Monitoring with Grafana

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While you wait ...

```
$ # Install Docker and Docker Engine
$ git clone https://github.com/grafana/tutorial-environment
$ cd tutorial-environment
$ docker-compose up -d
```

Who am I?

- **Developer Advocate at Grafana**
  - Developer Experience for plugin authors
  - Educating and supporting the Grafana community
- **Software Developer** since 2011
  - Frontend, backend, leftend and rightend
  - Product development, data engineering, SRE

What we'll cover today

- What is monitoring?
- Types of data
- Exploring data
- Building dashboards
- Annotations, variables, and links
- Creating alerts
- Best practices for dashboard design

What do you hope to learn today?

What is monitoring?

- Graphs on a TV on the walls of Engineering?
- Waking up to ~20 emails about CPU usage?
- Pinging services to make sure they’re alive?

“Monitoring tells you whether the system works.

Observability lets you ask why it’s not working.”

- Baron Schwartz

Why do we monitor?

- Make sure system works as **intended**
- Get **insights** in how the system is being used
- Fix problems **before** customers tell us about them
- Outage cost is more expensive than investing in quality
- Make knowledge available to the rest of the organization
- Make decisions on data rather the gut feeling

Monitoring is changing

- Infrastructure is becoming more dynamic
  - Servers are becoming **cattle**, rather that **pets**
- Teams are deploying changes several times a day
  - Less up-front testing
- Monitoring tools need to keep up

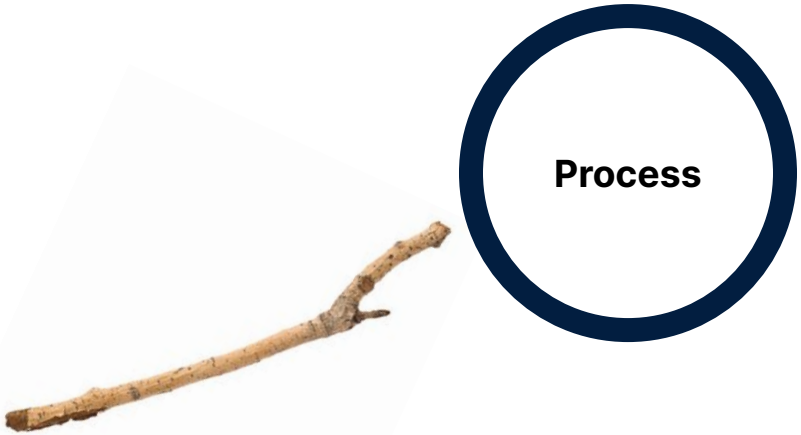
Why do you want to start monitoring?

If you already do, why?

How do I know my process is working?

You can poke it with a stick ...

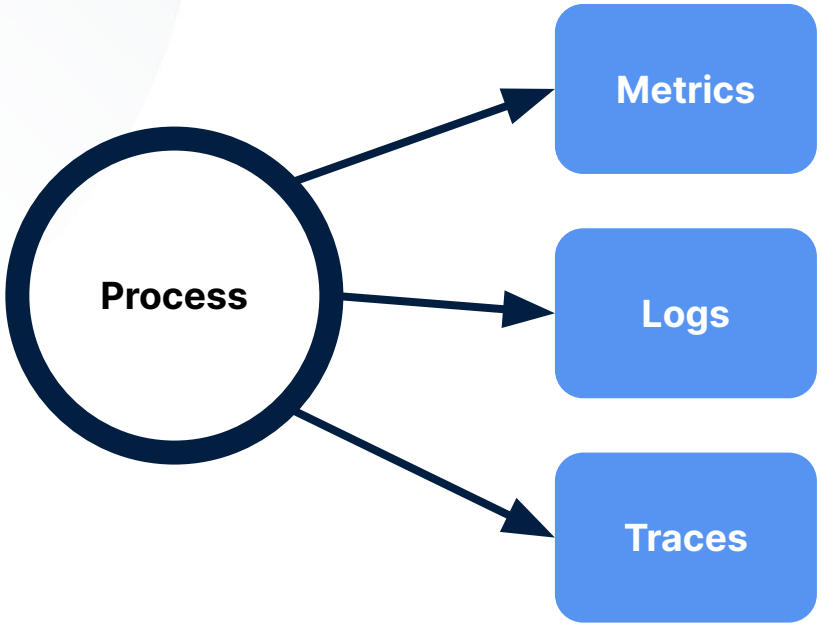
(*black box* monitoring)



… or have it tell you how it's doing

(*white box* monitoring)

Extracting data from a running process

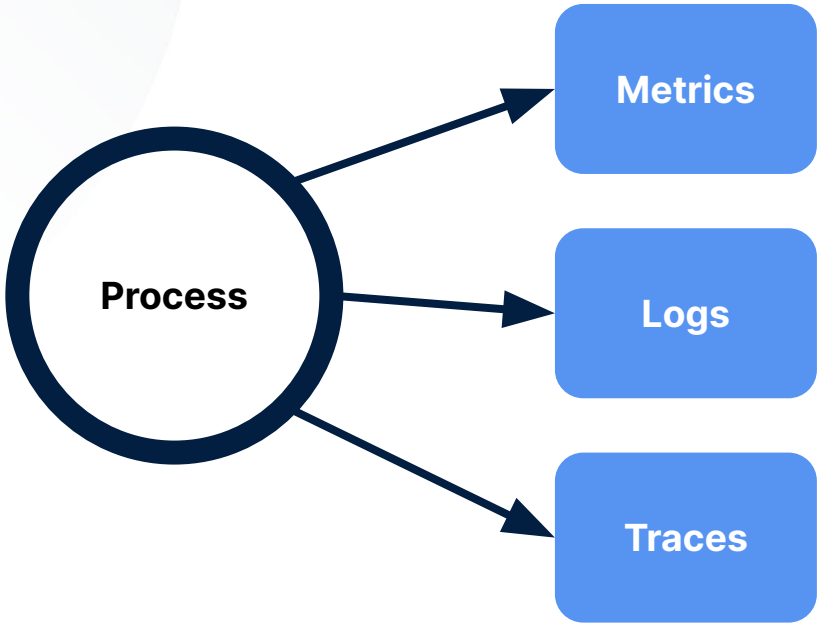


Numeric data for easy aggregation

Textual data for understanding what happened

Execution paths for individual requests

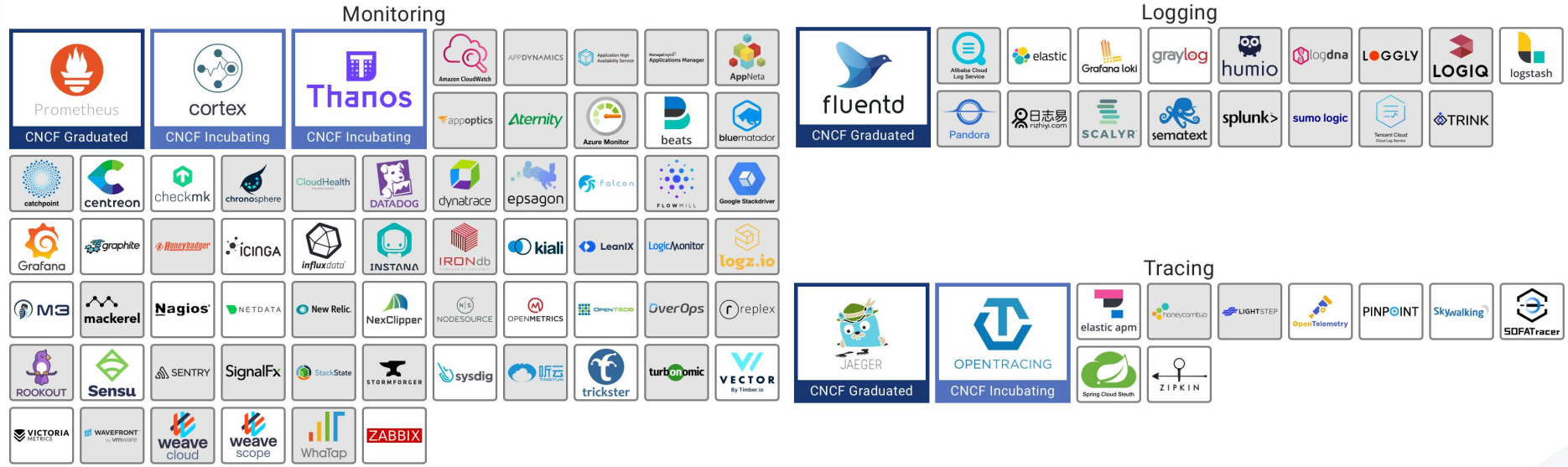
Extracting data from a running process



Pros: Lets you see trends and patterns. Less data, faster queries
Cons: Needs to be configured up-front

Pros: Lets you see exactly what the process was doing at a given time
Cons: Costly to store and to query

Pros: Lets you see the path a request took through the system, and where time was spent
Cons: Costly to store and query



https://landscape.cncf.io

What data are you monitoring on?

How do you get that data?

Grafana

An open composable observability platform

An open composable observability platform

- Aims to integrate rather than replace
- Ships with integrations for popular projects
- Offers a plugin platform for integrating with other projects
  - Browse the plugins written by the Grafana community at grafana.com/plugins

Choose your own stack

Our application

```
$ # Install Docker and Docker Engine
$ git clone https://github.com/grafana/tutorial-environment
$ cd tutorial-environment
$ docker-compose up -d
```

Browse to http://localhost:8081

Demo

A tour of Grafana

Data sources

- Data sources bring your data into Grafana
- **Data source options** configures how to connect to a data source
- The **Query editor** configures what data you want to display

Panels

- Panels consist of a **query** and a **visualization**
- **Display options** configure the currently selected visualization type
  - For example, whether you want to show a table header or not
- **Field options** configure how the data is displayed
  - For example, if the data ranges from 0–1, you want to display it as percentage (12%) regardless of the visualization type

Dashboards

- Dashboards consist of multiple panels
- All panels in a dashboard share time range
  - Zooming into one changes the time range for all panels

Metrics

Metrics

- A **quantifiable**, single type of **data** that's changing over time
- For example:
  - Temperature
  - Churn rate
  - Logged-in users

Metric type: Counter

- A counter starts at zero and is only **incremented**
- The *rate* of change is often more useful, and can be calculated using the counter value
  - Example: Requests per second for the last 24 hours

Metric type: Gauge

- A gauge is a snapshot in time of the current state
- Single numerical value that can go up and down
- For example:
  - 21°C at 13:00
  - 25°C at 14:00
  - 23°C at 15:00

Time series

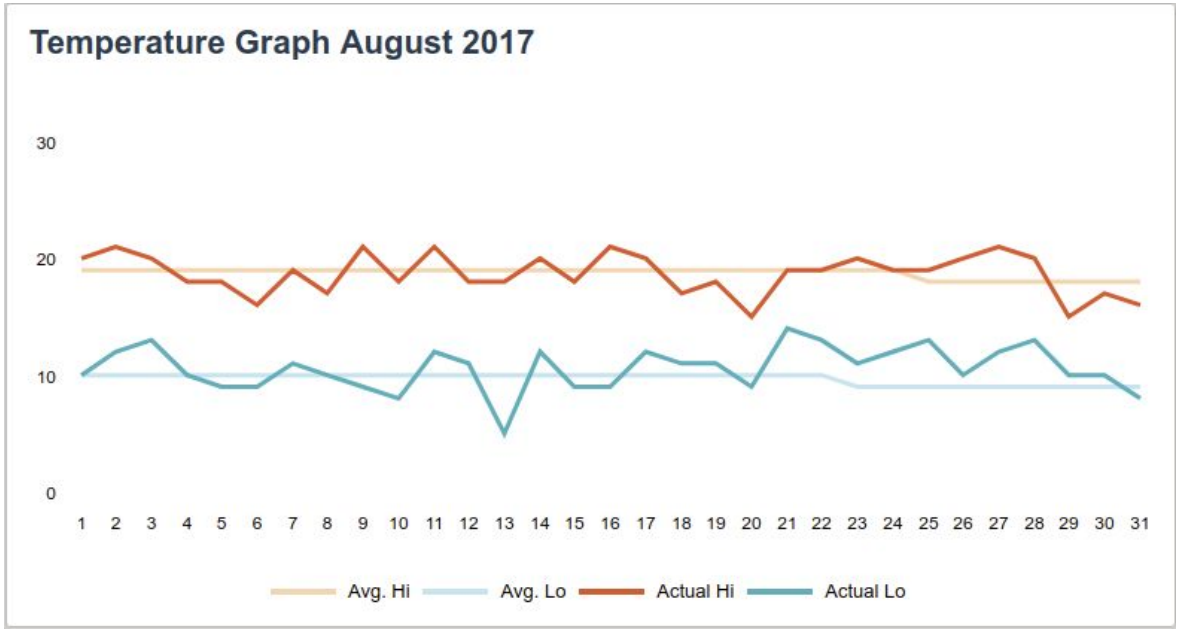
Time series

- Measuring a metric over time results in one or more *time series.*
- A sequence of measurements ordered in time.
- Each measurement consists of a point in **time**, and a **value**.
- Usually measurements are taken at regular intervals, such as every 30 second, hourly, or every quarter
  - Otherwise, we’re probably looking at event data, more fitting as logs

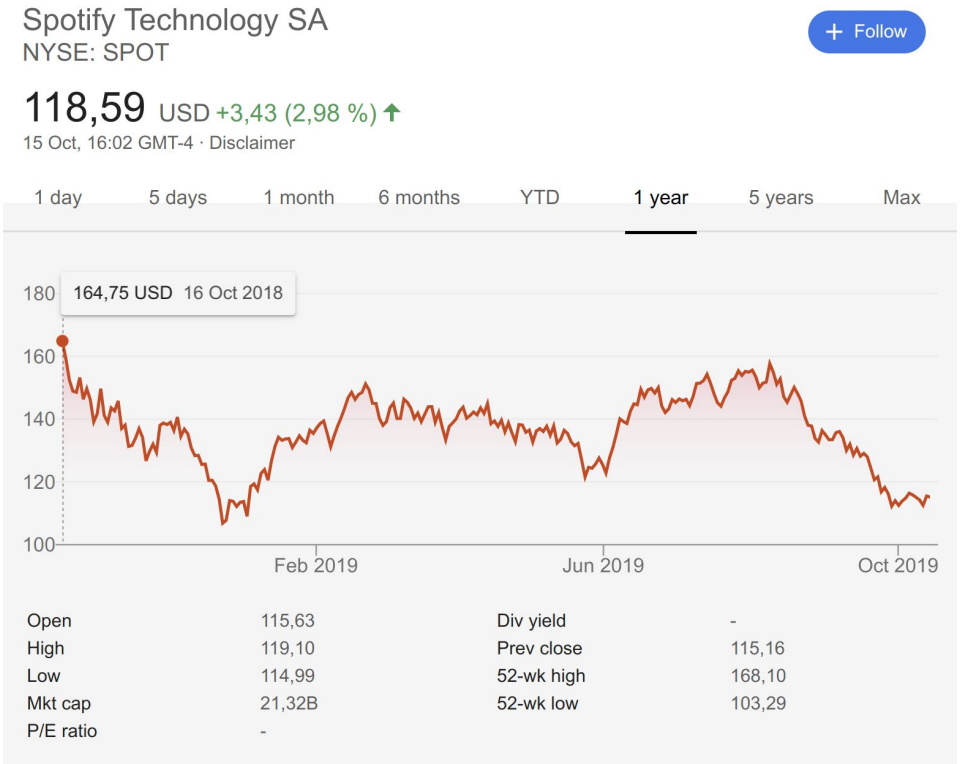
Raw time series data

Series	Time	Value
apps	2019-09-13 2:00:00	7651
apps	2019-09-14 2:00:00	37523
apps	2019-09-15 2:00:00	37668
datasources	2019-09-13 2:00:00	63021
datasources	2019-09-14 2:00:00	284467
datasources	2019-09-15 2:00:00	286193
panels	2019-09-13 2:00:00	62368
panels	2019-09-14 2:00:00	282907
panels	2019-09-15 2:00:00	284612
all	2019-09-13 2:00:00	66566
all	2019-09-14 2:00:00	302986
all	2019-09-15 2:00:00	304785

Example: Temperature



Example: Spotify share price



The cardinality problem

- Each time series has a unique name
  - `stats.sweden.stockholm.temperature`
  - `temperature{country="sweden", city="stockholm"}`
- Changing part of the identifier means creating a new time series
- Making things like user id part of the name could cause an explosion of time series, affecting performance.
  - Cardinality problem

Time series databases (TSDB)

- Not relational data (no joins)
- Specialized and optimized
- More efficient at storing time series data
  - Prometheus uses around 1-2 bytes per measurement on average
- Better at querying time series data


Prometheus

Demo

Metrics using Prometheus

Exercise: Create a dashboard to display Prometheus metrics

Data source URL: http://prometheus:9090

Useful queries:

```
rate(tns_request_duration_seconds_count[1m])
histogram_quantile(0.95, rate(tns_request_duration_seconds_bucket[1m]))
```

Logs

Logs

- Shows you what's happening inside the application
- Append-only text
- Typically large volumes

Logs

- Usually for applications, not so much for resources, like CPU or disk utilization.
- Be mindful about what you log
  - Avoid excessive logging
    - Makes it difficult to find the logs that matters
  - Storage may be cheap, but your time is not

Unstructured logs

```
User 752 bought 3 tickets
```

Structured logs

```
{msg: “bought tickets”, user: “752”, count: 3}
```


Grafana loki

Demo

Logs using Loki

Exercise: Add a Logs panel to display Loki logs in the dashboard

Data source URL: http://loki:3100

Useful queries:

```
{filename="/var/log/tns-app.log"}
{filename="/var/log/tns-app.log"} |= "error"
```

Troubleshoot without leaving Grafana

Annotations

Annotations

- Add context to a visualization by annotating it
- Annotate events or entire regions
- Query annotations from data sources

Demo

Annotations

Exercise: Annotate the graph panel with errors from Loki

Create an annotation query

```
{filename="/var/log/tns-app.log"} |= "error"
```

Dynamic dashboards

Dynamic dashboards

- In practice, most services will be monitored in similar ways
- Avoid duplicated dashboards by using **variables**
- Lets you create templated queries and panels

Demo

Variables

Exercise: Create a variable for selecting status code

1. Create a **Query** variable called `status_code`
2. Select Prometheus as the data source
3. Enter the following query

   ```
   label_values(tns_request_duration_seconds_count, status_code)
   ```
4. Click **Add** and save the dashboard
5. Change the panel query to

```
rate(tns_request_duration_seconds_count{status_code="${status_code}"}[1m])
```

Repeated panels

- Avoid duplicated panels by repeating them for every value in a variable

Demo

Repeated panels

Exercise: Repeat panel for multiple status codes

1. Update the `status_code` variable to be **Multi-value**
2. Click **Update**
3. Enter Edit mode for the panel
4. In the Panel editor, select **Repeat options**
5. Select your variable and click **Apply**

Dashboard design

Keep your user in mind

- Consider your target audience
- How much details do they need?
- Questions to ask yourself:
  - What issue let them to open this dashboard?
  - What questions should this dashboard answer?
  - When would the user want this information?

Monitor with intent

- Start small
  - Resist the urge to fill up your dashboard at first
  - Make sure you understand each panel before adding another
- Keep it simple
  - Every detail you add, adds to the complexity of the dashboard
  - Avoid putting to much information on a single dashboard
- Sort by importance
  - Not all panels are equally important

Will you understand the dashboard in the middle of the night during an outage?

Links

Links

- Prefer smaller dashboards with clear focus and **link** them together
- Grafana lets you link dashboards together using three types of links: *dashboard links*, *panel links*, and *data links*.

Links

- Dashboard links
  - Link to other dashboards or external websites
- Panel links
  - Same as dashboard link but in the context of a panel
- Data links
  - Use values from your query result in your link

Demo

Comparing link types

Alerting

What makes a good alert?

- Alerts are not warnings: They are calls for help
  - Only alert on **real problems**
- Avoid alert fatigue
- They’re **simple**
- Requires a human
- Includes **actionable** information

Alert on **symptoms, not causes**

- There are thousands of reasons for a website to not respond
- Alerting on symptoms **always** catch the problem
- Alerting on causes **might** catch the problem

The life of an alert in Grafana

Alerts can be **Paused** at any time

Demo

Create an alert

Exercise: Create an alert

1. Create a request box at https://rbox.app
2. Create a webhook notification channel with the URL to your request box
3. Enter panel edit mode and click the Alerts tab under the graph
4. Create an alert that evaluates every **5s** for **5s**
5. Select your webhook as notification channel
6. Make the alert trigger and watch the request box

What would you alert on?

What should you monitor?

USE

- Created by Brendan Gregg
- For every **resource**:
  - Utilization
  - Saturation
  - Errors

RED

- Created by Tom Wilkie
- For every **service**:
  - Rate
  - Errors
  - Duration

Golden signals

- Created at Google
- For every **system**:
  - Latency
  - Traffic
  - Errors
  - **Saturation**

What would you monitor?

Dashboard design

Dashboards

- Be consistent
  - Use same colors and styles for the same concepts across dashboards
  - During an outage, you’re not always thinking straight. Make it easy to understand.

Panels

- Will I still understand this panel a month from now?
- Use units
- Label your axes
- Give your panels proper titles
- Consider shared crosshairs
- Keep metrics of different scales in separate panels
  - Reads can be order of magnitudes larger than writes
- Combine aggregates for better insights

Colors

- Avoid overusing colors
- Colors have meaning
  - Traffic lights
  - Green indicates something good, such as free disk space
  - Red indicates something bad, grabs your attention, and should be used for critical things
- Consider color blindness

Grafana Cloud

Starter	Standard	Enterprise
Free	$49/mo + metered usage	Custom
Get started	Start your free trial	Contact us
Developers, operators, and hobbyists	Teams that want to quickly start sending metrics and logs	Teams with millions of metrics and mission critical workloads

https://grafana.com/signup

Monitoring doesn’t fix your problems.

It shows them to you.

Thank you!

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@marcusolsson

Bonus: Plugins

Plugins

- Three types of plugins
  - Data sources
  - Panels
  - Apps
- Browse published plugins on https://grafana.com/plugins

Demo

Install a plugin

Exercise: Install a plugin

Find a plugin you find interesting on https://grafana.com/plugins

Install in the tutorial environment:

```
docker-compose exec grafana /bin/bash
grafana-cli plugins install <plugin id>
```