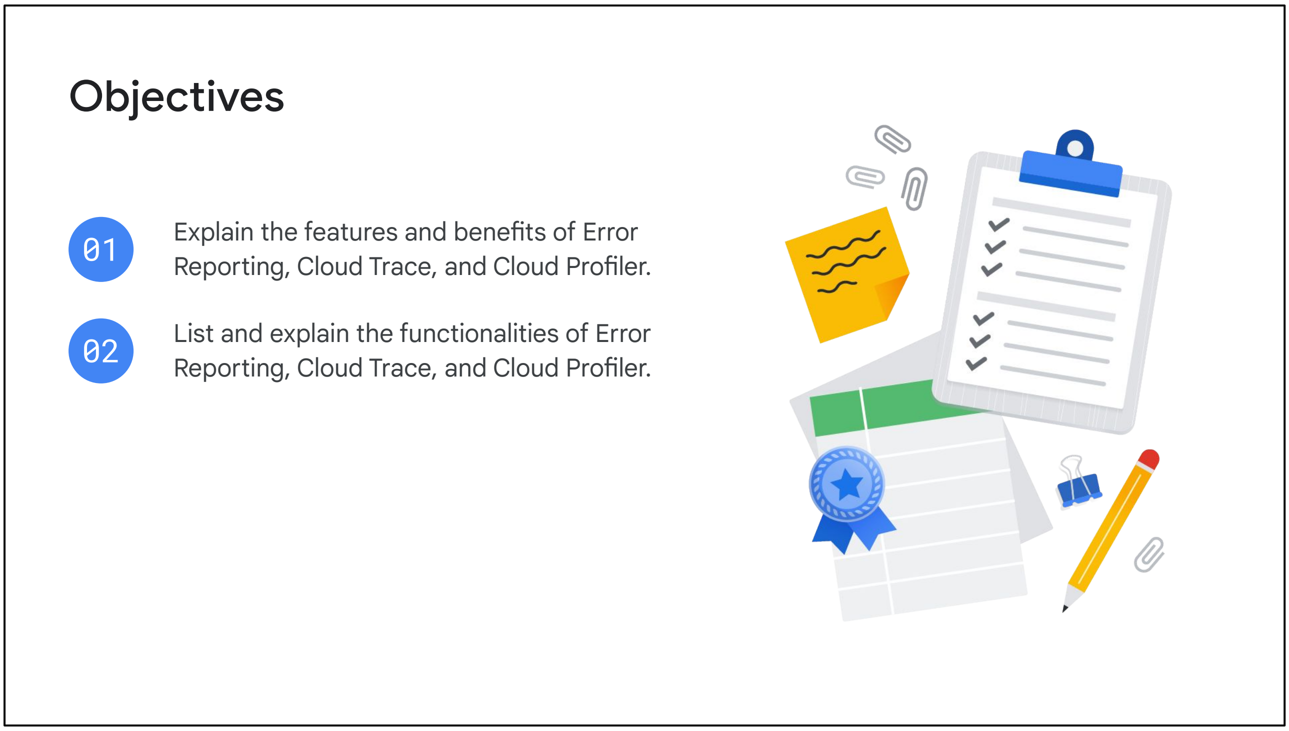
Google Cloud

Investigating Application Performance Issues

When deploying applications to Google Cloud, the Application Performance Management products (Cloud Trace and Cloud Profiler) provide insight into how your code and services are functioning. The tools also help troubleshoot when needed.



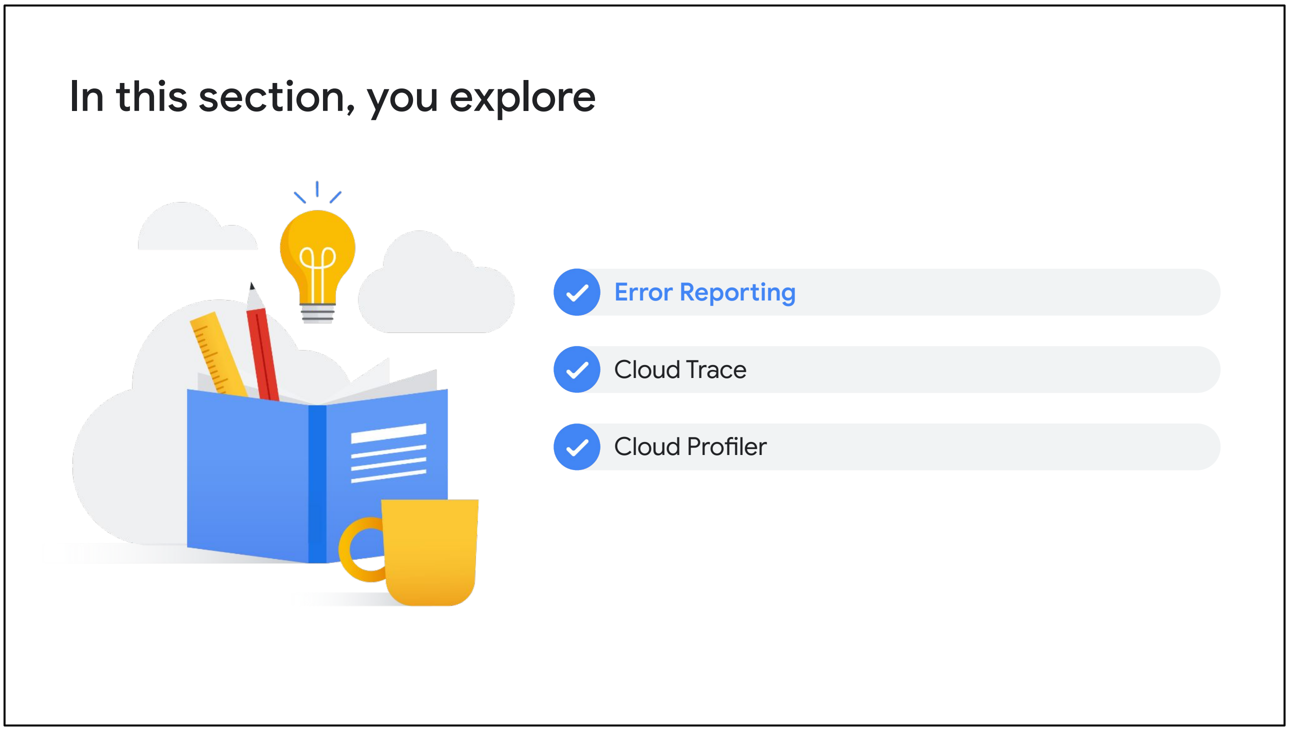
Objectives

01 Explain the features and benefits of Error Reporting, Cloud Trace, and Cloud Profiler.

02 List and explain the functionalities of Error Reporting, Cloud Trace, and Cloud Profiler.

In this module, you will learn to:

- Explain the features and benefits of Error Reporting, Cloud Trace, and Cloud Profiler.
- List and explain the functionalities of the Error Reporting, Cloud Trace, and Cloud Profiler components.

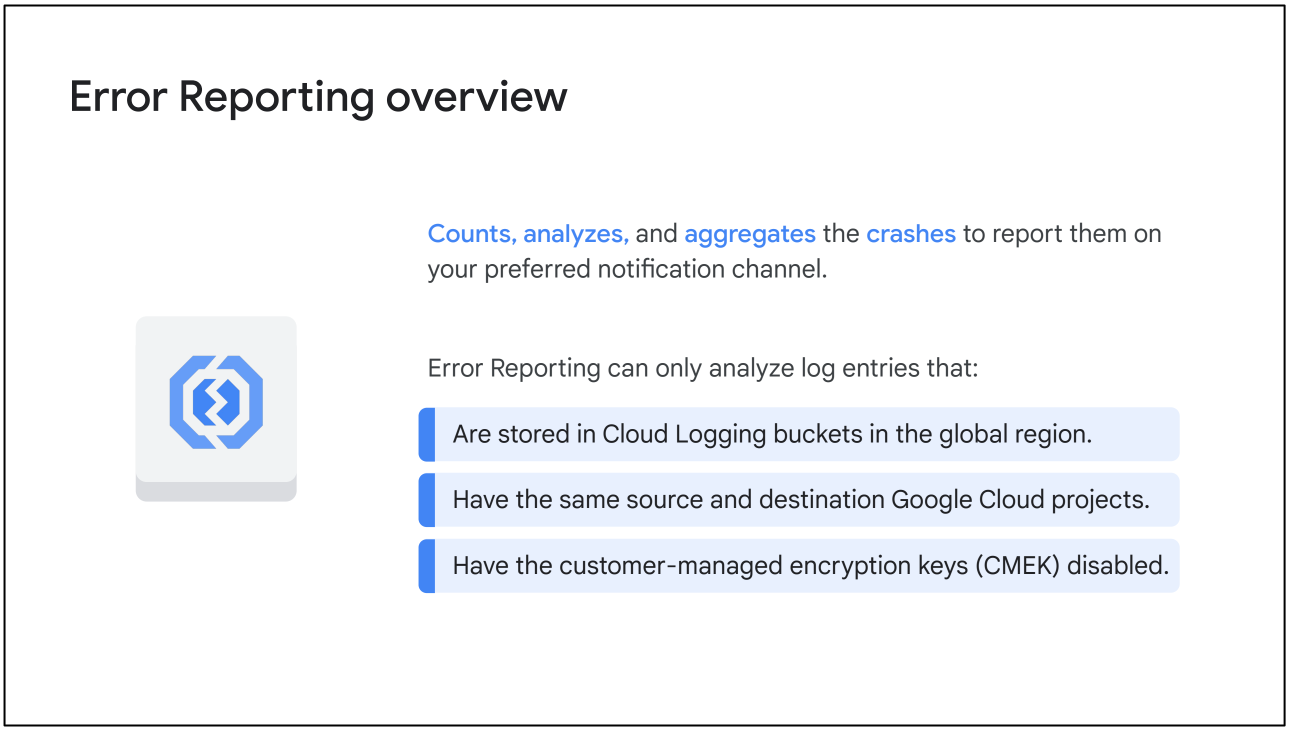


In this section, you explore

- ✓ Error Reporting
- ✓ Cloud Trace
- ✓ Cloud Profiler

Application Performance Management (APM) combines the monitoring and troubleshooting capabilities of Cloud Logging and Cloud Monitoring with Error Reporting, Cloud Trace, and Cloud Profiler. APM helps you reduce latency and cost so that you can run more efficient applications.

Let's start with Error Reporting.



Error Reporting overview

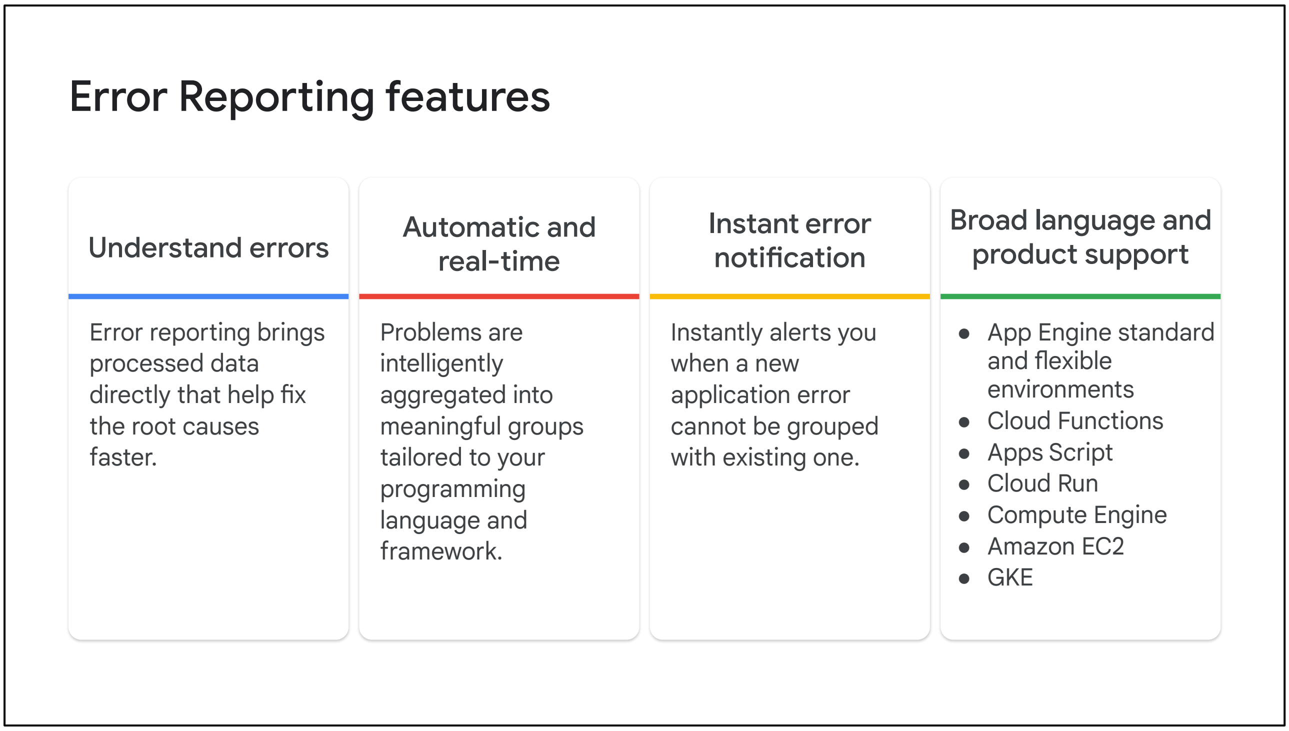
Counts, analyzes, and aggregates the crashes to report them on your preferred notification channel.

Error Reporting can only analyze log entries that:

- Are stored in Cloud Logging buckets in the global region.
- Have the same source and destination Google Cloud projects.
- Have the customer-managed encryption keys (CMEK) disabled.

Error Reporting looks through all the logs that your application and infrastructure has reported. It then counts, analyzes, and aggregates the exceptions to report them on your preferred notification channel such as email, mobile app, slack, or through web hooks.

Error Reporting can only analyze log entries that are stored in Cloud Logging buckets that are in the global region. The source and destination Google Cloud projects must be the same, and customer-managed encryption keys (CMEK) must be disabled. If you route logs to a different Cloud project, regionalized buckets, or enable CMEK, then Error Reporting doesn't capture and analyze those logs.



Error Reporting features

Understand errors	Automatic and real-time	Instant error notification	Broad language and product support
Error reporting brings processed data directly that help fix the root causes faster.	Problems are intelligently aggregated into meaningful groups tailored to your programming language and framework.	Instantly alerts you when a new application error cannot be grouped with existing one.	● App Engine standard and flexible environments ● Cloud Functions ● Apps Script ● Cloud Run ● Compute Engine ● Amazon EC2 ● GKE

Error reporting has several various features.

It helps understand errors. See at a glance the top or new errors for your application in a clear dashboard. Looking at a log stream to find important errors can slow you down when you're troubleshooting. Error Reporting brings you the processed data directly to help you understand and fix the root causes faster.

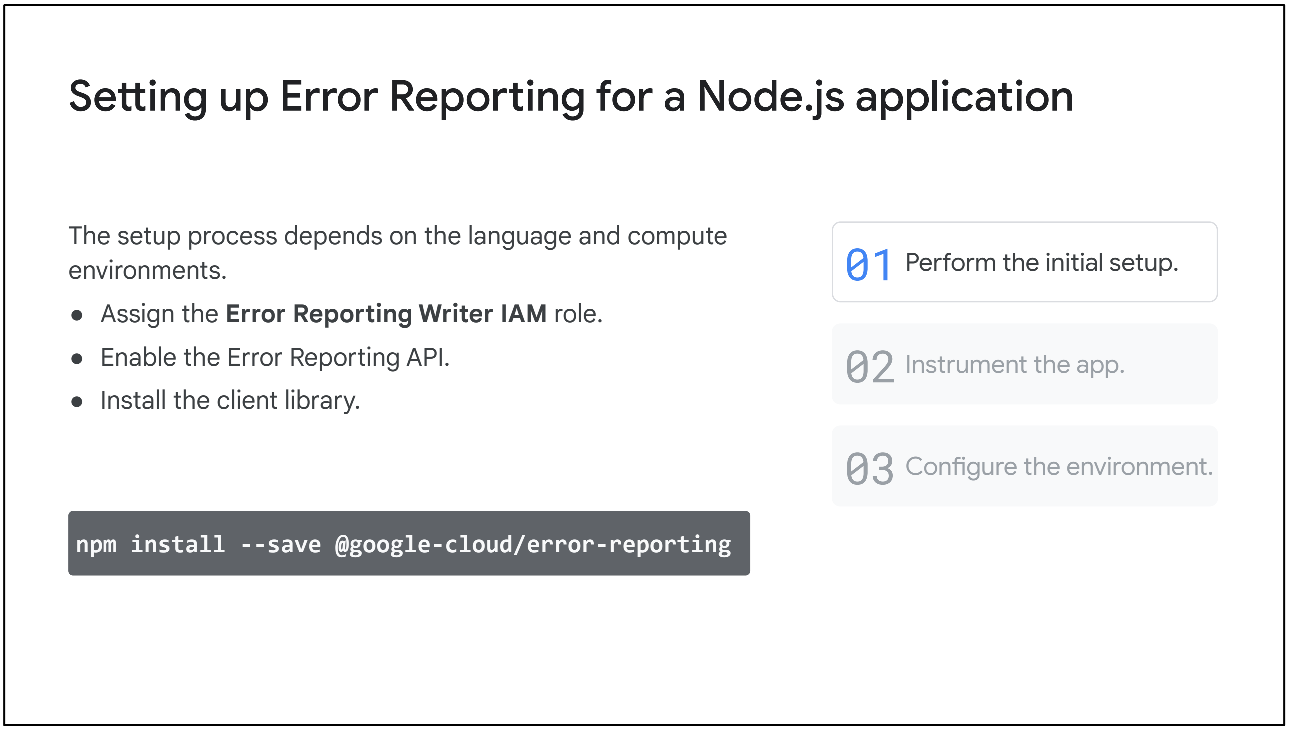
Real production problems can be hidden in mountains of data. Error Reporting helps you see the problems through the noise by constantly analyzing your exceptions. Problems are intelligently aggregated into meaningful groups tailored to your programming language and framework.

It provides instant error notification. You do not wait for your users to report problems. Error Reporting is always watching your service and instantly alerts you when a new application error cannot be grouped with existing ones. Directly navigate from a notification to the details of the new error. Error Reporting is available on desktop and in the Google Cloud app for iOS and Android.

It also provides popular language and product support. Support is available for many popular languages, including Go, Java, Node.js, PHP, Python, Ruby, or .NET. Use our client libraries, REST API, or send errors with Cloud Logging.

Error Reporting can aggregate and display errors for:

- App Engine standard environment and flexible environment
- Cloud Functions
- Apps Script
- Cloud Run
- Compute Engine
- Amazon EC2
- And Google Kubernetes Engine (or GKE)



Setting up Error Reporting for a Node.js application

The setup process depends on the language and compute environments.

- Assign the **Error Reporting Writer IAM** role.
- Enable the Error Reporting API.
- Install the client library.

```
npm install --save @google-cloud/error-reporting
```

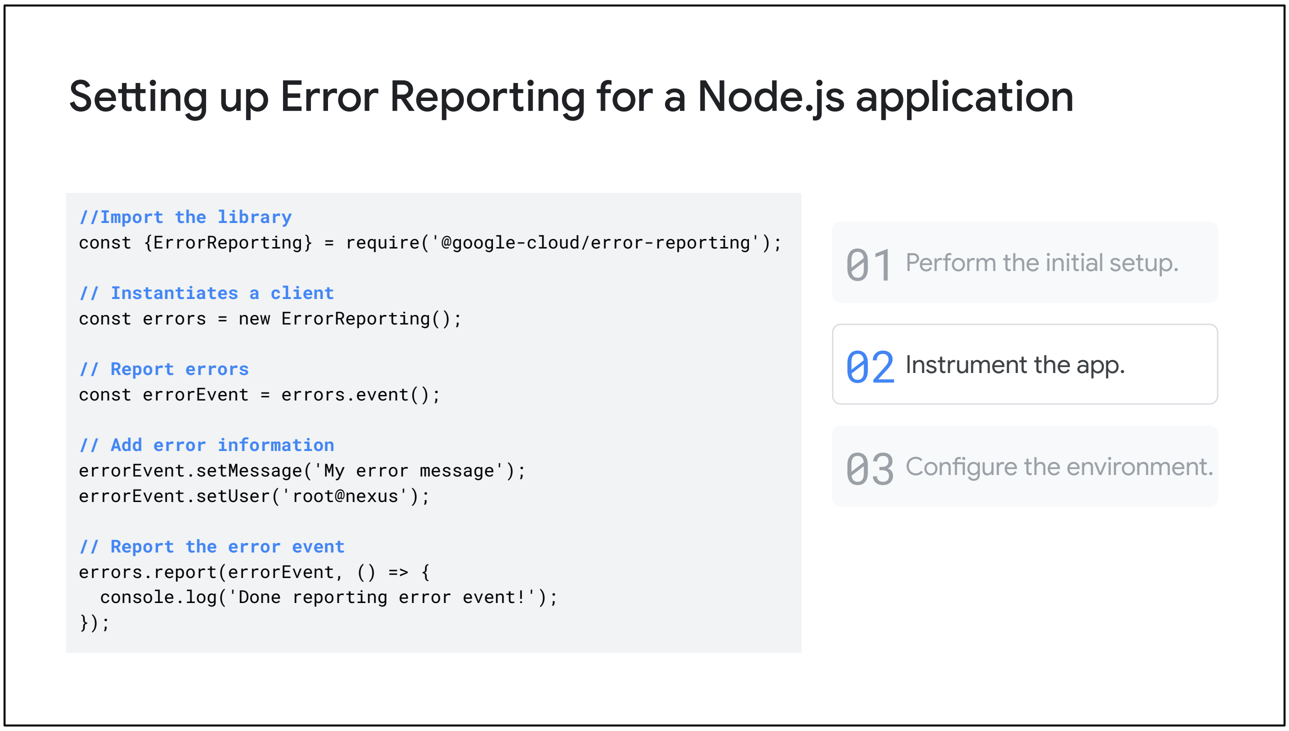
01 Perform the initial setup.

02 Instrument the app.

03 Configure the environment.

Setting up Error Reporting is simple and dependent on the language and compute environment. Here's an error-catching example written in Node.js (JavaScript) and run on Cloud Run.

To report errors, the code needs the Error Reporting Writer Identity and Access Management (IAM) role. Enable the Error Reporting API, and install the client library by using npm.



Setting up Error Reporting for a Node.js application

```
//Import the library
const {ErrorReporting} = require('@google-cloud/error-reporting');

// Instantiates a client
const errors = new ErrorReporting();

// Report errors
const errorEvent = errors.event();

// Add error information
errorEvent.setMessage('My error message');
errorEvent.setUser('root@nexus');

// Report the error event
errors.report(errorEvent, () => {
  console.log('Done reporting error event!');
});
```

01 Perform the initial setup.

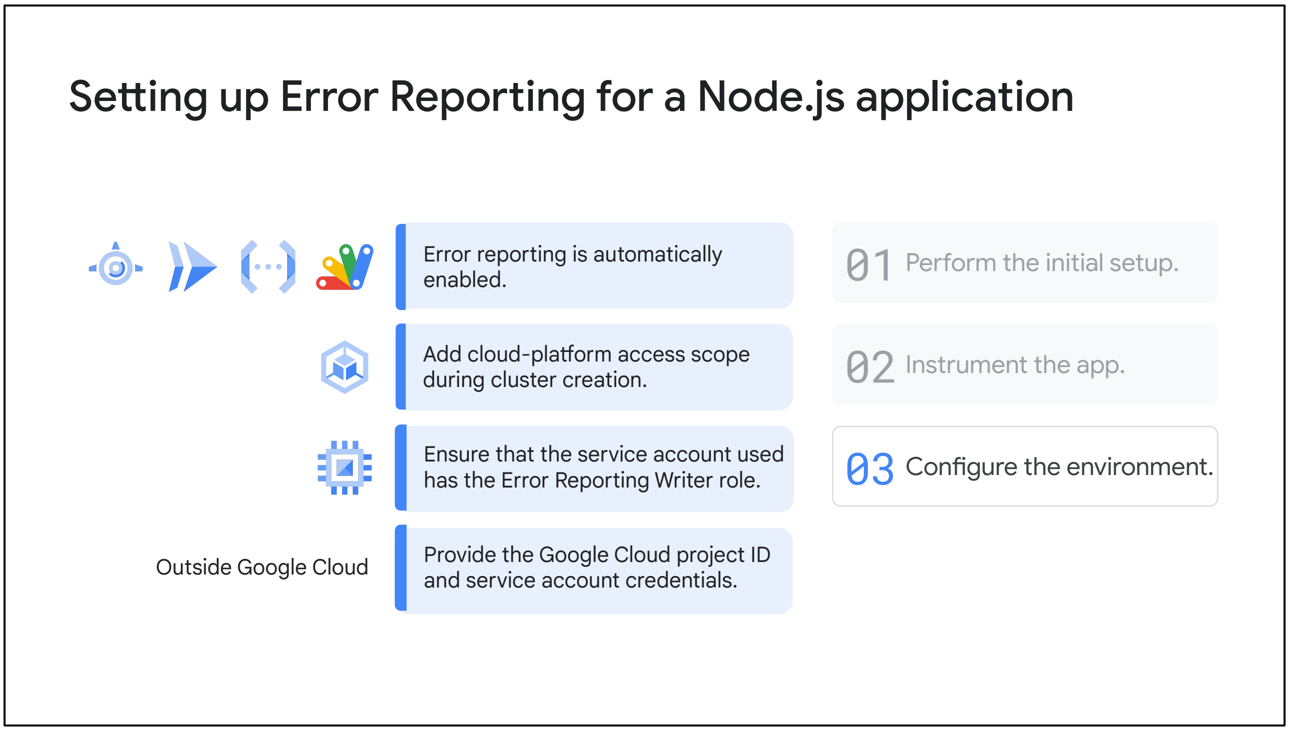
02 Instrument the app.

03 Configure the environment.

The easiest way to manually log errors to Error Reporting in Node.js is to import the Error Reporting library.

- You then instantiate a client to start reporting errors to Error reporting. Optionally, you can also customize the behavior of the Error Reporting library for Node.js. These can be configured by passing objects to options.
- Use error message builder to customize all fields.
- Call the `report` method to manually report an error.

You can also integrate Error Reporting library for Node.js to web frameworks like Express.js. Refer to the documentation for more details.



Setting up Error Reporting for a Node.js application

	Error reporting is automatically enabled.
	Add cloud-platform access scope during cluster creation.
	Ensure that the service account used has the Error Reporting Writer role.
Outside Google Cloud	Provide the Google Cloud project ID and service account credentials.

01 Perform the initial setup.

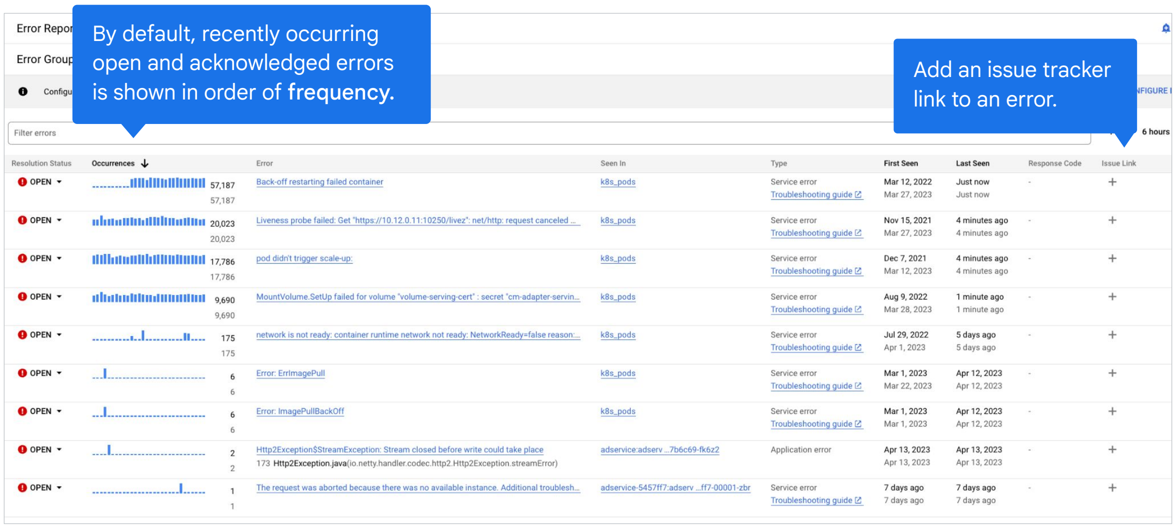
02 Instrument the app.

03 Configure the environment.

Error Reporting Library for Node.js can be configured on many Google Cloud environments. Let's explore the process for all.

- For App Engine flexible and standard environment, Cloud Run, Cloud Functions, and Apps Script, Error Reporting is automatically enabled.
- For Google Kubernetes Engine, add `cloud-platform` access scope during cluster creation.
- For Compute Engine, ensure service account used has the Error Reporting Writer role.
- Outside Google Cloud, provide the Google Cloud project ID and service account credentials to the Error Reporting library for Node.js.

View error reports


By default, recently occurring open and acknowledged errors is shown in order of **frequency.**
Add an issue tracker link to an error.
Error Repor
Error Group
Configu
NFIGURE
Filter errors
6 hours

Resolution Status	Occurrences ↓	Error	Seen In	Type	First Seen	Last Seen	Response Code	Issue Link
OPEN	57,187 57,187	Back-off restarting failed container	k8s_pods	Service error Troubleshooting guide	Mar 12, 2022 Mar 27, 2023	Just now Just now	-	+
OPEN	20,023 20,023	Liveness probe failed: Get "https://10.12.0.11:10250/livez": net/http: request canceled ...	k8s_pods	Service error Troubleshooting guide	Nov 15, 2021 Mar 27, 2023	4 minutes ago 4 minutes ago	-	+
OPEN	17,786 17,786	pod didn't trigger scale-up:	k8s_pods	Service error Troubleshooting guide	Dec 7, 2021 Mar 12, 2023	4 minutes ago 4 minutes ago	-	+
OPEN	9,690 9,690	MountVolume.SetUp failed for volume "volume-serving-cert" : secret "cm-adapter-servin...	k8s_pods	Service error Troubleshooting guide	Aug 9, 2022 Mar 28, 2023	1 minute ago 1 minute ago	-	+
OPEN	175 175	network is not ready: container runtime network not ready: NetworkReady=false reason:...	k8s_pods	Service error Troubleshooting guide	Jul 29, 2022 Apr 1, 2023	5 days ago 5 days ago	-	+
OPEN	6 6	Error: ErrImagePull	k8s_pods	Service error Troubleshooting guide	Mar 1, 2023 Mar 22, 2023	Apr 12, 2023 Apr 12, 2023	-	+
OPEN	6 6	Error: ImagePullBackOff	k8s_pods	Service error Troubleshooting guide	Mar 1, 2023 Mar 1, 2023	Apr 12, 2023 Apr 12, 2023	-	+
OPEN	2 2	Http2Exception$StreamException: Stream closed before write could take place 173 Http2Exception.java(io.netty.handler.codec.http2.Http2Exception.streamError)	adservice:adserv ...7b6c69-fk6z2	Application error	Apr 13, 2023 Apr 13, 2023	Apr 13, 2023 Apr 13, 2023	-	+
OPEN	1 1	The request was aborted because there was no available instance. Additional troublesh...	adservice-5457ff7:adserv ...ff7-00001-zbr	Service error Troubleshooting guide	7 days ago 7 days ago	7 days ago 7 days ago	-	+

To see your errors, open the Error Reporting page in the Google Cloud console.

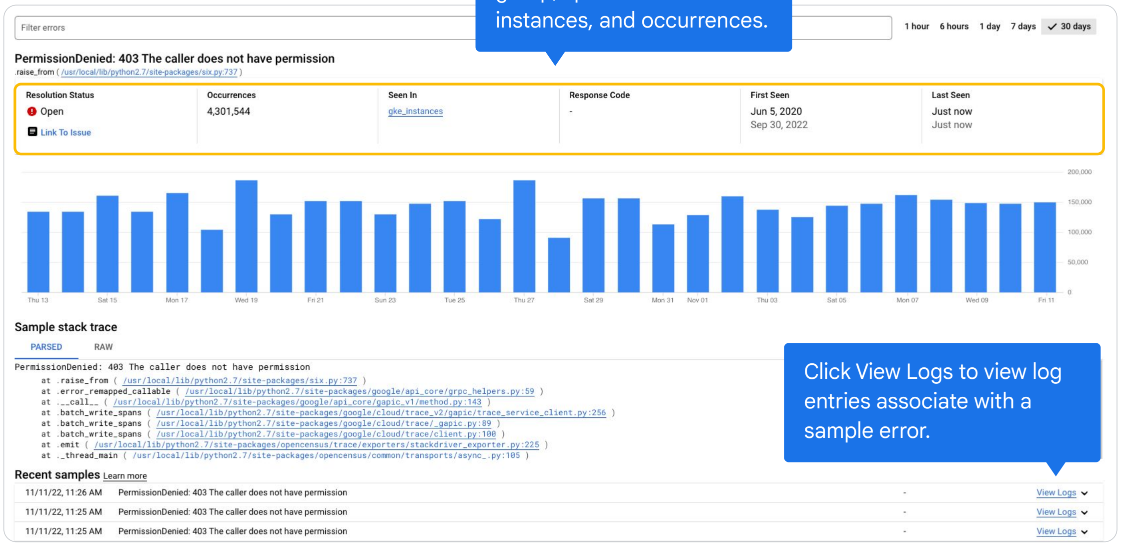
By default, Error Reporting shows you a list of recently occurring open and acknowledged errors in order of frequency.

Errors are grouped and de-duplicated by analyzing their stack traces. When *Auto reload* is turned on, Error Reporting automatically reloads the error list every 10 seconds.

Error Reporting recognizes the common frameworks used for your language and groups errors accordingly.

You can sort errors based on occurrences (first and last seen). You can also link an issue tracker link to an error group by clicking the + icon below **Insert link**.

View error reports


Filter errors
1 hour
6 hours
1 day
7 days
✓ 30 days
You can examine the error group, specific error instances, and occurrences.
Click View Logs to view log entries associate with a sample error.
PARSED
RAW
View Logs

PermissionDenied: 403 The caller does not have permission
.raise_from (/usr/local/lib/python2.7/site-packages/six.py:737)

Resolution Status	Occurrences	Seen In	Response Code	First Seen	Last Seen
Open Link To Issue	4,301,544	gke_instances	-	Jun 5, 2020 Sep 30, 2022	Just now Just now

Sample stack trace

```
PermissionDenied: 403 The caller does not have permission
    at .raise_from ( /usr/local/lib/python2.7/site-packages/six.py:737 )
    at .error_remapped_callable ( /usr/local/lib/python2.7/site-packages/google/api_core/grpc_helpers.py:59 )
    at .__call__ ( /usr/local/lib/python2.7/site-packages/google/api_core/gapic_v1/method.py:143 )
    at .batch_write_spans ( /usr/local/lib/python2.7/site-packages/google/cloud/trace_v2/gapic/trace_service_client.py:256 )
    at .batch_write_spans ( /usr/local/lib/python2.7/site-packages/google/cloud/trace/_gapic.py:89 )
    at .batch_write_spans ( /usr/local/lib/python2.7/site-packages/google/cloud/trace/client.py:100 )
    at .emit ( /usr/local/lib/python2.7/site-packages/opencensus/trace/exporters/stackdriver_exporter.py:225 )
    at ._thread_main ( /usr/local/lib/python2.7/site-packages/opencensus/common/transports/async_.py:105 )
```

Recent samples Learn more

11/11/22, 11:26 AM	PermissionDenied: 403 The caller does not have permission	-	View Logs
11/11/22, 11:25 AM	PermissionDenied: 403 The caller does not have permission	-	View Logs
11/11/22, 11:25 AM	PermissionDenied: 403 The caller does not have permission	-	View Logs

Selecting an error entry will let you expand into the Error Details page.

On this page, you can examine information about the error group, including the history of a specific error, specific error instances, and diagnostic information.

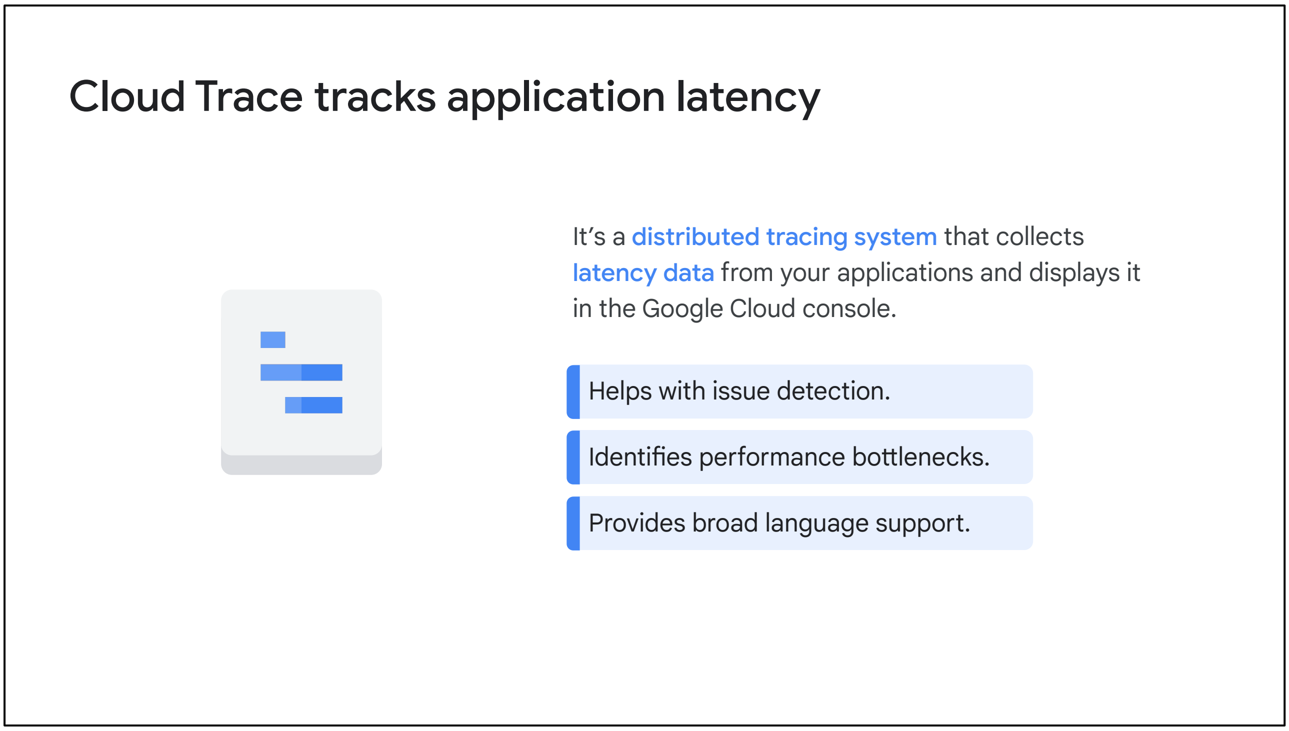
To view the log entry associated with a sample error, click **View logs** from any entry in the **Recent samples** panel.

You're taken to **Logs Explorer** in the Cloud Logging console.

In this section, you explore

- ✓ Error Reporting
- ✓ Cloud Trace
- ✓ Cloud Profiler

Now, let’s have a look at Cloud Trace.



Cloud Trace tracks application latency

It's a distributed tracing system that collects latency data from your applications and displays it in the Google Cloud console.

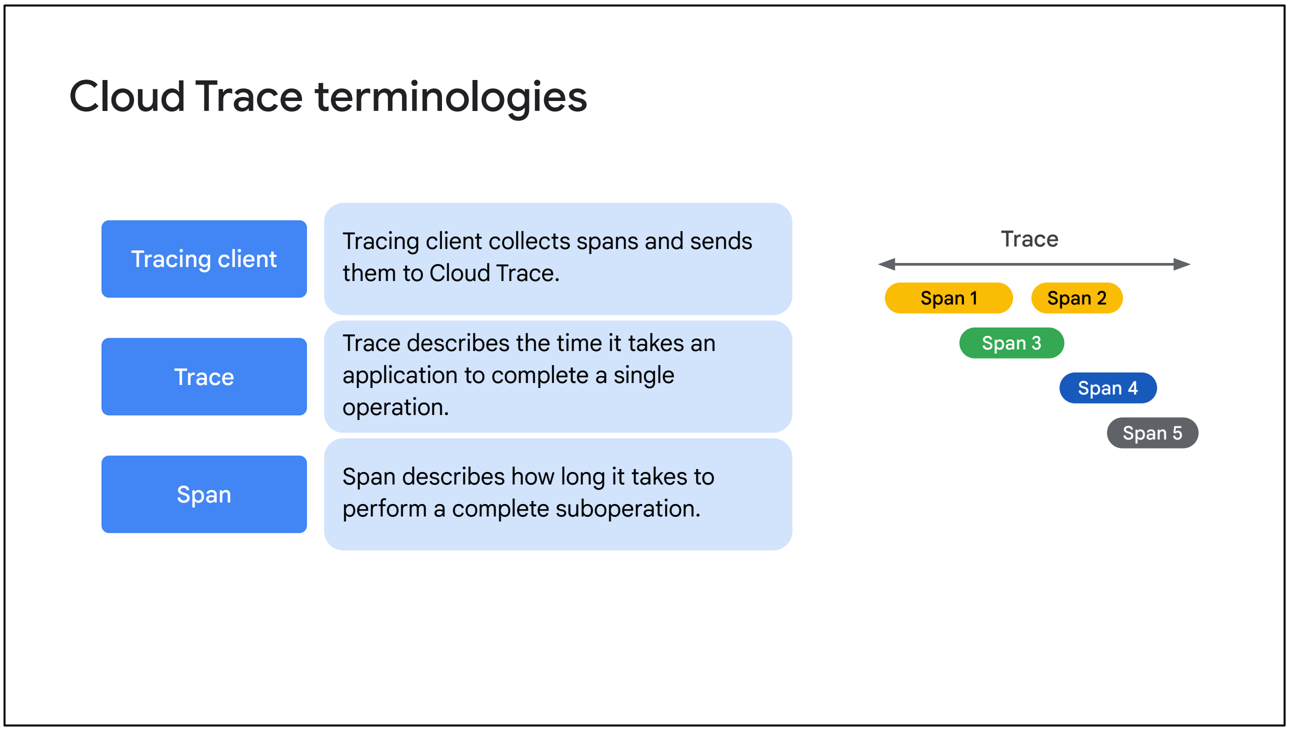
- Helps with issue detection.
- Identifies performance bottlenecks.
- Provides broad language support.

Cloud Trace is a distributed tracing system that collects latency data from your applications and displays it in the Google Cloud console. You can track how requests propagate through your application and receive detailed near-real time performance insights.

Trace automatically analyzes all of your application traces to generate in-depth latency reports to surface performance degradations.

- **It helps with Issue detection**
  Trace continuously gathers and analyzes trace data from your project to automatically identify recent changes to the performance of your application. These latency distributions, available through the Analysis Reports feature, can be compared over time or versions. If Trace detects a significant shift in the latency profile of your app, you're automatically alerted.
- **It also helps with Identification of performance bottlenecks**
  Cloud Trace help inspect detailed latency information for a single request or view aggregate latency for your entire application. Using the various tools and filters provided, you can quickly find where bottlenecks are occurring and more quickly identify their root cause. Trace is based off the tools used at Google to keep our services running at extreme scale.
- **Trace offers broad platform support**
  The language-specific SDKs of Trace can analyze projects that run on VMs (even VMs not managed by Google Cloud). The Trace SDK is available for Java, Node.js, Ruby, and Go. The Trace API can be used to submit and

retrieve trace data from any source.



Cloud Trace terminologies

Tracing client	Tracing client collects spans and sends them to Cloud Trace.
Trace	Trace describes the time it takes an application to complete a single operation.
Span	Span describes how long it takes to perform a complete suboperation.

Trace
Span 1
Span 2
Span 3
Span 4
Span 5

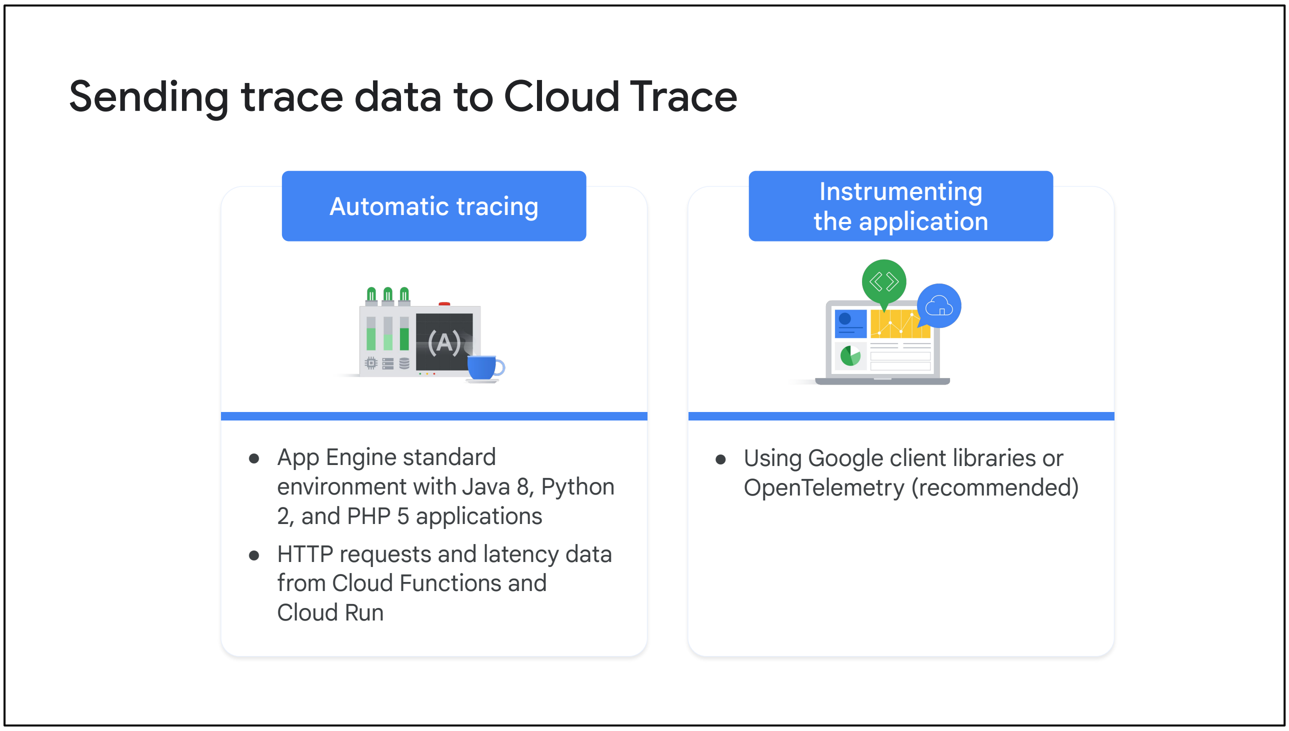
A Trace consists of a tracing client, which collects spans and sends them to Cloud Trace. You can then use the Google Cloud console to view and analyze the data collected by the agent.

A trace describes the time that it takes an application to complete a single operation. A trace is a collection of spans.

A span describes how long it takes to perform a complete suboperation. For example, a trace might describe how long it takes to process an incoming request from a user and return a response. A span might describe how long a particular RPC call requires.

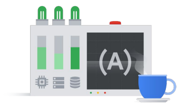
If an OpenCensus library is available for your programming language, you can simplify the process of creating and sending trace data by using OpenCensus. In addition to being simpler to use, OpenCensus implements batching that might improve performance.

If an OpenCensus library doesn't exist, instrument your code by importing the Trace SDK library and using the Cloud Trace API. The Cloud Trace API collects trace data and sends it to your Google Cloud project.



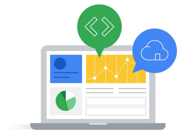
Sending trace data to Cloud Trace

Automatic tracing



- App Engine standard environment with Java 8, Python 2, and PHP 5 applications
- HTTP requests and latency data from Cloud Functions and Cloud Run

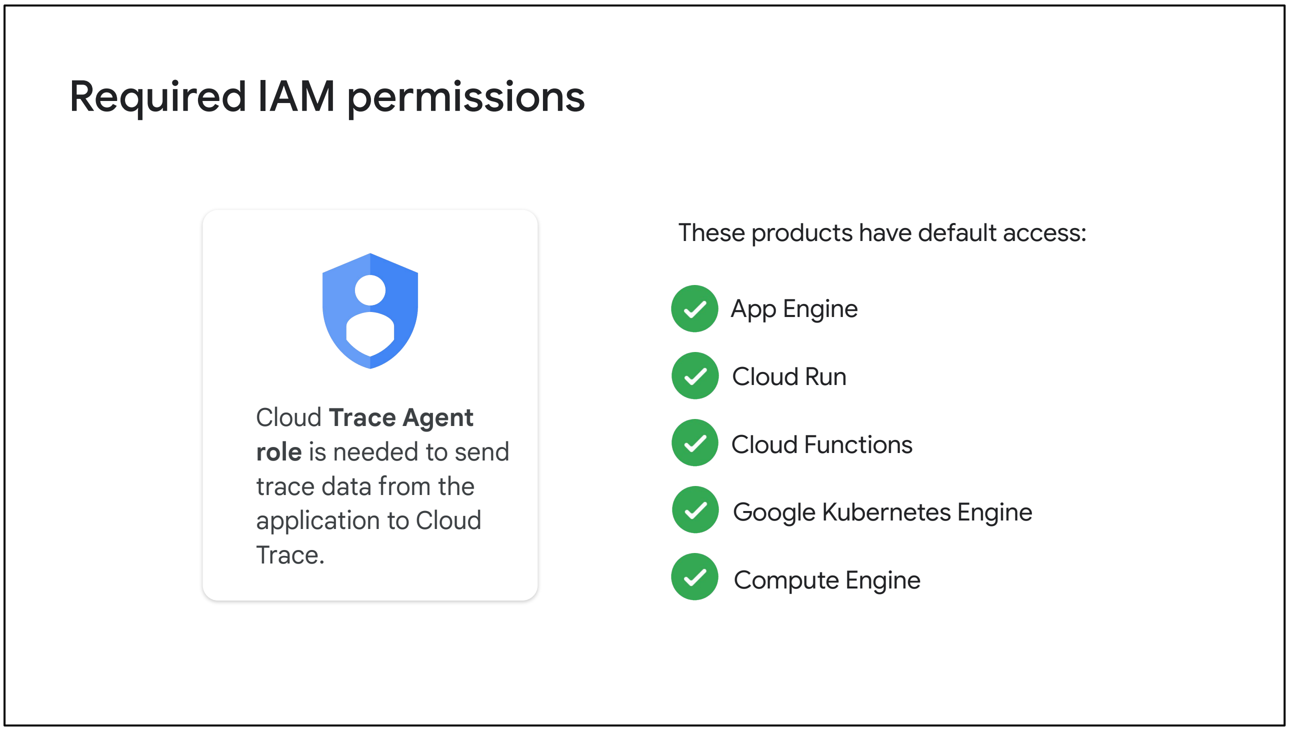
Instrumenting the application



- Using Google client libraries or OpenTelemetry (recommended)

There are two ways to send trace data to Cloud Trace:

- The first one is automatic tracing. Some configurations support automatic tracing. These include:
  - App Engine standard environment with Java 8, Python 2, and PHP 5 applications
  - HTTP requests and latency data from Cloud Functions and Cloud Run
- And the second one is by instrumenting the application. You can do this by using Google client libraries or OpenTelemetry, which is the recommended option.



Required IAM permissions

Cloud **Trace Agent role** is needed to send trace data from the application to Cloud Trace.

These products have default access:

- ✓ App Engine
- ✓ Cloud Run
- ✓ Cloud Functions
- ✓ Google Kubernetes Engine
- ✓ Compute Engine

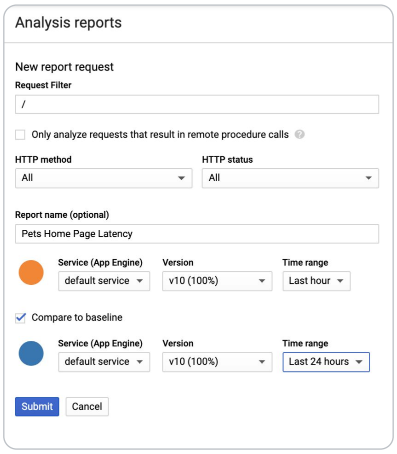
Trace will need to offload tracing metrics to Google Cloud.

As far as the required IAM permissions are concerned, for external systems, or Compute Engine and GKE environments that don't run under the default service account, ensure that they run under a service account with at least the Cloud Trace Agent role.

App Engine, Cloud Run, Google Kubernetes Engine, Cloud Functions, and Compute Engine have default access.

*Compute Engine and GKE get that access through the default Compute Engine service account.

Analysis reports show requests over time and compares versions and timespans



Analysis reports

New report request

Request Filter: /

☐ Only analyze requests that result in remote procedure calls

HTTP method: All

HTTP status: All

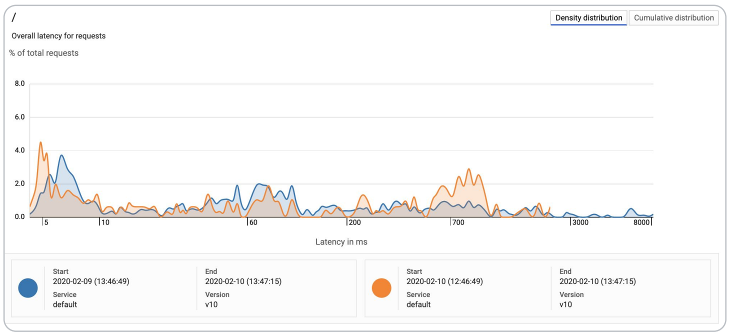
Report name (optional): Pets Home Page Latency

● Service (App Engine): default service — Version: v10 (100%) — Time range: Last hour

☑ Compare to baseline

● Service (App Engine): default service — Version: v10 (100%) — Time range: Last 24 hours

Submit | Cancel

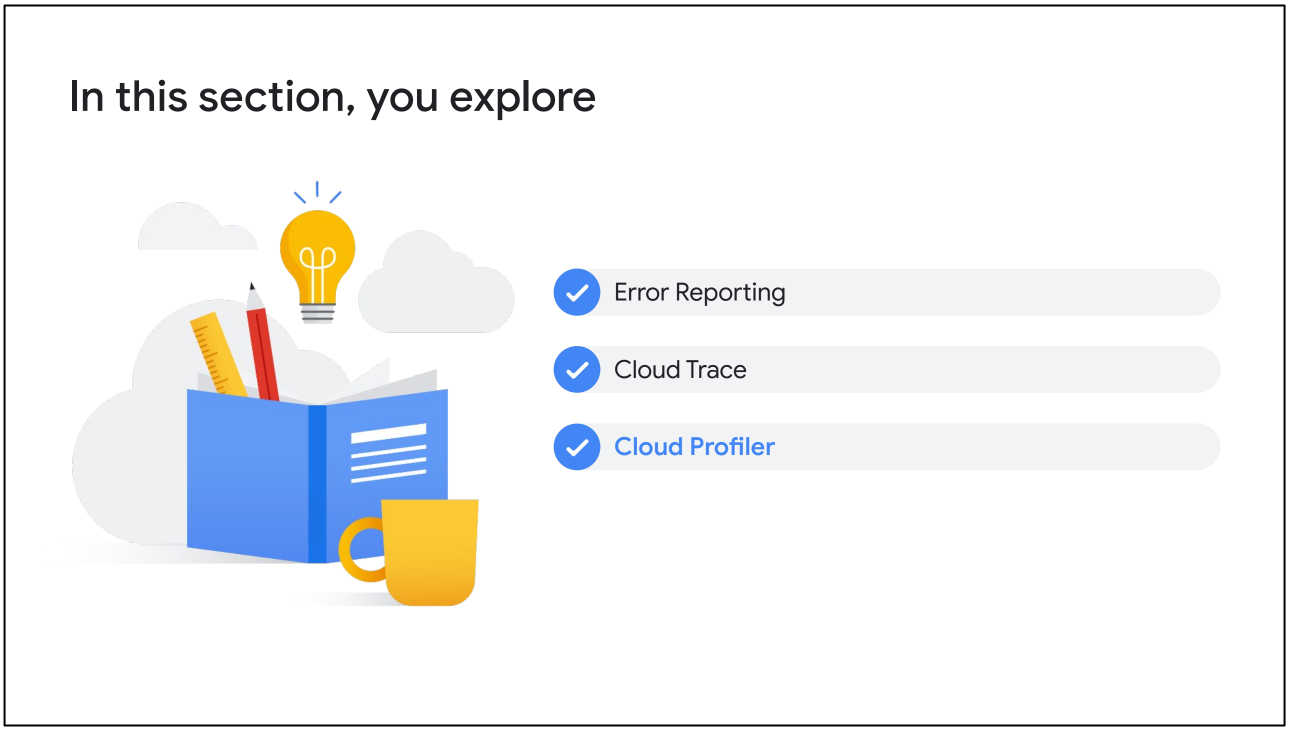


	Start	End
●	2020-02-09 (13:46:49)	2020-02-10 (13:47:15)
	Service: default	Version: v10
●	2020-02-10 (12:46:49)	2020-02-10 (13:47:15)
	Service: default	Version: v10

Analysis reports in Trace show you an overall view of the latency for all requests, or a subset of requests, to your application. Analysis reports will be similar to the daily report viewed on the **Trace Overview** main page.

Custom reports can be created for particular request URIs and other search qualifiers.

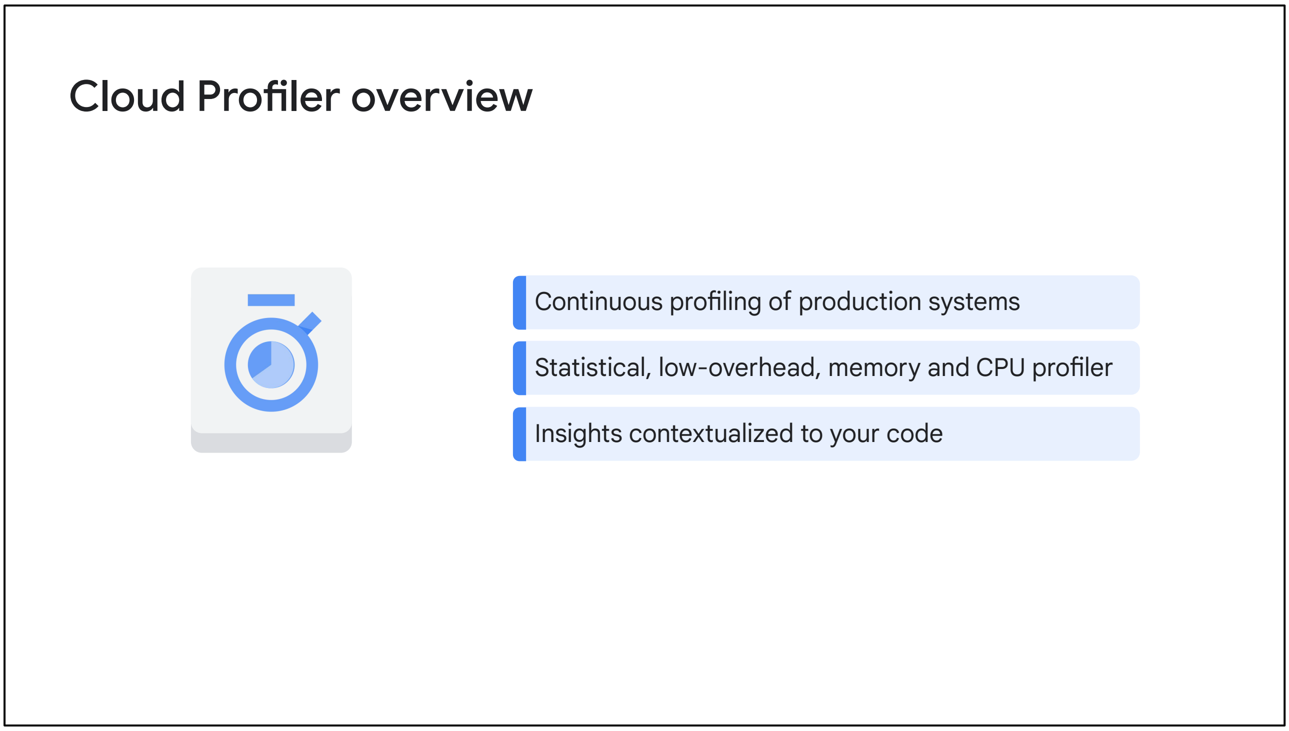
The report can show results as both a density distribution, as in the screenshot, or as a cumulative distribution.



In this section, you explore

- ✓ Error Reporting
- ✓ Cloud Trace
- ✓ Cloud Profiler

Finally, let's look at Cloud Profiler.



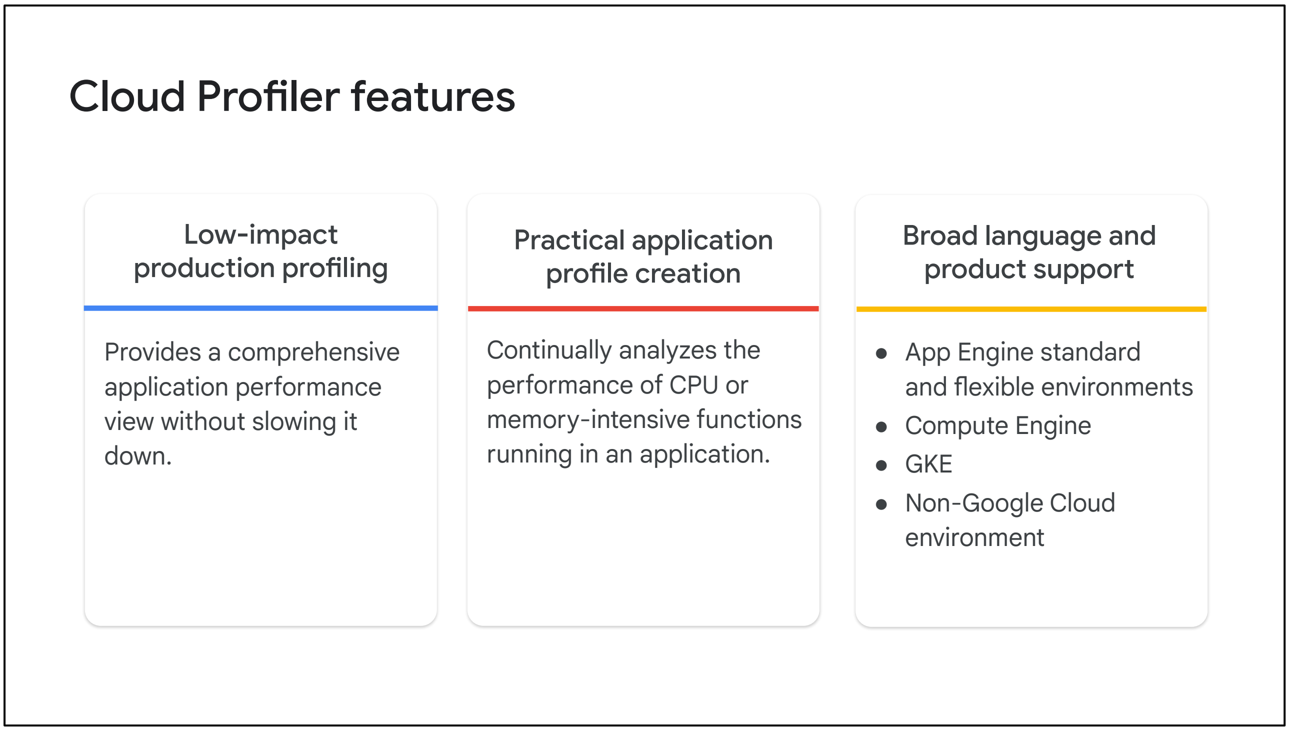
Cloud Profiler overview

- Continuous profiling of production systems
- Statistical, low-overhead, memory and CPU profiler
- Insights contextualized to your code

Understanding the performance of production systems is notoriously difficult. Attempting to measure performance in test environments usually fails to replicate the pressures on a production system.

Continuous profiling of production systems is an effective way to discover where resources like CPU cycles and memory are consumed when the service operates in its working environment.

Cloud Profiler is a statistical, low-overhead profiler that continuously gathers CPU usage and memory-allocation information from your production applications. It attributes that information to the source code that generated it, which helps you identify the parts of your application that are consuming the most resources. The insights provided illuminate the performance of your application characteristics.



Cloud Profiler features

Low-impact production profiling

Provides a comprehensive application performance view without slowing it down.

Practical application profile creation

Continually analyzes the performance of CPU or memory-intensive functions running in an application.

Broad language and product support

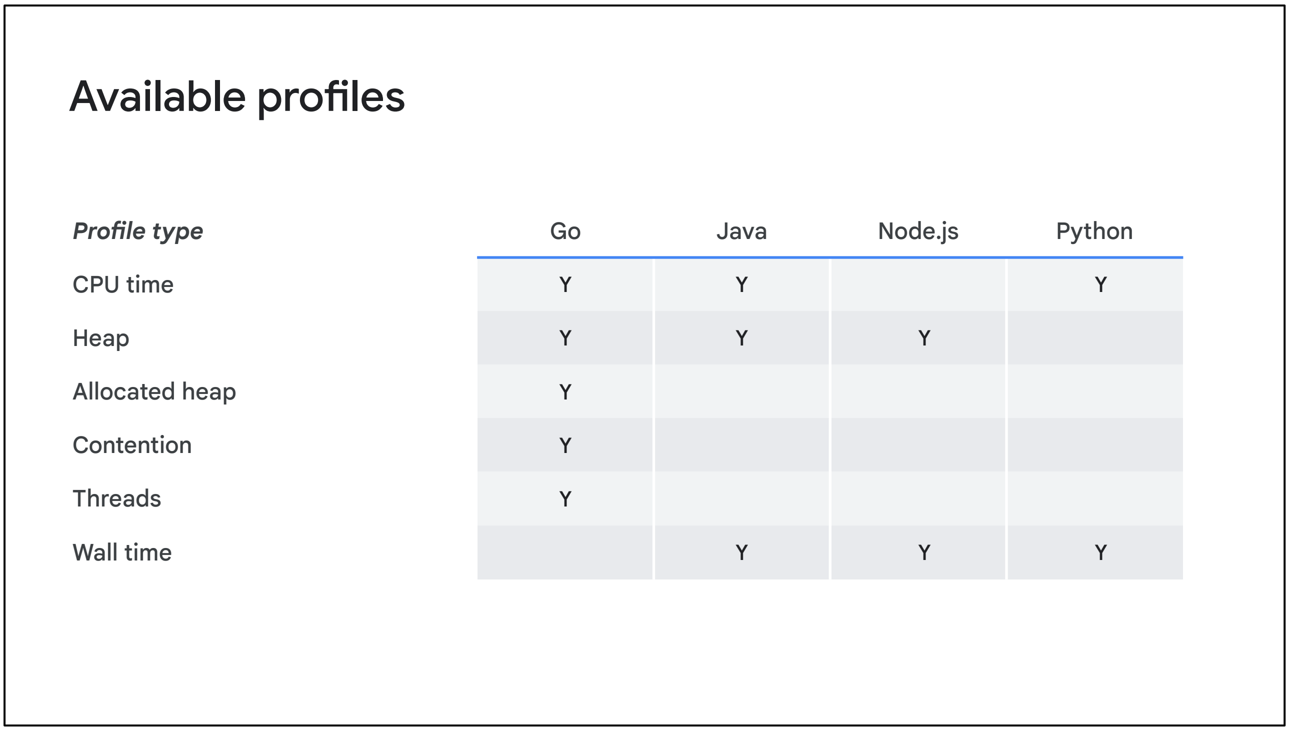
- App Engine standard and flexible environments
- Compute Engine
- GKE
- Non-Google Cloud environment

Cloud Profiler has many features.

It provides low-impact production profiling
Although it's possible to measure code performance in development environments, the results don't often show what happens in production. Many production profiling techniques slow down code execution or can only inspect a small subset of a codebase. A comprehensive application performance view is provided without slowing it down.

It offers practical application profile creation
Poorly performing code increases latency and costs for web applications and services every day, without anyone knowing or doing anything about it. Cloud Profiler changes this situation by continually analyzing the performance of CPU or memory-intensive functions that run in an application. Cloud Profiler presents the call hierarchy and resource consumption of the corresponding function in an interactive flame graph. This graph helps developers figure out which paths are consuming the most resources and what are the different ways your code is called.

It also offers broad language and product support
Cloud Profiler enables developers to analyze applications that run anywhere, including Google Cloud and other on-premises or cloud platforms that support Java, Go, Node.js, and Python. You can find a full explanation of language compatibility in the documentation.



Available profiles

Profile type	Go	Java	Node.js	Python
CPU time	Y	Y		Y
Heap	Y	Y	Y	
Allocated heap	Y			
Contention	Y			
Threads	Y			
Wall time		Y	Y	Y

The profiling types available vary by language. Check the Cloud Profiler documentation for the most recent options.

For the CPU metrics, you will find the following:

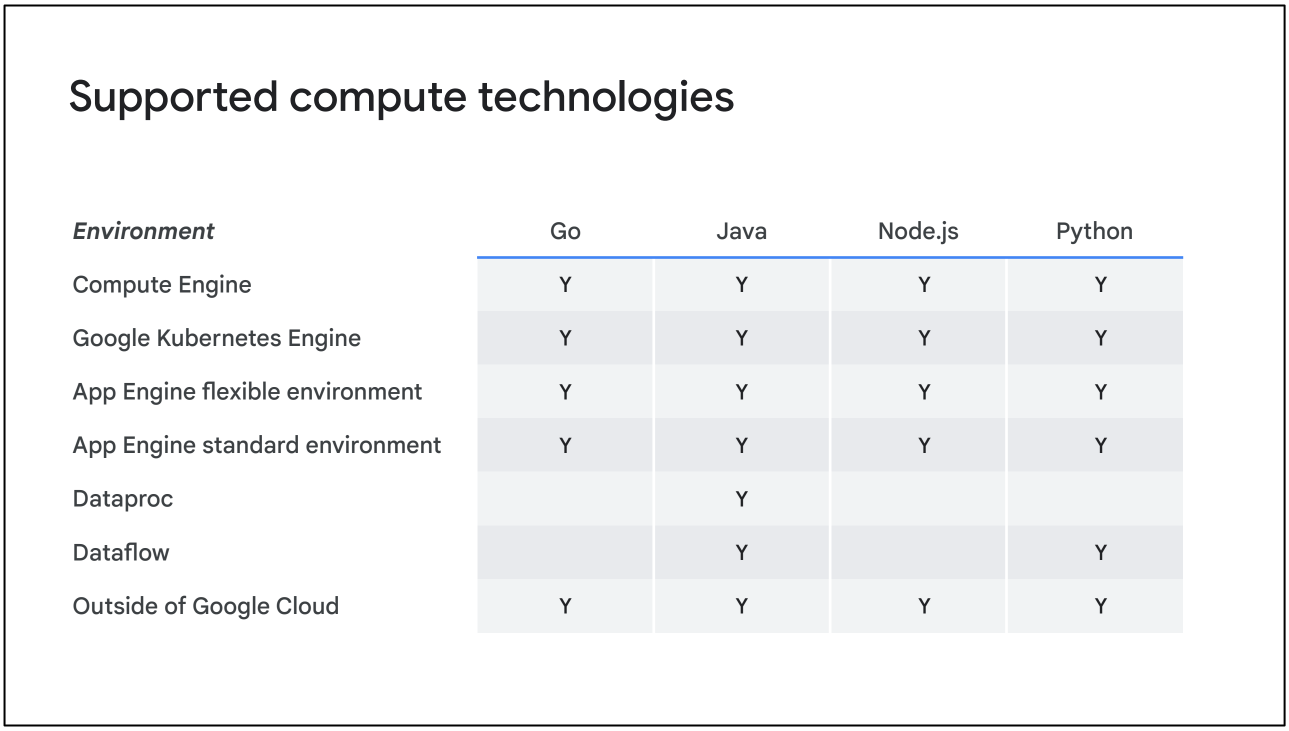
- CPU time is the time that the CPU spends executing a block of code. The time it was waiting or processing instructions for something else is not included.
- Wall time is the time that it takes to run a block of code, including all wait time, including that for locks and thread synchronization. The wall time for a block of code can never be less than the CPU time.

For heap, you have the following:

- **Heap** is the amount of memory allocated in the heap of the program when the profile is collected.
- **Allocated heap** is the total amount of memory that was allocated in the heap of the program. Allocated heap includes memory that has been freed and is no longer in use.

And for threads you have:

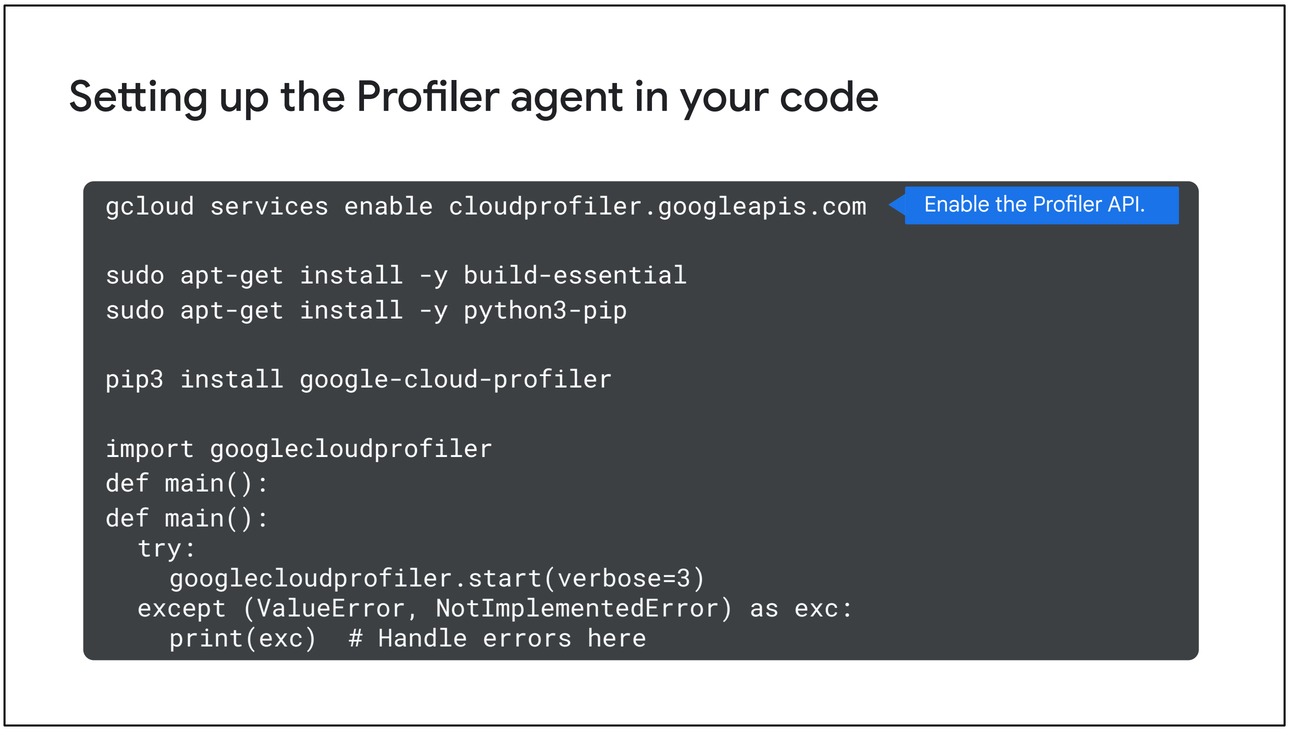
- **Contention,** which provides information about threads stuck waiting for other threads.
- **Threads**, which contain thread counts.



Supported compute technologies

Environment	Go	Java	Node.js	Python
Compute Engine	Y	Y	Y	Y
Google Kubernetes Engine	Y	Y	Y	Y
App Engine flexible environment	Y	Y	Y	Y
App Engine standard environment	Y	Y	Y	Y
Dataproc		Y		
Dataflow		Y		Y
Outside of Google Cloud	Y	Y	Y	Y

Profiler instruments applications that run in most Google and non-Google compute technologies. Note that Windows guest OS is not supported.



Setting up the Profiler agent in your code

```
gcloud services enable cloudprofiler.googleapis.com

sudo apt-get install -y build-essential
sudo apt-get install -y python3-pip

pip3 install google-cloud-profiler

import googlecloudprofiler
def main():
def main():
  try:
    googlecloudprofiler.start(verbose=3)
  except (ValueError, NotImplementedError) as exc:
    print(exc)  # Handle errors here
```

Enable the Profiler API.

Like with other Google application performance management products, the exact setup steps vary by language, so check the documentation to find more information. Here, we are sticking with our Python application, which will run on App Engine.

Before you start, ensure that the **Profiler API** is enabled in your project.

Setting up the Profiler agent in your code

```
gcloud services enable cloudprofiler.googleapis.com

sudo apt-get install -y build-essential
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pip3 install google-cloud-profiler

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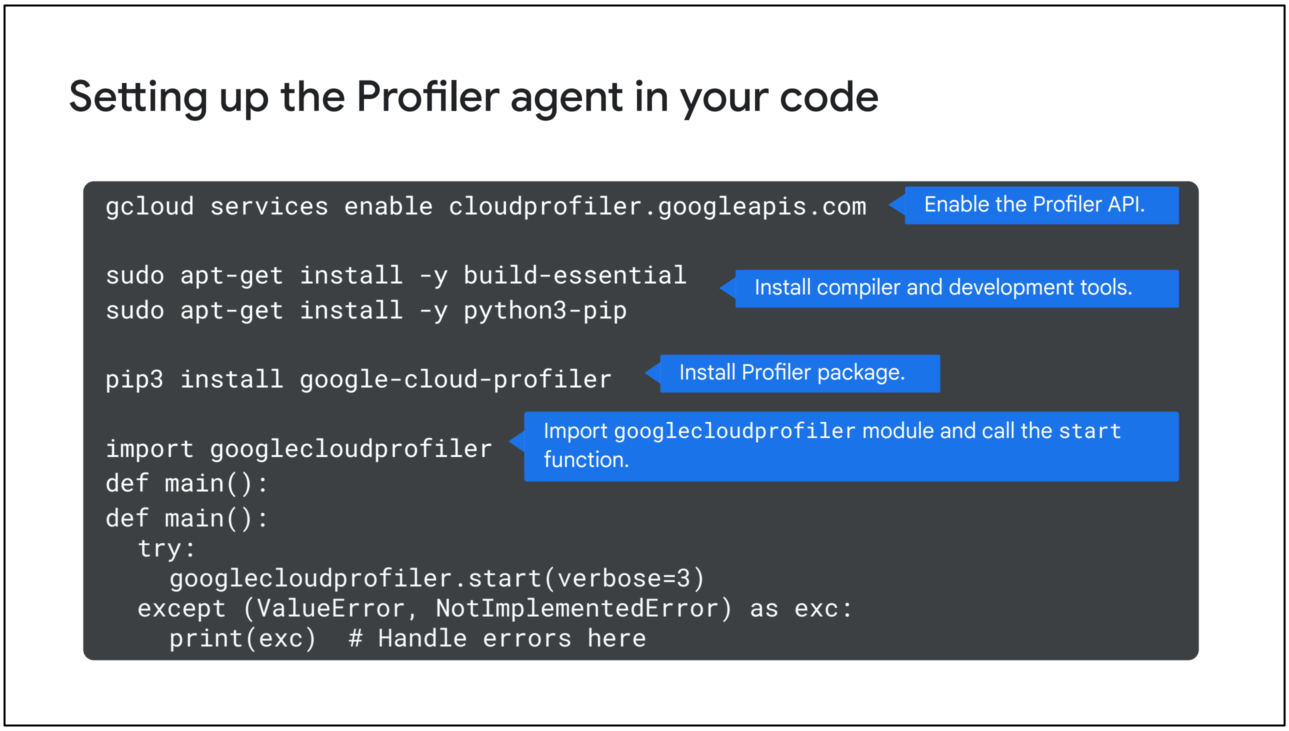
```

Enable the Profiler API.

Import `googlecloudprofiler` module and call the `start` function.

Start by importing the *googlecloudprofiler* package.



Setting up the Profiler agent in your code

```
gcloud services enable cloudprofiler.googleapis.com

sudo apt-get install -y build-essential
sudo apt-get install -y python3-pip

pip3 install google-cloud-profiler

import googlecloudprofiler
def main():
def main():
  try:
    googlecloudprofiler.start(verbose=3)
  except (ValueError, NotImplementedError) as exc:
    print(exc)  # Handle errors here
```

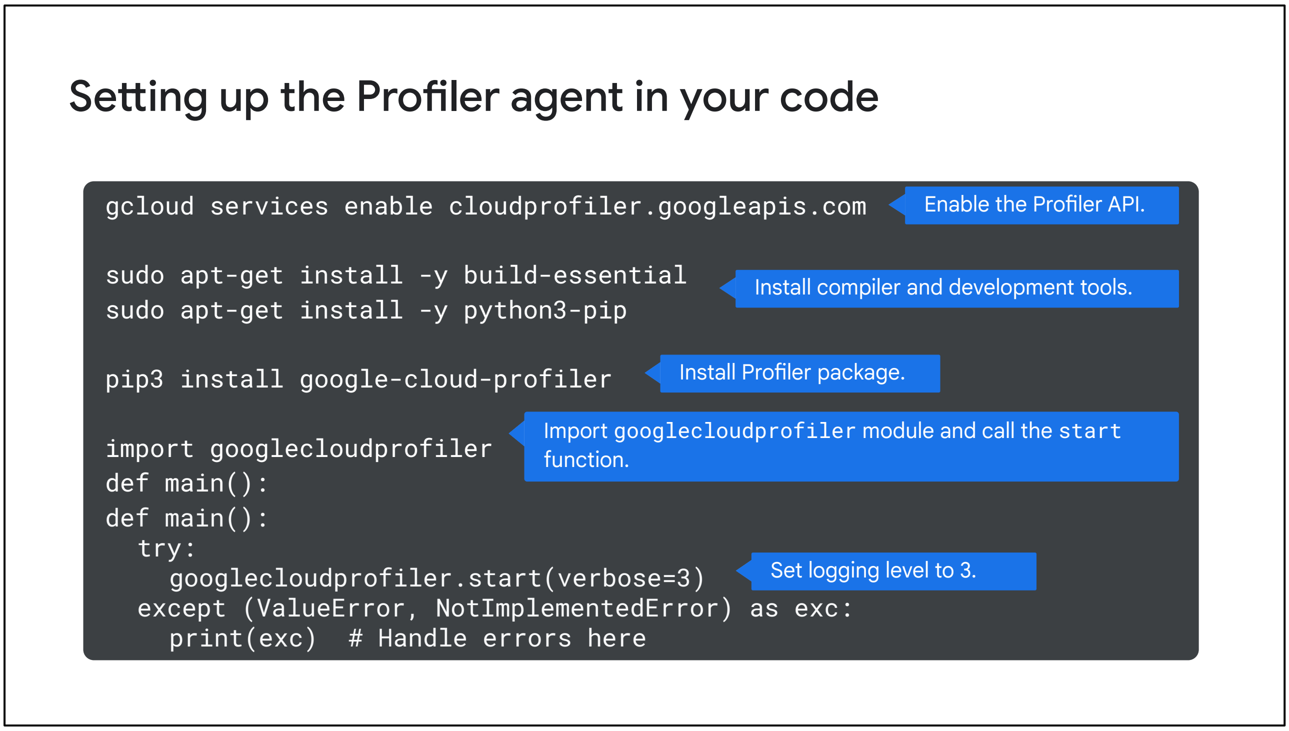
Enable the Profiler API.

Install compiler and development tools.

Install Profiler package.

Import `googlecloudprofiler` module and call the `start` function.

Install the C/C++ compiler and development tools, pip, and Profiler package.



Setting up the Profiler agent in your code

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```

Enable the Profiler API.

Install compiler and development tools.

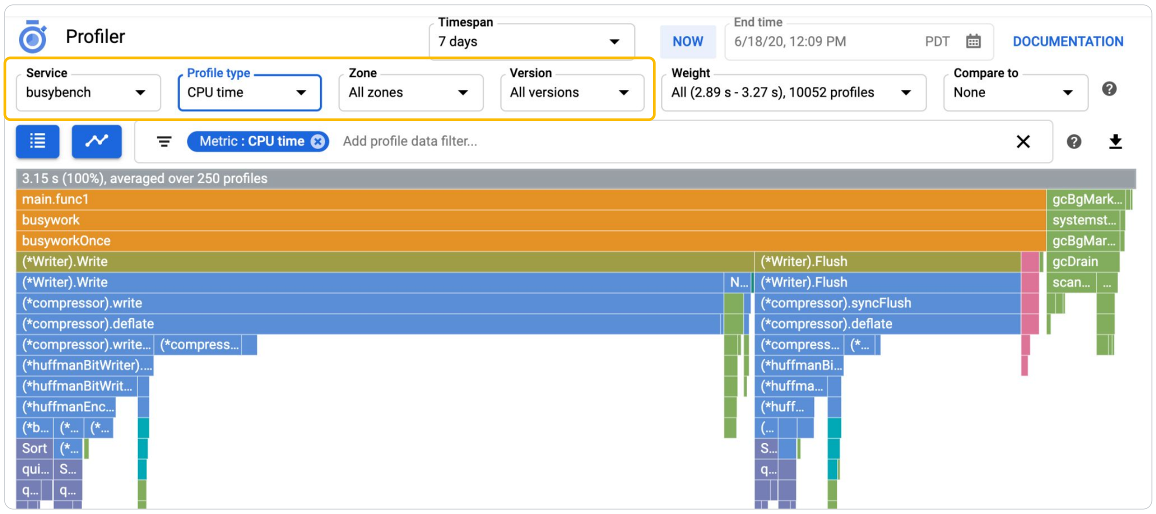
Install Profiler package.

Import `googlecloudprofiler` module and call the `start` function.

Set logging level to 3.

Then, early as possible in your code, start the profiler. In this example, we are setting the logging level (verbose) to 3, or debug level. That setting will log all messages. The default would be 0 or error only.

Profiler interface


Profiler

Timespan: 7 days

NOW

End time: 6/18/20, 12:09 PM PDT

DOCUMENTATION

Service: busybench

Profile type: CPU time

Zone: All zones

Version: All versions

Weight: All (2.89 s - 3.27 s), 10052 profiles

Compare to: None

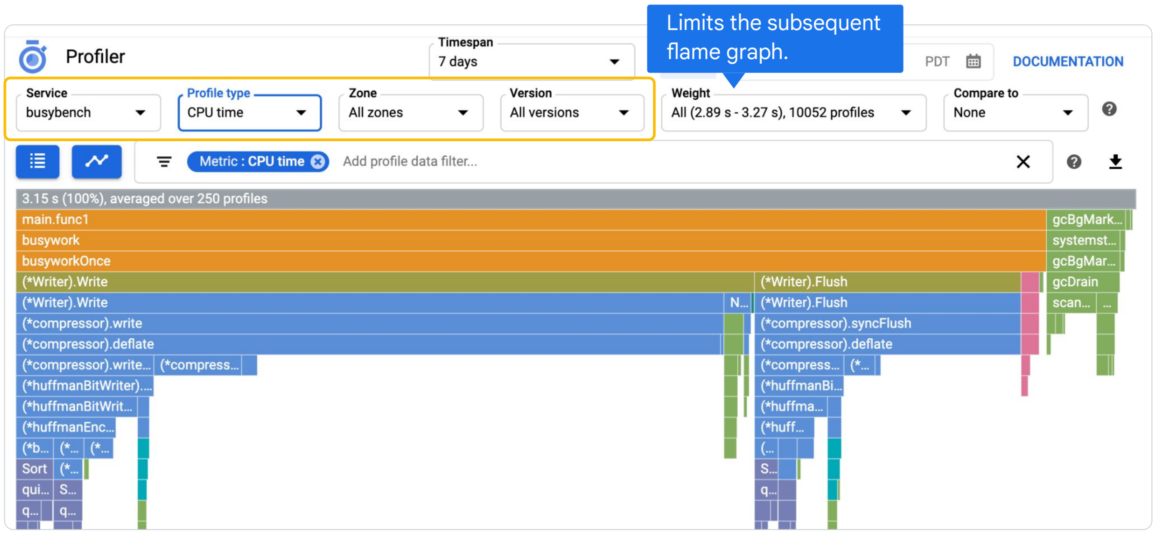
Metric : CPU time

Add profile data filter...

3.15 s (100%), averaged over 250 profiles

At the top of the Profiler interface, you can select the profile that you want to analyze. You can select by options including **Timespan**, **Service**, **Profile type**, **Zone**, and **Version**.

Profiler interface



Limits the subsequent flame graph.

Profiler

Timespan: 7 days

Service: busybench

Profile type: CPU time

Zone: All zones

Version: All versions

Weight: All (2.89 s - 3.27 s), 10052 profiles

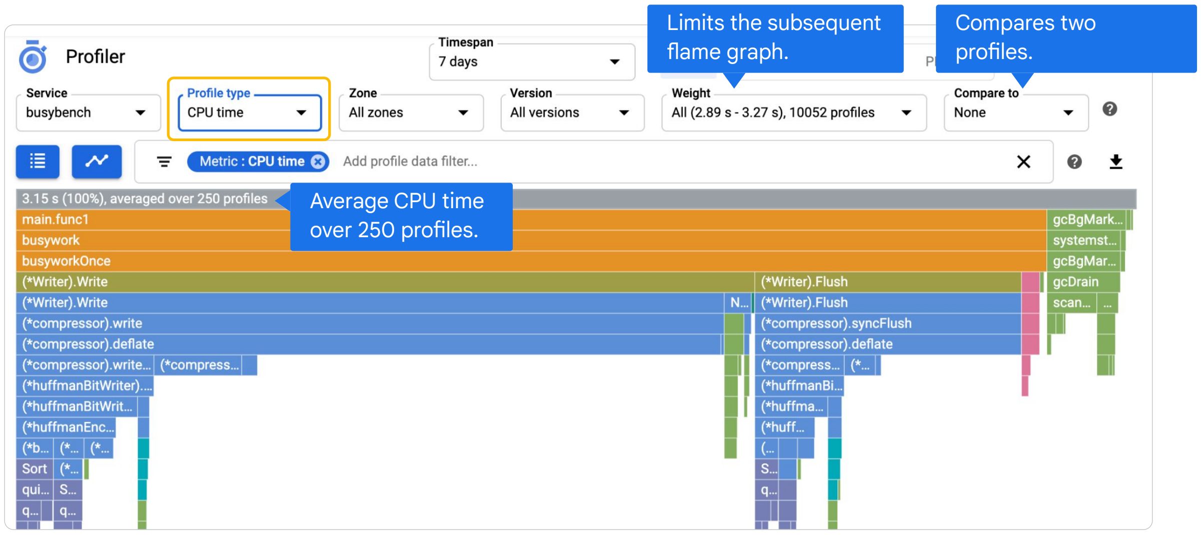
Compare to: None

Metric : CPU time

3.15 s (100%), averaged over 250 profiles

The **Weight** will limit the subsequent flame graph to particular peak consumptions. Top 5%, for example.

Profiler interface


Limits the subsequent flame graph.
Compares two profiles.
Average CPU time over 250 profiles.
Profiler

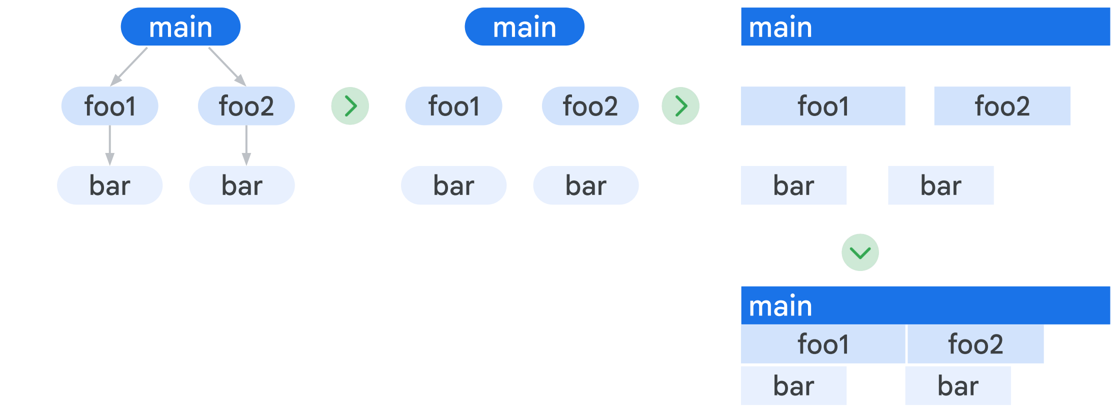
Timespan: 7 days
Service: busybench
Profile type: CPU time
Zone: All zones
Version: All versions
Weight: All (2.89 s - 3.27 s), 10052 profiles
Compare to: None
Metric : CPU time
Add profile data filter...

3.15 s (100%), averaged over 250 profiles

main.func1
busywork
busyworkOnce
(*Writer).Write
(*Writer).Write
(*compressor).write
(*compressor).deflate
(*compressor).write... (*compress...
(*huffmanBitWriter)....
(*huffmanBitWrit...
(*huffmanEnc...
(*Writer).Flush
(*Writer).Flush
(*compressor).syncFlush
(*compressor).deflate
gcBgMark...
systemst...
gcBgMar...
gcDrain
scan...

Compare to allows the comparison of two profiles. Profiler then randomly selects a maximum of 250 profiles from this set, and uses those to construct the flame graph.

Flame graph



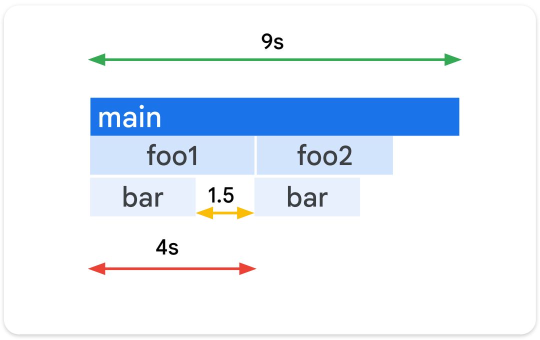
As mentioned earlier, cloud Profiler displays profiling data by using [Flame Graphs](). Unlike trees and standard graphs, flame graphs use screen space efficiently by representing a large amount of information in a compact and readable format.

Look at this example. We have a basic application with a *main* method, which calls *foo1*, which in turn calls *bar*. Then *main* calls *foo2*, which also calls *bar*.

As you move through the graphic left to right, you can see how the information is collapsed. First, by removing arrows, then by creating frames, and finally by removing spaces and left-aligning.

In the bottom view, you see the result as it appears in the Profiler.

Flame graph



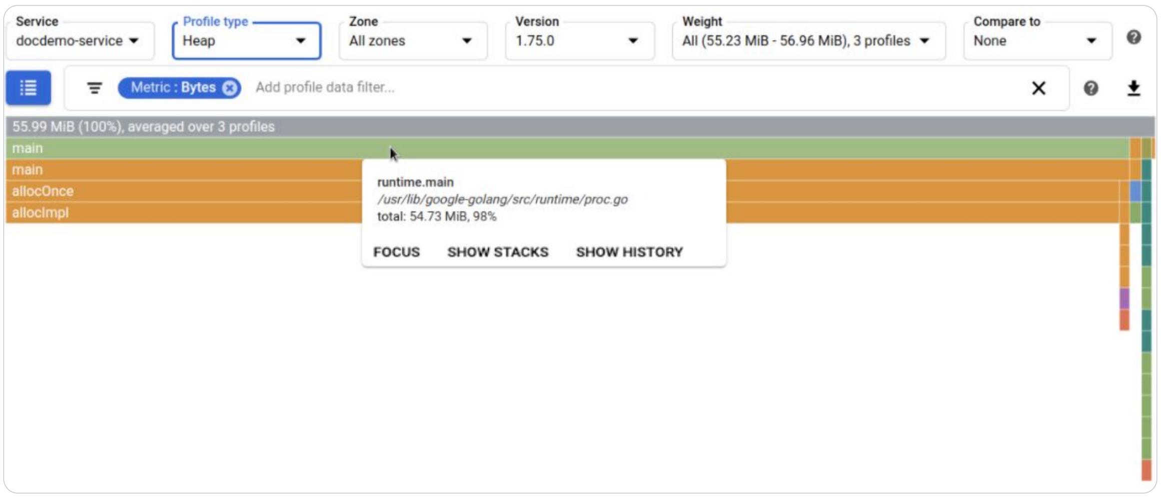
⟷	Total CPU usage of main
⟷	Self CPU usage of foo1
⟷	Self CPU usage of foo1

If you look at CPU time, then you can see that the *main* method takes a total of *9* seconds.

Beneath the *main* bar, you can see how that CPU time was spent: some in *main* itself, but most in the calls to *foo1* and *foo2*. And most of the *foo* time was spent in *bar*.

So, if we could make *bar* faster, we could really save some time in *main*.

Point to a frame


Service: docdemo-service
Profile type: Heap
Zone: All zones
Version: 1.75.0
Weight: All (55.23 MiB - 56.96 MiB), 3 profiles
Compare to: None

Metric : Bytes
Add profile data filter...

55.99 MiB (100%), averaged over 3 profiles
main
main
allocOnce
allocImpl

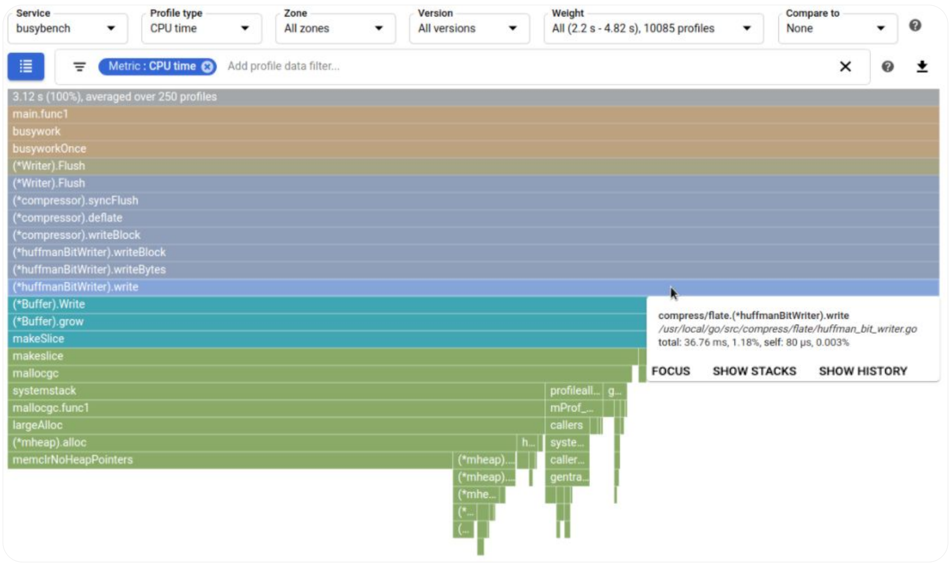
runtime.main
/usr/lib/google-golang/src/runtime/proc.go
total: 54.73 MiB, 98%

Here we have a full example.

When you hold the pointer over a frame, a tooltip opens and displays additional information, which includes:

- The function name
- The source file location
- And some metric consumption information

Selecting a frame



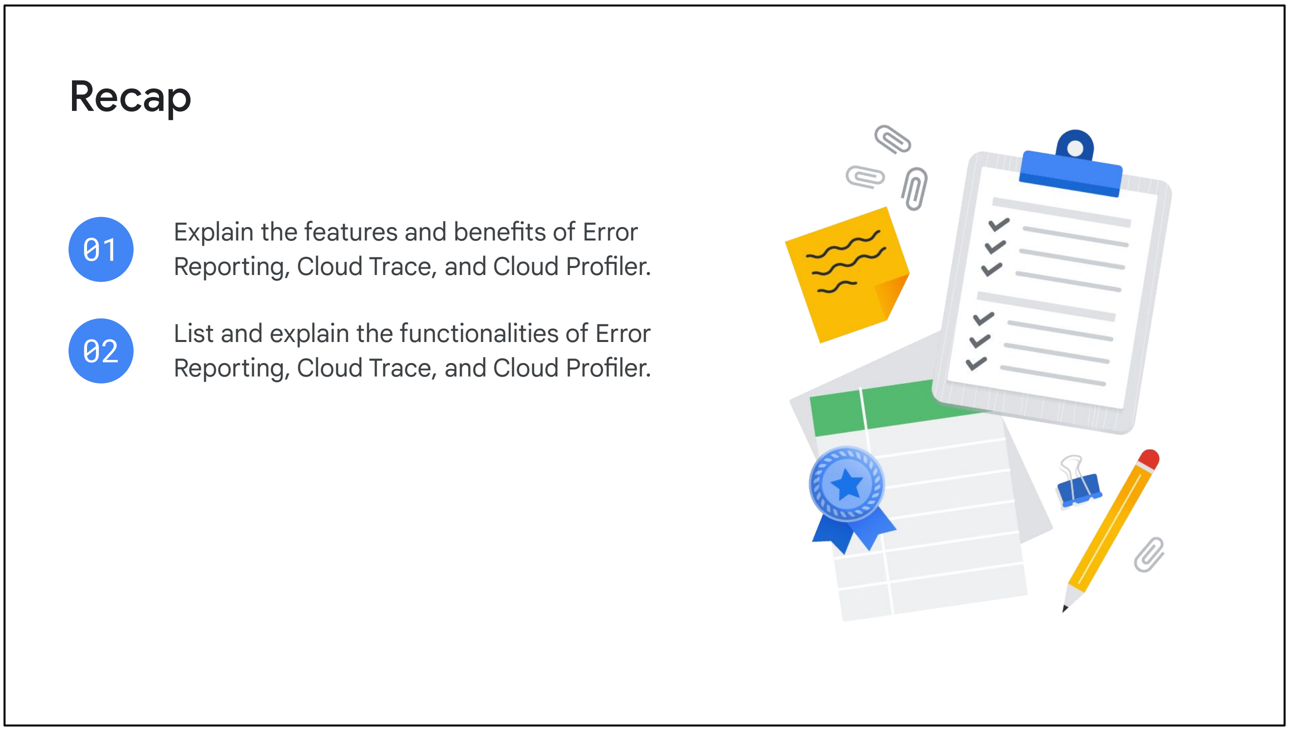
Service: busybench
Profile type: CPU time
Zone: All zones
Version: All versions
Weight: All (2.2 s - 4.82 s), 10085 profiles
Compare to: None

Metric : CPU time
Add profile data filter...

3.12 s (100%), averaged over 250 profiles

compress/flate.(*huffmanBitWriter).write
/usr/local/go/src/compress/flate/huffman_bit_writer.go
total: 36.76 ms, 1.18%, self: 80 µs, 0.003%

If you click a frame, the graph is redrawn, which makes the call stack of the selected method more visible.



Recap

01 Explain the features and benefits of Error Reporting, Cloud Trace, and Cloud Profiler.

02 List and explain the functionalities of Error Reporting, Cloud Trace, and Cloud Profiler.

In this module, you learned to:

- Explain the features and benefits of Error Reporting, Cloud Trace, and Cloud Profiler.
- List and explain the functionalities of the Error Reporting, Cloud Trace, and Cloud Profiler components.