Effective Reproducible Research with Org-Mode and Git

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Experimenting in the Wild

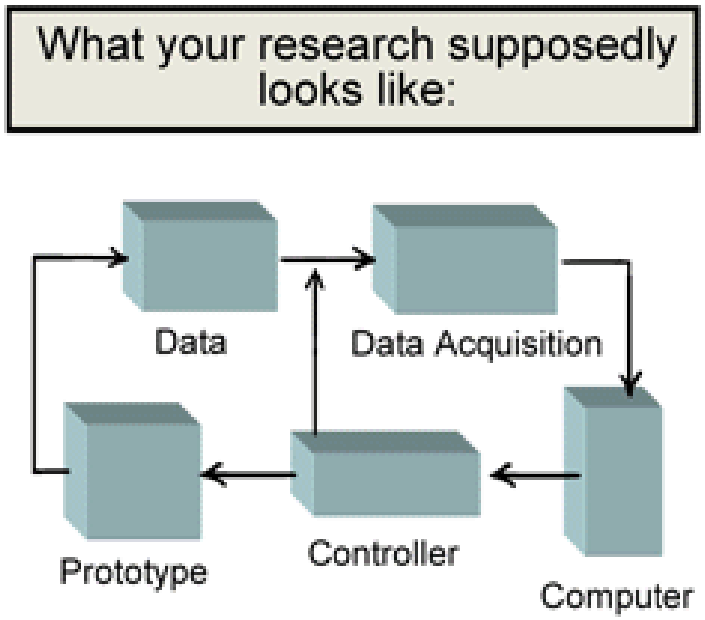


Figure 1. Experimental Diagram

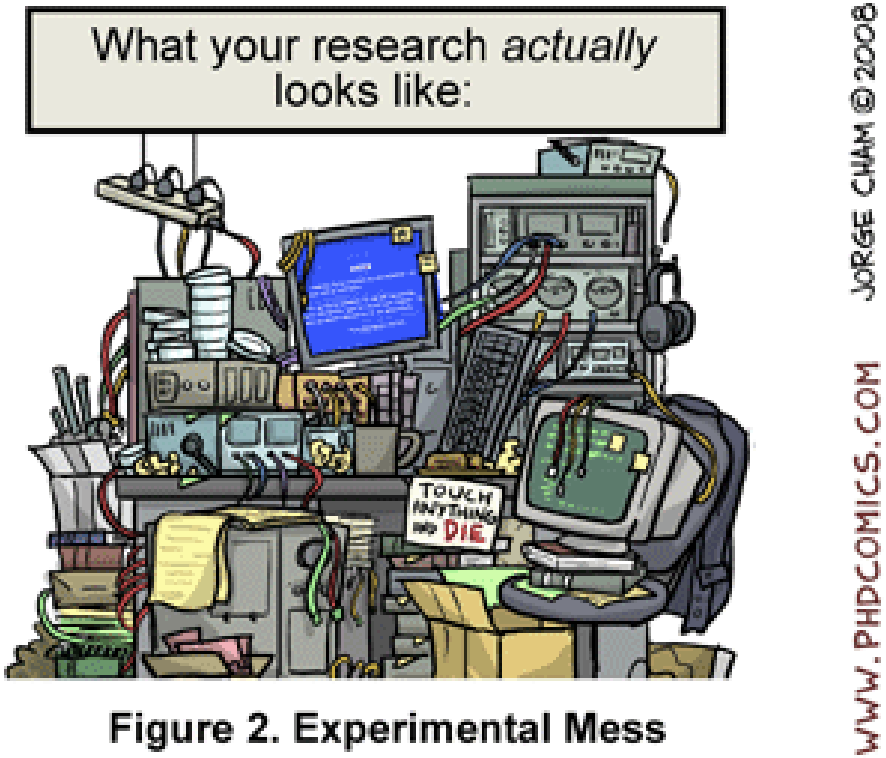


Figure 2. Experimental Mess

Experiments in HPC: Even Worse!

- Using large, distributed, hybrid, prototype hardware/software
- Measuring execution times (makespans, traces, . . .)
- More parameters, very costly and hard to *reproduce*

Reproducing in the Wild

In HPC Community

Reproducing results of others is not in the culture

- Novelty is more rewarded than consolidating existing results
- Excuse #1: Hardware and software evolve very quickly
- Excuse #2: Reproducible research is not mandatory

Why bother?

Motivation for Reproducible Research

- Mistakes are easily done (compiler, OS, ...)
- Compare with others (or even with your previous solutions...)
- Build on others' work

Reproducible Research: Challenging Issues

Experimental Machine Setup

1. Platform accessibility
2. Setting up environment
3. Conducting experiments

Often Neglected Aspects

1. Data and code accessibility
2. Provenance tracking
3. Documenting
4. Extendability
5. Replicable analysis

- Several tools developed to ease specific experimental workflows
- **Our approach**: use a lightweight combination of *existing generic* tools

Outline

Case Study #1: CPU Cache Performance

Studying CPU caches on various Intel and ARM micro-architectures

Issues

Platform related

- Non-standard OS, tools, ARM architectures → *minimal dependencies*
- Unstable environment setup → *need to track many information*
- Limited resources → *no complex workflow*

Application related

- Numerous, ever-growing number of input parameters
- Incrementally growing set of experimental results

→ *organize, browse, compare*

Case Study #2: StarPU+SimGrid

Simulating dynamic task-based runtime executed on hybrid (CPUs + GPUs) platforms

Issues

Platform related

- Prototype hardware with evolving libraries (CUDA, OpenCL, ...)
- Partial access to environment setup $\rightarrow$ *need to track many information*

Application related

- Complex evolving source codes $\rightarrow$ *need to manage external repositories*
- Incrementally growing set of experimental results

$\rightarrow$ *organize, browse, compare*

Outline

Conclusion (1/2)

Pros

- Fast and efficient for daily usage (loose safety belts: *git status, branch organization, labbook, . . .*)
- No perfect replicability but good level of confidence in reproduction
- Not limited to specific use cases
- Good provenance tracking (easy to extend and explore)
- Writing reproducible articles becomes a natural step

StarPU+SimGrid Euro-Par Paper

Anyone can check and try to reproduce this work

http://dx.doi.org/10.6084/m9.figshare.928338

Conclusion (2/2)

Cons

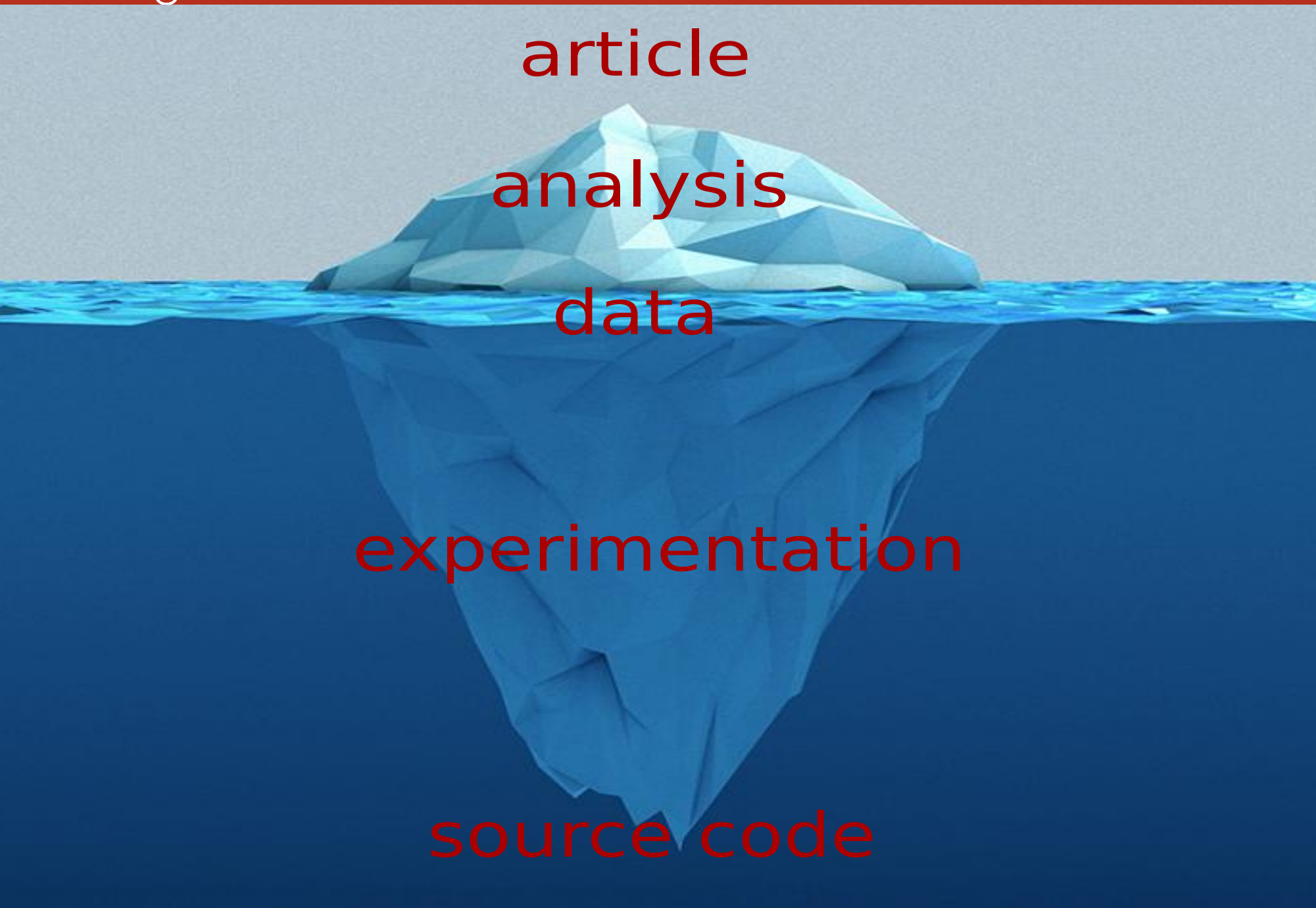
- Git + Emacs + Org-mode + R + ... = steep learning curve
- Git is not designed for storing large data files
  - Sometimes crash during transfers
  - Checkouts are slow
  - Free public git servers are not meant for such workload
- Managing several external source repositories can be cumbersome

Open Questions

- Multiple developers and experimenters working in parallel
- Ideally our whole git repository would be public (e.g., github)

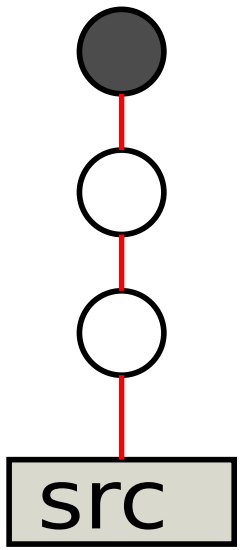
Does this really help external researchers?

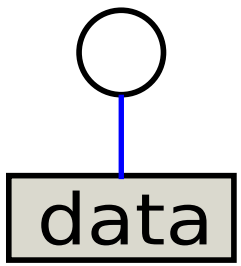
Iceberg



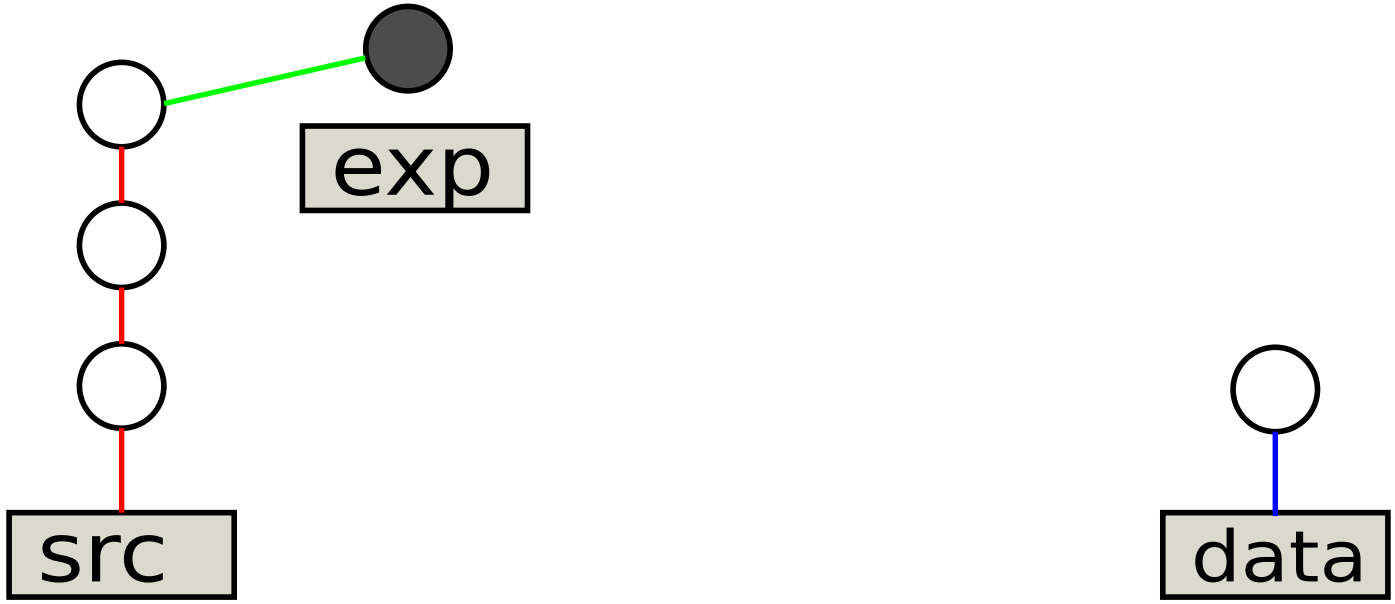
2 Branches

Source Modifications

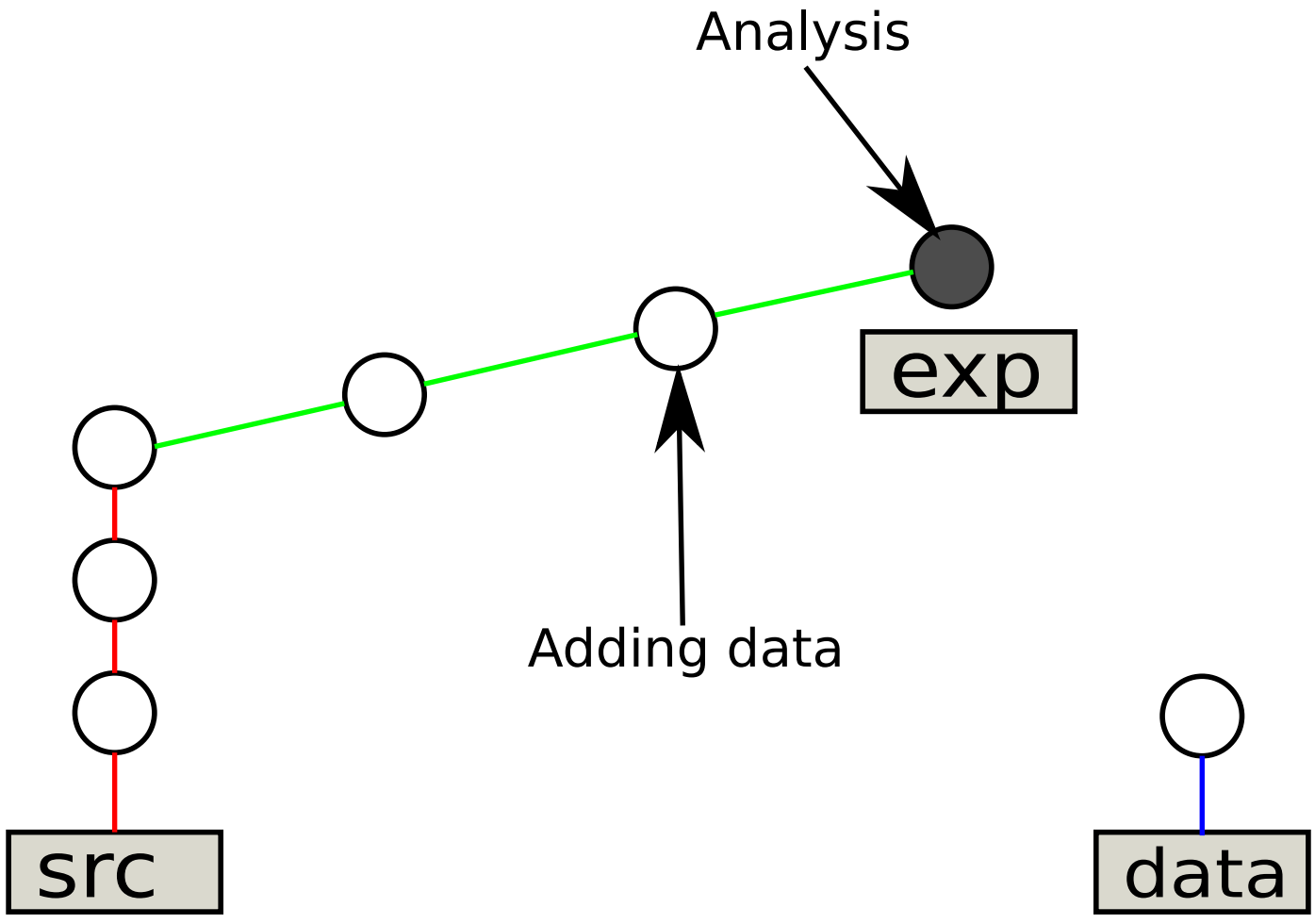




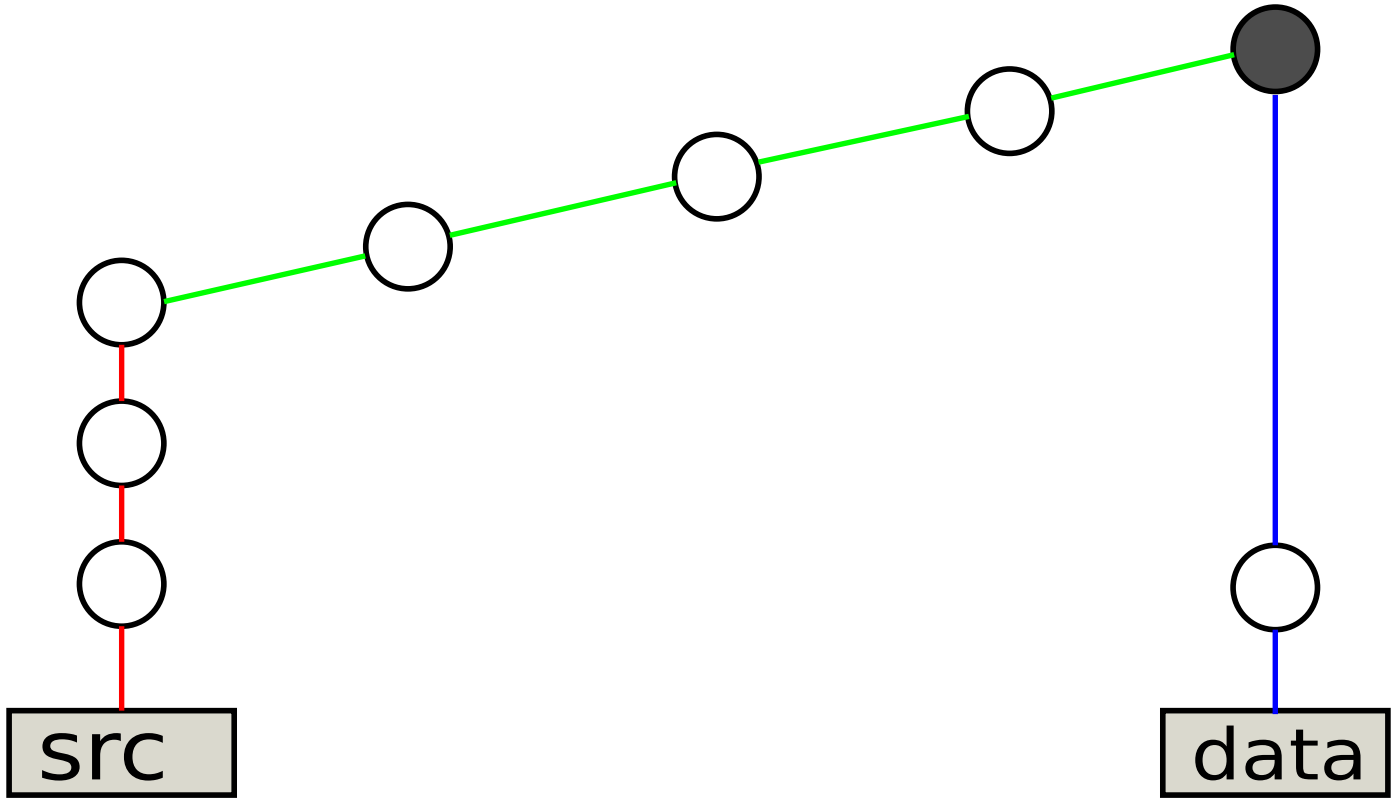
New Branch for Experimentation



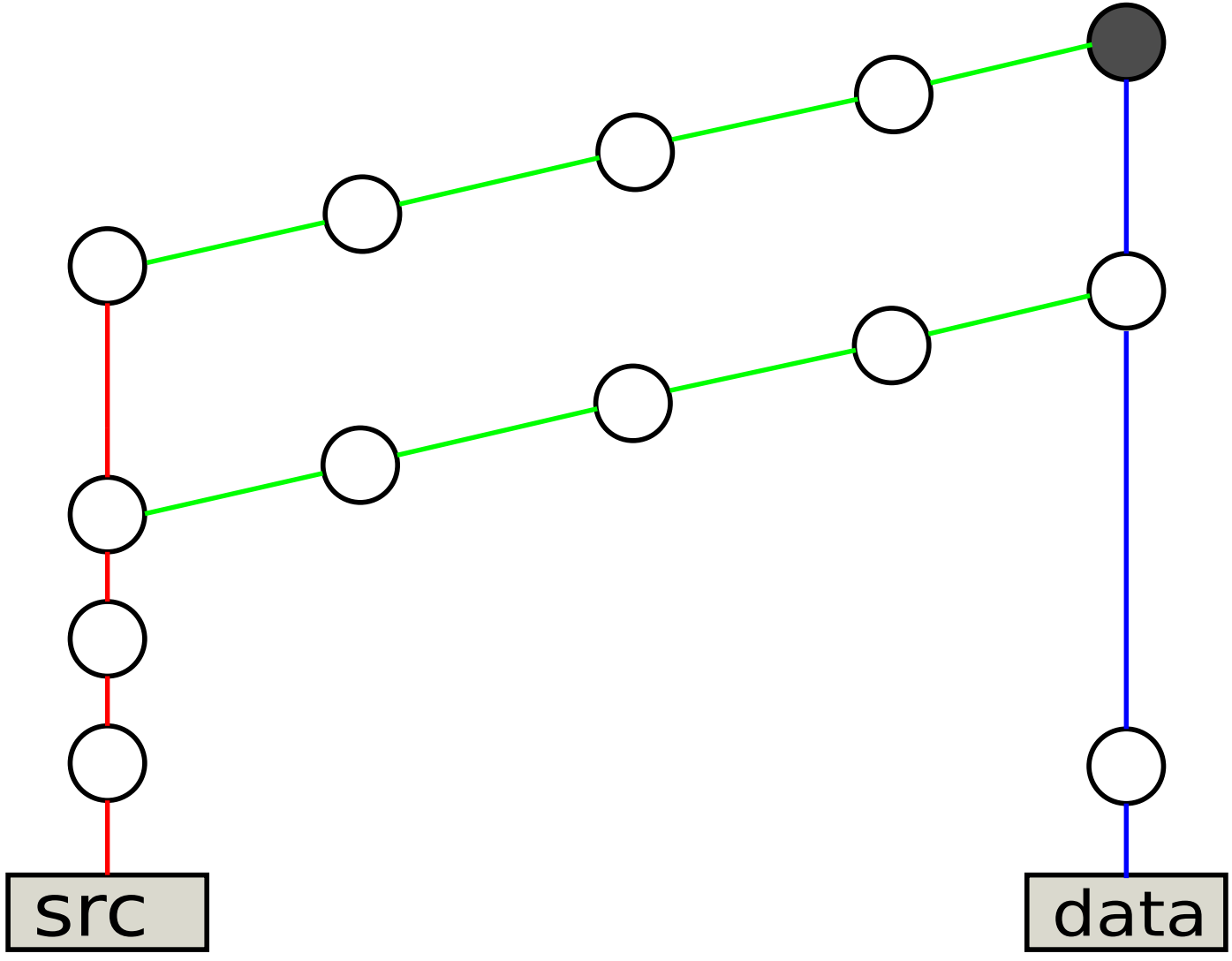
Analyzing Results



Merging Branches



New Experiment



Possible Conflicts