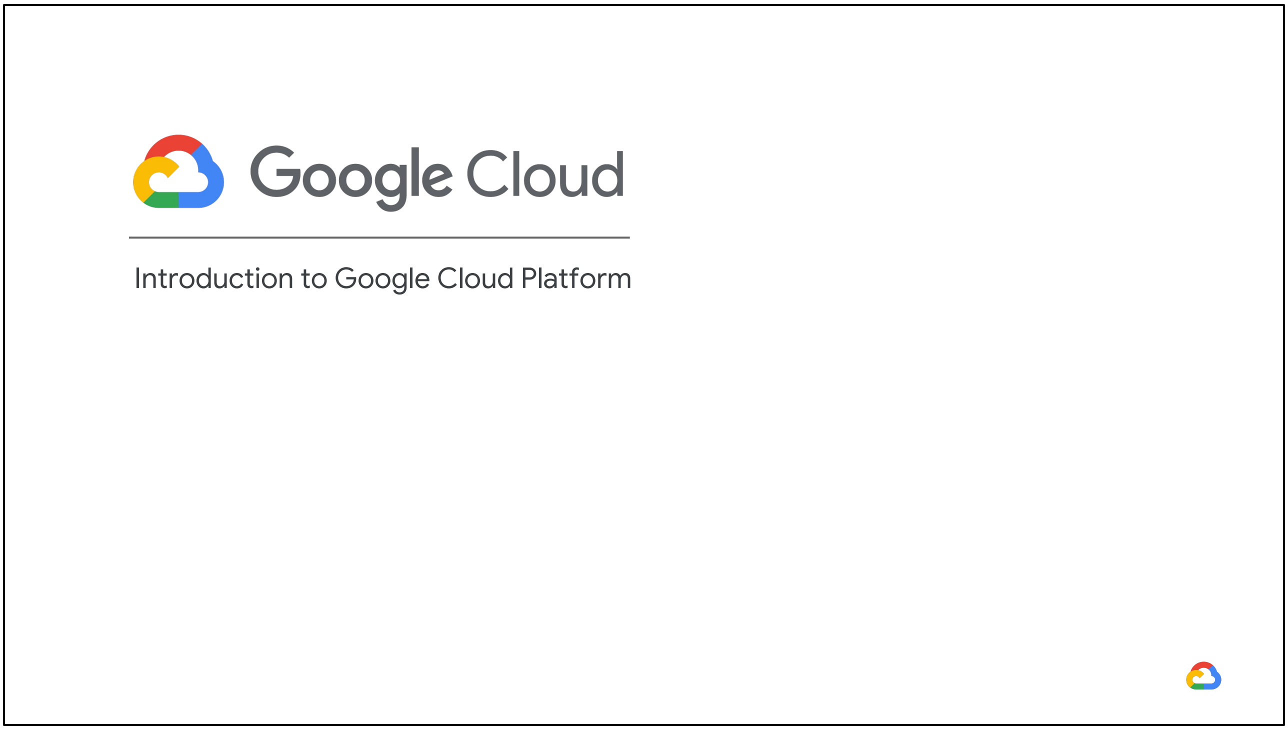
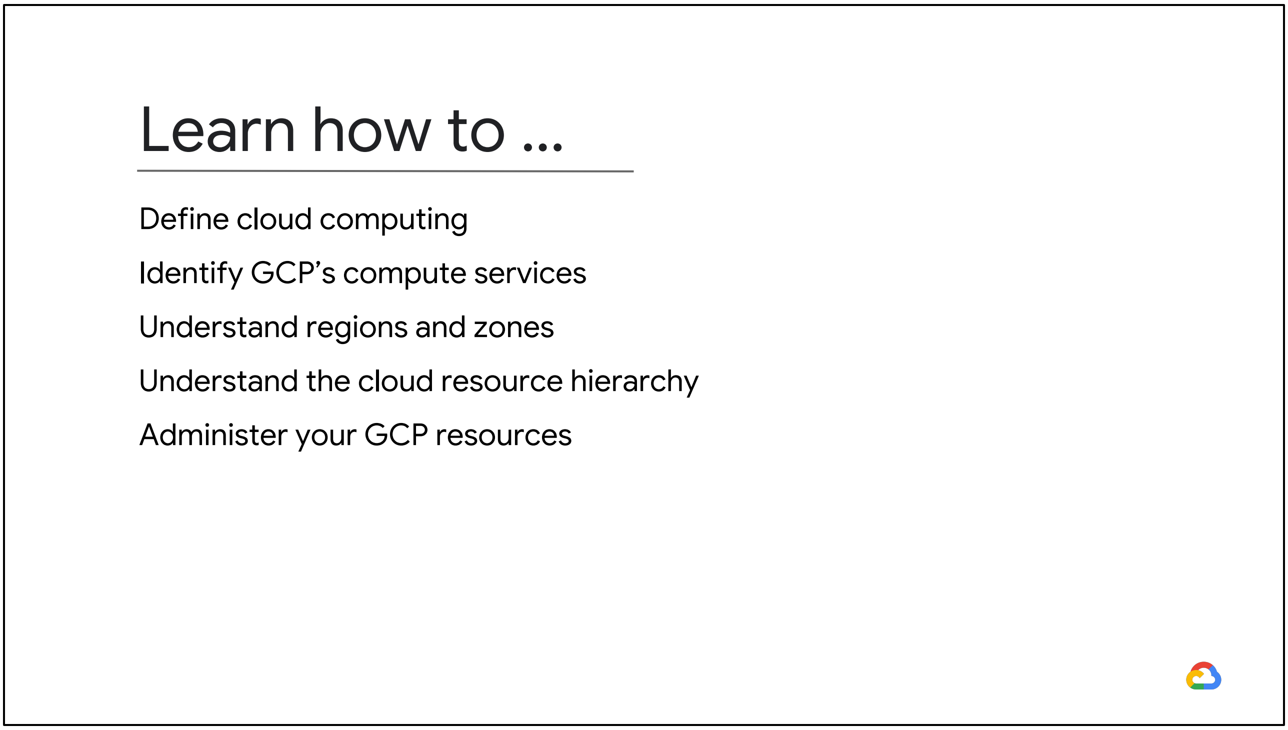


Google Cloud

Introduction to Google Cloud Platform



Learn how to ...

Define cloud computing

Identify GCP’s compute services

Understand regions and zones

Understand the cloud resource hierarchy

Administer your GCP resources

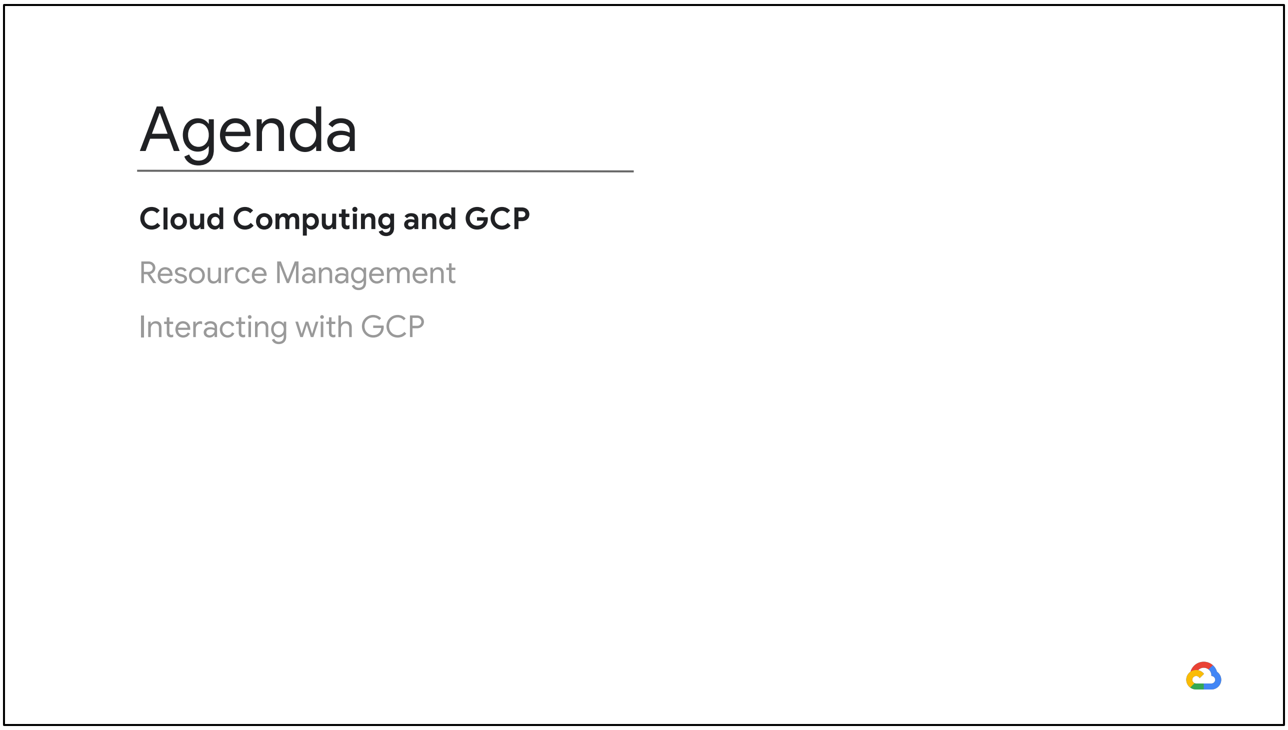
This first module shares a simple explanation of what cloud computing is, so that we start off with the right framework of concepts.

Here’s a quick preview: cloud computing entails resources being provided to you as a service. GCP offers several services that let you run general-purpose compute workloads on Google’s hardware, and we will meet them.

Google Cloud Platform has a global footprint. I will explain how GCP’s resources around the world are organized into regions and zones.

You can use these resources, but of course it’s your job to define policies for what you use. GCP offers a hierarchical structure for organizing your use of cloud resources, and we’ll meet it in this module.

Finally, you’ll meet the tools that let you connect to GCP and allocate, change, and release resources.



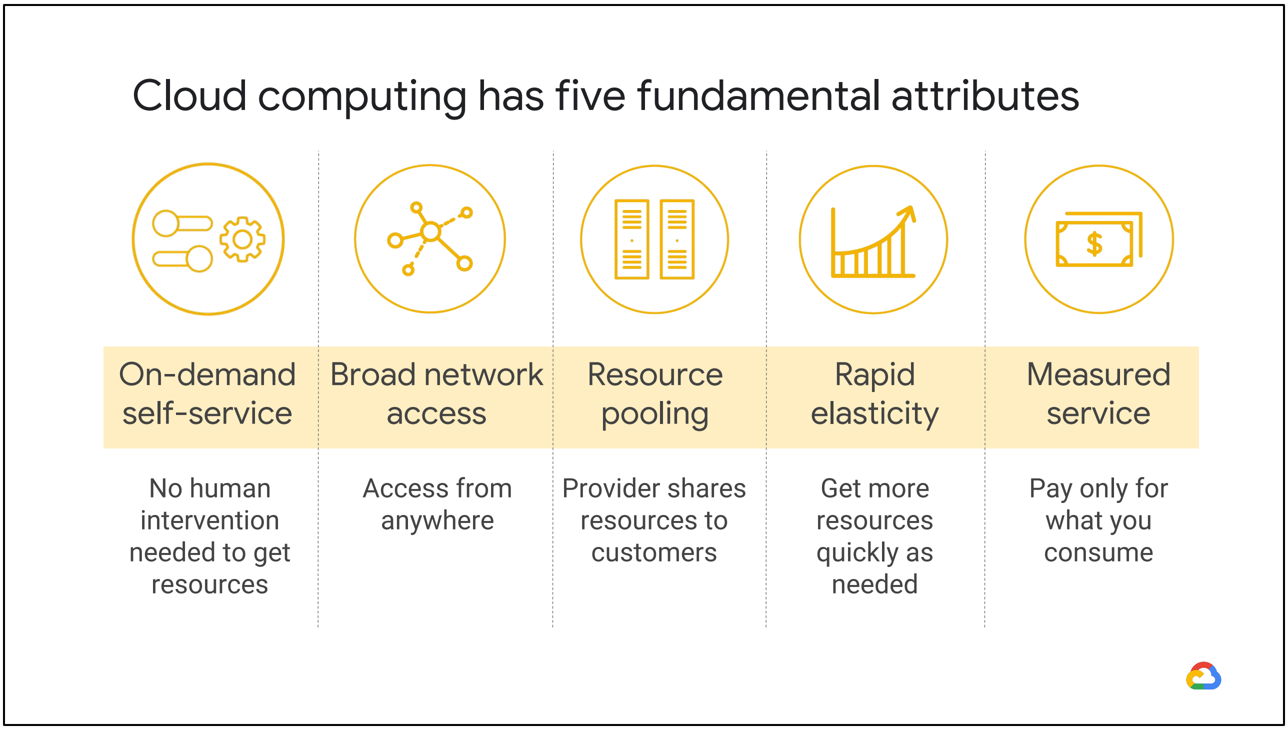
Agenda

Cloud Computing and GCP

Resource Management

Interacting with GCP

Let’s start by introducing the relationship between cloud computing and GCP.



Cloud computing has five fundamental attributes

On-demand self-service	Broad network access	Resource pooling	Rapid elasticity	Measured service
No human intervention needed to get resources	Access from anywhere	Provider shares resources to customers	Get more resources quickly as needed	Pay only for what you consume

Cloud computing has five fundamental attributes:

First, computing resources are on-demand and self-service. Cloud-computing customers use an automated interface and get the processing power, storage, and network they need, with no human intervention.

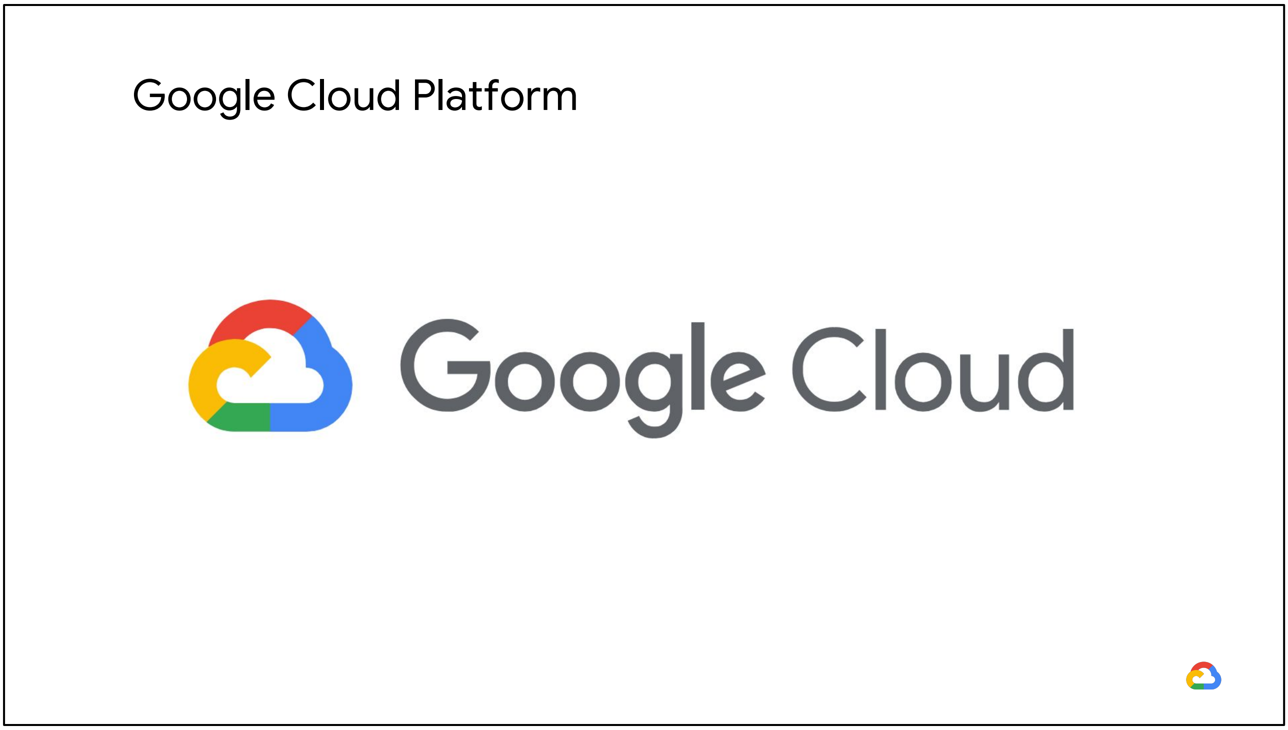
Second, resources are accessible over a network from any location.

Providers allocate resources to customers from a large pool, allowing them to benefit from economies of scale. Customers don’t have to know, or care, about the exact physical location of those resources.

Resources are elastic. Customers who need more resources can get them rapidly. And when they need less, they can scale back.

Finally, customers pay only for what they use or reserve, as they go. If they stop using resources, they simply stop paying.

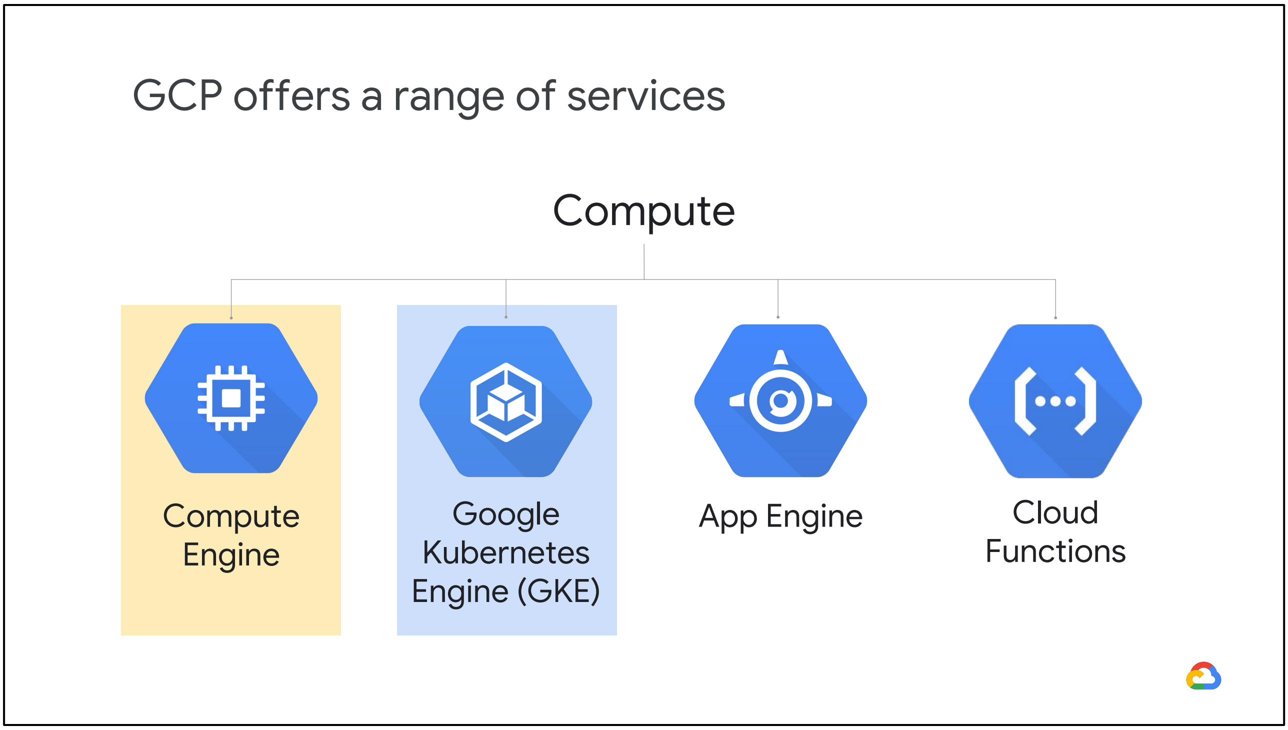
*** Source: According to the definition of cloud computing proposed by the United States National Institute of Standards and Technology.



Google Cloud Platform

Google Cloud

That’s how public clouds such as Google Cloud Platform work. GCP offers a variety of cloud services, and architects and developers like you can choose among them to build your solutions. Many of these cloud services are very familiar, such as virtual machines on demand. Other services represent an entirely new paradigm. One of those services, Google Kubernetes Engine, is the focus of this course and the ones that follow. By the way, we informally call the service GKE, and you can too.



GCP offers a range of services

Compute

Compute Engine

Google Kubernetes Engine (GKE)

App Engine

Cloud Functions

The first thing many people ask of GCP is: “Please run some code in the cloud for me” GCP provides a range of services for doing that, each aimed at satisfying a different set of user preferences. Here’s a quick summary of the choices. In a later module we will compare them in more detail.

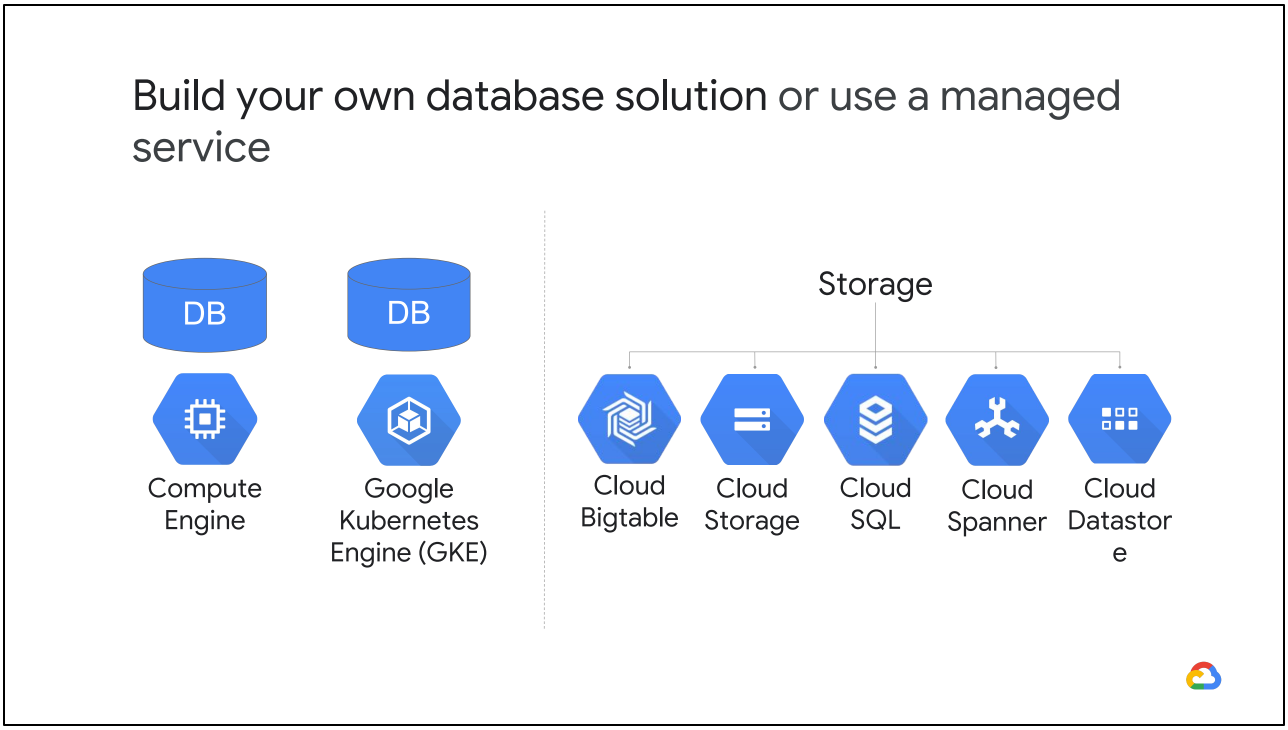
The service that might be most familiar to newcomers is Compute Engine, which lets you run virtual machines on demand in the cloud. It’s Google Cloud’s Infrastructure-as-a-Service solution. It provides maximum flexibility for people who prefer to manage server instances themselves.

GKE is different. It lets you run containerized applications on a cloud environment that Google manages for you, under your administrative control. What’s a “containerized application”? And what’s Kubernetes? We’ll learn a lot about those topics later in this course. For now, think of containerization as a way to package code that’s designed to be highly portable and to use resources very efficiently. And think of Kubernetes as a way to orchestrate code in containers.

App Engine is GCP’s fully managed Platform-as-a-Service framework. That means it’s a way to run code in the cloud without having to worry about infrastructure. You just focus on your code, and let Google deal with all the provisioning and resource management. You can learn a lot more about App Engine in the specialization “Developing Applications in Google Cloud Platform.”

Cloud Functions is a completely serverless execution environment, or Functions-as-a-Service. It executes your code in response to events, whether those occur once a day or many times per second. Google scales resources as required, but you only pay for the service while your code runs. The specialization “Developing Applications in Google Cloud Platform” also discusses Cloud Functions.

In this specialization, GKE is our main focus. And GKE is built on top of Compute Engine, so we’ll learn more about that service too along the way.



Build your own database solution or use a managed service

DB

Compute Engine

DB

Google Kubernetes Engine (GKE)

Storage

Cloud Bigtable

Cloud Storage

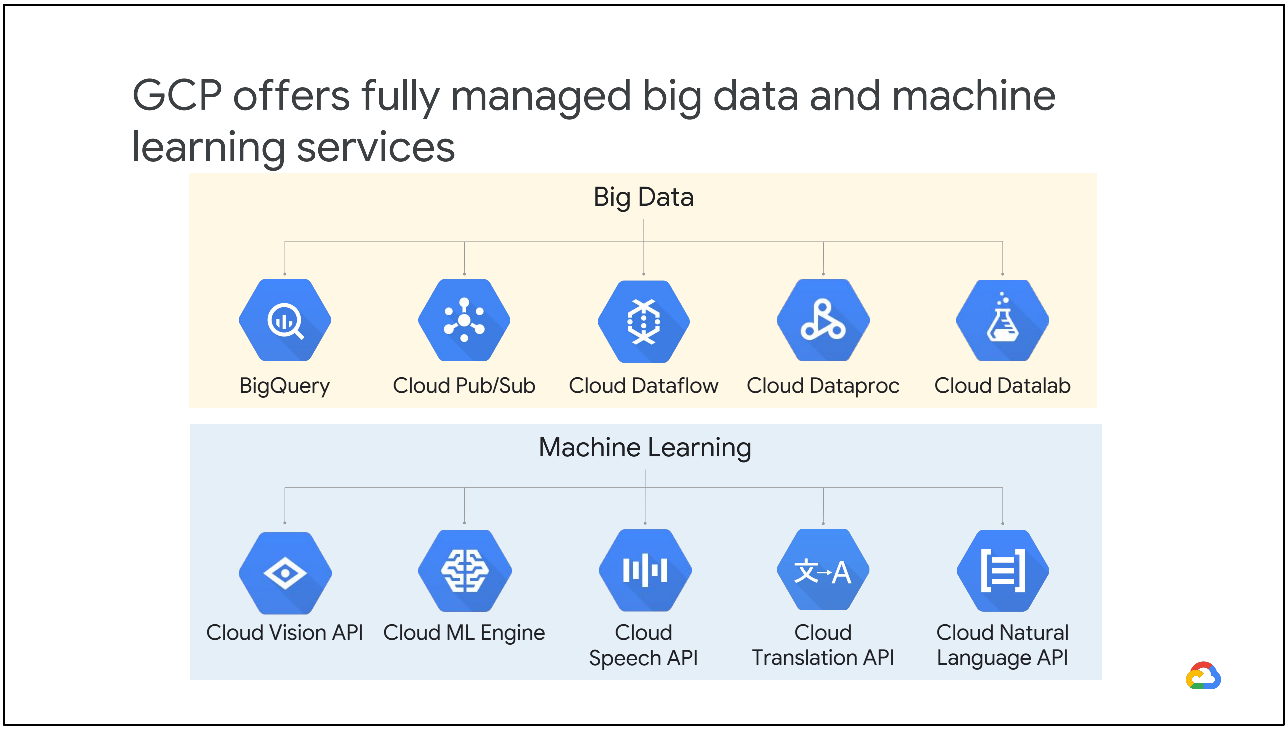
Cloud SQL

Cloud Spanner

Cloud Datastore

Most applications need a database of some kind. If you've built a cloud application, you can install and run your own database for it on a virtual machine in Compute Engine. You simply start up a virtual machine, install your database engine, and set it up, just like in your data center. Or you can run your own database server in Google Kubernetes Engine too. However, with either approach, you'll have to manage and support the database yourself.

Alternatively, you can use Google's fully managed database and storage services. What all these have in common is that they reduce the work it takes to store all kinds of data. GCP offers relational and non-relational databases, and worldwide object storage. You will learn more about these later in this specialization.



GCP offers fully managed big data and machine learning services

Big Data

BigQuery

Cloud Pub/Sub

Cloud Dataflow

Cloud Dataproc

Cloud Datalab

Machine Learning

Cloud Vision API

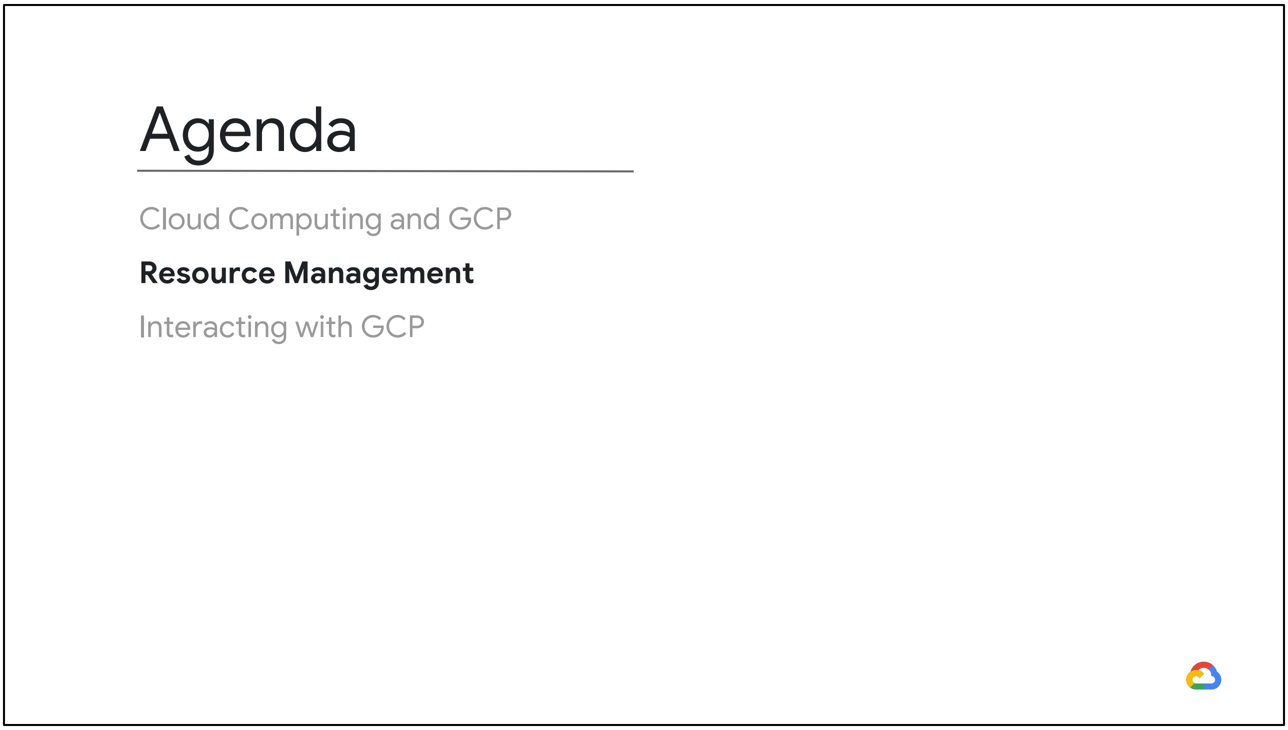
Cloud ML Engine

Cloud Speech API

Cloud Translation API

Cloud Natural Language API

Just as with storage and database services, you could build and implement these services yourself, and some GCP customers do. But the fact that they're available as a service means that you can get started faster and deal with a lot less routine work along the way.



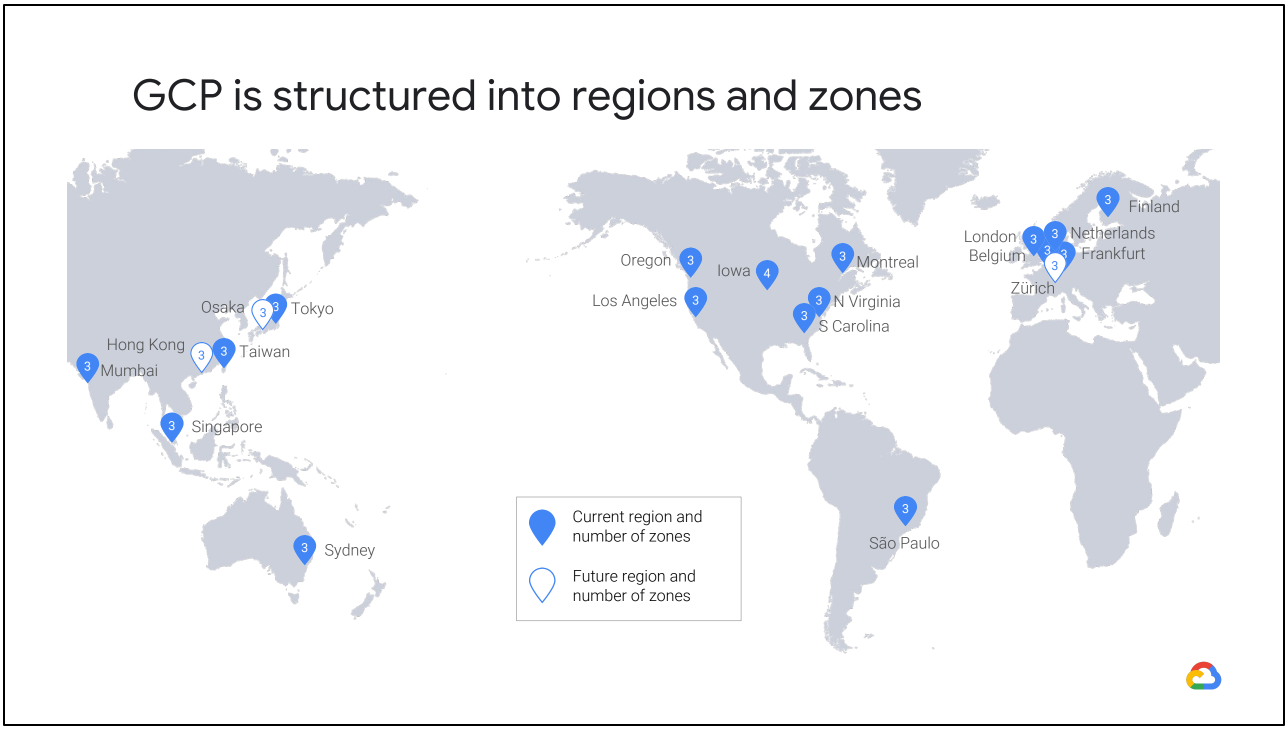
Agenda

Cloud Computing and GCP

Resource Management

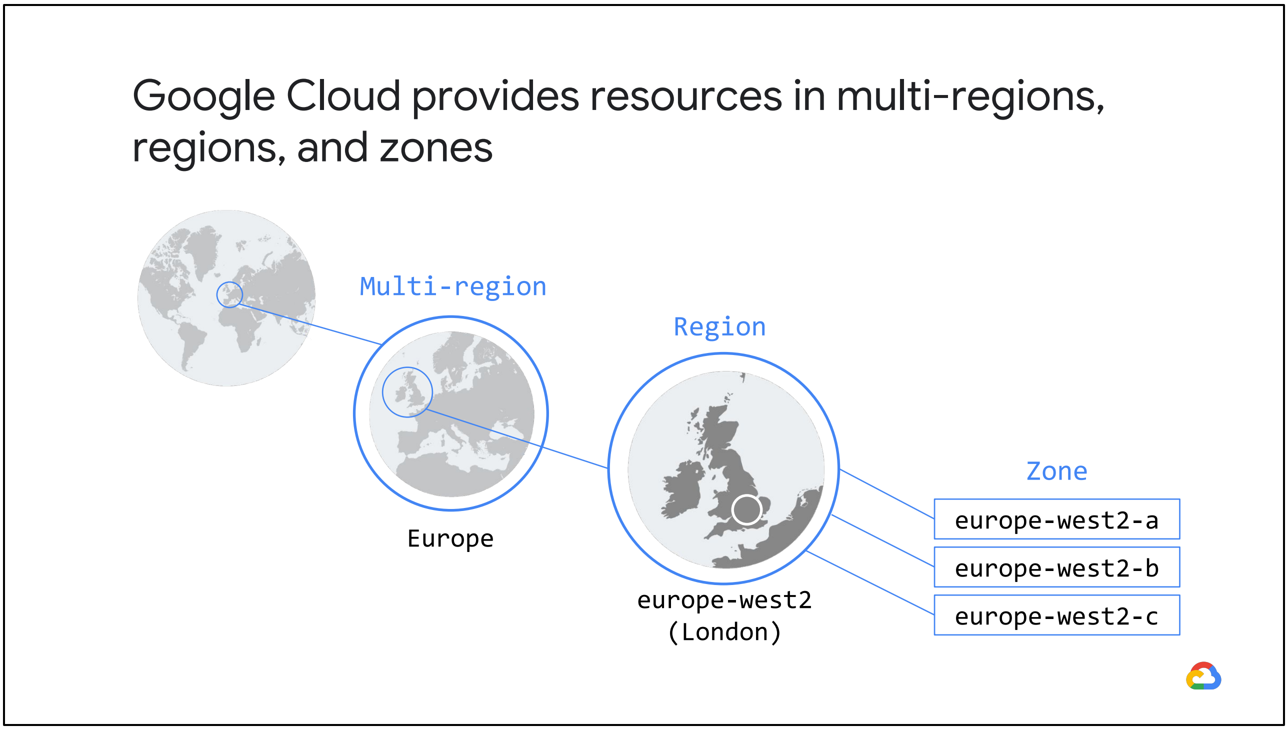
Interacting with GCP

In this lesson you will learn about the topology of GCP services and how they are distributed geographically in zones, regions and at a global scale. You will also learn how you structure the resources you use hierarchically, using Organizations, folders and projects, to manage your access control and your billing.



GCP is structured into regions and zones

Behind the services provided by Google Cloud Platform lie a huge range of GCP resources: physical assets, such as physical servers and hard disk drives; and virtual resources, such as virtual machines and containers. These resources are managed by Google within its global data centers. These data centers are located in 18 regions, 55 zones, and more than 100 points of presence across 35 countries.



Google Cloud provides resources in multi-regions, regions, and zones

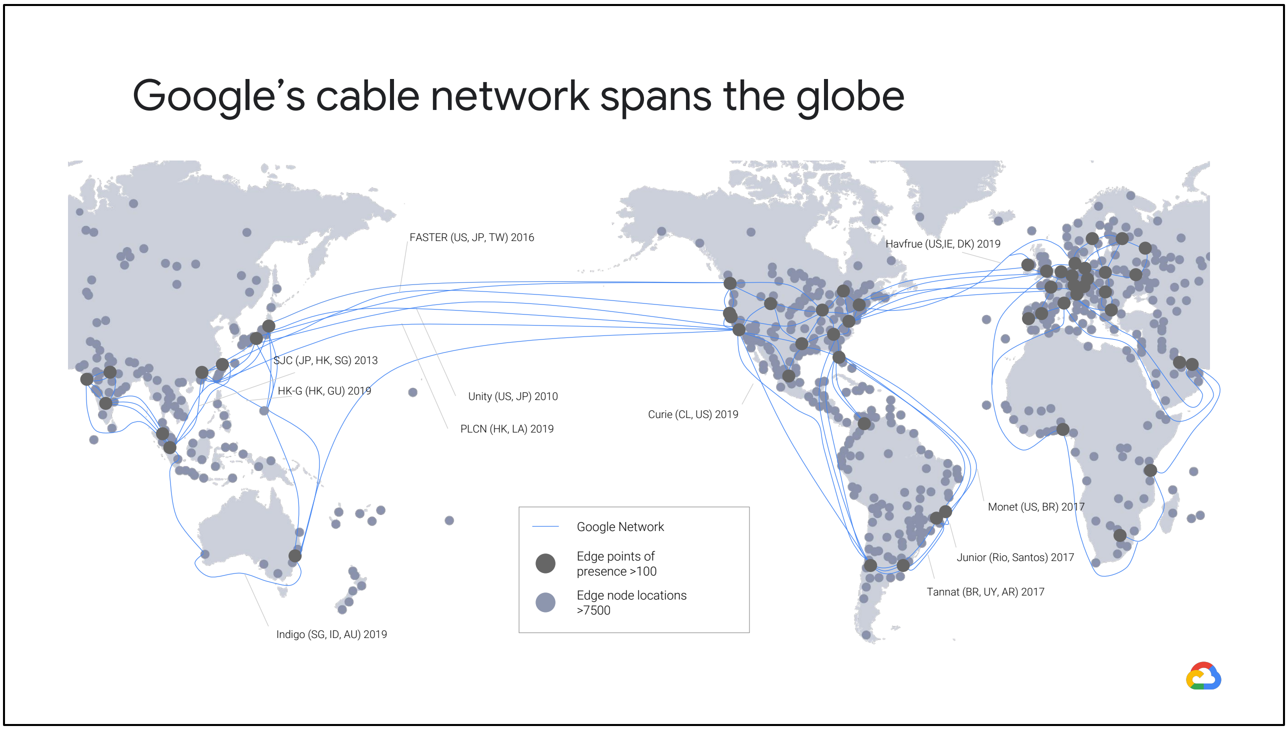
It divides the world into three multi-regional areas: the Americas, Europe, and Asia Pacific.

Next, the three multi-regional areas are divided into regions, which are independent geographic areas on the same continent. Within a region, there’s fast network connectivity: generally round-trip network latencies of under 1 millisecond (that is, at the 95th percentile).

Finally, regions are divided into zones, which are deployment areas for GCP resources within a focused geographic area. You can think of a zone as a data center within a region, although strictly speaking a zone isn’t necessarily a single data center.

We mentioned Compute Engine earlier. Compute Engine virtual-machine instances reside within a specific zone. If that zone became unavailable, so would your virtual machine and the workload running on it. And GKE uses Compute Engine, so your GKE workloads could be affected similarly.

Deploying applications across multiple zones enables fault tolerance and high availability, and in this specialization, we will learn how to do that.

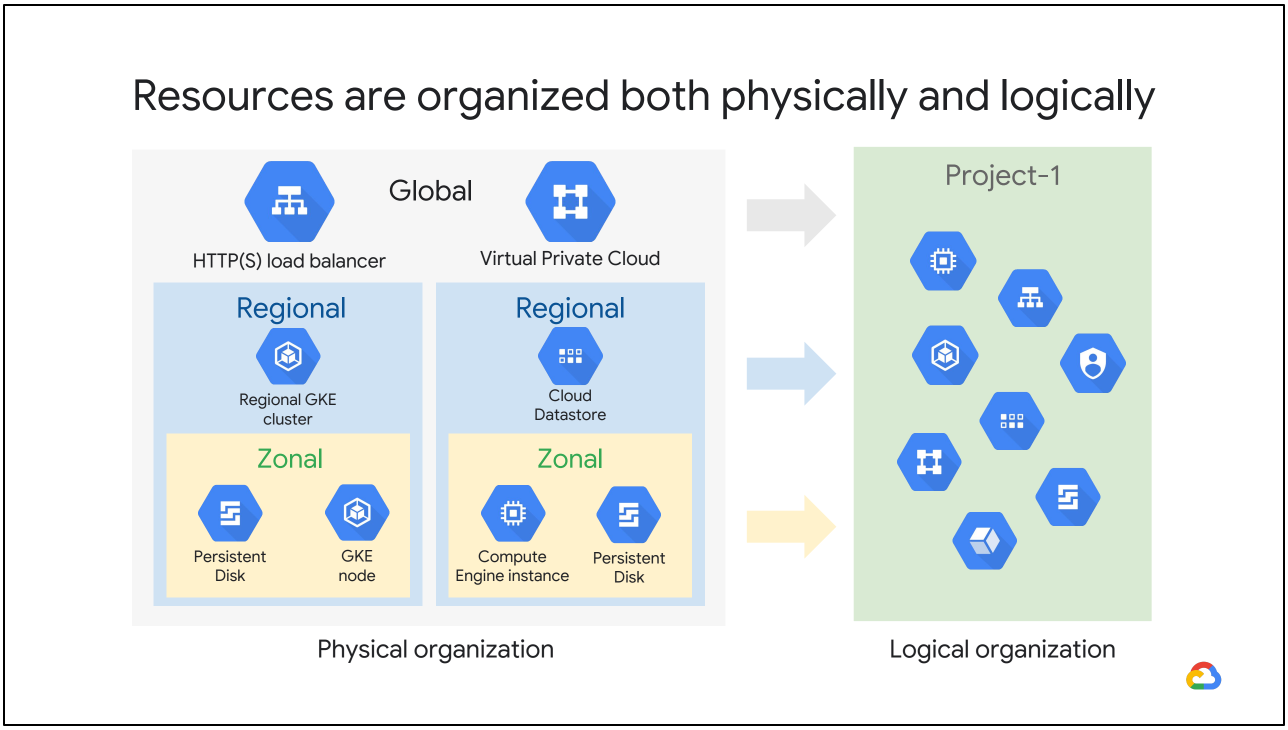


Google’s cable network spans the globe

Google’s data centers around the world are interconnected by the Google network, which, by some publicly available estimates, carries as much as 40% of the world’s internet traffic every day. This is the largest network of its kind on Earth, and it continues to grow.

It’s designed to provide the highest possible throughput and the lowest possible latencies for applications, including yours.

The network interconnects with the public internet at more than 90 internet exchanges and more than 100 points of presence worldwide. When an internet user sends traffic to a Google resource, Google responds to the user's request from an Edge Network location that will provide the lowest delay or latency. Google’s edge caching network places content close to end users to minimize latency. Your applications in GCP, including those running in GKE, can take advantage of this edge network too.



Resources are organized both physically and logically

Global

HTTP(S) load balancer

Virtual Private Cloud

Regional

Regional GKE cluster

Regional

Cloud Datastore

Zonal

Persistent Disk

GKE node

Zonal

Compute Engine instance

Persistent Disk

Physical organization

Project-1

Logical organization

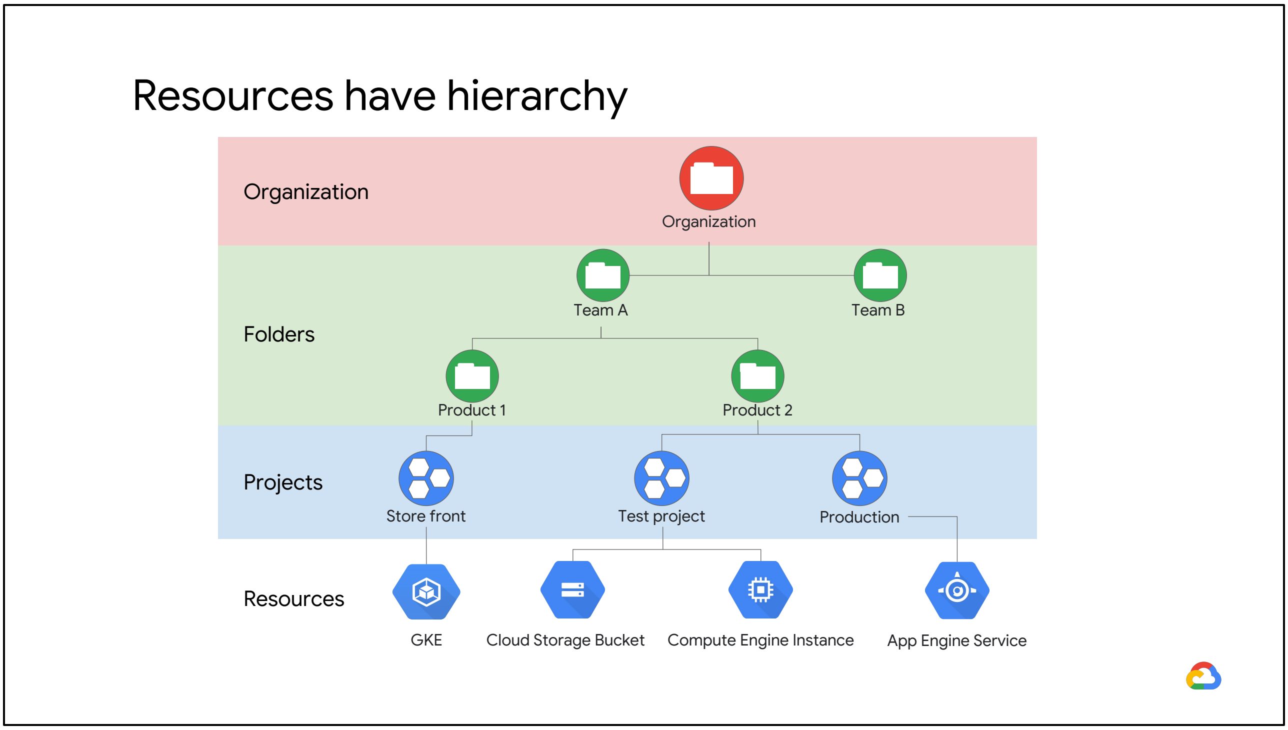
When you take advantage of GCP services and resources, you get to specify those resources' geographical locations. In many cases you can also specify whether you're doing so on a zonal level, a regional level, or a multi-regional level. Zonal resources operate within a single zone, which means that if a zone becomes unavailable, the resources will not be available either. A simple example would be a Compute Engine virtual machine instance and its persistent disks. GKE has a component called a "node," and these are zonal too.

Regional resources operate across multiple zones, but within one region. An application using these resources can be redundantly deployed to improve its availability. Later in this specialization, you'll learn how to use GKE so that it has resources spread across different zones in a region. Cloud Datastore is an example of another GCP service that can be deployed in a similar redundant way.

Finally, global resources can be managed across multiple regions.

These resources can further improve the availability of an application. Some examples of such resources include HTTPS load balancers and Virtual Private Cloud networks, which GKE users benefit from too.

The GCP resources you use, no matter where they reside, must belong to a project. So what is a project? A project is the base-level organizing entity for creating and using resources and services and managing billing, APIs, and permissions. Zones and regions *physically* organize the GCP resources you use, and projects *logically* organize them. Projects can be easily created, managed, deleted, or even recovered from accidental deletions.



Resources have hierarchy

Organization

Organization

Folders

Team A

Team B

Product 1

Product 2

Projects

Store front

Test project

Production

Resources

GKE

Cloud Storage Bucket

Compute Engine Instance

App Engine Service

Each project is identified by a unique project ID and project number. You can name your project and apply labels for filtering. These labels are changeable, but the project ID and project number remain fixed.
Projects can belong to a "folder" which is another grouping mechanism.

You should use folders to reflect the hierarchy of your enterprise and apply policies at the right levels in your enterprise. You can nest folders inside folders.

For example, you can have a folder for each department, and within each department's folder, you can have subfolders for each of the teams that make it up. Each team's projects belong to its folder.

A single organization owns the folders beneath it.

An organization is the root node of a GCP resource hierarchy. Although you are not required to have an organization to use GCP, organizations are very useful. Organizations let you set policies that apply throughout your enterprise. Also, having an organization is required to use folders.

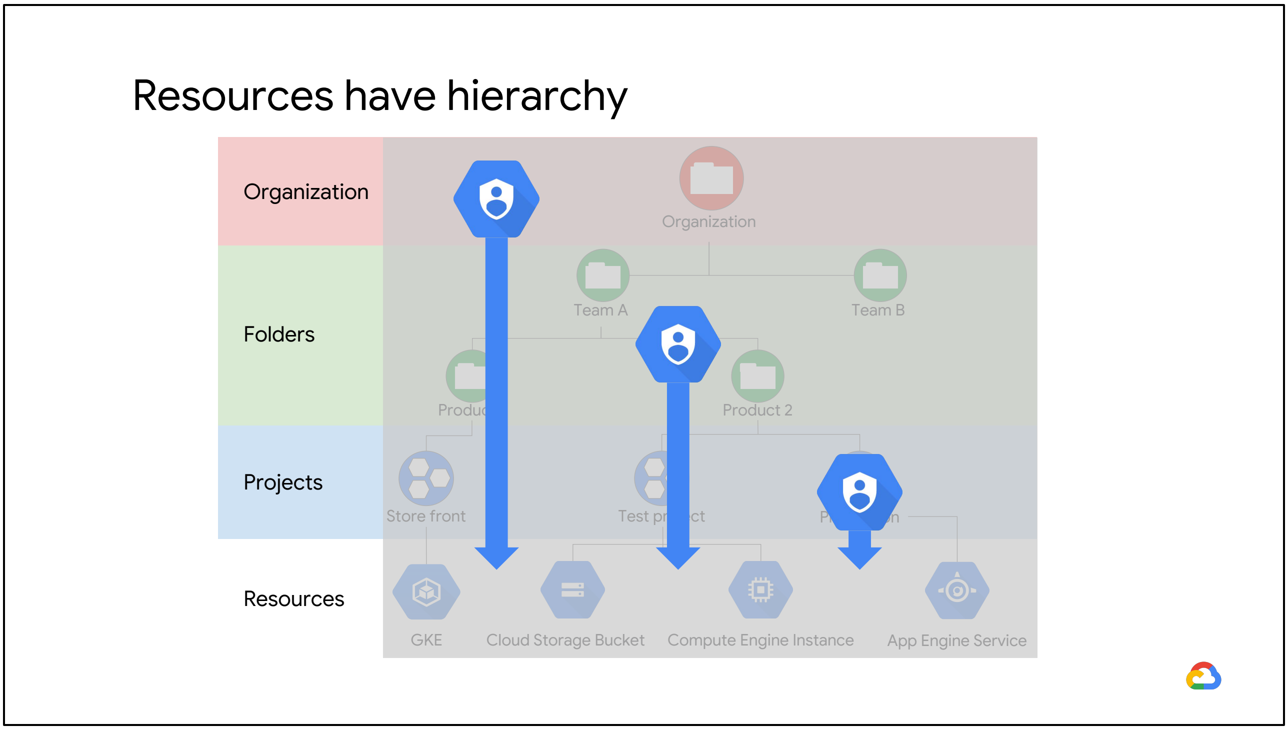
If you are already a G Suite customer, you have an organization already, and if not, you can get one for free through Google Cloud Identity.

Your organization will have a fixed organization ID and a changeable display name.

The GCP resource hierarchy helps you manage resources across multiple departments and multiple teams within an organization.

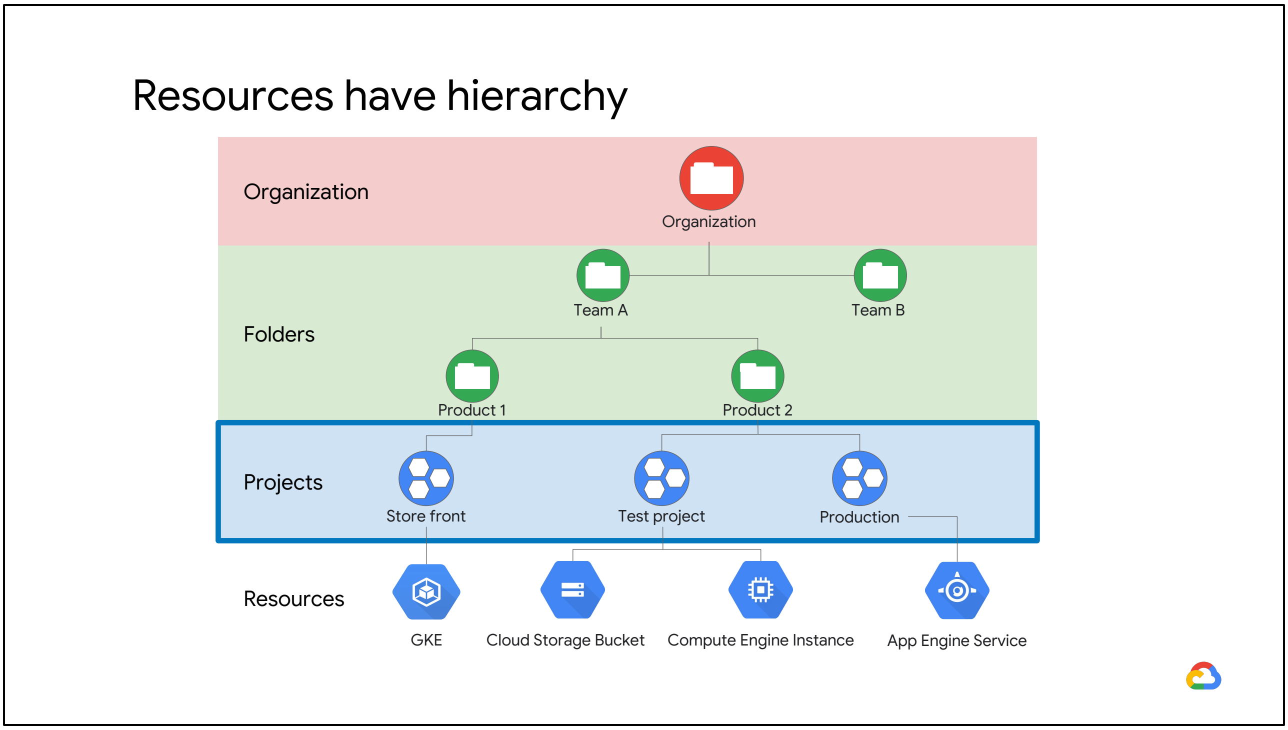
You can define a hierarchy that creates trust boundaries and resource isolation. For example, should members of your Human Resources team be able to delete running database servers? And should your engineers be able to delete the database containing employees' salaries? Probably not, in either case.

Cloud Identity and Access Management, also called IAM, lets you fine-tune access control to all the GCP resources you use. You define IAM policies that control user access to resources.



Resources have hierarchy

You apply these policies at the level you choose, and those policies inherit downwards. For example, an IAM policy applied at the organization level will be inherited by a folder, the project, and even the resources beneath it. Additional policies at lower levels of the hierarchy can grant additional permissions.



Resources have hierarchy

Organization

Organization

Folders

Team A

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Product 1

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Store front

Test project

Production

Resources

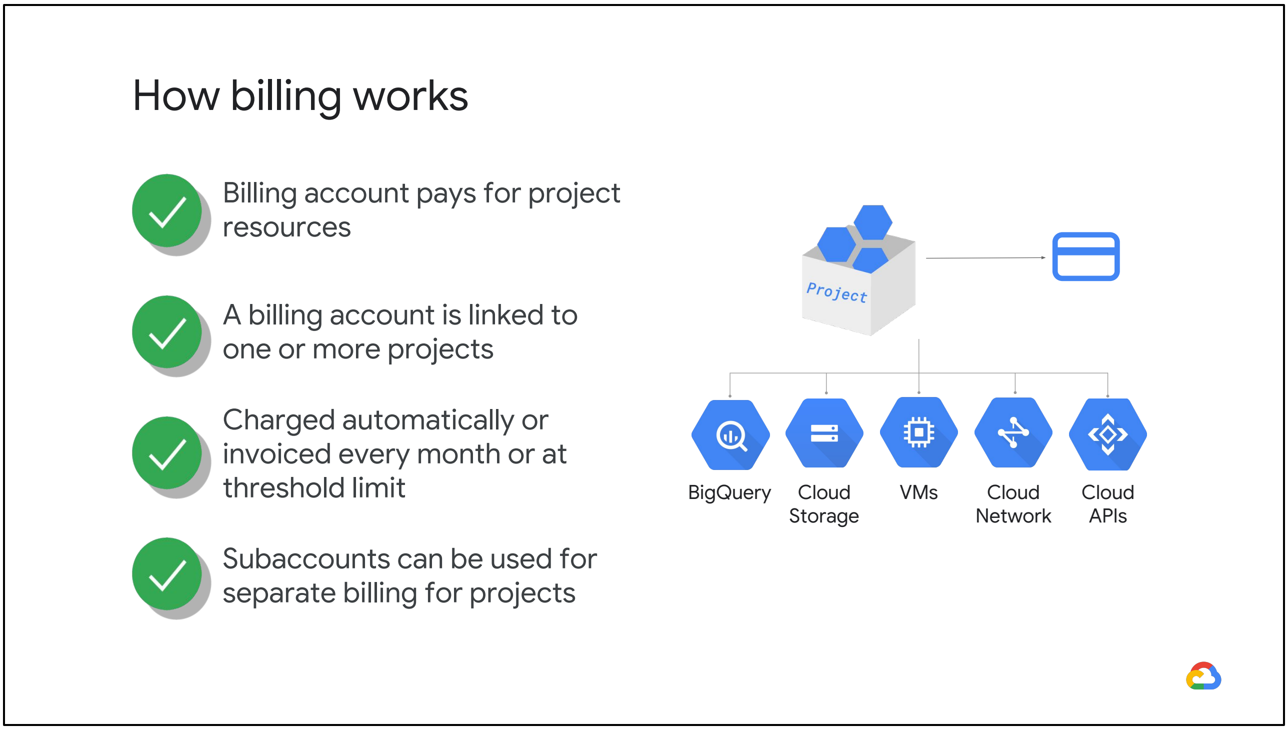
GKE

Cloud Storage Bucket

Compute Engine Instance

App Engine Service

Billing, on the other hand, accumulates at the project level. Most GCP customers have a resource hierarchy that looks like their employee organization chart, while their project billing looks like their cost-center structure.



How billing works

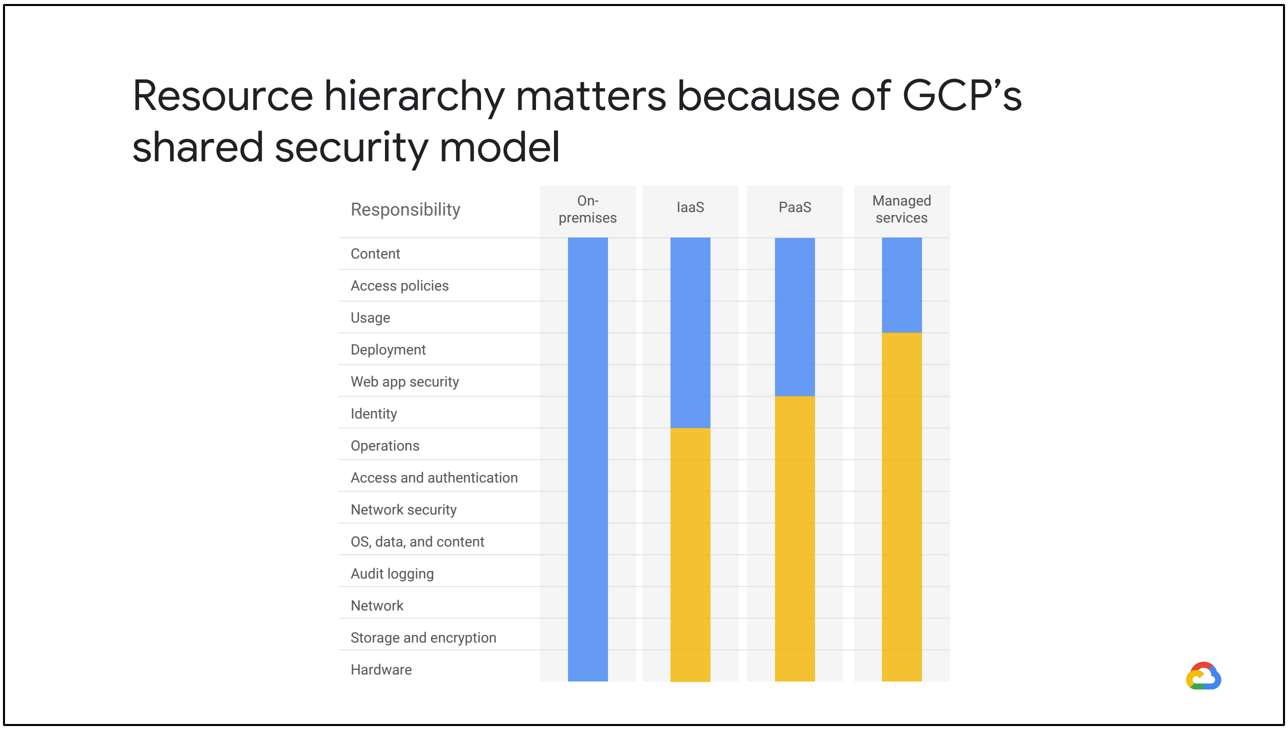
- ✓ Billing account pays for project resources
- ✓ A billing account is linked to one or more projects
- ✓ Charged automatically or invoiced every month or at threshold limit
- ✓ Subaccounts can be used for separate billing for projects

Billing in GCP is set up at the GCP project level. When you define a GCP project, you link a billing account to it. This billing account is where you will configure all your billing information, including your payment option.

You can link your billing account to one or more projects. Projects that you don't link to any billing account can only use free GCP services.

Your billing account can be charged automatically and invoiced every month, or at every threshold limit.

You can separate project billings by setting up billing subaccounts. Some GCP customers who resell GCP services use subaccounts for each of their own clients.

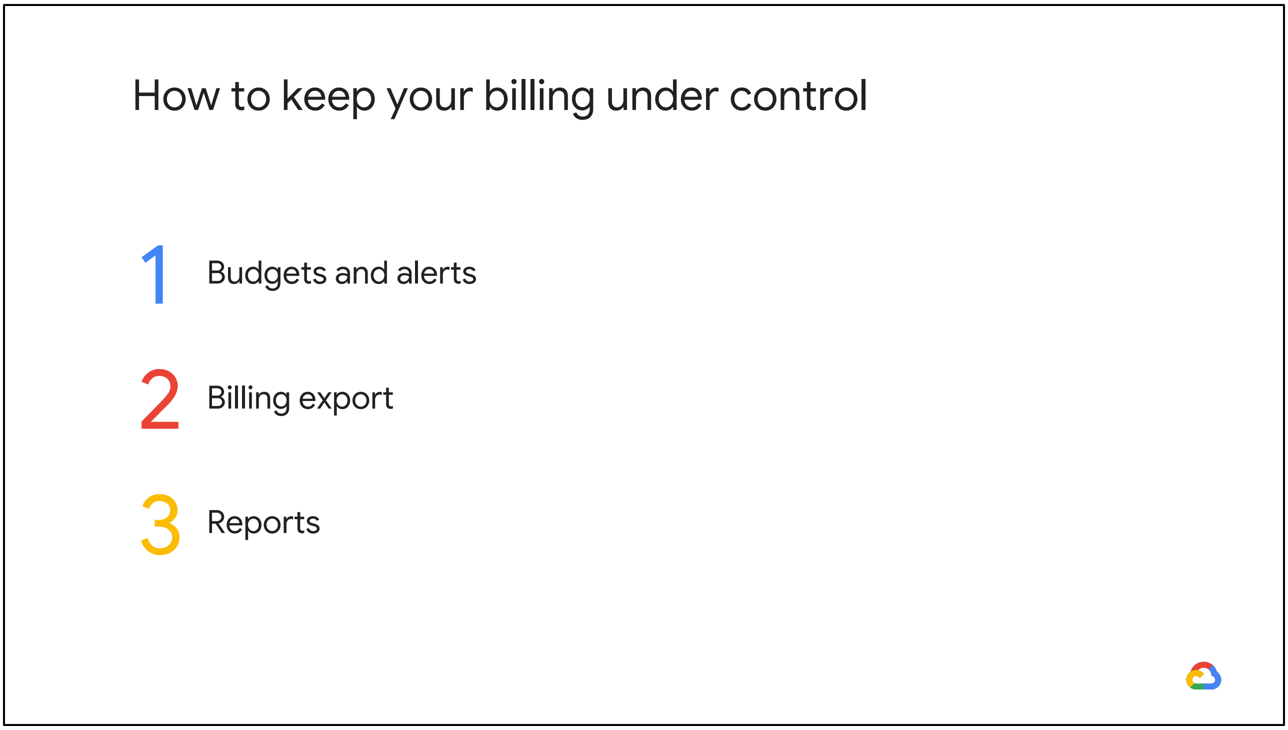


Resource hierarchy matters because of GCP's shared security model

When you build an application on your on-premises infrastructure, you're responsible for the entire stack's security: from the physical security of the hardware and the premises in which they are housed, through the encryption of the data on disk, the integrity of your network, and all the way up to securing the content stored in those applications.

But when you move an application to GCP, Google handles many of the lower layers of security, like the physical security of the hardware and its premises, the encryption of data on disk, and the integrity of the physical network. Because of its scale, Google can deliver a higher level of security at these layers than most customers could afford to on their own.

The upper layers of the security stack, including the securing of data, remain your responsibility. Google provides tools to help you implement the policies you define at these layers. The resource hierarchy we just explored is one of those tools. Cloud IAM is another. You will learn more about security in depth later in this specialization.



How to keep your billing under control

1 Budgets and alerts

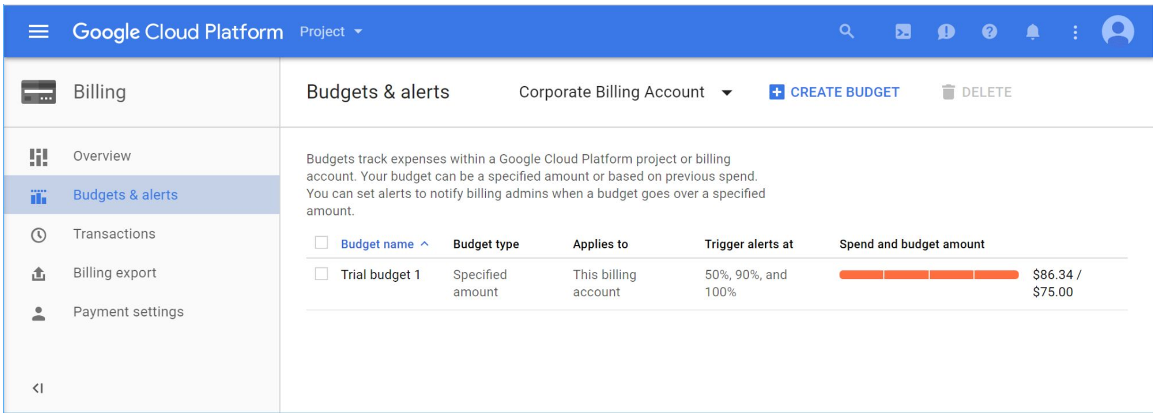
2 Billing export

3 Reports

You're probably thinking, "How can I make sure I don't accidentally run up a big GCP bill?" GCP provides three tools to help:

- Budgets and alerts,
- Billing export, and,
- Reports.

Budgets and alerts keep your billing under control



Budgets track expenses within a Google Cloud Platform project or billing account. Your budget can be a specified amount or based on previous spend. You can set alerts to notify billing admins when a budget goes over a specified amount.

□	Budget name ^	Budget type	Applies to	Trigger alerts at	Spend and budget amount
□	Trial budget 1	Specified amount	This billing account	50%, 90%, and 100%	$86.34 / $75.00

You can define budgets at the billing account level or at the project level.

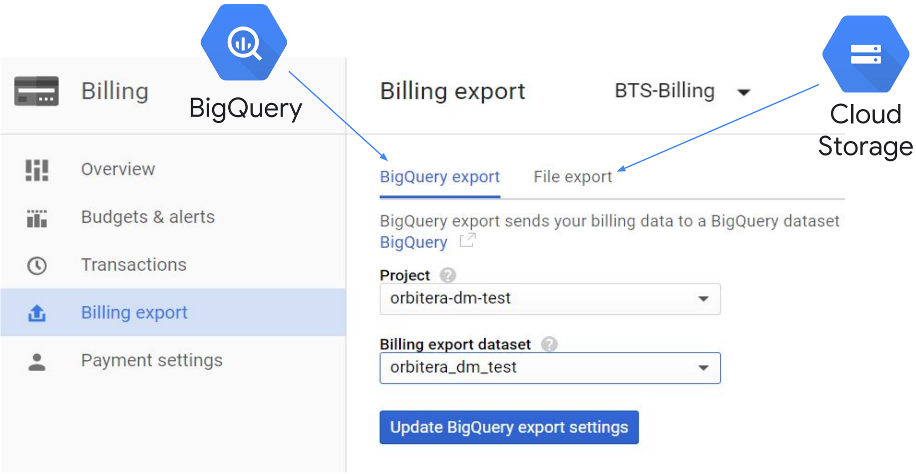
To be notified when costs approach your budget limit, you can create an alert. For example, with a budget limit of $20,000 and an alert set at 90%, you'll receive a notification alert when your expenses reach $18,000.

You can also set up a webhook to be called in response to an alert. This webhook can control automation based on billing alerts. For example, you could trigger a script to shut down resources when a billing alert occurs. Or you could use this webhook to file a trouble ticket for your team.

Source:
https://cloud.google.com/solutions/best-practices-for-iam-and-billing

-in-higher-education

Billing export allows you to store detailed billing information



BigQuery export sends your billing data to a BigQuery dataset

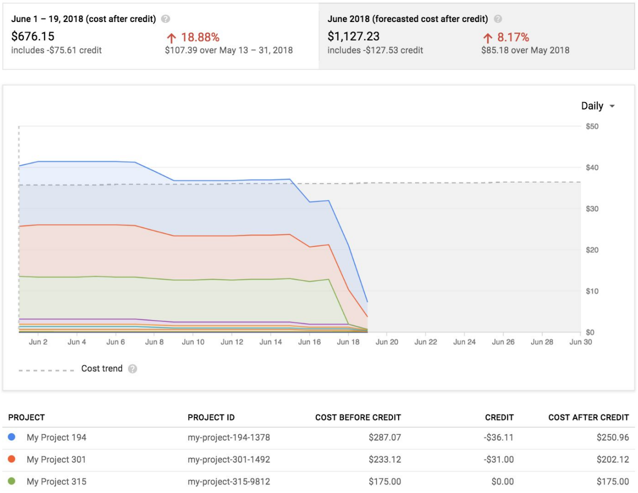
Project: orbitera-dm-test

Billing export dataset: orbitera_dm_test

Billing export allows you to store detailed billing information in places where it is easy to retrieve for external analysis, such as a BigQuery dataset or Cloud Storage bucket.

Source: https://codelabs.developers.google.com/codelabs/orbitera-gcp-billing/#1

Reports is a visual tool to monitor expenditure



June 1 – 19, 2018 (cost after credit)

$676.15

includes -$75.61 credit

↑ 18.88%

$107.39 over May 13 – 31, 2018

June 2018 (forecasted cost after credit)

$1,127.23

includes -$127.53 credit

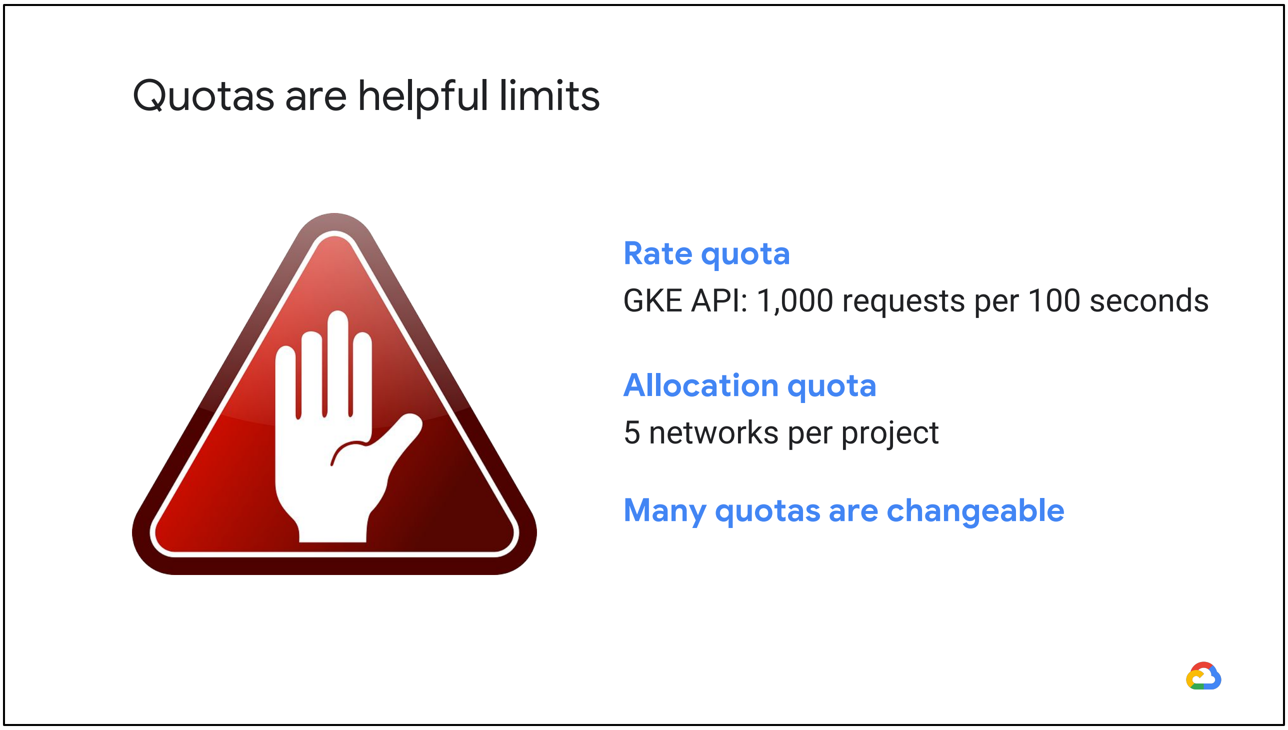
↑ 8.17%

$85.18 over May 2018

PROJECT	PROJECT ID	COST BEFORE CREDIT	CREDIT	COST AFTER CREDIT
● My Project 194	my-project-194-1378	$287.07	-$36.11	$250.96
● My Project 301	my-project-301-1492	$233.12	-$31.00	$202.12
● My Project 315	my-project-315-9812	$175.00	$0.00	$175.00

And Reports is a visual tool in the Console that allows you to monitor expenditure based on a project or services.

Source:
https://cloud.google.com/billing/docs/how-to/reports



Quotas are helpful limits

Rate quota
GKE API: 1,000 requests per 100 seconds

Allocation quota
5 networks per project

Many quotas are changeable

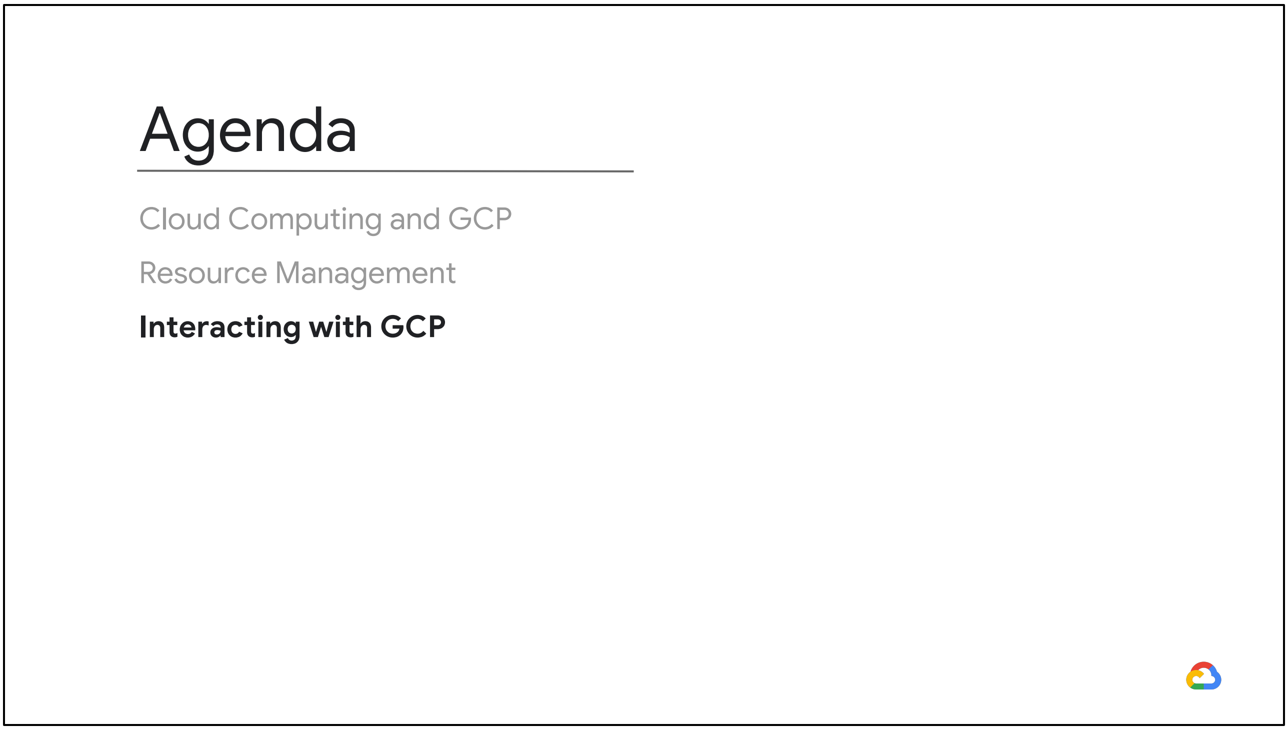
GCP also implements quotas, which limit unforeseen extra billing charges. Quotas are designed to prevent the over-consumption of resources because of an error or a malicious attack.
Quotas apply at the level of the GCP project.

There are two types of quotas: rate quotas and allocation quotas. Rate quotas reset after a specific time. For example, by default, the GKE service implements a quota of 1,000 calls to its API from each GCP project every 100 seconds. After that 100 seconds, the limit is reset. This doesn’t limit the rate of calls to your *applications running in GKE*, but, rather, calls to the administrative configuration of your GKE clusters themselves. It would be very unusual to make that many calls in such a short period of time. The quota might well catch and stop erroneous behavior.

Allocation quotas govern the number of resources you can have in your projects. This count doesn’t reset at intervals; instead you need to free up resources to stay within them. For example, by default, each GCP project has a quota allowing it no more than 5 Virtual Private Cloud networks.

These quotas are not the same for all projects. Although projects start with the same quotas, you can change some of them by requesting an increase from Google Cloud Support. Some quotas may increase automatically, based on your use of a product. And you can use the GCP Console to explicitly lower some of them for your own projects, say, if you want to put a more stringent cap on your consumption.

Finally, some quotas are fixed for all GCP customers. Regardless, in addition to their benefits to customers, GCP quotas also protect the community of GCP users by reducing the risk of unforeseen spikes in usage.
Image Source: https://pixabay.com/en/glossy-hand-red-stop-triangle-152862/



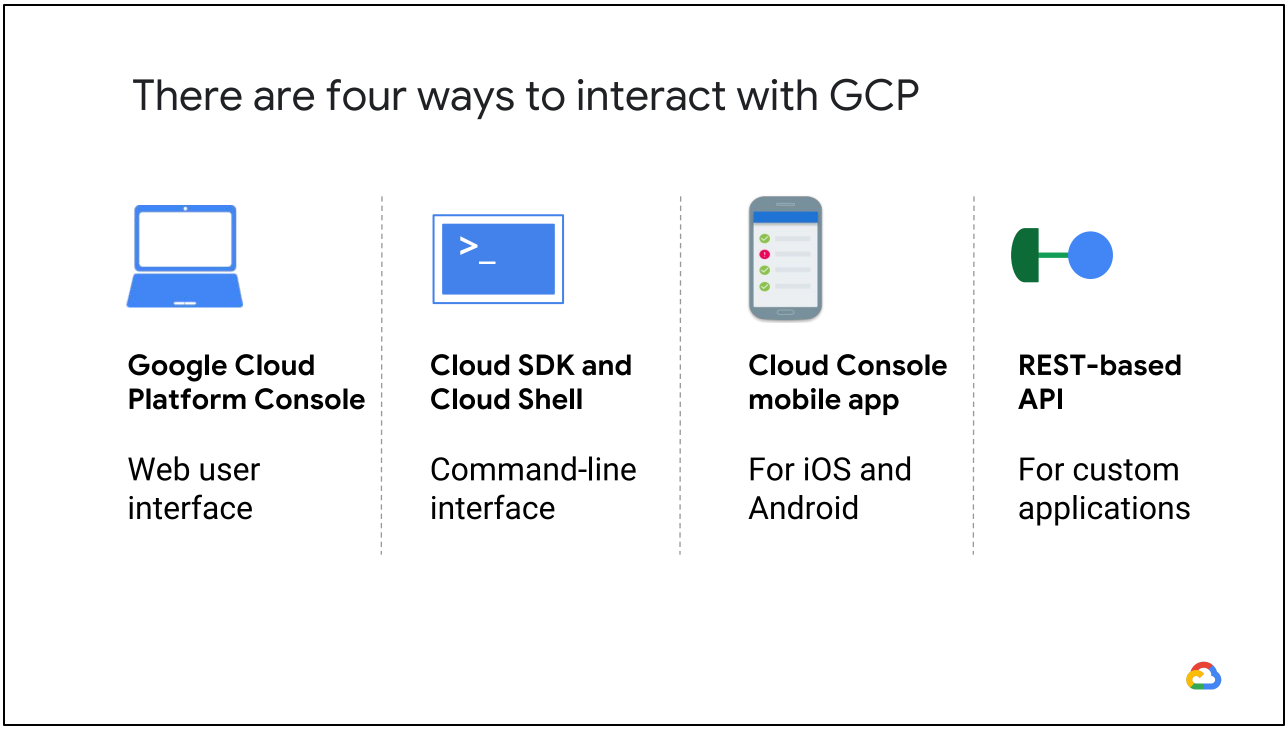
Agenda

Cloud Computing and GCP

Resource Management

Interacting with GCP

This next lesson looks at how you interact with GCP. You'll learn about the Google tools and interfaces that you can use to manage and configure GCP resources.



There are four ways to interact with GCP

Google Cloud Platform Console

Web user interface

Cloud SDK and Cloud Shell

Command-line interface

Cloud Console mobile app

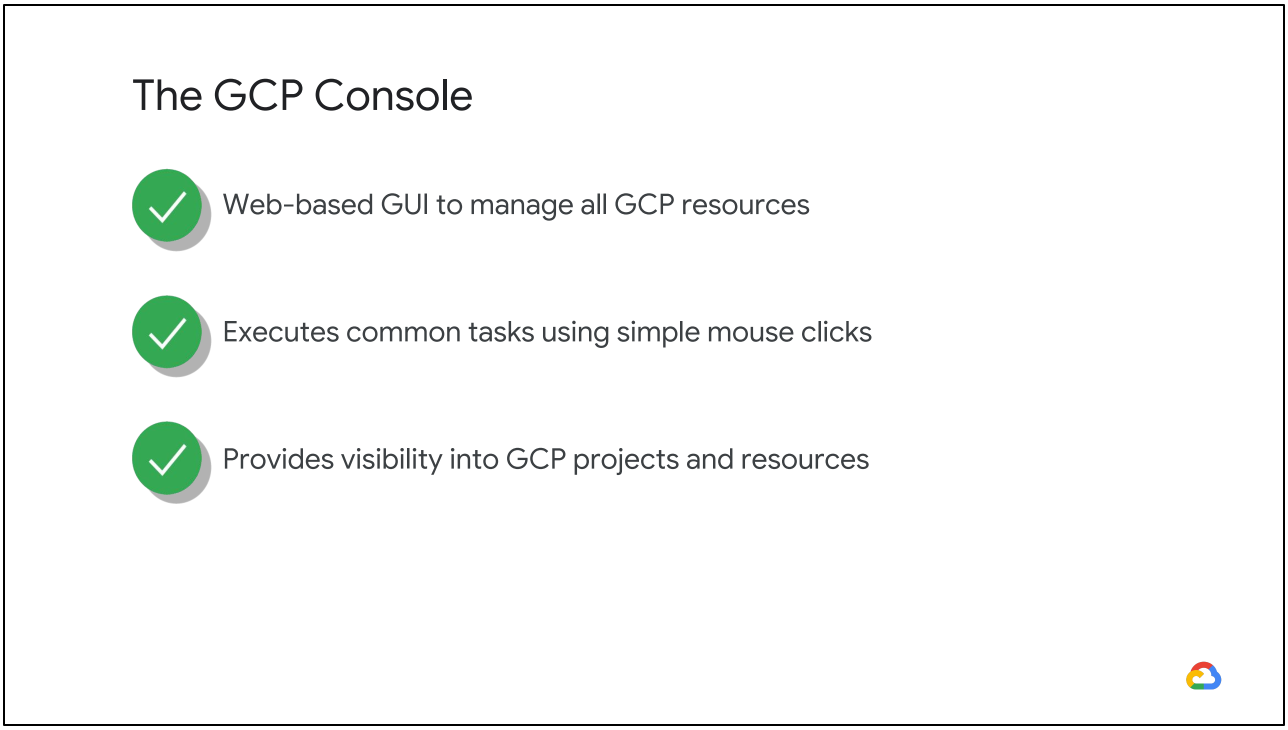
For iOS and Android

REST-based API

For custom applications

The Google Cloud Platform Console, the Cloud Shell and Cloud SDK, the Cloud Console mobile app, and REST-based APIs.

We will not focus very much on these APIs in this specialization. Developers use them to build applications that allocate and manage GCP resources. But our present focus is on letting Kubernetes manage resources for us.

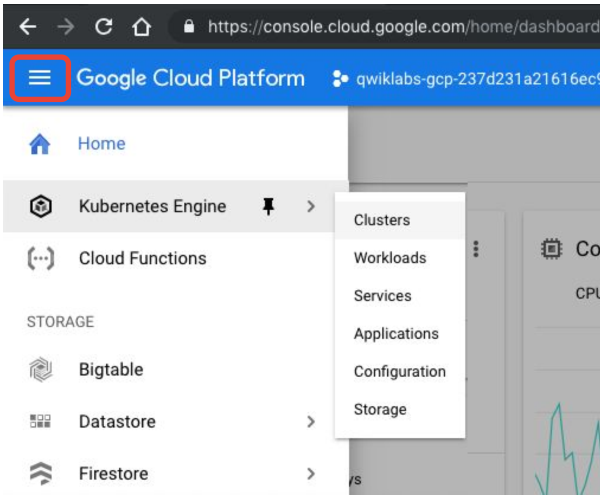


The GCP Console

- Web-based GUI to manage all GCP resources
- Executes common tasks using simple mouse clicks
- Provides visibility into GCP projects and resources

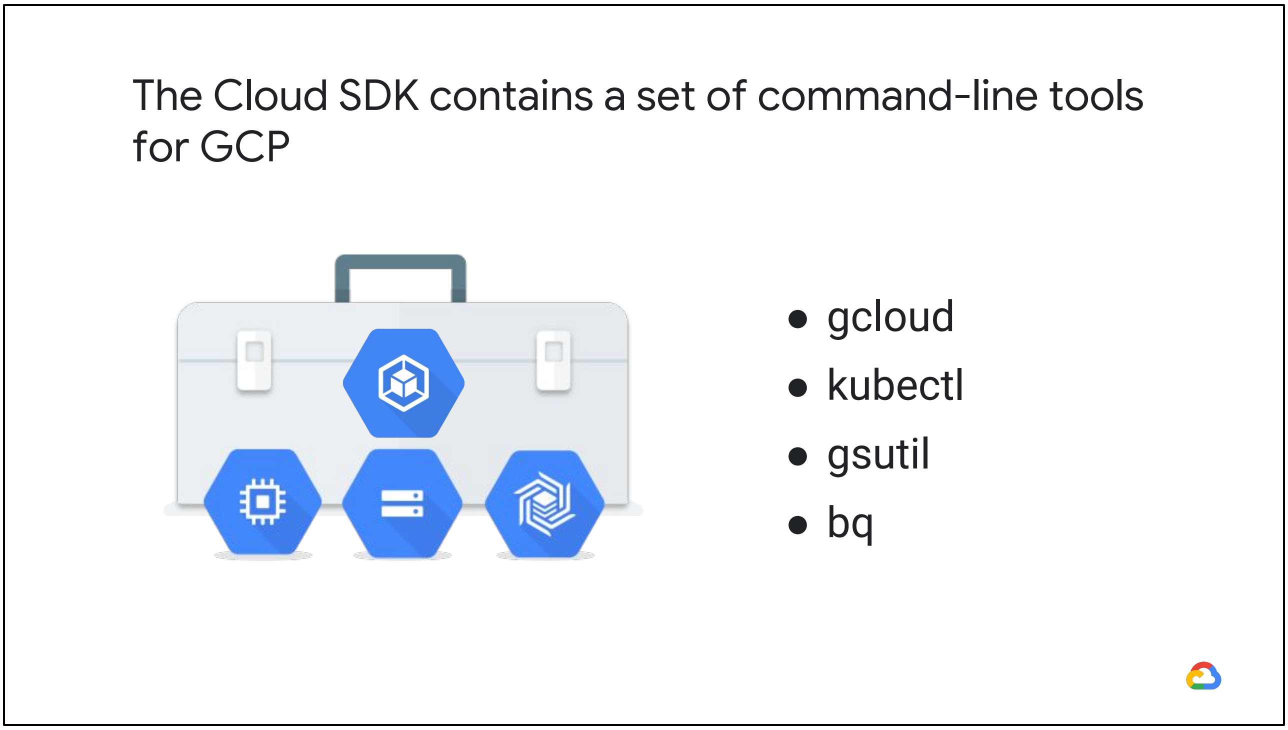
The GCP Console is a web-based, graphical user interface from where you manage your GCP resources.
It lets you execute common tasks using simple mouse clicks with no need to remember commands or avoid typos.
It also provides visibility into your GCP project and its resources.

Interacting with the GCP Console



https://console.cloud.google.com/home/dashboard

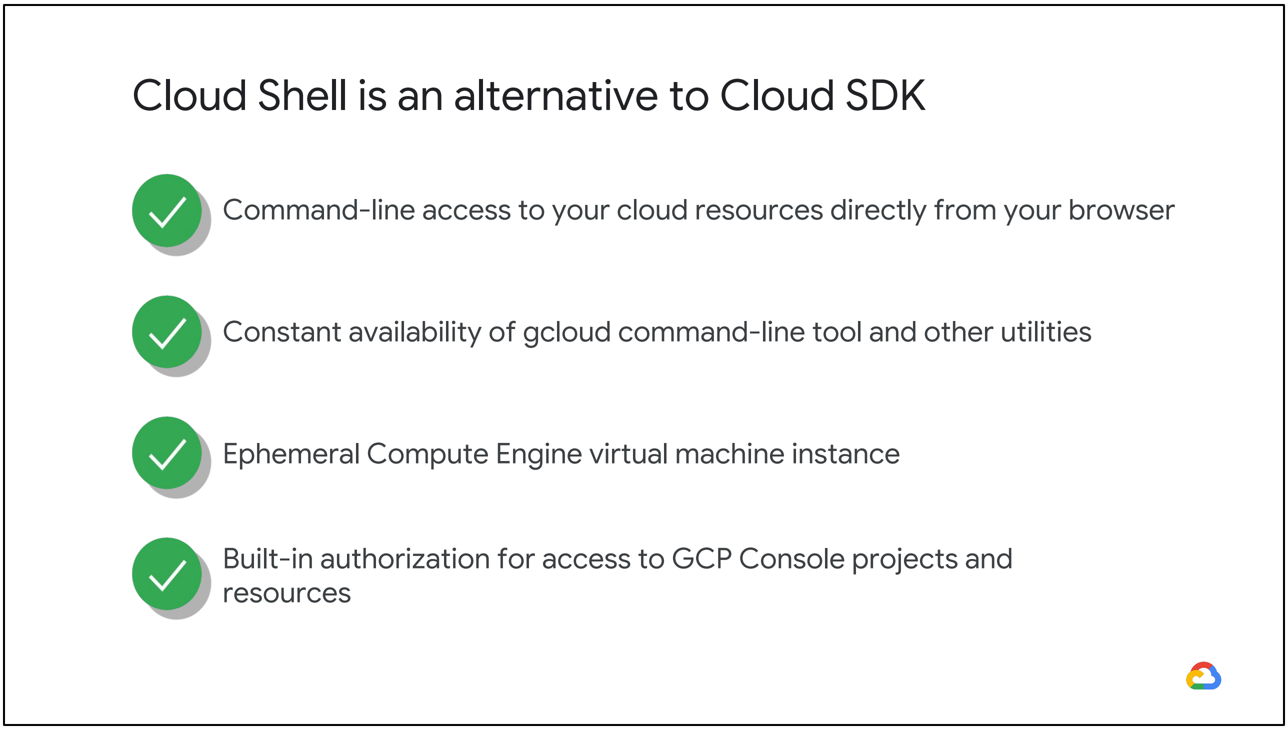
You can sign in to the GCP Console from a web browser at console.cloud.google.com. All GCP services are accessible through the simple menu button in the top-left corner. You can pin frequently used services to this menu. You'll learn how to use the GCP Console during an upcoming lab.



The Cloud SDK contains a set of command-line tools for GCP

- gcloud
- kubectl
- gsutil
- bq

Alternatively, you can download and install the Google Cloud SDK onto a computer of your choice. The Cloud SDK contains a set of command-line tools for Google Cloud Platform. Most notably, it contains the gcloud and kubectl commands, which we will use a lot in this course. It also contains the gsutil and bq utilities. You can run these tools interactively, or in your automated scripts. The Cloud SDK contains client libraries for various programming languages too.



Cloud Shell is an alternative to Cloud SDK

- ✓ Command-line access to your cloud resources directly from your browser
- ✓ Constant availability of gcloud command-line tool and other utilities
- ✓ Ephemeral Compute Engine virtual machine instance
- ✓ Built-in authorization for access to GCP Console projects and resources

But what if it isn’t convenient to install the Cloud SDK on the machine you’re working with? Cloud Shell provides command-line access to your cloud resources directly from within your browser.

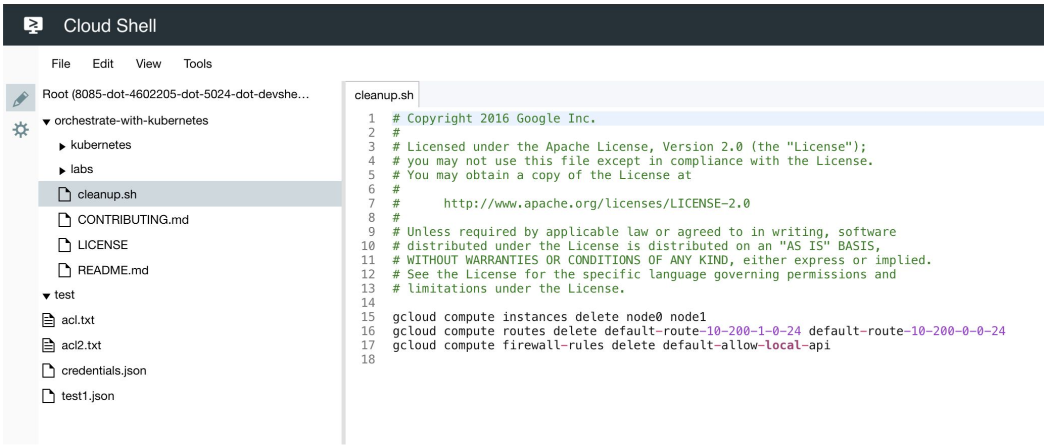
Using Cloud Shell, you can manage your projects and resources easily without having to install the Cloud SDK or other tools locally. The Cloud SDK gcloud and kubectl command-line tools and other utilities are always available, up to date, and fully authenticated.

So how does Cloud Shell do that? It’s built using a docker container running on a Compute Engine virtual machine instance that you’re not billed for. Each GCP user has one.

Your Cloud Shell virtual machine is ephemeral, which means that it will be stopped whenever you stop using it interactively, and it’ll be restarted when you re-enter Cloud Shell. So you wouldn’t want to run a production web server in your Cloud Shell, for example. You also get five gigabytes of persistent disk storage that is reattached for you every time a new Cloud Shell session is started.

It also provides web preview functionality and built-in authorization for access to GCP Console projects and resources, including your GKE resources.

Cloud Shell code editor is a tool for editing files inside your Cloud Shell environment



```
# Copyright 2016 Google Inc.
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# you may not use this file except in compliance with the License.
# You may obtain a copy of the License at
#
#      http://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.

gcloud compute instances delete node0 node1
gcloud compute routes delete default-route-10-200-1-0-24 default-route-10-200-0-0-24
gcloud compute firewall-rules delete default-allow-local-api

```
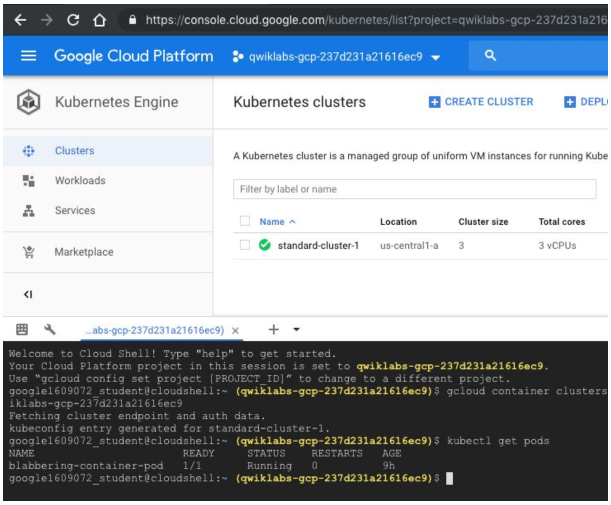

The Cloud Shell code editor is a tool for editing files inside your Cloud Shell environment in real time within the web browser. At the time this course was being developed, the Cloud Shell code editor was still in beta. You can also use text editors from the Cloud Shell command prompt.

This tool is extremely convenient when working with code-first applications or container-based workloads, because you can edit files easily without the need to download and upload changes. But is the easy way *always* the best way? Of course not. Later in the specialization, we’ll talk about best management practices.

The GCP Console and Cloud Shell



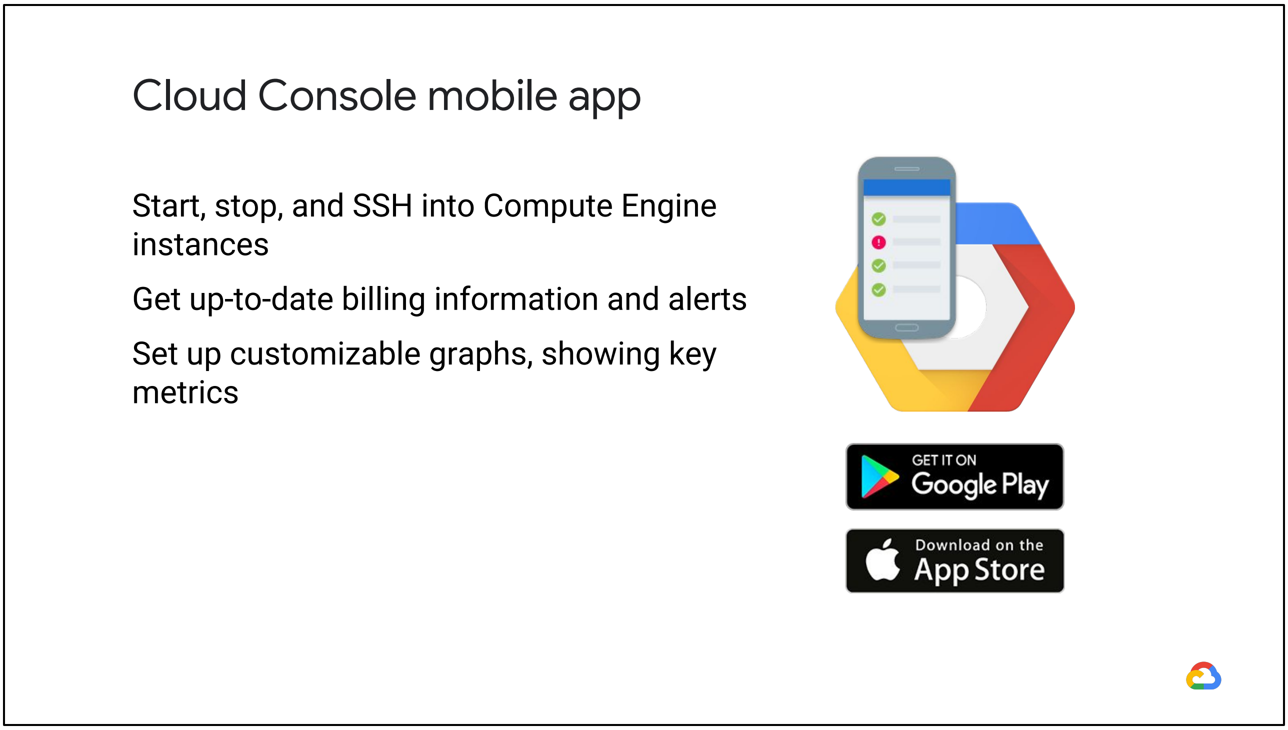
https://console.cloud.google.com/kubernetes/list?project=qwiklabs-gcp-237d231a216
Google Cloud Platform
qwiklabs-gcp-237d231a21616ec9
Kubernetes Engine
Clusters
Workloads
Services
Marketplace
Kubernetes clusters
CREATE CLUSTER
DEPL
Filter by label or name
...abs-gcp-237d231a21616ec9)

A Kubernetes cluster is a managed group of uniform VM instances for running Kube

Name	Location	Cluster size	Total cores
standard-cluster-1	us-central1-a	3	3 vCPUs

```
Welcome to Cloud Shell! Type "help" to get started.
Your Cloud Platform project in this session is set to qwiklabs-gcp-237d231a21616ec9.
Use "gcloud config set project [PROJECT_ID]" to change to a different project.
google1609072_student@cloudshell:~ (qwiklabs-gcp-237d231a21616ec9)$ gcloud container clusters
iklabs-gcp-237d231a21616ec9
Fetching cluster endpoint and auth data.
kubeconfig entry generated for standard-cluster-1.
google1609072_student@cloudshell:~ (qwiklabs-gcp-237d231a21616ec9)$ kubectl get pods
NAME                        READY     STATUS    RESTARTS   AGE
blabbering-container-pod    1/1       Running   0          9h
google1609072_student@cloudshell:~ (qwiklabs-gcp-237d231a21616ec9)$
```

Here's a screenshot of the GCP Console's GKE area, showing you its web-based interface for administering your GKE resources. The bottom third of the screenshot is your Cloud Shell in operation, where you can launch commands to administer those resources as well. Some of those commands are from the Google Cloud SDK, and others will be specific to your workload. Later in this course, we'll learn about the kubectl command, and you can see it being launched from Cloud Shell here.



Cloud Console mobile app

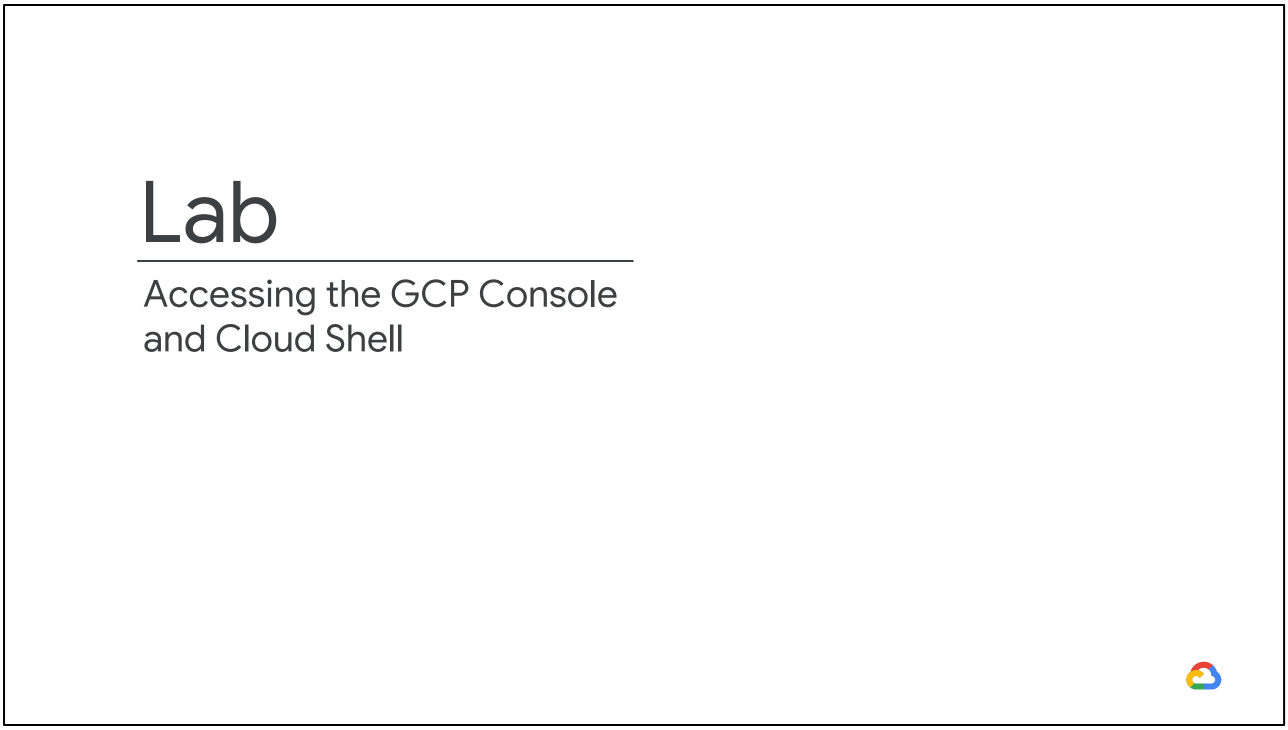
Start, stop, and SSH into Compute Engine instances

Get up-to-date billing information and alerts

Set up customizable graphs, showing key metrics

GET IT ON
Google Play
Download on the
App Store

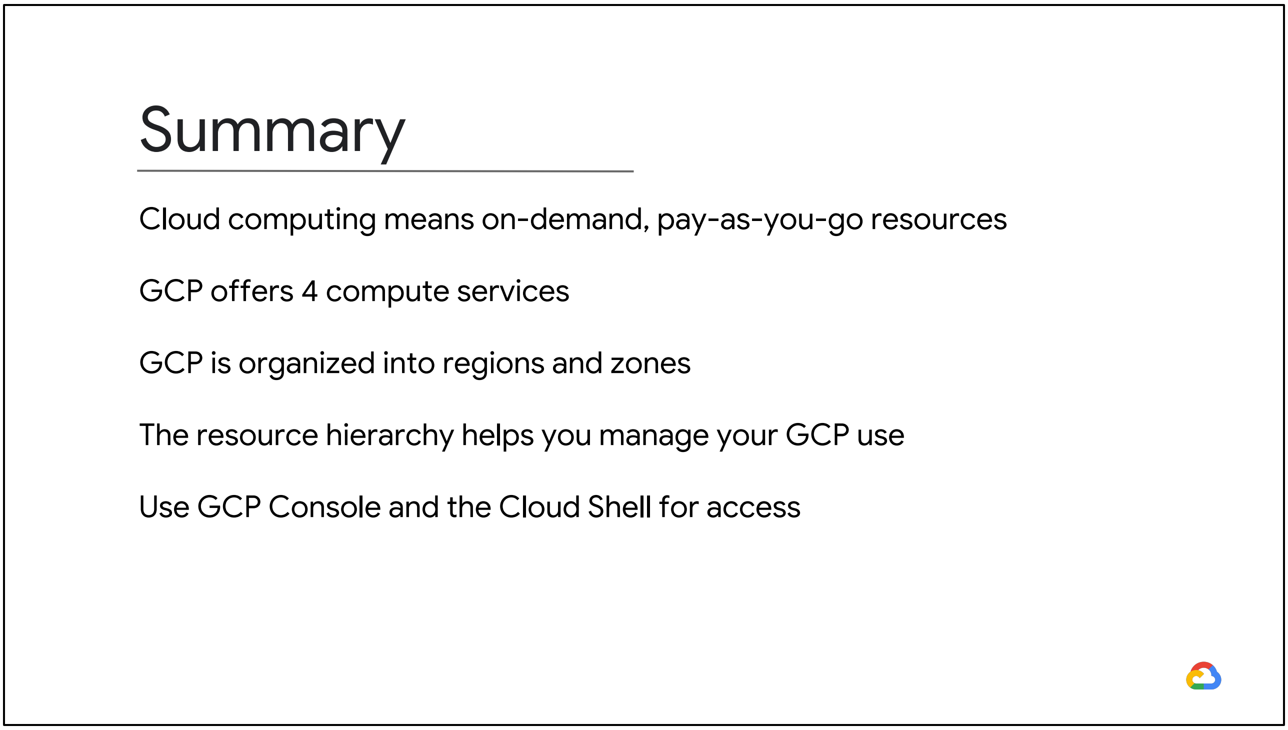
Finally, there's the Cloud Console mobile app, available for iOS and Android. It offers many capabilities, like managing virtual machines, and viewing their logs, getting up-to-date billing information for your projects, and getting billing alerts for projects that are going over budget, and setting up customizable graphs, showing key metrics such as CPU usage, network usage, requests per second, and server errors. We will not use it in this course, but it's a resource you might find convenient, and of course it's at no additional charge.



Lab

Accessing the GCP Console and Cloud Shell

In this lab, you’ll access and become familiar with the GCP Console. You’ll also become familiar with features of the Cloud Shell, including the Cloud Shell code editor.
You’ll create buckets, VMs, and service accounts using the GCP Console and the Cloud Shell and execute several other commands through the Cloud Shell.



Summary

Cloud computing means on-demand, pay-as-you-go resources

GCP offers 4 compute services

GCP is organized into regions and zones

The resource hierarchy helps you manage your GCP use

Use GCP Console and the Cloud Shell for access

That concludes the ‘Introduction to Google Cloud Platform’ module. Let me remind you of what you learned.

Cloud computing is a way to organize your use of IT in which a provider gives you on-demand access over the network to resources from a pool they maintain. You pay for what you use or reserve. The provider maintains the infrastructure for you, and you can turn it off when you’re done.

Google Cloud Platform offers a lot of different kinds of cloud computing services, including four that run your code for you on hardware Google maintains. In this course, we are focusing on Kubernetes Engine.

All the resources offered by GCP are organized into regions and zones. You can use resources in several zones in a region to increase your application’s resiliency.

GCP has a shared security model. You are responsible for defining security policies for your GCP resources, and the cloud resource management hierarchy helps you do that in a manageable way.

Two important tools you can use to administer your use of GCP resources are the GCP Console and Cloud Shell. We’ll use both throughout this specialization.

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