BenchFlow

A Platform for End-to-end Automation of Performance Testing and Analysis

@SPEC RG DevOps

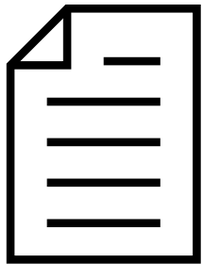
Università della Svizzera italiana

Facoltà di scienze informatiche

https://github.com/benchflow

Vincenzo Ferme, Cesare Pautasso

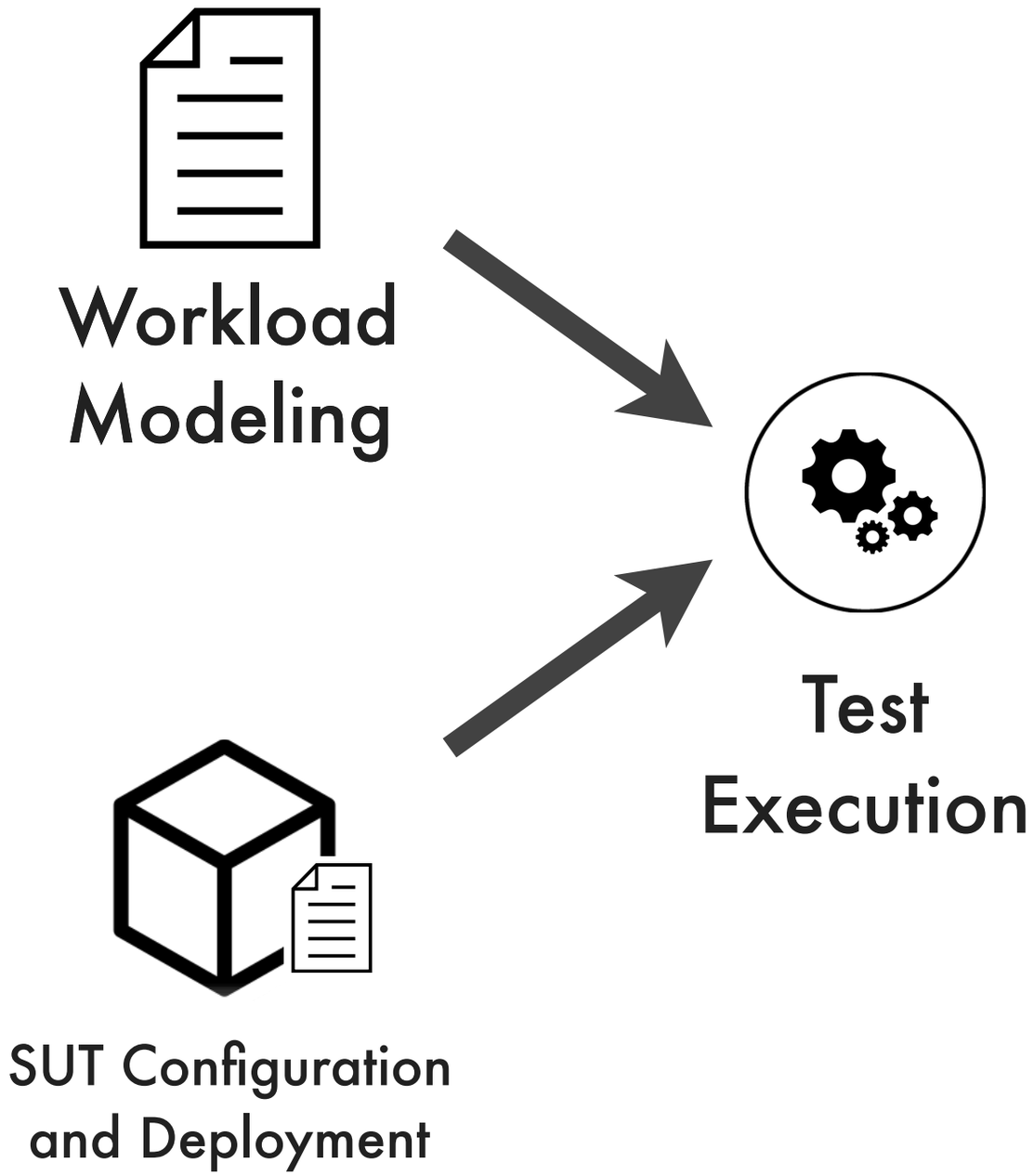
End-to-end (e2e) Performance Testing



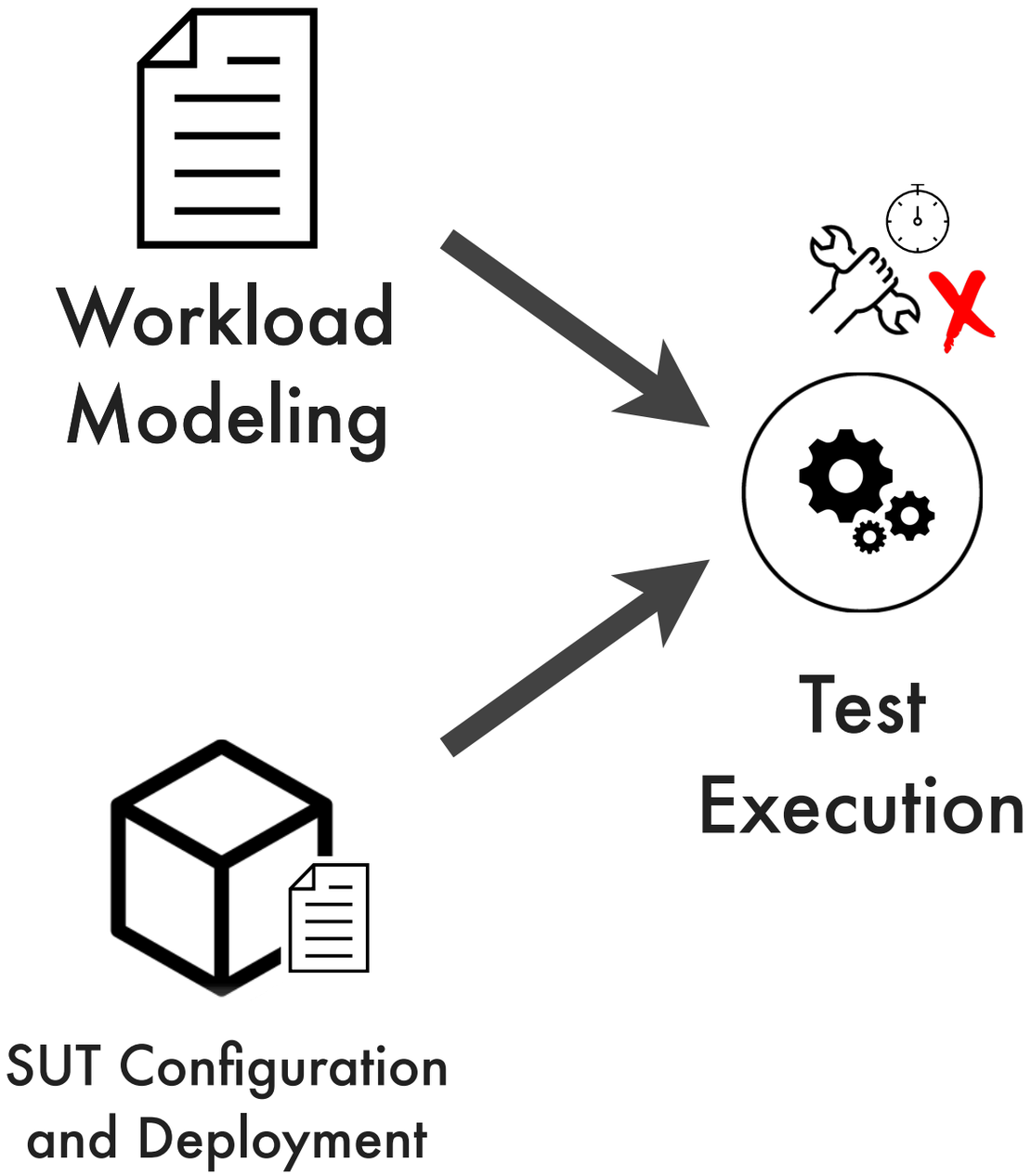
Workload Modeling

SUT Configuration and Deployment

End-to-end (e2e) Performance Testing



End-to-end (e2e) Performance Testing



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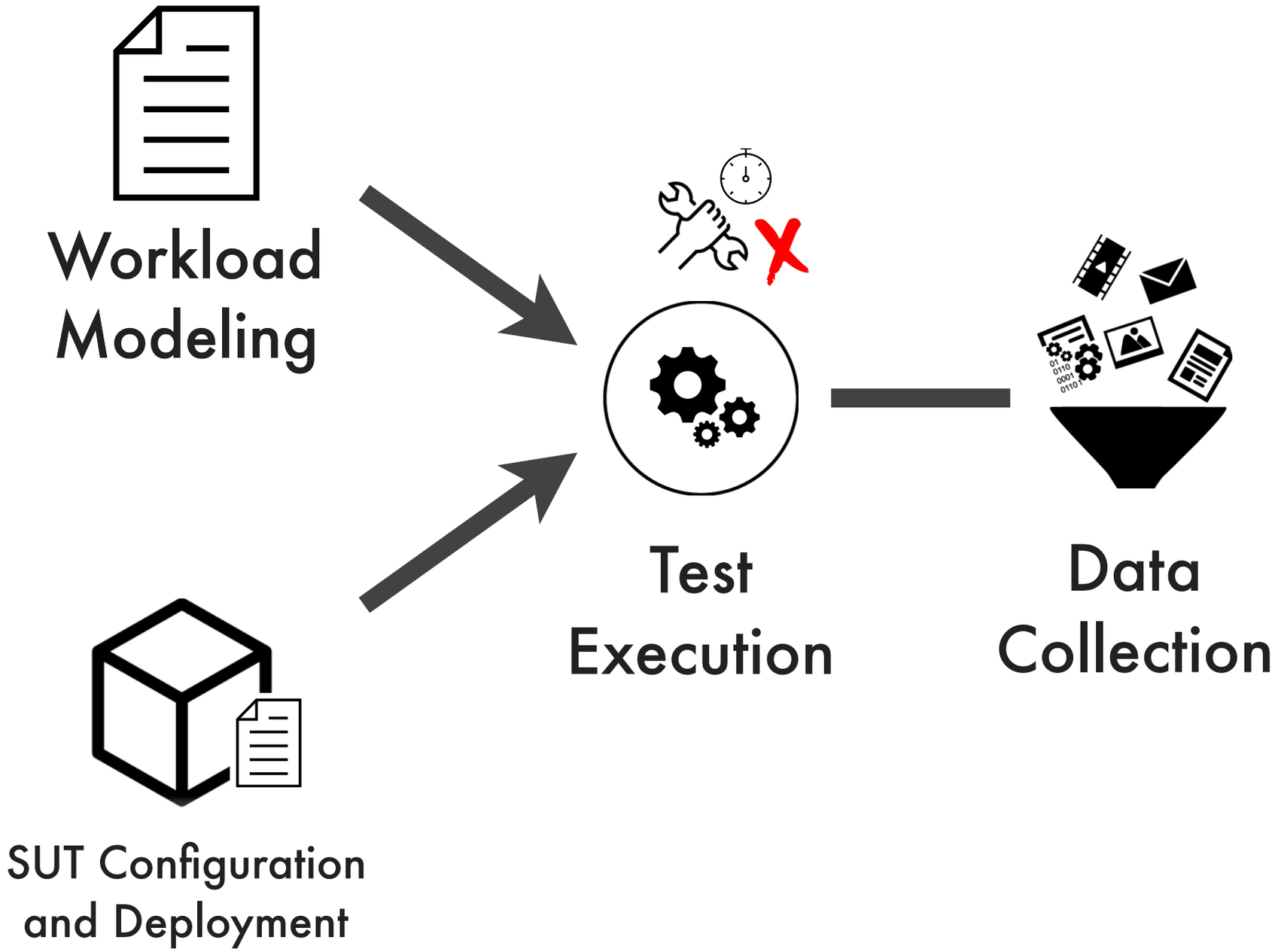

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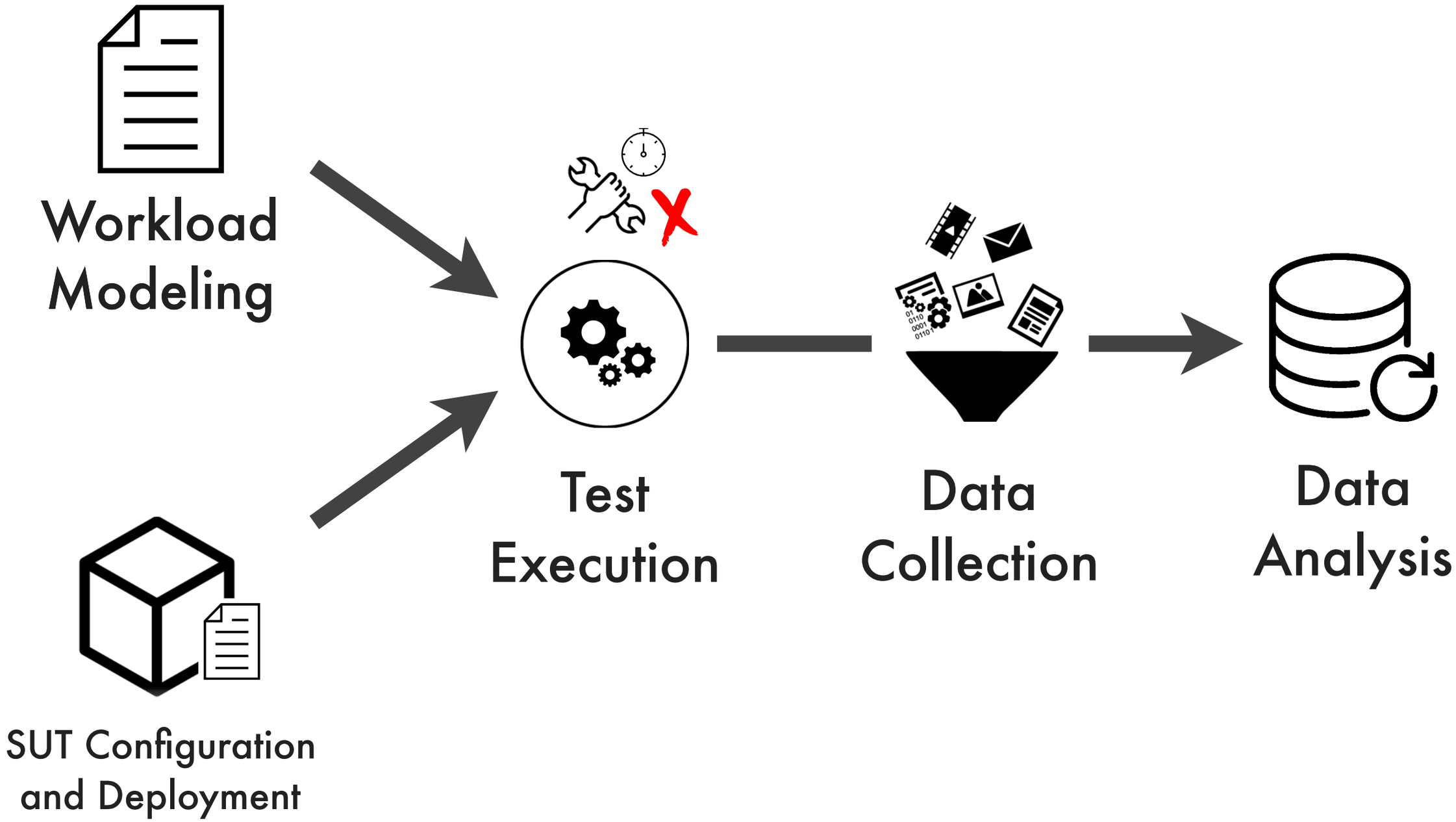

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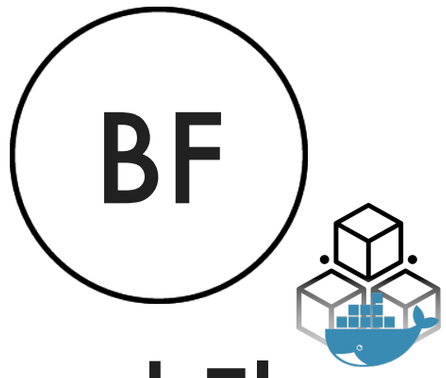
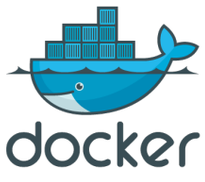
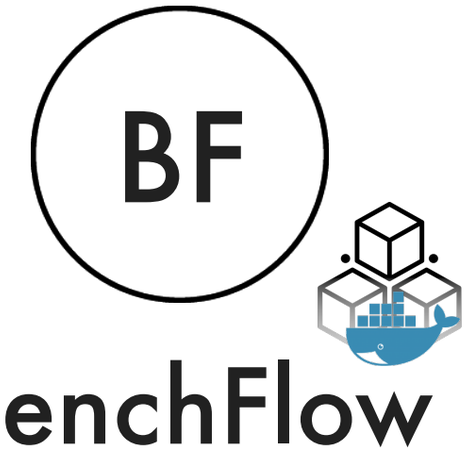
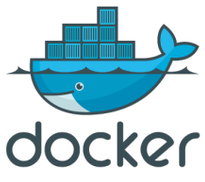




BenchFlow Overview

DSL





BenchFlow Overview

DSL

- Workload Modeling

BF

BenchFlow

Java

docker

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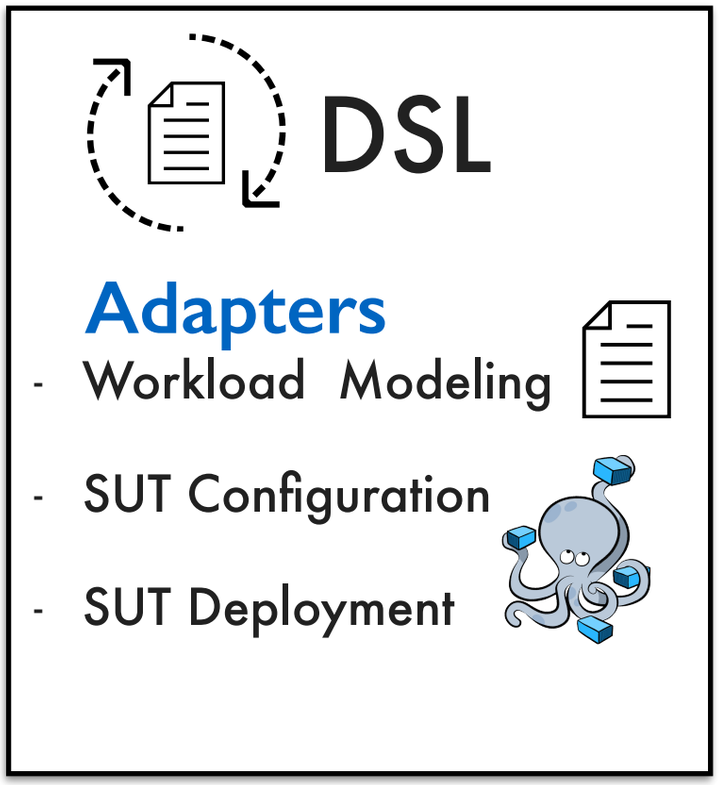

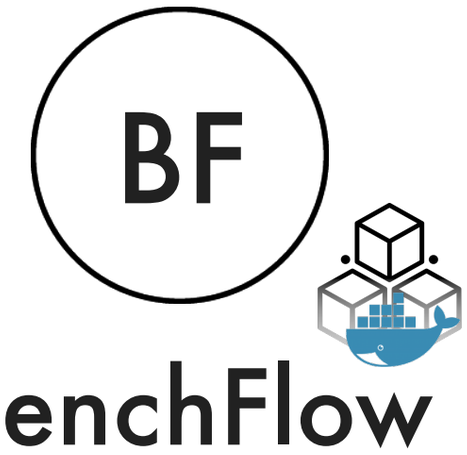

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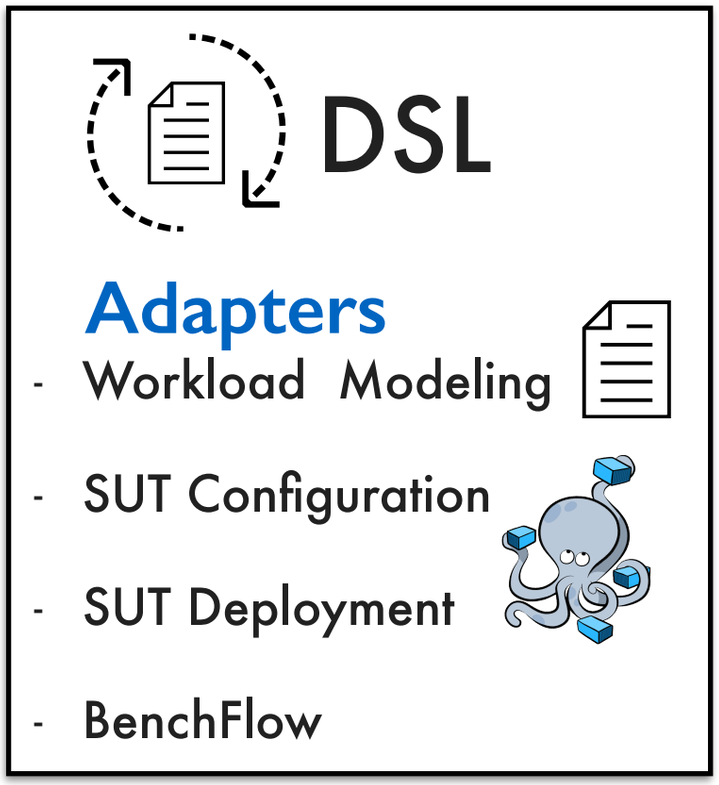

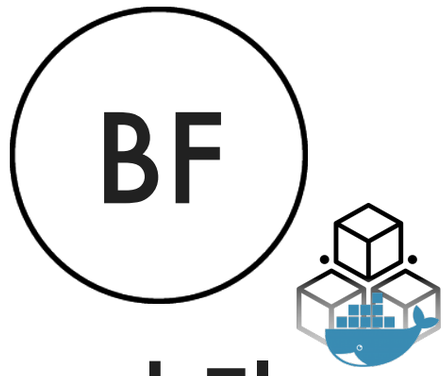

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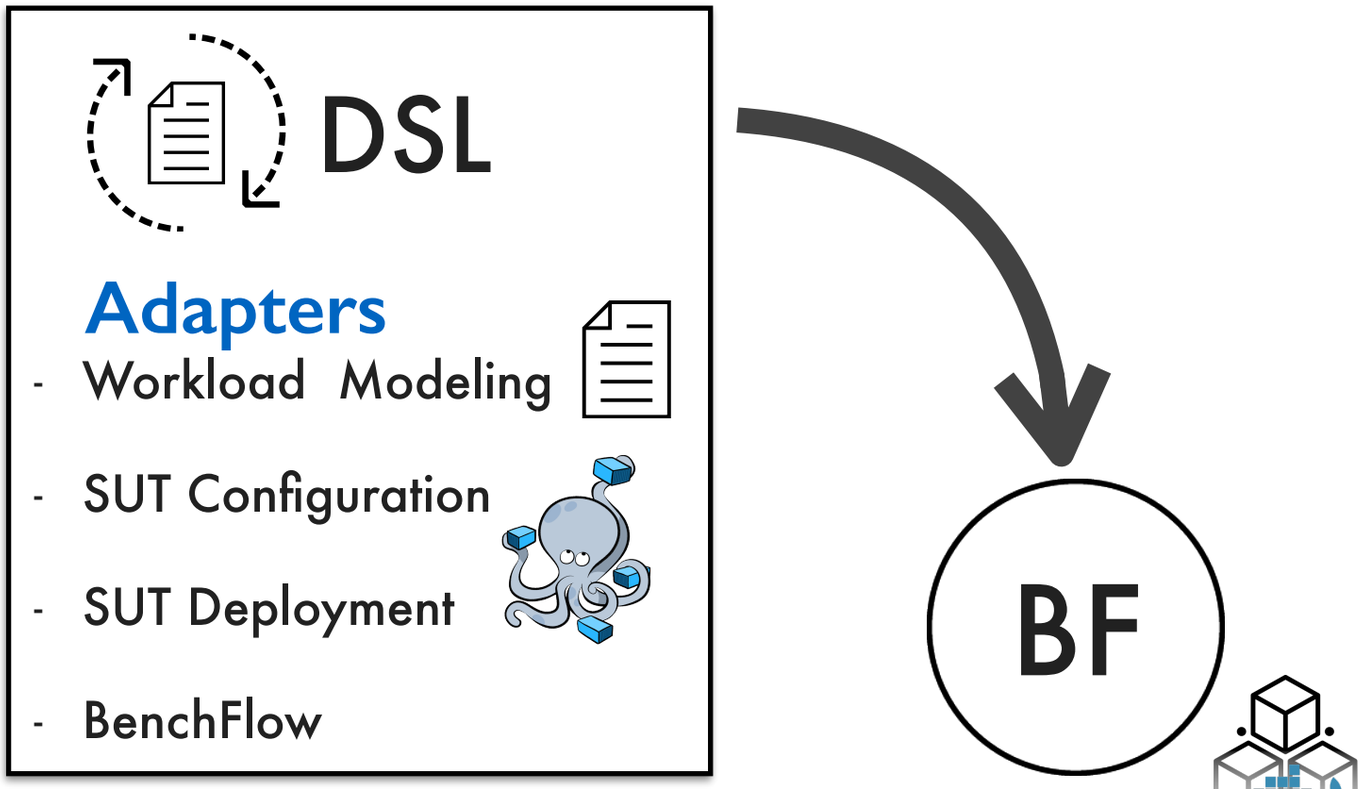

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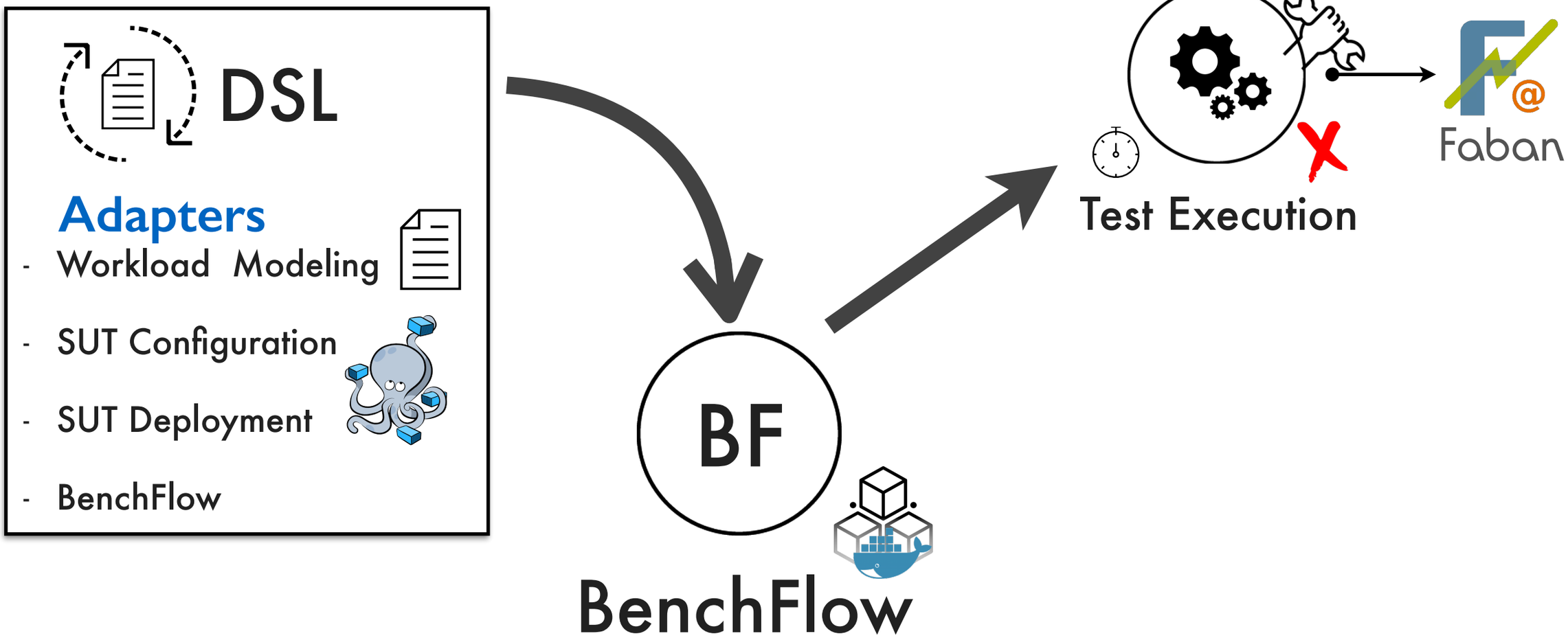

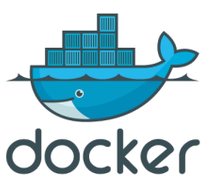

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DSL

Adapters

- Workload Modeling
- SUT Configuration
- SUT Deployment
- BenchFlow

BF

BenchFlow

Test Execution

Faban

Data Collection

Minio

Java

docker

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Data Analysis

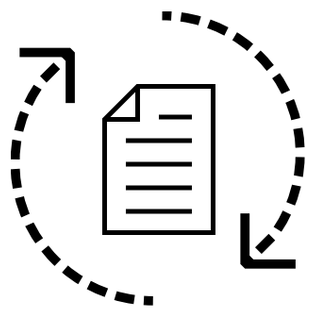
Spark

cassandra

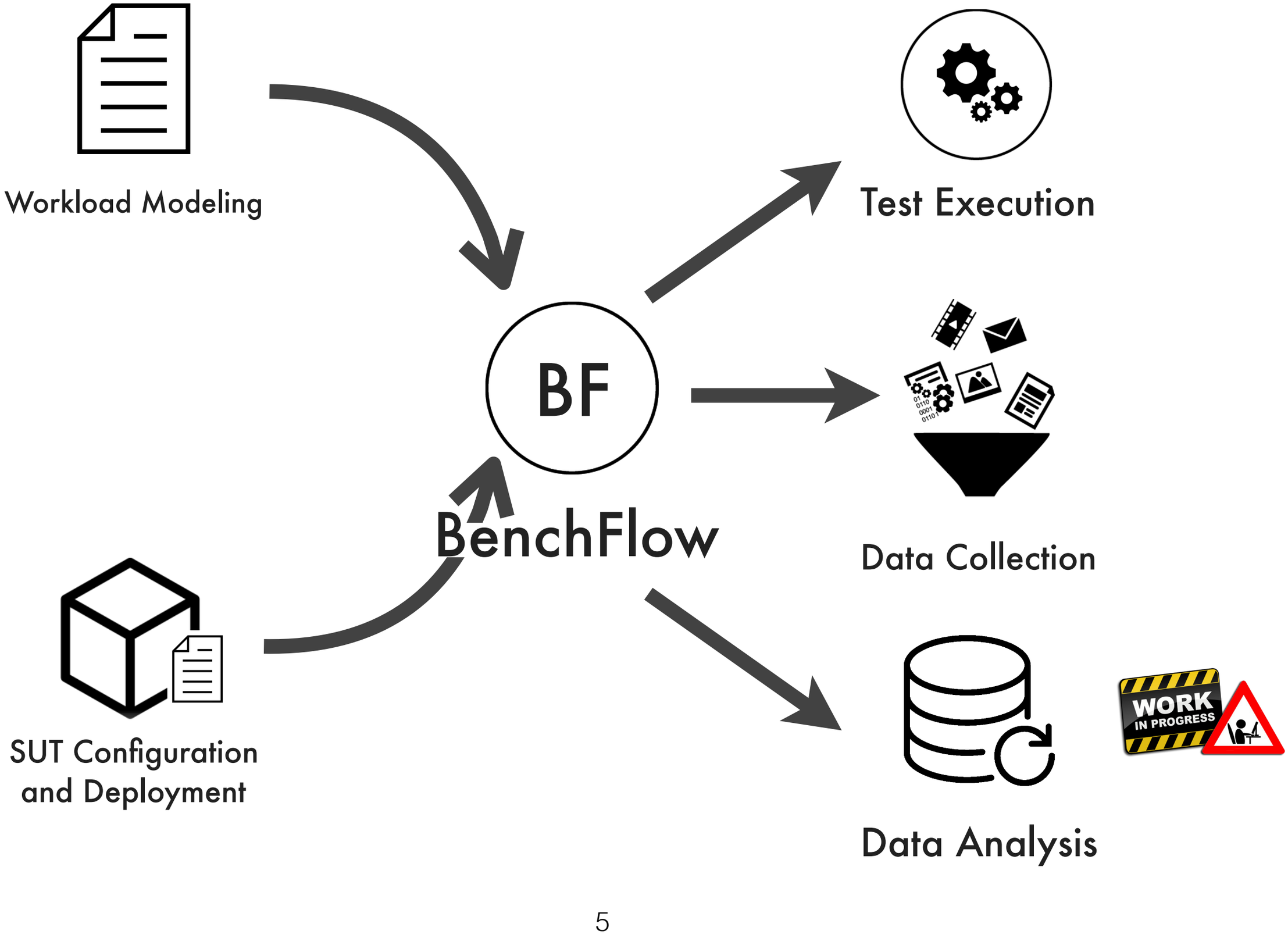
Java

docker

A Declarative DSL to Configure and Control the e2e Process



What is Possible to Configure?



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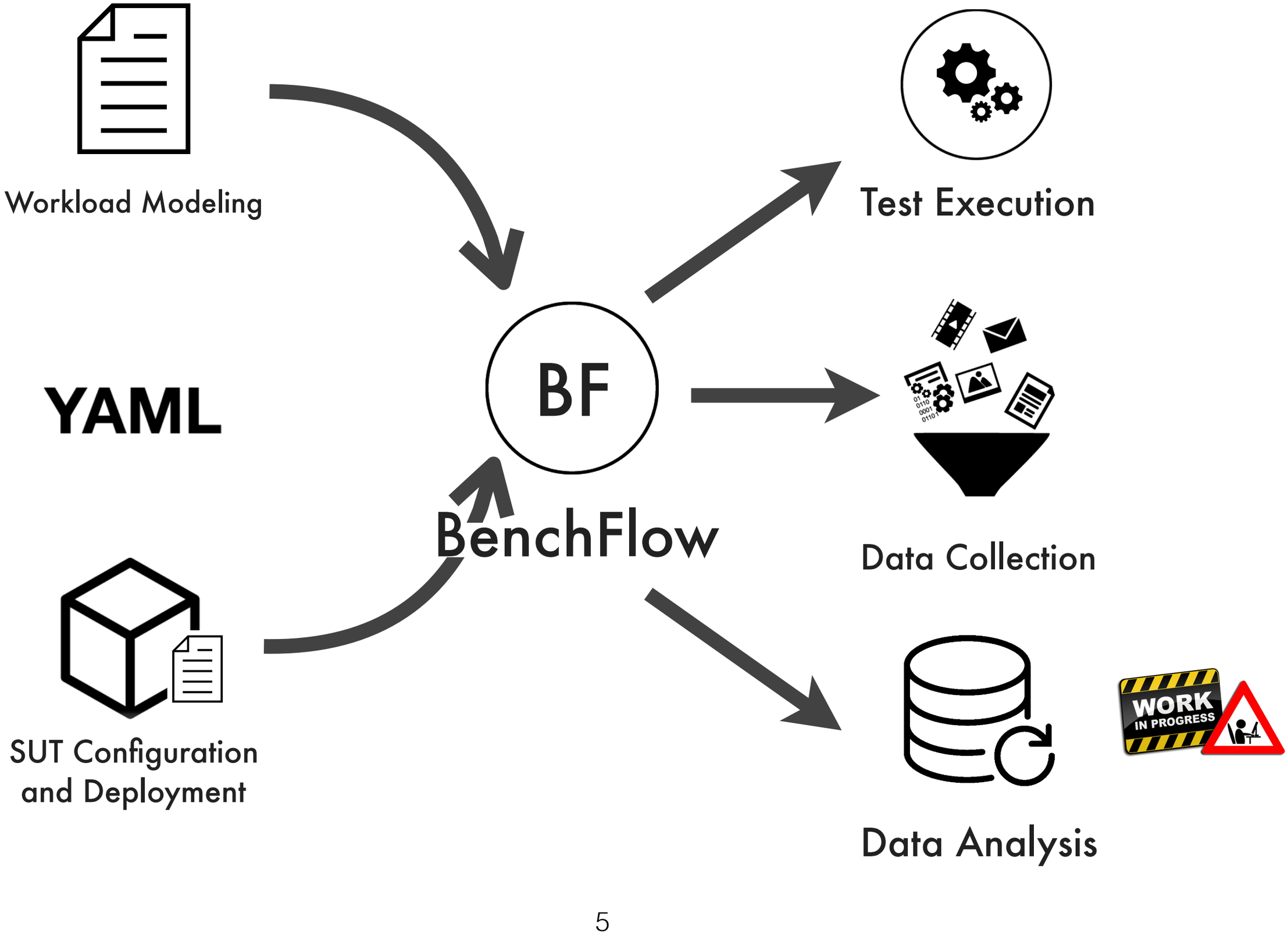

Workload Modeling

users: 1000

workload_execution:

ramp_up: 30s

steady_state: 10m

ramp_down: 30s

Workload Modeling

```
workload:
  name_of_the_workload:
    driver_type: "http"
    popularity: 100%
    inter_operation_timings: "uniform"
    operations:
      - ...
    mix:
      - ...
```

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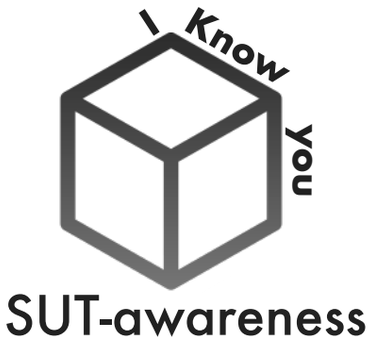

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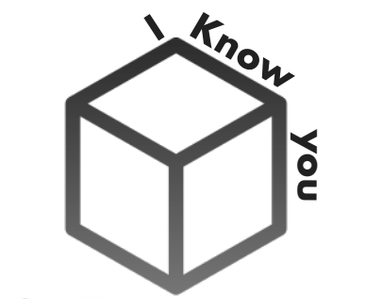


SUT-awareness

Faban

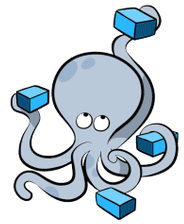
```
workload:
  { String : <name of the workload > }
    driver_type: { String : <"start","http"> }
    popularity: { [String] : <number + "%"> }
    inter_operation_timings: { String: <"negative-exponential", "uniform", "fixed-time"> }

    operations:
      - { String : <name of the .bpmn file with the process > }

    operations:
      { String : <Name of operation> }
        protocol: { String: <"http"> }
        endpoint: { String : <path of call> }
        method: { String : <"OPTIONS", "GET", "HEAD", "POST", "PUT", "DELETE", "TRACE", "CONNECT"> }
        headers:
          Accept: { String : <Media Type> }
          ...
        data: { String : <JSON object> }
        max90th_response_time: { Number : <max response time allowed for 90th percentile> }

    mix:
      fixed_sequence: { [String] : <name of operations in the wanted order> }
      flat: { [String] : <number + "%"> }
      # IF FlatSequenceMix
      flat: { [String] : <number + "%"> }
      sequences:
        - { [String] : <name of operations in the wanted order> }
        ...
      matrix:
        - { [String] : <number + "%"> }
        ...
      max_deviation: { String : <number + "%"> }
```

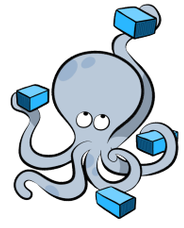
SUT Configuration and Deployment



```
services:
  service_a:
    image: 'service_a'
    environment:
      - DB_URL=jdbc:mysql://${BF_db_IP}:${BF_db_PORT}/${BF_db_MYSQL_DATABASE}
    network_mode: host
    ports:
      - 8080:8080

db:
  image: 'mysql:5.7.18'
  network_mode: host
  environment:
    - MYSQL_DATABASE="test_database"
  ports:
    - 3306:3306
```

SUT Configuration and Deployment

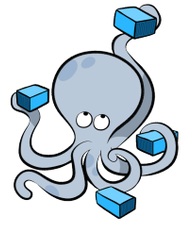


```
sut:
  name: example_name
  version: 1.0.0
  type: "http"

  configuration:
target_service:
  name: service_a
  endpoint: /
  sut_ready_log_check: "Started in (.*)"

deployment:
  service_a: server_1
  db: server_2
```

SUT Configuration and Deployment



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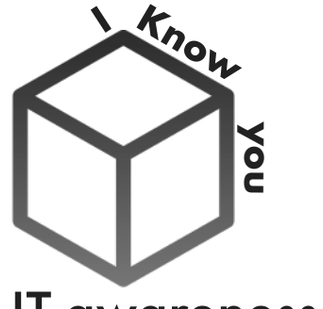
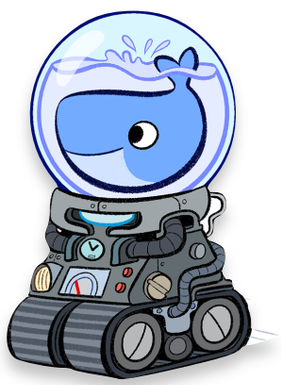


SUT-awareness

SUT Configuration and Deployment

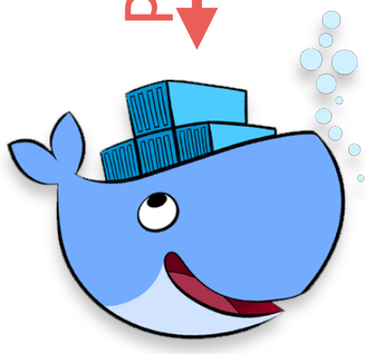
```
sut:
  ...
  service_a:
    resources:
      - memory: 1GB
      - cores: 1
    ...
environment:
  ...
```

SUT Configuration and Deployment



Docker Machine

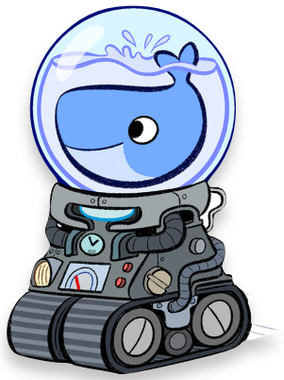
provides



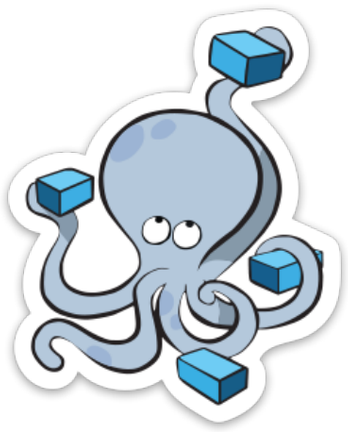
Docker Engine

Containers

SUT Configuration and Deployment



Docker Machine

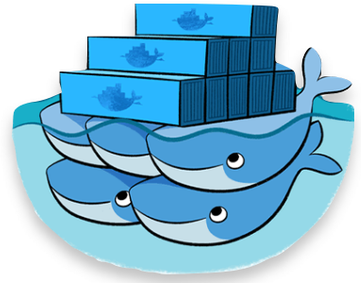


Docker Compose

SUT's Deployment Conf.

deploys

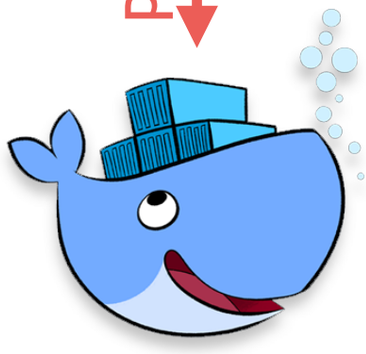
provides



Docker Swarm

Servers

manages



Docker Engine

Containers

BenchFlow and Test Execution

termination_criteria:

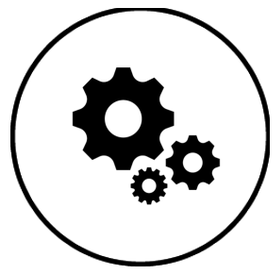
test:

max_time = 1h

...

...

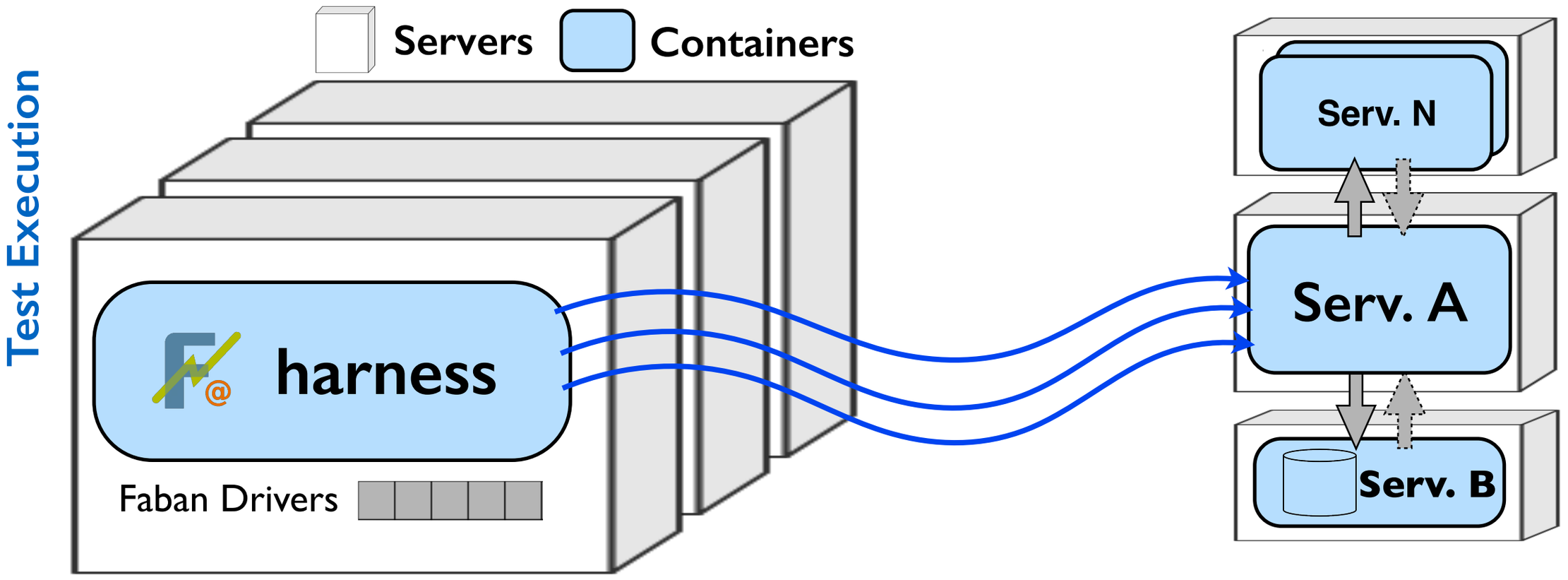
...



Data Collection

```
data_collection:
  client_side:
    faban:
      ...
      interval: 1s
      ...
server_side:
  service_a: logs
  db:
    mysql:
      environment:
        SETTING_A : example_setting
        ...
```

Server-side Data and Metrics Collection



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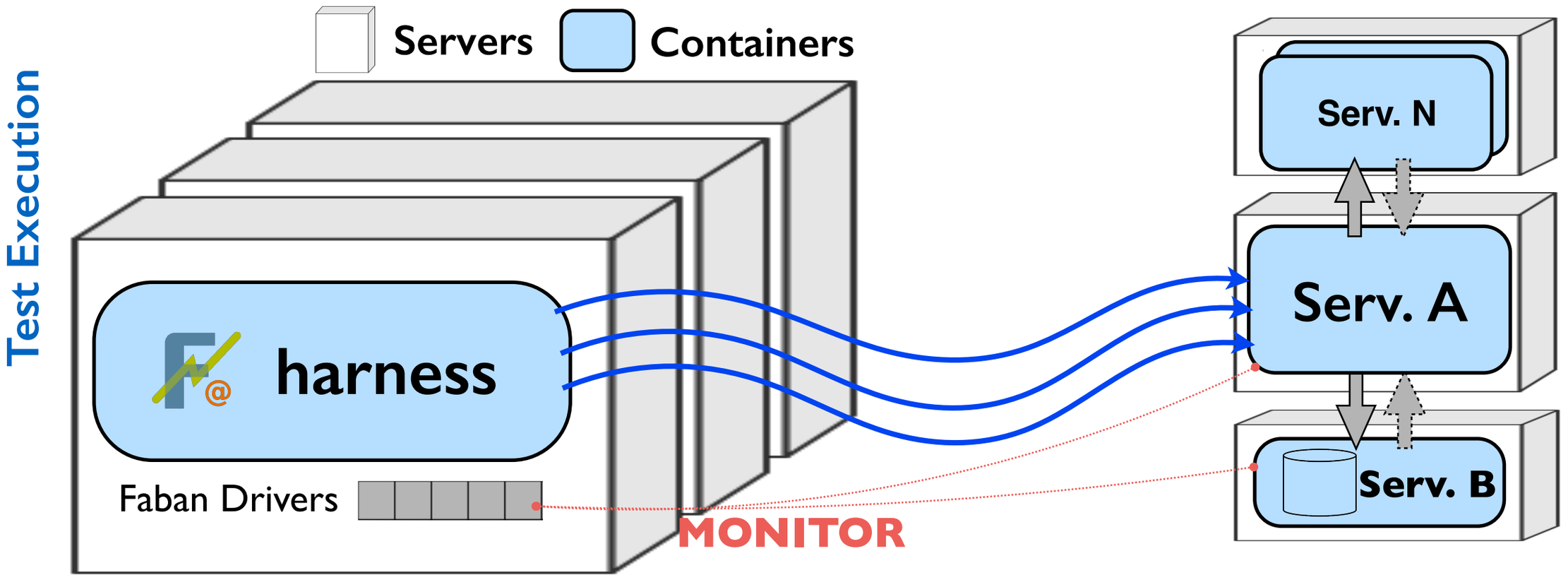

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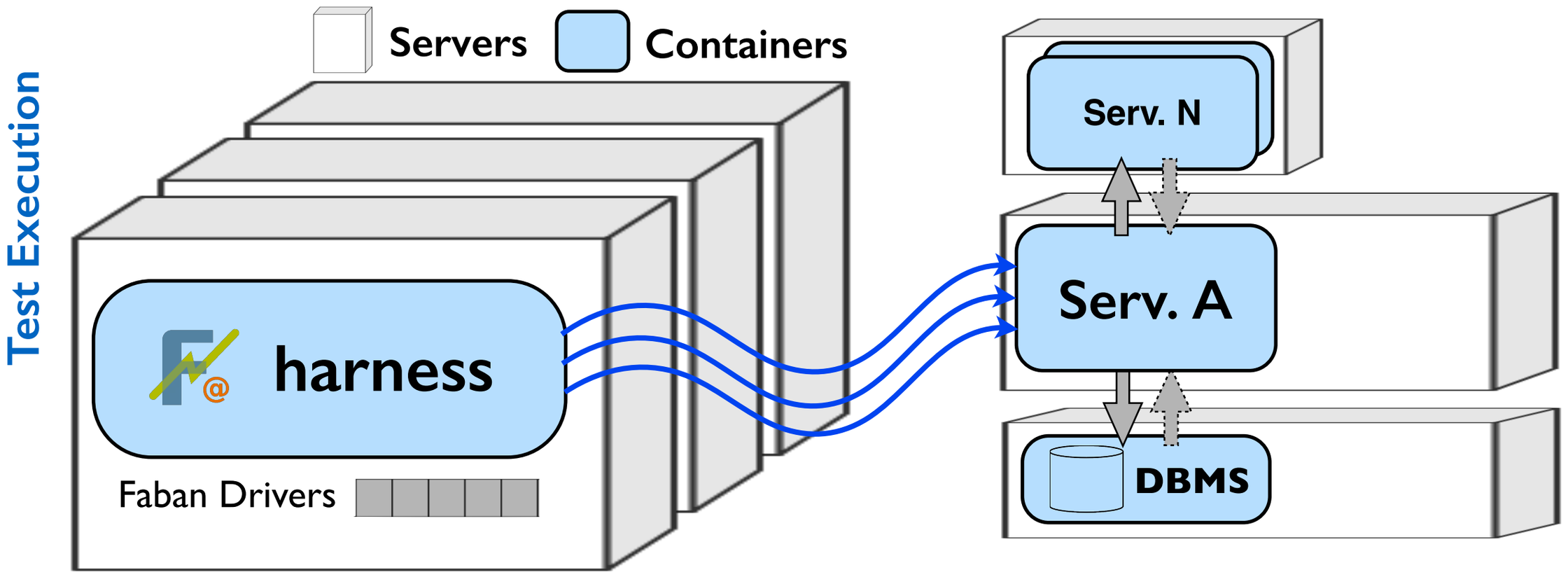

Monitors' Characteristics:

- RESTful services
- Lightweight (written in Go)
- Can embed any existing tool

Examples of Monitors:

- CPU usage
- Database state

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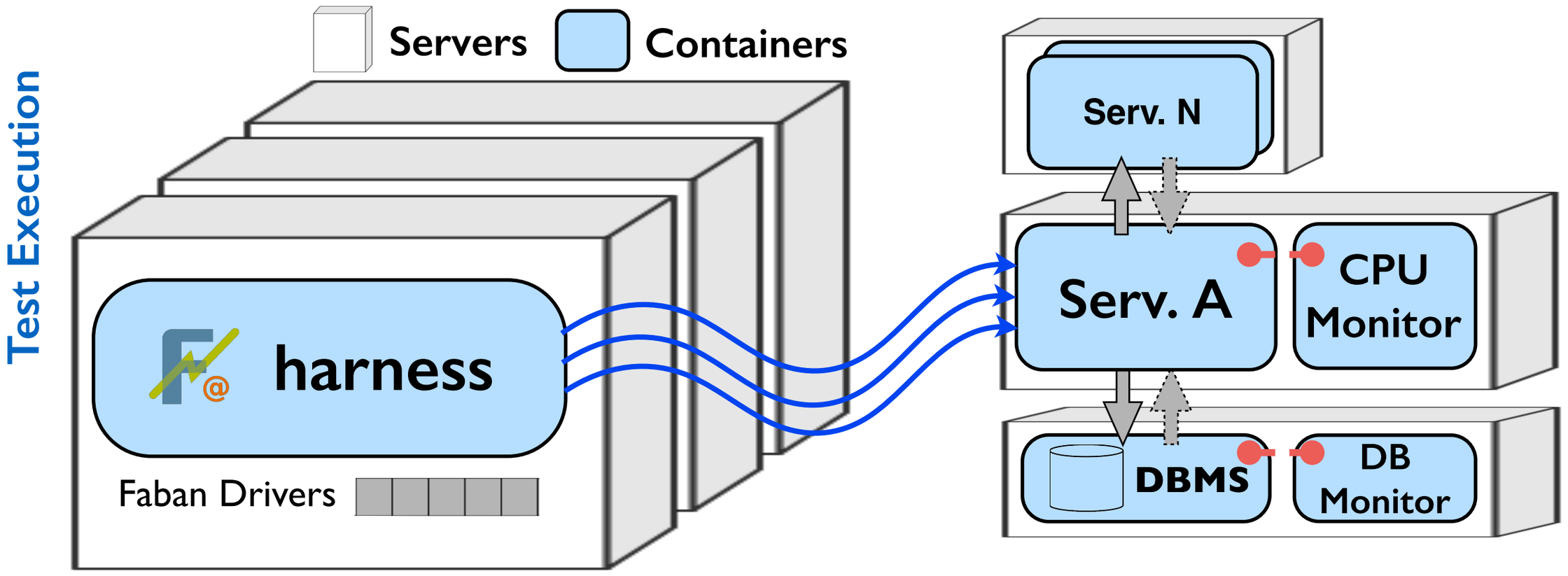

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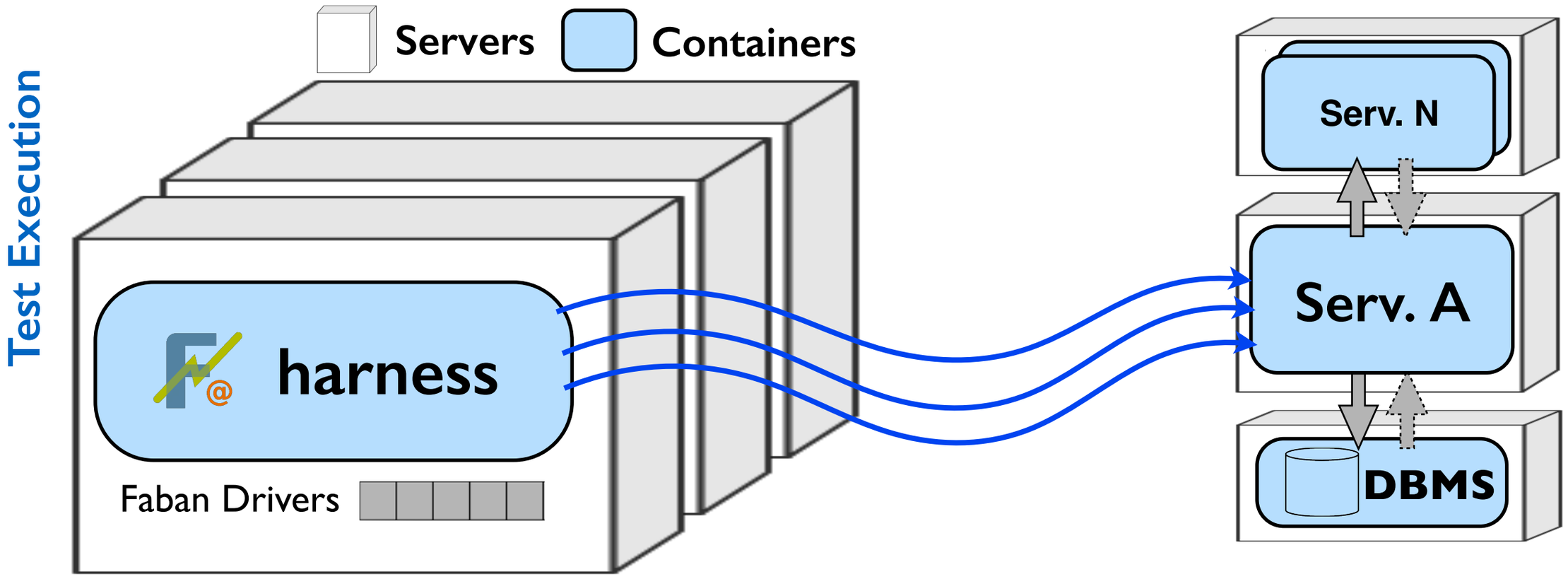

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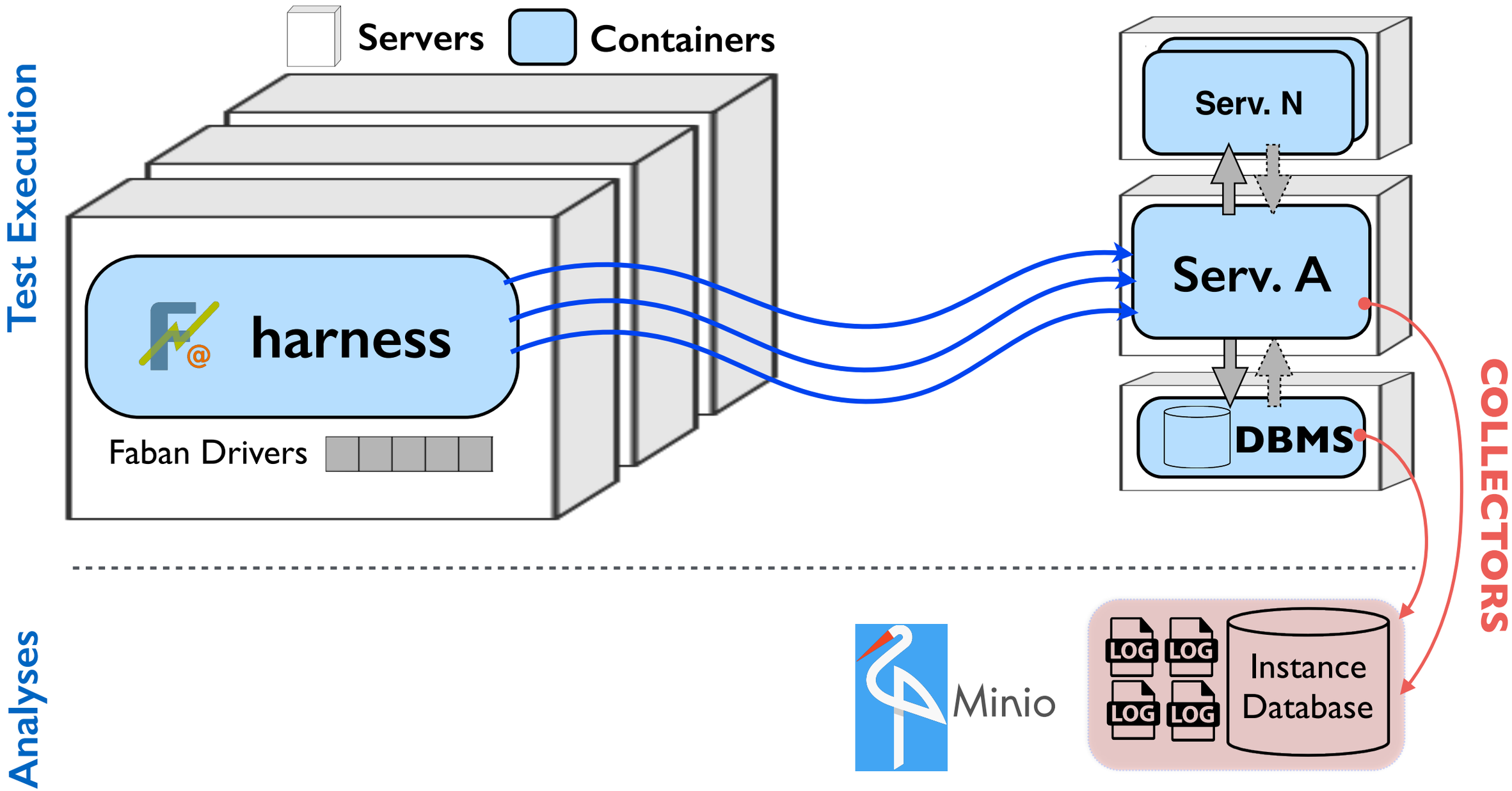

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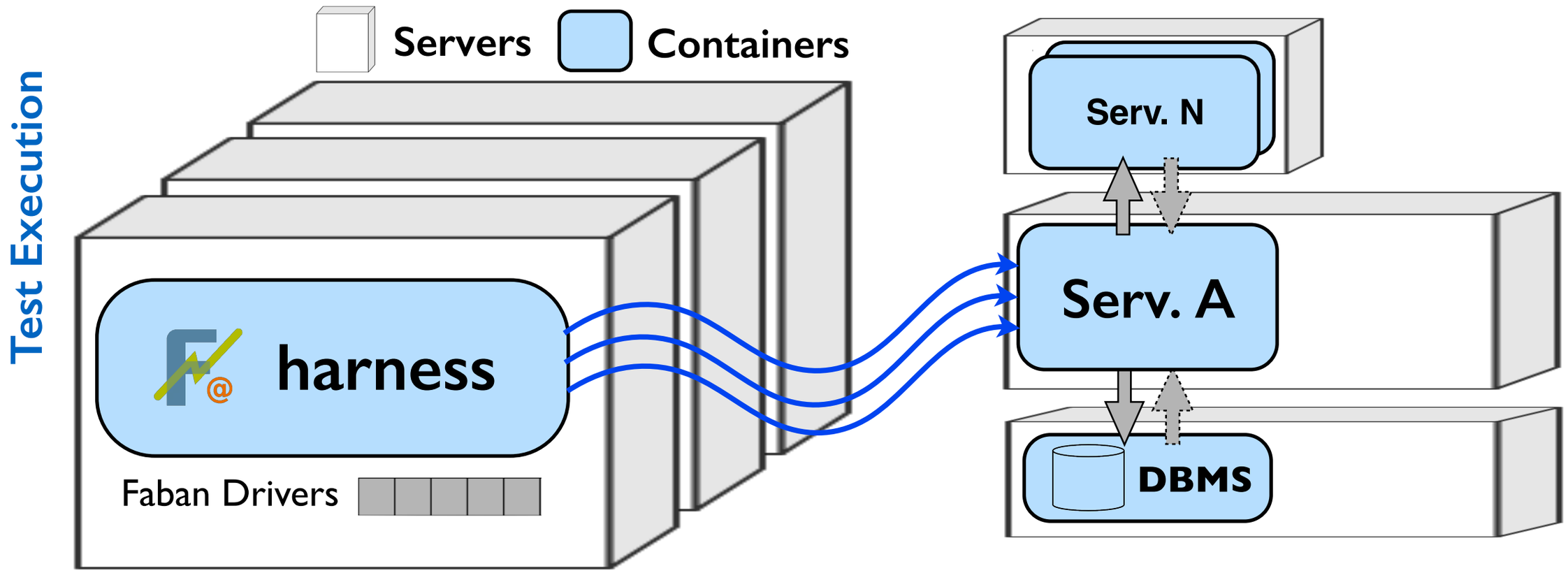

Collectors' Characteristics:

- RESTful services
- Lightweight (written in Go)
- Two types: online and offline
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- Buffer data locally

Examples of Collectors:

- Container's Stats (e.g., CPU usage)
- Database dump
- Applications Logs

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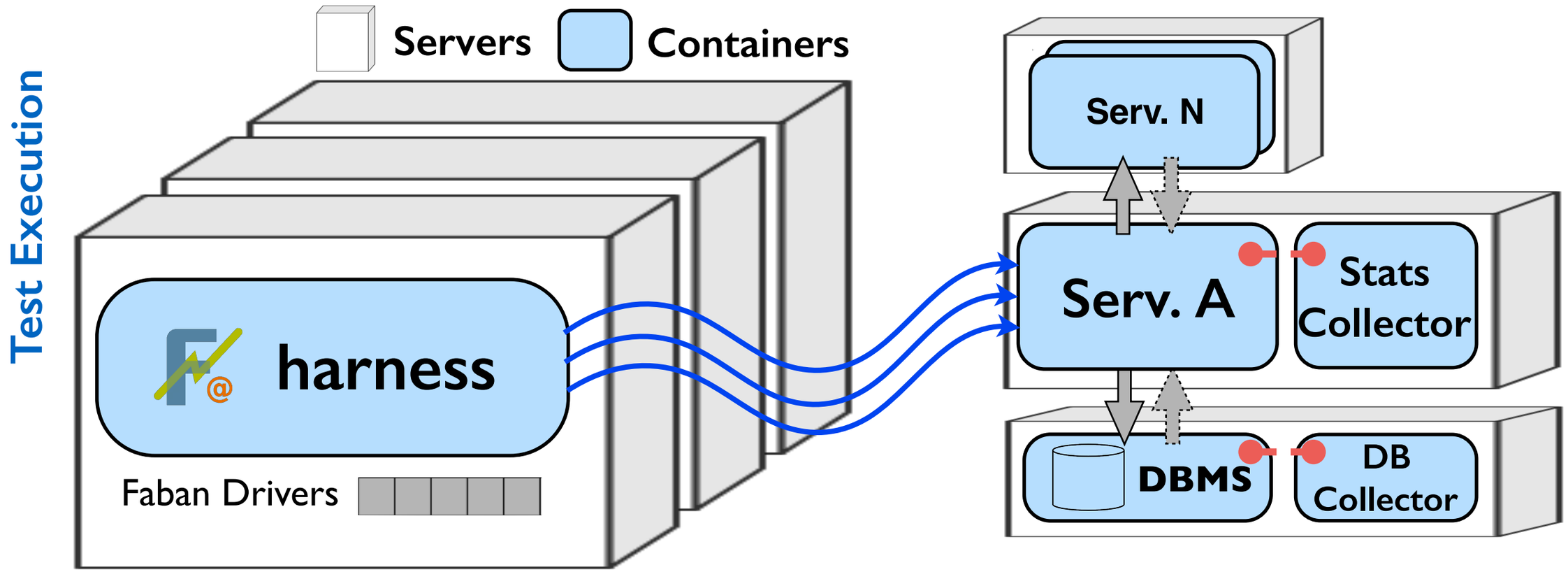

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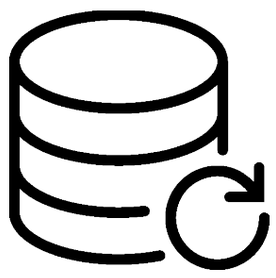
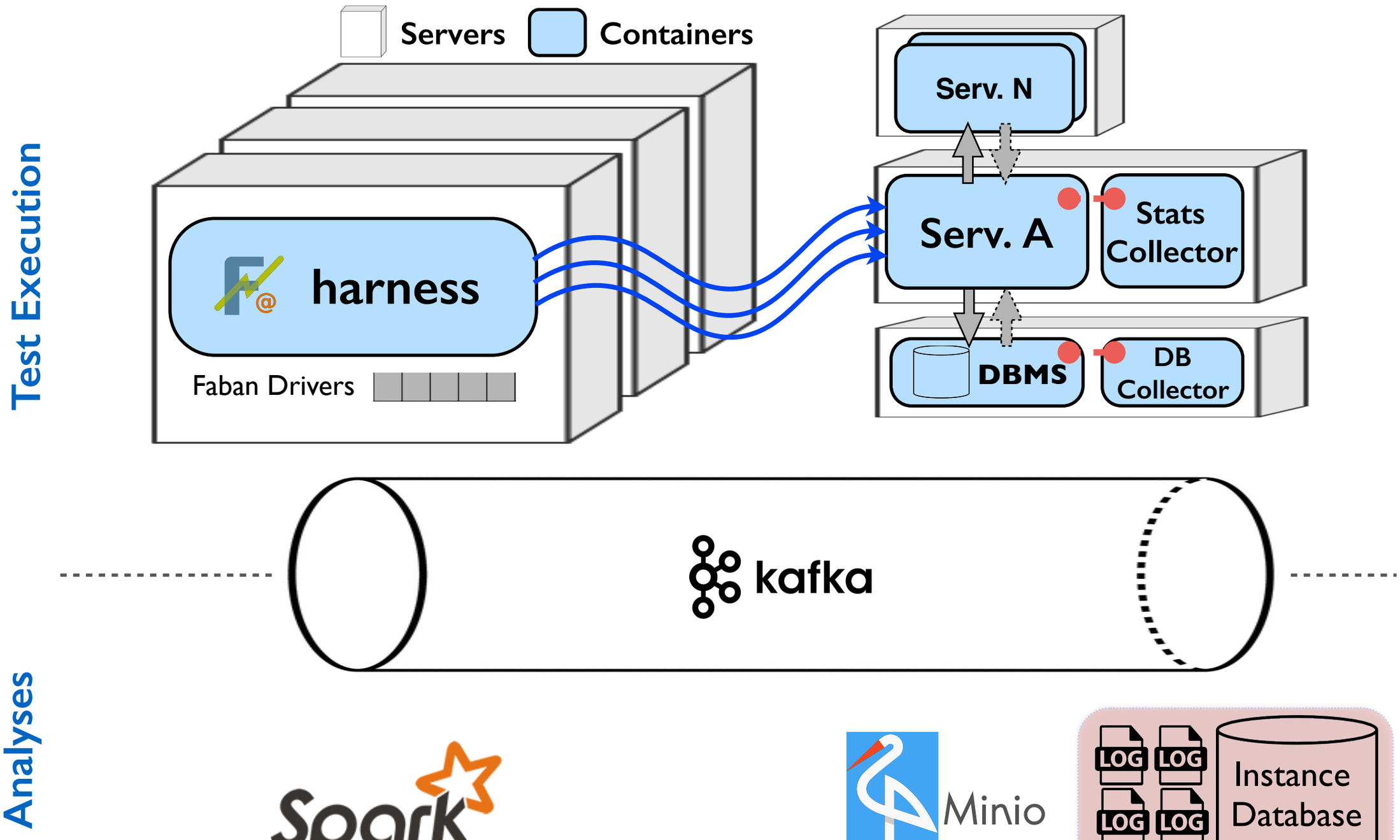
Data Analysis

1. Analysis to Perform
2. Metrics to Compute
3. Settings for the Analysis Logic



Data Analysis in BenchFlow



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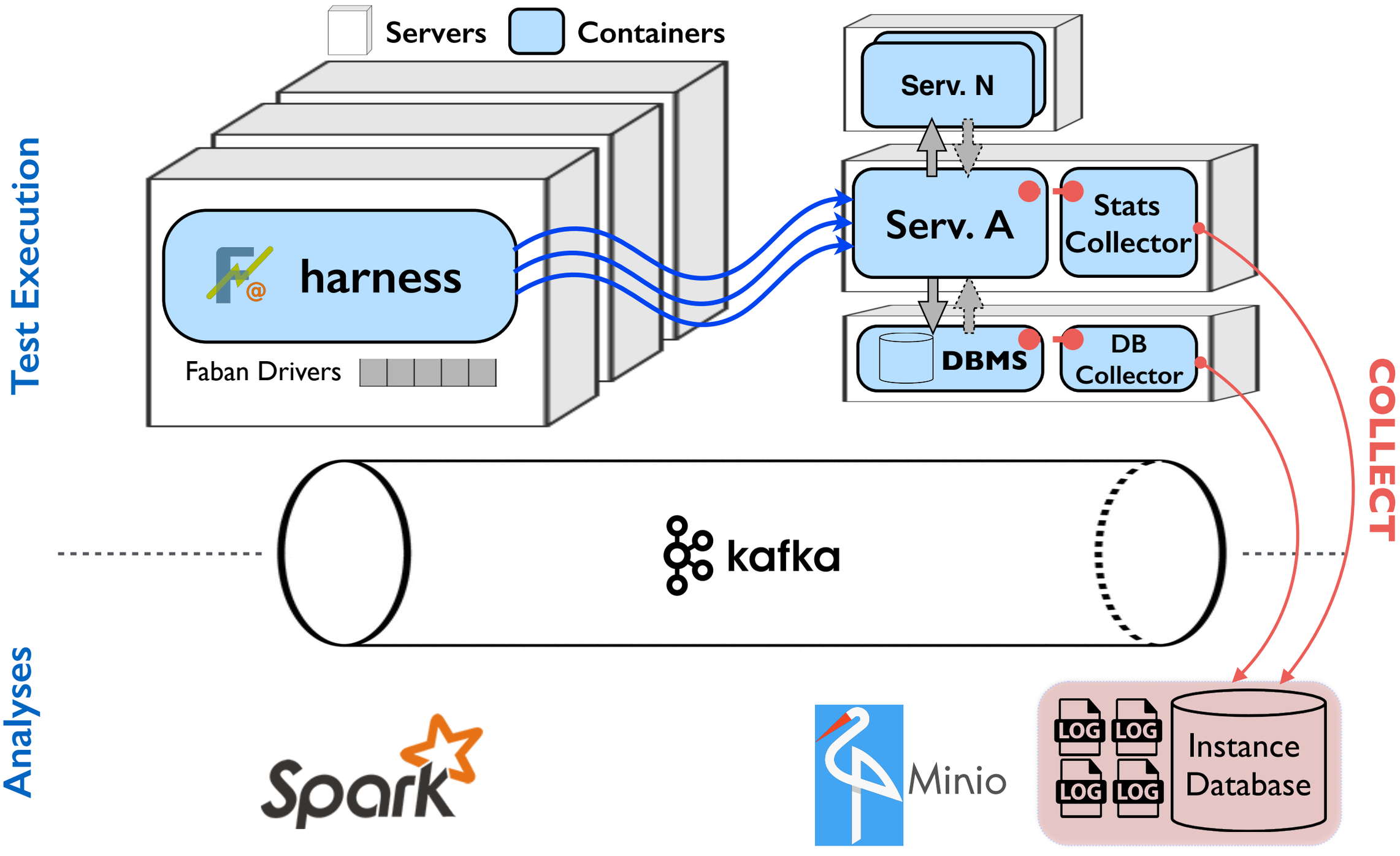

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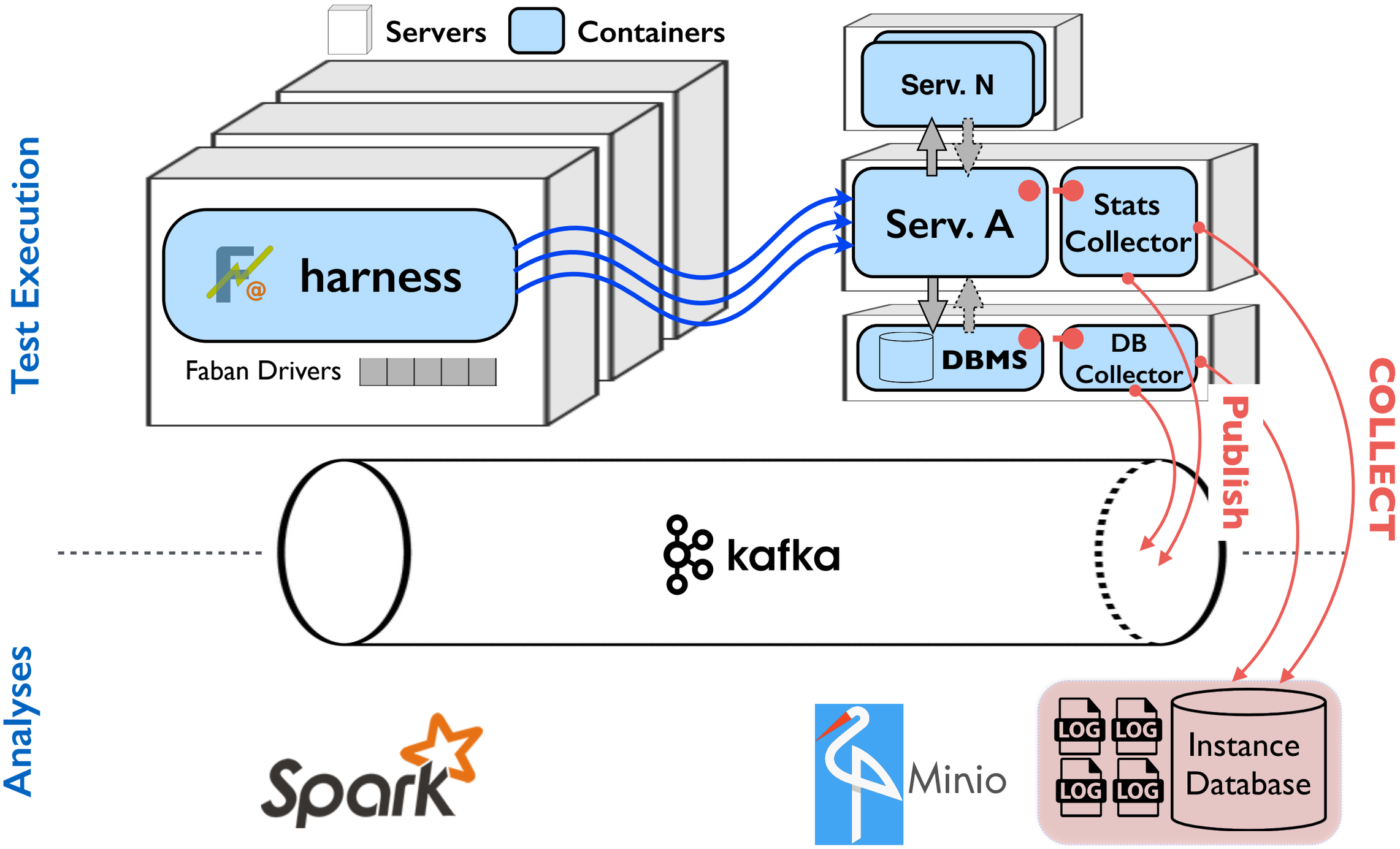

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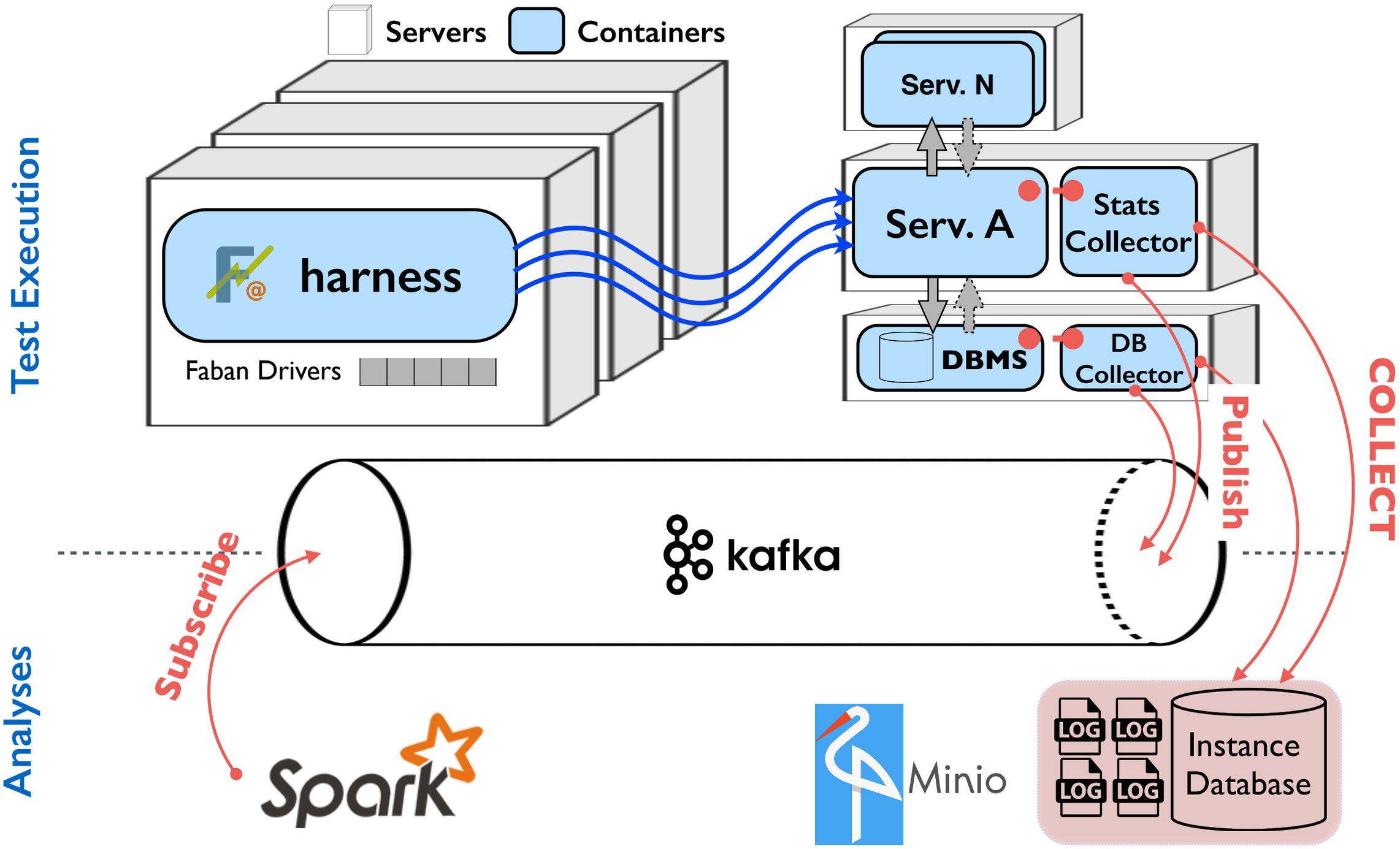
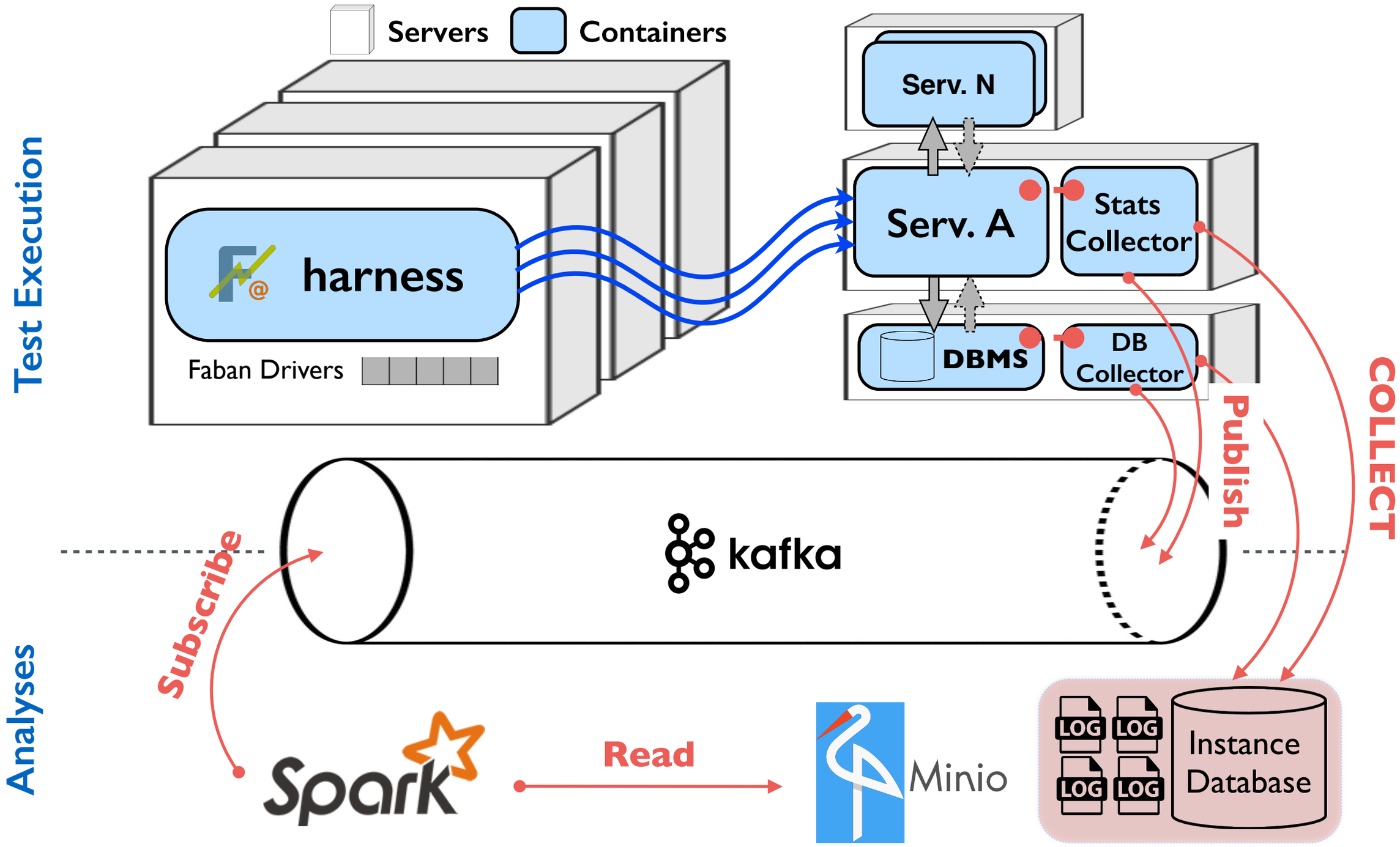


Data Analysis in BenchFlow



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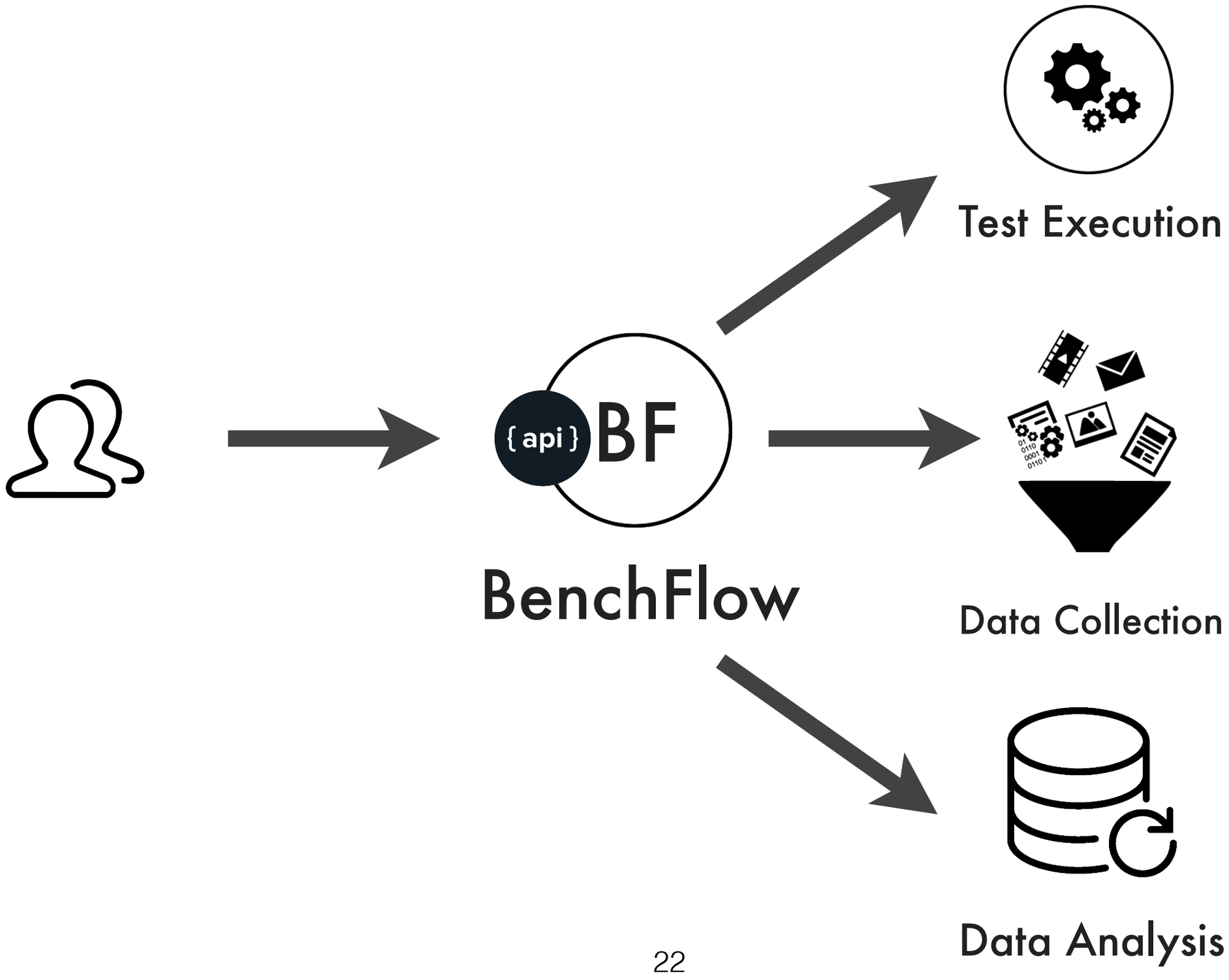
   - Descriptive Statistics (max, min, avg, ci, …), Little's Law, Covariance, Coefficient of Variation, …

BenchFlow Today



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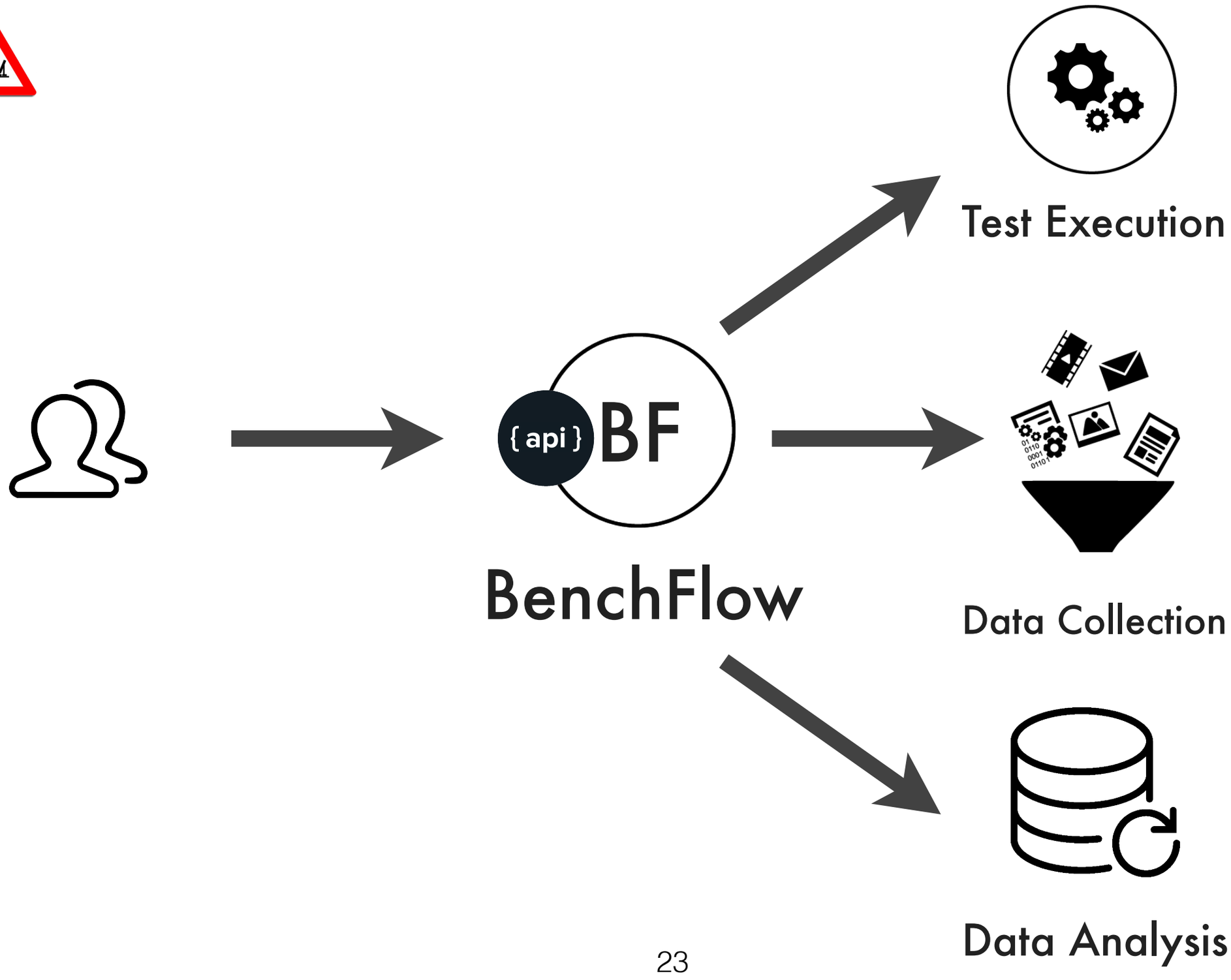

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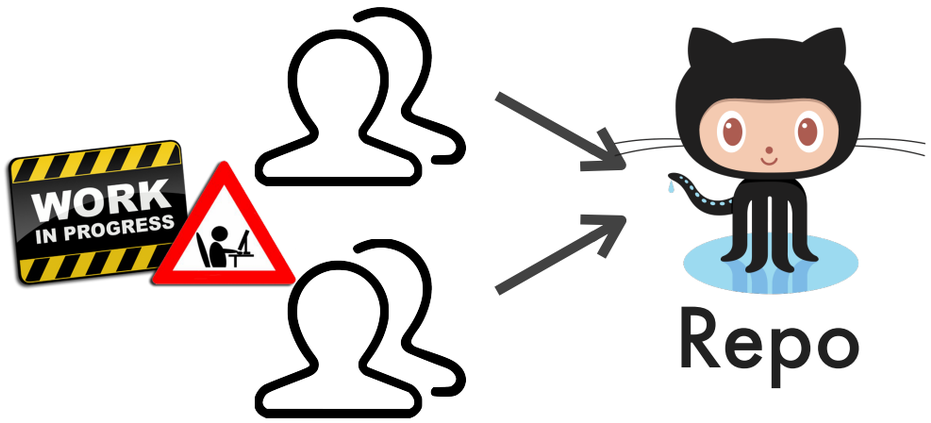
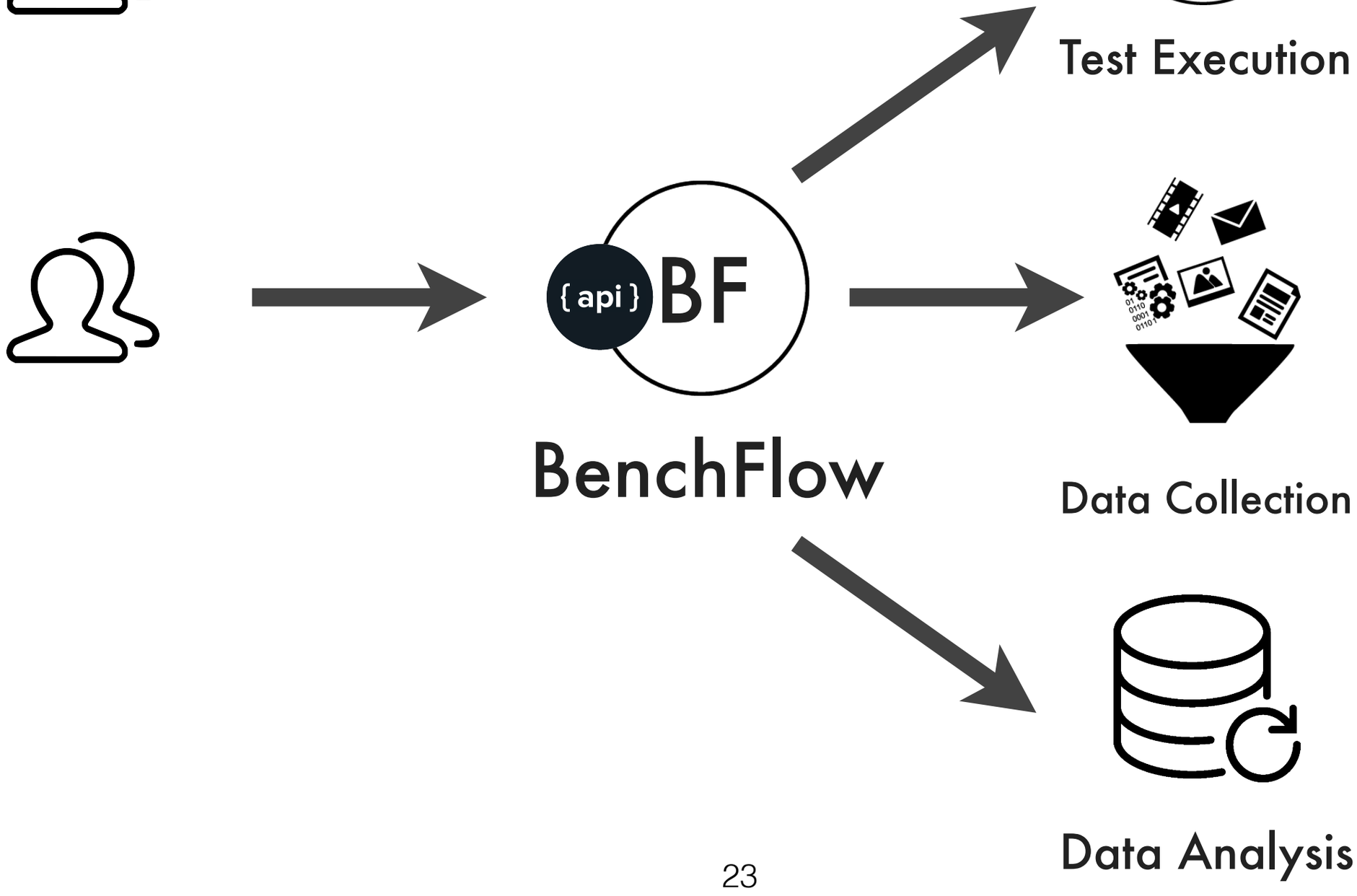


Repo



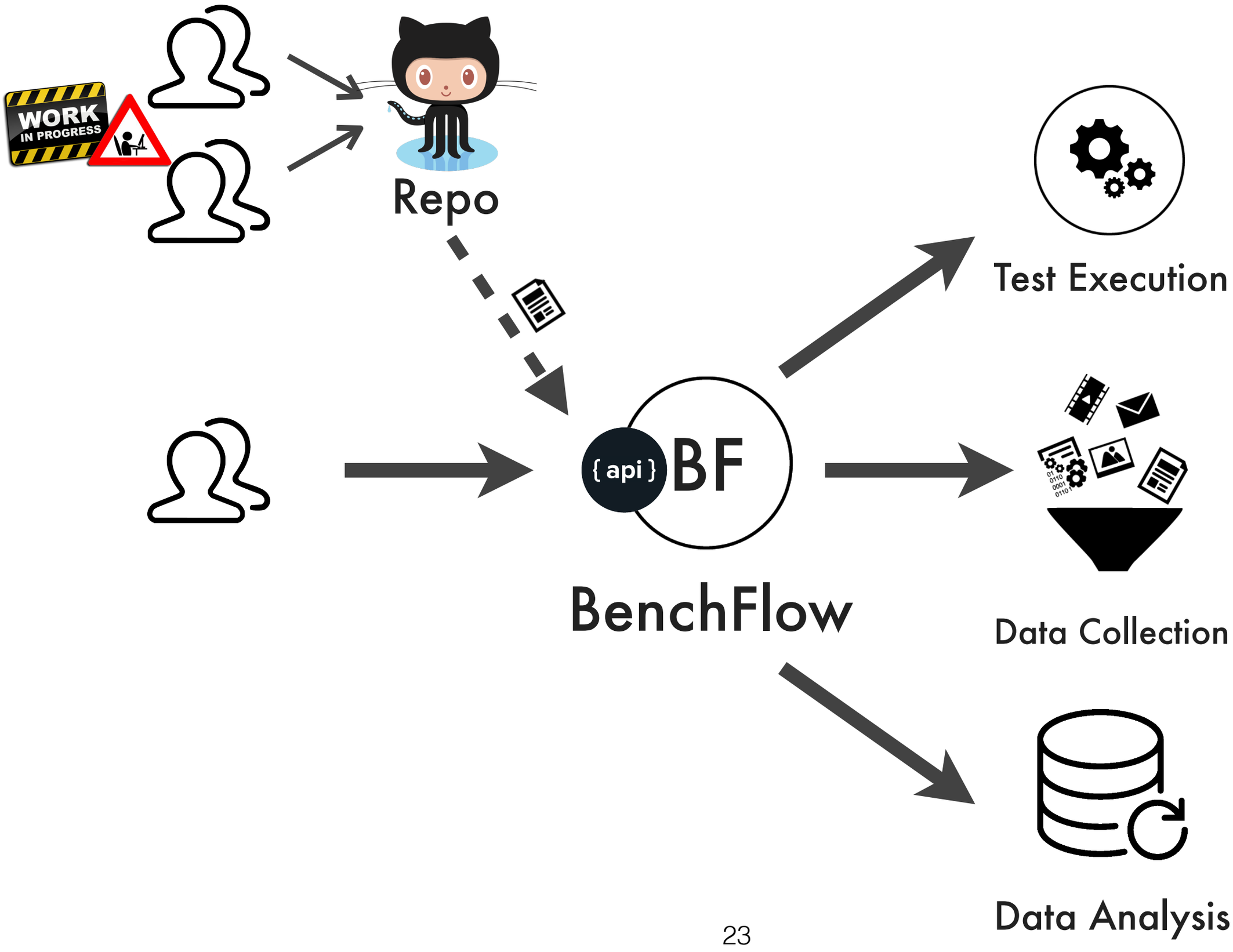
BenchFlow

Test Execution

Data Collection

Data Analysis

BenchFlow in DevOps



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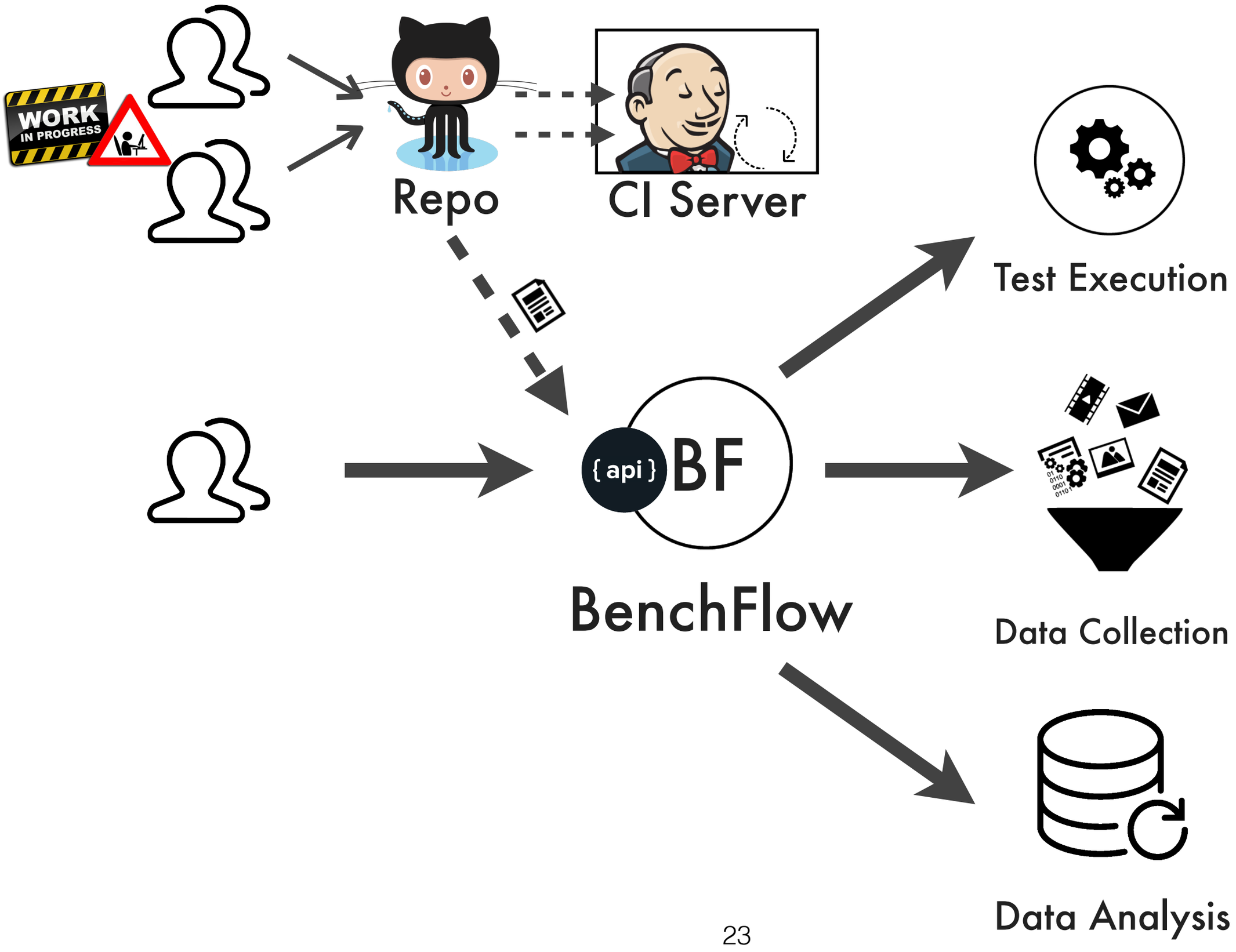

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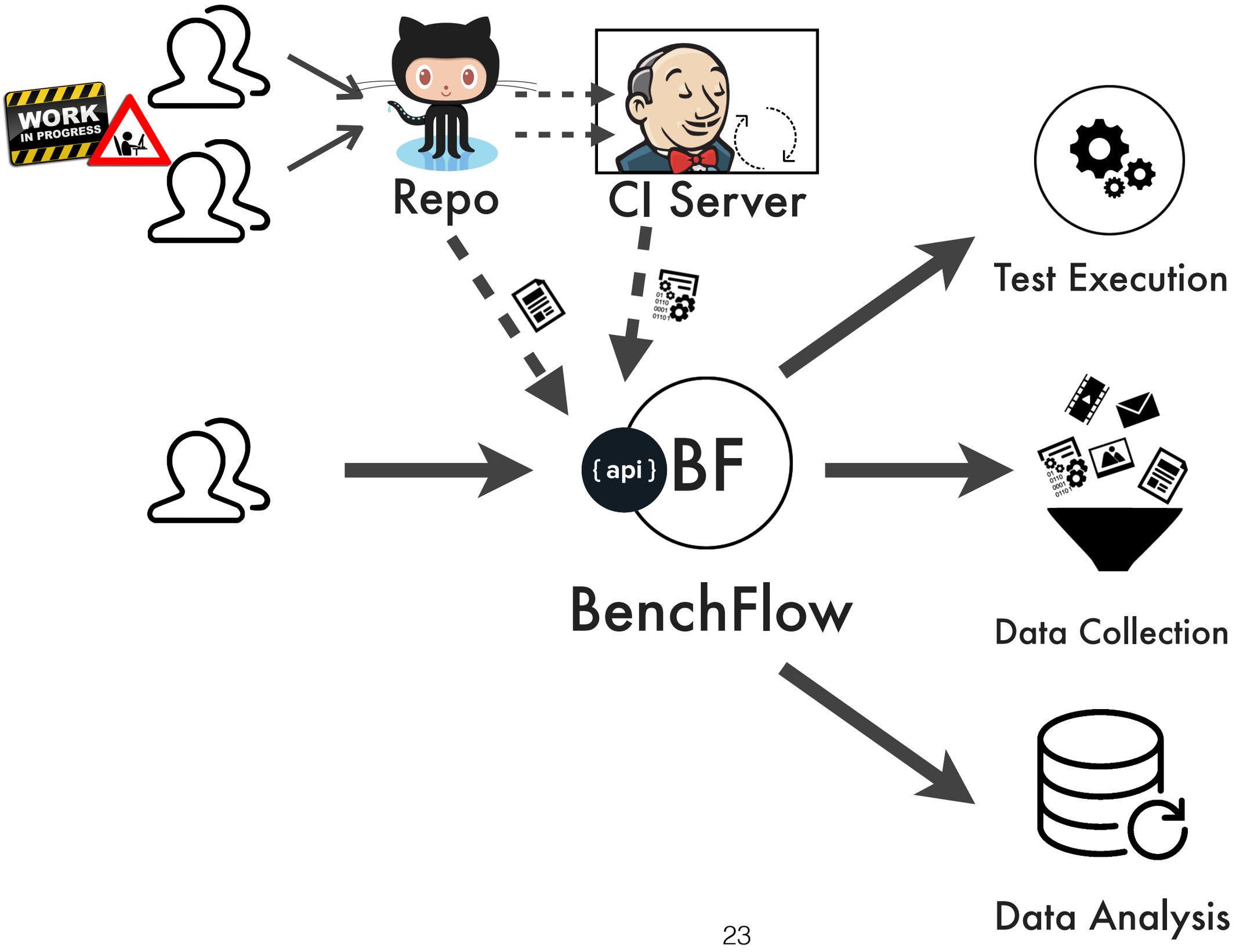

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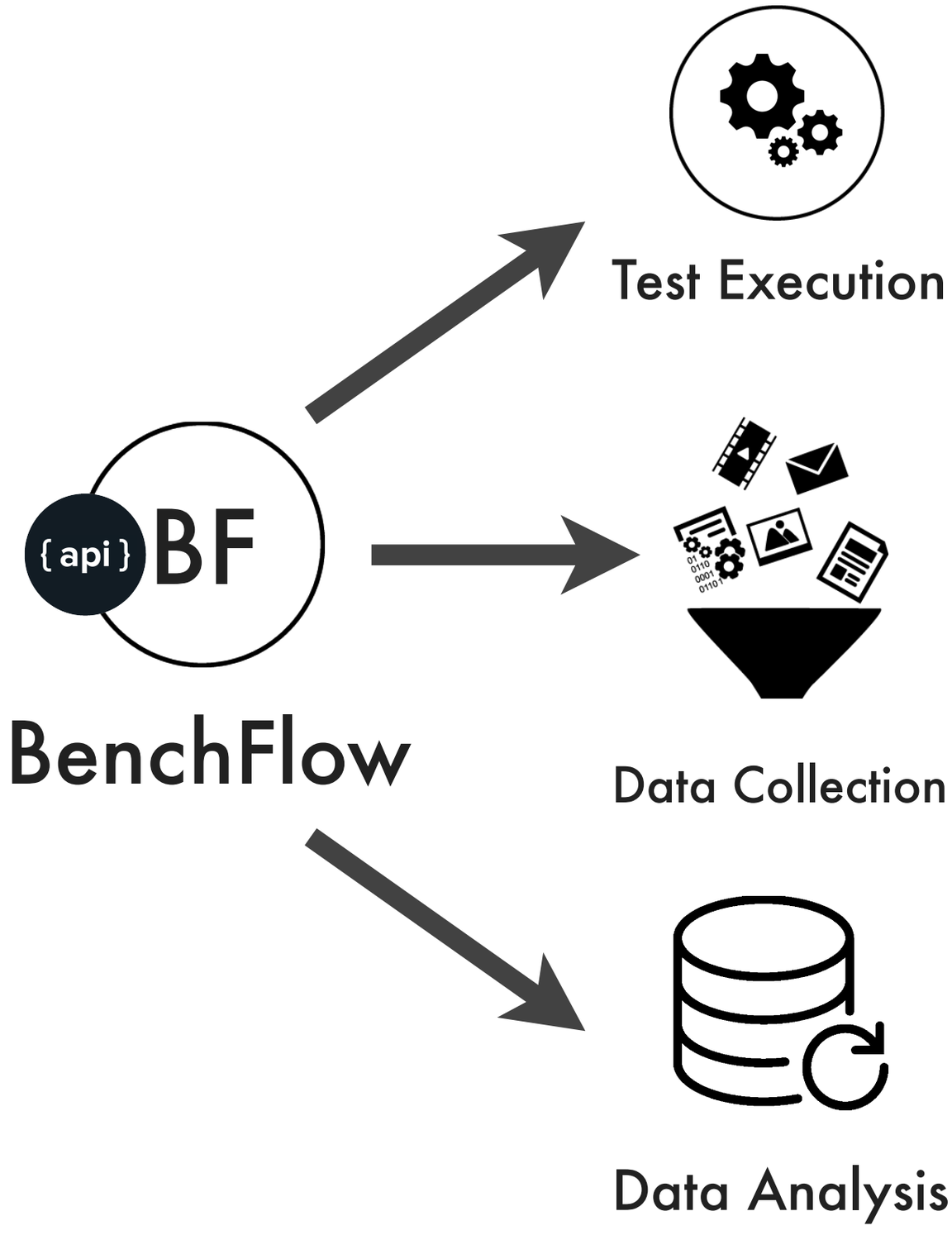

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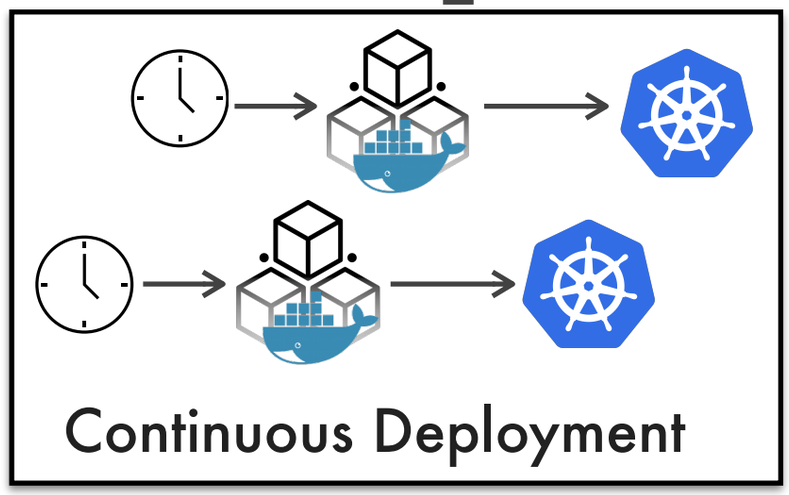

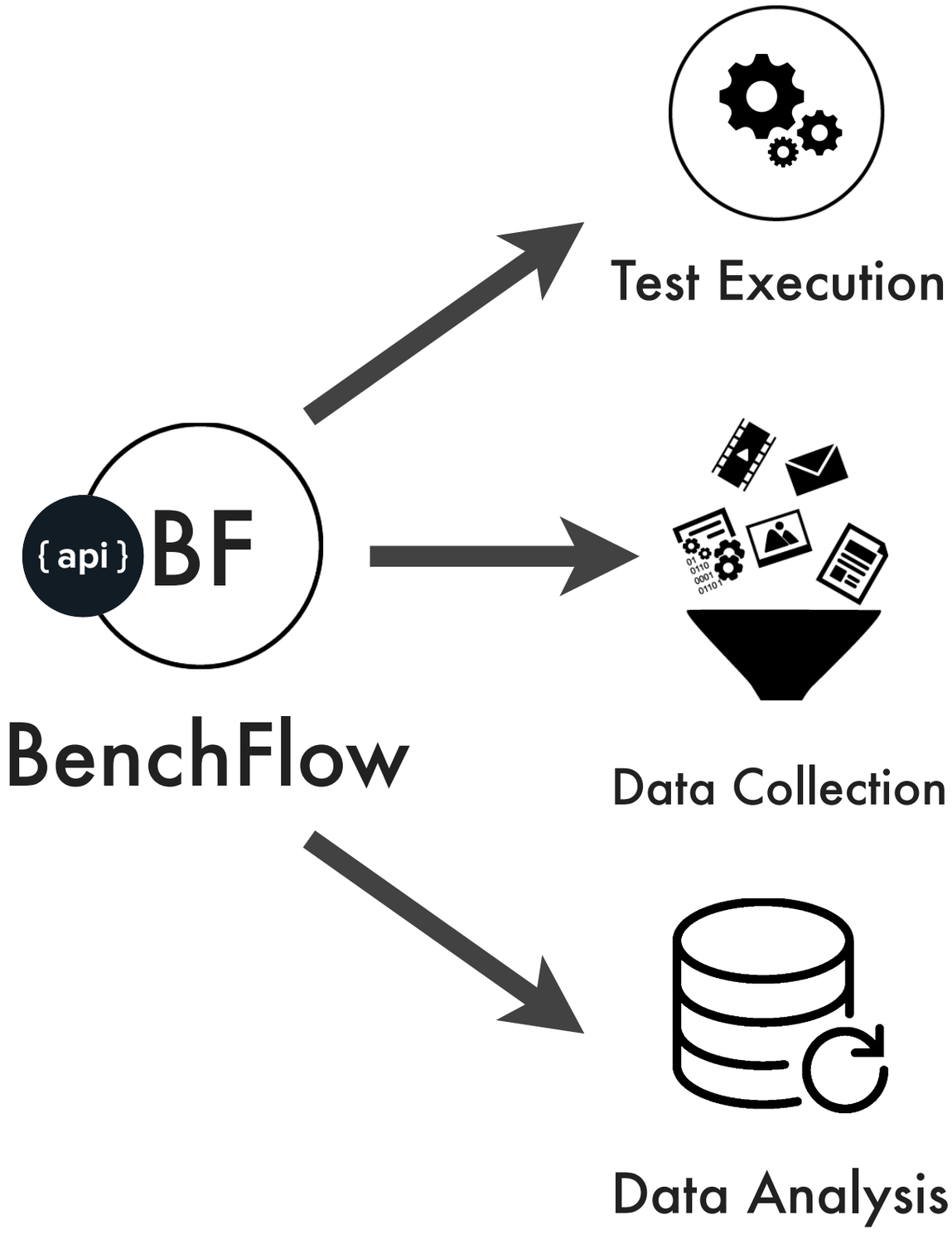

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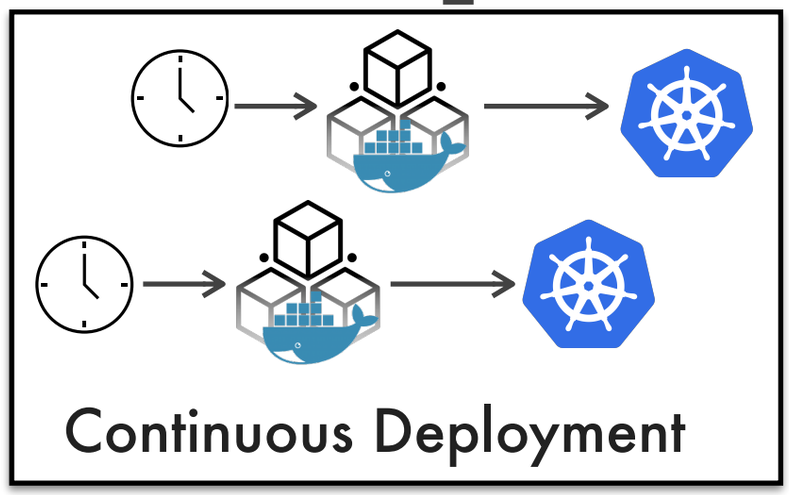

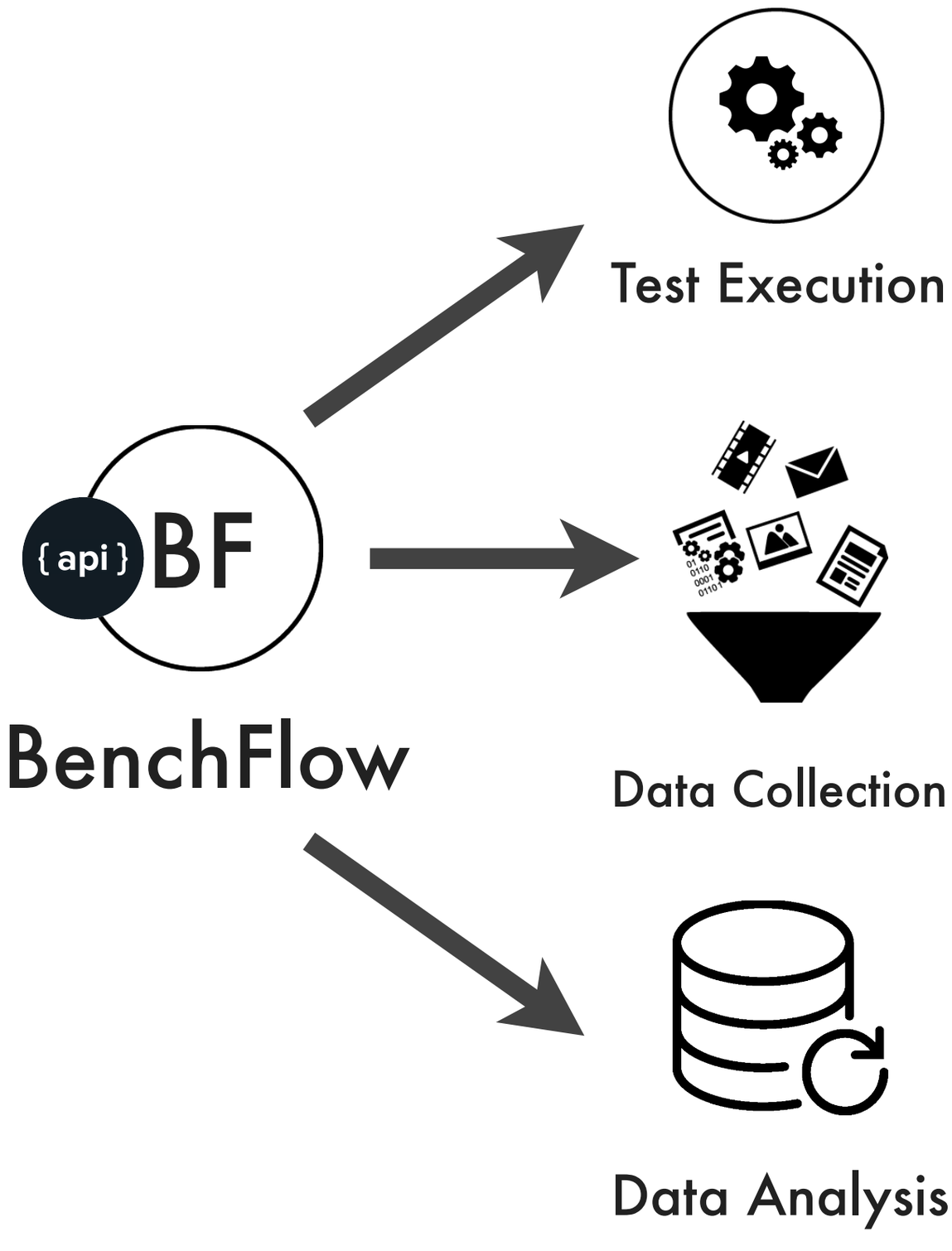

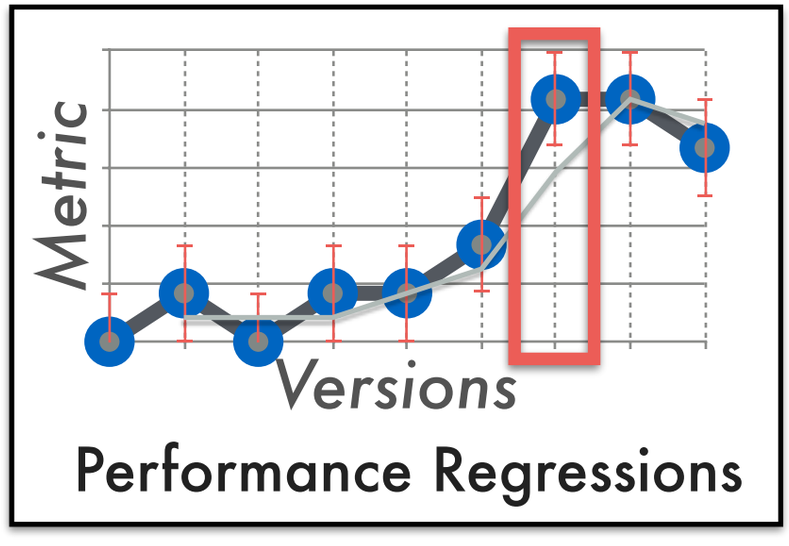

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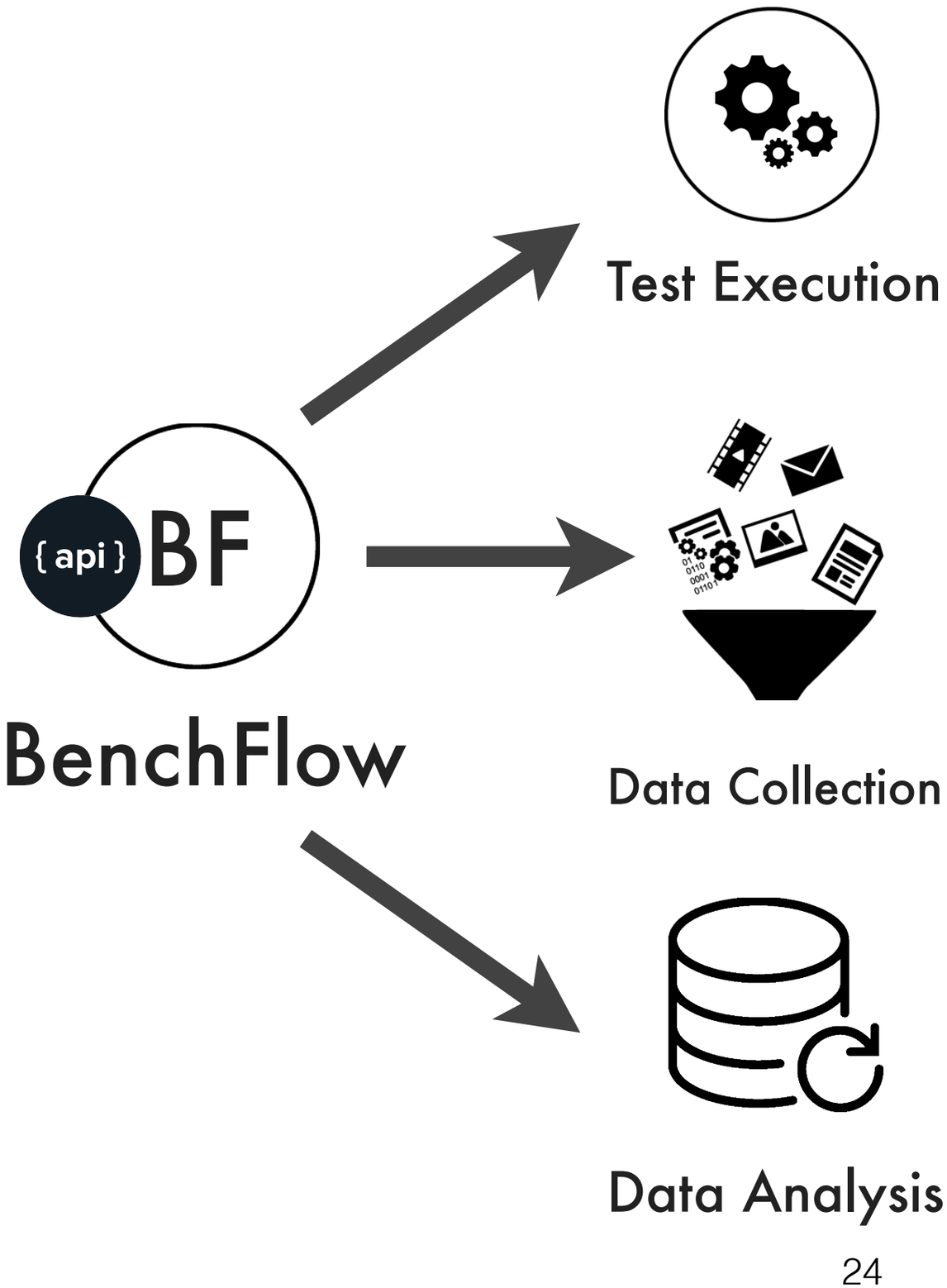

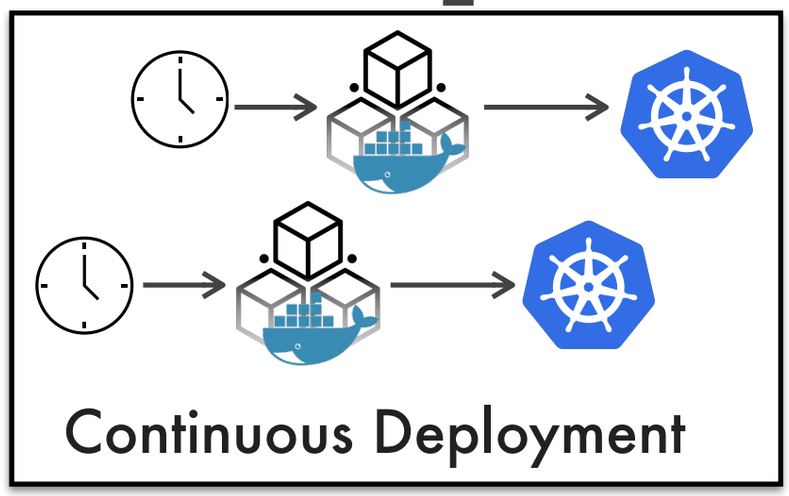

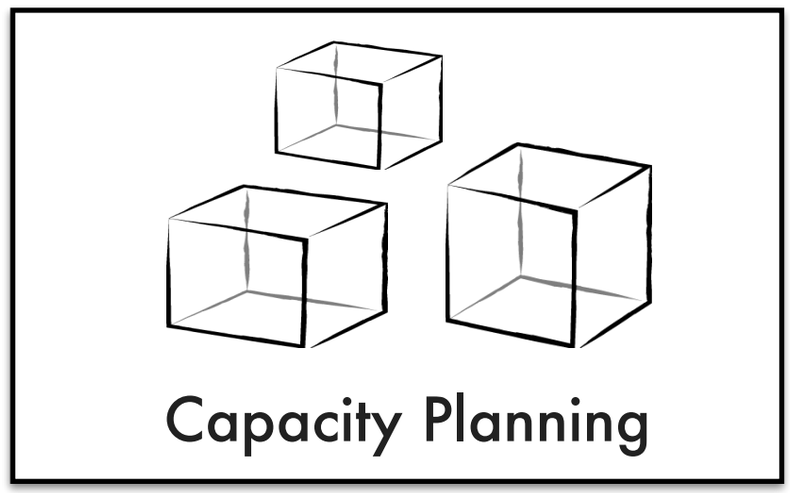

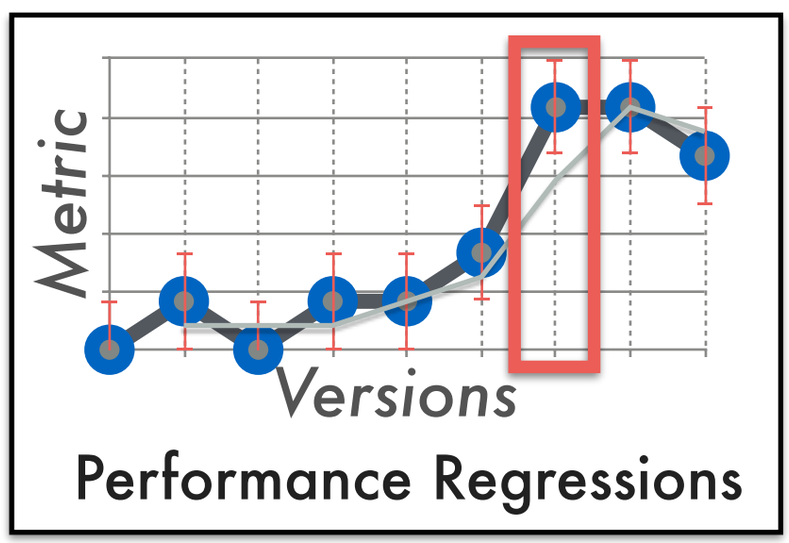

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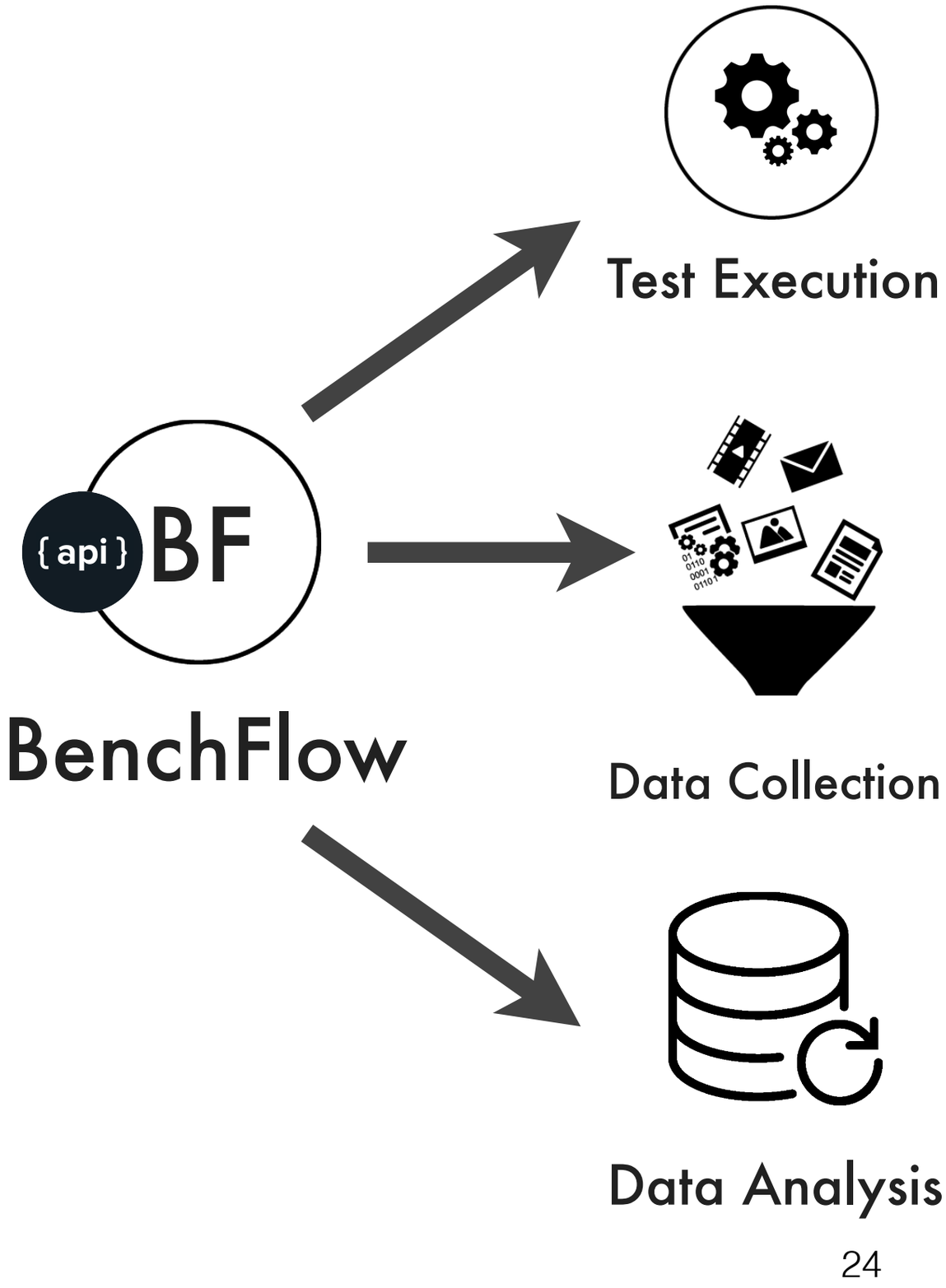
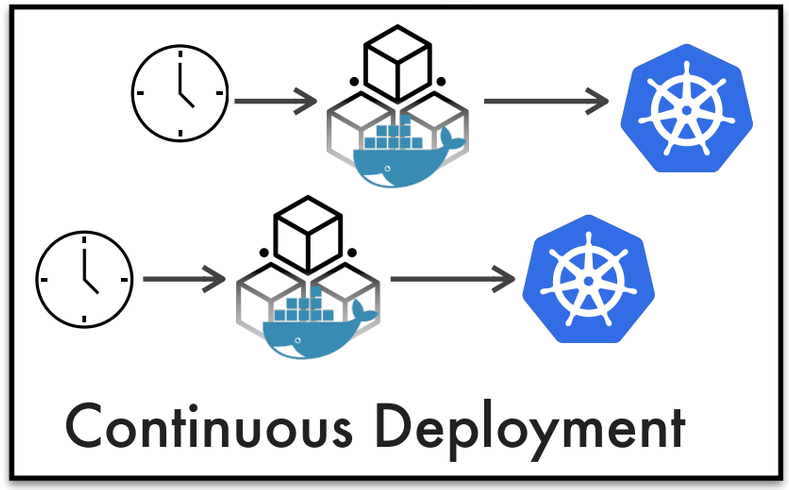
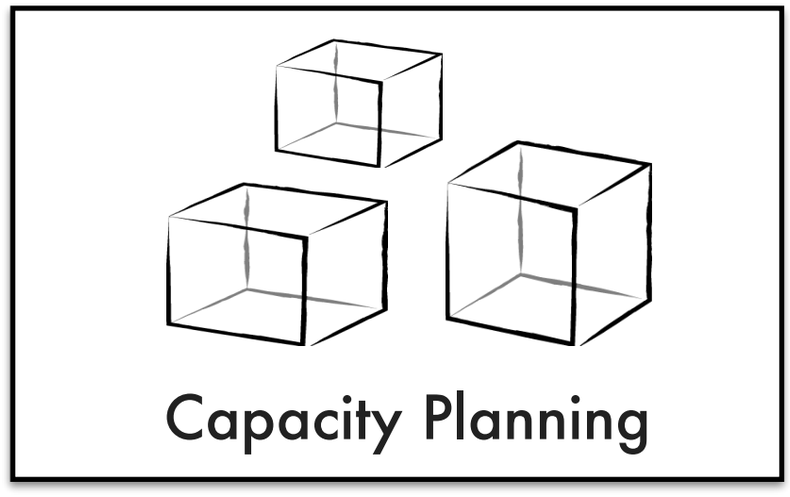
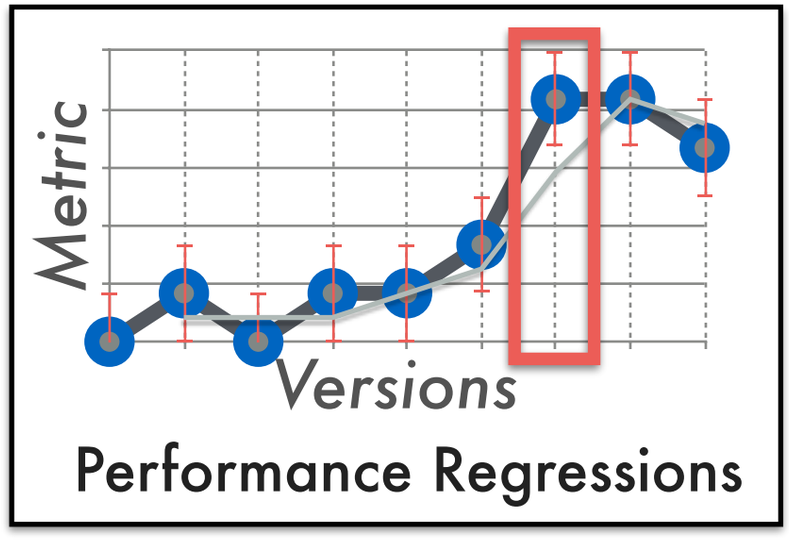
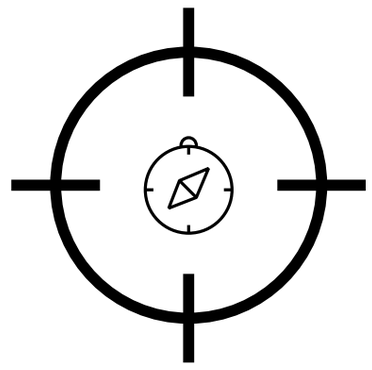








Objective-Driven Performance Testing



Objectives Taxonomy

Base Objectives (Test Types)
standard performance tests, e.g., load test, stress test, spike test, and **configuration test**

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specific types of performance engineering activities, e.g., capacity planning and performance tradeoffs

Meta-Objectives
defined from already collected performance knowledge, e.g., regressions detection, comparing different systems (or versions of the same system) using a benchmark

Example: Configuration Test

objective:

type: configuration

observation:

- ...

exploration_space:

- ...

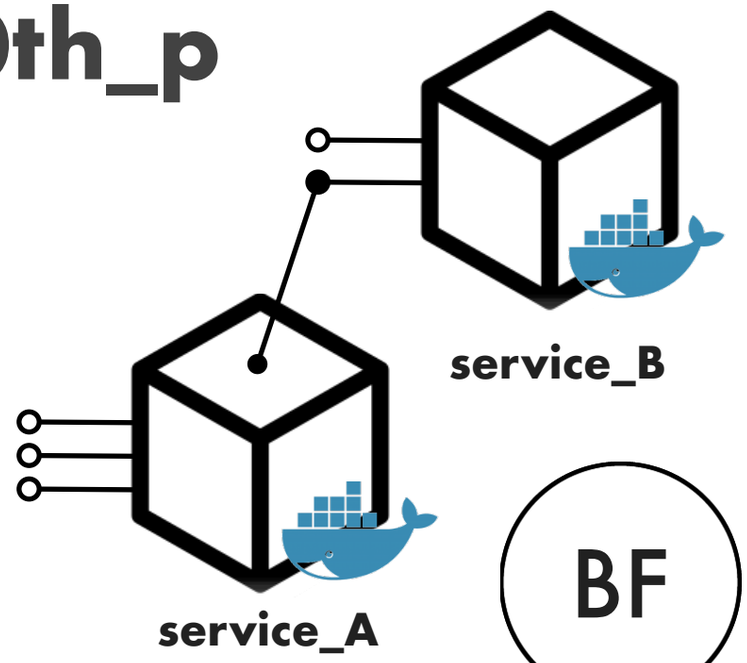
termination_criteria:

- ...

BF

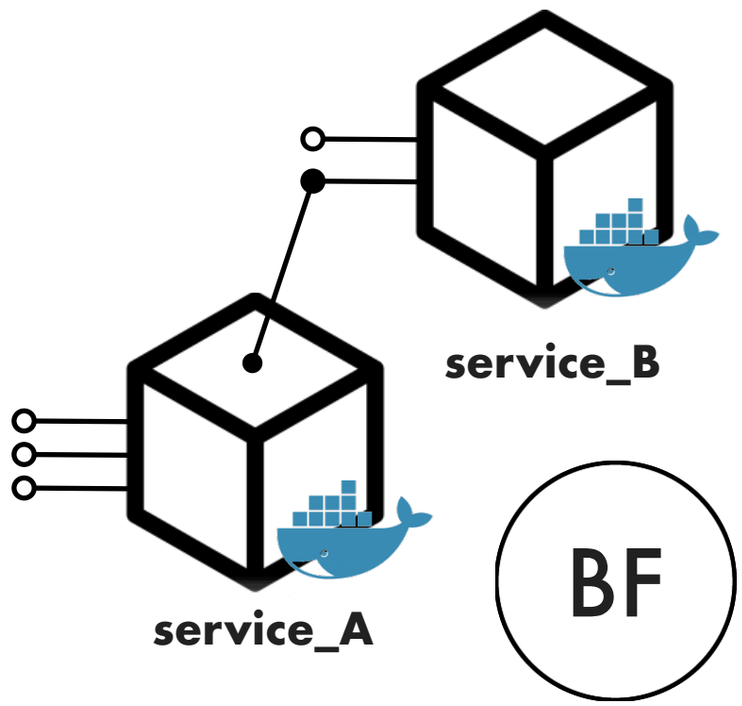
Example: Configuration Test

```
observation:
  service_A:
    - ram_avg
    - cpu_avg
    - response_time_90th_p
  service_B:
    - ram_avg
```



Example: Configuration Test

```
exploration_space:
  service_A:
    resources:
      - memory:
          range: 1GB... 5GB
          step: +1GB
      - cpus:
          range: 1...4
environment:
    - SIZE_OF_THREADPOOL:
        range: 5...100
        step: +5
  - ...
```

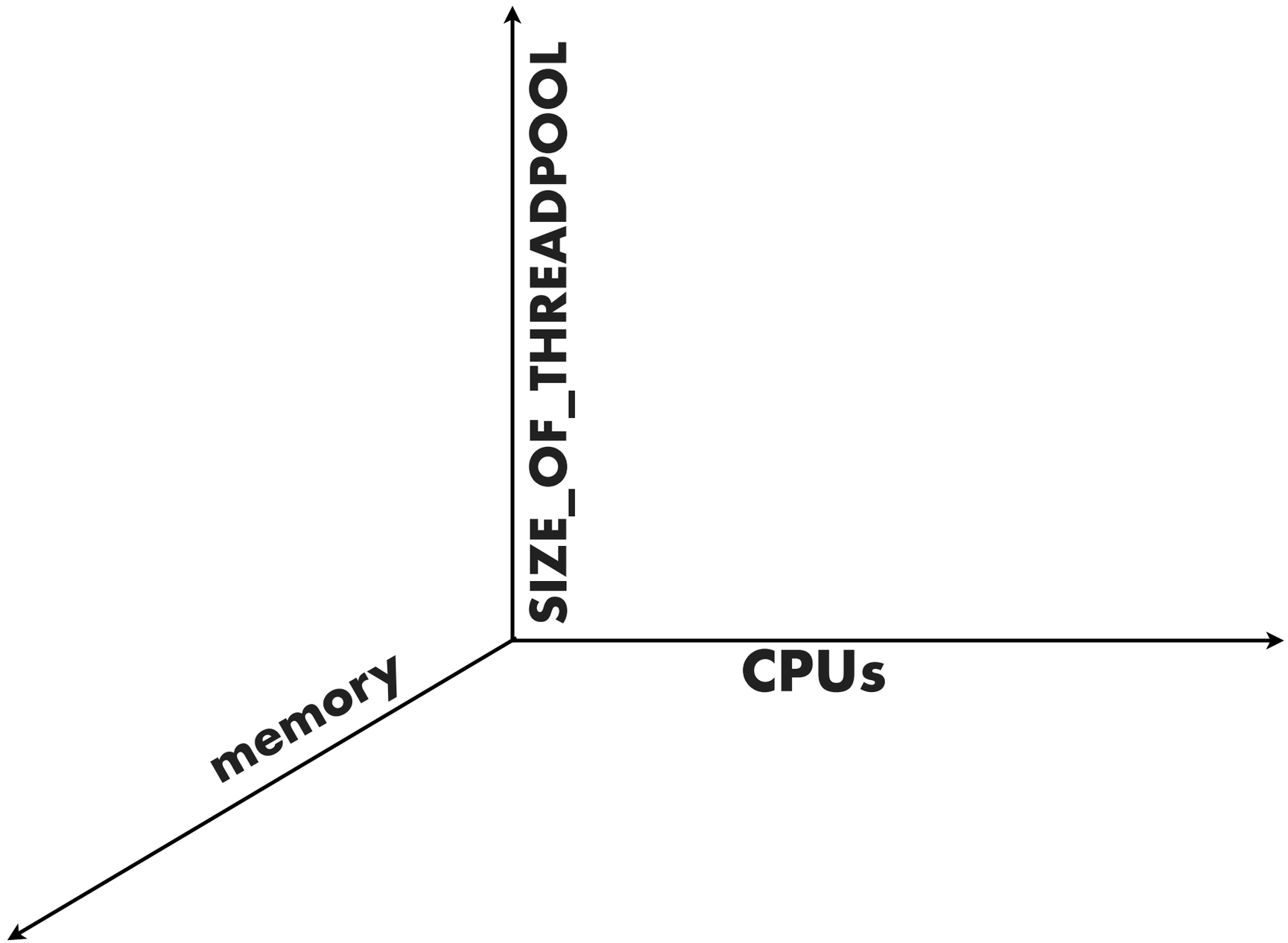


Example: Configuration Test

```
termination_criteria:
  exploration:
    ...
  test:
    max_time = 1h
experiment:
  number: 5
  confidence: 90%
  ...
```

BF

Example: Configuration Test



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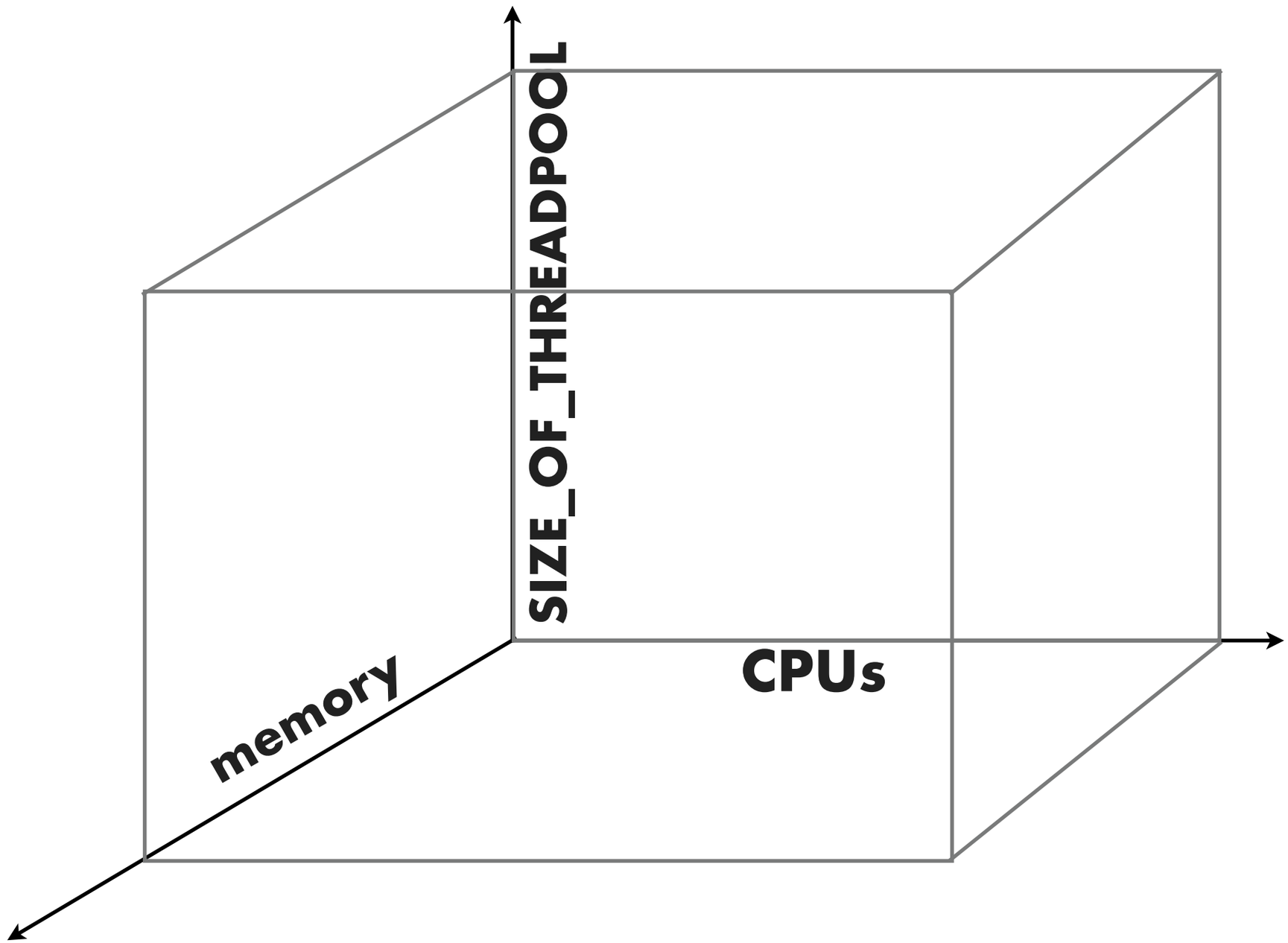

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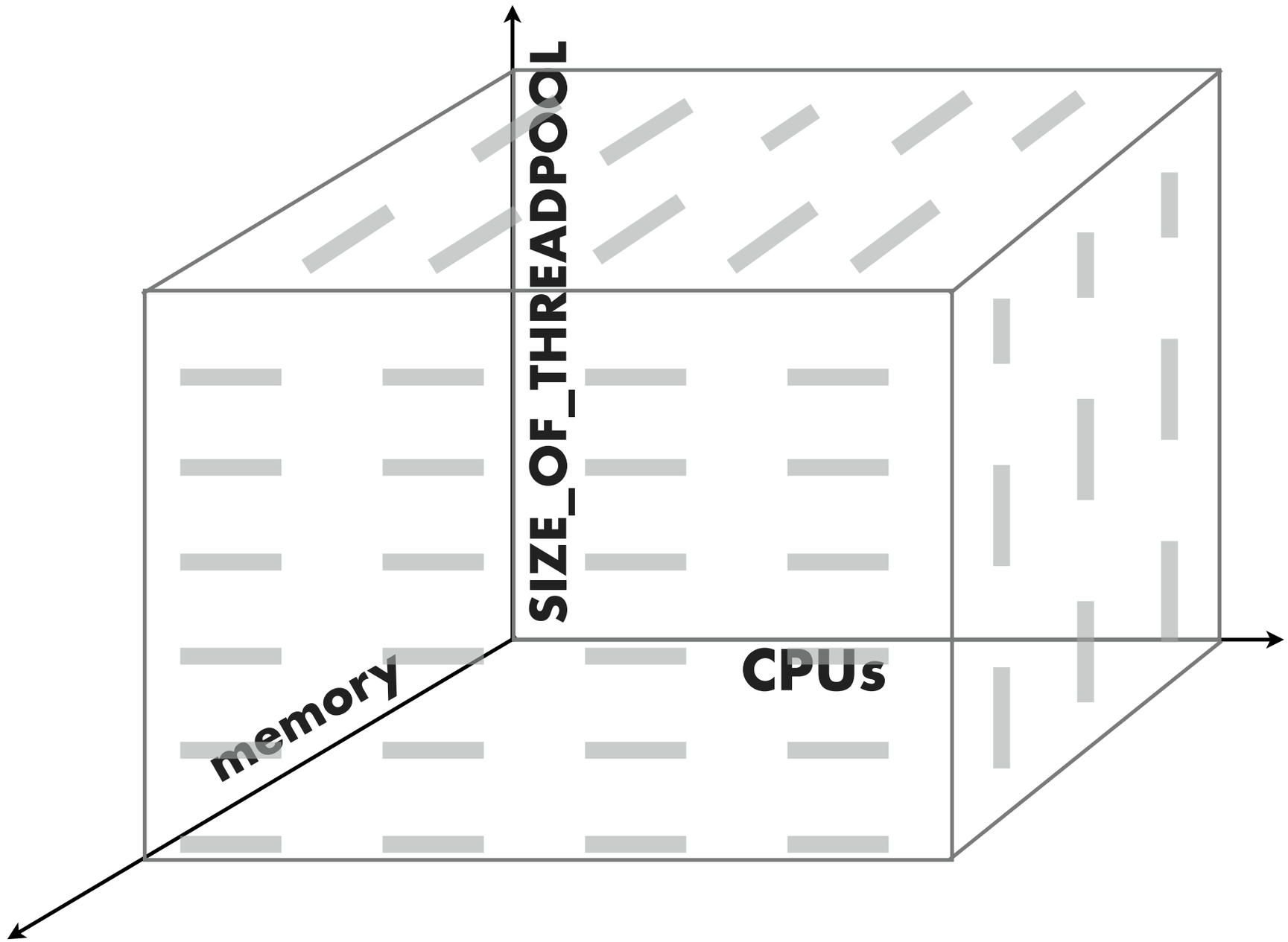

Example: Configuration Test

MARS

Kriging

...

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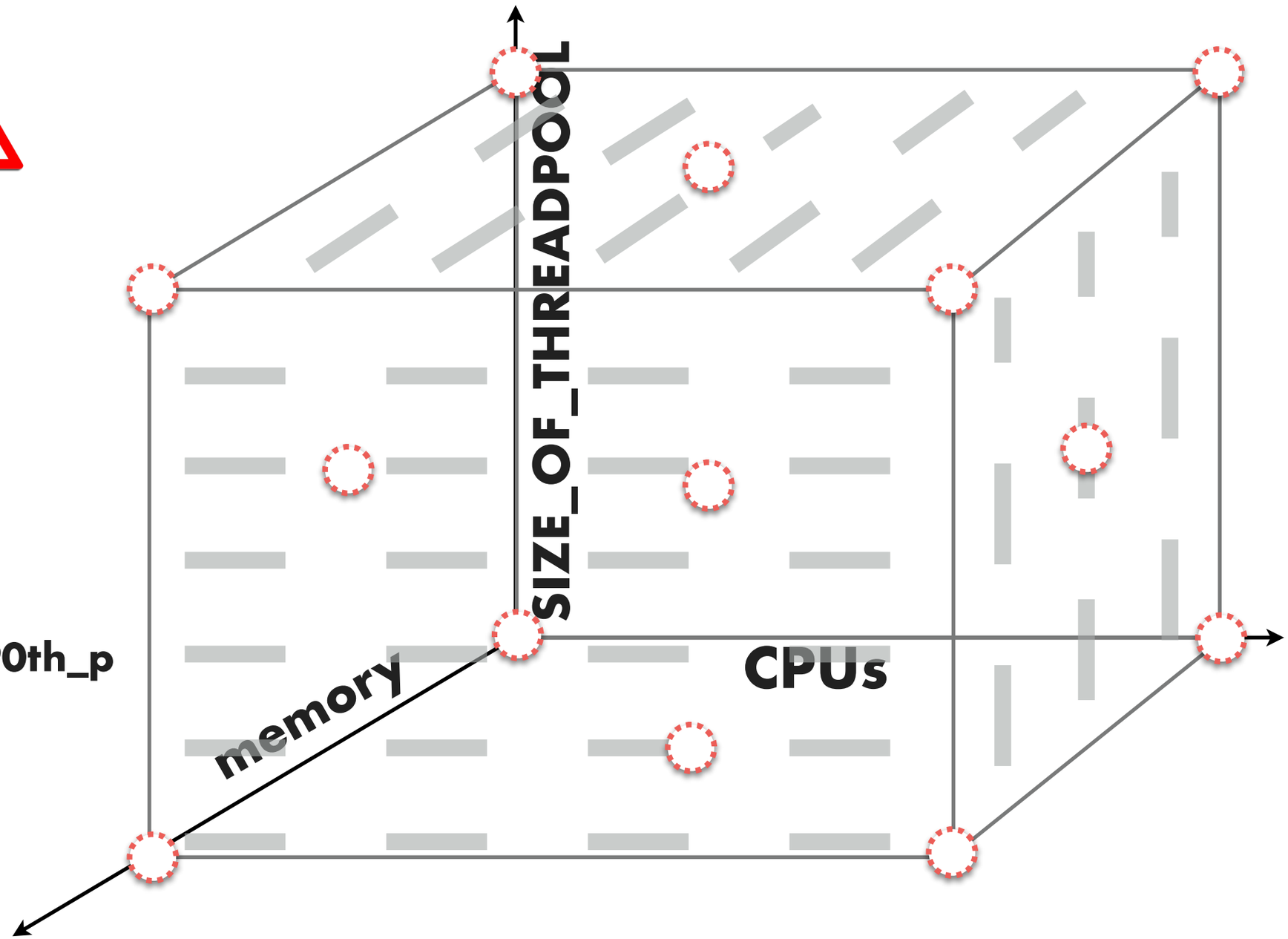

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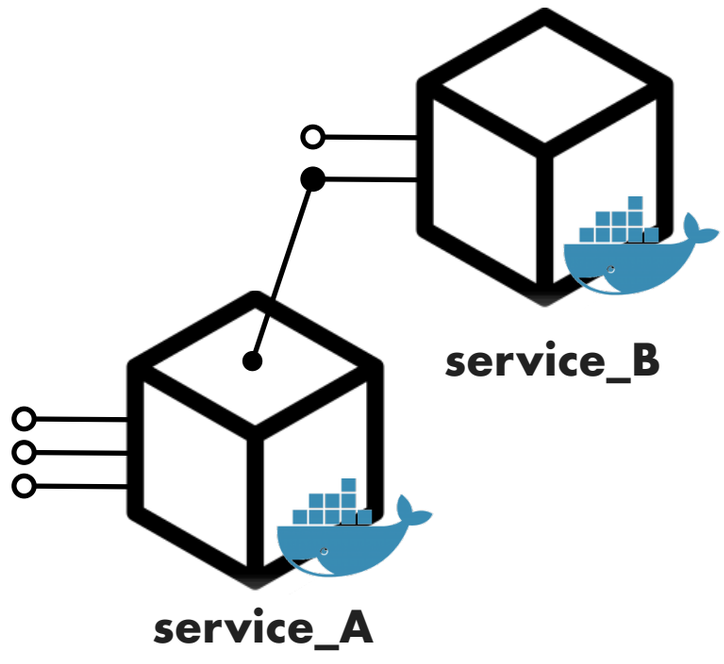
  e.g., CPU, RAM
  why? cost of resources -> important for the business

- **Performance tradeoffs based on some (resource) constraints**
  e.g., which configuration is good enough?
  why? responsiveness -> important for the user

Example: Performance Tradeoff

```
tradeoff_target:
  service_A:
      - min(response_time_90th_p)
  service_B:
      - min(memory)
...
```



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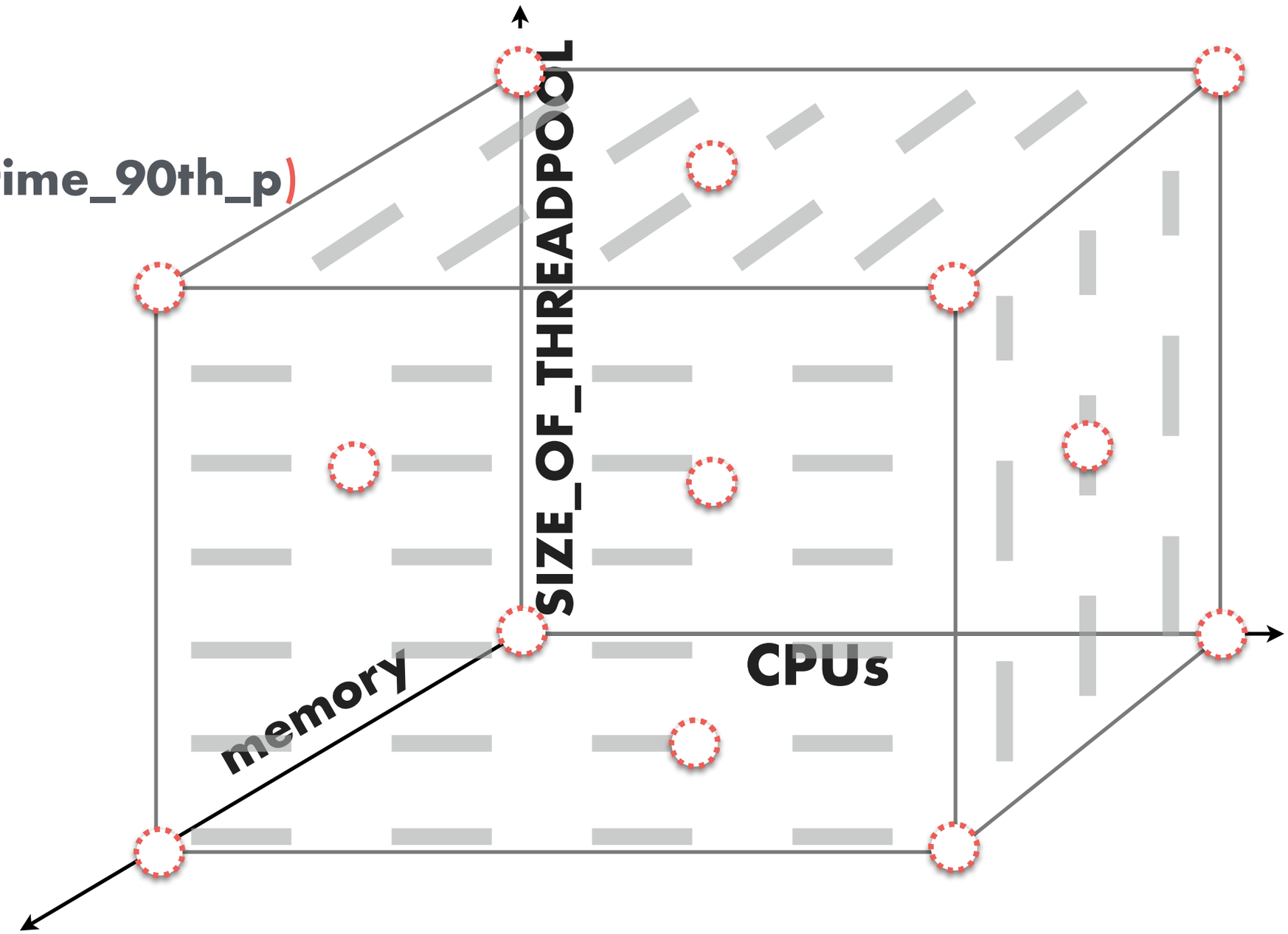

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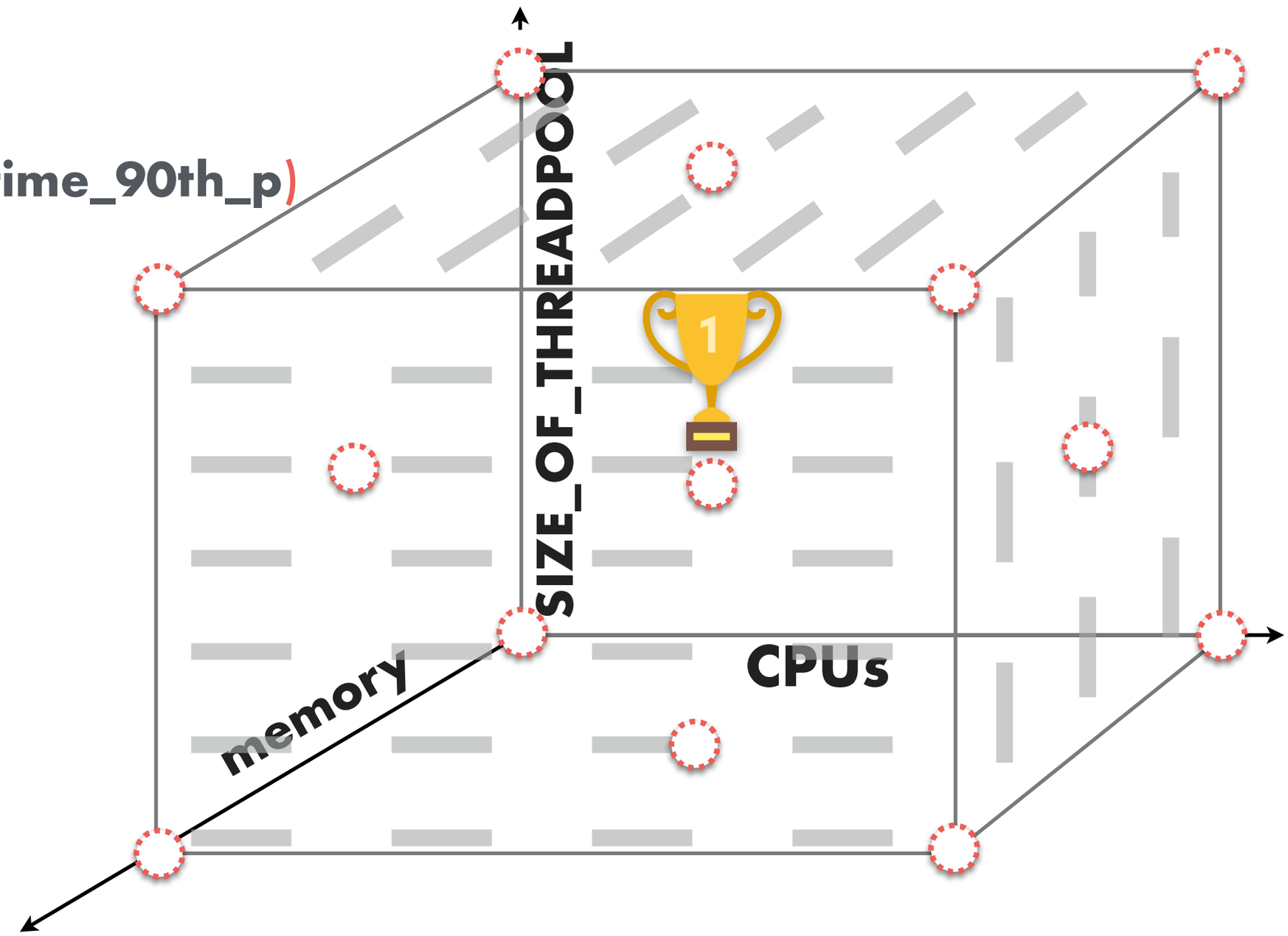

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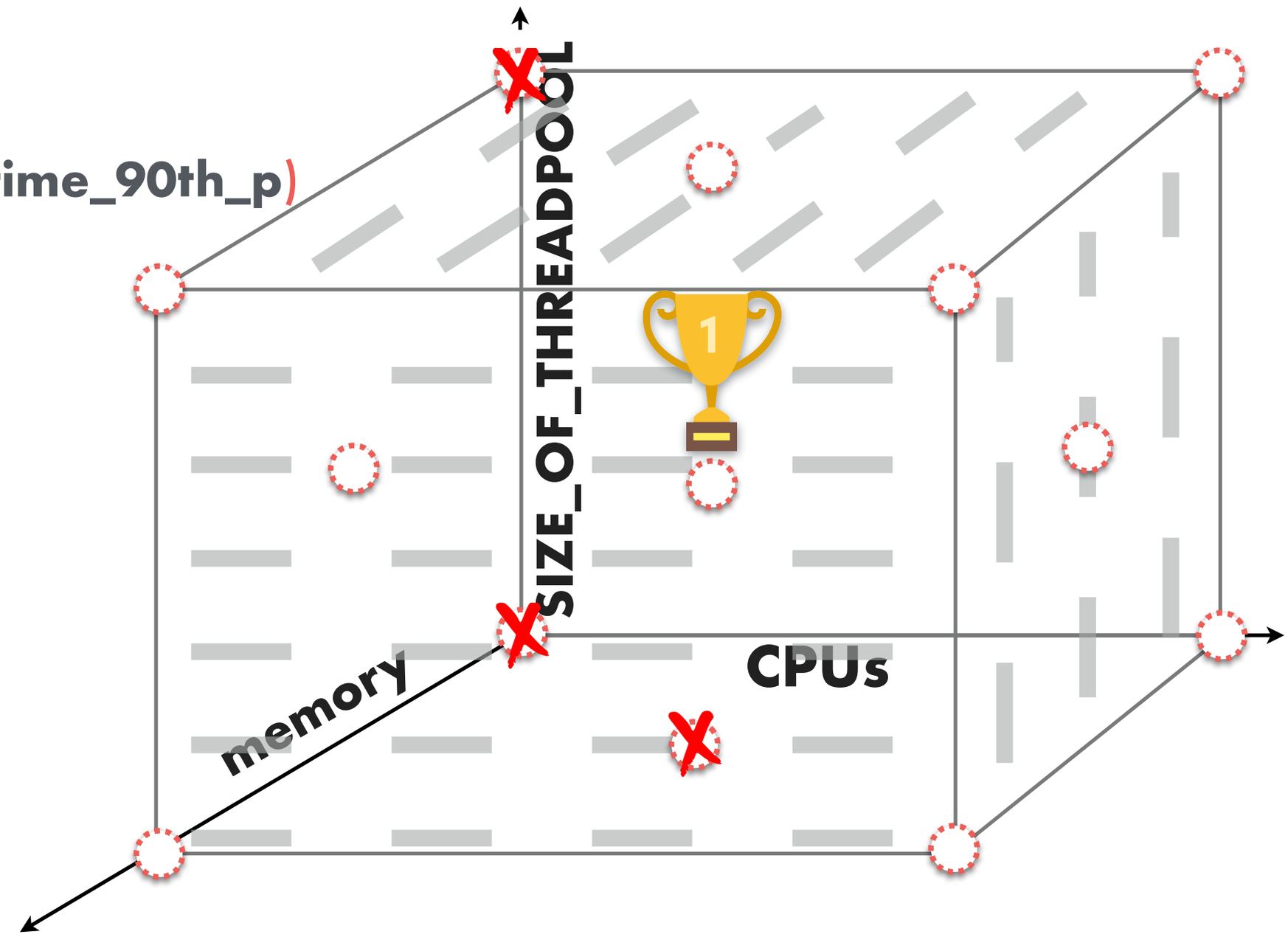

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4. New Data Analyses:
   - From Dedicated Services
   - From Collectors, or with Spark Tasks (python, Scala, R, Java)

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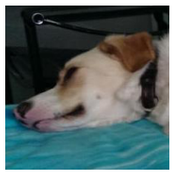



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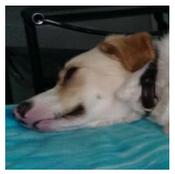



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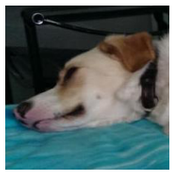



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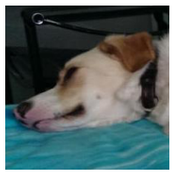



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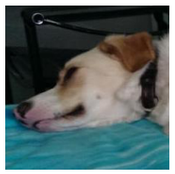



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20'000+ Computed Metrics and Statistics

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When a Release? September 2017

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Research Publications

http://benchflow.inf.usi.ch

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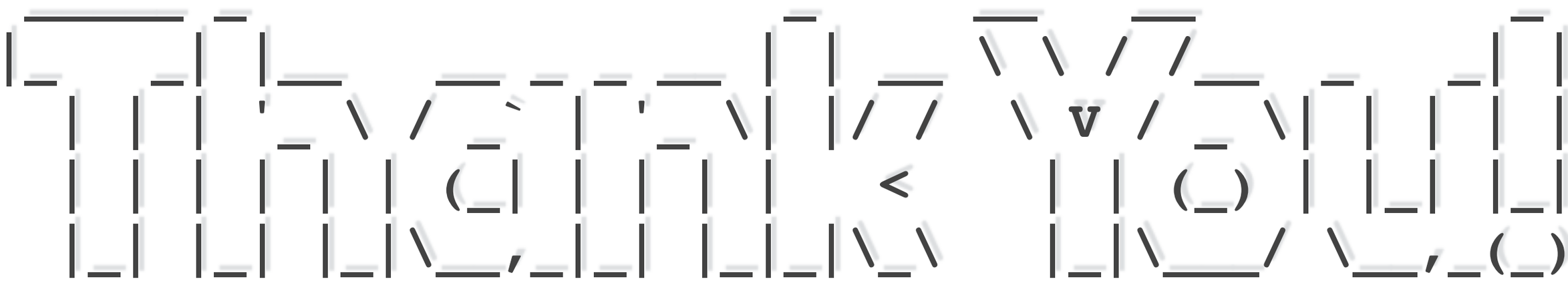
4. ...Other Ideas?



benchflow

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✉ vincenzo.ferme@usi.ch