of a developer at a fictional company, Fancy Store, running an ecommerce website. Due to problems with scaling and outages, you are tasked with deploying your application onto the Google Kubernetes Engine (GKE).

The exercises in this lab are ordered to reflect a common cloud developer experience:

1. Create a GKE cluster
2. Create a Docker container
3. Deploy the container to GKE
4. Expose the container via a service
5. Scale the container to multiple replicas
6. Modify the website
7. Rollout a new version with zero downtime

Architecture diagram



What you'll learn

- How to create a Google Kubernetes Engine cluster
- How to create a Docker image
- How to deploy Docker images to Kubernetes
- How to scale an application on Kubernetes
- How to perform a rolling update on Kubernetes

Prerequisites

- A basic understanding of Docker and Kubernetes:
    - Docker - https://docs.docker.com/
    - Kubernetes - https://kubernetes.io/docs/home/

Setup

Before you click the Start Lab button

Read these instructions. Labs are timed and you cannot pause them. The timer, which starts when you click **Start Lab**, shows how long Google Cloud resources will be made available to you.

This Qwiklabs hands-on lab lets you do the lab activities yourself in a real cloud environment, not in a simulation or demo environment. It does so by giving you new, temporary credentials that you use to sign in and access Google Cloud for the duration of the lab.

What you need

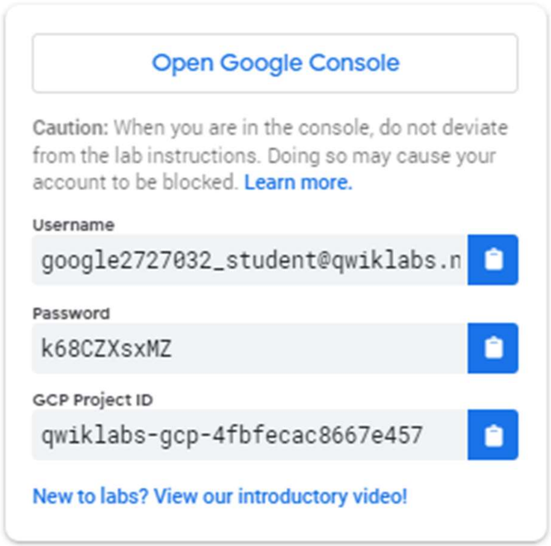
To complete this lab, you need:

- Access to a standard internet browser (Chrome browser recommended).
- Time to complete the lab.
  Note: If you already have your own personal Google Cloud account or project, do not use it for this lab.

Note: If you are using a Pixelbook, open an Incognito window to run this lab.

How to start your lab and sign in to the Google Cloud Console

1. Click the **Start Lab** button. If you need to pay for the lab, a pop-up opens for you to select your payment method. On the left is a panel populated with the temporary credentials that you must use for this lab.



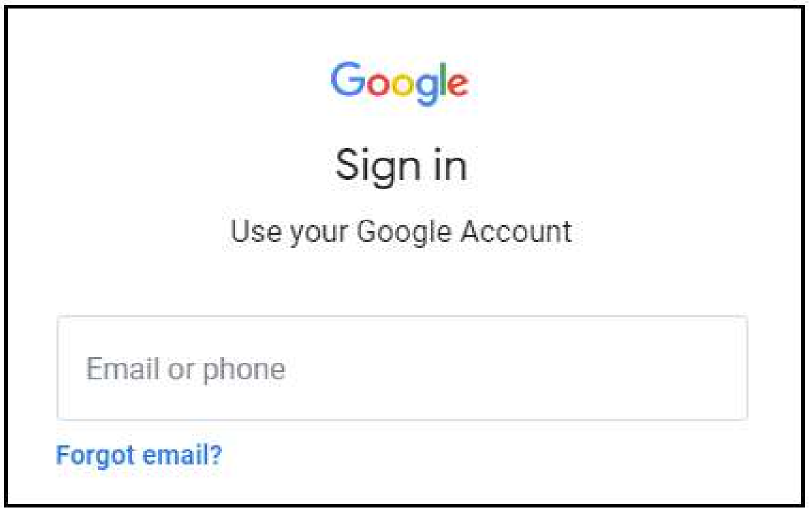
Caution: When you are in the console, do not deviate from the lab instructions. Doing so may cause your account to be blocked. Learn more.

Username
google2727032_student@qwiklabs.n

Password
k68CZXsxMZ

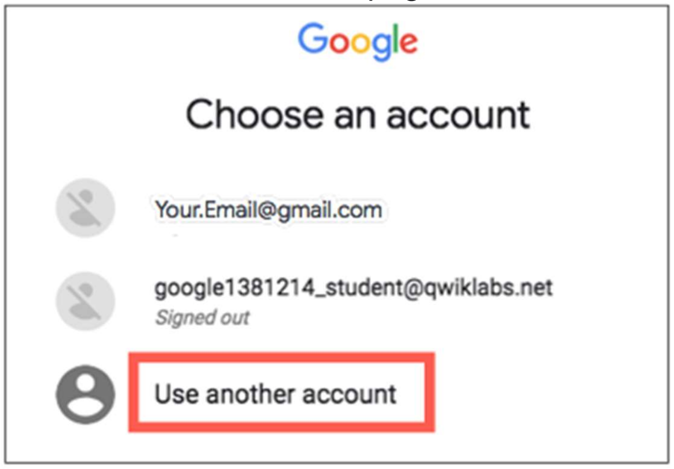
GCP Project ID
qwiklabs-gcp-4fbfecac8667e457

2. Copy the username, and then click **Open Google Console**. The lab spins up resources, and then opens another tab that shows the **Sign in** page.



Tip: Open the tabs in separate windows, side-by-side.

If you see the **Choose an account** page, click **Use Another**



Account.

3. In the **Sign in** page, paste the username that you copied from the Connection Details panel. Then copy and paste the password.

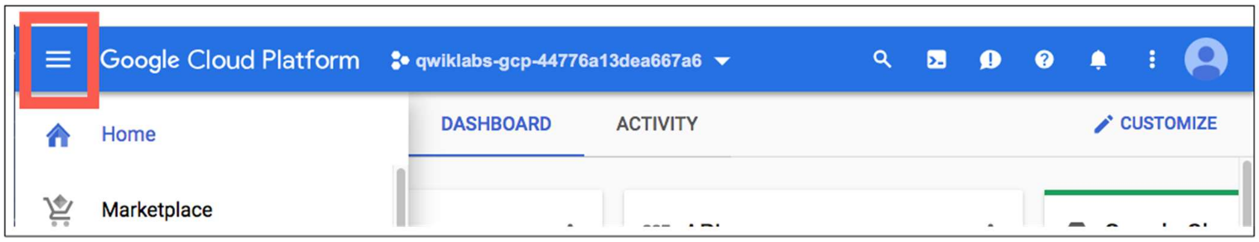
   Important: You must use the credentials from the Connection Details panel. Do not use your Qwiklabs credentials. If you have your own Google Cloud account, do not use it for this lab (avoids incurring charges).

4. Click through the subsequent pages:

   - Accept the terms and conditions.
   - Do not add recovery options or two-factor authentication (because this is a temporary account).
   - Do not sign up for free trials.

After a few moments, the Cloud Console opens in this tab.

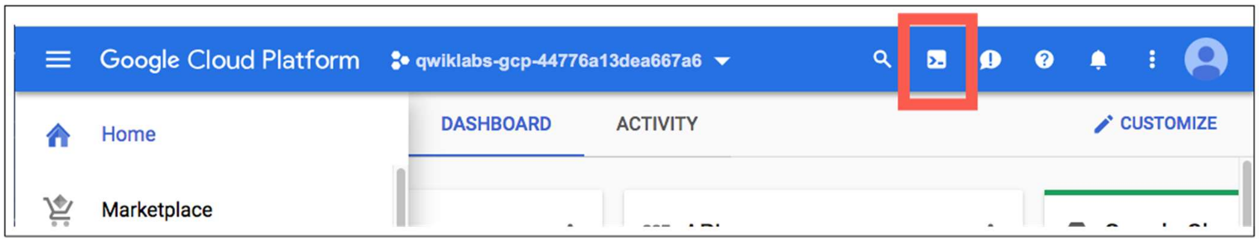
Note: You can view the menu with a list of Google Cloud Products and Services by clicking the **Navigation menu** at the top-left.



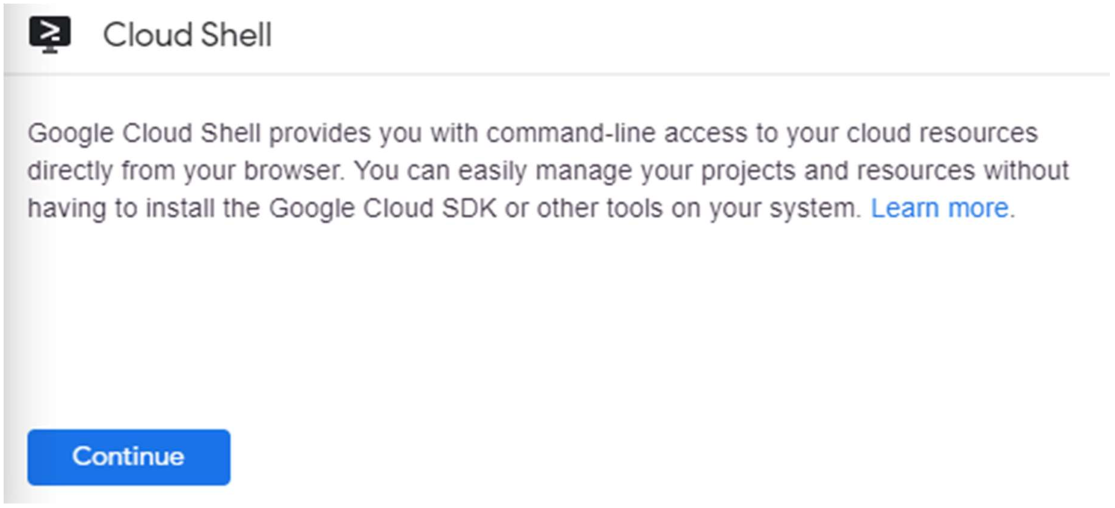
Activate Cloud Shell

Cloud Shell is a virtual machine that is loaded with development tools. It offers a persistent 5GB home directory and runs on the Google Cloud. Cloud Shell provides command-line access to your Google Cloud resources.

In the Cloud Console, in the top right toolbar, click the **Activate Cloud Shell** button.

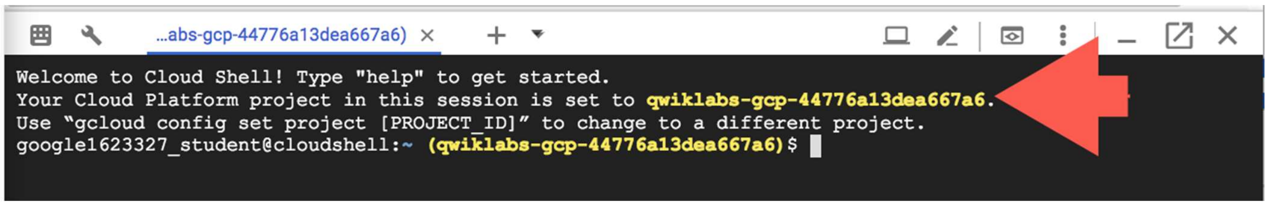


Click **Continue**.



Google Cloud Shell provides you with command-line access to your cloud resources directly from your browser. You can easily manage your projects and resources without having to install the Google Cloud SDK or other tools on your system. Learn more.

It takes a few moments to provision and connect to the environment. When you are connected, you are already authenticated, and the project is set to your *PROJECT_ID*. For example:



```
Welcome to Cloud Shell! Type "help" to get started.
Your Cloud Platform project in this session is set to qwiklabs-gcp-44776a13dea667a6.
Use "gcloud config set project [PROJECT_ID]" to change to a different project.
google1623327_student@cloudshell:~ (qwiklabs-gcp-44776a13dea667a6)$
```

`gcloud` is the command-line tool for Google Cloud. It comes pre-installed on Cloud Shell and supports tab-completion.

You can list the active account name with this command:

```
gcloud auth list
```

(Output)

```
Credentialed accounts:
 - <myaccount>@<mydomain>.com (active)
```

(Example output)

```
Credentialed accounts:
 - google1623327_student@qwiklabs.net
```

You can list the project ID with this command:

```
gcloud config list project
```

(Output)

```
[core]
project = <project_ID>
```

(Example output)

```
[core]
project = qwiklabs-gcp-44776a13dea667a6
```

For full documentation of `gcloud` see the gcloud command-line tool overview.

Set the default zone and project configuration:

```
gcloud config set compute/zone us-central1-f
```

Learn more in the Regions & Zones documentation.

Create a GKE cluster

You need a Kubernetes cluster to deploy your website to. First, make sure the proper APIs are enabled.

Run the following command to enable the Container Registry API:

```
gcloud services enable container.googleapis.com
```

Now you are ready to create a cluster!

Run the following to create a GKE cluster named `fancy-cluster` with **3** nodes:

```
gcloud container clusters create fancy-cluster --num-nodes 3
```

If you get an error about region/zone not being specified, please see the environment setup section to make sure you set the default compute zone.
It will take a few minutes for the cluster to be created.

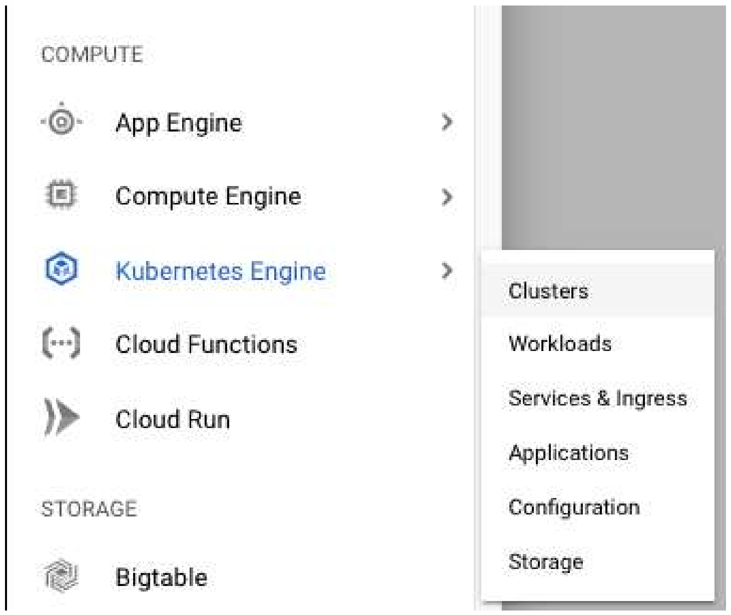
Now run the following command and see the cluster's three worker VM instances:

```
gcloud compute instances list
```

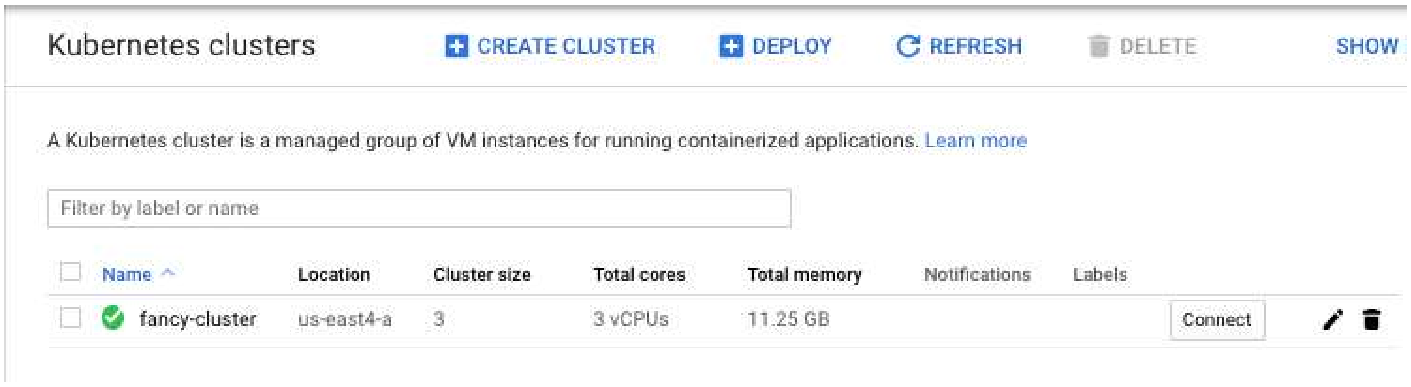
Output:

```
NAME                                          ZONE        MACHINE_TYPE   PREEMPTIBLE
INTERNAL_IP  EXTERNAL_IP    STATUS
gke-fancy-cluster-default-pool-ad92506d-1ng3  us-east4-a  n1-standard-1
10.150.0.7   XX.XX.XX.XX    RUNNING
gke-fancy-cluster-default-pool-ad92506d-4fvq  us-east4-a  n1-standard-1
10.150.0.5   XX.XX.XX.XX    RUNNING
gke-fancy-cluster-default-pool-ad92506d-4zs3  us-east4-a  n1-standard-1
10.150.0.6   XX.XX.XX.XX    RUNNING
```

Find your Kubernetes cluster and related information in the Google Cloud console. Click the **Navigation menu**, then scroll down to **Kubernetes Engine** and click **Clusters**.



You should see your cluster named *fancy-cluster*.



A Kubernetes cluster is a managed group of VM instances for running containerized applications. Learn more

Filter by label or name

	Name	Location	Cluster size	Total cores	Total memory	Notifications	Labels		
☐	✓ fancy-cluster	us-east4-a	3	3 vCPUs	11.25 GB			Connect	

Congratulations! You have just created your first Kubernetes cluster!

Click *Check my progress* to verify the objective.

Clone source repository

Since this is an existing website, you just need to clone the source, so you can focus on creating Docker images and deploying to GKE.

Run the following commands to clone the git repo to your Cloud Shell instance:

```
cd ~
git clone https://github.com/googlecodelabs/monolith-to-microservices.git
```

Change to the appropriate directory. You will also install the NodeJS dependencies so you can test your application before deploying:

```
cd ~/monolith-to-microservices
./setup.sh
```

Wait a few minutes for this script to finish running.

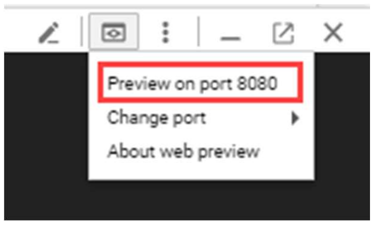
Change to the appropriate directory and test the application by running the following command to start the web server:

```
cd ~/monolith-to-microservices/monolith
npm start
```

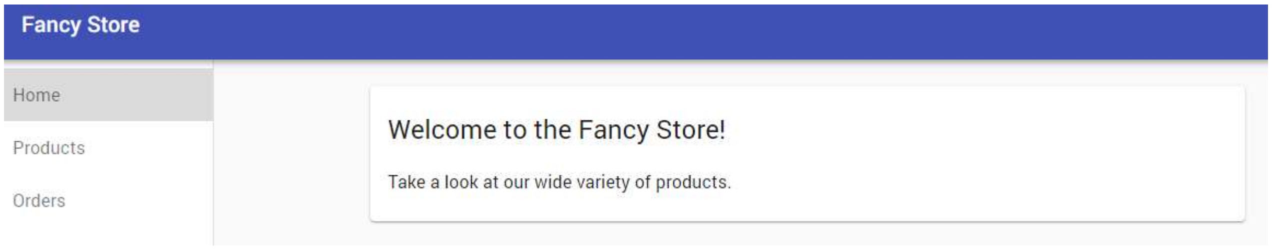
Output:

```
Monolith listening on port 8080!
```

You can preview your application by clicking the web preview icon and selecting **Preview on port 8080**:



This should open a new window where you can see our Fancy Store in action!


Fancy Store

Home

Products

Orders

Welcome to the Fancy Store!

Take a look at our wide variety of products.

Leave this tab open, you'll return to it later in the lab.

To stop the web server process, press `CTRL+C` in Cloud Shell.

Create Docker container with Cloud Build

Now that you have your source files ready to go, it is time to Dockerize your application!

Normally you would have to take a two step approach that entails building a Docker container and pushing it to a registry to store the image for GKE to pull from. Make life easier and use Cloud Build to build the Docker container and put the image in the Container Registry with a single command! With a single command you can build and move the image to the container registry. To view the manual process of creating a docker file and pushing it you can go here.
Google Cloud Build will compress the files from the directory and move them to a Google Cloud Storage bucket. The build process will then take all the files from the bucket and use the Dockerfile to run the Docker build process. Since we specified the `--tag` flag with the host as gcr.io for the Docker image, the resulting Docker image will be pushed to the Google Cloud Container Registry.

First, to make sure you have the Cloud Build API enable, run the following command:

```
gcloud services enable cloudbuild.googleapis.com
```

Run the following to start the build process:

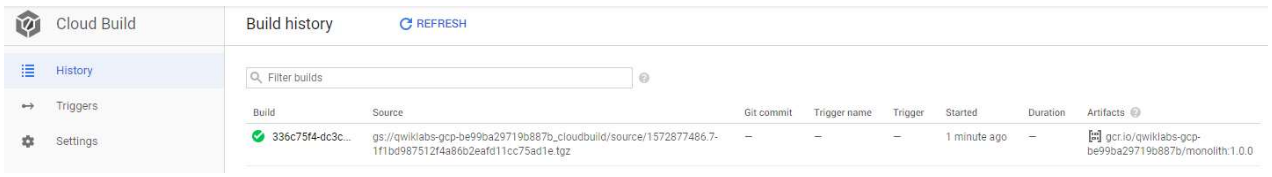
```
cd ~/monolith-to-microservices/monolith
gcloud builds submit --tag gcr.io/${GOOGLE_CLOUD_PROJECT}/monolith:1.0.0 .
```

This process will take a few minutes.

There will be output in the terminal similar to the following:

```
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
ID                                    CREATE_TIME                DURATION  SOURCE
IMAGES                               STATUS
1ae295d9-63cb-482c-959b-bc52e9644d53  2019-08-29T01:56:35+00:00  33S
gs://<PROJECT_ID>_cloudbuild/source/1567043793.94-abfd382011724422bf49af1558b894aa.tgz
gcr.io/<PROJECT_ID>/monolith:1.0.0  SUCCESS
```

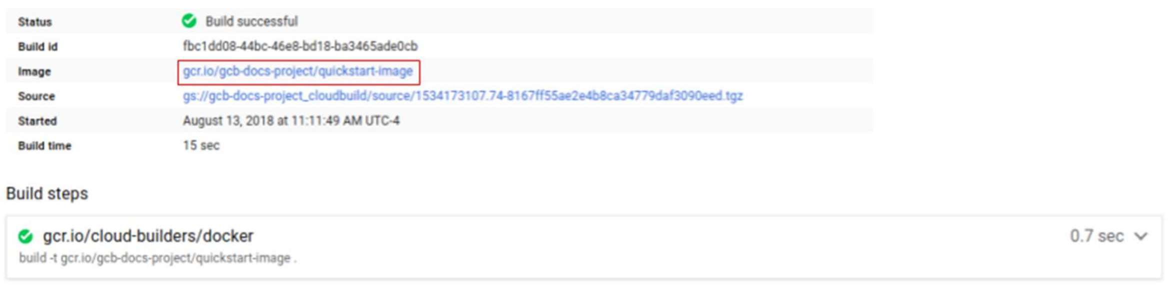
To view your build history or watch the process in real time by clicking the **Navigation menu** and scrolling down to Tools section, then click **Cloud Build** > **History**. Here you can see a list of all your previous builds.



Build	Source	Git commit	Trigger name	Trigger	Started	Duration	Artifacts
✓ 336c75f4-dc3c...	gs://qwiklabs-gcp-be99ba29719b887b_cloudbuild/source/1572877486.7-1f1bd987512f4a86b2eafd11cc75ad1e.tgz	–	–	–	1 minute ago	–	gcr.io/qwiklabs-gcp-be99ba29719b887b/monolith:1.0.0

Click on the build name to see all the details for that build including the log output.

Optional: From the Build details page, click on the image name in the build information section to see the container image:



Status	✓ Build successful
Build id	fbc1dd08-44bc-46e8-bd18-ba3465ade0cb
Image	gcr.io/gcb-docs-project/quickstart-image
Source	gs://gcb-docs-project_cloudbuild/source/1534173107.74-8167ff55ae2e4b8ca34779daf3090eed.tgz
Started	August 13, 2018 at 11:11:49 AM UTC-4
Build time	15 sec

Build steps

gcr.io/cloud-builders/docker 0.7 sec

```
build -t gcr.io/gcb-docs-project/quickstart-image .
```

Click *Check my progress* to verify the objective.

Deploy container to GKE

Now that you have containerized your website and pushed your container to the Google Container Registry, it is time to deploy to Kubernetes!

To deploy and manage applications on a GKE cluster, you must communicate with the Kubernetes cluster management system. You typically do this by using the `kubectl` command-line tool.

Kubernetes represents applications as Pods, which are units that represent a container (or group of tightly-coupled containers). The Pod is the smallest deployable unit in Kubernetes. In this lab, each Pod contains only your monolith container.
To deploy your application, create a Deployment resource. The Deployment manages multiple copies of your application, called replicas, and schedules them to run on the individual nodes in your cluster. For this lab the Deployment will be running only one Pod of your application. Deployments ensure this by creating a ReplicaSet. The ReplicaSet is responsible for making sure the number of replicas specified are always running.
The `kubectl create deployment` command you'll use next causes Kubernetes to create a Deployment named `monolith` on your cluster with **1** replica.

Run the following command to deploy your application:

```
kubectl create deployment monolith --
image=gcr.io/${GOOGLE_CLOUD_PROJECT}/monolith:1.0.0
```

Note: As a best practice, using YAML file and a source control system such as GitHub or Cloud Source Repositories is recommended to store those changes. See these resources for more
information: https://kubernetes.io/docs/concepts/workloads/controllers/deployment/
Click *Check my progress* to verify the objective.

Verify Deployment

Verify the Deployment was created successfully:

```
kubectl get all
```

Rerun the command until the pod status is Running.

Output:

```
NAME                              READY    STATUS     RESTARTS     AGE
pod/monolith-7d8bc7bf68-htm7z    1/1      Running    0            6m21s

NAME                    TYPE         CLUSTER-IP     EXTERNAL-IP    PORT(S)    AGE
service/kubernetes    ClusterIP    10.27.240.1    <none>         443/TCP    24h

NAME                        DESIRED     CURRENT     UP-TO-DATE     AVAILABLE     AGE
deployment.apps/monolith    1           1           1              1             20m
```

```
NAME                                       DESIRED   CURRENT   READY   AGE
replicaset.apps/monolith-7d8bc7bf68        1         1         1       20m
```

This output shows you several things:

- The Deployment, which is current
- The ReplicaSet with desired pod count of 1
- The Pod, which is running

Looks like everything was created successfully!

You can also view your Kubernetes deployments via the Console. **Navigation menu** > **Kubernetes Engine** > **Workloads**.

Note: If you are seeing errors or statuses you do not expect, you can debug your resources with the following commands to see detailed information about them:

```
kubectl describe pod monolith
```

```
kubectl describe pod/monolith-7d8bc7bf68-2bxts
```

```
kubectl describe deployment monolith
```

```
kubectl describe deployment.apps/monolith
```

At the very end of the output, you will see a list of events that give errors and detailed information about your resources.

Optional: You can run commands to your deployments separately as well:

```
# Show pods
kubectl get pods

# Show deployments
kubectl get deployments

# Show replica sets
kubectl get rs

#You can also combine them
kubectl get pods,deployments
```

To see the full benefit of Kubernetes, simulate a server crash by deleting a pod and see what happens!

Copy a pod name from the previous command, then use it when you run the following command to delete it:

```
kubectl delete pod/<POD_NAME>
```

You can watch the deletion from the **Workloads** page - click on the workload name (it will happen quickly).

If you are fast enough, you can run `get all` again, and you should see two pods: one terminating and the other creating or running:

```
kubectl get all
```

Output:

```
NAME                                READY   STATUS        RESTARTS   AGE
pod/monolith-7d8bc7bf68-2bxts       1/1     Running       0          4s
pod/monolith-7d8bc7bf68-htm7z       1/1     Terminating   0          9m35s

NAME                    TYPE        CLUSTER-IP     EXTERNAL-IP   PORT(S)   AGE
service/kubernetes      ClusterIP   10.27.240.1    <none>        443/TCP   24h

NAME                          DESIRED   CURRENT   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/monolith      1         1         1            1           24m

NAME                                      DESIRED   CURRENT   READY   AGE
replicaset.apps/monolith-7d8bc7bf68       1         1         1       24m
```

Why did this happen? The ReplicaSet saw that the pod was terminating and triggered a new pod to keep up the desired replica count. Later on you will see how to scale out to ensure there are several instances running, so if one goes down users won't see any downtime!

Expose GKE Deployment

You have deployed your application on GKE, but you don't havthere isn't a way to access it outside of the cluster. By default, the containers you run on GKE are not accessible from the Internet because they do not have external IP addresses. You must explicitly expose your application to traffic from the Internet via a Service resource. A Service provides networking and IP support to your application's Pods. GKE creates an external IP and a Load Balancer for your application.
Run the following command to expose your website to the Internet:

```
kubectl expose deployment monolith --type=LoadBalancer --port 80 --target-port 8080
```

Accessing the service

GKE assigns the external IP address to the Service resource, not the Deployment. If you want to find out the external IP that GKE provisioned for your application, you can inspect the Service with the `kubectl get service` command:

```
kubectl get service
```

Output:

```
NAME          CLUSTER-IP      EXTERNAL-IP      PORT(S)          AGE
monolith      10.3.251.122    203.0.113.0      80:30877/TCP     3d
```

Re-run the command until your service has an external IP address.

Once you've determined the external IP address for your application, copy the IP address, then point your browser the URL (such as http://203.0.113.0) to check if your application is accessible.

You should see the same website you tested earlier. You now have your website fully running on Kubernetes!

Click *Check my progress* to verify the objective.

Scale GKE deployment

Now that your application is running in GKE and is exposed to the internet, imagine your website has become extremely popular! You need a way to scale your application to multiple instances so it can handle all this traffic. Next you will learn how to scale the application up to 3 replicas.

In Cloud Shell, run the following command to scale you deployment up to 3 replicas:

```
kubectl scale deployment monolith --replicas=3
```

Verify the Deployment was scaled successfully:

```
kubectl get all
```

Output:

```
NAME                                READY   STATUS    RESTARTS   AGE
pod/monolith-7d8bc7bf68-2bxts   1/1     Running   0          36m
pod/monolith-7d8bc7bf68-7ds7q   1/1     Running   0          45s
pod/monolith-7d8bc7bf68-c5kxk   1/1     Running   0          45s

NAME                 TYPE           CLUSTER-IP      EXTERNAL-IP    PORT(S)        AGE
service/kubernetes   ClusterIP      10.27.240.1     <none>         443/TCP        25h
service/monolith     LoadBalancer   10.27.253.64    XX.XX.XX.XX   80:32050/TCP   6m7s

NAME                       DESIRED   CURRENT   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/monolith   3         3         3            3           61m

NAME                                  DESIRED   CURRENT   READY   AGE
replicaset.apps/monolith-7d8bc7bf68   3         3         3       61m
```

You should now see 3 instances of your pod running. Notice that your deployment and replica set now have a desired count of 3.

Click *Check my progress* to verify the objective.

Make changes to the website

Scenario: Your marketing team has asked you to change the homepage for your site. They think it should be more informative of who your company is and what you actually sell.

Task: You will add some text to the homepage to make the marketing team happy! It looks like one of the developers have already created the changes with the file name `index.js.new`. You can just copy this file to `index.js` and the changes should be reflected. Follow the instructions below to make the appropriate changes.

Run the following commands copy the updated file to the correct file name:

```
cd ~/monolith-to-microservices/react-app/src/pages/Home
mv index.js.new index.js
```

Print its contents to verify the changes:

```
cat ~/monolith-to-microservices/react-app/src/pages/Home/index.js
```

The resulting code should look like this:

```
/*
Copyright 2019 Google LLC

Licensed under the Apache License, Version 2.0 (the "License");
you may not use this file except in compliance with the License.
You may obtain a copy of the License at

    https://www.apache.org/licenses/LICENSE-2.0

Unless required by applicable law or agreed to in writing, software
distributed under the License is distributed on an "AS IS" BASIS,
WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
See the License for the specific language governing permissions and
limitations under the License.
*/

import React from "react";
import { makeStyles } from "@material-ui/core/styles";
import Paper from "@material-ui/core/Paper";
import Typography from "@material-ui/core/Typography";
const useStyles = makeStyles(theme => ({
  root: {
    flexGrow: 1
  },
  paper: {
    width: "800px",
    margin: "0 auto",
    padding: theme.spacing(3, 2)
  }
}));
export default function Home() {
  const classes = useStyles();
  return (
    <div className={classes.root}>
      <Paper className={classes.paper}>
        <Typography variant="h5">
          Fancy Fashion &amp; Style Online
        </Typography>
        <br />
        <Typography variant="body1">
          Tired of mainstream fashion ideas, popular trends and societal norms?
          This line of lifestyle products will help you catch up with the Fancy trend
and express your personal style.
          Start shopping Fancy items now!
        </Typography>
      </Paper>
    </div>
  );
}
```

The React components were updated, but the React app needs to be built to generate the static files.

Run the following command to build the React app and copy it into the monolith public directory:

```
cd ~/monolith-to-microservices/react-app
npm run build:monolith
```

Now that the code is updated, you need to rebuild the Docker container and publish it to the Google Cloud Container Registry. Use the same command as earlier, except this time update the version label.

Run the following command to trigger a new cloud build with an updated image version of 2.0.0:

```
cd ~/monolith-to-microservices/monolith
gcloud builds submit --tag gcr.io/${GOOGLE_CLOUD_PROJECT}/monolith:2.0.0 .
```

In the next section you will use this image to update your application with zero downtime.

Click *Check my progress* to verify the objective.

Update website with zero downtime

The changes are completed and the marketing team is happy with your updates! It is time to update the website without interruption to the users.

GKE's rolling update mechanism ensures that your application remains up and available even as the system replaces instances of your old container image with your new one across all the running replicas.

Tell Kubernetes that you want to update the image for your deployment to a new version with the following command:

```
kubectl set image deployment/monolith
monolith=gcr.io/${GOOGLE_CLOUD_PROJECT}/monolith:2.0.0
```

Verify Deployment

You can validate your deployment update by running the following command:

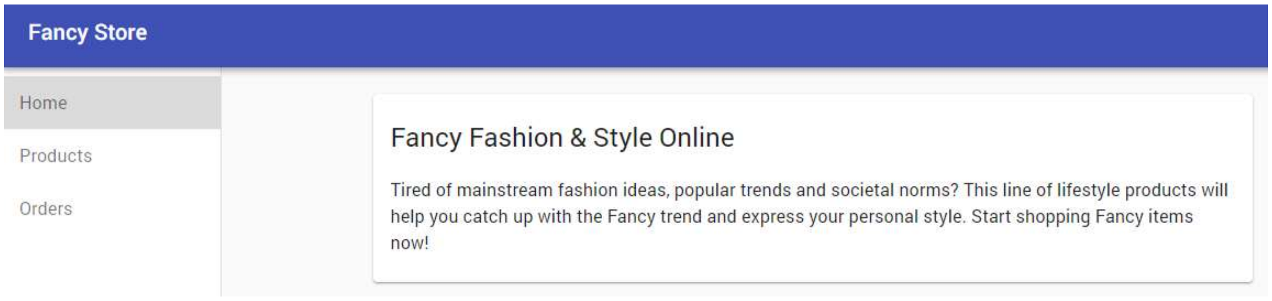
```
kubectl get pods
```

Output:

```
NAME                          READY   STATUS              RESTARTS   AGE
monolith-584fbc994b-4hj68     1/1     Terminating         0          60m
monolith-584fbc994b-fpwdw     1/1     Running             0          60m
monolith-584fbc994b-xsk8s     1/1     Terminating         0          60m
monolith-75f4cf58d5-24cq8     1/1     Running             0          3s
monolith-75f4cf58d5-rfj8r     1/1     Running             0          5s
monolith-75f4cf58d5-xm44v     0/1     ContainerCreating   0          1s
```

Here you will see 3 new pods being created and your old pods getting shut down. You can tell by the age which are new and which are old. Eventually, you will only see 3 pods again which will be your 3 updated pods.

To verify our changes, return to the app web page tab and refresh the page. Notice that your application has been updated.
Your web site should now be displaying the text you just added to the homepage component!



Fancy Fashion & Style Online

Tired of mainstream fashion ideas, popular trends and societal norms? This line of lifestyle products will help you catch up with the Fancy trend and express your personal style. Start shopping Fancy items now!

Click *Check my progress* to verify the objective.

Cleanup

Although all resources will be deleted with you complete this lab, in your own environment it's a good idea to remove resources you no longer need.

Delete git repository:

```
cd ~
rm -rf monolith-to-microservices
```

Delete Google Container Registry images:

```
# Delete the container image for version 1.0.0 of the monolith
gcloud container images delete gcr.io/${GOOGLE_CLOUD_PROJECT}/monolith:1.0.0 --quiet

# Delete the container image for version 2.0.0 of the monolith
gcloud container images delete gcr.io/${GOOGLE_CLOUD_PROJECT}/monolith:2.0.0 --quiet
```

Delete Google Cloud Build artifacts from Google Cloud Storage:

```
# The following command will take all source archives from all builds and delete them
from cloud storage

# Run this command to print all sources:
# gcloud builds list | awk 'NR > 1 {print $4}'

gcloud builds list | awk 'NR > 1 {print $4}' | while read line; do gsutil rm $line;
done
```

Delete GKE Service:

```
kubectl delete service monolith
kubectl delete deployment monolith
```

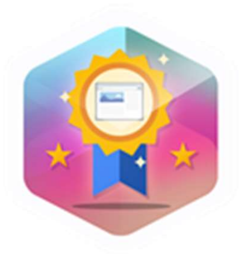
Delete GKE Cluster:

```
gcloud container clusters delete fancy-cluster
```

Type "Y" to confirm this action. This command may take a little while.

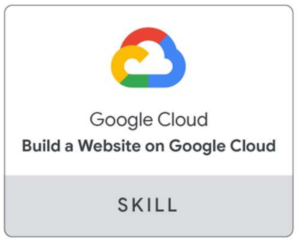
Congratulations!

You successfully deployed, scaled, and updated your website on GKE. You are now experienced with Docker and Kubernetes!



Finish Your Quest

This self-paced lab is part of the Qwiklabs Website on Google Cloud Quest. A Quest is a series of related labs that form a learning path. Enroll in this Quest and get immediate completion credit if you've taken this lab. See other available Qwiklabs Quests.
Looking for a hands-on challenge lab to demonstrate your skills and validate your knowledge? On completing this quest, finish this additional challenge lab to receive an exclusive Google Cloud digital badge.



Take your next lab

Continue your learning with Migrating a Monolithic Website to Microservices on Google Kubernetes Engine or check out these suggestions:

- Watch this video case study on Hosting Scalable Web Applications on Google Cloud
- Deploy your Website on Cloud Run

Next Steps / Learn More

- Docker - https://docs.docker.com/
- Kubernetes - https://kubernetes.io/docs/home/
- Google Kubernetes Engine (GKE) - https://cloud.google.com/kubernetes-engine/docs/
- Cloud Build - https://cloud.google.com/cloud-build/docs/
- Container Registry - https://cloud.google.com/container-registry/docs/