User Authentication: Identity-Aware Proxy

GSP499

Google Cloud Self-Paced Labs

Overview

In this lab, you build a minimal web application with Google App Engine, then explore various ways to use Identity-Aware Proxy (IAP) to restrict access to the application and provide user identity information to it. Your app will:

- Display a welcome page
- Access user identity information provided by IAP
- Use cryptographic verification to prevent spoofing of user identity information

What you'll learn

- How to write and deploy a simple App Engine app using Python
- How to enable and disable IAP to restrict access to your app
- How to get user identity information from IAP into your app
- How to cryptographically verify information from IAP to protect against spoofing

Introduction

Authenticating users of your web app is often necessary, and usually requires special programming in your app. For Google Cloud apps you can hand those responsibilities off to the Identity-Aware Proxy service. If you only need to restrict access to selected users there are no changes necessary to the application. Should the application need to know the user's identity (such as for keeping user preferences server-side) Identity-Aware Proxy can provide that with minimal application code.

What is Identity-Aware Proxy?

Identity-Aware Proxy (IAP) is a Google Cloud service that intercepts web requests sent to your application, authenticates the user making the request using the Google Identity Service, and only lets the requests through if they come from a user you authorize. In addition, it can modify the request headers to include information about the authenticated user.

What you'll need

A basic knowledge of the Python programming language will enhance your learning experience.

This lab is focused on Google App Engine and IAP. Non-relevant concepts and code blocks are glossed over and are provided for you to simply copy and paste.

Setup and requirements

Qwiklabs setup

Before you click the Start Lab button

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

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

What you need

To complete this lab, you need:

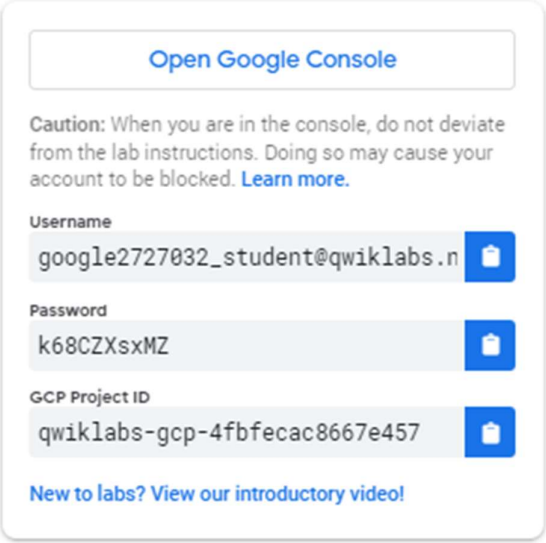
- Access to a standard internet browser (Chrome browser recommended).
- Time to complete the lab.
  Note: If you already have your own personal Google Cloud account or project, do not use it for this lab.

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

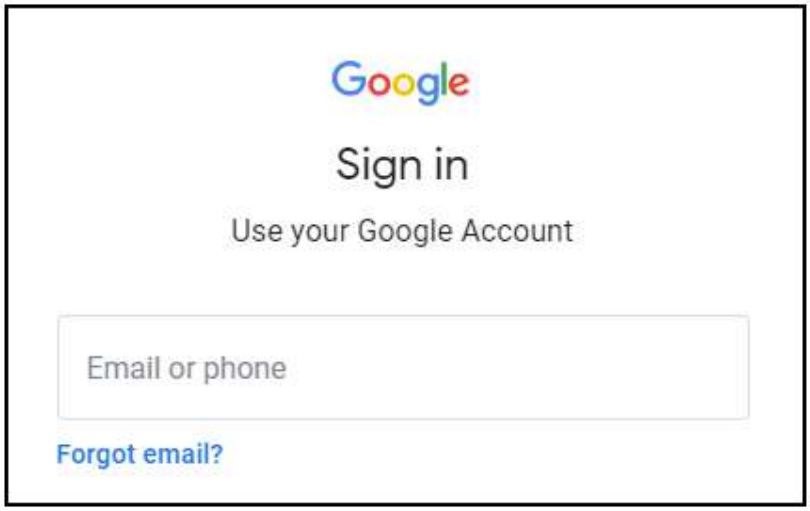
Cloud Console

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

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

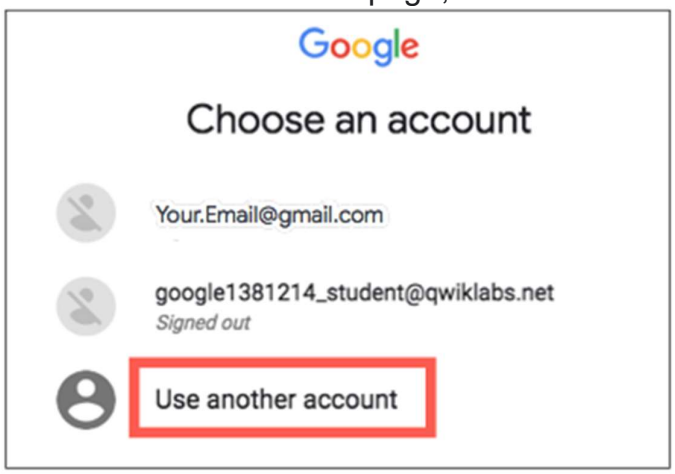


2. Copy the username, and then click **Open Google Console**. The lab spins up resources, and then opens another tab that shows the **Sign in** page.



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

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



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

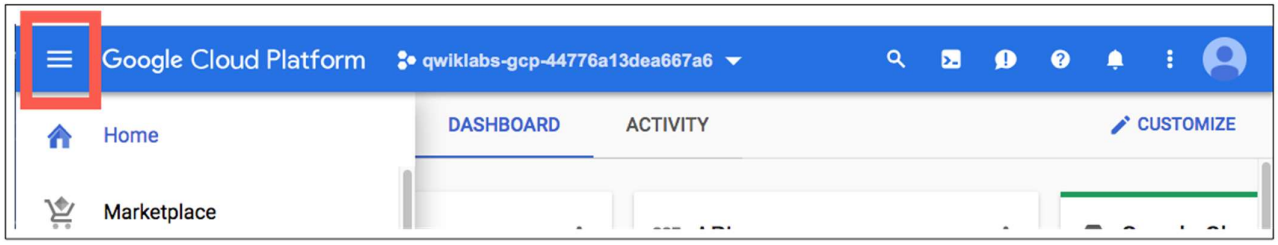
   Important: You must use the credentials from the Connection Details panel. Do not use your Qwiklabs credentials. If you have your own Google Cloud account, do not use it for this lab (avoids incurring charges).

4. Click through the subsequent pages:

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

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

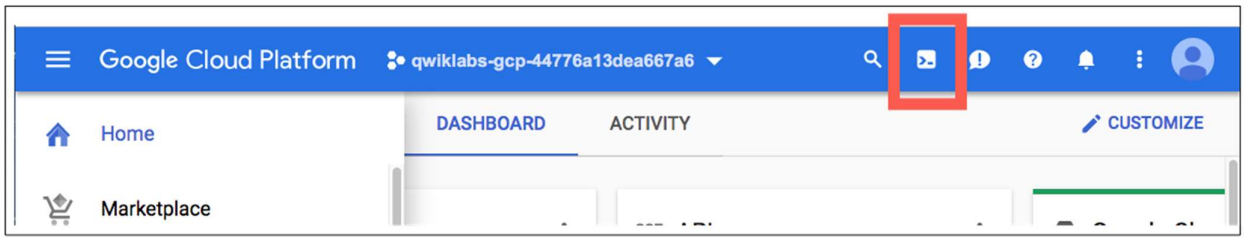
Note: You can view the menu with a list of Google Cloud Products and Services by clicking the **Navigation menu** at the top-left.



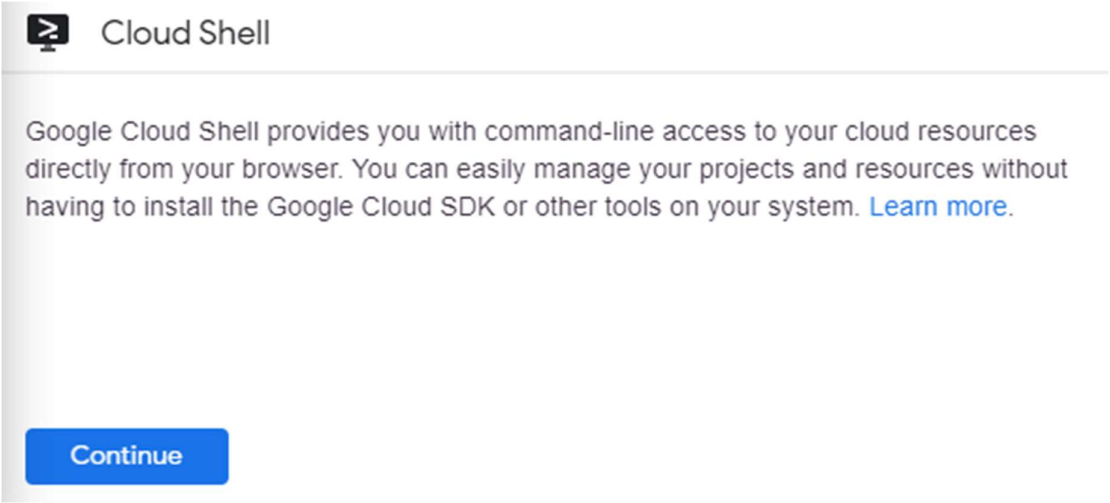
Activate Cloud Shell

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

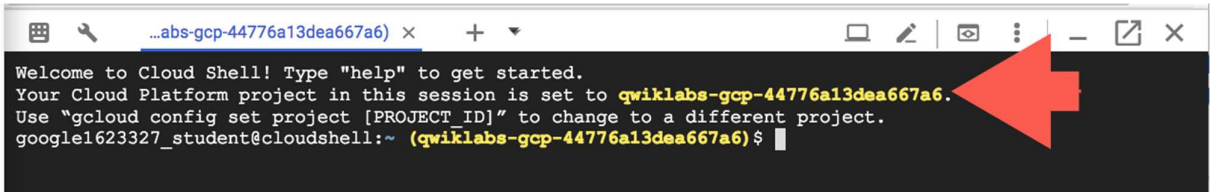
In the Cloud Console, in the top right toolbar, click the **Activate Cloud Shell** button.



Click **Continue**.



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



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

You can list the active account name with this command:

```
gcloud auth list
```

(Output)

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

(Example output)

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

You can list the project ID with this command:

```
gcloud config list project
```

(Output)

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

(Example output)

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

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

Download the Code

Click the command line area in the Cloud Shell so you can type commands. Fetch the code from Github and then change to the code folder:

```
git clone https://github.com/googlecodelabs/user-authentication-with-iap.git

cd user-authentication-with-iap
```

This folder contains one subfolder for each step of this lab. You will change to the correct folder to perform each step.

Deploy Application and Protect it with IAP

This is an App Engine Standard application written in Python that simply displays a "Hello, World" welcome page. We will deploy and test it, then restrict access to it using IAP.

Review the Application Code

Change from the main project folder to the `1-HelloWorld` subfolder that contains code for this step.

```
cd 1-HelloWorld
```

The application code is in the `main.py` file. It uses the Flask web framework to respond to web requests with the contents of a template. That template file is in `templates/index.html`, and for this step contains only plain HTML. A second template file contains a skeletal example privacy policy in `templates/privacy.html`.
There are two other files: `requirements.txt` lists all the non-default Python libraries the application uses, and `app.yaml` tells Google Cloud that this is a Python App Engine application.

You can list each file in the shell using the cat command, as in:

```
cat main.py
```

Or you can launch the Cloud Shell code editor by clicking the Pencil icon at the top right-hand side of the Cloud Shell window, and examine the code that way.

You do not need to change any files for this step.

Deploy to App Engine

Deploy the app to the App Engine Standard environment for Python.

```
gcloud app deploy
```

Select a region near to you that says it "supports standard".

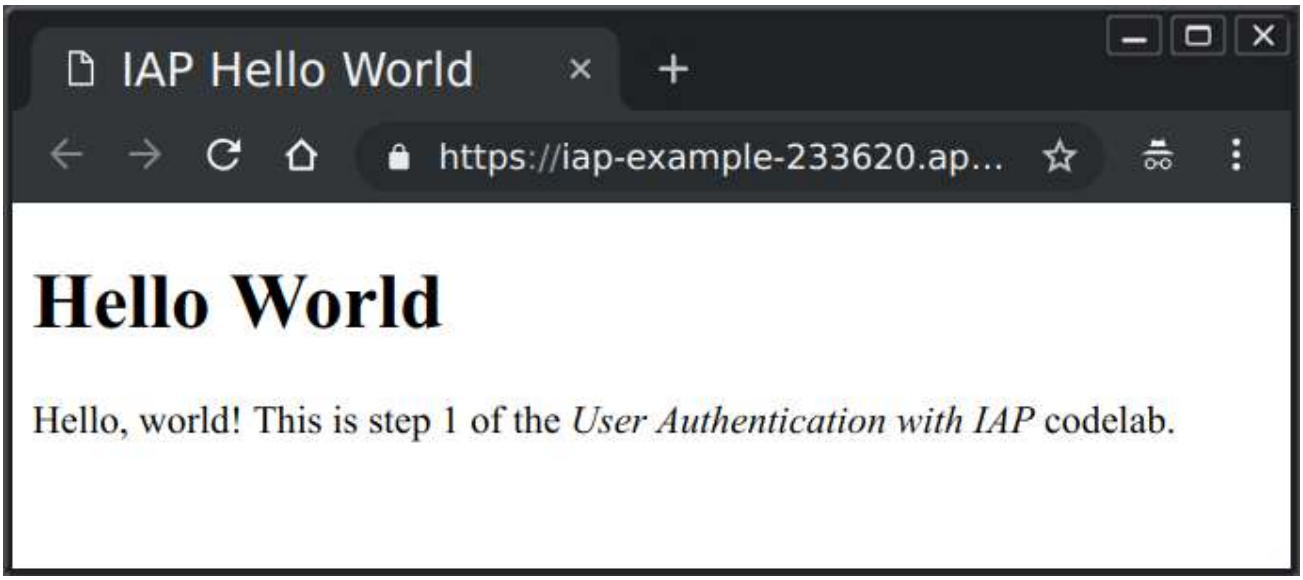
When you are asked if you want to continue, enter **Y** for yes.

In a few minutes the deploy completes. You will see a message that you can view your application with `gcloud app browse`.

Enter that command:

```
gcloud app browse
```

Click the displayed link to open it in a new tab, or copy it to a manually opened new tab if necessary. Since this is the first time this app is run, it will take a few seconds to appear while a cloud instance is started, and you should see the following window.

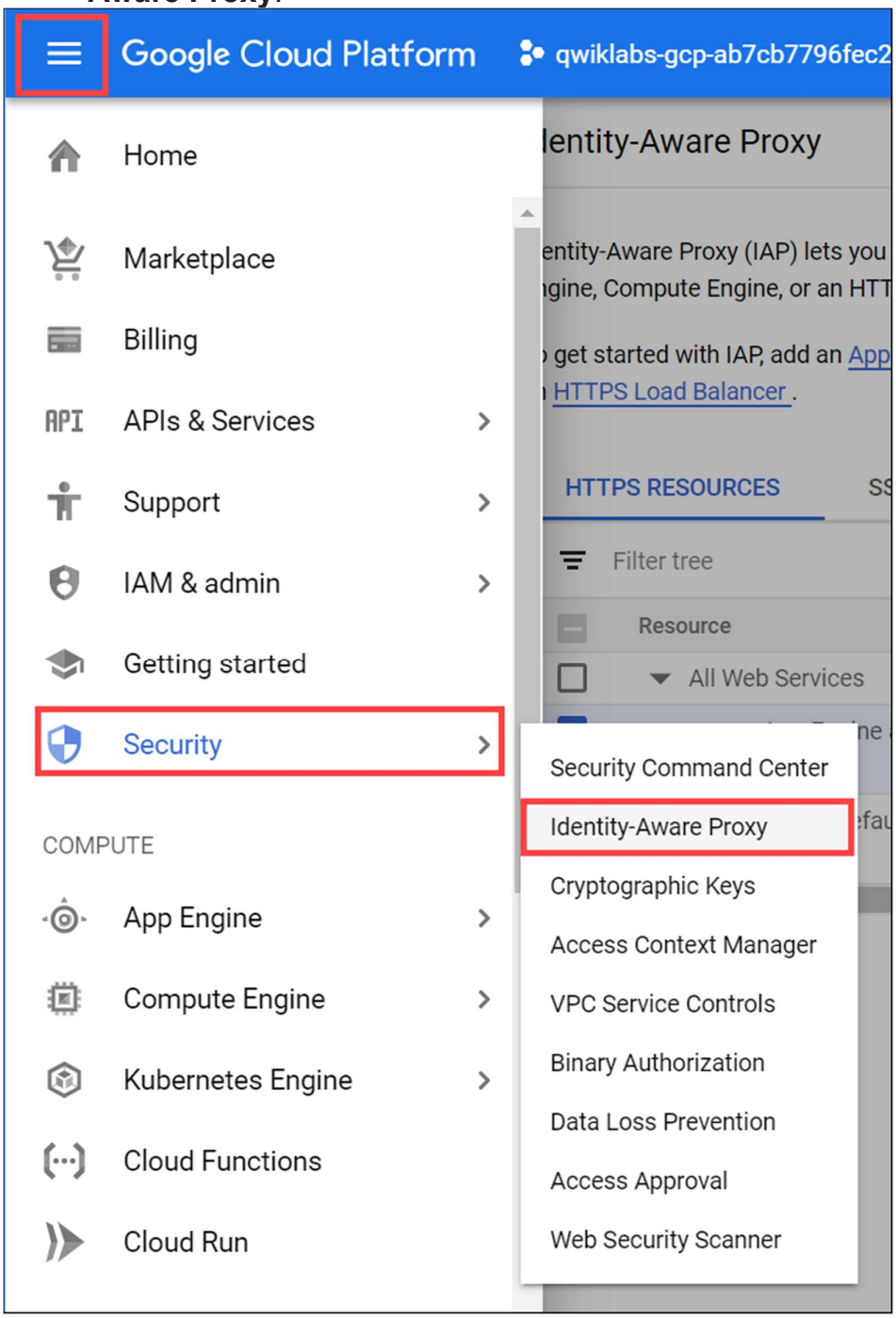


You can open that same URL from any computer connected to the Internet to see that web page. Access is not yet restricted.

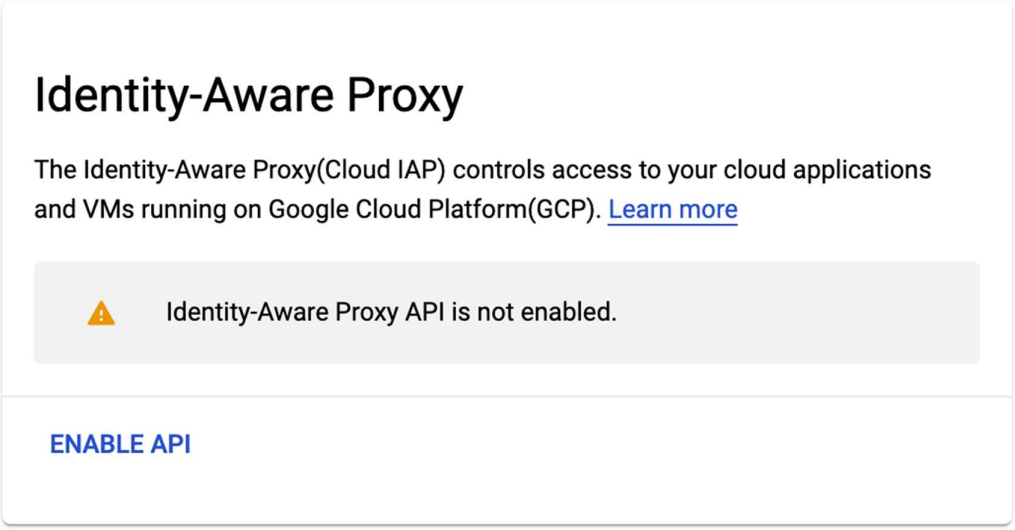
Click *Check my progress* to verify the objective.

Restrict Access with IAP

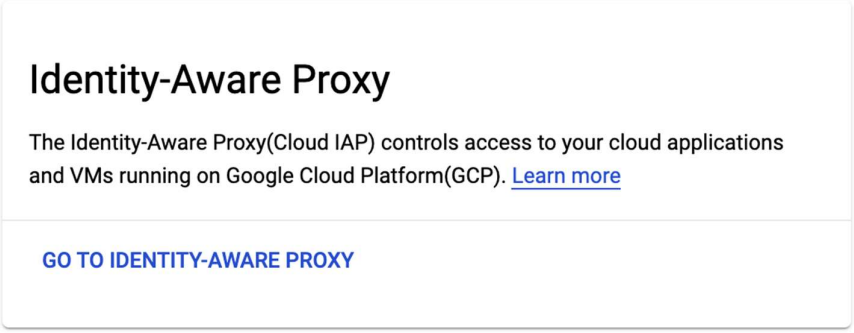
1. In the cloud console window, click the **Navigation menu** > **Security** > **Identity-Aware Proxy**.



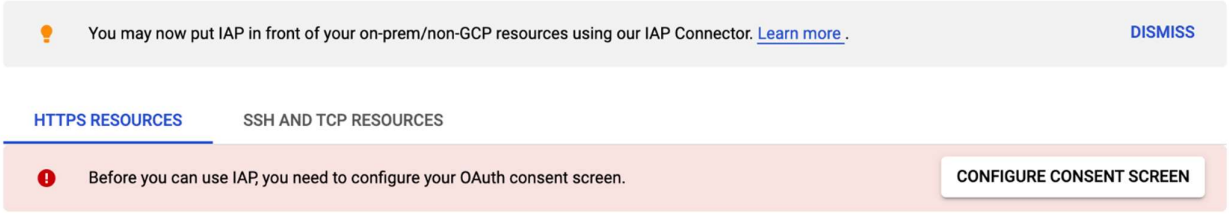
2. Click **Enable API**.



3. Click **Go to Identity-Aware Proxy**.



4. Click **CONFIGURE CONSENT SCREEN**.



5. Select **Internal** under User Type and click **Create**.

6. Fill in the required blanks with appropriate values:

Field	Value
Application name	IAP Example
Support email	*Your email address. it may already be filled in for you.*
Authorized domains	*The hostname portion of the application's URL, e.g. iap-example-999999.appspot.com. You can see this in the address bar of the Hello World web page you previously opened. Do not include the starting* `https://` *or trailing* `/` *from that URL.* ***You must press Enter after filling in this value.***
Application homepage link	*The URL you used to view your app*
Application privacy Policy link	*The privacy page link in the app, same as the homepage link with /privacy added to the end*
Developer Contact Information	*Enter at least one email*

7. Click **Save and Continue**. For **Scopes**, click **Save and Continue** and for **Summary** click **Back to Dashboard**. You will be prompted to create credentials. You do not need to create credentials for this lab, so you can simply close this browser tab.

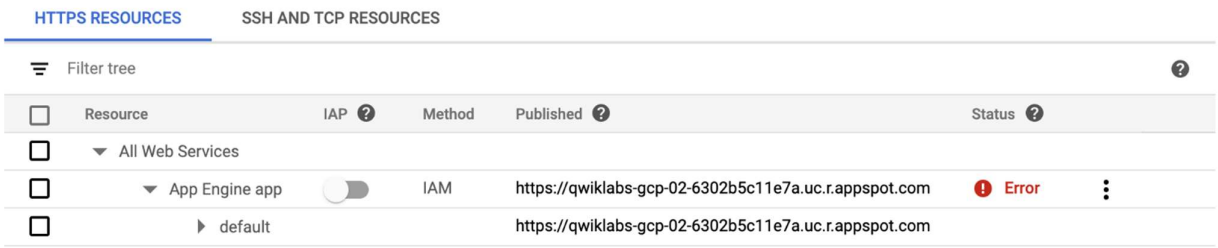
8. In Cloud Shell, run this command to disable the Flex API:

```
gcloud services disable appengineflex.googleapis.com
```

App Engine has its standard and flexible environments which are optimized for different application architectures. Currently, when enabling IAP for App Engine, if the Flex API is enabled, Google Cloud will look for a Flex Service Account. Your Qwiklabs project comes with a multitude of APIs already enabled for the purpose of convenience. However, this creates a unique situation where the Flex API is enabled without a Service Account created.

9. Return to the Identity-Aware Proxy page and refresh it. You should now see a list of resources you can protect.

Click the toggle button in the IAP column in the App Engine app row to turn **IAP** on.



10. The domain will be protected by IAP. Click **TURN ON**.

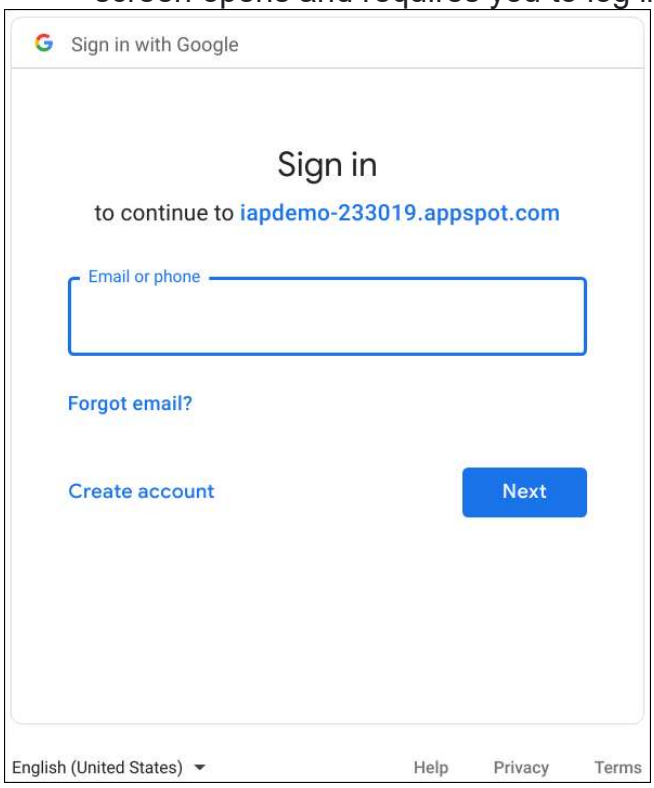
Turn on IAP

This will only allow access to App Engine app by members listed in the permission panel.

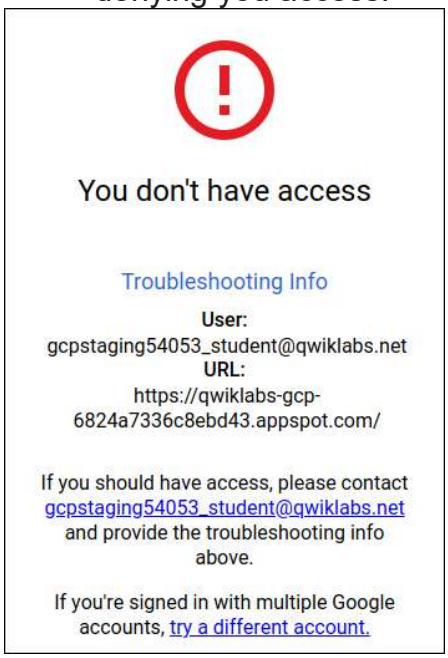
CANCEL TURN ON

Test that IAP is turned on

1. Open a browser tab and navigate to the URL for your app. A Sign in with Google screen opens and requires you to log in to access the app.

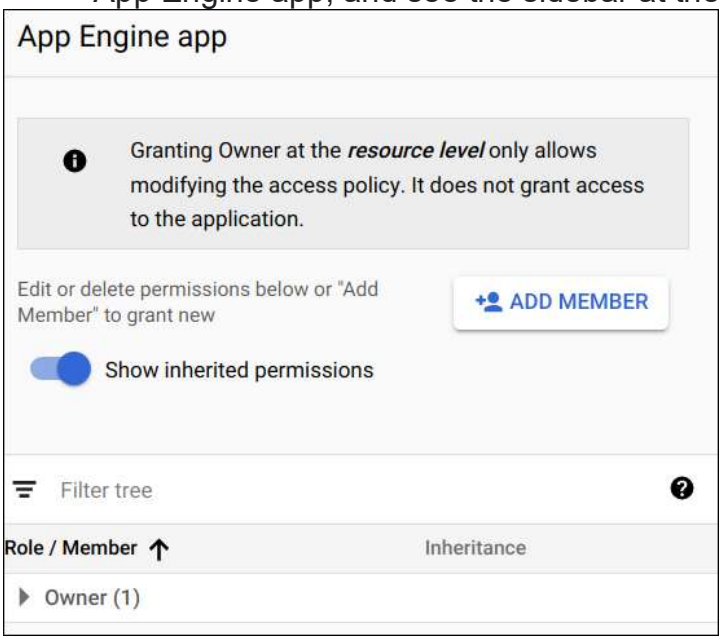


2. Sign in with the account you used to log into the console. You will see a screen denying you access.



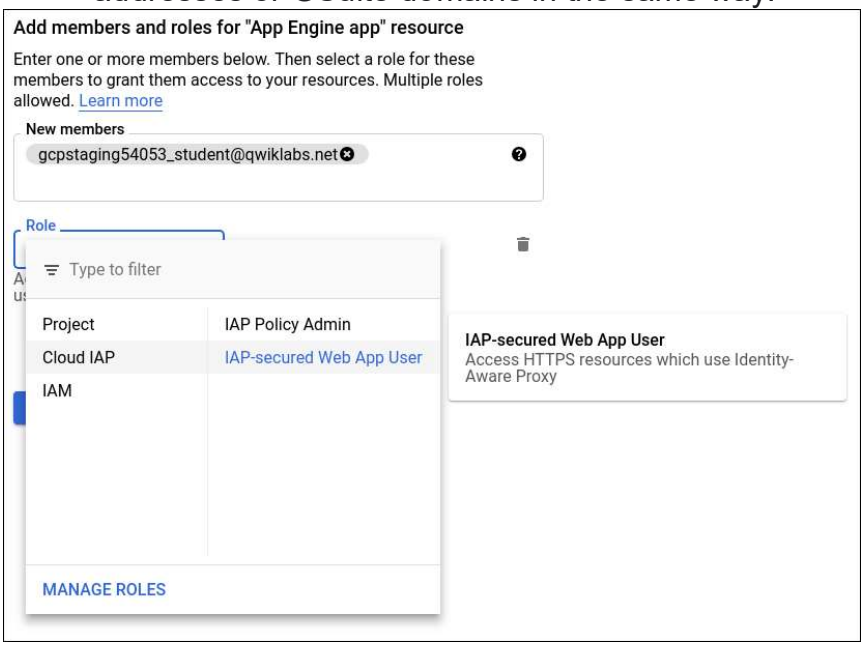
You have successfully protected your app with IAP, but you have not yet told IAP which accounts to allow through.

3. Return to the Identity-Aware Proxy page of the console, select the checkbox next to App Engine app, and see the sidebar at the right of the page.



Each email address (or Google Group address, or GSuite domain name) that should be allowed access needs to be added as a Member.

4. Click **ADD MEMBER**. Enter your email address, then pick the **Cloud IAP/IAP-Secured Web App User** role to assign to that address. You may enter more addresses or GSuite domains in the same way.



5. Click **Save**.

The message "Policy Updated" will appear at the bottom of the window.

Click *Check my progress* to verify the objective.

Test access

Navigate back to your app and reload the page. You should now see your web app, since you already logged in with a user you authorized.

If you still see the "You don't have access" page, IAP did not recheck your authorization. In that case, do the following steps:

1. Open your web browser to the home page address with `/_gcp_iap/clear_login_cookie` added to the end of the URL, as in `https://iap-example-999999.appspot.com/_gcp_iap/clear_login_cookie`.
2. You will see a new Sign in with Google screen, with your account already showing. Do not click the account. Instead, click Use another account, and re-enter your credentials.

These steps cause IAP to recheck your access and you should now see your application's home screen.

If you have access to another browser or can use Incognito Mode in your browser, and have another valid GMail or GSuite account, you can use that browser to navigate to your app page and log in with the other account. Since that account has not been authorized, it will see the "You Don't Have Access" screen instead of your app.

Access User Identity Information

Once an app is protected with IAP, it can use the identity information that IAP provides in the web request headers it passes through. In this step, the application will get the logged-in user's email address and a persistent unique user ID assigned by the Google Identity Service to that user. That data will be displayed to the user in the welcome page.

This is the last step ended with your Cloud Shell open in the `iap-codelab/1-HelloWorld` folder. Change to the folder for this step:

```
cd ~/user-authentication-with-iap/2-HelloUser
```

Deploy to App Engine

Since deployment takes a few minutes, start by deploying the app to the App Engine Standard environment for Python:

```
gcloud app deploy
```

When you are asked if you want to continue, enter **Y** for yes.

In a few minutes the deploy should complete. While you are waiting you can examine the application files as described below.

Click *Check my progress* to verify the objective.

Access User Identity Information

Check my progress

Examine the Application Files

This folder contains the same set of files as seen in `1-HelloWorld`, but two of the files have been changed: `main.py` and `templates/index.html`. The program has been changed to retrieve the user information that IAP provides in request headers, and the template now displays that data.

There are two lines in `main.py` that get the IAP-provided identity data:

```
user_email = request.headers.get('X-Goog-Authenticated-User-Email')
user_id = request.headers.get('X-Goog-Authenticated-User-ID')
```

The **X-Goog-Authenticated-User-** headers are provided by IAP, and the names are case-insensitive, so they could be given in all lower or all upper case if preferred. The render_template statement now includes those values so they can be displayed:

```
page = render_template('index.html', email=user_email, id=user_id)
```

The index.html template can display those values by enclosing the names in doubled curly braces:

```
Hello, {{ email }}! Your persistent ID is {{ id }}.
```

As you can see, the provided data is prefixed with `accounts.google.com`, showing where the information came from. Your application can remove everything up to and including the colon to get the raw values if desired.

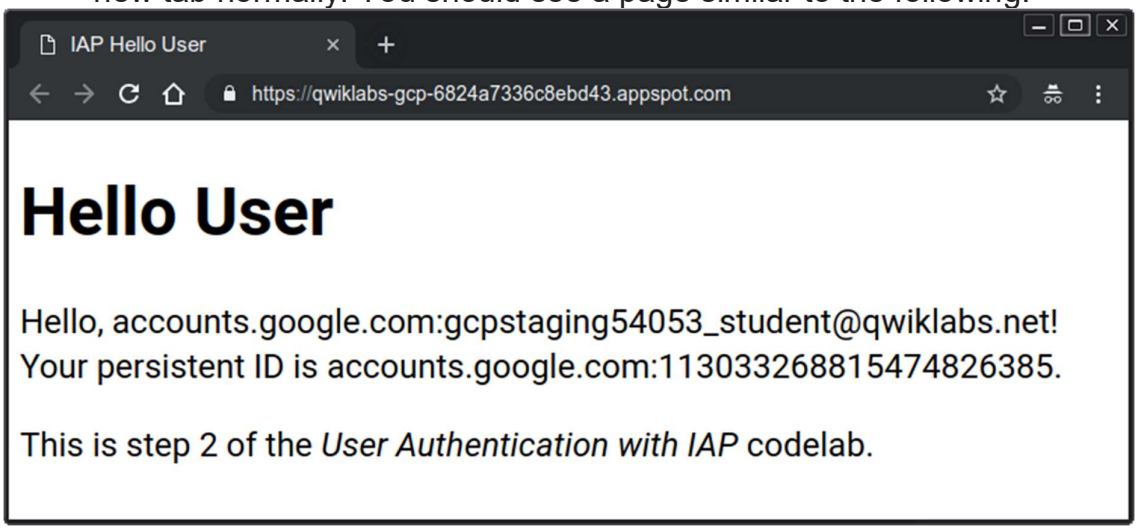
Test the updated IAP

Going back to the deployment, when it is ready, you will see a message that you can view your application with `gcloud app browse`.

1. Enter that command.

```
gcloud app browse
```

2. If a new tab does not open on your browser, copy the displayed link and open it in a new tab normally. You should see a page similar to the following:

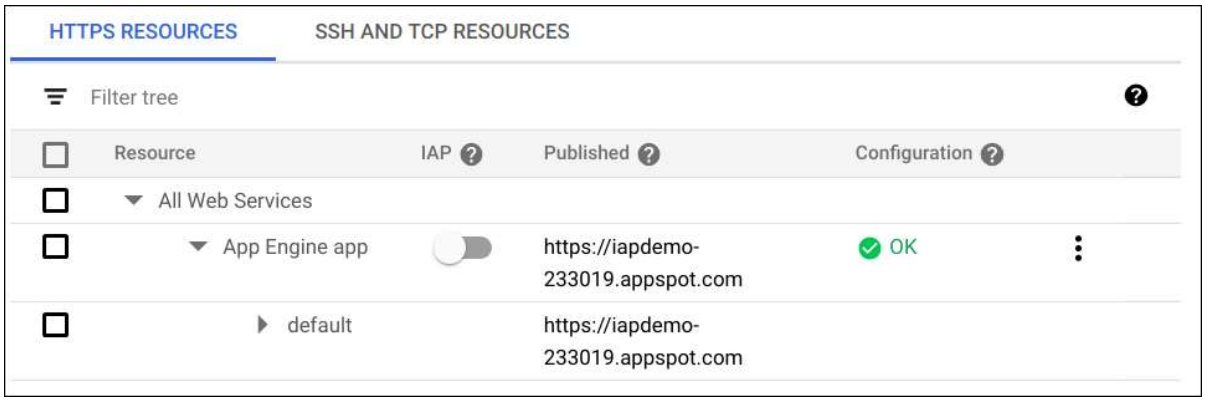


You may need to wait a few minutes for the new version of your application to replace the prior version. Refresh the page if needed to see a page similar to the above.

Turn off IAP

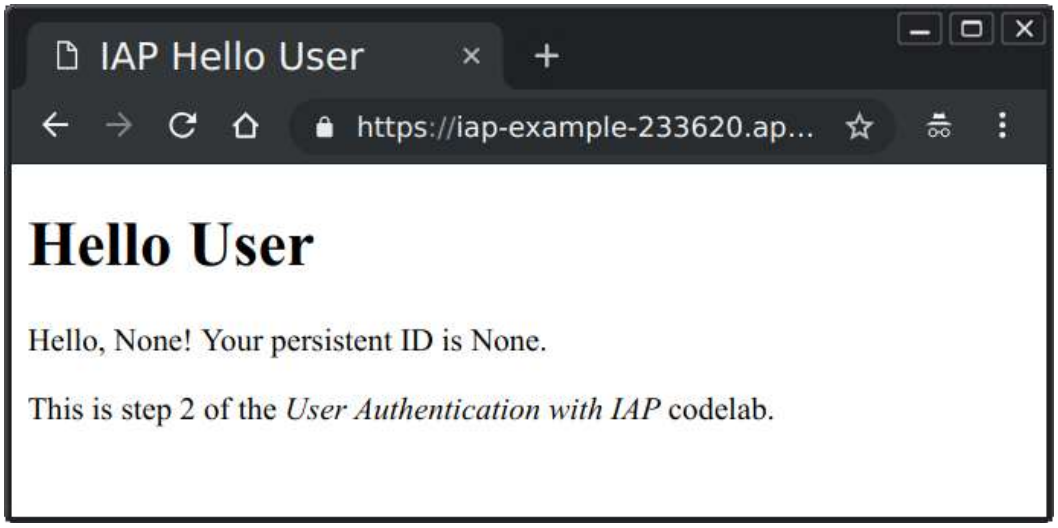
What happens to this app if IAP is disabled, or somehow bypassed (such as by other applications running in your same cloud project)? Turn off IAP to see.

In the cloud console window, click **Navigation menu** > **Security** > **Identity-Aware Proxy**. Click the **IAP** toggle switch next to App Engine app to turn **IAP** off.



You will be warned that this will allow all users to access the app.

Refresh the application web page. You should see the same page, but without any user information:



Since the application is now unprotected, a user could send a web request that appeared to have passed through IAP. For example, you can run the following curl command from the Cloud Shell to do that (replace `<your-url-here>` with the correct URL for your app):

```
curl -X GET <your-url-here> -H "X-Goog-Authenticated-User-Email: totally fake email"
```

The web page will be displayed on the command line, and look like the following *(do not copy)*:

```
<!doctype html>
<html>
<head>
  <title>IAP Hello User</title>
</head>
<body>
  <h1>Hello World</h1>

  <p>
    Hello, totally fake email! Your persistent ID is None.
  </p>

  <p>
    This is step 2 of the <em>User Authentication with IAP</em>
    codelab.
 </p>

</body>
</html>
```

There is no way for the application to know that IAP has been disabled or bypassed. For cases where that is a potential risk, Cryptographic Verification shows a solution.

Use Cryptographic Verification

If there is a risk of IAP being turned off or bypassed, your app can check to make sure the identity information it receives is valid. This uses a third web request header added by IAP, called `X-Goog-IAP-JWT-Assertion`. The value of the header is a cryptographically signed object that also contains the user identity data. Your application can verify the digital signature and use the data provided in this object to be certain that it was provided by IAP without alteration.

Digital signature verification requires several extra steps, such as retrieving the latest set of Google public keys. You can decide whether your application needs these extra steps based on the risk that someone might be able to turn off or bypass IAP, and the sensitivity of the application.

The last step ended with your Cloud Shell open in the `iap-codelab/2-HelloUser` folder. Change to the folder for this step:

```
cd ~/user-authentication-with-iap/3-HelloVerifiedUser
```

Deploy to App Engine

Deploy the app to the App Engine Standard environment for Python:

```
gcloud app deploy
```

When you are asked if you want to continue, enter **Y** for yes. In a few minutes the deploy should complete. While you are waiting you can examine the application files as described below.

Click *Check my progress* to verify the objective.

Examine the Application Files

This folder contains the same set of files as seen in `2-HelloUser`, with two files altered and one new file. The new file is `auth.py`, which provides a `user()` method to retrieve and verify the cryptographically signed identity information. The changed files are `main.py` and `templates/index.html`, which now use the results of that method. The unverified headers as found in the last deployment are also shown for comparison.

The new functionality is primarily in the `user()` function:

```
def user():
    assertion = request.headers.get('X-Goog-IAP-JWT-Assertion')
```

```
    if assertion is None:
        return None, None

    info = jwt.decode(
        assertion,
        keys(),
        algorithms=['ES256'],
        audience=audience()
    )

    return info['email'], info['sub']
```

The `assertion` is the cryptographically signed data provided in the specified request header. The code uses a library to validate and decode that data. Validation uses the public keys that Google provides for checking data it signs, and knowing the audience that the data was prepared for (essentially, the Google Cloud project that is being protected). Helper functions `keys()` and `audience()` gather and return those values.

The signed object has two pieces of data we need: the verified email address, and the unique ID value (provided in the `sub`, for subscriber, standard field).

This completes Step 3.

Test the Cryptographic Verification

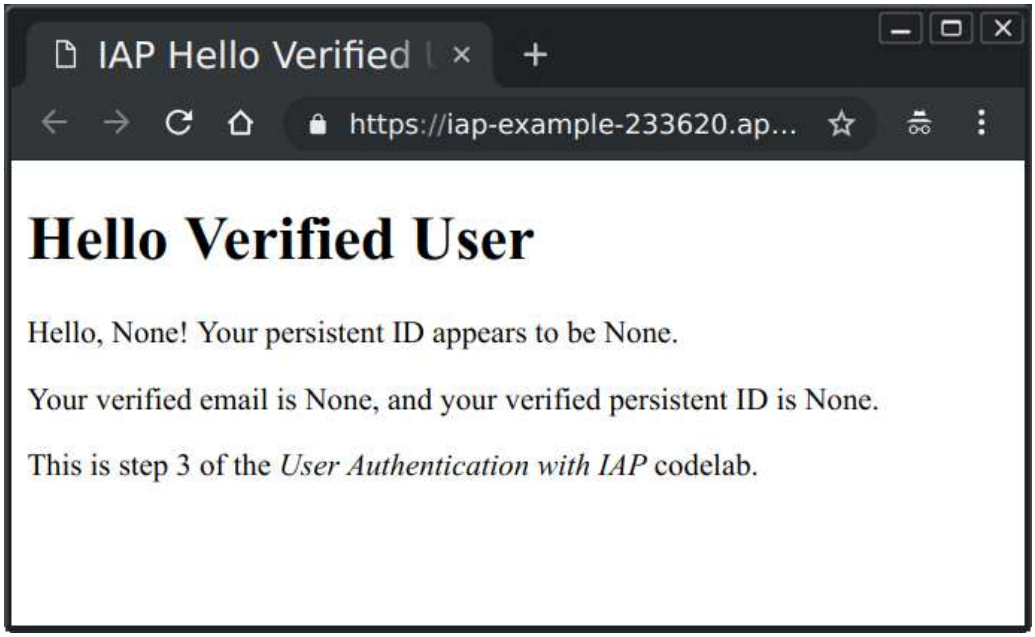
When the deployment is ready you will see a message that you can view your application with `gcloud app browse`.

Enter that command:

```
gcloud app browse
```

If a new tab does not open on your browser, copy the displayed link and open it in a new tab normally.

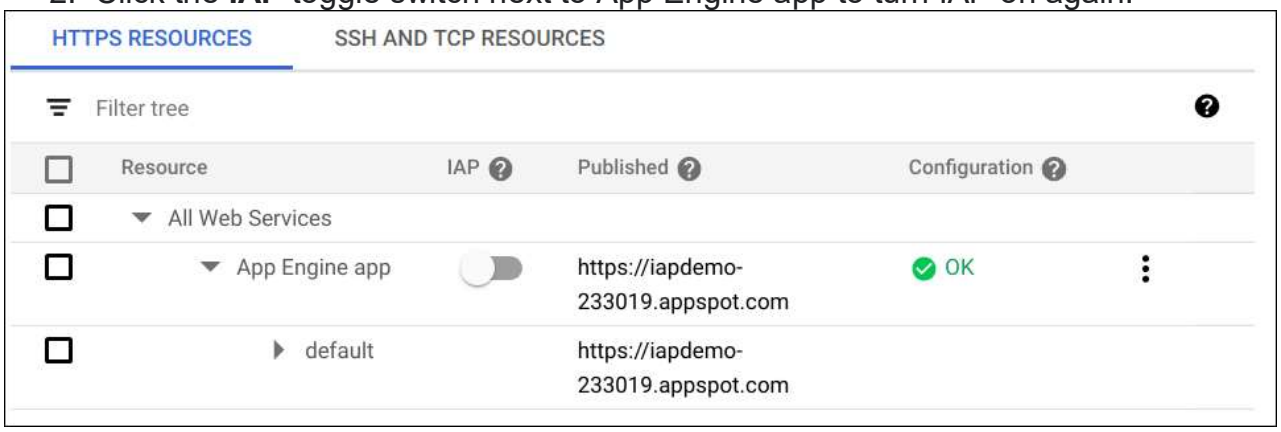
Recall that you previously disabled IAP, so the application provides no IAP data. You should see a page similar to the following:



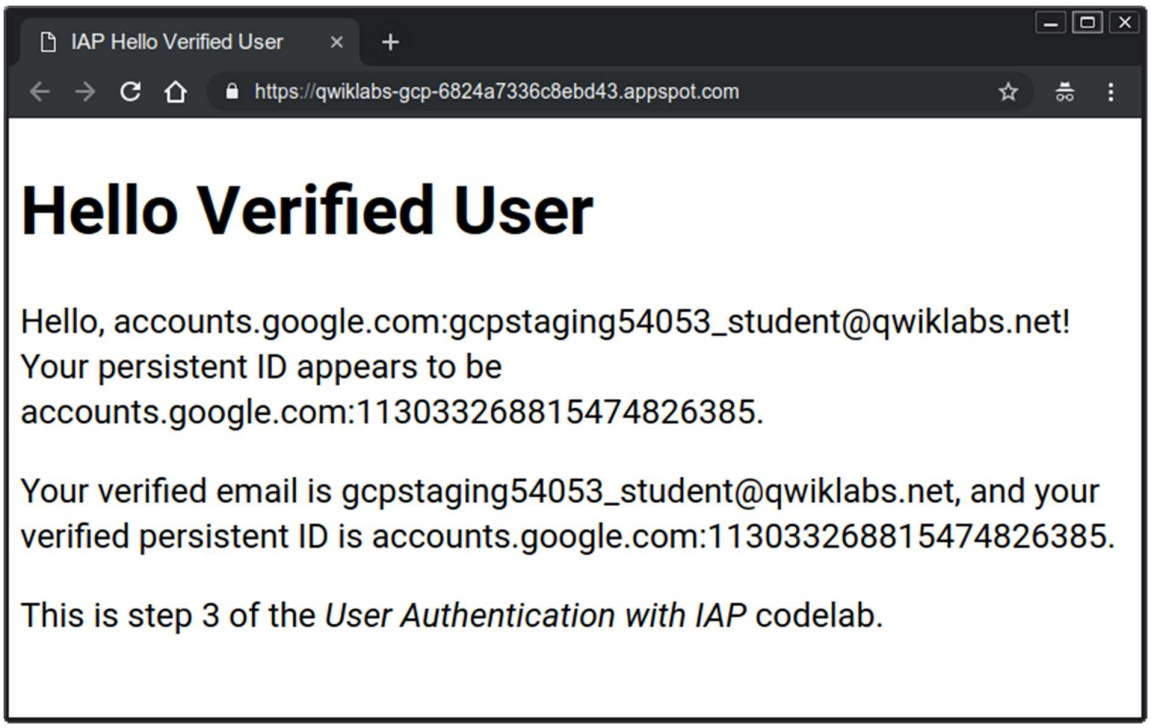
As before, you may need to wait a few minutes for the newest version to be live to see the new version of the page.

Since IAP is disabled, no user information is available. Now turn IAP back on.

1. In the cloud console window, click the **Navigation menu** > **Secrutiy** > **Identity-Aware Proxy**.
2. Click the **IAP** toggle switch next to App Engine app to turn IAP on again.



3. Refresh the page. The page should look like the following:



Notice that the email address provided by the verified method does not have the `accounts.google.com:` prefix.

If IAP is turned off or bypassed, the verified data would either be missing, or invalid, since it cannot have a valid signature unless it was created by the holder of Google's private keys.

Congratulations!

You deployed an App Engine web application. First, you restricted access to the application to only users you chose. Then you retrieved and displayed the identity of users that IAP allowed access to your application, and saw how that information might be spoofed if IAP were disabled or bypassed. Lastly, you verified cryptographically signed assertions of the user's identity, which cannot be spoofed.

Finish your Quest

This self-paced lab is part of the Qwiklabs Quest Security & Identity Fundamentals. A Quest is a series of related labs that form a learning path. Completing this Quest earns you the badge above, to recognize your achievement. You can make your badge (or badges) public and link to them in your online resume or social media account. Enroll in this Quest and get immediate completion credit if you've taken this lab. See other available Qwiklabs Quests.

Take your next lab

Continue your Quest with Getting Started with Cloud KMS, or try one of these suggestions:

- User Authentication with App Dev-Adding User Authentication to your Application - Python.
- Securing Applications on Kubernetes Engine - Three Examples.

Next steps / learn more

- Get more detail about Cloud Identity-Aware Proxy.
- Check out other Google Security products.

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