Pivotal

Spring Boot Actuator and Health Indicators

Utilizing Spring Boot's Built-in metrics and adding your own

Actuator

What value does it provide?

Actuators provide:

- Production grade monitoring without having to implement it yourself
- A framework to easily gather and return metrics
- Integration with 3rd party dashboards to show health and metrics of distributed systems

Actuator

How does it work?

The Actuator library adds many production-ready monitoring features

Accessible via JMX

Or as HTTP endpoints:

- `/actuator/info`
- `/actuator/health`
- `/actuator/metrics`

More endpoints

Important Note

Content applies to *Spring Boot 2.x*

Actuator implementation was very different in Spring Boot 1.x

Objectives

After completing this lesson, you should be able to

- Configure which Spring Boot Actuator HTTP endpoints are to be exposed
- Secure Spring Boot Actuator HTTP endpoints
- Define custom metrics
- Extend health endpoint to add custom health checks

Agenda

- **Spring Boot Actuator**
- Setting up Actuator
- Metrics
- Health indicators
- External monitoring systems

/actuator/info

General data, custom data, build information or details about the latest commit


```
{
   "build":  {
      "version": "5.0.c.RELEASE",
      "artifact": "37-actuator",
      "name": "37-actuator",
      "group": "io.pivotal.education.core-spring",
      "time": "2018-07-31T22:06:18.311Z"
   }
}
```

/actuator/health

Application health status

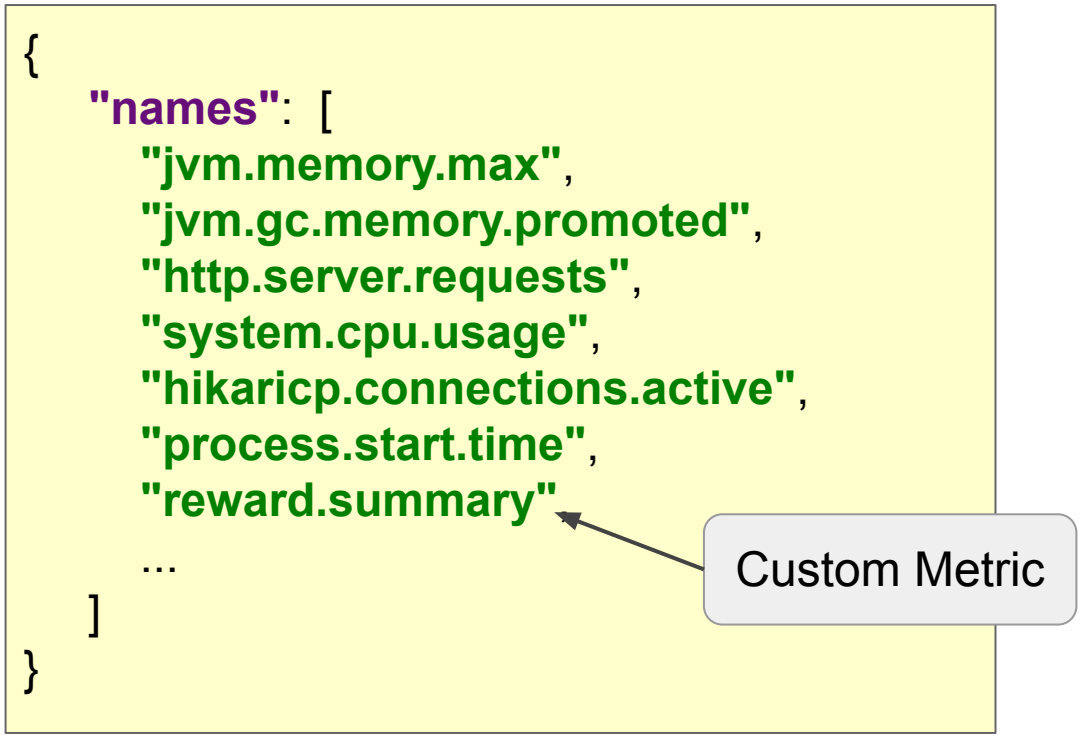
- Default output is minimal

```
{
    "status": "UP"
}
```

/actuator/metrics

List of generic and custom metrics measured by the application

- *Not* exposed by default



Example: /actuator/metrics/http.server.requests


```
{
 "name": "http.server.requests",
 "measurements": [
    { "statistic": "COUNT", "value": 13 },
    { "statistic": "MAX", "value": 0.003785154 },
    ...
 ],
 "availableTags": [ {
     "tag": "method",
     "values": [ "POST", "GET" ],
      ...
}
```

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Adding the Actuator dependency

- Include the Spring Boot actuator starter

```
<dependencies>
  <dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-actuator</artifactId>
  </dependency>
</dependencies>
```

Some of the Available Actuators - 1

`beans`	Spring Beans created by application
`conditions`	Conditions used by Auto-Configuration
`env`	Properties in the Spring Environment
`health`	Current state of the application
`httptrace`	Most recent HTTP requests in Web application
`info`	Displays arbitrary application information
`loggers`	Query and modify logging levels
`mappings`	Spring MVC request mappings

Some of the Available Endpoints - 2

`metrics`	List of available metrics
`session`	Fetch or delete user sessions (only if using Spring Session)
`shutdown`	Shutdown the application (gracefully), disabled by default
`threaddump`	Performs a thread dump
`jolokia`	Exposes JMX beans over HTTP (not just actuators)

For a full list see:

https://docs.spring.io/spring-boot/docs/current/reference/html/production-ready-endpoints.html#production-ready-endpoints-exposing-endpoints

Actuators: Enabled vs Exposed

Enabled = the given actuator is recorded / stored

Default = all are enabled except

shutdown,

httptrace, audit (from Spring Boot 2.2)

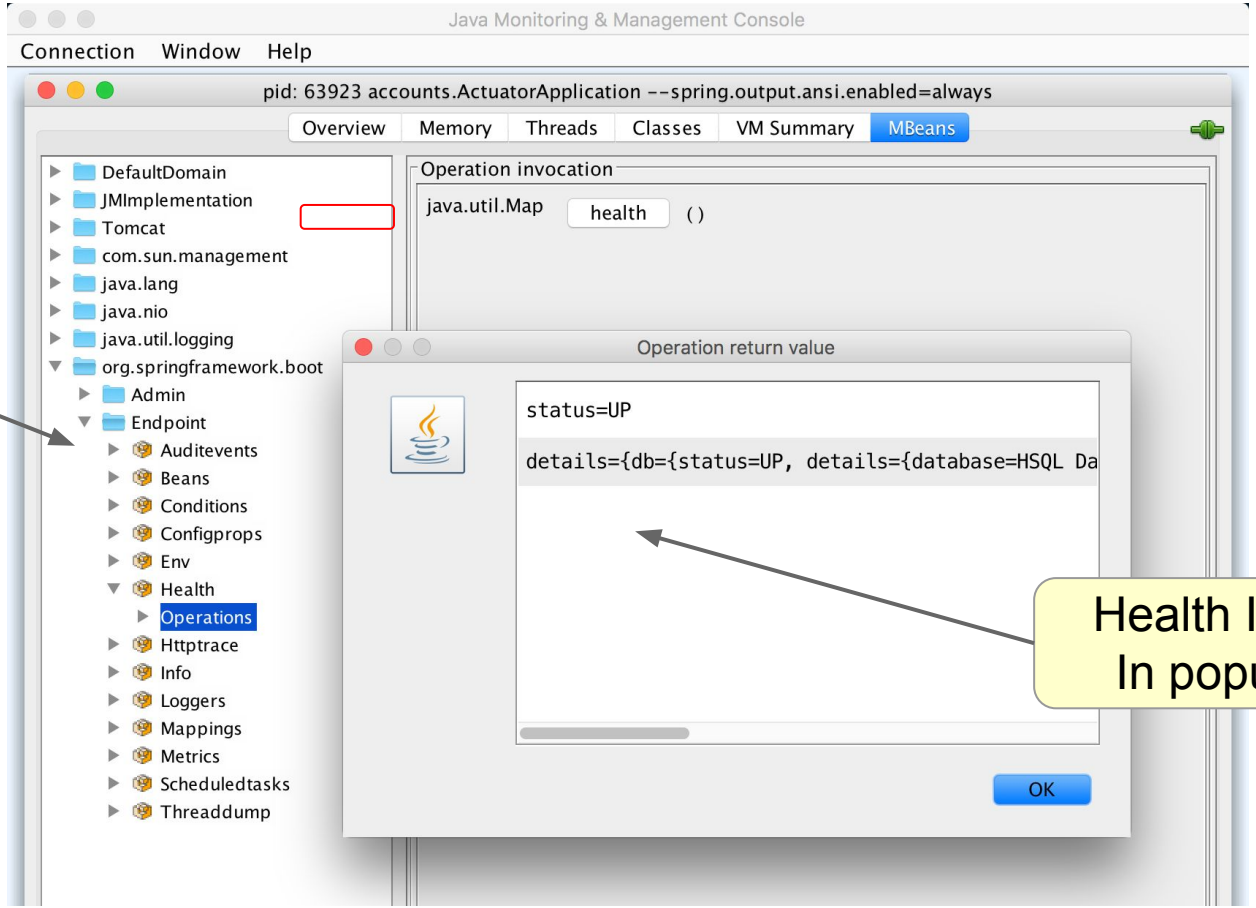
Exposed = the given actuator is accessible via JMX or HTTP

JMX Default = All exposed

HTTP Default = only info and health exposed

JMX Endpoints - Exposed By Default

Endpoints in **`JConsole`**



Health Info
In popup

Secure JMX Endpoints

SSL and LDAP also supported

- Always secure JMX in production
  - Here a password and access file are used

```
java -jar my-boot-app.jar
  -Dcom.sun.management.jmxremote.port=9999
  -Dcom.sun.management.jmxremote.authenticate=password
  -Dcom.sun.management.jmxremote.password.file=../jmxremote.password
  -Dcom.sun.management.jmxremote.access.file=../jmxremote.access
  -Dcom.sun.management.jmxremote.ssl=true
```

jmxremote.password

```
user     password
admin    secret
```

jmxremote.access

```
user     readonly
admin    readwrite
```

Controlling JMX Actuators

- The exposure of JMX endpoints can be controlled using properties
  - Either property can take a comma-separated list of actuators to include/exclude

```
# Default setup: all exposed, no exclusions
management.endpoints.jmx.exposure.exclude=
management.endpoints.jmx.exposure.include=*
```

HTTP Actuator Endpoints

- Mapped to **`/actuator/xxx`** by default - customizable

```
# Change actuator base path
management.endpoints.web.base-path=/admin
```

- For security reasons, only two are exposed by default
  - **`/actuator/health`**
  - **`/actuator/info`**
  - Secure actuator URLs using Spring Security

Exposing HTTP Endpoints

- If endpoints exposed explicitly, defaults overridden

```
# Default setup
management.endpoints.web.exposure.include=health,info
```

```
# Enable just beans, env and info
# NOTE: health and info disabled unless listed
management.endpoints.web.exposure.include=beans,env,info
```

```
# Enable all endpoints
management.endpoints.web.exposure.include=*
```

Secure Endpoints - Aligned with Spring Security

```
protected void configure(HttpSecurity http) throws Exception {
  http.authorizeRequests()
        .mvcMatchers(“/actuator/health”, “/actuator/info”).permitAll()
        .mvcMatchers(“/actuator/**”).hasRole("ACTUATOR")
        .anyRequest().authenticated();
}
```

```
// Base-path agnostic
protected void configure(HttpSecurity http) throws Exception {
  http.authorizeRequests()
        .requestMatchers(EndpointRequest.to("health","info")).permitAll()
        .requestMatchers(EndpointRequest.toAnyEndpoint()).hasRole("ACTUATOR")
        .anyRequest().authenticated();
}
```

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- **Metrics**
- Health indicators
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Metrics

How do you collect metrics?

- Spring Boot 2.0 uses Micrometer library
  - Multi-dimensional metrics
- It instruments your JVM-based application code without vendor lock-in
  - SLF4J for metrics
- Designed to add little to no overhead to your metrics collection activity

Custom metrics

What are they?

Custom metrics can be measured using Micrometer classes such as **`Counter`**, **`Gauge`**, **`Timer`**, and **`DistributionSummary`**.

- Classes are created or registered with a **`MeterRegistry`** bean
- Custom metric names are listed on the **`/actuator/metrics`** endpoint
- Custom metric data can be fetched at **`/actuator/metrics/[custom-metric-name]`**

Hierarchical vs Dimensional Metrics

- How can you access metrics data, i.e. on http requests?
- You want to use arbitrary combination of
  - Http method, URI, Response status, Exception status
  - Custom attributes
- Example metrics data on http requests
  - Http requests whose Http method is GET and Response status is 200
  - Http requests whose Http method is POST and “Region-of-origin” custom attribute is “us-east”

Hierarchical Metrics

- Often follow a naming convention that embeds key/value attribute pairs into the name separated by periods
  - http.method.<method-value>.status.<status-value>
- Examples
  - http.method.get.status.200
  - http.method.get.status.*
- Characteristics
  - Consistent naming convention is hard to achieve
  - Adding new attribute could break existing queries

Dimensional Metrics

- Metrics are tagged (a.k.a. dimensional)
- Examples (using Spring Boot 2.0 actuator)
  - http?tag=method:get&tag=status:200
  - http?tag=method:get&tag=status:200&tag=region:us-east
- Characteristics
  - Flexible naming convention
  - Adding a new attribute to a query is easy

MeterRegistry - Timer

```
public class OrderController {
   private Timer timer;

   public class OrderController(MeterRegistry registry) {
      this.timer = registry.timer("orders.submit");
   }

   @PostMapping("/orders")
   public Order placeOrder( ... ) {
      return timer.record( () -> { /* lambda: code placing an order … */ } );
   }

   @GetMapping("/orders")
   @Timed(“orders.summary”)
   public List<Order> orderSummary() {...}
}
```

Can also create counters, gauges or summaries

Timer is part of Micrometer project

`@Timed` avoids mixing of concerns

Timer provides count, mean, max and total of its metric

Recording to a `DistributionSummary`

```
@Controller
public class RewardController {
    private final DistributionSummary summary;

    public RewardController(MeterRegistry meter) {
        summary = DistributionSummary.builder("reward.summary").register(meter);
    }

    @PostMapping(value = "/rewards")
    public ResponseEntity<Void> create(@RequestBody Reward reward) {
        summary.record(reward.amount);
        ...
    }
}
```

Build a meter and register it

Distribution Summary provides a count, total, and max value for its metric

Example: /actuator/metrics/reward.summary


```
{
  "name": "reward.summary",
  "measurements": [
      {
        "statistic": "COUNT",
        "value": 3
      },
      {
        "statistic": "TOTAL",
        "value": 13
        ...
```

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/actuator/health

Application health status

By default, Actuator shows only basic health information.

```
{
    "status": "UP"
}
```

More Health Details Possible

application.properties

```
# Set Spring Boot property
management.endpoint.health.show-details=always
```

```
{
  "status": "UP",
  "details": {
    "db": {
      "status": "UP",
      "details": {
        "database": "MySQL",
      }
    },
    "diskSpace": {
      "status": "UP",
      "details": {
        "total": 499963170816,
        ...
```

Default: a validation query, such as ‘select 1’ returns successfully

Default: < 10MB free is down

List of Auto-configured HealthIndicators

- Many health-indicators setup automatically
  - Providing their dependencies are on the classpath
  - Disk Space, DataSource, Cassandra, Elasticsearch, InfluxDb, JMS, Mail, MongoDB, Neo4J, RabbitMQ, Redis, Solr, ...
- Full details

https://docs.spring.io/spring-boot/docs/current/reference/html/production-ready-endpoints.html#_auto_configured_healthindicators

/actuator/health

Custom health checks

Custom health checks can be added to the **`/actuator/health`** endpoint and will be rolled up into the overall application health status.

- Create a class which implements **`HealthIndicator`**
- Override the **`health()`** method to return the status

/actuator/health

Health indicator statuses

- Built in status values
  - **DOWN**
  - **OUT_OF_SERVICE**
  - **UNKNOWN**
  - **UP**

- Severity order can be overridden using

```
management.health.status.order =
FATAL, DOWN, OUT_OF_SERVICE,
UNKNOWN, UP
```

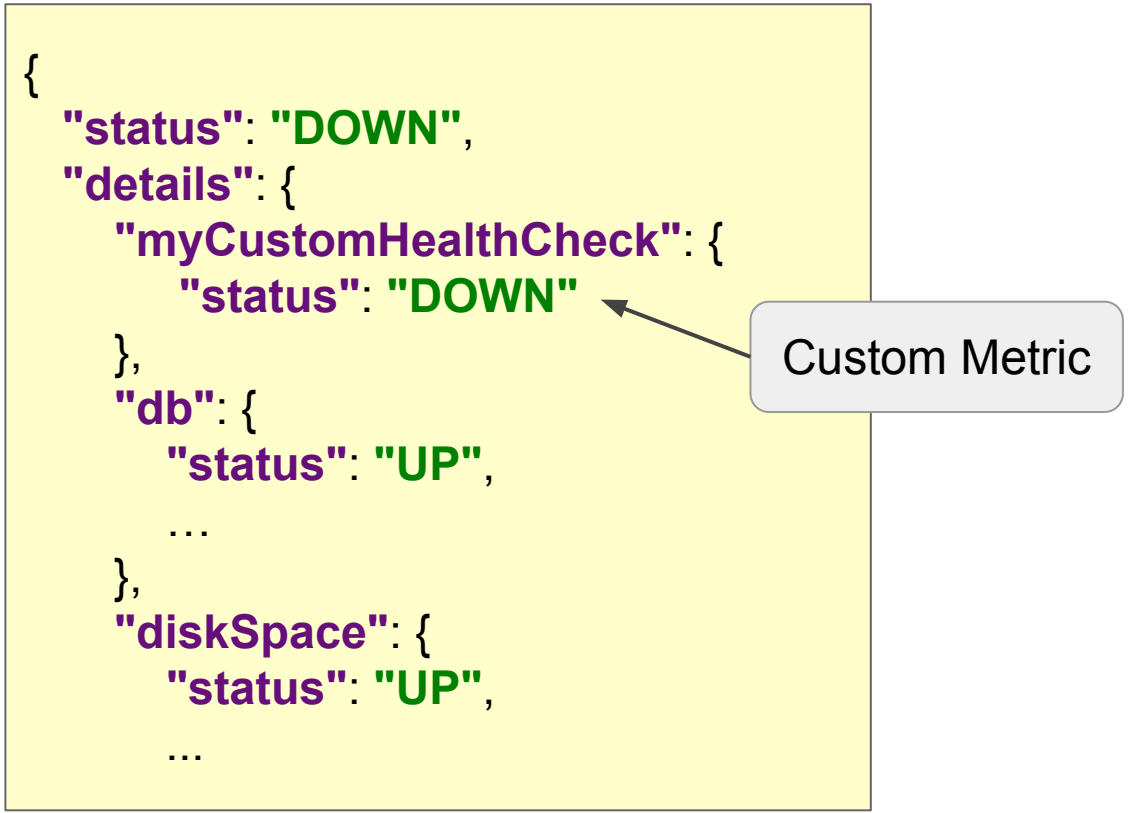
Implementing a custom Health Check

```
@Component
public class MyCustomHealthCheck implements HealthIndicator {

  @Override
  public Health health() {

    if (!customHealthValidationCheck()) {
      return Health.down().build();
    } else {
      …
```

/actuator/health



Adding Detailed Health Check Information

```
@Component
public class MyCustomHealthCheck implements HealthIndicator {

  @Override
  public Health health() {

    if (!customHealthValidationCheck()) {
      return Health.down().withDetail("metricName",0).build();
    } else {
      …
```

Adding Detailed Health Check Information

```
@Component
public class MyCustomHealthCh

  @Override
  public Health health() {

    if (!customHealthValidationCh
      return Health.down().withD
    } else {
      …
```

```
{
  "status": "DOWN",
  "details": {
    "myCustomHealthCheck": {
      "status": "DOWN",
      "details": {
        "metricName": 0
      }
    },
    "db": {
      "status": "UP",
      …
```

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Actuator data

What do we do with the data?

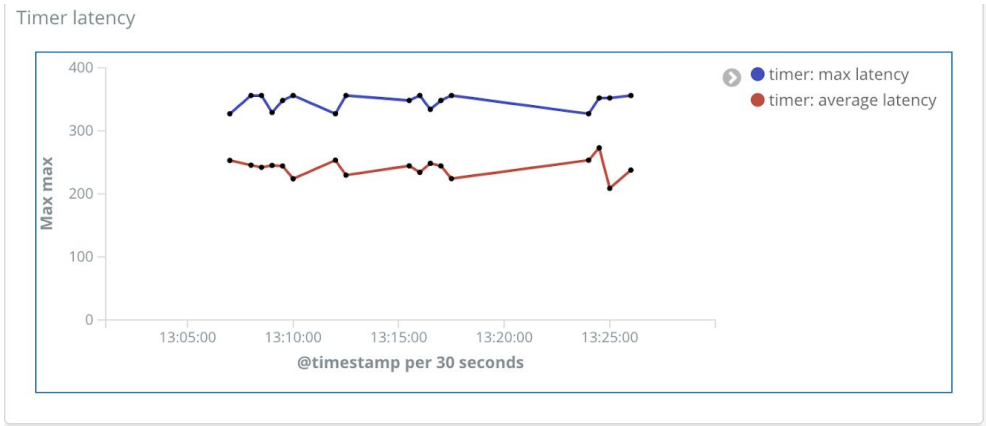
- Actuator alone doesn’t provide anything except REST endpoints
- To truly add value, this data needs to be gathered, aggregated, and graphed for easy consumption

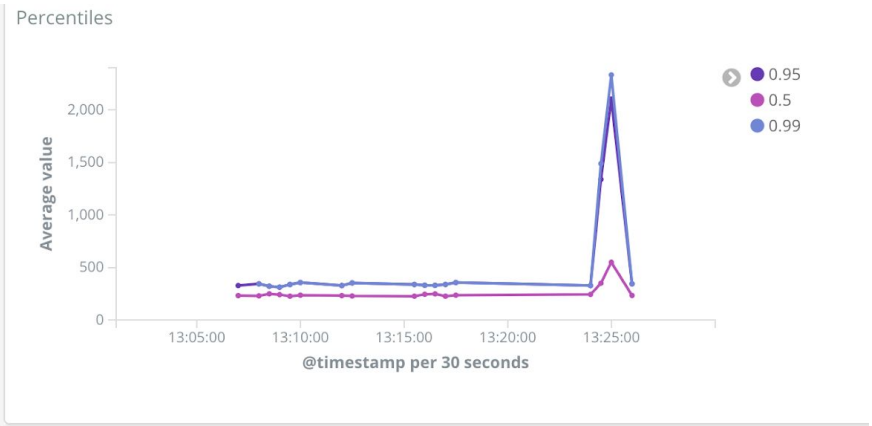
Integration options

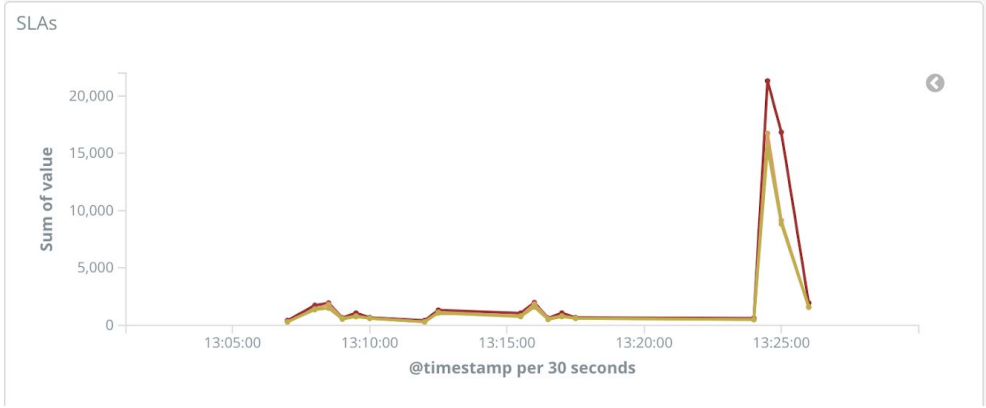
External monitoring systems that can be integrated with Actuator

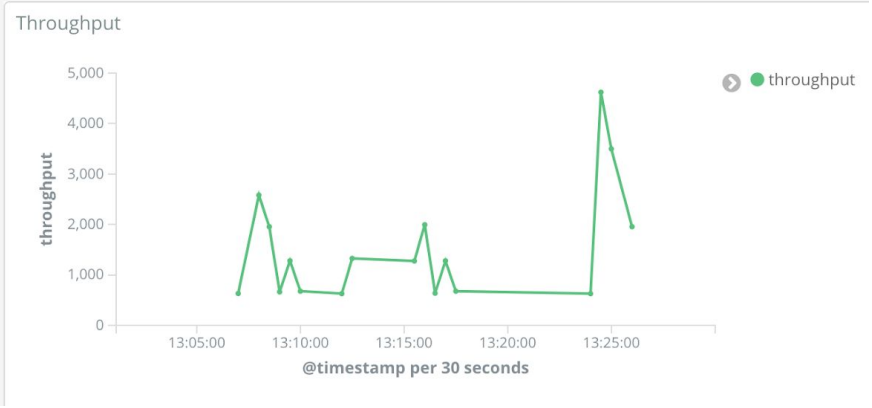
- Netflix Atlas
- CloudWatch
- Datadog
- Ganglia
- Graphite
- InfluxDB
- JMX
- New Relic
- Prometheus
- SignalFx
- StatsD
  - Etsy, dogstatsd, Telegraf, & proprietary formats
- Wavefront

Monitoring with timer









More info on external monitoring

https://spring.io/blog/2018/03/16/micrometer-spring-boot-2-s-new-application-metrics-collector

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Summary

What do you remember?

- What are three benefits of Actuator?
- What are the two default endpoints exposed?
- What does the health check endpoint tell you about your application?

Lab: Enabling standard actuators, adding custom metrics and custom health indicators

Lab project:
42-actuator

Anticipated Lab time:
30 Minutes