Feedback on Experimentation

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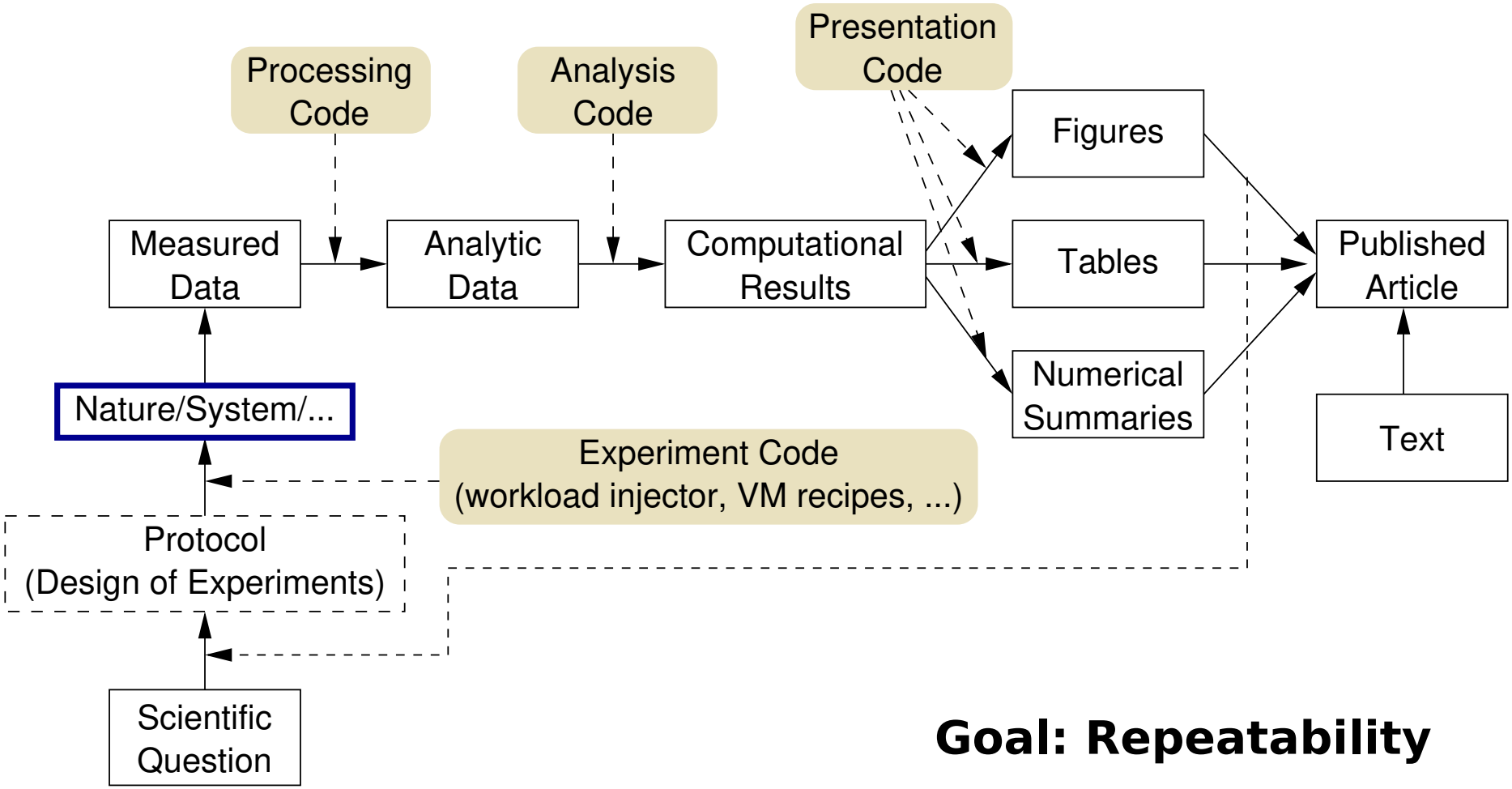
What is this session about?

Overview of technical choices to run an experiment.

Plan

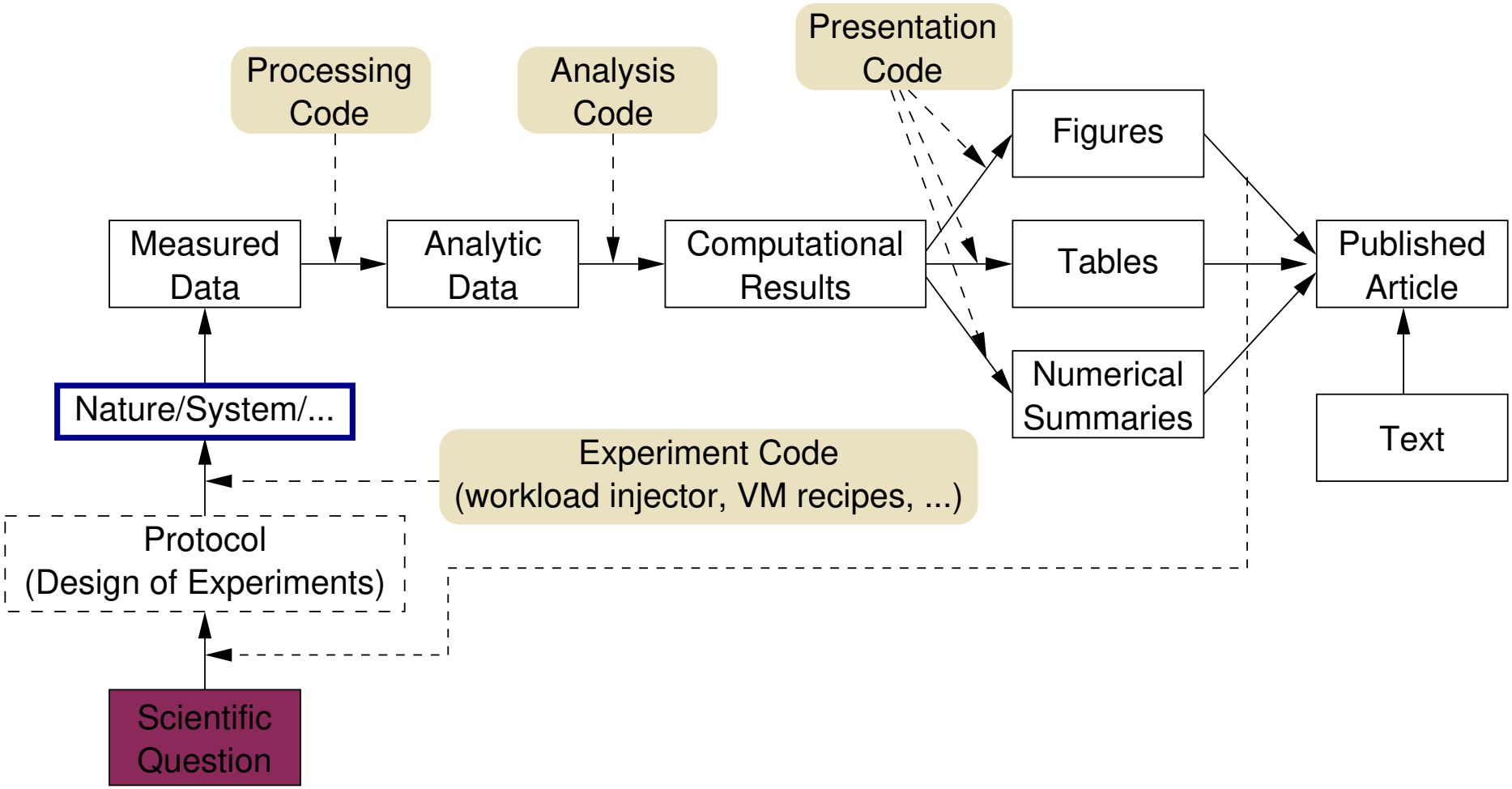
- *Short* presentation
- Discussion

General workflow (courtesy of Arnaud Legrand)



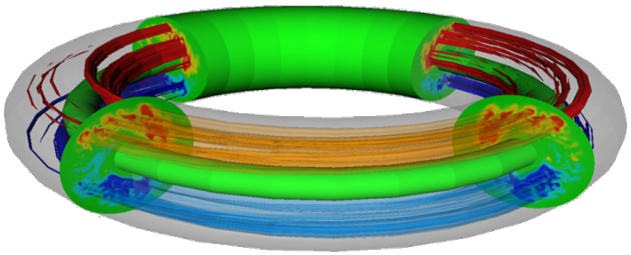
Goal: Repeatability

Science

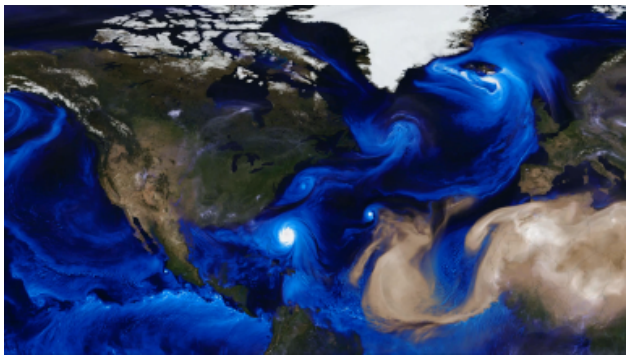

Processing Code
Analysis Code
Presentation Code
Measured Data
Analytic Data
Computational Results
Figures
Tables
Numerical Summaries
Published Article
Text
Nature/System/...
Experiment Code (workload injector, VM recipes, ...)
Protocol (Design of Experiments)
Scientific Question

High Performance Computing

Sunway Taihulight

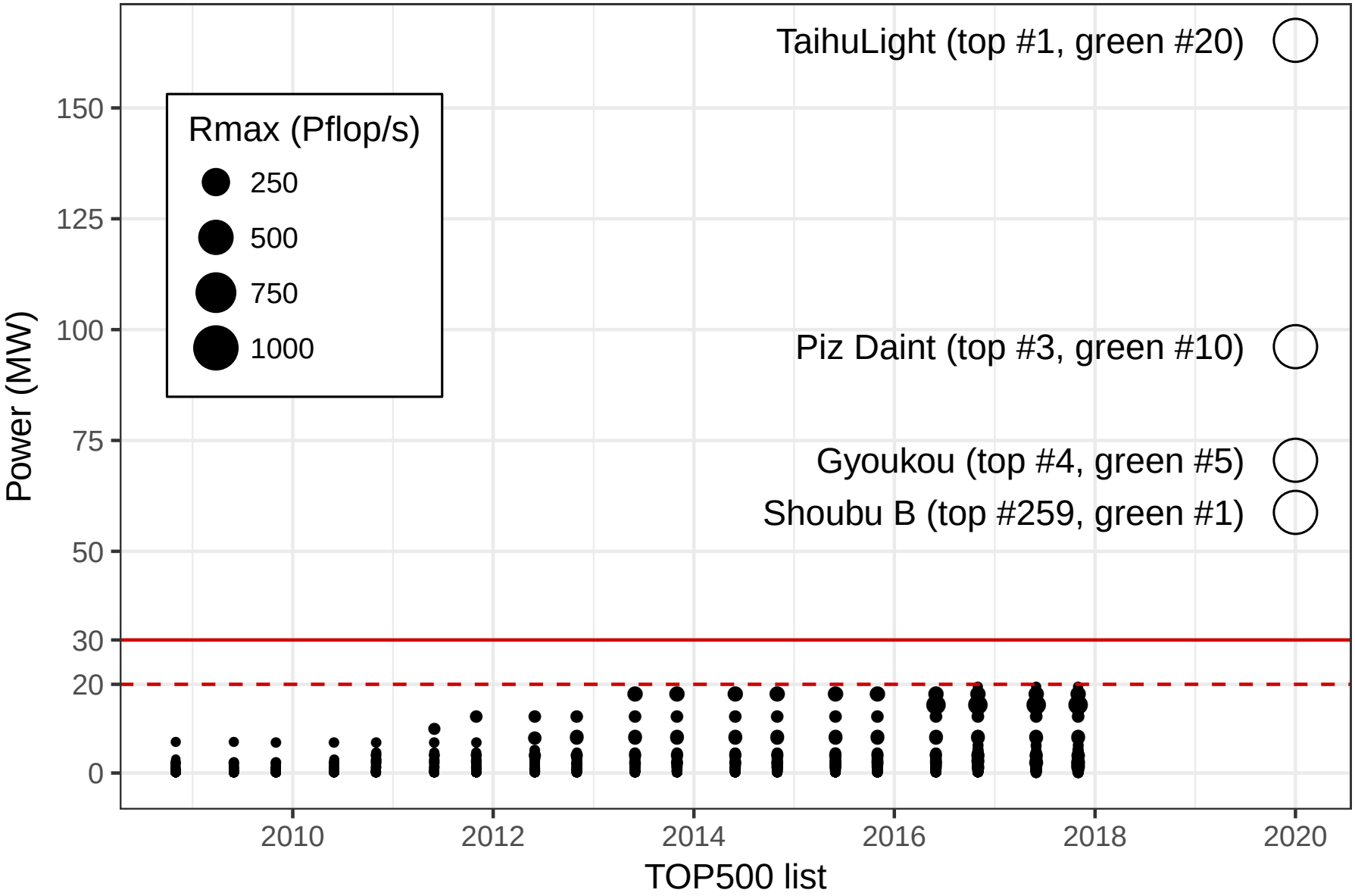


Tokamak plasmas (Gysela5D)

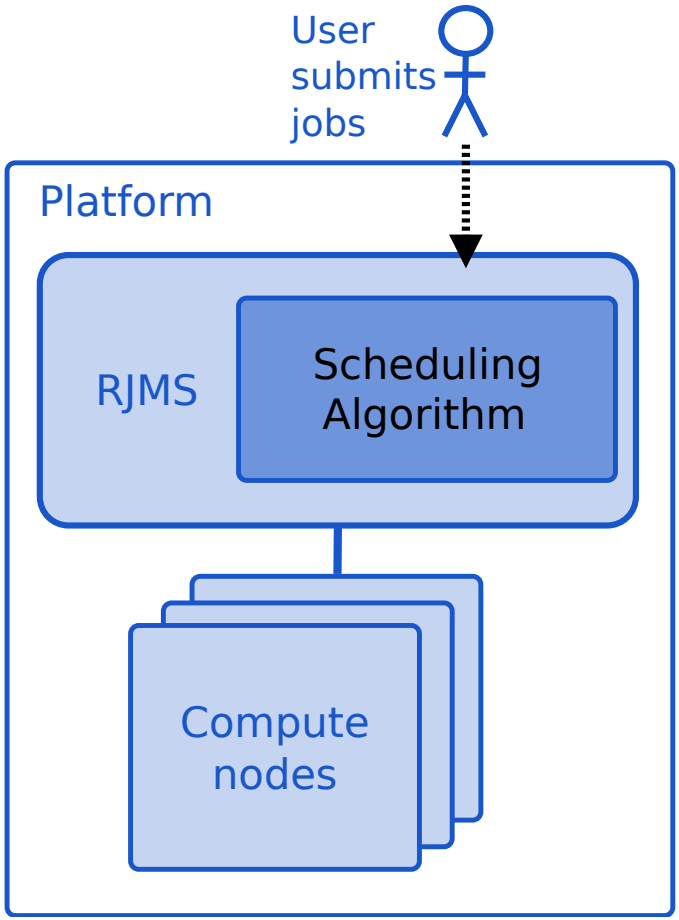


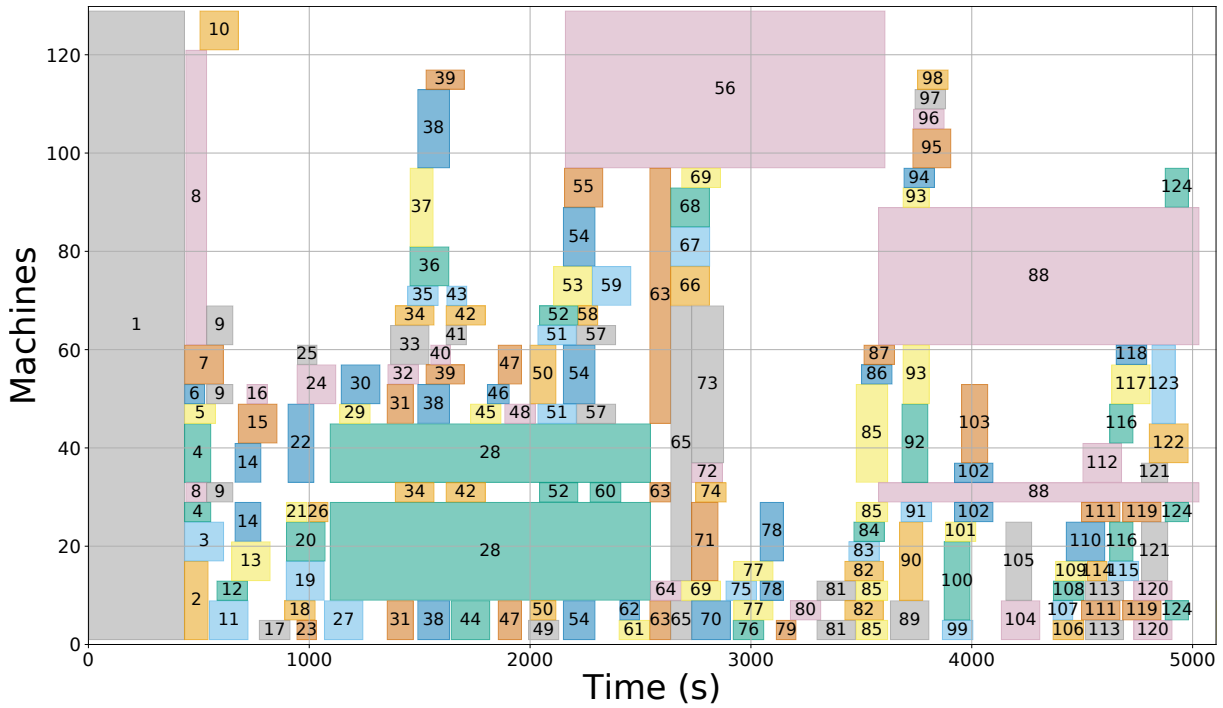
Weather prediction (GEOS)

Problem: Power consumption (naive) projection

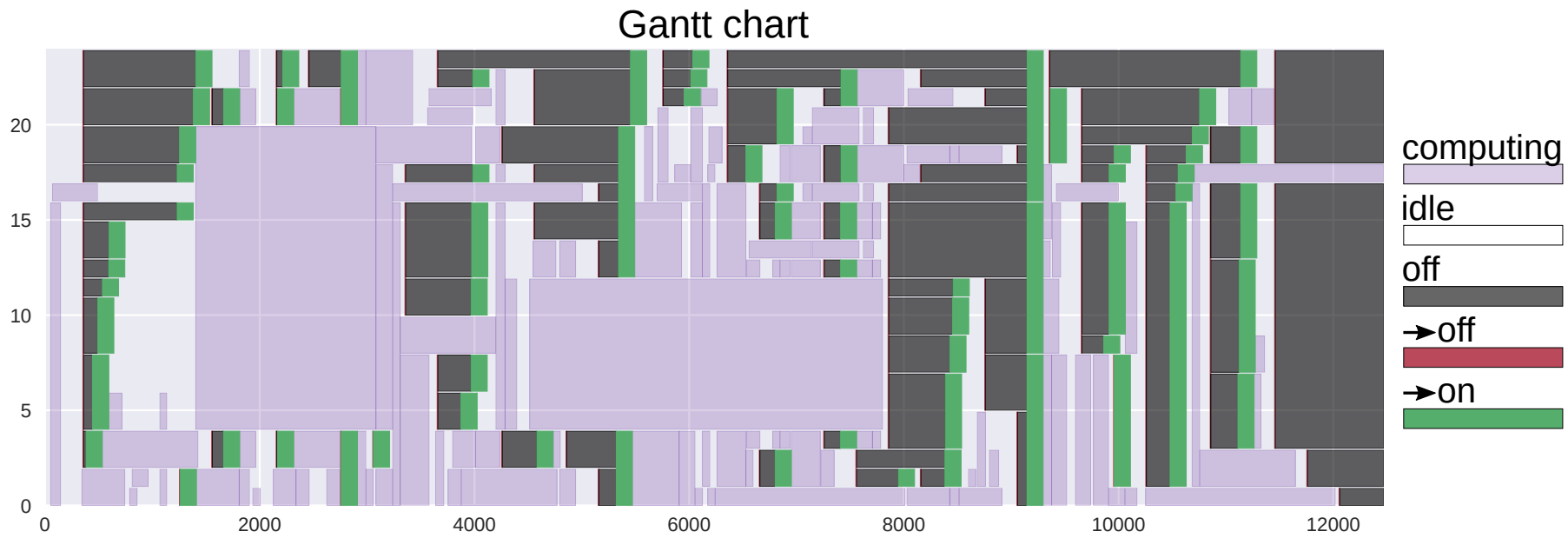


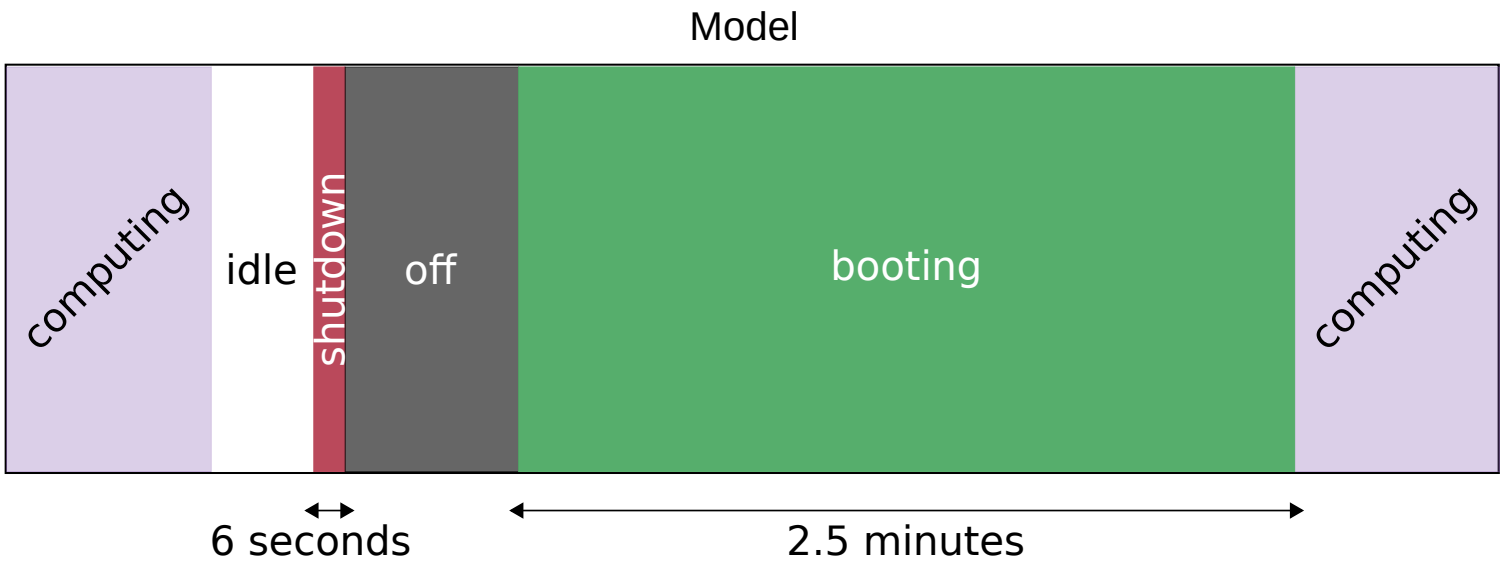
Lever: Resources and Jobs Management System (RJMS)



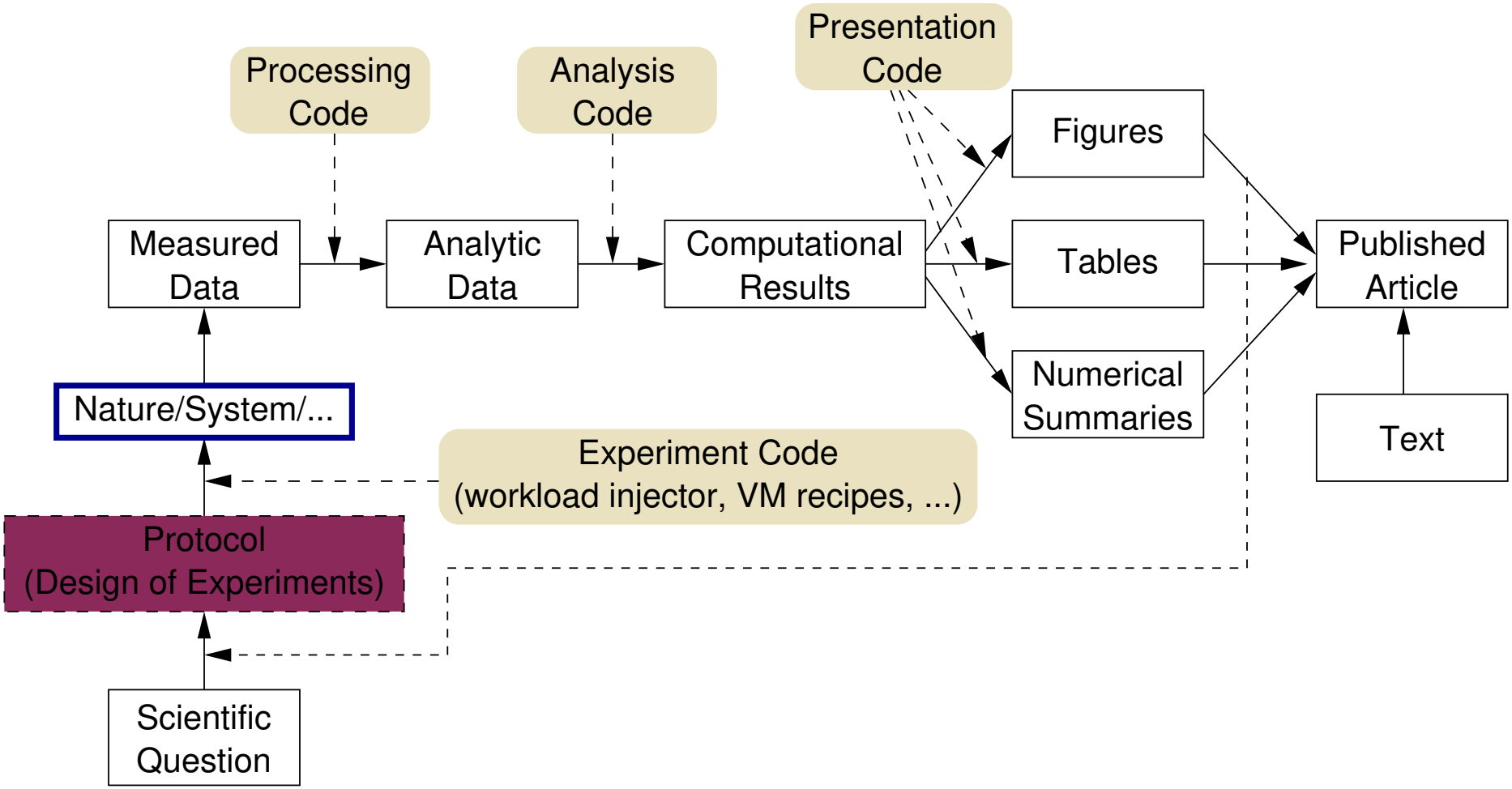


Study: Node shutdown policies





General workflow



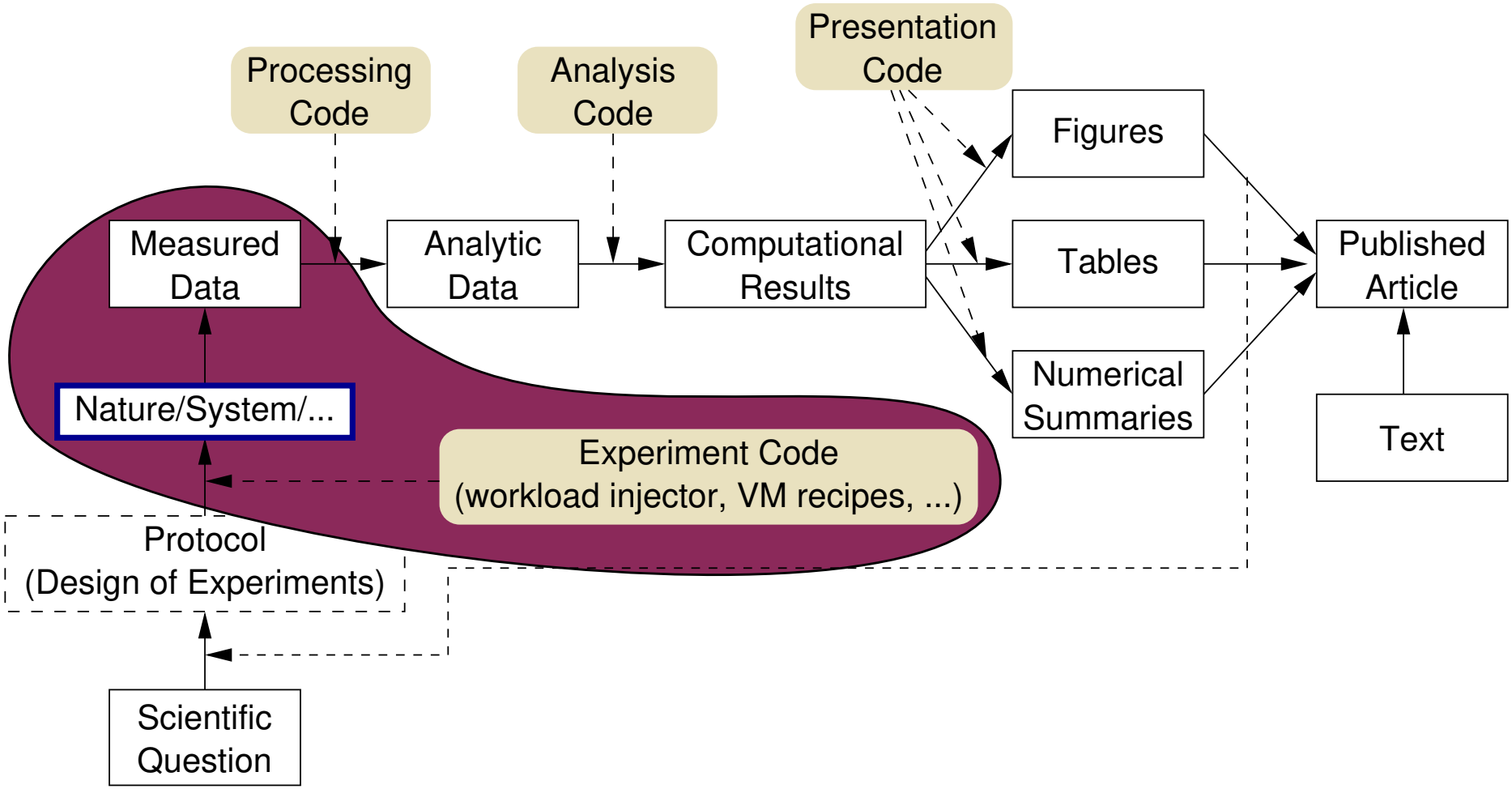
Protocol in a nutshell

Assess node shutdown policies in simulation.

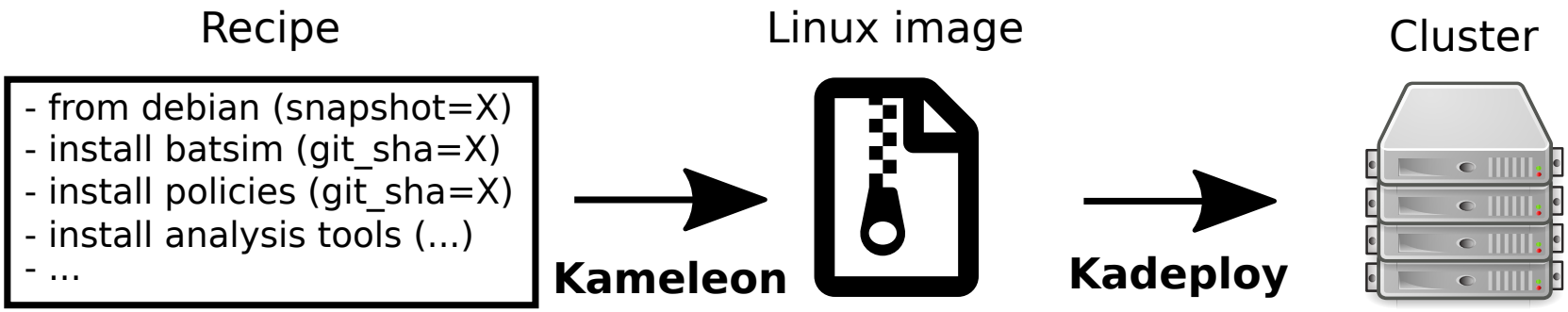
- Batsim
- (energy, job QoS)
- Various policies combined with EASY
  - Various parameters for each policy
- Replay existing HPC traces

Tune parameters **iteratively**.

Obtaining raw data



Reproducible environment (Bulldozer approach)

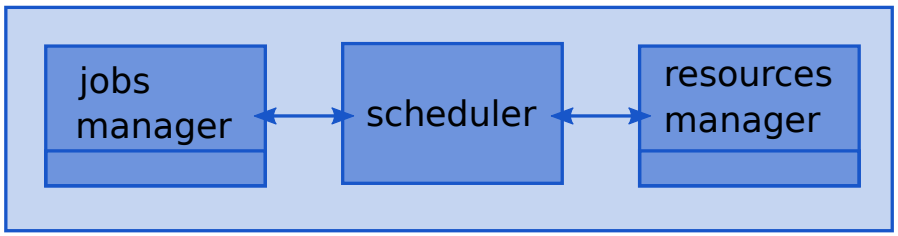


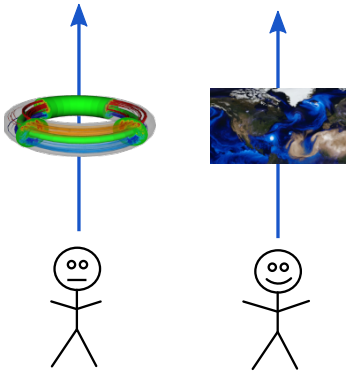
Documentation: `http://kameleon.imag.fr`

Batsim simulation overview

Real

RJMS (SLURM, OAR, PBS...)

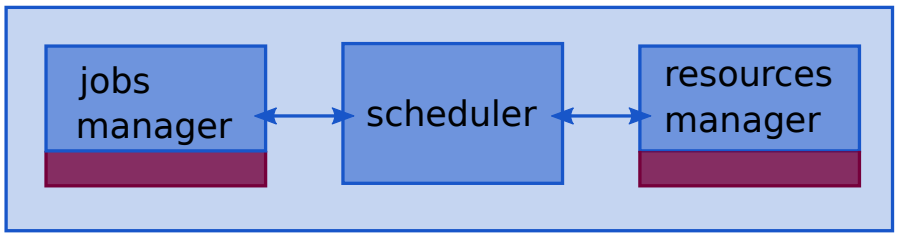


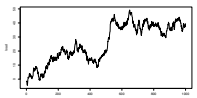


real platform

Batsim simulation

decision maker (RJMS + adaptor)

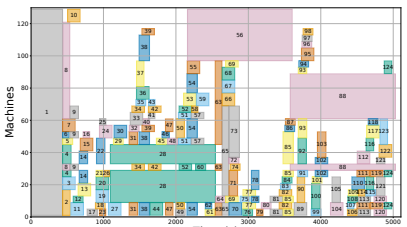




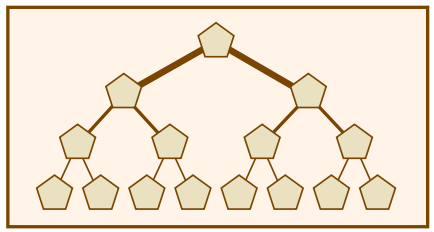
workload

batsim protocol

batsim



results



simulated platform

Required software to run 1 instance

Simulator: Batsim (version)

- SimGrid (version)
- ZMQ, RapidJSON, Boost... (+versions)

Algorithms: Batsched (version)

- ZMQ, RapidJSON, Boost, Redis, GMP... (+versions)

Execution manager: Ad hoc Python script (version)

- Python interpreter, standard lib, PyPI libs (+versions)

Execute1 Overview

Input:

- Batsim command (string)
- Scheduler command (string)
- Timeouts (float[])

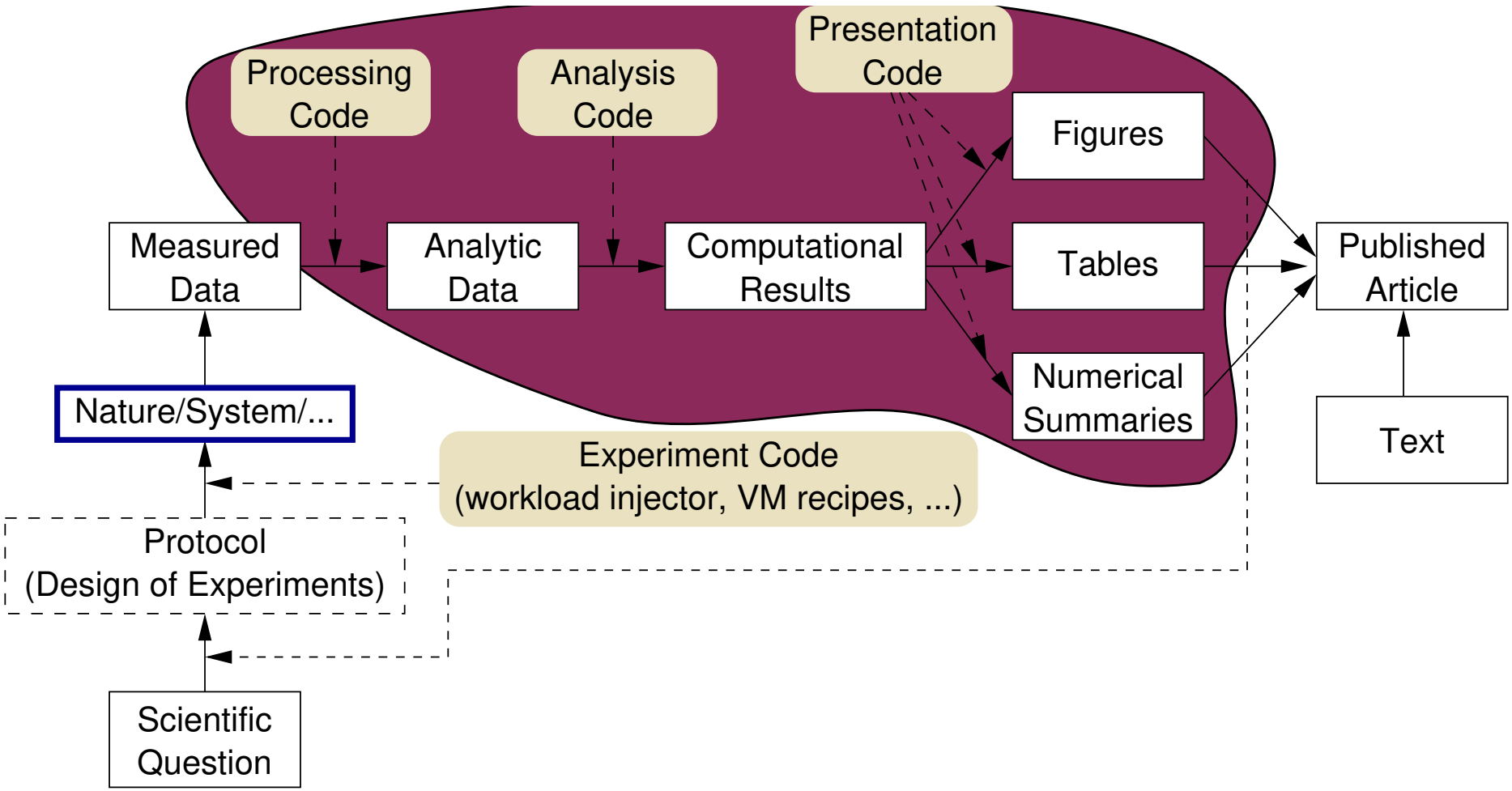
Output:

- Batsim output (CSV files)
- Scheduler internal traces (CSV files)

Should prevent process side effect.

- Processes may crash
- A timeout may be reached (infinite loop, deadlock...)

Data analysis



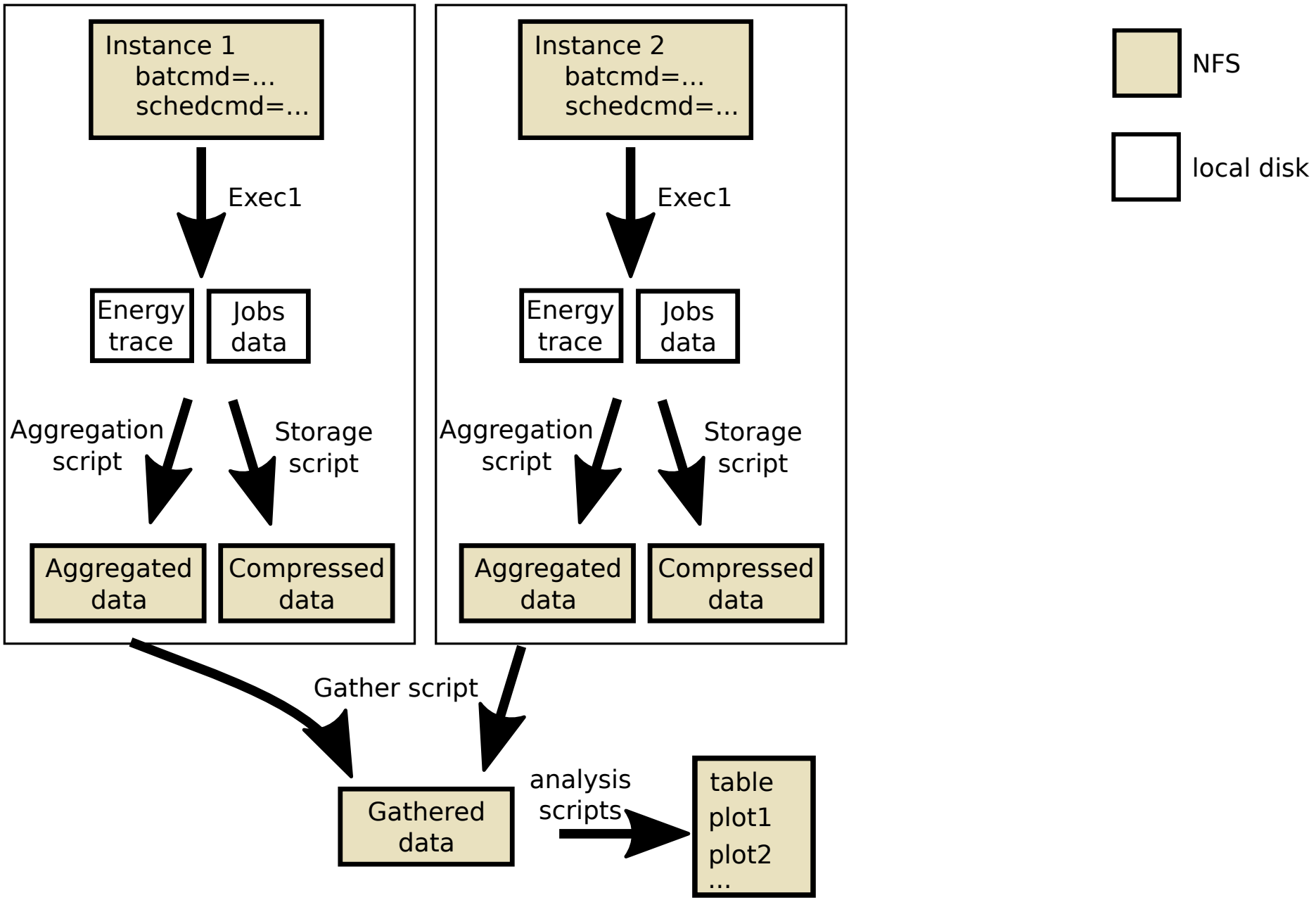
Data analysis

Usual desires.

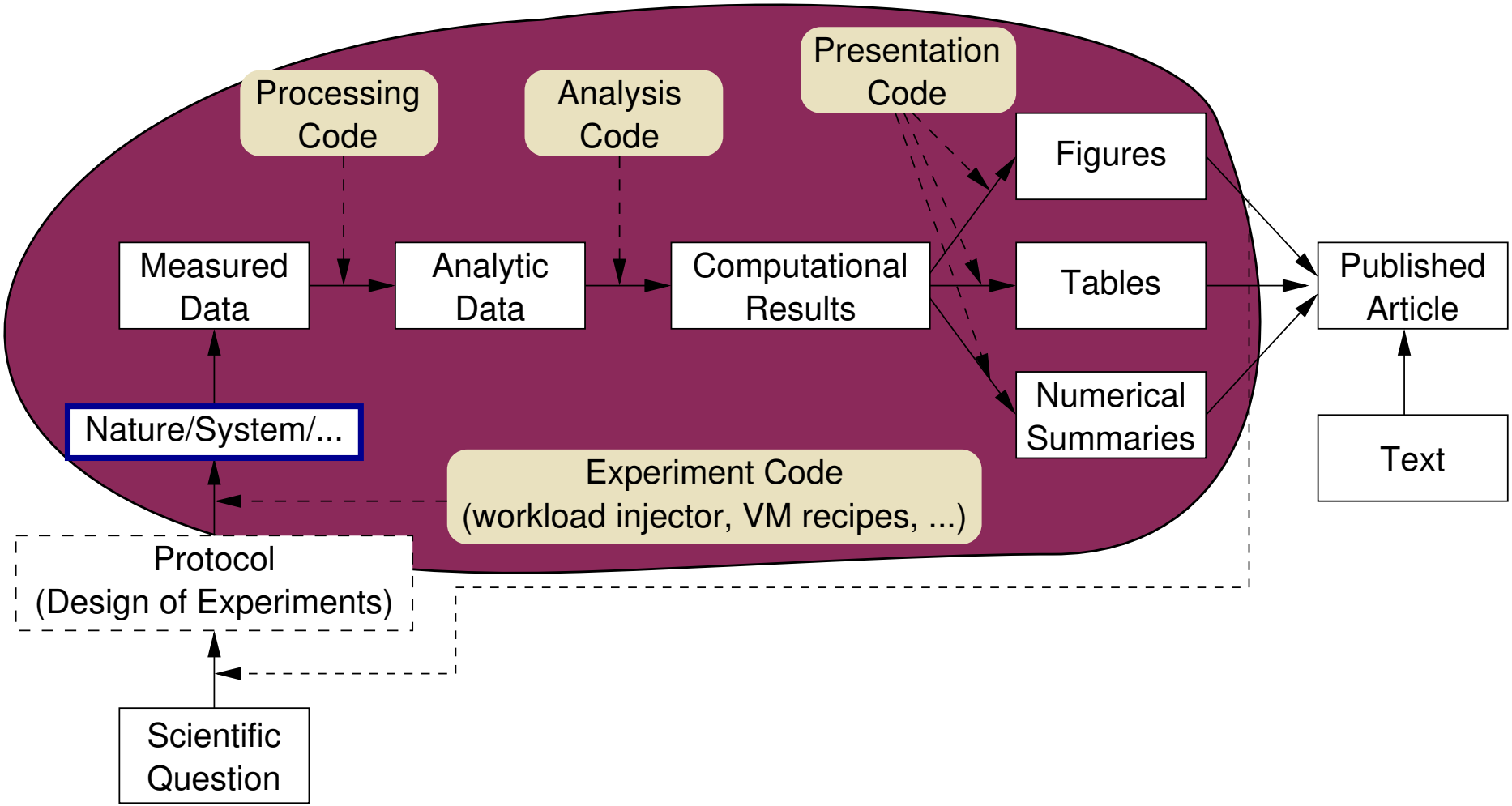
- Modifiability (easy to change/create a plot)
- Language-agnostic (R for plots, Python for algos...)

In our case.

- Simulation output $\simeq$ 320 Go $\rightarrow$ (in situ) aggregation


Instance 1
batcmd=...
schedcmd=...
Exec1
Energy trace
Jobs data
Aggregation script
Storage script
Aggregated data
Compressed data
Instance 2
batcmd=...
schedcmd=...
Exec1
Energy trace
Jobs data
Aggregation script
Storage script
Aggregated data
Compressed data
Gather script
Gathered data
analysis scripts
table
plot1
plot2
...
NFS
local disk

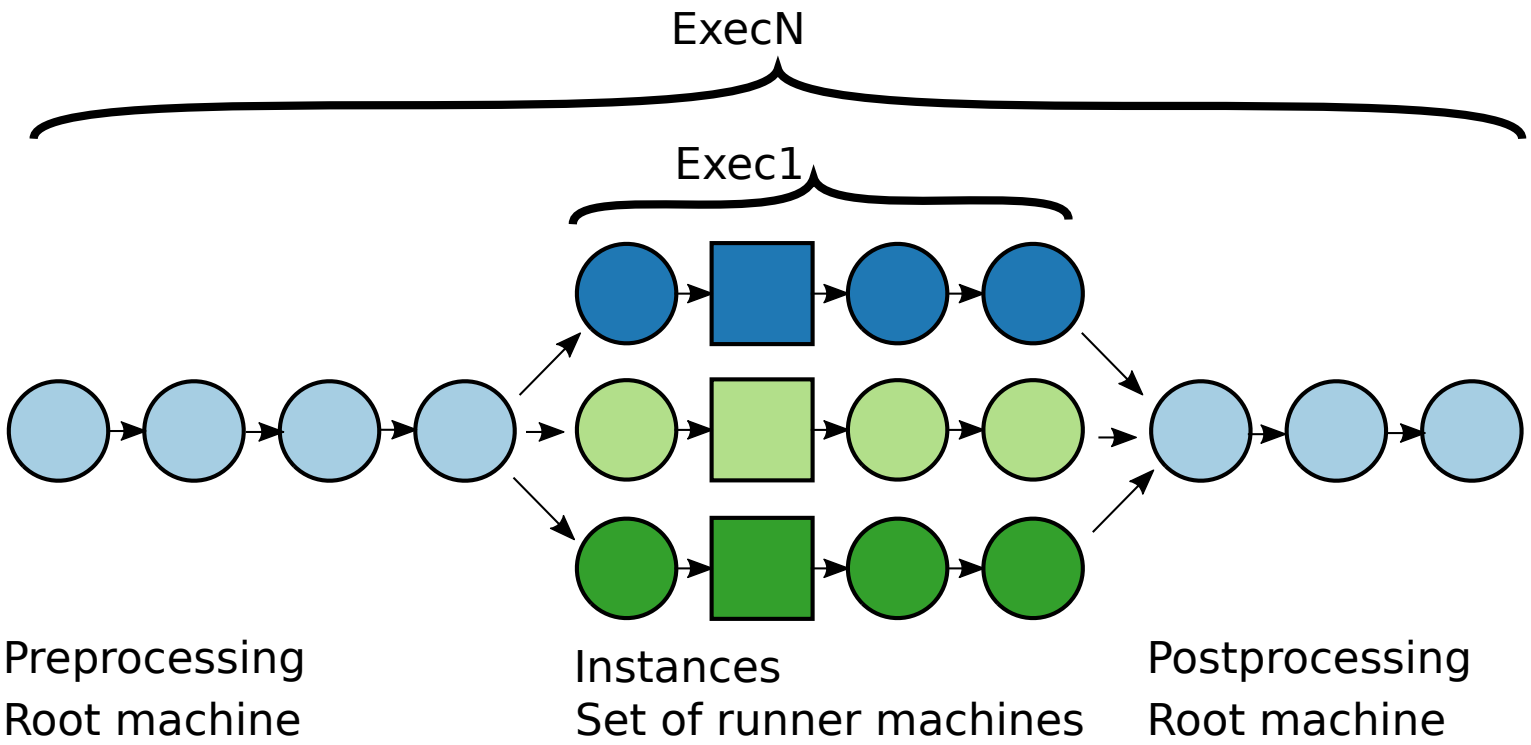
Monolithic Approach



Monolithic Approach

One file to rule them all.

1. Get / generate simulation inputs (platforms, workloads...)
2. Generate simulation instances (union of cartesian products)
3. Run instances + local computations
4. Gather all data
5. Analyze gathered data



Exec* scripts

Goal

- Batsim specific
- Genericity: Experiments and tests

Technology history

- 1: Execo (instance db, process management, remote exec...)
- 2: Execo (instance db) + instance db hacks + py3
- 3: 2 + coroutines

Current status

- Unmaintained.
- subset(exec1) → robin

Discussion

Conclusion

- Reproducible? OK.
- Convenient local/cluster run? OK.
- Caching system? Yes + manual.
- Easy to update params/scripts? Yes.
- Easy to update software env? =/
- Maintainable? =/

Alternatives?

- Nix/Guix (example)
- CWL, Swift