Behaviour Analysis and Visualization

Linux Plumbers Conference

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Agenda

Trace Analysis and Visualization

Behaviour Analysis

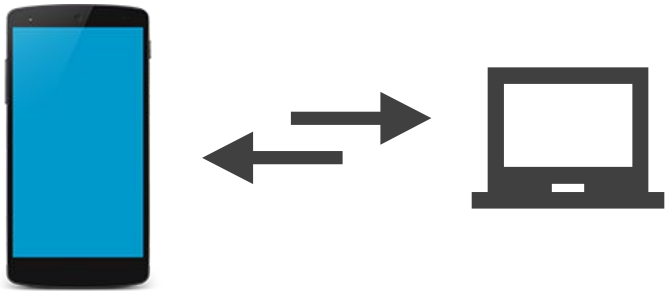
Example Behaviour

Demo

The Tools!

LISA	Linux Integrated Systems Analysis
TRAPpy	Trace Analysis and Plotting in Python
BART	Behavioural Analysis and Regression Toolkit

Workflow

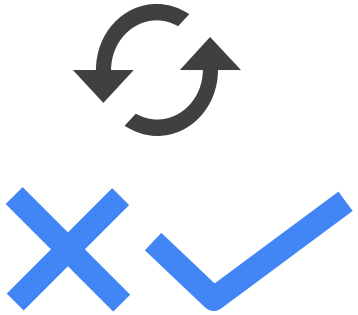


LISA

Run workloads and collect traces

TRAPpy

Parse traces and visualize



BART

Define Behaviours and assert

Trace Visualization

Parse

Predefined kernel events and custom `trace_printk` events.

Visualize

Interactive plotting API which allows filtering, grouping and comparing data

Analyse

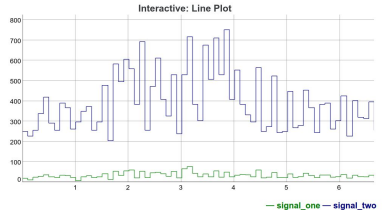
The data is parsed to pandas `DataFrames` which opens it to a whole new analysis methodologies

TRAPpy

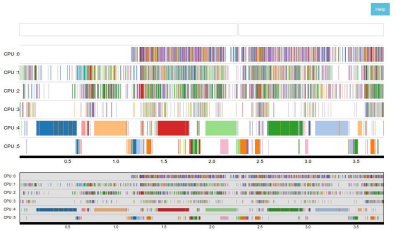
Trace Parsing and Plotting

```
trace_printk("my_event: key1=%s key2=%d", val1, val2)
```

	key1	key2
Time		
1.020	Linux	2
1.342	Plumbers	0
1.451	Conference	1
1.919	Santa Fe	6



Interactive Line Plots



Timelines

Behaviour Analysis

- For kernel developers and continuous integration.
- Visualize Behaviours.
- Automate Behaviour Analysis.

BART

Why do we need Behaviours?

Behaviours are the building blocks/premises for performance

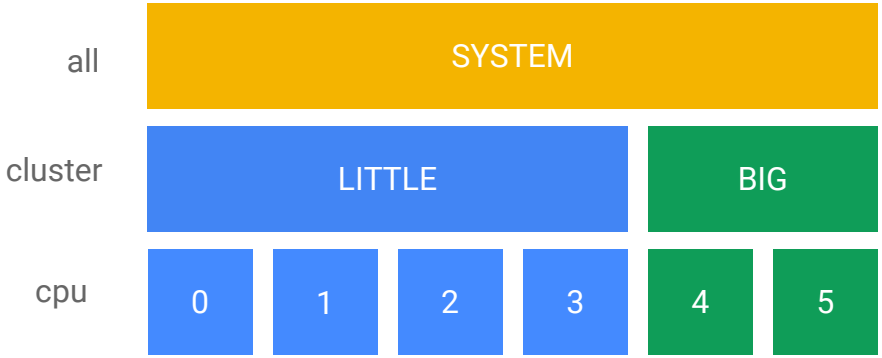
"If the scheduler exhibits these four behaviours, it will have the best power performance ratio"

How to do it?

Define and calibrate a behaviour, automate for regression analysis.
Adjust in the future with new data.

"Oh! my new patch breaks this behaviour and this means my device will use more energy"

Topologies




```
BIG = [4, 5]
LITTLE = [0, 1, 2, 3]
clusters = [BIG, LITTLE]

topology = Topology(clusters=clusters)
```

```
s = SchedMultiAssert(trace_dir, topology, execnames=[...])
```

Not only for the scheduler, topologies are hidden everywhere:

- File-systems (VFS, LVM, Block IO, RAID)
- Thermal Zones (Sensor hierarchy)
- Network

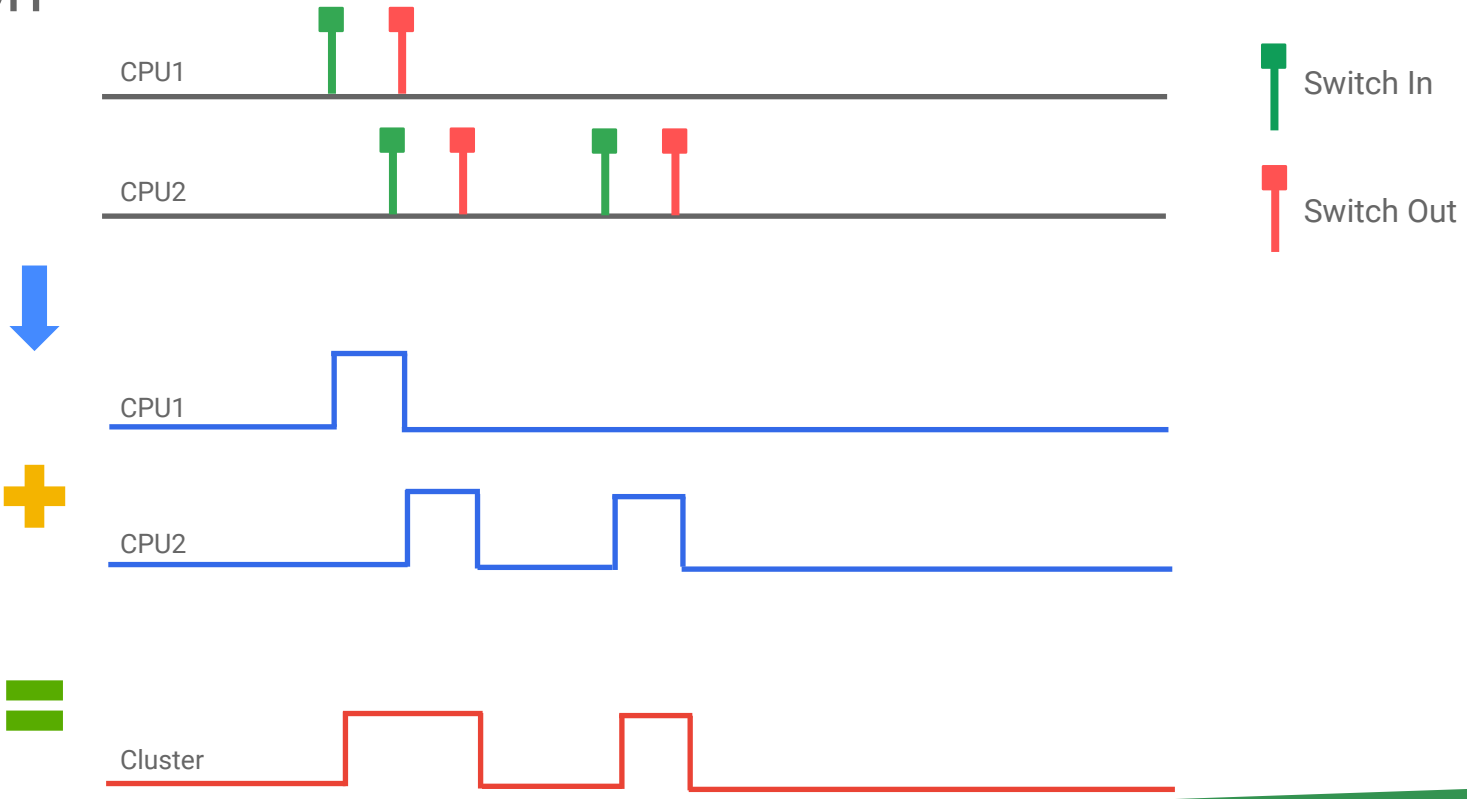
What is a Behaviour?

A behaviour is what a kernel developer would have in mind while working on a particular feature.

"*I want all the light weight tasks to be packed on the little cluster...*"

"I want the I/O scheduler to starve writes for reads"

Aggregation



Example Behaviour

"All light weight tasks should be packed on the little cluster"

Quantify

- Light weight task = 10% duty cycle on the BIG CPU
- Number of light weight tasks = `num_little_cpus`

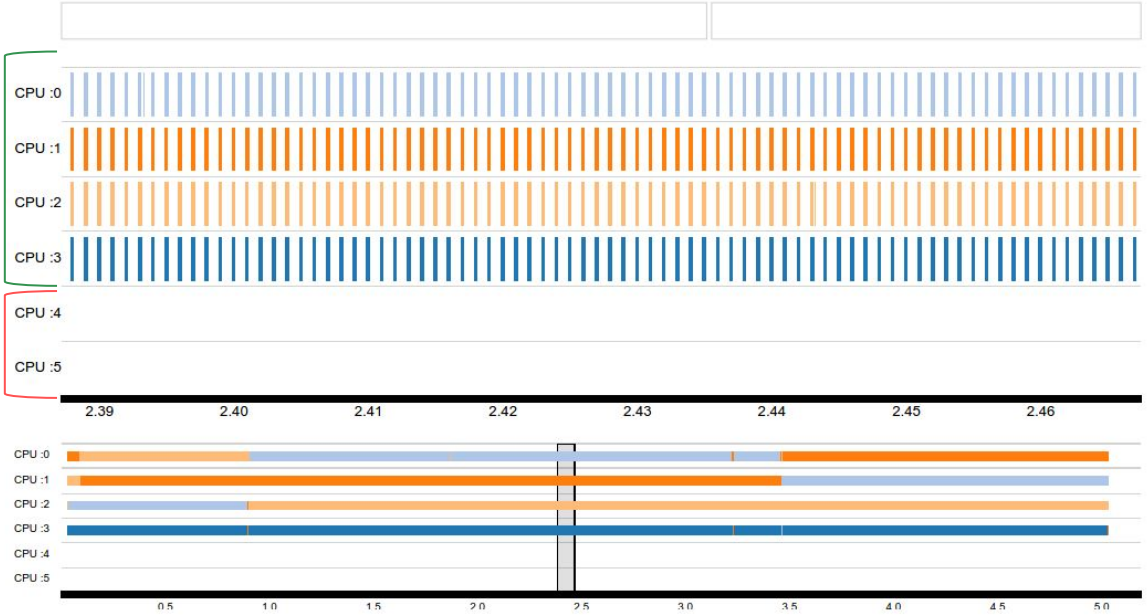
Success Criteria:

assertResidency(LittleCluster >75%)

Visualize

```
In [34]: trappy.plotter.plot_trace(trace, execnames=tasks.keys())
```

Help



Metrics

```
littleCluster = [0, 1, 2, 3]

getResidency('cluster', littleCluster)
```


```
{
    "11219": {
        "residency": 100.0,
        "task_name": "rt-app"
    },
    "11220": {
        "residency": 100.0,
        "task_name": "rt-app"
    },
    "11221": {
        "residency": 100.0,
        "task_name": "rt-app"
    },
    "11222": {
        "residency": 100.0,
        "task_name": "rt-app"
    }
}
```

Scheduler API

```
window = [tStart, tEnd]

getResidency('cluster', LITTLE, window)

getDutyCycle(window)

assertSwitch('cluster', BIG, LITTLE, window)

assertResidency('cluster',
                BIG,
                comparator,
                expectedValue,
)

assertDutyCycle(...)
```

Generic API

```
assertStatement("mean(THERMAL:temp) < CONTROL_TEMP")

assertStatement("stdev(sched_load_avg:load) < THRESHOLD")
```

Demo