Introduction to OmniTrace

Gina Sitaraman, Suyash Tandon, George Markomanolis,
Jonathan Madsen, Austin Ellis, Bob Robey

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AMD
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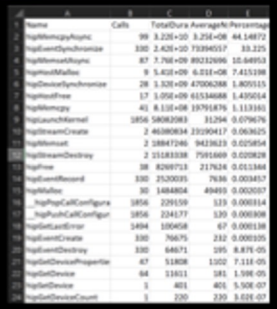
Background – AMD Profilers

ROC-profiler (rocprof)

Hardware Counters	Raw collection of GPU counters and traces
	Counter collection with user input files / Counter results printed to a CSV
Traces and timelines	Trace collection support for
	CPU copy / HIP API / HSA API / GPU Kernels
Visualisation	Traces visualized with Perfetto



Omnitrace

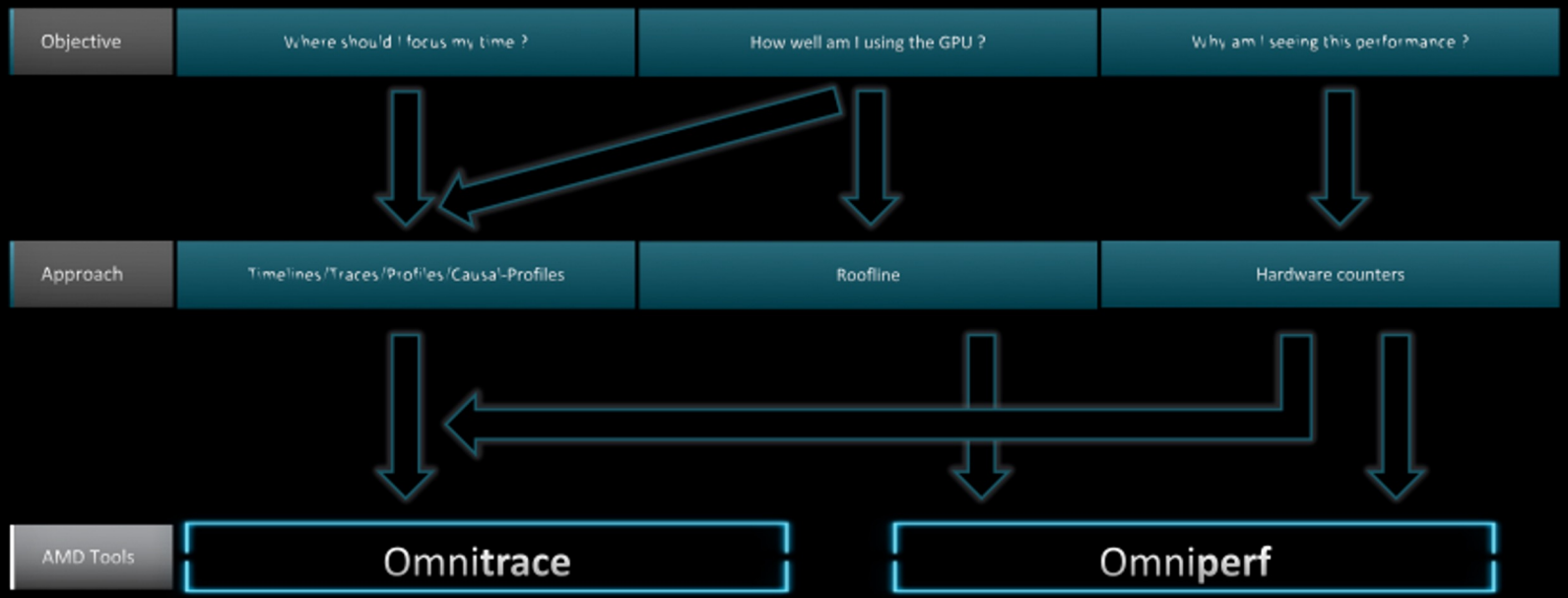
Trace collection	Comprehensive trace collection
	CPU / GPU
Supports	CPU copy / HIP API / HSA API / GPU Kernels
	OpenMP® / MPI / Kokkos / p-threads / multi-GPU
Visualisation	Traces visualized with Perfetto

Omniperf

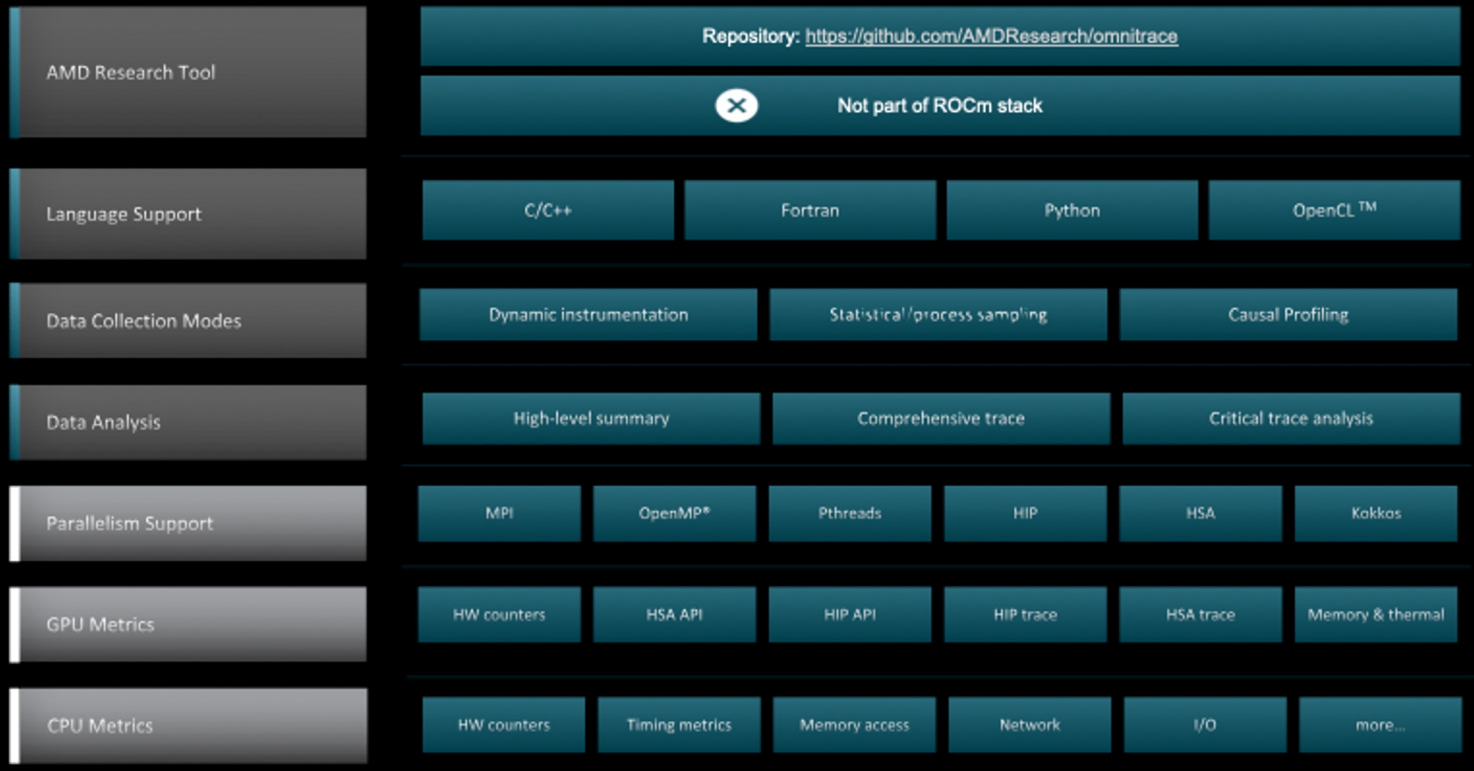
Performance Analysis	Automated collection of hardware counters
	Analysis / Visualisation
Supports	Speed of Light / Memory chart / Rooflines / Kernel comparison
Visualisation	With Grafana or standalone GUI

[Public]

Background – AMD Profilers



Omnitrace: Application Profiling, Tracing, and Analysis



Refer to current documentation for recent updates

Omnitrace instrumentation Modes

Basic command-line syntax:

```
$ omnitrace [omnitrace-options] -- <CMD> <ARGS>
```

For more information or help use -h/--help/? flags:

```
$ omnitrace -h
```

Can also execute on systems using a job scheduler. For example, with SLURM, an interactive session can be used as:

```
$ srun [options] omnitrace [omnitrace-options] -- <CMD> <ARGS>
```

For problems, create an issue here: https://github.com/AMDResearch/omnitrace/issues
Documentation: https://amdresearch.github.io/omnitrace/

Visualizing Trace

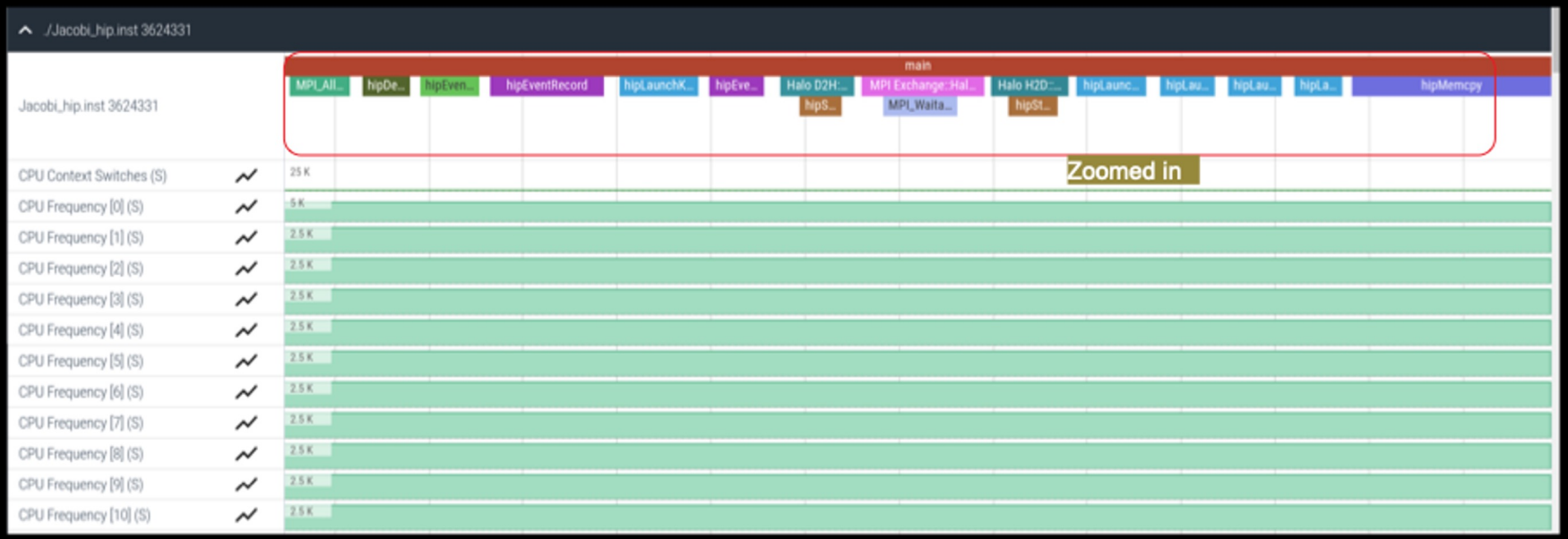
Use Perfetto

Copy `perfetto-trace-0.proto` to your laptop, go to https://ui.perfetto.dev/, Click "Open trace file", select perfetto-trace-0.proto

Visualizing Trace

Use Perfetto

Zoom in to investigate regions of interest



Visualizing Trace

Use Perfetto

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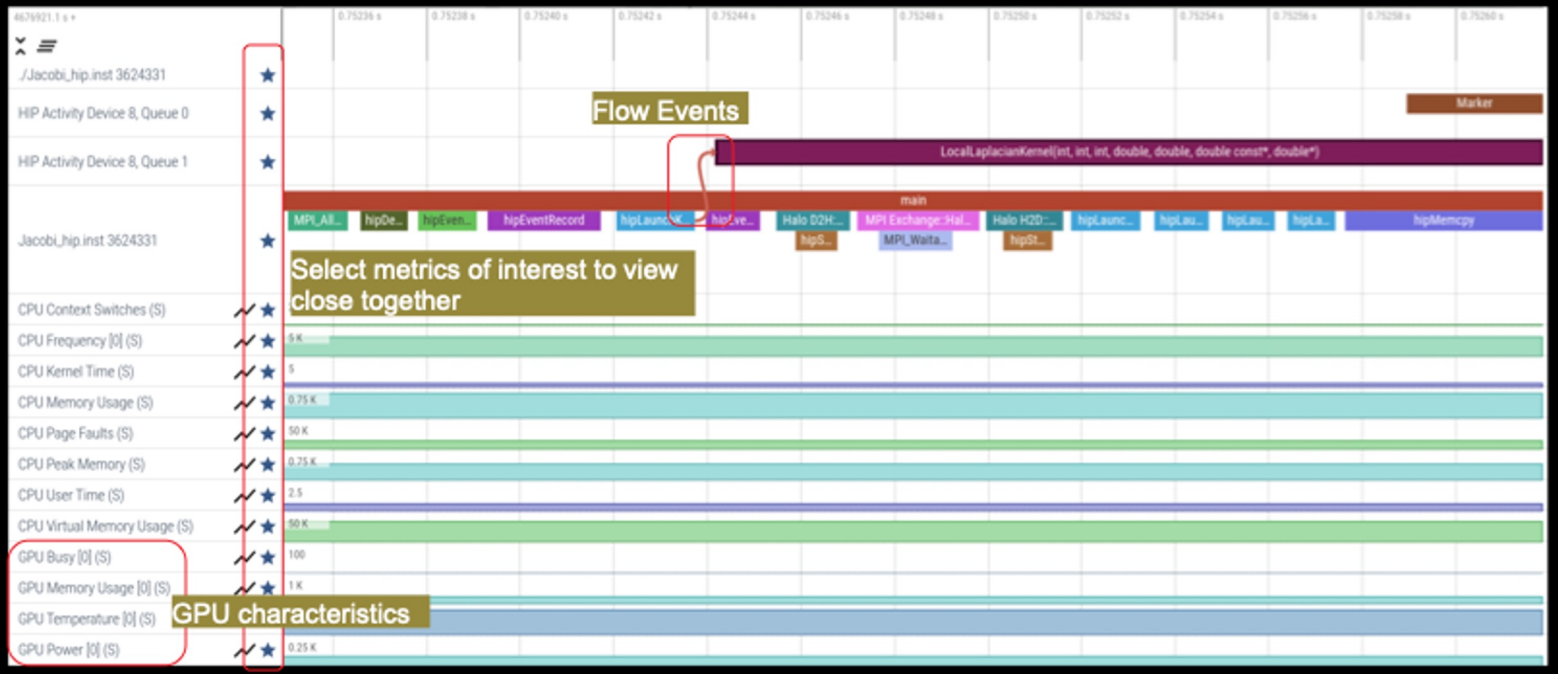


Commonly Used GPU Counters

VALUUtilization	The percentage of ALUs active in a wave. Low VALUUtilization is likely due to high divergence or a poorly sized grid
VALUBusy	The percentage of GPUTime vector ALU instructions are processed. Can be thought of as something like compute utilization
FetchSize	The total kilobytes fetched from global memory
WriteSize	The total kilobytes written to global memory
L2CacheHit	The percentage of fetch, write, atomic, and other instructions that hit the data in L2 cache
MemUnitBusy	The percentage of GPUTime the memory unit is active. The result includes the stall time
MemUnitStalled	The percentage of GPUTime the memory unit is stalled
WriteUnitStalled	The percentage of GPUTime the write unit is stalled

Modify config file

Create a config file in $HOME:

```
$ omnitrace-avail -G $HOME/.omnitrace.cfg
```

Modify the config file $HOME/.omnitrace.cfg to add desired metrics and for concerned GPU#ID:

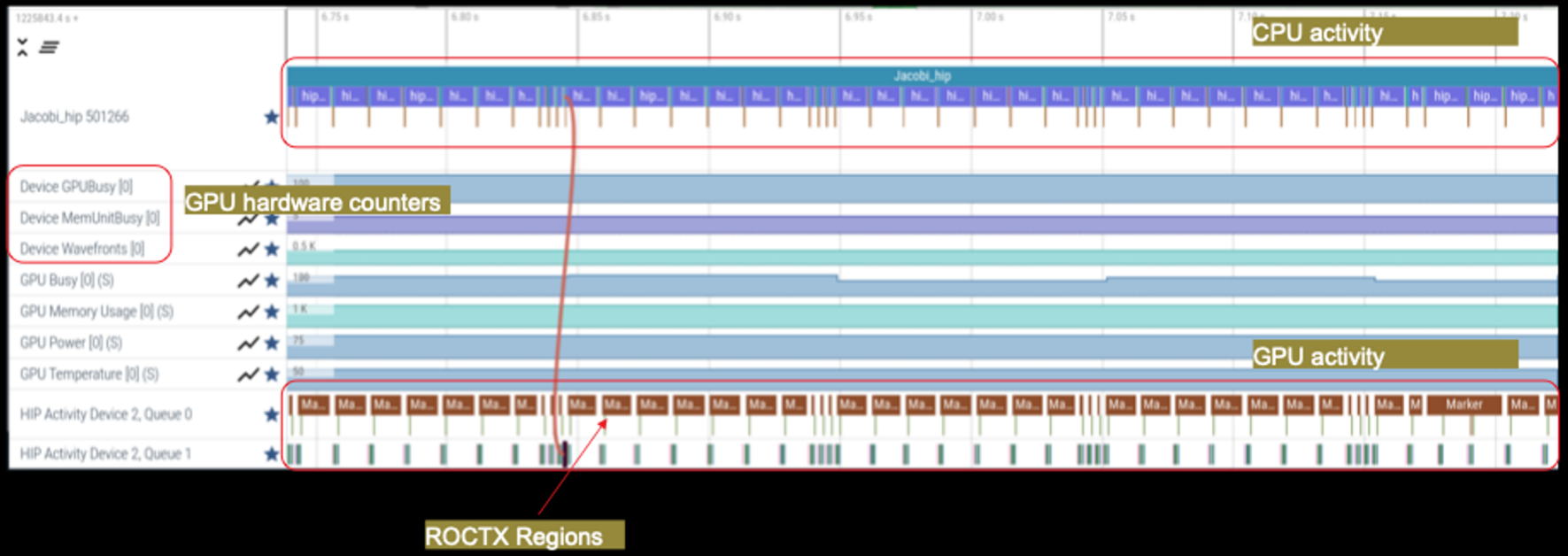
```
…
OMNITRACE_ROCM_EVENTS = GPUBusy:device=0,
Wavefronts:device=0, MemUnitBusy:device=0
…
```

To profile desired metrics for all participating GPUs:

```
…
OMNITRACE_ROCM_EVENTS = GPUBusy, Wavefronts,
MemUnitBusy
…
```

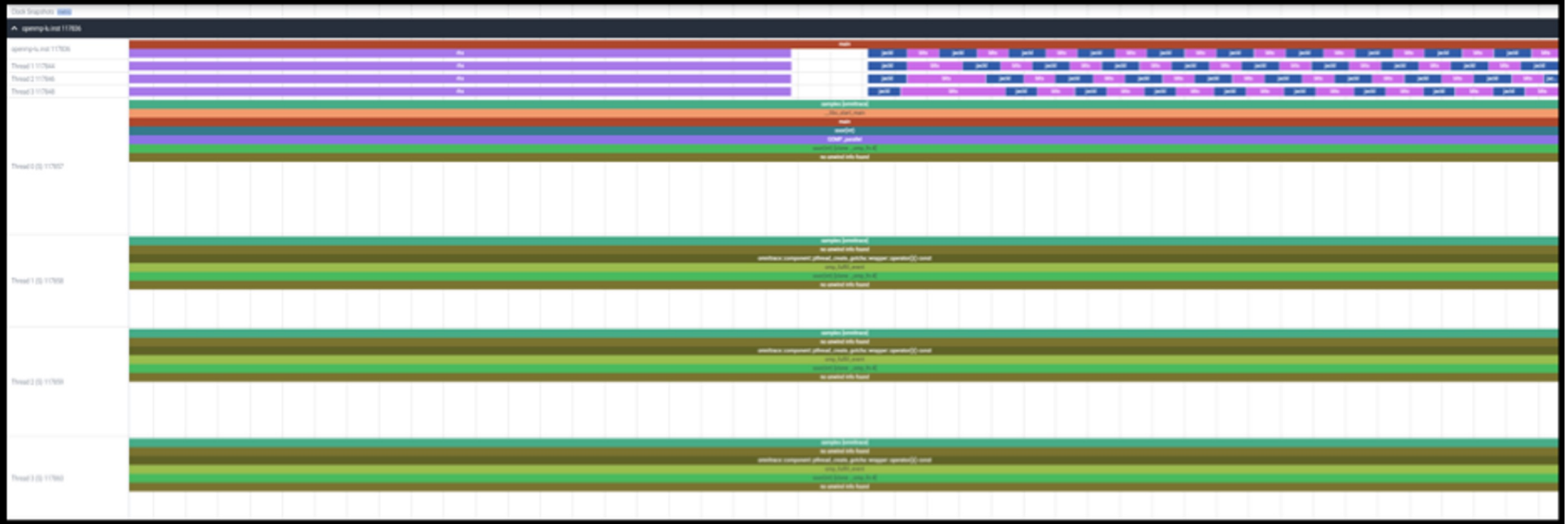
Full list at: https://github.com/ROCm-Developer-Tools/rocprofiler/blob/amd-master/test/tool/metrics.xml

Visualization with Hardware Counters



[Public]

OpenMP® Visualization



Summary

- OmniTrace is a powerful tool to understand CPU + GPU activity
  - Ideal for an initial look at how an application runs
- Leverages several other tools and combines their data into a comprehensive output file
  - Some tools used are AMD uProf, rocprof, rocm-smi, roctracer, perf, etc.
- Easy to visualize traces in Perfetto
- Includes several features:
  - Dynamic Instrumentation either at Runtime or using Binary Rewrite
  - Statistical Sampling for call-stack info
  - Process sampling, monitoring of system metrics during application run
  - Causal Profiling
  - Critical Path Tracing

[Public]

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