MAUS

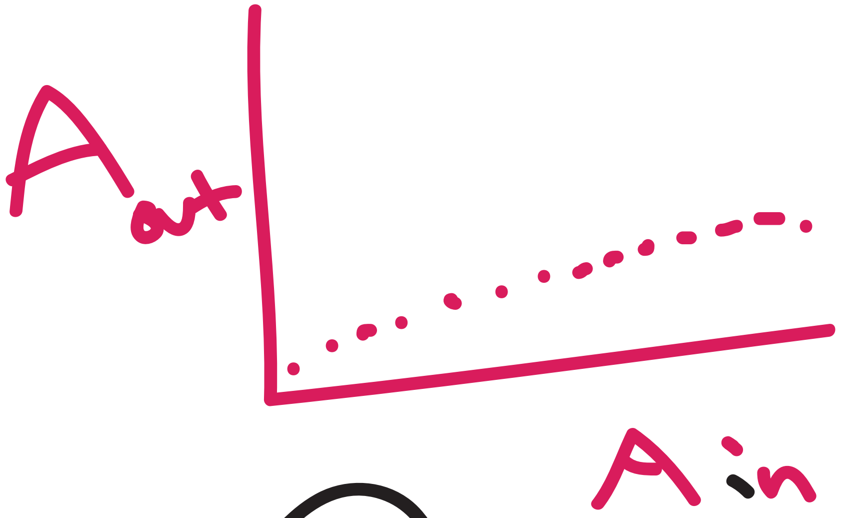
Christopher Tunnell
JAI @ Oxford

MAUS

Scientists aren’t stupid: software is.

Christopher Tunnell
JAI @ Oxford

PRL Arxiv Textbooks



Analysis

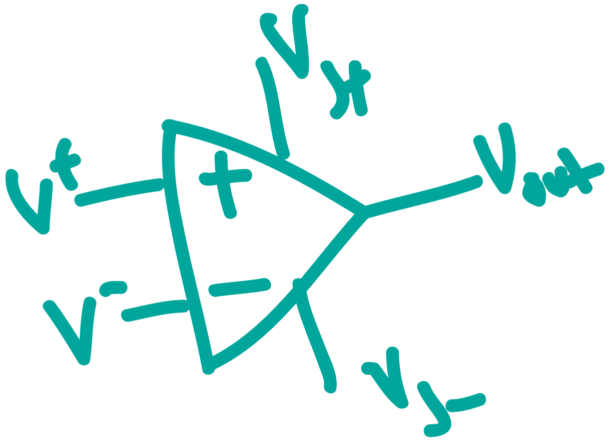
ROOT

$\mathcal{L}$ $F = q\vec{v}\times\vec{B}$ G4 dE/dx F.E.

Software

unpacking

DAQ TDC ADC



Detectors

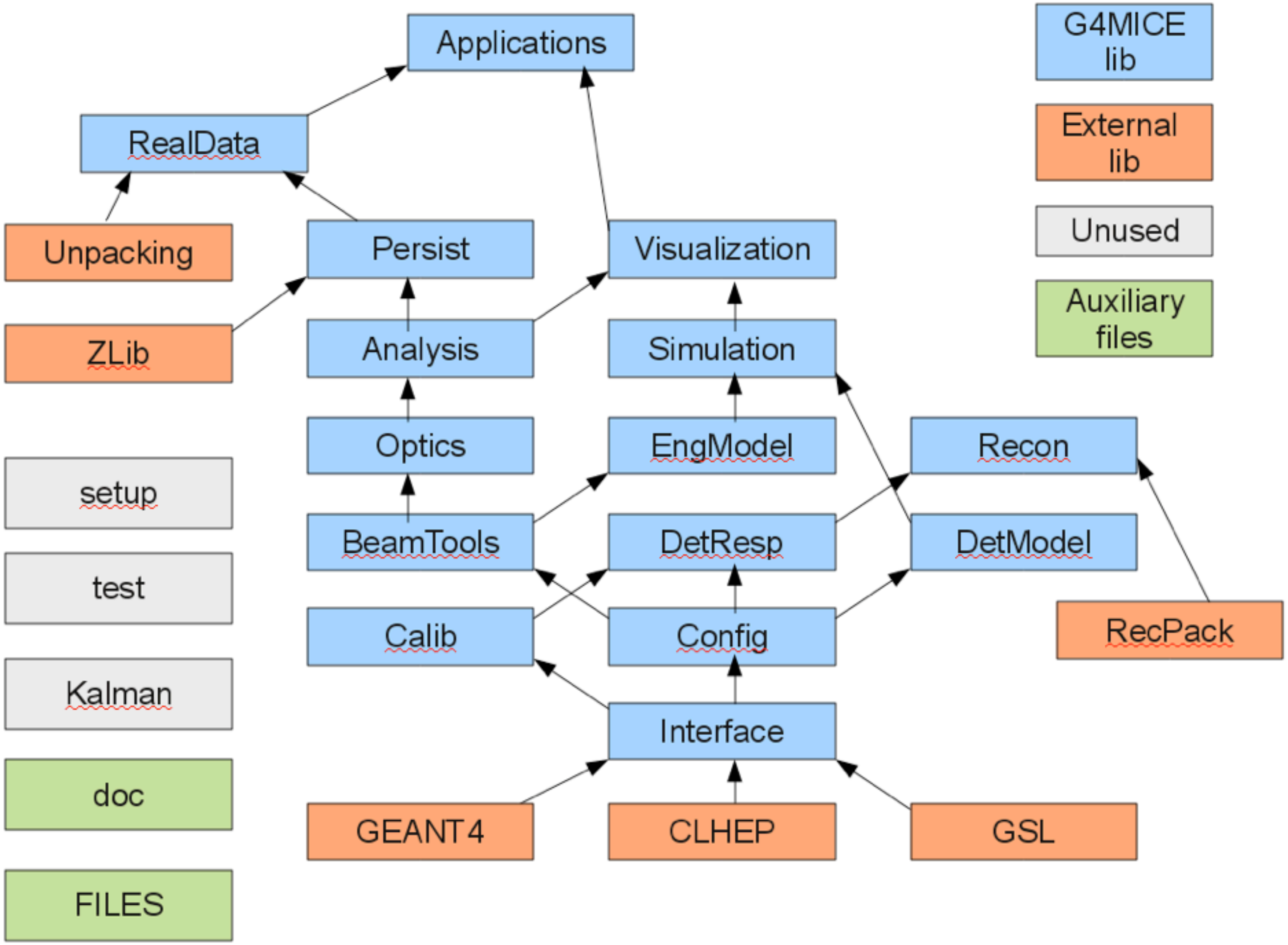
Software **is** Engineering

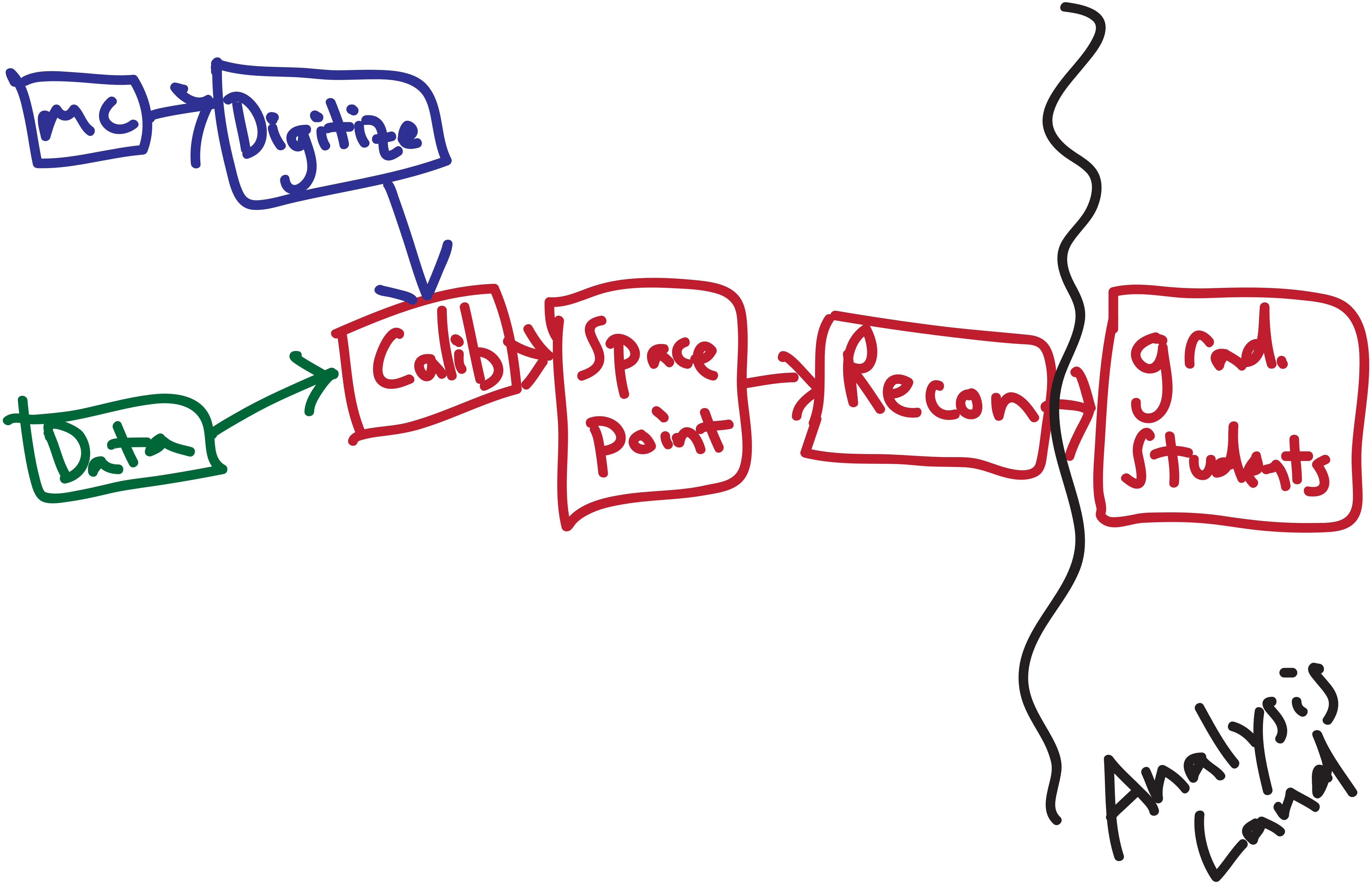
- Think DAQ: both should be general, but you tell DAQ people the rough idea
- Think RF: both software and RF are black arts where if you aren't careful... boom.
- Making software is slow: need to start now on >year workplan OR run blind
  - Wiki runplan? Control room plots? Detector plots?
- Should get a non-physics paper out of this.

MC & Data to Step 4 Physics

- G4Beamline and 'custom code' used heavily
  - G4MICE team is only approving Simulation application for MC truth
  - More to G4MICE than Geant4! Much of it is dead code.
- Inability to verify that code works; led to blind data taking
- Previous heads of G4MICE admit it's a proposal code

G4MICE


Applications
RealData
Unpacking
Persist
Visualization
ZLib
Analysis
Simulation
setup
Optics
EngModel
Recon
test
BeamTools
DetResp
DetModel
Calib
Config
RecPack
Kalman
Interface
doc
GEANT4
CLHEP
GSL
FILES
G4MICE lib
External lib
Unused
Auxiliary files


MC
Digitize
Data
Calib
Space Point
Recon
grad. Students
Analysis Land

Status Of Detector Code

TOF:

1.Detector

2.Geometry/Unpacking

3.Digitization

4.Spacepoint

5.Reconstruction

CKOV:

1.Detector

2.Geometry/Unpacking

3.Digitization

4.Spacepoint

5.Reconstruction

Trigger

SciFi:

1.Detector

2.Geometry/Unpacking

3.Digitization

4.Spacepoint

5.Reconstruction

EMR:

1.Detector

2.Geometry/Unpacking

3.Digitization

4.Spacepoint

5.Reconstruction

Move from proposal code to analysis code

- How to do this transition? Make possible new people contribute. Make functional. Make easy. Make good.
- Be able to save G4MICE data (ie. persist)
- For code blocks, be able to verify:
  - physics (KS tests)
  - functionality (unit tests)
  - stability (crash in control room?)
- Spills, triggers, DAQ-like dataflow, oh my...

MAUS: MICE Analysis User Software

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- Be able to save G4MICE data (ie. persist)
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  - functionality (unit tests)
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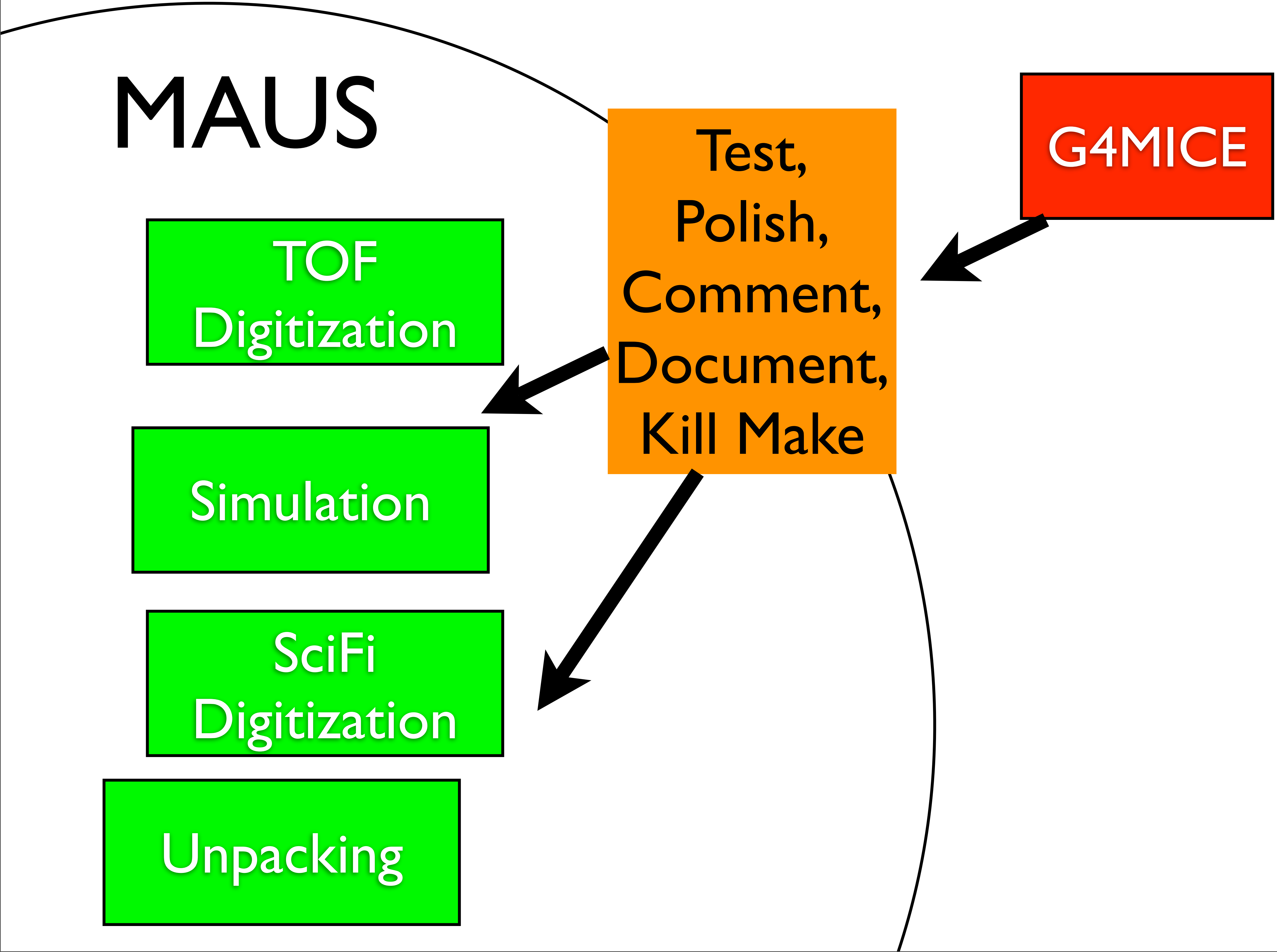
MAUS goals

- Repackage, cleanup, and test old code
- Make easy for new people to contribute
- Work well, efficiently, and correctly



MAUS

G4MICE

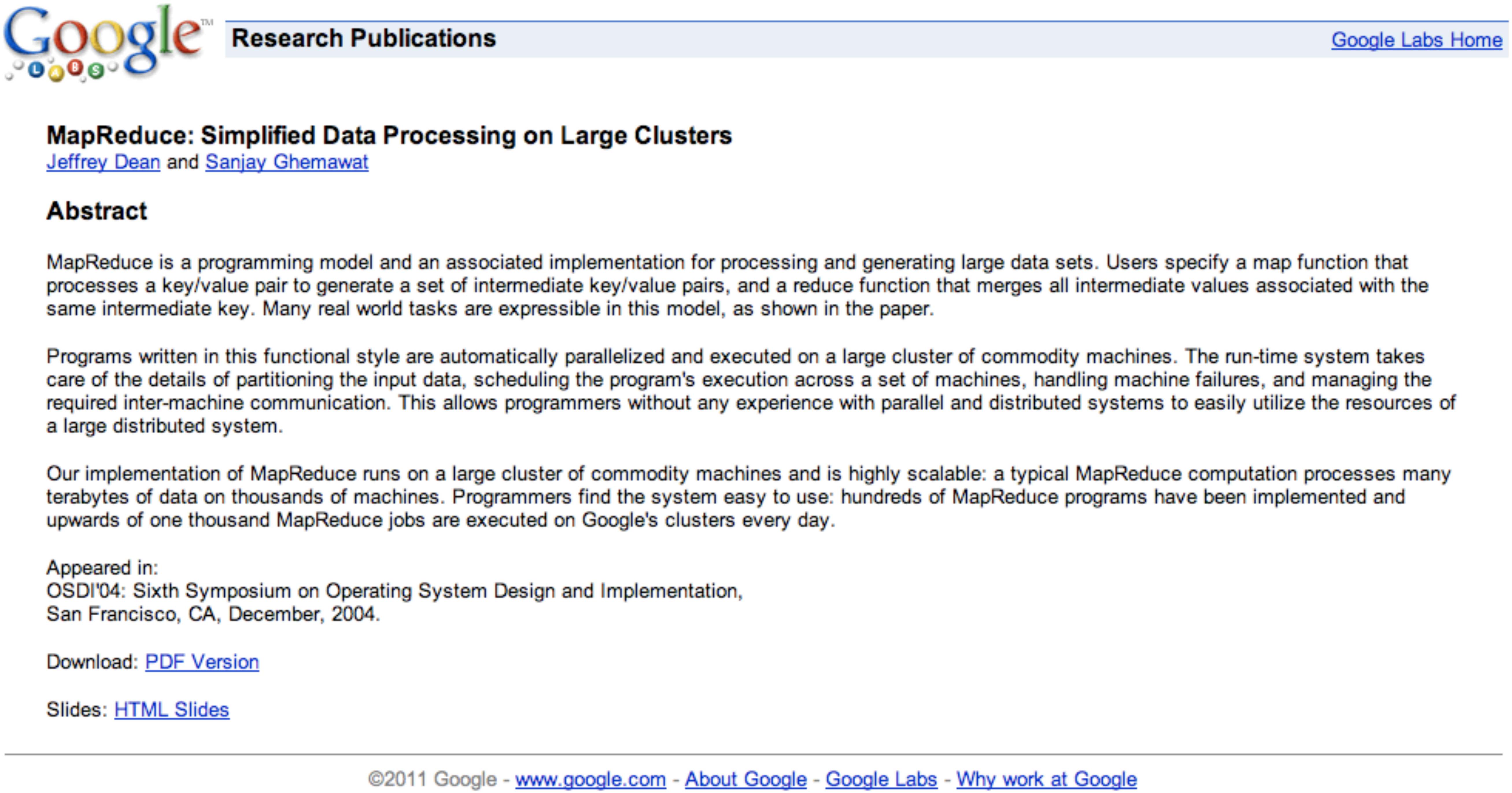
Test, Polish, Comment, Document, Kill Make

TOF Digitization

Simulation

SciFi Digitization

Unpacking



Research Publications

Google Labs Home

MapReduce: Simplified Data Processing on Large Clusters

Jeffrey Dean and Sanjay Ghemawat

Abstract

MapReduce is a programming model and an associated implementation for processing and generating large data sets. Users specify a map function that processes a key/value pair to generate a set of intermediate key/value pairs, and a reduce function that merges all intermediate values associated with the same intermediate key. Many real world tasks are expressible in this model, as shown in the paper.

Programs written in this functional style are automatically parallelized and executed on a large cluster of commodity machines. The run-time system takes care of the details of partitioning the input data, scheduling the program's execution across a set of machines, handling machine failures, and managing the required inter-machine communication. This allows programmers without any experience with parallel and distributed systems to easily utilize the resources of a large distributed system.

Our implementation of MapReduce runs on a large cluster of commodity machines and is highly scalable: a typical MapReduce computation processes many terabytes of data on thousands of machines. Programmers find the system easy to use: hundreds of MapReduce programs have been implemented and upwards of one thousand MapReduce jobs are executed on Google's clusters every day.

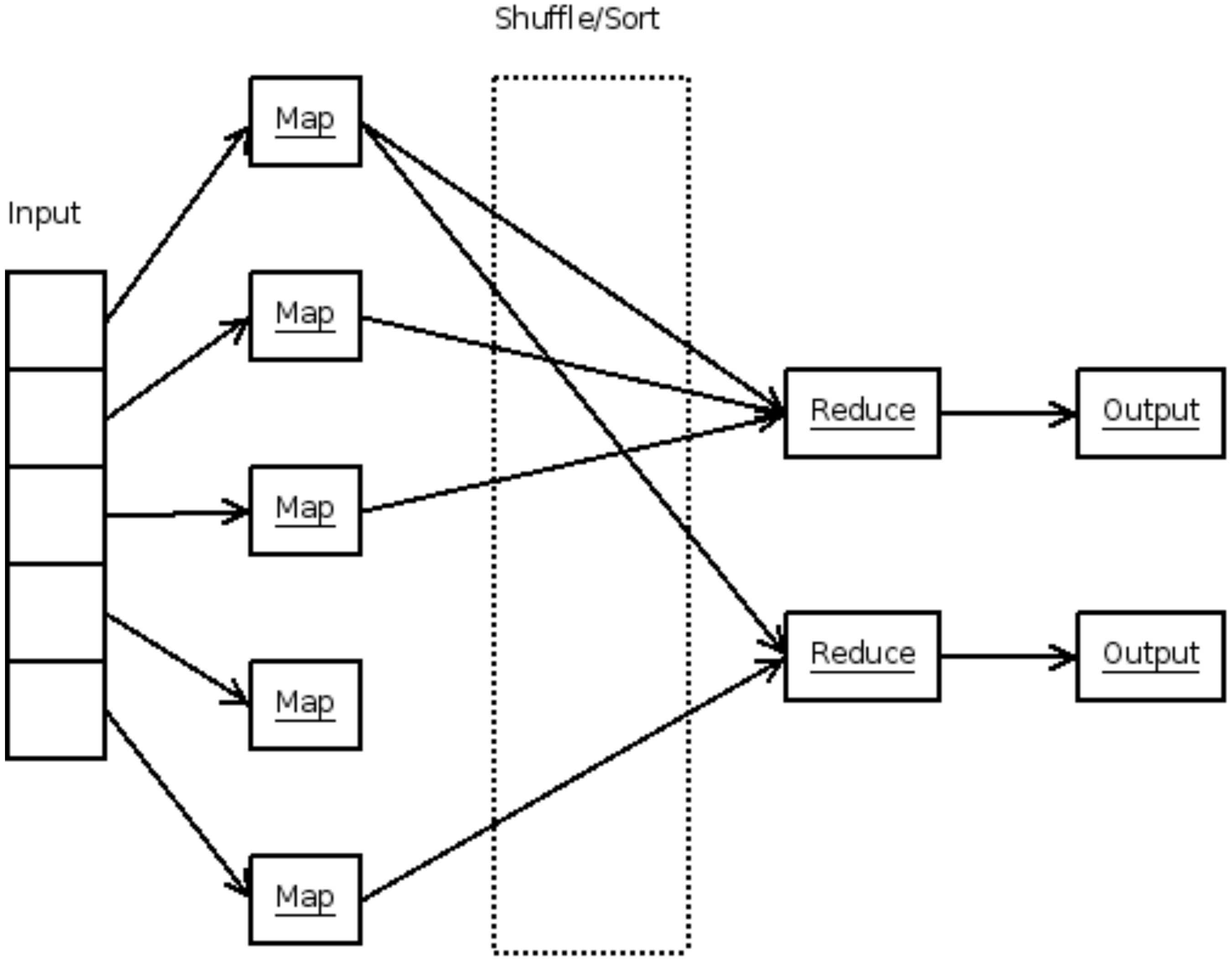
Appeared in:
OSDI'04: Sixth Symposium on Operating System Design and Implementation,
San Francisco, CA, December, 2004.

Download: PDF Version

Slides: HTML Slides

Map Reduce

- map: User specifies operation on single event
- reduce: User specifies operation on all events



A lot of ground to cover. Add something to the MICE arsenal...

What does the mouse need?

Input/Output

- JSON (human readable, XML-like)
- ROOT
- DATEServer (input only)
- Bytestream (input only)

Map: action on single event

- BeamMaker
- Simulation
- Unpacker
- Virtual Planes
- Digitization
- Tracker Fit

- EPICS Alarm
- Fake MCTruth
- TOF Fit
- Instrumental Cut
- Transfer Matrix
- ...

Reduce: action on many events

- XBoa - compute accelerator physics quantities like emittance, amplitude, beta, etc.
- Histogram
- Systematic corrections
- ...

Data Structure

- JSON format
- Extendable
- Spills
- spill['mc'][0]['energy'] = 210

```
{
    "mc": [
        {
            "energy": 210,
            "particle_id": 13,
            "position": {
                "x": 0.0,
                "y": -0.0,
                "z": -5000
            },
            "random_seed": 10,
            "unit_momentum": {
                "x": 0,
                "y": 0,
                "z": 1
            }
        }
    ]
}
```

Data Structure

- Spills have:
    - Triggers
    - Digits
    - MC Particles
    - Virtual Planes
    - Spill number
    - ...

```
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    "mc": [
        {
            "energy": 210,
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            }
        }
    ]
}
```

MapCppSimulation.Process(y)

```
{
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            "position": {
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                "y": -0.0,
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            },
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            "unit_momentum": {
                "x": 0,
                "y": 0,
                "z": 1
            }
        }
    ]
}
```

→

```
{
    "digits" : [ ... ],
    "mc": [
        {
            "hits": [ ... ],
            "tracks": [ ... ],
            "energy": 210,
            "particle_id": 13,
            "position": {
                "x": 0.0,
                "y": -0.0,
                "z": -5000
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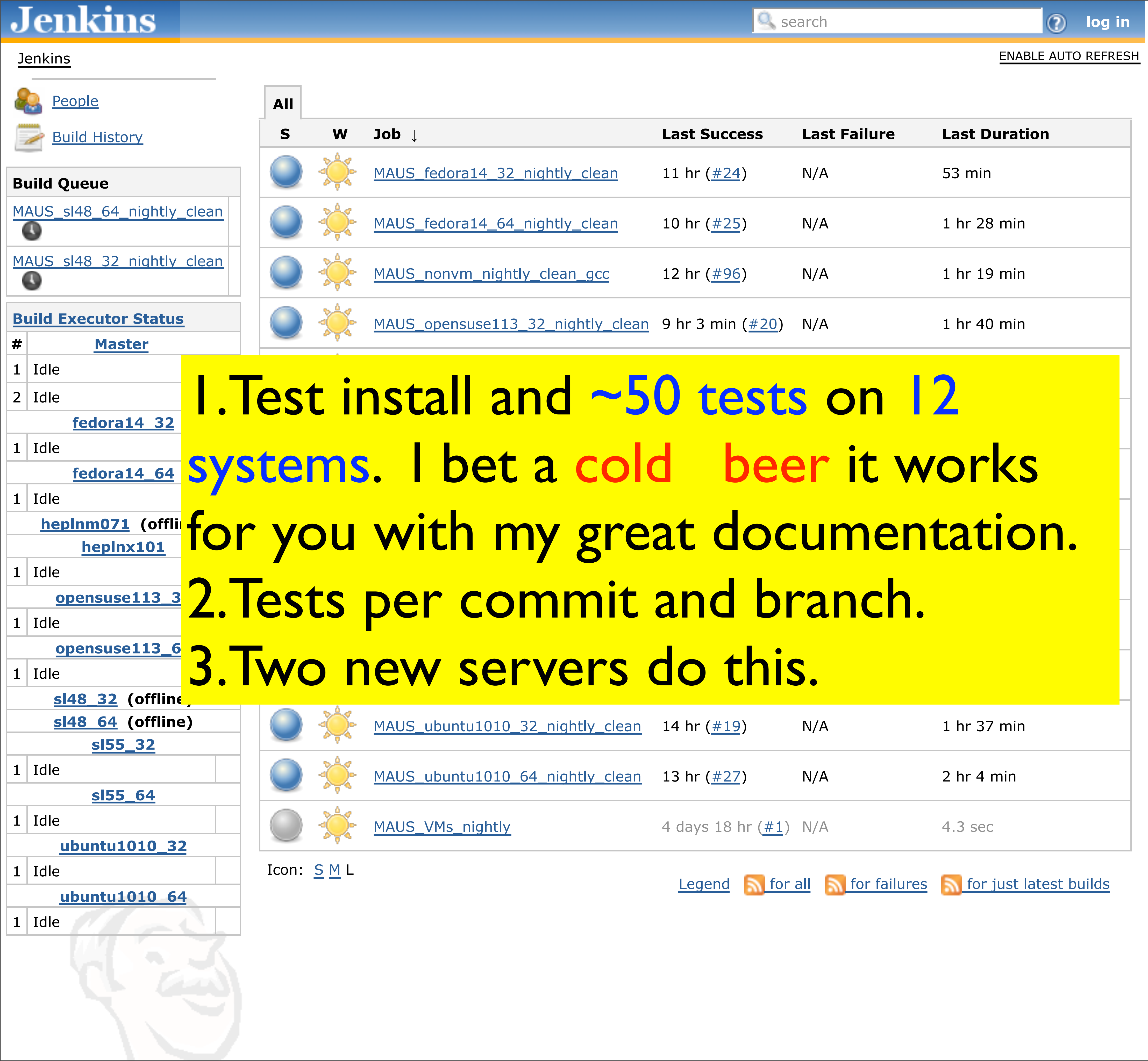


Jenkins

search

log in

Jenkins

ENABLE AUTO REFRESH

People

Build History

Build Queue

MAUS_sl48_64_nightly_clean

MAUS_sl48_32_nightly_clean

#	Build Executor Status Master
1	Idle
2	Idle
	fedora14_32
1	Idle
	fedora14_64
1	Idle
	heplnm071 (offli
	heplnx101
1	Idle
	opensuse113_3
1	Idle
	opensuse113_6
1	Idle
	sl48_32 (offline)
	sl48_64 (offline)
	sl55_32
1	Idle
	sl55_64
1	Idle
	ubuntu1010_32
1	Idle
	ubuntu1010_64
1	Idle

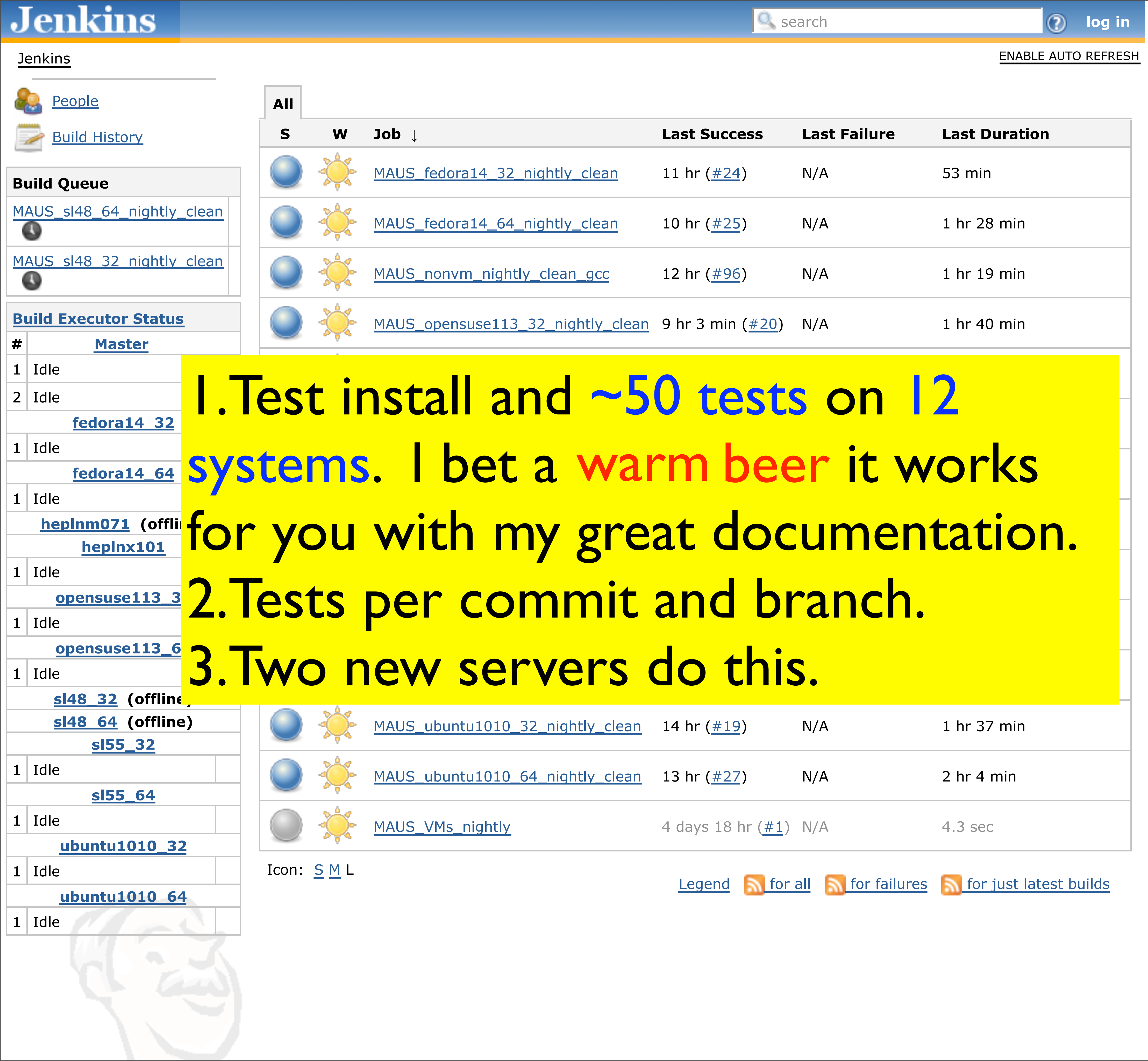
All

S	W	Job ↓	Last Success	Last Failure	Last Duration
●	☀	MAUS_fedora14_32_nightly_clean	11 hr (#24)	N/A	53 min
●	☀	MAUS_fedora14_64_nightly_clean	10 hr (#25)	N/A	1 hr 28 min
●	☀	MAUS_nonvm_nightly_clean_gcc	12 hr (#96)	N/A	1 hr 19 min
●	☀	MAUS_opensuse113_32_nightly_clean	9 hr 3 min (#20)	N/A	1 hr 40 min
●	☀	MAUS_ubuntu1010_32_nightly_clean	14 hr (#19)	N/A	1 hr 37 min
●	☀	MAUS_ubuntu1010_64_nightly_clean	13 hr (#27)	N/A	2 hr 4 min
○	☀	MAUS_VMs_nightly	4 days 18 hr (#1)	N/A	4.3 sec

Icon: S M L

Legend for all for failures for just latest builds

1. Test install and ~50 tests on 12 systems. I bet a cold beer it works for you with my great documentation.
2. Tests per commit and branch.
3. Two new servers do this.



Jenkins   search   log in

Jenkins   ENABLE AUTO REFRESH

People

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al Muon Ionization Cooling Experiment http://mice.iit.edu/

INTERNATIONAL MUON IONIZATION COOLING EXPERIMENT

— General Information —

Historical document on goals and preliminary design (A. Blondel)

Overview of the experiment and schedule

MICEmine System

Executive Board, Technical Board and working group contacts

Collaborator list Collaboration Board

Governance Job openings

MICE-Notes Technical Reference Document

Theses

MICE at RAL, RA

process

— Upcoming Meetings —

MICE Collaboration Meeting (February 15-18, 2011 – RAL)

— Communication —

Weekly news digest

Meeting Calendar Collaboration Meetings

Speakers Bureau Mailing Lists

Video and Phone Conferences

FAC Open Sessions

EuCARD transnational access to MICE

— Working Groups —

Operations

Beamli — Onli

Softwa (MAUS) Analysis

Detecto — Track r Module

http://micewww.pp.rl.ac.uk/projects/maus