Running and monitoring a low maintenance web application

Looking into the ElasticCC platform

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Today's goal

> How to run and maintain a modern web java application with minimal resources

Agenda

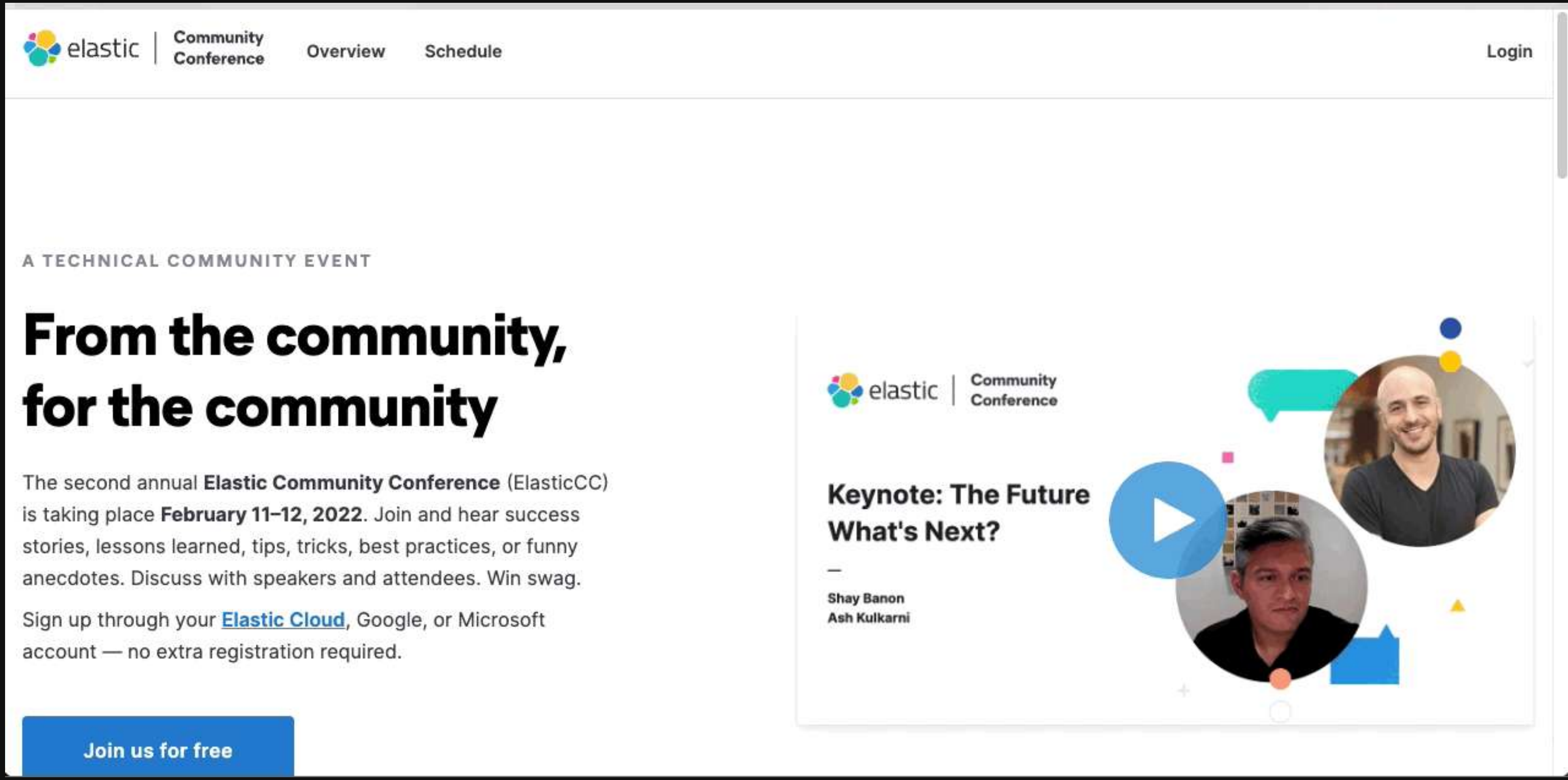
- Conference app as a platform? Build vs. Buy?
- Requirements
- Technologies used
- Persistence layer
- Downtime free rollouts
- Monitoring
- Frontend for backend devs
- Dashboards for tracking

Requirements

- Schedule & Speaker info
- Registration
- Feedback & Rating
- Quiz

Schedule

- Display
- Filtering
- Personalization
- Provide ical file



A TECHNICAL COMMUNITY EVENT

From the community, for the community

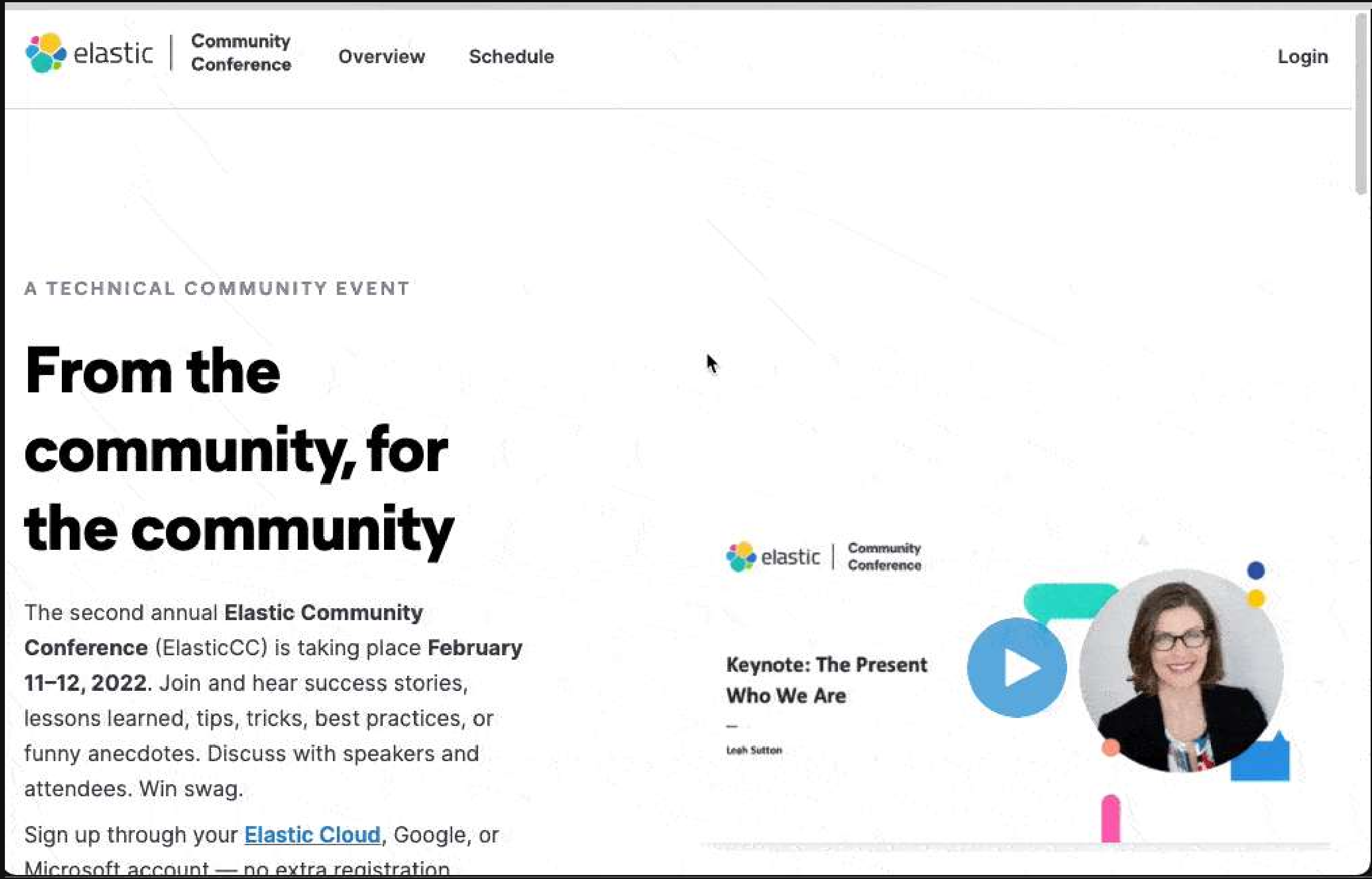
The second annual **Elastic Community Conference** (ElasticCC) is taking place **February 11–12, 2022**. Join and hear success stories, lessons learned, tips, tricks, best practices, or funny anecdotes. Discuss with speakers and attendees. Win swag.

Sign up through your Elastic Cloud, Google, or Microsoft account — no extra registration required.

Join us for free
elastic | Community Conference
Keynote: The Future What's Next?
—
Shay Banon
Ash Kulkarni

Registration

- No password data in this system!
- SAML: Use Elastic Cloud login
- Danger: Breaks single page flow!



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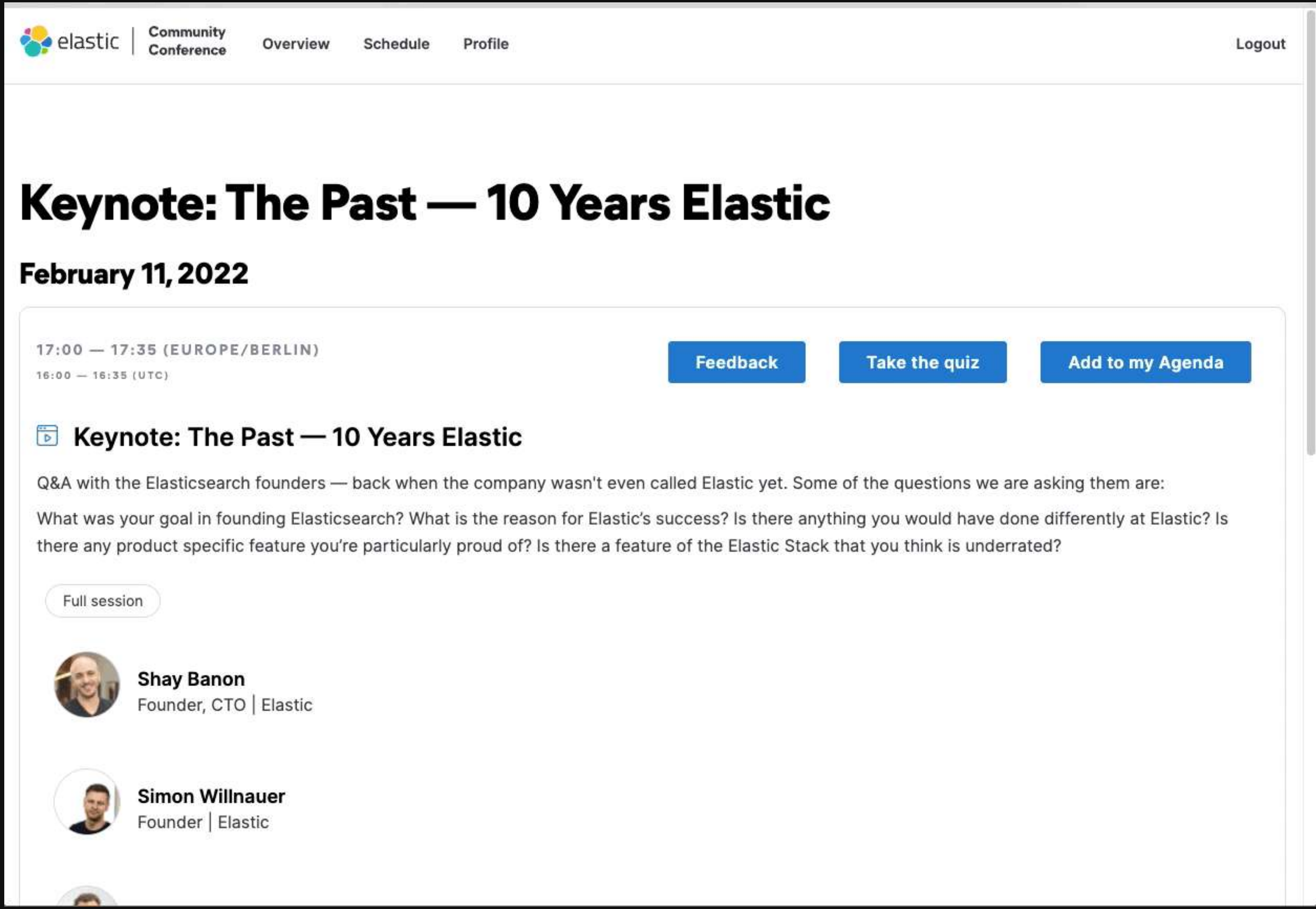
Keynote: The Present Who We Are
—
Leah Sutton

Feedback

- Rating
- Feedback wall



Keynote: The Past — 10 Years Elastic

February 11, 2022

17:00 — 17:35 (EUROPE/BERLIN)
16:00 — 16:35 (UTC)

Keynote: The Past — 10 Years Elastic

Q&A with the Elasticsearch founders — back when the company wasn't even called Elastic yet. Some of the questions we are asking them are:

What was your goal in founding Elasticsearch? What is the reason for Elastic's success? Is there anything you would have done differently at Elastic? Is there any product specific feature you're particularly proud of? Is there a feature of the Elastic Stack that you think is underrated?

Full session

Shay Banon
Founder, CTO | Elastic

Simon Willnauer
Founder | Elastic

Build vs. Buy

- Customization
- SAML integration
- Hefty price tag
- Focus on commercial events, not free ones

> Use your own technologies in production!
>
> *-- Me*

Requirements

- Speed (rendering)
- Ease of use & feature development
- Fast startup
- Monitoring/APM
- Docker image to deploy to k8s
- **Low maintenance**

Technologies used

- Javalin (Jetty)
- JTE
- pac4j
- Elastic Stack
- Config file parsing: typesafe/lightbend config
- Testing: assertJ, testcontainers, equalsverifier
- Frontend: htmx & hyperscript

Javalin

- Based on jetty, servlet based
- No reflection, no annotations
- Fast startup
- Extensible
- Built-in support for WS, SSE, OpenAPI

JTE

- **Fast**, typed, built-in escaping
- Hot reloading in development
- Build time compilation for production
- Tag support

```
@import my.Entry
@param Entry entry
@param boolean verbose = false

<h2>${entry.title}</h2>
@if(verbose)
    <h3>${entry.subtitle}</h3>
@endif
```

pac4j

> The Java security engine to protect all your web applications and web services

- Authorization
- Authentication (OAuth, SAML, CAS, OpenID Connect, JWT, SPNEGO)
- Supports almost 20 web frameworks

Persistence layer

- CfP process is done via sessionize
- Contains schedule data, speaker data
- Allows to add custom fields
- Has an API, read-only
- Schedule can be polled and updated every 10 minutes
- No need for persistence for the schedule, but...

Persistence layer

- Storing registrations, ratings, feedback, custom agenda
- Elasticsearch
- Use new Elasticsearch Java Client to provide feedback

Elasticsearch persistence

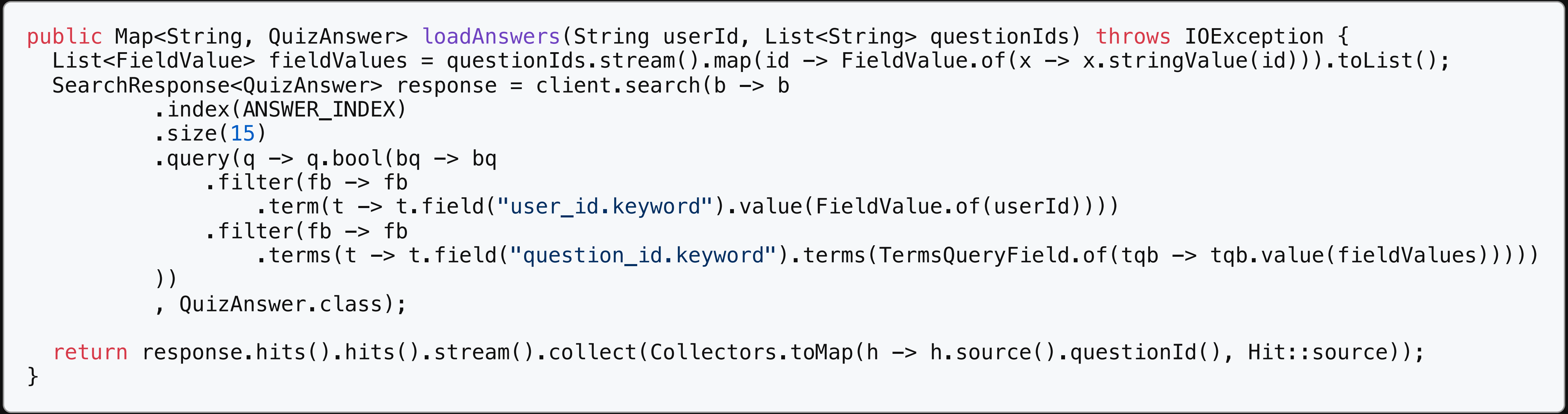
```java
public record Rating(String sessionId, String userId,
                     Integer rating, List<Feedback> feedbacks, OffsetDateTime createdAt) {
}
```

```java
public class RatingService {

    public static final String INDEX = "elasticcc-ratings";

    private final ElasticsearchClient client;

    public RatingService(ElasticsearchClient client) {
        this.client = client;
    }

    public void save(Rating rating) throws IOException {
        client.index(b -> b.index(INDEX)
                  .id(rating.sessionId() + "-" + rating.userId())
                  .document(rating)
        );
    }
}
```

Elasticsearch persistence

```
public final static ObjectMapper mapper = new ObjectMapper()
        .registerModule(new JavaTimeModule())
        .setPropertyNamingStrategy(PropertyNamingStrategies.SNAKE_CASE)
        .configure(SerializationFeature.WRITE_DATES_AS_TIMESTAMPS, false)
        .setSerializationInclusion(JsonInclude.Include.NON_NULL);

public ElasticsearchClient toElasticsearchClient(Config config) {
  final RestClientBuilder builder = RestClient.builder(HttpHost.create(config.getString("host")));

  if (config.hasPath("user") && config.hasPath("password")) {
    final String user = config.getString("user");
    final String password = config.getString("password");
    final CredentialsProvider credentialsProvider = new BasicCredentialsProvider();
    credentialsProvider.setCredentials(AuthScope.ANY, new UsernamePasswordCredentials(user, password));
    builder.setHttpClientConfigCallback(b -> b.setDefaultCredentialsProvider(credentialsProvider));
  }

  RestClient restClient = builder.build();
  ElasticsearchTransport transport = new RestClientTransport(restClient, new JacksonJsonpMapper(mapper));
  return new ElasticsearchClient(transport);
}
```

Elasticsearch persistence



```java
public Map<String, QuizAnswer> loadAnswers(String userId, List<String> questionIds) throws IOException {
  List<FieldValue> fieldValues = questionIds.stream().map(id -> FieldValue.of(x -> x.stringValue(id))).toList();
  SearchResponse<QuizAnswer> response = client.search(b -> b
          .index(ANSWER_INDEX)
          .size(15)
          .query(q -> q.bool(bq -> bq
              .filter(fb -> fb
                  .term(t -> t.field("user_id.keyword").value(FieldValue.of(userId))))
              .filter(fb -> fb
                  .terms(t -> t.field("question_id.keyword").terms(TermsQueryField.of(tqb -> tqb.value(fieldValues)))))
          ))
          , QuizAnswer.class);

  return response.hits().hits().stream().collect(Collectors.toMap(h -> h.source().questionId(), Hit::source));
}
```

Downtime free rollouts

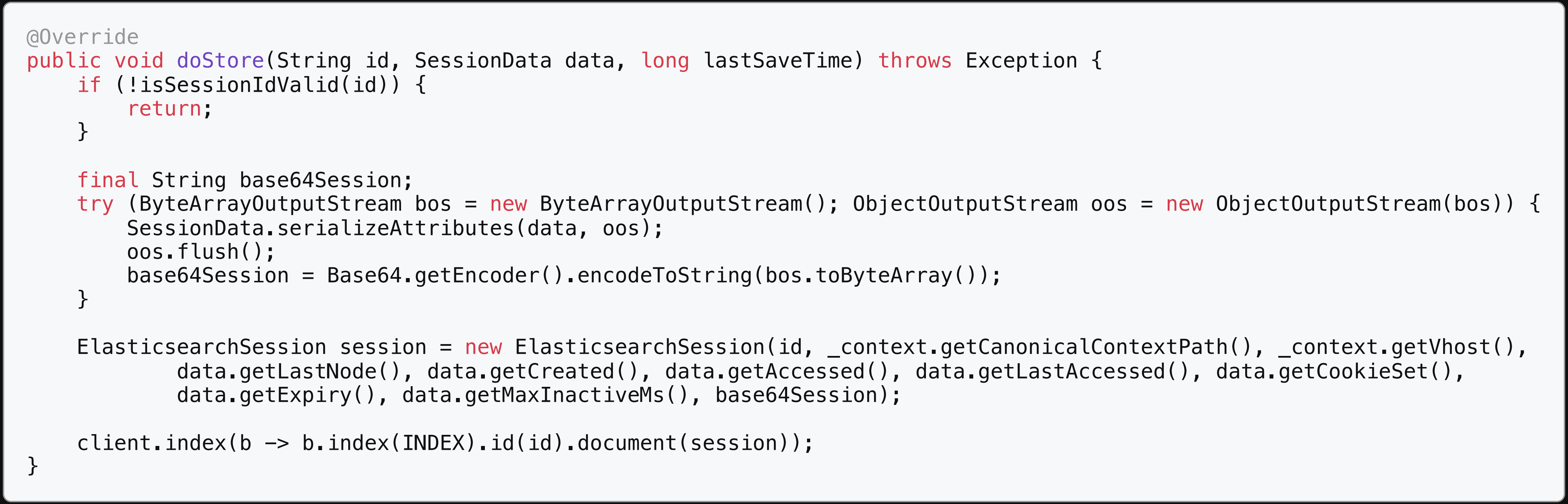
```
kubectl rollout restart deployment/elasticcc-app
```

- readiness probes
- liveness probes
- persistent sessions (> 1 replicas, round robin)

Persistent sessions

```java
public static SessionHandler createSessionHandler(ElasticsearchClient client) {
    SessionHandler sessionHandler = new SessionHandler();
    sessionHandler.setMaxInactiveInterval(86_400 * 7); // full week
    sessionHandler.setHttpOnly(true);
    sessionHandler.setSameSite(HttpCookie.SameSite.STRICT);
    sessionHandler.setSecureRequestOnly(true);

    SessionCache sessionCache = new NullSessionCache(sessionHandler);
    sessionCache.setSaveOnCreate(true);
    sessionCache.setFlushOnResponseCommit(true);
    sessionCache.setSessionDataStore(new ElasticsearchSessionDataStore(client));
    sessionHandler.setSessionCache(sessionCache);
    return sessionHandler;
}
```

Persistent sessions



```java
@Override
public void doStore(String id, SessionData data, long lastSaveTime) throws Exception {
    if (!isSessionIdValid(id)) {
        return;
    }

    final String base64Session;
    try (ByteArrayOutputStream bos = new ByteArrayOutputStream(); ObjectOutputStream oos = new ObjectOutputStream(bos)) {
        SessionData.serializeAttributes(data, oos);
        oos.flush();
        base64Session = Base64.getEncoder().encodeToString(bos.toByteArray());
    }

    ElasticsearchSession session = new ElasticsearchSession(id, _context.getCanonicalContextPath(), _context.getVhost(),
            data.getLastNode(), data.getCreated(), data.getAccessed(), data.getLastAccessed(), data.getCookieSet(),
            data.getExpiry(), data.getMaxInactiveMs(), base64Session);

    client.index(b -> b.index(INDEX).id(id).document(session));
}
```

Persistent sessions - problem: bots

- About 99% of the requests are bots, security scanners, that create a new session per request
- Persists a six digit amount of sessions per day
- Solution: Persist session only, if users are logged in

Persistent sessions - login check

```
app.after("/login", ctx -> {
  ctx.sessionAttribute("persist_session", true);
});
```

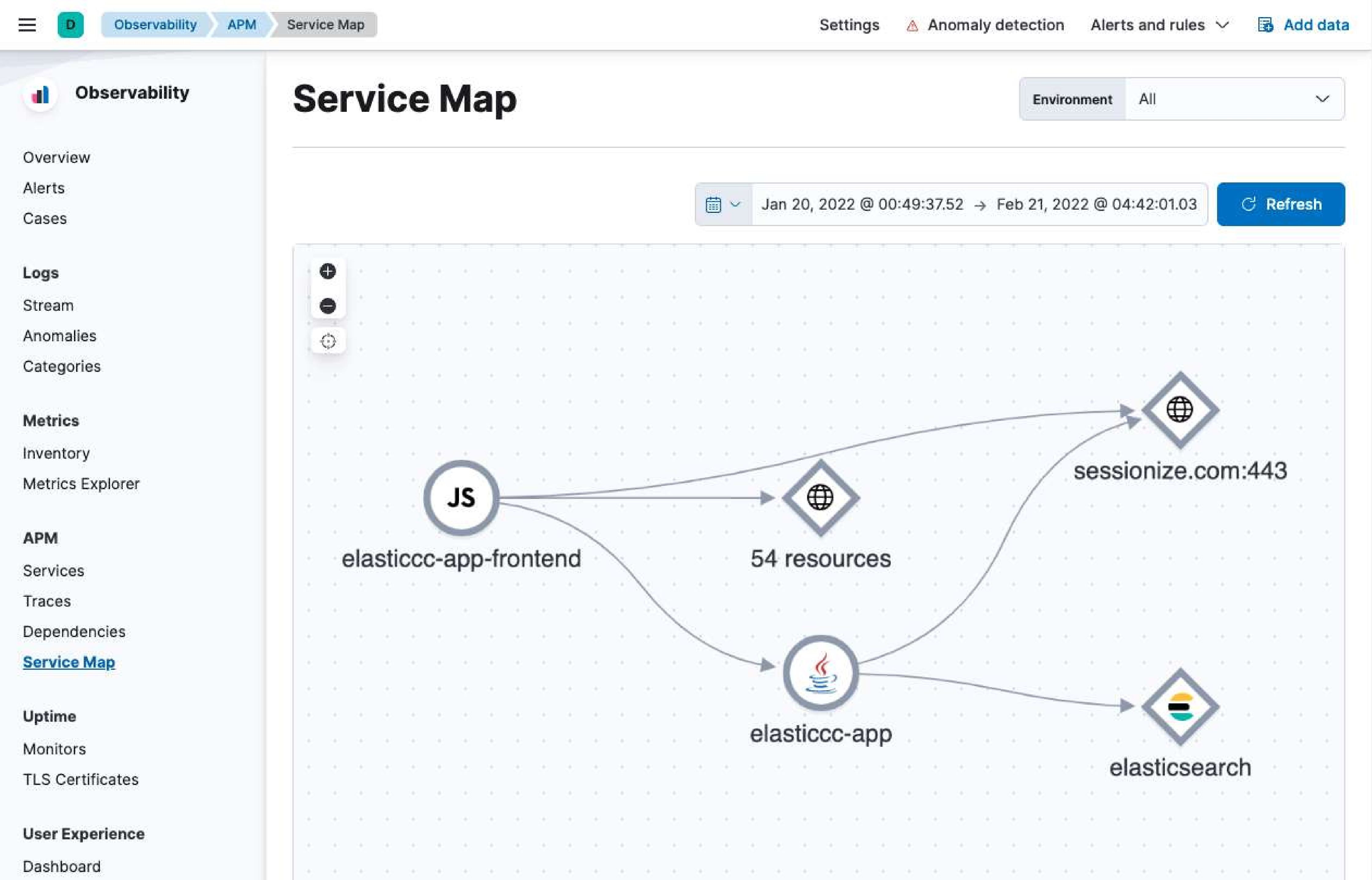
```
public void doStore(String id, SessionData data, long lastSaveTime) throws Exception {
  // validation

  // check if should be persisted
  Boolean persistSession = (Boolean) data.getAttribute("persist_session");
  if (persistSession == null || persistSession == false) {
    return;
  }

  // persist
  // ...
}
```

Persistent sessions - login check

- **much** less processing time for most requests
- **much** less Elasticsearch indexing work
- less CPU time wasted, less useless work done 👍

Monitoring

- Elastic APM, from the browser to the backend



Service Map

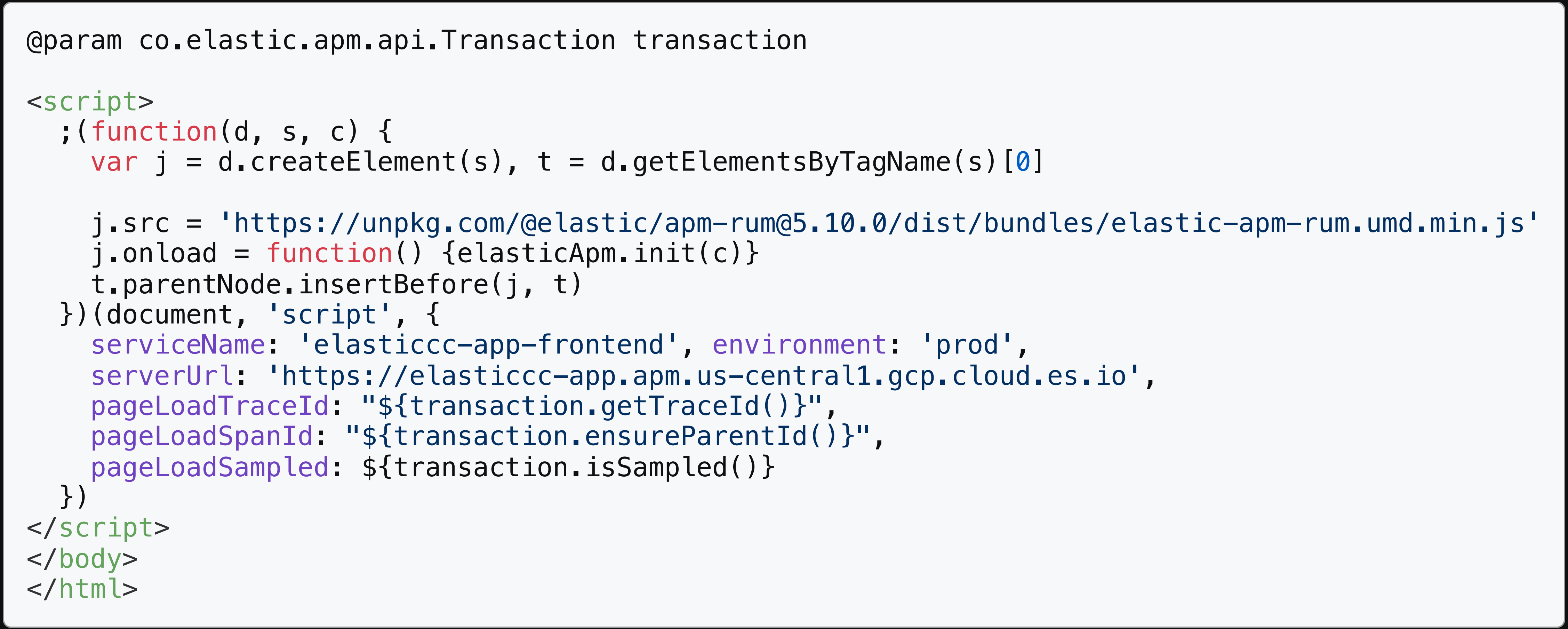
Environment All

Jan 20, 2022 @ 00:49:37.52 → Feb 21, 2022 @ 04:42:01.03

Elastic APM setup

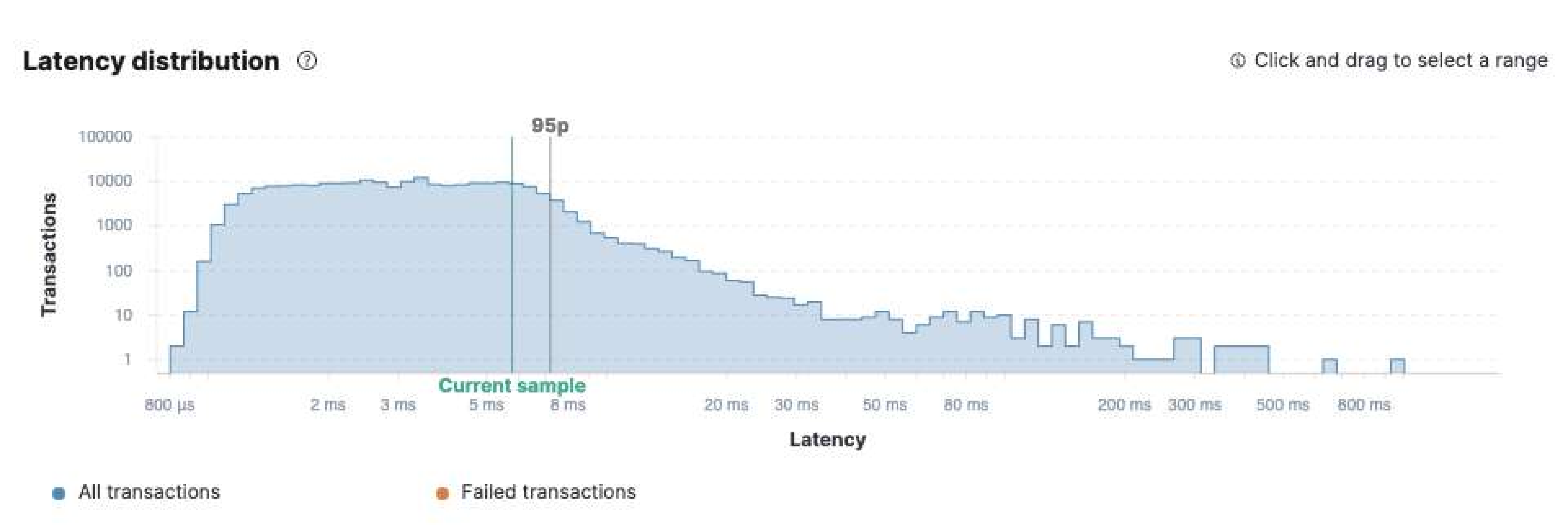
```
// set version at build time to annotate rollouts
setElasticApmServiceVersion();

System.setProperty("elastic.apm.environment", isProduction() ? "prod" : "dev");
System.setProperty("elastic.apm.application_packages", "co.elastic.community");

// add a span for rendering .jte templates and a span for Context.render()
System.setProperty("elastic.apm.trace_methods",
    "io.javalin.plugin.rendering.template.JavalinJte#render,io.javalin.http.Context#render");

// those should not be shown in the APM UI, as they are controlling flow/logic
System.setProperty("elastic.apm.ignore_exceptions",
    "io.javalin.http.RedirectResponse,*ResponseNoopException");

// this is to have consistent JVM stats across restarts in the APM UI
System.setProperty("elastic.apm.service_node_name", "elasticcc-service-java");

// programmatic attachment, no need to configure an agent
ElasticApmAttacher.attach();
```

Elastic APM setup

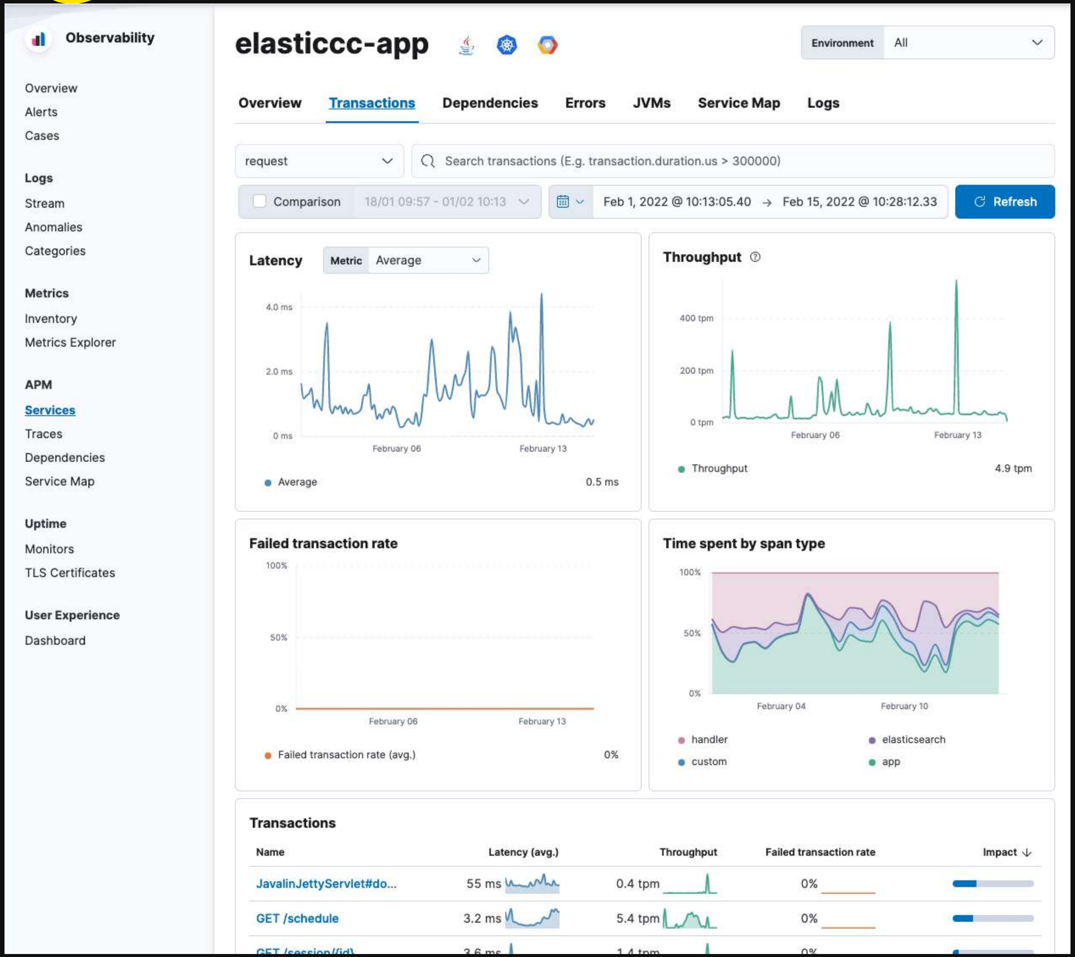


```
@param co.elastic.apm.api.Transaction transaction

<script>
  ;(function(d, s, c) {
    var j = d.createElement(s), t = d.getElementsByTagName(s)[0]

    j.src = 'https://unpkg.com/@elastic/apm-rum@5.10.0/dist/bundles/elastic-apm-rum.umd.min.js'
    j.onload = function() {elasticApm.init(c)}
    t.parentNode.insertBefore(j, t)
  })(document, 'script', {
    serviceName: 'elasticcc-app-frontend', environment: 'prod',
    serverUrl: 'https://elasticcc-app.apm.us-central1.gcp.cloud.es.io',
    pageLoadTraceId: "${transaction.getTraceId()}",
    pageLoadSpanId: "${transaction.ensureParentId()}",
    pageLoadSampled: ${transaction.isSampled()}
  })
</script>
</body>
</html>
```

Monitoring - Latency



Monitoring - Transactions



elasticccc-app

Environment: All

request

Search transactions (E.g. transaction.duration.us > 300000)

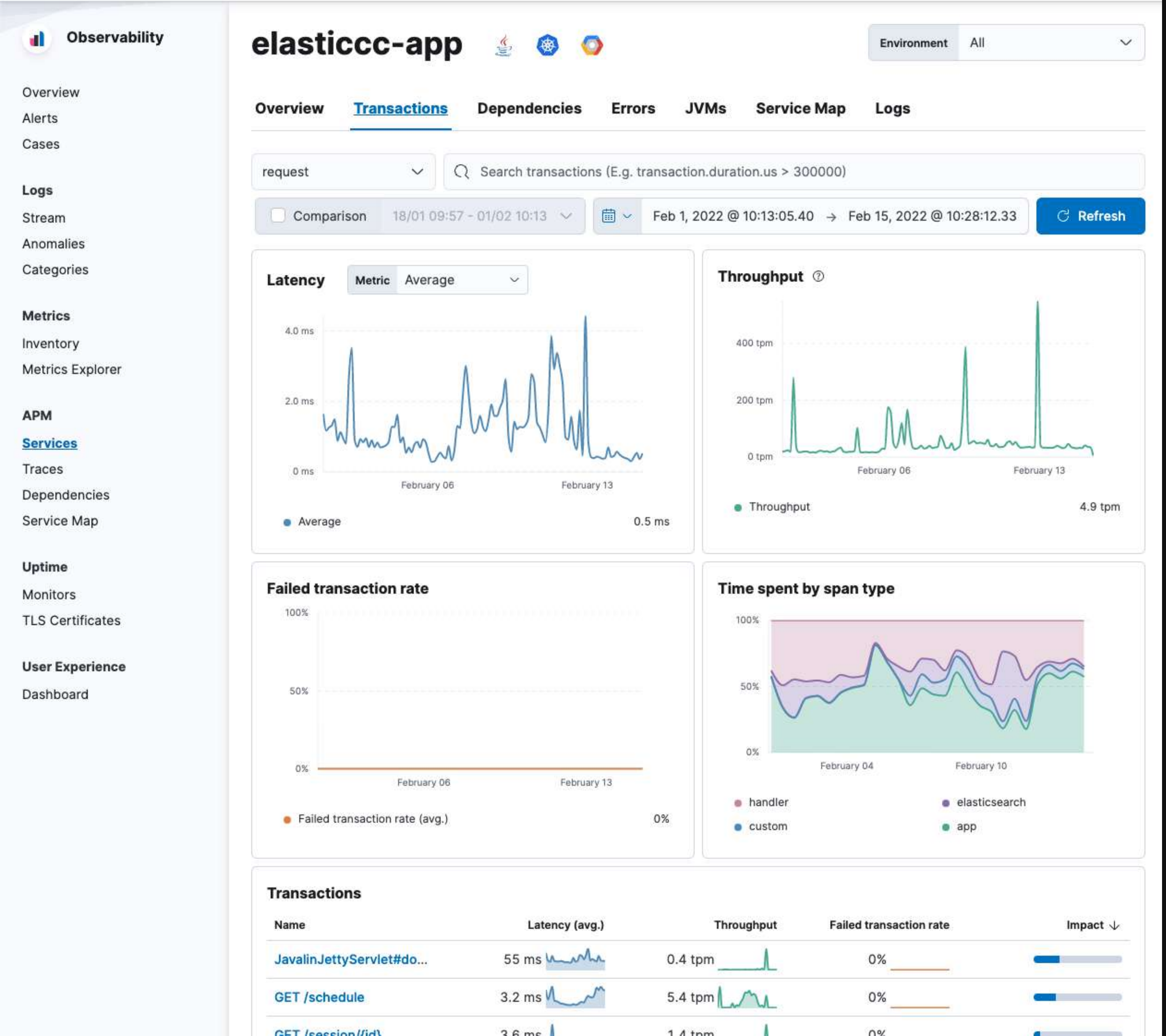
□ Comparison 18/01 09:57 - 01/02 10:13

Feb 1, 2022 @ 10:13:05.40 → Feb 15, 2022 @ 10:28:12.33

Latency — Metric: Average

Transactions

Name	Latency (avg.)	Throughput	Failed transaction rate	Impact ↓
JavalinJettyServlet#do...	55 ms	0.4 tpm	0%	
GET /schedule	3.2 ms	5.4 tpm	0%	
GET /session/{id}	3.6 ms	1.4 tpm	0%	



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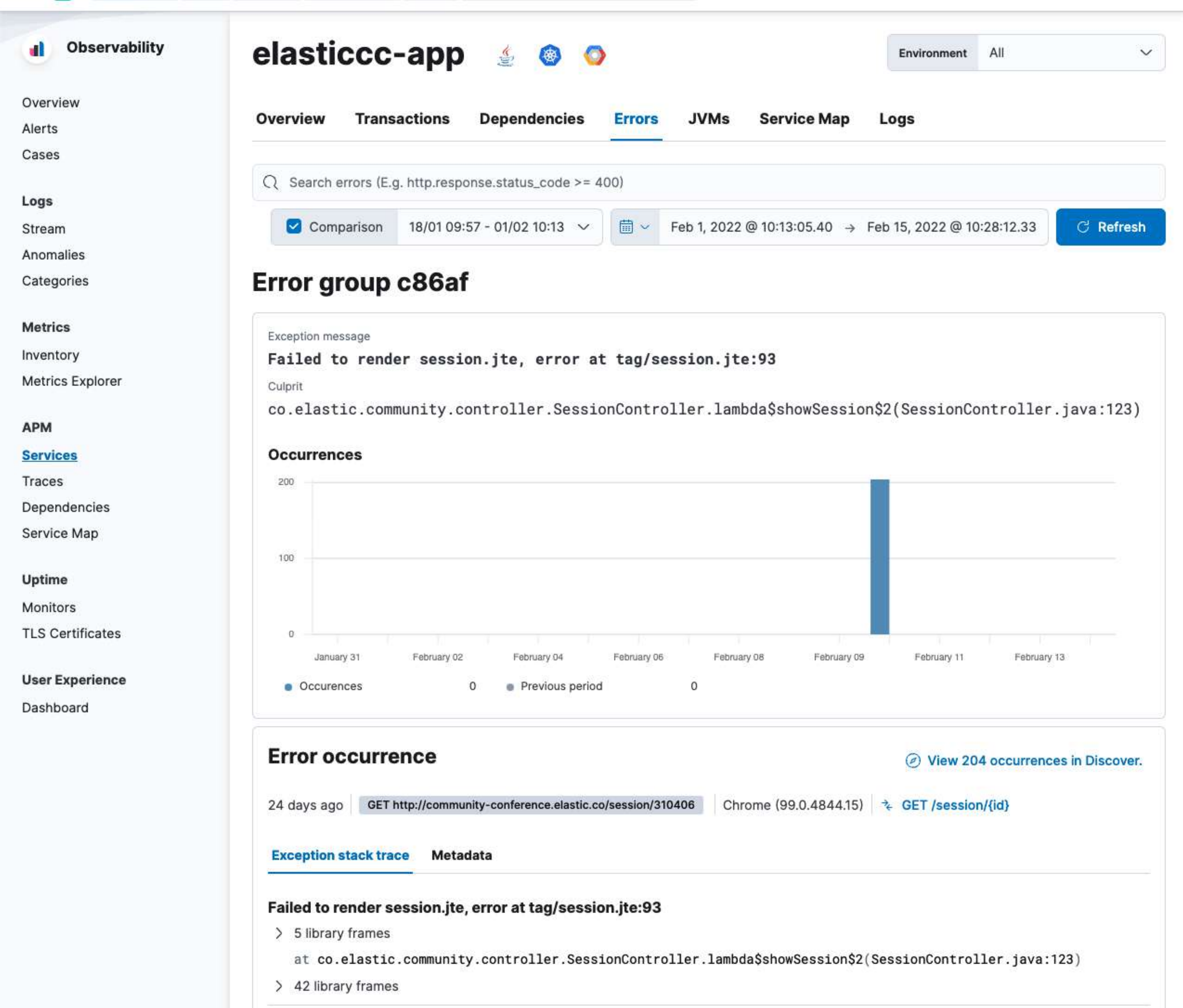
GET /schedule	3.2 ms	5.4 tpm	0%	
GET /session/{id}	3.6 ms	1.4 tpm	0%	

Errors

- NPE detection



Environment: All

Search errors (E.g. http.response.status_code >= 400)

☑ Comparison 18/01 09:57 - 01/02 10:13

Feb 1, 2022 @ 10:13:05.40 → Feb 15, 2022 @ 10:28:12.33

Error group c86af

Exception message

```
Failed to render session.jte, error at tag/session.jte:93
```

Culprit

```
co.elastic.community.controller.SessionController.lambda$showSession$2(SessionController.java:123)
```

Occurrences

● Occurences 0 ● Previous period 0

Error occurrence

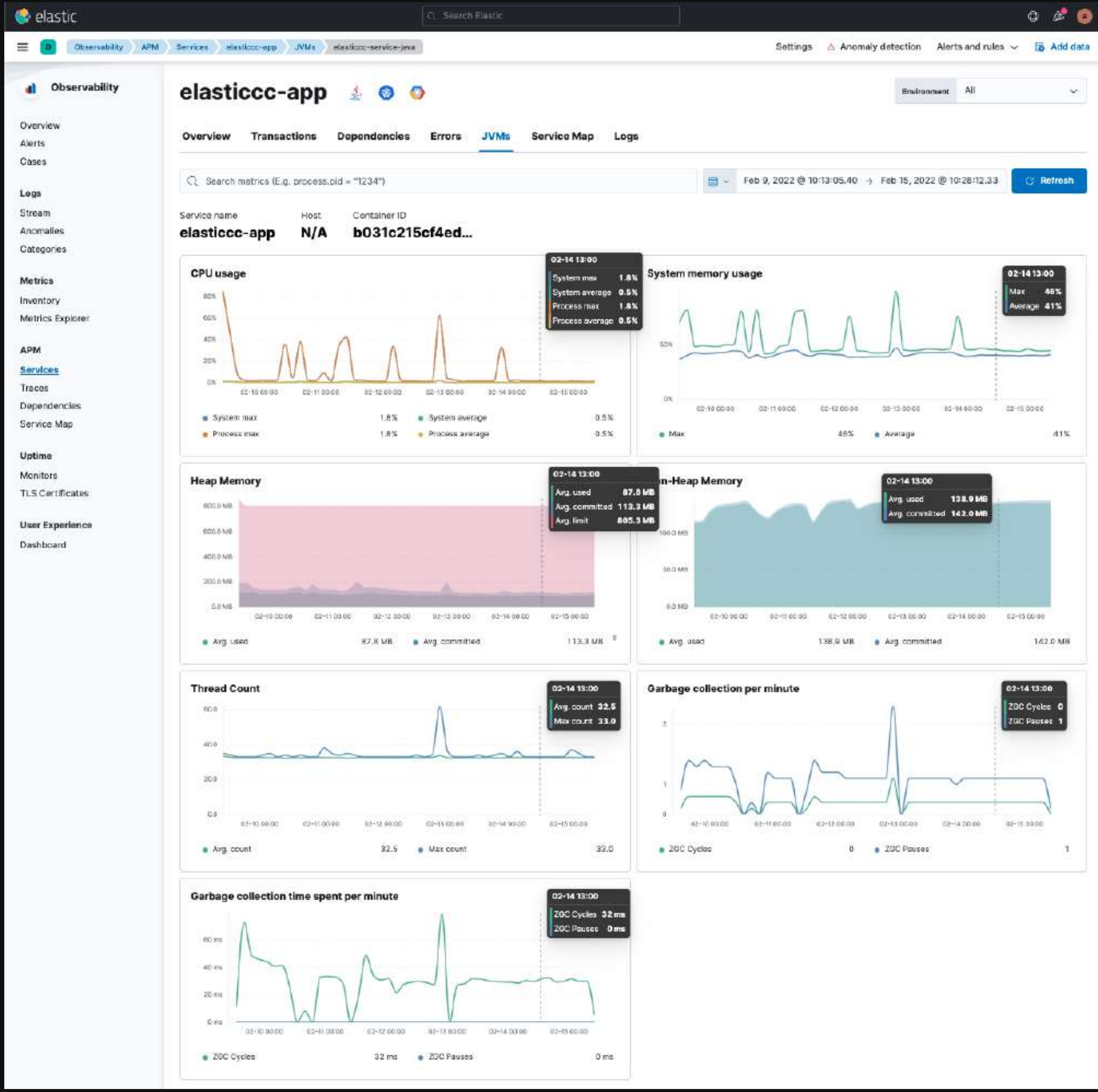
View 204 occurrences in Discover.

24 days ago | GET http://community-conference.elastic.co/session/310406 | Chrome (99.0.4844.15) | GET /session/{id}

```
Failed to render session.jte, error at tag/session.jte:93
> 5 library frames
  at co.elastic.community.controller.SessionController.lambda$showSession$2(SessionController.java:123)
> 42 library frames
```

JVM monitoring

- ZGC: 👍
- CPU: 👍
- Mem: 👍



Service name: elasticcc-app
Host: N/A
Container ID: b031c215cf4ed...

CPU usage — 02-14 13:00: System max 1.8%, System average 0.5%, Process max 1.8%, Process average 0.5%
● System max 1.8% ● System average 0.5%
● Process max 1.8% ● Process average 0.5%

System memory usage — 02-14 13:00: Max 46%, Average 41%
● Max 46% ● Average 41%

Heap Memory — 02-14 13:00: Avg. used 87.8 MB, Avg. committed 113.3 MB, Avg. limit 805.3 MB
● Avg. used 87.8 MB ● Avg. committed 113.3 MB

n-Heap Memory — 02-14 13:00: Avg. used 138.9 MB, Avg. committed 142.0 MB
● Avg. used 138.9 MB ● Avg. committed 142.0 MB

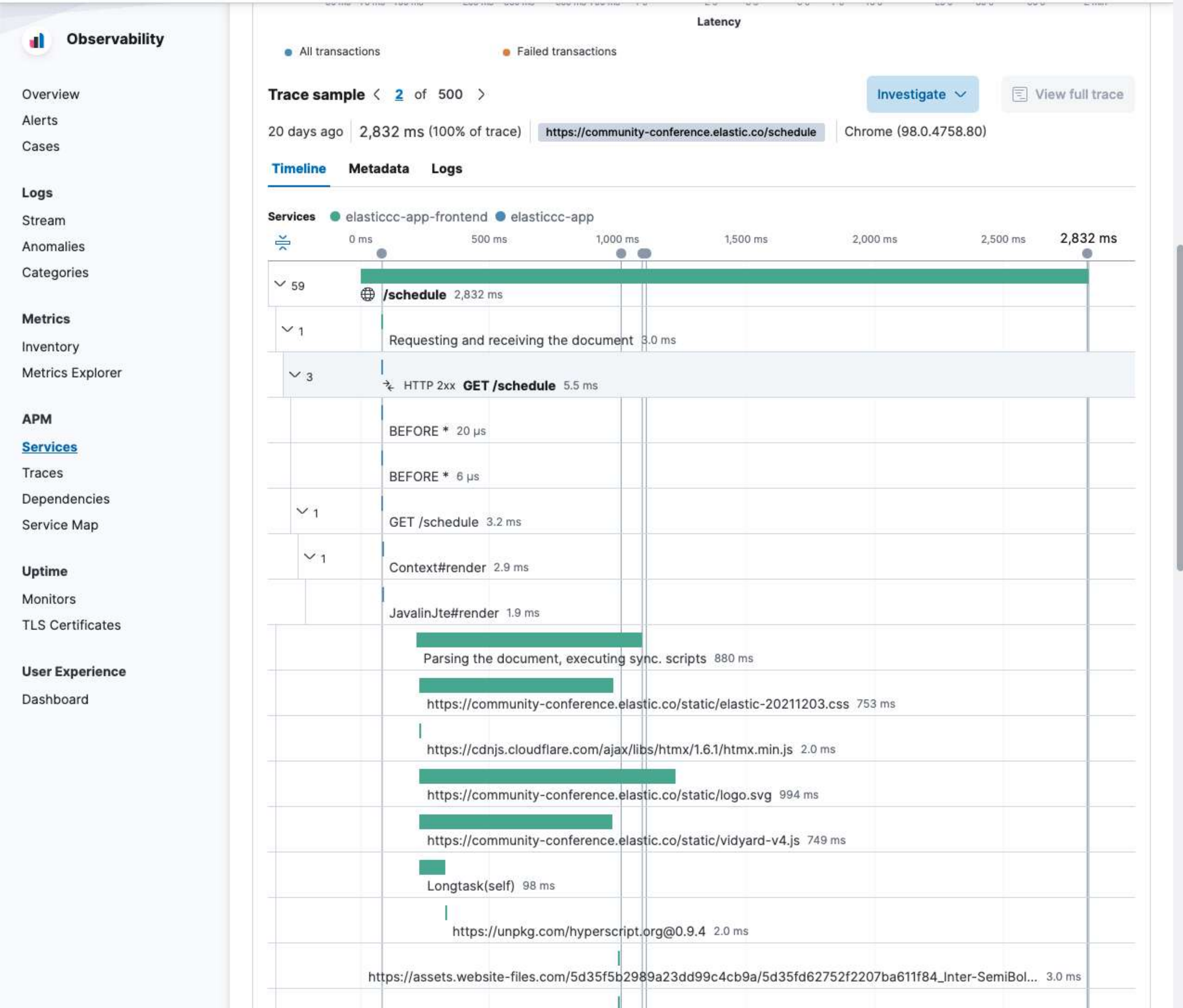
Thread Count — 02-14 13:00: Avg. count 32.5, Max count 33.0
● Avg. count 32.5 ● Max count 33.0

Garbage collection per minute — 02-14 13:00: ZGC Cycles 0, ZGC Pauses 1
● ZGC Cycles 0 ● ZGC Pauses 1

Garbage collection time spent per minute — 02-14 13:00: ZGC Cycles 32 ms, ZGC Pauses 0 ms
● ZGC Cycles 32 ms ● ZGC Pauses 0 ms

Frontend

...is part of your performance!



Trace sample 2 of 500

20 days ago | 2,832 ms (100% of trace) | https://community-conference.elastic.co/schedule | Chrome (98.0.4758.80)

Services ● elasticcc-app-frontend ● elasticcc-app

```
59 /schedule 2,832 ms
1 Requesting and receiving the document 3.0 ms
3 HTTP 2xx GET /schedule 5.5 ms
BEFORE * 20 μs
BEFORE * 6 μs
1 GET /schedule 3.2 ms
1 Context#render 2.9 ms
JavalinJte#render 1.9 ms
Parsing the document, executing sync. scripts 880 ms
https://community-conference.elastic.co/static/elastic-20211203.css 753 ms
https://cdnjs.cloudflare.com/ajax/libs/htmx/1.6.1/htmx.min.js 2.0 ms
https://community-conference.elastic.co/static/logo.svg 994 ms
https://community-conference.elastic.co/static/vidyard-v4.js 749 ms
Longtask(self) 98 ms
https://unpkg.com/hyperscript.org@0.9.4 2.0 ms
https://assets.website-files.com/5d35f5b2989a23dd99c4cb9a/5d35fd62752f2207ba611f84_Inter-SemiBol... 3.0 ms
```

Frontend for backend devs

- SPAs as a no-go due to lacking skills
- `htmx` for making websites dynamic, but rendering server side
- `hyperscript` for events

htmx

- alternatives: Hotwire, Turbo
- HTML tag enrichment to send AJAX request
- render results server side
- configure HTML element to be updated with the response
- optional: update browser history

htmx

```
@param String sessionId

<ul id="rating_${sessionId}" style="list-style-type:none;display:inline;margin-left:0px;">
  @for(int i = 1; i <= 5; ++i)
    <li style="display:inline;">
      <a hx-post="/session/${sessionId}/rating/${i}"
         hx-target="#rating_${sessionId}"
         hx-swap="outerHTML"
         style="cursor:pointer;text-decoration:none;">
        💙
      </a>
    </li>
  @endfor
</ul>
```

hyperscript

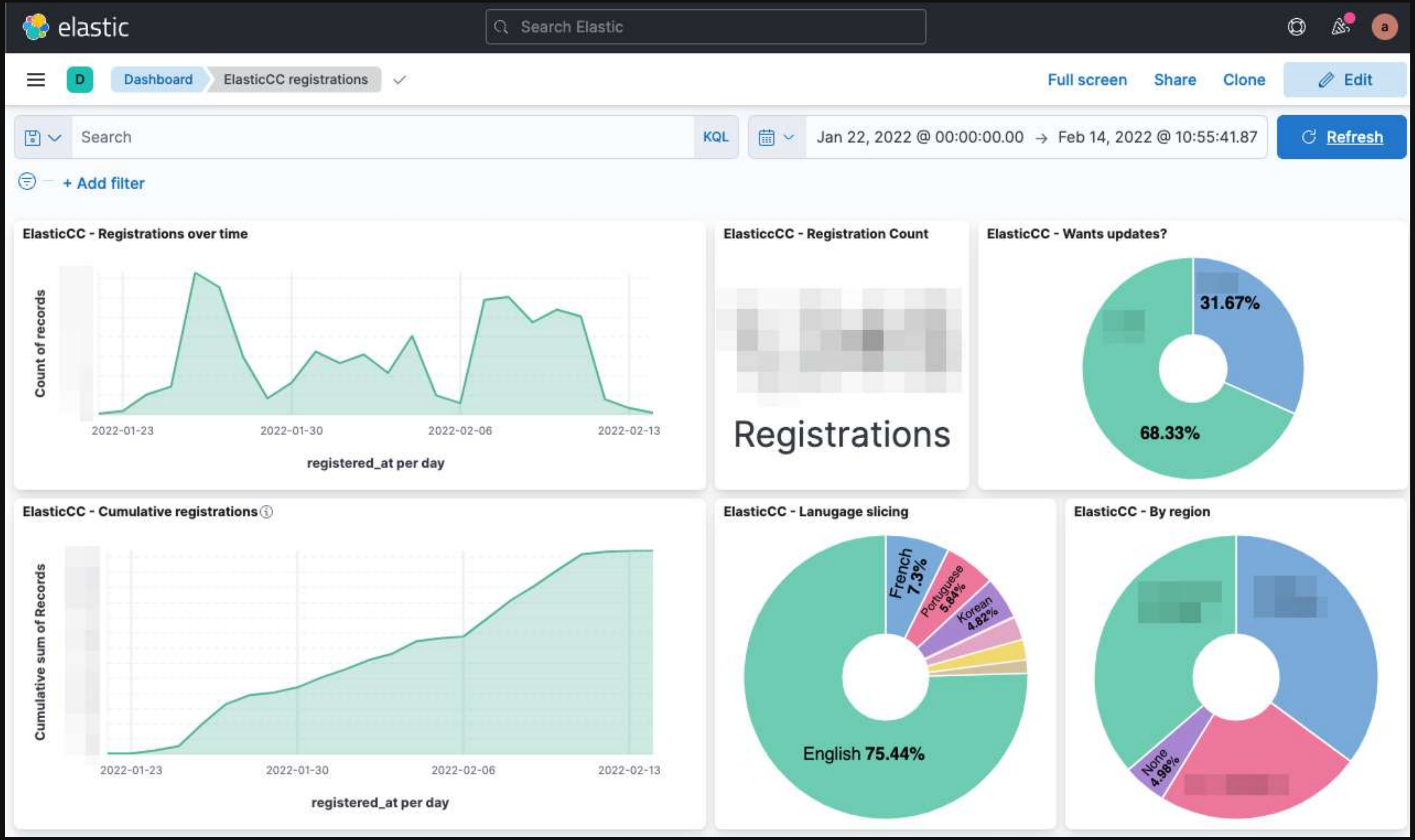
> hyperscript makes writing event handlers and highly responsive user interfaces easy with a clear, DOM-oriented syntax and by transparently handling asynchronous behavior for you — easier than callbacks, promises, even async/await.

```
<div _="on mouseenter toggle .visible on #help until mouseleave">
Mouse Over Me!
</div>
<div id="help"> I'm a helpful message!</div>
```

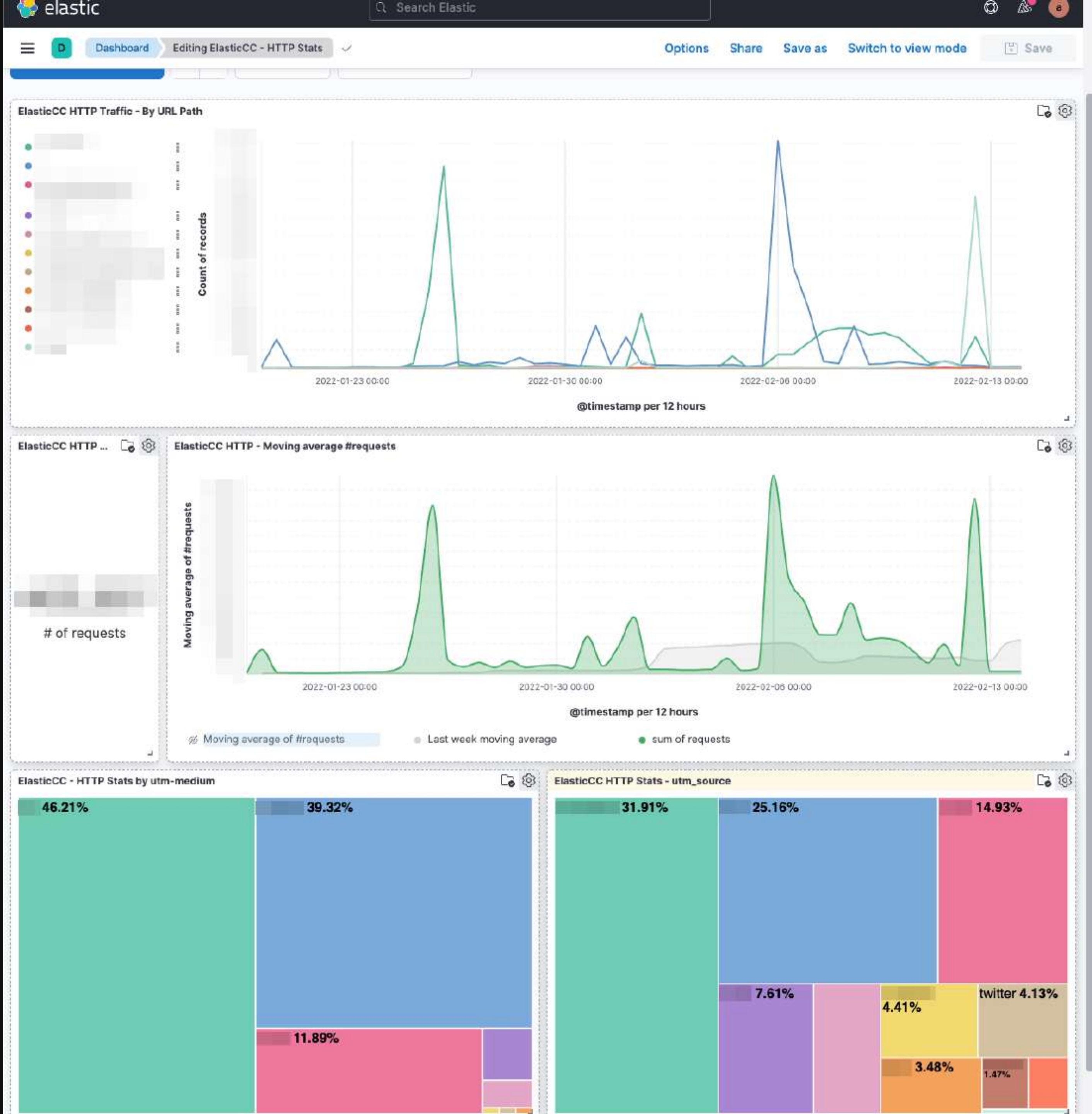
hyperscript

```
<div style="display: grid; grid-template-columns:1fr 1fr 1fr 1fr;">
  @for(var feedback : Feedback.values())
    !{var hasFeedback = rating != null && rating.feedbacks() != null
          && rating.feedbacks().contains(feedback);}

    <div class="@if(hasFeedback)button-primary-blue@elsebutton-secondary-blue@endif"
         _="on click
            toggle .button-secondary-blue toggle .button-primary-blue
            toggle [@checked=true] on #${feedback.name().toLowerCase(Locale.ROOT)}"
         >${feedback.displayName()}
    </div>

    <input type="checkbox"
           style="display:none"
           id="${feedback.name().toLowerCase(Locale.ROOT)}"
           name="${feedback.name()}" checked="${hasFeedback}"/>
  @endfor
</div>
```

Registrations



HTTP requests



Docker build

- multi layer build
- template precompilation
- use gradle `application` plugin to create shell scripts to start apps
- configure JVM options in `build.gradle`, i.e. `ZGC` usage

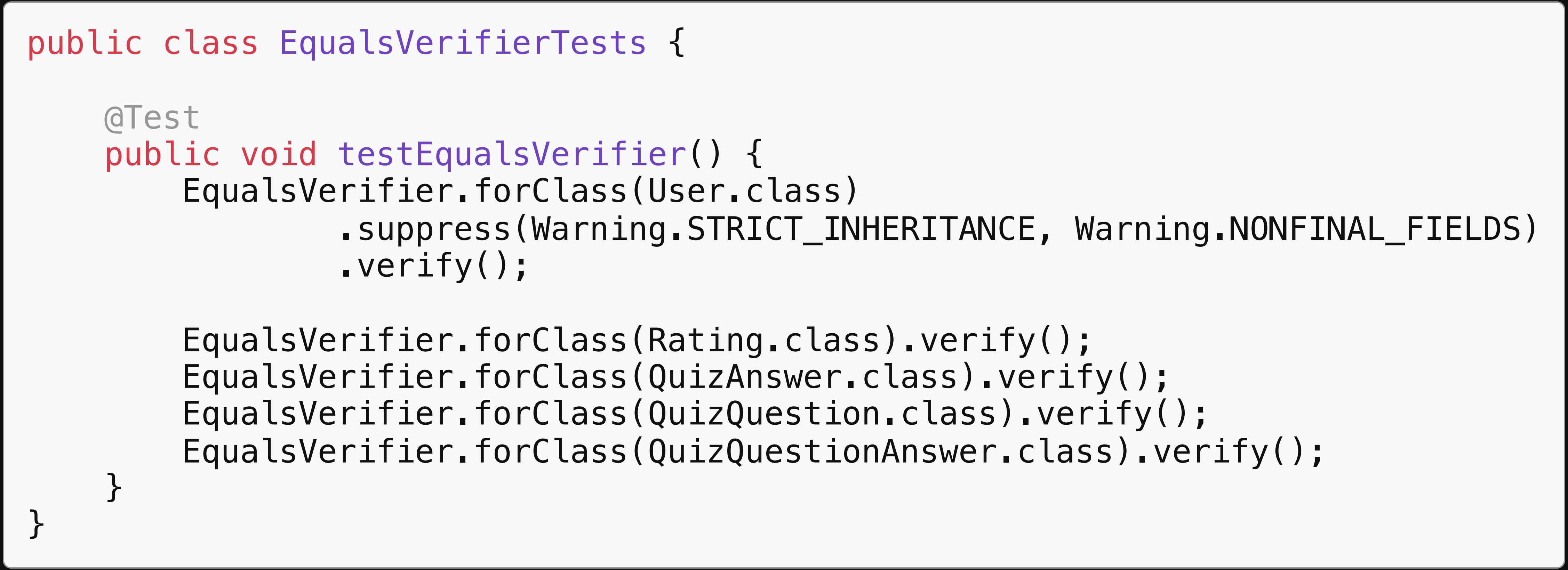
Docker build

```
FROM gradle:7.4-jdk17 AS build
COPY --chown=gradle:gradle . /home/gradle/src
WORKDIR /home/gradle/src
RUN gradle clean --no-daemon
RUN gradle copyDepsToLib --no-daemon
RUN gradle check --no-daemon
RUN gradle precompileJte --no-daemon
RUN gradle copyStartScriptsToBin --no-daemon
RUN gradle copyAppToLib --no-daemon

###############
FROM --platform=linux/amd64 openjdk:17.0.2-slim-bullseye
RUN addgroup --system elasticcc && adduser --system elasticcc --ingroup elasticcc
USER elasticcc:elasticcc

WORKDIR /elasticcc-app
# copy resources
COPY ...

EXPOSE 8080
ENTRYPOINT [ "/elasticcc-app/install/elasticcc-app/bin/elasticcc-app" ]
```

Testing

- Unit tests & integration tests
- `Equalsverifier`, `assertJ`, `mockito`
- Testcontainers

Testing - Equalsverifier

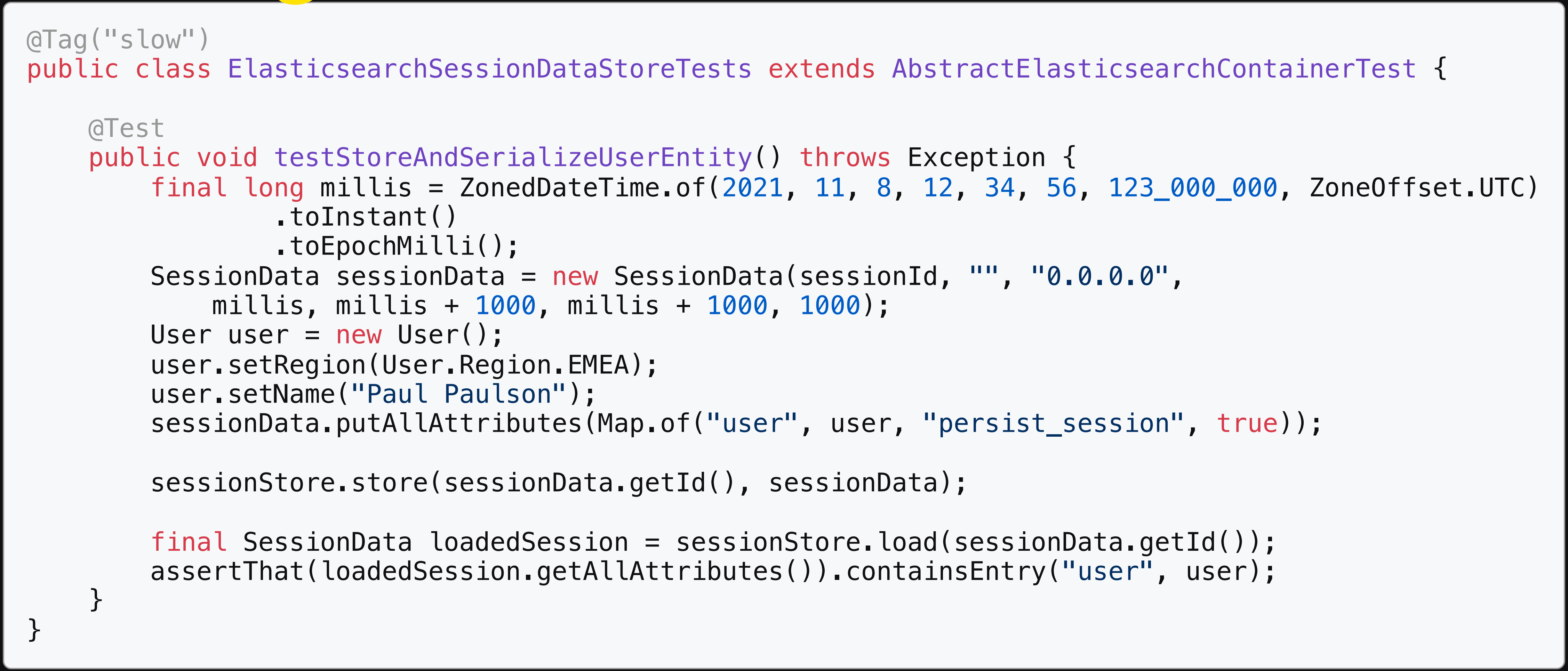


```
public class EqualsVerifierTests {

    @Test
    public void testEqualsVerifier() {
        EqualsVerifier.forClass(User.class)
                .suppress(Warning.STRICT_INHERITANCE, Warning.NONFINAL_FIELDS)
                .verify();

        EqualsVerifier.forClass(Rating.class).verify();
        EqualsVerifier.forClass(QuizAnswer.class).verify();
        EqualsVerifier.forClass(QuizQuestion.class).verify();
        EqualsVerifier.forClass(QuizQuestionAnswer.class).verify();
    }
}
```

Testing - Controller

```java
@Test
public void testShowSessionWhenNotLoggedIn() throws Exception {
    when(ctx.pathParam(eq("id"))).thenReturn("123");
    final Session session = createSession("123");
    when(sessionService.session(eq(session.id()))).thenReturn(session);
    // not logged in
    when(ctx.sessionAttribute(eq("user"))).thenReturn(null);

    controller.showSession().handle(ctx);

    assertThat(ctx).hasRenderTemplate("session");
    assertThat(ctx).renderMap().containsEntry("session", session);
    verifyNoInteractions(quizService);
    verifyNoInteractions(ratingService);
}
```

Testing - Testcontainers



```java
@Tag("slow")
public class ElasticsearchSessionDataStoreTests extends AbstractElasticsearchContainerTest {

    @Test
    public void testStoreAndSerializeUserEntity() throws Exception {
        final long millis = ZonedDateTime.of(2021, 11, 8, 12, 34, 56, 123_000_000, ZoneOffset.UTC)
                .toInstant()
                .toEpochMilli();
        SessionData sessionData = new SessionData(sessionId, "", "0.0.0.0",
            millis, millis + 1000, millis + 1000, 1000);
        User user = new User();
        user.setRegion(User.Region.EMEA);
        user.setName("Paul Paulson");
        sessionData.putAllAttributes(Map.of("user", user, "persist_session", true));

        sessionStore.store(sessionData.getId(), sessionData);

        final SessionData loadedSession = sessionStore.load(sessionData.getId());
        assertThat(loadedSession.getAllAttributes()).containsEntry("user", user);
    }
}
```

Keep in mind...

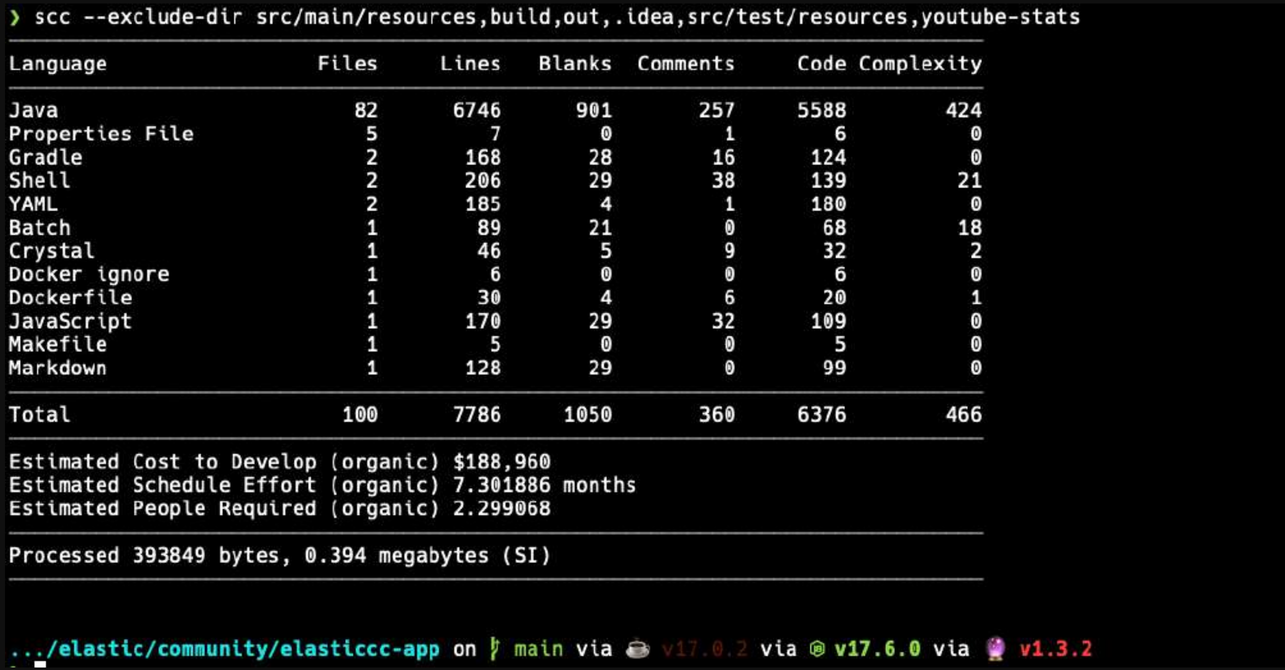
> low maintenance != no maintenance

- dependabot
- security is an ongoing task

Going live

- Secrets via vault
- JSON logging
- Access to logfiles
- k8s readiness/liveness probes

Summary



```
❯ scc --exclude-dir src/main/resources,build,out,.idea,src/test/resources,youtube-stats
───────────────────────────────────────────────────────────────────────────────
Language                 Files     Lines   Blanks  Comments     Code Complexity
───────────────────────────────────────────────────────────────────────────────
Java                        82      6746      901       257     5588        424
Properties File              5         7        0         1        6          0
Gradle                       2       168       28        16      124          0
Shell                        2       206       29        38      139         21
YAML                         2       185        4         1      180          0
Batch                        1        89       21         0       68         18
Crystal                      1        46        5         9       32          2
Docker ignore                1         6        0         0        6          0
Dockerfile                   1        30        4         6       20          1
JavaScript                   1       170       29        32      109          0
Makefile                     1         5        0         0        5          0
Markdown                     1       128       29         0       99          0
───────────────────────────────────────────────────────────────────────────────
Total                      100      7786     1050       360     6376        466
───────────────────────────────────────────────────────────────────────────────
Estimated Cost to Develop (organic) $188,960
Estimated Schedule Effort (organic) 7.301886 months
Estimated People Required (organic) 2.299068
───────────────────────────────────────────────────────────────────────────────
Processed 393849 bytes, 0.394 megabytes (SI)
───────────────────────────────────────────────────────────────────────────────


.../elastic/community/elasticcc-app on  main via ☕ v17.0.2 via  v17.6.0 via 🔮 v1.3.2
```

Summary

- Modern ✅
- Minimal resources ✅
- Other java developers commit changes ✅
- Low maintenance ✅
- Maximum performance? Graal ❌

Resources

- Community Conference website
- Web server: Javalin, Jetty, JTE, pac4j
- Elastic: Elastic Stack, Elasticsearch Java Client, Elastic Java APM Agent
- Configuration: typesafe config library
- Testing: assertJ, mockito, Testcontainers, EqualsVerifier
- Frontend: htmx, hyperscript, hotwire

Thanks for listening

Q & A

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