Production-time Profiling for Python

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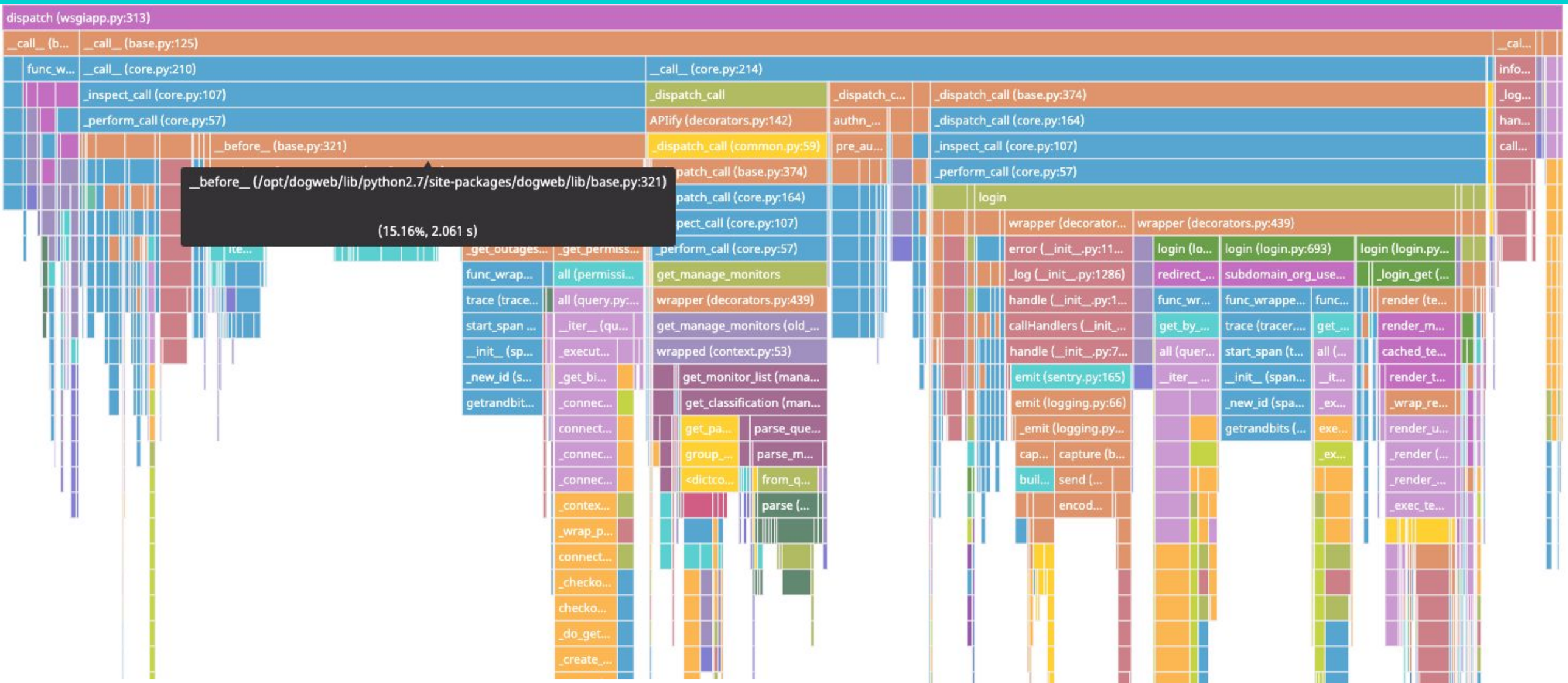
What is profiling?



Getting frequency and usage of your code

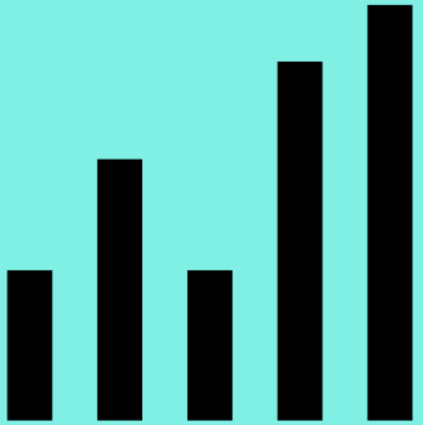
Two types of profiling

Deterministic

Run a scenario and meter all execution function by function

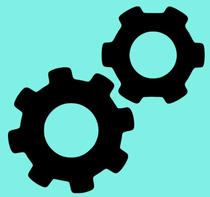
Statistical

Sample your program periodically to see what it is doing



Deterministic profiling

Register time before ***`function()`*** is called



Call ***`function()`***

Register time after ***`function()`*** is called

cProfile shortcomings

Only wall time

0–∞% overhead

Granularity to the function

Custom data format

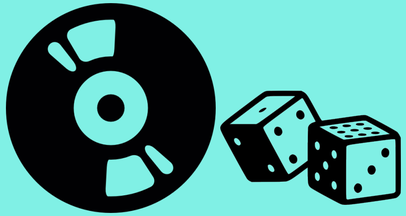
Production system

=

statistical profiling

Statistical profiling

Wake up



Register what the program’s doing right now (maybe)

Go back to sleep

Sampling strengths

Wall & CPU time

Low overhead

Granularity to the line

Can report raised exceptions

State of the art

CPU & Wall time

1

Sleep 10 ms.

`time.sleep()`

2

Get threads stacks.

`sys._current_frames()`

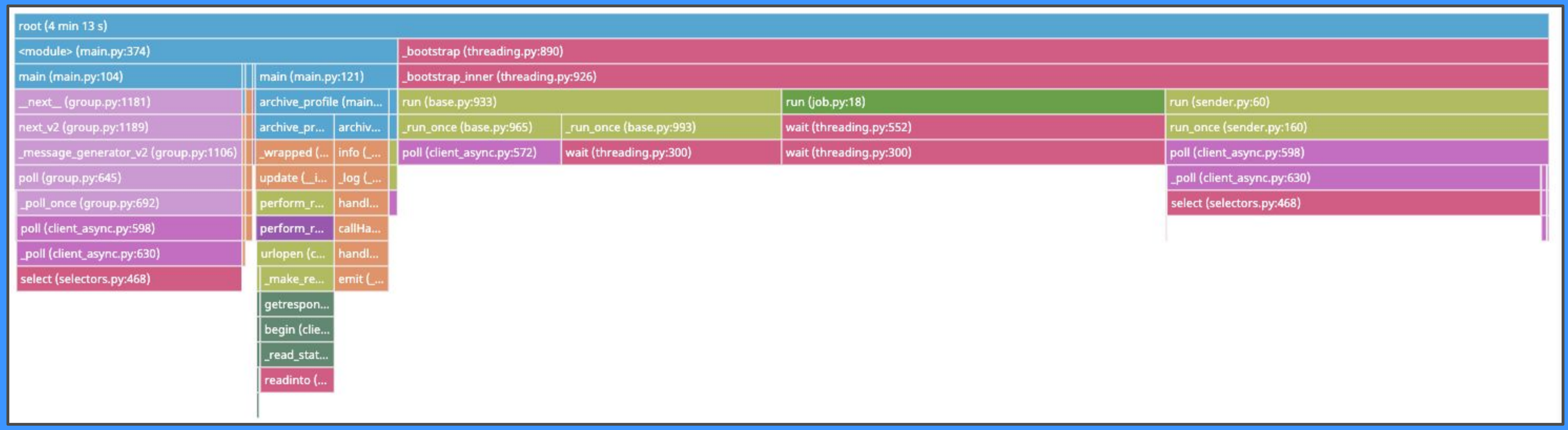
```
<Thread-1>
  a() myfile.py:123
    b() myfile.py:394
      c() mymodule.py:049
<Thread-2>
  d() myfile.py:123
    b() myfile.py:395
```

3

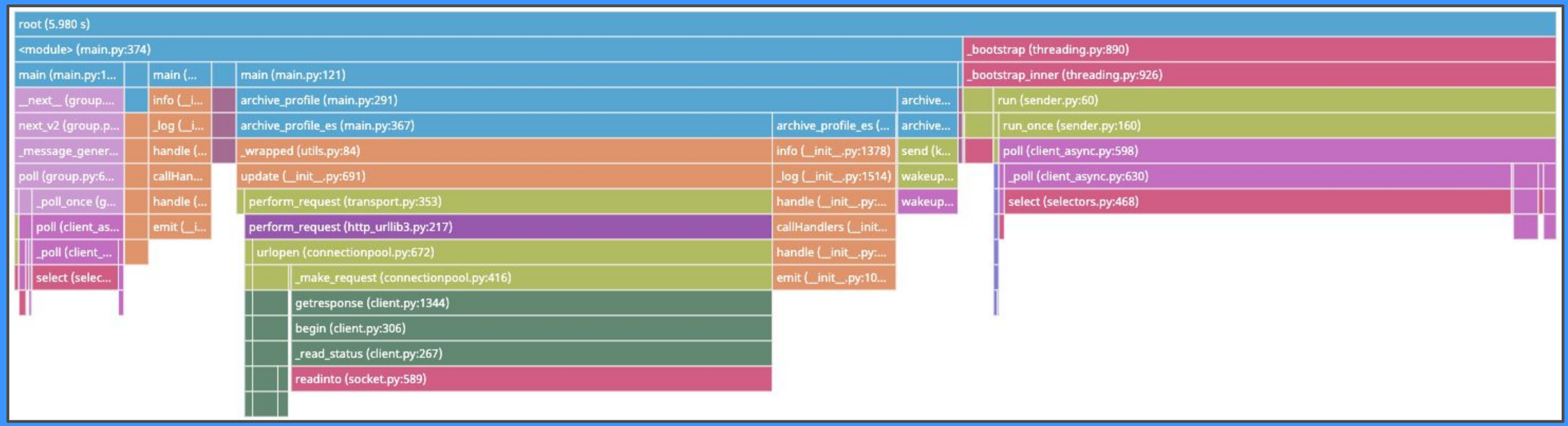
Get CPU time for each thread.

`time.pthread_getcpuclockid()`

Wall Time



CPU Time



High performance & precision

High Performance

Exception Profiling

Limit resources usage

~1% CPU usage @ 100 Hz
10 threads × 30 functions

No C profiling

(yet)

Memory

tracemalloc

1

```
time.sleep(0.01)
```

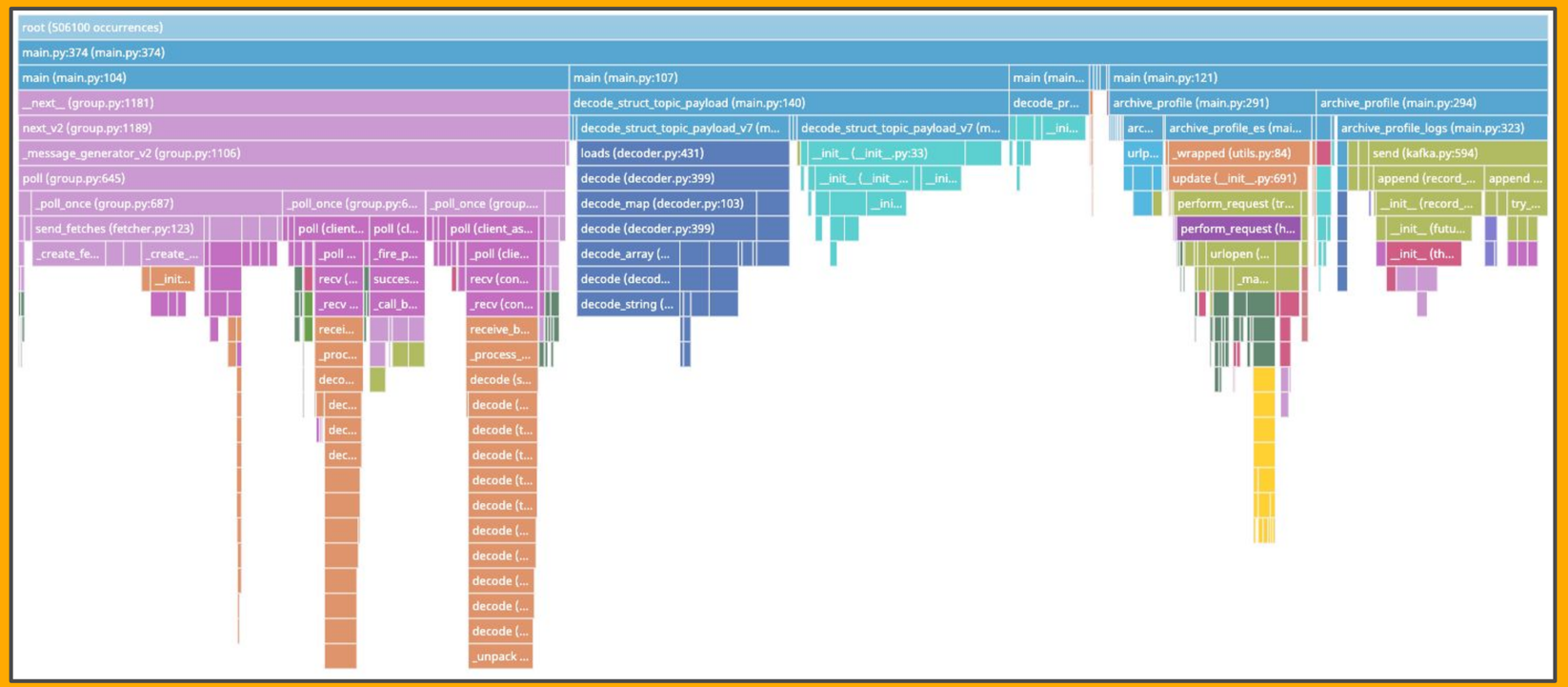
2

```
# 0 <= n <= 100
counter += n
```

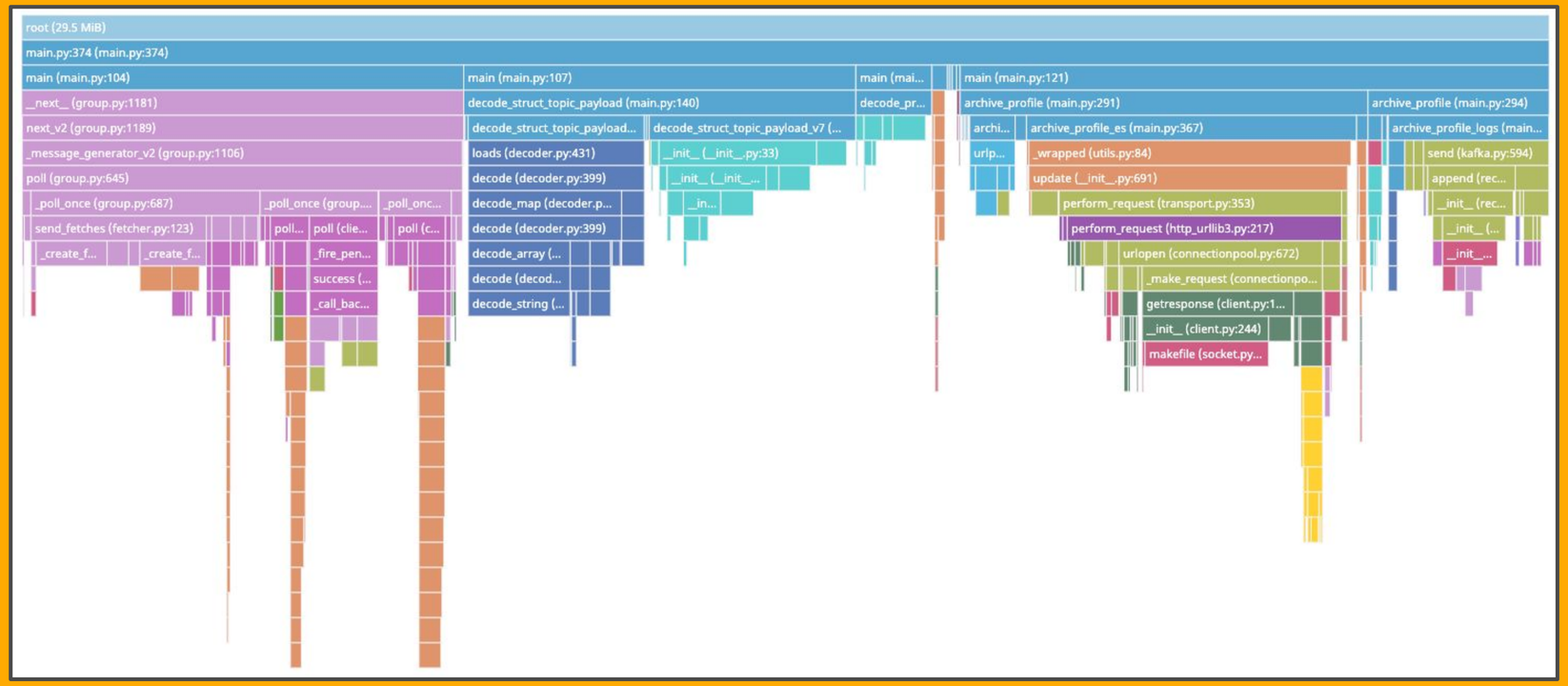
3

```
if counter >= 100:
    counter -= 100
    tracemalloc.start()
else:
    tracemalloc.stop()
```

Allocations Count



Allocations Size



Tracemalloc limitations

Overhead

No thread information

Only file names and line numbers

Threading

1

Intercept & wrap `threading.Lock` instances

2

Determine if `acquire()` is to be intercepted

3

Register `acquire()` and `release()` timings and stack traces

Lock Acquire Wait Time Total

Exporting and using the data

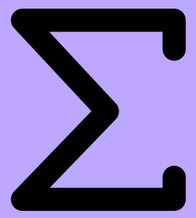
There is no real standard.

- cProfile → custom format
- Callgrind supports in some tools
- Many Python profilers focus on their output
- pprof to the rescue

The pprof format

Based on protobuf

Fast + schema

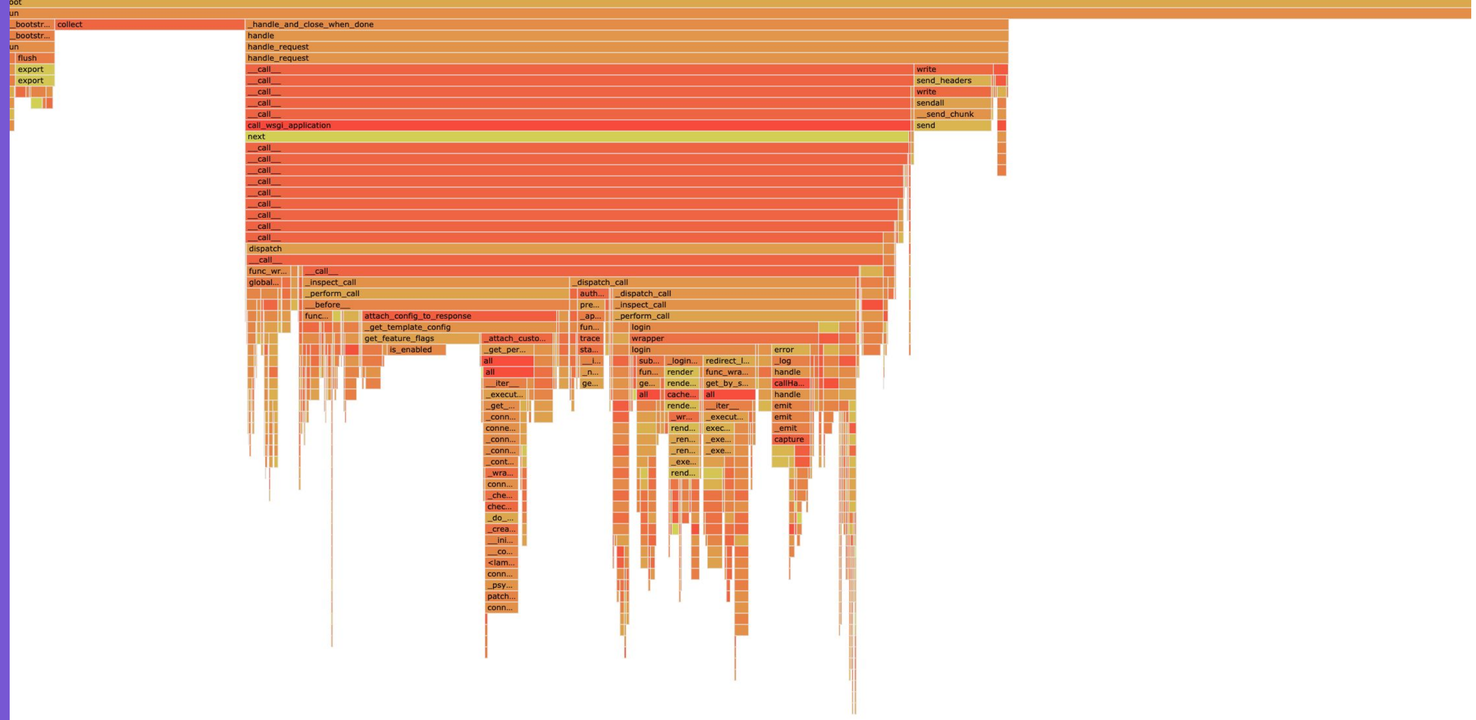


Aggregates data

Can compute KPM

Space efficient

String pool +
gzip
~20 KB / minute / process

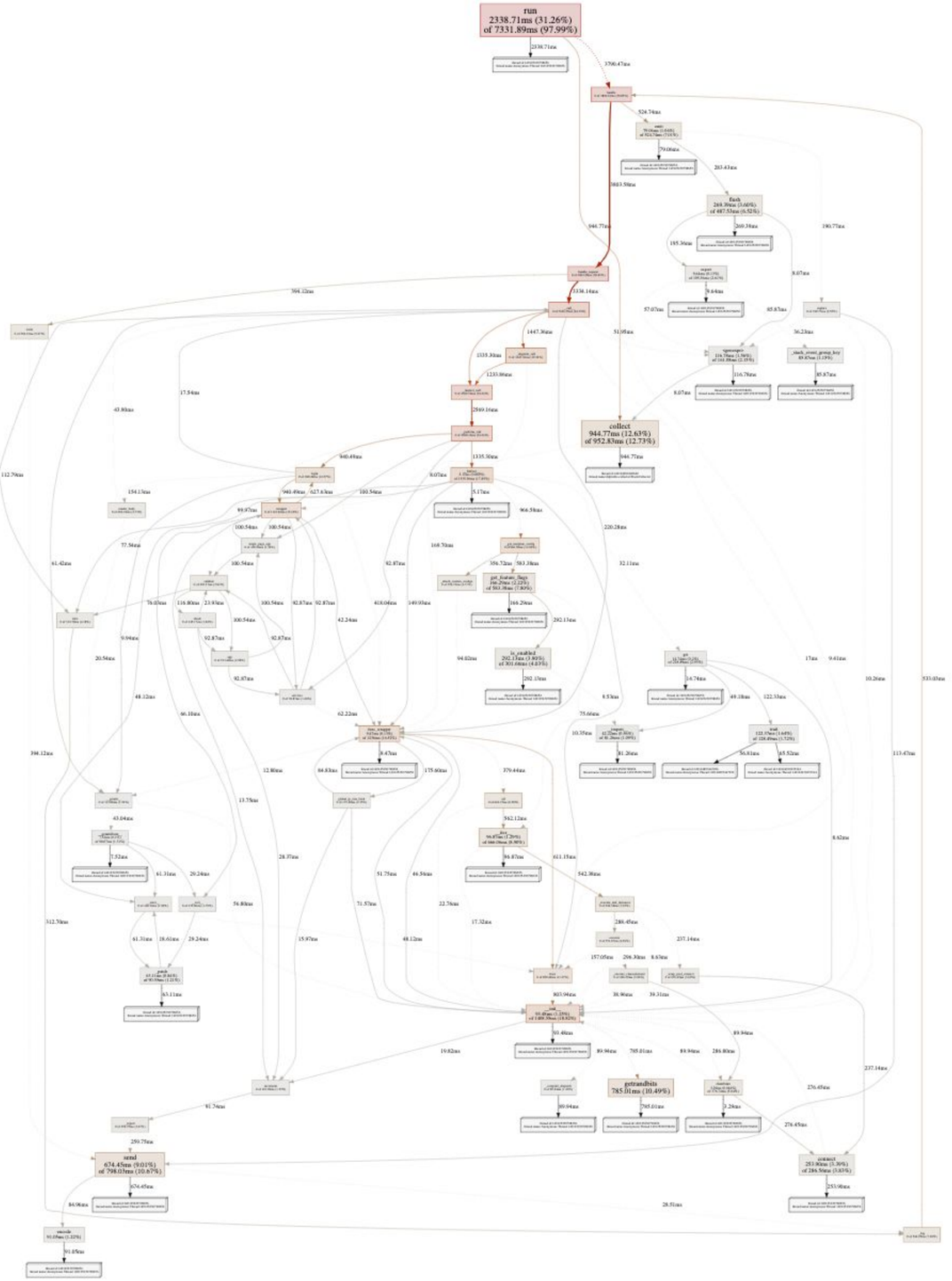


Visualization tool

– Also named pprof 🤦

– Fancy visualizations

– Written in Go 



Open-source library upcoming

(Apache / BSD)

`https://github.com/datadog/dd-trace-py`

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pprof

Thank you

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Questions, feedback?

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