

Metrics as Music

an Open Source Symphony

Matt Davis ° **Scale 23x** ° **March 7, 2026**

What is a System?

**“a system is never the sum of its parts;
it’s the product of their interaction.”**

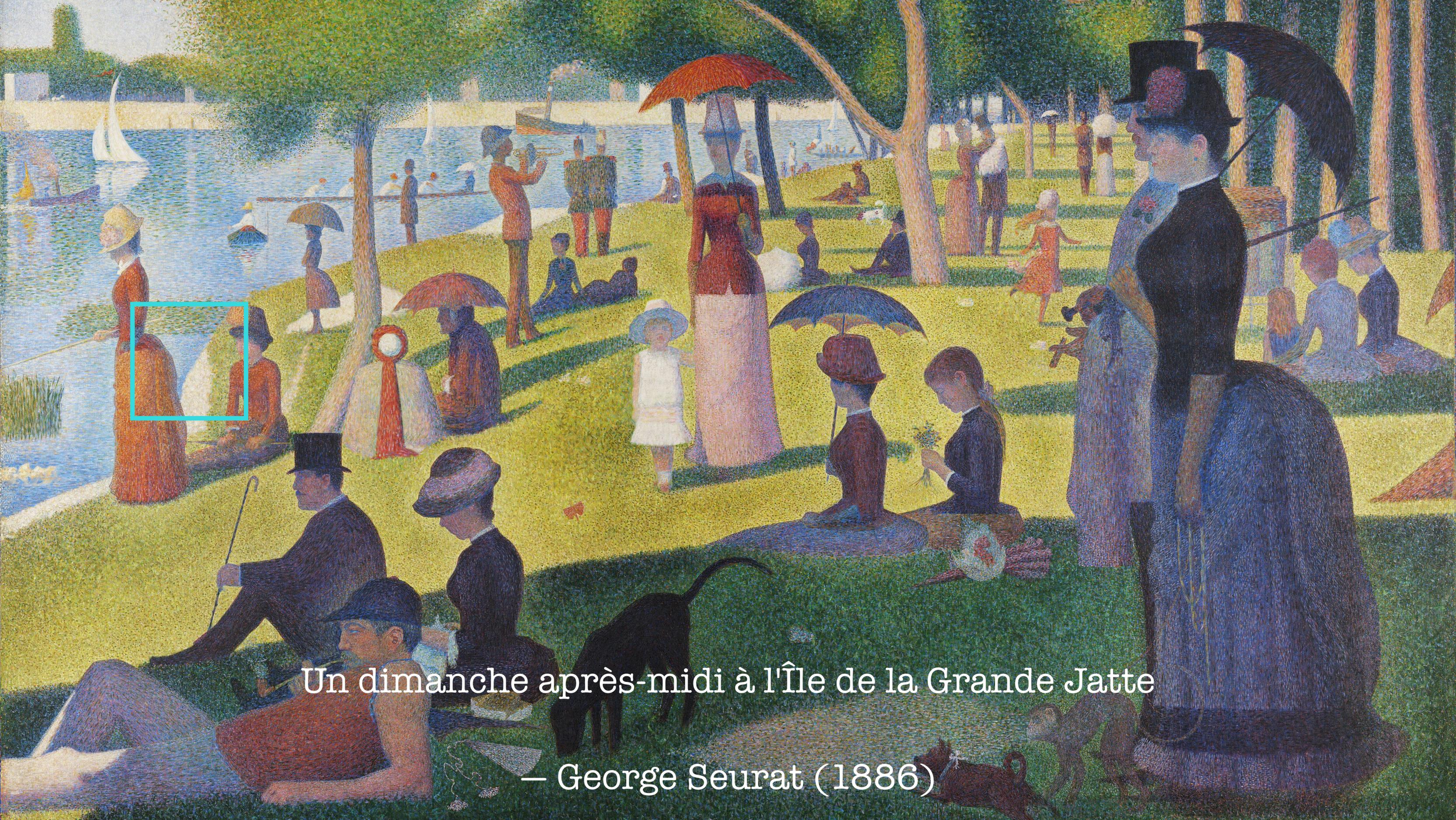
— *Russell Ackoff*

How do we see a System?

In control theory, “observability” measures how well a system’s state can be determined from its outputs.

In software, “observability” measures how well a system’s state can be understood from the obtained telemetry (metrics, logs, traces, profiling).

— [*https://en.wikipedia.org/wiki/Observability_\(software\)*](https://en.wikipedia.org/wiki/Observability_(software))



Un dimanche après-midi à l'Île de la Grande Jatte

— George Seurat (1886)



The Law of Good Continuation

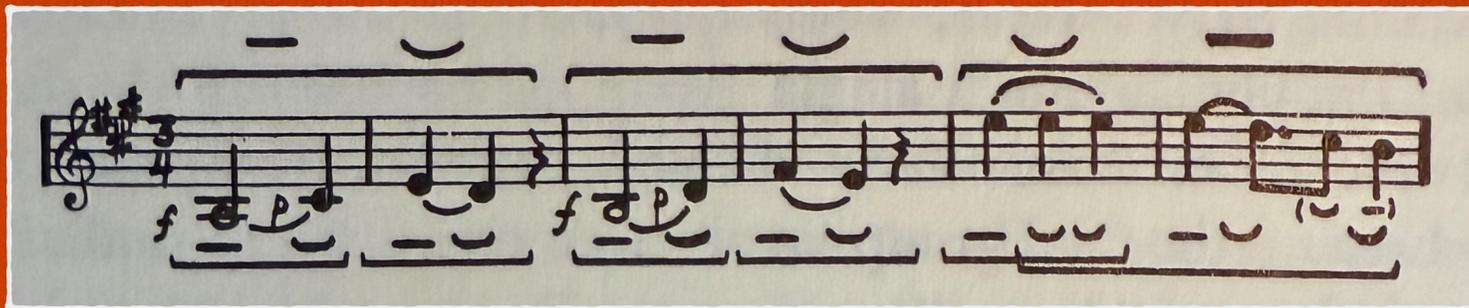
“We expect continuation only so long as it appears significant and meaningful ... as motion towards a goal.

**If meaning becomes obscured,
then change will be expected.”**

— Leonard Meyer

Leonard Meyer

*Developed a musical language
borrowing terms from poetry
to define the location of accents
that mark motions of continuation
in hierarchic structures.*



Hierarchical accent structure in Mozart's String Quartet in A Major (K.464), Minuetto



Hierarchical accent structure in Beethoven's String Quartet in C# Major (Op.131), fifth movement

Iamb ° **Trochee** ° **Amphibrach** ° **Anapest** ° **Dactyl**

What is an Accent?

Now is the winter of our discontent

*the first line of Shakespeare's **Richard III***

What is an Accent?

Now is | the **win** | ter **of** | our **dis** | **content**

trochee

iamb

iamb

iamb

iamb

What is an Accent?

Now is | the **win** | ter **of** | our **dis** | **content**

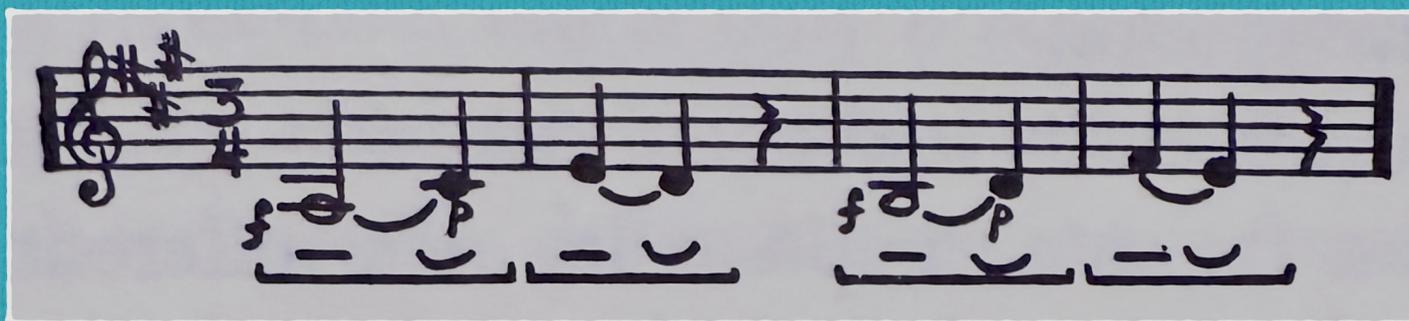
trochee

iamb

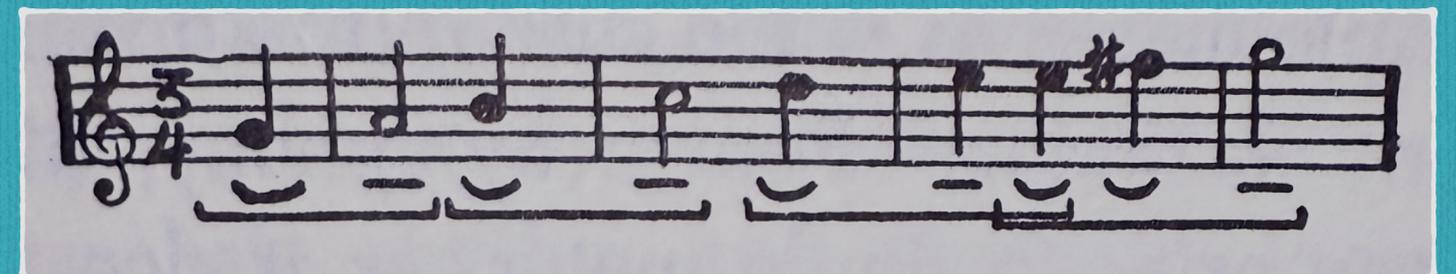
iamb

iamb

iamb



trochee patterns in Mozart's
String Quartet in A Major



iamb patterns in Beethoven's
First Symphony

What is an Accent?

Now is | the **win** | ter **of** | our **dis** | con**tent**

trochee

iamb

iamb

iamb

iamb



We can measure these metrics in patterns of accents!!

Monteverdi Observability

Can I engineer and deploy an OSS Tool?

Can I learn how to effectively incorporate LLM?

Can Harmonic Accent Analysis even work?

Can I play system data as music?



Claudio Monteverdi by Bernardo Strozzi (c. 1630)

Who?

Monteverdi

Late-Renaissance (1600s) composer

who developed new musical ideas

like *basso continuo* that would define

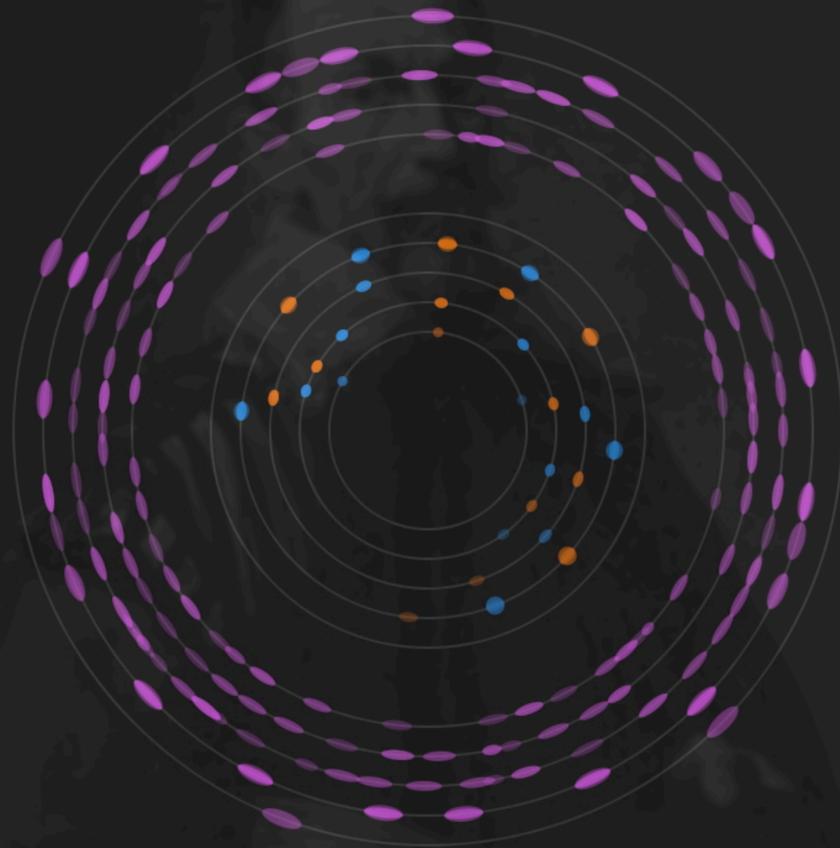
Baroque music, which he called

seconda pratica.

Monteverdi 0.19.6

[Metrics Data](#) | [Value Editor](#) | [Plugins](#)

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Why?

Observability

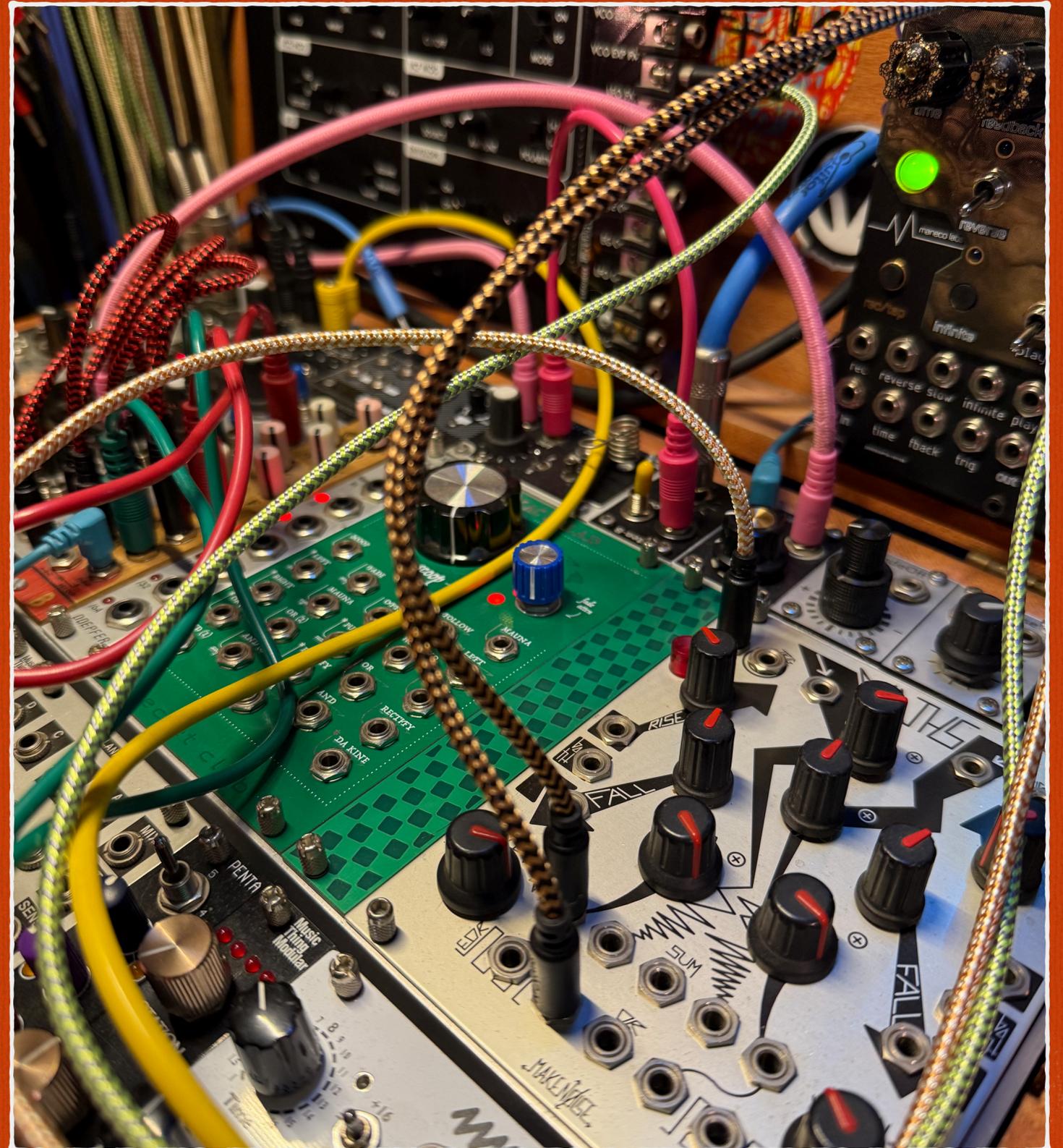
In order to see an emergent system, we need to constantly emerge our way of seeing it.

Monteverdi is a **seconda practica**, built to work with existing tools by reimagining what they can show.

Monteverdi displaying iambs, trochees, amphibrachs

Monteverdi

Let's make some noise!





Making Sound

Eurorack modular format
MIDI protocol

- ***Eurorack* was specified in 1995 by Dieter Doepfer, that uses electric voltage to shape sound**
- ***Musical Instrument Digital Interface, or MIDI*, was designed by Dave Smith and Chet Wood in 1981**
- **Both are non-commercial, free to use formats that have become international standards**

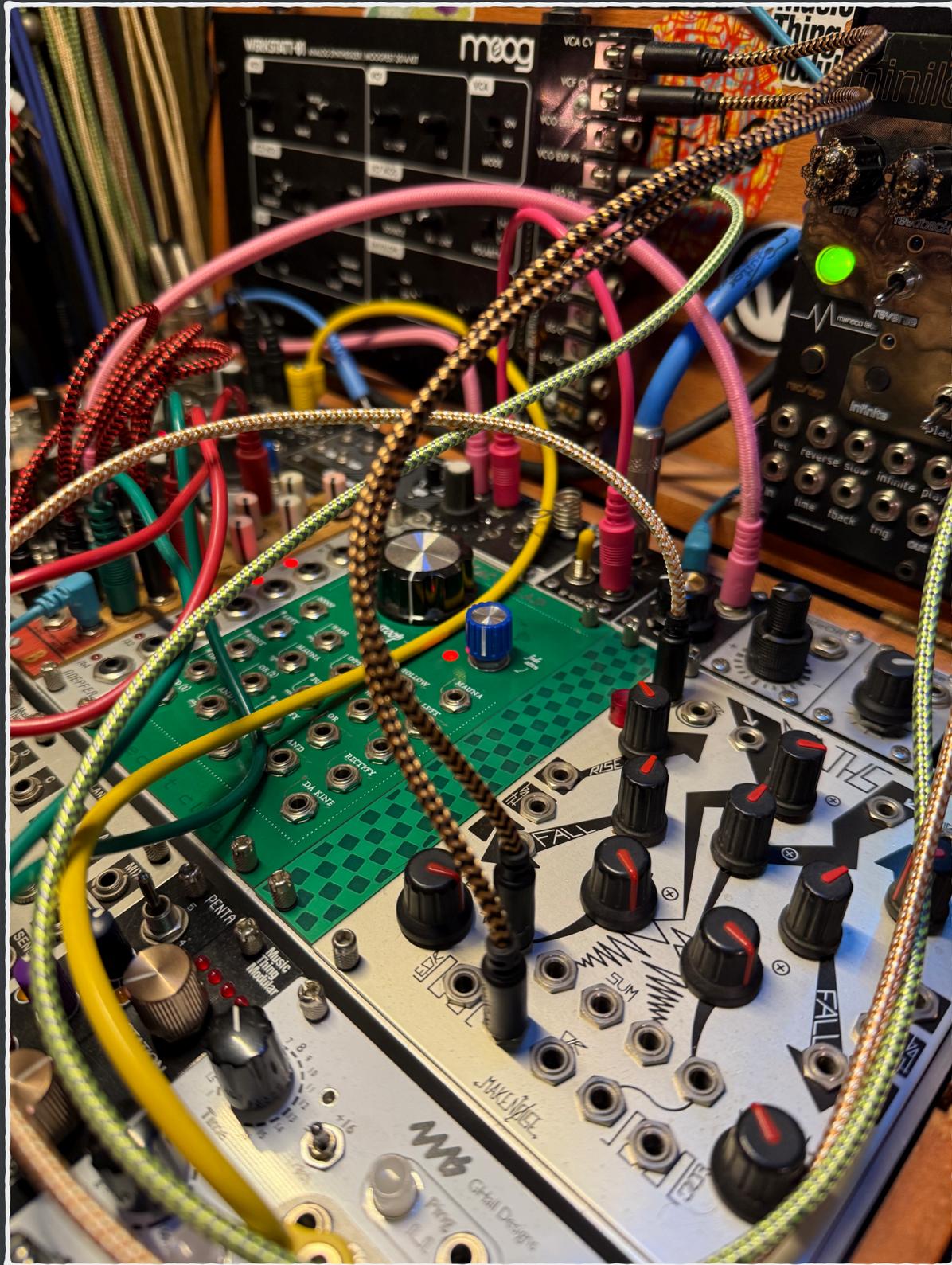
```
MONTEVERDI_LOGLEVEL=info
MONTEVERDI_TUI_TSDB_VISUAL_WINDOW=100
MONTEVERDI_PULSE_WINDOW_SECONDS=3600
MONTEVERDI_OUTPUT=MIDI
MONTEVERDI_PLUGIN_MIDI_PORT=1 # MIDI port number
MONTEVERDI_PLUGIN_MIDI_ROOT=60 # Starting MIDI note (60='Middle C')
# MONTEVERDI_PLUGIN_MIDI_SCALE=0,2,2,1,2,2,2,1 # Major (Default)
# MONTEVERDI_PLUGIN_MIDI_SCALE=0,2,1,2,2,2,1,2 # Minor
# MONTEVERDI_PLUGIN_MIDI_SCALE=0,2,2,2,2,2,2,2 # Wholetone
# MONTEVERDI_PLUGIN_MIDI_SCALE=0,1,1,1,1,1,1,1 # Chromatic
MONTEVERDI_PLUGIN_MIDI_SCALE=0,2,3,2,2,3 # Pentatonic
MONTEVERDI_PLUGIN_MIDI_ARP_INTERVAL=1 # Interval for arpeggio notes
MONTEVERDI_PLUGIN_MIDI_ARP_DELAY=200 # chord or arpeggio grouping ms
OTEL_RESOURCE_ATTRIBUTES="service.name=midimonteverdi"
OTEL_EXPORTER_OTLP_ENDPOINT="https://otlp-gateway-prod-us-west-0.grafana.net/otlp"
OTEL_EXPORTER_OTLP_HEADERS="Authorization=Basic <<TOKEN>>"
```



Winterbloom Sol

*Eurorack Module
w/ Circuit Python*

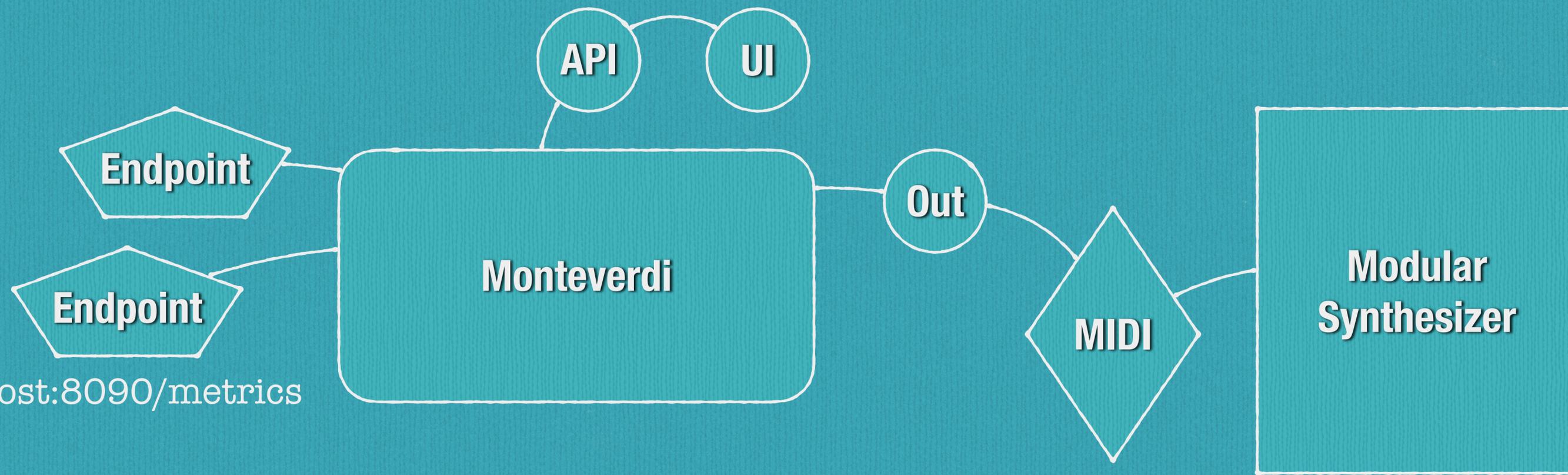
- **Programmable outputs with MIDI**
 - *Default: Single voice Pitch & Gate*
- **Works with MacOS and Linux drivers**
- **Reprogrammable for alternate outputs like LFOs, clock divider, polyphony, etc**
- **Open Source Hardware:**
<https://github.com/wnttblm/Sol>



Sound Sources

Eurorack Modules with Pitch and Gate

- **Moog Werkstatt-01 Kit (VCO for pitch)**
- **Make Noise Maths (envelope for gate)**
- **Music Thing Modular Radio Music**
- **Open Source:**
[https://www.musicthing.co.uk/
Radio-Music/](https://www.musicthing.co.uk/Radio-Music/)



<http://localhost:8090/metrics>

go_memstats_heap_inuse_bytes

max: 500000
 actual: 504200
 424100
 502310
 470690

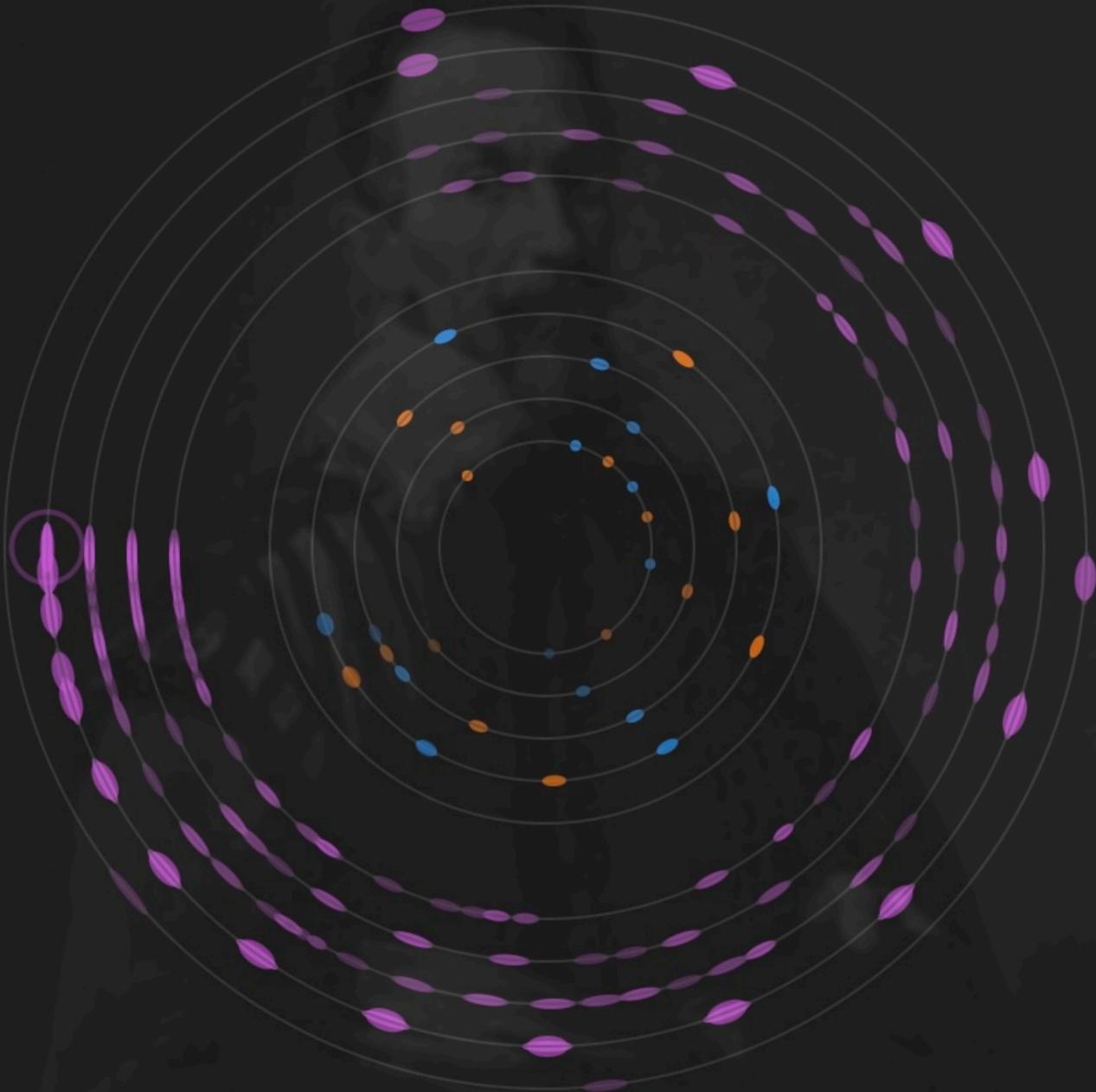


Accents Detected
 in a "Trochee" Pattern



MIDI Plugin translates
 data into NoteOn events,
 playing one for each Pattern.

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Live Metric Preview (see current values while editing)

Select Metric:

Endpoint	Metric	Current	Max	% Used	?
TOADLESTER_SERIAL	Metric_float_up	807	600	134.5%	🔥

Current Configuration

```
[  
  {  
    "id": "TOADLESTER_RANDOMIZER",  
    "url": "http://toadlester.rainbowq.net:8899/rand/all",  
    "delim": ":",  
    "interval": 2,  
    "metrics": {  
      "ExpMetric": {  
        "type": "gauge",  
        "transformer": "",  
        "max": 50000000  
      },  
      "FloatMetric": {  
        "type": "gauge"      }  
    }  
  }  
]
```

Current Metric Values (for tuning maxval in config.json)

Endpoint	Metric	Current	Max	% Used	?
TOADLESTER_RANDOMIZER	FloatMetric	96,765,951	50,000,000	193.5%	🔥
TOADLESTER_RANDOMIZER	IntMetric	21,483,986	50,000,000	43.0%	✓
TOADLESTER_RANDOMIZER	ExpMetric	22,183,000	50,000,000	44.4%	✓
TOADLESTER_SERIAL	Metric_exp_down	566,300,000	3,500,000,000	16.2%	✓
TOADLESTER_SERIAL	Metric_exp_up	36,970,000	160,000,000	23.1%	✓
TOADLESTER_SERIAL	Metric_float_down	833	5,500	15.1%	✓
TOADLESTER_SERIAL	Metric_float_up	201	600	33.5%	✓
TOADLESTER_SERIAL	Metric_int_down	160,886,704	73,000,000	220.4%	🔥
TOADLESTER_SERIAL	Metric_int_up	441,600	250,000	176.6%	🔥

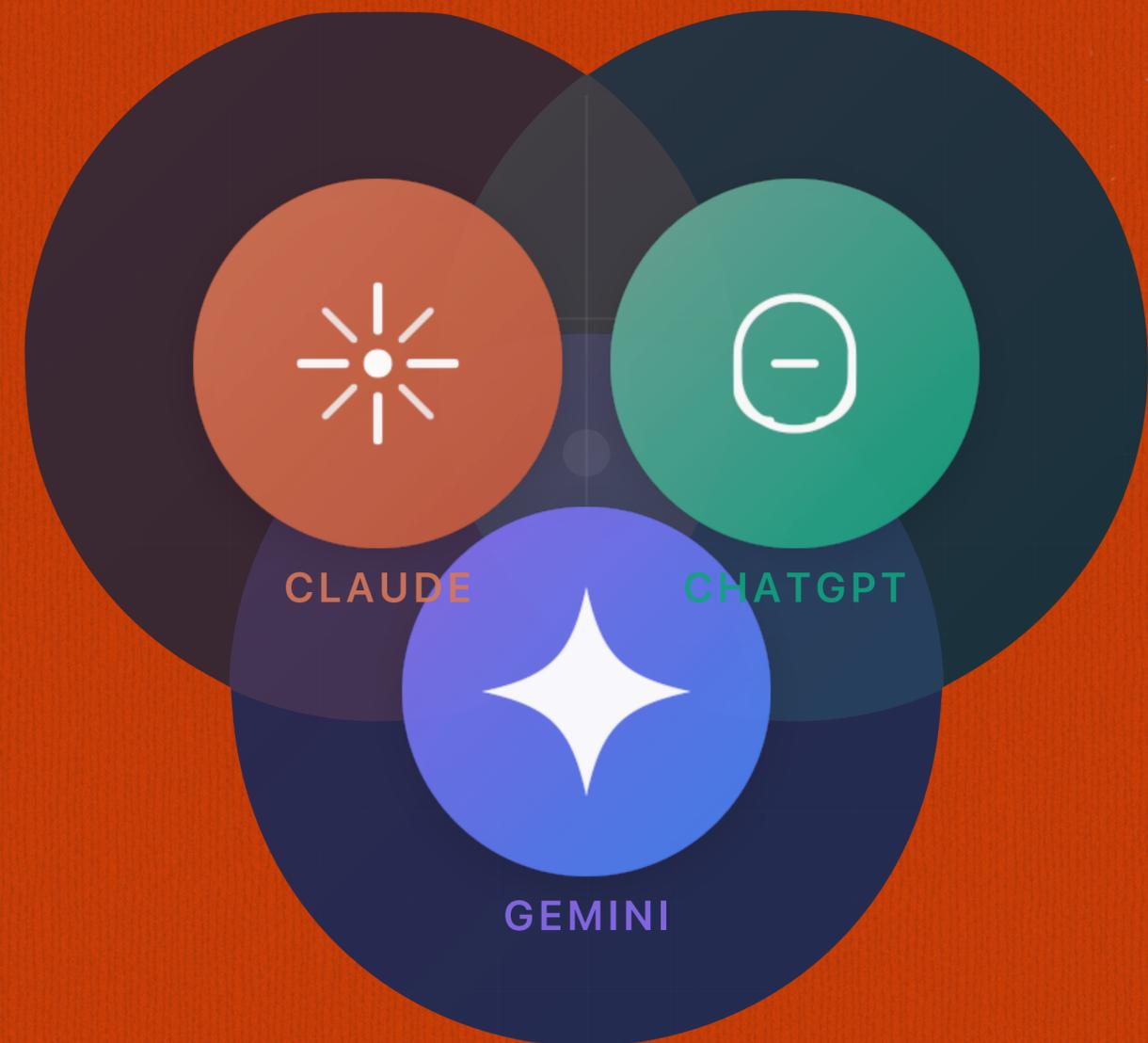
Joint Cognitive Systems

The intersection of people, technology, and work.

Success in complex systems is created through work accomplished by joint cognitive systems.

Joint Cognitive Systems: Patterns in Cognitive Systems Engineering — David Woods, Erik Hollnagel

Can you build me an image? I need something for a presentation that shows the Claude logo, the ChatGPT logo, and the Gemini logo ... all overlapped in a stylistic way. This feels like it could be done in an SVG?



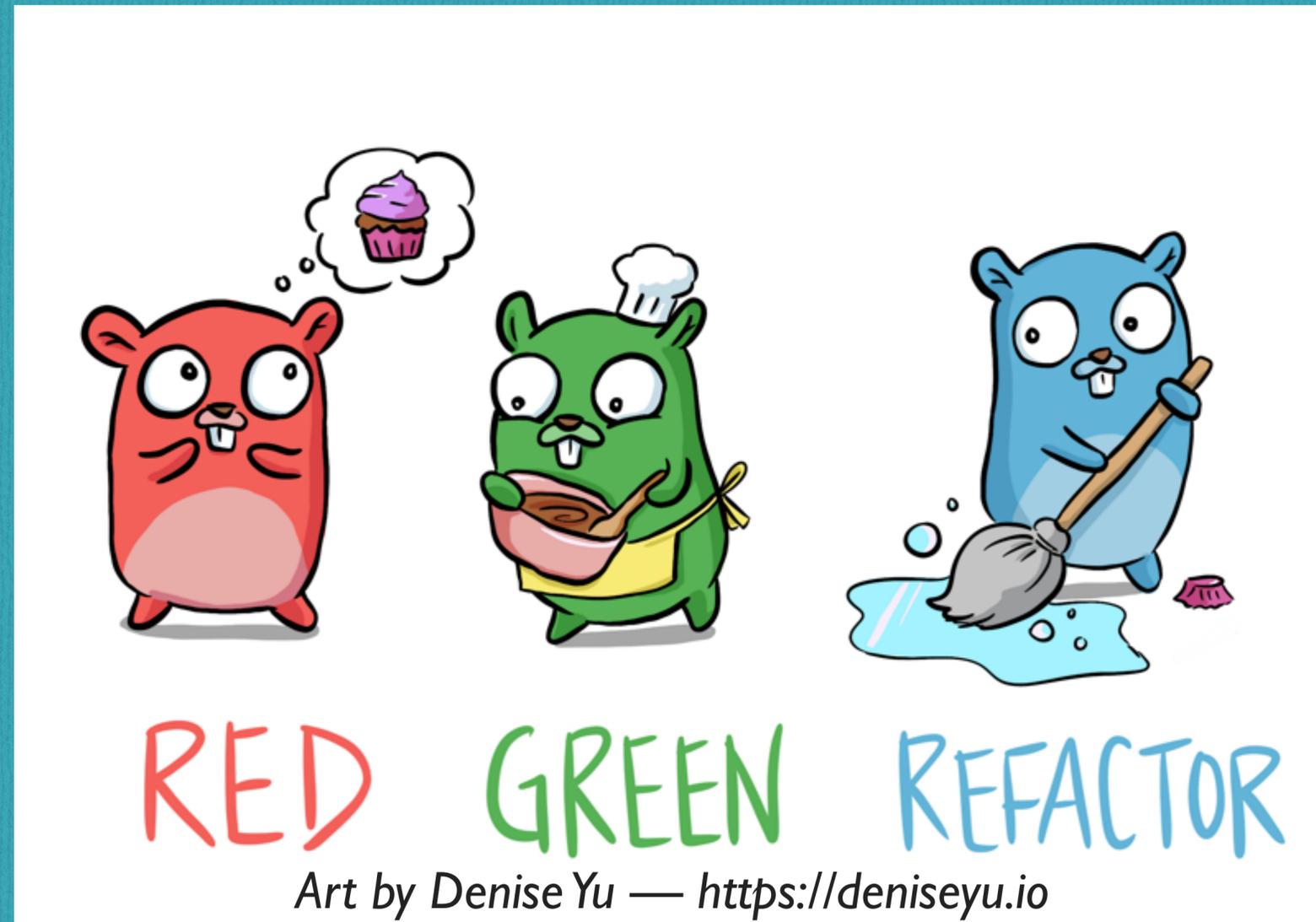
LLM Recommendations

in “Personal preferences” I have:

When giving me code fixes to existing code I have shared, instead of displaying a full page of new code with the changes, show me the specific code to fix so I can apply the fix myself.

When the LLM recommends an algorithm or method, the first thing I do is write my own test for it.

Learn Go With Tests



<https://quii.gitbook.io/learn-go-with-tests>

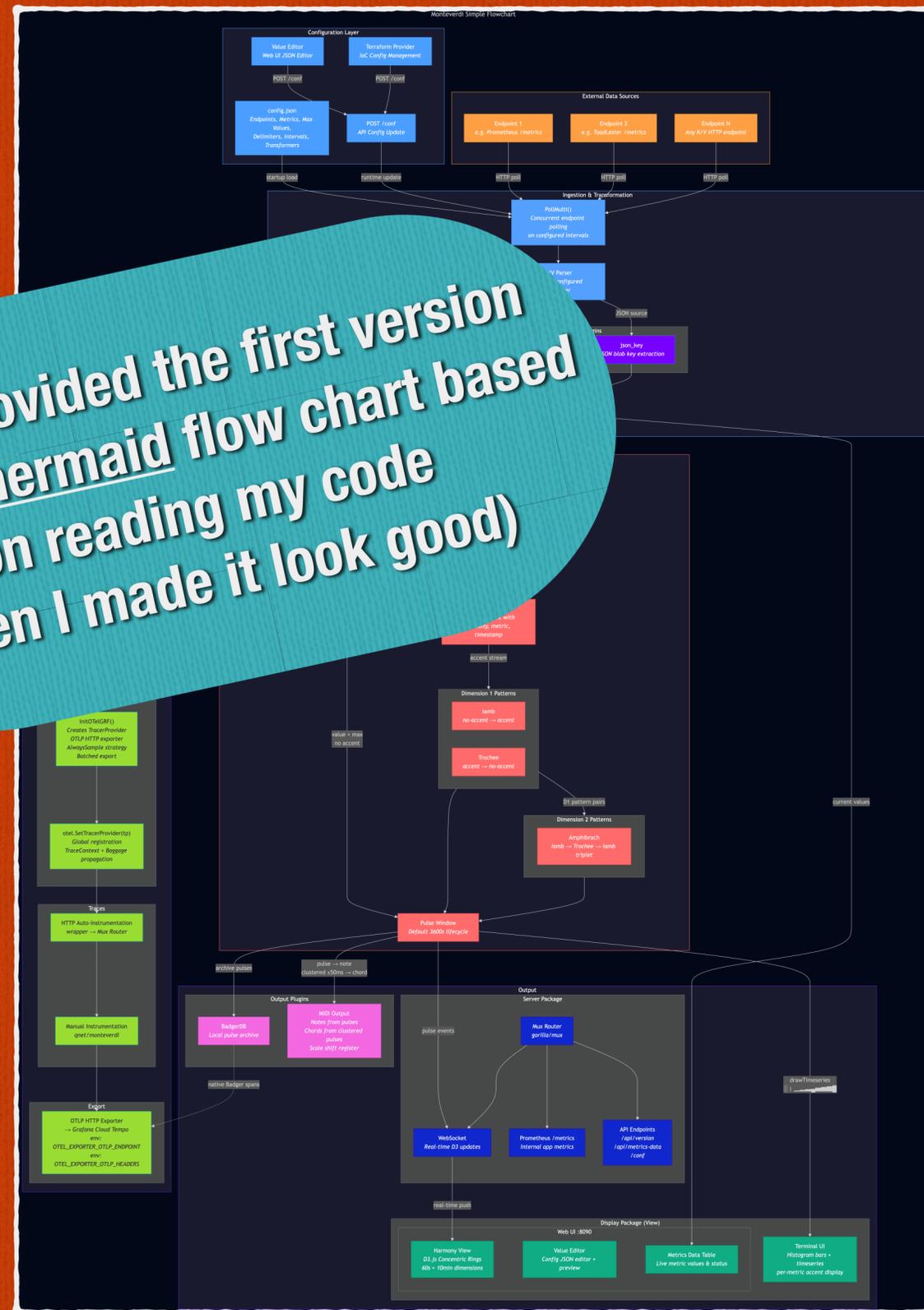
Monteverdi

Application Data Flow

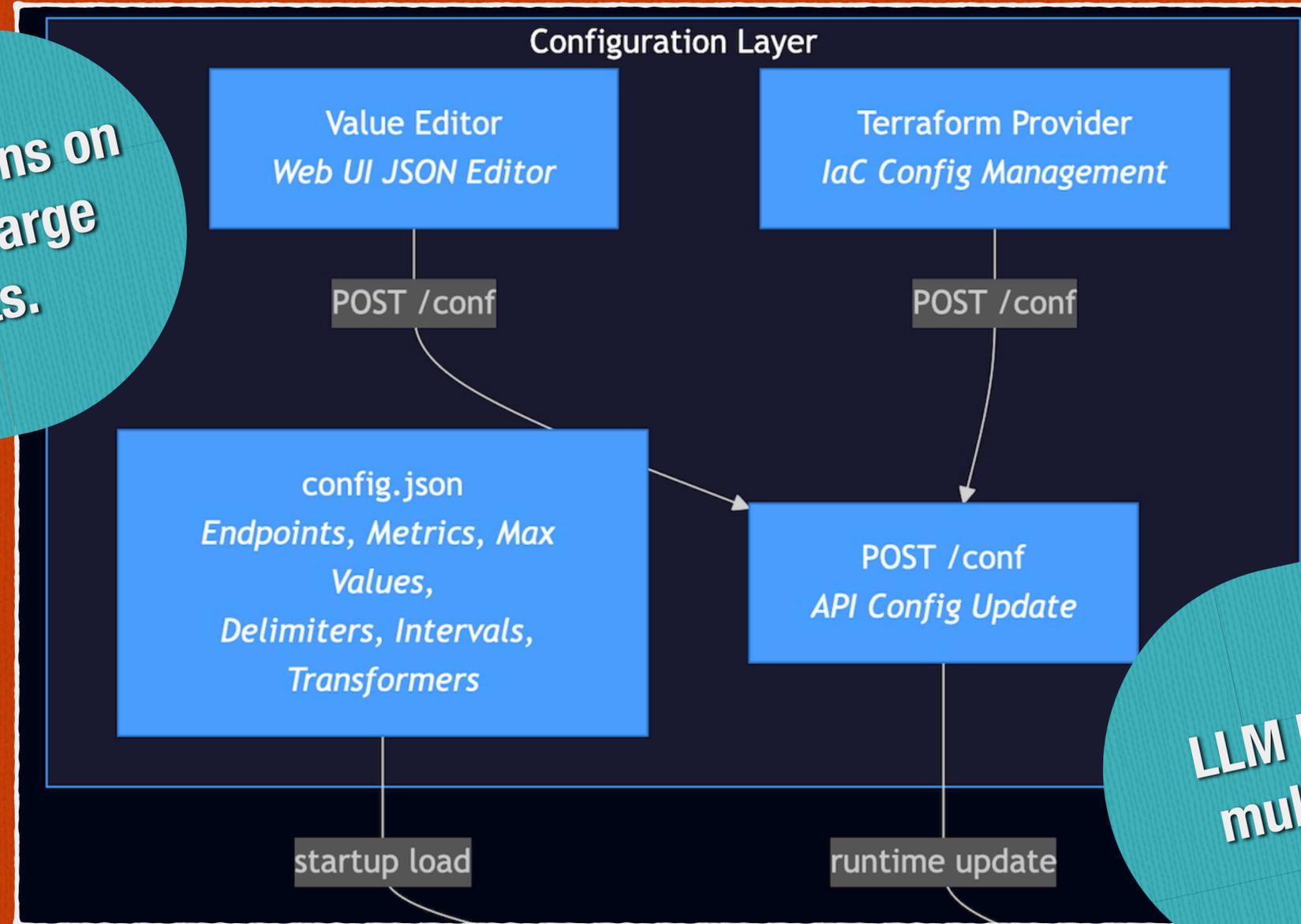
<https://github.com/maroda/monteverdi>

[monteverdi.mermaid](https://github.com/maroda/monteverdi)

LLM provided the first version of this mermaid flow chart based on reading my code (then I made it look good)



LLM gave recommendations on coverage and building large property-based tests.

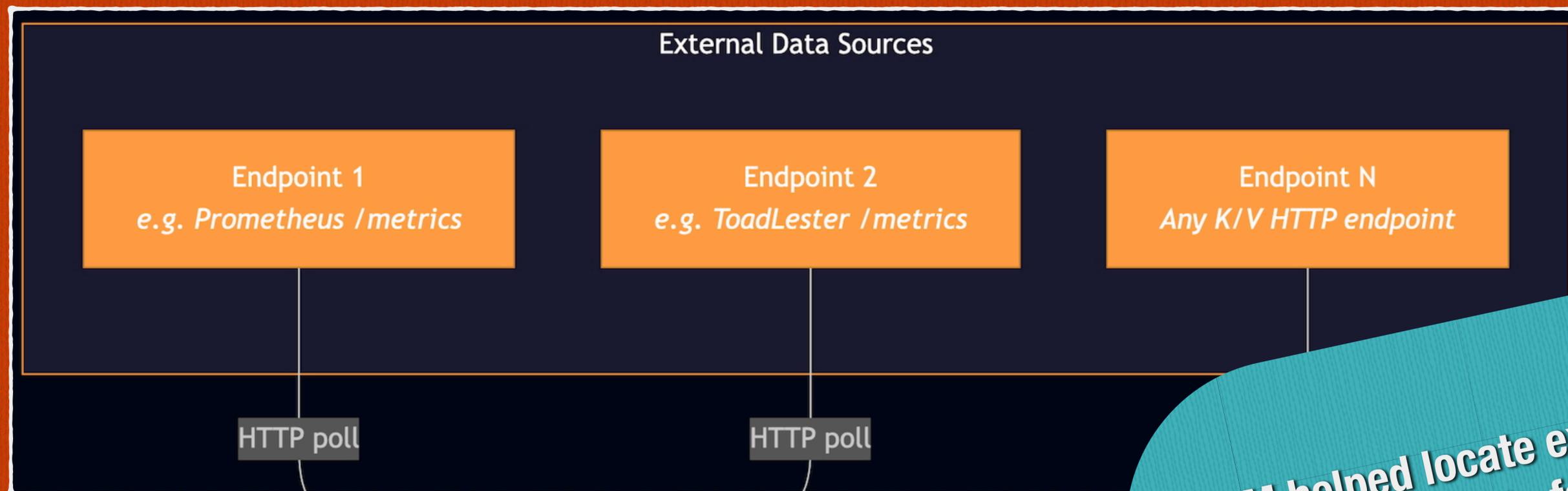


LLM built complex JSON for multiple endpoint metrics.

Configuration

Data sources are defined in a JSON array of different Endpoints.

These Endpoints make up a Quality Network (QNet).



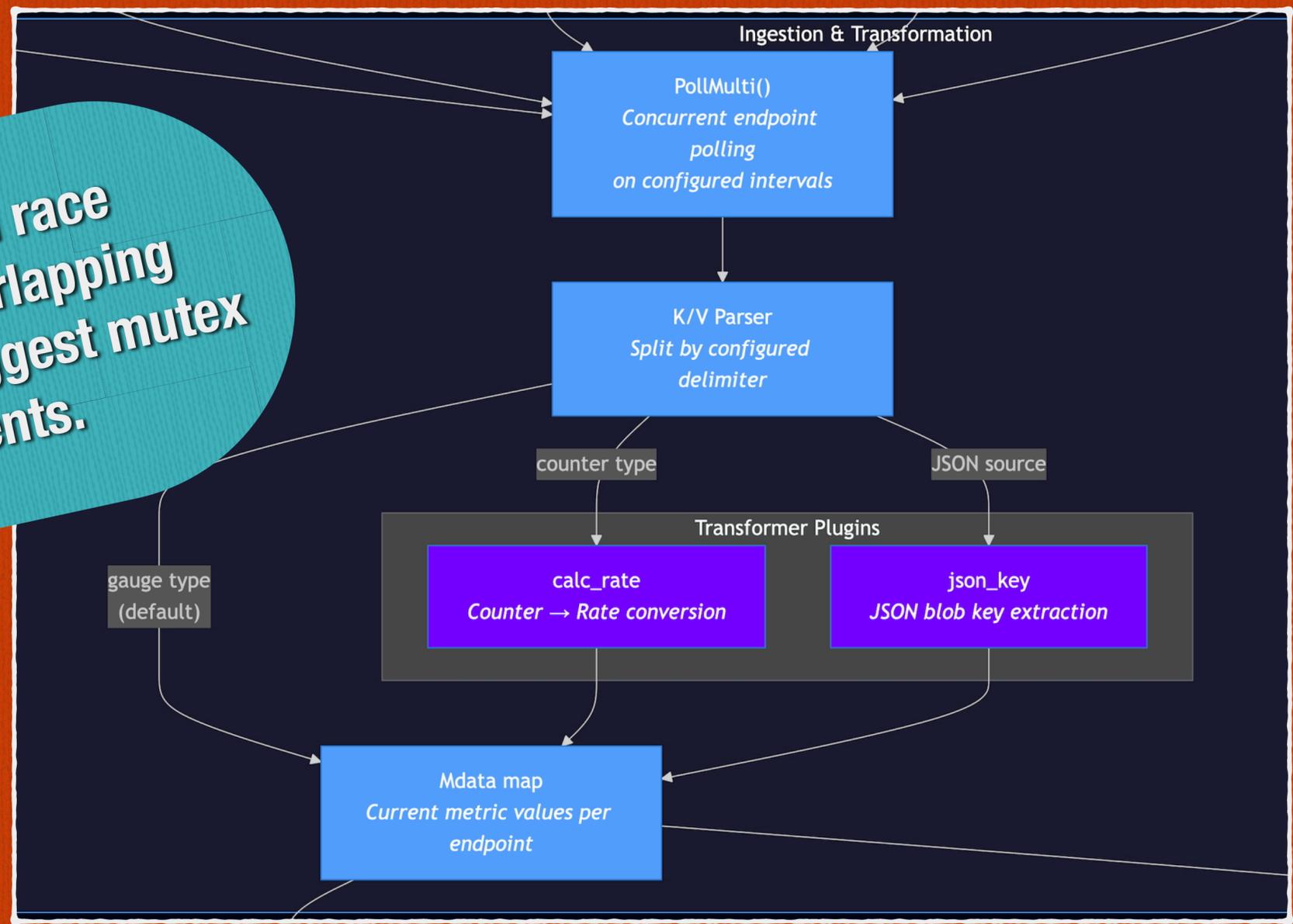
LLM helped locate example endpoints with data for testing.

Data Sources

Values are retrieved from Endpoint APIs, like the familiar /metrics path for Prometheus.

Each Endpoint configuration contains parameters for polling interval.

LLM helped find race conditions or overlapping parallelism and suggest mutex improvements.

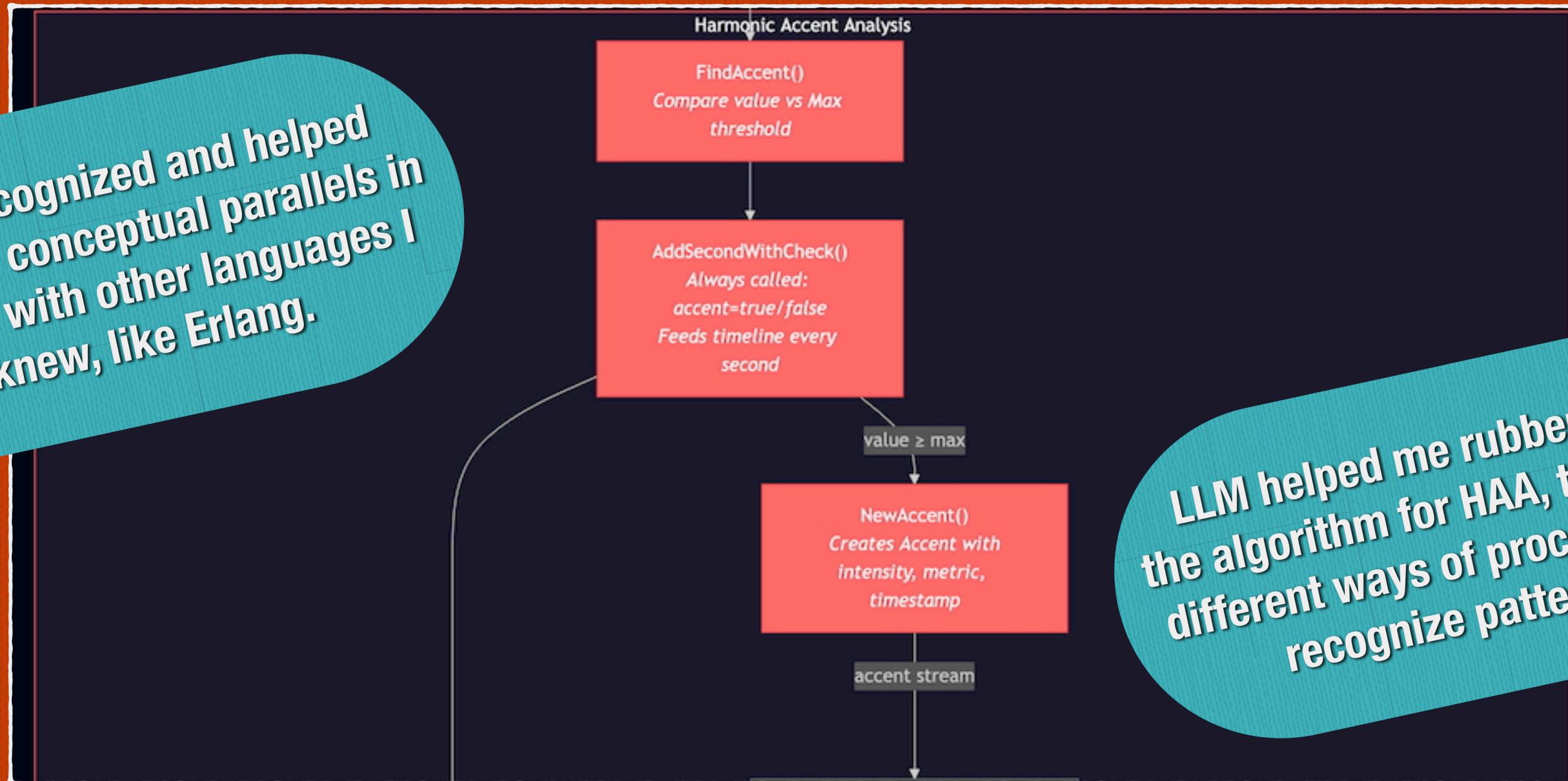


Ingest and Transform

Three types are supported: Gauge (default), Counter (calc_rate plugin), and JSON (json_key plugin).

Retrieved values are kept alongside other Endpoint metadata.

LLM recognized and helped me draw conceptual parallels in Golang with other languages I knew, like Erlang.



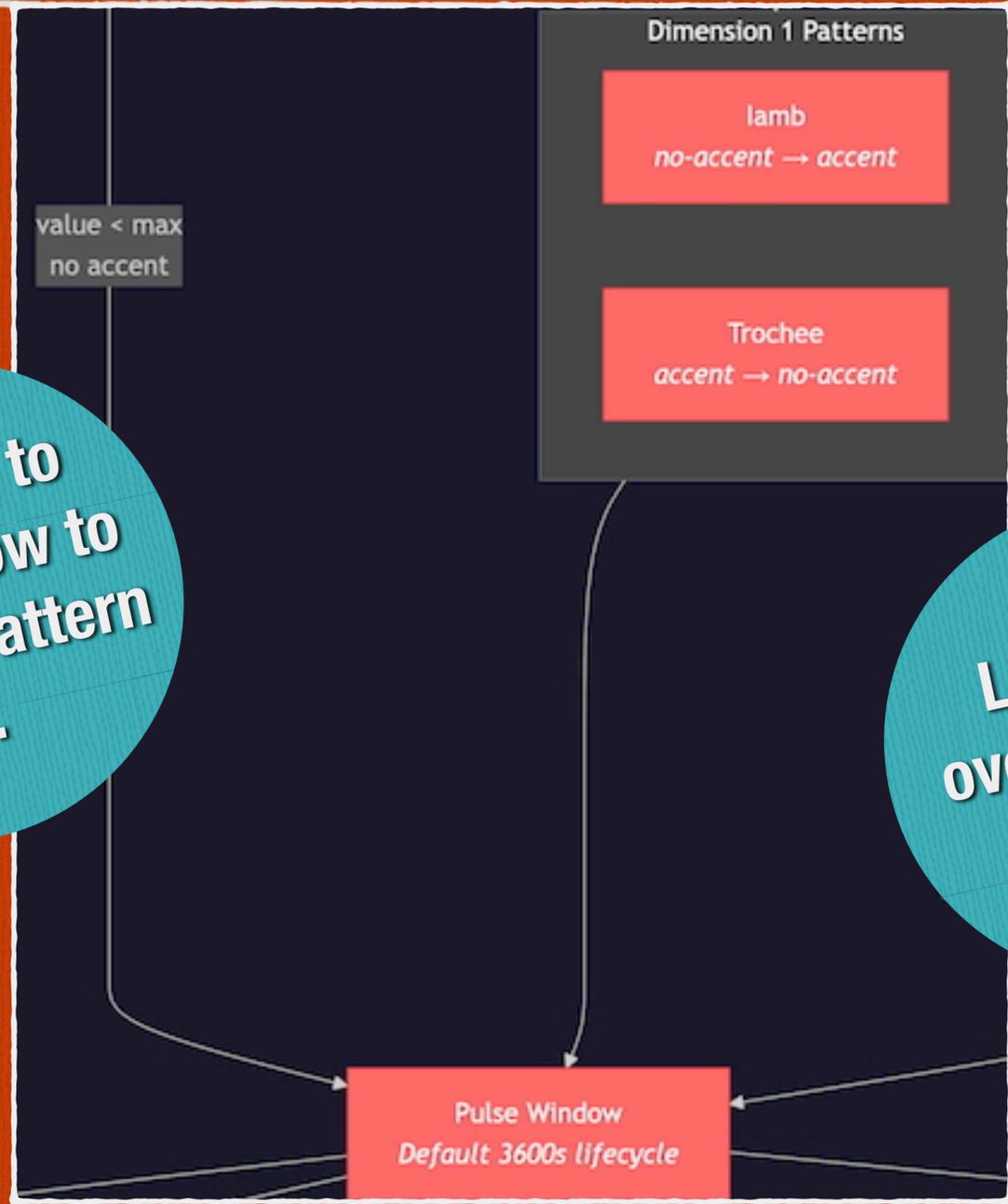
LLM helped me rubber duck the algorithm for HAA, trying out different ways of processing to recognize patterns.

Harmonic Accent Analysis

When a new value is retrieved, it is compared to the MAX.

If the MAX is crossed, an Accent is marked.

LLM helped fill out testing to cover cases of real-time flow to simulate enough data for pattern recognition to occur.



LLM collaboration helps me overcome dyslexia and practice mathematical concepts.

One Pulse is a Framed Accent

“No Accent” followed by “Accent” ... or ... “Accent” followed by “No Accent”

A Pulse Window contains the last hour of these groupings for display and output.



169020

... Metric_int_up ...

/p/ for pulses | /ESC/ to quit | Polling: TOADLESTER_SERIAL | MONTEVERDI

PULSE VIEW - Iamb Only (triple ictus analysis)

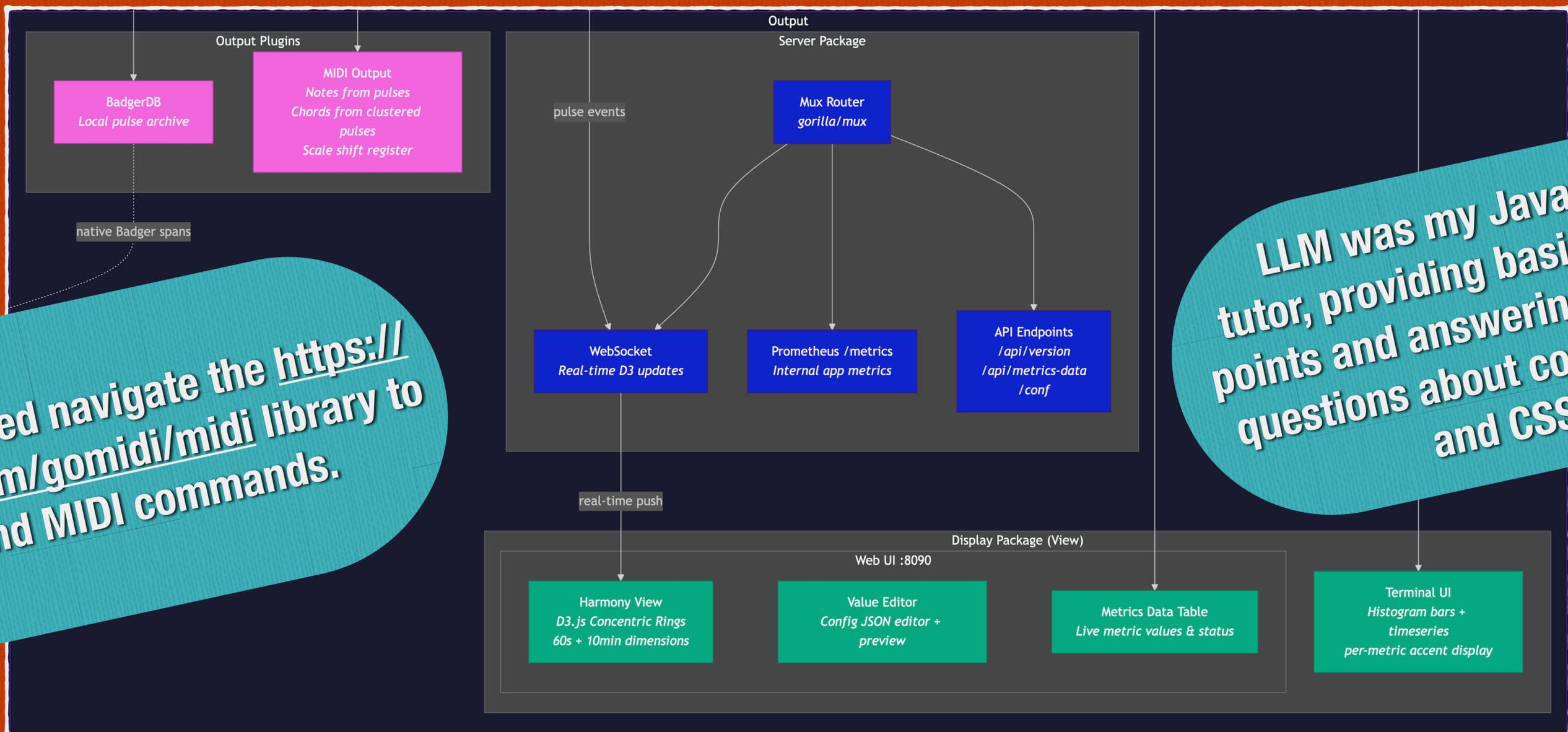
i=Iamb | t=Trochee | a=Amphibrach | x=All | ► stacked long pulses ◀



... Metric_int_up ...

/p/ to exit | /ESC/ to quit | Polling: TOADLESTER_SERIAL | MONTEVERDI

LLM helped navigate the <https://gitlab.com/gomidi/midi> library to send MIDI commands.



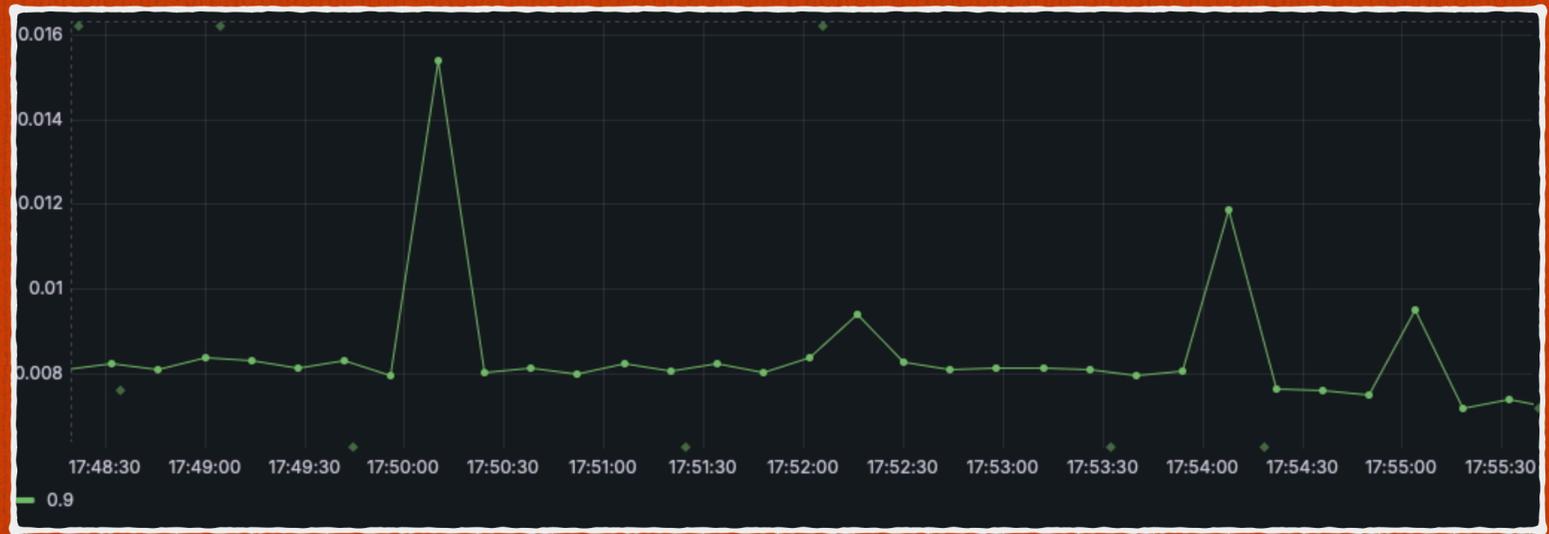
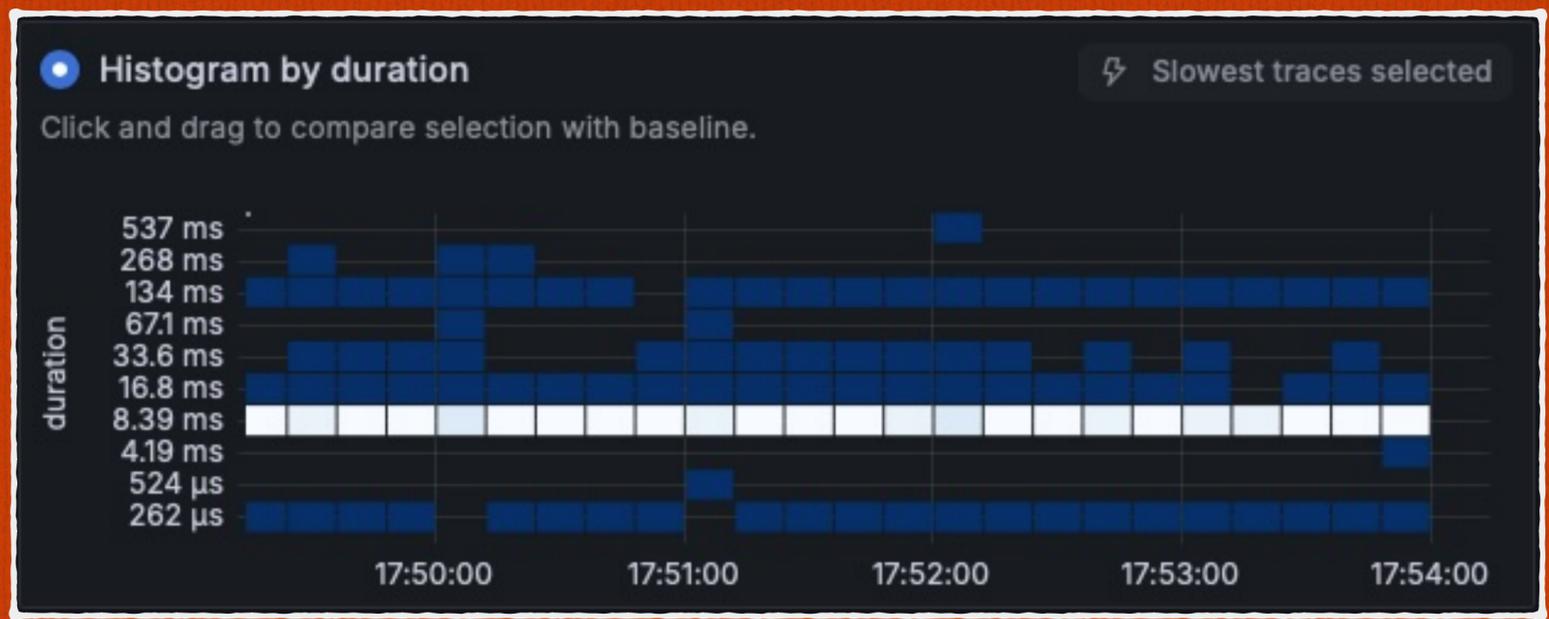
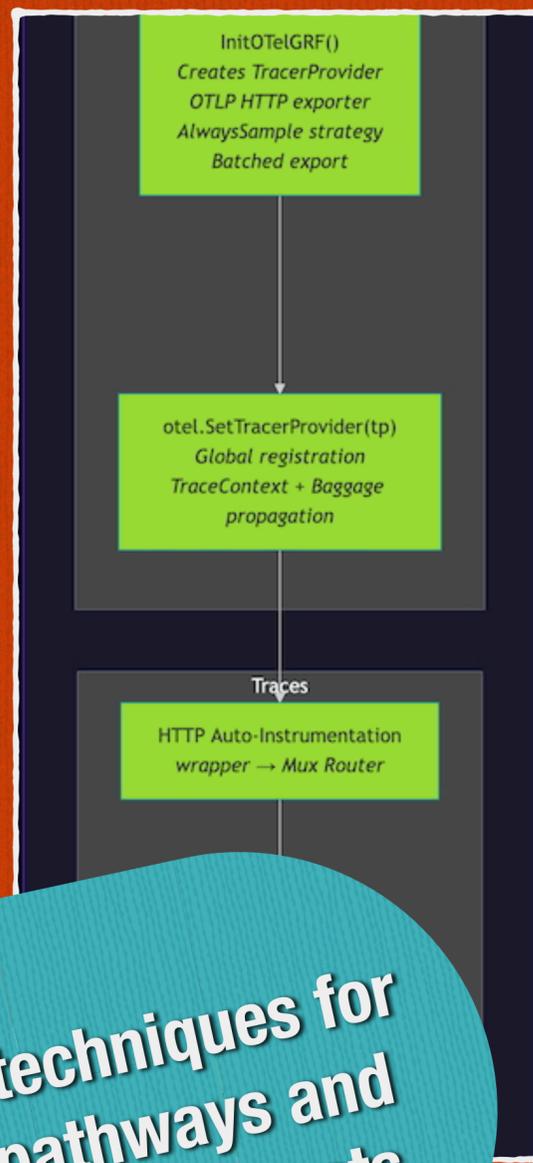
LLM was my JavaScript tutor, providing basic starting points and answering my dumb questions about correct HTML and CSS.

Output

Optional startup with BadgerDB or MIDI Notes, headless Web UI or Terminal UI included.

REST API with Configuration controls, Retrieved Metrics Data, Internal Metrics

LLM suggested techniques for possible trace pathways and wrapping front-end requests.



OpenTelemetry

Automatic traces by wrapping Handlers (WebUI and API)

Manual traces for QNet (internal functions)

What next?

Trace pattern recognition results in OTEL

Create Output to Machine Learning

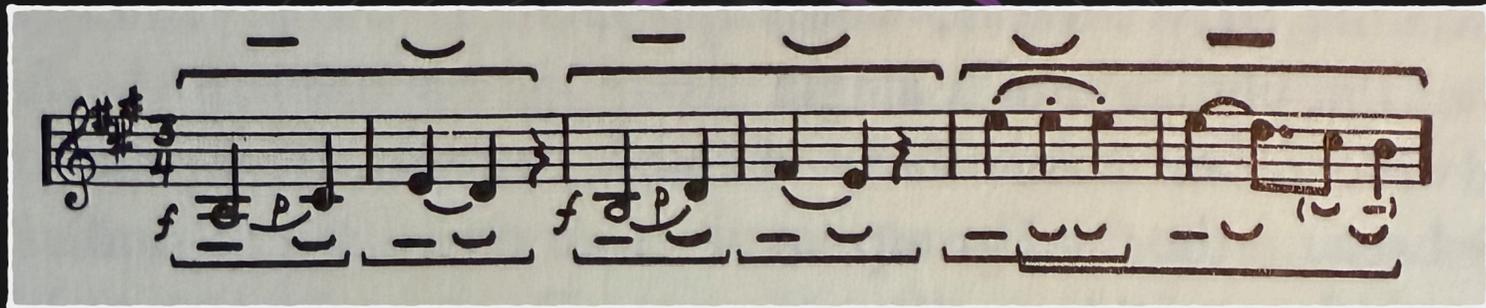
Import and replay an existing K/V timeseries

Improve robustness of MIDI Output

Performance testing

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Fin! Questions?



Musical examples from
Emotion and Meaning in Music
by Leonard Meyer

@ <https://c.im/@dtauvdiodr>

? **Matt Davis** ° **Scale 23x**

Winterbloom Sol

Protobuf

OTel SDK tcell golang.org/x

otelhttp Ristretto xxhash

LearnGoWithTests

OTLP GoMIDI FlatBuffers

OpenTelemetry

Prometheus

Eurorack

Gorilla Mux

Gorilla WebSocket gRPC

BadgerDB