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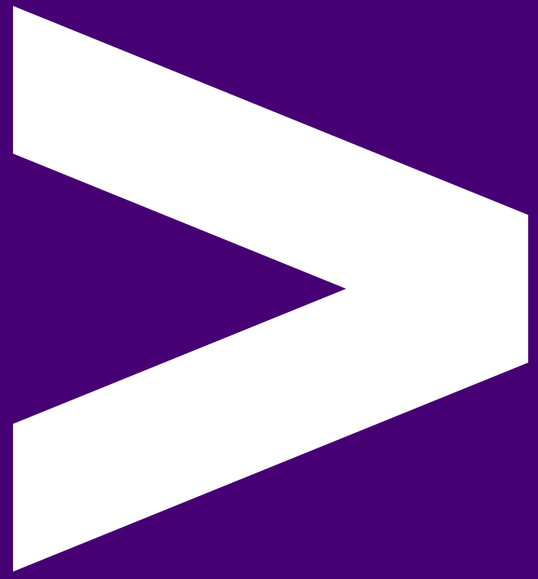
Monitoring with AWS



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AWS sessions list

This is the list of AWS sessions done so far, and the following ones:

- AWS 01 AWS + Cloud Intro ✅ *1.5hrs*
- AWS 02 AWS CLI Setup ✅ *1.5hrs*
- AWS 03 S3 Storage (Console) ✅ *1.5hrs*
- AWS 04 CloudFormation Intro + S3 Storage (IaC) ✅ *1.5hrs*
- AWS 05 Lambda Intro ✅ *1.5hrs*
- AWS 06 Lambda (IaC) ✅ *1.5hrs*
- AWS 07 Redshift (IaC) ✅ *1.5hrs*
- AWS 08 EC2 (IaC) + Grafana setup ✅ *1.5hrs*
- AWS 09 Queues ✅ *1.5hrs*
- AWS 10 Monitoring ⬅ *1.5hrs*

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Prep for later

- Start `podman` or `docker`
- Pull the grafana image by running:

```
podman pull docker.io/grafana/grafana
podman pull docker.io/python:3-alpine
```

or

```
docker pull docker.io/grafana/grafana
docker pull docker.io/python:3-alpine
```

Overview

- What does software monitoring consist of?
- Why do we monitor software?
- Monitoring infrastructure
- Monitoring applications

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Learning Objectives

- Identify the features of software monitoring
- Explain why and what we monitor
- Define logging and what logs are used for
- Detail the features of CloudWatch and Grafana

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Monitoring our software

Monitoring software involves continuously examining a running system with two main aspects

1. Monitoring and measuring the performance of the system
2. Monitoring and auditing events that occur within the system

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A real monitoring picture

Here's an image form a few years ago of real monitors displaying real info. (This image was once upon a time on the landing page of the Infinity Works website):

> What sort of things might we be seeing?

What do we track?

What kind of things do we track?

- Uptime
- Resource utilisation (CPU, memory, network)
- Performance (requests/s, ops/s)
- Errors
- Business KPIs
- User interactions

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Why do we monitor?

- To take action as soon as (or even before) things go wrong
- Understand actual application usage patterns
- Make more accurate business decisions
- Learn what normal looks like
- Assess the impact of our releases: performance degradation, regressions, downtime...
- Identify areas in our architecture to improve
- **Make on-call work humanly possible - make life easier for everyone**

What do we monitor?

- Infrastructure
- Applications
- Component interactions

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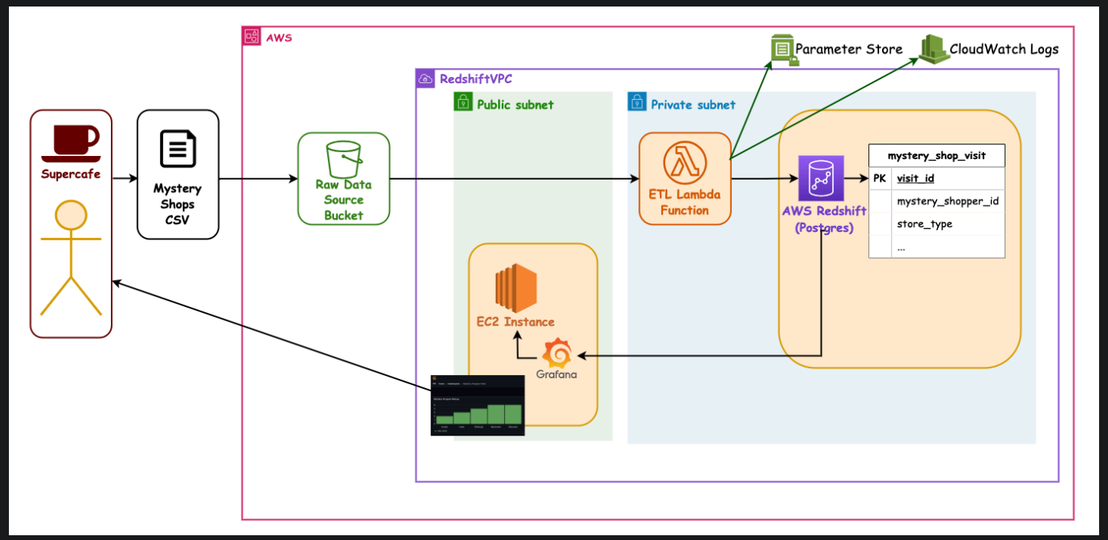
What can we monitor here?

Consider the Mystery Shopper architecture from AWS sessions 01 through 08...



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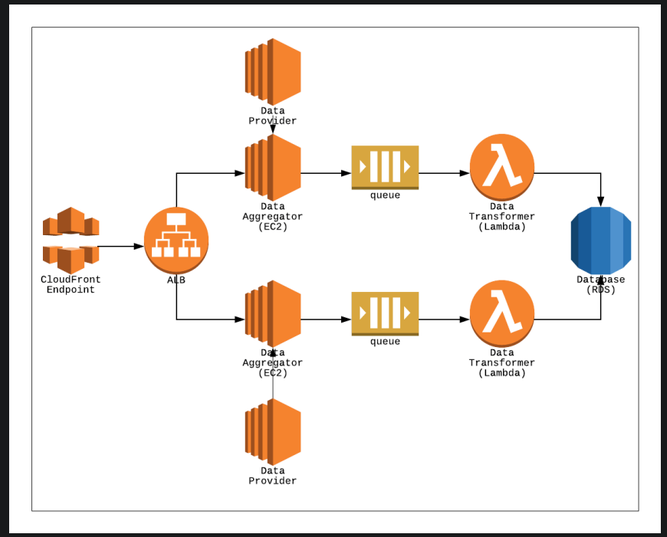
What can we monitor?

> How about on a diagram we're not familiar with? What could we monitor here?



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Monitoring Infrastructure

CloudWatch

CloudWatch is a monitoring and alerting managed service for AWS and offers the following:

- Log aggregation, retention, rotation and search
- Monitoring dashboards for AWS infrastructure out-of-the-box
- Alarms and system events

We will expand on CloudWatch shortly.

SNS

This is a commonly used AWS service when we are adding monitoring. It can push out notifications to different subscribers via various channels, e.g.

- Email
- SMS
- Mobile push notifications
- Lambda

...which can be very useful when we detect errors in the system.

SNS - Concepts (recap)

As a recap from our previous sessions:

- *Topic*: notification category. You or an application can subscribe to it and get notified when a new event gets pushed to it
- *Subscription*: sets the receiver of a notification and also dictates how they'll receive it - we can have many of these

Practical application: For example, when we detect an error, we can publish a notification to an alert *Topic*, and have several subscribers (Slack, Email, Pager, etc) all *Subscribed* to that topic.

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Monitoring applications

Application Logs

A **log** is a message produced by a running application capturing some noteworthy information about its state or an event taking place at that point in time.

Useful logs

> What sort of information should we put in log messages to make them useful?

Good logs tell the "story" of what is happening in our system.

What do we use logs for?

- Obtaining failure messages when our app crashes
- Tracing application flow
- Debugging our running application
- App health monitoring
- Timing stuff precisely

What do we NOT log?

- Any *Data* from the system - do not log what you loaded from a file or are inserting to a DB or are getting from a DB, and so on
- Passwords
- Secrets
- Tokens
- PII (Personally Identifiable Information)

How do you log?

At it's simplest - write the message to stdout!

```python
# Python
try:
    div = 1 / 0
except Exception as e:
    print("ERROR: " + str(e))
```

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No, really, how do you log

Most languages now have logging libraries available.

These remove much of the boilerplate and setup required to produce manageable and standardised logs.

```
# Import the built-in logging lib
import logging

# Create an app logger
logger = logging.getLogger(__name__)

try:
  div = 1 / 0
except Exception as e:
  # Log an exception, it will go to stdout by default
  logger.exception(e) # we can also pass a message
```

Logging Levels

Logging statements are added at key areas of your codebase and can serve many different purposes

ℹ️ Info: they document normal state changes in the app. They contain non-actionable information

⚠️ Warning: non-fatal errors, the kind of events you can leave until the next morning

🚨 Error: fatal, the kind of events you'd be woken up in the middle of the night to resolve

Python logging

In python we can log at different levels like this:

```
import logging
# Create an app logger
logger = logging.getLogger(__name__)

logger.debug('Tracing my function', *args, **kwargs)
logger.info('My useful message', *args, **kwargs)
logger.warning('This is unusual', *args, **kwargs)
logger.exception('Exception', *args, **kwargs)
```

Where do logs go?

By default all logs will be printed to stdout and stderr (usually terminal output) and will therefore disappear after a short while.

If we want to store our logs for future reference we need to send them to some persistent storage. eg. a file or CloudWatch.

```
# Redirect stdout to a file
$ python app.py > app.log

# Redirect stdout and stderr to a file
$ python app.py &> app.log
```

Storing Logs

Most applications have a default location where they store their log files, although many will allow you to set the location.

On Unix systems that location is usually `/var/log`. In CloudWatch they go into *Log Streams*.

The app will keep appending logs to its log file as long as it's running.

This has a couple of downsides...

Downsides of log files

- Log files will keep growing if you keep logging
- Log files sent to stdout are only available on the server that produced them
- Log files are hard to search and query

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Emoji Check:

Do you understand the concept that we need verbose and accurate logs in our applications?

1. 😢 Haven't a clue, please help!
2. 😕 I'm starting to get it but need to go over some of it please
3. 😐 Ok. With a bit of help and practice, yes
4. 🙂 Yes, with team collaboration could try it
5. 😀 Yes, enough to start working on it collaboratively

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AWS CloudWatch

What is CloudWatch?

- Allows you to monitor AWS applications in near-real-time
- Automatically configured to provide metrics on request counts, latency, and CPU usage
- Can also send your own logs and custom metrics to CloudWatch for monitoring
- Keep track of your application performance, resource use, operational issues, and constraints
- Helps organizations resolve technical issues and streamline operations

CloudWatch Logs

CloudWatch can collate and store all of your logs for as long as you want so you don't have to worry about maintaining them.

Some AWS managed services, like Lambda, will forward all logs automatically to CloudWatch, where you'll be able to search and query them.

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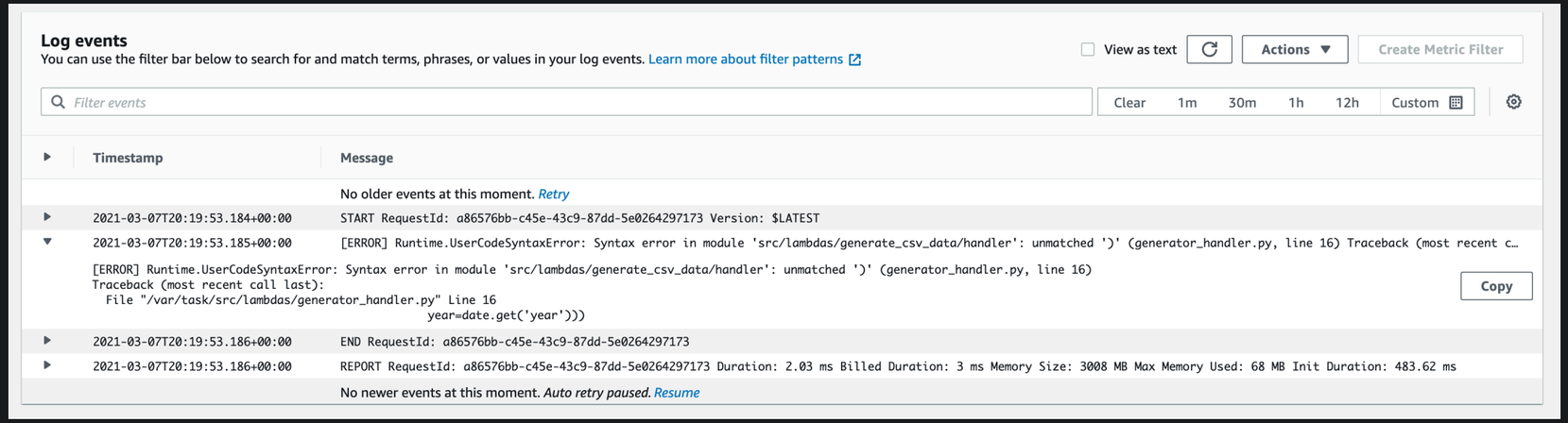
CloudWatch Logs Example

Here's an example of what some default Lambda logs might look like in CloudWatch:



CloudWatch Logs - Finding them

> Do a 5 min demo in CloudWatch, get everyone to follow along for practice

E.g:

- How to find your logs for your Lambda
- Log *Groups* contain multiple *Streams*
- Log *Streams* may contain multiple invocations

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CloudWatch Logs - Simple Queries in Log Streams

CloudWatch logs can be queried by filtering on specific parameters, and it supports reg-ex (see the AWS docs here):

```
%INFO% %starting%
```

- The above would find all logs with either of those two words in them
- You can search for multiple terms like `INFO starting file`
- You can add wildcards like `%INF%`; this would match `INFO` and `INFORMATION`
- You can exclude terms, e.g. `INFO -ERROR`; this would exclude lines with `ERROR` in them
- You can also query by dates and other factors

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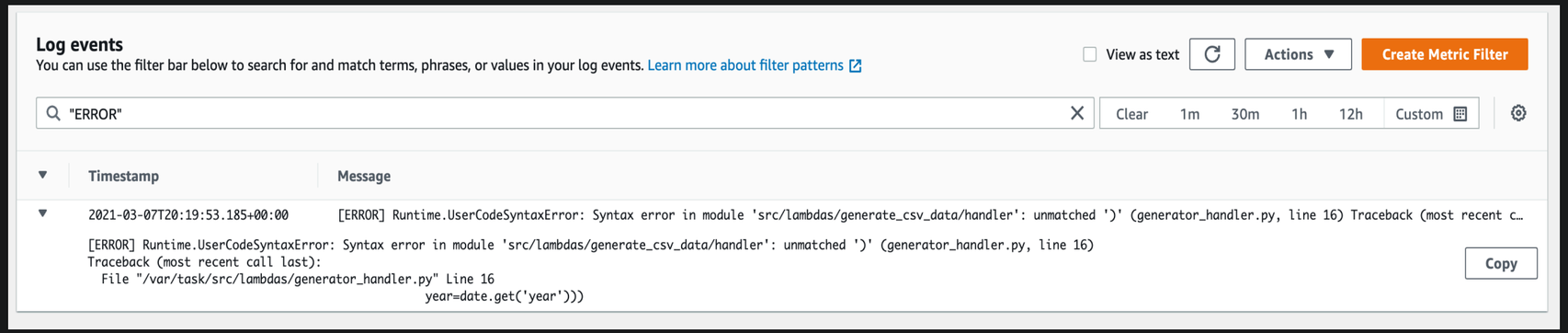
CloudWatch Logs - Simple Queries



CloudWatch Logs - Simple Queries

> Do a 5 min demo in CloudWatch, get everyone to follow along for practice

E.g:

- Show how the simple query filters from the previous slides work

CloudWatch Logs - Insights

- CloudWatch Logs Insights is a vital part of the AWS monitoring ecosystem.
- You can use Log Insights to interact with your log data.
- It lets you query your logs and will assist in responding to operational issues.

The below query demonstrates selecting few fields, applying a filter and then a sort. This is useful if you are sifting through stacks of logs.

```
fields @timestamp, @message
| filter @message like /error/
| sort @timestamp desc
```

You can also count, group, group by time period with `bin()` and do other complex operations.

CloudWatch Logs - Insights

> Do a 5 min demo in CloudWatch, get everyone to follow along for practice

E.g.

- Selecting the right Log Groups
- Running insights-style queries
- Saving queries for use later

CloudWatch Metrics

- Metrics are the fundamental concept in CloudWatch. A metric represents a time-ordered set of data points that are published to CloudWatch.
- Think of a metric as a variable to monitor, and the data points will be the values of that variable over time.
- For example, the CPU usage of a particular EC2 instance is one metric provided by AWS. The data points themselves can come from any application or business activity from which you collect data.

CloudWatch Metrics

> Do a 5 min demo in CloudWatch, so everyone can follow along for practice

E.g:

- How to find the different metrics

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Emoji Check:

Do you understand that CloudWatch can be a really useful tool?

1. 😢 Haven't a clue, please help!
2. 😕 I'm starting to get it but need to go over some of it please
3. 😐 Ok. With a bit of help and practice, yes
4. 🙂 Yes, with team collaboration could try it
5. 😄 Yes, enough to start working on it collaboratively

Monitoring AWS Lambda

CloudWatch monitors your Lambda applications automatically since it is created. CloudWatch will start tracking metric data for it.

Some of the core metrics that it gathers on Lambda are:

- **Invocations**: The number of times your function is invoked.
- **Errors**: The number of times your function fails with an error, due to timeouts, memory issues, unhandled exceptions, or other issues.
- **Throttles**: The number of times your function is throttled. AWS limits the concurrent number of executions across all your functions. If you exceed that, your function will be throttled and won't be allowed to run.
- **Duration**: How long your function runs.

Monitoring AWS Lambda

> Do a 5 min demo of Lambda metrics graphs

- Make graphs of e.g. Duration, Invocations, Errors

CloudWatch Alarms

An *alarm* watches a single metric over a specified time period, and performs one or more specified actions, based on the value of the metric relative to a threshold over time.

You can use an *alarm* to automatically initiate *actions* on your behalf.

An *action* is a notification that can sent to a service like Simple Notification Service (SNS) or a monitoring dashboard.

CloudWatch Alarms

Alarms invoke actions for sustained state changes only. Alarms do not invoke actions simply because they are in a particular state.

The state must have changed and been maintained for a specified number of periods. An example is the CPU usage of an EC2 instance going over 90% for 5 minutes.

CloudWatch Alarms

> Do a 5 min demo of making an Alert, get everyone to follow along so they can practice

E.g:

- Lambda Duration too big
- Lambda Errors > 0 in the last hour

Exercise - CloudWatch - 30 mins

> Open file `exercises/monitoring-exercises.md`
>
> Try the "CloudWatch" section

Don't do the "Grafana" section yet.

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Emoji Check:

Do you feel you understand Metrics and Alarms on a high level?

1. 😢 Haven't a clue, please help!
2. 😕 I'm starting to get it but need to go over some of it please
3. 😐 Ok. With a bit of help and practice, yes
4. 🙂 Yes, with team collaboration could try it
5. 😄 Yes, enough to start working on it collaboratively

Grafana

What is Grafana?

Grafana is an open source monitoring dashboard application with lots of features which make it easy to use, flexible and very powerful.

It pulls in data from supported data sources to create dashboards including databases and CloudWatch metrics.

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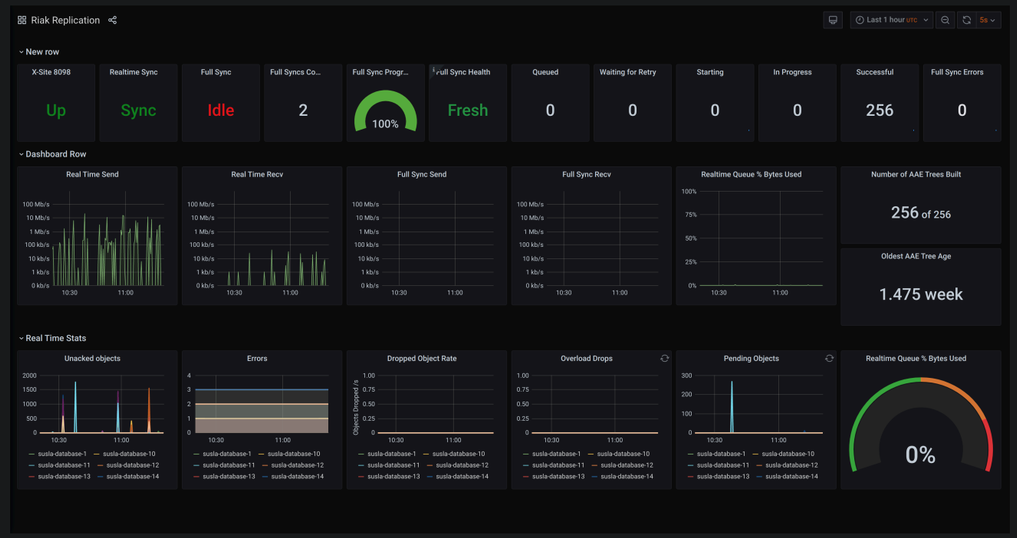
What does it look like?



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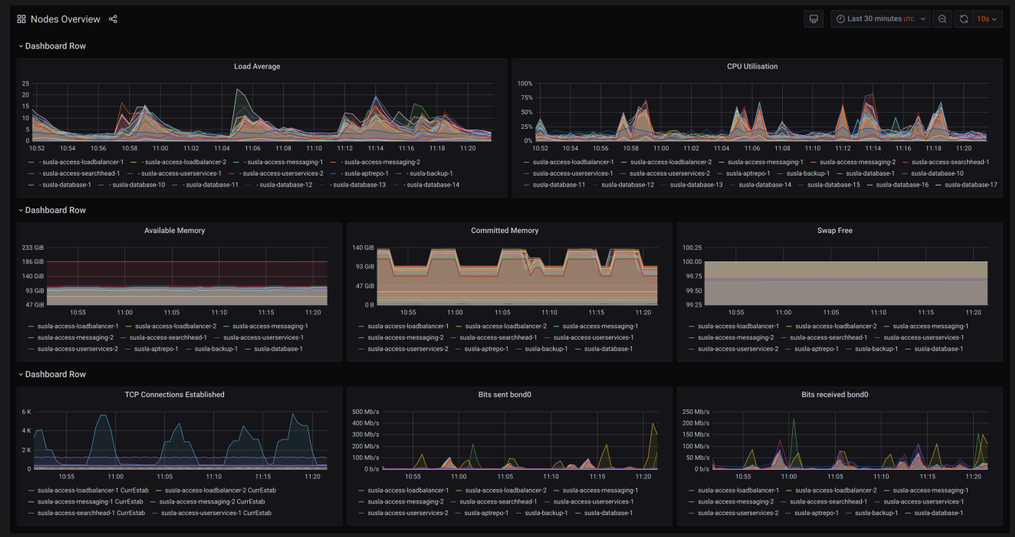
What does it look like?



Exercise - Grafana - 30 mins

> Open file `exercises/monitoring-exercises.md`
>
> Try the "Grafana" section

Don't do the "Final Project" section.

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Emoji Check:

How did you get on with the Grafana exercises?

1. 😢 Haven't a clue, please help!
2. 😕 I'm starting to get it but need to go over some of it please
3. 😐 Ok. With a bit of help and practice, yes
4. 🙂 Yes, with team collaboration could try it
5. 😄 Yes, enough to start working on it collaboratively

Offline task - Final Project Grafana

> In your final projects, Grafana will be required to visualise your data.
>
> The "Final Project" section at the end of file `exercises/monitoring-exercises.md` refers to the file `./exercises/final-project-grafana-setup-sot.md`, which has lots of information for you.

Overview - recap

- What does software monitoring consist of?
- Why do we monitor software?
- Monitoring infrastructure
- Monitoring applications

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Learning Objectives - recap

- Identify the features of software monitoring
- Explain why and what we monitor
- Define logging and what logs are used for
- Detail the features of CloudWatch and Grafana

Further Reading and Credits

- CloudWatch Docs
- CloudWatch Logs Insights Query Syntax
- CloudWatch Logs Query Syntax
- Grafana Docs
- AWS X-Ray

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Emoji Check:

On a high level, do you think you understand the main concepts of this session? Say so if not!

1. 😢 Haven't a clue, please help!
2. 😕 I'm starting to get it but need to go over some of it please
3. 😐 Ok. With a bit of help and practice, yes
4. 🙂 Yes, with team collaboration could try it
5. 😀 Yes, enough to start working on it collaboratively