

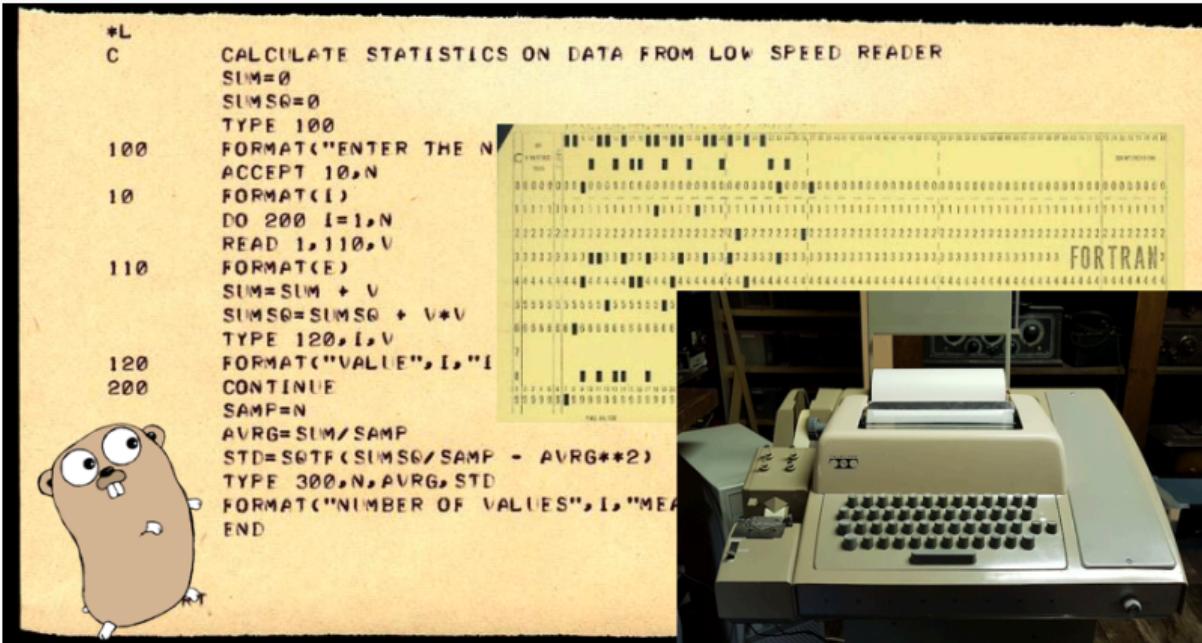


Go and Google App Engine

Matt Holiday
March 2021



“Never stop learning”



See my online class

Context as a tree structure

It's a tree of **immutable** nodes which can be extended

The diagram illustrates a context tree structure. At the bottom is a grey square node. Two arrows point upwards from it to two circular nodes: a light blue one on the left labeled "v: 7" and a red one on the right labeled "o 23". From the light blue node, an arrow points up to a dark blue circular node at the top. From the red node, an arrow points up to a light blue circular node. Handwritten annotations in red circle the code for "ctx := context.Background()" above the first node and "ctx, canc := context.WithTimeout(ctx, t)" above the second node. A bracket labeled "cancel" is drawn under the "canc" variable. Another bracket on the right side groups the final two lines of code: "req, _ := http.NewRequest(method, url, nil)" and "req = req.WithContext(ctx)".

```
ctx := context.Background()  
ctx = contextWithValue(ctx, "v", 7)  
ctx, canc := context.WithTimeout(ctx, t)  
req, _ := http.NewRequest(method, url, nil)  
req = req.WithContext(ctx)  
resp, err := http.DefaultClient.Do(req)
```

<https://www.youtube.com/playlist?list=PLoILbKo9rG3skRCj37Kn5Zj803hhiuRK6>

App Engine

Serverless PAAS for web applications

- stateless HTTP requests
- auto-scaling & auto-failover
- “build in the cloud” deployment
- no writeable filesystem
- Google handles ingress (HTTPS reverse proxy)
- zero-trust security via “identity-aware proxy” (IAP)

In many ways, it's like a glorified cloud function

Getting started

In a GCP account:

- create a project if you don't have one
- enable app engine
- enable monitoring
- enable cloud profiling

In addition to your server “program” you need an `app.yaml` file to deploy

- define service name, instance type, scaling
- parameterize routes

GAE example repo

Screenshot of a GitHub repository page for "matt4biz / go-gae-example".

The repository has 1 star, 0 forks, and 0 issues.

Code tab is selected. The code tree shows the following files:

- cmd
- .gcloudignore
- README.md
- default-app.yaml
- go.mod
- go.sum
- sort-app.yaml
- todo-app.yaml

A commit by matt4biz is shown:

matt4biz Remove metrics from todo; simplify sort & count returned bytes
f8fb66 17 hours ago 3 commits

The README.md file contains the text "go-gae-todo".

Right sidebar sections include:

- About: GAE example apps, tags (google, gae, gcp, google-cloud-platform)
- Releases: No releases published, Create a new release
- Packages: No packages published, Publish your first package
- Languages: Go 100.0%

Default app

```
func handler(w http.ResponseWriter, r *http.Request) {
    fmt.Fprintln(w, "Hello, web!")
}

func main() {
    port := os.Getenv("PORT")

    if port == "" {
        port = "8080"
    }

    log.Printf("Listening on port %s", port)

    http.HandleFunc("/", handler)
    log.Fatal(http.ListenAndServe(": "+port, nil))
}
```

Deployment

```
# default-app.yaml

runtime: go114
instance_class: F1
service: default

main: ./cmd/default

automatic_scaling:
  max_instances: 1

handlers:
  - url: /.*
    secure: always
    redirect_http_response_code: 301
    script: auto
```

Deployment

```
$ gcloud app deploy --appyaml=default-app.yaml
Services to deploy:

descriptor:      [default-app.yaml]
source:          [/Users/mholiday/Projects/go-gae-todo]
target project:  [polar-equinox-275017]
target service:   [default]
target version:  [20210129t101042]
target url:      [https://polar-equinox-275017.uc.r.appspot.com]

Do you want to continue (Y/n)?  Y

Beginning deployment of service [default]...
[ Uploading 4 files to Google Cloud Storage ]
File upload done.
Updating service [default]...done.
Setting traffic split for service [default]...done.
Deployed service [default] to [https://polar-equinox-275017.uc.r.appspot.com]

You can stream logs from the command line by running:
$ gcloud app logs tail -s default

To view your application in the web browser run:
$ gcloud app browse
```

Security

Google Cloud Platform My First Project Search products and resources 12 :

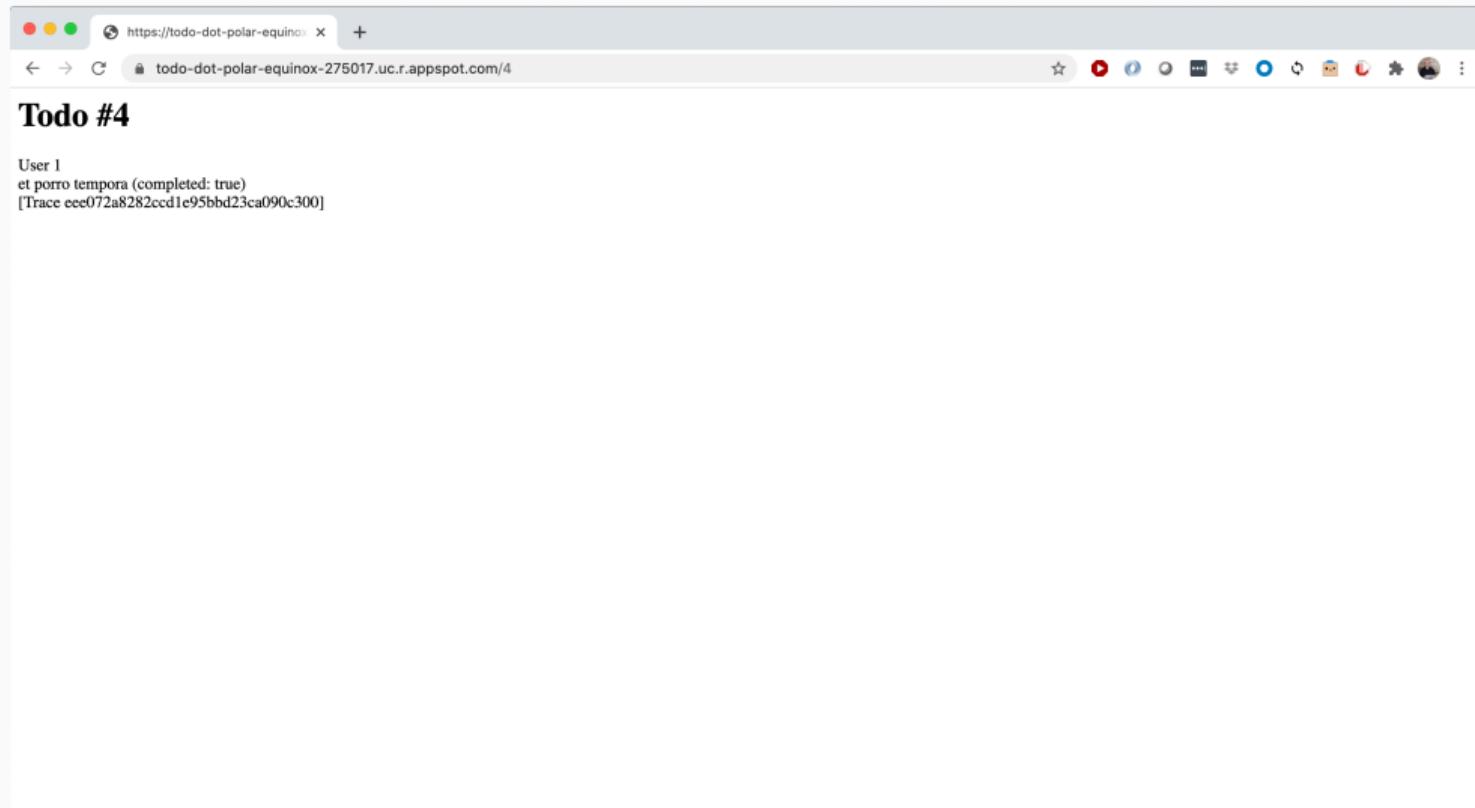
| Security | Identity-Aware Proxy | ON-PREM CONNECTORS SETUP | Premium | HIDE INFO PANEL | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|--------------------------|-----------|---|-----------|------|------------------|--------------------------|--|--|--|----------------|-------------------------------------|-----------------------|-----|---|---------|--------------------------|--|--|---|------|--------------------------|--|--|---|------|--------------------------|--|--|---|---|
| <ul style="list-style-type: none">Security Command CenterreCAPTCHA EnterpriseThreat DetectionBeyondCorp EnterpriseIdentity-Aware ProxyAccess Context ManagerVPC Service ControlsBinary AuthorizationData Loss PreventionCryptographic KeysCertificate Authority ServiceSecret ManagerAccess ApprovalWeb Security ScannerManaged Microsoft AD | <p>Identity-Aware Proxy (IAP) lets you manage who has access to services hosted on App Engine, Compute Engine, or an HTTPS Load Balancer. Learn more</p> <p>To get started with IAP, add an App Engine app, a Compute Engine instance or configure an HTTPS Load Balancer.</p> <p>HTTPS RESOURCES SSH AND TCP RESOURCES</p> <table border="1"><thead><tr><th>Resource</th><th>IAP</th><th>Method</th><th>Published</th><th>Star</th></tr></thead><tbody><tr><td>All Web Services</td><td><input type="checkbox"/></td><td></td><td></td><td></td></tr><tr><td>App Engine app</td><td><input checked="" type="checkbox"/></td><td><input type="radio"/></td><td>IAM</td><td>https://polar-equinox-275017.uc.r.appspot.com</td></tr><tr><td>default</td><td><input type="checkbox"/></td><td></td><td></td><td>https://polar-equinox-275017.uc.r.appspot.com</td></tr><tr><td>sort</td><td><input type="checkbox"/></td><td></td><td></td><td>https://sort-dot-polar-equinox-275017.uc.r.appspot.com</td></tr><tr><td>todo</td><td><input type="checkbox"/></td><td></td><td></td><td>https://todo-dot-polar-equinox-275017.uc.r.appspot.com</td></tr></tbody></table> | Resource | IAP | Method | Published | Star | All Web Services | <input type="checkbox"/> | | | | App Engine app | <input checked="" type="checkbox"/> | <input type="radio"/> | IAM | https://polar-equinox-275017.uc.r.appspot.com | default | <input type="checkbox"/> | | | https://polar-equinox-275017.uc.r.appspot.com | sort | <input type="checkbox"/> | | | https://sort-dot-polar-equinox-275017.uc.r.appspot.com | todo | <input type="checkbox"/> | | | https://todo-dot-polar-equinox-275017.uc.r.appspot.com | <p>App Engine app</p> <p>Use external identities for authorization START</p> <p>Granting Owner at the <i>resource level</i> only allows modifying the access policy. It does not grant access to the application. Learn more</p> <p>Edit or delete permissions below or "Add Member" to grant new ADD MEMBER</p> <p>Show inherited permissions</p> <p>Role / Member ↑ Inheritance</p> <ul style="list-style-type: none">Editor (2)IAP-secured Web App User (2)<ul style="list-style-type: none">matt@k0dvh.commatthew.holiday@nytimes.comOwner (1) |
| Resource | IAP | Method | Published | Star | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| All Web Services | <input type="checkbox"/> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| App Engine app | <input checked="" type="checkbox"/> | <input type="radio"/> | IAM | https://polar-equinox-275017.uc.r.appspot.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| default | <input type="checkbox"/> | | | https://polar-equinox-275017.uc.r.appspot.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| sort | <input type="checkbox"/> | | | https://sort-dot-polar-equinox-275017.uc.r.appspot.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| todo | <input type="checkbox"/> | | | https://todo-dot-polar-equinox-275017.uc.r.appspot.com | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Delete old versions

The screenshot shows the Google Cloud Platform App Engine Versions page. On the left sidebar, under the 'App Engine' section, the 'Versions' option is selected. In the main content area, there is a table listing versions for a service named 'sort'. One version, '20210129t132157', is selected and highlighted with a blue border. A modal dialog box is centered over the table, asking 'Delete version 20210129t132157?'. Below the question, it says 'Do you want to delete the version 20210129t132157 of the service sort?'. At the bottom of the dialog are two buttons: 'CANCEL' on the left and 'DELETE' on the right.

| Version | Status | Traffic Allocation | Instances | Runtime | Environment | Size | Deployed |
|-----------------|---------|--------------------|-----------|---------|-------------|---------|---------------------|
| 20210129t13250 | Serving | 100% | 1 | go114 | Standard | 24.7 MB | Jan 21 1:35:3 matt@ |
| 20210129t132157 | Serving | 100% | 1 | go114 | Standard | 24.7 MB | Jan 21 1:23:2 matt@ |

Todo proxy app



Logs

We can easily tie together all the logs of a request

- App Engine logs every incoming HTTP request
- every request has the header X-Cloud-Trace-Context
- which we can grab and inject into logs from our own code
- and also inject it into responses

Showing logs from the last hour ending at 8:34 AM (MST)

Download logs View Options ▾

▼ 2021-02-01 08:30:01.688 MST GET 200 327 B 2.8 s Chrome 88 /4

73.243.10.245 - matt [01/Feb/2021:08:30:01 -0700] "GET /4 HTTP/1.1" 200 327 - "Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/88.0.4324.96 Safari/537.36" "todo-dot-polar-equinox-275017.uc.r.appspot.com" ms=2759 cpu_ms=1821 cpm_usd=3.6545e-8 load ing_request=1 instance=00c61b117c02f271a8f59856b6d7039bbf759d3cb953bc47d4a5012fdd9912ec432dc863369d7b286fe78318e6243f7c334af57911e84633c7c55975dc0 8da070cccd4b082c3f95 app_engine_release=1.9.71 trace_id=eee072a8282ccde95bbd23ca090c300

Logs

```
const cloudKey = "X-Cloud-Trace-Context"

func getTraceID(r *http.Request) string {
    if traceKey := r.Header.Get(cloudKey); traceKey != "" {
        return strings.Split(traceKey, "/")[0]
    }

    return ""
}

func handler(w http.ResponseWriter, r *http.Request) {
    traceID := getTraceID(r)
    logger := log.New(log.Writer(), traceID+" ", log.LstdFlags|log.Lmsgprefix)

    . .
.
```

Log Viewer

The screenshot shows the Google Cloud Platform interface with the title "Log Viewer". The left sidebar lists "Operations Logging" and several menu items: "Legacy Logs Viewer" (selected), "Logs Dashboard", "Logs-based Metrics", "Logs Router", and "Logs Storage". The main area is titled "Legacy Logs Viewer" and includes a "UPGRADE" button, "CREATE METRIC", "CREATE SINK", "SAVE SEARCH", and "SHOW LIBRARY" buttons. A message at the top encourages upgrading to the updated Logs Explorer. The search bar contains the query "text:eee072a8282ccde1e95bbd23ca090c300". The filter dropdown shows "GAE Application, todo". The log list displays two entries from "2021-02-01":

- 2021-02-01 08:30:01.688 MST GET 200 327 B 2.8 s Chrome 88 /4
- 2021-02-01 08:30:04.407 MST 2021/02/01 15:30:04 eee072a8282ccde1e95bbd23ca090c300 found 4: et porro tempora

The second entry is expanded, showing its JSON structure:

```
{
  "insertId": "60181e7c0006364bb00f8890",
  "labels": {...},
  "logName": "projects/polar-equinox-275017/logs/stderr",
  "receiveTimestamp": "2021-02-01T15:30:04.446724499Z",
  "resource": {...},
  "textPayload": "2021/02/01 15:30:04 eee072a8282ccde1e95bbd23ca090c300 found 4: et porro tempora",
  "timestamp": "2021-02-01T15:30:04.407115Z"
}
```

Buttons for "Load older logs" and "Load newer logs" are visible at the bottom of the log list.

Goroutine profile

Profiling

```
func initMonitoring() error {
    projectID := os.Getenv("GOOGLE_CLOUD_PROJECT")
    service := os.Getenv("GAE_SERVICE")
    config := profiler.Config{ProjectID: projectID, Service: service}

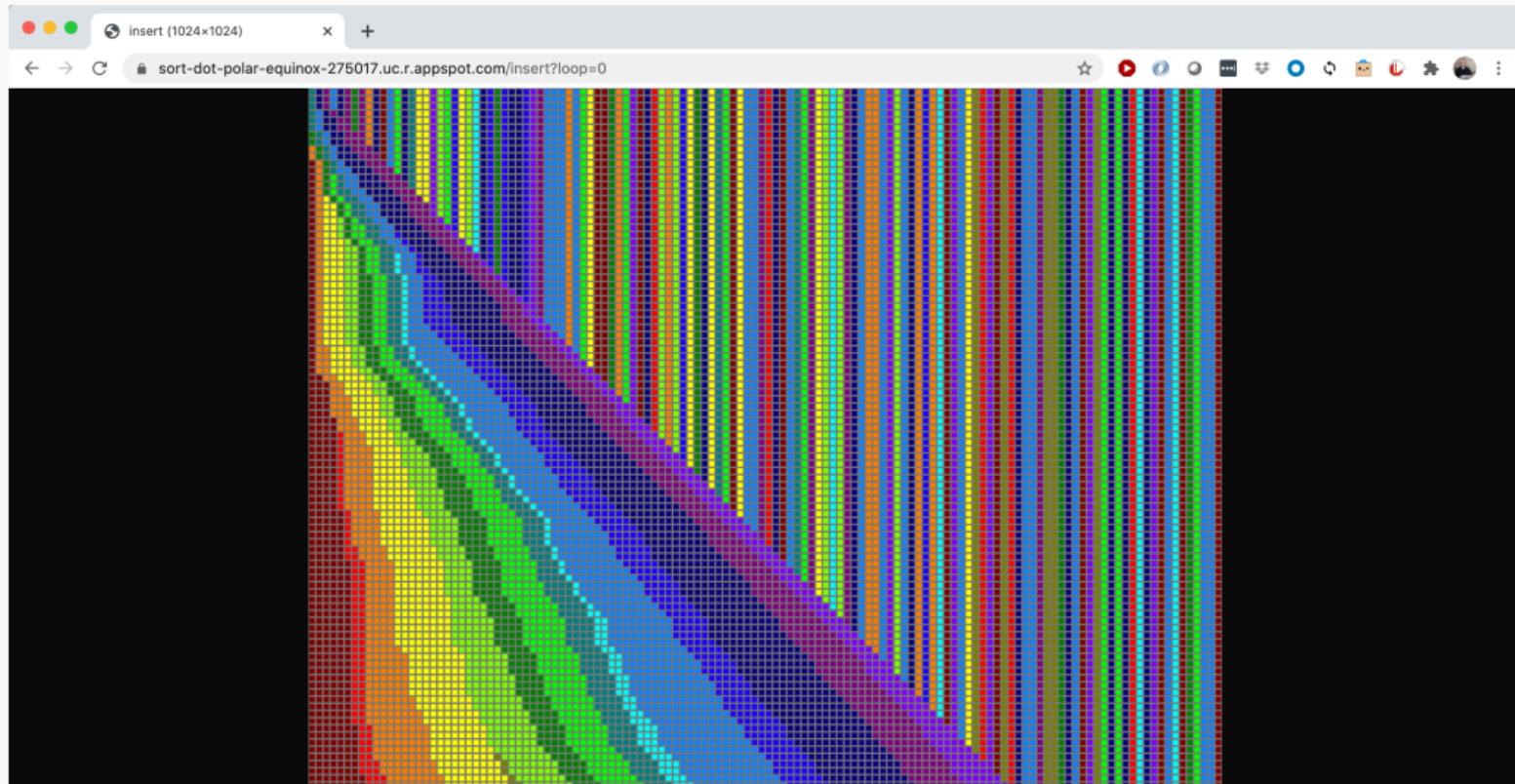
    if err := profiler.Start(config); err != nil {
        return err
    }

    return nil
}

func main() {
    if err := initMonitoring(); err != nil {
        log.Fatalf("profiling: %s", err.Error())
    }
}

. . .
```

Sort animation app



App Engine dashboard

Google Cloud Platform My First Project Search products and resources

App Engine Dashboard SHOW INFO PANEL LEARN

Dashboard Services Versions Instances Task queues Cron jobs Security scans Firewall rules Quotas Memcache Search Settings

Service sort Version 20210129t133250 (100%) polar-equinox-275017 uc.r.appspot.com Region: us-central

Summary 1 hour 6 hours 12 hours 1 day 2 days 4 days 7 days 14 days 30 days RESET ZOOM

Summary

Count/sec

by module id (sum) 1 min interval (rate)

0.08/s
0.06/s
0.04/s
0.02/s
0

1:50 1:55 2 PM 2:05 2:10 2:15 2:20 2:25 2:30 2:35 2:40 2:45

Client (4XX): 0 Server (5XX): 0 Total requests: 0.067/s

Metrics Explorer

Google Cloud Platform Search products and resources

Monitoring Metrics explorer

METRIC VIEW OPTIONS

Build Your Query

Find resource type and metric

Metric: OpenCensus/sort/requ... Select a resource

⚠ Selecting a metric without a resource may have performance implications.

Filter

+ Add a filter

Group By

route + Add a label

Aggregator

50th percentile

Period

1 minute

Line 1H 6H 1D 1W 1M 6W CUSTOM

by route (50th percentile) 1 min interval (delta)

10
8
6
4
2
0

2 PM 2:15 2:30 2:45

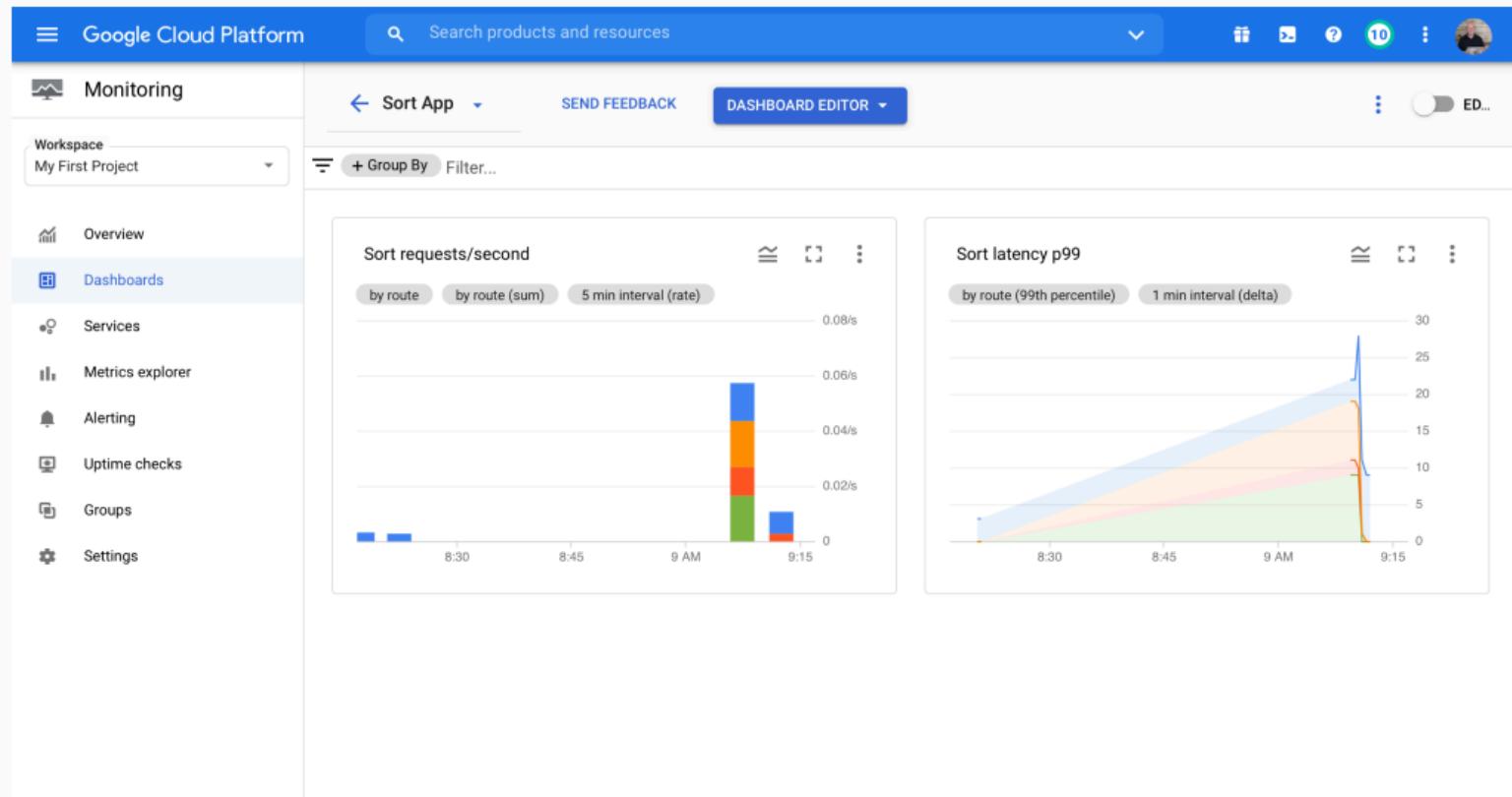
route Value

insert 8.500

qsort 8.500

The screenshot shows the Google Cloud Metrics Explorer interface. On the left, there's a sidebar with navigation links like Overview, Dashboards, Services, Metrics explorer (which is selected), Alerting, Uptime checks, Groups, and Settings. The main area has a search bar at the top. Below it, the title 'Metrics explorer' is followed by 'METRIC' and 'VIEW OPTIONS' tabs. Under 'METRIC', there's a 'Build Your Query' section with a 'Query Editor' button. It includes fields for 'Metric' (set to 'OpenCensus/sort/requ...'), 'Select a resource', and a warning about performance implications if no resource is selected. There are also 'Filter', 'Group By', 'Aggregator' (set to '50th percentile'), and 'Period' (set to '1 minute') sections. To the right, there's a chart area with a line graph showing data over time (from 2 PM to 2:45) and a table below it showing specific data points for 'route': one entry for 'insert' with a value of 8.500 and another for 'qsort' with the same value. The chart has a y-axis from 0 to 10 and an x-axis with ticks at 2 PM, 2:15, 2:30, and 2:45.

Custom app dashboard



OpenCensus metrics

```
var (
    RouteKey    tag.Key
    Requests    = stats.Int64("sort/requests", "request count", "1")
    RequestTime = stats.Int64("sort/request-time", "request duration (s)", "1")
)

func initMonitoring() error {
    var err error

    if RouteKey, err = tag.NewKey("route"); err != nil {
        return fmt.Errorf("route key: %w", err)
    }

    . . .
}
```

OpenCensus metrics

```
RequestView := view.View{
    Name:      "sort/requests",
    Measure:   Requests,
    Description: "Number of requests",
    Aggregation: view.Count(),
    TagKeys:   []tag.Key{RouteKey},
}

RequestTimeView := view.View{
    Name:      "sort/request-time",
    Measure:   RequestTime,
    Description: "Duration of requests (s)",
    Aggregation: view.Distribution(1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12),
    TagKeys:   []tag.Key{RouteKey},
}

. . .
```

OpenCensus metrics

```
if err = view.Register(&RequestView, &RequestTimeView); err != nil {
    return fmt.Errorf("register view: %w", err)
}

projectID := os.Getenv("GOOGLE_CLOUD_PROJECT")
opts := stackdriver.Options{ProjectID: projectID}
exporter, err := stackdriver.NewExporter(opts)

if err != nil {
    return fmt.Errorf("exporter: %w", err)
}

view.RegisterExporter(exporter)
view.SetReportingPeriod(60 * time.Second)

return nil
}
```

Use the metrics

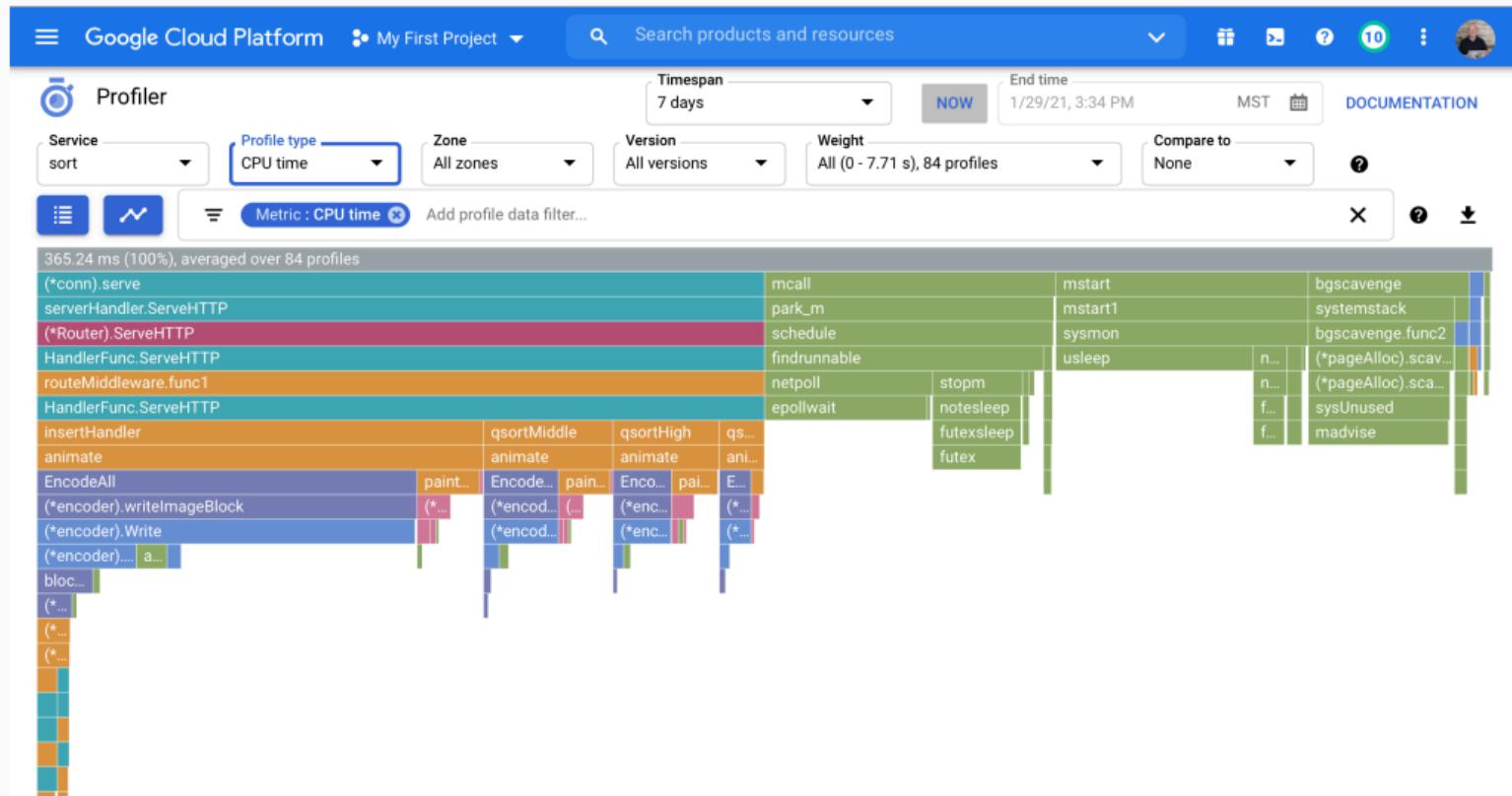
```
func routeMiddleware(next http.Handler) http.Handler {
    return http.HandlerFunc(func(w http.ResponseWriter, r *http.Request) {
        route := r.URL.Path[1:]
        ctx, _ := tag.New(r.Context(), tag.Insert(RouteKey, route))
        trace := getTraceID(r)
        logger := log.New(log.Writer(), trace+" ", log.LstdFlags|log.Lmsgprefix)
        start := time.Now()

        stats.Record(ctx, Requests.M(1))           // count
        next.ServeHTTP(w, r)

        done := time.Since(start).Milliseconds()

        stats.Record(ctx, RequestTime.M(done/1000)) // duration
        logger.Println(r.URL.String(), done)
    })
}
```

CPU profile



Learning resources (books, blogs, videos)

The screenshot shows a GitHub repository page for `matt4biz/go-resources`. The repository has 2 stars, 2 forks, and 2 commits. It contains a single branch named `master` and no tags. The repository's README.md file is visible, containing sections for `Go resources`, a list of learning resources, and a note about the `apple` emoji.

Code | **Issues** | **Pull requests** | **Actions** | **Projects** | **Wiki** | **Security** | **Insights** | **Settings**

Code | **1 branch** | **0 tags** | **Go to file** | **Add file** | **Code**

About
Resources for Go (golang) developers
Readme

Releases
No releases published
[Create a new release](#)

Packages
No packages published
[Publish your first package](#)

Contributors 2

matt4biz Matt Holiday
 mholiday-nyt Matthew Holiday

README.md

Go resources

This is a list of books, articles, videos, and other resources about learning Go along with some related topics.

Although a few tools or frameworks are mentioned, this site is particularly oriented towards tutorials or articles to improve one's knowledge of Go or software development, particularly development for the cloud.

If you're looking for links to software, [Awesome Go](#) is a site primarily oriented toward Go projects with some information on conventions and tutorials also.

The apple marks items of particular note.

Thank you!

You can reach me at

e: matt@k0dvb.com

t: @k0dvb

Again, the repos are under <https://github.com/matt4biz>

On YouTube, search for [kødvh](#) (that's an option-o character, sorry :-)