Making Commercially-Sensitive Workloads Safe to Release

Charles Reiss (UC Berkeley)
John Wilkes (Google)
Joseph L. Hellerstein (Google)

Motivation

We had a *cluster scheduler* trace

- *Machines* and their availability
- *Jobs* submitted by *users* composed of many *tasks* (request to run a VM)
- Resource *requests* and *usage* (per task)
- When/where each task was started and stopped

Enables new research:

- Batch + interactive together
- Research needs realistic example

Obstacles to releasing traces

Privacy

Competitive concerns

Privacy

"information … that can be used to contact or identify [*any* user]"

Regulatory restrictions

Subject of most prior work:

- (De)anonymizing Netflix prize
- Researching health info legally

Quote: Quantcast privacy policy

Competitive concerns

"could be used to hurt the company"

- Info sensitive for X, Inc.
  may be in press releases for Y, Inc.
- Examples:
  - Performance/capability numbers
    - Competitors could compare
  - Supply chain issues:
    - Committed to certain devices

Goal

Select a version of the raw workload that is safe to release

Obfuscating the workload

Why is obfuscation hard?

- **Outside** data sources
  - Zip code + Date of Birth

- Some **aggregates** are sensitive
  - Total number of users, machines, etc.

Obfuscation techniques

- **Transform**
  - preserve equality/order/etc.
- **Subset**
  - *representative*, not complete
- **Aggregate**
  - provide only *summaries*

Transforming

- *Choose* what users need to do
  - "check equality"
  - "check if less/greater”

- Each datatype independently
- Choose parameters neutrally
  - e.g. maximum value becomes 1; not "random" scaling factor

Example: Task constraints

e.g. "foo_version >= 143"

Specify machines that can run task

Allow

- comparing attribute values *only*

Example: Task constraints

Solution:

- foo_version becomes MAC(*secret*, foo_version)
  - *secret* only used for this purpose

- For each attribute:
  - sort values **that actually appear**
  - rename values 1, 2, 3, …

Example: CPU usage

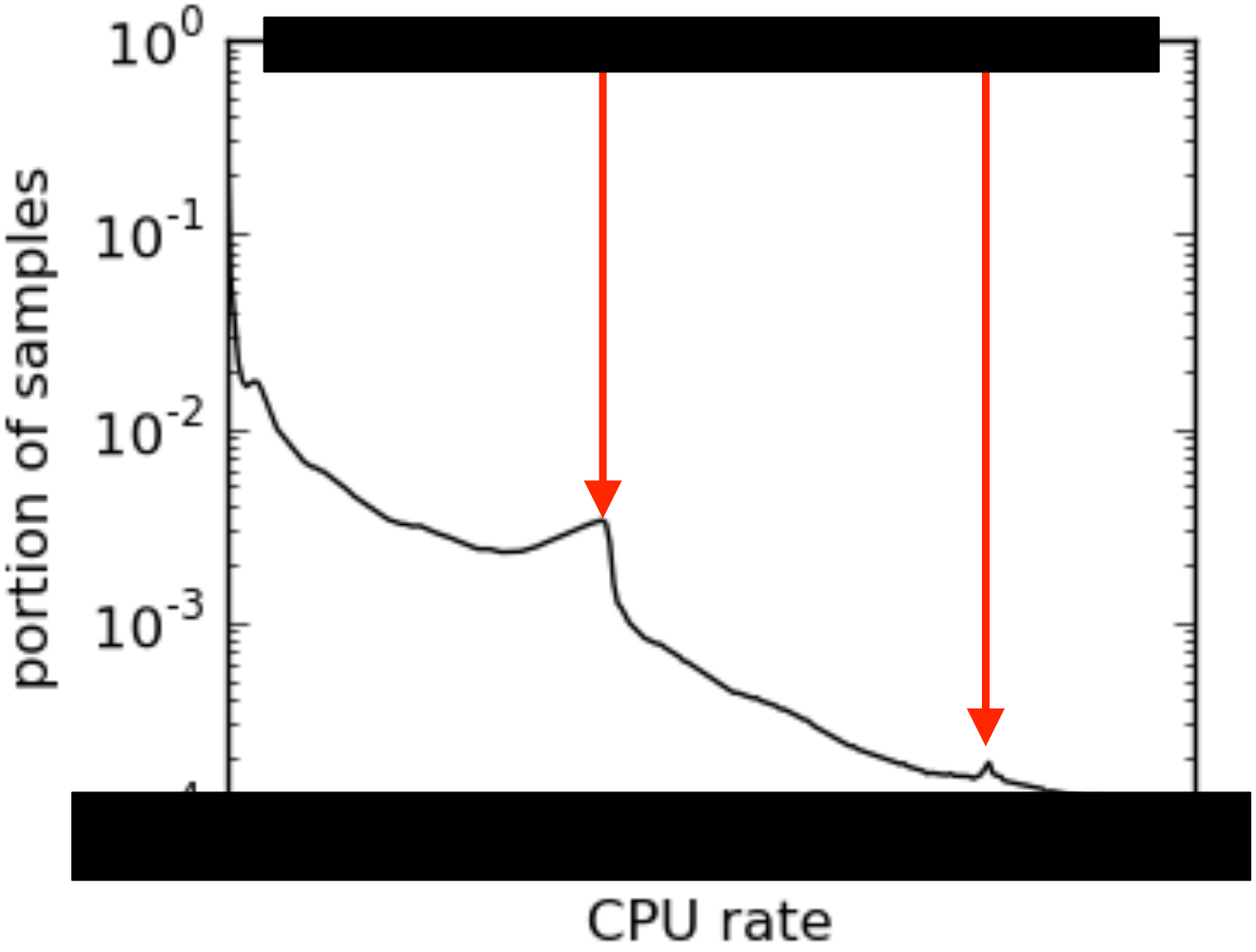
Can we allow:

- Summing CPU usages and comparing to capacities
  - effectively requires linear scaling

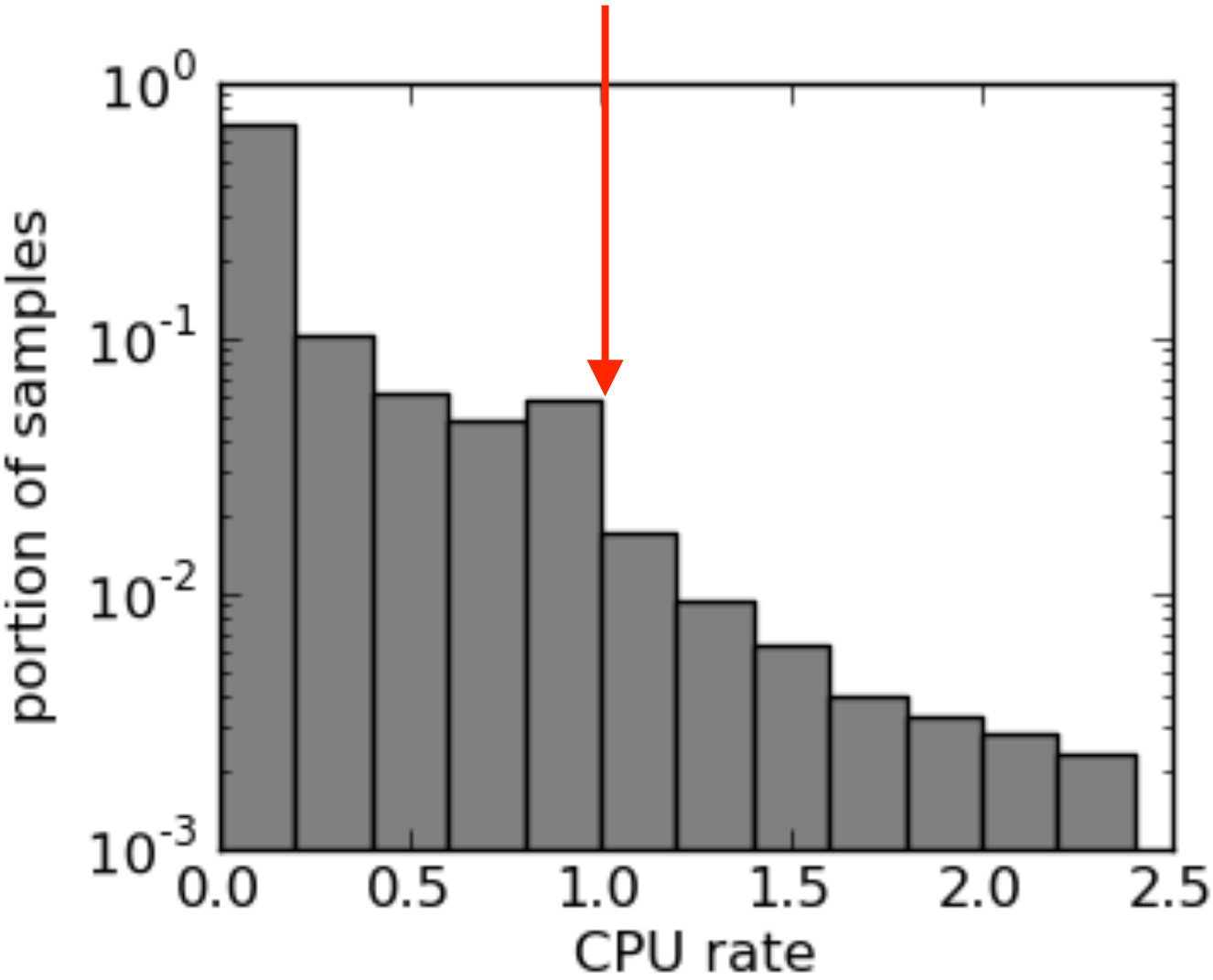
but **not** allow?

- discovery of machine core counts

Example: CPU usage



Example: CPU usage



Example: CPU usage

No transformation that allows summing usages will avoid revealing "1 core"

Compromise:

- Choose ***subset of machines*** for which revealing core count is okay
- *representative* of the workload type

Example: Job purpose

Applications with different performance goals

Researchers want the **semantics** of jobs

Internally: job names + user names

Manually label **1000s** of job names??

Example: Job purpose

Compromise:

- Scheduler parameters
  - priority, latency-sensitivity
- Extra measurements
  - CPI, memory traffic

… but no way to *verify* purpose

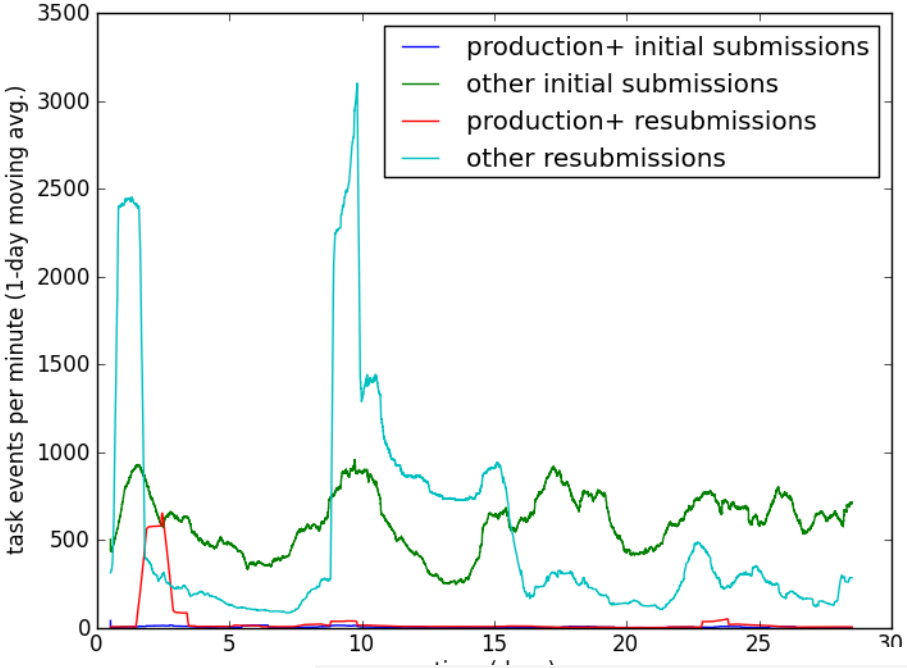
Aggregation

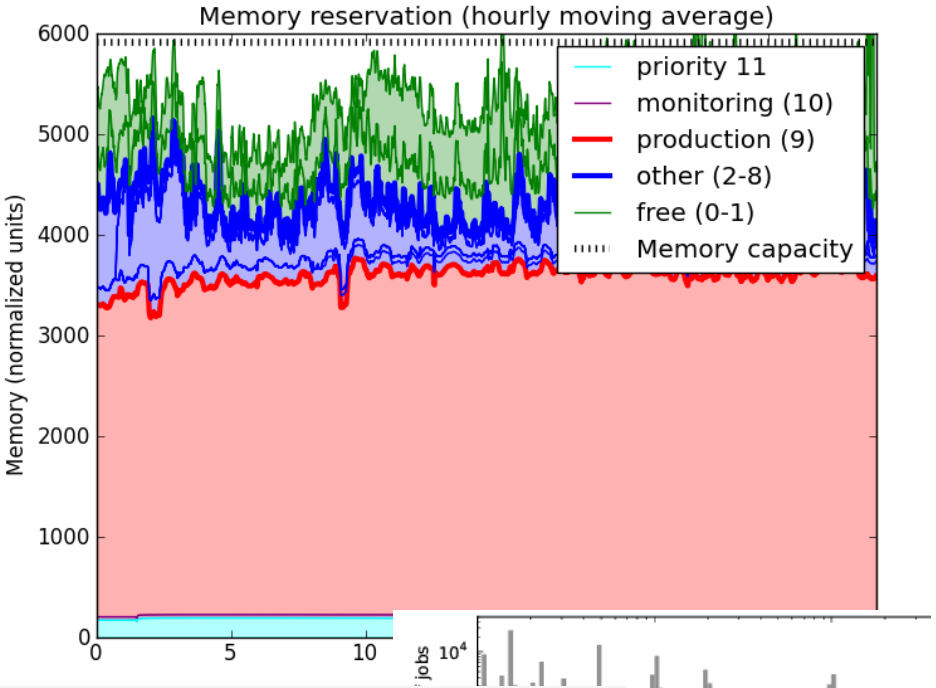
- Summaries only
  - e.g. 5/25/50/75/95th percentiles
- Good for privacy
- But need to *choose* what's important
  - We didn't really know

Conclusion

- Releasing useful traces is hard
- Privacy isn't enough
- Be systematic
  - *Choose* what trace users should do
- Subsetting often more useful than field-by-field transformations

- No free lunch … but we got a trace.





https://code.google.com/p/googleclusterdata/