Introduction to Map Reduce

Sponsored by AWS

Continuum Analytics

MapReduce

- A story about **Big Data** ?

CONTINUUM
ANALYTICS

MapReduce

- A story about **Big Data** ?
- I Prefer Large Data
  - No Hype Machine
- *Data of An Unsual Size*
  - C. Titus Brown

CONTINUUM
ANALYTICS

Large Relative to What?

Large Relative to What?

- Can’t fit into Excel

CONTINUUM
ANALYTICS

Large Relative to What?

- Can’t fit into Excel
  - Increase Memory

Large Relative to What?

- Can’t fit into Excel
  - Increase Memory
- Can’t fit into R

CONTINUUM
ANALYTICS

Large Relative to What?

- Can’t fit into Excel
  - Increase Memory
- Can’t fit into R
  - Increase Memory

CONTINUUM
ANALYTICS

Large Relative to What?

- Can’t fit into Excel
  - Increase Memory
- Can’t fit into R
  - Increase Memory
- Can’t fit into Memory
  - Increase Memory

CONTINUUM
ANALYTICS

Large Relative to What?

- Can’t fit into Excel
  - Increase Memory
- Can’t fit into R
  - Increase Memory
- Can’t fit into Memory
  - Increase Memory
- Can’t fit on a single disk
  - Distributed Filesystem: SAN, HDFS/DDFS, AWS: S3, Redshift, etc.

CONTINUUM ANALYTICS

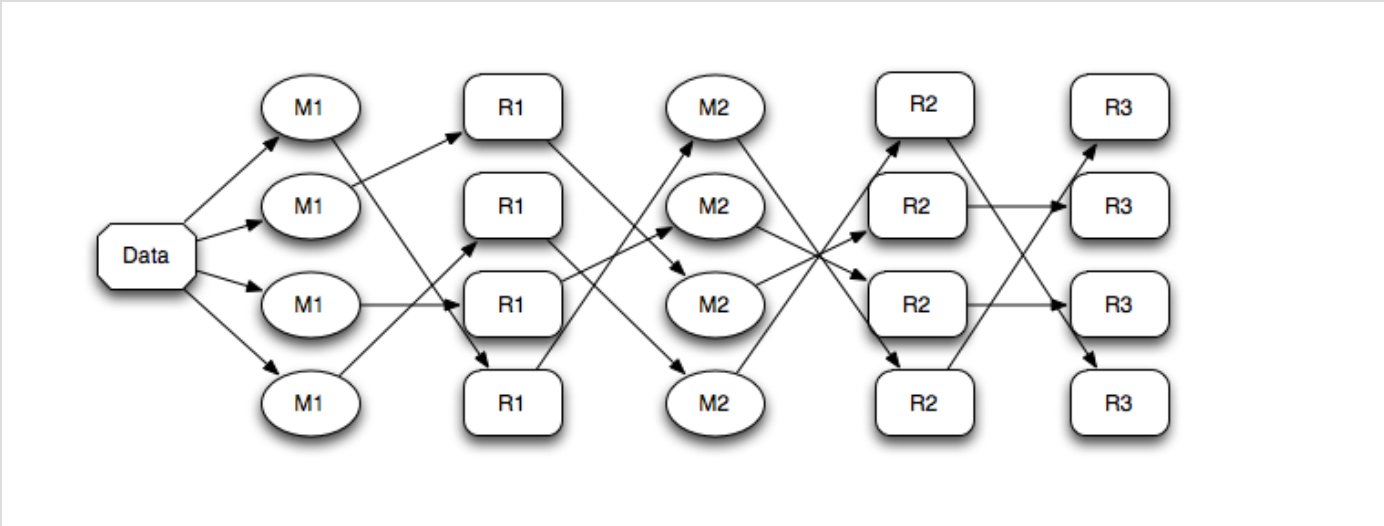
MapReduce

Framework to help solve the problem of distributed computation for distributed data

- A mass of data: records
- Split/**Map** records into key-values pairs
- Collect/Partition kv pairs (Optional Sort)
- Buckets are passed to **Reduce** function
- Result is returned

CONTINUUM ANALYTICS

MapReduce Workflow



- Push Code to Data
- Lots of Network Traffic

CONTINUUM ANALYTICS

MR Implementations

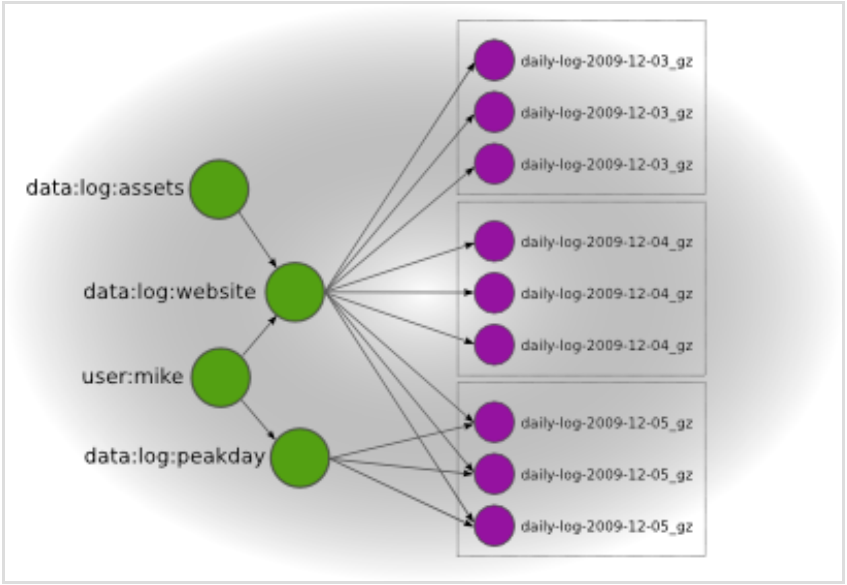
- Disco: Python + Erlang
  - Distributed FileSystem: DDFS

- Hadoop: Java
  - Streaming with Python
  - Dumbo
  - MRJob
  - Hadoopy

CONTINUUM
ANALYTICS

DDFS

- Tag based system



- `ddfs push tag:mytag /the/path/data`
- Replication spreads data across across distributed filesystem
- Comes with chunker

CONTINUUM ANALYTICS

MapReduce: It's a Party

CONTINUUM
ANALYTICS

Batteries Included

- NumPy
- SciPy
- pandas
- scikits-learn
- OpenCV
- ...

CONTINUUM
ANALYTICS

Canonical Example

```
1  from disco.job import Job
2  from disco.core import result_iterator
3
4  class WordCount(Job):
5
6      partitions = 3
7      input=["sherlock.txt","poirot.txt","clouseau.txt"]
8
9      @staticmethod
10     def map(line, params):
11         import string
12         for word in line.split():
13             yield word, 1
14
15     @staticmethod
16     def reduce(iter, params):
17         from disco.util import kvgroup
18         for word, counts in kvgroup(sorted(iter)):
19             yield word, sum(counts)
20
21 if __name__ == "__main__":
22     from disco_words import WordCount
23
24     wordcount = WordCount().run()
25
26     for (word, counts) in result_iterator(wordcount.wait(show=True)):
27         print word, counts
28
```

CONTINUUM ANALYTICS

Bitly Data

- URL shortening service
  - URLs with .gov/.mil are made public
- Typical Clickstream Data
  - JSON encoded
  - url
  - GeoLoc
  - Time
  - OS/Browser
  - ...
- Thank you Wes McKinney

CONTINUUM ANALYTICS

Demo 1

Questions

- What are the top 10 websites are for the day, month, quarter, etc.
- Most popular government institutions
  - NIH vs NASA vs CDC?
- Do most people look at links on mobile devices?
  - what is the break down of Windows vs OSX?
- Click through rate from Facebook vs twitter?

Regional Questions

- NIH only popular in DC, NY, LA ?
- what links are popular outside of the US

CONTINUUM ANALYTICS

WikiLog Data

- Hourly summary statistics
- 4 fields: projectcode, pagename, pageviews, byte size

```
ca Casino_de_Manresa 1 8334
ca Caspar_David_Friedri 2 20242
ca Casquet_Glacial_Pata 1 8640
ca Castell_d%27Eramprun 6 11885
```

- Project codes can *almost* be tied to country/region

CONTINUUM ANALYTICS

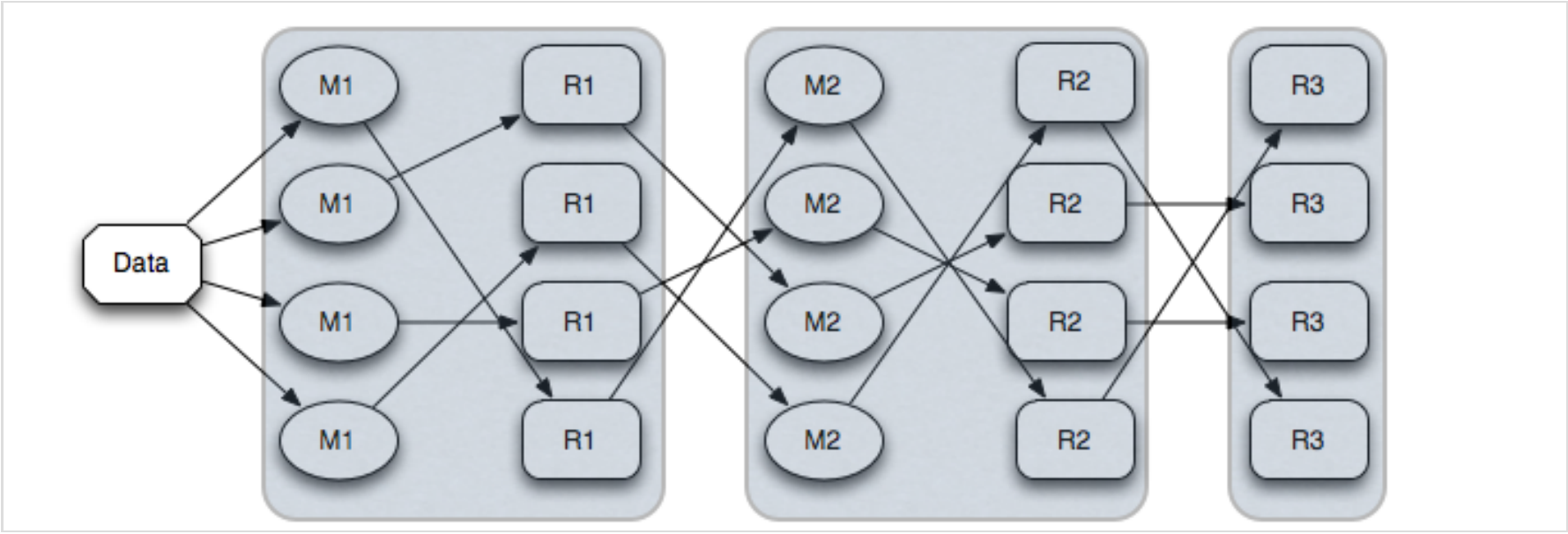
Demo 2

ETL Thoughts

- Try not to use MapReduce for ETL for every job
- Often not tied to SQL
- Be conscience of file storage
  - JSON
  - CSV
  - HDF5
  - AVRO
  - NETCDF4
  - NPZ -Compression
  - IOPS are expensive, GBs/TBs/PBs are cheap

CONTINUUM ANALYTICS

Chaining Jobs

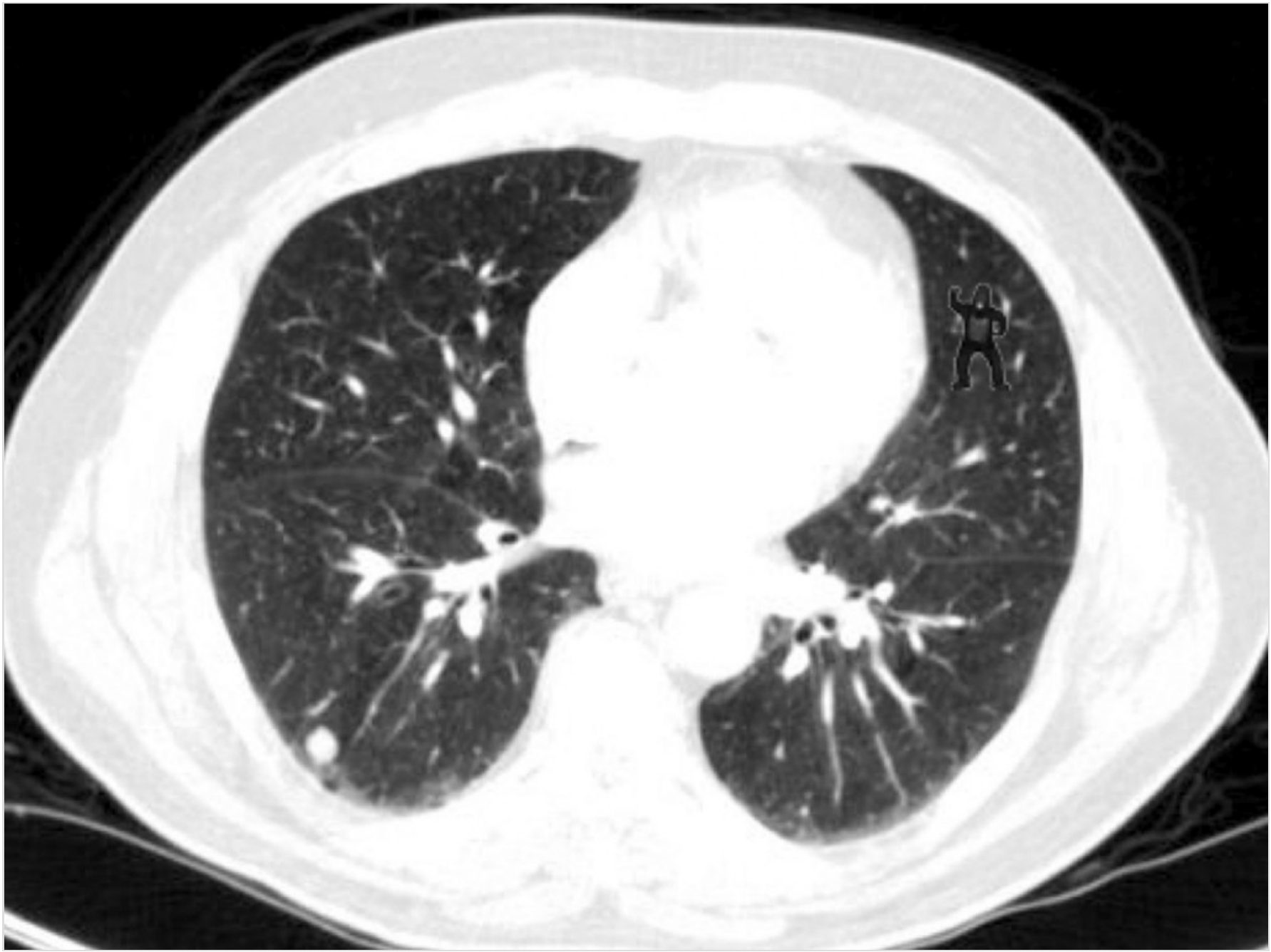


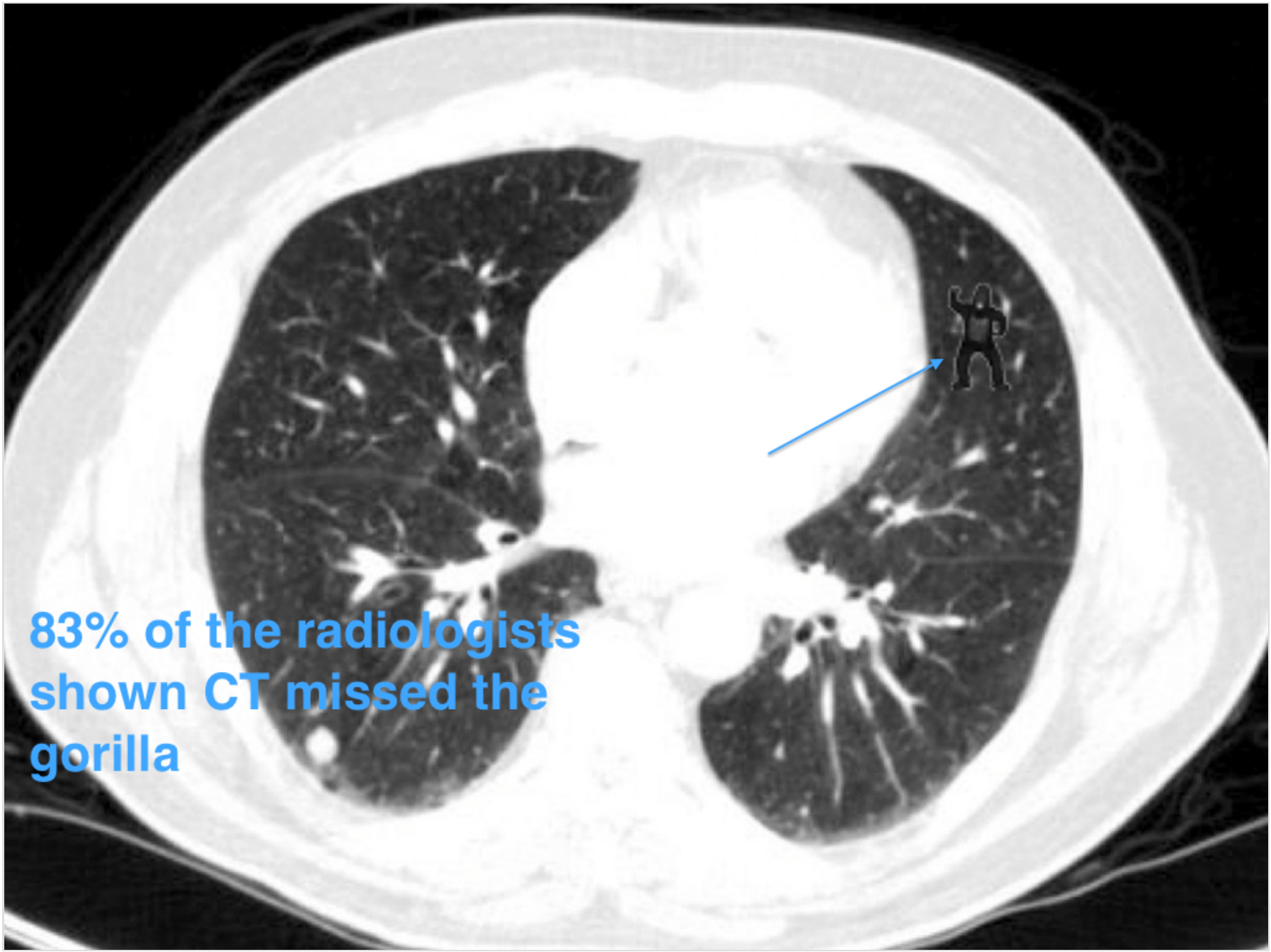
CONTINUUM ANALYTICS

MapReduce Thoughts

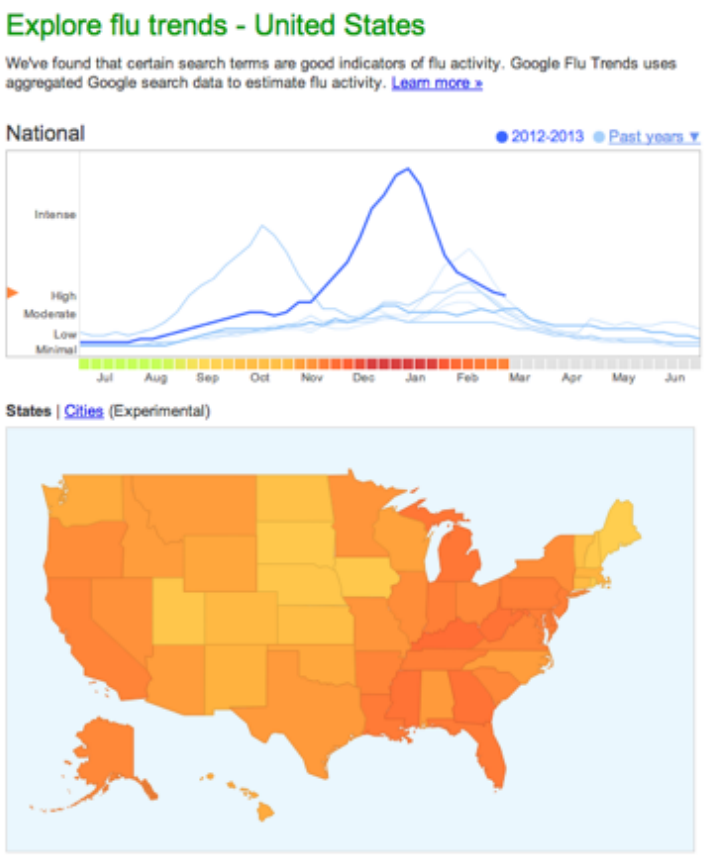
- Data Cleansing
  - Everyone's pain point
- Task Deconstruction
  - Good for code management
  - Hides -- in a good way -- data management
- Can Be Inefficient
  - Network traffic
  - Job organization

CONTINUUM
ANALYTICS




83% of the radiologists shown CT missed the gorilla

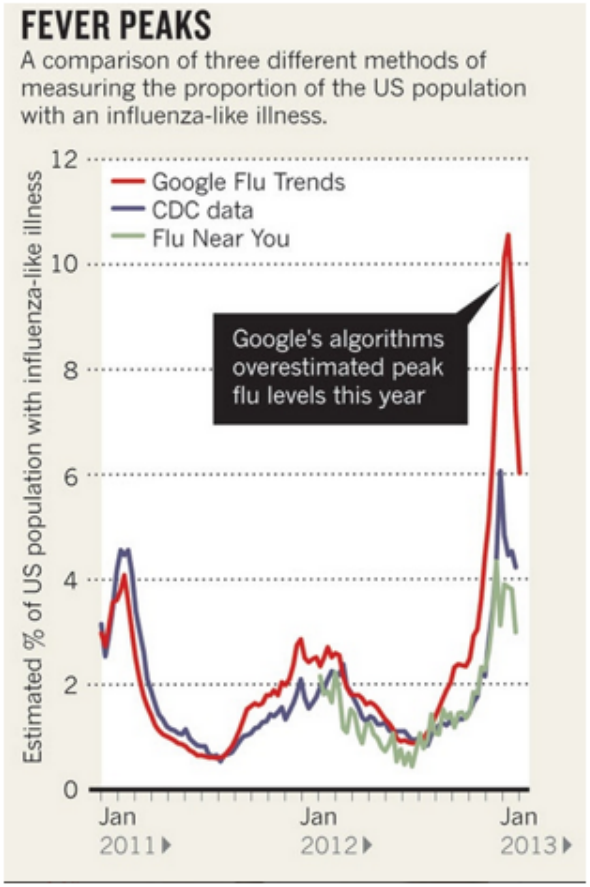
Google Flu



- Data Mining
- Faster than CDC

CONTINUUM ANALYTICS

Google Gets It Wrong



- Typically, prediction is great!
- This year not so much
- Google: No comment!
- Feedback mechanism from hype-up media

CONTINUUM ANALYTICS

Data Philosophy

- Invisible Gorillas will stay Invisible
  - Inattentional Blindess
- Machine Learning without Oversight
  - Turnkey analytics is dangerous
- Good Analysis
  - Requires iterative exploration
  - Peer review and collaboration

CONTINUUM
ANALYTICS

Thank you!

And thank you to the SciPy Sponsors and Organizing Committee