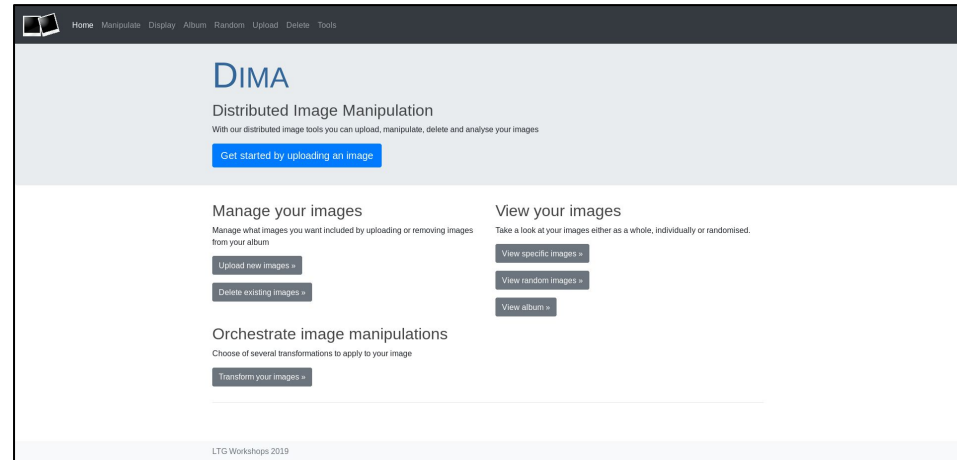


# Exploring systems quality in a distributed world

With Abby Bangser and Benjamin Hofmann  
Supported by Jon Barber

# Welcome

- Join [https://tlk.io/atd\\_o11y](https://tlk.io/atd_o11y)
- Open DIMA website from link in chat (<http://46.101.170.74>)
- Upload an image you think represents yourself
- Paste the ID of the image into the chat



Say hello! 🙌  
(name, home city, tech role)



What are your observability goals?

What fears do you have for this workshop?



# Understanding our domain

Create a model of the application which can help you design tests and identify risks

# Sharing your domain models

As you share, let's collect and group all the questions and risks that we have about the system

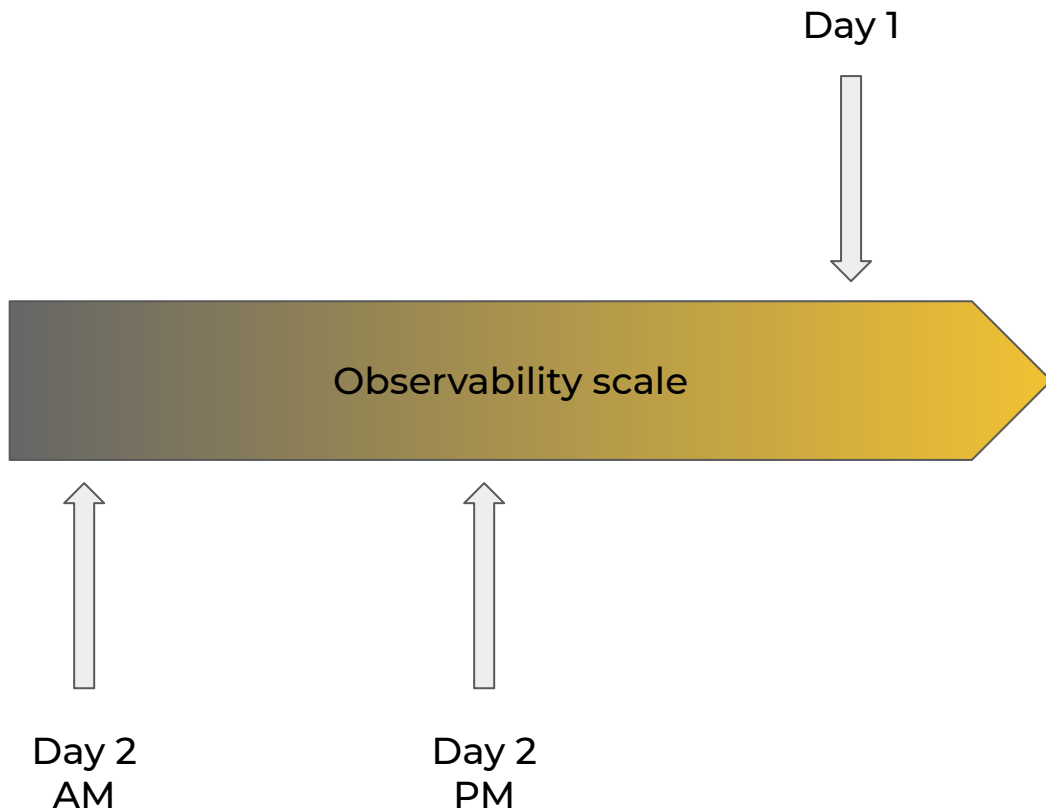
# Our two days together

## Goal:

To introduce the power of arbitrarily wide, context rich events and how to leverage them to explore a distributed environment

## Takeaways:

- Identify what can impact levels of observability
- Exposure to tools and techniques that are used when exploring observable systems
- Understand how the industry has moved towards observability



# Our day today

## Goal:

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- Exposure to the data structures of logs, metrics and traces



Welcome



Understanding our business domain



Architecture and observability intro



Observability within kibana



Explore APM



Dive into detailed logs and events



Understand the bigger trend of metrics



More experience with logs

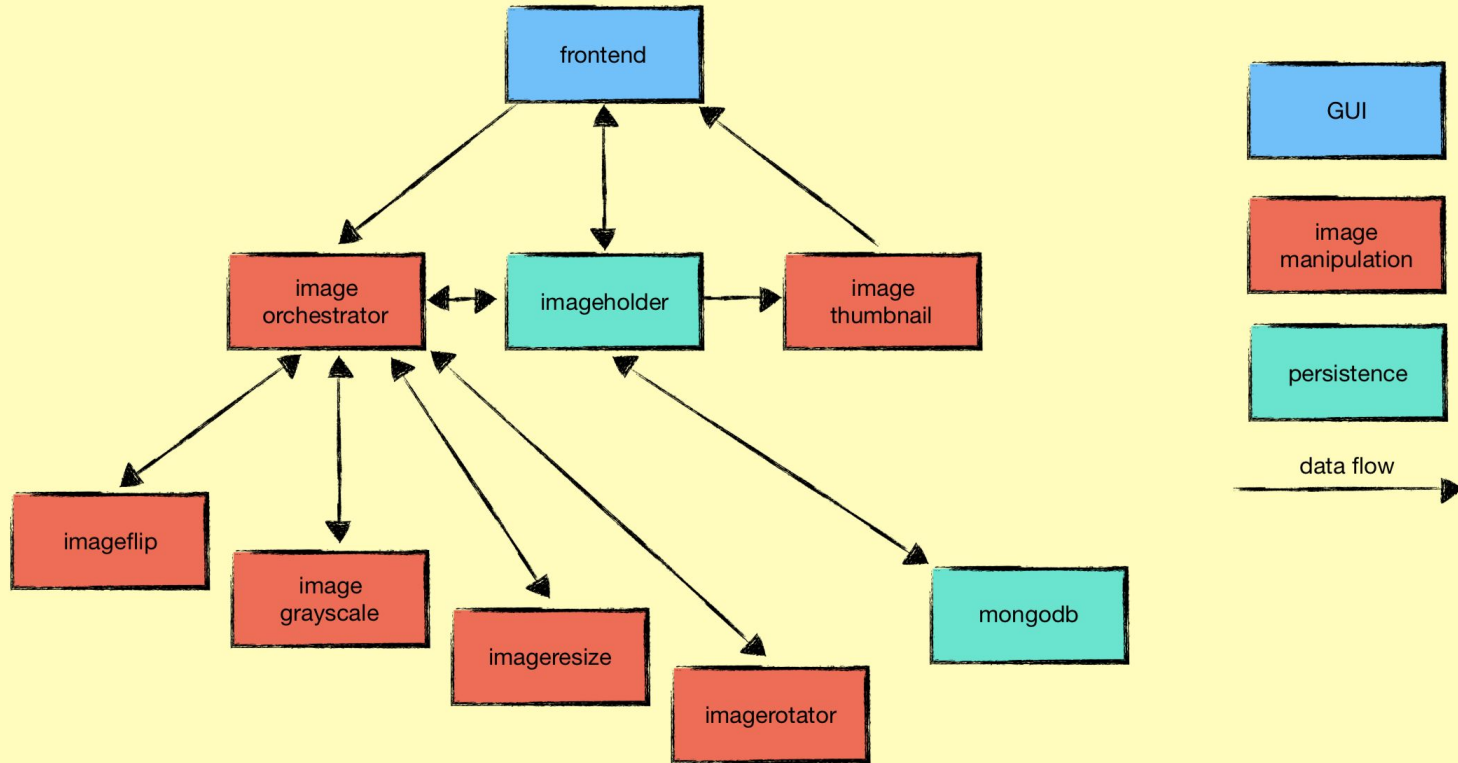


More experience with metrics (prometheus)



Preparing for tomorrow

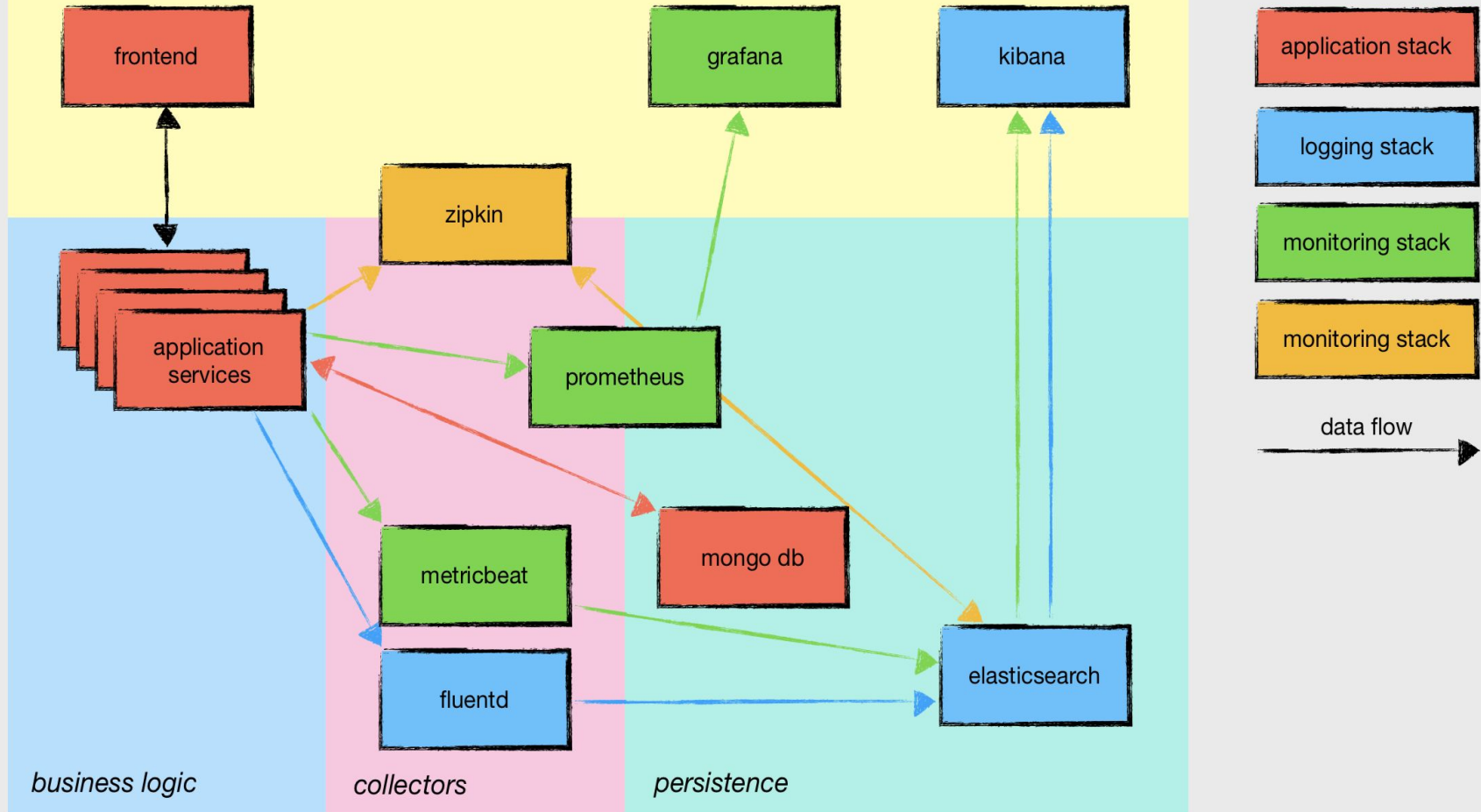
# Architecture





# Truths about distributed systems...

- The entire system is never fully healthy
- Users and use cases are unpredictable
- It's impossible to predict all kinds of failure states
- Failure can occur at every phase
- Debugging is a cornerstone activity



# Three common data types...

Logs

Metrics

Traces

# Three common data types...

## Logs

```
June 9th 2019, 23:21:47.313 container_id: 7539e37f488e61476c18aab4304e035148dc13463edcee0599ef42e1ebaa1a15 container_name: dima_imageholde  
r_1 source: stdout message: To enable URLs as dynamic configuration sources, define System property archaius.c  
onfigurationSource.additionalUrls or make config.properties available on classpath. service: imageholder @time  
stamp: June 9th 2019, 23:21:47.313 logger_name: com.netflix.config.sources.URLConfigurationSource level: INFO  
@log_name: 7539e37f488e _id: 3JdVPmsBVWqi44Upcum- _type: access_log _index: fluentd-20190609 _score: -
```

## Metrics

## Traces

# Three common data types...

**Logs:** An immutable, timestamped record of discrete events that happened.

```
June 9th 2019, 23:21:47.313 container_id: 7539e37f488e61476c18aab4304e035148dc13463edcee0599ef42e1ebaa1a15 container_name: dima_imageholder_1 source: stdout message: To enable URLs as dynamic configuration sources, define System property archaius.configurationSource.additionalUrls or make config.properties available on classpath. service: imageholder @timestamp: June 9th 2019, 23:21:47.313 logger_name: com.netflix.config.sources.URLConfigurationSource level: INFO @log_name: 7539e37f488e _id: 3JdVPmsBVWqi44Upcum- _type: access_log _index: fluentd-20190609 _score: -
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## Metrics

## Traces

# Three common data representations...

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## Metrics

```
# TYPE application_images_uploaded_total counter
application_images_uploaded_total{type="image/png"}, 371.0
application_images_uploaded_total{type="image/jpeg"}, 162.0
application_images_uploaded_total{type="image/tiff"}, 333.0
application_images_uploaded_total{type="image/gif"}, 303.0
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## Traces

# Three common data representations...

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**Metrics:** a numeric representation of data measured over time as either a rising counter or a gauge (point in time value)

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**Traces**

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```

## Traces

Services	39.335ms	78.671ms	118.006ms	157.342ms	196.677ms
imageorchestrator	196.677ms : post /api/images/transform	-	-	-	-
imageholder	2.983ms : get /api/images/{id}	-	-	-	-
imageflip	170.602ms : post /api/image/flip	-	-	-	-
imageholder	-	-	-	-	15.306ms : post /api/images



# Three common data representations...

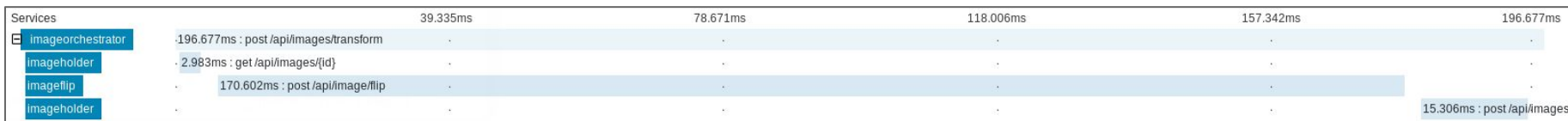
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application_images_uploaded_total{type="image/gif"}, 303.0
```

**Traces:** representation of a series of events that describe the end-to-end request



# Our day today

## Goal:

To introduce the power of arbitrarily wide, context rich events and how to leverage them to explore a distributed environment

## Takeaways:

- Understanding "normal" for an application
- Experience with Kibana data visualisation tool
- Exposure to the data structures of logs, metrics and traces

- ✓ Welcome
- ✓ Understanding our business domain
- ✓ Architecture and observability intro
- ❑ Observability within kibana
  - ❑ Explore APM
  - ❑ Dive into detailed logs and events
  - ❑ Understand the bigger trend of metrics
- ❑ More experience with logs
- ❑ More experience with metrics (prometheus)
- ❑ Preparing for tomorrow

# Coffee break



# Our day today

## Goal:

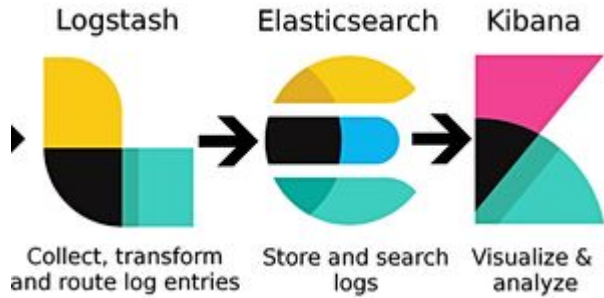
To introduce the power of arbitrarily wide, context rich events and how to leverage them to explore a distributed environment

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# Time to get down and dirty with the data



46.101.170.74:5601

## And join us on the **APM** page



# Not much to see here, but what about within a service?

Select the `imageflip` service and explore the available information

# Not much to see here, but what about within a service?

Select the `imageflip` service and explore the available information



Where would we get more detailed information  
about the execution of image flips by the service?

As calm as a service may appear at the surface,  
we need to dive below to understand more

Select the `ImageController#flipImage` transaction and explore the  
`Transactions duration distribution` work



As calm as a service may appear at the surface,  
we need to dive below to understand more

Select the `ImageController#flipImage` transaction and explore the  
`Transactions duration distribution` work



Why does that gap exist, how could we review uptime?

# Looking at uptime

Select the **Actions** > **View monitor status** and open in a new tab



Ah that downtime blip looks at about the same time!

# Drilling into a specific trace (sample)

Returning to the trace details...

Select the **2nd histogram bucket**, and focus on **Transaction sample** data

# Drilling into a specific trace (sample)

Returning to the trace details...

Select the 2nd histogram bucket, and focus on Transaction sample data



What does that % of trace mean?

imageFlip is just a small cog in a big wheel.  
What ever happened to that big distributed system?

Select the `View full trace` and explore the other pieces of the puzzle

imageFlip is just a small cog in a big wheel.  
What ever happened to that big distributed system?

Select the `View full trace` and explore the other pieces of the puzzle



How would we get more details on these spans?

# Now that we know where, how do we learn about what

Select the `Action > View trace logs` what does this new view give us?

# Now that we know where, how do we learn about what

Select the `Action > View trace logs` what does this new view give us?



How can we use **EVENT** lines different from non-**EVENT** lines?



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# Rewind...how are logs written during a request?




# Rewind...how are logs written during a request?

 Home Manipulate Display Album Random Upload Delete

## Manipulate Images

Orchestrate different image transformations on your image

uploaded wave spear [wczwjxmozerwmc4y0pey]



☐ Apply Grayscale

☐ Apply Rotation

Enter rotation degrees, eg 90

☐ Resize

Enter resizing factor: (0..n)

Flip image

☐ vertically☒ horizontally

☐ Persist image

Enter name

Submit Query

Workshops 2019

# Detailing how logs get written during a request

```
@PostMapping("flip")
public ResponseEntity flipImage(@RequestParam("image") MultipartFile file,
                                @RequestParam(value = "vertical") Boolean vertical,
                                @RequestParam(value = "horizontal") Boolean horizontal) {

    if (file.getContentType() != null) {
        LOGGER.warn("Wrong content type uploaded: {}", file.getContentType());
        return new ResponseEntity<>("Wrong content type uploaded: " + file.getContentType());
    }

    LOGGER.info("Receiving {} image to flip.", file.getContentType());
    byte[] flippedImage = imageService.flip(file, vertical, horizontal);

    if (flippedImage == null) {
        return new ResponseEntity<>("Failed to flip image", HttpStatus.INTERNAL_SERVER_ERROR);
    }

    LOGGER.info("Successfully flipped image id: {}", file.getId());
    return new ResponseEntity<>(flippedImage, headers, HttpStatus.OK);
}
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}
```

# Log outputs

Time ▾	message
> Oct 21, 2019 @ 20:17:57.899	Successfully flipped image id: f1eqrievdiwxt0d7vknf
> Oct 21, 2019 @ 20:17:57.822	Receiving image/png image to flip.

# In contrast, how an event is created during a request

```
@PostMapping("flip")
public ResponseEntity flipImage(...) {
    EVENT.addField("content.type", file.getContentType());
    EVENT.addField("action", "flip");
    EVENT.addField("image_id", file.getId());
    EVENT.addField("flip_vertical", vertical);
    EVENT.addField("flip_horizontal", horizontal);
    ...

    LOGGER.info("Receiving {} image to flip.", file.getContentType());
    byte[] flippedImage = imageService.flip(file, vertical, horizontal);
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    ...

    LOGGER.info("Receiving {} image to flip.", file.getContentType());
    byte[] flippedImage = imageService.flip(file, vertical, horizontal);
    ...

    LOGGER.info("Successfully flipped image id: {}", file.getId());
    EVENT.addField("action.success", "true");
    return new ResponseEntity<>(flippedImage, headers, HttpStatus.OK);
}
```

# In contrast, how an event is created during a request

```
@PostMapping("flip")
public ResponseEntity flipImage(...) {
    EVENT.addField("content.type", file.getContentType());
    EVENT.addField("action", "flip");
    EVENT.addField("image_id", file.getId());
    EVENT.addField("flip_vertical", vertical);
    EVENT.addField("flip_horizontal", horizontal);
    ...

    LOGGER.info("Receiving {} image to flip.", file.getContentType());
    byte[] flippedImage = imageService.flip(file, vertical, horizontal);
    ...

    LOGGER.info("Successfully flipped image id: {}", file.getId());
    EVENT.addField("action.success", "true");
    return new ResponseEntity<>(flippedImage, headers, HttpStatus.OK);
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# In contrast, how an event is created during a request

```
@PostMapping("flip")
public ResponseEntity flipImage(...) {
    EVENT.addField("content.type", file.getContentType());
    EVENT.addField("action", "flip");
    EVENT.addField("image_id", file.getId());
    EVENT.addField("flip_vertical", vertical);
    EVENT.addField("flip_horizontal", horizontal);
    ...

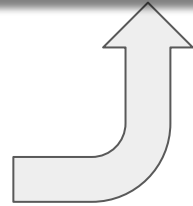
    LOGGER.info("Receiving {} image to flip.", file.getContentType());
    byte[] flippedImage = imageService.flip(file, vertical, horizontal);
    ...

    LOGGER.info("Successfully flipped image id: {}", file.getId());
    EVENT.addField("action.success", "true");
    return new ResponseEntity<>(flippedImage, headers, HttpStatus.OK);
}
```

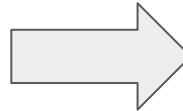
# Comparing the outputs

Time ▾	message
> Oct 21, 2019 @ 20:17:57.899	Successfully flipped image id: f1eqrievdiwxt0d7vknf
> Oct 21, 2019 @ 20:17:57.822	Receiving image/png image to flip.

Multiple logs



A single event



Expanded document	
Table	JSON
@timestamp	Oct 21, 2019 @ 20:17:57.822
t action	flip
t action.success	true
t content.type	image/png
t image.id	5dae0465b43b742b635bb0016eb49014
t flip.horizontal	false
t flip.vertical	true

# Our day today

## Goal:

To introduce the power of arbitrarily wide, context rich events and how to leverage them to explore a distributed environment

## Takeaways:

- Understanding "normal" for an application
- Experience with Kibana data visualisation tool
- Exposure to the data structures of logs, metrics and traces

- ✓ Welcome
- ✓ Understanding our business domain
- ✓ Architecture and observability intro
- ✓ Observability within kibana
  - ✓ Explore APM
  - ✓ Dive into detailed logs and events
  - ❑ Understand the bigger trend of metrics
- ❑ More experience with logs
- ❑ More experience with metrics (prometheus)
- ❑ Preparing for tomorrow



# Using those event details, let's review trends over time



Visualize

Create a new `line graph` visualisation based on our `logs-*` index

# Using those event details, let's review trends over time



Visualize

Create a new `line graph` visualisation based on our `logs-*` index



How do we get a count of requests over time?

# Count is interesting, but what about latency?

Change from count to `p50`, `p95`, `p99` latency based on `span.duration_ms`

# Count is interesting, but what about latency?

Change from count to `p50`, `p95`, `p99` latency based on `span.duration_ms`



What if we wanted to see how `content_type` impacts latency

Latency over time sure...  
but how about per image type?

Add a new `split series bucket` by the term `span.content_type`

# And then...

And then...just kidding, it's lunch time!



# Our day today

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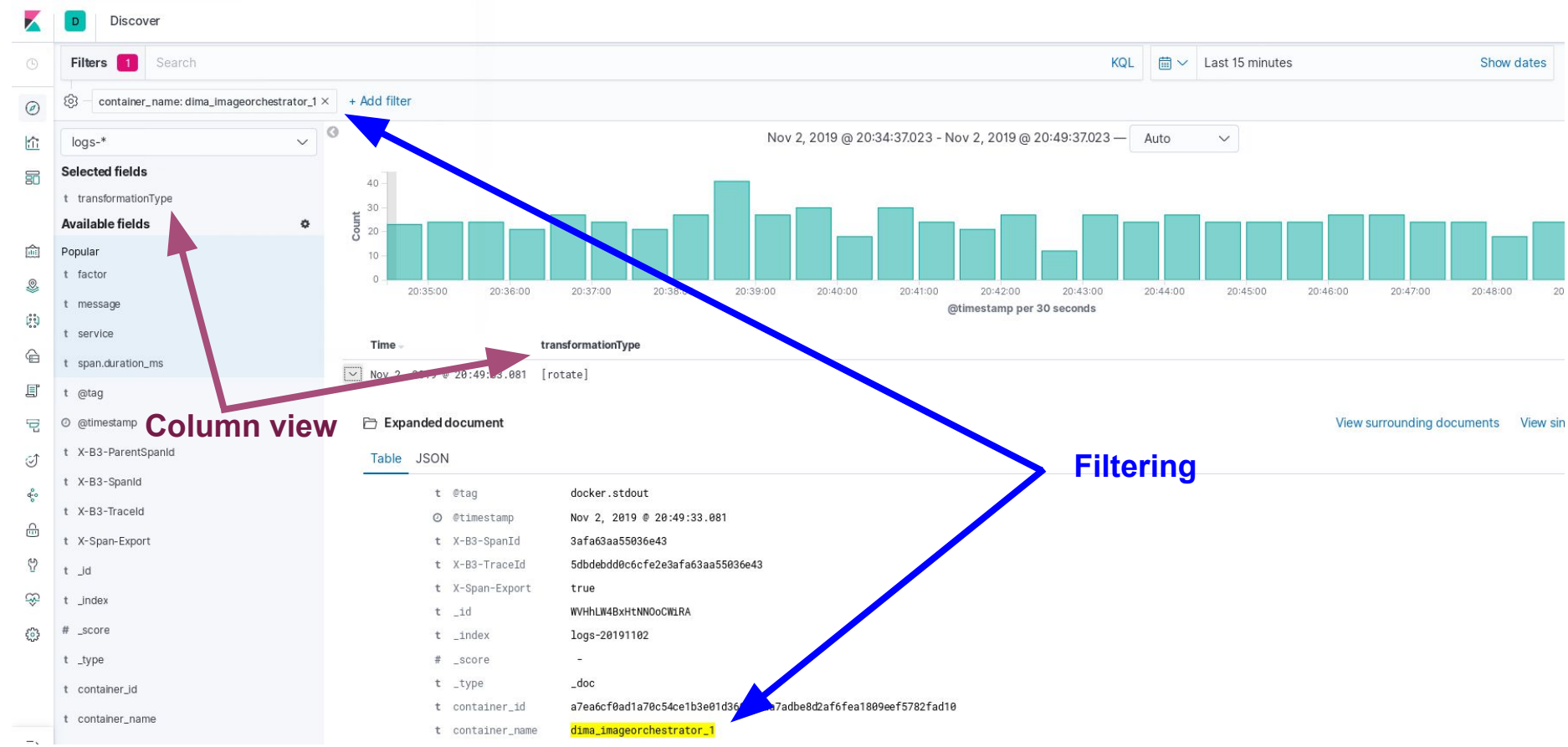
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# Deeper dive on logging with Kibana (ELK):

46.101.170.74:5601

# Some Kibana tips and tricks



# Exploring with logs...

## → Understanding log aggregation

- ◆ Compare two different services, what value is there having logs for both in the same search

## → Add a custom filter

- ◆ Make a filter based on different field types (string, date, number)

## → Working with time

- ◆ Find the oldest log we have available in kibana
- ◆ Select a specific time range using the graph as your guide

## → Collaborating with Kibana

- ◆ Make a filter based on different field try saving it and sharing with a teammate
- ◆ What scenarios would best fit an “Absolute” time frame vs a “Relative” when sharing queries?

# Exploring with logs...

- How did that feel?
- What similarities and differences did you feel from metrics?
- What do you want to ask next?
- What tool would best answer that question?

# Our day today

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# Coffee break



# Our day today

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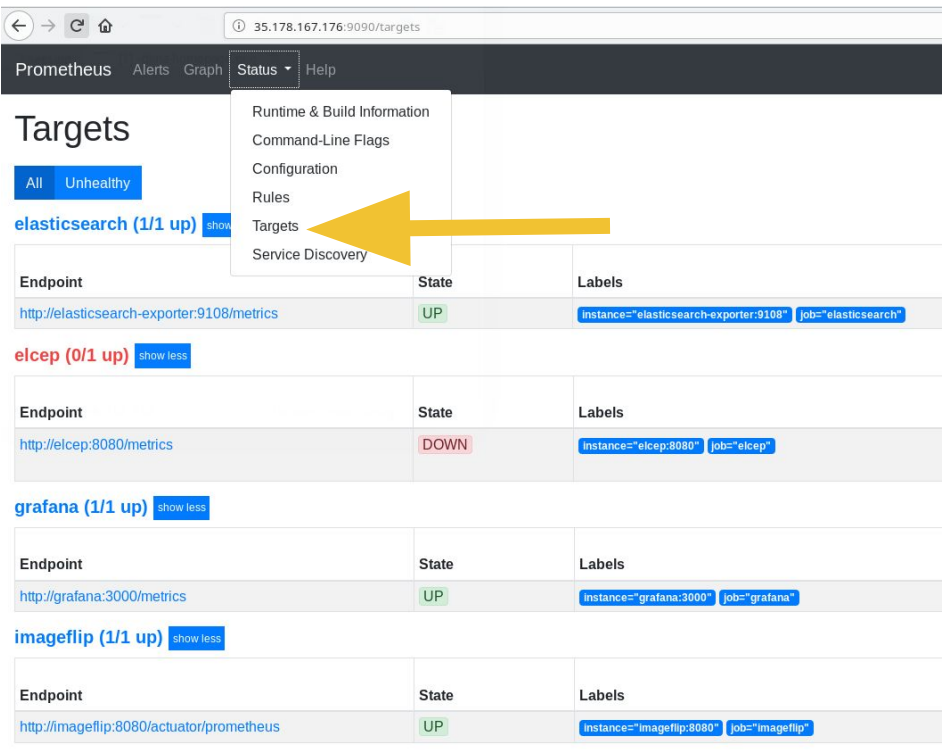
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Answer a metrics based question by  
using Prometheus:

46.101.170.74.48:9090

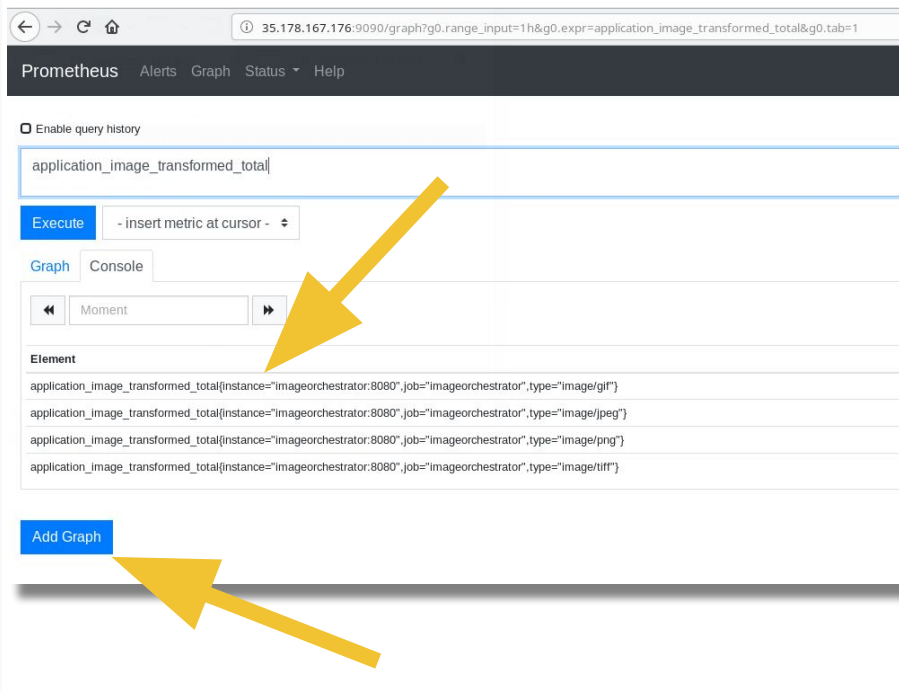


# Some Prometheus tips and tricks



The screenshot shows the Prometheus web interface at `35.178.167.176:9090/targets`. The 'Status' dropdown menu is open, and a yellow arrow points to the 'Targets' option. The main content area displays a list of targets with columns for Endpoint, State, and Labels.

Endpoint	State	Labels
<a href="http://elasticsearch-exporter:9108/metrics">http://elasticsearch-exporter:9108/metrics</a>	UP	<code>instance="elasticsearch-exporter:9108"</code> <code>job="elasticsearch"</code>
<a href="http://elcep:8080/metrics">http://elcep:8080/metrics</a>	DOWN	<code>instance="elcep:8080"</code> <code>job="elcep"</code>
<a href="http://grafana:3000/metrics">http://grafana:3000/metrics</a>	UP	<code>instance="grafana:3000"</code> <code>job="grafana"</code>
<a href="http://imageflip:8080/actuator/prometheus">http://imageflip:8080/actuator/prometheus</a>	UP	<code>instance="imageflip:8080"</code> <code>job="imageflip"</code>



The screenshot shows the Prometheus web interface at `35.178.167.176:9090/graph?g0.range_input=1h&g0.expr=application_image_transformed_total&g0.tab=1`. The 'Graph' tab is selected, and a yellow arrow points to the 'Add Graph' button. The query bar contains `application_image_transformed_total`, and the 'Execute' button is visible.

Query: `application_image_transformed_total`

Execute - insert metric at cursor -

Graph Console

Element

```
application_image_transformed_total{instance="imageorchestrator:8080",job="imageorchestrator",type="image/gif"}
application_image_transformed_total{instance="imageorchestrator:8080",job="imageorchestrator",type="image/jpeg"}
application_image_transformed_total{instance="imageorchestrator:8080",job="imageorchestrator",type="image/png"}
application_image_transformed_total{instance="imageorchestrator:8080",job="imageorchestrator",type="image/tiff"}
```

Add Graph

# Thought you may ask...ports the services run on:

xx.xx.xx.xx:8080	imageorchestrator
xx.xx.xx.xx:8081	imageholder
xx.xx.xx.xx:8082	imagerotator
xx.xx.xx.xx:8083	imagegrayscale
xx.xx.xx.xx:8084	imageresize
xx.xx.xx.xx:8085	imageflip
xx.xx.xx.xx:8086	imagethumbnail

# A first query

## → Identify the metric you care about

- ◆ Go to the `status` menu and select `targets` to view the metrics endpoint as a web page
- ◆ Browse available metrics from the drop down next to the `execute` button
- ◆ Use the fuzzy search in the `Expression` input field

## → Then get a feel for the “shape” of the metric

- ◆ Just run a query asking for the metric without any filters, time periods, or functions
- ◆ Start to formulate what is important about the metric through some questions:
  - What are the common labels vs those that are very unique?
  - What are the datatypes of the labels?
  - How variant are the values across unique label combinations?

# Moving to more powerful queries

## → Filter and select by string labels

- ◆ Copy and paste a label in as a filter, add a second filter
- ◆ Filter based on not equals, or a partial match

## → Work with the three different types of metrics

- ◆ View the graph of a metric whose value could only increase in value over time
- ◆ View the graph of a metric whose value should fluctuate up and down over time
- ◆ Find a bucketed metric and get the value of the highest two bucket values

## → Understand metrics over time

- ◆ Get a metrics value for the last 5 minutes
- ◆ Compare a metric between now and 5 minutes ago (and every 5 minutes for an hour)

## → Compare metrics

- ◆ Select only the top 5 results of a query
- ◆ Find values over a certain number
- ◆ Select metrics which are both under a certain count and over a different count

# Exploring with metrics...

- How did that feel?
- What do you want to ask next?
- What tool would best answer that question?

# Our day today

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# We will get a bit more down and dirty tomorrow

## Generating an ssh key

In the terminal

```
$ ssh-keygen -t rsa -b 4096 -C "email@host.com"
```

Defaults will create a file at `/home/<you>/.ssh/id_rsa` without a passphrase

```
$ cat /home/<you>/.ssh/id_rsa.pub
```

Copy this text and send it to us. We will add it to `~/.ssh/authorized_keys`

# Day Break



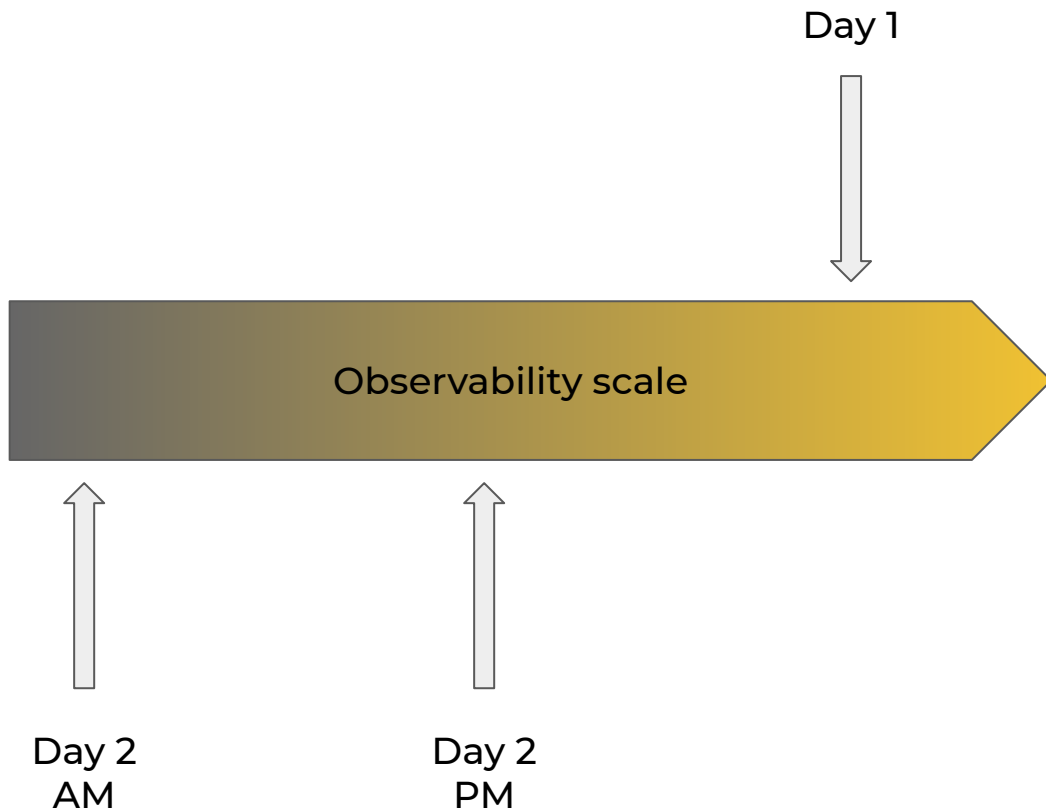
# Our two days together

## Goal:

To introduce the power of arbitrarily wide, context rich events and how to leverage them to explore a distributed environment

## Takeaways:

- Identify what can impact levels of observability
- Exposure to tools and techniques that are used when exploring observable systems
- Understand how the industry has moved towards observability



# Our day today

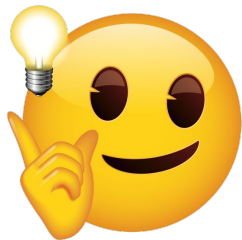
## Goal:

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- Observability is a scale
- Investment in observability can be expensive, but also impactful
- We can find value in our system outputs even at low levels of observability

- ❑ Recap
- ❑ Take a journey through log experiences
  - ❑ No aggregation, no structure
  - ❑ Aggregation without structure
  - ❑ Aggregation and structure
  - ❑ Events
- ❑ Take a journey through metrics
  - ❑ Up
  - ❑ Server metrics
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- ❑ Discussion about observability and testing



- Tooling
  - Kibana APM
  - Prometheus
- Power of data in ELK

**what do you think you  
can apply when you get  
back home next week?**



- Tooling
  - Kibana APM
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**what do you think you  
can apply when you get  
back home next week?**



**What questions have  
popped up overnight?**

# Our day today

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## Recap

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Let's look at **how** to debug stuff...

# Logs “on disk”

## Finding the right log file

Get onto the computer:

```
$ ssh atd@46.101.170.74
```

Figure out what is running:

Opening a log file for a service:

# Logs “on disk”

## Finding the right log file

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# Logs “on disk”

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$ docker ps
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Opening a log file for a service:

```
$ docker logs <service_name>
```

```
(e.g. dima_imageflip_1)
```

# Logs “on disk”

## Finding the right log file

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Figure out what is running:

```
$ docker ps
```

Opening a log file for a service:

```
$ docker logs <service_name>
```

(e.g. `dima_imageflip_1`)

## Finding the right log details

Watch the logs as they come in:

Open your logs to search:

Jump to the bottom of the file:

Search for a string:

*Next result:*      *Previous result:*

Count search results:

# Logs “on disk”

## Finding the right log file

Get onto the computer:

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```

Figure out what is running:

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Opening a log file for a service:

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$ docker logs <service_name>
```

(e.g. `dima_imageflip_1`)

## Finding the right log details

Watch the logs as they come in:

```
$ docker logs -f <service_name>
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Open your logs to search:

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# Logs “on disk”

## Finding the right log file

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$ docker ps
```

Opening a log file for a service:

```
$ docker logs <service_name>
```

(e.g. `dima_imageflip_1`)

## Finding the right log details

Watch the logs as they come in:

```
$ docker logs -f <service_name>
```

Open your logs to search:

```
$ docker logs <service_name> | less
```

Jump to the bottom of the file:

Search for a string:

*Next result:*

*Previous result:*

Count search results:

# Logs “on disk”

## Finding the right log file

Get onto the computer:

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$ ssh atd@46.101.170.74
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(e.g. `dima_imageflip_1`)

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$ docker logs -f <service_name>
```

Open your logs to search:

```
$ docker logs <service_name> | less
```

Jump to the bottom of the file: `shift + G`

Search for a string:

*Next result:*

*Previous result:*

Count search results:

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## Finding the right log file

Get onto the computer:

```
$ ssh atd@46.101.170.74
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$ docker ps
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(e.g. `dima_imageflip_1`)

## Finding the right log details

Watch the logs as they come in:

```
$ docker logs -f <service_name>
```

Open your logs to search:

```
$ docker logs <service_name> | less
```

Jump to the bottom of the file: `shift + G`

Search for a string: `/<search_term>`

*Next result:*      *Previous result:*

Count search results:

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## Finding the right log file

Get onto the computer:

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```

Jump to the bottom of the file: `shift + G`

Search for a string: `/<search_term>`

*Next result:* `n`      *Previous result:* `N`

Count search results:

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## Finding the right log file

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```

Open your logs to search:

```
$ docker logs <service_name> | less
```

Jump to the bottom of the file: `shift + G`

Search for a string: `/<search_term>`

*Next result:* `n`      *Previous result:* `N`

Count search results:

```
$ docker logs <service_name> |  
  grep -o '<search_term>' | wc -l
```



# Our day today

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## Takeaways:

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## Recap

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- ☐ Discussion about observability and testing



# Whew, we have Kibana back!

→ Look at some of the tools you used yesterday...

- ◆ How does include/exclude work now?  
- ◆ How valuable are columns now?  



How would we search for logs of a certain image type now?

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# Coffee break



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# Structures, how much does this help?

→ How would we search for logs of a certain image type now?



How many times did we persist a flipped image?

# Our day today

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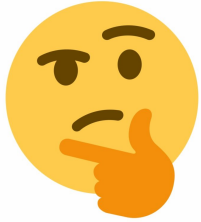


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# Events...a world beyond logs



How many times did we persist a flipped image?



So we know **how** to debug stuff...

... how do we know **when** to start debugging??

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Recap



Take a journey through log experiences



No aggregation, no structure



Aggregation without structure



Aggregation and structure



Events



Take a journey through metrics



Up



Server metrics



Business metrics



Take a journey through traces



APM



Contextual tracing



Discussion about observability and testing

# What does “up” really mean?



→ Review what is currently “up” to make sure we are in a healthy state



Well then, why is “Manipulate” acting funny?

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Take a journey through log experiences



No aggregation, no structure



Aggregation without structure



Aggregation and structure



Events



Take a journey through metrics



Up



Server metrics



Business metrics



Take a journey through traces



APM



Contextual tracing



Discussion about observability and testing



# “Technical” monitoring to the rescue!

- Review prometheus (46.101.170.74:9090) for newly available data to help debug that weird grayscale behaviour?



While this is great, what more could we want?

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Recap



Take a journey through log experiences



No aggregation, no structure



Aggregation without structure



Aggregation and structure



Events



Take a journey through metrics



Up



Server metrics



Business metrics



Take a journey through traces



APM



Contextual tracing



Discussion about observability and testing



# Context...we always want more context!

→ Now we have custom metrics, we can be more business context aware



What is a question we can answer with the  
``application_`` metrics that we can not without them?

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- Observability is a scale
- Investment in observability can be expensive, but also impactful
- We can find value in our system outputs even at low levels of observability



Recap



Take a journey through log experiences



No aggregation, no structure



Aggregation without structure



Aggregation and structure



Events



Take a journey through metrics



Up



Server metrics



Business metrics



Take a journey through traces



Basic tracing



Contextual tracing



Discussion about observability and testing



