

Google side

25 February 2024 04:35

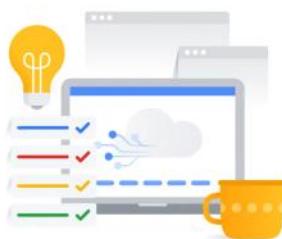
Date-- 25/04/2024

[Cloud Digital Leader Certification Learning Path](#)

[Digital Transformation with Google Cloud](#)

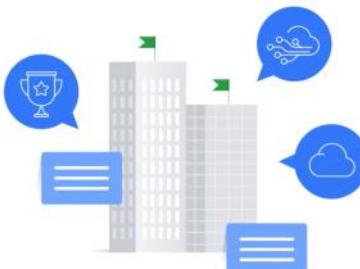
Digital Transformation with Google Cloud

Course Introduction



- Understand why and how the cloud revolutionizes businesses
- Explain general cloud concepts
- Identify the benefits and tradeoffs of using IaaS, PaaS, and SaaS

- Important terms
- Benefits of cloud technology
- Fundamental cloud concepts
- How migrating to cloud affects:
 - Flexibility
 - Agility
 - Reliability
 - Total cost of ownership
- Use cases



You'll also explore the different types
of infrastructure and explore various use

Why Cloud Technology is Transforming Business-->

Introduction -->

The video player interface includes a play button, volume control, and sharing options.

Introduction

Watch later Share

- Key cloud and digital transformation terms
- The benefits of cloud technology
- The differences between on-premises and cloud
- The drivers and challenges in digital transformation

the drivers and challenges that lead organizations
to undergo a digital transformation.



Paradigm shift

A fundamental and irreversible change in the way that humans work and engage with the world.

a paradigm shift:
a fundamental and irreversible change in the

1:30 / 4:20

CC HD YouTube



Innovations, paradigm shifts, and digital transformation



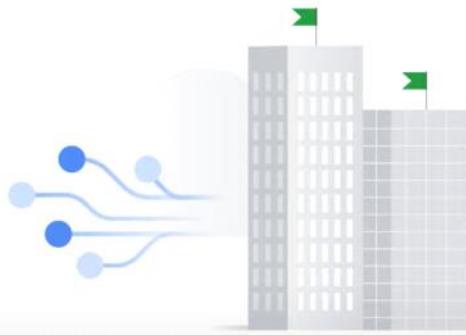
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Digital transformation

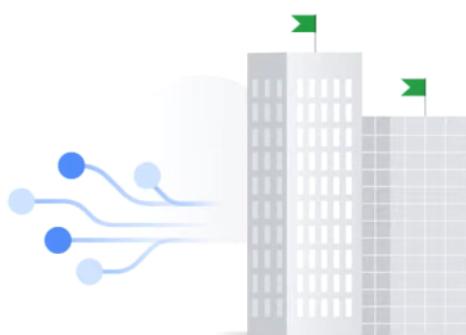
When an organization uses **new digital technologies**, such as public, private, and hybrid cloud platforms **to create or modify** business processes, culture, and customer experiences **to meet the needs** of changing business and market dynamics.

such as public, private, and hybrid cloud
platforms to create or modify business processes,



- Foster innovation
- Generate new revenue streams
- Adapt to market changes
- Adapt to customer needs

and customer needs.



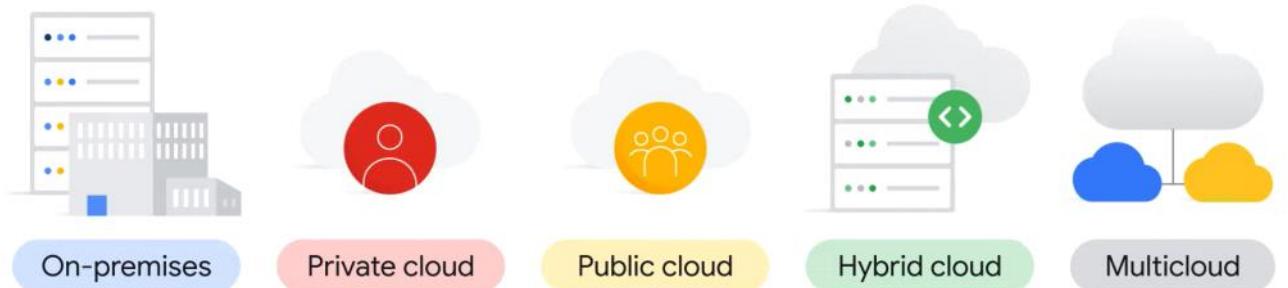
- Change how they operate
- Redefine relationships
- Modernize applications
- Create services
- Deliver value

and delivering value.

What is cloud -->

The cloud is a metaphor for the network of data centers which store and compute information that's available through the internet.

Essentially, instead of describing a complex web of software, servers, computers, networks, and security systems, all of that has been combined into one word: "cloud."



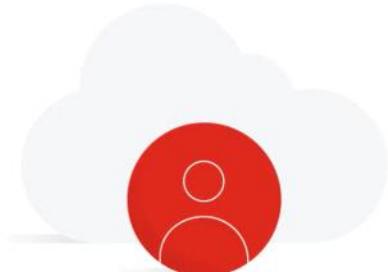
On-premises and **On-prem** environments are shown side-by-side. A vertical line connects them to a list of benefits for On-prem.

- Hosted on-site
- Located and operated in an organization's data center
- Traditional way of managing IT infrastructure
- Doesn't require third-party access
- Owners have physical control
- No payment for ongoing access

and doesn't require them to pay for ongoing access.

A large orange exclamation mark icon is positioned above the **On-premises** environment icon. A vertical line connects the two to a list of challenges.

- Require physical space
- Require a specialized room
- Require expert personnel
- Difficult to scale
- Acquire more computing resources than needed



Private cloud

- Dedicated to a single organization
- Single-tenant or corporate cloud



Private cloud

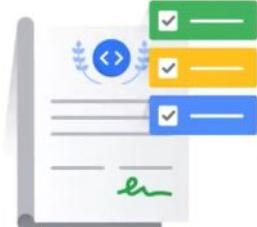
- ✓ Self-service
- ✓ Scalability
- ✓ Elasticity



Private cloud

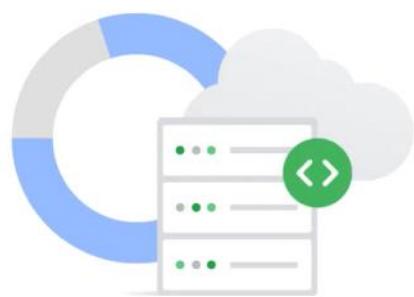
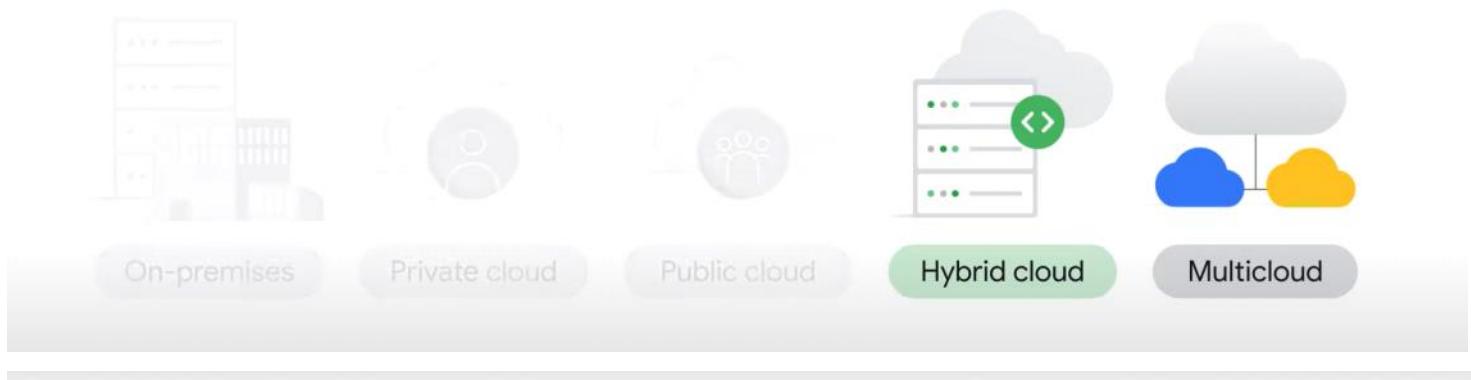
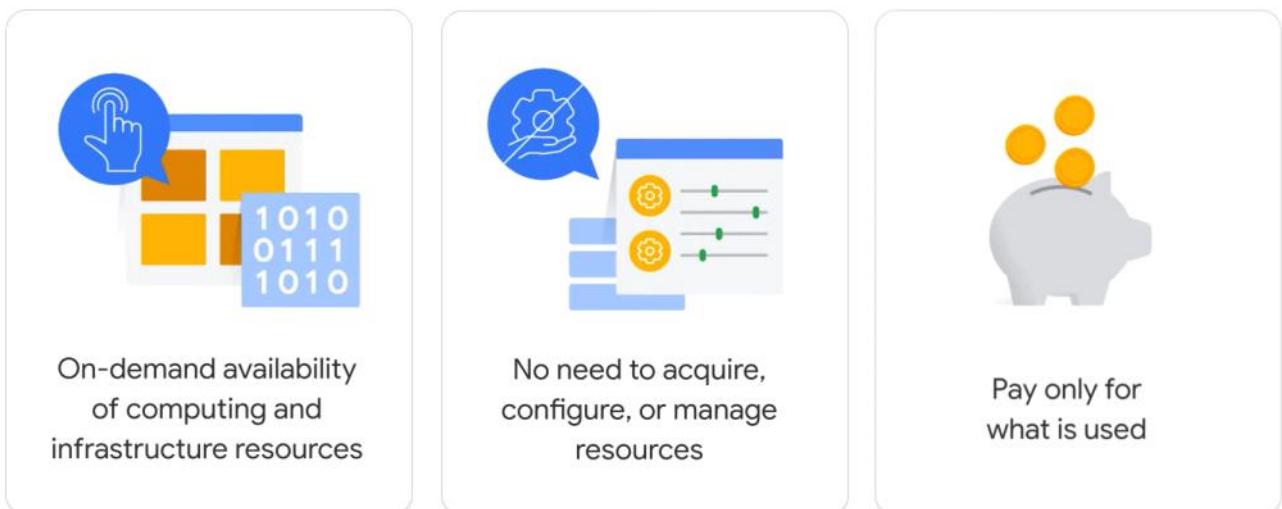


Investments



Regulatory reasons

Public cloud --



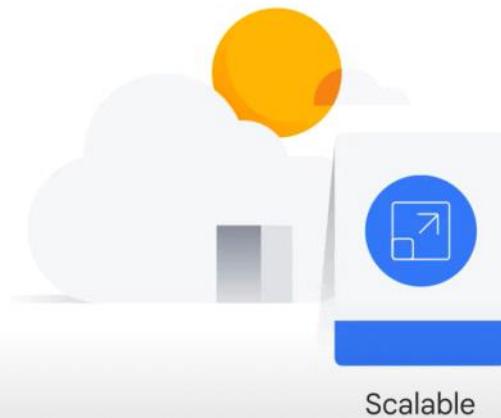
80% of respondents have a hybrid strategy



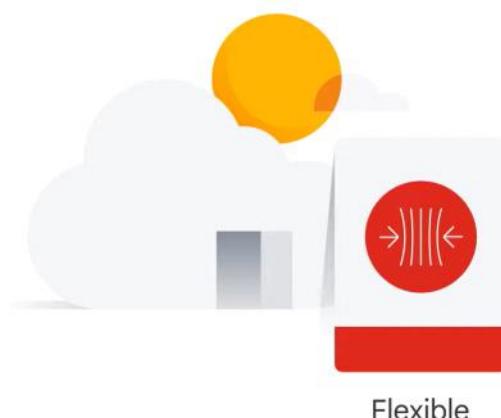
89% of respondents have a multicloud strategy

Flexera 2022 State of the Cloud Report
and 80% of them take a hybrid approach by combining public and private cloud.

[The benefits of cloud computing -->](#)



- Access to scalable resources
- Latest technology on-demand
- Accelerates deployment time



- Access services from anywhere
- Scale services up
- Scale services down



Agile

- ✓ Develop new applications
- ✓ Rapidly get them into production
- ✓ No infrastructure worries

without worrying about the underlying infrastructure.



Strategic value

- ✓ Competitive advantages
- ✓ Higher return on investment
- ✓ Innovate and try new ideas

This lets organizations innovate and try new ideas faster.



Secure

- ✓ Stronger than enterprise data centers
- ✓ Depth and breadth of mechanisms
- ✓ Dedicated teams



Cost-effective

- ✓ Pay for what is used
- ✓ No overbuilding data centers
- ✓ IT staff can work on strategic initiatives

or business growth,
and they can deploy IT staff to work on more

Date-- 26/04/2024

[Real-world examples: Why it's critical to transform and embrace new technology](#) -->



Cloud era --



- ✓ No need to buy or operate hardware
- ✓ Major catalyst for cloud-native companies



VM Cloud Era

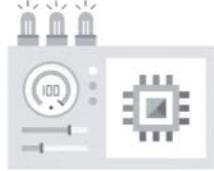


- ✓ Saved costs
- ✓ Faster development
- ✓ Better security
- ✓ Reduction of management load
- ✓ Focus on building new capabilities



Infrastructure
Cloud Era

to
focus on building new capabilities.



Didn't provide:

— Transformative results

— Disruptive results

Didn't change:

— How people worked

VM Cloud Era

Infrastructure
Cloud Era

or fundamentally change how people worked
outside of IT.

Digital transformation is more than simply
migrating and shifting systems to the cloud
for cost saving and convenience

Transformation Clouds

Transformation Cloud Era

- App and infrastructure modernization
- Data democratization
- People connections
- Trusted transactions

It's built on an easy-to-use platform with customized industry solutions

Organization

Transformation Cloud Era

- Benefits from cloud computing
- Drives innovation
- Generates new revenue streams
- Adapts quickly to market changes

and adapt quickly to market changes and customer needs.

Challenges that lead to a digital transformation

Google, when we talk to our customers about their biggest business challenges and what they need to accelerate digital transformation, we consistently hear five themes.

00:37First, they want to be the best at **understanding**

and using data.

00:42Today, organizations must unify data across streams, lakes, warehouses, and databases so that they can quickly and

00:49easily break down data silos, generate real-time insights, and make better business decisions; thus reducing cost and inefficiencies.

00:59Second, they want **the best technology infrastructure.**

01:03Organizations are looking for a cloud platform that will serve as their foundation for growth and has the flexibility to innovate securely and adapt quickly based on market needs.

01:13Third, they want to create **the best hybrid workplace.**

01:17The fundamental shift in how and where we work requires new, stronger connections and collaboration, and many interactions that took place in person have been digitized.

01:27This change requires more intentional connections and collaboration.

01:32Fourth, it's critical for organizations to know **that their data, systems, and users are secure.**

01:38The digital world is seeing more severe security issues, so now companies are rethinking their security posture.

01:45They must find ways to identify and protect everything from people customers customers to data and transactions in a fast-changing environment.

01:54Finally, organizations are **prioritizing sustainability as a critical, board-level topic.**

02:01They want to create a more sustainable future through products and services that minimize environmental impact.

02:07These are the top drivers for digital transformation that we see, and the challenges that many organizations face as they navigate their journey.

[Google's Transformation Cloud](#)



Data

Open
infrastructure

Collaboration



Trust

Sustainable
technology

Let's explore each, starting with the data cloud.



Data



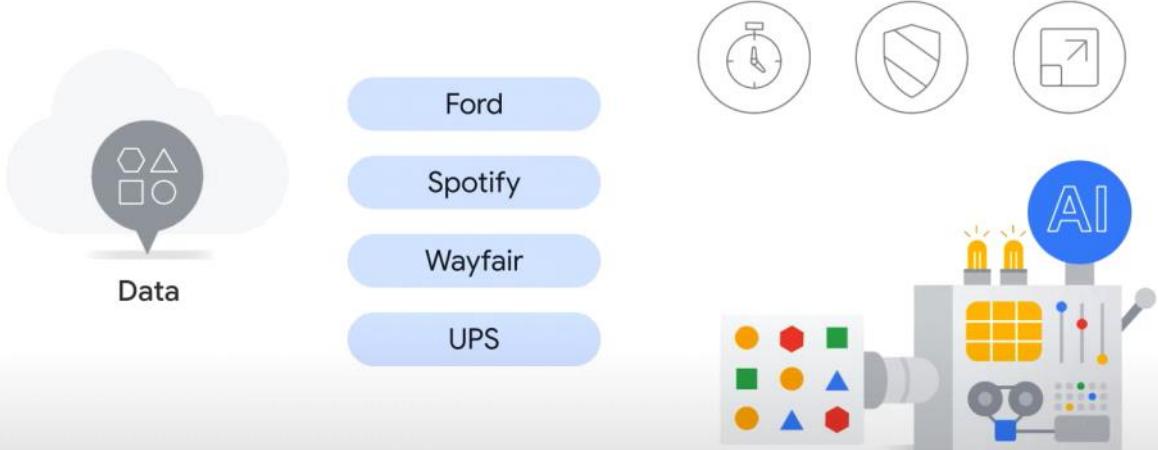
Innovation

Differentiation

Data is the key to unlocking value from AI, making it critical for innovation and differentiation.

It lets organizations identify and process data with great **scale, speed, security, and reliability**

It lets organizations identify and process data with great scale, speed, security, and



transformation quickly, securely, and at scale,
all with AI built in.



- Facilitates faster innovation
- Reduces lock-in to a single cloud provider
- Flexibility to build, migrate, and manage applications



Open standard

- Software with particular specifications
- Accessible and usable by anyone
- Guidelines for software functionality

that the products that use these standards
perform in an interoperable way.

open infrastructure.

Organizations choose to modernize their IT systems on Google's open infrastructure cloud because it gives them freedom to securely innovate and scale from on-premises, to edge, to cloud on an easy, transformative, and open platform.

Open infrastructure cloud brings Google Cloud services to different physical locations, while leaving the operation, governance, and evolution of the services to Google Cloud.

Instead of relying on a single service provider or closed technology stack, today most organizations want the freedom to run applications in the place that makes the most sense, using hybrid and multicloud approaches based on open source software.

An open infrastructure cloud facilitates faster innovation and reduces lock-in to a single cloud provider by giving organizations the choice by giving organizations the choice and flexibility to build, migrate, and manage their applications across on-premises and multiple clouds.

Let's take a moment to define two terms that are often confused: open standard and open source.



Open standard

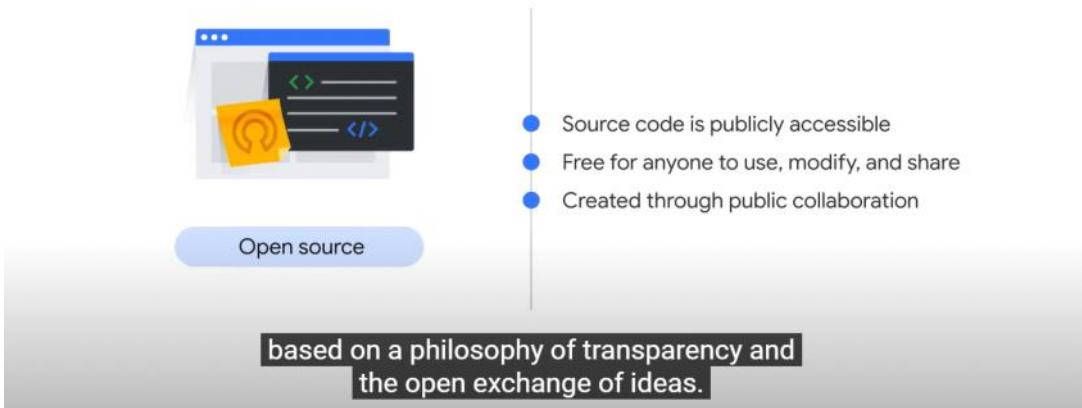
- Software with particular specifications
- Accessible and usable by anyone
- Guidelines for software functionality

that the products that use these standards
perform in an interoperable way.

Open standard refers to software that follows particular specifications that are openly accessible and usable by anyone.

They have guidelines for software functionality, which help avoid vendor lock-in and ensure that the products that use these standards perform in an interoperable way.

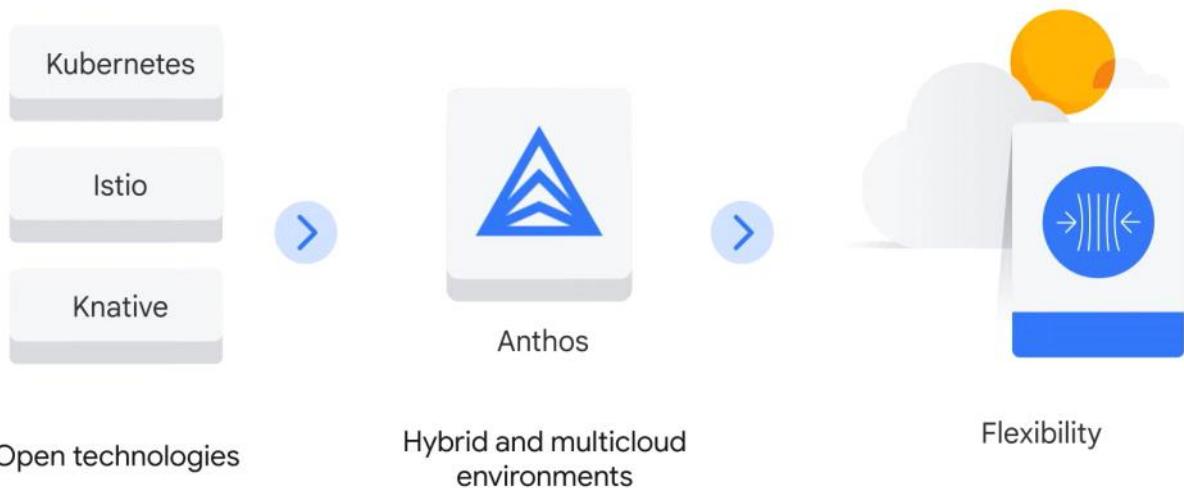
Examples of open standards are HTTP for requesting content on the web or XML for storing structured data.



Open source refers to software whose source code is publicly accessible and free for anyone to use, modify, and share. A decentralized community generally develops open source software as a public collaboration, based on a philosophy of transparency and the open exchange of ideas.

Open source plays a critical role in an open cloud to deliver customers the **portability** they expect

Open source plays a critical role in an open cloud to deliver customers the portability they expect.



03:23 Google has a long history of sharing technology through open source: from projects like Kubernetes, which is now the industry standard in container interoperability in the cloud, to TensorFlow, a platform to help everyone develop and train machine learning models. **03:40** Another way we provide flexibility is through hybrid and multicloud environments managed by products like Anthos, which is built on open technologies like Kubernetes, Istio, and Knative.

03:52 And finally, an open infrastructure embraces a partner ecosystem— —and the breadth of solutions it can offer its customers —instead of competing with it.

Collaboration



Collaboration helps transform how people connect, create, and collaborate.

[04:02](#)Collaboration helps transform how people connect, create, and collaborate.

A transformation cloud isn't just about technology.

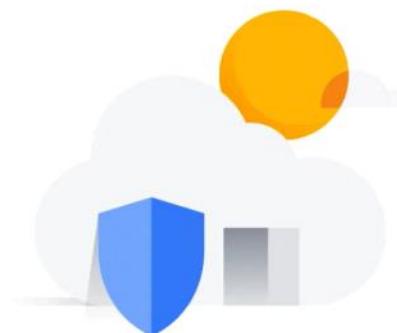
[04:10](#)People and culture are just as important.

[04:37](#)This new hybrid work environment needs to support a mix of in-person and remote interactions, including immersive digital and mobile experiences.

[04:46](#)At Google, for example, we offer a collaboration cloud through **Google Workspace**.

[04:52](#)Workspace brings together communication and collaboration apps including Gmail, Chat, Calendar, Drive, Docs, Sheets, and Meet into a people-first experience powered by Google AI.

Trust



- Create better visibility
- Remediate threats
- Benefit from innovations
- Maintain control

while maintaining control of their digital assets.

05:06A trusted cloud helps organizations protect what's important with advanced security tools.

05:13According to Cybersecurity Ventures, the annual cost of cyber crime is expected to reach \$10.5 trillion annually by 2025.

05:23Due to the rise of cybersecurity threats, every company is rethinking its security posture.

05:29This means finding ways to identify and protect everything, from people and customers to data and transactions —in a fast-changing environment.

05:39Organizations see the cloud as more secure than on-premises, and they want to make it simple so that employees, customers, and contractors can safely access their services.

05:48They want to create better visibility to find, analyze, resist, and remediate threats at global scale, and benefit from cloud innovations while maintaining control of their digital assets.

sustainable foundation

06:00Finally, a transformation cloud is built on a sustainable foundation, using technology and solutions that help organizations build and work more sustainably.

06:10Today, organizations are now encouraged to help create a cleaner, more sustainable world and they need new technologies that help them progress consistently.

06:20According to IDC, cloud computing is estimated to **save 1 billion metric tons of CO2 emissions by 2024**.

06:27The largest corporations have the opportunity to lead the way in helping the world reduce its emissions and operate on carbon-free energy always.

06:36For that reason, companies are moving to the cloud, and they want a sustainable infrastructure to power their business.

06:43At Google Cloud, for example, we partner with customers to decarbonize their digital apps and infrastructure with our sustainable technology and solutions.

06:53We proudly operate the cleanest cloud in the industry, with the smartest data centers that are 2 times as energy-efficient as a typical enterprise data center.

07:02Moving to Google Cloud can dramatically decrease a customer's IT-related carbon footprint.

The Google Cloud Adoption Framework

The framework structures and aligns

- ✓ Short-term tactical objectives
- ✓ Mid-term strategic objectives
- ✓ Long-term transformational objectives



term transformational business objectives.

A **cloud maturity assessment** helps to establish where an organization is currently regarding the cloud adoption themes recognized by Google Cloud

A cloud maturity assessment helps to establish where an organization is currently regarding

After cloud maturity has been assessed and actions have been recommended, it's easy to **scope and structure a cloud adoption program** using the framework

After cloud maturity has been assessed and actions have been recommended, it's easy to

So how can organizations approach their cloud journey?

00:04 Moving to the cloud offers enormous benefits for transforming businesses.

00:08 Yet there are also risks.

00:11 The challenge is **multi-dimensional**, with far reaching implications for the solutions that will run in the cloud and also for the technologies that support them.

00:20 The people who must implement them and the processes that govern them.

00:25 The rubric of people, process, and technology is a familiar one.

00:30 It forms the basis of the Google Cloud Adoption Framework, which was created to support customers on their cloud journey.

00:37 The value of the Google Cloud adoption Framework is that it serves as a map to help

00:41 organizations adopt the cloud quickly and effectively by creating a comprehensive action plan for accelerating cloud adoption.

00:50 It does this by structuring and aligning short term tactical, mid-term, strategic, and long term transformational business objectives.

00:58 It provides a solid assessment of where an organization is in its cloud journey and actionable programs that get it to where it wants to be.

01:08 A cloud maturity assessment helps to establish where an

organization is currently regarding the cloud adoption themes recognized by Google Cloud.

01:17It can quickly reveal any areas where an organization might be weaker or underinvested.

01:23This is especially powerful if an organization was previously unaware of this lack of maturity.

01:30The Google Cloud adoption framework is more than just a model.

01:33It's also a map to real, tangible tasks that organizations need to adopt the cloud.

01:40After cloud maturity has been assessed and actions have been recommended, it's easy to scope and structure a cloud adoption program using the framework.

What is seen as a limitation of on-premises infrastructure, when compared to cloud infrastructure?

Check The on-premises hardware procurement process can take a long time.

The on-premises networking is more complicated.

Maintenance workers do not have physical access to the servers.

Scaling processing is too difficult due to power consumption.

That is the correct answer!

check

2.

What is the cloud?

A metaphor for the networking capability of internet providers.

A Google product made up of on-premises IT infrastructure.

A Google product for computing large amounts of data.

Check A metaphor for a network of data centers.

That is the correct answer!

check

3.

An organization has a new application, and user subscriptions are growing faster than on-premises infrastructure can handle. What benefit of the cloud might help them in this situation?

It's cost effective, so the organization will no longer have to pay for computing once the app is in the cloud.

It provides physical access, so the organization can deploy servers faster.

It's secure, so the organization won't have to worry about the new subscribers data.

Check It's scalable, so the organization could shorten their infrastructure deployment time.

That is the correct answer!

4.

Which item describes a goal of an organization seeking digital transformation?

Reduce emissions by using faster networks in their on-premises workloads.

5.

As the world and business changes, organizations have to decide

between embracing new technology and transforming, or keeping their technology and approaches the same. What risks might an organization face by not transforming as their market evolves?

Organizations risk losing market leadership if they spend too much time on digital transformation.

check

6.

What is the benefit of implementing a transformation cloud that is based on open infrastructure?

Check Open source software reduces the chance of vendor lock-in.

On-premises software isn't open source, so cloud applications are more portable.

Open source software makes it easier to patent proprietary software.

Open standards make it easier to hire more developers.

That is the correct answer!

check

7.

An organization has made significant investments in their own infrastructure and has regulatory requirements for their data to be hosted on-premises. Which cloud implementation would best suit their needs?

Public Cloud

Software as a service

Platform as a service

Check Private Cloud

That is the correct answer!

check

8.

Select the two capabilities that form the basis of a transformation cloud?

Select two correct answers.

Check Open infrastructure gives the freedom to innovate by running applications in the place that makes the most sense.

That is the correct answer!

A trusted cloud gives control of all resources to the user to ensure high availability at all times.

Collaboration cloud ensures that the device a user connects with only works on the corporate network.

Check Data cloud provides a unified solution to manage data across the entire data lifecycle.

That is the correct answer!

Sustainable cloud ensures the costs of cloud resources are controlled to prevent budget overrun.

9.

Select the definition of digital transformation.

When an organization uses new digital technologies to create or modify on-premises business processes.

Check When an organization uses new digital technologies to create or modify business processes, culture, and customer experiences.

When an organization uses new digital technologies to create or modify financial models for how a business is run.

When an organization uses new digital technologies to create or modify technology infrastructure to focus on cost saving.

Fundamental Cloud Concepts

Introduction

To understand the impact that the cloud can have on a business, it's important to first recognize some of the



Introduction

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Watch later Share

- ✓ Describe the benefits of moving to cloud infrastructure
- ✓ Explain how moving to the cloud shifts an organization's spending and how that affects their total cost of ownership
- ✓ Identify when private, hybrid, or multicloud infrastructures best apply to different business use cases
- ✓ Define basic network infrastructure terminology
- ✓ Explain how Google Cloud supports digital transformation

And explain how Google Cloud supports digital transformation with global infrastructure

enhanced and future-proof their risk management on the cloud.

02:33Their previous on-premises system was not capable of meeting future regulatory and business demands.

02:39HSBC built a **cloud-native risk management** solution that boosts **calculation** speed to be ten times faster while lowering costs.

02:47This equated to three billion calculations per second.

02:51The power of a data cloud is that it has almost unlimited resources to process large volumes of data and reduce time to insights.

03:00A Global Head of Traded Risk Technology at HSBC explains, "We knew that a cloud-native solution gave us the ability to scale and

03:07run at a reduced cost. We did a proof of concept using Google Cloud, and we quickly realized that this could be very successful."

03:15HSBC built a cost-effective platform that is faster and more efficient while meeting their regulatory and compliance requirements.

03:23And in a final example, let's look at how the cloud has brought agility and valuable insights, while maintaining trust, to an organization.

03:33The American Cancer Society is a community-based voluntary health organization dedicated to eliminating cancer as a major health problem.

03:41Their mission is to free the world from cancer by funding and conducting research, sharing expert information, supporting patients, and spreading the word about prevention.

03:52Among women, breast cancer is the most commonly diagnosed type of cancer.

03:56Yet, if detected early, it's also one of the most survivable cancers.

04:02Mia M. Gaudet, PhD, is the Scientific Director of Epidemiology Research at the American Cancer Society.

04:09Through her research, she's obtained over 1,700 high-resolution tissue images from participants diagnosed with breast cancer.

04:17This valuable data could help them discover factors that could lead to a cancer diagnosis and improve survival rates.

04:23The challenge was to identify novel patterns in digital images of breast cancer tissues to potentially improve patient outcomes.

04:31Their research group partnered with Slalom, a Google Cloud Premier Partner, and sought to combine machine learning-powered insights with cloud computing performance to improve timeliness and accuracy.

04:42By building a machine learning pipeline using Google Cloud AI Platform, now called Vertex AI, they trained models for AI image analysis of tissue scans to find cancer indicators.

04:53The team achieved 12 times faster image analysis with enhanced quality and accuracy by removing human limitations.

05:00Dr. Gaudet said, "The ability to perform image analysis by using deep learning for epidemiologic breast cancer studies

05:08opens a new frontier of research, and Google Cloud makes it easier. We're excited about what we'll find."

05:16The American Cancer Society is now equipped with processes and a cloud infrastructure that will be reusable on similar projects, providing a foundation for future work.

TCO

Organizations often perform a **cloud total cost of ownership (or TCO)** analysis when they are considering moving to the cloud.

00:09This analysis aims to weigh the cost of cloud adoption against the cost of running their current on-premises systems.

00:16For on-premises, TCO is associated with assessing the cost of static resources throughout their lifetime.

00:24However due to the dynamic nature of the cloud, predicting future costs can be challenging.

00:29A common mistake that organizations make when attempting to calculate cloud TCO is to directly compare the running costs of the cloud against their on-premises system.

00:40These costs are not equivalent.

00:42The cost of on-premises infrastructure is dominated by the initial purchase of hardware and software, but cloud computing costs are based on monthly subscriptions or pay-per-use models.

00:54It's also important to consider all the operational costs of running your own data center, such as power, cooling, maintenance, and other support services.

01:03A data center is a building or facility that houses a large amount of IT infrastructure, computing, and storage resources in one place.

01:13Finally, intangible costs, such as the opportunity cost of not migrating to cloud and the missed benefits, should be considered.

Capital expenditures (CapEx) versus operating expenses (OpEx)

One area where cloud differs from traditional IT is in how managing costs changes when you move to the cloud.

00:07With organizations moving from on-premises infrastructure to on-demand cloud services, there's a major shift in spending from capital expenditures to operating expenses.

00:18But what's the difference between these two?

00:21Capital expenditures, or CapEx, are **upfront business expenses put toward fixed assets**.

00:28Organizations buy these items once, and they benefit their business for many years.

00:33For example, **in IT, these expenditures might mean buying hardware like servers, printers, or cooling systems**.

00:41Maintaining these assets is also considered CapEx because it extends their lifetime and usefulness.

00:47Small businesses can find CapEx spending

challenging because large **one-time purchases are often high cost.**

00:54The more money you put toward CapEx means less free cash flow for the rest of the business.

01:00And then there are operating expenses, or **OpEx, which are recurring costs for a more immediate benefit.**

01:06This represents the **day-to-day expenses to run a business.**

01:11In IT, these expenses might be yearly services like website hosting or domain registrations, or the subscription fee for cloud services.

01:20OpEx covers the spendings on **pay-as-you-go items, but are not considered major long-term investments like CapEx items.**

01:28Understanding the difference between CapEx and OpEx is helpful in recognizing how costs differ between on-premises and the public cloud.

01:35In the on-premises CapEx model, cost management and budgeting are a one-time operational process completed annually.

01:44Data centers require a huge CapEx investment up front as organizations purchase space, equipment, and software and hire a workforce to run and maintain everything.

01:56Forecasting is based on a metric such as historic growth to determine the needs for the next month, quarter, year, or even multiple years.

02:06Moving to cloud's **on-demand OpEx model enables organizations to pay only for what they use and only when they use it.**

02:15Budgeting is no longer a one-time operational process completed annually.

02:20Instead, spending must be monitored and controlled on an ongoing basis due to the dynamic nature of cloud use within organizations.

02:29How infrastructure is procured has radically changed, too.

02:32In a more decentralized cloud world, any employee can create resources in seconds on infrastructure owned and managed by a cloud provider.

02:41Organizations save on power, cooling, and floor space; they save on management because they don't have to install, operate, upgrade, and troubleshoot it themselves.

02:52And they're not depreciating the equipment—the cloud provider is.

02:57Cloud gives organizations the ability to start small and grow organically instead of having to guess at what is needed next week, next month, and next year.

03:07Costs match actual usage and are now operational expenses.



Capital expenditures
(CapEx)

Upfront business expenses
put toward fixed assets



Operating
expenses
(OpEx)

Recurring costs for a more
immediate benefit

Organizations save on:

- Power
- Cooling
- Floor space
- Management

Private cloud, hybrid cloud, and multi-cloud strategies

It's not always possible, or necessary, for an organization to rely solely on the cloud.

00:06For example, requirements might call for on-premises infrastructure to work with public cloud services provided by companies, like Google Cloud.

00:15With the availability of different cloud options and configurations, it's important to understand what each means.

00:21Let's explore the definitions of private, hybrid, and multi-cloud, and when an organization might choose each approach.

00:30Let's begin with private cloud, which is when an

organization has virtualized servers in its own
00:35data centers, or those of a private cloud provider,
to create its own private dedicated environment.

00:44On-premises servers are also often referred to
as private clouds, but generally the distinction can be
made

00:49that on-premises software runs in a local
environment, whereas a private cloud is accessed
through the internet.

00:56Private cloud computing gives an organization
many of the benefits of a public cloud — including self-
service, scalability, and elasticity — with more
customization available than from dedicated on-premises
infrastructure.

01:10This approach is often used when an
organization has already made significant
infrastructure investments, or if, for regulatory reasons,
data must be kept on-premises.

01:21In contrast, a hybrid cloud is one in which
applications are running in a combination of different
environments.

01:28The most common example is combining a
private and public cloud environment, like an on-
premises data center, and a public cloud computing
environment like Google Cloud.

01:38Finally, there's multicloud, which describes
architectures that combine at least two public cloud
providers, such as Google Cloud, Amazon Web
Services, Microsoft Azure, or others.

01:52An organization might choose multicloud if they
want to take advantage of the key strengths of
different public cloud providers.

01:59Organizations may also operate a combination of
on-premises and multiple public cloud environments,
effectively being both hybrid and multicloud
simultaneously.

02:09A hybrid cloud approach is one of the most
common infrastructure setups today because
organizations can continue to use their on-premises
servers while also taking advantage of public cloud.

02:20According to Gartner, 81% of organizations are
working with two or more public cloud providers.

02:27Additionally a Flexera state of the cloud report
showed 93% of enterprises have a multicloud strategy.

02:35So, what is a hybrid or multicloud strategy used
for?

02:41Let's explore some different business
requirements, drivers, and use cases that lead an
organization to choose this kind of approach.

02:50Access to the latest technologies Running
workloads in multiple clouds empowers organizations
to leverage the latest innovations and capabilities from
02:58each cloud provider, thus taking a best-in-class
approach to cloud features and obtaining the scale,

security, and agility to innovate fast.

03:09Cloud can help organizations build out capabilities, such as advanced analytics services, that might be difficult, or impossible, to implement in existing environments Modernize at the right

03:21pace With a hybrid cloud, organizations can migrate applications to the cloud at the pace that makes sense for their business and transform their technical infrastructure over time.

03:33Improved return on investment By adding a public cloud provider to their existing on-premises infrastructure, organizations can expand their cloud computing capacity without increasing their data center expenses.

03:47This can help reduce CapEx or general IT spending, and improve transparency regarding costs and resource consumption.

03:55Flexibility through choice of tools Hybrid and multi-cloud strategies have advantages for organizations as a whole, but specifically

04:02benefit development teams that are working on different projects and tackling unique challenges across different lines of business.

04:10A wider choice of tools and developer talent can be applied to a particular business problem, which means responding better to changing market demands.

04:18It also avoids vendor lock-in concerns.

04:23Improve reliability and resiliency Organizations can distribute core workloads across multiple cloud and on-premises infrastructures to reduce downtime and concerns about over-dependence on a single source of failure.

04:37This approach can improve the quality and availability of a service.

04:42Maintain regulatory compliance Many industries have rules from governmental or regulatory bodies regarding where their app can operate.

04:50Adopting a hybrid solution is an effective way for an organization to ensure compliance with regional data governance, residency, or digital sovereignty requirements.

05:03Running apps on-premises Organizations may have regulated applications that must remain on-premises or mainframe systems that are difficult to move to the cloud.

05:13A hybrid approach provides the freedom to innovate while still meeting And finally, running apps at remote edge locations Organizations in

05:25industries that run distributed apps at remote locations, such as kiosks in retail or networks in telecom, can benefit from hybrid cloud.

05:35These apps often require improved performance and low latency, and a hybrid approach lets them run

select apps at the network edge.

what is a hybrid or multicloud strategy used for?

01 Access to the latest technologies

- Best-in-class approach to cloud features
- Scale, security, and agility to innovate fast
- Advanced capabilities

02 Modernize at the right pace

- Migrate at a pace that makes sense
- Transform technical infrastructure over time



03 Improved return on investment

- Expand cloud computing capacity without increasing data center expenses
- Reduce CapEx or general IT spending
- Improve transparency



04 Flexibility through choice of tools

- Wider choice of tools and developer talent
- Better response to changing market demands
- Avoid vendor lock-in concerns



05

Improve reliability and resiliency

- Distribute core workloads across multiple cloud and on-premises infrastructures
- Reduce downtime
- Reduce concerns about over-dependence on a single source of failure
- Improve quality and availability of a service



06

Maintain regulatory compliance

- Ensure compliance with regional data governance, residency, or digital sovereignty requirements



07

Running apps on-premises

- Freedom to innovate while still meeting legacy technology needs

08

Running apps at remote edge locations

- Meet performance and latency requirements
- Run select apps at the network edge



Network performance Bandwidth and latency

- A measure of how much data a network can transfer in a given amount of time
- It's measured in megabits per second (Mbps) or gigabits per second (Gbps)
- A higher bandwidth allows a computer to download information more quickly



Bandwidth



- The amount of time it takes for data to travel from one point to another
- Measured in milliseconds
- Describes delays in communication over a network

Latency

No matter how much data you can send and receive at once, it can only travel **as fast as network latency allows.**

k

1.

Which network performance metric describes the amount of data a network can transfer in a given amount of time?

Fiber optics

Domain Name System (DNS)

Latency

checkBandwidth

That is the correct answer!

check

2.

An organization wants to ensure they have redundancy of their resources so their application remains available in the event of a disaster. How can they ensure this happens?

By putting resources in the Domain Name System (DNS).

checkBy putting resources in different zones.

By assigning a different IP address to each resource.

Using the edge network to cache the whole application image in a backup.

That is the correct answer!

check

3.

An organization wants to innovate using the latest technologies, but also has compliance needs that specify data must be stored in specific locations. Which cloud approach would best suit their needs?

Public Cloud
On-premises infrastructure
checkHybrid Cloud
Multicloud
That is the correct answer!

check

4.

An organization has shifted from a CapEx to OpEx based spending model. Which of these statements is true?

checkThey will only pay for what they use.

They will only pay for what they forecast.

Budgeting will only happen on an annual basis.

Hardware procurement is done by a centralized team.

That is the correct answer!

check

5.

A financial services organization has bank branches in a number of countries, and has built an application that needs to run in different configurations based on the local regulations of each country. How can cloud infrastructure help achieve this goal?

Reliability of the infrastructure availability.

Total cost of ownership of the infrastructure.

Scalability of infrastructure to needs.

checkFlexibility of infrastructure configuration.

That is the correct answer!

Cloud Computing Models and Shared Responsibility

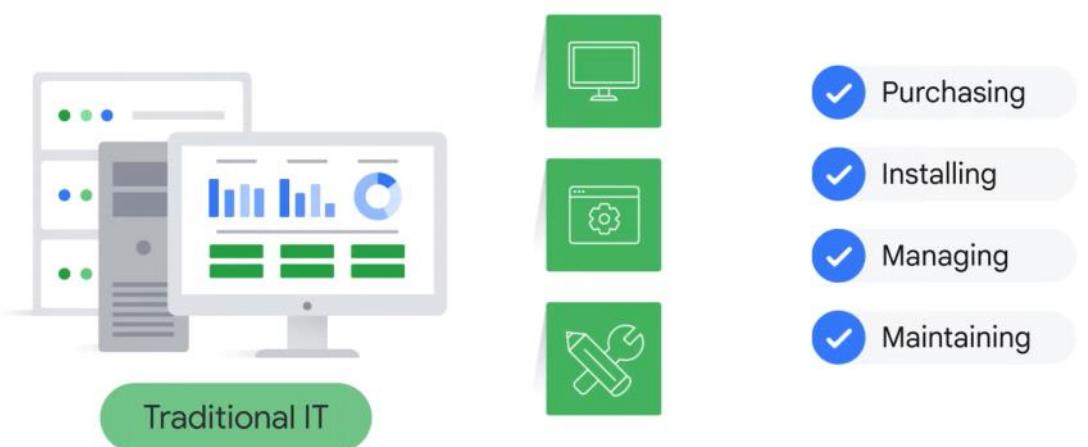
Introduction to cloud computing models and shared responsibility

Cloud Digital Leader Learning Path > Digital Transformation with Google Cloud > Cloud Computing Models and Shared Responsibility

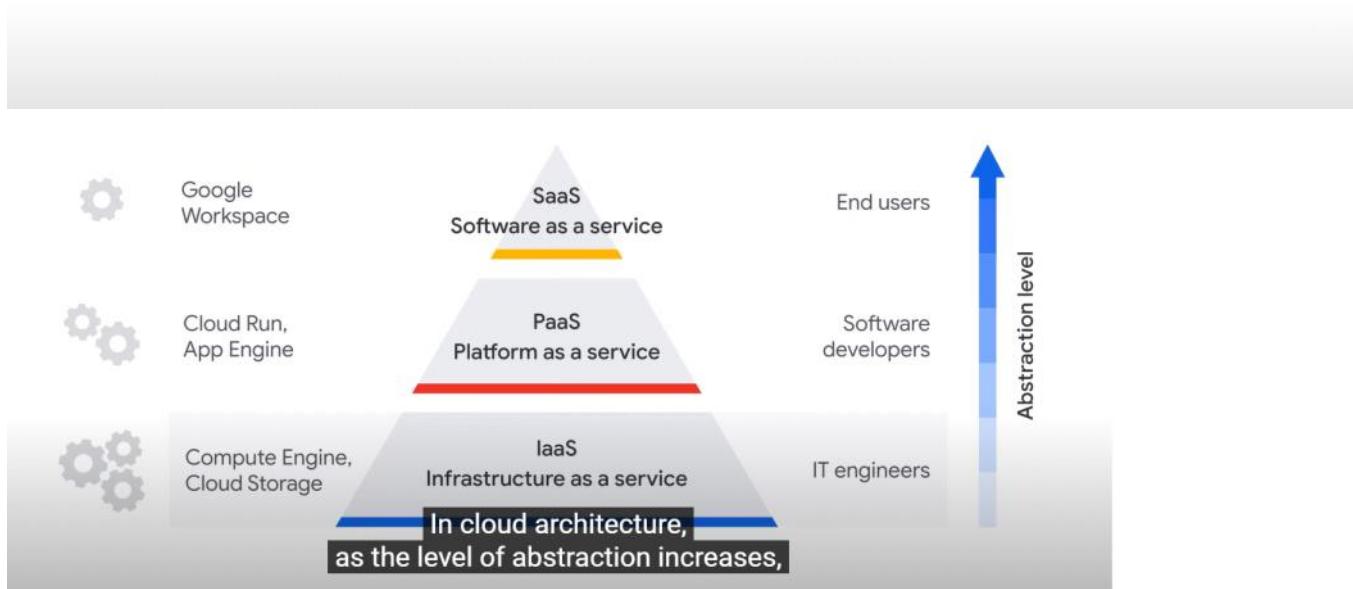


- Define IaaS, PaaS, and SaaS
- Compare and contrast the benefits and tradeoffs of IaaS, PaaS, and SaaS
- Determine which computing model applies to various use cases
- Describe the cloud shared responsibility model
- Identify responsibilities of the cloud provider and the customer

Cloud computing service models



Cloud computing allows for a **third party** to **be responsible** for **some part** of the infrastructure





On-premises

- Like owning a car
- Responsible for its usage and maintenance
- To upgrade you buy a new car, which takes time and can be costly



IaaS

- Like leasing a car
- You choose a car and drive it wherever you want
- The car isn't yours
- To upgrade you can just lease a new car



PaaS

- Like taking a taxi
- You provide specific directions
- The driver does the actual driving



SaaS

- Like going by bus
- You still get access to transport, but it's less customizable
- Buses have designated routes
- You share the space with other passengers

The world of cloud computing has a diverse set of computing service models to choose from, depending on customer requirements.

00:07You might have heard of terms like IaaS, PaaS and SaaS.

00:11These terms represent the different cloud computing models provided “as a service” by cloud providers.

00:17“As a service” refers to the way IT resources are consumed in these models, and is a key difference between cloud computing and traditional IT.

00:26In traditional IT, an organization consumes resources, such as hardware, software, and development tools, by purchasing, installing, managing, and maintaining them in its own on-premises or self-managed data center.

00:42Organizations are responsible for all of their IT infrastructure when it's completely on-premises.

00:46In cloud computing, the cloud service provider owns, manages, and maintains the resources.

00:54The customer consumes those resources, which are provided on a subscription or pay-as-you-go basis.

00:59All you need is an internet connection.

01:04Cloud computing allows for a third party to be responsible for some part of the infrastructure.

01:08This means that organizations then have more time to focus on their core business.

01:14Coming up, we're going to explore three different cloud computing service models: Infrastructure as a service, or IaaS, which offers infrastructure resources such as compute and storage.

01:26Platform as a service, or PaaS, which offers a develop-and-deploy environment to build cloud apps.

01:33And software as a service, or SaaS, which delivers complete applications as services.

01:40Each model offers distinct features and functionalities, and knowing the differences between

them helps organizations choose one to best fit their business' needs.

01:48It's important to remember that most organizations that use cloud often use a combination of cloud computing models to solve for different needs.

01:57You can visualize these cloud computing models in layers.

02:01As you move up the layers from one model to another, each model requires less knowledge and management of the underlying infrastructure.

02:08This concept is called abstraction.

02:11In cloud architecture, as the level of abstraction increases, less is known about the underlying implementation.

02:17The goal of "abstracting away" infrastructure is to reduce complexity by removing unnecessary information and simplifying operations.

02:27Think about abstraction in the way that you operate a car.

02:31When you turn on the ignition, press the brake, put the car into gear, and accelerate, you're not thinking about how the engine is physically operating under the hood, right?

02:40That complexity is abstracted away from you, so you can focus on driving safely to your destination.

02:47Abstraction is one of the core features of cloud computing.

02:51When choosing between cloud computing service models, organizations must decide the level of control and management

02:55they'll require, or how much they want to hide technical details and focus on business needs.

03:02Let's use a transportation analogy to see how on-premises, IaaS, PaaS, and SaaS compare with each other.

03:09On-premises IT infrastructure is like owning a car.

03:14When you buy a car, you're responsible for its usage and maintenance.

03:18Upgrading means buying a new car, which takes time and can be costly.

03:23IaaS is like leasing a car.

03:26When you lease a car, you choose a car and drive it wherever you want, but the car isn't yours.

03:32Upgrading is easier though, as you can just lease a new car.

03:36PaaS is like taking a taxi.

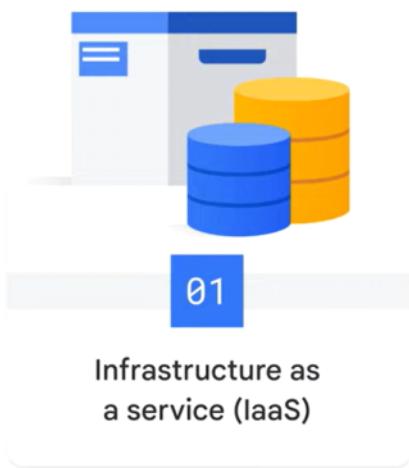
03:39You provide specific directions, like the code, but the driver does the actual driving.

03:45And SaaS is like going by bus.

03:48You still get access to transport, but it's less customizable.

03:52Buses have designated routes, and you share the space with other passengers.

IAAS



Infrastructure as
a service (IaaS)

Compute

Networking

Storage

Databases

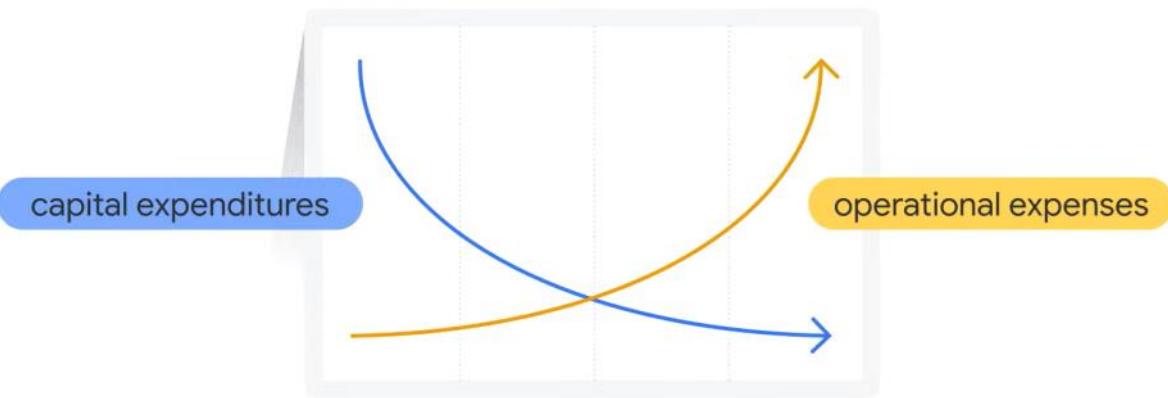


Infrastructure as
a service (IaaS)

Lease resources

Only pay for what is used

IaaS provides the **same technologies** and **capabilities** as a traditional data center without having to physically **maintain** or **manage** all of it

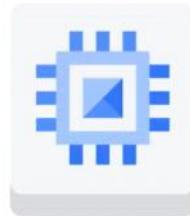


- Offered as individual services
- Infrastructure managed by cloud provider
- Businesses can concentrate on software operations and data security

configuring,
and managing software and keeping their data



IaaS



Compute
Engine



Cloud
Storage



Create and run
virtual machines



Store any
type of data

and you can store any type of data with Cloud
Storage.

Benefits of IaaS



Economical



Efficient



Boosts
productivity



Reliable



Scalable



Economical

- You only pay for what you use
- Costs are predictable and easy to budget for

IaaS costs are fairly predictable and easy to budget for.



Efficient

- Resources are available when you need them
- There are fewer delays
- Resources aren't wasted by overbuilding capacity
- Faster development and a faster time to market



Boosts productivity

- IT departments save time and money
- Redirect resources to more strategic activities



Reliable

- No single point of failure
- Service remains available



Traditional IT

- Procurement processes
- Physical spaces
- IT professionals
- Challenging to scale



Scalable

- Scale the resources up and down rapidly

- Scale according to business needs



IaaS

- Unpredictable workload volumes or need to move quickly in response to business fluctuations

- Require more infrastructure scalability and agility than traditional data centers can provide

- High business growth that outpaces infrastructure capabilities.



IaaS

- Unpredictable spikes in demand for infrastructure services

- Low utilization of existing infrastructure resources

Now let's look at each of these computing models in more detail.

[00:03](#) We'll start with infrastructure as a service, or IaaS.

[00:08](#) IaaS is a computing model that offers the on-demand availability of almost infinitely scalable

infrastructure resources, such as compute, networking, storage, and databases as services over the internet.

00:21IaaS allows organizations to lease the resources they need instead of having to buy hardware outright, and they only pay for what they use.

00:31It provides the same technologies and capabilities as a traditional data center without having to physically maintain or manage all of it.

00:40One of the main reasons businesses choose IaaS is to reduce their capital expenditures and transform them into operational expenses.

00:48IaaS is appealing because acquiring computing resources to run applications or store data the traditional way requires time and capital.

00:57Organizations must purchase equipment through procurement processes that can take months.

01:02They must also invest in physical spaces, which are typically specialized rooms with power and cooling.

01:08And after deploying the systems, they need IT professionals to manage them.

01:12This traditional way is challenging to scale when demand spikes or business grows.

01:19Organizations risk running out of capacity, or overbuilding and ending up with underutilized infrastructure.

01:25In contrast, IaaS resources are offered as individual services, so organizations can choose what they need.

01:32The cloud provider manages the infrastructure, and businesses can concentrate on installing, configuring, and managing software and keeping their data secure.

01:41Compute Engine and Cloud Storage are examples of Google Cloud IaaS products.

01:47You can create and run virtual machines with Compute Engine, and you can store any type of data with Cloud Storage.

01:53So, what are the benefits of IaaS?

01:56It's economical.

01:59Because IaaS resources are used on demand and you only pay for what you use, IaaS costs are fairly predictable and easy to budget for.

02:06It's efficient.

02:08IaaS resources are regularly available when you need them.

02:12As a result, there are fewer delays when infrastructure is expanded resources aren't wasted by overbuilding capacity.

02:19This efficiency leads to faster development lifecycles and ultimately a faster time to market.

02:24It boosts productivity.

02:27Because the cloud provider is responsible for setting up and maintaining the physical infrastructure, IT departments save time and money.

02:35They can then redirect resources to more strategic activities.

02:39It's reliable.

02:41IaaS has no single point of failure.

02:44Even if one component of the hardware resources fails, the service usually remains available.

02:49And it's scalable.

02:51One of the biggest advantages of IaaS in cloud computing is the capability to scale the resources up and down rapidly according to business needs.

02:59So, what scenarios would IaaS be good for?

03:04The flexibility and scalability of IaaS is useful for organizations that: Have unpredictable workload volumes or need to move quickly in response to business fluctuations.

03:14Require more infrastructure scalability and agility than traditional data centers can provide.

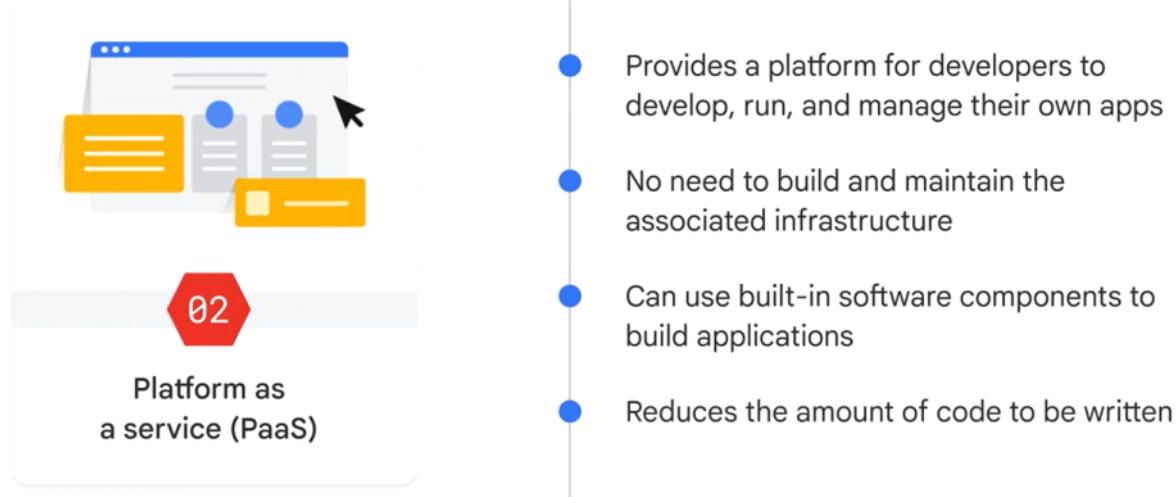
03:20Have high business growth that outpaces infrastructure capabilities.

03:24Experience unpredictable spikes in demand for infrastructure services.

03:28And see low utilization of existing infrastructure resources.

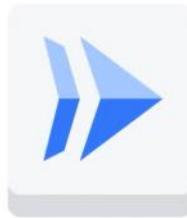
From <https://www.cloudskillsboost.google/parts/9/course_templates/266/video/457034>

PAAS





02

Platform as
a service (PaaS)

Cloud Run

Serverless
platformDevelop and host
applications

BigQuery

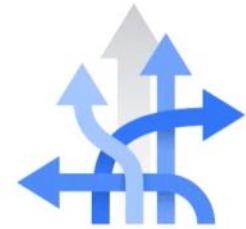
Enterprise data
warehouseManage and
analyze data

warehouse that manages and analyzes data,
and can be queried to answer big data questions

Benefits of PaaS

Reduces
development
time

Scalable

Reduces
management

Flexible

with zero infrastructure management.
So, what are the benefits of PaaS?

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Reduces development time

- Developers can go straight to coding
- No need to spend time setting up and maintaining a development environment
- Faster time to market

faster time to market.
which leads to faster time to market.



Scalable

- Organizations can purchase additional capacity for building, testing, staging, and running applications whenever they need it
- Take advantage of the scalability of cloud infrastructure

It also allows for applications to be designed
to take advantage of the inherent scalability



Reduces
management

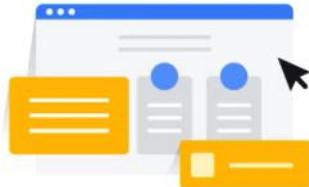
- Abstracts the management
- Cost-effective way to focus on new functionality

on new functionality.
And it's flexible.



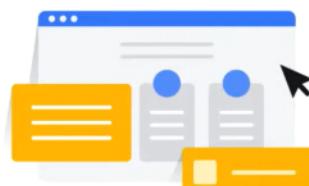
Flexible

- Support for different programming languages and easy collaboration for distributed teams
- Provides developers with the flexibility to deliver various projects on the same platform



PaaS

- Create unique and custom applications without investing in owning and managing infrastructure
- Rapidly test and deploy applications
- Have legacy applications and want to reduce the cost of operations
- Have a new app project that they want to deploy quickly by growing and updating the app as fast as possible



PaaS

- Want to only pay for resources while they're being used
- Want to offload time-consuming tasks such as setting up and maintaining application servers and development and testing environments

Platform as a Service, or PaaS, is a computing model that offers a cloud-based platform for developing, running, and managing applications.

00:07PaaS provides a framework for developers that they can build upon and use to create customized applications.

00:16PaaS is appealing because it provides a platform for developers to develop, run, and manage their own apps without having to build and maintain the associated infrastructure.

00:25They can also use built-in software components to build their applications, which reduces the amount of code they have to write.

00:34Cloud Run and BigQuery are examples of Google Cloud PaaS products.

00:38Cloud Run is a fully managed, serverless platform for developing and hosting applications at scale, which takes care of provisioning servers and scaling app instances based on demand.

00:50BigQuery is a fully managed enterprise data warehouse that manages and analyzes data, and can be queried to answer big data questions with zero infrastructure management.

01:01So, what are the benefits of PaaS?

01:06It reduces development time.

01:07Developers can go straight to coding instead of spending time setting up and maintaining a development environment, which leads to faster time to market.

01:14which leads to faster time to market.

01:17It's scalable.

01:18With PaaS, organizations can purchase additional capacity for building, testing, staging, and running applications whenever they need it.

01:27It also allows for applications to be designed to take advantage of the inherent scalability of cloud infrastructure.

01:33It reduces management.

01:35By abstracting the management of underlying resources even further than IaaS, PaaS offloads infrastructure management, patches, updates, and other administrative tasks to the cloud service

provider.

01:45This provides a cost-effective way to focus on new functionality.

01:51And it's flexible.

01:53With support for different programming languages and easy collaboration for distributed teams, PaaS provides developers with the flexibility to deliver various projects—from prototypes to enterprise solutions—on the same platform.

02:05So, what scenarios would PaaS be good for?

02:10PaaS is suitable for organizations that: Want to create unique and custom applications without investing a lot in owning and managing infrastructure.

02:19Want to rapidly test and deploy applications.

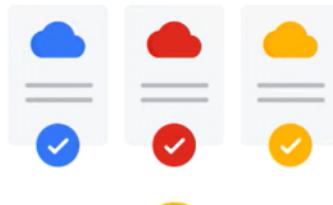
02:22Have many legacy applications and want to reduce the cost of operations.

02:27Have a new app project that they want to deploy quickly by growing and updating the app as fast as possible.

02:33Want to only pay for resources while they're being used.

02:36And want to offload time-consuming tasks such as setting up and maintaining application servers and development and testing environments.

SAAS



03

Software as
a service (SaaS)

- Abstracts technology completely from the consumer
- The end user doesn't need to care about the underlying infrastructure
- Organizations pay a subscription fee for access to a ready-to-use software product

Organizations simply pay a subscription fee for access to a ready-to-use software product.

Benefits of SaaS



Low
maintenance



Cost-effective



Flexible



Low maintenance

- Eliminates the need to have IT staff download and install applications
- Vendors manage all potential technical issues
- Helps to streamline maintenance and support for an organization

This helps to streamline maintenance and support for an organization.



Cost-effective

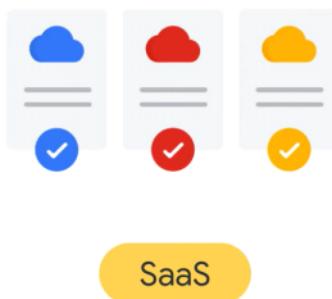
- Fixed monthly or annual account fee
- Predictable costs and per-user budgeting
- Clear financial governance



Flexible

- Everything is available over the internet
- Access to the software from anywhere, any device, anytime

They can access the software from anywhere, any device, anytime.



- Want to use standard software solutions that require minimal customization
- Don't want to invest time or internal expertise in maintaining applications or infrastructure
- Need more time for IT teams to focus on strategic projects
- Need to access apps from various devices and locations

And need to access apps from various devices and locations.

Software as a service, or SaaS, is a computing model that offers an entire application, managed by a cloud provider, through a web browser.

00:09 The cloud provider hosts the application software in the cloud and delivers it through a browser.

00:15 With this model, you don't need to download or install any of it.

00:19 SaaS is appealing because it abstracts technology completely from the consumer; SaaS is appealing because it abstracts technology completely

00:23 from the consumer; the end user doesn't need to care about the underlying infrastructure, which is the cloud provider's responsibility.

00:30 Organizations simply pay a subscription fee for access to a ready-to-use software product.

00:36 Google Workspace, which includes tools such as Gmail, Google Drive, Google Docs, and Google Meet, is a Google Cloud SaaS product.

00:44 So, what are the benefits of SaaS?

00:47 It's low maintenance.

00:49 SaaS eliminates the need to have IT staff download and install applications on each individual computer.

00:55 With SaaS, vendors manage all potential technical issues, such as data, servers, storage, and updates in the cloud.

01:03 This helps to streamline maintenance and support for an organization.

01:07 It's cost-effective.

01:09 SaaS is based on a subscription model with a fixed, inclusive, monthly or annual account fee.

01:14 Predictable costs and per-user budgeting allows for clear financial governance.

01:20 It's flexible.

01:21 Everything is available over the internet when a user signs in to their personalized account online.

01:26 They can access the software from anywhere, any device, anytime.

01:31 And what scenarios would SaaS be good for?

01:32 Well, SaaS is suitable for organizations that:

Want to use standard software solutions that require minimal customization.

01:39 Don't want to invest time or internal expertise in maintaining applications or infrastructure.

01:46 Need more time for IT teams to focus on strategic projects.

01:50 And need to access apps from various devices and locations.



IaaS



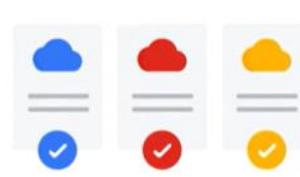
A highly flexible, scalable service, while maintaining control of infrastructure.



PaaS



A platform designed for building software products.



SaaS

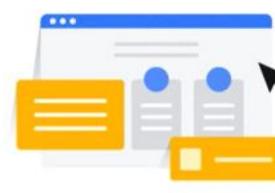


Ready to use features, without the hassle of installations.

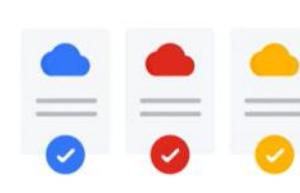
SaaS might be the best option.

[Watch on YouTube](#)

IaaS



PaaS



SaaS

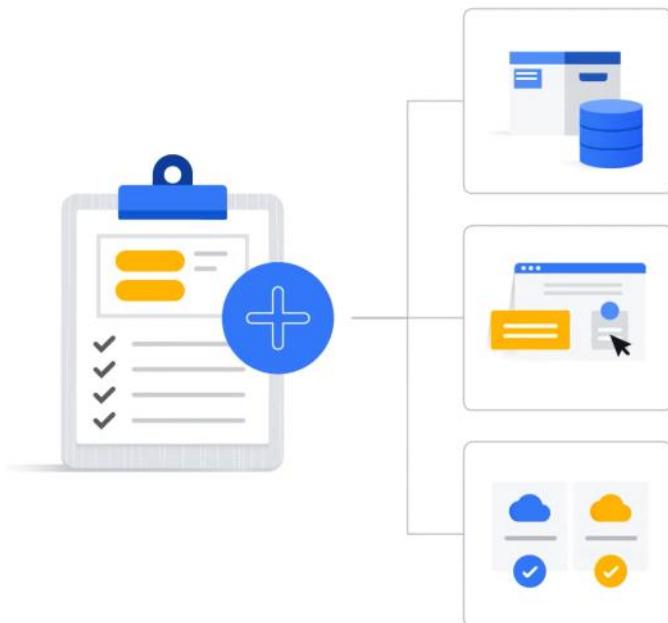
Business needs

Required functionality

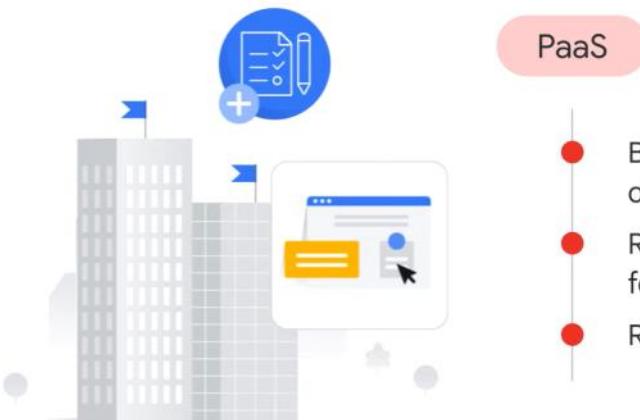
Available expertise

required functionality,
and available expertise.

- ✓ Management level
- ✓ Control
- ✓ Responsibility
- ✓ Flexibility
- ✓ Expertise needed



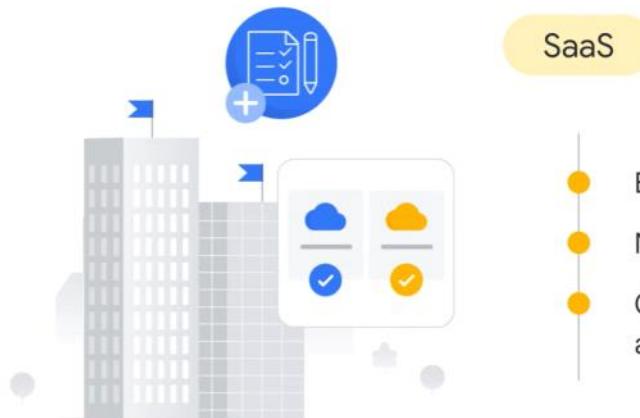
but also bear the burden of managing and maintaining them.



PaaS

- Build a custom CRM application while offloading management of infrastructure
- Retain complete control over application features
- Reduce management load

but reducing the management load.



SaaS

- Buy a ready-made solution
- No daily management of infrastructure
- Give up all control over software features and functionality

having no daily management of infrastructure,
, but also giving up all control over features

So, how does an organization decide which cloud computing model is the best option for them?

[00:07](#)The answer depends on their business needs, required functionality, and available expertise.

[00:11](#)If they are looking for a highly flexible, scalable service—while maintaining control of their infrastructure—then IaaS is the right choice.

[00:21](#)This model offers the most control and customization, but also requires the most management responsibilities and technical expertise.

[00:27](#)If they need a platform designed for building software products, then PaaS would help their business immediately.

[00:34](#)This provides a cost-effective way to build applications, but still requires some technical expertise and less management.

[00:42](#)If they want features that are ready to use, without the hassle of installations, then SaaS might be the best option.

[00:48](#)This represents the least management responsibilities and technical expertise, but also offers the least control and customization.

[00:56](#)These computing models are not mutually exclusive, though.

01:00Depending on the use case, most organizations will use combinations of all three to solve for different business needs.

01:06They'll need to compare their options based on variables such as management level, control, responsibility, flexibility, and expertise needed.

01:17For example, imagine a large organization needs to implement a new inventory management system.

01:23If they had the in-house expertise to develop it and the willingness to manage the infrastructure, they could build this with IaaS resources.

01:31The organization's IT team would have complete control over server configurations, but also bear the burden of managing and maintaining them.

01:39They could choose a PaaS solution and build a custom CRM application while offloading management of

01:43infrastructure to the cloud service provider; retaining complete control over application features, but reducing the management load.

01:52Finally they could choose to buy a ready-made SaaS solution; having no daily management of infrastructure, , but also giving up all control over features and functionality in the software.

02:03Each of these options is a viable solution, so organizations must compare the benefits and tradeoffs for each use case.

02:11These cloud computing service models give organizations choices, flexibility, and options that on-premises hosting simply can't provide.

Security

Security in the cloud is a **shared responsibility** between the **cloud provider** and the **customer**



Security *of* the cloud

Cloud provider



Security *in* the cloud

Customer

while the customer is responsible for security
in the cloud.

One area of responsibility where each of the cloud computing models differ is security.

00:06When an organization manages its data in its own data centers, that organization is responsible for all aspects of its security.

00:14However, as infrastructure is moved to the cloud, some aspects of the responsibility shift to the cloud provider.

00:20This concept is called the shared responsibility model.

00:25Security in the cloud is a shared responsibility between the cloud provider and the customer.

00:30Although direct responsibilities change based on the cloud computing service model, organizations are always in

00:35control of securing their data, and the cloud provider is always responsible for securing the infrastructure.

00:42At Google Cloud, we defend organizations' data against threats and fraudulent activity with the same infrastructure and security services we use for our own operations.

00:51However, security of the cloud and security in the cloud are two different things.

00:57Simply put, the cloud provider is responsible for the security of the cloud, while the customer is responsible for security in the cloud.

01:07It's important for organizations to understand how the specific customer responsibilities vary according to the type of cloud computing model used.

01:15This is especially important because, according to a Gartner report, 99% of all cloud security failures will result from user error through the year 2025.

01:27Organizations must understand their roles and responsibilities in cloud security to guarantee it.

How the shared responsibility model works



provider's responsibility ends and where
the customer's responsibility begins.

If **you** configure or store it,
you're responsible for securing it.

 Google Responsibility

 Customer Responsibility

	On-prem	IaaS	PaaS	SaaS
Content				
Access Policies				
Usage				
Deployment				
Web App security				
Identify				
Operations				
Access and authentication				
Network security				
Guest OS, data & content				
Audit logging				
Network				
Storage + encryption				
Hardened Kernel + IPC				
Boot				
Hardware				
Physical security				

is responsible for, while the yellow squares represent the elements that Google Cloud is

Customers are always responsible for the security of their data.

If you look at the various cloud computing models together, you can see where the cloud provider's responsibility ends and where the customer's responsibility begins.

00:08A general guideline for shared responsibility is that "if you configure or store it, you're responsible for securing it."

00:16This generally means that a cloud provider is responsible for securing the parts of the cloud that it directly controls, such as hardware, networks, and physical security.

00:26At the same time, the customer is responsible for securing anything that they create within the cloud, such as the configurations, access policies, and user data.

00:37No matter which cloud provider you use, there is shared responsibility.

00:41Let's examine the ratios of responsibility between Google Cloud as a service provider and our customers.

00:48The blue squares represent the parts of the infrastructure security that the customer is responsible for, while the yellow squares represent the elements that Google Cloud is responsible for.

00:58Let's begin with on-premises.

01:01 When an organization runs its own on-premises data centers, security for the infrastructure is solely the responsibility of the organization's internal teams.

01:10 They are responsible for securing servers and the data stored on them.

01:15 Next is infrastructure as a service.

01:18 When an organization transitions to an IaaS computing model, it assigns some IT security responsibilities to Google Cloud.

01:25 This includes being responsible for the physical resources and sharing responsibility with the customer for the security of the infrastructure and network.

01:34 The rest, such as the security of the operating system, software stack required to run their applications, and their data, is the responsibility of the customer.

01:44 This allows customers the most freedom and control, but also places most of the responsibility in their hands.

01:51 When an organization uses the platform as a service model, more of the responsibility is passed over to Google Cloud.

01:57 This includes full responsibility for the physical infrastructure, the access and authentication, network security, and guest operating systems.

02:06 The customer is still responsible for the security of any content, such as code or data, produced on the platform.

02:15 Lastly, with the software as a service model, Google Cloud is responsible for almost every aspect of security—from the underlying infrastructure to the actual application.

02:25 Customers still have some security responsibilities, such as application usage, access policies like authentication settings to prevent phishing attacks, and the user content.

02:36 One important aspect of the shared responsibility model is that customers are always responsible for the security of

02:41 their data, whether they have on-premises data centers or only pay a monthly subscription for a single user license.

02:48 The customer controls who or what has access to their data.

02:53 Google Cloud is committed to keeping customers' data secure, but security is a shared responsibility, and requires collaboration.

1.

In the cloud computing shared responsibility model, what types of content are customers always responsible for, regardless of the computing model chosen?

check The customer is responsible for securing anything that they create within the cloud, such as the configurations, access policies, and user data.

The customer is responsible for all infrastructure decisions, server configurations and database monitoring.

The customer is not responsible for any of the data in the cloud, as data management is the responsibility of the cloud provider who is hosting the data.

The customer is responsible for security of the operating system, software stack required to run their applications and any hardware, networks, and physical security.

That is the correct answer!

check

2.

Which option best describes a benefit of Infrastructure as a Service (IaaS)?

check It's efficient, as IaaS resources are available when needed and resources aren't wasted by overbuilding capacity.

It reduces development time, as developers can go straight to coding instead of spending time setting up and maintaining a development environment.

It's cost-effective, as all infrastructure costs are handled under a

single monthly or annual subscription fee.

It has low management overhead, as all administration and management tasks for data, servers, storage, and updates are handled by the cloud vendor.

That is the correct answer!

check

3.

Which cloud computing service model offers a develop-and-deploy environment to build cloud applications?

checkPlatform as a Service (PaaS)

Infrastructure as a Service (IaaS)

Function as a Service (FaaS)

Software as a Service (SaaS)

That is the correct answer!

check

4.

An organization wants to move their collaboration software to the cloud, but due to limited IT staff one of their main drivers is having low maintenance needs. Which cloud computing model would best suit their requirements?

IT as a service (ITaaS)

checkSoftware as a Service (SaaS)

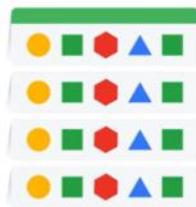
Infrastructure as a Service (IaaS)

Platform as a Service (PaaS)

That is the correct answer!

Exploring Data Transformation with Google Cloud

Unlocking business value from data



Structured data

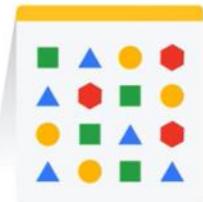
Highly organized and well-defined

Typically stored in a table

Examples: spreadsheet or database

Easy to analyze

customer relationship management tools,
or CRMs,



Semi-structured data

- Organized into a hierarchy
- Without full differentiation or order
- Examples: emails, HTML, JSON, XML
- Doesn't have a formal structure
- Contains tags for easier analysis

other markers that make it easier
to analyze than unstructured data.



Unstructured data

Categories

- Text, like documents and presentations
- Data files, like images, audio, and video
- Infrastructure activity and performance data

Data files like images, audio files, and
videos and infrastructure activity and



- Uses machine learning
- Detects products within a picture
- Labels the picture to describe its contents

Cloud Vision API

can then even label the picture to describe its contents.

Unlocking the value of data is central to digital transformation.

00:04To generate insights, you might need to combine different types of data.

00:08However, not all data is created and organized the same way.

00:13Data can be categorized into three main types, structured, semi-structured, and unstructured.

00:21Structured data is highly organized and well-defined.

00:24It's typically stored in a table with relationships between the different rows and columns, like in a spreadsheet or database.

00:31Because structured data is organized this way, it's easy to analyze.

00:36For example, it's common for organizations to use structured data and customer relationship management tools, or CRMs, as they follow customer behavior patterns and trends.

00:47Semi-structured data falls somewhere in between structured and unstructured data.

00:52It's organized into a hierarchy, but without full differentiation or any particular ordering.

00:58Examples include emails, HTML, JSON, and XML files.

01:04Although this data type doesn't have a formal structure, it contains tags or other markers that make it easier to analyze than unstructured data.

01:12Unstructured data is information that either doesn't have a predefined data model or isn't organized in a predefined manner.

01:19Categories include text, which is the most common and is often generated and collected from sources like documents, presentations, or even social

media posts.

01:31Data files like images, audio files, and videos and infrastructure activity and performance data like **01:37**log files from servers, networks, and applications or output data from Internet of things IoT sensors.

01:46Organizations can use unstructured data in many ways.

01:50For example, a marketing team might analyze social media posts to identify sentiment toward a brand.

01:57Or customer service teams might train automated chatbots to augment support staff by analyzing language in customer communications, and providing interactive responses.

02:07But in general, unstructured data has historically been difficult to analyze.

02:12According to the Harvard Business Review, on average, less than 1% of an organization's unstructured data is analyzed or used at all.

02:21Until recently, tools to tap the potential of unstructured data were either unavailable or prohibitively expensive and complex.

02:29What makes this statistic even more concerning is that, according to Gartner research, unstructured data represents 80% to 90% of all new enterprise data.

02:38This reveals a staggering gap between the data being generated and the value that it's providing.

02:44But Cloud technology has changed that.

02:47With the right Cloud tools, businesses can extract value from unstructured data by using machine learning

02:53to discover trends or even use application programming interfaces or APIs to extract structure from the data.

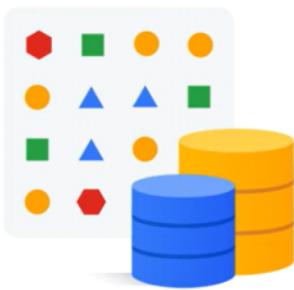
03:00An example of an API is Google Cloud's Vision API, which uses machine learning to

03:04detect products within a picture and can then even label the picture to describe its contents.

03:11Understanding the different types of data available can help organizations define what's possible with the data solutions they have.

03:19One of the transform powers of the Cloud is how it can unlock value from structured and the previously untapped unstructured data.

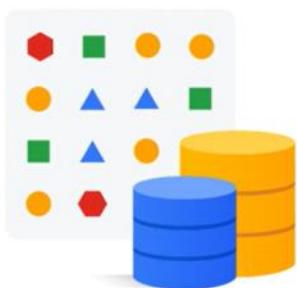
Data management concepts



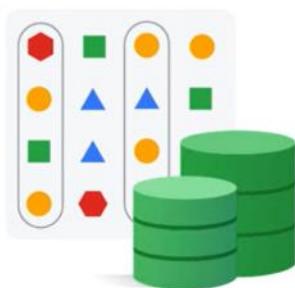
An organized collection of data stored in tables and accessed electronically from a computer system

Databases

accessed electronically
from a computer system.



Databases



Relational databases



Non-relational databases

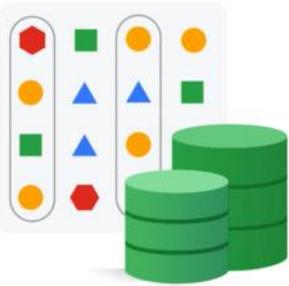
Let's examine two types of databases,
relational and nonrelational.



Relational databases



SQL



Relational databases

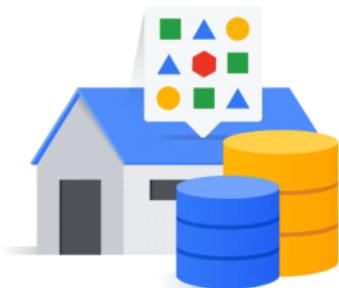
- ✓ Highly consistent and reliable
- ✓ Suited for large amounts of structured data
- ✓ Designed for business data processing
- ✓ Storing online transactional data



Non-relational databases
(NoSQL)

- ✓ Doesn't use a tabular format
- ✓ Follow a flexible data model
- ✓ Ideal for data with changing organization
- ✓ Ideal for applications with diverse data types

or for applications that



Data warehouse

An enterprise system used for the analysis and reporting of structured and semi-structured data from multiple sources

Business data:

- Point of sale
- Marketing automation
- CRM data

even customer relationship management data.



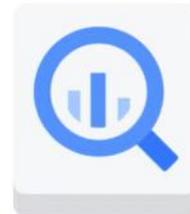
Data management concepts



Watch later Share

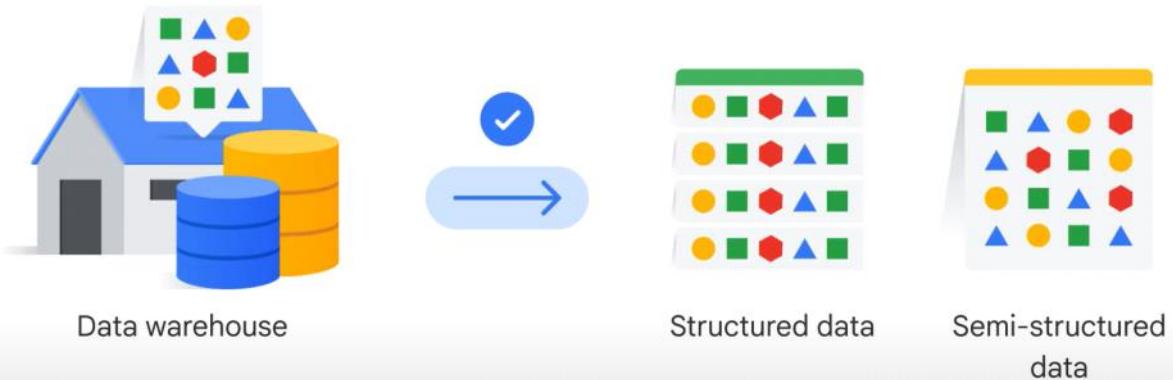


Data warehouse



BigQuery

We'll explore BigQuery in more detail later.



Although data warehouses handle structured and semi structured data,



Data lake

A repository designed to ingest, store, explore, process, and analyze any type or volume of raw data

- Operational systems
- Web sources
- Social media
- IoT

**web sources, social media or
Internet of things or IoT.**

Raw data



✗ Data contamination

✗ Adding bias

✓ Enriched with other data

Data lake

other data at the same time.

Raw data



Data lake

Structured data



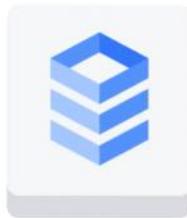
Data warehouse

cleaned and processed ready for

Structured data



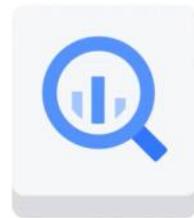
Data lake



Cloud SQL



Cloud
Spanner



BigQuery

storing structured data are Cloud SQL,
Cloud Spanner, or BigQuery.

Semi-structured data



Data lake

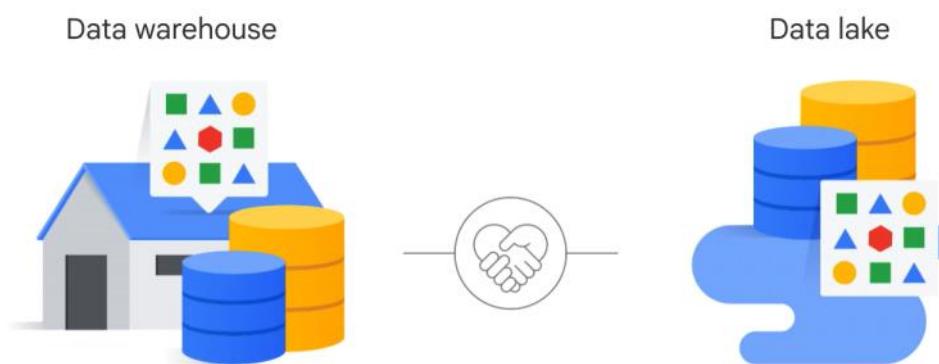
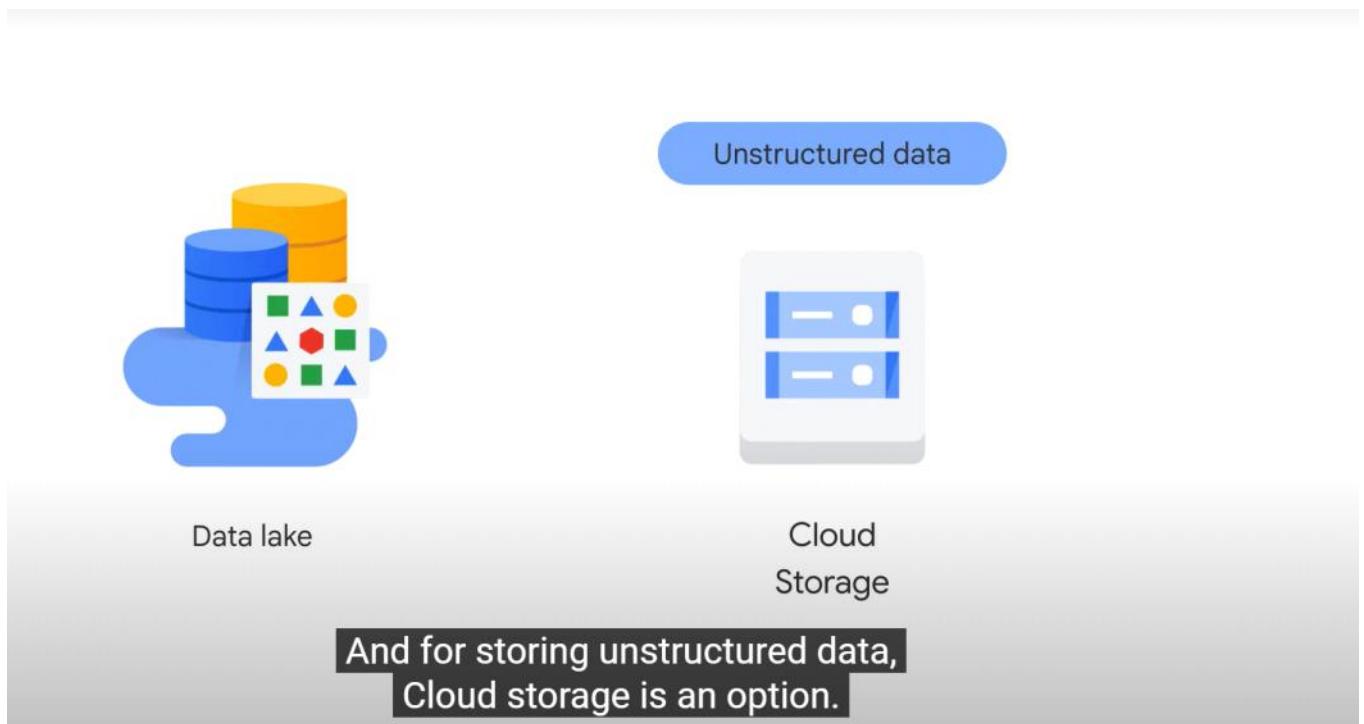


Datastore



Bigtable

For semi-structured data, the options
include Datastore and Bigtable.



Users - Business intelligence analysts
Goal - Use the data answer questions

Users - Business intelligence analysts, data engineers, and data scientists
Goal - Explore, mine, and experiment with raw data

Organizations need a modern approach to enterprise data to manage the vast volumes that are produced.

00:06The list of options often includes databases, data warehouses, and data lakes.

00:12Let's explore each of these options, starting with databases.

00:16A database is an organized collection of data stored in tables and accessed electronically from a computer system.

00:23Let's examine two types of databases, relational and nonrelational.

00:28A relational database stores and provides access to data points that are related to one another.

00:33This means storing information in tables, rows, and columns that have a clearly defined schema that represents the structure or logical configuration of the database.

00:43A relational database can establish links or relationships between information by joining tables, and structured query language or SQL can be used to query and manipulate data.

00:56Relational databases are highly consistent, reliable, and best suited for dealing with large amounts of structured data.

01:03They're designed for business data processing and storing the online transactional data needed to support the daily operations of a company.

01:11A nonrelational database, sometimes known as a NoSQL database, is less structured in format and doesn't use a tabular format of rows and columns like relational databases.

01:22Instead, nonrelational databases follow a flexible data model, which makes them ideal for storing data that changes its organization frequently, or for applications that handle diverse types of data.

01:35This includes when large quantities of complex and diverse data need to be organized, or when the data regularly evolves to meet new business requirements.

01:45Choosing the right database depends on the use case.

01:48Google Cloud relational database products include Cloud SQL and Cloud Spanner, while Bigtable is a non relational database product.

01:56We'll look at these products in more detail later.

02:00Let's explore another data management concept the data warehouse.

02:05Like a database, a data warehouse is a place to store data.

02:09However, while a database is designed to capture data for storage, retrieval, and use, a data warehouse is designed to analyze data.

02:19A data warehouse is an enterprise system used for the analysis and reporting of structured and semi-structured data from multiple sources.

02:27Think of the data warehouse as the central hub for all business data.

02:31Business data might include, point of sale transactions, marketing automation, or even customer relationship management data.

02:39Suited for both ad hoc analysis and custom reporting, a data warehouse can help analyze

02:44sales and identify trends because it can store both current and historical data in one place.

02:51This capability can provide a long range view of data over time, which makes a data warehouse a primary component of business intelligence.

03:00BigQuery is Google Cloud's data warehouse offering.

03:03We'll explore BigQuery in more detail later.

03:07Although data warehouses handle structured and semi structured data, they're not typically the answer for how to handle large amounts of available unstructured data like images, videos, and documents.

03:18Unstructured data which doesn't conform to a well-defined schema is often disregarded in traditional analytics.

03:26A data lake is a repository designed to ingest, store, explore, process, and analyze any type or volume of

03:34raw data, regardless of the source, like operational systems, web sources, social media or Internet of things or IoT.

03:45It can store different types of data in its original format, ignoring size limits and without much preprocessing or adding structure.

03:53Having this unprocessed raw data available for analysis prevents unintentionally contaminating the data or adding bias.

04:01It also means that raw data can be enriched by merging it with other data at the same time.

04:06This differs from a data warehouse that contains structured data that has been cleaned and processed ready for the strategic analysis based on predefined business needs.

04:16Data lakes often consist of many different products depending on the nature of the data that is ingested.

04:22For example, the best Google Cloud products for storing structured data are Cloud SQL, Cloud Spanner, or BigQuery.

04:30For semi-structured data, the options include Datastore and Bigtable.

04:35And for storing unstructured data, Cloud storage is an option.

04:40Data warehouses and data lakes should be considered complementary instead of competing tools.

04:46Although both store data in some capacity, each is optimized for different uses.

04:52Traditional data warehouse users are business intelligence analysts who are closer to the business and focus on driving insights from data.

05:00These users traditionally use the data to answer questions.

05:04Data lake users and also analysts include data engineers and data scientists.

05:10They're closer to the raw data with the tools and capabilities to explore, mine, and experiment with the data.

05:18These users find answers in the data, but they also find questions.

05:22 As enterprises are increasingly focus on data driven decision making, data warehouses and data lakes play a critical role in an organization's data transformation journey.

05:33 Democratization of data lets users gain a deeper understanding of business situations because they have more context than ever before.

05:41 Today, organizations need a 360 degree real time view of their businesses to gain a competitive edge.

[The role of data in digital transformation](#)

First-party data	Second-party data	Third-party data
The proprietary customer datasets that a business collects from customer or audience transactions and interactions	First-party data from another organization that can be easily deployed to augment a company's internal datasets	Datasets collected and managed by organizations that don't directly interact with an organization's customers or business



Government



Nonprofit



Academic



Analyst reports

Third-party data

Datasets collected and managed by organizations that don't directly interact with an organization's customers or business

Organizations have access to data like never before.

00:03 This includes both internal information called first-party data and external information, which is usually data about customers and industry, often called second or third-party data.

00:15 As organizations have digitized their operations, many types of business data have become available, including information about their customers.

00:25 First-party data is the proprietary customer

datasets that a business collects from customer or audience transactions and interactions.

00:33These datasets might include information about digital interactions, like the length of time a user spends at a web page.

00:41Second-party data often describes first-party data from another organization, such as a partner or other

00:47business in their supply chain that can be easily deployed to augment a company's internal datasets.

00:54The organization does not directly own this data, but it is relevant to their business.

01:00Finally, there is third-party data, which are datasets collected and managed by organizations that do not directly interact with an organization's customers or business.

01:10These datasets might come from government, nonprofit, or academic sources like weather or public demographic data, or from industry specific sources like analysts reports, or industry benchmarking.

01:24Third-party data is often shared or purchased on data marketplaces or exchanges such as the Google Cloud Marketplace.

01:31Using external data can greatly increase the value of data by providing new context and insights.

01:38Let's explore an example of how an airline transform their business through data.

01:43Budget airlines don't provide food as part of their service, instead they charge customers for meals if they want them.

01:50The solution might seem cost effective, but it can be difficult to estimate the number of meals required on board.

01:56If the airline overestimates the number of meals needed, they risk wasting food and losing revenue.

02:02But if they underestimate, they risk selling out of food, providing poor customer service, and losing potential revenue.

02:10One budget airline in Asia reimagined how they could solve this problem by using data.

02:15They began by identifying factors to help estimate stock, such as the size of the plane and the number of passengers.

02:23But they soon discovered that estimates based on these factors were inaccurate.

02:28This meant having to think about their data differently by analyzing information such as destination, time of flight, and flight connections before and after each journey.

02:38Using this information, they uncovered actionable insights.

02:42For example, they learned that flights to and from India required 73% more vegetarian meals.

02:49With these new insights, the airline was able to

predict the number of meals required more accurately, **02:55** which in turn provided a more positive customer experience and improve the profitability of their food service.

03:02This is just one example of how Cloud technology can unlock new value by reimagining data.

03:07No matter where you are in your company, you too can use data to solve challenges.

The data value chain

When you think about data processing, it's important to place it within the broader context of the data value chain.

00:06Imagine data traveling along an assembly line, like a car in a factory.

00:11The assembly line progressively adds parts and value to an object that moves along it.

00:16Raw data at the beginning of the line is eventually transformed into actions that humans or machines take.

00:23Let's examine the steps in this data value chain.

00:26Data genesis is the initial creation of a unit of data.

00:31This could be a click on a website, the swipe of a card, a sensor recording from an IoT device, or countless other examples.

00:39It's the raw material that will eventually be turned into an insight ready for action.

00:44Data collection brings that initial unit of data to the assembly line through ingestion.

00:50The basic function of ingestion is to extract data from the system in which it's hosted and bring it to a new system.

00:57It could have dramatically different requirements based on the volume, velocity, and variety of the raw **01:02**data that's required for a given analysis and how fast the data needs to be analyzed.

01:09Data processing is where the collected raw data is transformed into a form that's ready to derive insights from.

01:16The data will likely need to be adjusted for example, by merging different datasets together.

01:21It can be a single-stage operation or can be a complex tree of cascading procedures.

01:27In our manufacturing process analogy, this phase is where raw materials take the shape of the pre-assembly parts of a manufactured product.

01:36Data storage is where the data lands can be found and is ready for analysis and action.

01:43As with real-world manufacturing, where storage options vary depending on the type of product that is processed, different types of data can be stored in different ways.

01:54For example, NoSQL is available for fast reads

and writes, data warehousing for fast access to analysis, and object storage for unstructured data.

02:04 There are also customized options of these standard stores.

02:08 Data analysis provides direction for business-oriented action.

02:13 To continue with our manufacturing line analogy in this stage, inputs from the data processing stage are assembled into a final product.

02:22 Finally, the last step in the data value chain is data activation.

02:28 When an analysis is produced, it needs to be pushed to the relevant business procedures and decision-makers so that action can be taken and the value chain completed.

02:38 The most common points of activation are applications that make automated decisions, and business intelligence dashboards that guide humans toward better, more informed decisions.

02:49 In our manufacturing line example, this is the step where a fully produced product is put to its intended use.

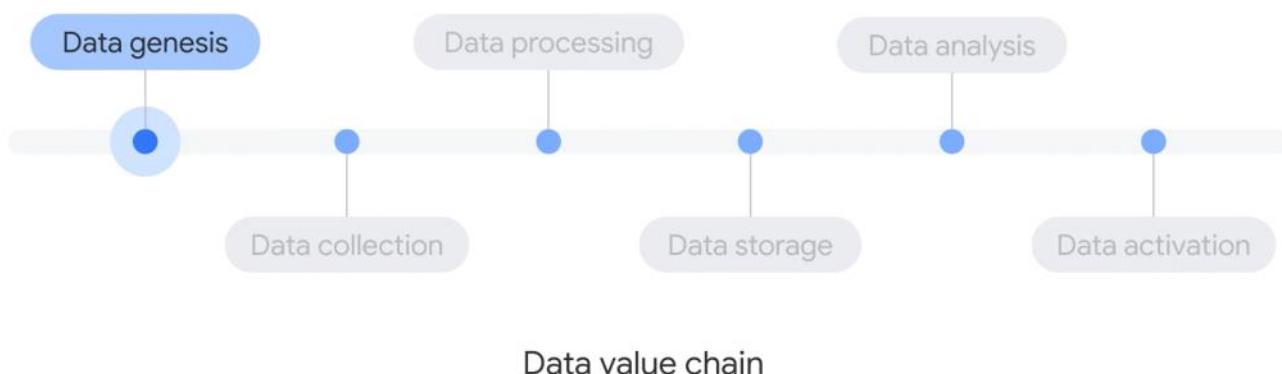
02:56 There's no one way to assemble a data value chain, as there's no one way to create a real-world manufacturing line.

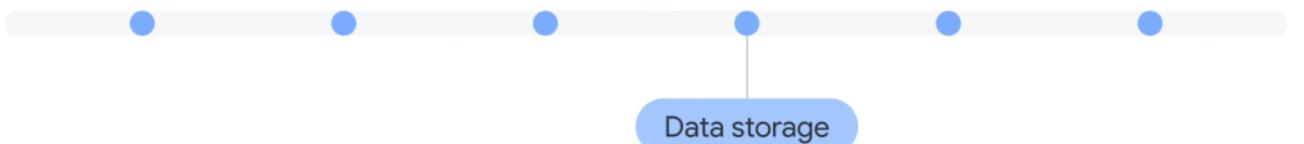
03:03 Similarly, as technologies progress, new inputs become available, your workforce evolves, or the desired output changes.

03:11 The optimal value chain will also change.

03:14 However, at its core, the value chain principles hold.

03:18 We want to use raw data to perform actions that benefit the business.





NoSQL
Fast reads and writes

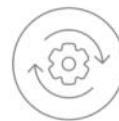
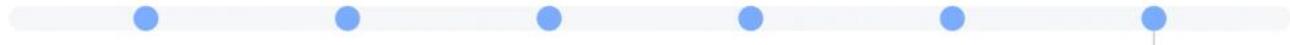


Data warehousing
Fast access to analysis

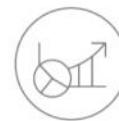


Object storage
Unstructured data

and object storage for unstructured data



Automation



BI dashboards

Data activation



humans toward better, more informed decisions.

Data governance

In the last decade, the amount of data produced has increased exponentially, and the Cloud has made it easier to collect, store, and analyze it at a lower cost.

00:09 Organizations are now challenged to democratize and embed data in every decision, while they also ensure that it's

secure and protected from unauthorized use.

00:19An effective data governance program can help implement data directives to achieve this.

00:26But what exactly is data governance?

00:29Data governance means setting internal standards, data policies that apply to how data is gathered, stored, processed, and disposed of.

00:39It governs who can access certain data, what data is under governance.

00:44It also involves complying with external standards set by industry associations, government agencies, and other stakeholders.

00:52Data governance focuses on making the data available to all stakeholders across the full life cycle of the data in a form that they can readily access and

01:02use, in a manner that generates the desired business outcomes through insights and analysis, and if relevant, in a way that conforms to regulatory standards and compliance needs.

01:14Data governance brings several benefits.

01:17It makes data more valuable.

01:20Data Governance implements processes to ensure high quality data and provides a platform that makes it easier to share data securely with stakeholders across the organization.

01:30It helps users make better, more timely decisions, through data governance.

01:35Users throughout an organization get the data they need to reach and service customers, design and improve products and services and seize opportunities for new revenues.

01:45By democratizing data, organizations can embed data in all decision making.

01:51It improves cost controls.

01:54Data helps organizations manage resources and operate more efficiently.

01:58Because they can eliminate data duplication caused by information silos, they don't overbuy and have to maintain expensive hardware.

02:07It enhances regulatory compliance.

02:10An increasingly complex regulatory climate has made it more important for organizations to establish rigorous data governance practices.

02:18They avoid risks associated with noncompliance and proactively anticipate new regulations.

02:24It helps earn greater trust from customers and suppliers.

02:28By being in auditable compliance with both internal and external data policies, organizations gain the trust of customers and partners.

02:37It helps manage risk.

02:40With robust data governance, organizations can reduce concerns about exposure of sensitive data to individuals or systems who lack proper authorization.

02:49Security breaches from malicious, outsiders, or even insiders who access data they don't have the right to see.

02:55It allows more personnel access to more data.

02:59Strong data governance provides confidence that the right personnel get access to the right data and that this democratization of data does not negatively impact the organization.

03:10It's possible that organizations without an effective data governance program will suffer from compliance violations.

03:17This can lead to finds poor data quality which generates lower quality insights that impact business decisions.

03:25Challenges in finding data which results in delayed analysis and missed business opportunities, and poorly trained data models for AI, which reduces the model accuracy and benefits of using AI.

03:38Every organization needs data governance.

03:42As businesses throughout all industries progress on their

digital transformation journeys, data has quickly become the most valuable asset they possess.



Data governance

- Setting internal standards for data

- Granting access permissions

- Complying with external standards

government agencies,
and other stakeholders.



Data governance



Lifecycle



Access



Insights



Standards

conforms to regulatory
standards and compliance needs.

It makes data more valuable

It helps users make better, more timely decisions

It improves cost controls

It enhances regulatory compliance

It helps earn greater trust from customers and suppliers

It helps manage risk

It allows more personnel access to more data



Data governance

organizations can reduce concerns about exposure of

New cloud tools make it possible to harness the potential of unstructured data. Which of these use cases best demonstrates this?

Using GPS coordinates to power a ride-sharing app

checkAnalyzing social media posts to identify sentiment toward a brand

Creating visualizations from seasonal weather data

Analyzing historical sales figures to predict future trends

That is the correct answer!

check

2.

An online retailer uses a smart analytics tool to ingest real-time customer behavior data to surface the best suggestions for particular users. How can machine learning guide this activity?

Machine learning can help identify user behavior in real time, but cannot make personalized suggestions based on the data.

checkThrough machine learning, with every click that the user makes, their website experience becomes increasingly personalized.

Machine learning can be used to make all users see the same product recommendations, regardless of their preferences or behavior.

Through machine learning, a user's credit card transactions can be analyzed to determine regular purchases.

That is the correct answer!

check

3.

What is data governance?

checkThe process of setting internal data policies and ensuring compliance with external standards

The process of analyzing data to gain insights and make informed decisions

The process of deleting unnecessary data to save storage space

The process of collecting and storing data for future use

That is the correct answer!

check

4.

A solar energy company wants to analyze weather data to better understand the seasonal impact on their business. On which platform could they find free-to-use weather datasets?

App Engine

Google Cloud console

Google Play

checkGoogle Cloud Marketplace

That is the correct answer!

check

5.

A car insurance company has a large database that stores customer details, including the vehicles they own and past claims. The structure of the database means that information is stored in tables, rows, and columns. What type of database is this?

An XML database

An object database

A non-relational database

checkA relational database

That is the correct answer!

check

6.

What is Google Cloud's modern and serverless data warehousing solution?

checkBigQuery

Compute Engine

Vertex AI

Cloud Storage

That is the correct answer!

check

7.

Which is a repository designed to ingest, store, explore, process, and analyze any type or volume of raw data, regardless of the source?

Database

Data warehouse

Data archive

checkData lake

That is the correct answer!

close

8.

Which represents the proprietary customer datasets that a business collects from customer or audience transactions and interactions?

First-party data

check

9.

Which data type is highly organized and well-defined?

Check Structured data

Unstructured data

A hybrid of structured, semi-structured, and unstructured data

Semi-structured data

That is the correct answer!

check

10.

Which step in the data value chain is where collected raw data is transformed into a form that's ready to derive insights from?

Data genesis

Data storage

Check Data processing

Data analysis

That is the correct answer!

Google Cloud Data Management Solutions

Unstructured data storage

Every application needs to store data like media to be streamed, or even sensor data from devices, and different applications and workloads require different storage solutions.

00:11 Google Cloud offers several core storage products.

00:15 This list includes: Cloud Storage, Cloud SQL, Cloud Spanner, Big Query, Fire Store and Cloud Bigtable.

00:25 Depending on your use case, you might use one or several of these services to do the job.

00:31 Let's begin with Cloud Storage, which is a service that offers developers and IT organizations durable and highly available object storage.

00:40 But what is object storage?

00:43 Object storage is a computer data storage architecture that manages data as objects instead of as file

00:50 storage, which is a file and folder hierarchy, or as block storage, which is chunks of a disc.

00:58 These objects are stored in a packaged format that contains the binary form of the actual data

01:03 and relevant associated metadata such as creation date, author, resource type and permissions and a globally unique identifier.

01:14 These unique keys are in the form of URLs, which means object storage interacts well with web technologies.

01:22 Data commonly stored as objects include video, pictures, and audio recordings.

01:28 This type of data is referred to as unstructured, which means that it doesn't have a predefined

01:34 data model or isn't organized in a predefined manner as you might find in a structured database format.

01:41 Cloud storage lets customers store any amount of data and retrieve it as often as needed.

01:47 It's a fully managed, scalable service that has a wide variety of uses, such as serving website content,

01:54 storing data for archival and disaster recovery and distributing large data objects to end users through direct download.

02:02 There are four primary storage classes in Cloud storage.

02:06 The first is standard storage.

02:09 Standard storage is considered best for frequently accessed or hot data.

02:13 It's also great for data that's stored for only brief periods of time.

02:18The second storage class is nearline storage.

02:21This option is best for storing infrequently accessed data, like reading or modifying data on average once a month or less.

02:29Examples might include data backups, long tail multimedia content, or data archiving.

02:36The third storage class is coldline storage.

02:40This is also a low cost option for storing infrequently accessed data.

02:44However, as compared to nearline storage, coldline storage is meant for reading or modifying data at most, once every 90 days.

02:54The fourth storage class is archive storage.

02:57This is the lowest cost option used, ideally, for data archiving, online backup and disaster recovery.

03:04It's the best choice for data that you plan to access less than once a year

03:08because it has higher costs for data access and operations and a 365 day minimum storage duration.

03:16Although each of these four classes have differences, it's worth noting there are several characteristics that apply across all of these storage classes which include: unlimited storage

03:26with no minimum object size requirement, worldwide accessibility and locations, low latency and high durability, a uniform experience which extends to security tools and API's and Geo redundancy.

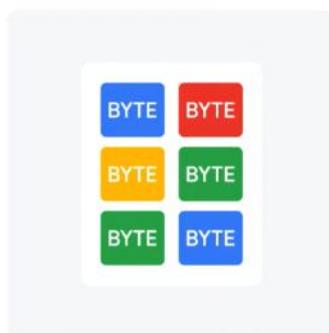
03:42If data is stored in a multi region or dual region, this means placing physical servers in geographically

03:48diverse data centers to protect against catastrophic events and natural disasters, and load balancing traffic for optimal performance.

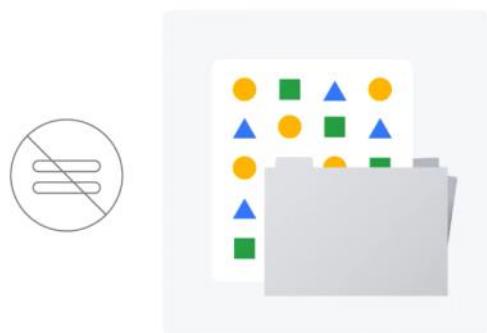
03:56Cloud storage also provides a feature **called auto class which automatically transitions objects to appropriate storage classes based on each object's access pattern.**

04:07The feature moves data that's not access to colder storage classes to reduce storage cost and moves data that is access to standard storage to optimize future accesses.

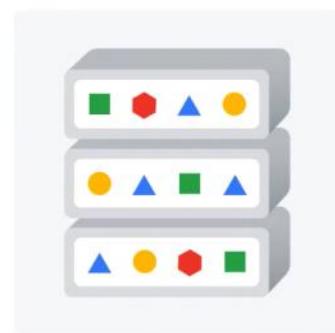
04:18Auto class simplifies and automates cost saving for your Cloud storage data.



Object storage



File storage



Block storage

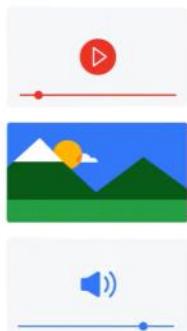
or as block storage, which
is chunks of a disc.



Object packaged format contains:

- Binary form of the actual data itself
- Relevant associated metadata
- Globally unique identifier

permissions and a globally
unique identifier.



Unstructured

Predefined data model

Organized in a predefined manner



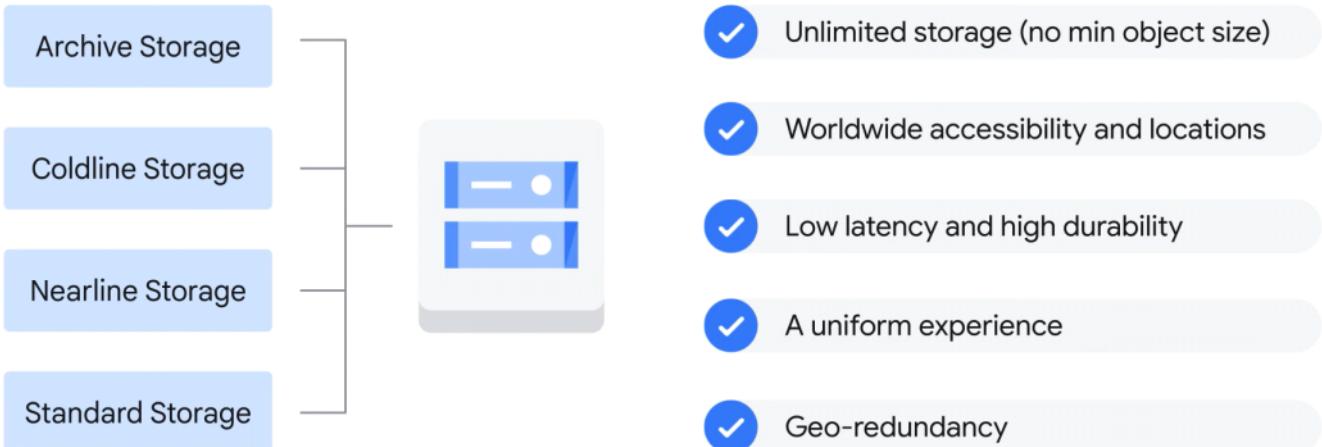
Cloud Storage



Allows customers to store any amount of data, and to retrieve it as often as needed



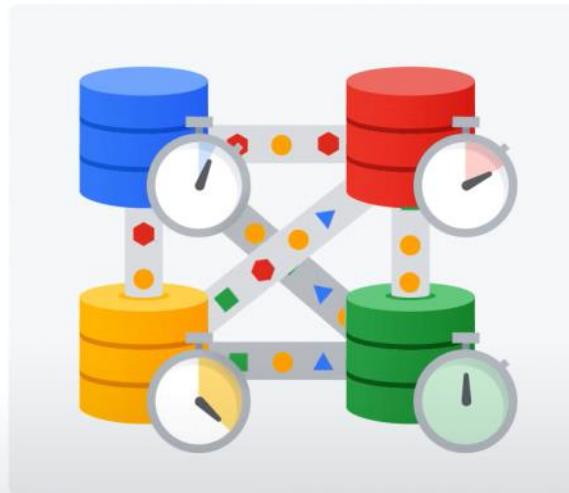
Fully managed scalable service that has a wide variety of uses



If data is stored in a multi
region or dual region,

Autoclass

- Moves data that is not accessed to colder storage classes to reduce storage cost
- Moves data that is accessed to Standard storage to optimize future accesses



access to standard storage
to optimize future accesses.

Structured data storage

In the previous lesson, you saw how Cloud storage is used to store unstructured data.

00:05

Now let's explore some Google Cloud data storage products that are suited for storing structured data.

00:11

Structured data consists of numbers and values that are

organized in a predefined format that's easily searchable in a relational database.

00:21

Earlier in the course, we mentioned that a relational database stores information in tables, rows and

00:26

columns, that have a clearly defined schema that represents the structure or logical configuration of the database.

00:34

Cloud SQL offers fully managed relational databases, including MySQL, PostgreSQL and SQL server, as a service.

00:44

It's designed to transfer mundane, but necessary and often time-consuming tasks to Google, like applying

00:51

patches and updates, managing backups, and configuring replications so you can focus on building great applications.

01:00

Trusted by thousands of the largest enterprises around the world, organizations that use Cloud SQL obtain various benefits.

01:09

It doesn't require any software installation or maintenance, it supports managed backups, so backed up data is securely stored and accessible if a restore is required, it encrypts customer

01:19

data when on Google's internal networks and when stored in database tables, temporary files and backups, and it includes a network firewall which controls network access to each database instance.

01:33

Cloud Spanner is a fully managed, mission, critical relational database service that scales horizontally to handle unexpected business spikes.

01:43

Battle tested by Google's own mission, critical applications and services, Spanner is a service that powers Google's multi-billion dollar business.

01:52

Cloud Spanner is especially suited for applications that require a SQL relational database management system with joins and secondary indexes built in high availability,

02:03

which provides data redundancy to reduce downtime when a zone or instance becomes unavailable, the goal is to prevent a single point of failure.

02:11

Strong global consistency, which ensures that all locations where data is stored are updated to the most recent data version quickly,

02:20

and high numbers of input and output operations per second, tens of thousands of reads and writes per second or more.

02:28

Both Cloud SQL and Cloud Spanner are fully managed database services, but how do they differ?

02:35

Cloud SQL is a fully managed relational database service for MySQL, PostgreSQL, and SQL server with greater than 99.95% availability.

02:46

Database migration service, DMS, makes it easy to migrate your production databases to Cloud SQL with minimal downtime.

02:55

Then there's Cloud Spanner, which is a fully managed relational database with unlimited scale, strong consistency, and up to 99.999% availability with zero downtime for planned maintenance and schema changes.

03:10

This globally distributed acid compliant Cloud database automatically handles replicas, sharding, and transaction processing so you can quickly scale to meet any usage pattern and ensure success of products.

03:24

When considering which option is best for your business, consider this.

03:28

If you've outgrown any relational database, are sharding your databases for throughput, high performance, need transactional

03:35

consistency, global data and strong consistency, or just want to consolidate your database, consider using Cloud Spanner.

03:44

If you don't need horizontal scaling or a globally available system, Cloud SQL is a cost-effective solution.

03:52

The final structured data storage solution that we'll explore is BigQuery.

03:57

BigQuery is a fully managed data warehouse.

04:00

As we've already learned, the data warehouse is a large

store that contains petabytes of data

04:05

gathered from a wide range of sources within an organization and is used to guide management decisions.

04:12

Because it's fully managed, BigQuery takes care of the underlying infrastructure, so users can focus on

04:18

using SQL queries to answer business questions without having to worry about deployment, scalability, and security.

04:26

BigQuery provides two services in one; storage and analytics.

04:32

It's a place to store petabytes of data.

04:36

For reference, one petabyte is equivalent to 11,000 movies at 4K quality.

04:42

BigQuery is also a place to analyze data with built-in features like machine learning, geospatial analysis, and business intelligence.

04:52

Data in BigQuery is encrypted at rest by default, without any action required from a user.

04:58

Encryption at rest is encryption used to protect data that's stored on a disc, including solid state drives or backup media?

05:06

BigQuery provides seamless integration with the existing partner ecosystem.

05:12

Businesses can tap into our ecosystem of system integrators and data integration partners to help enhance analytics and reporting.

05:20

These integrations mean that BigQuery lets organizations make the most of existing investments in business intelligence, data ingestion, and data integration tools.

05:31

Industry research shows that 90% of organizations have a multi Cloud strategy, which adds complexity to data integration, orchestration, and governance.

05:41

BigQuery works in a multi Cloud environment, which lets data teams eradicate data silos by using BigQuery to securely and cost effectively analyze data across multiple

Cloud providers.

05:54

BigQuery also has built in machine learning features so that ML models can be written directly in BigQuery by using SQL.

06:03

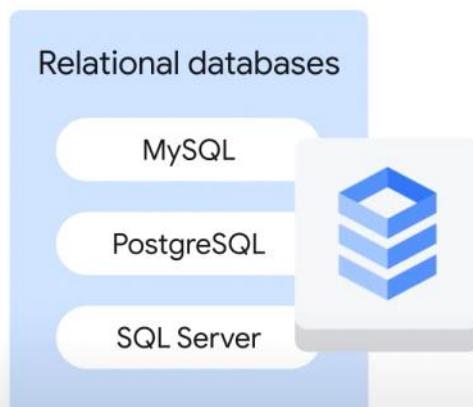
If other professional tools such as Vertex AI from Google Cloud are used to train ML models, datasets can

06:10

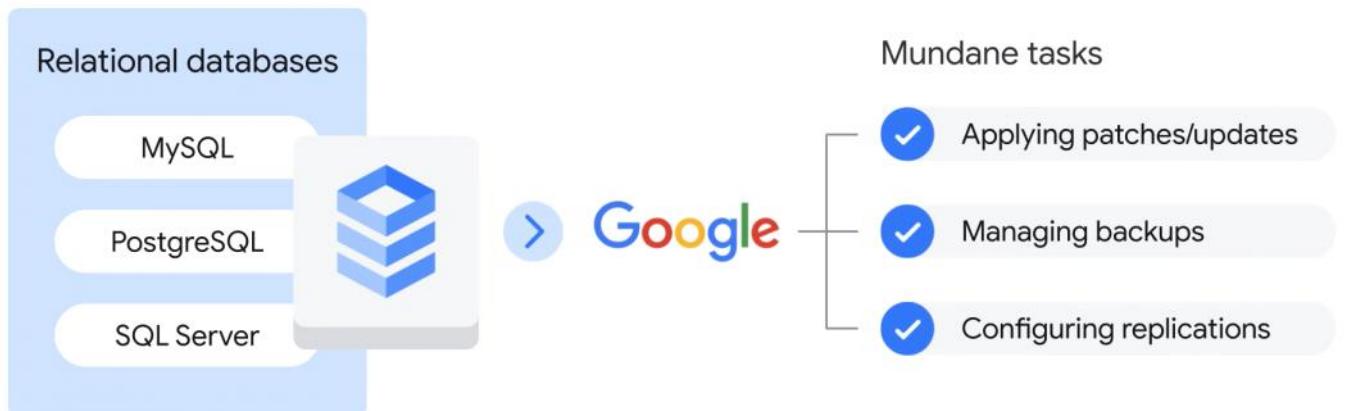
be exported from BigQuery directly into Vertex AI for a seamless integration across the data to AI life cycle.

Structured data storage

Watch



PostgreSQL and SQL
server, as a service.



and configuring
replications so you

Watch later Share



Cloud SQL

Trusted by thousands of the largest enterprises around the world

Doesn't require software installation or maintenance

Supports managed backups

Encrypts customer data

Includes a network firewall

controls network access to
each database instance.



Cloud Spanner

Fully managed

Mission-critical

Scales horizontally

Especially suited for applications that require:



Cloud Spanner

SQL relational database management system with joins and secondary indexes

Built-in high availability

Strong global consistency

High numbers of input/output operations per second

**input and output
operations per second,**



Cloud SQL

Fully managed relational database service for MySQL, PostgreSQL, and SQL Server

Greater than 99.95% availability

DMS makes it easy to migrate your production databases to Cloud SQL with minimal downtime



Cloud Spanner

Fully managed relational database with unlimited scale, strong consistency

Up to 99.999% availability

Handles replicas, sharding, and transaction processing, so you can quickly scale to meet any usage pattern and ensure success of products

and ensure success of products.



Cloud Spanner



Have outgrown any relational database



Are sharding your databases for throughput high performance

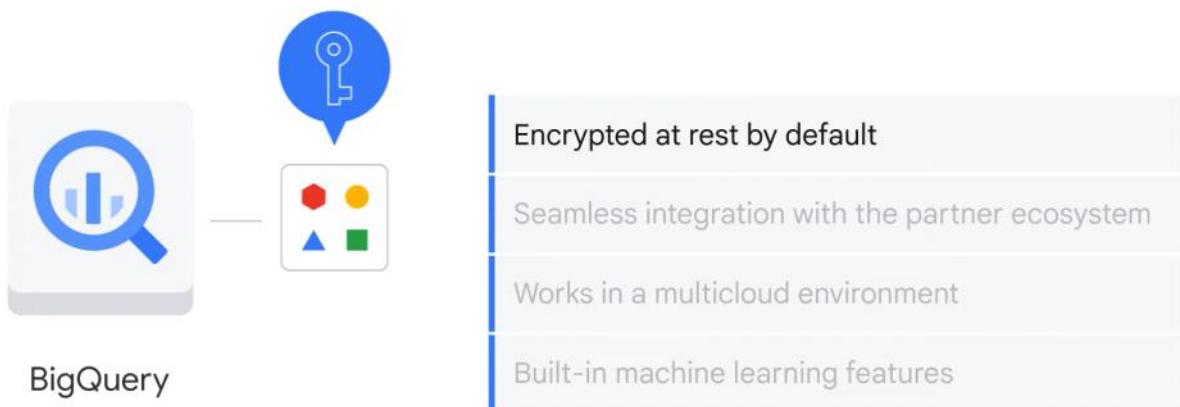
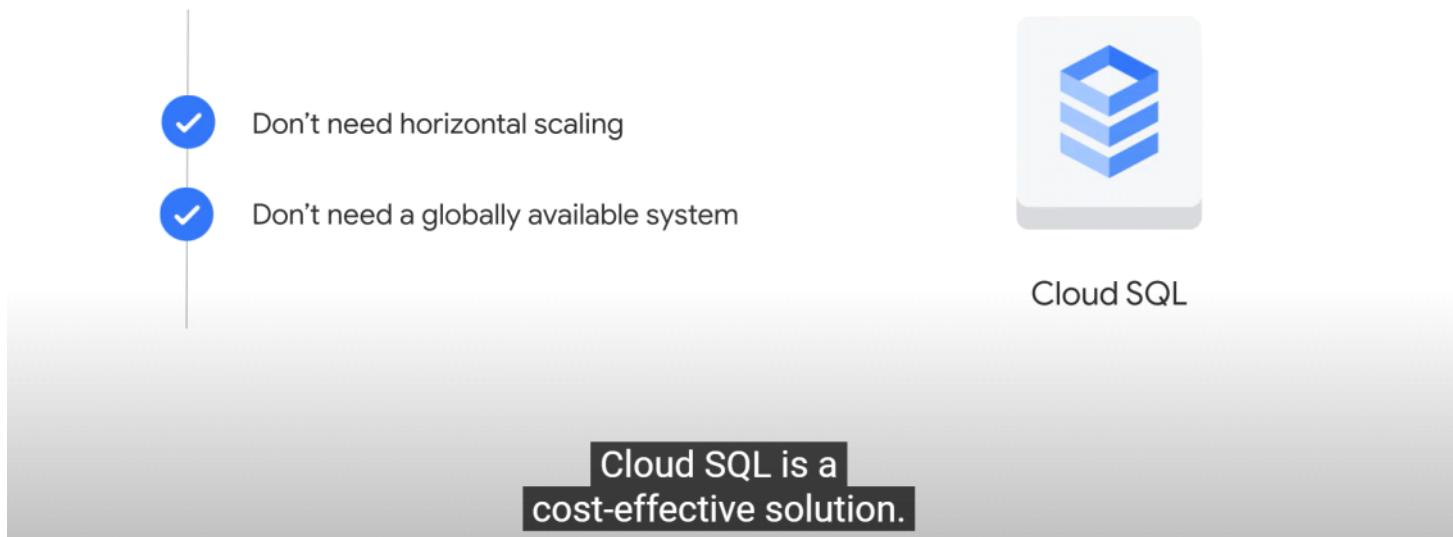


Need transactional consistency, global data, and strong consistency



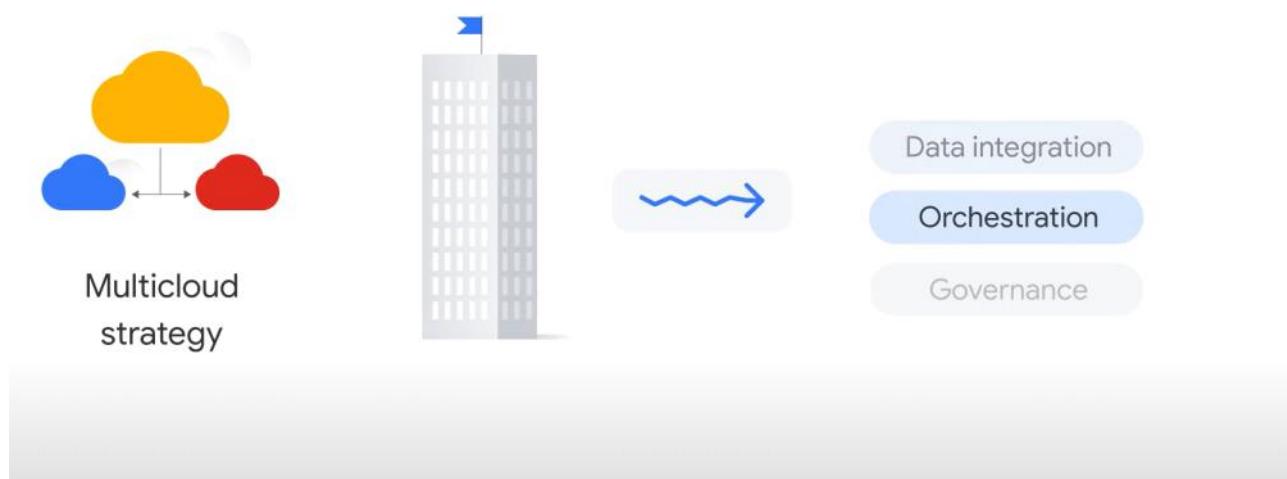
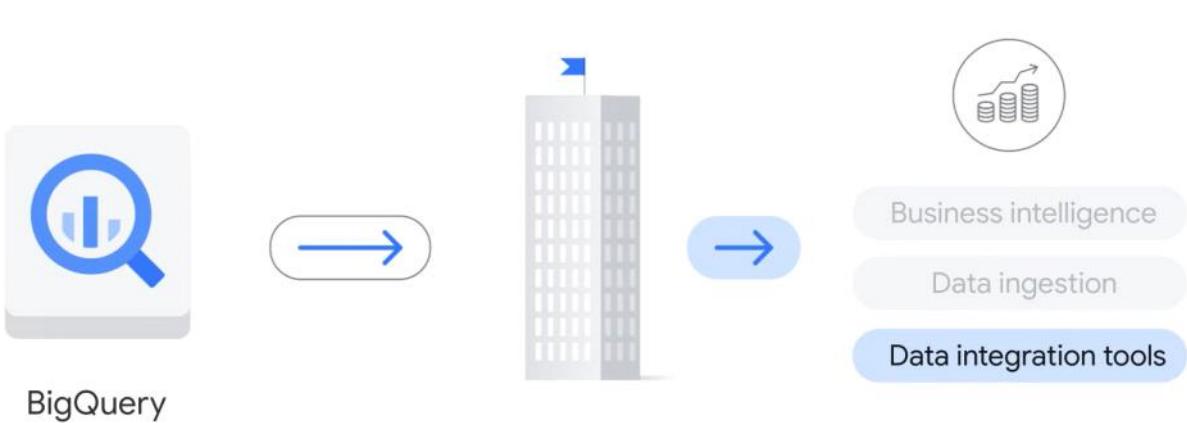
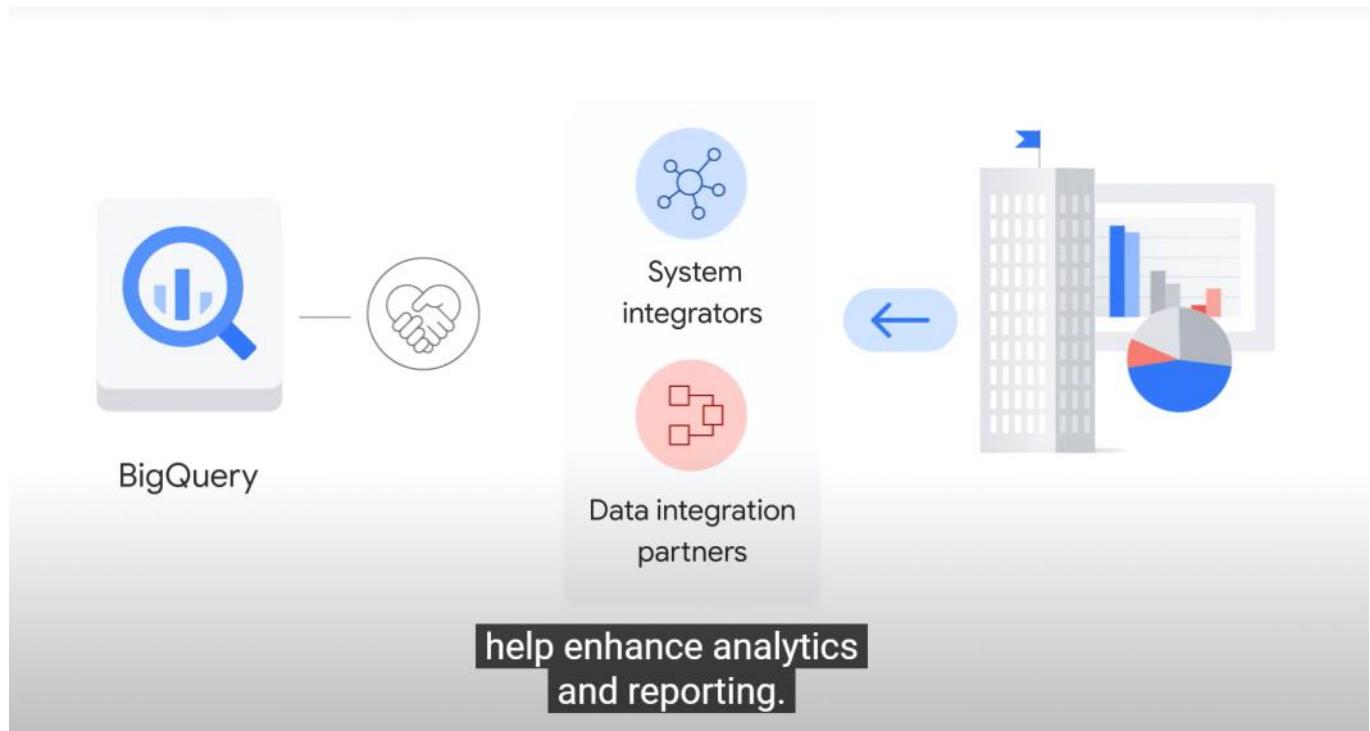
Just want to consolidate your database

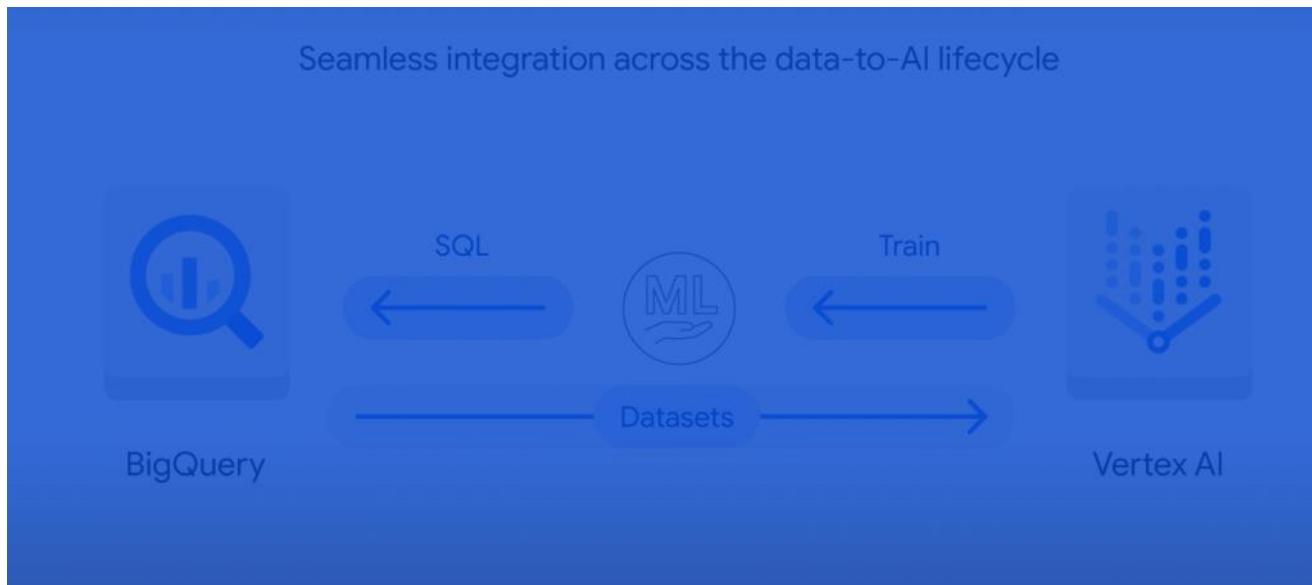
consider using Cloud Spanner.



without any action required from a user.

Encryption at rest is encryption used to protect data that's stored **on a disk**, including solid-state drives, or backup media.





Semi-structured data storage

Semi structured data contains elements of both structured and unstructured data.

00:05It does have some defining or consistent characteristics, but generally doesn't follow a structure as rigid as a relational database.

00:13Semi structured data is easier to organize because it usually contains some organizational properties such as tags or meta data.

00:21An example of unstructured data is an email message.

00:26While the actual content of the email is unstructured, it does contain structured data such as

00:31the name and email address of the sender and recipient, the time sent, and so on.

00:37Google Cloud offers two semi structured data storage products, Firestore and Cloud Bigtable.

00:44Firebase is a flexible, horizontally scalable NoSQL Cloud database for storing and syncing data in real time.

00:52Firebase can be directly accessed by mobile and web applications.

00:58**Firebase performs data storage in the form of documents, with the documents being stored in collections.**

01:05**Documents support a wide variety of data types, such as nested objects, numbers, and strings.**

01:12**One of Firebase's main features is automatic scaling.**

01:16**It's been designed to scale automatically depending on user demand, but retains the same level of performance irrespective of database size.**

01:24**Firebase also provides offline usage through a**

comprehensive database on users devices.

01:30Offline data access ensures that applications run without interruption, even if the user gets disconnected from the Internet.

01:38Then there's Cloud Bigtable, Google's NoSQL, big data database service.

01:44It's the same database that powers many core Google services including Search Analytics, Maps, and Gmail.

01:52Bigtable is designed to handle large workloads at consistent low latency, which means Bigtable responds to 01:59requests quickly and high throughput, which means it can send and receive large amounts of data.

02:05For this reason, it's a great choice for both operational and analytical applications, including Internet of Things, user analytics, and financial data analysis.

02:16When deciding on a storage option, you might choose Bigtable.

02:19If you're working with more than one terabyte of semi structured or structured data, data

02:24is fast with high throughput or it's rapidly changing, you're working with NoSQL data, data is

02:31a time series or has natural ordering, you're working with big data and running batch

02:36or real time processing on the data, or you're running machine learning algorithms on the data.

navigate_beforePreviousNextnavigate_next

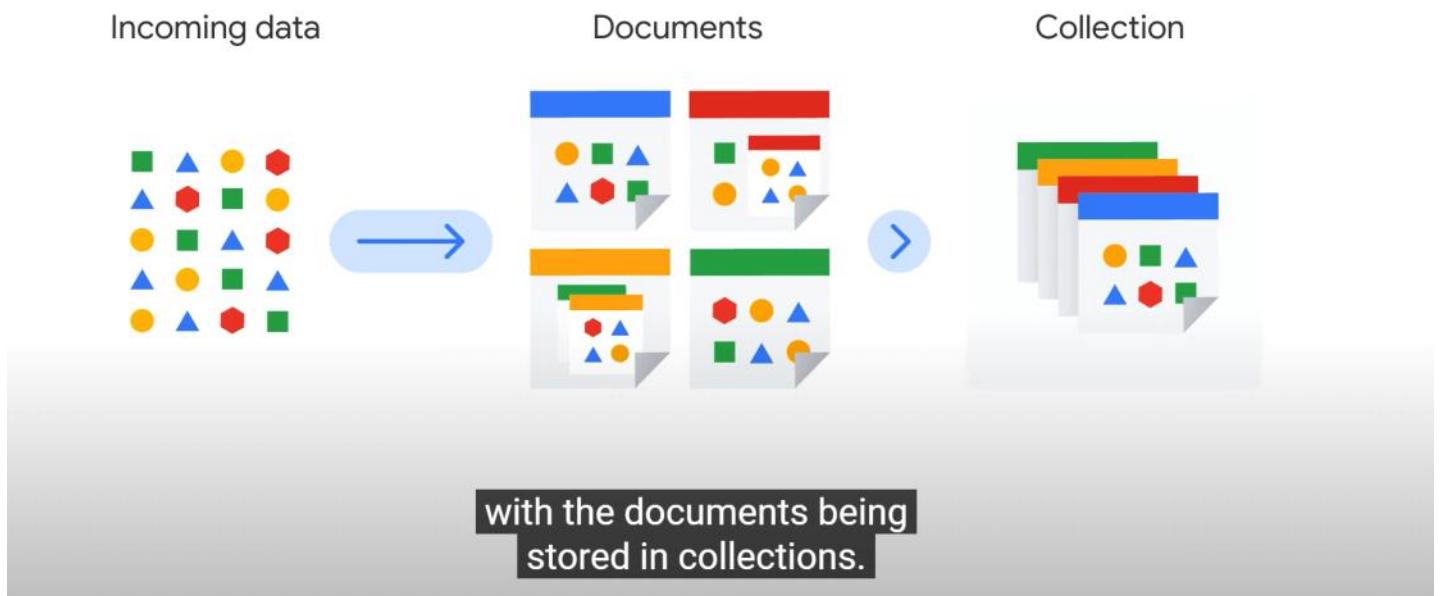


Firestore

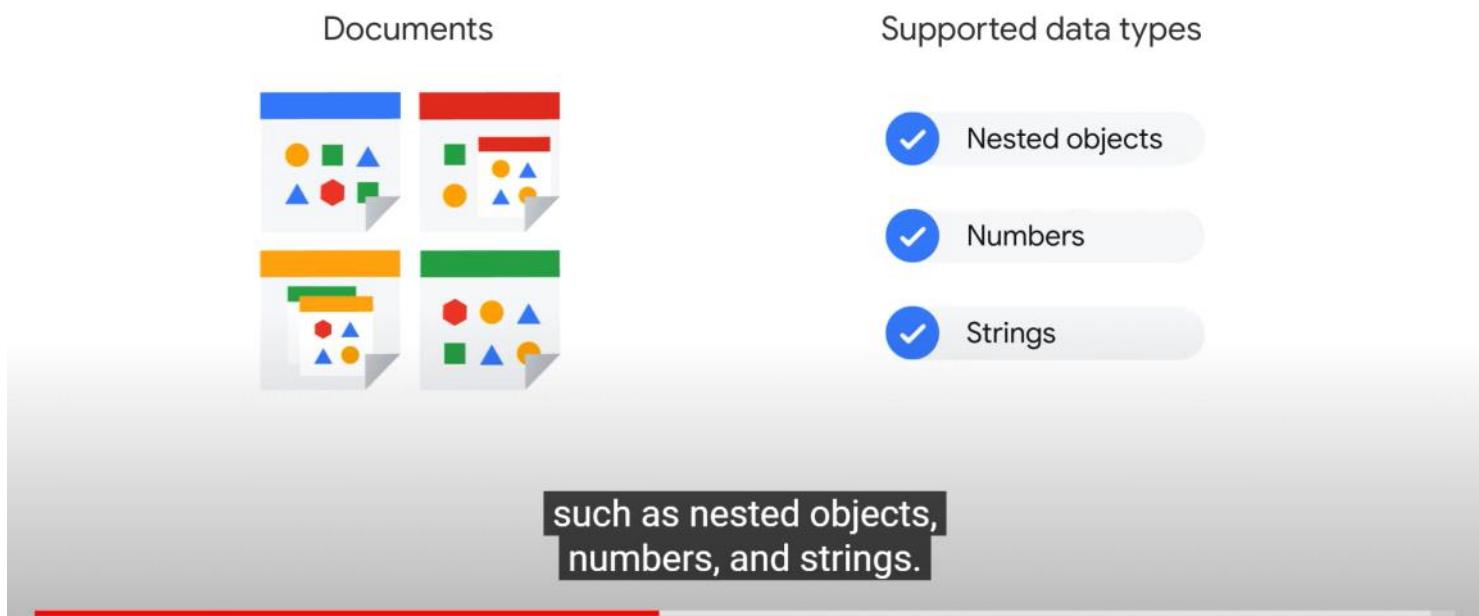
Flexible

Horizontally scalable

NoSQL cloud database



Semi-structured data storage Watch later Share





Cloud Bigtable

Google's NoSQL big data database service

- Handle massive workloads
- Consistent low latency
- High throughput
- Great choice for:
- Operational applications
- Analytical applications

both operational and analytical applications,



Cloud Bigtable

You're working with more than 1 TB of semi-structured or structured data

Data is fast with high throughput, or it's rapidly changing

You're working with NoSQL data

Data is a time-series or has natural ordering

You're working with big data and running batch or real-time processing on the data

You're running machine learning algorithms on the data

data is fast with

Choosing the right storage product

You've learned about the different storage options that Google Cloud offers, but in what scenarios should you use each one?

00:06 Ultimately, it's a combination of the data type that needs to be stored and the business need.

00:13 If data is unstructured then Cloud storage is the most appropriate option.

00:18 You have to decide a storage class, standard near line, code line or archive, or whether to let the

auto class feature decide that for you.

00:29If data is structured or semi structured choosing a storage product will depend on whether work loads are transactional or analytical.

00:37Transactional workloads stem from online transaction processing or OLTP systems, which are used when fast data inserts and updates are required to build row based records.

00:49An example of this is point of sale transaction records.

00:53Then there are analytical workloads which stem from online analytical processing or OLAP systems, which are used when entire datasets need to be read.

01:04They often require complex queries, for example, aggregations.

01:08An example here would be analyzing sales history to see trends and aggregated views.

01:14After you determine if the workloads are transactional or analytical, you must determine whether the data will be accessed by using SQL.

01:23If your data is transactional and you need to access it by using SQL, then Cloud SQL and Cloud Spanner are two options.

01:31Cloud SQL works best for local to regional scalability and Cloud Spanner is best to scale a database globally.

01:39If the transactional data will be accessed without SQL Firestore might be the best option.

01:44Firebase is a transactional no SQL document oriented database.

01:49If you have analytical workloads that require SQL commands, BigQuery might be the best option.

01:55BigQuery Google's data warehouse solution lets you analyze petabyte scale datasets.

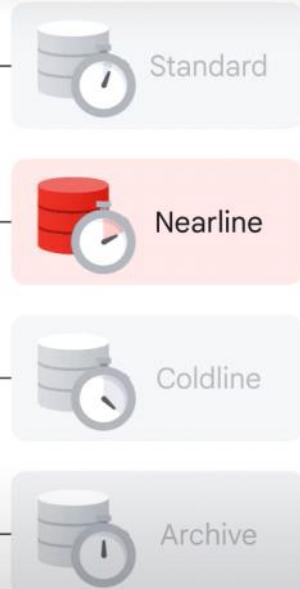
02:01Alternatively, Cloud Bigtable provides a scalable no SQL solution for analytical workloads.

02:08It's best for real time high through put applications that require only millisecond latency.



Cloud Storage

Decide a storage class



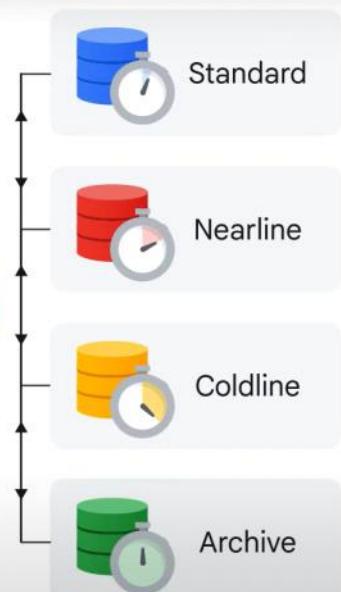
Unstructured

You have to decide a storage class, standard near line,



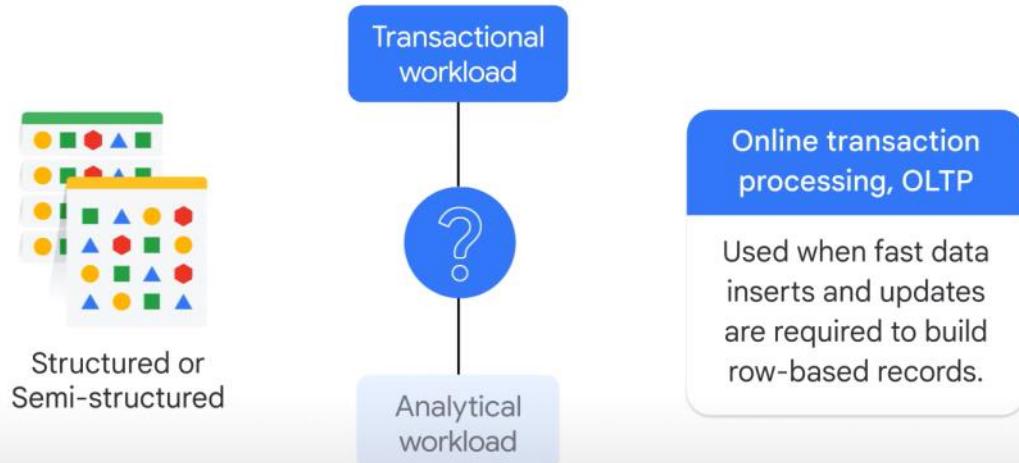
Cloud Storage

Use Autoclass

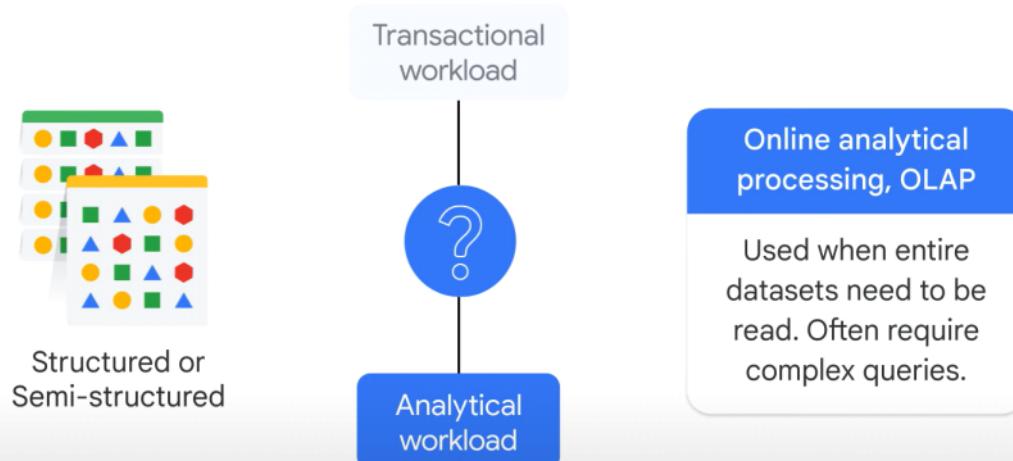


Unstructured

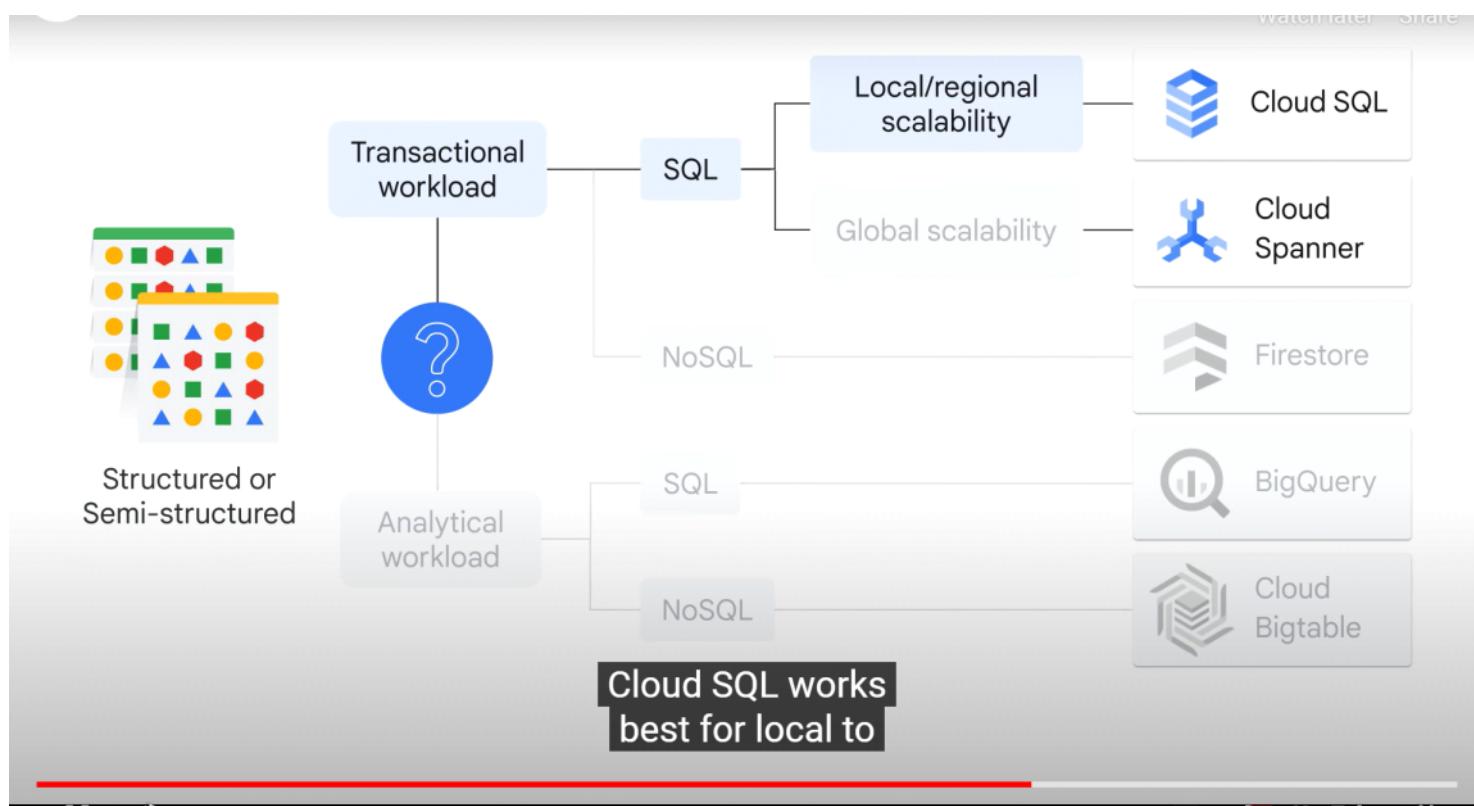
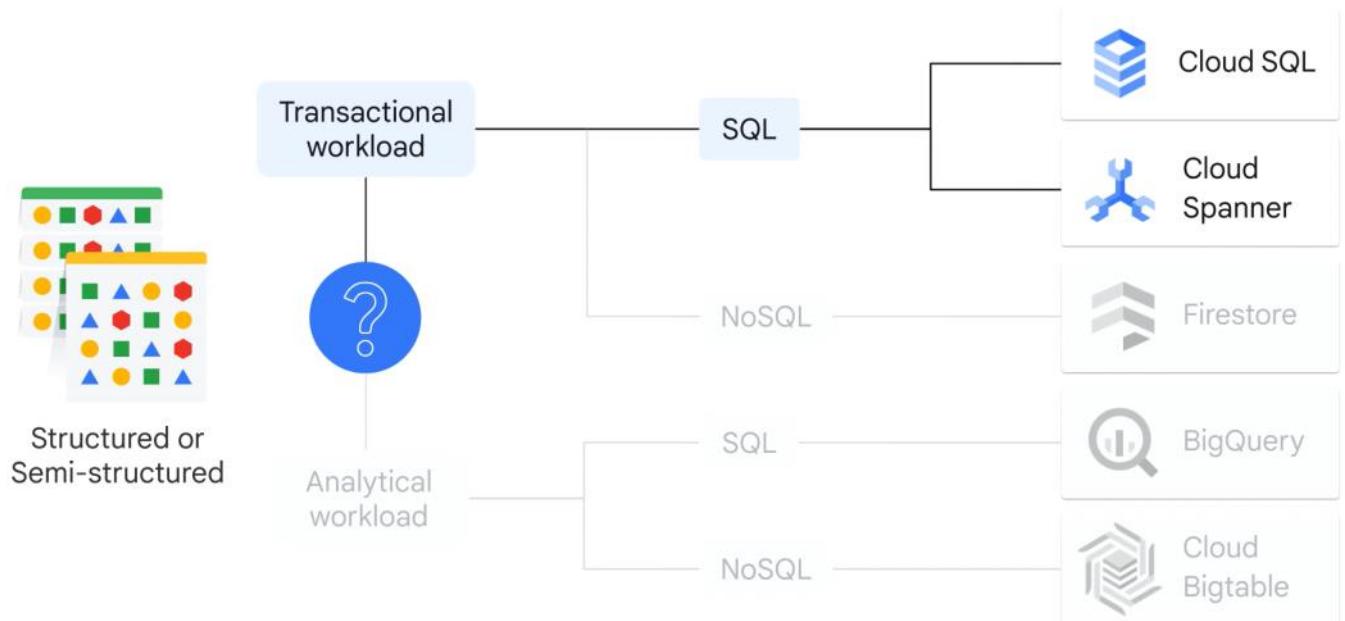
class feature decide
that for you.



An example of this is point
of sale transaction records.



online analytical
processing or OLAP systems,



[Database migration and modernization](#)

Running modern applications on legacy on-premises databases requires overcoming expensive, time-consuming challenges around latency, throughput, availability, and scaling.

00:11 With database modernization, organizations can move data from traditional databases to fully managed, or modern databases with relative ease.

00:20 There are different ways that an organization can migrate or modernize their current database in the

Cloud.

00:26The most straightforward method is a lift and shift platform migration.

00:31This is where databases are migrated from on-premises and private Cloud environments to the same type of database hosted by a public cloud provider such as Google Cloud.

00:41Although this solution makes the database more difficult to modernize, it does bring with it the benefits of minimal upheaval, and having data and infrastructure managed by the Cloud provider.

00:51Alternatively, a managed database migration allows the migration of databases from SQL server, MySQL, post grace equal, and others to a fully managed Google Cloud database.

01:03Although this migration requires careful planning and might call slight upheaval, a fully managed solution lets you focus on higher-priority work that really adds value to your organization.

01:14Google Cloud's database migration service, DMS can easily migrate your databases to Google Cloud, or data stream can be used to synchronize data across databases, storage systems, and applications.

01:28Let's look at a real-life use case, with 18 fulfillment centers, 38 delivery centers, and a catalog of more than 22 million items.

01:39The online retailer Wayfair needed a way to quickly move from their on-premises data centers, which ran on SQL server, to Google Cloud.

01:47This had to be achieved without inconveniencing their team of over 3,000 engineers, their tens of millions of customers, or their 16,000 supplier partners.

01:58The goal was to lift and shift their workloads as quickly as possible with minimal changes, and then use Cloud databases to modernize those workloads.

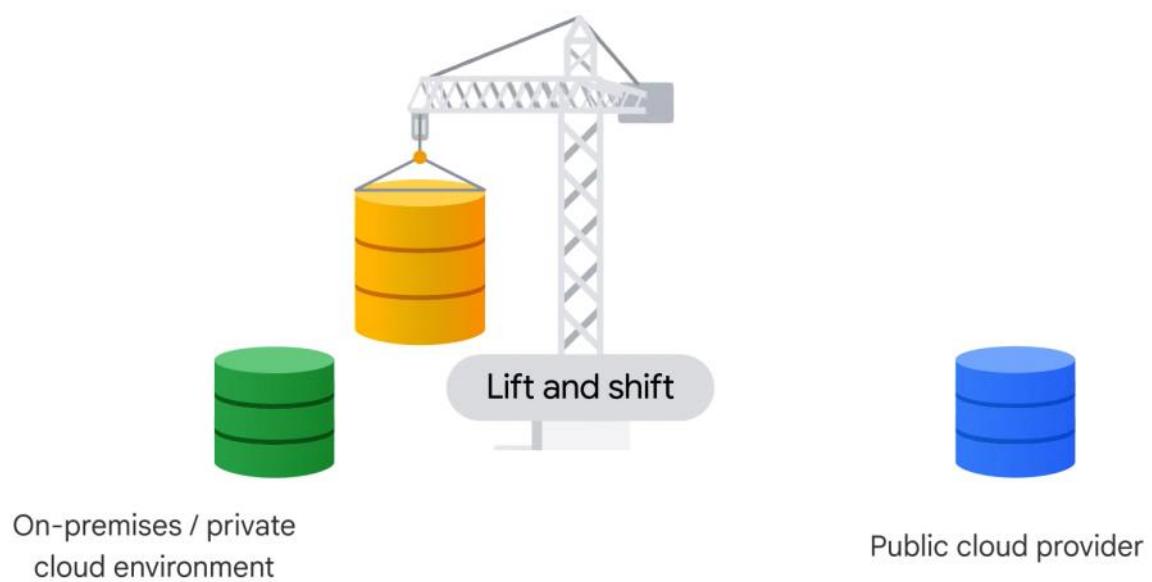
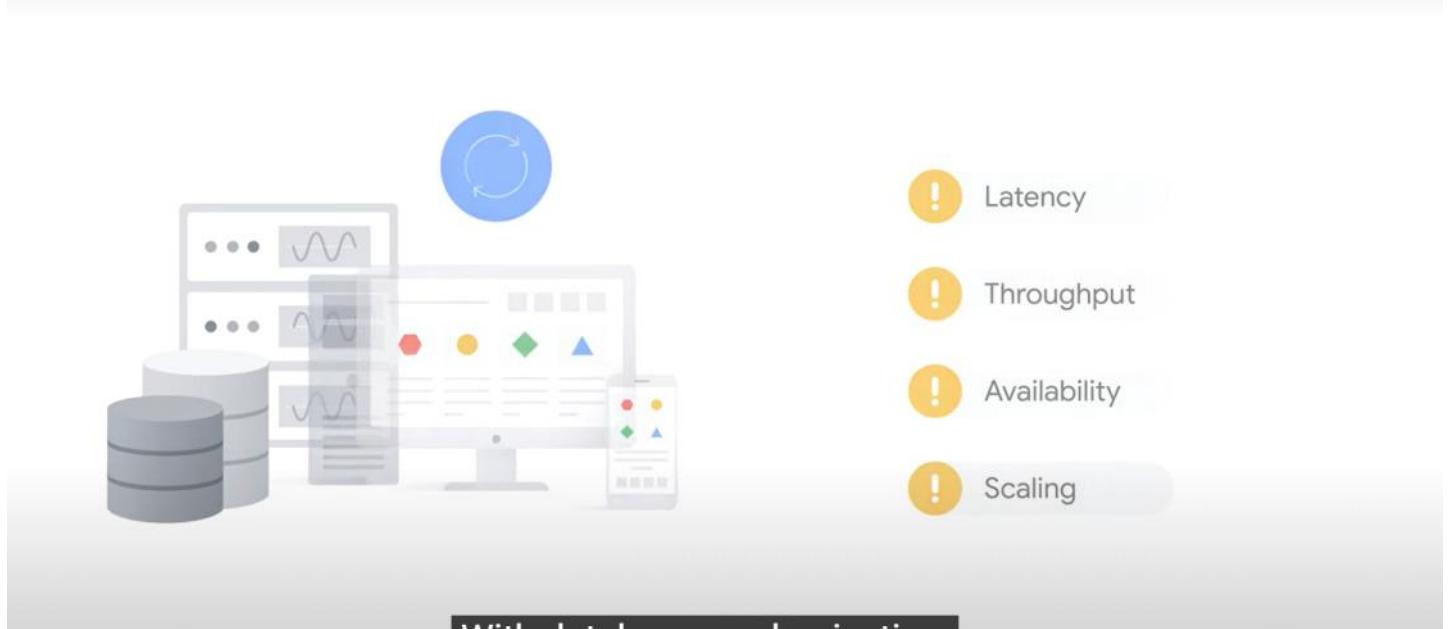
02:07Wayfair chose Google Cloud, because of the clear path for shifting workloads to the Cloud.

02:13By using Cloud SQL server, Google Cloud provided the flexibility to be deliberate about which engine and product to run Wayfair systems on going forward.

02:24They liked how they could run SQL server on virtual machines, VMs for example, but could also benefit from database offerings like Cloud SQL and Cloud Spanner.

02:35Now that migration is complete, they also use Google Cuponet's Engine GKE and Compute Engine VMs to host the services built by the Google Cloud Team.

02:45They also use Pub-Sub and data flow for sending operational data, to their analytical store in big query.



Lift and shift



- ! Database more difficult to modernize
- ✓ Minimal upheaval
- ✓ Managed by the cloud provider

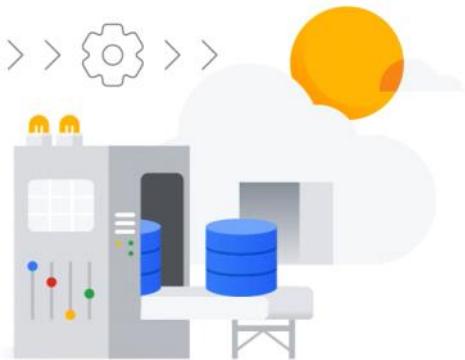
Alternatively, a managed database migration

Managed database migration



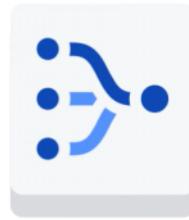
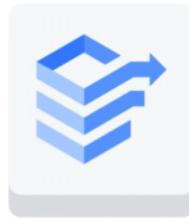
and others to a fully managed Google Cloud database.

Managed database migration



- ! Requires careful planning
- ! Might cause slight upheaval
- ✓ Focus on higher priority work

higher-priority work that really



Database Migration Service (DMS)

Easily migrate your databases to Google Cloud

Datastream

Used to synchronize data across databases, storage systems, and applications

storage systems, and applications.

heck

1.

What are the two services that BigQuery provides?

Networking and storage

Compute and analytics

Migration and analytics

checkStorage and analytics

That is the correct answer!

check

2.

A data analyst for an online retailer must produce a sales report at the end of each quarter. Which Cloud Storage class should the retailer use for data accessed every 90 days?

Nearline

Archive

Standard

checkColdline

That is the correct answer!

check

3.

What is Google's big data database service that powers many core Google services, including Google Search, Google Analytics, Google Maps Platform, and Gmail?

Cloud Storage

checkCloud Bigtable

Cloud SQL

Cloud Spanner

That is the correct answer!

close

4.

Which characteristic is true for all Cloud Storage classes?

High latency and low durability

check

5.

BigQuery works in a multicloud environment. How do organizations benefit from this feature?

Multicloud support in BigQuery is only intended for use in disaster recovery scenarios.

BigQuery lets organizations save costs by limiting the number of cloud providers they use.

Security is more effective when BigQuery is run in on-premises environments.

checkData teams can eradicate data silos by analyzing data across multiple cloud providers.

That is the correct answer!

check

6.

Which would be the best SQL-based storage option for a transactional workload that requires global scalability?

Cloud SQL

checkCloud Spanner

Cloud Bigtable

Firestore

That is the correct answer!

check

7.

Which is the best SQL-based storage option for a transactional workload that requires local or regional scalability?

Cloud Spanner

Cloud Storage

checkCloud SQL

Cloud Bigtable

That is the correct answer!

check

8.

Which strategy describes when databases are migrated from on-premises and private cloud environments to the same type of database hosted by a public cloud provider?

Remain on-premises

Refactoring

Managed database migration

checkLift and shift

That is the correct answer!

check

9.

Data in the form of video, pictures, and audio recordings is well suited to

object storage. Which product is best for storing this kind of data?

BigQuery

Cloud SQL

Firestore

checkCloud Storage

That is the correct answer!

check

10.

Which Google Cloud product can be used to synchronize data across

databases, storage systems, and applications?

Dataproc

Pub/Sub

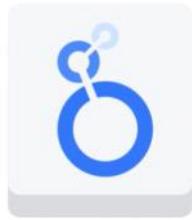
checkDatastream

Dataprep

That is the correct answer!

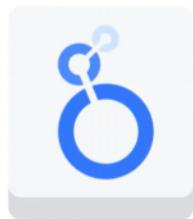
Making Data Useful and Accessible

Business intelligence and insights using Looker



Google Cloud business intelligence
(BI) platform designed to help
individuals and teams **analyze**,
visualize, and **share** data.

Looker



Looker

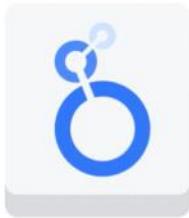
Interactive dashboards

Interactive reports

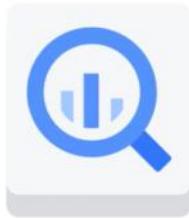
Easy to understand

Easy to share

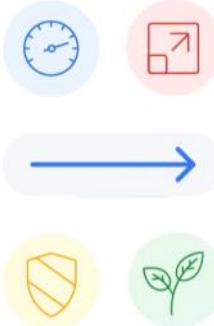
reports that are easy to understand and
share.



Looker



BigQuery



When data is in a database, a fair amount of effort and expertise might still be required to uncover insights.

00:06This goal can be achieved by using a business intelligence solution.

00:11However, the challenge that organizations often face is identifying the right business intelligence solution.

00:18Some solutions are too complex and not accessible by those outside the data engineering or data analysis teams.

00:24The this means other teams have to put in requests and wait for answers which defeats the purpose of gaining real-time insights.

00:32Other solutions let everyone in the business perform

their own data analysis, but they can only perform their analysis with a selection of the available data.

00:40This means that only a few people or possibly no one, has a full view of the organization's business data.

00:47Looker is a Google Cloud business intelligence platform designed to help individuals and teams analyze, visualize and share data.

00:55This includes creating interactive dashboards and reports that are easy to understand and share.

01:01By having a reliable authority for business data, anyone on a team can explore it, ask and answer their own questions, and create visualizations.

01:10This approach empowers organizations to not just uncover insights, but also act on them.

01:16Looker supports BigQuery, along with more than 60 different SQL databases.

01:22Together, BigQuery and Looker provide rich interactive dashboards and reports without compromising performance, scale, security or data freshness.

01:32Looker is also 100% web based, which makes it easy to integrate into existing workflows and share with multiple teams at an organization.

01:41So how can Looker be used?

01:43Let's explore an example.

01:45Diamond Resorts, a global leader in hospitality offers destinations, events and experiences to help people recharge, connect and enjoy.

01:55They had previously used a mixture of complex Excel workbooks and legacy BI tools to track important metrics.

02:02Each business unit operated and ran their own silo data initiatives.

02:06As a result, there were no common view of business or single authority for common metrics, redundant data engineering efforts.

02:15Because work was never shared or used across the organization, and inconsistent project prioritization because decisions were driven primarily on intuition as opposed to actual data.

02:27Also, infrastructure did not meet business requirements with executive reporting efforts that took months to complete.

02:35Data that was duplicative across multiple business units without proper governance, multiple reporting tools and data warehouses throughout the business.

02:44And infrastructure that didn't support advanced analytics aspirations.

02:49Diamond Resorts wanted to create a single common Cloud-based architecture that was fully managed.

02:54Establishing data governance and enabling the

business to be more data-driven while they set the foundation for advanced analytics efforts.

03:02They migrated to the Cloud and began using Looker to help improve business agility.

03:07This decision let them gain access to real-time insights in less than three months.

03:12It helped them to navigate COVID changes with important operational metrics such as daily booking and cancellations, while it also provided a 360 degree customer view.

03:23And in addition to this manual, reporting for the yield management team was decreased by hours each day.

03:29The Chief Information Officer said projects that we anticipated coming in future years were suddenly ready to be tackled within weeks.

03:37This is just one example of how an effective business intelligence solution can let businesses transform to better serve their customers.

Streaming analytics

Data traditionally is moved in batches.

00:02Batch processing often processes large volumes of data at the same time with long periods of latency.

00:09An example is payroll and billing systems that have to be processed on either a weekly or monthly basis.

00:16Although this approach can be efficient to handle large volumes of data, it doesn't work with time

00:21sensitive data that's meant to be streamed because that data can be stale by the time it's processed.

00:27Streaming analytics is the processing and analyzing of data records continuously instead of in batches.

00:34Generally, streaming analytics is useful for all types of data sources that send data in small sizes, often in kilobytes, in a continuous flow as the data is generated.

00:45This results in the analysis and reporting of events as they happen.

00:49Sources of streaming data include equipment sensors, clickstreams, social media feeds, stock market quotes, app activity, and more.

00:59Companies use streaming analytics to analyze data in real time and provide insights into a wide range of activities such as metering, server activity, geolocation of devices or website clicks.

01:12Use cases include e-commerce.

01:15User clickstreams can be analyzed to optimize the shopping experience with real time pricing,

promotions, and inventory management.

01:23Financial services.

01:25Account activity can be analyzed to detect abnormal behavior in the data stream and generate a security alert.

01:32Investment services.

01:34Market changes can be tracked in settings adjusted to customer portfolios based on configure constraints such as selling when a certain stock value is reached.

01:44News media.

01:44User click records can be streamed from various news source platforms, and the data can

01:50be enriched with demographic information to better serve articles that are relevant to the targeted audience.

01:56Utilities.

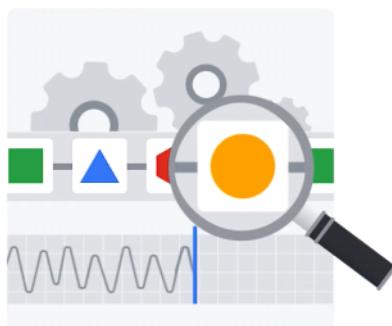
01:56Throughput across a power grid can be monitored and alerts generated, or workflows initiated when established thresholds are reached.

02:06Google Cloud offers two main streaming analytics products to ingest, process, and analyze event streams in real time, which makes data more useful and accessible from the instant it's generated.

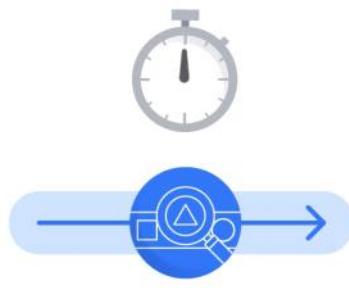
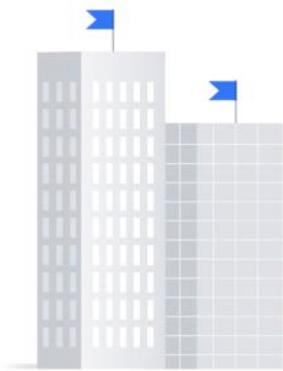
02:18Pub/Sub ingests hundreds of millions of events per second, but data flow unifies streaming in batch data analysis and builds cohesive data pipelines.

02:28A data pipeline represents a series of actions or stages that ingest raw data from different sources and then move that data to a destination for storage and analysis.

02:39You'll explore these products in more detail in the next section.



Streaming analytics is the processing and analyzing of data records **continuously** instead of in batches.



Streaming analytics



metering



server activity

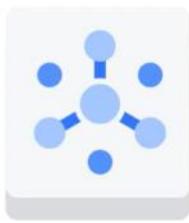


geolocation
of devices



website clicks

Pub/Sub



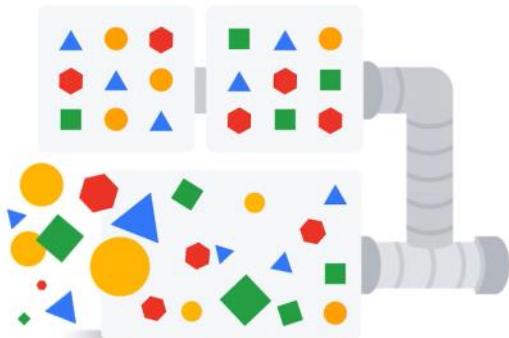
Ingests hundreds of millions
of events per second

Dataflow



Unifies streaming and batch
data analysis and builds
cohesive **data pipelines**

**batch data analysis and builds
cohesive data pipelines.**



Data pipeline

A series of actions, or stages, that ingest raw data from different sources and then move that data to a destination for storage and analysis.

from different
sources and then move

Pub/Sub and Dataflow

One of the early stages in a Data pipeline is Data Ingestion, which is where large amounts of streaming data are received.

00:07 Data, however, might not always come from a single structured database.

00:11 Instead, the data might stream from a thousand or even a million different events that are all happening asynchronously.

00:18 A common example of this data is from IoT, or Internet of Things applications.

00:24 These can include sensors on taxis that send out location data every 30 seconds or temperature sensors around a data center to help optimize heating and cooling.

00:34 Pub/Sub is a distributed messaging service that can receive messages from various device streams, such as gaming events, IoT devices, and application streams.

00:44 The name is short for Publisher/Subscriber or Publish messages to subscribers.

00:50 After messages have been captured

from the streaming input sources, you need a way to pipe that data into a data warehouse for analysis.

00:58This is where Dataflow comes in.

01:01Dataflow creates a pipeline to process both streaming data and Batch Data.

01:05Process, in this case, refers to the steps to extract, transform, and load data, sometimes referred to as ETL.

01:14A popular solution for pipeline design is Apache Beam.

01:18It's an open source, unified programming model to define and execute data processing pipelines, including ETL, batch, and stream processing.

01:27Dataflow handles much of the complexity for infrastructure setup and maintenance and is built on Google's infrastructure.

01:34This product allows for reliable auto scaling to meet data pipeline demands.

01:39Dataflow is serverless and fully managed.

01:42Serverless computing means that software developers can build and run applications without having to provision or manage the backend infrastructure.

01:50For example, Google Cloud manages infrastructure tasks on behalf of the users, like resource provisioning, performance tuning, and ensuring pipeline reliability.

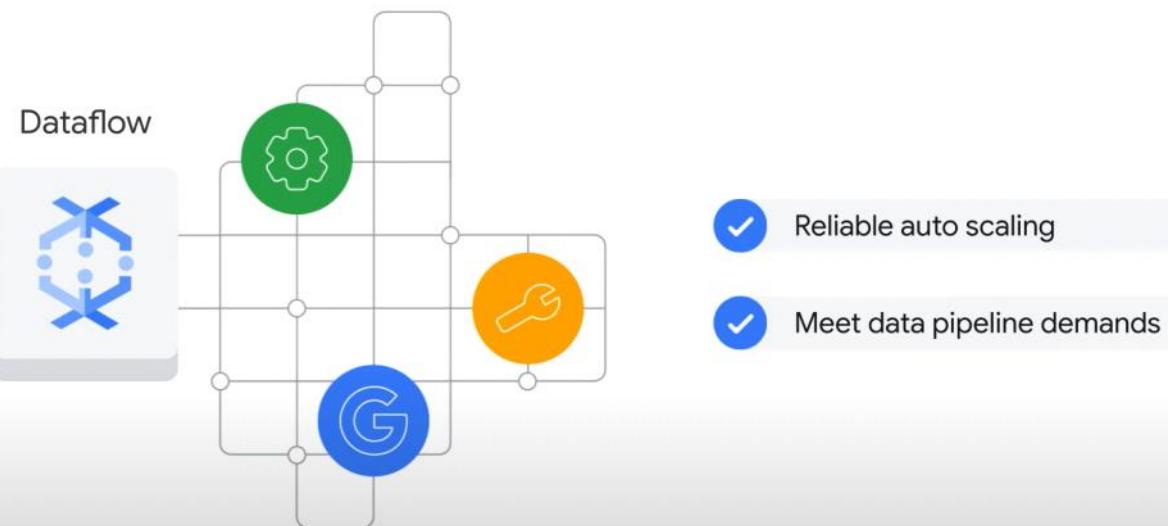
02:00And a fully managed environment is one where software can be deployed, monitored, and managed without needing an operations team.

02:07You can create this environment by using automation tools and technologies.

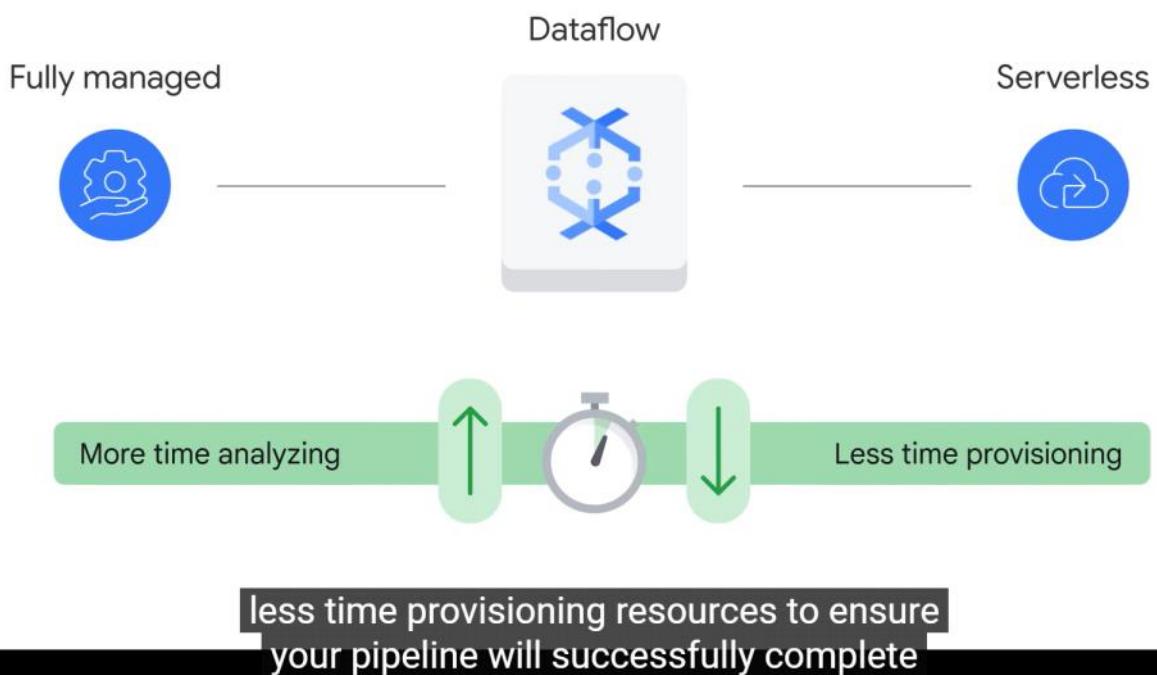
02:12Using a serverless and fully managed solution like Dataflow means that you can

spend more time analyzing the insights from your datasets and less time provisioning resources to ensure your pipeline will successfully complete its next cycles.

[navigate_before](#)[Previous](#)[Next](#)[navigate_next](#)



This product allows for reliable auto scaling to meet data pipeline demands.



Streaming analytics is the processing and analyzing of data records continuously instead of in batches. Which option is a source of streaming data?

- Payroll records
- checkTemperature sensors
- Customer email addresses
- Medical test results

That is the correct answer!

check
2.

What does ETL stand for in the context of data processing?

- Enhanced transaction logic
- Enrichment, tagging, and labeling
- checkExtract, transform, and load
- Event-time logic

That is the correct answer!

check
3.

What feature of Looker makes it easy to integrate into existing workflows and share with multiple teams at an organization?

- It supports over 60 different SQL databases.
- It's cost effective.

It creates easy to understand visualizations.
checkIt's 100% web based.

That is the correct answer!

check
4.

What Google Cloud business intelligence platform is designed to help individuals and teams analyze, visualize, and share data?

- Dataplex
- Dataflow
- checkLooker
- Cloud Storage

That is the correct answer!

check
5.

Which statement is true about Dataflow?

- It's a messaging service for receiving messages from various device streams.

It allows easy data cleaning and transformation through visual tools and machine learning-based suggestions.

It's a cloud-based data warehouse for storing and analyzing streaming and batch data.

checkIt handles infrastructure setup and maintenance for processing pipelines.

That is the correct answer!

check
6.

What is Google Cloud's distributed messaging service that can receive messages from various device streams such as gaming events, Internet of Things (IoT) devices, and application streams?

- checkPub/Sub
- Dataplex
- Looker
- Dataproc

That is the correct answer!

Innovating with Google Cloud Artificial Intelligence

Course Introduction

AI and ML defined

People commonly use the terms artificial intelligence, AI, and machine learning, ML interchangeably.

00:07The confusion is understandable because artificial intelligence and machine learning are closely related.

00:14However, these trending technologies differ in several ways, including scope and application.

00:20Before we advance, let's define each of the terms.

00:25Artificial intelligence is a broad field which refers to the use of technologies to build machines and computers that can mimic cognitive functions associated with human intelligence.

00:37These functions include, being able to see, understand, and respond to spoken or written language, analyze data, make recommendations and more.

00:49Although artificial intelligence is often thought of as a system in itself, it's a set of

00:53technologies implemented in a system to let it reason, learn, and act to solve a complex problem.

01:01Machine learning is a subset of AI that lets a machine learn from data without being explicitly programmed.

01:09It relies on various models to analyze large amounts of data, learn from the insights, and then make predictions and informed decisions.

01:18Machine learning algorithms improve performance over time as they are trained or exposed to more data.

01:25Machine learning models at the output, or what the program learns from running an algorithm on training data.

01:32When more data is used, the model improves.

01:36One helpful way to remember the difference between the two is to imagine them as umbrella categories.

01:42Artificial intelligence is the overarching term that covers a variety of specific approaches and algorithms.

01:49Machine learning sits beneath that umbrella, but so do other major sub fields such as deep learning, robotics, expert systems, and natural language processing.

02:01Another area of AI you may be hearing a lot about is generative AI.

02:06This is a type of artificial intelligence that can produce new content, including text, images, audio, and synthetic data.

02:15Google applies generative AI to products like Google Workspace to help users easily automate different types of tasks, like generating summaries of long documents.

02:26Google also provides development tool kits, such as generative AI APIs to developers to help them create customized products and services.

02:35Generative AI can be used in a variety of applications, such as conversational bots, content generation, document synthesis, and product discovery.



The use of technologies to build machines and computers that are able to mimic cognitive functions associated with human intelligence.

Artificial intelligence



analyze data, make
recommendations and more.



Machine learning

A subset of AI that enables a machine to learn from data without being explicitly programmed.

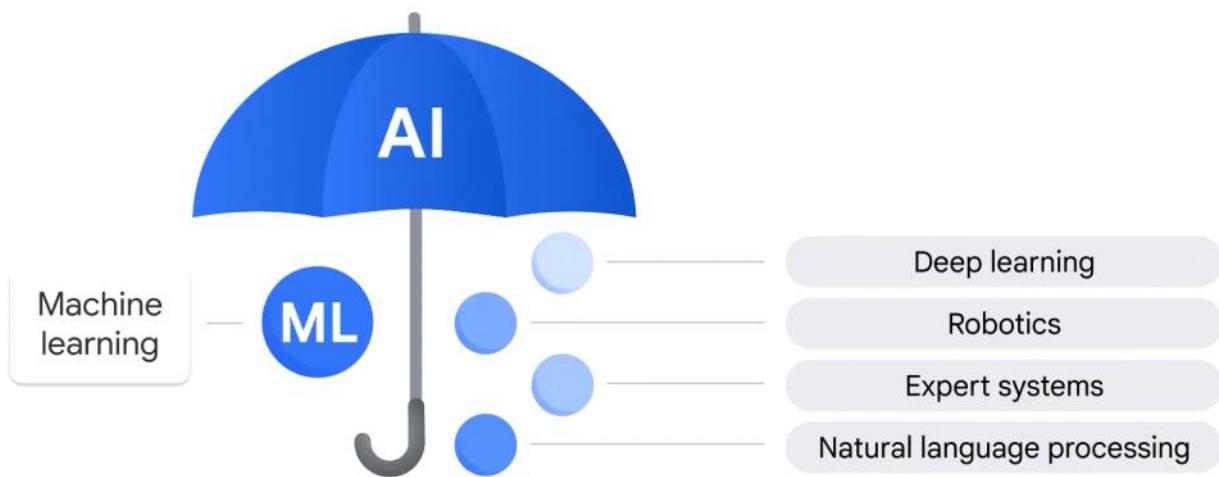




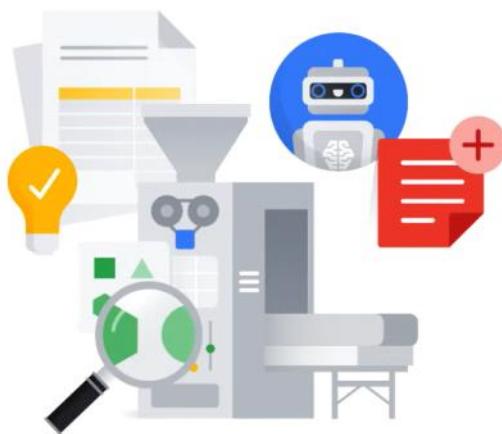
It relies on various models to:

- ✓ Analyze large amounts of data
- ✓ Learn from the insights
- ✓ Make predictions and informed decisions

make predictions and informed decisions.



and natural language processing.



Generative AI can be used in:

- Conversational bots
- Content generation
- Document synthesis
- Product discovery

and product discovery.

Problems that ML is suited to solve

Machine learning lets computer systems continuously adjust and enhance themselves as they accrue more experiences.

00:07

For this reason, when more data is put into them, the results are more accurate.

00:12

With this in mind, ML is suited to solve four common business problems.

00:17

The first is replacing or simplifying rule based systems.

00:22

Let's use Google Search as an example.

00:26

Suppose you want to search for the Giants, a US sports team.

00:30

If you type in Giants, should the search results show you the San Francisco Giants or the New York Giants?

00:37

One's a baseball team based in California and the other is an American football team based in New York.

00:44

In years gone by, the search engine used hand coded rules to decide which sports team to show user.

00:51

If the query is Giants and the user is in the Bay Area, show them results about San Francisco Giants.

00:58

If the user is in the New York area, show them results about NY Giants.

01:04

If the user is anywhere else, show them results about tall people.

01:09

This was for just one query.

01:11

If you multiply this process by millions of different queries and users each day, you can probably imagine how complex the whole code base became.

01:20

This is a perfect problem for ML to solve.

01:23

If all the data that's available shows which search results users clicked on per query, a machine learning model can be trained to predict the rank for search results.

01:33

A second business problem ML can help solve relates to automating processes.

01:40

ML is designed to make predictions and repeated decisions at scale.

01:45

Let's explore another example, this time from a property developer headquartered in Thailand called Ananda Development.

01:52

For every sale, both an Ananda Development inspector and the buyer have to conduct a detailed check of the property.

02:00

This was a manual, time-consuming process that was prone to much human error.

02:05

Inspectors would visually check hundreds of items a day for problems, list any issues on paper and then photograph the findings.

02:14

Multiplied across several projects, this workload adds up.

02:18

Ananda Development decided to create a mobile application to make this process more efficient.

02:24

Inspectors would verbally describe defects and critical issues to the application that ran on their smartphones.

02:30

The application would then track and document the inspection results.

02:35

In planning the application, the business realized it would need to recognize and convert to text, Thai language, speech and a version of English spoken by many Thai people.

02:45

They decided to automate this process using Google's speech-to-text API.

02:51

Furthermore, Ananda Development wanted to establish a pathway to use machine learning to complete condominium inspections by using remotely piloted drones.

03:00

They decided to automate that process by using the Cloud Vision API to capture images of defects and automatically classify information about each one.

03:11

Within three months of implementation, Ananda Development had saved around 130 hours of inspection time and over 100,000 US dollars in manpower costs.

03:22

The inspection process is now more efficient and accurate.

03:26

And as another benefit, buyers also receive copies of electronic inspection reports and updated status notes as defects are repaired.

03:35

So far, you heard about ML problems that use structured data to make predictions at scale.

03:41

A third type of business problem that ML can help solve is understanding unstructured data like images, videos, and audio.

03:50

This example comes from Ocado, one of the world's largest online only grocery supermarkets.

03:56

Previously, when Ocado received emails, they would all go to a central mailbox for sorting and forwarding by a human.

04:03

This process was time-consuming and led to a poor customer experience.

04:08

To improve and scale this process, Ocado used ML's ability to process natural language to identify the customer's

04:13

sentiment and the topic of each message, so that they could route it immediately to the relevant department.

04:21

This eliminated multiple rounds of reading and triaging, and ultimately improved customer satisfaction, and retention.

04:28

And finally, there's personalization.

04:32

Many businesses use ML to personalize user experiences and YouTube is a great example of personalization in action.

04:40

When you watch a video on YouTube, you've probably noticed there's a list of recommended videos that are up next.

04:46

When your video finishes, a new video will play and YouTube wants it to be interesting and useful for you.

04:53

By using ML to provide personalized recommendations, YouTube can deliver a better customer experience.

05:01

Many businesses use this same approach to surface product recommendations on their websites that are personalized to individual users.

05:08

Other businesses use personalization to surface new content like music recommendations or films to stream.

05:16

It's important to remember that ML models aren't standalone solutions and that solving complex business challenges requires combinations of models.

05:25

There are of course, many more applications of machine learning for businesses and you can learn even more about them in our machine learning courses.



Automate
processes

ML is designed to make
predictions and repeated
decisions at scale.

**ML is designed to make predictions and
repeated decisions at scale.**

Why ML requires high-quality data

Data is used by machine learning models to derive predictive insights and make repeated decisions.

00:05However, the accuracy of those predictions relies on large volumes of data that is correct and free of errors.

00:13Data is considered low quality if it's not aligned to the problem, or is biased in some way.

00:18If you feed an ML model low quality data, it's like teaching a child with incorrect information.

00:25An ML model can't make accurate predictions by learning from incorrect data.

00:30So, how can you ensure that you have quality data when training an ML model?

00:36To assess its quality, data is evaluated against six dimensions.

00:40Completeness, uniqueness, timeliness, validity, accuracy, and consistency.

00:49Let's explore what each of these mean in more detail.

00:53The completeness of data refers to whether all the required information is present.

00:58If the data is incomplete, then the model will not learn all the patterns that are necessary to make accurate predictions.

01:05Take, for example, the training of an ML model that's reliant on a data set of customer transactions.

01:11If some transactions are missing critical information, such as the date of the transaction, the accurate training of the model will be affected.

01:19Data should be unique.

01:21If a model is trained on a data set with a high number of duplicates, the ML model may not be able to learn accurately.

01:27This is because it will be confused by the duplicate records and won't be able to accurately identify patterns.

01:34For example, if you're training a model to identify a breed of dog from a photo, it's important to have images of many different unique breeds.

01:42If the data set contains many thousands of images, but most of them are just

01:46photos of Labradors, the model will find it difficult to correctly identify most other breeds accurately.

01:52The timeliness of the data refers to whether the data is up-to-date and reflects the current state of the phenomenon that's being modeled.

02:00If the data is not timely, then the model might be making predictions based on outdated or irrelevant information.

02:07Training an ML model to predict stock market fluctuations might rely on a data set of stock prices.

02:12If the data is several months old, it's untimely for making current predictions.

02:18Validity means the data conforms to a set of predefined standards and definitions, such as type and format.

02:26Validity also ensures that data is in an acceptable range.

02:29An example of invalid data is a date of 08-12-2019, when the standard format is defined as year, month, and date.

02:40Accuracy reflects the correctness of the data, such as the correct birth date or the accurate number of units sold.

02:46For example, in a data set of images, some images might be labeled as dogs when they actually show cats.

02:54Note how accuracy is different from validity.

02:57Whereas validity focuses on type, format, and range, accuracy is focused on form and content.

03:04Finally, the consistency of the data refers to whether the data is uniform and doesn't contain any contradictory information.

03:12If data is inconsistent, then an ML model might be unable to make accurate predictions.

03:18If the same entity appears with different names or values across different parts of the data, it would lead to inconsistent data.

03:26For example, in a dataset of customer information, the same customer might appear as John Smith in one place, and J.Smith in another.

03:35Remember, data is the only lens through which a model views the world.

03:40Anything the model can't see, it assumes doesn't

exist.

03:44 So it's your responsibility to provide the model with complete and correct data.

03:49 The good news is that most of these problems can be solved simply by getting more high quality data, but you have to be purposeful in collecting that data.



Completeness



Uniqueness



Timeliness



Validity



Accuracy



Consistency



Completeness

The completeness of the data refers to whether all the required information is present.



Data should be unique.

Unique



The data is up-to-date and reflects
the current state of the phenomenon
that is being modeled

Timeliness



The data conforms to a set of
predefined standards and definitions
such as type and format

Validity

Validity means the data conforms to
a set of predefined standards and



Accuracy reflects the correctness of the data

Accuracy



Accuracy

Accuracy

Form

Content



Validity

Type

Format

Range



Consistency

Consistency of the data refers to whether the data is uniform and doesn't contain any contradictory information

Important of responsible

AI has significant potential to help solve challenging problems, including advancing medicine, understanding language, and fueling scientific discovery.

00:09To realize that potential, it's critical that AI is used responsibly.

00:14To that end, Google has established principles that guide Google AI applications, best practices to share our work with communities outside of Google and programs to operate rationalize our efforts.

00:27The principles state that **AI should be socially beneficial, avoid creating or reinforcing unfair bias, be built**

00:34**and tested for safety, be accountable to people, incorporate privacy design principles, uphold high standards of scientific excellence.**

00:46**And be made available for uses that accord with these principles.**

00:50In addition to these principles, Google will not design or deploy AI in the following application areas.

00:57Technologies that cause or are likely to cause overall harm.

01:01Weapons or other technologies whose principal purpose or implementation is to cause or directly facilitate injury to people.

01:09Technologies that gather or use information for surveillance, violating internationally accepted norms.

01:15And technologies whose purpose contravenes widely accepted principles of international law and human rights.

01:23Although these are Google's own guiding AI principles, we urge other organizations to develop their own set of principles that encourage responsible AI development.

01:33It's also important for organizations to debug and improve ML model performance and help others understand their model's behavior.

01:41Organizations building ML models also need help with detecting and resolving bias, drift, and other gaps in their data and models.

01:50In addition, having human interpretable explanations of your ML models will help grow end-user trust and improve transparency.

01:58**Explainable AI is Google Cloud's set of tools and frameworks to help you understand and interpret predictions made by your machine learning models.**

02:07These tools are natively integrated with several Google products and services to ensure transparent AI development.

navigate_beforePreviousNextnavigate_next



Responsible AI

-
-
-

- Principles that guide Google AI applications
- Best practices to share our work with communities outside of Google
- Programs to operationalize our efforts

Which use case demonstrates ML's ability to process natural language?

Detecting people and objects in surveillance footage to use as evidence in criminal cases.

Identifying the artist, title, or genre of a song to create playlists based on the user's listening habits.

Check Identifying the topic and sentiment of customer email messages so that they can be routed to the relevant department.

Segmenting images into different parts or regions to extract information, such as the text on a sign.

That is the correct answer!

check

2.

What does the consistency dimension refer to when data quality is being measured?

Whether a dataset is free from duplicate values that could prevent an ML model from learning accurately.

Whether the data is up-to-date and reflects the current state of the phenomenon that is being modeled.

Whether all the required information is present.

check Whether the data is uniform and doesn't contain any contradictory information.

That is the correct answer!

check

3.

Google's AI principles are a set of guiding values that help develop and use artificial intelligence responsibly. Which of these is one of Google's AI principles?

AI should create or reinforce unfair bias.

AI should be made available for any use.

check AI should be socially beneficial.

AI should be accountable to other machines.

That is the correct answer!

check

4.

Google applies generative AI to products like Google Workspace, but what is generative AI?

A type of artificial intelligence that can understand and respond to human emotions.

A type of artificial intelligence that can make decisions and take actions.

check A type of artificial intelligence that can produce new content,

including text, images, audio, and synthetic data.

A type of artificial intelligence that can create and sustain its own consciousness.

That is the correct answer!

check

5.

You're watching a video on YouTube and are shown a list of videos that YouTube thinks you are interested in. What ML solution powers this feature?

Video transcription

Clickbait detection

checkPersonalized recommendations

Content moderation

That is the correct answer!

check

6.

Which option refers to the use of technologies to build machines and computers that can mimic cognitive functions associated with human intelligence?

Machine learning

Deep learning

checkArtificial intelligence

Natural language processing

That is the correct answer!

check

7.

How do data analytics and business intelligence differ from AI and ML?

Data analytics and business intelligence are used only in small businesses, whereas AI and ML are used exclusively by large corporations.

Data analytics and business intelligence involve advanced algorithms for predicting future trends, whereas AI and ML focus on processing historical data.

checkData analytics and business intelligence identify trends from historical data, whereas AI and ML use data to make decisions for future business.

Data analytics and business intelligence use automated decision-making processes, whereas AI and ML require human intervention and interpretation of data.

That is the correct answer!

check

8.

Artificial intelligence is best suited for replacing or simplifying rule-based systems. Which is an example of this in action?

Using a reinforcement learning algorithm to train autonomous drones for package delivery.

Using AI to replace a human decision-maker in complex situations, such as those involving life-or-death choices.

Implementing AI to develop a new product or service that has never been seen before.

checkTraining a machine learning model to predict a search result ranking.

That is the correct answer!

check

9.

Which technology relies on models to analyze large amounts of data, learn from the insights, and then make predictions and informed decisions?

Robotics

checkMachine learning

Expert systems

Natural language processing

That is the correct answer!

check

10.

Which dimension for measuring data quality means that the data conforms to a set of predefined standards and definitions such as type and format?

Consistency

Uniqueness

checkValidity

Accuracy

That is the correct answer!

Google Cloud's AI and ML Solutions

Introduction

ML options on Google Cloud

01 BigQuery ML	02 Pre-trained APIs	03 AutoML	04 Custom training
Use SQL queries to create and execute machine learning models in BigQuery.	Leverage ML models that have already been built and trained by Google.	A no-code solution to build ML models on Vertex AI.	Code your own ML environment to have the control over the ML pipeline.

machine learning environment, the training, and the deployment,

Historically, artificial intelligence and machine learning were not accessible to ordinary people.

00:05 Most of the people capable of developing AI and ML solutions were specialty engineers, who were scarce in number and expensive to hire.

00:14 The reality is that ML is more accessible now than ever before, which allows more people to build, even those without the technical expertise.

00:23 Google Cloud offers four options for building machine learning models.

00:28 The first option is BigQuery ML.

00:30 This is a tool for using SQL queries to create and

execute machine learning models in BigQuery.

00:36If you already have your data in BigQuery and your problems fit the predefined ML models, this could be your choice.

00:43The second option is to use pre trained APIs, or application programming interfaces.

00:49This option lets you use machine learning models that were built and trained by Google, so you don't have

00:53to build your own ML models if you don't have enough training data or sufficient machine learning expertise in house.

01:01The third option is AutoML, which is a no code solution, letting you build your own machine learning models on Vertex AI through a point and click interface.

01:11And finally, there's custom training through which you can code your very own machine learning environment,

01:16the training, and the deployment, which gives you flexibility and provides control over the ML pipeline.

01:24In this second section of the course, you'll learn more about these four options for building machine learning models, and you'll also learn about some of Google's other AI solutions.

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[BigQuery ML](#)

Machine learning on large data sets requires extensive programming and knowledge of ML frameworks.

00:06These requirements restrict solution development to a very small set of people within each company, and

00:11they exclude data analysts who understand the data but have limited machine learning knowledge and programming expertise.

00:18Although BigQuery started solely as a data warehouse, over time it has evolved to provide additional features that support the data to AI life cycle.

00:27BigQuery ML democratizes the use of machine learning by empowering data analysts, but primary data warehouse users, to build and run models by using existing business intelligence tools and spreadsheets.

00:40Predictive analytics can guide business decision making across the organization.

00:45Using Python or Java to program an ML solution isn't necessary.

00:50Models are trained and access directly in BigQuery by using SQL, which is a language familiar to data analysts.

00:57 BigQuery ML brings machine learning to the data.

01:01 It reduces complexity because fewer tools are required.

01:05 It also increases speed of production because moving and formatting large amounts of data for Python-based ML frameworks is not required for model training in BigQuery.

01:16 BigQuery ML also integrates with Vertex AI, Google Cloud's end to end AI and ML platform.

01:23 When BigQuery ML models are registered to the Vertex AI model registry, they can be deployed to endpoints for online prediction.



✓ Extensive programming

✓ Knowledge of ML frameworks

extensive programming and knowledge of ML frameworks.

✓ Can be deployed to endpoints for online prediction



BigQuery ML model



Vertex AI Model Registry

Registration

Pre-trained APIs



- ✓ The **Cloud Translation API** converts text from one language to another.
- ✓ The **Speech-to-Text API** converts audio to text for data processing.
- ✓ The **Text-to-Speech API** converts text into high-quality voice audio.
- ✓ And the **Video Intelligence API** recognizes motion and action in video.

And the video intelligence API

Google Cloud's pre trained API's are a great option if you don't have your own training data.

00:05 These are ideal in situations where an organization doesn't have specialized data scientists, but it does have business analysts and developers.

00:13 This is the fastest and lowest effort of the machine learning approaches, but is less customizable than the others.

00:20 Google Cloud's pre trained API's can help developers build smart apps quickly by providing access to ML models for common tasks like analyzing images, videos, and text.

00:32 API's can be deployed in a **virtual private cloud**, **on premises**, or in Google's **public cloud** regardless of the level of ML experience.

00:41 Let's imagine a developer building a mobile app that users will submit photos to the developer needs

00:47 the app to recognize what the images are and filter out any that aren't safe for work.

00:53 The developer might choose Vision API.

00:56 This offers powerful, pre trained machine learning models, which use Google data to automatically detect faces, objects, text, and even sentiment in images.

01:07 The developer can use Vision API to assign labels to images and quickly classify them into millions of predefined categories.

01:16 The natural language API is another out of the box, pre trained API.

01:21 If a business has a contact form on its website that receives many messages every day.

01:26 This data can be difficult and time intensive to manually handle, categorize an action.

01:32 Natural language API discovers syntax, entities and sentiment in text and classifies texts into a predefined set of categories.

01:41 In this case, it can decide if comments represent complaints, Praise, and attempt to learn more about your business and more.

01:49 Google also offers several other pre trained API's.

01:54 The Cloud Translation API converts texts from one language to another.

01:59 The speech to text API converts audio to text for data processing.

02:05 The text to speech.

02:05 API converts text into high quality voice audio.

02:10 And the video intelligence API recognizes motion and action in video.

02:16 How well a machine learning model is trained depends on how much data is available to train it.

02:22 As you might expect, Google has lots of images, texts and ML researchers to train its pre trained models.

02:29 This means less work for you and a faster return on your investment.

AutoML

Another more custom way to use machine learning to solve problems is to train models by using your own data.

00:06 This is where Vertex AI comes in.

00:08 Vertex AI brings together Google Cloud services for building ML under one unified user interface.

00:16 You can use your own training data with Vertex AI to manage and build ML projects.

00:22 AutoML and Vertex AI lets you build and train

machine learning models from end to end by using graphical user interfaces.

00:30Often referred to as GUIs without writing a line of code.

00:34This means that after your data is ingested into Vertex AI, AutoML chooses the best machine learning model for you by comparing different models and tuning parameters.

00:44What once required, a lot of manual work is done automatically and quickly, which results in a trained model that is both accurate and customized to your data.

00:53This lets machine learning practitioners focus on the problems that they are trying to solve.

00:57Instead of the details of machine learning.

01:00AutoML is a great option for businesses that want to produce a customized ML model,

01:05but are not willing to spend too much time coding and experimenting with thousands of models.

01:10Let's go back to our image recognition example, which used Vision API, a pre-existing model trained with Google data.

01:18Imagine you work for a car manufacturing company.

01:21Vision API can tell you the difference between generic images found in Google databases, like the difference between a wheel and a door.

01:28But it can't help a car manufacturer distinguish between good or defective parts.

01:33In this case, a developer could use an AutoML vision instance and train it with your specialized data.

01:40This automates the training of machine learning models, which means that you could upload a batch

01:44of images and train an image classification model through the easy to use graphical interface of AutoML.

01:50Models can be further optimized and deployed directly from the cloud.

01:56Now let's focus on another feature of AutoML.

02:00Earlier you saw how the natural language API could be used for processing entries into an online contact form.

02:06But if your text examples don't fit neatly into the natural language API, sentiment based or vertical topic based

02:11classification scheme, and you want to use your own specialized data instead, you need to use AutoML natural language.

02:19AutoML natural language lets you build and deploy custom machine learning models.

02:24The analyzed documents, categorize them, identify entities within them, or assess attitudes within them.

02:32You can use the AutoML user interface to upload your

training data and test your custom model without a single line of code.

02:39Vertex AI makes this customization possible.

02:43Those examples are just a few of the many Google Cloud ML offerings.

02:47You can also find APIs that categorize videos, convert audio to text, or text to audio, understand natural language, translate from one language to another, and more.

02:59In fact, in many of the most innovative applications for machine learning, several of these applications are combined.

Custom models

Vertex AI is also the essential platform for creating custom end to end machine learning models.

00:05This means not only are models trained with your own data, but the models are custom built as well.

00:12Vertex AI provides a suite of products to help at each stage of the ML

00:16workflow, from gathering data to future engineering, building models, and finally, deploying and monitoring those models.

00:25As this approach is fully custom built, end to end, its process takes the longest and requires a specialized team of data scientists and engineers.

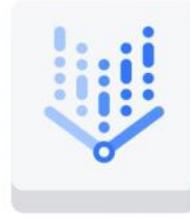
00:34However, these fully custom ML models are the most specialized to your needs, and give your business the most differentiation and innovative results.

00:43Vertex AI contains tools that assist programmers with virtual machine imaging in data labeling, training, and predictions.

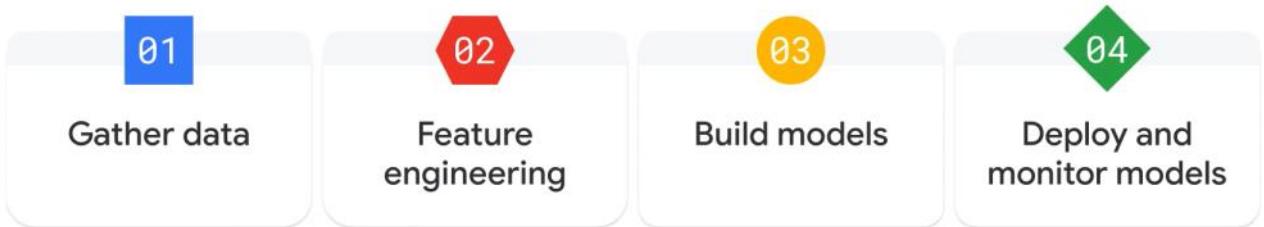
00:51It also provides pre-built algorithms.

00:54It's important to remember that although these tools are the building blocks to using your data at every stage, there is no one size fits all approach.

01:03Every use case requires a different combination of tools and products.



Vertex AI



TensorFlow

All Machine Learning models are built on top of Google Cloud's AI foundational infrastructure.

00:05A part of this foundation is TensorFlow, which is an end to end open source platform for machine learning.

00:12TensorFlow has a flexible ecosystem of tools, libraries, and community resources that enable researchers to innovate in ML and developers to build and deploy ML powered applications.

00:24First developed for Google's Internal use, TensorFlow is now open source so that everyone can benefit.

00:31TensorFlow takes advantage of the Tensor Processing Unit, or TPU, which is Google's custom developed application specific integrated circuit used to accelerate machine learning workloads.

00:43TPUs act as domain specific hardware as opposed to general purpose hardware with CPUs and GPUs.

00:51With TPUs, the computing speed increases more than 200 times.

00:56This means that instead of waiting 26 hours for results with a state of the art GPU, you

01:01only need to wait for 7.9 minutes for a full cloud TPU pod to deliver the same results.

01:08Cloud TPUs have been integrated across Google products, and this state of the art hardware and supercomputing technology is available with Google Cloud products and services.



Enable researchers to innovate in ML



Enable developers to build and deploy
ML powered applications



TensorFlow

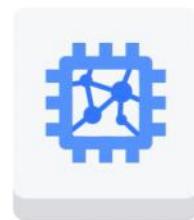
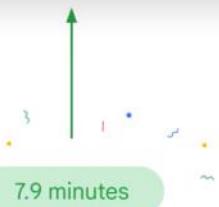
developers to build and
deploy ML powered applications.



TensorFlow



Watch later Share



Tensor Processing Unit



CPU / GPU

7.9 minutes for a full cloud TPU
pod to deliver the same results.

**ASIC**

Google's custom-developed application-specific integrated circuit

**Tensor Processing Unit****TensorFlow**

integrated circuit used to accelerate machine learning workloads.

AI solutions

Beyond the customizable options, Google Cloud has also created a set of full AI solutions aimed to solve specific business needs.

00:09 Contact Center AI provides models for speaking with customers and assisting human agents, increasing operational efficiency, and personalizing customer care to transform your contact center.

00:21 Document AI unlocks insights by extracting and classifying information from unstructured documents such as invoices, receipts, forms, letters, and reports.

00:34 The extracted data can then be saved in a database or exported to another application for further analysis.

00:41 Discovery AI for retail uses machine learning to select the optimal ordering of products on a retailer's e-commerce site when shoppers choose a category like winter jackets or kitchen ware.

00:53 Over time, the AI learns the ideal product ordering for each page on the site by using

00:58 historical data, optimizing how and what products are shown for accuracy, relevance, and likelihood of making a sale.

01:06 And Cloud Talent Solution uses AI with job search and talent acquisition capabilities, matches candidates to ideal jobs faster, and allows employers to attract and convert higher quality candidates.

01:19 These are just some of the fully built AI solutions offered by Google Cloud.

[Considerations when selecting Google Cloud AI/ML solutions](#)

Google Cloud offers a range of AI and ML solutions and products, but there are several decisions and trade-offs to consider when selecting which to employ.

00:09The first consideration is speed.

00:12How quickly do you need to get your model to production?

00:15AI projects can typically take anywhere 3-36 months to plan and implement, depending on the scope and complexity of the use case.

00:23But business decision makers often underestimate the time it will take.

00:27Pre-trained API's require no model training, because that time-consuming task has already been carried out.

00:34Custom training usually takes the longest time because it builds the ML model from the beginning, unlike autoML and Big query ML.

00:42The next consideration is differentiation.

00:46How unique is your model, or how unique does it need to be?

00:50Google Cloud offers a range of out of the box solutions for organizations that want to quickly use ML models in their day to day business operations.

00:58These include image recognition solutions and chatbots, which are quick to deploy and can be applied in various use cases.

01:06Alternatively, Vertex AI, which is Google Cloud's unified platform for building, deploying, and managing AI solutions, can give ML engineers and data scientists full control of the ML workflow.

01:19Vertex AI custom training lets you train and serve custom models with code on vertex workbench, which results in highly bespoke ML models.

01:28Another consideration is the expertise required when embarking on an AI or ML project.

01:34Infusing AI into business processes requires roles such as data engineers, data scientists, and machine learning engineers among others.

01:43Organizations should consider their current team and then determine a people strategy, which could include reusing or

01:49repurposing existing resources, upskilling and training current staff, or hiring or working with outside consultants or contractors.

01:58Google Cloud's AI and ML products vary from those that can be employed by data analysts

02:04and business intelligence teams, right up to those more suited to ML engineers and data scientists.

02:10The final consideration is the effort required to build an AI solution.

02:15This depends on several factors, including the complexity of the problem, the amount of data available, and the experience of the team.

02:23Google Cloud can help provide solutions for projects at both ends of the scale.

02:28However, any AI undertaking will generally require much time, effort, and expertise to have a worthwhile impact on business operations.

Which Google Cloud AI solution is designed to help businesses improve their customer service?

Document AI

checkContact Center AI

Discovery AI for Retail

Cloud Talent Solution

That is the correct answer!

check

2.

A large media company wants to improve how they moderate online content. Currently, they have a team of human moderators that review content for appropriateness, but are looking to leverage artificial intelligence to improve efficiency. Which of Google's pre-trained APIs could they use to identify and remove inappropriate content from the media company's website and social media platforms.

Speech-to-Text API

checkNatural Language API

Vision API

Video Intelligence API

That is the correct answer!

check

3.

Which feature of Vertex AI lets users build and train end-to-end machine learning models by using a GUI (graphical user interface), without writing a line of code.

MLOps

Managed ML environment

Custom training

checkAutoML

That is the correct answer!

check

4.

Google Cloud offers four options for building machine learning models.

Which is best when a business wants to code their own machine learning environment, the training, and the deployment?

Pre-trained APIs

AutoML

BigQuery ML

checkCustom training

That is the correct answer!

check

5.

What's the name of Google's application-specific integrated circuit (ASIC) that is used to accelerate machine learning workloads?

checkTensor Processing Unit (TPU)

Graphic Processing Unit (GPU)

Vertex Processing Unit (VPU)

Central Processing Unit (CPU)

That is the correct answer!

check

6.

Which Google Cloud AI solution is designed to help businesses automate document processing?

Discovery AI for Retail

Cloud Talent Solution

Contact Center AI

checkDocument AI

That is the correct answer!

check

7.

BigQuery ML is a machine learning service that lets users:

checkBuild and evaluate machine learning models in BigQuery by using SQL.

Build and evaluate machine learning models in BigQuery by using Python and Java.

Seamlessly connect with a data science team to create an ML model.

Export small amounts of data to spreadsheets or other applications.

That is the correct answer!

check

8.

An online retailer wants to help users find specific products faster on their website. One idea is to allow shoppers to upload an image of the product they're looking to purchase. Which of Google's pre-trained APIs could the retailer use to expand this functionality?

Natural Language API

Speech-to-Text API

checkVision API

Video Intelligence API

That is the correct answer!

Modernize Infrastructure and Applications with Google Cloud

Important cloud migration terms

You'll hear some common terminology when learning about modernizing infrastructure and applications in the Cloud.

00:05Let's introduce or remind you of some of these terms.

00:09The first is workload.

00:11In Cloud computing, a workload is a specific application, service, or capability that can be run in the Cloud or on premises.

00:20Workloads include containers, databases, and virtual machines.

00:25Sometimes workloads get retired.

00:28Retiring a workload means removing it from a platform.

00:32A workload might be retired because it's unnecessary, not cost effective, secure, or compatible with a specific platform.

00:40Alternatively, workloads are often retained.

00:44Retaining a workload means that it's intentionally kept.

00:47When a workload is retained, it's typically kept on premises or in a hybrid Cloud environment.

00:53This means that the workload will continue to be managed by the business and will not be subject to the same level of Cloud provider control.

01:01Many workloads are rehosted in Cloud computing.

01:06Rehost refers to the migration of a workload to the Cloud without changing anything in the workload's code or architecture.

01:13This is often done as a first step in Cloud migration because it's the simplest and quickest way to run a workload in the Cloud.

01:21This process is often referred to as lift and shift.

01:25However, rehosting also has some drawbacks, including it doesn't use all the benefits of Cloud computing.

01:31Managing workloads that were rehosted without making any changes can be difficult.

01:36Scaling workloads that were rehosted without making any changes can also be difficult.

01:41Then there's replatform.

01:42In Cloud computing, replatform refers to the process of migrating a workload to the Cloud while making some changes to the workload's code or architecture.

01:53This process is often called move and improve.

01:57Replatforming lets organizations benefit from the Cloud's scalability, reliability and cost effectiveness, improve the performance of their workloads, and reduce the cost of their workloads.

02:09However, replatforming also has some drawbacks, including it can be a complex and time consuming process.

02:16Making the necessary changes to the workload's code or architecture can be difficult and testing the changes to the workload's code or architecture can also be difficult.

02:26Sometimes workloads are refactored, which refers to the process of changing the code of a workload.

02:33For example, an organization might refactor a workload to use either a Cloud-based microservices architecture or a Cloud-based server-less architecture.

02:42We'll explore what those concepts mean later in this course.

02:46Refactoring has some benefits.

02:48It means that workloads can become more efficient, scalable, or secure, and a valuable investment for organizations that want to use all Cloud capabilities.

02:57That being said, a possible drawback for organizations is that refactoring a workload can be a complex and time consuming process.

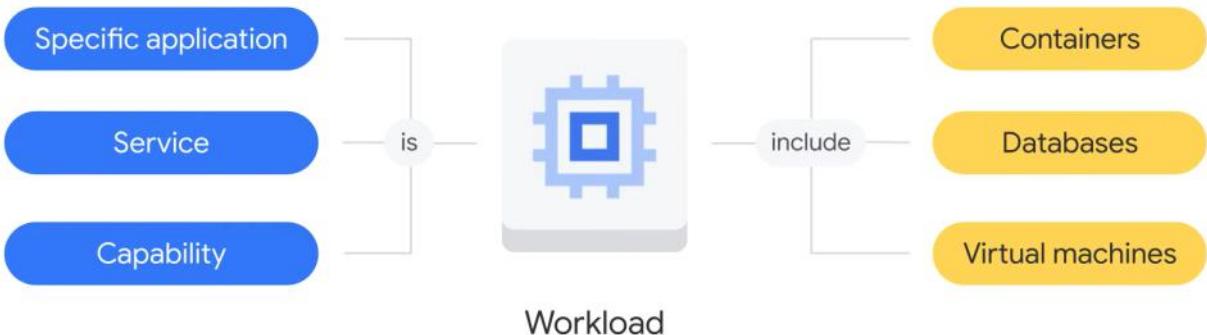
03:06Finally, Cloud modernization can inspire and incentivize organizations to reimagine.

03:13In Cloud computing, reimagine refers to the process of rethinking how an organization uses technology to achieve its business goals.

03:22This can involve reconsidering the organization's current Cloud strategy and its use of other technologies such as artificial intelligence and machine learning.

03:31Reimagining Cloud computing can help organizations to improve their efficiency, reduce costs, and increase agility.

03:39It can also help organizations better meet the needs of their customers and partners.



Workload

Retired

Retained

Rehosted

Replatform

Refactored

Reimagined

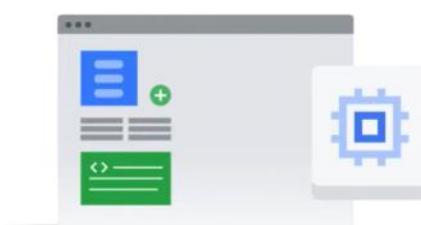
databases, and virtual machines.



0:23 / 3:44



YouTube



– Unnecessary

– Not cost-effective

– Not secure

– Not compatible with a specific platform

Workload

Retired

Retained

Rehosted

Replatform

Refactored

Reimagined

or compatible with a
specific platform.

Retained



Workload

Kept on-premises

Kept in a hybrid cloud environment

Managed by the business

Not subject to the same level of cloud provider control

Workload

Retired

Retained

Rehosted

Replatform

Refactored

Reimagined

the business and
will not be subject

Lift and shift

-
-
-

- It does not use all the benefits of cloud computing.
- Managing workloads that were rehosted without making any changes can be difficult.
- Scaling workloads that were rehosted without making any changes can also be difficult.

Workload

Retired

Retained

Rehosted

Replatform

Refactored

Reimagined

Scaling workloads that
were rehosted without

Move and improve



- Benefit from the cloud's scalability, reliability, and cost-effectiveness.
- Improve the performance of their workloads.
- And reduce the cost of their workloads.

Workload

Retired

Retained

Rehosted

Replatform

Refactored

Reimagined

and reduce the cost
of their workloads.

Move and improve



- It can be a complex and time-consuming process.
- Making the necessary changes to the workload's code or architecture can be difficult.
- Testing the changes to the workload's code or architecture can also be difficult.

Workload

Retired

Retained

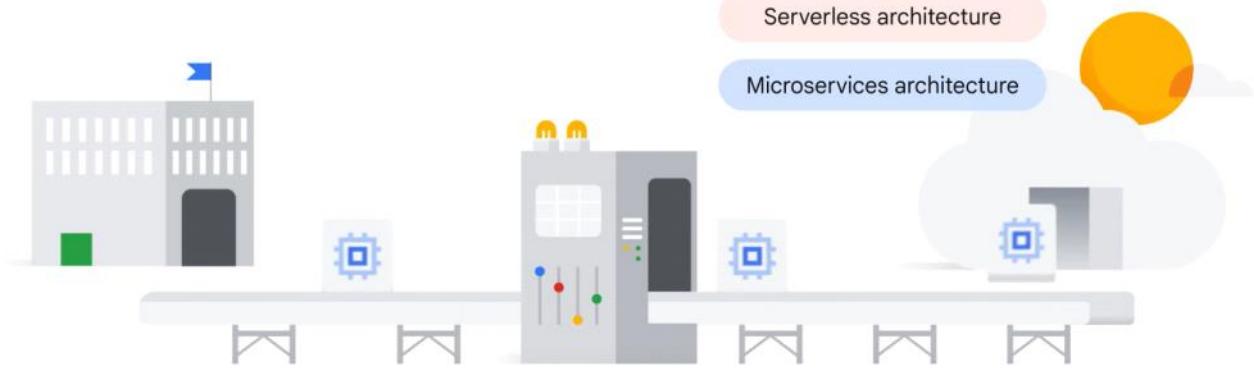
Rehosted

Replatform

Refactored

Reimagined

to the workload's code or



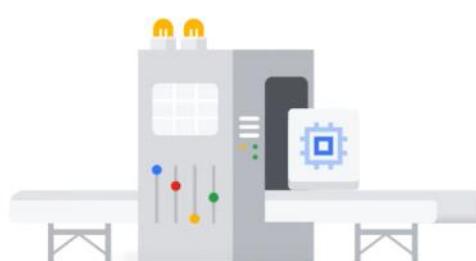
We'll explore what
those concepts



2:42 / 3:44



YouTube



- ✓ More efficient, scalable, or secure
- ✓ A valuable investment for organizations that want to use all cloud capabilities.
- ❗ Can be a complex and time-consuming process

Workload

Retired

Retained

Rehosted

Replatform

Refactored

Reimagined

That being said, a possible
drawback for organizations is



3:00 / 3:44



YouTube





Cloud strategy

Artificial intelligence

Machine learning

Workload

Retired

Retained

Rehosted

Replatform

Refactored

Reimagined

Reimagining Cloud computing can

3:31 / 3:44



YouTube



Help improve their efficiency

Help reduce costs

Help increase agility

Help better meet the needs of their customers and partners

Workload

Retired

Retained

Rehosted

Replatform

Refactored

Reimagined

It can also help organizations better

3:40 / 3:44



YouTube



Modernizing Infrastructure in the Cloud

The benefits of running compute workloads in the

cloud

Why should an organization consider running compute workloads in the Cloud?

00:04 Let's explore some benefits that running compute workloads in the Cloud can bring to an organization.

00:09 We'll begin with total cost of ownership, or TCO, which is a measure of the total cost of a system or solution over its lifetime.

00:18 It includes the cost of the initial purchase, maintenance and operation, along with any other associated costs.

00:26 Cloud computing can help businesses save money on IT costs by eliminating the need to purchase and maintain physical infrastructure.

00:34 Cloud providers offer a pay-as-you-go model, which means that organizations only pay for the resources used.

00:41 They also offer discounts for long term commitments, which can further reduce TCO for businesses that are planning to use Cloud services for a long period.

00:50 Next, there is scalability, which refers to the ability to increase or decrease the number of resources

00:56 such as servers, storage, and bandwidth that are available to a Cloud-based application to meet changing demand.

01:04 Scalability is important because it provides a means to meet changing demand without having to make large upfront investments in infrastructure.

01:13 If a business experiences a sudden spike in demand, it can easily scale up its Cloud resources to meet the demand.

01:20 Conversely, if they experience reduced demand, infrastructure can quickly scale down its Cloud resources to save money.

01:28 Another benefit to Cloud computing is reliability.

01:32 Cloud providers offer a high degree of reliability and up-time, which gives businesses confidence that their data and applications will be available when they need them.

01:42 Cloud providers have many ways to ensure the reliability of their services.

01:47 Google Cloud for example has multiple data centers located in different parts of the world.

01:52 This helps to ensure that if one data center goes down, the others can continue to operate.

01:58 Cloud providers also use various technologies to monitor their services and automatically detect and fix problems.

02:05 Next is security.

02:08 Cloud computing providers offer a high level of security for data and applications.

02:14 Organizations need to be sure that their data is being kept safe.

02:18 In addition to physical data center security, Cloud security features include data encryption, identity and access management, network

02:26 security, virtual private Clouds, and monitoring services that can detect and respond to security threats in real time.

02:34 These security features can also help to ensure

compliance with government or industry regulations.

02:41Running compute workloads in the Cloud offers a high degree of flexibility for organizations.

02:47Organizations can choose the Cloud services that best meet their needs at any point in time, and then change or adapt those services when necessary.

02:56For example, a business that needs to increase the amount of storage space that it uses can easily add more storage space to its Cloud storage service.

03:06Finally, another benefit of running compute workloads in the Cloud is abstraction.

03:11Abstraction refers to how Cloud providers remove the need for customers to understand the finer details of

03:17the infrastructure implementation by providing management of the hardware, software, and certain aspects of security and networking.

03:25For example, a Cloud storage provider might provide a way for customers to store files so that they

03:30don't have to worry about the finer details of how the files are stored on the Cloud providers' infrastructure.

03:36Abstraction also lets Cloud providers offer many services.

03:40For example, Google Workspace lets customers run productivity applications so that they don't have to

03:45worry about the details of how the applications are actually run or maintained on Google's infrastructure.

03:52Running compute workloads in the Cloud can help organizations get their products and services to market faster by eliminating the need to develop and maintain their own infrastructure.

04:01At the same time, it provides a platform for innovation by providing access to the latest technologies and tools as and when they are released.



- Storing information
- Retrieving information
- Comparing information
- Analyzing information

retrieving, comparing, and analyzing the information.



0:12 / 0:48



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Total Cost of Ownership (TCO)

Measure of the total cost of a system or solution over its lifetime

a system or solution over its lifetime.



0:16 / 4:10



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Total Cost of Ownership (TCO)

+ Initial purchase

+ Maintenance

+ Operation

+ Other associated costs

along with any other
associated costs.



Cloud providers offer:

Pay-as-you-go model

Long-term commitment discounts

They also offer discounts
for long term commitments,



Cloud providers offer a high degree of:

Reliability

Uptime



Data



Applications

which gives businesses confidence that their data



Cloud security features include:

Data encryption

Identity and access management

Network security

Virtual private clouds

Monitoring services

and monitoring services that can detect and

Virtual machines

Traditionally, various technological pressures compelled many organizations to tightly bind specific computing

hardware resources to specific applications.

00:09Virtualization, technology relieved these pressures.

00:13Virtualization is a form of resource optimization that lets multiple systems run on the same hardware.

00:20These systems are called Virtual Machines or VMs.

00:24This means that they share the same pool of processing, storage, and networking resources.

00:30VMs enable organizations to run multiple applications at the same time on a server in a way that is efficient and manageable.

00:38Compute engine is Google Cloud's infrastructure as a service product, that lets users create and run virtual machines on Google infrastructure.

00:46There are no upfront investments, and thousands of virtual CPUs can run on a system that's designed to be fast and to offer consistent performance.

00:54Each virtual machine contains the power and functionality of a full fledged operating system.

01:00This means a virtual machine can be configured much like a physical server by specifying the amount

01:04of CPU power and memory needed, the amount and type of storage needed, and the operating system.

01:12A virtual machine instance can be created through the Google Cloud Console, which is a web based tool to manage Google Cloud

01:18projects, resources and Google Cloud CLI command line interface by using infrastructure automation tools such as Terraform or the Compute Engine API.

01:29An API or application programming interface, is a set of instructions that allows different software programs to communicate with each other.

01:37We'll learn about API's in more detail later in this course.

01:41When you use virtual machines, compute engine bills by the second with a one minute minimum and sustained use discounts start

01:49to apply automatically to virtual machines the longer they run, for each VM that runs for more than 25% of a month.

01:57Compute engine automatically applies a discount for every incremental hour of use.

02:02Compute engine also offers committed use discounts.

02:06This means that when committing to use resources for either a one year or three year

02:10period, discounts are offered over the on demand prices and then there are preemptable and spot VMs.

02:18Let's say that a workload doesn't require a human to sit and wait for it to finish, such as a batch job analyzing a large dataset.

02:27Costs can be reduced in some cases by up to 90% by choosing preemptable or spot VMs to run the job.

02:35A preemptable or spot VM is different from an ordinary compute engine VM in only one respect.

02:41Compute engine has permission to terminate a VM if its resources are needed elsewhere.

02:46Although savings are possible with preemptable or spot VMs, it needs to be ensured that a job can be stopped and restarted without impact.

02:55Spot VMs differ from preemptible VMs by offering more features.

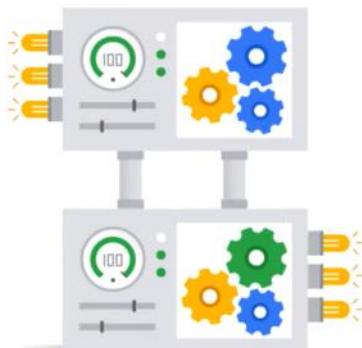
03:00For example, preemptable VMs can only run for up to 24 hours at a time, but spot VMs don't have a maximum run time.

03:08However, the pricing is currently the same for both.

03:11Finally, Compute Engine lets users choose the machine properties of their instances, like the number of virtual CPUs, the operating

03:19system, and the amount of memory by using a set of predefined machine types, or by creating custom machine types.

[navigate_before](#)[Previous](#)[Next](#)[navigate_next](#)



systems

Virtual machines (VMs)

These systems are called
Virtual Machines or VMs.



Virtualization is a form of resource optimization that lets **multiple systems** run on the same hardware.

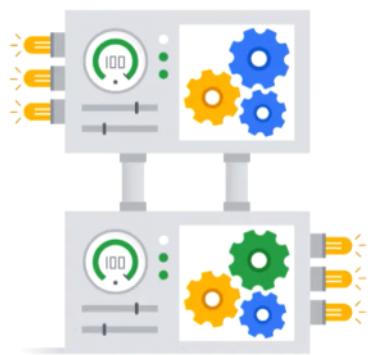
multiple systems run
on the same hardware.



0:18 / 3:28



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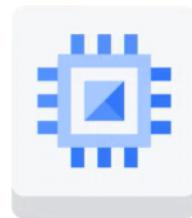


This means that they share the same:

- Pool of processing
- Storage
- Networking resources

Virtual machines (VMs)

storage, and
networking resources.



Compute Engine

IaaS solution



virtual machines on
Google infrastructure.



0:44 / 3:28



YouTube



Compute Engine

- ✓ No upfront investments
- ✓ Thousands of virtual CPUs can run on a system that's designed to be fast and to offer consistent performance
- ✓ Each VM contains the power and functionality of a full-fledged operating system
- ✓ Can be configured much like a physical server by specifying:
 - The amount of CPU power and memory needed
 - The amount and type of storage needed
 - The operating system

and the operating system.



Virtual machine

Can be created through the:

- 01 Google Cloud console which is a web-based tool to manage Google Cloud projects and resources

- 02 Google Cloud CLI (command-line interface) by using infrastructure automation tools such as Terraform or the Compute Engine API

which is a web based tool

API

Application Programming Interface

A **set of instructions** that allows different software programs to **communicate** with each other.

communicate with each other.



- Bills by the second

- 1 minute minimum

- Sustained-use discounts



Compute Engine

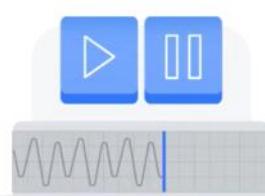
a one minute minimum and
sustained use discounts



1:48 / 3:28



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Preemptible/Spot VM

Spot VMs

- More features
- No maximum runtime
- Same pricing

Preemptible VMs

- Less features
- Runtime up to 24h
- Same pricing

However, the pricing is
currently the same for both.



3:09 / 3:28



YouTube



Choose machine properties:

Number of virtual CPUs

Operating system

Amount of memory



Compute Engine

Using a set of predefined machine types

Creating custom machine types

memory by using a set of
predefined machine types,

Containers

Infrastructure as a service, or IaaS, lets users share compute resources with other developers by using virtual machines to virtualize the hardware.

00:09This lets each developer deploy their own operating system, access the hardware, and build their applications in a self-contained environment with access to the necessary system resources.

00:20Containers follow the same principle as virtual machines.

00:23They provide isolated environments to run software services and optimize resources from one piece of hardware.

00:30However, they're even more efficient.

00:33The key difference between virtual machines and containers is that virtual machines virtualize an entire machine down to the hardware layers.

00:41Whereas containers only virtualize software layers above the operating system level.

00:47Containers start faster and use a fraction of the memory compared to booting an entire

operating system.

00:53A container is packaged with your application and all of its dependencies, so it has everything it needs to run.

00:59Containers can be independently developed, tested, and deployed, and are well suited for a microservices based architecture.

01:07This architecture is made up of smaller individual services that run containerized applications, that communicate with each other through APIs or other lightweight communication methods, such as REST or gRPC.

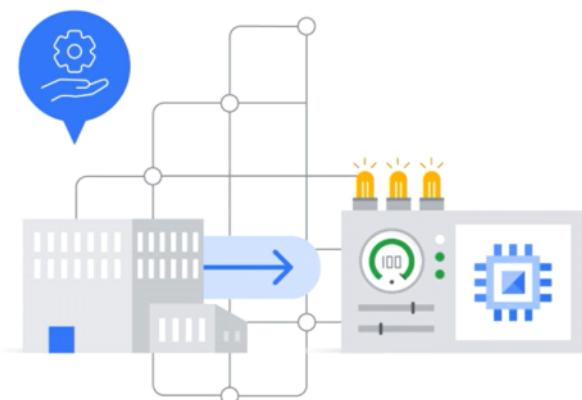
01:21Containers let developers create predictable environments isolated from other system resources.

01:26So if a customer asks for a new feature or a change in the application, developers

01:30can easily make an update to that particular part of the application without affecting the REST.

01:38Containers can run virtually and anywhere, which makes development and deployment easy.

From <https://www.cloudskillsboost.google/parts/9/course_templates/265/video/452942>



Deploy their own operating system



Access the hardware



Build their applications in a self-contained environment

access the hardware, and build their
applications in a self-contained

Containers provide **isolated environments** to run software services and optimize resources from **one piece of hardware**.

optimize resources from
one piece of hardware.



Containers



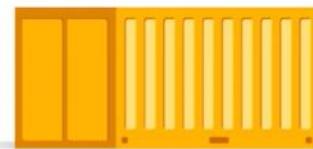
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Virtualize an entire machine down to the hardware layers



Virtual machines

Virtualize software layers above the operating system level



Containers

Whereas containers only virtualize software layers above the operating

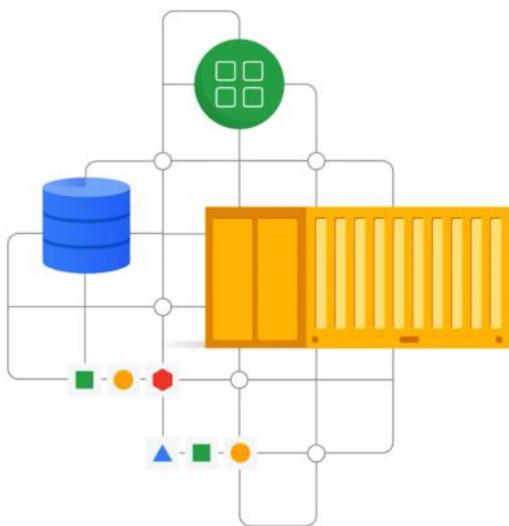


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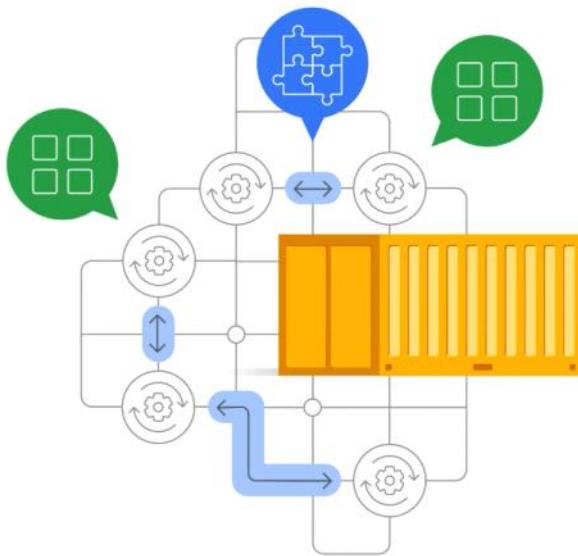
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- ✓ Independently developed
- ✓ Independently tested
- ✓ Independently deployed
- ✓ Well suited for a microservices-based architecture

are well suited for
a microservices based architecture.



Lightweight
communication methods

REST gRPC

other lightweight communication methods,
such as REST or gRPC.

Managing containers

Containers improve agility, enhance security, optimize resources

and simplify managing applications in the cloud.

00:08Many organizations have a mix of virtual machines and containers.

00:11However, as their IT infrastructure setup becomes more complex, they often need a way to manage their services and machines.

00:19For example, an organization can have millions and millions of containers.

00:24This requires keeping them secure and ensuring that they operate efficiently can require significant oversight and management.

00:31Kubernetes, originally developed by Google, is an open-source platform for managing containerized workloads and services.

00:39It makes it easy to orchestrate many containers on many hosts, scale them, and easily deploy rollouts and rollbacks.

00:47This improves application reliability and reduces the time and resources needed to spend on management and operations.

00:55Google Kubernetes Engine or GKE is a Google hosted, managed Kubernetes service in the Cloud.

01:02The GKE environment consists of multiple machines, specifically compute engine instances grouped to form a cluster.

01:09GKE clusters can be customized, and they support different machine types, numbers of nodes, and network settings.

01:17GKE makes it easy to deploy applications by providing an API and a Web based console.

01:23Applications can be deployed in minutes and can be scaled up or down as needed.

01:28GKE also provides many features that can help monitor applications, manage resources, and troubleshoot problems.

01:35Let's explore how Ubie, a Japan based healthcare technology startup, reduced their infrastructure costs and maintenance requirements with Google Kubernetes Engine.

01:45Founded in 2017, Ubie's goal is to get people the right medical care when they need it, and it does this with products designed for hospitals and individuals.

01:55Ubie for Hospital, their flagship product, is AI powered questionnaire software that lets patients provide medical details before an appointment.

02:03Ubie initially relied on an alternative, Cloud, to make Ubie for Hospital available in Japan.

02:09As the business added new customers, they needed an infrastructure that could support daily deployments and

02:14provide a secure gateway to connect Ubie to a wide range of customer networks and settings.

02:20Ubie evaluated available options and decided to use Kubernetes in Google Kubernetes Engine.

02:26

Google Kubernetes Engine Autopilot, a mode that enables full management of an entire cluster's infrastructure and provides per-pod

02:33billing, presented a compelling option for the business to run Ubie for Hospital more efficiently and cost effectively.

02:41With GKE Autopilot, Ubie could eliminate the need to configure and monitor clusters while only paying for running pods.

02:50The shift reduced Ubie's infrastructure costs by 20%, and GKE Autopilot has helped the business eliminate

02:56Ubie for Hospital infrastructure maintenance and upgrade tasks that could take hours and days to complete.

03:03Another popular option for running containerized applications on Google Cloud is Cloud Run.

03:09Cloud Run is a fully managed serverless platform to deploy and run containerized applications without needing to worry about the underlying infrastructure.

03:18After your application code is containerized and deployed to Cloud Run, Google Cloud takes care of scaling and managing the infrastructure automatically.

03:26Cloud Run is ideal for running stateless applications that need to scale up and down quickly in response to traffic.

03:33This makes cloud run most suitable for simple and lightweight applications such as web applications.

03:40In summary, GKE is ideal when lots of control is required over a Kubernetes Environment and there are complex applications to run.

03:49Alternatively, Cloud Run is ideal for when a simple, fully managed serverless platform that can scale up and down quickly is required.



Containers

- Improve agility
- Enhance security
- Optimize resources
- Simplify managing applications

simplify managing
applications in the cloud.

Kubernetes

Google

An open-source platform
for managing containerized
workloads and services

managing containerized workloads and
services.

Kubernetes



Many containers

- Hosts
- Scale
- Deploy rollouts
- Deploy rollbacks

scale them, and
easily deploy rollouts and rollbacks.

**Kubernetes**

↑ Reliability

↓ Time

↓ Resources

Many containers

reduces the time and resources needed
to spend on management and operations.

|| 0:54 / 3:57

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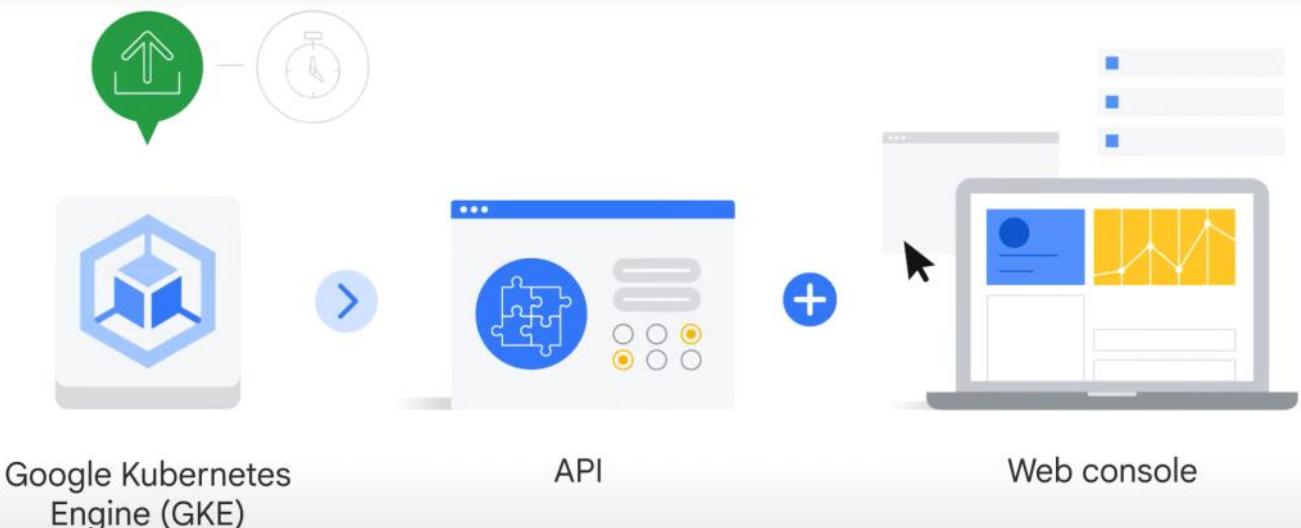


✓ Different machine types

✓ Numbers of nodes

✓ Network settings

numbers of nodes, and network settings.



a Web based console.



1:23 / 3:57



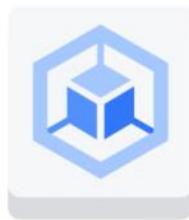
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Google Kubernetes
Engine - Autopilot

A mode that enables full
management of an entire
cluster's infrastructure and
provides per-pod billing

a mode that enables full management of
an entire cluster's infrastructure and



- Eliminate the need to configure and monitor clusters
- ✓ Only pay for running pods

Google Kubernetes
Engine - Autopilot

monitor clusters while only paying for
running pods.



Managing containers



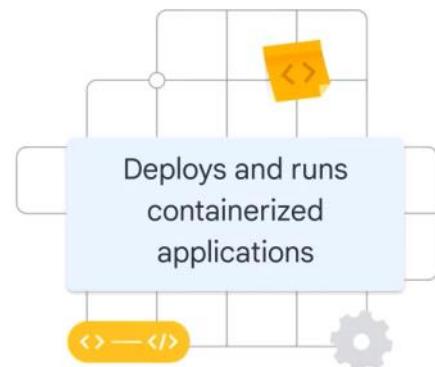
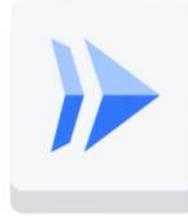
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Fully managed



Serverless



Cloud Run

applications without needing to worry
about the underlying infrastructure.



GKE

Provides lots of control over a Kubernetes environment with complex applications to run.



Cloud Run

A simple, fully managed serverless platform that can scale up and down quickly

fully managed serverless platform that can scale up and down quickly is required.



3:54 / 3:57



YouTube



Serverless computing

Another option for modernizing Cloud applications is serverless computing.

00:04 Serverless computing doesn't mean there's no server, it means that resources like compute power are automatically provisioned in the background as needed.

00:13 The advantage here is that organizations won't pay for compute power unless they're running a query or application.

00:20 At its simplest definition, serverless means that businesses provide the code for whatever function they want and the public Cloud provider does everything else.

00:29 Imagine you provide software to businesses that help employees manage their corporate expenses.

00:34 You want to add a feature that lets users upload an image with their expense receipt.

00:38 In this case, the ability to upload an image is called a function.

00:42 You as the software development company write the code for that function directly into your public Cloud platform.

00:49 From there, the public Cloud provider manages everything else.

00:53 One type of serverless computing solution is called

function as a service.

00:58 Some functions are a response to specific events, like file uploads to Cloud storage, or changes to database records.

01:06 You write the code that defines the response to those events and the Cloud provider does everything else.

01:12 Google Cloud offers many serverless computing products.

01:16 The first is Cloud Run, which is a fully managed environment for running containerized applications.

01:21 With this product, you don't have to worry about the underlying infrastructure.

01:26 Then there is Cloud functions, which is the platform for hosting simple single purpose functions that are attached to events emitted from your Cloud infrastructure and services.

01:36 For example, sending a notification to a mobile device when a new order is placed on a website.

01:43 There is also App Engine, which is a service to build and deploy web applications.

01:49 Serverless computing has many benefits, reduced operational costs.

01:54 The Cloud provider is responsible for the infrastructure and its maintenance.

01:58 Therefore, the application owner does not need to invest in the infrastructure or the human resources required to manage it.

02:05 Scalability.

02:05 Serverless computing provides automatic scaling of computing resources based on the applications demand.

02:13 The Cloud provider manages the scaling process and the application owner only pays for the resources they use.

02:20 Faster time to market, the need for infrastructure, setup and configuration is eliminated, which reduces the time required to deploy applications.

02:30 This feature lets the application owner focus on writing code and quickly deploying new features.

02:36 Reduce development costs.

02:39 The development process is simplified because developers can focus on the application's logic and not on the underlying infrastructure.

02:46 Improved resilience.

02:48 Serverless computing offers improved resilience and availability as the Cloud provider automatically manages the infrastructure's failover and disaster recovery.

capabilities.

02:58 Pay per use pricing model, The application owner only pays for the computing resources they use.

03:05 This reduces the cost of unused resources and helps optimize costs.

03:10 How might an organization benefit from Cloud computing infrastructure technology?

03:15 Let's explore an example specializing in educational technology.

03:21 Mashme.io provides video collaboration experiences for over 3 million users in 73 countries.

03:28 Connecting 250 full HD live video streams in real time is a major technical challenge.

03:35 Latencies need to be kept very low to achieve the face to face experience, and continuous integration in deployment is vital to avoid disruptive downtime for global clients.

03:45 Meanwhile, costs have to be kept to a minimum to keep the solution affordable for a growing start up.

03:52 To meet those needs, Mashme.io chose to use Google Kubernetes Engine.

03:57 Every teacher we speak to tells us that latency is the most important thing for educational video conferencing.

04:03 Says Mashme.io meet founder Victor Sanchez Belmar.

04:06 Low latency means having servers close to every student that connects to Mashme.io.

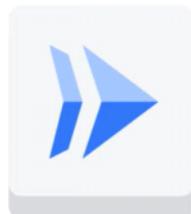
04:12 With students connecting from around the world, Google Cloud has the global network to make that happen.

04:18 The view was that setting up data centers around the world with your own hardware is a good way for a start up to never start.

04:24 Instead, Mashme.io started using Google's global network with App Engine before moving to Google Cloud with their own docker containers, and finally, to Google Kubernetes Engine.

04:35 This allowed them to update their nodes and services in an almost continuous way without disruption.

04:40 Students didn't lose an hour or even a second of class.



Cloud Run

A fully managed environment
for running containerized apps.

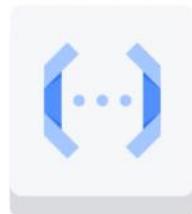
With this product,
you don't have to



App Engine

A service to build and deploy web
applications.

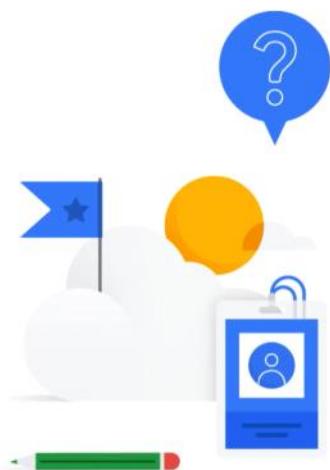
which is a service to build
and deploy web applications.



Cloud Functions

A platform for hosting simple, single-purpose functions that are attached to events emitted from your cloud infrastructure and services.

attached to events emitted from



- ✓ Reduced operational costs
- ✓ Scalability
- ✓ Faster time-to-market
- ✓ Reduced development costs
- ✓ Improved resilience
- ✓ Pay-per-use pricing model

How might an organization benefit from

What open source platform, originally developed by Google, manages containerized workloads and services?
Angular

checkKubernetes

TensorFlow

Go

That is the correct answer!

check

2.

What portion of a machine does a container virtualize?

checkSoftware layers above the operating system level

Hardware layers above the electrical level

Software layers above the firmware level

The entire machine

That is the correct answer!

check

3.

What phrase refers to when a workload is rehosted without changing anything in the workload's code or architecture.

Refactor and reshape

Reimagine and plan

checkLift and shift

Move and improve

That is the correct answer!

check

4.

A manufacturing company is considering shifting their on-premises infrastructure to the cloud, but are concerned that access to their data and applications won't be available when they need them. They want to ensure that if one data center goes down, another will be available to prevent any disruption of service. What does this refer to?

checkReliability

Total cost of ownership

Security

Flexibility

That is the correct answer!

check

5.

A travel company is in the early stages of developing a new application and wants to test it on a variety of configurations: different operating systems, processors, and storage options. What cloud computing option should they use?

checkVirtual machine instances

Colocation

Containers

A local development environment

That is the correct answer!

check

6.

What computing option automatically provisions resources, like compute power, in the background as needed?

IaaS (infrastructure as a service)

PaaS (platform as a service)

checkServerless computing

Traditional on-premises computing

That is the correct answer!

Modernizing Applications in the Cloud

The benefits of modern cloud application development

Thanks to advances in cloud technology, the way that software applications are developed has drastically changed.

00:07With modern cloud application development, software development is flexible, scalable, and uses the latest cloud computing technologies to build and deploy applications.

00:17In the past, the traditional software development approach, often referred to as monolithic applications, required all the components of

00:25an application to be developed and deployed as a single, tightly coupled unit, typically using a single programming language.

00:33There are many benefits to the modern cloud application development approach.

00:37Let's explore a few.

00:39We'll begin with architecture.

00:41Modern cloud applications are typically built as a collection of microservices.

00:46Microservices are independently deployable, scalable and maintainable components that can be used to build a wide range of applications.

00:55This can help organizations bring business value to market faster because features can be released as they're completed without waiting for the rest of the application to be complete.

01:05Regarding deployment, modern applications are typically deployed to the cloud and can use managed or partially managed services.

01:13Managed services take care of the day-to-day management of cloud-based infrastructure, such as patching, upgrades, and monitoring.

01:21This can free up staff to focus on other tasks, such as developing new applications.

01:27Partially managed services offer a hybrid approach, where businesses manage some aspects of their cloud-based applications themselves and the cloud provider manages others.

01:37In terms of cost, modern cloud applications use a pay as you go pricing model, which can make them extremely cost effective when configured efficiently.

01:46That means that organizations don't always need to pay for resources they aren't fully utilizing.

01:53Developers can also use prebuilt APIs, which we'll explore later in this section of the

01:57course, and other tools offered by the cloud provider to build and deploy their applications quicker.

02:04And then there's scalability.

02:06Modern cloud-based applications can easily be scaled up or down to meet user demands.

02:12Modern cloud applications are designed to be highly available and resilient with built in features like load

02:18balancing, which is the process of distributing

network traffic evenly across multiple servers that support an application.

02:25 And automatic failover, which is a process that allows a cloud-based application to automatically switch to a backup server if a failure occurs.

02:34 Additionally, cloud service providers typically offer robust monitoring and management tools that allow developers to quickly identify and respond to issues, which can further improve the reliability of cloud applications.

The benefits of modern cloud application development

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Modern cloud application development

scalable, and uses the latest cloud computing technologies to build and

Flexible

Scalable

Uses the latest technologies

0:15 / 2:47

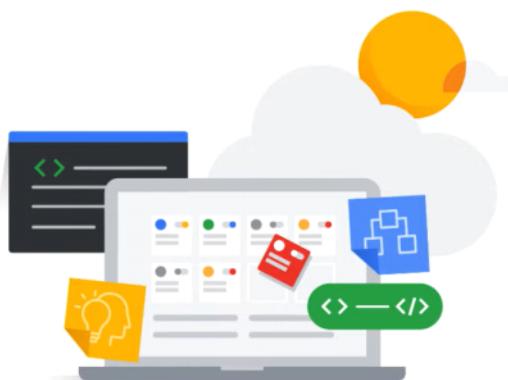
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Monolithic applications

Required application components to be developed and deployed as a single, tightly coupled unit, typically using a single programming language.

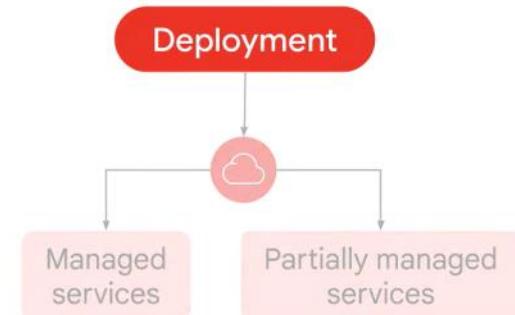
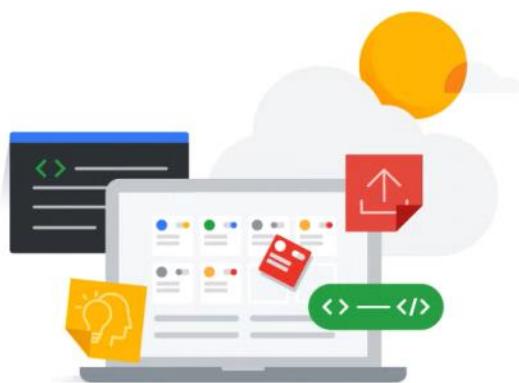
of an application to be developed and deployed as a single,



Architecture

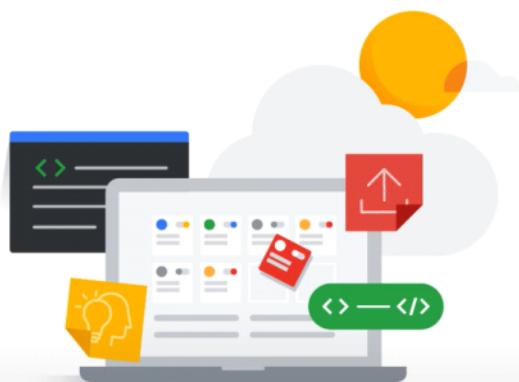
Modern cloud applications are typically built as a collection of microservices.

Modern cloud applications are typically built as a collection of microservices.



The benefits of modern cloud application development

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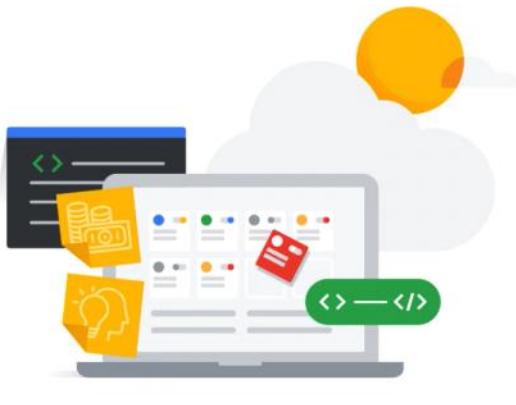


Deployment

Managed services take care of the day-to-day management of cloud-based infrastructure, such as:

- Patching
- Upgrades
- Monitoring

Managed services take care of
the day-to-day management of cloud-based

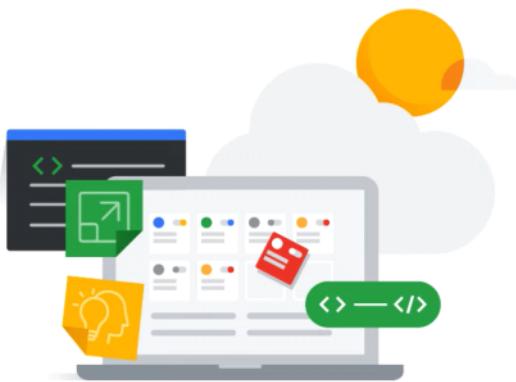


Cost

Modern cloud applications use a pay-as-you-go pricing model.



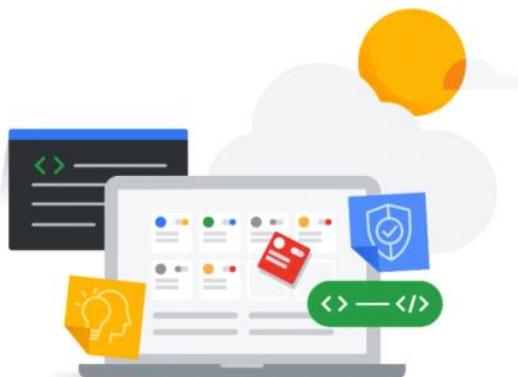
model, which can make them extremely cost effective when configured efficiently.



Scalability

Modern cloud-based applications can easily be scaled up or down to meet user demands.

Modern cloud-based applications can easily be scaled up or down to meet user demands.



Highly available and resilient

Load balancing

Distributing network traffic evenly across multiple servers that support an application.

Automatic failover

Allows a cloud-based application to automatically switch to a backup server if a failure occurs.

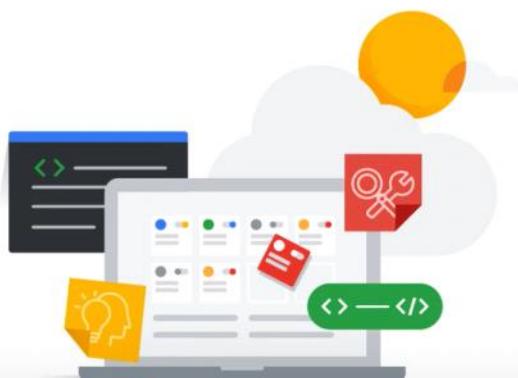
And automatic failover, which is a process that allows a cloud-based



The benefits of modern cloud application development



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Monitoring and management tools

Allow developers to quickly identify and respond to issues.

which can further improve the reliability of cloud applications.

Rehosting legacy applications in the cloud

When a business decides to modernize and move its

operations to the cloud, it might be running several specialized legacy applications that aren't compatible with cloud-native applications.

00:10 In these situations, a business might take a rehost migration path, commonly referred to as lift and shift, where

00:17 an application is moved from an on-premises environment to a cloud environment without making any changes to the application itself.

00:25 Rehosting applications brings with it the many benefits of cloud computing that we explored earlier, such as cost savings, scalability, reliability, and security.

00:36 However, there are also some potential drawbacks to choosing a rehost migration path for legacy applications, including:

Complexity: rehosting can be a complex process.

00:46 Businesses need to carefully plan the migration process and ensure that they have the right resources in place.

00:53 Risk: migrating applications to the cloud always involves some risk.

00:57 Businesses need to carefully assess and identify potential risks and ensure that they have a plan in place in case of any problems.

01:05 Vendor lock-in: by moving applications to the cloud, businesses might become locked into a particular cloud provider.

01:13 This can potentially make it difficult to switch providers later.

01:18 Google Cloud offers many solutions for rehosting specialized legacy applications.

01:23 The first is Google Cloud VMware Engine, which helps migrate existing VMware workloads to the cloud without having to rearchitect the applications or retool operations.

01:35 With Google Cloud VMware Engine, organizations can maintain their existing VMware environments and operational processes, while benefiting from the scalability, security, reliability of Google Cloud.

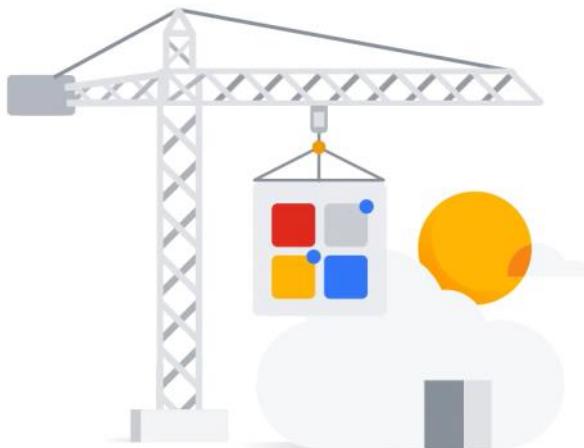
01:47 By doing this, organizations can also access a range of Google Cloud services such as BigQuery, AI/ML,

01:55 and Google Kubernetes Engine, which lets them modernize their application environment and use new capabilities and technologies as needed.

02:04 And for organizations with legacy applications on Oracle, Google Cloud offers Bare Metal Solution.

02:09 This is a fully managed cloud infrastructure solution that lets organizations run their Oracle workloads on dedicated, bare metal servers in the cloud.

Lift and shift



- ✓ Cost savings
- ✓ Scalability
- ✓ Reliability
- ✓ Security

reliability,
and security.

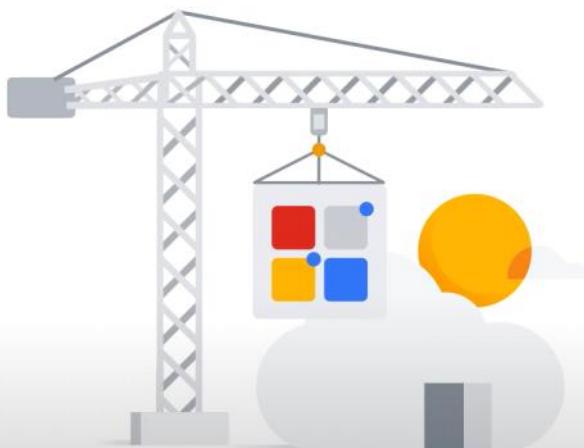


Rehosting legacy applications in the cloud



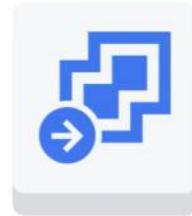
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Lift and shift



- ! Complexity
- ! Risk
- ! Vendor lock-in

Vendor lock-in: by moving applications to the
cloud, businesses might become locked into a



Google Cloud
VMware Engine

Scalability

Security

Reliability

security,
reliability of Google Cloud.

A fully managed cloud infrastructure solution that lets organizations run their Oracle workloads on dedicated, bare metal servers in the cloud.



Bare Metal Solution

This is a fully managed cloud infrastructure solution that lets organizations run their

Application programming interfaces (APIs)

Implementing a software service can be complex and changeable.

00:03And if each software service that an organization uses has to be coded for each implementation, the result can be fragile and error-prone.

00:11One way to make things easier is to use APIs or application programming interfaces.

00:18Earlier in this course, you saw how cloud providers offer a variety of resources and services for running applications and performing computational tasks in the cloud.

00:28However, to fully use these resources and services, applications need to be able to interact with them in a standardized and efficient way.

00:37This is where APIs come in.

00:39An API is a set of instructions that lets different software programs communicate with each other.

00:45Think of it as an intermediary between two different programs, which provides a standardized and predictable way for them to exchange data and interact.

00:54An API is like a waiter in a restaurant.

00:57The waiter takes orders from customers, communicates with the kitchen, and then brings the food back to the customers.

01:03Similarly, an API takes requests from one software program, the customer, communicates with another program,

01:09the kitchen, and then returns a response, the food, back to the requesting program, the customer.

01:17APIs can be used in many different applications, from social media platforms to mobile apps and web services.

01:25They let developers access functionality and data from other programs without having to write all the code themselves, saving time and effort.

01:33Google itself provides many APIs that let developers access its products and services.

01:38These include APIs that use the power of Google to search across a website or collection of websites, APIs that let developers

01:46access Google Maps data such as maps, directions and traffic information, and APIs that let developers translate text from one language to another.

01:57In fact, many Google Cloud products and services have documented APIs.

02:03Using APIs can create new business opportunities for organizations and improve online experiences for users.

02:10For example, an organization could expose an API that allows customers to track their shipments or

check their account balances from within a third party app.

02:20There's also an opportunity for organizations to create new products that let other companies access their data or services through an API.

02:28Let's explore why an organization might consider this business opportunity.

02:33APIs can be used to create new products and services.

02:36An organization could create an API that allows developers to access data from its database.

02:41This data could then be used to create new products and services.

02:46APIs can be used to generate new revenue streams.

02:49An organization could charge developers to access its APIs.

02:52This could generate new revenue streams for the organization and help to offset the cost of developing and maintaining the APIs.

03:00APIs can create partnerships.

03:02By exposing APIs, organizations can create partnerships with other companies or developers which can lead to new business opportunities and collaborations.

03:12By carefully considering the needs of their customers and partners, organizations can develop APIs that provide value and help to grow their businesses.



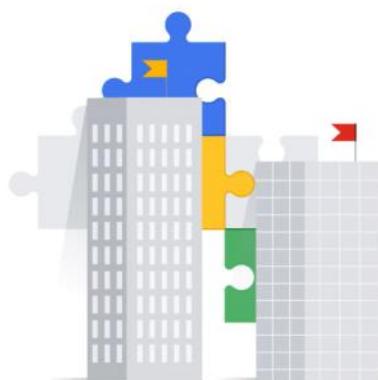
Using APIs can create new business opportunities for organizations and improve online experiences for users.



their shipments or check their account balances from within a third party app.

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- APIs can be used to create new products and services.
- APIs can be used to generate new revenue streams.
- APIs can create partnerships.

By exposing APIs, organizations can create partnerships with other companies or

Apigee API Management

When an organization has implemented API's, it's

important to maintain and manage them effectively.

00:05This can be done using a platform such as Apigee API management, Google Cloud's API management service to operate API's with enhanced scale security and automation.

00:16Apigee is a popular choice for organizations that need to manage their API's because it offers many benefits.

00:24It helps organizations secure their API's by providing features such as authentication, authorization and data encryption.

00:32It tracks and analyzes API usage with real time analytics and historical reporting.

00:38It helps with developing and deploying API's through a visual API editor and a test sandbox.

00:44It offers API versioning, API documentation, and even API throttling, which is the process of limiting the number of API requests a user can make in a certain period.

00:55AccuWeather has enjoyed great success, sharing its world class weather data through APIs with a range of

01:01global partners who have built applications for connected cars, smart homes, wearables, smart TV's, mobile devices, and more.

01:10But the company wanted to get its data into the hands of a new customer, individual developers.

01:16It needed a way to engage this audience and tailor its offerings to the varying needs of developers and monetize those different offering levels accordingly.

01:24To implement a simple and fast way for developers to start building with an appropriate level

01:28of API calls and features for their needs, AccuWeather realized it required a sophisticated API management platform.

01:36One that enabled different tiers of offerings by bundling API's into different products, each with their own rate limits and pricing.

01:44With Apigee managing API's for AccuWeather, their users can customize API consumption to their specific needs.

01:50While Apigee helps attract and build that traffic.

01:54With the customizable Apigee developer portal, developers can sign up quickly, learn about the AccuWeather API's and test them out.

02:02With built in analytics, AccuWeather can keep close tabs on who's signing up, what traffic they're producing and from where, and also observe unexpected patterns in traffic activity.



Apigee API
Management

Google Cloud's API management service to operate APIs with enhanced scale, security, and automation.

Google Cloud's API management service to operate



Apigee API
Management

- ✓ It helps organizations secure their APIs.
- ✓ It tracks and analyzes API usage.
- ✓ It helps with developing and deploying APIs.
- ✓ It offers API versioning, API documentation, and even API throttling.

and even API throttling,

Hybrid and multi-cloud

As you've seen throughout this course, organizations can thrive with the help of cloud.

00:04 But the reality is that most of the world's enterprise computing still happens on premises.

00:09 The path to the cloud can be complex and full of difficult decisions and sometimes workloads remain on premises due to compliance or operational concerns.

00:19 How can organizations modernize their IT infrastructure without completely migrating to the cloud?

00:25 How can they maintain flexibility and avoid lock in?

00:29 Two options are hybrid and multi cloud solutions.

00:32 A hybrid cloud environment comprises some combination of on premises or private cloud infrastructure and public cloud services.

00:42 This is the situation many organizations are currently in, where some of their data and applications have been migrated to the cloud, while others remain on premises.

00:50 Interconnects between the private and public clouds allow interoperability.

00:56 A multi-cloud environment is where an organization uses multiple public cloud providers as part of its architecture.

01:02 This is ideal for organizations that need flexibility and secure connectivity between the different networks.

01:09 An organization might choose to use hybrid cloud multi-cloud or a combination of both if they want

01:14 to incorporate specific elements of a public cloud to benefit from the main strengths of that provider.

01:21 This lets organizations keep parts of the system's infrastructure on premises while they move other parts to the cloud.

01:28 This way they create an environment that is uniquely suited to the organization's needs.

01:33 Move only specific workloads to the cloud because a full scale migration is not required for it to

01:38 work, benefit from the flexibility, scalability, and lower computing costs offered by Cloud services for running specific workloads.

01:47 Add specialized services such as machine learning, content caching, data analysis, long term storage, and IOT or Internet of Things.

01:56 To the organization's computing resources toolkit.

01:59 How can Google Cloud help in this context?

02:03 Google's answer to modern hybrid and Multi-cloud distributed systems and services management is called GKE Enterprise.

02:12 GKE Enterprise is a managed production ready platform for running Kubernetes applications across multiple cloud environments.

02:20 It provides a consistent way to manage Kubernetes,

clusters, applications and services regardless of where they are running.

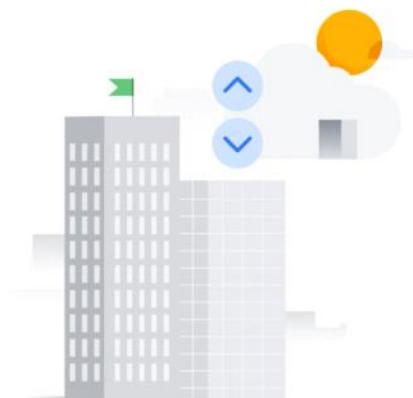
02:29 Some of the benefits of GKE enterprise include Multi-cloud and hybrid-cloud support.

02:36 GKE enterprise can run Kubernetes clusters on Google Cloud, AWS, Azure, and other public clouds.

02:43 Centralized management GKE Enterprise provides a single centralized console for managing Kubernetes clusters and applications, security and compliance.

02:53 GKE Enterprise includes many features that help secure Kubernetes clusters and applications and comply with industry regulations, networking and load balancing.

03:04 GKE Enterprise includes a number of features that help network and load balance Kubernetes applications, monitoring and logging GKE Enterprise provides a rich **03:14** set of tools for monitoring and maintaining application consistency across an entire network, whether on premises in the cloud or in multiple clouds.



This lets organizations:

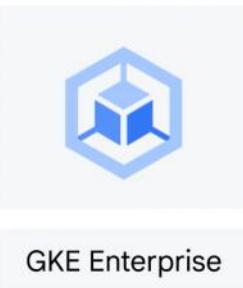
Keep parts of the system's infrastructure on-premises while they move other parts to the cloud.

Move only specific workloads to the cloud.

Benefit from the flexibility, scalability, and lower computing costs.

Add specialized services to the organization's computing resources toolkit.

Add specialized services such as



GKE Enterprise

Production-ready platform
for running Kubernetes
applications across multiple
cloud environments.

across multiple
cloud environments.



Hybrid and multi-cloud



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GKE Enterprise

Multi-cloud and hybrid-cloud support

Centralized management

Security and compliance

Networking and load balancing

Monitoring and logging

monitoring and logging
GKE Enterprise

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Trust and Security with Google Cloud

Trust and Security in the Cloud

Key security terms and concepts

In the field of Cloud security.

00:01 Understanding the terminology is crucial to navigating the landscape effectively.

00:07 In this lesson, we introduce essential security terms and concepts that are commonly encountered when discussing Cloud security.

00:15 Let's explore these terms and their significance.

00:19 The first three concepts relate to reducing the risk of unauthorized access to sensitive data.

00:25 The privileged access security model grants specific users access to a broader set of resources than ordinary users.

00:33 For example, a system administrator may have privileged access to perform tasks such as troubleshooting and data restoration.

00:41 However, the misuse of privileged access can pose risks.

00:45 It's essential to manage and monitor such access carefully.

00:49 The least privileged security principle advocates granting users only the access they need to perform their job responsibilities.

00:58 By providing the minimum required access, organizations can reduce the risk of unauthorized access to sensitive data.

01:05 For instance, a sales representative might only need access to a customer relationship management CRM system without requiring access to other systems like payroll or finance.

01:17 The zero-trust architecture security model assumes that no user or device can be trusted by default.

01:24 Every user and device must be authenticated and authorized before accessing resources.

01:30 Zero-trust architecture helps ensure robust security by implementing strict access controls and continuously verifying user identities.

01:40 The next three concepts relate to how an organization can protect itself from cyber threats.

01:46 Security by default is a principle that emphasizes integrating security measures into systems and applications

from the initial stages of development.

01:55 By prioritizing security throughout the entire process, organizations can establish a strong security foundation in their Cloud environments.

02:04 Security posture refers to the overall security status of a Cloud environment.

02:10 It indicates how well an organization is prepared to defend against cyber attacks by evaluating their security controls, policies, and practices.

02:19 Cyber resilience refers to an organization's ability to withstand and recover quickly from cyber attacks.

02:26 It involves identifying, assessing and mitigating risks, responding to incidents effectively, and recovering from disruptions quickly.

02:35 Finally, let's explore essential security measures to protect Cloud resources from unauthorized access.

02:42 A firewall is a network device that regulates traffic based on predefined security rules.

02:49 You can think of a firewall like a security guard for a network.

02:53 It follows certain rules to decide which traffic is allowed to enter or leave a network.

02:59 These rules help keep unauthorized people or harmful things away from important Cloud resources, such as servers, databases, and applications.

03:08 Following our previous analogy, a security guard checks everyone who wants to enter and only lets in those who have permission.

03:16 Similarly, a firewall checks the incoming and outgoing traffic in a network and only allows the ones that are safe and authorized.

03:24 Encryption is the process of converting data into an unreadable format by using an encryption algorithm.

03:31 Decryption, however, is the reverse process that uses an encryption key to restore encrypted data back to its original form.

03:40 Safeguarding the encryption key is crucial because it holds the secret algorithm necessary for decrypting the data.

03:47 Another way to think about encryption and decryption is writing a message in a secret language that only you and the person you want to send it to can understand.

03:56 This way, even if someone intercepts the message, they won't be able to read it because they don't know the secret language.



Privileged access

Grants specific users access to a broader set of resources than ordinary users

The least privileged security

0:50 / 4:05

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Least privilege

Advocates granting users only the access they need to perform their job responsibilities

need to perform their job responsibilities.

0:56 / 4:05

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Least privilege

Advocates granting users only the access they need to perform their job responsibilities



Sales Representative

requiring access to other systems



Key security terms and concepts



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Zero-trust architecture

Assumes that no user or device can be trusted by default



Every user and device must be authenticated

▶ 🔍 1:24 / 4:05

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Security by default

Emphasizes integrating security measures into systems and applications from the initial stages of development



in their Cloud environments.

Security posture

The overall security status of a cloud environment

the overall security status of a Cloud environment.

Cyber resilience

An organization's ability to withstand and recover quickly from cyber attacks



responding to incidents effectively,

Firewall

A network device that regulates traffic based on predefined security rules



It follows certain rules to decide which

Encryption

The process of converting data into an unreadable format by using an encryption algorithm



an unreadable format by using an encryption algorithm.

Decryption

Uses an encryption key to restore encrypted data back to its original form

encrypted data back to its original form.

Cloud security components

Lesson, we learn about the components that make up a

cloud security model and discover how they contribute to a robust security posture in today's digital landscape.

00:10We'll first explore three essential aspects of security; confidentiality, integrity, and availability.

00:18These three principles form the foundation of the CIA Triad, a widely used model for developing effective security systems.

00:26The CIA Triad emphasizes the importance of protecting sensitive information, ensuring data accuracy and trustworthiness, and maintaining uninterrupted access to resources and services.

00:38By understanding and implementing measures to address these aspects, organizations can establish a strong security framework to safeguard their digital assets.

00:49Confidentiality is about keeping important information safe and secret.

00:54It ensures that only authorized people can access sensitive data, no matter where it's stored or sent.

01:00Confidentiality is of utmost importance in the Cloud, as sensitive information stored and transmitted across Cloud environments must be protected from unauthorized access or disclosure.

01:12Encryption plays a crucial role in ensuring confidentiality in the Cloud.

01:17By using encryption techniques and safeguarding encryption keys, organizations can ensure that only authorized individuals

01:23can access and decrypt sensitive data, effectively mitigating the risk of data breaches in the Cloud.

01:31Integrity means keeping data accurate and trustworthy.

01:35It ensures that information doesn't get changed or corrupted no matter where it's stored or how it's moved around.

01:42You can think of it like making sure a message doesn't get altered during delivery.

01:48Integrity in the Cloud involves ensuring the accuracy and trustworthiness of data throughout its life cycle.

01:56Implementing data integrity controls such as checksums or digital signatures, enables organizations to verify the authenticity and reliability of their data in the Cloud.

02:07This helps prevent unauthorized modifications or tampering ensuring the integrity of critical information stored and processed in Cloud environments.

02:17Availability is all about making sure that Cloud systems and the services are always accessible and ready for use by the right people when needed.

02:26It's like having a reliable electricity supply that never goes out.

02:31Cloud environments must be designed with redundancy fail-over mechanisms and disaster recovery plans to maximize availability and minimize downtime.

02:41By implementing these measures, organizations can ensure that their systems and applications in the Cloud remain accessible whenever needed, promoting business continuity even in the face of potential disruptions.

02:54Control refers to the measures and processes implemented to manage and mitigate security risks.

03:01It involves establishing policies, procedures, and technical safeguards to protect against unauthorized access, misuse, and potential threats.

03:10Control measures in the Cloud include implementing robust authentication mechanisms, access restrictions, and security awareness training.

03:20These measures help organizations manage and mitigate security risks associated with Cloud based systems.

03:26By ensuring that only authorized individuals have access to sensitive data and systems in the Cloud, organizations can reduce the risk of data breaches and unauthorized activities.

03:37Finally, compliance relates to adhering to industry regulations, legal requirements, and organizational policies.

03:45It involves ensuring that security practices and measures align with established standards and guidelines.

03:52Meeting compliance standards in the Cloud demonstrates an organization's commitment to data privacy and security building trust with stakeholders and minimizing legal and financial risks.

04:04Cloud providers often offer compliance frameworks and certifications that organizations can leverage to meet their regulatory obligations.

04:13By integrating these principles into a comprehensive Cloud security model, organizations can establish a strong foundation for protecting their data, maintaining data integrity, and ensuring continuous access to critical resources.

[navigate_before](#)[Previous](#)[Next](#)[navigate_next](#)

Confidentiality

Integrity

Availability

These three principles form



Data integrity controls



Helps prevent unauthorized modifications or tampering



Ensures the integrity of critical information stored and processed

the integrity of critical information

**Control**

The measures and processes implemented to manage and mitigate security risks

implemented to manage and mitigate security risks.



2:58 / 4:28

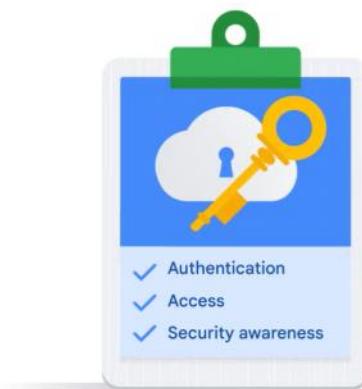


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**Control**

Protect against unauthorized access, misuse, and potential threats

misuse, and potential threats.



Control

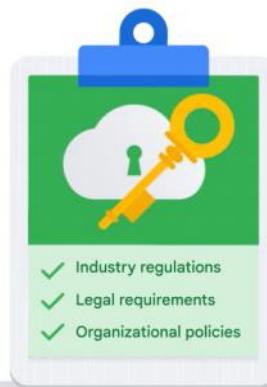
access restrictions, and
security awareness training.



Cloud security components



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Compliance

legal requirements, and
organizational policies.



3:45 / 4:28



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- Protecting their data
- Maintaining data integrity
- Ensuring continuous access to critical resources

ensuring continuous access
to critical resources.



4:25 / 4:28



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Cloud security versus traditional on-premises security

In the past, businesses heavily relied on their own infrastructure and local data centers, to manage and protect their digital assets.

00:08They had complete control over their hardware, software, and network components, fostering a sense of trust within their premises.

00:17However, as organizations now connect digitally with customers, partners, and employees, worldwide new risks have emerged that require enhanced security measures.

00:28This is where Cloud service comes into play, by offering a different approach compared to traditional on premises security.

00:36Let's explore these important differences.

00:39The first is, location.

00:41Cloud security involves hosting and managing data and applications in off site data centers operated by cloud service providers.

00:50The responsibility for securing the infrastructure and underlying hardware lies with the cloud provider.

00:56Conversely, traditional on premises security involves hosting and managing data and applications locally on an organization's

01:03own servers and infrastructure, granting direct

control and responsibility for securing the physical and virtual environment.

01:11 Next is responsibility.

01:13 In a Cloud model, the cloud service provider is responsible for securing the infrastructure, network, and physical facilities.

01:21 The customer is typically responsible for securing their data, applications, user access, and configurations.

01:28 On the other hand, in an on premises set up, the organization is responsible for securing the entire infrastructure including hardware, network, operating systems, applications, and data.

01:40 The next difference is scalability.

01:43 Cloud security offers scalability and elasticity, which allows organizations to easily scale their resources up or down based on demand.

01:52 This flexibility is suitable for dynamic workloads and rapid growth.

01:57 In contrast, on premises security requires organizations to provision and maintain their own infrastructure, which can be more time consuming and costly when they scale up or down.

02:09 Next is maintenance and updates.

02:12 Cloud service providers handle infrastructure maintenance, including security updates, patching, and software upgrades.

02:19 Customers can focus on managing their applications and data without worrying about the underlying infrastructure.

02:25 On premises environments require organizations to maintain and update their own infrastructure involving regular tasks such as patching, software updates, and hardware upgrades.

02:36 The final difference is capital expenditure.

02:40 Cloud security follows an operational expenditure OpEx model, where organizations pay for the services they consume on a subscription basis.

02:49 This eliminates the need for large, upfront capital investments in physical security infrastructure.

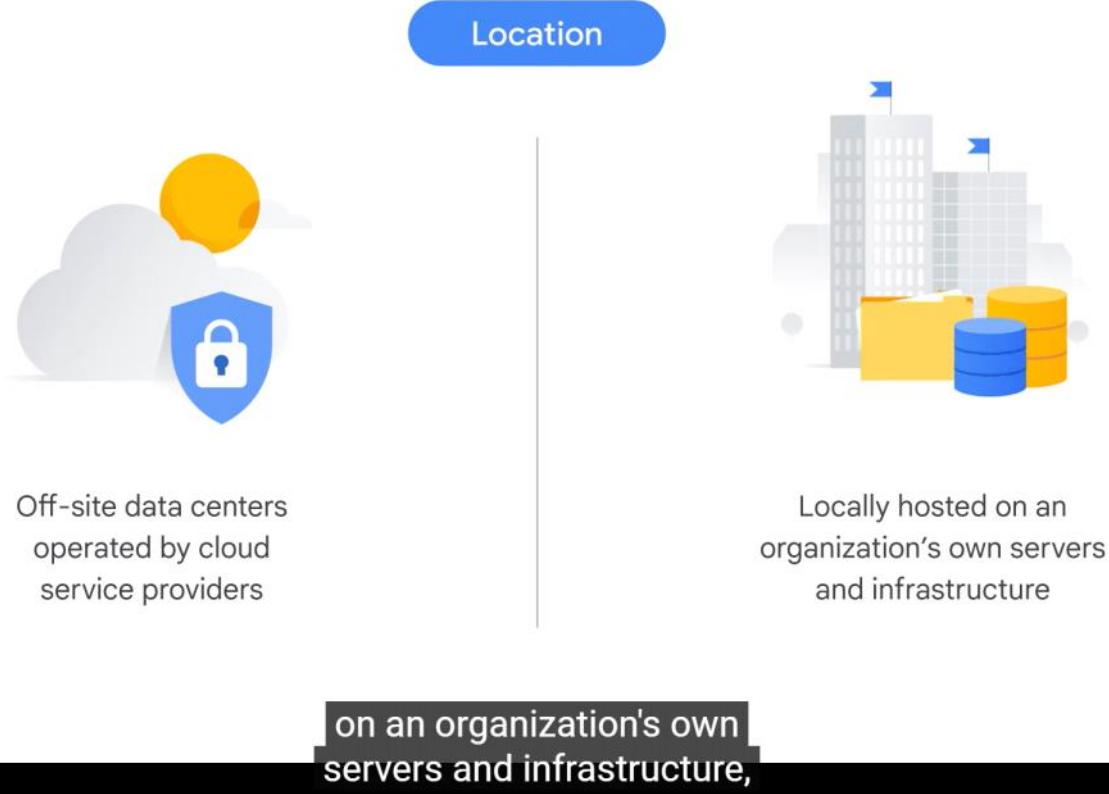
02:55 Traditional on premises security models involve significant capital expenditure CapEx, because organizations must purchase and maintain their own security infrastructure.

03:05 Understanding these differences between Cloud service and traditional on premises security helps organizations make informed decisions about the most suitable approach for their specific needs.

03:16 Cloud service offers benefits such as offloading infrastructure management, scalability, and cost flexibility.

03:23 However, traditional on premises security provides direct control over the entire infrastructure.

03:29Organizations must carefully evaluate their requirements and consider factors such as data sensitivity, compliance regulations, and scalability to determine the most effective security strategy for their business.





Responsibility



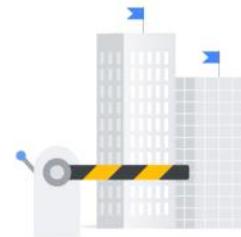
Cloud service provider is responsible for securing:

- Infrastructure
- Network
- Physical facilities



The customer is typically responsible for securing:

- Data
- Applications
- User access
- Configurations



The organization is responsible for securing the entire infrastructure, including:

- Hardware
- Network
- Operating systems
- Applications
- Data

**network, operating systems,
applications, and data.**



1:40 / 3:42



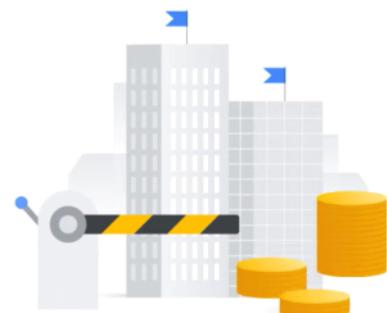
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Scalability



- Scalability
- Elasticity



Organizations are required to provision and maintain their own infrastructure.

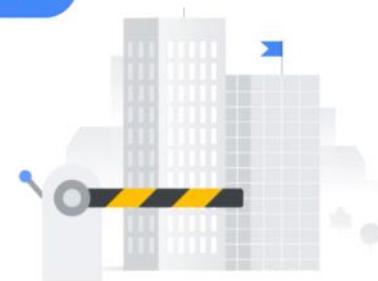
**which can be more
time consuming and**

Maintenance and updates



Cloud service providers handle infrastructure maintenance, including:

- Security updates
- Patching
- Software upgrades



Organizations maintain and update their own infrastructure, involving regular tasks such as:

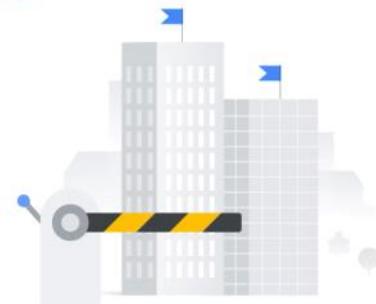
- Patching
- Software updates
- Hardware upgrades

software updates, and hardware upgrades.

Capital expenditure



Follows an operational expenditure (OpEx) model, where organizations pay for the services they consume on a subscription basis.

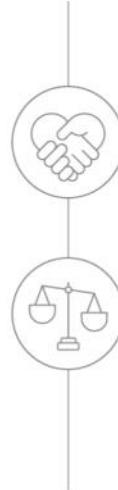


Significant capital expenditure (CapEx), because organizations must purchase and maintain their own security infrastructure.

maintain their own security infrastructure.



- Offloading infrastructure management
- Scalability
- Cost flexibility

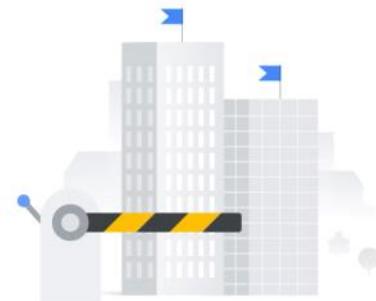
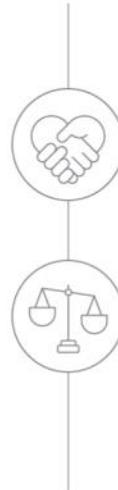


Direct control over the entire infrastructure.

Organizations must carefully evaluate



- Offloading infrastructure management
- Scalability
- Cost flexibility



- Data sensitivity
- Compliance regulations
- Scalability

determine the most effective

Cybersecurity threats

In today's fast-paced digital world, we're bombarded with

attention-grabbing headlines, COEs Beware: The Perils of Career Ending Cyberattacks.

00:10Retailer Pays a Hefty \$179 Million Due to Data Breach Fallout.

00:16Credit Agency Settles US Data Breach, Facing up to \$700 Million in Penalties.

00:22The realm of cyberattacks is evolving rapidly, and these threats can emerge from unexpected sources, even disguised as government entities.

00:31So what are some common cybersecurity threats faced by organizations?

00:36First is deceptive social engineering, imagine that a skilled manipulator is seeking to extract confidential system information from unsuspecting individuals.

00:46These cybercriminals employ phishing attacks, which collect personal details about you, your employees, or your students.

00:55They skillfully craft tailored emails and mimic authenticity to deceive their targets.

01:00Therefore, anyone within your organization can be tricked into inadvertently downloading malicious attachments, divulging passwords, or compromising sensitive data.

01:11Next is physical damage, whether it be damage to hardware components, power disruptions, or natural disasters such

01:17as floods, fires, and earthquakes, organizations are responsible for safeguarding data even in the face of physical adversity.

01:26You can think of this as protecting precious assets amidst nature's unforgiving forces.

01:33Another threat is malware, viruses, and ransomware, these digital adversaries architect chaos within the cyber domain.

01:41Employing malicious software, they aim to disrupt operations, inflict damage, or gain unauthorized access to computer systems.

01:49The most insidious of these is ransomware, where crucial files are held hostage until a considerable ransom is paid, it's like witnessing the digital equivalent of a calculated extortion scheme.

02:02The next cybersecurity threat is vulnerable third-party systems, imagine inviting a trusted ally into your domain only to discover that they inadvertently compromise your security.

02:13Many organizations rely on third party-systems for essential functions such as finance, inventory management, or account operations.

02:22However, without adequate security measures and

regular evaluations, these systems can transform into potential threats, leaving data security vulnerable.

02:33 It's like using a tool that unwittingly introduces risks to your own treasured possessions.

02:39 The final threat is configuration mishaps.

02:42 Even the most seasoned experts make mistakes, misconfiguration occurs when errors arise during the setup or configuration of resources, which inadvertently exposes sensitive data and systems to unauthorized access.

02:56 Surveys consistently identify misconfiguration as the most prominent threat to cloud security.

03:03 In turn, adopting principles of least privilege and privileged access are imperative because they allow resource access only when explicitly required and authorized.

03:13 This is like granting access only to those who have earned your trust.

03:17 As technology continues to advance at an astonishing pace, organizations must invest in the right expertise to assess, develop, implement and maintain robust data security plans.

Which definition best describes a firewall?

A software program that encrypts data to make it unreadable to unauthorized users

A security model that assumes no user or device can be trusted by default

A set of security measures designed to protect a computer system or network from cyber attacks

check A network security device that monitors and controls incoming and outgoing network traffic based on predefined security rules

That is the correct answer!

check

2.

Which is the responsibility of the cloud provider in a cloud security model?

Securing the customer's data.

Managing the customer's user access.

Configuring the customer's applications.

check Maintaining the customer's infrastructure.

That is the correct answer!

check

3.

Which cybersecurity threat demands a ransom payment from a victim to regain access to their files and systems?

Spyware

Trojan

check Ransomware

Virus

That is the correct answer!

check

4.

What common cybersecurity threat involves tricking users into revealing sensitive information or performing actions that compromise security?

check Phishing

Malware

Ransomware

Configuration mishap

That is the correct answer!

check

5.

Which cybersecurity threat occurs when errors arise during the setup of resources, inadvertently exposing sensitive data and systems to unauthorized access?

Malware

Virus

check Configuration mishaps

Phishing

That is the correct answer!

check

6.

Which cloud security principle ensures that security practices and measures align with established standards and guidelines?

Confidentiality

Control

check Compliance

Integrity

That is the correct answer!

check

7.

Which cloud security principle relates to keeping data accurate and trustworthy?

checkIntegrity
Confidentiality
Control
Compliance
That is the correct answer!

check

8. Which three essential aspects of cloud security form the foundation of the CIA triad?

Certificates, intelligence, and authentication
checkConfidentiality, integrity, and availability
Containers, infrastructure, and architecture
Compliance, identity, and access management
That is the correct answer!

check

9.

Which security principle advocates granting users only the access they need to perform their job responsibilities?

Security by default
Zero-trust architecture
Privileged access
checkLeast privilege
That is the correct answer!

check

10.

Which is a benefit of cloud security over traditional on-premises security?

checkIncreased scalability.
Having physical access to hardware.
Only having to install security updates on a weekly basis.
Large upfront capital investment.
That is the correct answer!

Google's Trusted Infrastructure

Data centers

Data centers are more than just facilities filled with computers.

00:03They're the backbone of round the clock operations for Google services, including search, Gmail, and YouTube.

00:11Moreover, they play a crucial role in storing and processing data for all the services provided on Google Cloud.

00:18At present, Google operates over 30 state of the art data centers worldwide, with some still under construction.

00:25These advanced facilities are meticulously designed to deliver exceptional reliability, top notch security, and outstanding efficiency.

00:34And they ensure that Google services are always available when you need them.

00:39But it doesn't stop there.

00:40Google is committed to minimizing the environmental impact of data centers.

00:45By using cutting edge technologies and renewable energy sources, we strive to reduce our ecological footprint.

00:52Let's explore the benefits of Google designing and building its own data centers using purpose built servers, advanced networking solutions, and custom security hardware and software.

01:03One of the greatest advantages of Google's data centers is the implementation of a zero-trust architecture, which ensures enhanced security at every level.

01:12Our custom hardware and software are purpose

built with features like tamper, evident hardware.

01:17Secure boot, and hardware based encryption, which establish a strong security posture within the data center environment.

01:25Physical security is paramount as well, with robust access control measures and biometric authentication in place.

01:32By adopting the principle of least privilege, only authorized personnel have access to the data centers, which minimizes the risk of physical breaches and maintains a privilege access framework.

01:44Furthermore, our data centers embody the concept of security by default.

01:49From the moment you step into a Google data center, you can trust that every aspect has been designed and implemented with your security in mind.

01:56With cyber resilience as a core principle, our data centers are equipped to withstand and recover from potential security incidences and ensure the continuity and integrity of your data.

02:08Efficiency is another important aspect of our data centered design.

02:12Purpose-built servers are optimized for specific tasks.

02:15Which allows them to perform at great speed and with exceptional efficiency.

02:20This reduces energy consumption, cuts down on operating costs, and saves resources in the environment.

02:26In fact, we measure our success through the power usage effectiveness, or PUE score.

02:32By continually striving for the lowest PUE scores, we ensure maximum efficiency in our data centers, leading to significant cost savings and a reduced carbon footprint.

02:44For instance, our data center in Hamina, Finland, stands out as one of the most advanced and efficient facilities in our fleet.

02:51Its innovative cooling system, which uses seawater from the Bay of Finland, sets a new standard for energy efficiency worldwide.

03:00Scalability is another benefit.

03:02Our data centers can quickly and seamlessly accommodate new hardware and servers, which allows us to scale up computing resources on demand.

03:11This flexibility is critical for Google to handle massive data volumes and traffic without any disruptions to services.

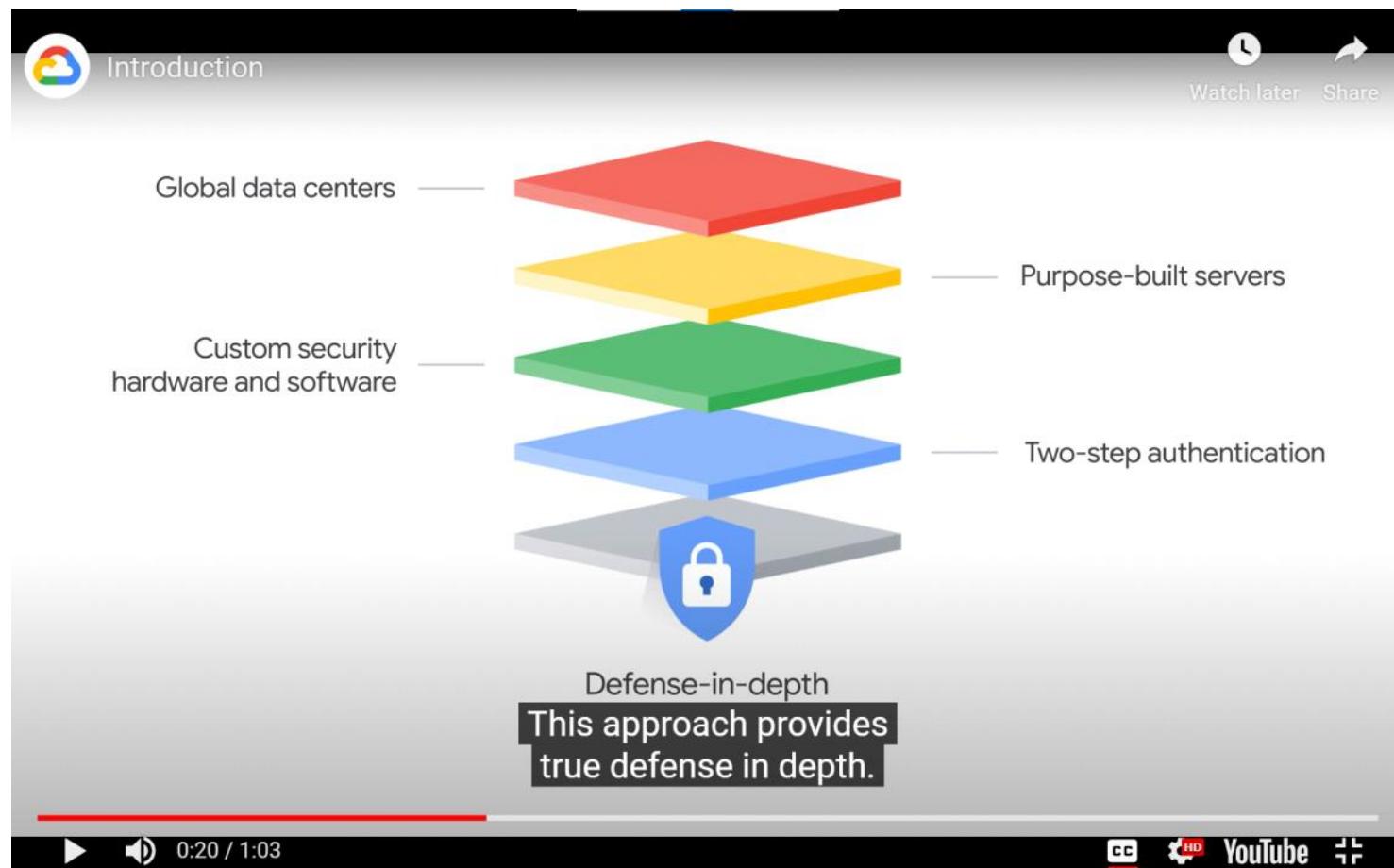
03:18Furthermore, managing our own servers and network provides us with unparalleled customization capabilities.

03:25This level of flexibility empowers us to deliver unique services and capabilities that are not available

from other providers, giving you access to exclusive features and innovations.

03:36 Although designing and building data centers require significant upfront investment, the long-term benefits are substantial.

03:43 By optimizing resource for efficiency and scalability, Google can significantly reduce energy consumption and operating costs, which results in remarkable savings over time.





Google Cloud

Purpose built servers

Advanced networking solutions

Custom security hardware and software

advanced networking solutions, and
custom security hardware and software.

Zero-trust architecture



Google Cloud

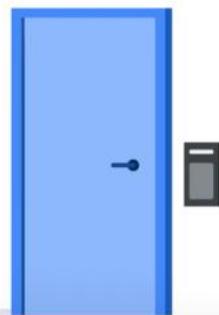
Our custom hardware and software
are purpose built with features like:

Tamper-evident hardware

Secure boot

Hardware-based encryption

Secure boot, and
hardware based encryption,



Robust access control measures

Biometric authentication in place

with robust access control measures and
biometric authentication in place.



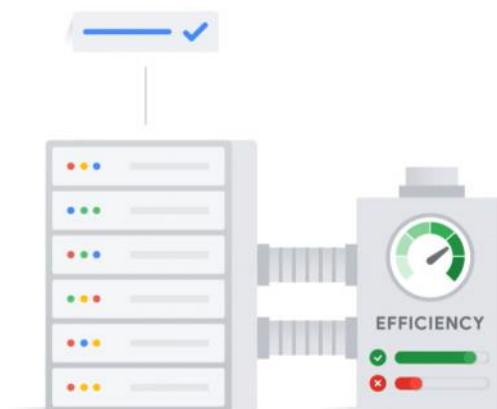
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YouTube



Efficiency



Reduces energy consumption

Cuts down on operating costs

Saves resources and the environment

saves resources in the environment.



PUE - Power Usage Effectiveness



Min. PUE



Max. efficiency



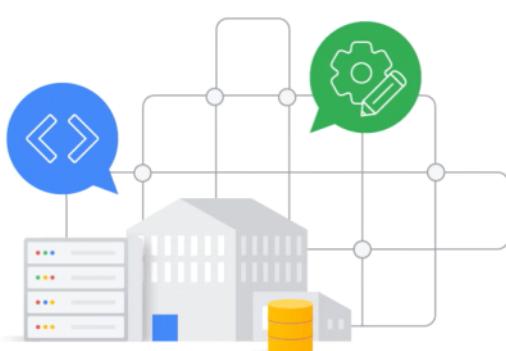
Cost savings and reduced carbon footprint

leading to significant cost savings and a reduced carbon footprint.

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Customization



Deliver unique services and capabilities

Give access to exclusive features and innovations

Google Cloud

giving you access to exclusive features and innovations.

Efficiency

Scalability

- Energy consumption

- Operating costs

Google can significantly reduce energy consumption and operating costs,

|| 3:50 / 3:54

CC HD YouTube

Secure storage

Previously, we learned that encryption is like a secret code that transforms data into an unreadable format using special algorithms.

00:07This process ensures that only those with the right key or password can make sense of the data.

00:13It's like using a secret language to protect your information.

00:16By encrypting your data, you can protect it from various risks such as unauthorized access, loss, or damage.

00:24Imagine your data is locked away in a safe.

00:27Without the right key, no one can steal it, tamper with it, or even understand the information inside.

00:32Let's take a closer look at how encryption protects your data in different states.

00:37When data is at rest, it's stored on physical devices like computers or servers.

00:43By encrypting data at rest, even if someone gains physical access to the device, they won't be able to decipher the data without the encryption key.

00:52At Google Cloud, we automatically encrypt all customer content at rest, without any effort required from you.

00:59It's a free and built in feature that adds an extra layer of protection to your valuable data.

01:04If you prefer to manage your encryption keys

yourself, you can use our Cloud key management service, Cloud KMS, for added control.

01:13When data is in transit, it's moving over networks or the Internet.

01:18Encryption plays a crucial role here by shielding your data from interception by cyber criminals or unauthorized parties.

01:25It's like sending your information in a locked box that only the intended recipient can open.

01:30At Google Cloud, we employ robust security measures to ensure the authenticity, integrity, and privacy of your data during transit.

01:39We encrypt and authenticate data at multiple network layers, especially when it travels outside the physical boundaries we control.

01:46This way, your information remains safe and secure as it journeys through the digital world.

01:52Data in use refers to data being actively processed by a computer.

01:56Encrypting data in use adds another layer of protection, especially against unauthorized users who might physically access the computer.

02:04We use a technique called memory encryption, which locks your data inside the computer's memory, making it nearly impossible for unauthorized users to gain access to it.

02:14When it comes to encryption algorithms, the advanced encryption standard AES takes center stage.

02:21AES is a powerful encryption algorithm trusted by governments and businesses worldwide.

02:27It's like having a top secret encryption method that keeps your data safe from prying eyes.

02:33Whether your data is resting, traveling, or actively in use, encryption acts as your loyal guardian because it ensures its confidentiality and protection.

02:43At Google Cloud we take encryption seriously to provide you with a secure storage solution you can trust.

Identity

Often referred to as the 3As, authentication, authorization, and auditing, are important aspects of cloud identity management used to ensure secure access, manage user privileges, and monitor resource usage.

00:13Let's begin with the first A, authentication.

00:17It serves as a gatekeeper because it verifies the identity of users or systems that seek access.

00:23Authentication involves presenting unique credentials, such as passwords, physical tokens, or biometric data, like fingerprints or voice recognition.

00:32 Think of it as presenting your identification card before entering a restricted area.

00:37 By validating the credentials provided, the server confirms that you are who you claim to be.

00:42 Two-step verification, which you may also hear being referred to as two-factor authentication or multi-factor authentication, is a security feature that adds an extra layer of protection to Cloud-based systems.

00:55 With two SV enabled, users need to provide two different pieces of information to log in.

01:01 For example, it could be a combination of a password and a code sent to their phone through text message, voice call, or an app like Google Authenticator.

01:09 This powerful feature makes unauthorized access more difficult, even if someone manages to obtain your password. The second A is authorization.

01:19 After a user's identity is authenticated, authorization steps in to determine what that user or system is allowed to do within the system.

01:28 Think of it as the access control mechanism.

01:32 Different permissions are assigned to individuals or groups based on their roles, responsibilities, and organizational hierarchy.

01:39 For example, a system administrator might have the authority to create and remove user accounts, whereas a standard user might only be able to view a list of other users.

01:49 This fine-grain control ensures that each user has the appropriate level of access to perform their tasks while preventing unauthorized actions.

01:58 The third A, auditing, sometimes referred to as accounting, plays a critical role in monitoring and tracking user activities within a system.

02:09 By collecting and analyzing logs of user activity, system events, and other data, auditing helps organizations detect anomalies, security breaches, and policy violations.

02:20 It provides a comprehensive record of actions taken on a system or resource which proves invaluable during security incident investigations, compliance tracking, and system performance evaluation.

02:33 Just like the surveillance cameras in a shopping mall, auditing keeps a watchful eye on activities happening within your system.

02:41 To provide granular control over who has access to Google Cloud resources and what they can do with those resources, organizations can use identity and access management, or IAM.

02:52 With IAM, you can create and manage user accounts, assign roles to users, grant and revoke permissions to resources, audit user activity, and monitor your security position.

03:04It provides a centralized and efficient approach to managing access control within your Google Cloud environment.

03:11Imagine IAM as your organization's security headquarters, equipped with robust tools to manage and safeguard your digital assets.

03:20By integrating IAM into your Google Cloud security strategy, you can ensure fine-grained access control, enhanced visibility, and centralized resource management.

03:30This empowers you to protect your organization's sensitive data and resources effectively.



Authentication

Authorization

Auditing

Ensure secure access

Manage user privileges

Monitor resource usage

and monitor resource usage.

Authentication



It verifies the identity of users
or systems that seek access

the identity of users or
systems that seek access.



Identity



Watch later Share

Authentication



Two-factor authentication

Two-step verification

Multi-factor authentication

or multi-factor authentication,

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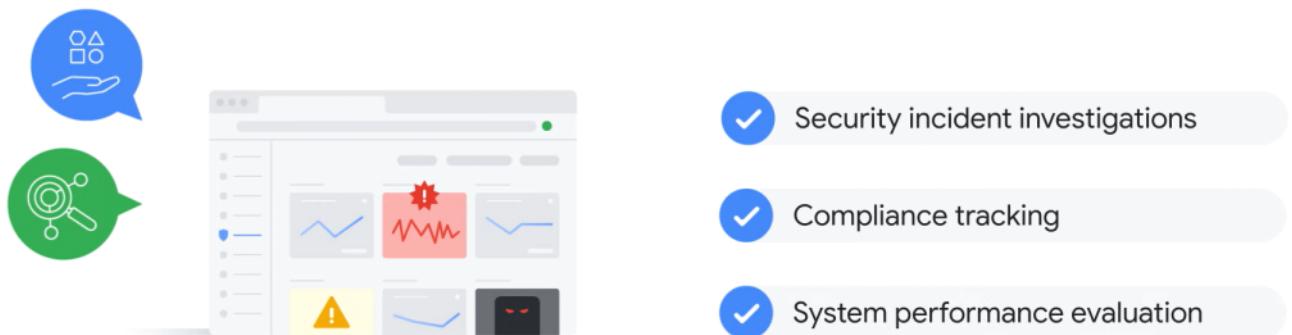
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Authorization

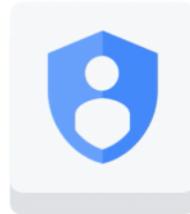


be able to view a
list of other users.

Auditing



compliance tracking, and
system performance evaluation.



Identity and Access Management (IAM)

- Create and manage user accounts
- Assign roles to users
- Grant and revoke permissions to resources
- Audit user activity
- Monitor your security position

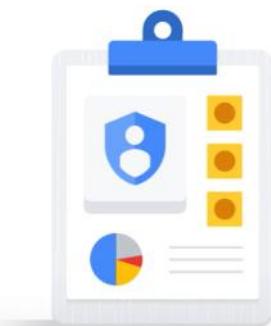
audit user activity, and
monitor your security position.



Identity



Watch later Share



- Fine-grained access control
- Enhanced visibility
- Centralized resource management

This empowers you to protect



3:30 / 3:35



YouTube



Network security

When you expand your network to include Cloud

environments, security considerations take on a whole new dimension.

00:05Unlike traditional on-premises setups with clear perimeters, the Cloud brings new possibilities and challenges.

00:13Let's explore some strategies to secure your organization's network and ensure the safety of your valuable data and workloads in Google Cloud.

00:22Embrace the power of zero trust networks.

00:26In the world of security, trust shouldn't be given freely, with Google Cloud's BeyondCorp enterprise, you can implement a zero trust security model.

00:35It means that every access request is thoroughly verified and both the user's identity and context are considered.

00:42This way you maintain strict control over who can access your network and resources, both inside and outside your organization.

00:50Secure your connections to on-premises and multi-Cloud environments.

00:55Many organizations have a mix of Cloud and on-premises workloads or they use multiple Cloud providers for resiliency.

01:03Ensuring secure connectivity across these environments is crucial.

01:07Google Cloud provides private access methods through services like Cloud VPN and Cloud Interconnect, which let you establish secure connections between your on-premises networks and Google Cloud resources.

01:19Protect your perimeter with Google Cloud's powerful tools.

01:23Google Cloud offers various methods to help secure your perimeter, including firewalls and virtual private Cloud

01:28VPC service controls, which help you divide your Cloud into different sections and keep them secure.

01:35You can also utilize shared VPC, which is like having a large fence that separates each Google Cloud project so they can work independently and safely.

01:45With these tools, you can keep your Cloud environment protected and give different teams their own space to work in.

01:52Stay ahead with a web application firewall, External web applications and services are often targeted by cyber threats, including DDoS attacks.

02:02DDoS, which stands for a Distributed Denial-of-Service, is a cyber attack that uses multiple compromised computer systems to

02:10flood a target with more traffic than it can handle, which causes a denial of service to legitimate users.

02:17 Google Cloud Armor comes to the rescue by providing robust DDoS protection.

02:22 It's like a force field that stops harmful attacks and keeps your website or application safe from things that can make it stop working properly.

02:30 Automate infrastructure provisioning for enhanced security.

02:34 By adopting automation tools, you can create immutable infrastructure, which means that it can't be changed after provisioning.

02:42 Think of infrastructure provisioning tools as your personal assistance for setting up and maintaining your Cloud environment.

02:49 When you use tools like Terraform, Jenkins, and Cloud Build, they handle all the behind the scenes work to create a secure and reliable Cloud environment.

02:59 It's like having a team of efficient workers who build and organize everything you need to run your environment smoothly.

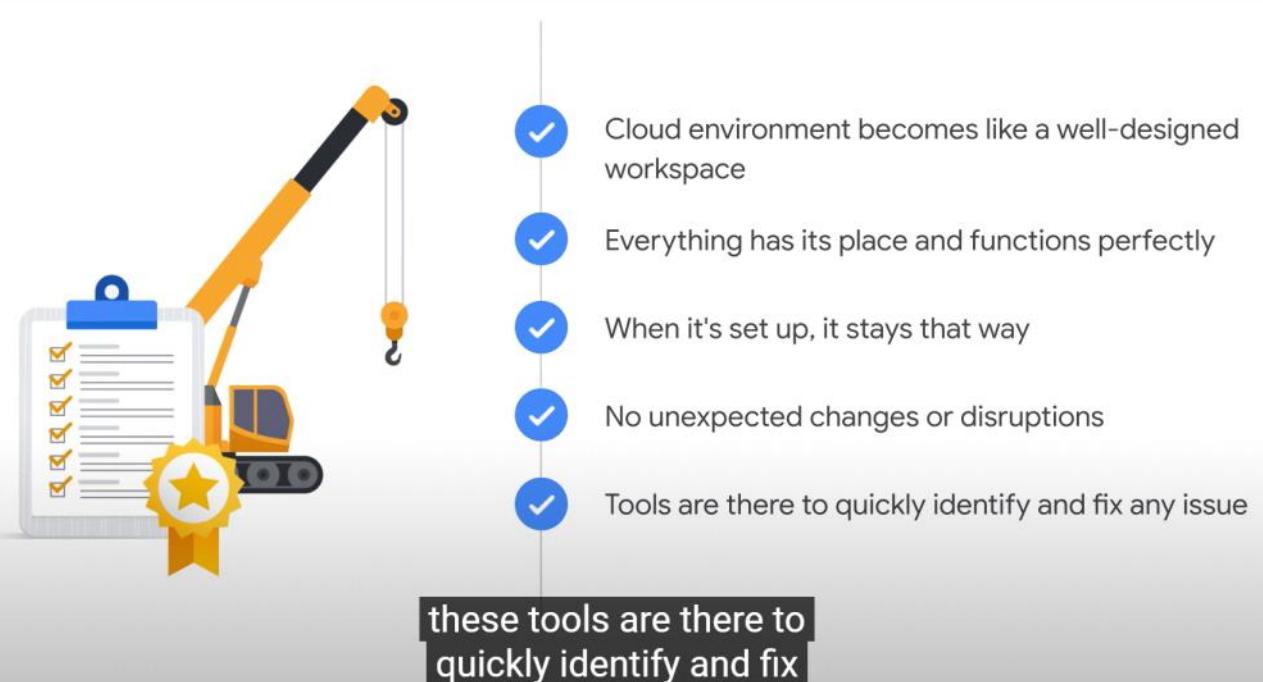
03:05 With these tools, your Cloud environment becomes a well designed workspace where everything has its place and functions perfectly.

03:13 The best part is when it's set up, it stays that way, no unexpected changes or disruptions.

03:19 If anything does go wrong, these tools are there to quickly identify and fix any issue and ensure that your Cloud environment keeps running smoothly.

03:29 These examples illustrate just a few of the ways organizations use Google Cloud to fortify their networks against attacks.

03:36 Your specific network set up and security measures will depend on your unique business requirements and risk tolerance.



3:23 / 3:45

YouTube

Security operations

SecOps, short for security operations, is all about protecting your organization's data and systems in the Cloud.

00:07 It involves a combination of processes and technologies that help reduce the risk of data breaches, system outages, and other security incidents.

00:16 Think of it as your secret weapon for keeping your valuable data safe.

00:21 Let's explore some of the essential activities involved in SecOps.

00:25 Vulnerability management, is the process of identifying and fixing security vulnerabilities in Cloud infrastructure and applications.

00:33 It's like regularly checking your castle walls for weak spots.

00:37 Google Cloud's security command center, or SCC, provides a centralized view of your security posture.

00:45 It helps to identify and fix vulnerabilities, and it ensures that your infrastructure remains solid and protected.

00:52 Another crucial activity is log management.

00:56 It's like having a watchful eye on your castle grounds, looking out for any suspicious activity.

01:01 Google Cloud offers a Cloud logging a service to collect and analyze security logs from your entire Google Cloud environment.

01:09 It helps you detect and respond to any signs of trouble.

01:12 It ensures you anticipate any potential threats.

01:16 Of course, being prepared for security incidents is equally important.

01:21 This is where incident response comes in.

01:24 Imagine having a team of knights ready to defend your castle at a moment's notice.

01:29 Google Cloud has expert incident responders across various domains who are equipped with the knowledge and tools to tackle any security incident swiftly and effectively.

01:39 Another crucial aspect of SecOps is educating your employees on security best practices.

01:45 Just like teaching everyone in the castle to be vigilant and lock the gates, security awareness

01:49 training helps prevent incidents by raising awareness and empowering employees to protect themselves and the organization.

01:57 Now you might be wondering, why should your organization implement SecOps?

02:02 Well, here are the benefits, reduced risk of data breaches.

02:07 SecOps helps identify and fix vulnerabilities, which significantly reduces the risk of data breaches.

02:14 Increased up time, a swift and effective incident response minimizes the impact of outages on your business operations, which ensures smoother and uninterrupted services.

02:26 Improved compliance, SecOps helps with meeting security regulations such as the General Data Protection Regulation or GDPR, and keeps your organization in good standing.

02:39 Enhanced employee productivity, by educating employees on security best practices, SecOps minimizes the risk of human error and promotes a more secure and productive work environment.

02:52 SecOps is an integral part of your organization's security strategy.

02:57 By implementing SecOps practices, you can fortify your defenses, reduce security risks, and protect your data in the ever changing landscape of Cloud security.

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SecOps - Security Operations



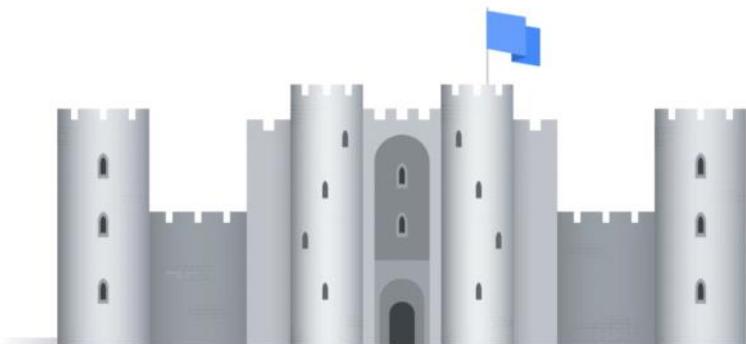
Reduce:

- Data breaches
- System outages
- Other security incidents

system outages, and other
security incidents.

Vulnerability management

The process of identifying and fixing security vulnerabilities in cloud infrastructure and applications.



Cloud infrastructure
and applications.



Log management



A service to collect and analyze security logs from your entire Google Cloud environment.

Cloud Logging

from your entire Google
Cloud environment.



1:08 / 3:08



YouTube



Education



Raising awareness and empowering employees to protect themselves and the organization.

protect themselves
and the organization.



1:56 / 3:08



YouTube



SecOps Benefits:

Reduced risk of data breaches

Increased uptime

Improved compliance

Enhanced employee productivity

reduced risk of data breaches.

SecOps - Security Operations

By implementing SecOps practices, you can:

- Fortify your defenses
- Reduce security risks
- Protect your data



your data in the ever changing landscape

Which is a powerful encryption algorithm trusted by governments and businesses worldwide?
Post-quantum cryptography (PQC)
Isomorphic encryption (IE)
Lattice-Based Cryptography (LBC)
checkAdvanced Encryption Standard (AES)
That is the correct answer!

check

2.

Select the correct statement about Identity and Access Management (IAM).

IAM is a cloud security information and event management solution that collects and analyzes log data from cloud security devices and applications.

IAM is a cloud service that encrypts cloud-based data at rest and in transit.

IAM is a system that detects and prevents malicious traffic from entering a cloud network.

checkIAM provides granular control over who has access to Google Cloud resources and what they can do with those resources.

That is the correct answer!

check

3.

What Google Cloud product provides robust protection from harmful distributed denial-of-service (DDoS) attacks?

Cloud Monitoring

Cloud IAM

Cloud Load Balancing

checkGoogle Cloud Armor

That is the correct answer!

check

4.

What security feature adds an extra layer of protection to cloud-based systems?

Data loss prevention (DLP)

checkTwo-step verification (2SV)

Firewall as a service (FaaS)

Security information and event management (SIEM)

That is the correct answer!

check

5.

Which aspect of cloud identity management verifies the identity of users or systems?

Accounting

Auditing

Authorization

checkAuthentication

That is the correct answer!

check

6.

Which practice involves a combination of processes and technologies that help reduce the risk of data breaches, system outages, and other security incidents in the cloud?

Cloud security posture management (CSPM)

Zero trust security

Site reliability engineering (SRE)

checkSecurity operations (SecOps)

That is the correct answer!

check

7.

Google Cloud encrypts data at various states. Which state refers to when data is being actively processed by a computer?

Data at rest

Data lake

Data in transit

checkData in use

That is the correct answer!

check

8.

What metric does Google Cloud use to measure the efficiency of its data centers to achieve cost savings and a reduced carbon footprint?

Data Center Infrastructure Efficiency (DCiE)

checkPower Usage Effectiveness (PUE)

Energy Efficiency Ratio (EER)

Total cost of ownership (TCO)

That is the correct answer!

Google Cloud's Trust Principles and Compliance

At Google, we believe in transparency and want you to have complete confidence in our services.

00:05 Google Cloud's trust principles are designed to empower you and ensure that the security and control of your business data isn't compromised.

00:13 Let's review these principles.

00:16 One, you own your data, not Google.

00:20 We prioritize your control and let you access, export, delete, and manage data permissions within Google Cloud.

00:27 Two, Google does not sell customer data to third parties.

00:32 We safeguard your data from being used for Google's

marketing or advertising purposes.

00:37Three, Google Cloud does not use customer data for advertising.

00:42Your data remains confidential because Google Cloud ensures that it's never utilized to target ads.

00:48Four, all customer data is encrypted by default.

00:53Your data is protected with robust encryption because Google Cloud safeguards it even in the unlikely event of unauthorized access.

01:02Five, we guard against insider access to your data.

01:06We implement stringent security measures to prevent unauthorized employee access to customer data.

01:12Six, we never give any government entity backdoor access.

01:18Your data remains secure and no government entity can access it without proper authorization.

01:24Seven, our privacy practices are audited against international standards.

01:30We undergo regular audits to ensure compliance with rigorous privacy standards.

01:36Transparency reports and independent audits transparency are a core element of our commitment to trust.

01:43We provide valuable insights and accountability through our transparency reports, which shed light on government and corporate actions that affect privacy, security and access to information.

01:54These reports let you stay informed and maintain trust in our services.

01:59Additionally, Google Cloud undergoes independent third party audits and certifications.

02:06This verification process ensures that our data protection practices align with our commitments and industry standards.

02:14Our participation in initiatives like the EU Cloud Code of Conduct further reinforces our dedication to accountability, compliance support, and robust data protection principles.

Data residency and data sovereignty

When it comes to storing data and keeping it secure, data sovereignty and data residency are two important concepts to understand.

00:09Data sovereignty refers to the legal concept that data is subject to the laws and regulations of the country where it resides.

00:17For example, the General Data Protection

Regulation GDPR in the European Union requires companies to comply **00:24**with data protection laws when processing or storing personal data of eu citizens, regardless of their location.

00:33This ensures that individuals have control over their personal data and its usage.

00:39In contrast, data residency refers to the physical location where data is stored or processed.

00:46Some countries or regions have laws or regulations that require data to be stored within their borders.

00:52For instance, some countries mandate that personal data of its citizens must be stored on servers within the country.

01:00This ensures data remains within the jurisdiction of local laws.

01:05Now let's explore how Google Cloud addresses data residency requirements.

01:10We offer a range of options to control the physical location of your data through regions.

01:17Each region consists of one or more data centers, which lets you choose where your data resides.

01:23For example, within the European Union, you can select regions located in various countries like the UK, Belgium, Germany, Finland, Switzerland, and the Netherlands.

01:35By configuring your resources in specific regions, Google ensures that your data is stored only within the selected region, as stated in our service specific terms.

01:46Additionally, Google Cloud provides organization policy constraints coupled with IAM configuration to prevent accidental data storage in the wrong region.

01:56These controls offer peace of mind and reinforce your data residency requirements.

02:02Furthermore, Google Cloud offers features like VPC service controls, which let you restrict network.

02:08Access to data based on defined perimeters.

02:12You can limit user access through IP address filtering, even if they have authorization.

02:18Google Cloud Armor lets you restrict traffic locations for your external load balancer by adding an extra layer of protection.

02:25By using these capabilities, organizations can adhere to data residency and data sovereignty requirements.

02:31Ensure compliance, and maintain control over their valuable data within the Google cloud ecosystem.

Industry and regional compliance

As organizations migrate to Cloud, it becomes essential to protect sensitive workloads while ensuring compliance with diverse regulatory requirements and guidelines.

00:11Compliance is a critical aspect of the Cloud journey, because not meeting regulatory obligations can have far reaching consequences.

00:20To assist you in achieving compliance, Google Cloud offers robust resources and tools tailored to support your specific needs.

00:28First, let's explore the [Google Cloud Compliance Resource center](#).

00:33This comprehensive hub provides detailed information on the certifications and compliance standards we satisfy.

00:40You can find mappings of our security, privacy and compliance controls to global standards.

00:47This transparency lets you validate our adherence to industry leading practices.

00:52The resource center also offers valuable documentation on regional and sector specific regulations, and empowers you to navigate complex compliance landscapes.

01:03Imagine you're a healthcare organization subject to HIPAA regulations, which protect sensitive patient health information from being disclosed without the patient's

01:12consent or knowledge, the Resource Center equips you with the necessary insights and documentation to align your compliance efforts with HIPAA requirements.

01:23Similarly, if you operate within the financial sector, you'll find guidance on meeting regulations like PCI DSS, which stands for payment card industry data security standard.

01:35Google Cloud's Compliance Resource Center is your go to source for actionable information and support.

01:42In addition to the resource center, we provide the [compliance reports manager](#); a powerful tool at your disposal.

01:49This intuitive platform offers easy on demand access to critical compliance resources at no extra cost.

01:57Within the [compliance reports manager](#), you'll discover our latest ISO/IEC certificates, SOC reports, and self-assessments.

02:06These resources provide evidence of our adherence to rigorous compliance standards, and help streamline your own reporting and compliance efforts.

02:15Imagine you're enterprise seeking ISO/IEC 27001 certification.

02:22The [compliance reports manager](#) lets you access the necessary documentation efficiently, and it saves you time and effort in the certification process.

02:31With this tool, we aim to simplify your compliance journey and empower you to meet your regulatory obligations effectively.

02:39By using the Google Cloud Compliance Resource Center and the Compliance Reports Manager, you can navigate the complex realm of industry and regional compliance with confidence.

02:50Our dedicated teams of engineers and compliance experts work hand in hand with you to address your specific regulatory needs.

02:57Together, we create an integrated controls and governance framework, while we ensure a robust compliance posture.

03:05You can visit the Compliance Resource Center at cloud.google.com/security/compliance, and explore the Compliance Reports Manager at cloud.google.com/security/compliance/compliance-reports-manager.

Where can you find details about certifications and compliance standards met by Google Cloud?

Cloud Storage client libraries
checkCompliance resource center
Google Cloud console
Marketplace

That is the correct answer!

check
2.

Which report provides a way for Google Cloud to share data about how the policies and actions of governments and corporations affect privacy, security, and access to information?

Billing reports
checkTransparency reports
Security reports
Compliance reports

That is the correct answer!

check
3.

Which is one of Google Cloud's seven trust principles?

We give "backdoor" access to government entities when requested.
checkAll customer data is encrypted by default.
Google sells customer data to third parties.
Google Cloud uses customer data for advertising.

That is the correct answer!

check
4.

Which term describes the concept that data is subject to the laws and regulations of the country where it resides?

Data residency
Data redundancy
Data consistency
checkData sovereignty

That is the correct answer!

check
5.

Which Google Cloud feature allows users to control their data's physical location?

checkRegions
Districts
Places
Areas

That is the correct answer!

Scaling with Google Cloud Operations

Course Introduction

Cloud operations refers to the set of practices and strategies employed to ensure the smooth functioning, optimization, and scalability of cloud-based systems.

Cloud operations refer to the set of practices and strategies employed to ensure the smooth

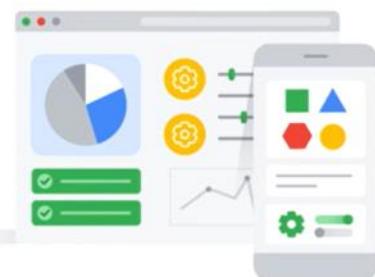


Course introduction



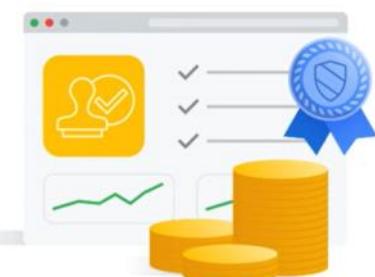
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Cloud operations



Managing and monitoring:

- Infrastructure
- Applications
- Services



Adhering to best practices:

- Reliability
- Performance
- Security
- Cost optimization

Cloud operations play a pivotal role in enabling organizations to achieve digital transformation



0:44 / 1:38



YouTube



Financial Governance and Managing

Cloud Costs

Easy access to cloud resources presents a need for precise, real-time control of what's being consumed.

00:06 Having cloud financial governance, which is in part a set of processes and controls that organizations use to **00:12** manage cloud spend, can mean the difference between peace of mind and spiraling costs that lead to budget overruns.

00:21 As an organization adapts, it'll need a core team across technology, finance, and business functions

00:26 to work together to stay on top of cloud costs and make decisions in real time.

00:33 The variable nature of cloud costs impacts people, process, and technology.

00:38 Let's explore these three areas, starting with people.

00:43 People refers to the different roles involved in managing cloud costs.

00:48 For small organizations, one person might fulfill multiple roles and be responsible for managing all aspects of a cloud infrastructure and associated finance.

00:57 From budgeting to procurement, tracking optimization, and more.

01:01 Large organizations, however, will likely look to a finance team to take on a financial planning and advisory role.

01:09 Using business priorities, a finance team is expected to make data-driven decisions on cloud spending, but

01:13 they might struggle to understand or monitor cloud spend on a daily, weekly, or monthly basis.

01:21 Then there are members of technology and line of business teams.

01:25 They can advise on how cloud resources are being used to meet the organization's overall business strategy and what additional resources might be needed throughout the upcoming year.

01:35 However, they don't necessarily factor costs into their decision making.

01:41 To manage cloud costs effectively, a partnership across finance, technology, and business functions is required.

01:48 This partnership might already exist, or it may take the form of a centralized hub, such as a cloud center of excellence.

01:56 The central team would consist of several experts who ensure that best practices are in place across the organization and that there's visibility into the ongoing cloud spend.

02:06The centralized group would also be able to make real-time decisions and discuss trade-offs when spending is higher than planned.

02:14Now let's transition from people to process.

02:16On a daily or weekly basis, organizations should monitor and analyze their cloud usage and costs.

02:24Then, on a weekly or monthly basis, the finance team should analyze the results, charge back the costs through **02:29**the appropriate teams, and determine whether any changes are needed to ensure that the organization's cloud spend is optimized.

02:38Having a culture of accountability in place across teams helps organizations recognize waste, quickly act to eliminate it, and ensure they're maximizing their cloud investment.

02:48It will also help drive cross-group collaboration across technology, finance, and business teams to ensure that their cloud spend aligns with broader business objectives.

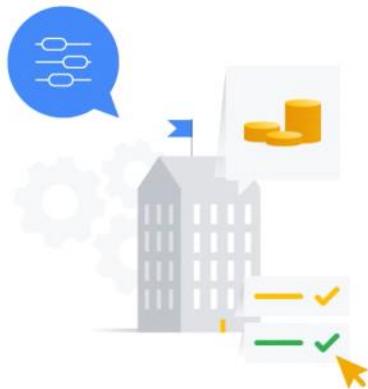
03:00And finally, there's technology.

03:02Google Cloud provides built-in tools to help organizations monitor and manage costs.

03:08These tools help organizations gain greater visibility, drive a culture of accountability for cloud spending across the

03:14organization, control costs to reduce risks of overspending, and provide intelligent recommendations to optimize cost and usage.

03:23You'll explore some of these tools later in this section.



Cloud financial governance

A set of processes and controls that organizations use to manage cloud spend



Technology

Finance

Business



People

Process

Technology

The variable nature of cloud costs impacts people, process, and technology.

01

Ensure that best practices are in place across the organization.

02

Ensure there's visibility into the ongoing cloud spend.



Cloud center of excellence

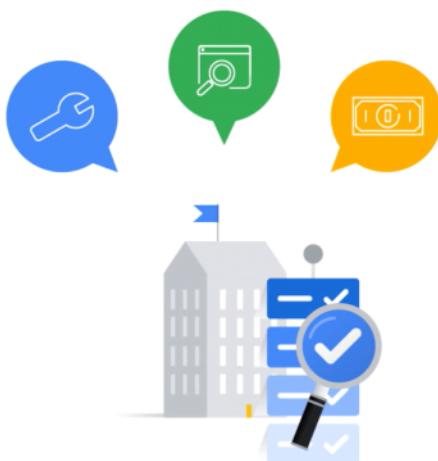


Recognize waste, quickly act to eliminate it, and ensure they're maximizing their cloud investment.



Drive cross-group collaboration across technology, finance, and business teams to ensure their cloud spend aligns with broader business objectives.

It will also help drive cross-group collaboration across technology, finance, and business teams



These tools help organizations:

- Gain greater visibility
- Drive a culture of accountability for cloud spending across the organization
- Control costs to reduce risks of overspending
- Provide intelligent recommendations to optimize cost and usage

and provide intelligent recommendations to optimize cost and usage.

Cloud financial governance best practices

Let's explore some cloud financial governance best practices that organizations can adopt to increase the predictability and control of their cloud resources.

00:09 The first best practice is to identify who manages cloud costs.

00:14If it's a team, it should ideally be a mix of IT managers and financial controllers.

00:19Because Cloud spending is decentralized and variable, it's important to establish a culture of accountability for costs across the organization.

00:28Defining clear ownership for projects and sharing cost views with the departments and teams that are using cloud resources helps establish this accountability culture and more responsible spending.

00:40As well as making teams accountable for their spending, Google Cloud financial governance policies and permissions make it easy to control who can spend and view costs across your organization.

00:51In addition, Google Cloud offers flexible options to organize resources and allocate costs to individual departments and teams.

01:00For example, budgets notify key stakeholders based on your actual or forecasted cloud costs.

01:07Creating multiple budgets with meaningful alerts is an important practice for staying on top of your cloud costs.

01:14The second best practice is to understand what kind of information can be found in an invoice versus cost management tools.

01:21They're not the same concept.

01:24An invoice is a document that is sent by a cloud service provider to a customer to request payment for the services that were used.

01:31However, a cost management tool is software to help track, analyze, and optimize cloud spend.

01:39An organization is rarely only interested in how much they spend.

01:43They also want to know why they spent that much.

01:46Cost management tools, like those built into the Google Cloud console, are effective for answering the why.

01:53They can provide granular data, uncover trends, and identify actions to take to control or optimize costs.

02:01And this brings us to the third best practice for increasing the predictability and control of cloud resources: use Google Cloud's cost management tools.

02:11Google Cloud believes in supporting organizations by providing strong financial governance tools that make it easier for customers to align their strategic priorities with their cloud usage.

02:22Before organizations can optimize their cloud costs, they first need to understand what they're spending, whether there are any trends, and what their forecasted costs are.

02:32So, how can this be done?

02:35Start by capturing what cloud resources are being used, by whom, for what purpose, and at what cost.

02:43From there, determine who will be responsible for monitoring that information, who will be involved in managing costs, and how the spending information will be reported on an ongoing basis.

02:54It's also important to set up the cadence and format for ongoing communication with main cloud stakeholders.

03:01Having this plan outlined up front helps ensure that managing costs isn't an afterthought.

03:07And how can you monitor current cost trends and identify areas of waste that could be improved?

03:12Google Cloud provides built-in reporting capabilities, which can help your team gain visibility into costs.

03:18Ideally, reports should be reviewed weekly, at a minimum.

03:23One powerful tool is the Google Cloud Pricing Calculator.

03:27The Pricing Calculator lets you estimate how changes to cloud usage will affect costs.

03:33The calculator is available at cloud.google.com/products/calculator.

03:41Now that you've had a chance to explore some cloud financial governance best practices, the next step is to implement them.

03:47If this doesn't fall into your scope of responsibility, be sure to pass on those best practices to the relevant stakeholders within your organization.

Using the resource hierarchy to control access

One important cloud computing consideration involves controlling access to resources.

00:05With on-premises infrastructure, physical access controls were used.

00:09This method, however, is not as effective with resources stored in the cloud.

00:15The Google Cloud resource hierarchy is a powerful tool that can be used to control access to cloud resources.

00:20Much like the folder structure you use to organize and control access to your own files, this resource hierarchy is a tree-like structure that organizes resources into logical groups.

00:32This makes it easier to manage resources and control.

00:36Google Cloud's resource hierarchy contains four

levels, and starting from the bottom up they are: resources, projects, folders, and an organization node.

00:48The first level, resources, represent virtual machines, Cloud Storage buckets, tables in BigQuery, or anything else in Google Cloud.

00:57Resources are organized into projects, which sit on the second level.

01:02Projects can be organized into folders, or even subfolders.

01:06These sit at the third level.

01:07And then at the top level is an organization node, which encompasses all the projects, folders, and resources in your organization.

01:16It's important to understand this resource hierarchy because it directly relates to how policies are managed and applied when you use Google Cloud.

01:26A policy is a set of rules that define who can access a resource and what they can do with it.

01:32Policies can be defined at the project, folder, and organization node levels.

01:38Some Google Cloud services can also apply policies to individual resources.

01:44The third level of the Google Cloud resource hierarchy is folders.

01:49Folders let you assign policies to resources at the level of granularity that you choose.

01:53The resources in a folder inherit policies and permissions assigned to that folder.

01:58A folder can contain projects, other folders, or a combination of both.

02:05Now that you understand the structure of the Google Cloud resource hierarchy, let's explore some additional benefits of using it to control access to cloud resources.

02:14First, the resource hierarchy provides granular access control, meaning you can assign roles and permissions at different levels of the hierarchy, such as at the folder, project, or individual resource level.

02:27Second, because the resource hierarchy follows inheritance and propagation rules, permissions set at higher levels of the resource hierarchy are automatically inherited by lower-level resources.

02:39For example, if you grant a user access at the folder level, all projects and resources within that folder inherit those permissions by default.

02:48This inheritance simplifies access management and reduces the need for manual configuration at each individual resource level.

02:56Third, the resource hierarchy enhances security and compliance through least privilege principles.

03:03By assigning access permissions at the appropriate level in the hierarchy, you can ensure that users only have the necessary privileges to perform

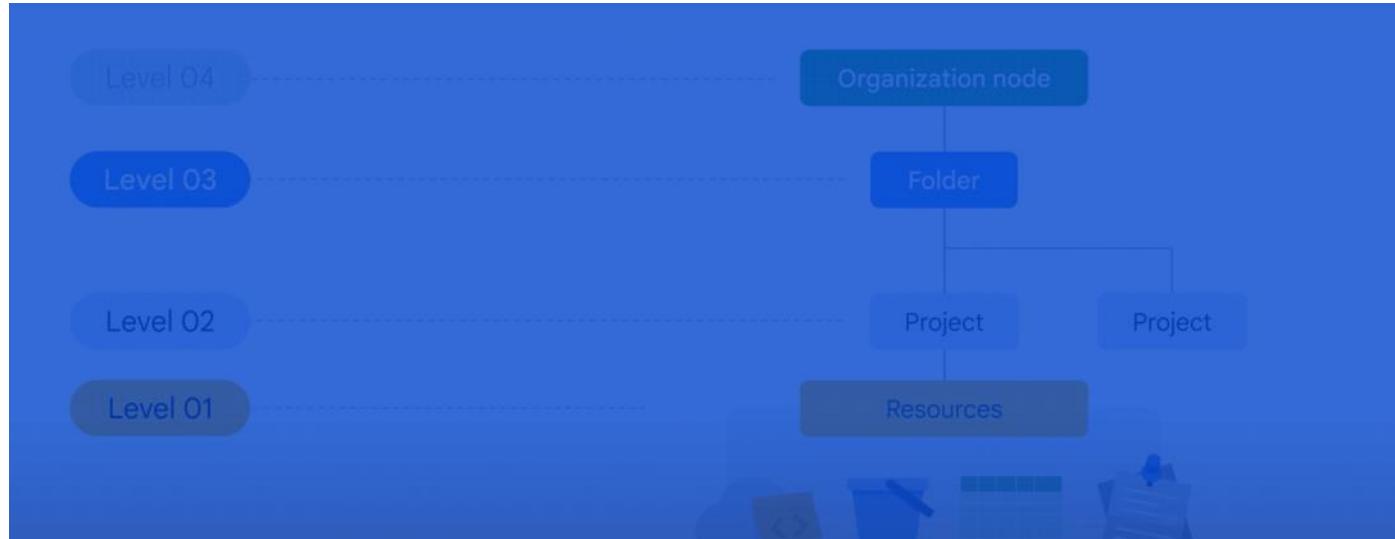
their tasks.

03:13This reduces the risk of unauthorized access and helps maintain regulatory compliance.

03:18Finally, the resource hierarchy provides strong visibility and auditing capabilities.

03:24You can track access permissions and changes across different levels of the hierarchy, which makes it easier to monitor and review access controls.

03:33This improves accountability and helps identify and address potential security issues.



Controlling cloud consumption

Organizations want to control cloud consumption for many reasons.

00:04It could be about cost savings by ensuring they're not overspending on unnecessary resources, increased visibility by providing a better understanding of how

00:13resources are being used and identifying areas to reduce costs, or improved compliance by ensuring your cloud environment is compliant with industry regulations.

00:27Google Cloud offers several tools to help control cloud consumption, including resource quota policies, budget threshold rules, and Cloud Billing reports.

00:36Let's define each of these terms.

00:41Resource quota policies let you set limits on the amount of resources that can be used by a project or user.

00:47They can help prevent overspending on cloud resources; therefore, they help you ensure that your

cloud usage is within your budget.

00:55Then there are budget threshold rules, which let you set alerts to be informed when your cloud costs exceed a certain threshold.

01:03They can act as an early warning for potential cost overruns, and let you take corrective action before costs get out of control.

01:11Both resource quota policies and budget threshold rules are set in the Google Cloud console.

01:17And then there are Cloud Billing reports.

01:20Whereas resource quota policies and budget threshold rules provide proactive means to control cloud consumption, Cloud Billing reports offer a reactive method

01:27to help you track and understand what you've already spent on Google Cloud resources and provide ways to help optimize your costs.

01:37You can use Cloud Billing reports to monitor costs by exporting billing data to BigQuery.

01:42This means exporting usage and cost data to a BigQuery dataset, and then using the dataset for detailed analyses.

01:50You can also visualize data with tools like Looker Studio.

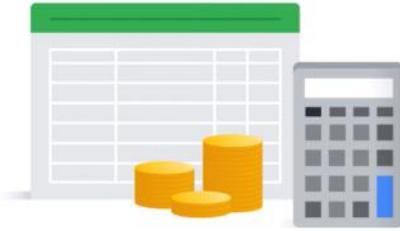
01:53After analyzing how you're spending on cloud resources, you might realize that your organization can optimize costs through committed use discounts (CUDs).

02:04If your workloads have predictable resource needs, you can purchase a Google Cloud commitment, which gives you

02:09discounted prices in exchange for your commitment to use a minimum level of resources for a specific term.



Resource quota policies



Budget threshold rules



Cloud Billing reports

Which feature lets you set alerts for when cloud costs exceed a certain limit?

Cost optimization recommendations

Cost forecasting

checkBudget threshold rules

Billing reports

That is the correct answer!

check

2.

Which term describes a centralized hub within an organization composed of a partnership across finance, technology, and business functions?

checkCenter of excellence

Hub center

Competency center

Center of innovation

That is the correct answer!

check

3.

Which represents the lowest level in the Google Cloud resource hierarchy?

checkResources

Organization node

Projects

Folders

That is the correct answer!

check

4.

Which offers a reactive method to help you track and understand what you've already spent on Google Cloud resources and provide ways to help optimize your costs?

Resource usage

Google Cloud Pricing Calculator

checkCloud billing reports

Cost forecasting

That is the correct answer!

check

5.

Which feature lets you set limits on the amount of resources that can be used by a project or user?

checkQuota policies

Committed use discounts

Billing reports

Invoicing limits

That is the correct answer!

check

6.

Why is it a benefit that the Google Cloud resource hierarchy follows inheritance and propagation rules?

Inheritance in the hierarchy reduces the overall cost of cloud computing.

Faster propagation can simplify a cloud migration.

checkPermissions set at higher levels of the resource hierarchy are automatically inherited by lower-level resources.

Resources at lower levels can improve the performance of cloud applications.

That is the correct answer!

check

7.

Which Google Cloud tool lets you estimate how changes to cloud usage will affect costs?

Cloud Monitoring

checkGoogle Cloud Pricing Calculator

Cloud Trace

Cloud Billing

That is the correct answer!

Operational Excellence and Reliability at Scale

Fundamentals of cloud reliability

Within any IT team, developers are responsible for writing code for systems and applications, and operators are responsible for ensuring that those systems and applications operate reliably.

00:13 Developers are expected to be agile and are often pushed to write and deploy code quickly.

00:18 Their aim is to release new functions frequently, increase core business value with new features, and release fixes fast for an overall better user experience.

00:28 In contrast, operators are expected to keep the system stable, and so they often prefer to work more slowly to ensure reliability and consistency.

00:38 Traditionally, developers pushed their code to operators who often had little understanding of how the code would run in a production or live environment.

00:47 When problems arise, it can be very difficult for either group to identify the source of the problem and resolve it quickly.

00:53 Worse, accountability between the teams isn't always clear.

00:59 DevOps is a software development approach that emphasizes collaboration and communication between development and operations teams to enhance the efficiency, speed, and reliability of software delivery.

01:13 It aims to break down silos between these teams and foster a culture of shared responsibility, automation, and continuous improvement.

01:23 One particular concept within the DevOps framework is Site Reliability Engineering, or SRE, which ensures the reliability, availability, and efficiency of software systems and services deployed in the cloud.

01:37 SRE combines aspects of software engineering and operations to design, build, and maintain scalable and reliable infrastructure.

01:47 Monitoring is the foundation of product reliability.

01:50 It reveals what needs urgent attention and shows trends in application usage patterns, which can

01:55 yield better capacity planning and generally help

improve an application client's experience and lessen their pain.

02:02 There are “Four Golden Signals” that measure a system’s performance and reliability.

02:08 They are latency, traffic, saturation, and errors.

02:15 Latency measures how long it takes for a particular part of a system to return a result.

02:21 Latency is important because it directly affects the user experience, changes could indicate emerging issues, its

02:26 values might be tied to capacity demands, and it can be used to measure system improvements.

02:35 Traffic measures how many requests reach your system.

02:39 Traffic is important because it’s an indicator of current system demand, its historical trends are used for capacity planning, and it’s a core measure when calculating infrastructure spend.

02:51 Saturation measures how close to capacity a system is.

02:55 It’s important to note, though, that capacity is often a subjective measure that depends on the underlying service or application.

03:03 Saturation is important because it’s an indicator of how full the service is, it focuses

03:07 on the most constrained resources, and it’s frequently tied to degrading performance as capacity is reached.

03:16 And errors are events that measure system failures or other issues.

03:21 Errors are often raised when a flaw, failure, or fault in a computer program or system causes it to produce incorrect or unexpected results, or behave in unintended ways.

03:33 Errors are important because they can indicate something is failing, configuration or capacity issues, service level objective violations, or that it’s time to send an alert.

03:45 Three main concepts in site reliability engineering are service-level indicators (SLIs), service-level objectives (SLOs), and service-level agreements (SLAs).

03:56 They are all types of targets set for a system’s Four Golden Signal metrics.

04:02 Service level indicators are measurements that show how well a system or service is performing.

04:09 They’re specific metrics like response time, error rate, or percentage uptime—which is the amount of time a system is available for use—that help us understand the system’s behavior and performance.

04:21 Service level objectives are the goals that we set for a system's performance based on SLIs.

04:28 They define what level of reliability or performance that we want to achieve.

04:33 For example, an SLO might state that the system should be available for 99.9% of the time in a month.

04:40 Service level agreements are agreements between a cloud service provider and its customers.

04:45 They outline the promises and guarantees regarding the quality of service.

04:50 SLAs include the agreed-upon SLOs, performance metrics, uptime guarantees, and any penalties or remedies if the provider fails to meet those commitments.

05:01 This might include refunds or credits when the service has an outage that's longer than this agreement allows.

Designing resilient infrastructure and processes

When infrastructure and processes in a cloud environment are designed, they need to be resilient, fault-tolerant, and scalable, for high availability and disaster recovery.

00:11 High availability refers to the ability of a system to remain operational and accessible for users even if hardware or software failures

00:18 occur, whereas disaster recovery refers to the process of restoring a system to a functional state after a major disruption or disaster.

00:27 Let's explore some of the key design considerations and their significance in more detail.

00:34 Redundancy refers to duplicating critical components or resources to provide backup alternatives.

00:40 Redundancy can be implemented at various levels, such as hardware, network, or application layers.

00:45 For example, having redundant power supplies, network switches, or load balancers ensures that if one fails, the redundant component takes over seamlessly.

00:56 Redundancy enhances system reliability and mitigates the impact of single points of failure.

01:03 Replication involves creating multiple copies of data or services and distributing them across different servers or locations.

01:10 It ensures redundancy and fault tolerance by allowing systems to continue functioning even if certain components or servers fail.

01:19 By replicating data across multiple servers, the impact of hardware failures or outages is minimized, and the

availability of services is improved.

01:28Cloud service providers offer multiple regions or data center locations spread across different geographic areas.

01:36By distributing resources across regions, businesses can ensure that if an entire region becomes unavailable due

01:41to natural disasters, network issues, or other incidents, their services can continue running from another region.

01:50This approach improves resilience and reduces the risk of prolonged service interruptions.

01:56Building a scalable infrastructure allows organizations to handle varying workloads and accommodate increased demand without compromising performance or availability.

02:07Cloud technologies enable the dynamic allocation and deallocation of resources based on workload fluctuations.

02:14Autoscaling mechanisms can automatically adjust resource capacity to match demand, ensuring that services remain available and responsive during peak periods or sudden spikes in traffic.

02:27Regular backups of critical data and configurations are crucial to ensure that if data loss, hardware failures, or cyber-attacks occur, organizations can restore their systems to a previous state.

02:39Cloud providers often offer backup services, and they let organizations automate backups, store them securely, and easily restore data when needed.

02:49Backups should be stored in geographically separate locations to protect against regional outages or disasters.

02:56These measures improve high availability, allow for rapid recovery from disasters or failures, and minimize downtime and data loss.

03:04It's important to regularly test and validate these processes to ensure that they function as expected during real-world incidents.

03:11Also, monitoring, alerting, and incident response mechanisms should be implemented to identify and address issues promptly, further enhancing the overall resilience and availability of the cloud infrastructure.

Modernizing operations by using Google Cloud

If you've ever worked with on-premises environments, you know that you can physically touch the servers.

00:05If an application becomes unresponsive, someone can physically determine why that happened.

00:11In the cloud though, the servers aren't yours—they belong to the cloud provider—and you can't physically inspect them.

00:18So the question becomes: how do you know what's happening with your server, database, or application?

00:24The answer is: by using Google's integrated observability tools.

00:30Observability involves collecting, analyzing, and visualizing data from various sources within a system to gain insights into its performance, health, and behavior.

00:41To achieve this, Google Cloud offers an operations suite, which is a comprehensive set of monitoring, logging, and diagnostics tools.

00:50It offers a unified platform for managing and gaining insights into the performance, availability, and health of applications and infrastructure deployed on Google Cloud.

01:00Let's look at some of the managed services that constitute the operations suite.

01:06Cloud Monitoring provides a comprehensive view of your cloud infrastructure and applications.

01:11It collects metrics, logs, and traces from your applications and infrastructure, and provides you with insights into their performance, health, and availability.

01:19It also lets you create alerting policies to notify you when metrics, health check results, and uptime check results meet specified criteria.

01:30Cloud Logging collects and stores all application and infrastructure logs.

01:34With real-time insights, you can use Cloud Logging to troubleshoot issues, identify trends, and comply with regulations.

01:43Cloud Trace helps identify performance bottlenecks in applications.

01:47It collects latency data from applications, and provides insights into how they're performing.

01:53Cloud Profiler identifies how much CPU power, memory, and other resources an application uses.

01:59It continuously gathers CPU usage and memory-allocation information from production applications and provides insights into how applications are using resources.

02:10Error Reporting counts, analyzes, and aggregates the crashes in running cloud services in

real-time.

02:16A centralized error management interface

displays the results with sorting and filtering

capabilities.

02:21A dedicated view shows the error details: time chart, occurrences, affected user count, first- and last-seen dates, and a cleaned exception stack trace.

02:33Error Reporting supports email and mobile alerts notification through its API.

02:39Google's integrated observability tools provided by the operations suite offer valuable insights into the performance and health of applications and infrastructure in the cloud.

[Google Cloud Customer Care](#)

Any cloud adoption program can encounter challenges, so it's important to have an effective and efficient support plan from your cloud provider.

00:08Google Cloud Customer Care can simplify and streamline your support experience with scalable and flexible services built with your business needs at the center.

00:19There are four different service levels, which lets you choose the one that's right for your organization.

00:26Basic Support is free and is included for all Google Cloud customers.

00:30It provides access to documentation, community support, Cloud Billing Support, and Active Assist recommendations.

00:38Active Assist is the portfolio of tools used in Google Cloud to generate insights and recommendations to help you optimize your cloud projects.

00:46Standard Support is recommended for workloads under development.

00:51You can kickstart your cloud journey with unlimited access to tech support, which lets you troubleshoot, test, and explore.

00:58It offers unlimited individual access to English-speaking support representatives during working hours, 5 days a week.

01:06Standard support also provides access to the Cloud Support API, which lets you integrate Cloud Customer Care with your organization's customer relationship management (CRM) system.

01:18Enhanced Support is designed for workloads in production, with fast response times and additional services to optimize your experience with high-quality, robust support.

01:29Support is available 24/7 in a selection of languages, and initial response times are quicker than those provided by Standard Support.

01:37Enhanced Support also offers technical support escalations and third-party technology support to help you resolve multi-vendor issues.

01:47Premium Support is designed for enterprises with critical workloads.

01:51It features the fastest response time, Customer Aware Support, and a dedicated Technical Account Manager.

01:57Our Premium Support level also offers credit for the Google Cloud Skills Boost training platform, an event

02:03management service for planned peak events, such as a product launch or major sales events, operational health reviews

02:10to help you measure your progress and proactively address blockers to your goals with Google Cloud, and

02:17customer aware support, where Customer Care learns and maintains information about your architecture, partners, and Google Cloud projects.

02:27This information ensures that our support experts can resolve your cases promptly and efficiently.

02:33Both the Enhanced and Premium support plans offer Value-Add Services that are available for additional purchase.

02:39You can learn more about the value-add services and all Google Cloud Customer Care support offerings at cloud.google.com/support.

[The life of a support case](#)

Any Google Cloud customer on the Standard, Enhanced, or Premium Support plan can use the Google Cloud console to create and manage support cases.

00:10Outside of filing a support case through the Google Cloud console, Customer Care Support also offers

00:14other contact options for live interactions with Support staff such as phone and video call support.

00:22The life of a support case during the Google Cloud Customer Care process typically involves several stages and interactions between the customer and the support team.

00:31Here's an overview of the typical journey of a support case.

00:35First, the customer initiates the support request by creating a case in the Google Cloud Console.

00:42 Only users who were assigned the Tech Support Editor role within an organization can do this.

00:47 The customer provides relevant details about the issue they are experiencing, including any error messages, logs, or steps to reproduce the problem.

00:56 It's important for the user to select a priority from P4, which means low impact, up

01:01 to P1, which means critical impact, because this will influence response times from the Customer Care team.

01:07 After the case is created, it goes through a triage process.

01:12 The team reviews the information provided by the customer to understand the problem and determine its severity and impact on the customer's business operations.

01:22 The team might request additional information or clarification from the customer at this stage.

01:28 In many cases, the Customer Care representative will resolve the case, but for more complex issues, the case is assigned to a support engineer with the appropriate level of expertise.

01:38 After the case is assigned, the team starts the troubleshooting and investigation process.

01:45 They analyze the provided information, review system logs, and conduct various diagnostic tests to identify the root cause of the issue.

01:53 Depending on the complexity of the problem, this stage might involve collaboration with other internal teams or experts.

02:00 Throughout the investigation, the Customer Care team maintains regular communication with the customer.

02:06 They provide updates on the progress, share findings, and request additional information or actions from the customer when needed.

02:15 Escalation is meant for flagging process breaks or for the rare occasion that a case is stuck because a

02:20 customer and the Customer Care team aren't fully in sync, despite actively communicating the issue to determine the next steps.

02:28 However, it's important to note that escalation isn't always the best solution, and with high-impact issues, escalation might not make the case go faster.

02:37 This is because escalation can disrupt the workflow of the Customer Care team and lead to delays in other cases.

02:43 The best solution for high-impact issues is to ensure that the case is set to the

02:47 appropriate priority, ensuring that the case is assigned to the right resources as quickly as possible.

02:53 Escalation is a tool that can be used to regain traction on a stuck case.

02:58 However, it's important to use escalation sparingly and only when it's absolutely necessary.

03:05 When the root cause is identified, the team works on resolving the issue or providing a mitigation plan.

03:11 They might provide the customer with step-by-step instructions, configuration changes, or workaround suggestions to address the problem.

03:18 In some cases, they might consult the issue with higher-level support or engineering teams for further assistance.

03:26 The Customer Care team might also need to submit a feature request to the Google Cloud engineering team.

03:33 After implementing the resolution or mitigation plan, the Customer Care team collaborates with the customer to validate the effectiveness of the solution.

03:42 They might request the customer to perform specific tests or provide feedback on the outcome.

03:47 This step ensures that the problem is fully resolved and meets the customer's expectations.

03:53 When the customer confirms that the issue is resolved, the support case is closed.

03:57 The team provides a summary of the resolution, documents the steps taken, and ensures that the customer is satisfied with the outcome.

04:05 If needed, they might also offer recommendations for preventive measures or future best practices to avoid similar issues.

04:12 The customer also receives a feedback survey, so the support team can learn what they did well and what needs improvement.

04:20 Throughout the entire lifecycle of the support case, Google Cloud's Customer Care team aims to provide timely and effective assistance to the customer.

04:29 They prioritize customer satisfaction, responsiveness, and strive to address the possible technical challenges faced by customers when they use Google Cloud services.

LITE OT a support case

Case creation

Case triage

Case assignment

Troubleshooting and investigation

Communication and updates

Escalation

Resolution and mitigation

Validation and testing

Case closure

Google Cloud's operations suite provides a comprehensive set of monitoring, logging, and diagnostics tools. Which tool collects latency data from applications and provides insights into how they're performing?

Cloud Logging

Cloud Profiler

checkCloud Trace

Cloud Monitoring

That is the correct answer!

check

2.

What does the Cloud Profiler tool do?

It counts, analyzes, and aggregates the crashes in running cloud services in real-time.

It collects and stores all application and infrastructure logs.

It provides a comprehensive view of your cloud infrastructure and applications.

checkIt identifies how much CPU power, memory, and other resources an application uses.

That is the correct answer!

check

3.

Which of these measures should be automated on a regular basis and stored in geographically separate locations to allow for rapid recovery from disasters or failures?

Security patches

Inventory data

checkBackups

Log files

That is the correct answer!

check

4.

Which metric shows how well a system or service is performing?

Service level agreements

Service level contracts

Service level objectives

checkService level indicators

That is the correct answer!

check

5.

How does replication help the design of resilient and fault-tolerant infrastructure and processes in a cloud environment?

It duplicates critical components or resources to provide backup alternatives.

checkIt creates multiple copies of data or services and distributes them across different servers or locations.

It monitors and controls incoming and outgoing network traffic based on predetermined security rules.

It scales infrastructure to handle varying workloads and accommodate increased demand.

That is the correct answer!

check

6.

One of the four golden signals is latency. What does latency measure?

How many requests reach a system.

checkHow long it takes for a particular part of a system to return a result.

System failures or other issues.

How close to capacity a system is.

That is the correct answer!

check

7.

Why is escalating a support ticket not always the best course of action when trying to resolve an issue?

It can increase the monthly cost of support plans.

It can result in increased power consumption, impacting carbon neutrality.

checkIt may disrupt the workflow of the Customer Care team and lead to delays in other cases.

It may reduce the number of available virtual machines.

That is the correct answer!

check

8.

Which Google Cloud Customer Care support level is designed for enterprises with critical workloads and features the fastest response time?

Enhanced Support

checkPremium Support

Basic Support

Standard Support

That is the correct answer!

close

9.

Whose job is to ensure the reliability, availability, and efficiency of software systems and services deployed in the cloud?

Cloud architect

Site reliability engineer

Cloud security engineer

closeDevOps engineer

That's incorrect. Review the module content for the correct answer.