Enabling Reproducible and Agile Full-System Simulation

Work by Bobby R. Bruce, Ayaz Akram, Hoa Nguyen, Kyle Roarty, Mahyar Samani, Marjan Fariborz, Trivikram Reddy, Matthew D. Sinclair, and Jason Lowe-Power

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Presented by Bobby R. Bruce

The Problem

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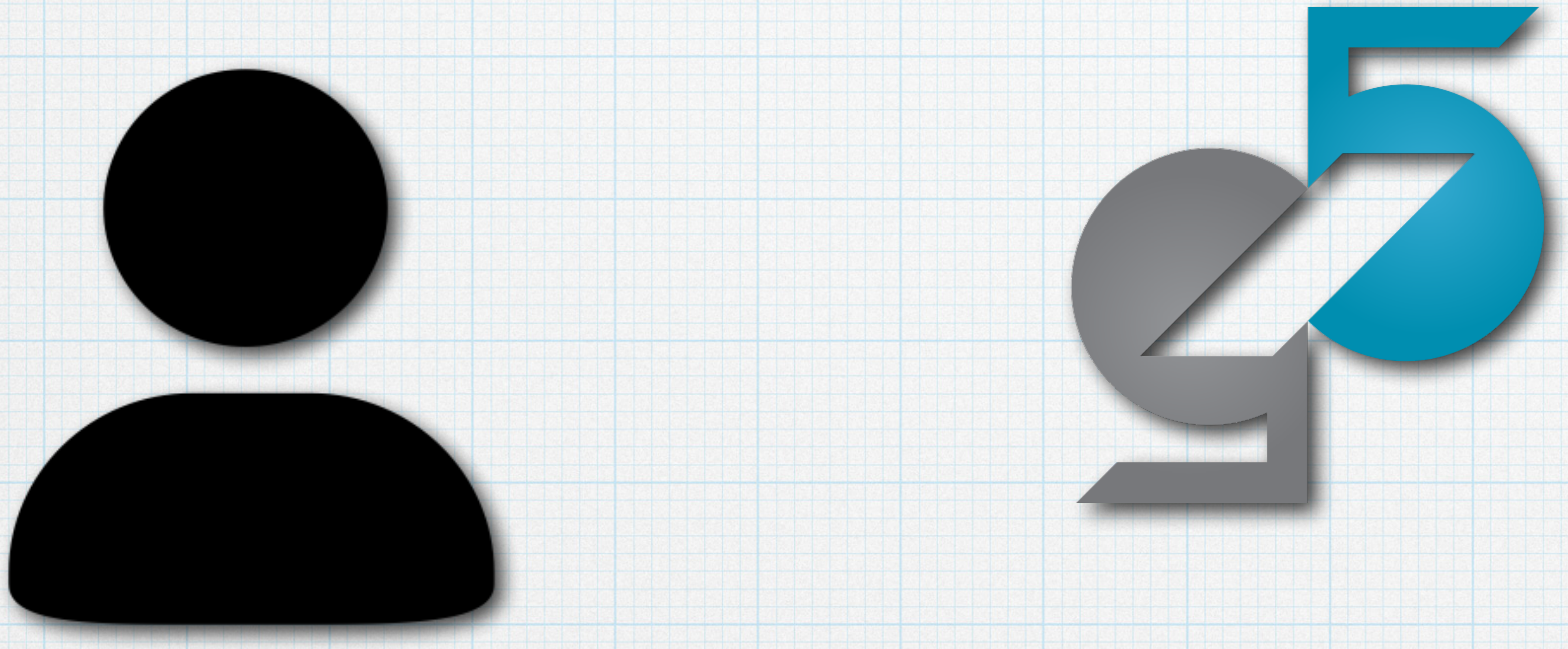

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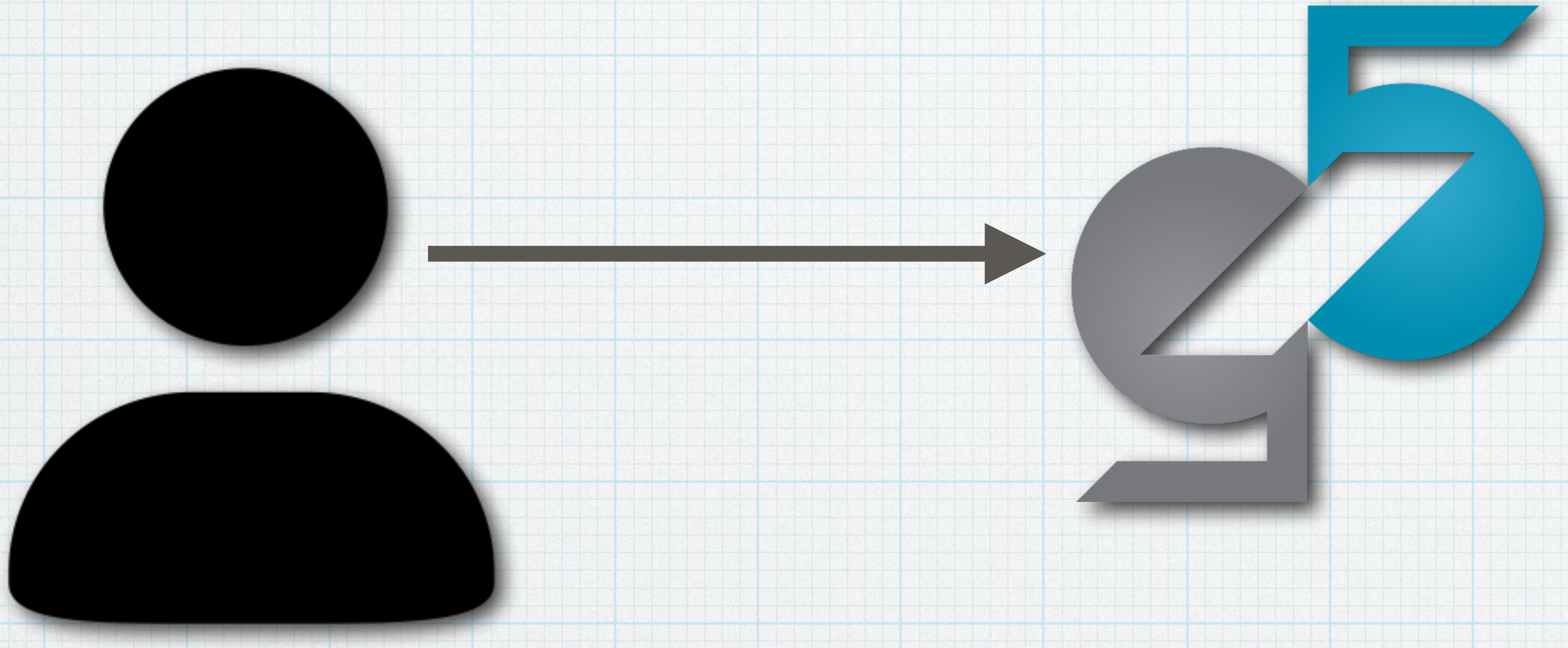

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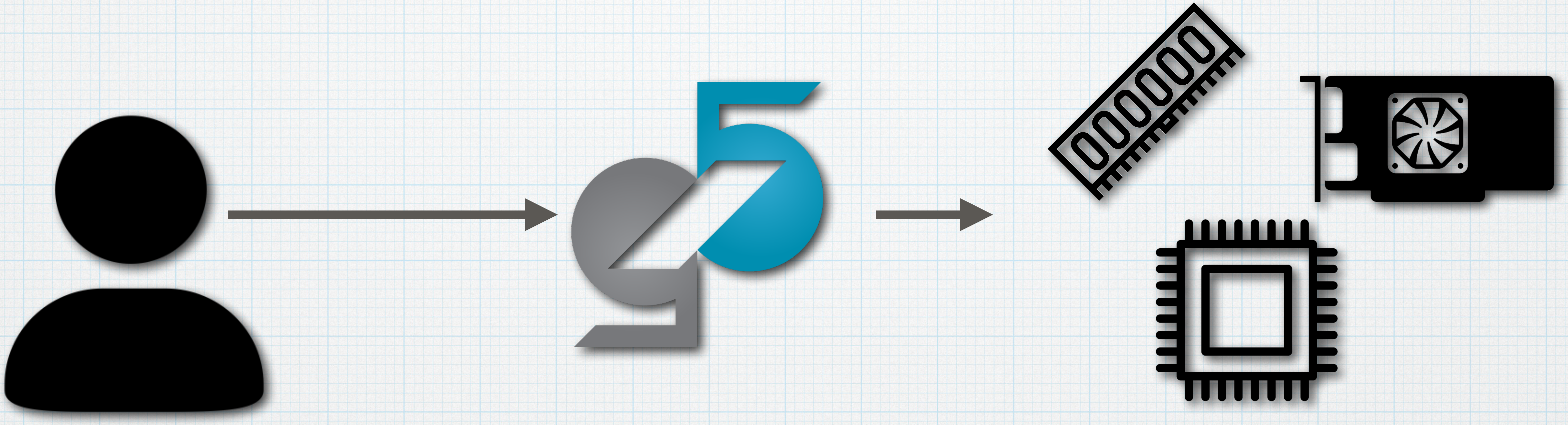

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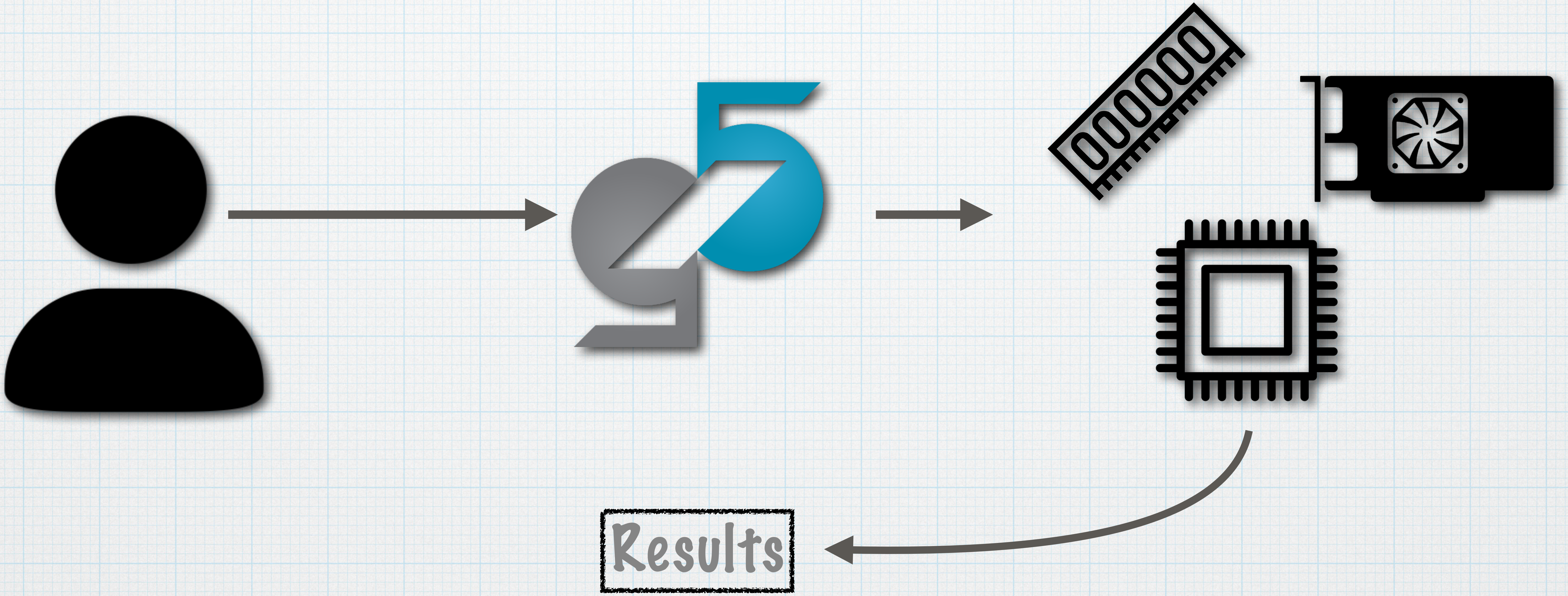

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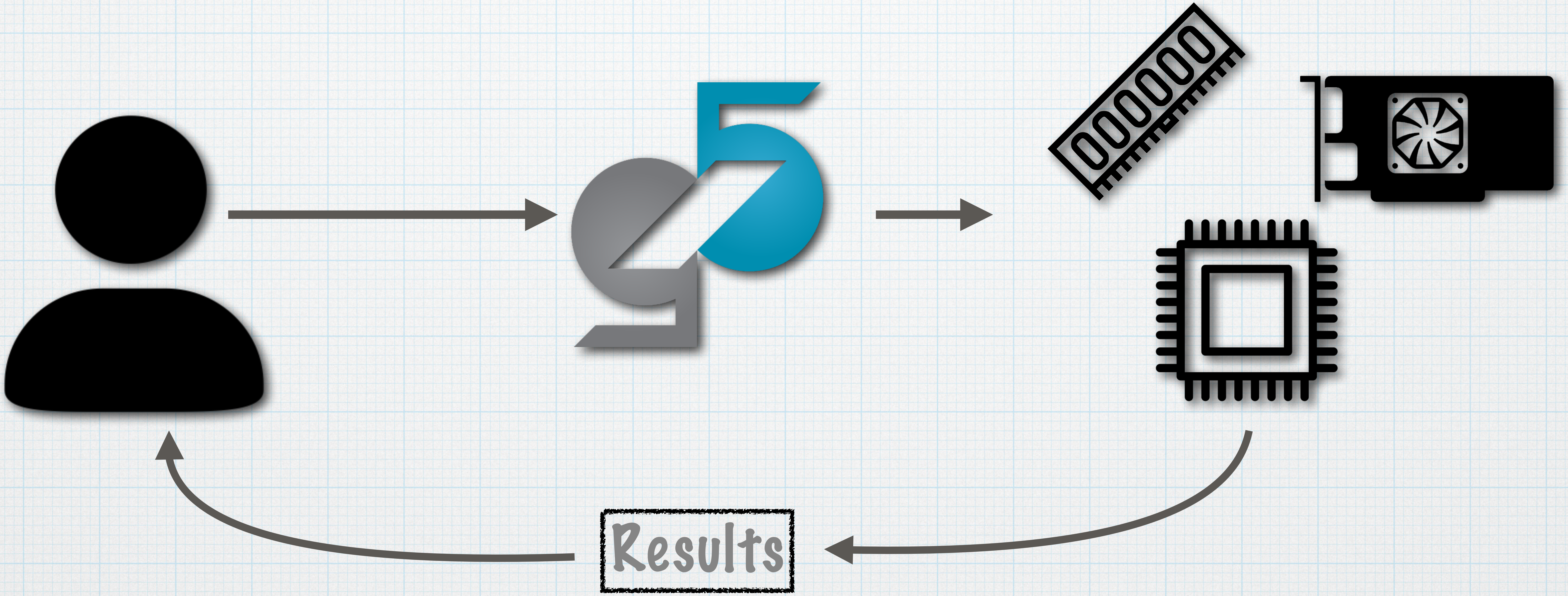

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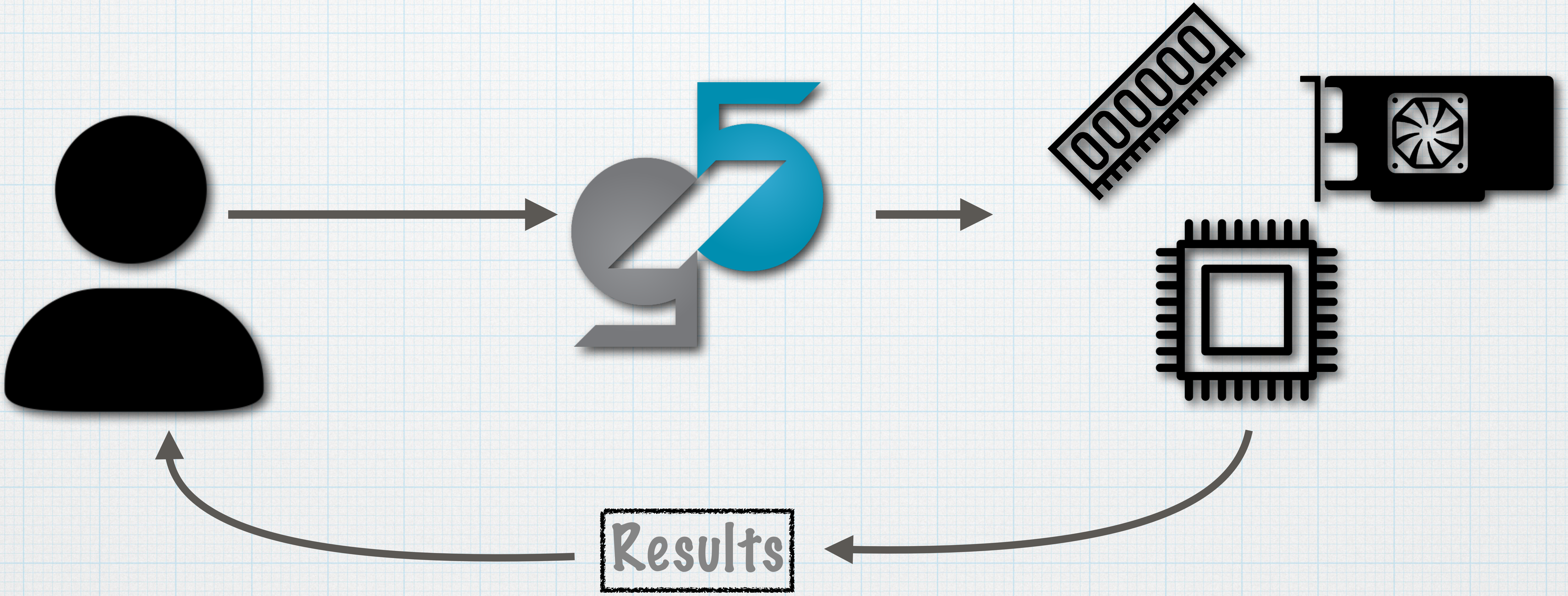

How do we manage this information?

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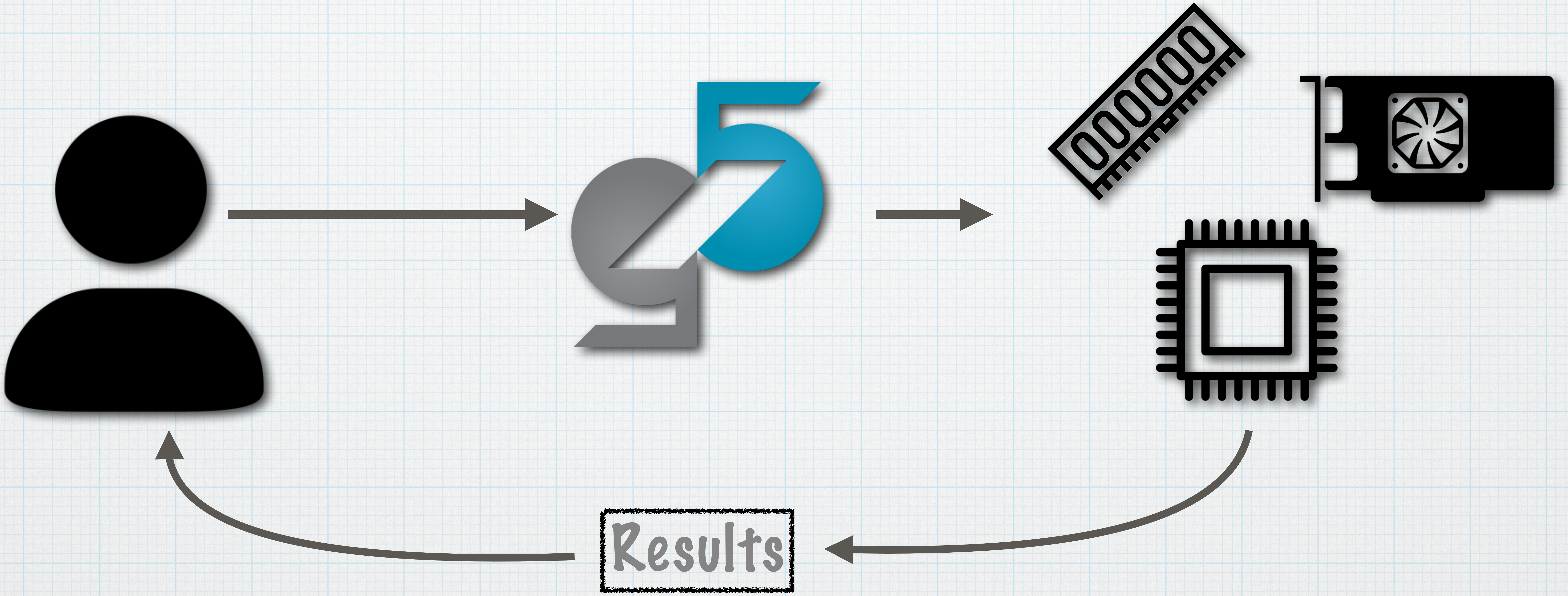

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How do we easily reproduce what we've done?

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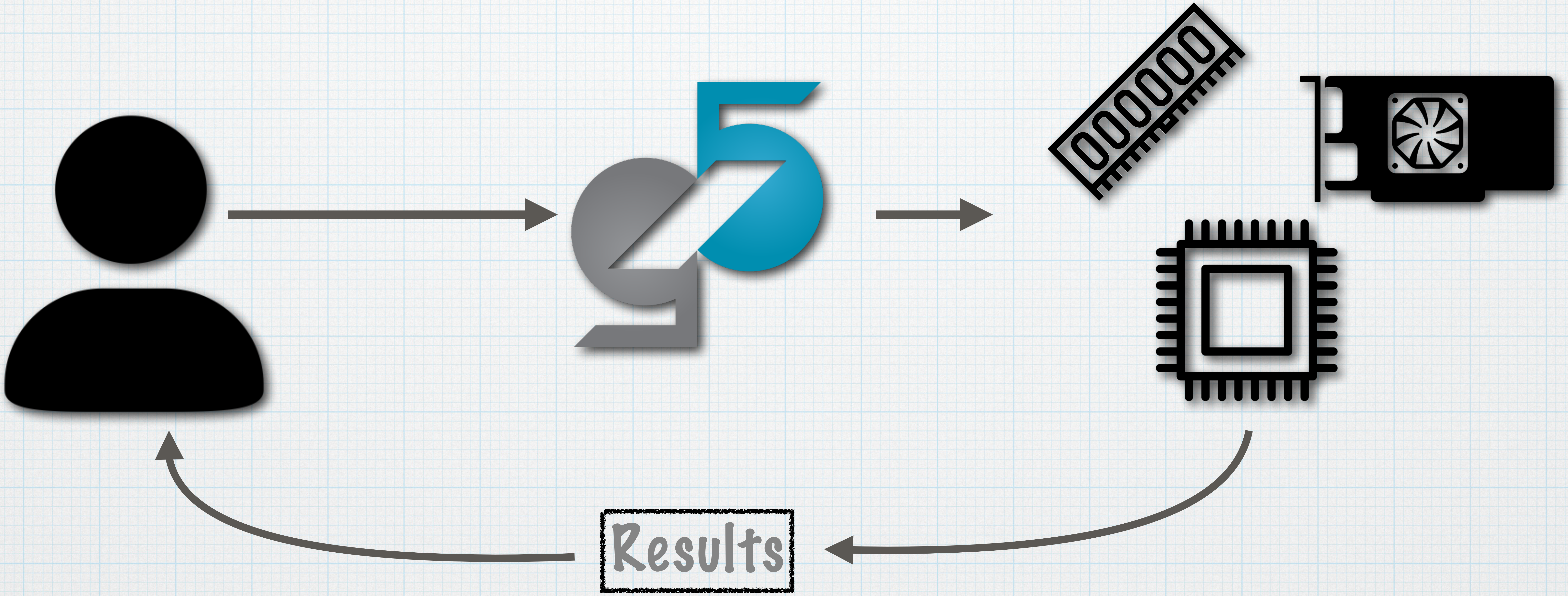

Results

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How do we easily reproduce what we've done?

How do we communicate our setup/results in a standardized way?

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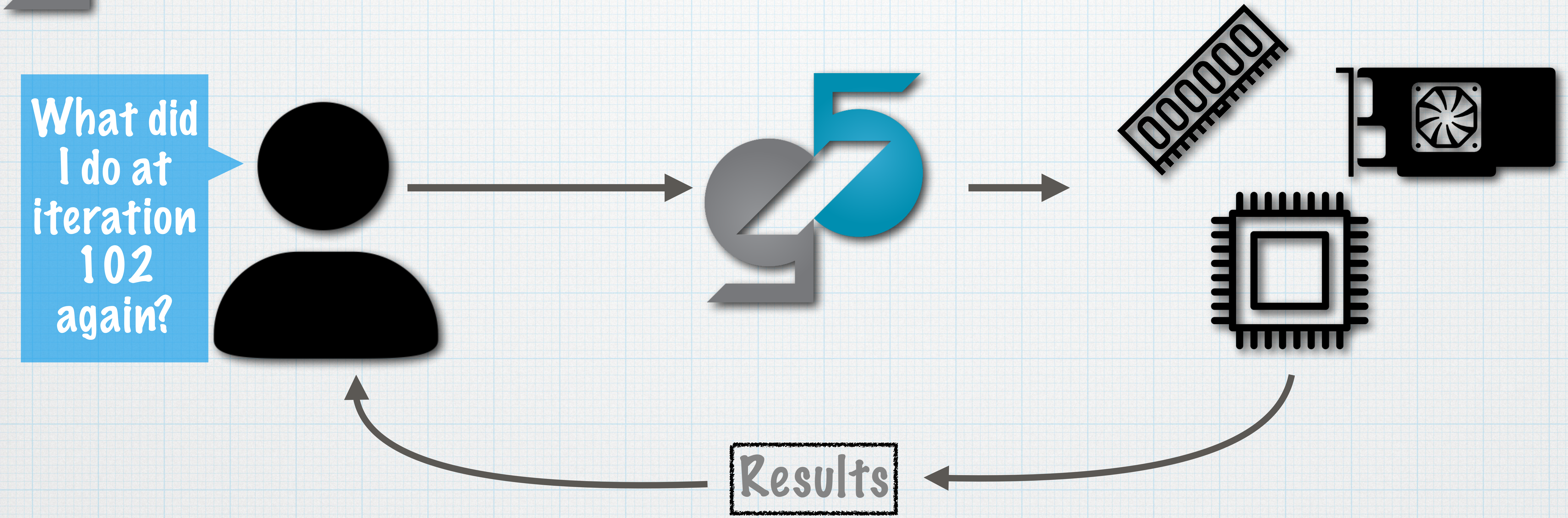

What did I do at iteration 102 again?

Results

How do we manage this information?

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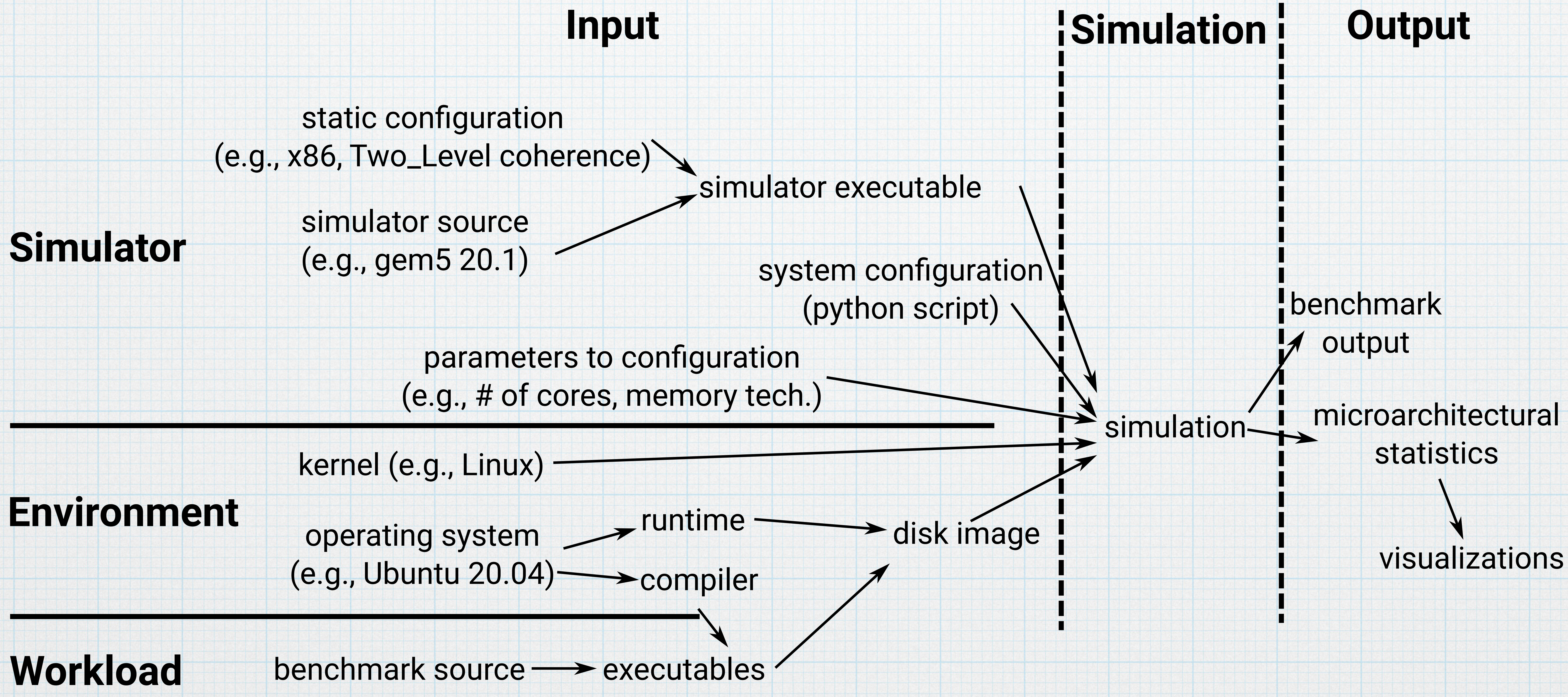
A Full-System workflow



For most experiments:

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Too many configurations!

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No standardized way to communicate setups, or allow reproducibility.

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Too many configurations!

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No standardized way to communicate setups, or allow reproducibility.

No official source of components/resources.

The Solution

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gem5art

- Artifacts.
- Reproducibility.
- Testing.

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gem5 Resources

- Pre-built.
- gem5-compatible.
- Open-source, extendable.

gem5art:
A high-level overview

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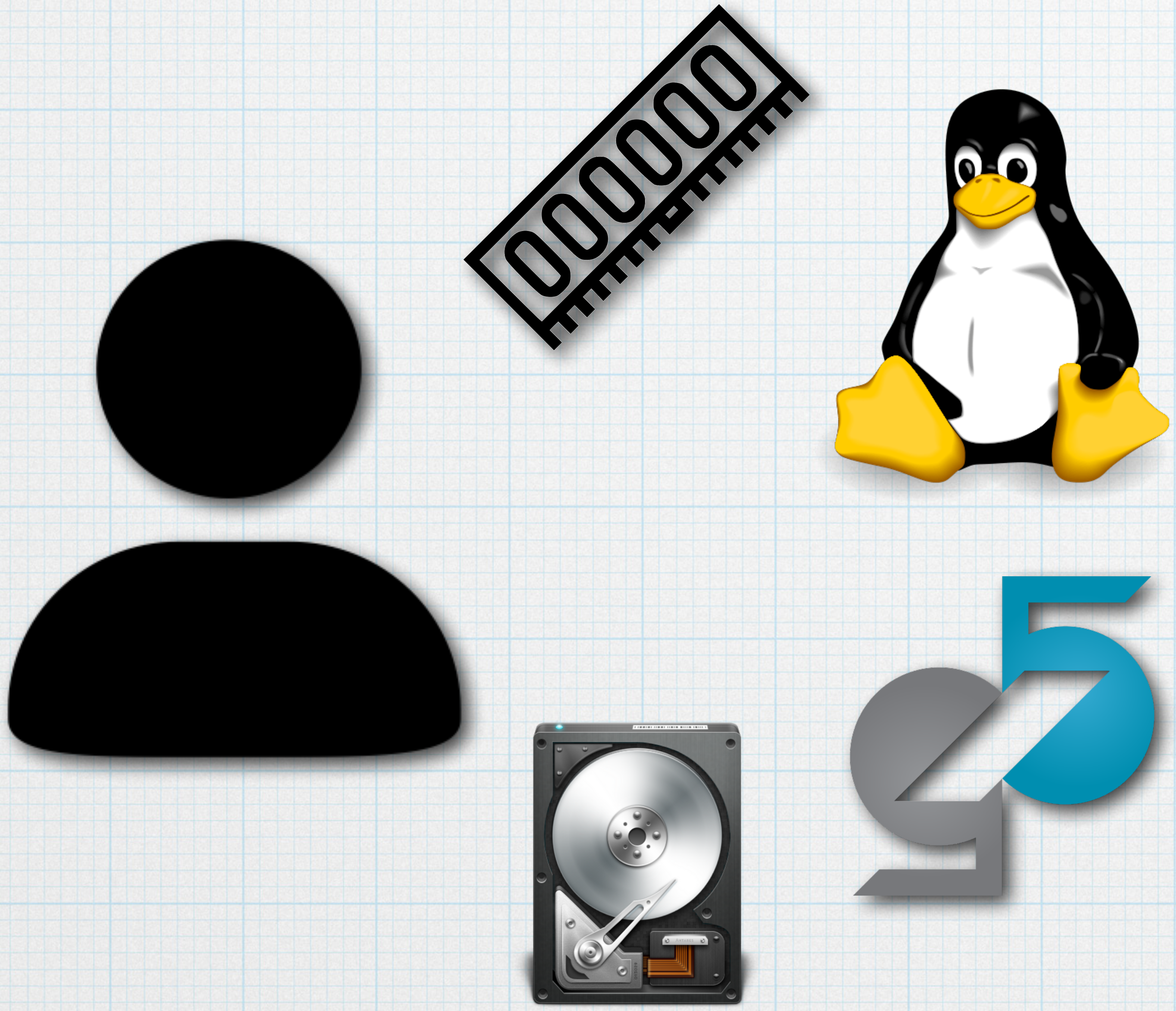

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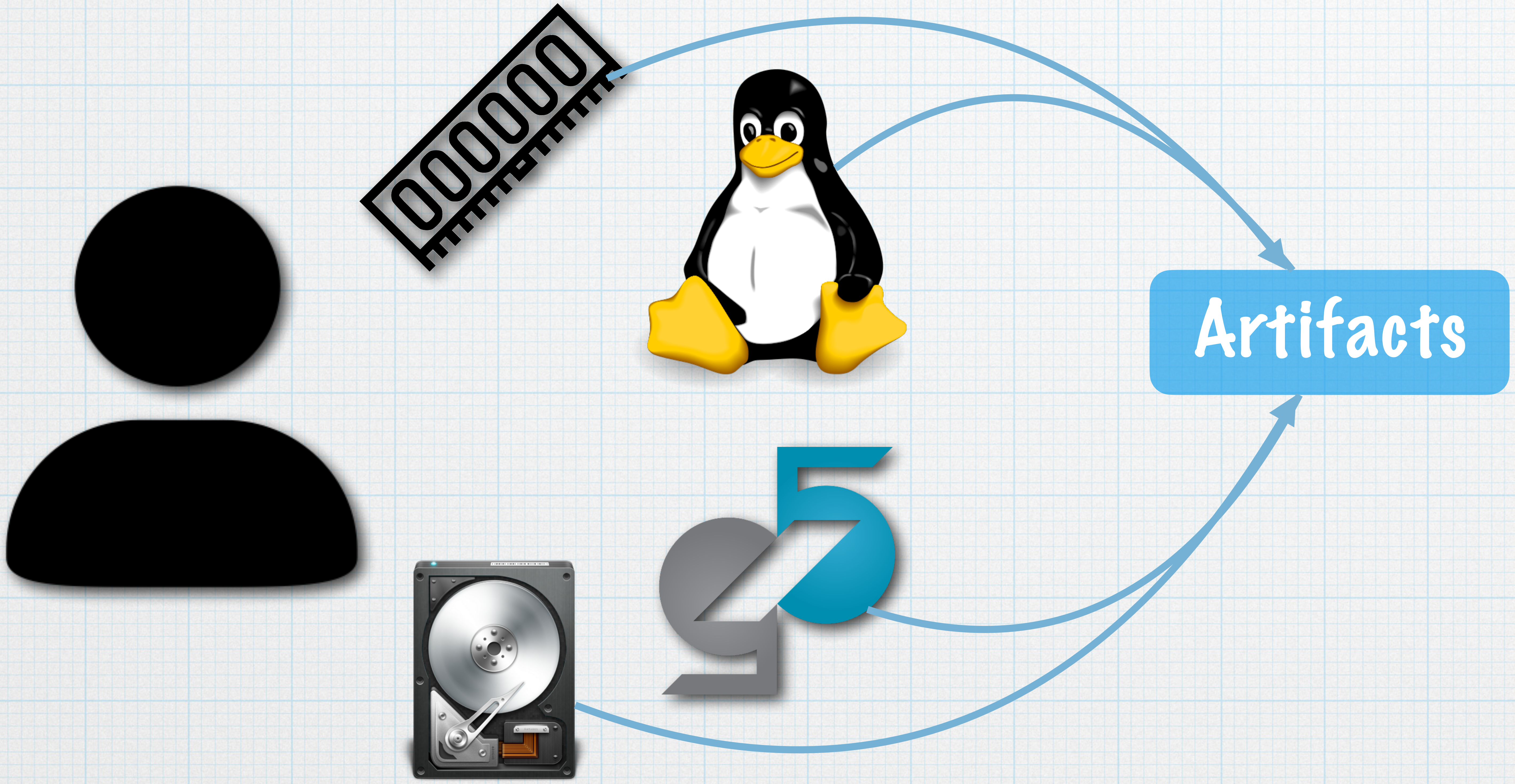

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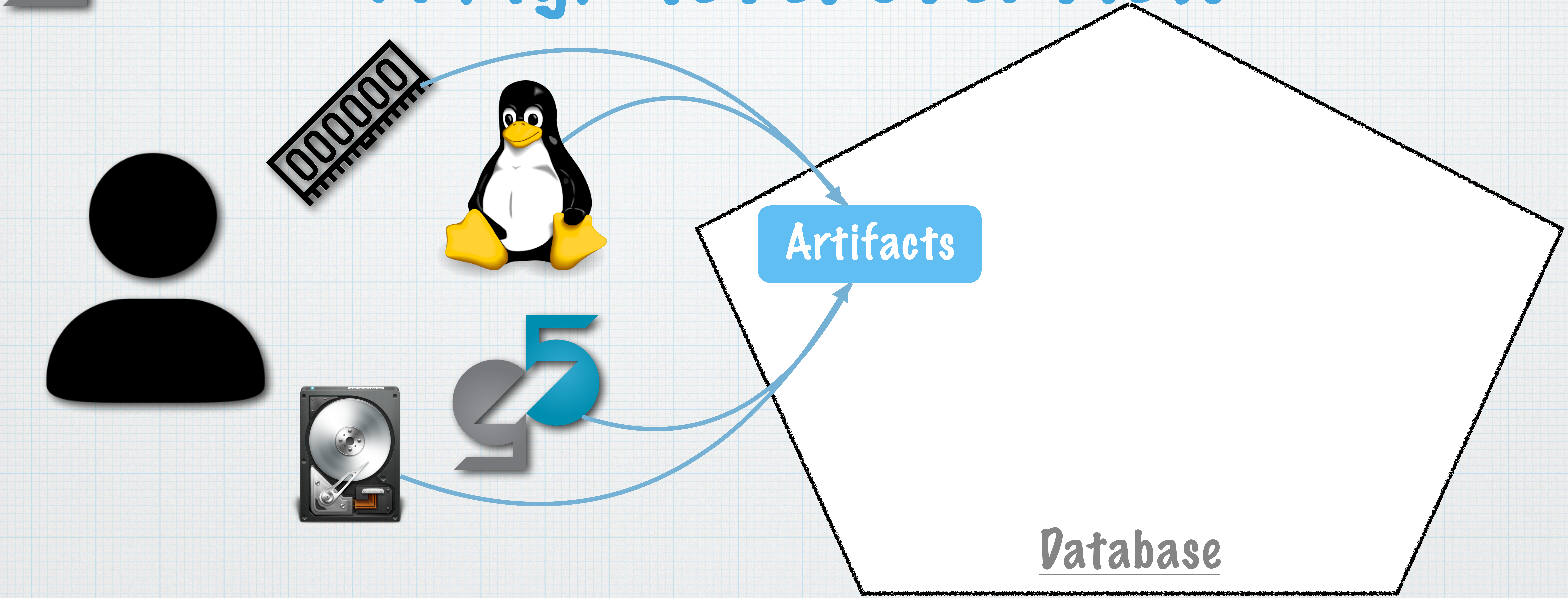

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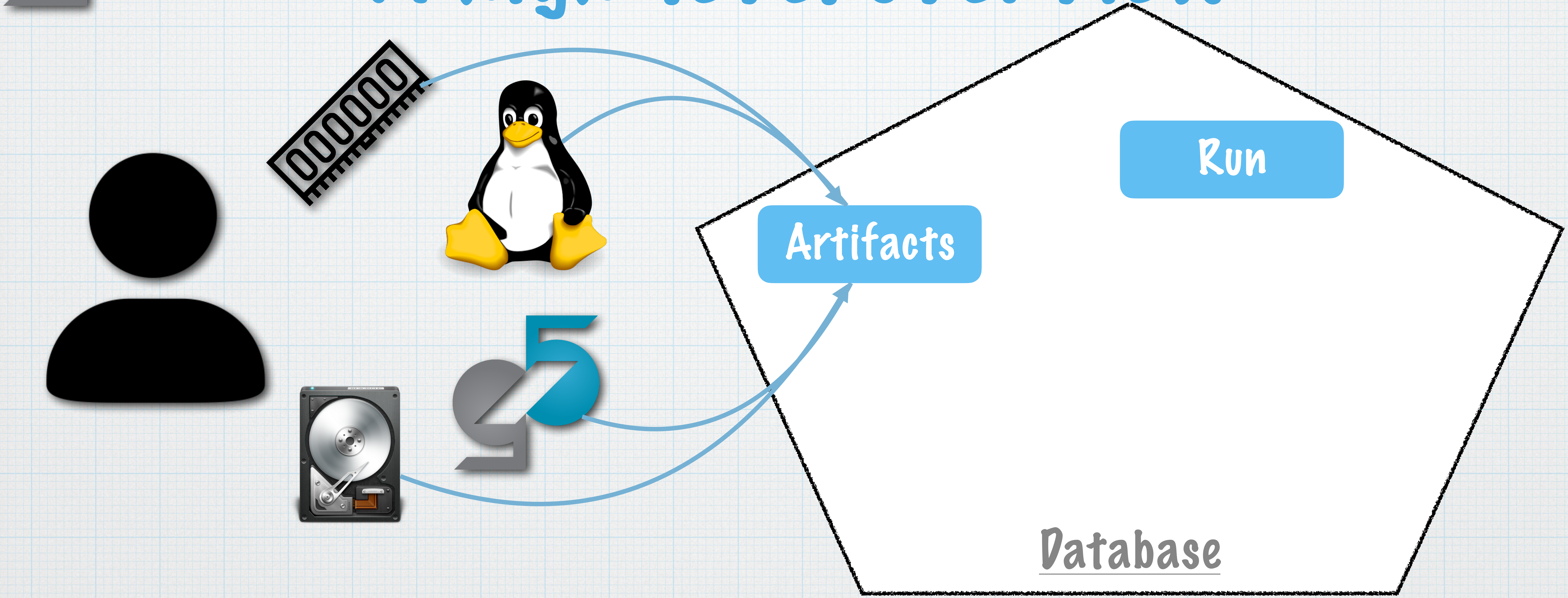

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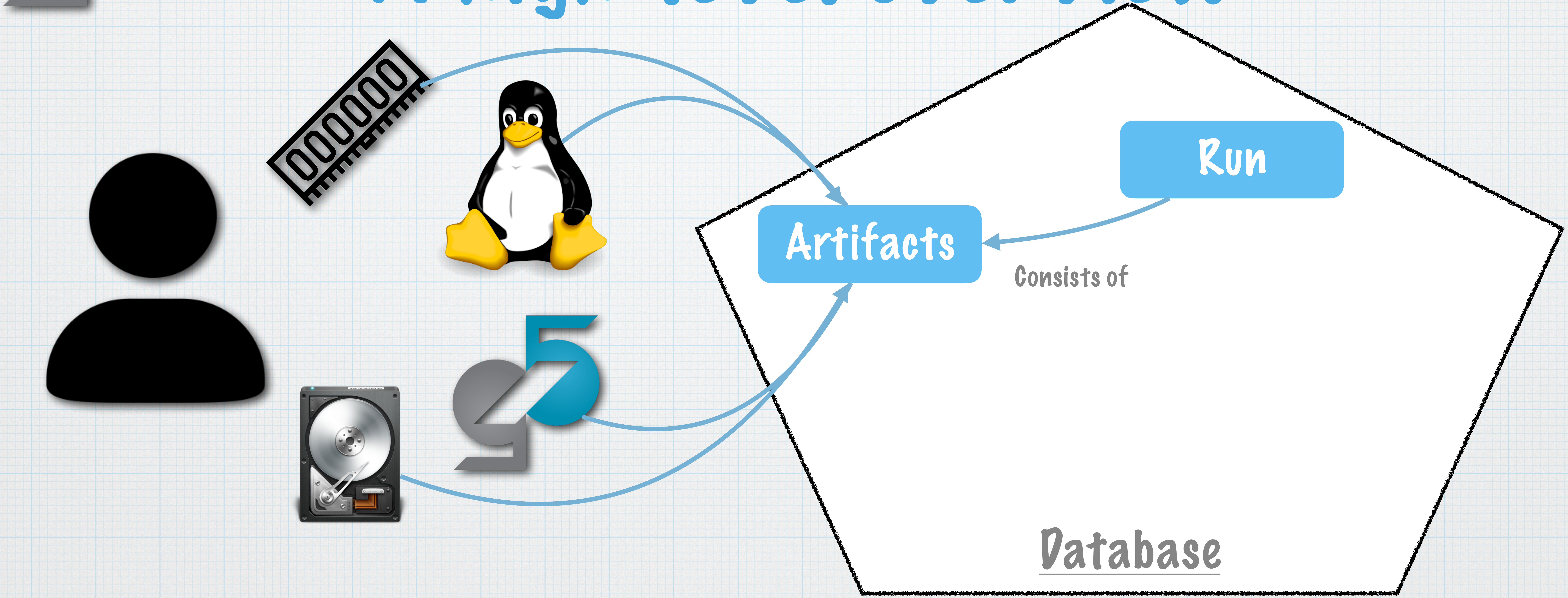

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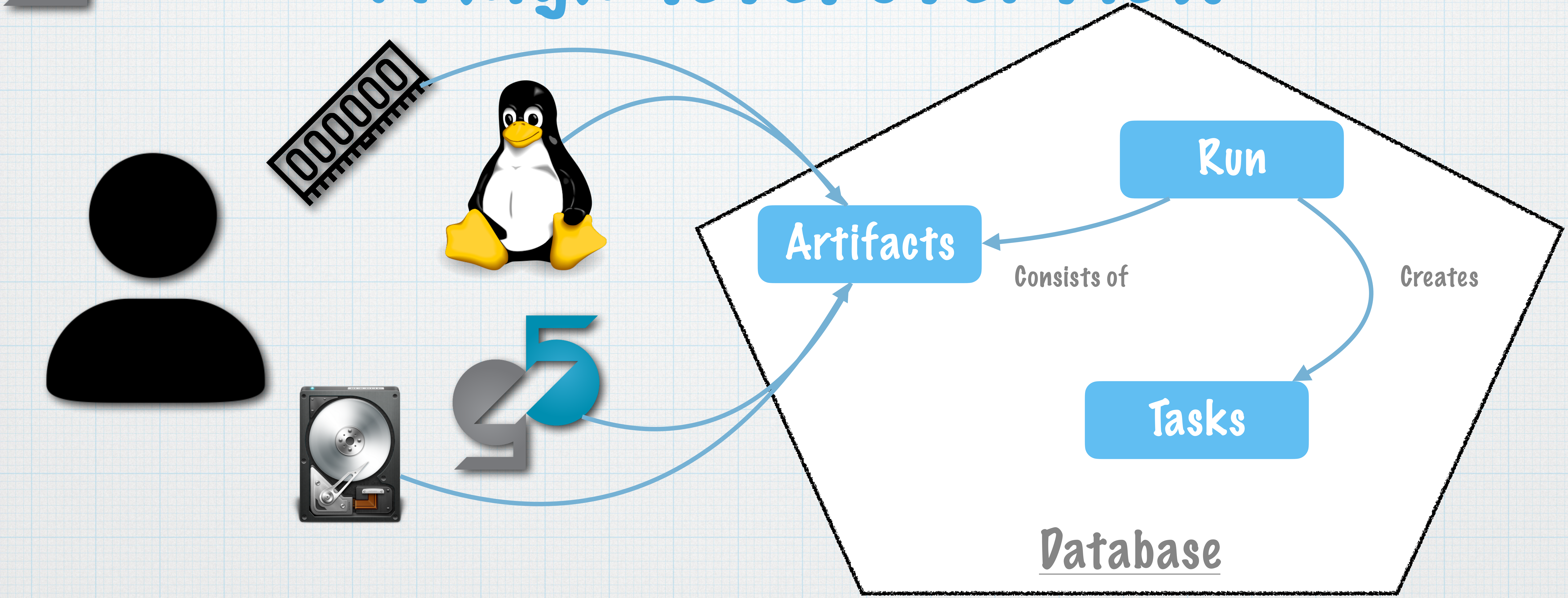

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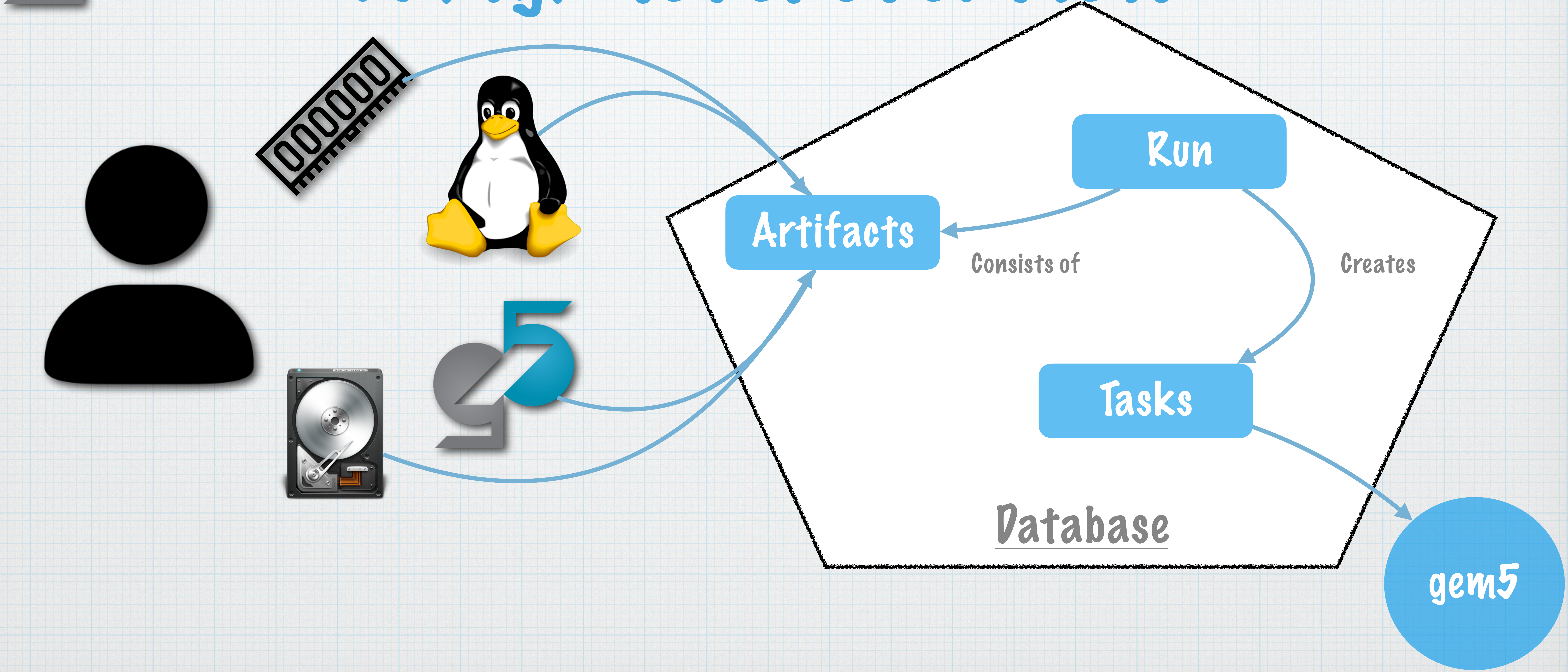

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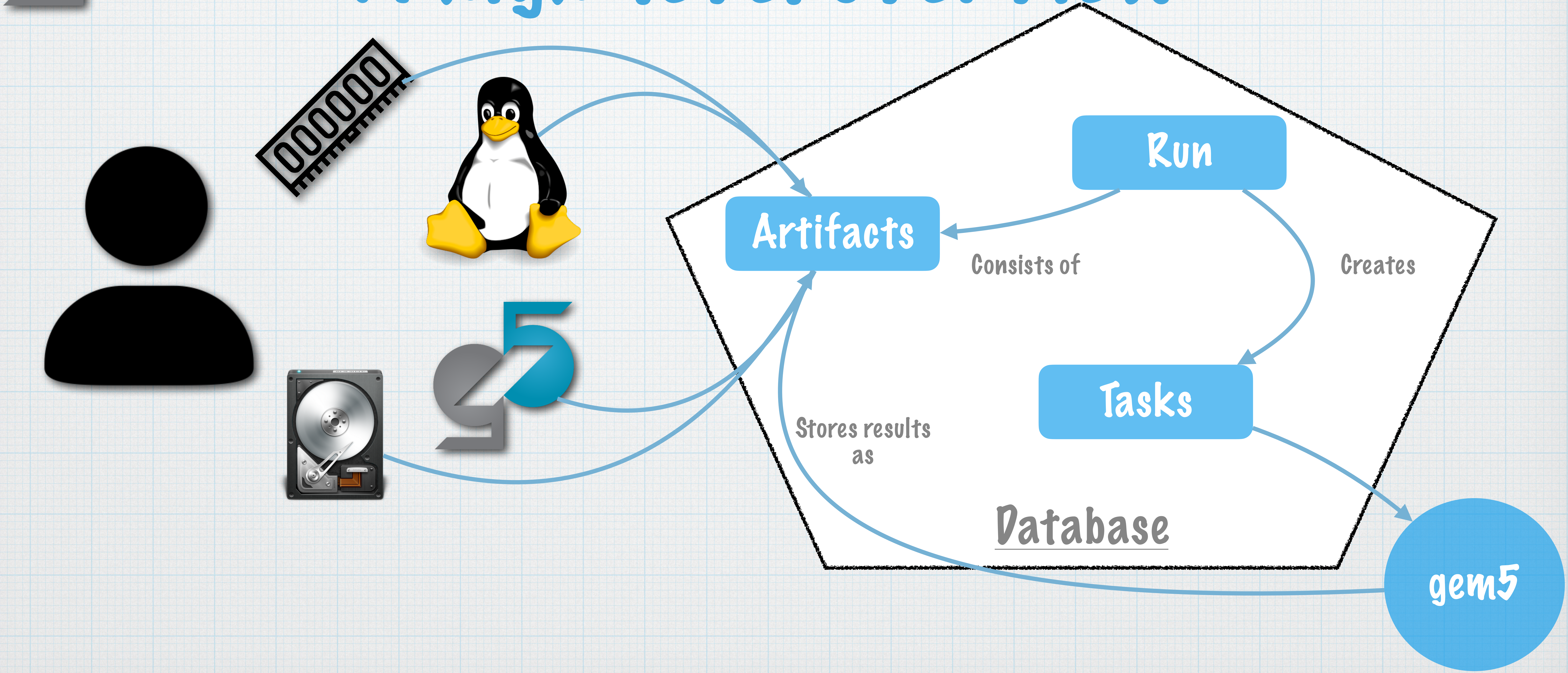

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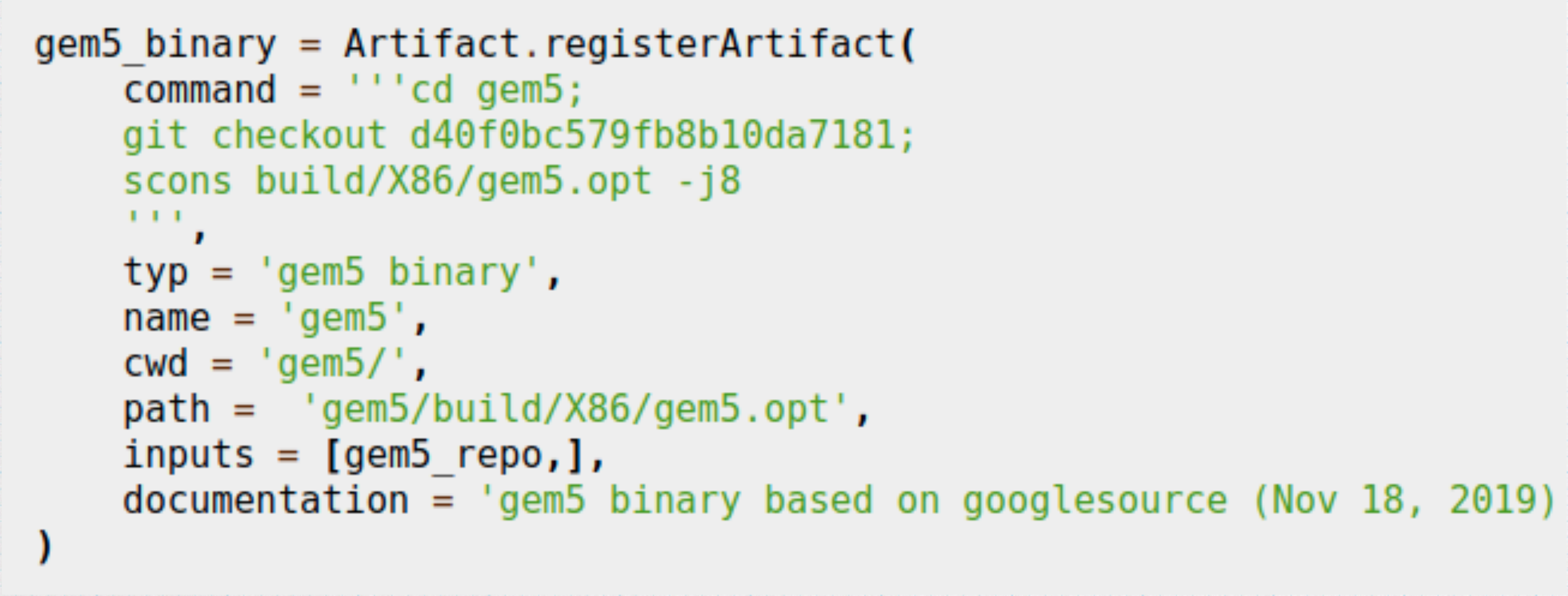

```
gem5_binary = Artifact.registerArtifact(
    command = '''cd gem5;
    git checkout d40f0bc579fb8b10da7181;
    scons build/X86/gem5.opt -j8
    ''',
    typ = 'gem5 binary',
    name = 'gem5',
    cwd = 'gem5/',
    path =  'gem5/build/X86/gem5.opt',
    inputs = [gem5_repo,],
    documentation = 'gem5 binary based on googlesource (Nov 18, 2019)
)
```

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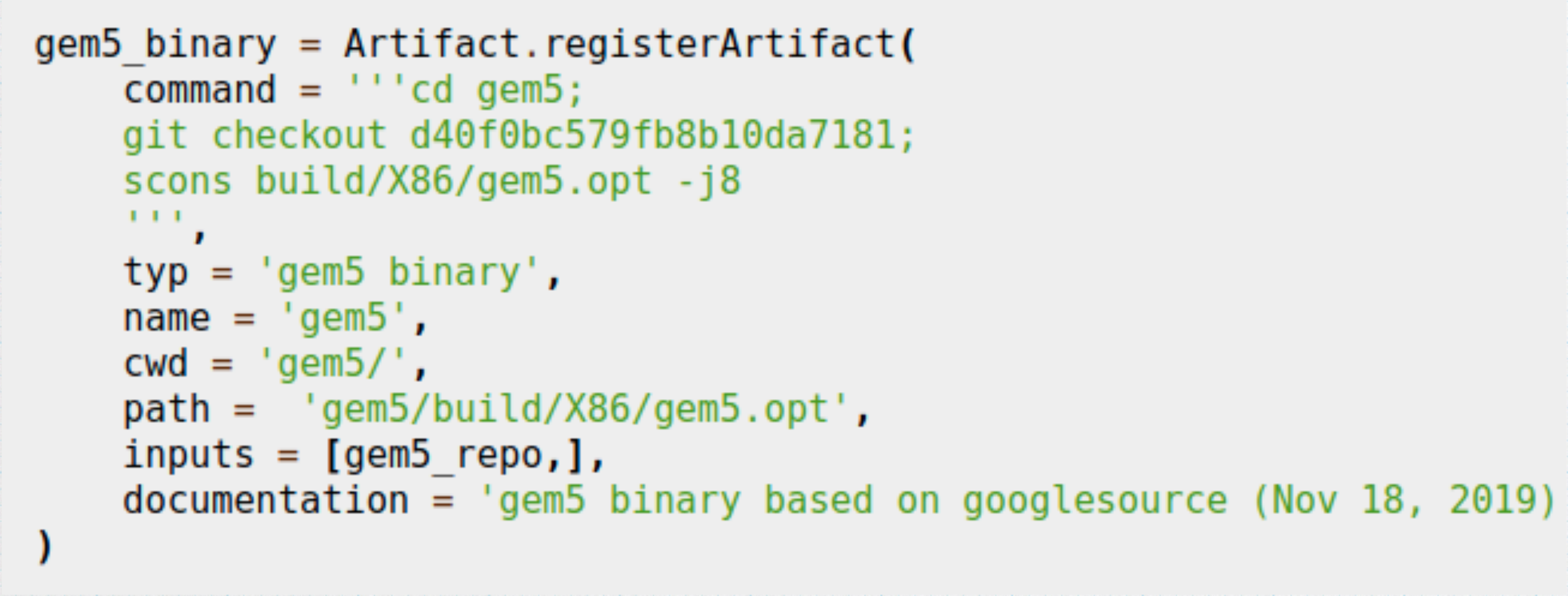

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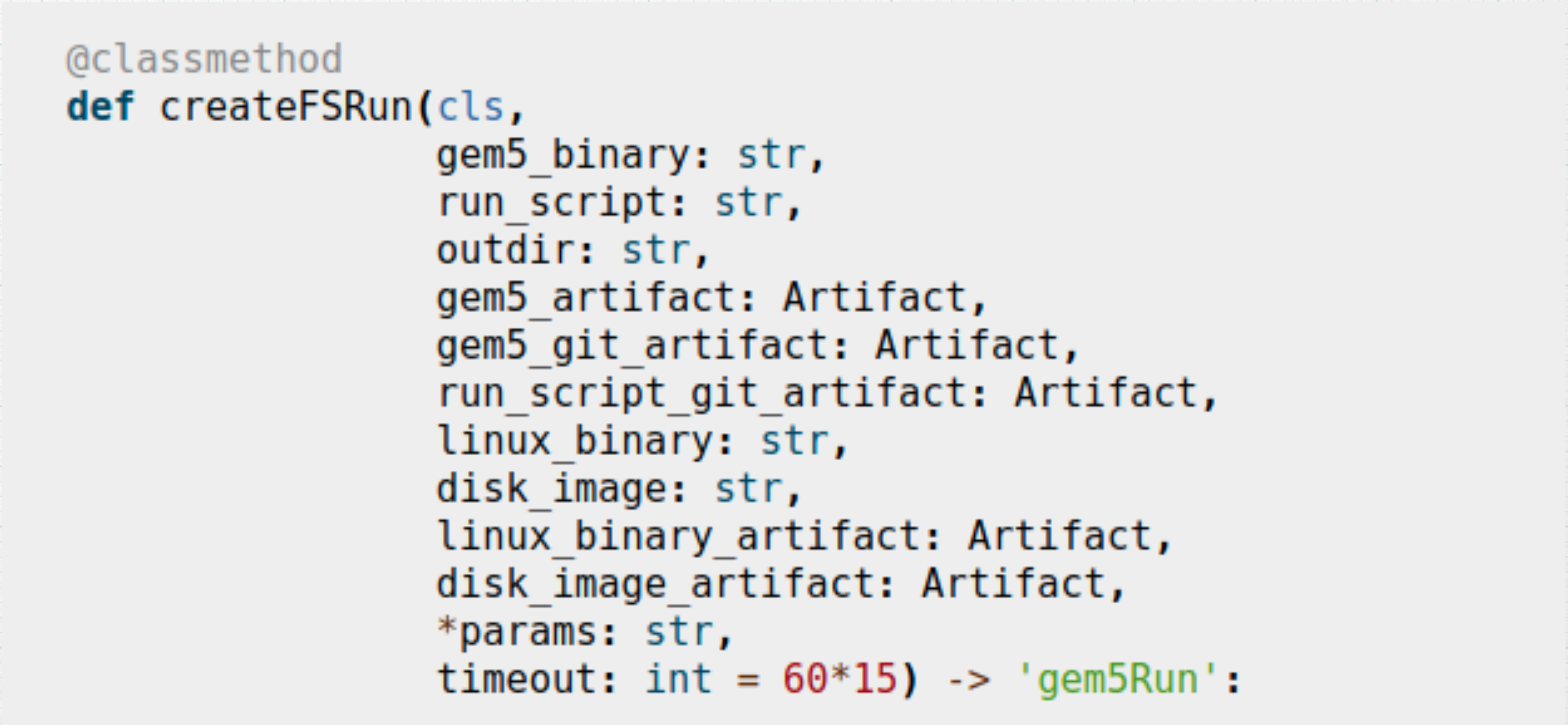
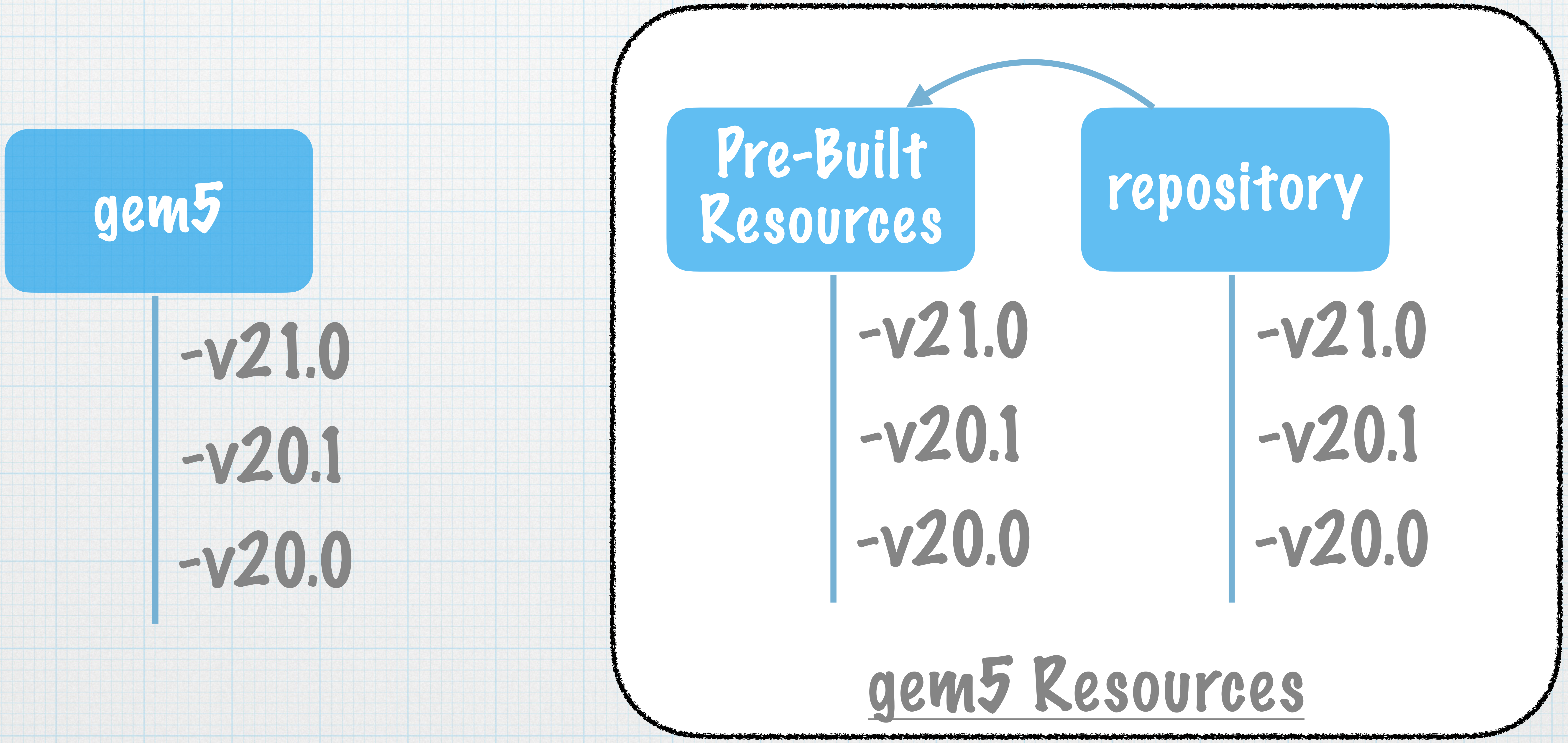


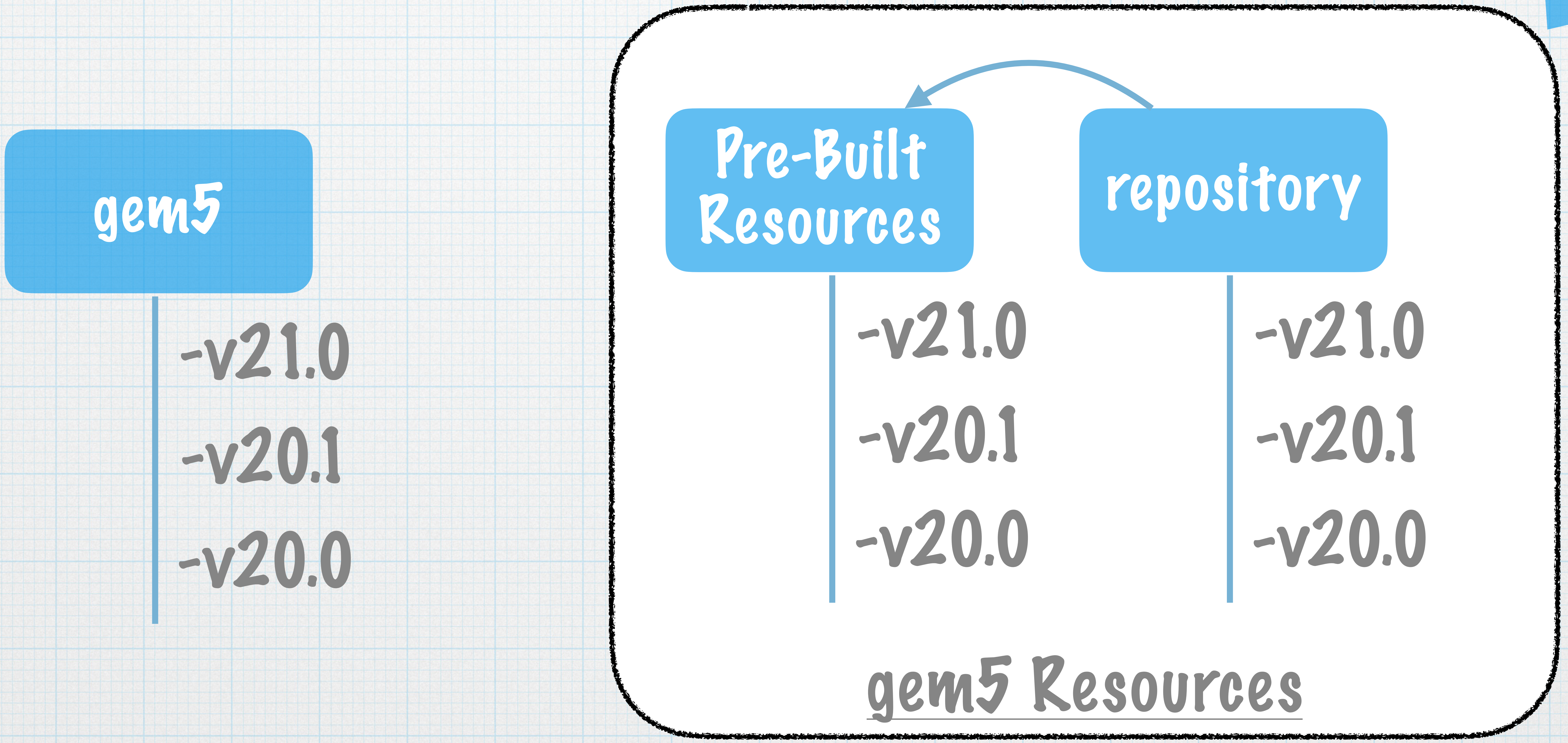
```
@classmethod
def createFSRun(cls,
                gem5_binary: str,
                run_script: str,
                outdir: str,
                gem5_artifact: Artifact,
                gem5_git_artifact: Artifact,
                run_script_git_artifact: Artifact,
                linux_binary: str,
                disk_image: str,
                linux_binary_artifact: Artifact,
                disk_image_artifact: Artifact,
                *params: str,
                timeout: int = 60*15) -> 'gem5Run':
```

gem5 Resources: A high-level overview



gem5 Resources:
A high-level overview

16+ apps/ benchmarks/ images



gem5
- -v21.0
- -v20.1
- -v20.0

Pre-Built Resources
- -v21.0
- -v20.1
- -v20.0

repository
- -v21.0
- -v20.1
- -v20.0

gem5 Resources

Use-Case 1: Co-Design

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"How does the execution time of PARSEC applications change between Ubuntu 18.04 and 20.04, for single core and 8 core CPU setups?"

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Moving parts:

Operating System: Ubuntu 18.04, Ubuntu 20.04

Applications: 10 benchmark applications

Num Processors: Single Core, 8 Core

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Each run produces results. In this case we concern ourselves with execution time.

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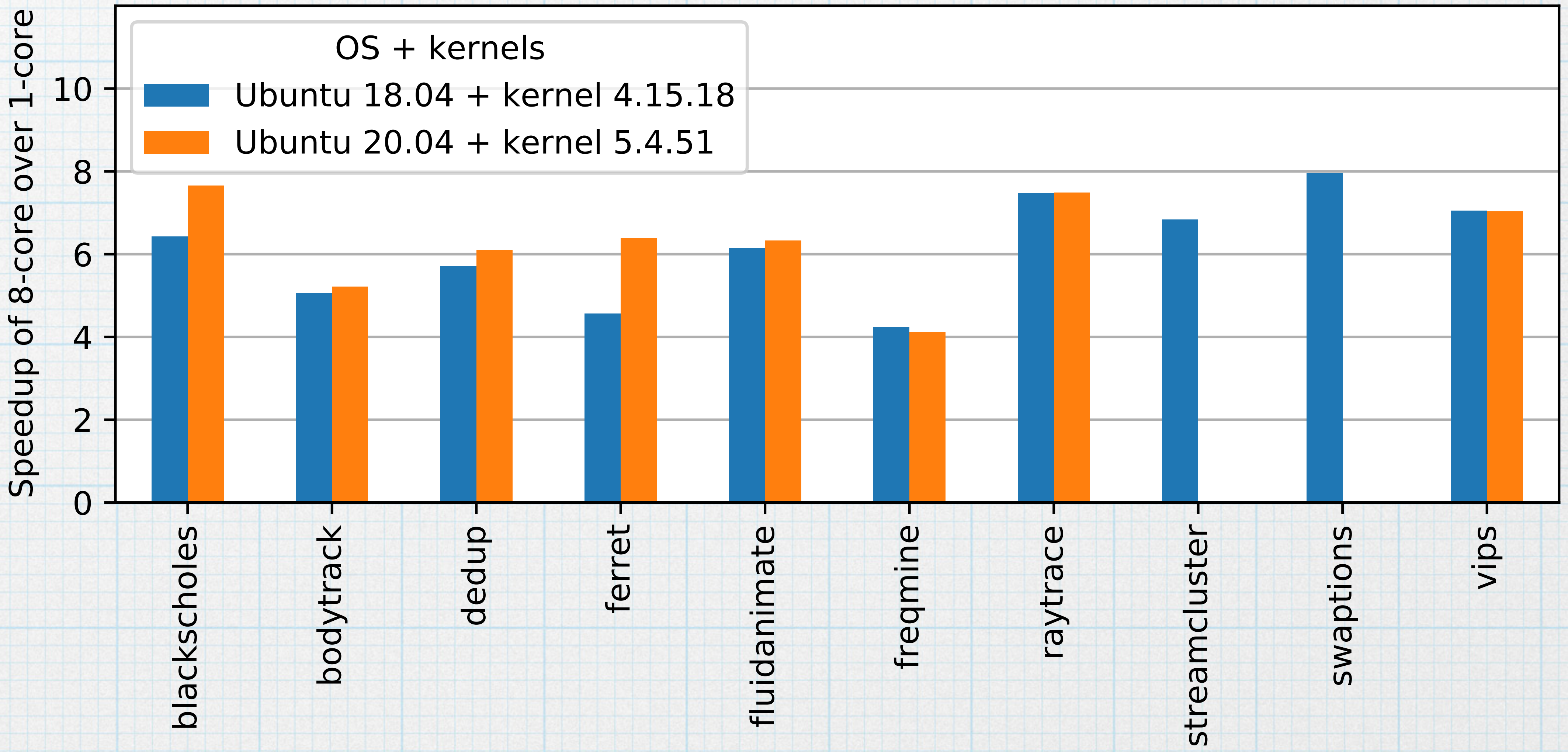

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This is a common gem5 test

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Kernel: 4.4.186, 4.9.186, 4.14.134, 4.19.84, 5.4.49

Num Processors: 1, 2, 4, 8

CPU Models: kvm, atomic, simple, o3

Memory System: classic, MI_Example, MESI_Two_Level

Boot: Kernel Only, Full Ubuntu

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For each run we wish to keep track of whether the run was a success, there was a gem5 error, or a kernel panic.

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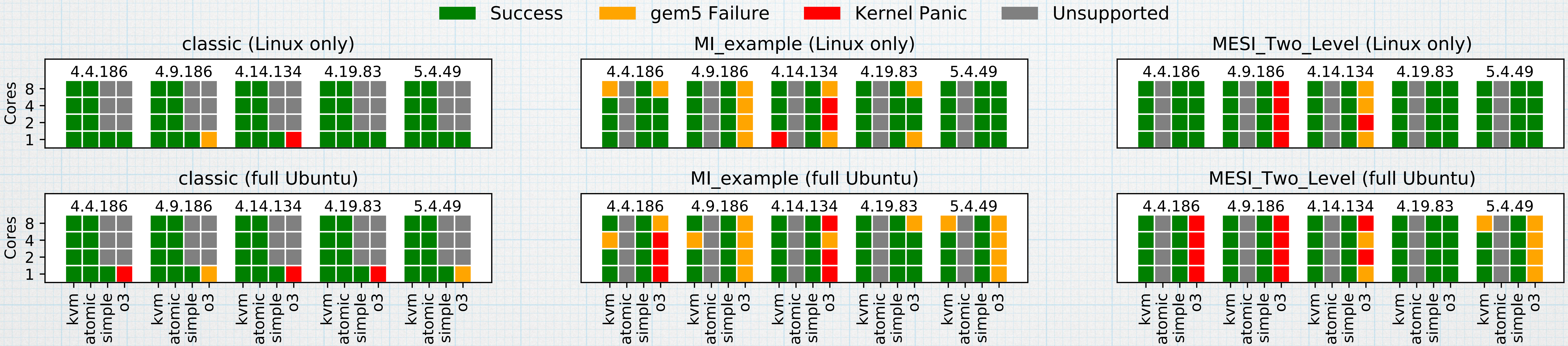

Thank you!

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Artifact: https://doi.org/10.6084/m9.figshare.14176802

Paper at: https://arch.cs.ucdavis.edu/assets/papers/ispass21-gem5art.pdf

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