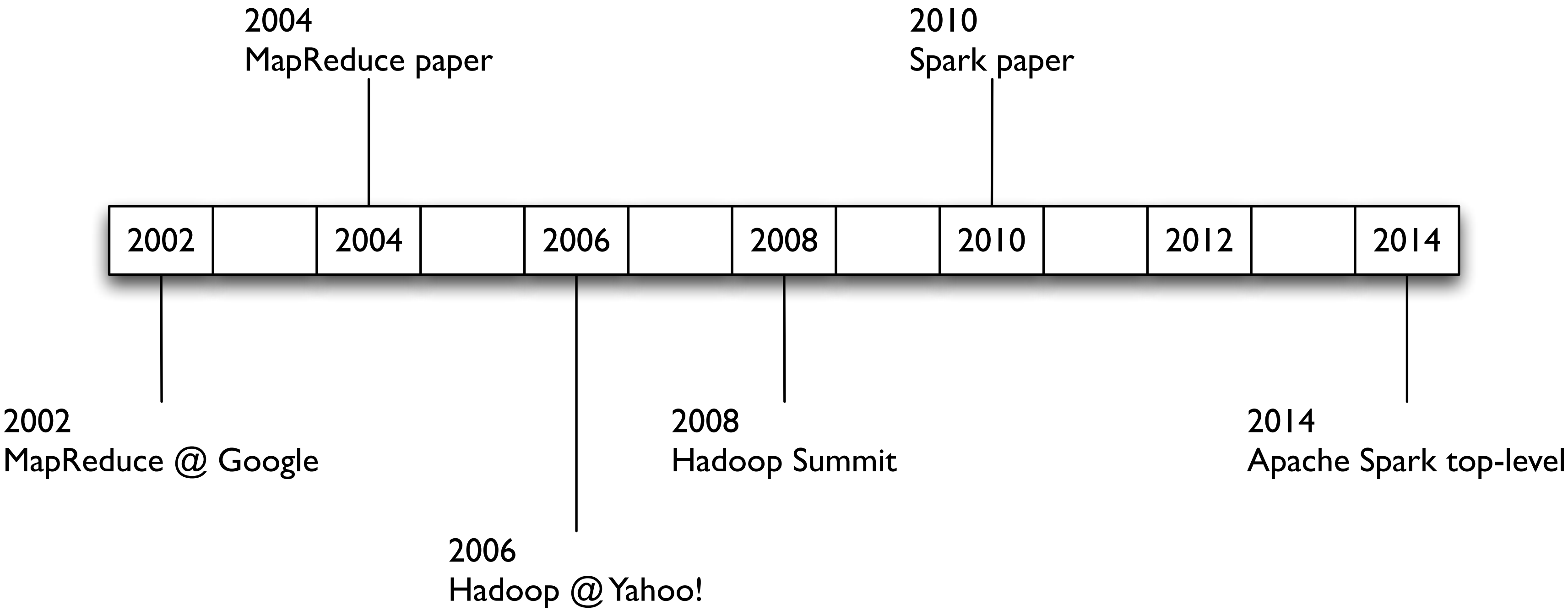
05: Getting Started

A Brief History

lecture: 35 min

A Brief History:



2004
MapReduce paper

2010
Spark paper

2002
MapReduce @ Google

2006
Hadoop @ Yahoo!

2008
Hadoop Summit

2014
Apache Spark top-level

A Brief History: *MapReduce*

circa 1979 – **Stanford**, **MIT**, **CMU**, etc.
set/list operations in LISP, Prolog, etc., for parallel processing
www-formal.stanford.edu/jmc/history/lisp/lisp.htm

circa 2004 – **Google**
MapReduce: Simplified Data Processing on Large Clusters
Jeffrey Dean and Sanjay Ghemawat
research.google.com/archive/mapreduce.html

circa 2006 – **Apache**
Hadoop, originating from the Nutch Project
Doug Cutting
research.yahoo.com/files/cutting.pdf

circa 2008 – **Yahoo**
web scale search indexing
Hadoop Summit, HUG, etc.
developer.yahoo.com/hadoop/

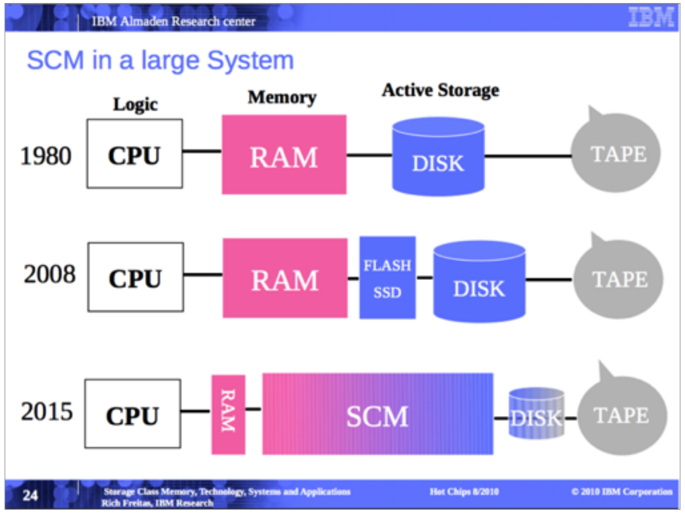
circa 2009 – **Amazon AWS**
Elastic MapReduce
Hadoop modified for EC2/S3, plus support for Hive, Pig, Cascading, etc.
aws.amazon.com/elasticmapreduce/

A Brief History: *MapReduce*

Open Discussion:

Enumerate several changes in data center technologies since 2002…

A Brief History: *MapReduce*



IBM Almaden Research center

IBM

SCM in a large System

Logic

Memory

Active Storage

1980 CPU — RAM — DISK — TAPE

2008 CPU — RAM FLASH SSD DISK — TAPE

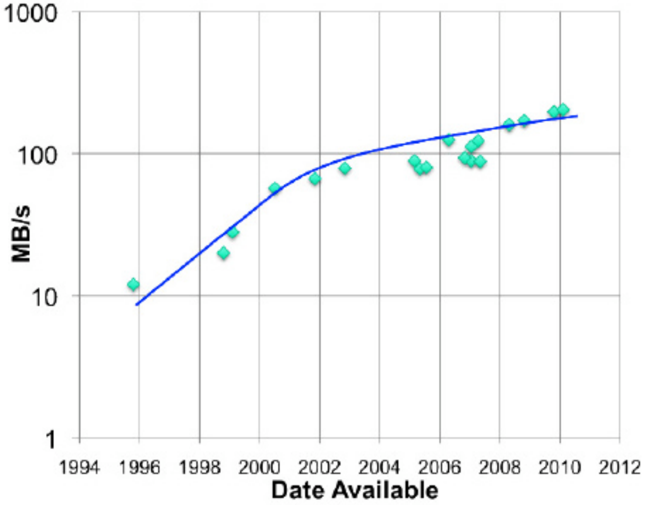
2015 CPU — RAM — SCM — DISK — TAPE

24 Storage Class Memory, Technology, Systems and Applications
Rich Freitas, IBM Research

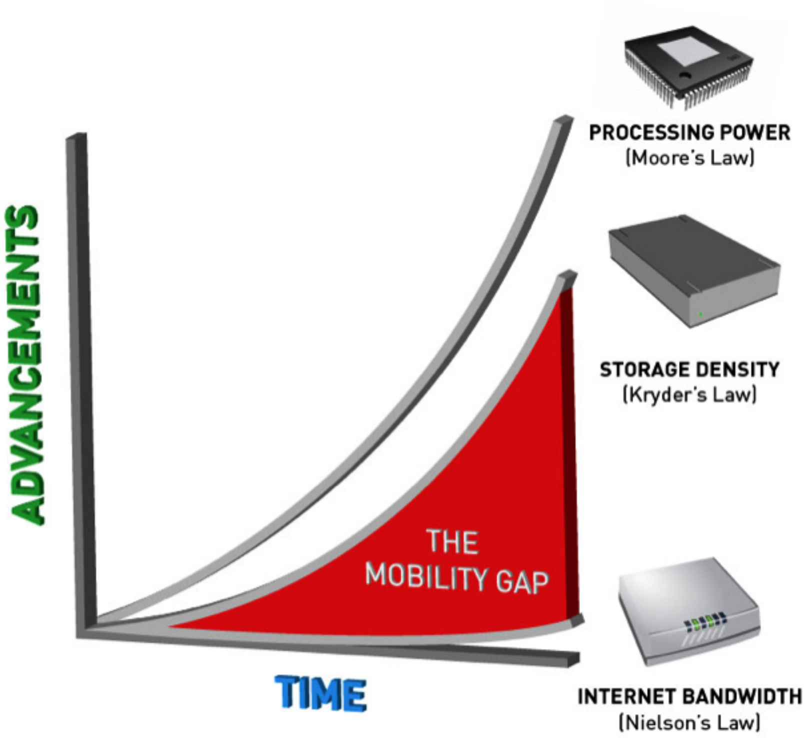
Hot Chips 8/2010

© 2010 IBM Corporation

Rich Freitas, **IBM Research**



storagenewsletter.com/rubriques/hard-disk-drives/hdd-technology-trends-ibm/



pistoncloud.com/2013/04/storage-and-the-mobility-gap/

meanwhile, spinny disks haven't changed all that much…

A Brief History: *MapReduce*

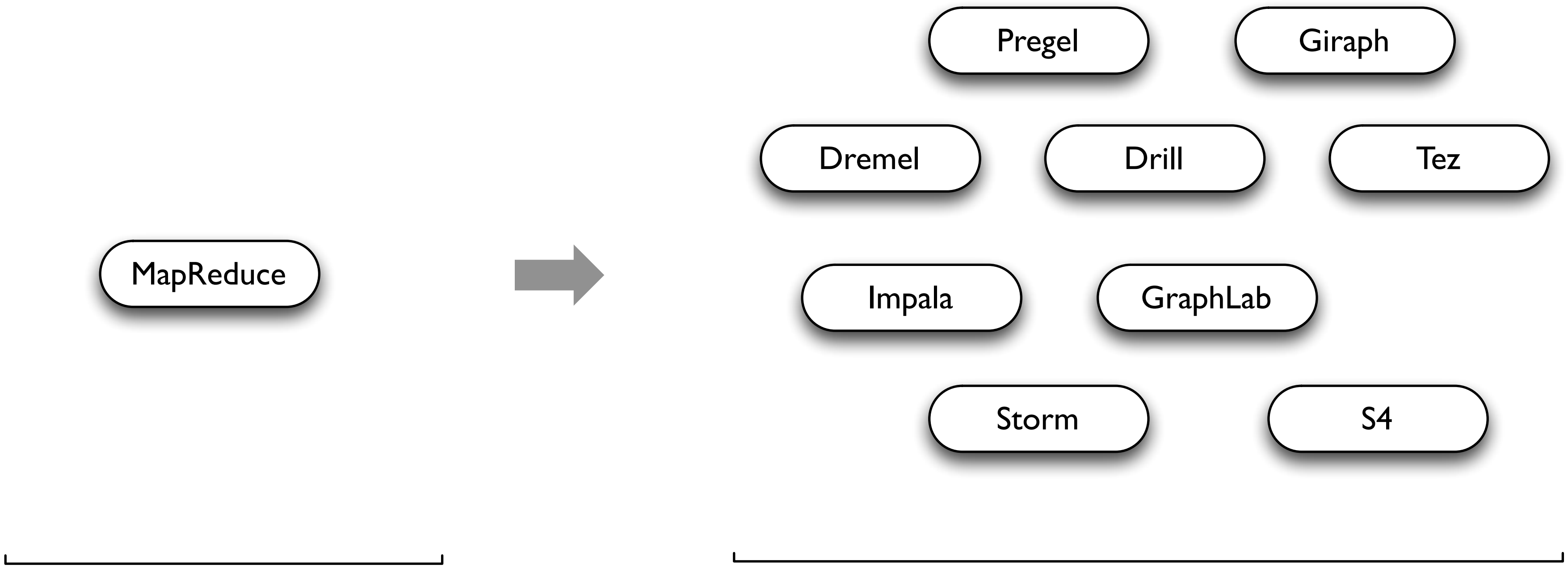
MapReduce use cases showed two major limitations:

1. difficultly of programming directly in MR
2. performance bottlenecks, or batch not fitting the use cases

In short, MR doesn't compose well for large applications

Therefore, people built *specialized systems* as workarounds…

A Brief History: *MapReduce*

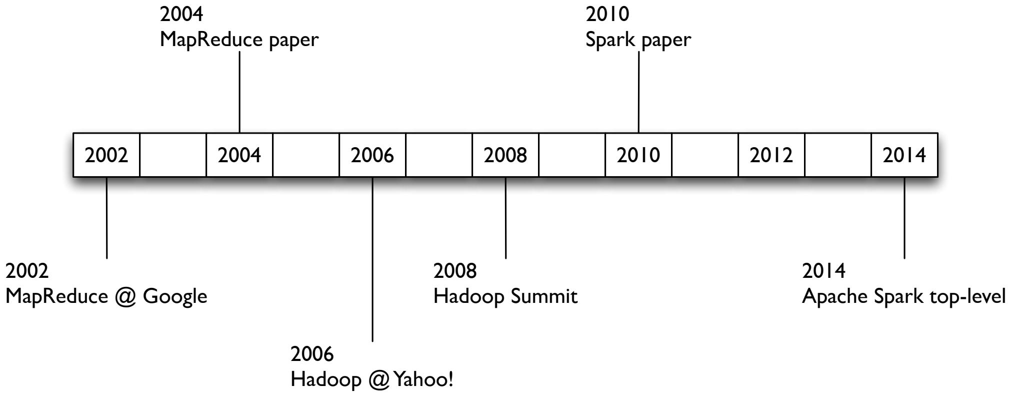


General Batch Processing

Specialized Systems:
iterative, interactive, streaming, graph, etc.

The State of Spark, and Where We're Going Next
Matei Zaharia
Spark Summit (2013)
youtu.be/nU6vO2EJAb4

A Brief History: *Spark*



Spark: Cluster Computing with Working Sets
Matei Zaharia, Mosharaf Chowdhury,
Michael J. Franklin, Scott Shenker, Ion Stoica
USENIX HotCloud (2010)
people.csail.mit.edu/matei/papers/2010/hotcloud_spark.pdf

Resilient Distributed Datasets: A Fault-Tolerant Abstraction for In-Memory Cluster Computing
Matei Zaharia, Mosharaf Chowdhury, Tathagata Das, Ankur Dave,
Justin Ma, Murphy McCauley, Michael J. Franklin, Scott Shenker, Ion Stoica
NSDI (2012)
usenix.org/system/files/conference/nsdi12/nsdi12-final138.pdf

A Brief History: *Spark*

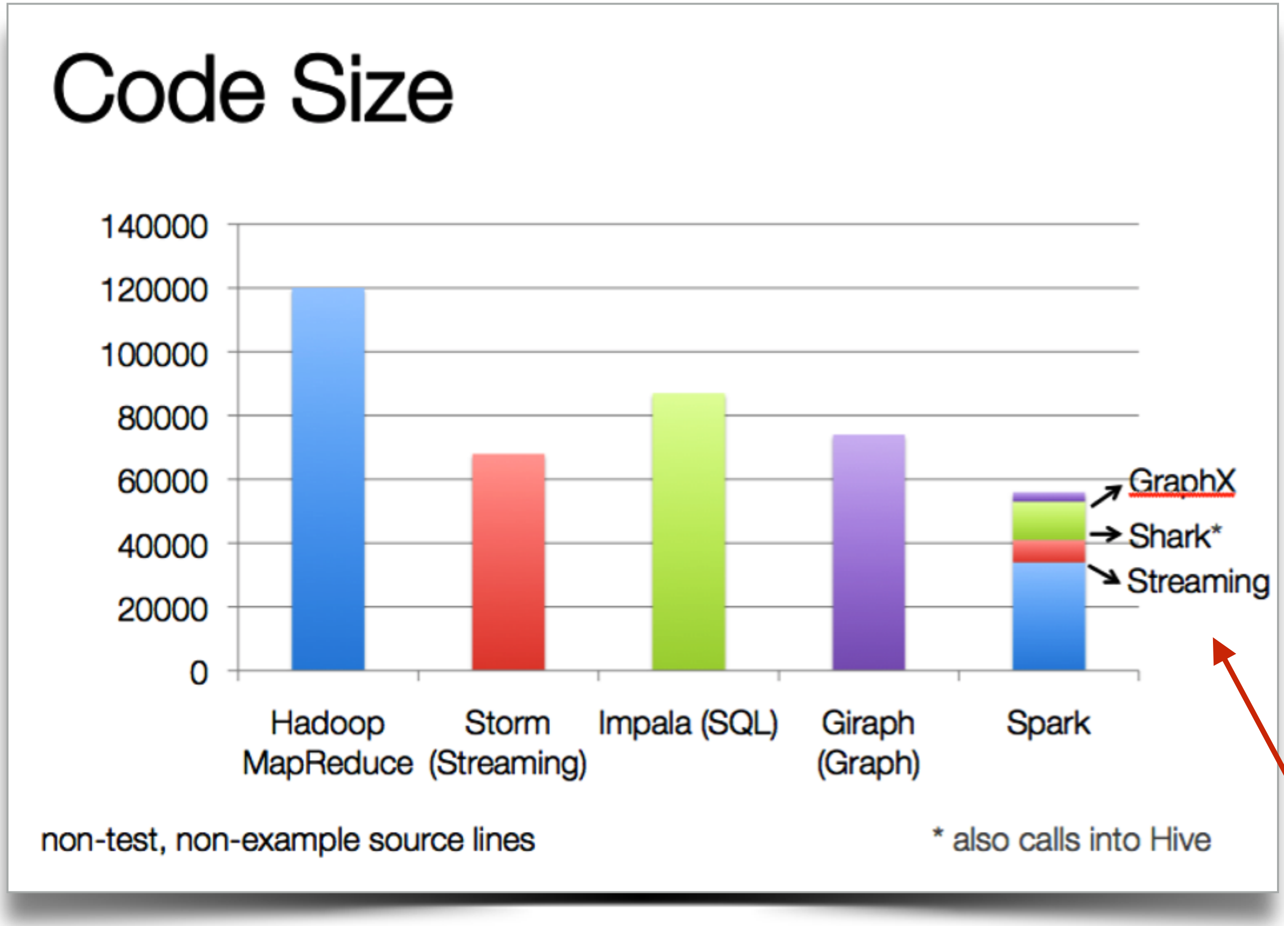
Unlike the various specialized systems, Spark's goal was to *generalize* MapReduce to support new apps within same engine

Two reasonably small additions are enough to express the previous models:

- *fast data sharing*
- *general DAGs*

This allows for an approach which is more efficient for the engine, and much simpler for the end users

A Brief History: *Spark*



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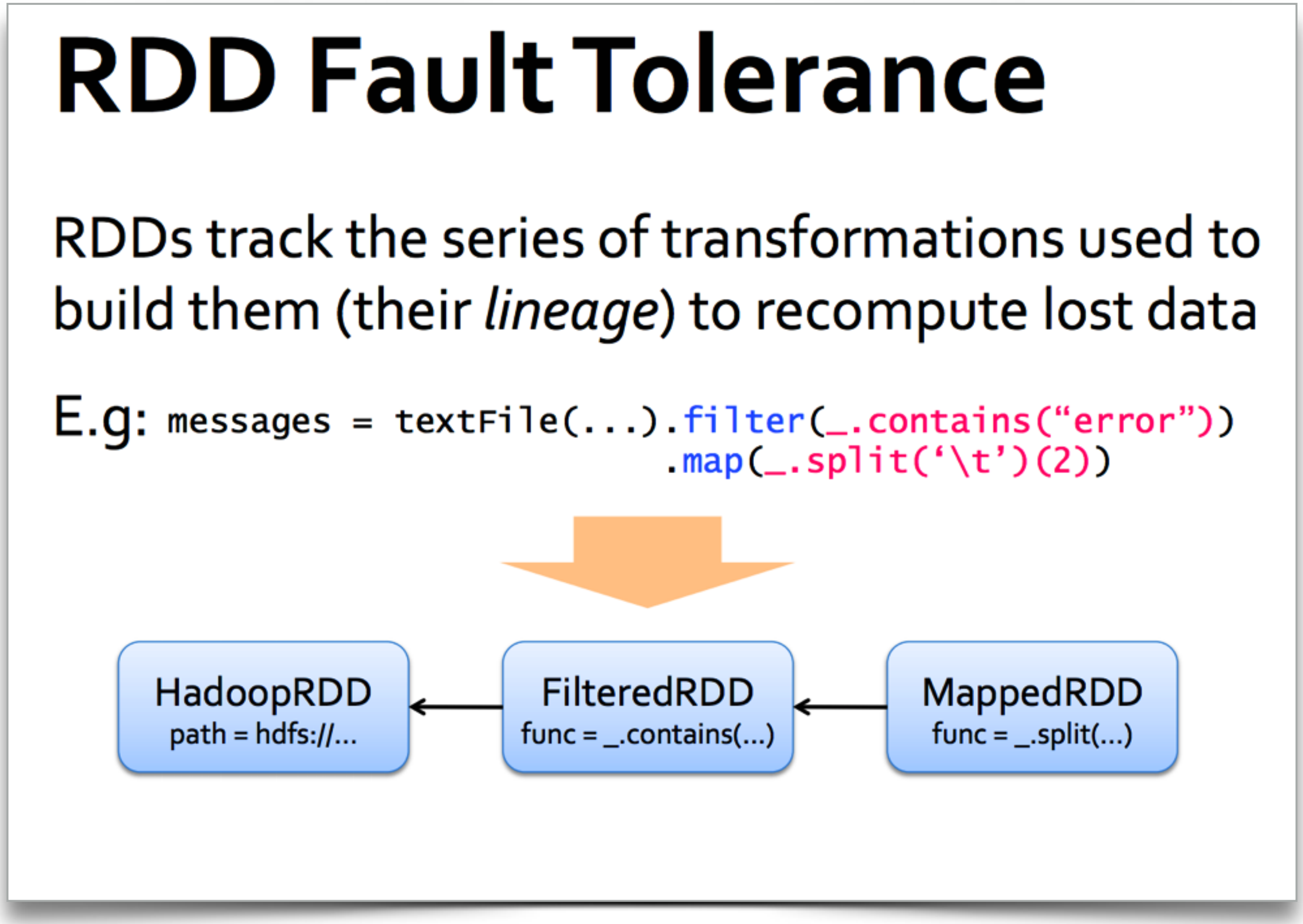
used as libs, instead of specialized systems

A Brief History: *Spark*

Some key points about Spark:

- handles batch, interactive, and real−time within a single framework
- native integration with Java, Python, Scala
- programming at a higher level of abstraction
- more general: map/reduce is just one set of supported constructs

A Brief History: *Spark*



RDD Fault Tolerance

RDDs track the series of transformations used to build them (their *lineage*) to recompute lost data

E.g:
```
messages = textFile(...).filter(_.contains(“error”))
                        .map(_.split(‘\t’)(2))
```

HadoopRDD
path = hdfs://…

FilteredRDD
func = _.contains(...)

MappedRDD
func = _.split(…)

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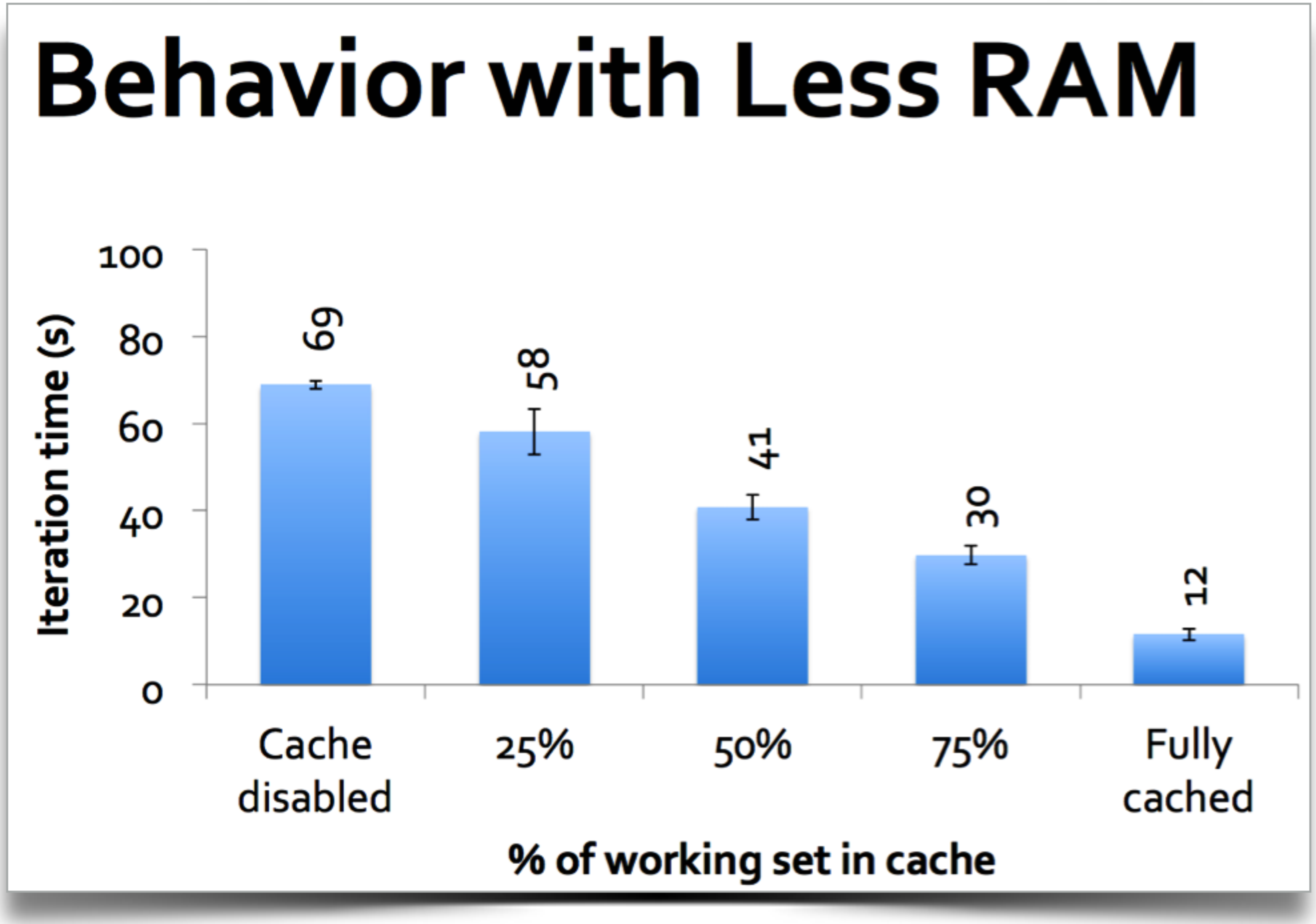
A Brief History: *Spark*



Behavior with Less RAM

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