Google Cloud

Partner Certification Academy

Professional Cloud Developer

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Google Cloud

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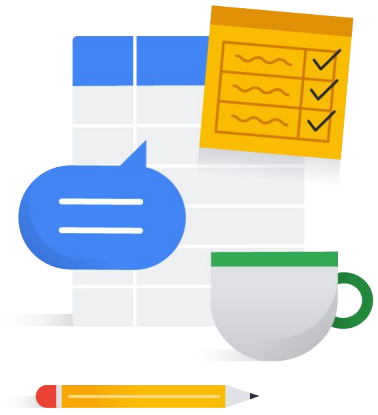
- For questions regarding Cloud Skills Boost access, Qwiklabs issues, voucher queries, etc.
  - cloud-partner-training@google.com
- For questions regarding Partner Advantage access
  - https://support.google.com/googlecloud/topic/9198654



Partner Certification Academy

A differentiated learning experience for the busy professional

Our goal is to help you prepare for Google Cloud certification exams

These programs may include:

- On-demand learning
- Self-paced labs
- Mentor-led workshops
- A voucher for the exam

The workshop sessions:

- **Are NOT training sessions - that's the purpose of the on-demand content.**
- Help you review key concepts on the exam guide.
- Will NOT discuss actual exam questions.

Professional Cloud Developer (PCD)

A Professional Cloud Developer builds scalable and highly available applications using Google-recommended tools and best practices. This individual has experience with cloud-native applications, developer tools, managed services, and next-generation databases. A Professional Cloud Developer also has proficiency with at least one general-purpose programming language and instruments their code to produce metrics, logs, and traces.

The Professional Cloud Developer exam assesses your ability to:

- ✓ Design highly scalable, available, reliable cloud-native applications
- ✓ Deploy applications
- ✓ Manage deployed applications
- ✓ Build and test applications
- ✓ Integrate Google Cloud services

https://cloud.google.com/learn/certification/cloud-developer

Experience level assumptions

- Per the certification site: *"3+ years of industry experience including 1+ years designing and managing solutions using Google Cloud"*
- Workshops do not cover "programming 101" topics
  - Discussion centers on topics specific to Google Cloud services, e.g.,
    - Authentication and authorization
    - Best practices, etc.
- If you lack experience with Google Cloud
    - Additional content is provided as part of this program which provides a basic overview on Google Cloud compute and storage options

Module Agenda

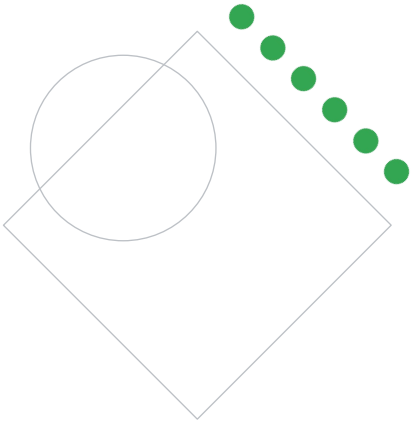
01 Google Cloud Client Libraries and Google API Libraries

02 Google Cloud APIs

03 Service Accounts Review

04 Application Authentication

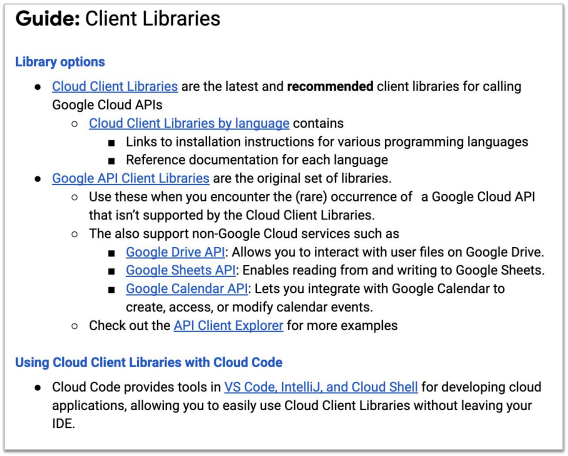
Google Cloud Client Libraries and Google API Libraries



Guide: Client Libraries

This guide provides an overview of:

- Google Cloud Client Libraries
- Google API Client Libraries
- How to use them with Cloud Code



Guide: Client Libraries

Library options

- Cloud Client Libraries are the latest and **recommended** client libraries for calling Google Cloud APIs
  - Cloud Client Libraries by language contains
    - Links to installation instructions for various programming languages
    - Reference documentation for each language
- Google API Client Libraries are the original set of libraries.
  - Use these when you encounter the (rare) occurrence of a Google Cloud API that isn't supported by the Cloud Client Libraries.
  - The also support non-Google Cloud services such as
    - Google Drive API: Allows you to interact with user files on Google Drive.
    - Google Sheets API: Enables reading from and writing to Google Sheets.
    - Google Calendar API: Lets you integrate with Google Calendar to create, access, or modify calendar events.
  - Check out the API Client Explorer for more examples

Using Cloud Client Libraries with Cloud Code

- Cloud Code provides tools in VS Code, IntelliJ, and Cloud Shell for developing cloud applications, allowing you to easily use Cloud Client Libraries without leaving your IDE.

Client Libraries

Two choices of client libraries

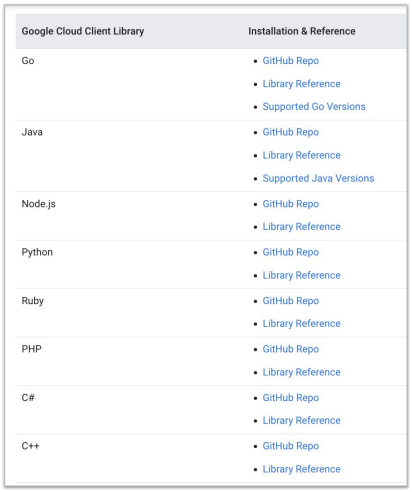
Google Cloud Client Libraries	Google API Client Libraries
• **Recommended option** for accessing Cloud APIs programmatically, where available • Provides idiomatic code in each language to make Cloud APIs simple and intuitive to use • Provides a consistent style across client libraries to simplify working with multiple Cloud services • Some support gRPC which provides performance benefits	• **Use when there is no Cloud Client Library for your preferred language or a specific service is not supported** • Has auto-generated interface code that might not be as idiomatic as the Cloud Client Libraries. • Provides access to the API's REST interface only; gRPC is not supported.

They both

- Handle all the low-level details of communication with the server, including authentication
- Can be installed using familiar package management tools such as npm and pip

Google Cloud Libraries are available in multiple programming languages

- Install the entire Google Cloud Library
  - Or install libraries for individual Google Cloud services, e.g. Cloud Storage
- Each GitHub Library repository has installation instructions for getting started in the chosen language

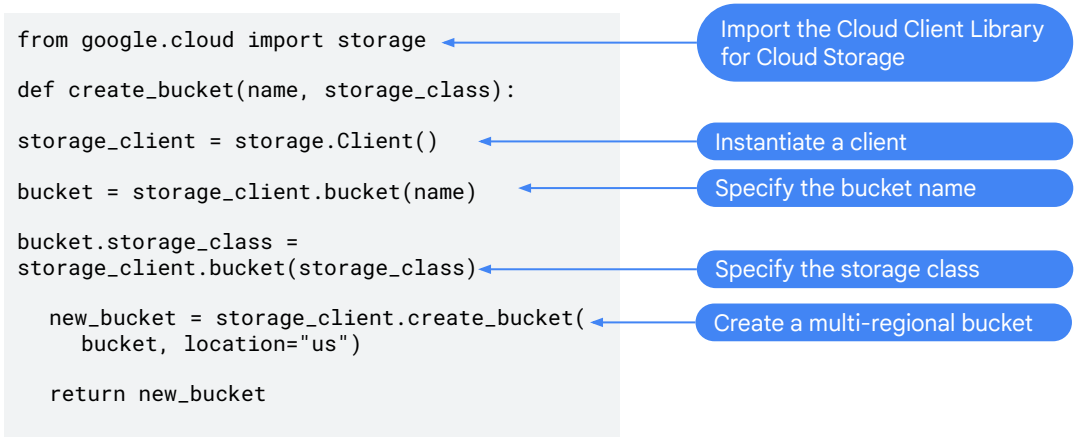


Google Cloud Client Library	Installation & Reference
Go	• GitHub Repo • Library Reference • Supported Go Versions
Java	• GitHub Repo • Library Reference • Supported Java Versions
Node.js	• GitHub Repo • Library Reference
Python	• GitHub Repo • Library Reference
Ruby	• GitHub Repo • Library Reference
PHP	• GitHub Repo • Library Reference
C#	• GitHub Repo • Library Reference
C++	• GitHub Repo • Library Reference

Cloud Client Libraries

https://cloud.google.com/apis/docs/cloud-client-libraries

Example -Using Python to create a Cloud Storage bucket



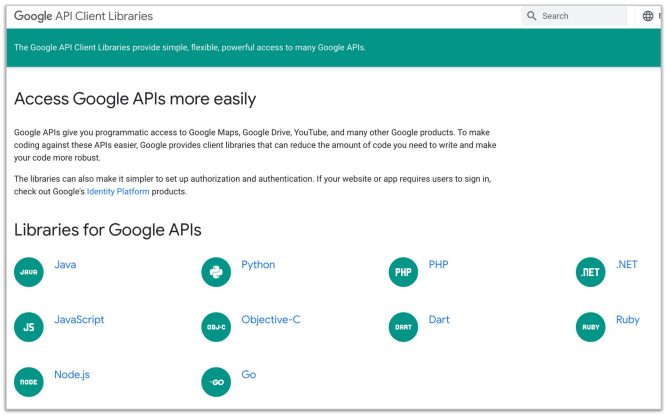
Here's an example of using the Python Cloud Client Library to create a Cloud Storage bucket.

Every package provides a client that interacts with an API. Your application runs with a particular identity, which is typically a service account. This example imports the Cloud Storage client library, instantiates the client by using the default credentials provided by the service account, and creates a cloud bucket.

The Cloud Client Libraries let you easily manage your Google Cloud resources by using the natural style of the language you have chosen.

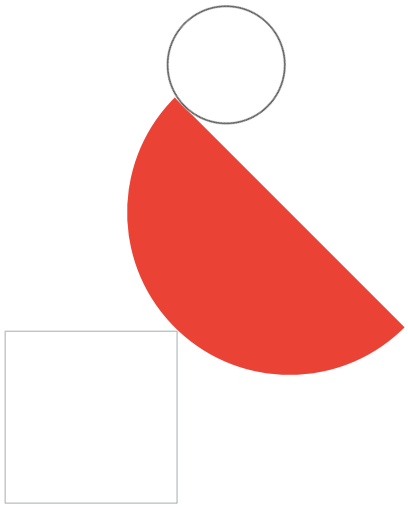
Google API Client Library

- Provides programmatic access to Google Maps, Google Drive, YouTube, and many other Google products
- Older library as compared to Google Cloud Client Libraries
  - Use Google Cloud Client Libraries if possible



Google API Client Libraries

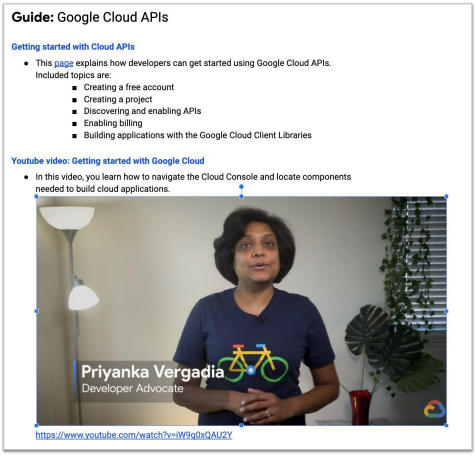
Google Cloud APIs



Guide: Google Cloud APIs

Topics covered include

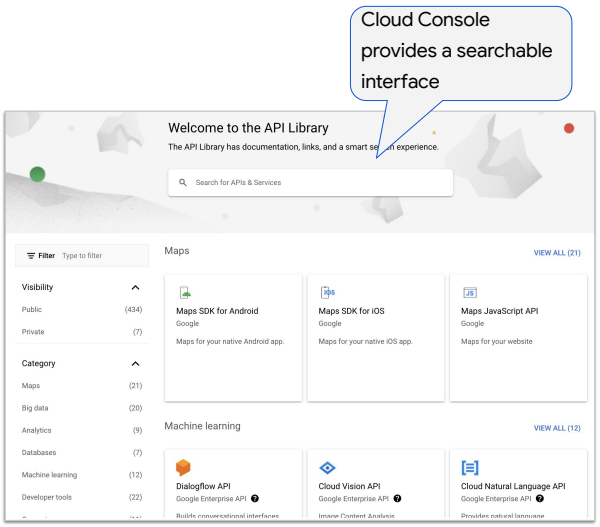
- How to get started
- API documentation
- API Explorer
- Working with quotas



Google Cloud APIs

Google Cloud APIs

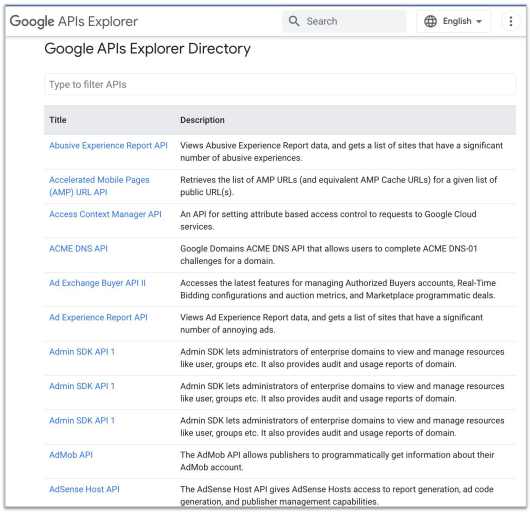
- Programmatic interfaces to Google services
- Typically runs on one or more subdomains of `googleapis.com`
  - E.g. `compute.googleapis.com`, `pubsub.googleapis.com`
- APIs are enabled and used within a project
  - Some Cloud APIs are enabled by default
  - Others must be enabled within a project*
    - E.g., Must enable the Compute Engine API prior to creating a virtual machine



*Developer must have **`Service Controller`** and **`Service Consumer`** role to enable APIs and view quotas

API Explorer

- Provides documentation for each API call
  - All APIs support REST
    - Some support gRPC
      - Look at the specific API documentation for details
- Access the APIs from
  - Client libraries in many popular programming languages
  - Mobile/web apps via the Firebase SDKs
  - Google Cloud command line (CLI) tools
  - Google Cloud console



Google APIs Explorer Directory

Example: Detect labels in an image by using the Cloud Vision API

- Quickstart: Detect labels in an image by using the Cloud Vision API
  - Create a storage bucket
  - Upload this image and make it public
    - https://cloud.google.com/static/vision/docs/images/demo-img.jpg
  - Enable the Cloud Vision API
  - Make a request to the Cloud Vision API by going to this link at the bottom of the quickstart
    - Edit the request body to match your Cloud Storage bucket name - example is shown on the next slide
    - Click **`EXECUTE`**
      - User account must have access **`Storage Object Viewer`** role on the bucket

Image stored in bucket

Steps can be found in https://cloud.google.com/vision/docs/detect-labels-image-api

Request body

```
{
  "requests": [
    {
      "features": [
        {
          "type": "LABEL_DETECTION"
        }
      ],
      "image": {
        "source": {
          "imageUri": "gs://api-explorer-demo/demo-img.jpg"
        }
      }
    }
  ]
}
```

Full path to file in the storage bucket

Partial results returned from the API call

200

```
{
  "mid": "/m/083wq",
  "description": "Wheel",
  "score": 0.9770954,
  "topicality": 0.9770954
},
{
  "mid": "/m/0h9mv",
  "description": "Tire",
  "score": 0.9736712,
  "topicality": 0.9736712
},
{
  "mid": "/m/07mhn",
  "description": "Trousers",
  "score": 0.9619434,
  "topicality": 0.9619434
},
```

Score: % Confidence

Topicality: Importance of the entity to the overall theme.

Same example using the Google Cloud Python library

```python
from google.cloud import vision_v1 as vision

def analyze_image(bucket_name, file_name):
    # Create a client for the Vision API
    client = vision.ImageAnnotatorClient()

    # Construct the image object with the storage URI
    image = vision.Image()
    image.source.image_uri = f'gs://{bucket_name}/{file_name}'

    # Make the request to the Vision API
    response = client.label_detection(image=image)

    # Print out the labels detected in the image
    for label in response.label_annotations:
        print(label.description, label.score)

if __name__ == "__main__":
    bucket_name = "api-explorer-demo"
    file_name = "demo-img.jpg"
    analyze_image(bucket_name, file_name)
```

Following best practices for authentication (Application Default Credentials)

Output

```
Bicycle 0.9850001931190491
Wheel 0.9770954251289368
Tire 0.9736711978912354
Trousers 0.9619433879852295
Bicycle wheel 0.9272286295890808
Sky 0.923011302947998
Bicycles--Equipment and supplies
0.92181795835495
Human 0.8934807777404785
Bicycle handlebar 0.8904159069061279
Bicycle tire 0.8738805055618286
```


Detect labels in an image by using client libraries
https://cloud.google.com/vision/docs/detect-labels-image-client-libraries

Calling REST APIs directly vs using the Google Cloud client libraries

- Use the REST APIs directly if
  - You're using a programming language not available with the Google Cloud client libraries
  - Need to use a feature that isn't exposed through the client libraries or want to handle the low-level details in a specific way
  - Need to use a newer version of an API that isn't yet supported by the client library, or need to use a specific older version
- In general, Google Cloud client libraries are a better option
  - Provides higher-level abstractions and hide much of the lower-level HTTP/REST detail
  - Retry logic and error handling is built in, making code cleaner and easier to maintain

API quota and error handling

All APIs have quotas

- Quota is set at the project level
  - Prevents customers from consuming so many resources that they become unavailable to other customers
  - Helps you manage resources to avoid unexpected costs
- Type of quotas vary for service but typically fall into the following categories
  - Rate quotas - per minute or per day
    - Reset after a predefined time interval that is specific to each service
      - For example, Cloud SQL (MySQL) quota for queries per minute per user is set to 180
  - Allocation quotas - for resources that don't have a rate limit
    - For example, number of VMs used per project
      - When maximum is reached must delete a resource before creating another
  - Concurrent quotas
    - Restricts the total number of concurrent operations in flight at any given time
      - For example, Cloud SQL (MySQL) has a limit of 100,000 concurrent connections
- Look at specific API documentation for details, e.g., Cloud SQL (MySQL)

Handling quota related errors

- Rate quotas (maximum of N requests per X minutes)
  - HTTP 429 rate limit exceeded
  - To resolve these issues, retry the operation after a few seconds using truncated exponential backoff
- Allocation quotas
  - HTTP 403 quota exceeded or resource exhausted
  - Wait for at least 10 minutes before retrying
    - Consider optimizing your workload or requesting a quota increase
- Concurrent quotas
  - HTTP 429 too many requests or too many operations
  - Use exponential backoff when retrying operations that have hit concurrent limits

```
{
   "code": 429,
   "message": "Rate Limit Exceeded",
   "errors": [
      {
         "message": "Rate Limit Exceeded",
         "domain": "usageLimits",
         "reason": "rateLimitExceeded"
      }
   ]
}
```

Complete list of error codes and a short description of their cause

Note: The actual HTTP code/message returned may vary depending on the API. See the specific API documentation for details on error handling. Cloud Storage example

Exponential Backoff vs Truncated Exponential Backoff

- Exponential Backoff
  - Increasing the wait time between retries exponentially
    - After the first failed attempt, wait ‘t’ seconds.
      - If it fails again, you wait ‘2t’ seconds, then ‘4t’ seconds, and so on
      - The delay between retries doubles with each subsequent retry
        - Leads to very long wait times after several failed attempts
    - Effective for situations where the cause of the error is likely to be temporary
- Truncated Exponential Backoff
  - Variation of exponential backoff where the wait time is capped at a maximum value
    - Once it reaches the maximum cap, subsequent retries will use that maximum value
  - The cap ensures that the system doesn't wait excessively long periods between retries

Wikipedia: Exponential backoff

Python example of truncated exponential backoff

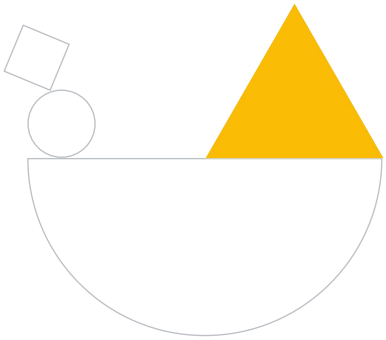
```python
import time
import random
from googleapiclient.errors import HttpError

def make_request_with_exponential_backoff(api_call):
    max_retries = 5
    base_delay = 1  # start with a 1-second delay
    max_delay = 32  # max delay is 32 seconds

    retries = 0
    while retries <= max_retries:
        try:
            # Make the API call
            response = api_call()
            return response
        except HttpError as e:
            if e.resp.status in [500, 502, 503, 504]:  # Retry on these HTTP errors
                delay = base_delay * (2 ** retries)  # exponential delay
                delay = min(delay, max_delay)  # don't exceed max delay
                time.sleep(delay + random.uniform(0, 0.1 * (2 ** retries)))
                retries += 1
            else:
                raise  # re-raise the exception if it's not a retryable error
    raise Exception("Max retries exceeded")

# Example usage:
# response = make_request_with_exponential_backoff(lambda: some_google_api_call())
```

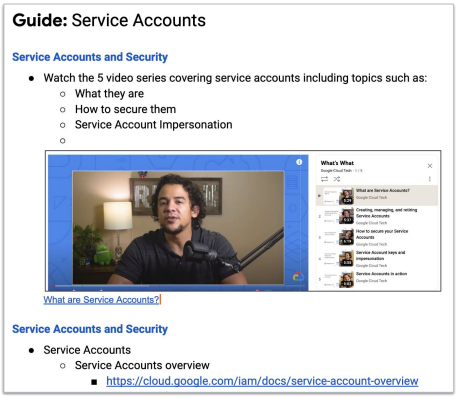
Service Accounts review



Guide: Service Accounts

Topics covered include

- Service account overview
- Service account security
- Best practices



Service Accounts

Service Accounts

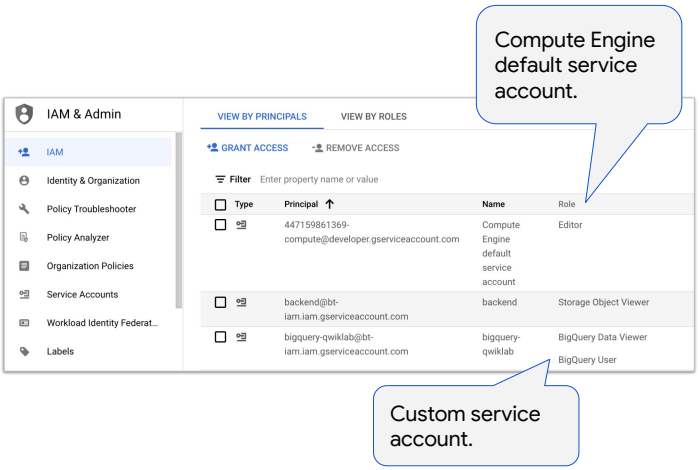
- A special type of principal in Google Cloud that provides IAM roles to an application and limits what the application can do
  - Applies to applications running within Google Cloud compute services
    - Compute Engine
    - Kubernetes Engine
    - Cloud Run
    - Cloud Functions
    - App Engine
  - May apply to applications running external to Google Cloud
    - Application assumes the identity of the service account for IAM purposes
- **Best practice**: Create custom service accounts for each use case and follow principle of least privilege when assigning IAM roles

Example Service Account use cases

- Server-to-Server Interactions where user intervention is not required
  - For example, Pub/Sub triggering a Cloud Run service
    - Pub/Sub service account needs **`Cloud Run Invoker`** role
    - Cloud Run service account needs **`Pub/Sub Subscriber`** role
- Automated Tasks not initiated by a user
  - For example, batch jobs, data processing tasks, or automated backups
  - Service accounts needs the appropriate IAM roles required by the tasks
- Applications running on any Google Cloud compute resources
  - For example, a Python app deployed to Compute Engine which needs to query a BigQuery dataset
    - The service account needs **`BigQuery Data Viewer`** and **`BigQuery User`** roles

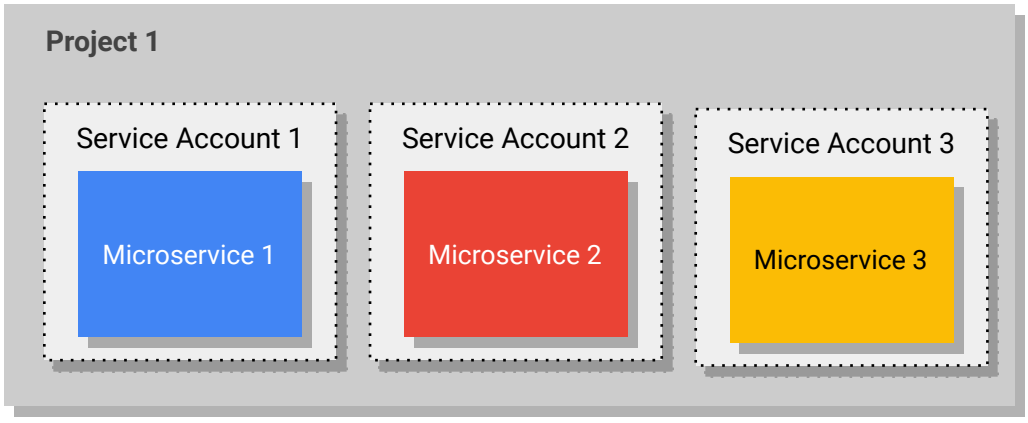
Viewing Service Accounts in the Console

- Google Cloud creates default service accounts for the compute services when their APIs are enabled
  - Enables people new Google Cloud to create compute resources without have to learn IAM first
  - These accounts have the **`Editor`** role and don't follow the principle of least privilege
- **Best practice:** Create custom service accounts with appropriate IAM roles given the use case



Multiple service accounts can exist within a project

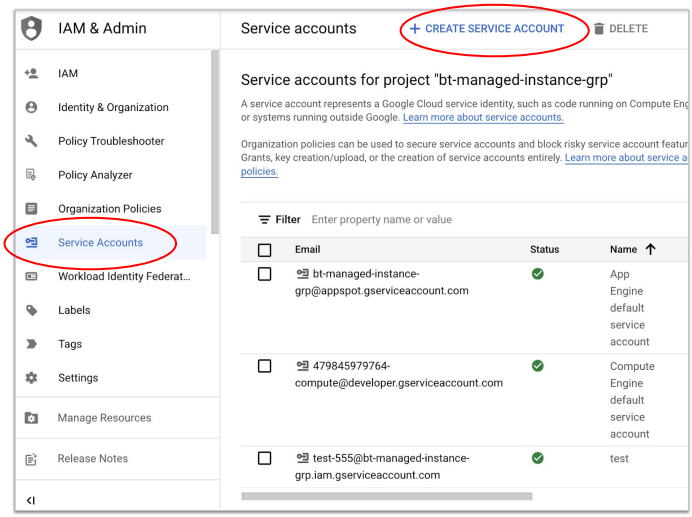
- Different service accounts for different use cases



Creating Service Accounts in the Console

IAM & Admin > Service Accounts> Create Service account

Developers must have **`Owner`** or **`Service Account Admin`** role in order to create service accounts and assign roles to them

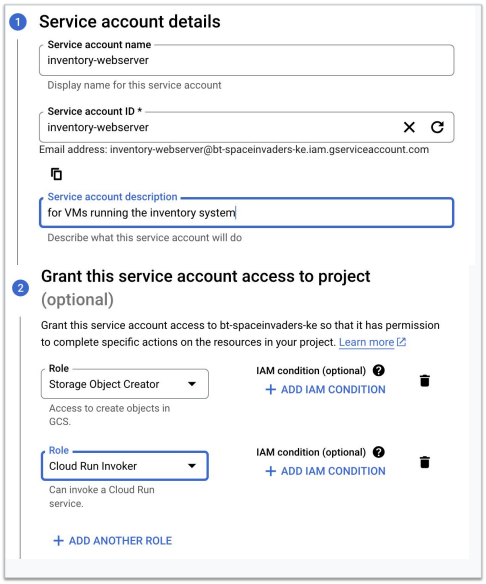


Creating service accounts
https://cloud.google.com/iam/docs/creating-managing-service-accounts

Creating Service Accounts (continued)

Service account name →

Add one or more roles →



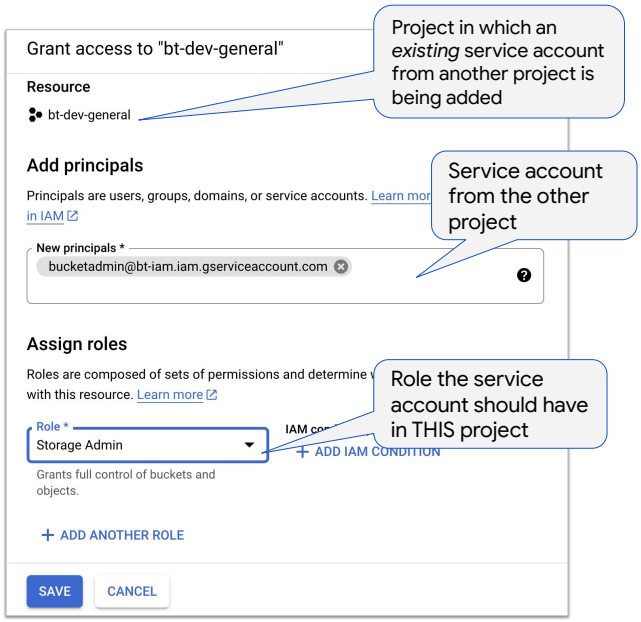
Here is an example of creating a service account.

First, give your service account a name. A best practice is to give the account a name that can be used to easily determine the purpose of the service account.

Next, you add one or more roles to associate with the service account. The roles will determine the permissions associated with the account.

Cross-project usage

- Service accounts live in a specific project
  - Can be granted permissions to access resources in *other* projects
    - Used when resources in one project need to be accessed by apps/services running in a different project
      - E.g., Cloud Run service needs to access a Cloud Storage bucket located in another project
  - Allows for centralized management of service accounts while ensuring that resources in other projects can be accessed securely



Where to create service accounts

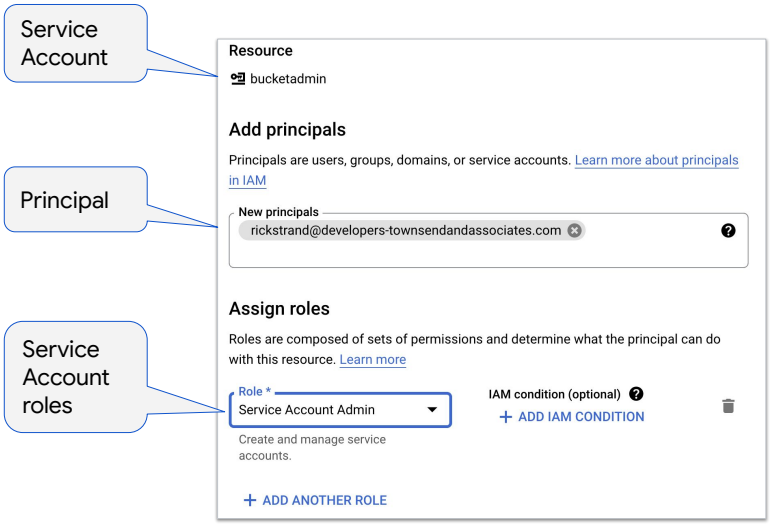
Service Account have their own predefined roles

- Service Account Admin
  - Create and manage service accounts
- Service Account User
  - Can attach service account to resources (e.g., Compute Engine)
  - Can “impersonate” the service account and perform the tasks allowed by IAM given to the service account
- Service Account Key Admin
  - Create and manage (and rotate) service account keys
  - Keys are used by applications external to Google Cloud (**not best practice**)
- Service Account Token Creator
  - Short lived credentials represented as OAuth 2.0 access tokens, OpenID Connect ID tokens, self-signed JSON Web Tokens (JWTs), and self-signed binary objects (blobs)
  - Different use cases - applications external to Google Cloud, authentication of one cloud service to another, etc. (**best practice**)

All of these are discussed later in this module

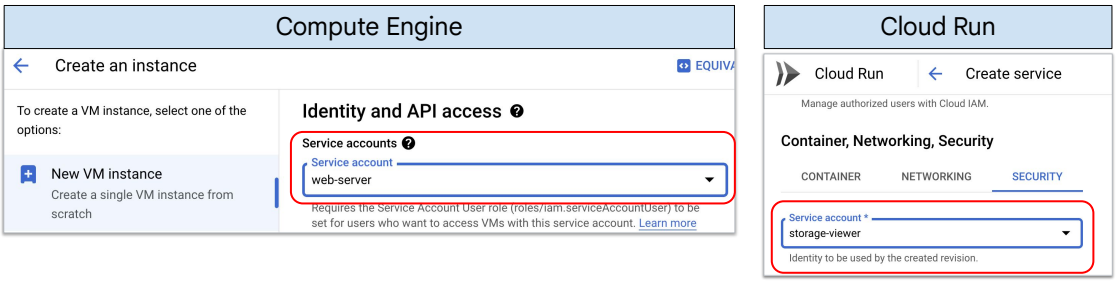
Reasons discussed later in the module

Assigning a service account role to a principal



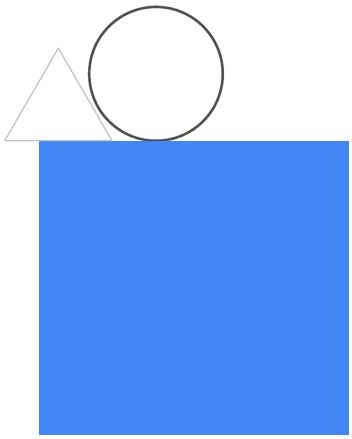
Example of attaching Service Accounts to services

- Developer must have **`Service Account User`** role in order to attach service accounts to services



Application Authentication

- **Overview**
- API keys
- Application Default Credentials
- Workload Identity
- Workload Identity Federation



Google API Authentication vs Authorization

- This module covers ***application*** authentication and authorization

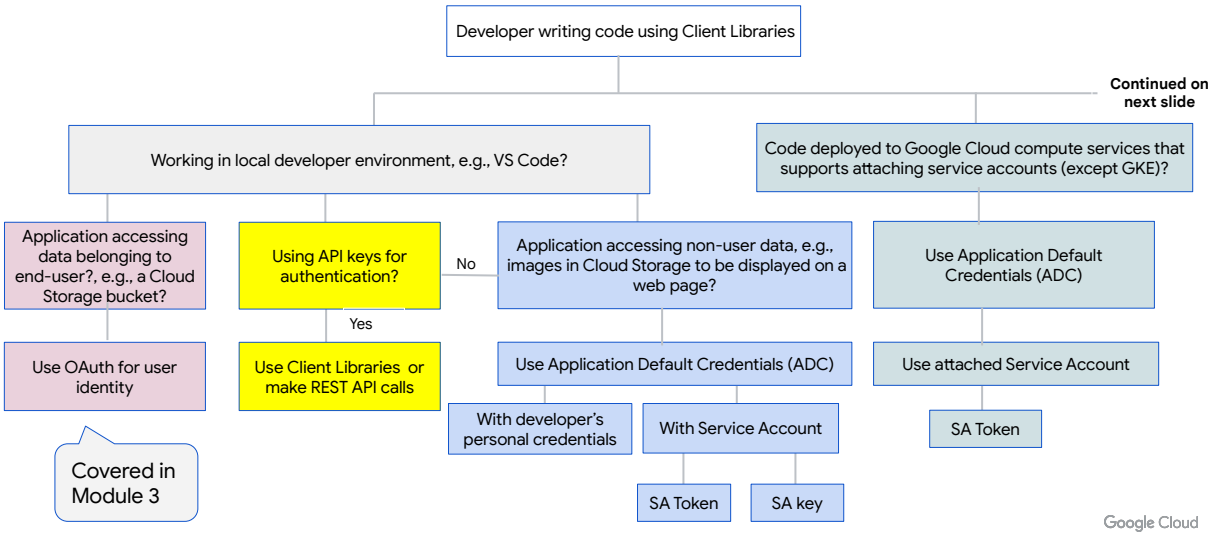
Authentication

What is the application?

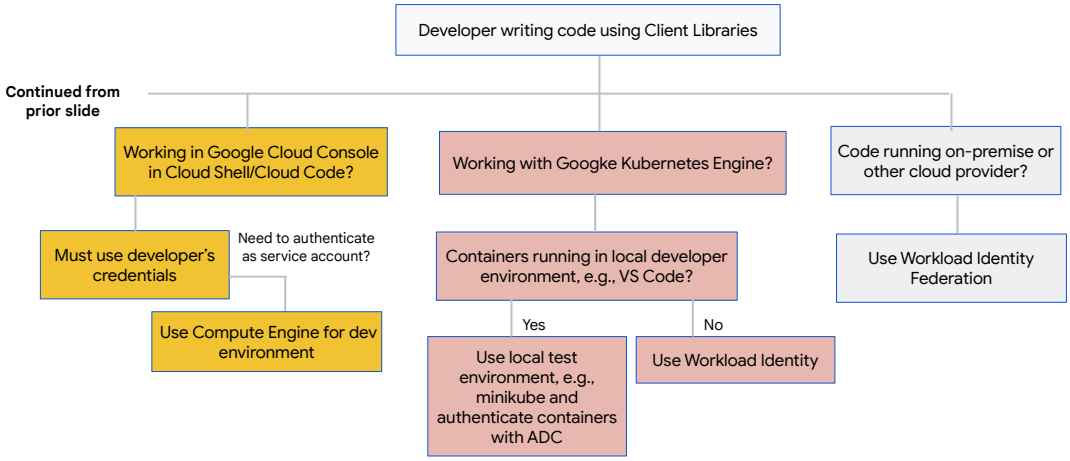
Authorization

What is it allowed to do?

Application authentication depends on where it is running

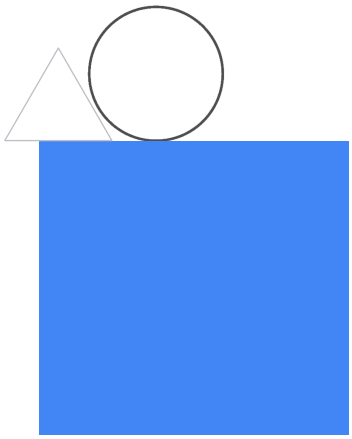


Application authentication depends on where it is running (continued)



Application Authentication

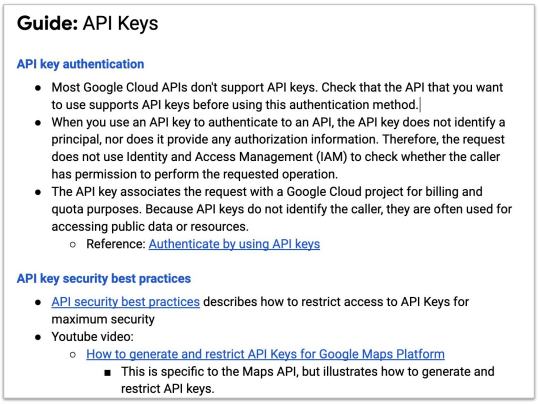
- Overview
- **API keys**
- Application Default Credentials
- Workload Identity
- Workload Identity Federation



Guide: API Keys

Topics covered include

- How to generate API Keys
- Security best practices
- Walk-through using the Cloud Natural Language API with an API Key



Guide: API Keys

API key authentication

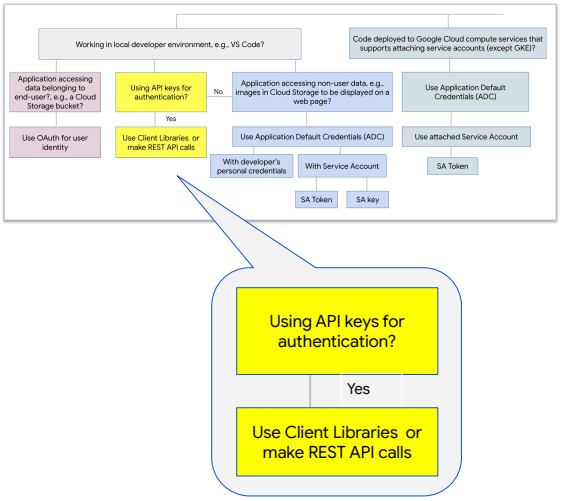
- Most Google Cloud APIs don't support API keys. Check that the API that you want to use supports API keys before using this authentication method.
- When you use an API key to authenticate to an API, the API key does not identify a principal, nor does it provide any authorization information. Therefore, the request does not use Identity and Access Management (IAM) to check whether the caller has permission to perform the requested operation.
- The API key associates the request with a Google Cloud project for billing and quota purposes. Because API keys do not identify the caller, they are often used for accessing public data or resources.
  - Reference: Authenticate by using API keys

API key security best practices

- API security best practices describes how to restrict access to API Keys for maximum security
- Youtube video:
  - How to generate and restrict API Keys for Google Maps Platform
    - This is specific to the Maps API, but illustrates how to generate and restrict API keys.

API Keys

Authentication with API keys



What is a API key?

- Secret tokens usually in the form of an encrypted string
  - Used by many API providers as an easy way for developers to access their APIs
  - Typical use of an API key is to pass the key into a REST API call as a query parameter with the following format

```
http://library.googleapis.com/v1/publishers/mypublisher/books?key=API_KEY
```

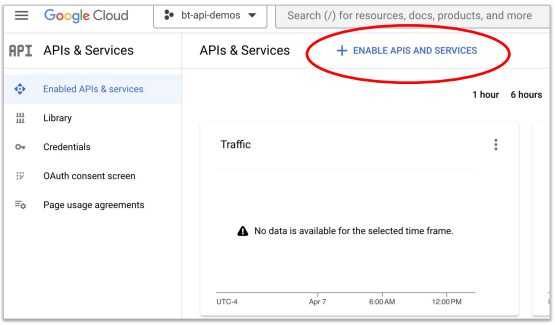
- API keys provide
  - Verification that the calling application has been granted access to the API and the API has been enabled at the Google Cloud project level
  - Usage information for billing and quota purposes
  - Identification of application or project that's making the call
    - ***Does not provide the identity of the caller***
      - **Most Google Cloud APIs do not accept API keys for this reason**
- API keys are often used for accessing public data or resources, where authentication/authorization is not required

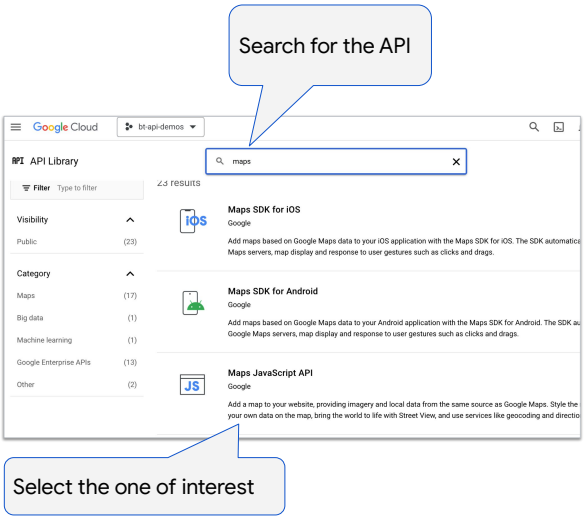
Example Google Cloud APIs that accept keys:
Cloud Translation API
Cloud Natural Language API

API keys provide project authorization
https://cloud.google.com/endpoints/docs/openapi/when-why-api-key#api_keys_provide_project_authorization

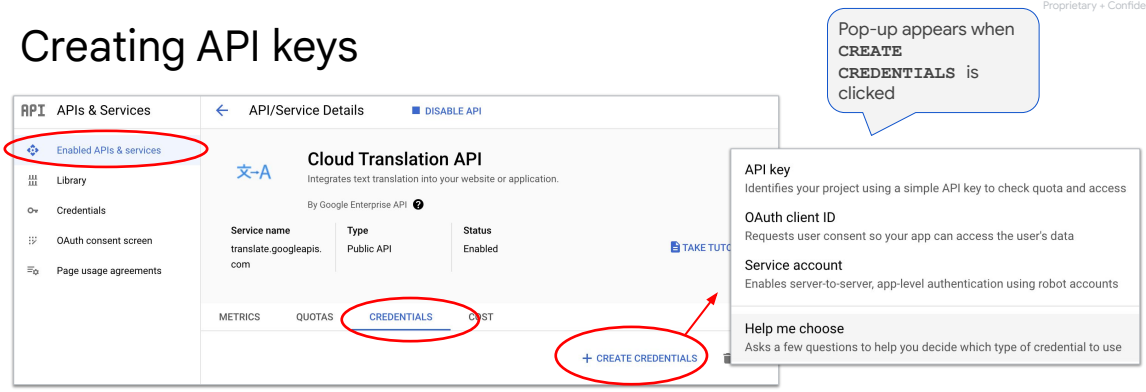
Enabling APIs in Google Cloud

- APIs are enabled on a project by project basis
  - Billing for API usage is at the project level





Creating API keys



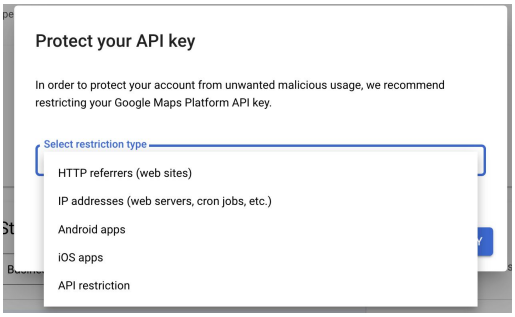
- Authentication options
  - API keys — This discussion
    - Not supported by most Google Cloud APIs
      - Keys do not identify a principal, nor provide any authorization information
  - OAuth when accessing data belonging to an end-user, e.g., Firestore documents
  - Service account when access data belonging to the application, e.g., images in a Cloud Storage bucket for a website

Authenticate by using API keys
https://cloud.google.com/docs/authentication/api-keys#using-with-rest

Adding restrictions to API keys
https://cloud.google.com/api-keys/docs/add-restrictions-api-keys

Restrict API key to specific resources

- Selecting one of the following:
  - HTTP referrers (websites) that are allowed to use the key
    - E.g., www.example.com, www.example2.com
  - IP addresses of callers that are allowed to use the key
    - “198.51.100.0/24”,"198.51.100.1"
  - Android apps that are allowed to use the key
  - iOS apps that are allowed to use the key
- Only one restriction per key is allowed
  - Create another key if needed, e.g, one for Android and one for iOS apps



Adding restrictions to API keys

Adding restrictions to API keys
https://cloud.google.com/api-keys/docs/add-restrictions-api-keys

Securing API Keys

- API keys must be stored securely
  - Anyone who has access to the key can make API calls
- Never store keys in plain text files or in source control systems
- Use environment variables
  - Helps prevent the API key from being hard-coded into the application code or configuration files
- Restrict usage to specific web sites or IP addresses
- Use a third-party API key management service to store and manage the API keys
  - Google Cloud Secret Manager stores API keys, passwords, certificates, and other sensitive data

Two ways to use an API Key

- Via REST API calls
- Using the client libraries
- Examples of both are on the following slides

Method 1 - making a REST call

Making a POST request to the Cloud Translation API

- Pass the API key into a REST API call as a query parameter

```
curl -X POST -H "Content-Type: application/json" \
     -d '{
  "q": "Welcome everyone.  I hope you are enjoying the workshop.",
  "source": "en",
  "target": "es",
  "format": "text"
}' \
     "https://translation.googleapis.com/language/translate/v2?key=[my_key_here]"
```

API key

Using an API key with REST

Method 2 - Use a client library to make a REST API call

```python
import requests
import json

# Define the endpoint URL and your API key
endpoint_url = "https://translation.googleapis.com/language/translate/v2"
api_key = "your-api-key-here"

# Define the payload for the POST request
data = {
    "q": "Welcome everyone.  I hope you are enjoying the workshop.",
    "source": "en",
    "target": "es",
    "format": "text"
}

# Make the POST request
headers = {"Content-Type": "application/json"}
response = requests.post(f"{endpoint_url}?key={api_key}", data=json.dumps(data), headers=headers)

# Parse and print the response
response_data = response.json()
if response.status_code == 200:
    translated_text = response_data["data"]["translations"][0]["translatedText"]
    print(translated_text)
else:
    print(f"Request failed with status code {response.status_code}")
```

API key

Note: Not best practice to store the API key in code.

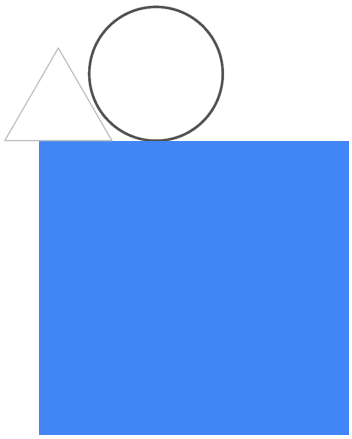
Use Secrets Manager to store sensitive data.

See Using Secret Manager with Python codelab for example usage

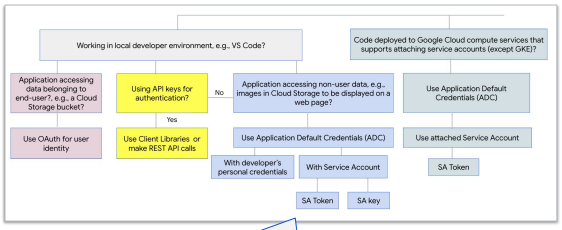
Using an API key with client libraries

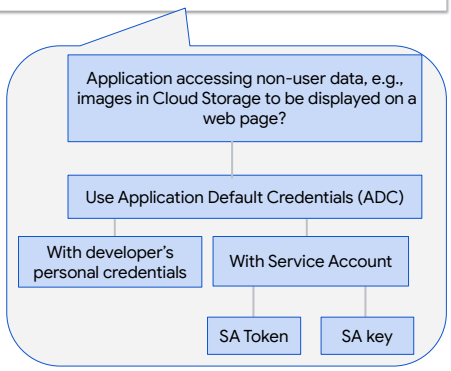
Application Authentication

- Overview
- API keys
- **Application Default Credentials**
- Workload Identity
- Workload Identity Federation



Authentication with Application Default Credentials (ADC)

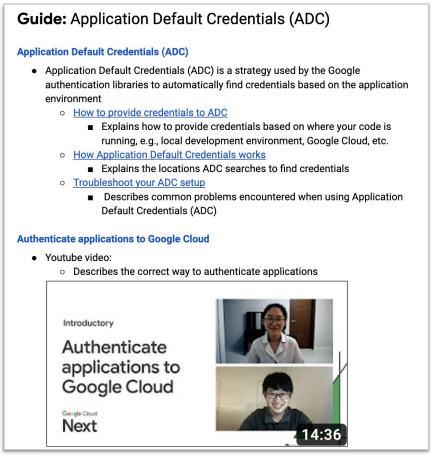




Guide: Application Default Credentials (ADC)

Topics covered include

- How ADC works
- How to set ADC up depending on where your where your code is running
  - Local environment
  - Google Cloud Compute
  - etc.



Application Default Credentials

Application Default Credentials (ADC)

- Strategy used by the Google authentication library to automatically find credentials based on the application environment (Python example)
  - Uses Application Default Credentials (ADC) to find credentials you provide
    - Your code does not need to explicitly authenticate or manage tokens
      - Automatically managed by the authentication library
  - Code can run in either a development or production environment without changing how it authenticates to Google Cloud services and APIs
- ***ADC is already integrated into the Cloud Client Libraries and Google API Client Libraries***
  - No need to add the Google Authentication library in your application and call it directly
- Benefits:
  - Consistent authentication across different environments
  - Reduces manual configuration and potential errors
  - Enhances security by promoting best practices.

How to provide credentials to ADC

Method used depends on the environment where your code is running:

- Local development environment
- Compute Engine or other Google Cloud services that support attaching a service account
- Cloud Shell or other Google Cloud cloud-based development environments
- Google Kubernetes Engine
- On-premises or another cloud provider

Next topic

Crea

How do Application Default Credentials (ADC) work in a local development environment?

- Three options
  - Each are explained on the following pages

1

Using developer's credentials (easy to get started this way)

Developer needs IAM roles that reflect the permissions needed by the code

```
gcloud auth application-default login
```

2

Using service account impersonation

Developer needs `Service Account Token Creator` role to impersonate the service account

```
gcloud auth application-default login --impersonate-service-account [SERVICE_ACCT_EMAIL_HERE]
```

Creates an access token which has a limited lifetime

Best practice

3

Using service account key

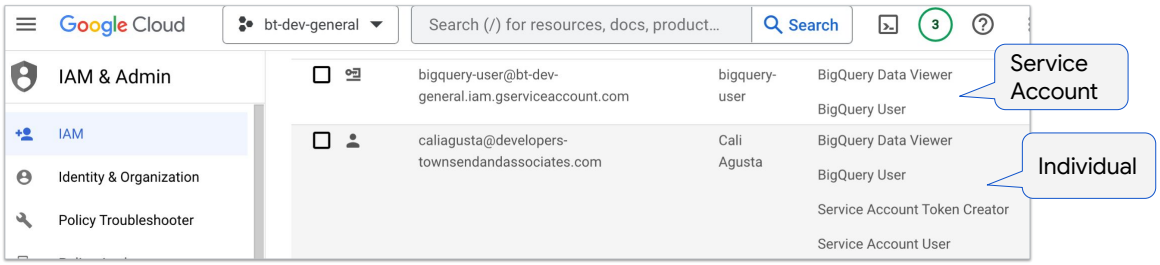
Developer needs `Service Account User` role plus `Service Account Key Admin` if need to create/download keys

Set the `GOOGLE_APPLICATION_CREDENTIALS` environment value to the path of the service account's key key

AVOID THIS OPTION. Keys don't expire by default

Review: Console view of IAM assignments

- Image shows both individual accounts* and service accounts



*IAM can also be assigned to groups. Members of that group have the assigned roles.

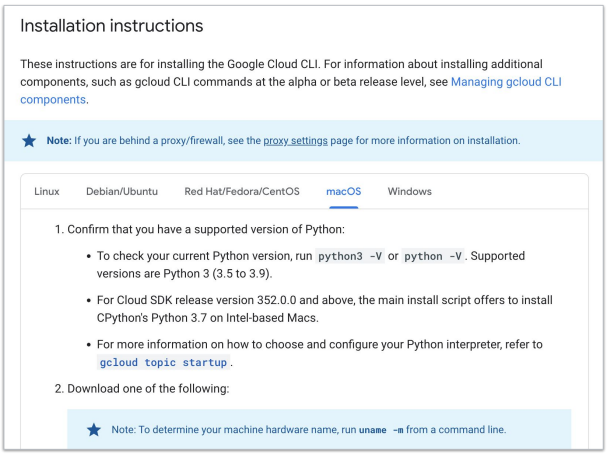
Using developer's personal credentials

- Used during the initial development and testing phase
  - **Not for shared environments such as staging, test, production**
- Allows developer start quickly without the overhead of managing service accounts
  - Developer's account needs IAM roles that reflect the permissions needed by the code to access Google Cloud resources
- Process is initiated by developer logging into Google Cloud from the CLI

Must install the Cloud CLI first

Review: Installing the Google Cloud CLI

- After installation, need to initialize its settings



Installing the CLI

Initializing the gcloud CLI:
https://cloud.google.com/sdk/docs/initializing

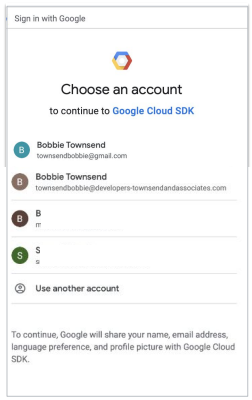
gcloud command to set configuration:
https://cloud.google.com/sdk/gcloud/reference/config/set

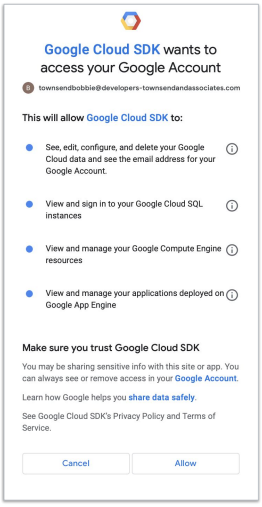
gcloud tool guide:
https://cloud.google.com/sdk/gcloud/

After the CLI is installed, you need to do an initial setup. That includes things such as setting a default region and zone.

Using developer's personal credentials for ADC - step 1

- Developer logins at the command line using
  - `gcloud auth login`
- Uses OAuth2 for authentication
  - The Google Authorization Server is contacted and responds with a token
    - The token is stored in a SQLite database associated with the CLI
      - `~/.config/gcloud/credentials.db`





This activates **personal** credentials

Using developer's personal credentials for ADC - step 2

- Developer creates a credential file for ADC by running the following in the CLI
  - `gcloud auth application-default login`
    - Enter **your** credentials in the login screen that appears
- ADC creates a credential file in a "well known location"
  - Linux, macOS:
    - `$HOME/.config/gcloud/application_default_credentials.json`
  - Windows:
    - `%APPDATA%\gcloud\application_default_credentials.json`

This activates **ADC** credentials using developer's personal login

ADC credential file contents


```
{
  "client_id": "764086051850-6qr4p6gpi6hn506pt8ejuq83di341hur.apps.googleusercontent.com",
  "client_secret": "d-FL95Q19q7MQmFpd7hHD0Ty",
  "quota_project_id": "bt-dev-general",
  "refresh_token": "1//0dKjnQWfeqCYRCgYIARAAGA0SNwF-L9Ir2h4ocQGUvH1zA1bWBzqxk2spK3Wn3rJ",
  "type": "authorized_user"
}
```


- client_id
  - Identifies the application making a request to the authentication server
- client_secret:
  - Known only to the application and the authorization server
  - Used to ensure that the client application is the one it claims to be
- refresh_token:
  - Used to obtain a new access token when the current one expires
  - Automatically handled by ADC
- type
  - “authorized_user" indicates that these are user credentials

Revoke credentials when no longer needed

- IMPORTANT! The local ADC contains your access and refresh tokens.
  - Any user with access to your file system can use those credentials
  - If you no longer need these local credentials, revoke them by using the following
    - `gcloud auth application-default revoke`

Example: ADC in local environment using developer credentials - Querying BigQuery with Python

- Developer needs **`BigQuery User`** and **`BigQuery Data Viewer`** roles
- Developer logs into command line with personal credentials
  - **`gcloud auth login`**
- Developer creates credentials for ADC
  - **`gcloud auth application-default login`**

Output of command:

```
Credentials saved to file:
[$HOME/.config/gcloud/application_default_credentials.json]

These credentials will be used by any library that requests
Application Default Credentials (ADC).
```

- Developer can now test the code using personal credentials

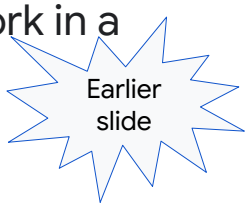
```
from google.cloud import bigquery

#query a public dataset available in BigQuery
query = '''
SELECT
  year,
  COUNT(1) as num_babies
FROM
  publicdata.samples.natality
WHERE
  year > 2000
GROUP BY
  year
'''

#no credentials provided so will use ADC
client = bigquery.Client()
print(client.query(query).to_dataframe())
```

If you don't specify credentials when constructing the client, ADC will look for credentials in the environment.

How do Application Default Credentials (ADC) work in a local development environment?



- Three options
  - Each are explained on the following pages

Next topic

1

Using developer's credentials (easy to get started this way)

Developer needs IAM roles that reflect the permissions needed by the code

```
gcloud auth application-default login
```

2

Using service account impersonation

Developer needs `Service Account Token Creator` role to impersonate the service account

```
gcloud auth application-default login --impersonate-service-account [SERVICE_ACCT_EMAIL_HERE]
```

Creates an access token which has a limited lifetime

Best practice

3

Using service account key

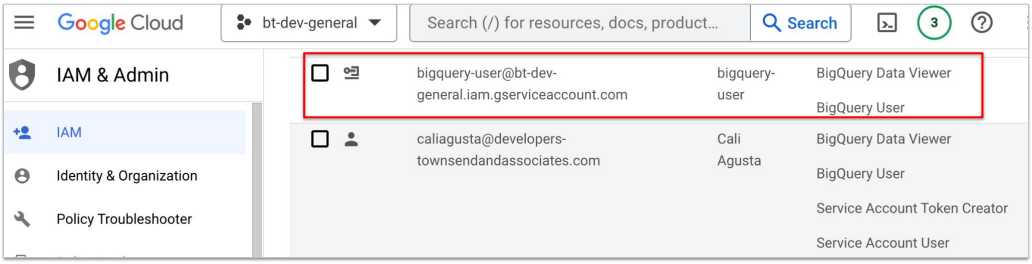
Developer needs `Service Account User` role plus `Service Account Key Admin` if need to create/download keys

Set the `GOOGLE_APPLICATION_CREDENTIALS` environment value to the path of the service account's key key

AVOID THIS OPTION. Keys don't expire by default

Using service account impersonation - step 1

- Create the service account and assign the appropriate IAM roles
  - E.g., **`BigQuery User`** and **`BigQuery Data Viewer`**
    - Note: Developer must have **`Owner`** or **`Service Account Admin`** role in order to create service accounts and assign roles to them
    - Developer needs **`Service Account Token Creator`** role to impersonate the service account while creating ADC credentials



Impersonate the service account - step 2

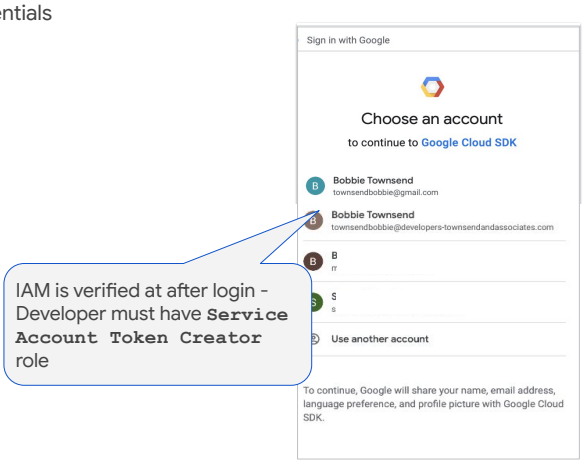
- Developer logs into command line with personal credentials
  - **`gcloud auth login`**
- Developer creates credentials for ADC
  - **`gcloud auth application-default login --impersonate-service-account [SERVICE_ACCT_EMAIL_HERE]`**
  - Are prompted to login
    - Use personal credentials

Output of command is the same as before

```
Credentials saved to file:
[$HOME/.config/gcloud/application_default_credentials.json]

These credentials will be used by any library that requests
Application Default Credentials (ADC).
```

- Developer can now test the code while impersonating the service account



IAM is verified at after login - Developer must have **`Service Account Token Creator`** role

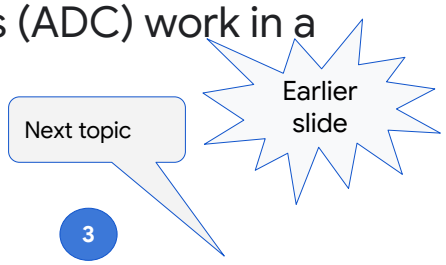
Service account impersonation credentials

```
{
  "delegates": [],
  "service_account_impersonation_url":
"https://iamcredentials.googleapis.com/v1/projects/-/serviceAccounts/cloud-storage-admin@bt-dev-general.iam.gserviceaccount.com:generateAccessToken",
  "source_credentials": {
    "client_id": "764086051850-6qr4p6gpi6hn506pt8ejuq83di341hur.apps.googleusercontent.com",
    "client_secret": "d-FL95Q19q7MQmFpd7hHD0Ty",
    "refresh_token": "1//0d3jkl6HO3w9ICgYIARAAGA0SNwF-L9IrSCIIHsMZdeku_yp6qbS-1RusEQu5GIsM6HdPTCOXksRrsOoKXu-aSJ_Qq-UzhHgUC2A",
    "type": "authorized_user"
  },
  "type": "impersonated_service_account"
}
```

- Credentials file stored in the same location as the prior example
- Client Libraries automatically retrieve the credential and refresh the access token as needed
  - *Developers do not need to manage access tokens if using Client Libraries with ADC*

How do Application Default Credentials (ADC) work in a local development environment?

- Three options
  - Each are explained on the following pages



1

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Developer needs IAM roles that reflect the permissions needed by the code

`gcloud auth application-default login`

2

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Developer needs **`Service Account Token Creator`** role to impersonate the service account

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Creates an access token which has a limited lifetime

Best practice

3

Using service account key

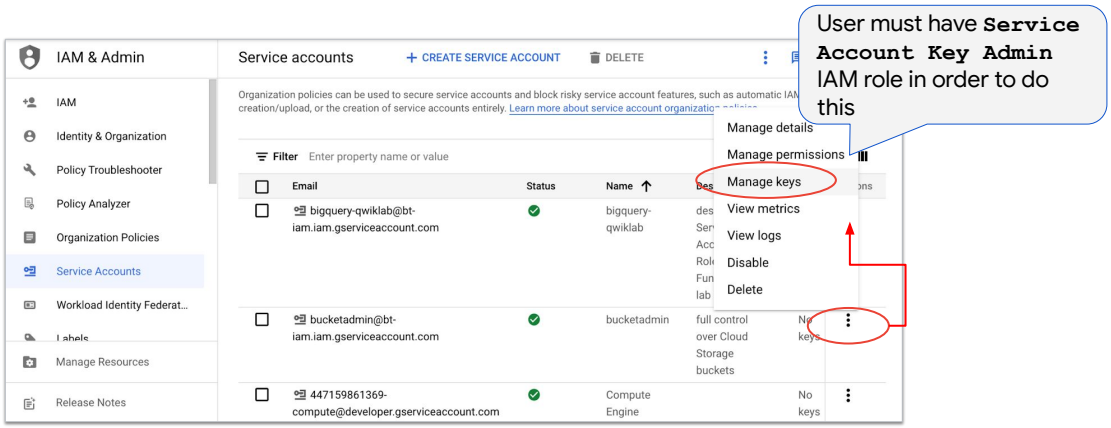
Developer needs **`Service Account User`** role plus **`Service Account Key Admin`** if need to create/download keys

Set the **`GOOGLE_APPLICATION_CREDENTIALS`** environment value to the path of the service account's key key

AVOID THIS OPTION. Keys don't expire by default

Service account key management

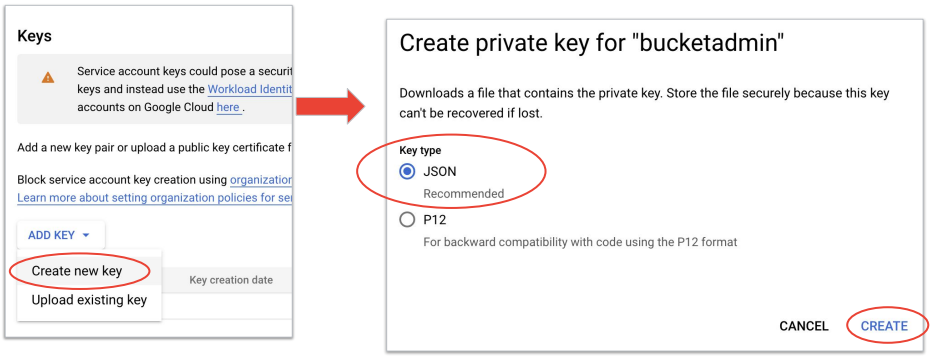
- Each service account can have one or more public/private RSA key pairs associated with it
  - Can be used by applications running externally to Google Cloud for authentication*
    - **Not best practice, due to key exposure risk**



*Applications running within Google Cloud compute services do not need keys

Service Account keys must be secured

- When keys are created
  - Public key is kept in Google Cloud
  - Private key is downloaded to the developer's desktop
  - **Customer is responsible for storing the private key securely**



Create and manage service account keys
https://cloud.google.com/iam/docs/creating-managing-service-account-keys

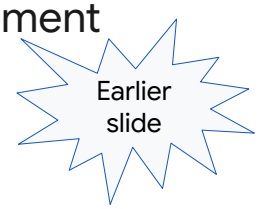
Why service account keys can be a security issue

- Applications running in Google Cloud rely on SAs for day-to-day operations
  - SAs have more privileged access than end-user identities
    - Provide access to workloads and applications in production environments
  - **Keys by default do not expire** to help ensure operations are not interrupted by an expired key
- Key leakage is similar to a password leak - bad actors can gain access to unauthorized resources
  - For example, developers may accidently embed SA keys in code and upload it to a code repository
    - Anyone with access to the repository can see the key and potentially use it to access to the services and APIs it is authorized to access
- Options are available to better secure keys
  - Setup key rotation (Service account key rotation) and monitor keys using cloud asset inventory
    - Send warning notifications to developers when a key is about to expire and it is time to rotate the key
  - Leverage third party tools such HashiCorp Vault to embed the key rotation process into the developer's workflow
  - New as of July 2023, setup Service Account key expiry
- Given the security risks associated with SA keys, **best practices is not to use them unless no other options are available**

Using service account keys

- Create the service account and assign the appropriate IAM roles
  - E.g., **`BigQuery User`** and **`BigQuery Data Viewer`**
    - Note: Developer must have **`Owner`** or **`Service Account Admin`** role in order to create service accounts and assign roles to them
    - Developer needs **`Service Account Key Admin`** to create and download service account keys
    - Developer needs **`Service Account User`** to "act as" the service account
- Create and download a key (or create key on-premise and upload the public key)
- Set the **`GOOGLE_APPLICATION_CREDENTIALS`** environment variable to the path of the JSON file that contains your service account key
  - **`export GOOGLE_APPLICATION_CREDENTIALS="PATH_TO_KEY_FILE"`**
  - Valid for the existing shell session

Summary - ADC in the local development environment



Developer logs into the CLI
`gcloud auth login`

ADC can be setup 3 ways

1

Using developer's credentials (easy to get started this way)

Developer needs IAM roles that reflect the permissions needed by the code

```
gcloud auth application-default login
```

USED WHEN GETTING STARTED AND DEVELOPER'S ACCOUNT HAS ROLES NEEDED BY THE APPLICATION

2

Using service account impersonation

Developer needs **`Service Account Token Creator`** role to impersonate the service account

```
gcloud auth application-default login --impersonate-service-account [SERVICE_ACCT_EMAIL_HERE]
```

Creates an access token which has a limited lifetime

BEST PRACTICE

3

Using service account key

Developer needs **`Service Account User`** role plus **`Service Account Key Admin`** if need to create/download keys

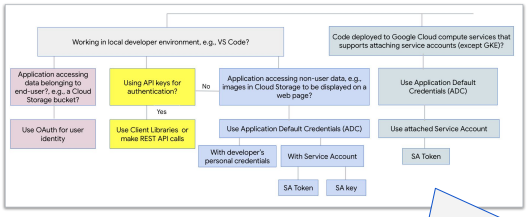
Set the **`GOOGLE_APPLICATION_CREDENTIALS`** environment value to the path of the service account key

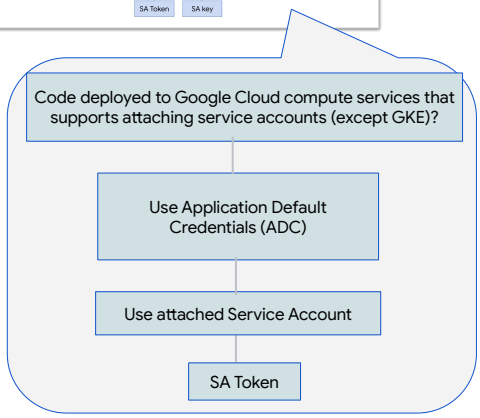
AVOID THIS OPTION. Keys don't expire by default

ADC searches for credentials in this order

1. Checks the **`GOOGLE_APPLICATION_CREDENTIALS`** environment value to see if it contains a path to a service account key
   - Uses the key to "act as" the service account
2. Checks the "well known path" for credentials created by using either
   - `gcloud auth application-default login`
     - Uses the credentials of the person logging in at the prompt that is generated
   - `gcloud auth application-default login --impersonate-service-account [SERVICE_ACCT_EMAIL_HERE]`
     - Uses service account impersonation
3. If neither are found, an exception is thrown

Authentication with Application Default Credentials (ADC)





How to provide credentials to ADC

- Method used depends on the environment where your code is running:
  - Local development environment
  - Compute Engine or other Google Cloud services that support attaching a service account
  - Cloud Shell or other Google Cloud cloud-based development environments
  - Google Kubernetes Engine
  - On-premises or another cloud provider

Next topic

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How do Application Default Credentials (ADC) work when running in Google Cloud compute services?

- Code running on the following compute uses a service account as its identity
  - Compute Engine
  - Cloud Run
  - Cloud Functions
  - App Engine
- Google Cloud provide a default service account for these services
  - Using this service account is not recommended as it is highly privileged
    - Violates the principle of least privilege
- **Best practice: Create a custom service account for each use case**

All Google Cloud compute environments use a metadata server

- Available only from within the instance
  - Is not exposed to the public internet.
- Provides information about the running instance, including
  - ProjectID
  - Service account credentials
  - Zone in which the instance is running
- Client libraries detect when applications run in Google Cloud compute environments
  - Automatically makes a request to the metadata server to fetch the token of the attached service account
  - This token is then used to authenticate API requests made by the client library.
- Do **NOT** set ADC credentials like you did in the local environment or use the GOOGLE_APPLICATION_CREDENTIALS environment variable
  - This will override what the Client Libraries automatically do

Using ADC with Compute Engine

Retrieving metadata

- Example code to retrieve metadata from a VM after connecting to the instance
  - Always include the header `-H "Metadata-Flavor: Google"` when querying the metadata server to ensure you're interacting with the genuine metadata server

```
import requests

METADATA_URL = "http://metadata.google.internal/computeMetadata/v1/"
HEADERS = {"Metadata-Flavor": "Google"}

response = requests.get(METADATA_URL + "project/project-id", headers=HEADERS)
print("ProjectID: ", response.text)

response = requests.get(METADATA_URL +
"/instance/service-accounts/default/email", headers=HEADERS)
print("ServiceAccount: ",response.text)

response = requests.get(METADATA_URL +
"/instance/service-accounts/default/token", headers=HEADERS)
print("Token: ",response.text)
```

Shown for demo purposes only

Not something a developer typically needs to do

Client Libraries do this automatically

Output

```
ProjectID:  bt-dev-general

ServiceAccount:  bigquery-user@bt-dev-general.iam.gserviceaccount.com

Token:  {"access_token":"ya29.c.rest-of-token-here","expires_in":3230,"token_type":"Bearer"}
```

Compute Engine metadata server

- Each compute option (GCE, GCR, GCF) stores different data on its metadata server depending on the type of compute
- Documentation regarding Compute Engine's metadata server
  - Default values include the name of the attached service account, plus more
- Another way to retrieve Compute Engine metadata
  - SSH into a VM in Google Cloud
    - To see the machine type
      - `curl "http://metadata.google.internal/computeMetadata/v1/instance/machine-type" -H "Metadata-Flavor: Google"`
    - To see the service account
      - `curl "http://metadata.google.internal/computeMetadata/v1/instance/service-accounts/" -H "Metadata-Flavor: Google"`
- The gcloud command is used to access metadata from the developer's CLI
  - `gcloud compute instances describe [VM-Name-Here]  --zone [ZONE-HERE]`

Compute Engine metadata server

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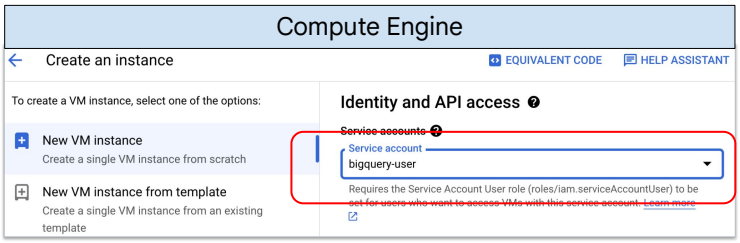
- The gcloud command is used to access metadata from the developer's CLI
  - `gcloud compute instances describe [VM-Name-Here]  --zone [ZONE-HERE]`

Using a custom service account with Compute Engine

- Developers must have
  - **`Owner`** or **`Service Account Admin`** role in order to create service accounts and assign roles to them
  - **`Service Account User`** role to attach a service account to a compute resource



Example: ADC on Compute Engine - Querying BigQuery with Python

- Same code that was running in a local development environment
  - Now it is running in a Compute Instance VM
- A service account with the **`BigQuery User`** and **`BigQuery Data Viewer`** roles is attached
- ADC queries the VM's metadata server for the attached service account and uses its token for authentication

```
from google.cloud import bigquery

#query a public dataset available in BigQuery
query = '''
SELECT
  year,
  COUNT(1) as num_babies
FROM
  publicdata.samples.natality
WHERE
  year > 2000
GROUP BY
  year
'''

#no credentials provided so will use ADC
client = bigquery.Client()
print(client.query(query).to_dataframe())
```

Output

```
$ python3 query.py
   year  num_babies
0  2008     4255156
1  2001     4031531
2  2002     4027376
3  2007     4324008
4  2006     4273225
5  2004     4118907
6  2003     4096092
7  2005     4145619
```

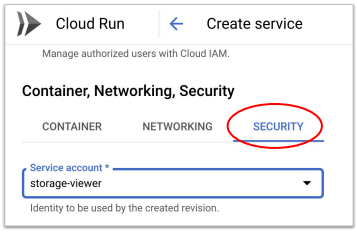
DON'T specify credentials when constructing the client. ADC will query the metadata server for the attached service account

Using ADC with Cloud Run

Using ADC with Cloud Run

- Developers must have
  - **`Owner`** or **`Service Account Admin`** role in order to create service accounts and assign roles to them
  - **`Service Account User`** role to attach a service account to a compute resource
- Set the Cloud Run service's service account using the Google Cloud console or the **`gcloud`** CLI

Console



CLI

```
gcloud run deploy [APP-NAME] --image
[IMAGE_URL] --service-account
[SERVICE-ACCOUNT-HERE]

gcloud run services update [APP-NAME]
--service-account [SERVICE-ACCOUNT-HERE]
```

Cloud Run metadata server

- Cloud Run's metadata server is similar in concept to Compute Engine metadata server
  - ADC will automatically query the metadata server to retrieve token associated with the attached service account

Example: ADC on Cloud Run - Querying BigQuery with Python

- Same code that was running in a local development environment
  - Now it is running as a Cloud Run API
    - Can pass in a year for the SQL query
- Attach a service account with the **`BigQuery User`** and **`BigQuery Data Viewer`** roles
- ADC will query the metadata server for the service account token and use that for authentication and authorization

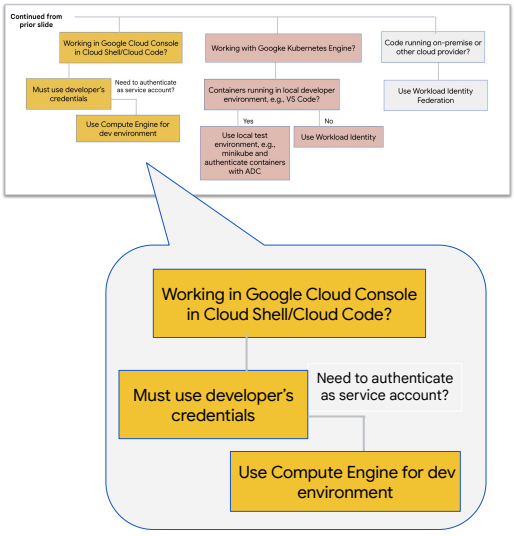
```python
import os

from flask import Flask, request, jsonify
from google.cloud import bigquery

app = Flask(__name__)

@app.route('/get_num_babies', methods=['GET'])
def get_num_babies():
    year = request.args.get('year', default=2000, type=int)

    query = f'''
    SELECT
      year,
      COUNT(1) as num_babies
    FROM
      publicdata.samples.natality
    WHERE
      year > {year}
    GROUP BY
      year
    '''

    client = bigquery.Client()
    result = client.query(query).to_dataframe().to_dict(orient='records')
    return jsonify(result)

if __name__ == "__main__":
    app.run(debug=True, host="0.0.0.0", port=int(os.environ.get("PORT", 8080)))
```

Using ADC with Cloud Functions or App Engine

Using ADC with Cloud Functions or App Engine

- ADC uses the metadata server for Cloud Functions and App Engine in a manner similar to Compute Engine and Cloud Run
  - No further discussion is needed

Authenticating to Cloud Shell or Cloud Code in Cloud Shell



How to provide credentials to ADC

- Method used depends on the environment where your code is running:
  - Local development environment
  - Compute Engine or other Google Cloud services that support attaching a service account
  - Cloud Shell or other Google Cloud cloud-based development environments
  - Google Kubernetes Engine
  - On-premises or another cloud provider

Next topic

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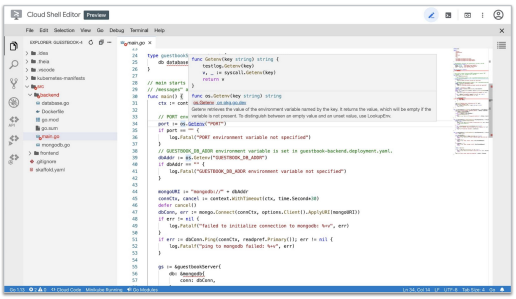
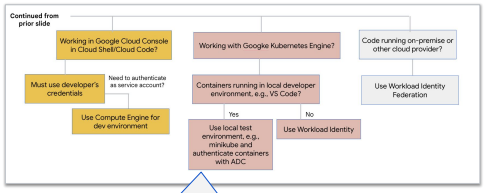
Authenticating to Cloud Shell or Cloud Code in Cloud Shell

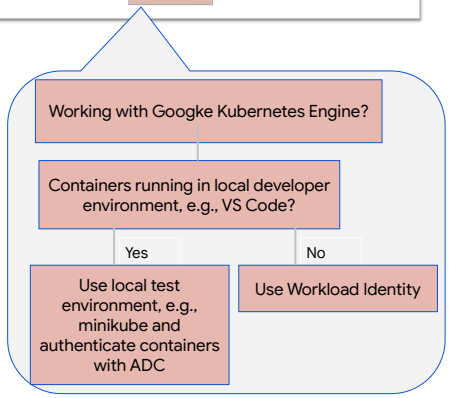
- Cloud Shell and Cloud Code in Cloud Shell use the credentials provided upon login
  - Cannot change the ADC credentials in Cloud Shell by using either of these commands
    - `gcloud auth application-default login`
    - `gcloud auth application-default login --impersonate-service-account [SERVICE_ACCT_EMAIL_HERE]`
- If you need to provide a different user account to ADC, or provide credentials by using a service account,
  - Use a local development environment or a Google Cloud compute resource as your development environment



Cloud Code with Cloud Shell editor

Authenticating to a Google Kubernetes Engine environment





How to provide credentials to ADC

- Method used depends on the environment where your code is running:
  - Local development environment
  - Compute Engine or other Google Cloud services that support attaching a service account
  - Cloud Shell or other Google Cloud cloud-based development environments
  - Google Kubernetes Engine*
  - On-premises or another cloud provider

Next topic

*This discussion assumes a knowledge of Kubernetes

Crea

Testing containers locally

- Use a local Kubernetes implementation such as minikube and the GCP Auth minikube addon
  - Configure containers to authenticate with ADC
- When containerized applications are running on Google Cloud
  - Use Workload Identity for GKE

Focus of this section

Automated Google Cloud Platform Authentication

The `gcp-auth` addon automatically and dynamically configures pods to use your credentials, allowing applications to access Google Cloud services as if they were running within Google Cloud.

The addon defaults to using your environment's Application Default Credentials, which you can configure with `gcloud auth application-default login`. Alternatively, you can specify a JSON credentials file (e.g. service account key) by setting the `GOOGLE_APPLICATION_CREDENTIALS` environment variable to the location of that file.

The addon also defaults to using your local gcloud project, which you can configure with `gcloud config set project <project name>`. You can override this by setting the `GOOGLE_CLOUD_PROJECT` environment variable to the name of the desired project.

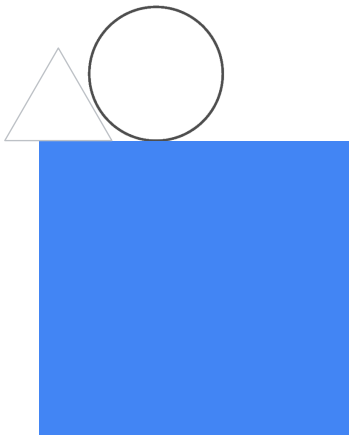
Once the addon is enabled, pods in your cluster will be configured with environment variables (e.g. `GOOGLE_APPLICATION_DEFAULTS`, `GOOGLE_CLOUD_PROJECT`) that are automatically used by GCP client libraries. Additionally, the addon configures registry pull secrets, allowing your cluster to access the container images hosted in Artifact Registry and Google Container Registry.

Using the gcp-auth addon for minikube

Minikube tutorial

Application Authentication

- Overview
- API keys
- Application Default Credentials
- **Workload Identity**
- Workload Identity Federation



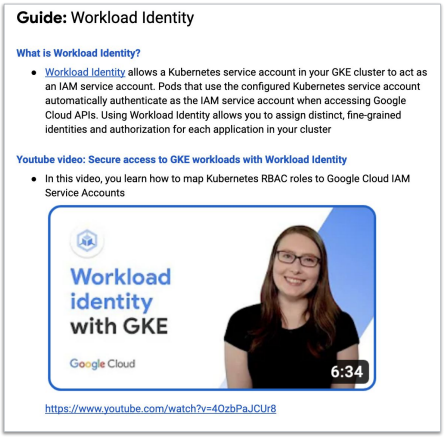
GKE Workload Identity

- Workload Identity is the recommended way for workloads to access Google Cloud services in a secure way
  - A Kubernetes service account (KSA) in a specific namespace is bound to a Google Cloud service account (GSA)
  - Allows the KSA to act as the GSA for the purpose of accessing Google Cloud services.
- When enabled
  - When a pod uses a KSA to access Google Cloud services, the GKE metadata server issues an identity token.
    - Has the necessary claims to act as the associated Google Cloud service account
    - The token is then used to authenticate the application to the Google Cloud service

Guide: Workload Identity

Topics covered include

- Workload Identity
- An overview of how to map Kubernetes RBAC service account to Google Cloud service accounts



Workload Identity

Service accounts usage

- A GKE cluster is a collection of compute instance “nodes”
  - **Each node has an attached service account**
    - Used to grant the VM instances permissions to interact with Google Cloud services
      - For example, to pull container images from the Artifact Registry
    - These SAs are not used as part of Workload Identity
- **Kubernetes service account (KSA)**
  - An **identity within Kubernetes used to grant permissions to workloads (like pods) running inside the cluster**
    - For example, a pod can use a KSA with the appropriate permissions to list other pods in the same namespace
  - Permissions are managed through Kubernetes' Role-Based Access Control (RBAC)
- **Workload Identity**
  - **IAM role based service accounts**
  - **KSAs are bound to these accounts**
    - Allows workloads running in GKE (using a specific KSA) to act as the associated Google Cloud service account to access Google Cloud services, e.g., Cloud Storage

Enabling workload identity

- To get started, enable Workload Identity on clusters and node pools using the Google Cloud CLI or the Google Cloud console.
  - Once enabled at the cluster level is automatically enabled on node pools

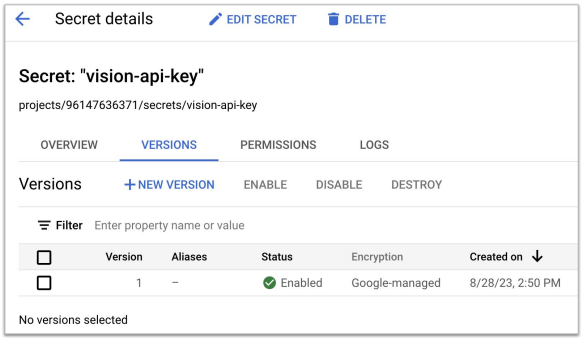
```
gcloud container clusters create workload-identity-test \
    --zone us-central1-a  --machine-type=e2-micro  \
    --workload-pool=bt-dev-general.svc.id.goog
```

Enabling the workload identity

Use Workload Identity

Demo: Secret Manager access

- Secret Manager is a service that provides a secure and convenient method for storing API keys, passwords, certificates, and other sensitive data
  - For the purpose of this demo, a secret named **`vision-api-key`** has already been created



Create a secret

Create service accounts with Secret Manager roles

- Create 2 service accounts using IAM
  - One has read-only permission to the **`vision-api-key`** in Secret Manager
  - One has read-write permission to the **`vision-api-key`** in Secret Manager

☐	readonly-secrets@bt-dev-general.iam.gserviceaccount.com	readonly-secrets	Secret Manager Secret Accessor
☐	readwrite-secrets@bt-dev-general.iam.gserviceaccount.com	readwrite-secrets	Secret Manager Secret Accessor Secret Manager Secret Version Adder

Create pods with different namespaces and RBAC roles

- Create 2 namespaces
  - **`kubectl create namespace readonly-ns`**
  - **`kubectl create namespace admin-ns`**

```
#This Pod uses the readonly-sa service account in
the readonly-ns namesapce
apiVersion: v1
kind: Pod
metadata:
  name: readonly-test
  namespace: readonly-ns
spec:
  containers:
  - image: google/cloud-sdk:slim
    name: workload-identity-test
    command: ["sleep","infinity"]
    resources:
      requests:
        cpu: "150m"
        memory: "150Mi"
  serviceAccountName: readonly-sa
```

In the **`readonly-ns`** namespace

Kubernetes RBAC role

- Create 2 pods
  - **`kubectl apply -f readonly-pod.yaml`**
  - **`kubectl apply -f readwrite-pod.yaml`**

```
#This Pod uses the admin-sa service account in the
admin-ns namespace.
apiVersion: v1
kind: Pod
metadata:
  name: admin-test
  namespace: admin-ns
spec:
  containers:
  - image: google/cloud-sdk:slim
    name: workload-identity-test
    command: ["sleep","infinity"]
    resources:
      requests:
        cpu: "150m"
        memory: "150Mi"
  serviceAccountName: admin-sa
```

In the **`admin-ns`** namespace

Kubernetes RBAC role

[Kubernetes best practices: Organizing with Namespaces]

Bind the Google Cloud IAM service accounts to the Kubernetes service accounts

```
gcloud iam service-accounts add-iam-policy-binding
readonly-secrets@bt-dev-general.iam.gserviceaccount.com \
   --member=serviceAccount:bt-dev-general.svc.id.goog[readonly-ns/readonly-sa] \
  --role='roles/iam.workloadIdentityUser'
```

Google Cloud IAM service account

Google Cloud IAM role

GKE name space and RBAK service account

```
gcloud iam service-accounts add-iam-policy-binding
readwrite-secrets@bt-dev-general.iam.gserviceaccount.com \
    --member=serviceAccount:bt-dev-general.svc.id.goog[admin-ns/admin-sa] \
    --role='roles/iam.workloadIdentityUser'
```

Connect to the pods and test access to Secret Manager

- Open a shell in the read-only pod
  - `kubectl exec -it readonly-test --namespace=readonly-ns -- /bin/bash`
- Can I access the secret? (yes)
  - `gcloud secrets versions access 1 --secret=vision-api-key`
- Can I write? (no)
  - `printf "my-second-api-key" | gcloud secrets versions add vision-api-key --data-file=-`
- **`Exit`** the pod

- Repeat with
  - `kubectl exec -it admin-test --namespace=admin-ns -- /bin/bash`

Application Authentication

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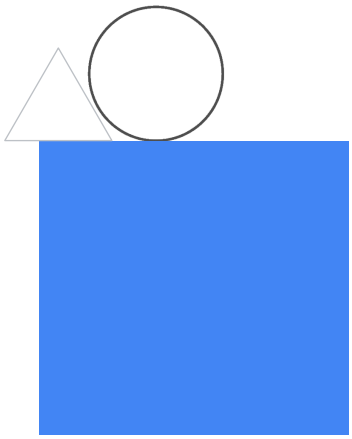
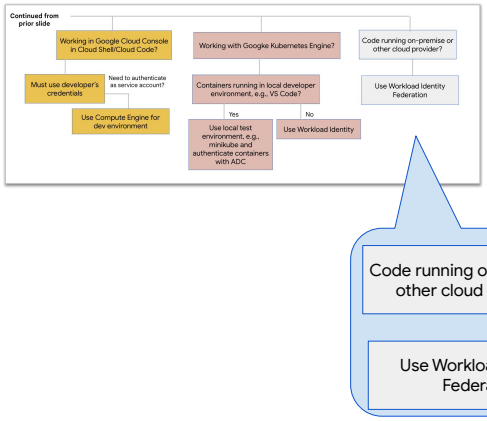
- **Workload Identity Federation**



Authenticate code running in on-premises or another cloud provider



Code running on-premise or other cloud provider?

Use Workload Identity Federation

How to provide credentials to ADC

- Method used depends on the environment where your code is running:
  - Local development environment
  - Compute Engine or other Google Cloud services that support attaching a service account
  - Cloud Shell or other Google Cloud cloud-based development environments
  - Google Kubernetes Engine
  - On-premises or another cloud provider

Next topic

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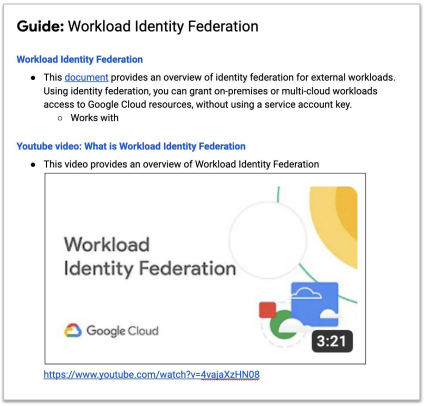
Applications running on-premise or in other clouds

- Application running outside of Google Cloud need to provide credentials that are recognized by Google Cloud to use Google Cloud services
  - In the past, this was accomplished through the use of downloaded service account keys
- Workload identity federation is the preferred way to grant on-premises or multi-cloud workloads access to Google Cloud resources
  - Can grant external identities IAM roles, including the ability to impersonate service accounts
    - Service account keys are no longer required

Guide: Workload Identity Federation

Topics covered include

- Workload Identity Federation
- An example of how to use it in a CI/CD pipeline with GitHub Actions



Workload Identity Federation


Google Cloud