Apache Hama

Big Data 2nd Generation,
Big Compute and Big Insight!

2014 Samsung Open Source Conference

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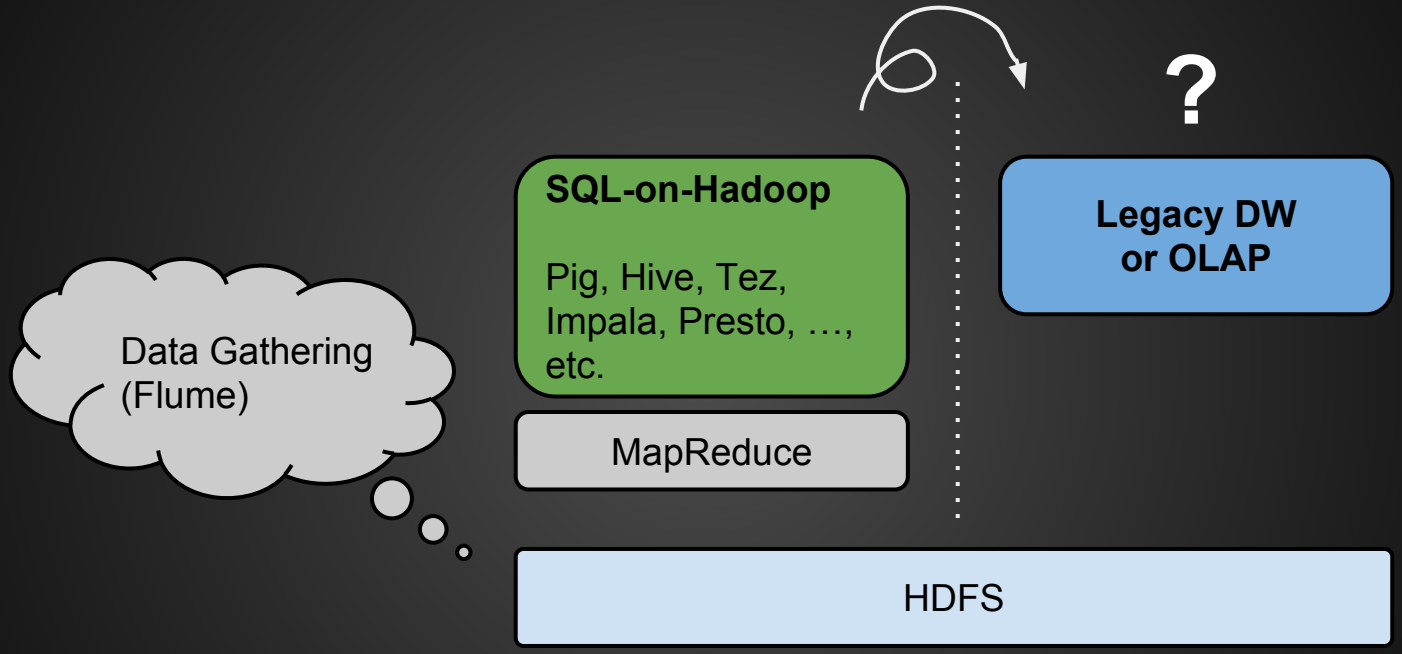
1. Big Compute Platform based on Apache Hama.
2. Big Data Crowdsourcing Service: datacrowds.com

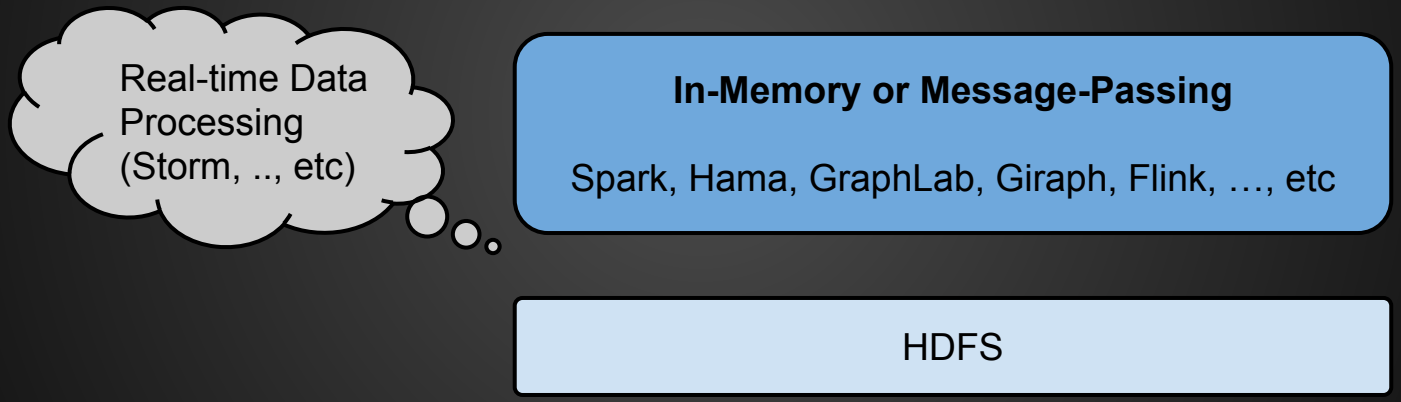
1. Big Data Trends
2. What’s Hama?
3. Future Architecture of Hama

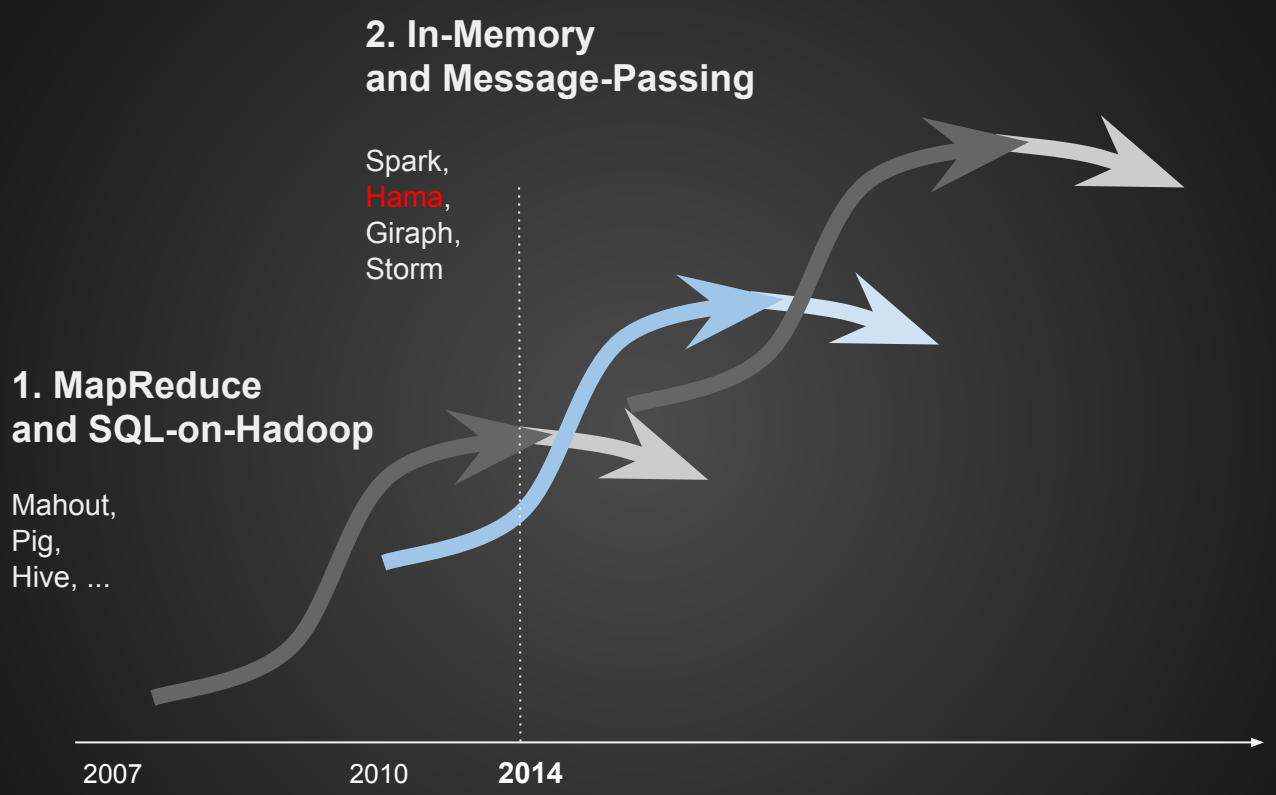
Big Data Analytics

- Large-scale unstructured **data processing**
- **Statistics and Data mining**

To mine the valuable insights


?
SQL-on-Hadoop
Pig, Hive, Tez, Impala, Presto, …, etc.
Legacy DW or OLAP
Data Gathering (Flume)
MapReduce
HDFS


Real-time Data Processing (Storm, .., etc)
In-Memory or Message-Passing
Spark, Hama, GraphLab, Giraph, Flink, …, etc
HDFS


2. In-Memory
and Message-Passing
Spark,
Hama,
Giraph,
Storm
1. MapReduce
and SQL-on-Hadoop
Mahout,
Pig,
Hive, ...
2007
2010
2014

- 1990 ~ : Web Documents

Web 2.0

Blog, Open API

Smartphone

Social Network

- ~ 2014 : Responsive Apps for multi-devices

- 1990 ~ : Server/Web Hosting

Google Apps

Cloud Computing

IaaS, PaaS, SaaS

- ~ 2014 : Cloud/App Hosting

- 1990 ~ : Text processing and mining

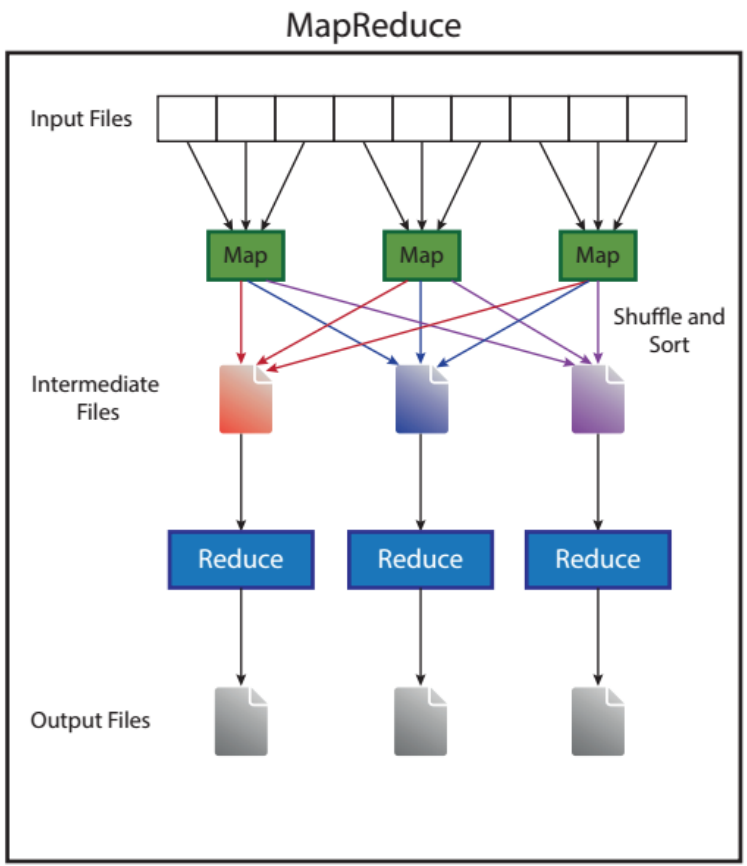
MapReduce

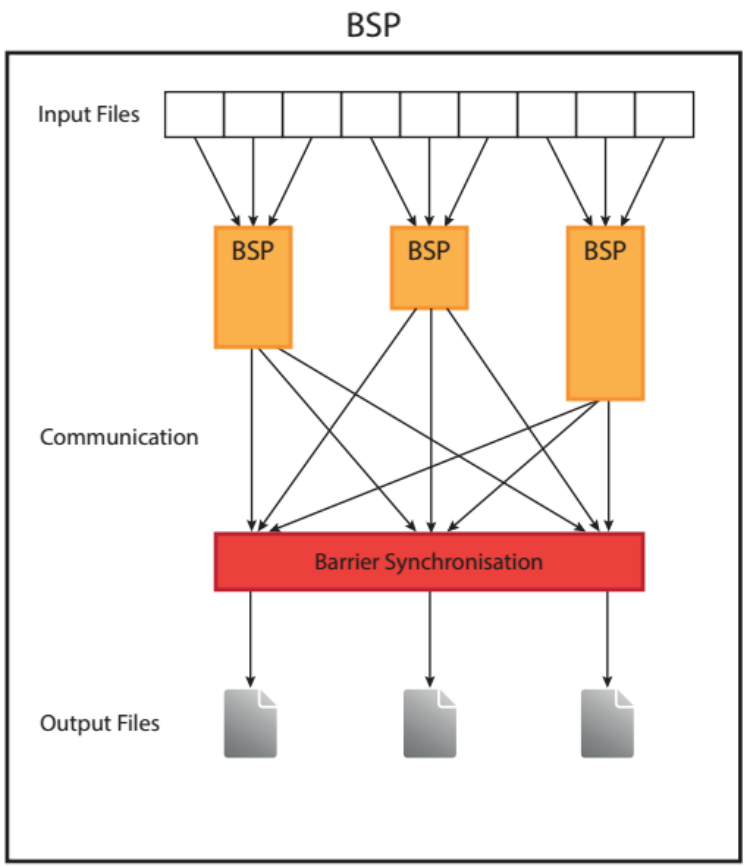
SQL-on-Hadoop

In-memory or Message-Passing

- ~ 2014 : Matrix, Mining Networks and Graphs

Hama[hɑ́ːma] is a general-purpose **BSP** computing engine on Top of Hadoop


MapReduce
Input Files
Map
Map
Map
Shuffle and Sort
Intermediate Files
Reduce
Reduce
Reduce
Output Files


BSP
Input Files
BSP
BSP
BSP
Communication
Barrier Synchronisation
Output Files

Apache Hama is listed on the Best Open Source Big Data tools, **Bossie Awards 2013**

Bossie Awards 2013: The best open source big data tools

InfoWorld's top picks in the expanding Hadoop ecosystem, the NoSQL universe, and beyond

By InfoWorld staff, InfoWorld, September 17, 2013

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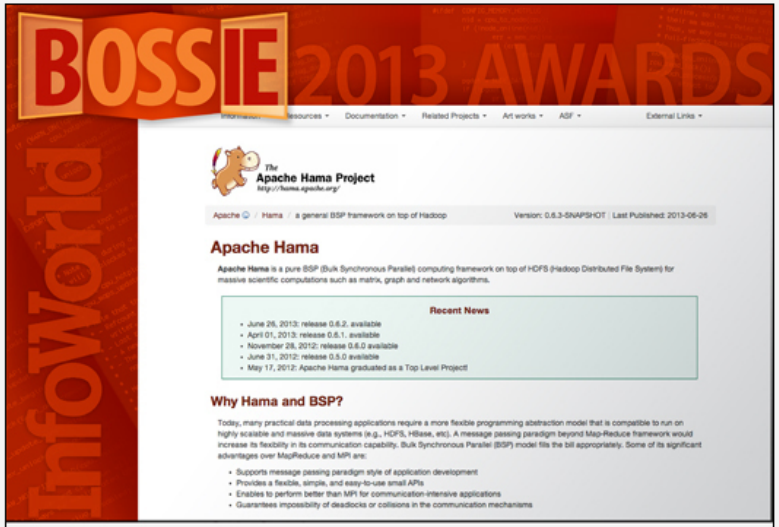
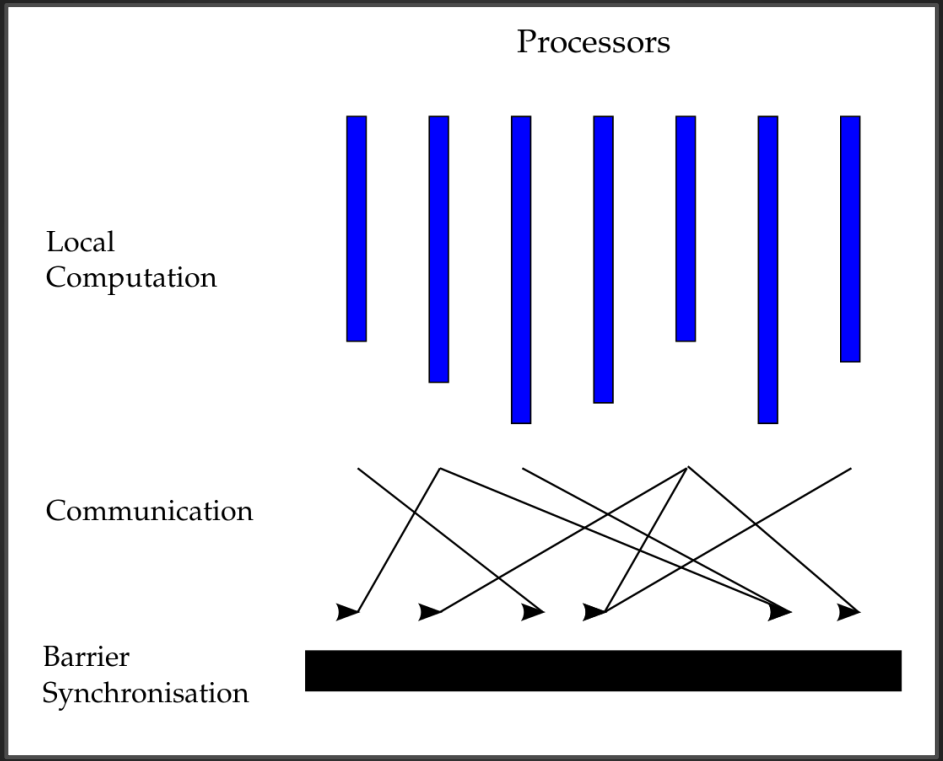


Hama

Apache Hama

Like Giraph, Apache Hama brings Bulk Synchronous Parallel processing to the Hadoop ecosystem and runs on top of the Hadoop Distributed File System. However, whereas Giraph focuses exclusively on graph processing, Hama is a more generalized framework for performing massive matrix and graph computations. It combines the advantages of Hadoop compatibility with a more flexible programming model for tackling data-intensive scientific applications.

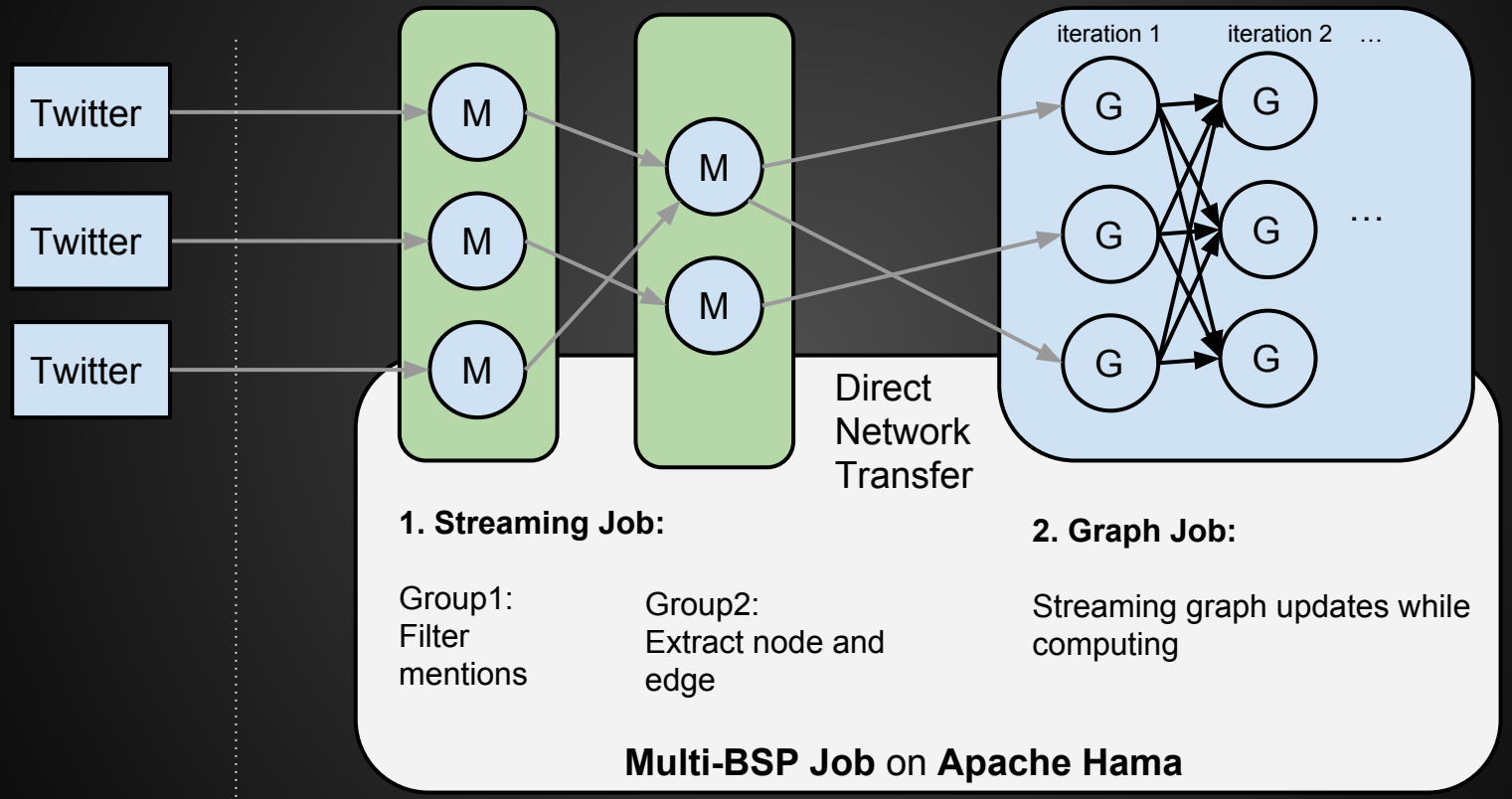
-- *Indika Kotakadeniya*


Processors
Local
Computation
Communication
Barrier
Synchronisation

	Streaming	Graph	Machine Learning	Incremental Learning
Hama (General-purpose BSP)	O	O	O	O
Spark (Databricks) (In-memory MapReduce)	O	O (GraphX)	O	X
GraphLab (Asynchronous graph computing)	X	O	O	O (Limited)
Giraph (BSP-based graph computing)	X	O	X	X

Think about **the Spam Filtering** of Google's Gmail!

Another Example



Appendix.

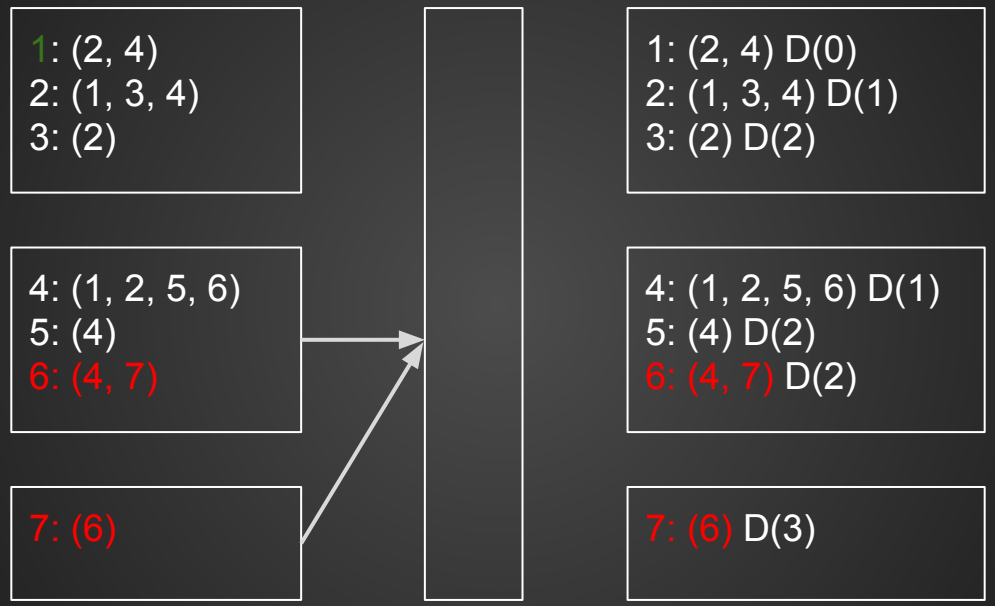
Why all platforms uses **BSP-style for graph-parallel**?

MR version: Shortest Path

- A map task receives a node n as a key, and (D, points-to) as its value
- D is the distance to the node from the start
- points-to is a list of nodes reachable from n

  $\forall p \in$ points-to, emit (p, D+1)
- Reduce task gathers possible distances to a given p and selects the minimum one

BSP version: Shortest Path



Why **Google's** Pregel (graph)
and DistBelief (deep learning) **uses BSP-style**?

Thomas Jungblut
@tjungblut

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@Seoul_Tech @eddieyoon spark is garbage for that computation, because all your weight updates are in the RDD and that's a network b'neck

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9:37 PM - 16 Jul 2014

Apache Hama's **Advanced Analytics** Examples:

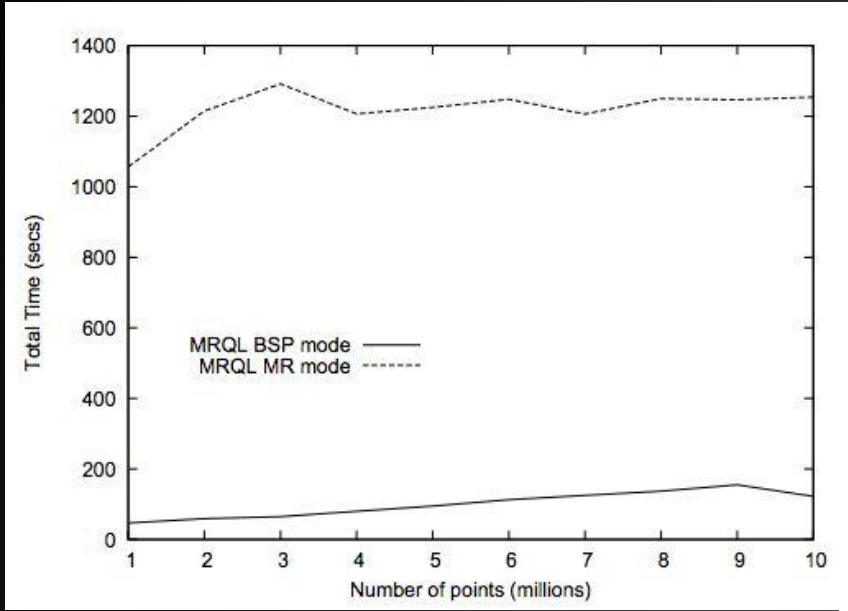
- Sparse Matrix-Vector Multiplication
- Semi-Clustering
- **K-means Clustering**
- Neural Networks
- **Gradient Descent**
- **PageRank**
- Single Source Shortest Path
- Bipartite Matching

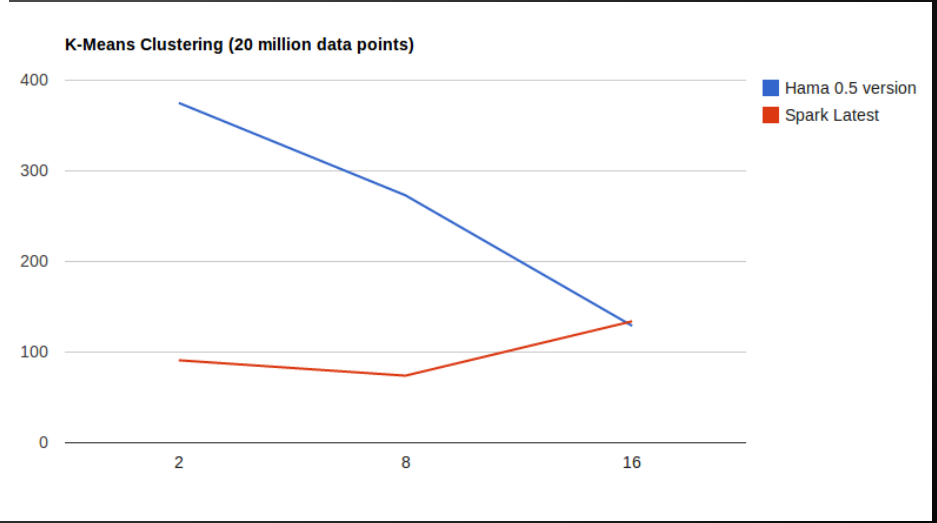
Hama Supports:

Hadoop 1.0

Hama on Hadoop 2.0 YARN

Hama on Apache Mesos


1400
1200
1000
800
600
400
200
0
Total Time (secs)
MRQL BSP mode
MRQL MR mode
1
2
3
4
5
6
7
8
9
10
Number of points (millions)


K-Means Clustering (20 million data points)
400
300
200
100
0
2
8
16
Hama 0.5 version
Spark Latest

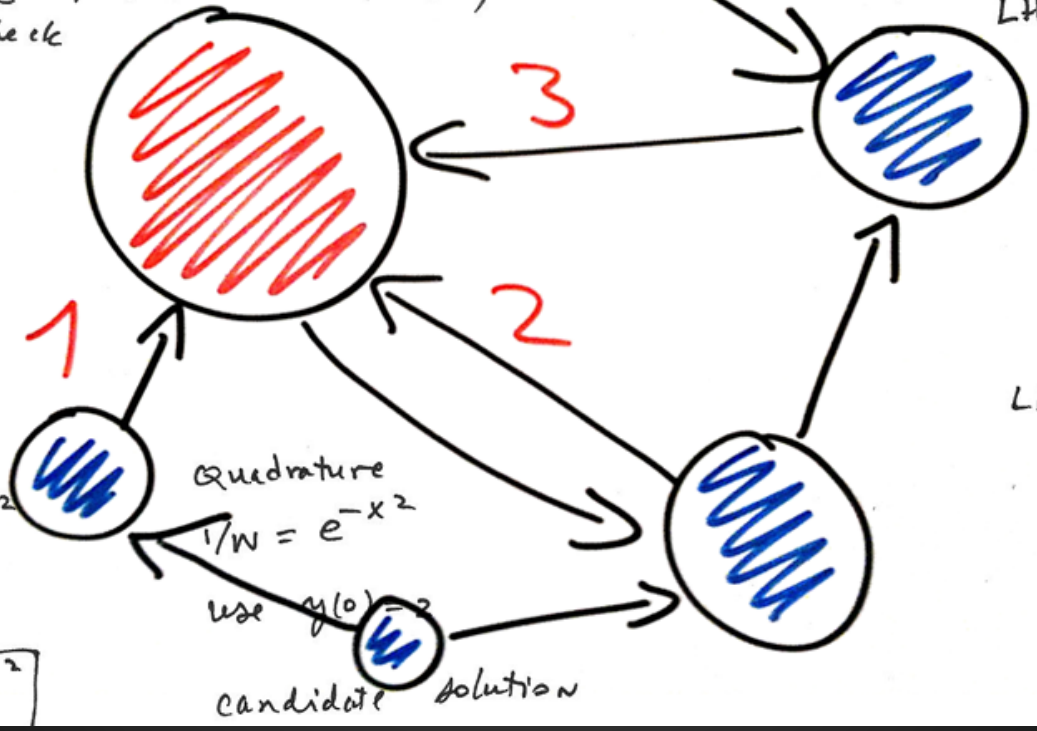
Apache Hama

at Sogou

Sogou.com runs **7,200 cores Hama cluster** for SiteRank.

- SiteRank is the ranking generated by applying the classical PageRank algorithm to the graph of Web sites.
- Dataset is about 400GB, contains 6 Billion edges.

L3.1 The symbolic solution of $y' = -2xy$, $y(0) = 2$ is $y = 2e^{-x^2}$. Derive it and display a full answer check



Solution

$$y' + 2xy = 0$$

$$\frac{(Wy)'}{W} = 0$$

$$(Wy)' = 0$$

$$Wy = c$$

$$y = c\,e^{-x^2}$$

$$2 = c\,e^{0}$$

$$\boxed{y = 2e^{-x^2}}$$

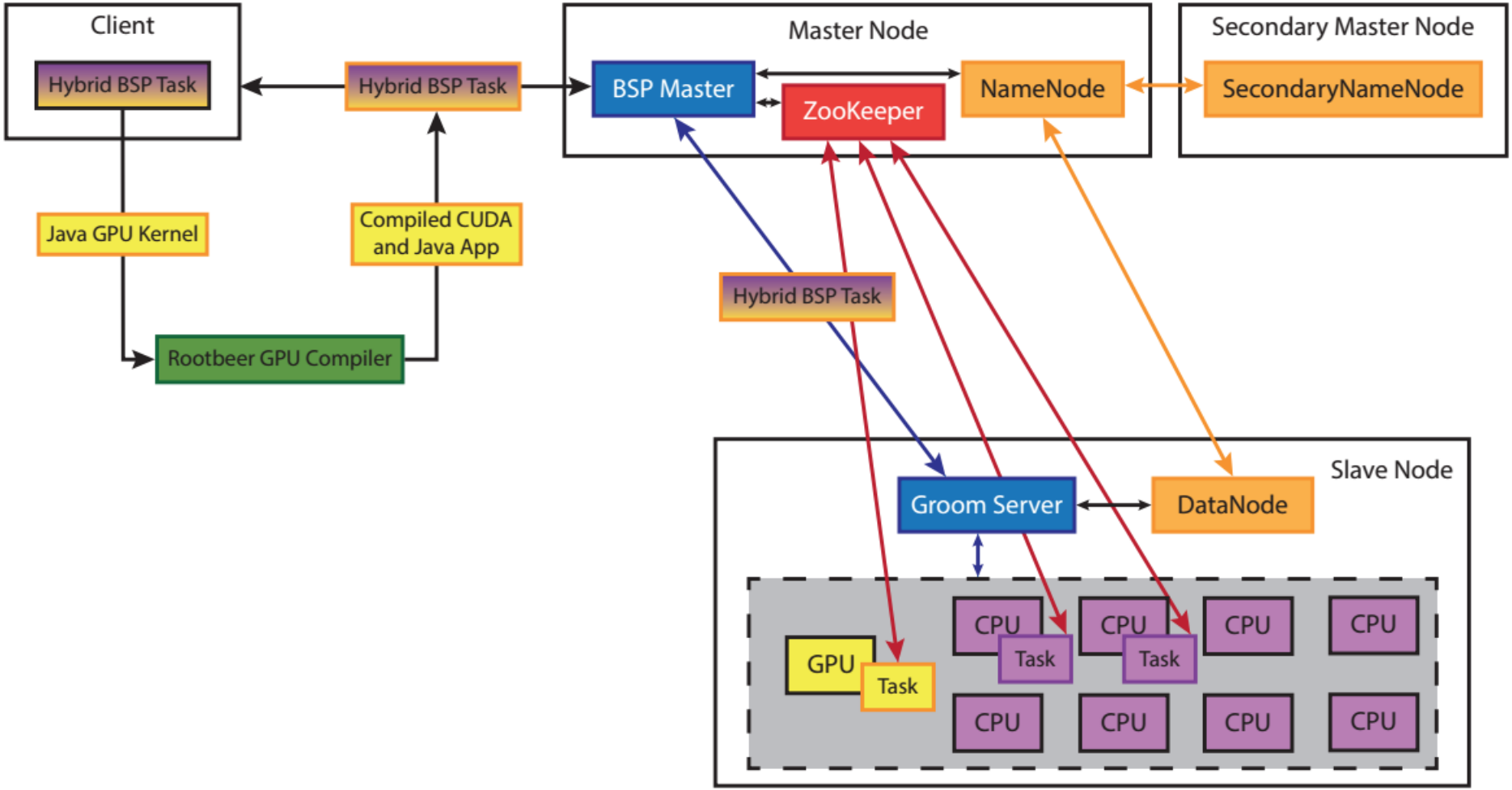
Answer check.

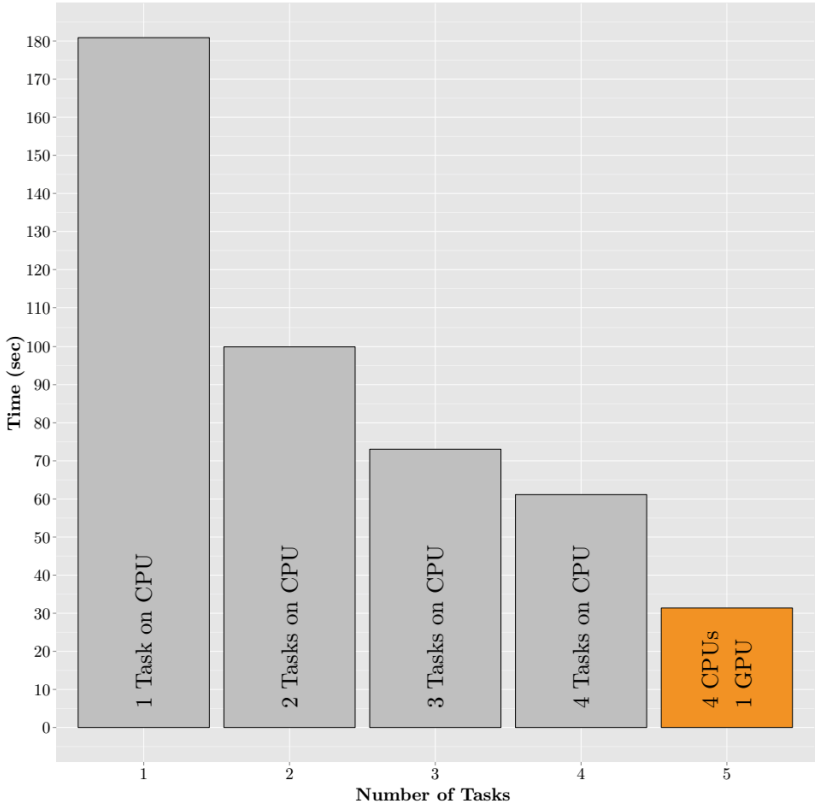
$$\text{LHS} = y'$$
$$= (2e^{-x^2})'$$
$$= 2(-2x)e^{-x^2}$$
$$= (-2x)\,2e^{-x^2}$$
$$= (-2x)\,y$$
$$= \text{RHS}$$

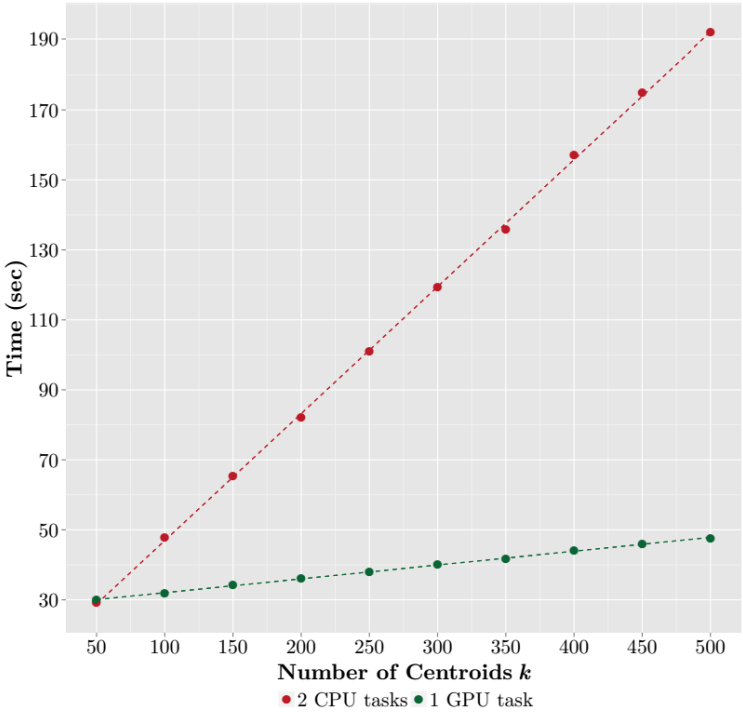
$$\text{LHS} = y(0)$$
$$= 2e^{-x^2}\Big|_{x=0}$$
$$= 2e^{0}$$
$$= 2$$
$$= \text{RHS}$$

The future features of Apache Hama:

Kryo serialization, Rootbeer GPU acceleration (Martin Illecker, University of Innsbruck), …, etc.


Client
Hybrid BSP Task
Hybrid BSP Task
Master Node
BSP Master
ZooKeeper
NameNode
Secondary Master Node
SecondaryNameNode
Java GPU Kernel
Compiled CUDA and Java App
Rootbeer GPU Compiler
Hybrid BSP Task
Slave Node
Groom Server
DataNode
GPU
Task
CPU
Task
CPU
Task
CPU
CPU
CPU
CPU
CPU
CPU


Time (sec)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
1 Task on CPU
2 Tasks on CPU
3 Tasks on CPU
4 Tasks on CPU
4 CPUs
1 GPU
1
2
3
4
5
Number of Tasks


Time (sec)
30
50
70
90
110
130
150
170
190
50
100
150
200
250
300
350
400
450
500
Number of Centroids k
2 CPU tasks
1 GPU task

References

- Hama Website http://hama.apache.org/
- Scientific Computing in the Cloud with Apache Hadoop and Apache Hama on GPU by Martin Illecker

If you want to be one of us, **be one of us.**

Thanks!