

Legion Performance Analytics

Septembre 2021

Legion Performance Analytics

- Introduction
- Requirements
- Architecture
- Roadmap

Introduction

Definition

- Performance : quantified non-functional requirement
- **The test of the machine is the satisfaction it gives you.**— Robert M. Pirsig, *Zen and the Art of Motorcycle Maintenance: An Inquiry Into Values*
- Performance for software
 - Latency
 - ex.: frame time, reaction time, replication time, load time
 - Stability
 - ex.: MTBF, crashes, error logs, memory use
 - Satisfaction
 - ex.: retention, engagement, biometrics, surveys

Introduction

Stages of data storage

- in-app: buffered streams of structured events
- **Data Lake**
 - write-friendly format
 - shallow index
- **Data Warehouse**
 - ephemeral subset
 - deeply indexed
 - SQL



Introduction

Levels of analytics

- in-app: basic stats, adjust level of details of telemetry
- Basic stats over multiple sessions: MTBF, max memory use
- Deep inspection of a single session: Mem use of every asset, flame graphs
- Aggregates of high-frequency events over many sessions: Heat maps



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Requirements

Frequency of events

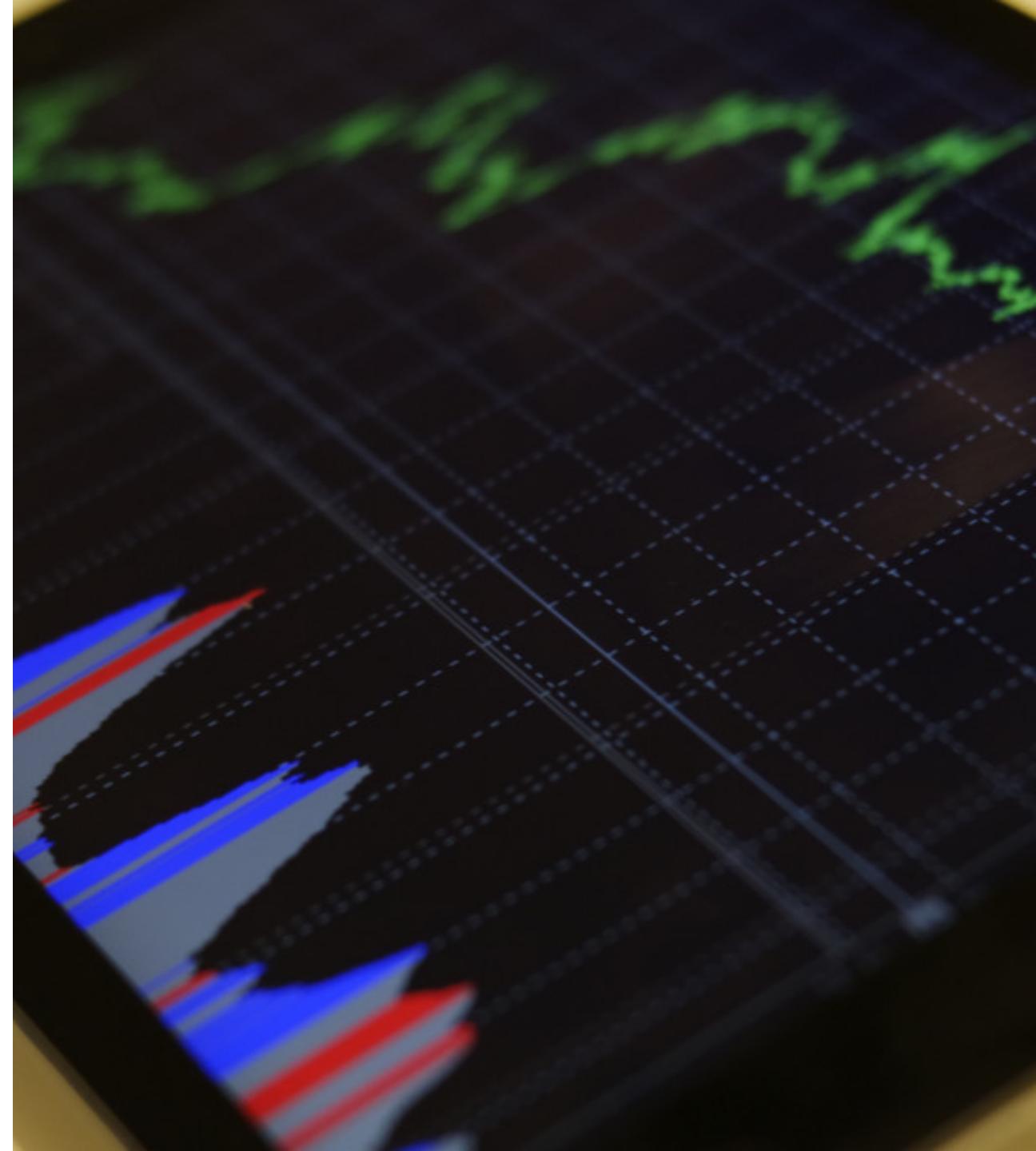
- High Frequency: thousands of events per frame
 - begin/end function call
 - begin/end asset-specific scope
 - memory alloc/free



Requirements

Frequency of events

- Frame metrics
 - frame time, engine time, render sync
 - player health, #npcs
 - process memory allocated/available
 - i.e. mostly time series



Requirements

Frequency of events

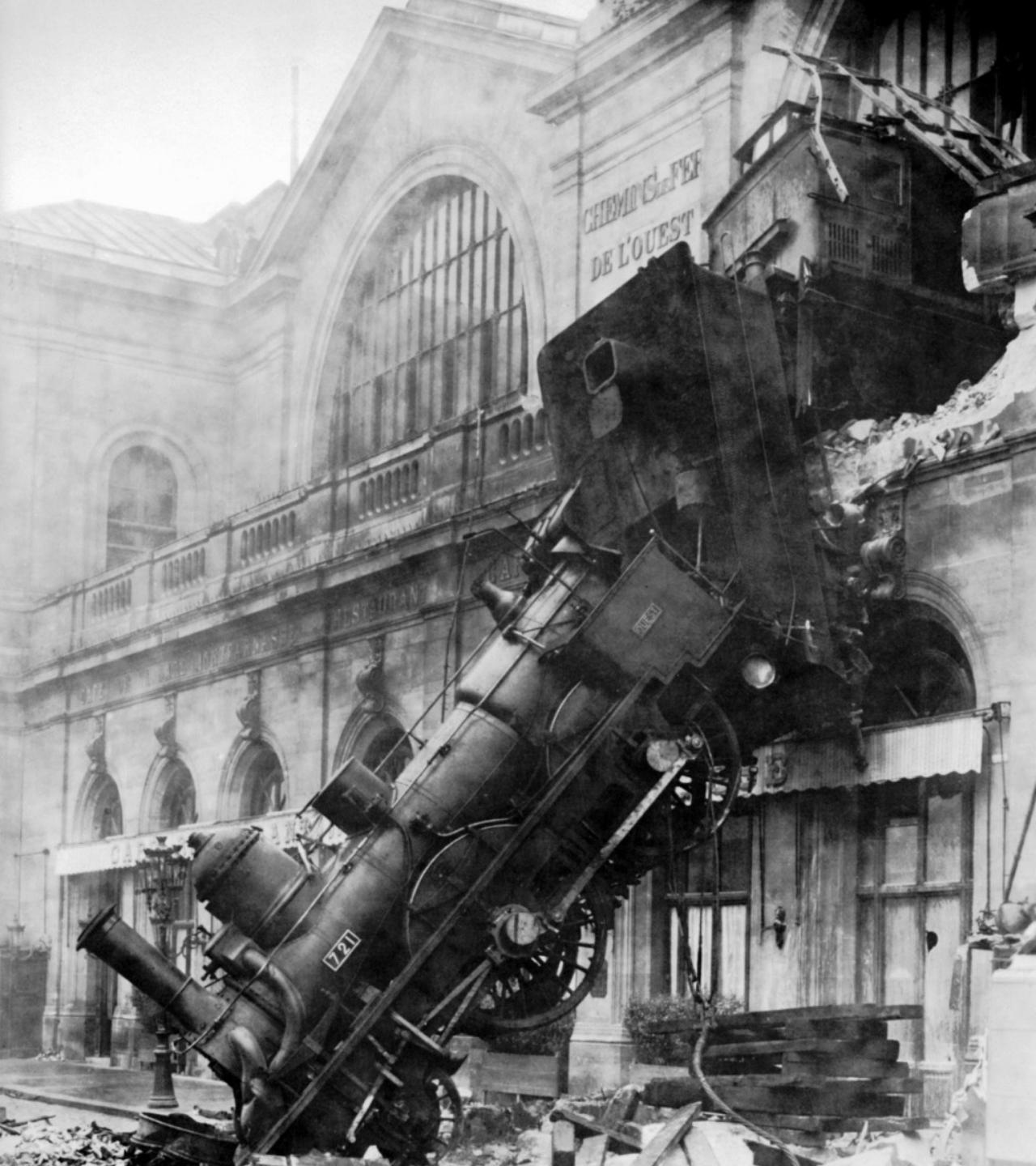
- Behaviour events
 - begin/end system state
 - gameplay events
 - user input



Requirements

Frequency of events

- Logs
 - begin/end app state (world loaded, in-play, matchmaking)
 - warnings
 - crashes with callstack



Requirements

Generic and Extensible event stream format

- Open/Closed principle: open for extension, but closed for modification
- Adding a feature-specific event should have no impact on ingestion pipeline
- No magic: specific reports/views depend on the presence of specific events
 - tagging of streams to advertise the purpose/suitability
 - i.e. dynamic duck typing
- not limited to time series

Requirements

Generic and Extensible event stream format

Performance characteristics

- write-friendly
 - most work is done with memcpy
 - important size optim: object references
- ingest-friendly
 - store without parsing whole block
 - compressed payload is not decompressed
- generic reader
 - as generic as JSON
 - metadata to decode the writer's memory model

Requirements

Understanding distributed applications

- one application session can extend to multiple processes
- sync clock easier for RPC model of distributed computation

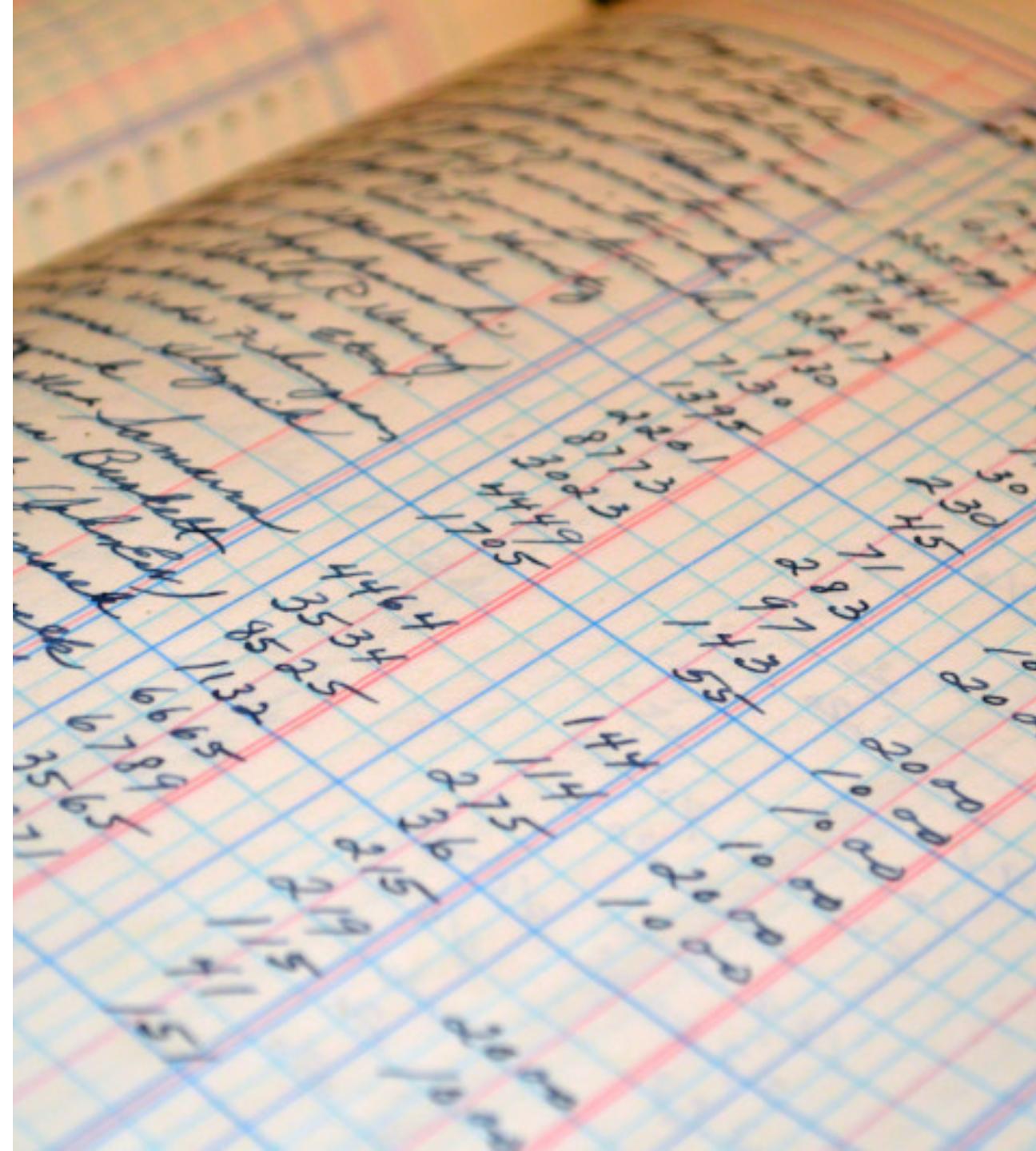


Requirements

5 views to rule over all data

List / Table / Search

- recent sessions
- top crashes
- cpu budget report



Requirements

5 views to rule over all data

Time series

- Individual frame times over time
- Player health over time
- Cohort engagement over 30 days



Requirements

5 views to rule over all data

Graphs & Trees

- Cumulative function call statistics
- Loaded object graph



Requirements

5 views to rule over all data

Timeline

- Call tree instances per thread

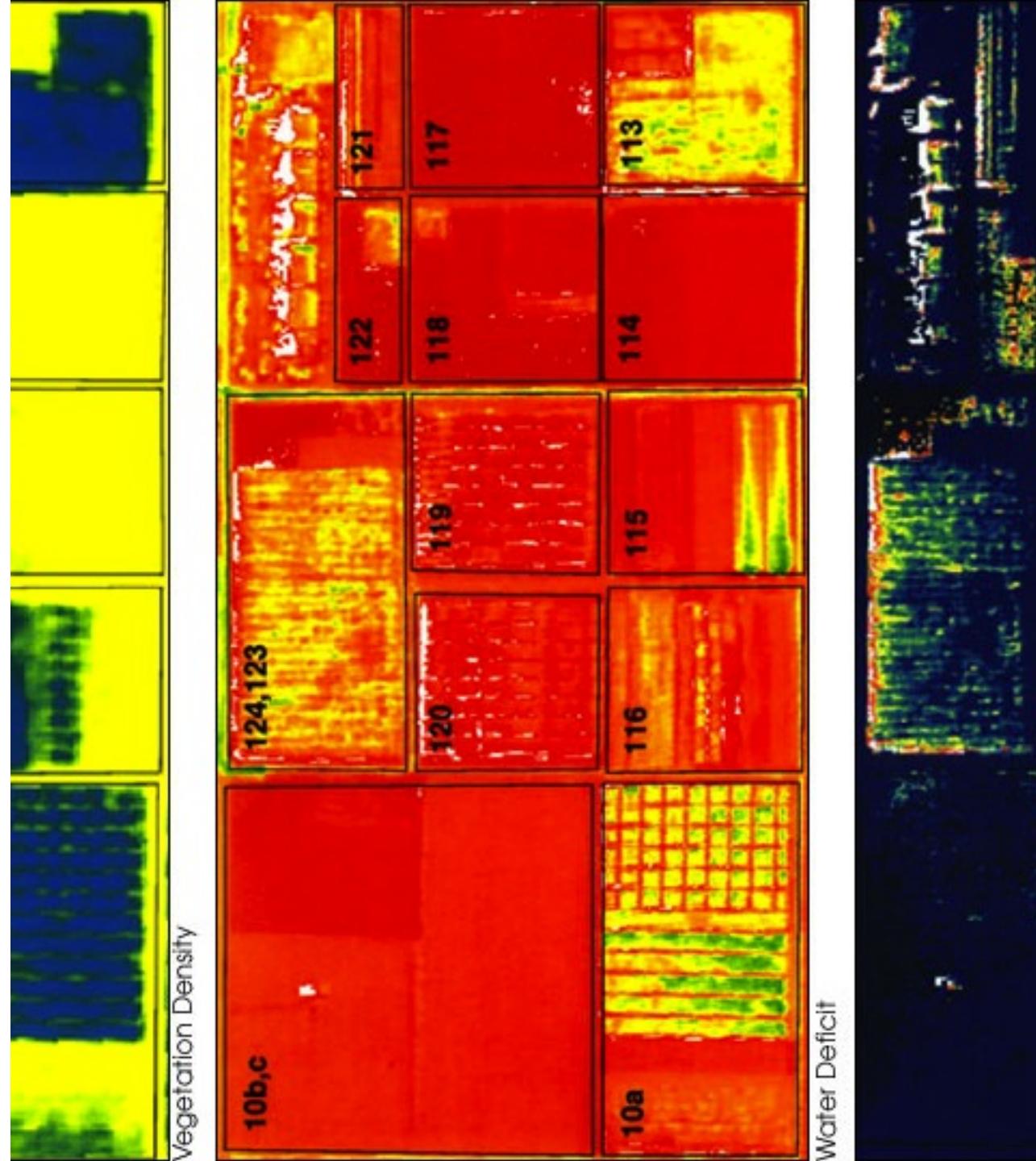


Requirements

5 views to rule over all data

Heatmap

- death map
- geographic slow frames distribution



Requirements

non-requirements

- interactive debugging
- per-pixel profiling
- low-level cpu events (L1 cache miss, branch mispredictions, ...)

not yet

- Video streaming & overlay
- cpu sampling
- context switches



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Architecture

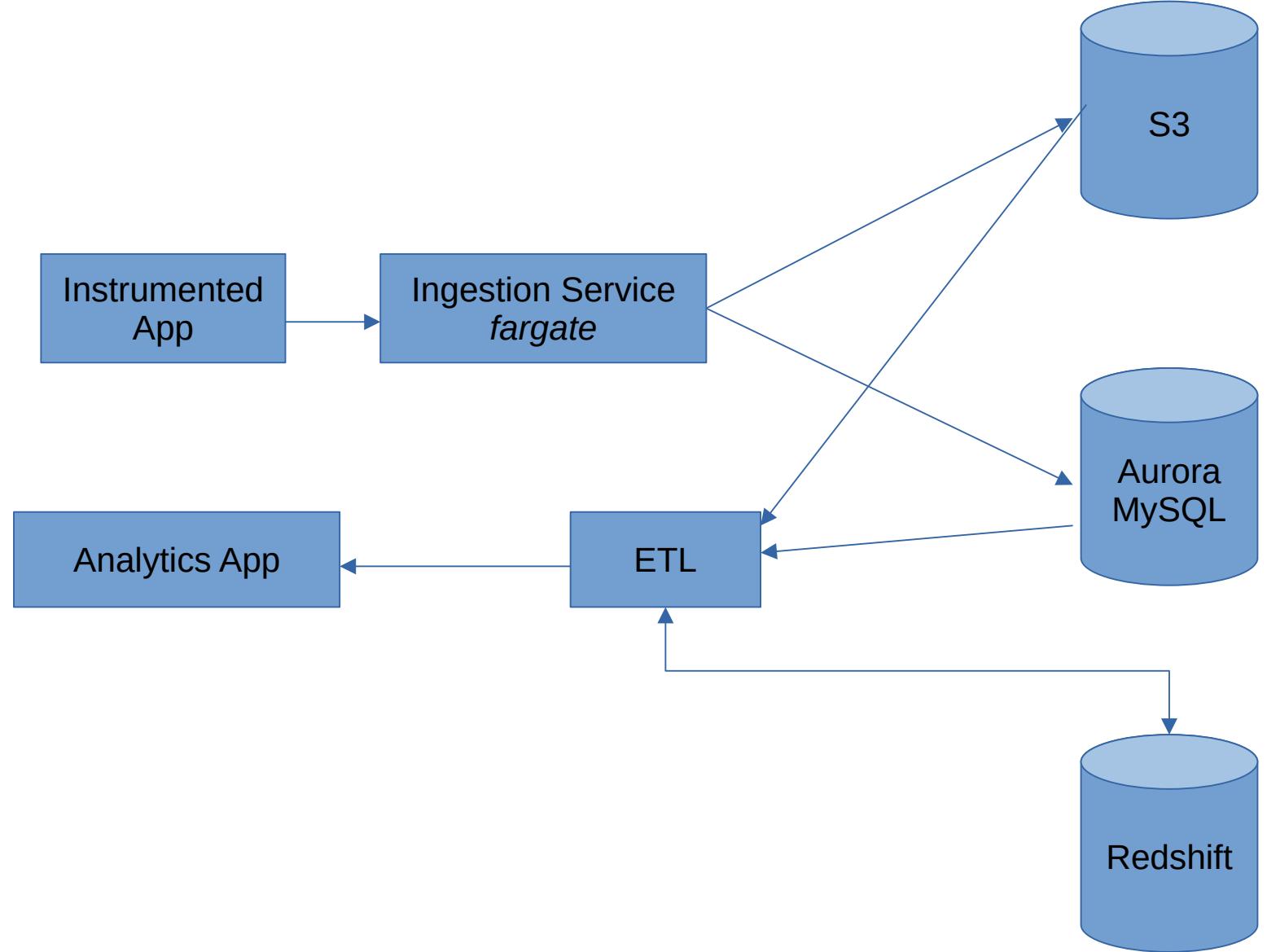
Object hierarchy

- Process instance
 - Stream
 - Stream block
 - Event



Architecture

Online architecture



Architecture

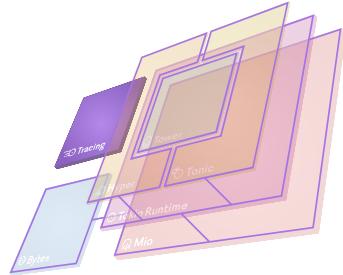
Integration/reuse of existing solutions

Many ideas in common with `tracing` crate from the `tokio` project.

<https://docs.rs/tracing/0.1.26/tracing/>

But `Collect` trait at the center of the system is a poor fit.

Could support the interface to get visibility into crates that are already instrumented.



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Progress 2021

Halloween 2021

- Initial version of client telemetry library
- Local ingestion server (sqlite & files)
- CLI analytics (csv output)

Christmas 2021

- Web Analytics client (svelte & Canvas)
- Visualization of call tree timeline



Progress 2022

January 2022

- Logging improvements (Jalal)
- Timeline levels of details (MAD)

February 2022

- Ingestion & analytics services in the cloud (MAD)
- Time series levels of details (Tim)
- UI redesign (Alexandra)

Roadmap

March 2022

- Time series continued (Tim)
- Timeline improvements (Tim)
- Async function tracing (MAD)

April 2022

- Unreal telemetry module (MAD)
- Cumulative call graph improvements (Tim)

Backlog

- Logs (dual mode)
 - Paging when not filtering
 - n-first results when there is a filter
- GPU profiling
- Memory profiling
- Object Graphs
 - Why is this texture loaded?
- Process dashboards
 - monitoring thousands of processes
- Task-based timeline & async span parenting
 - unifying thread-bound and async tasks
- Heat maps
- Real-time logs, metrics and timeline

