Performance study of Spindle, a web analytics query engine implemented in Spark

CloudCom 2014

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December 19, 2014

Motivation

Spindle Architecture
- Overview.
- Features.
- Queries.

Empirical Results
- Caching.
- Data partitioning.
- Benchmarking concurrent queries.
- Scaling Spark and HDFS workers.

Future Work

Conclusions

Motivation

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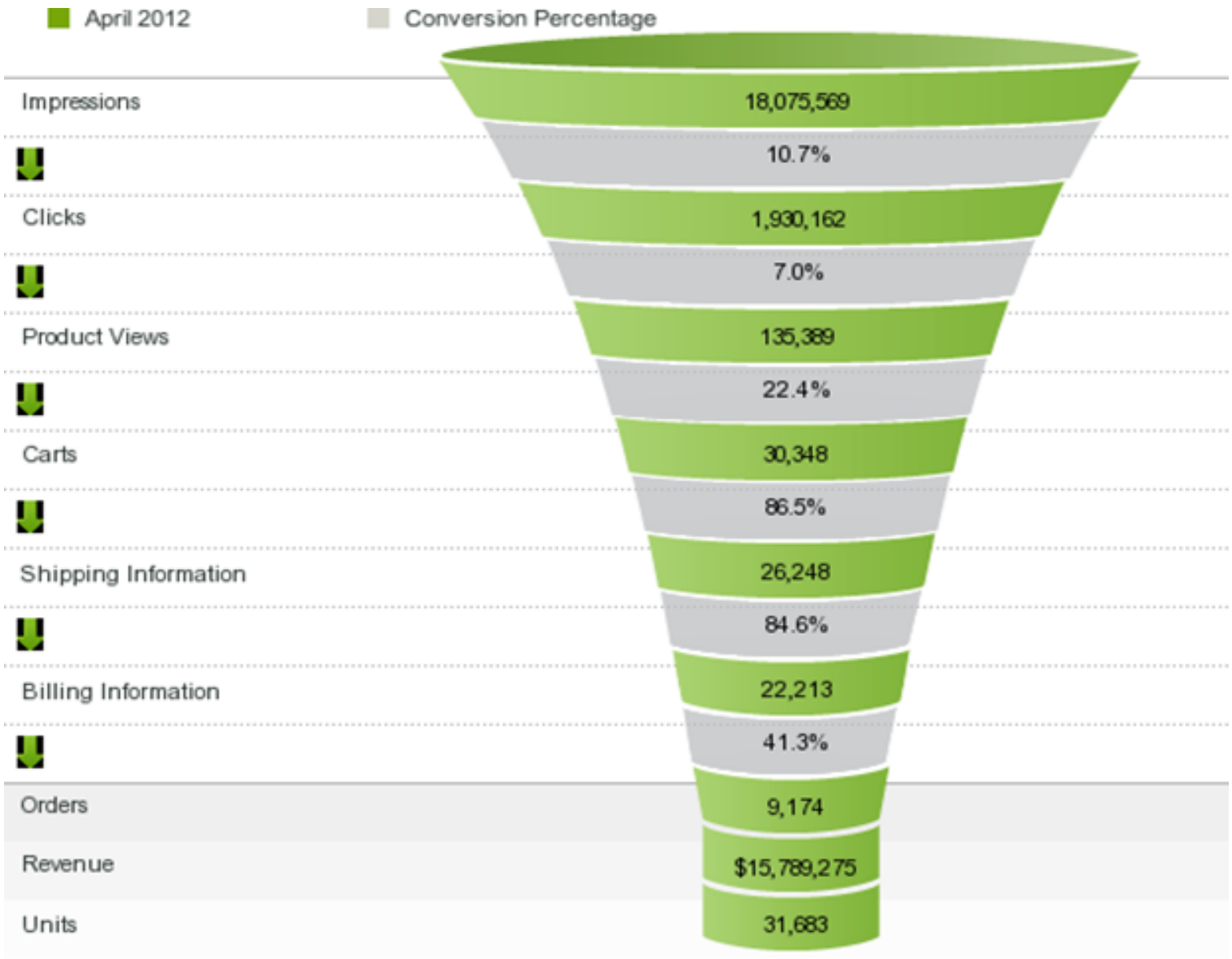
- Adobe Marketing Cloud offers web analytics.



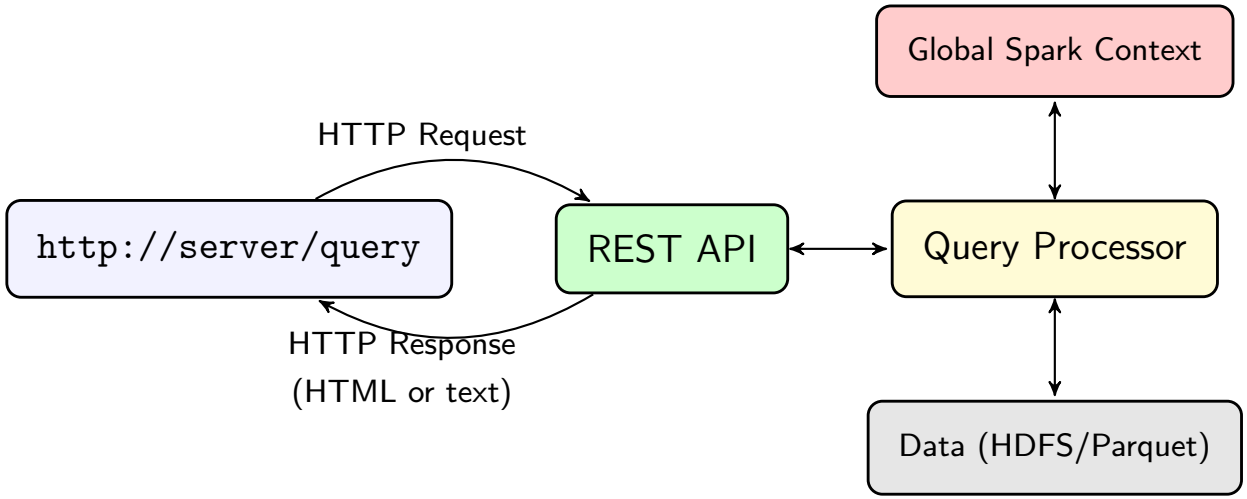
Motivation

- Adobe Marketing Cloud offers web analytics for interactive data exploration.
- Terabytes of data, thousands of servers.
- Trending general-purpose distributed data processing engines.
  - Apache Spark
    - Queries implemented with map and reduce functions.
    - In-memory caching.
  - Cloudera Impala
    - Analytic Database for Apache Hadoop.
  - Google Dremel
    - Analytics of web-scale datasets.
- We present **Spindle**, which is an early investigation of the feasibility of Apache Spark for web analytics
- Goal: Low-latency query execution time.

Spindle Architecture

Overview.

What is Spindle?



Spindle Architecture

Features.

- Data format challenges:
  - Operates on archival data with 250 columns.
  - Data is sparse and queries use <10 columns at a time.
- Use columnar data format on distributed filesystem.
- Spindle makes tuning parameters easy.
  - Intermediate data partitioning
  - Caching

Spindle Architecture

Queries.

- Experimental setup: Representative set of analytics queries.

Shorthand	Name
Q0	Pageviews
Q1	Revenue
Q2	RevenueFromTopReferringDomains
Q3	RevenueFromTopReferringDomainsFirstVisitGoogle
Q4	TopPages
Q5	TopPagesByBrowser
Q6	TopPagesByPreviousTopPages
Q7	TopReferringDomains

Spindle Architecture

Queries.

- Queries use a small columnar subset.

Columns	Q0	Q1	Q2	Q3	Q4	Q5	Q6	Q7
post_pagename	×				×	×	×	
user_agent						×		
visit_referrer			×	×				
post_visid_high			×	×			×	×
post_visid_low			×	×			×	×
visit_num			×	×			×	×
visit_referrer								×
hit_time_gmt							×	
post_purchaseid		×	×	×				
post_product_list		×	×	×				
first_hit_referrer				×				

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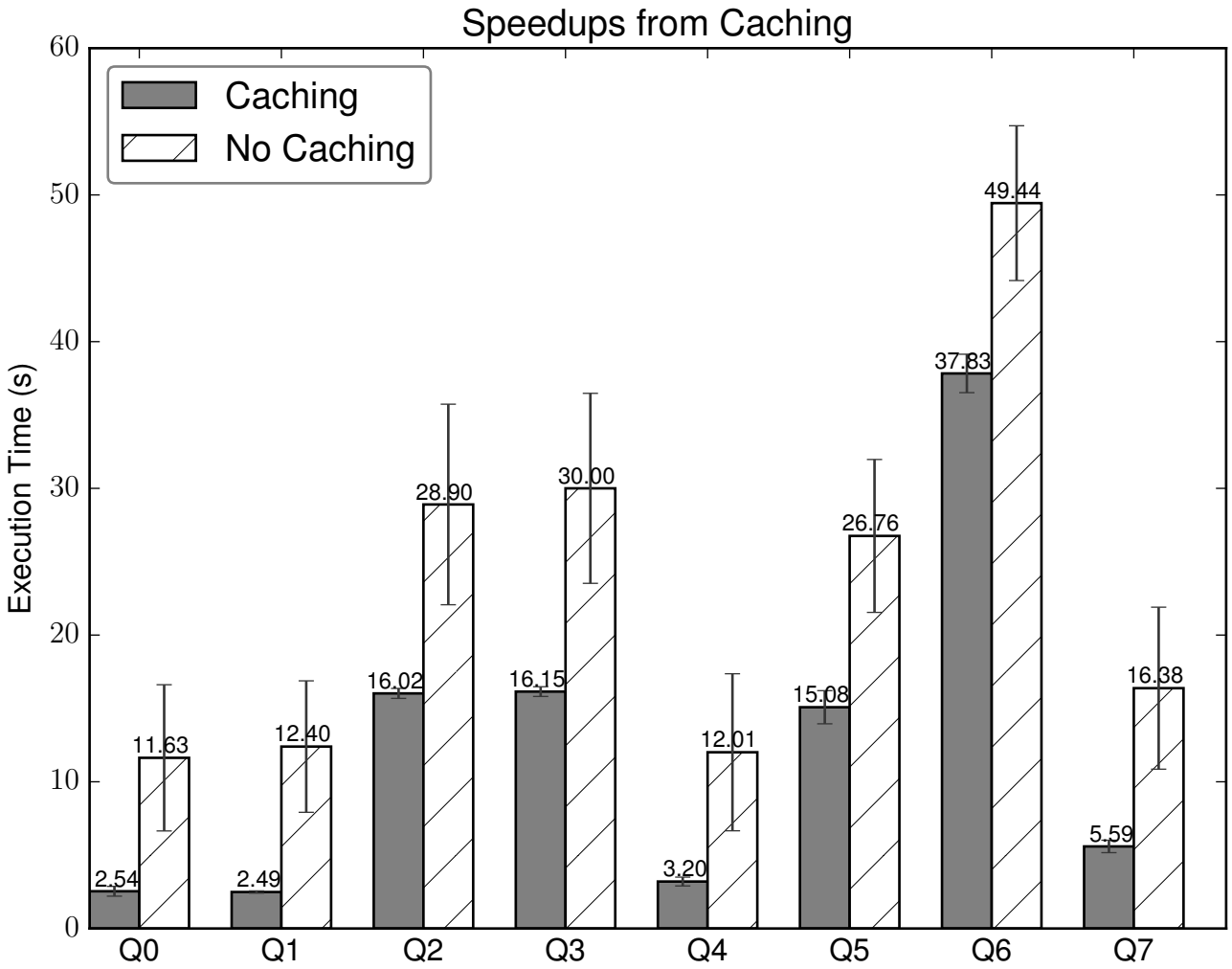
Empirical Results

Caching.

- Six cluster nodes (32 GB memory each), Spark and HDFS on each.
- 13.1GB of data, 1 week, 1 customer.
- **Question:** How does caching in-memory improve performance?

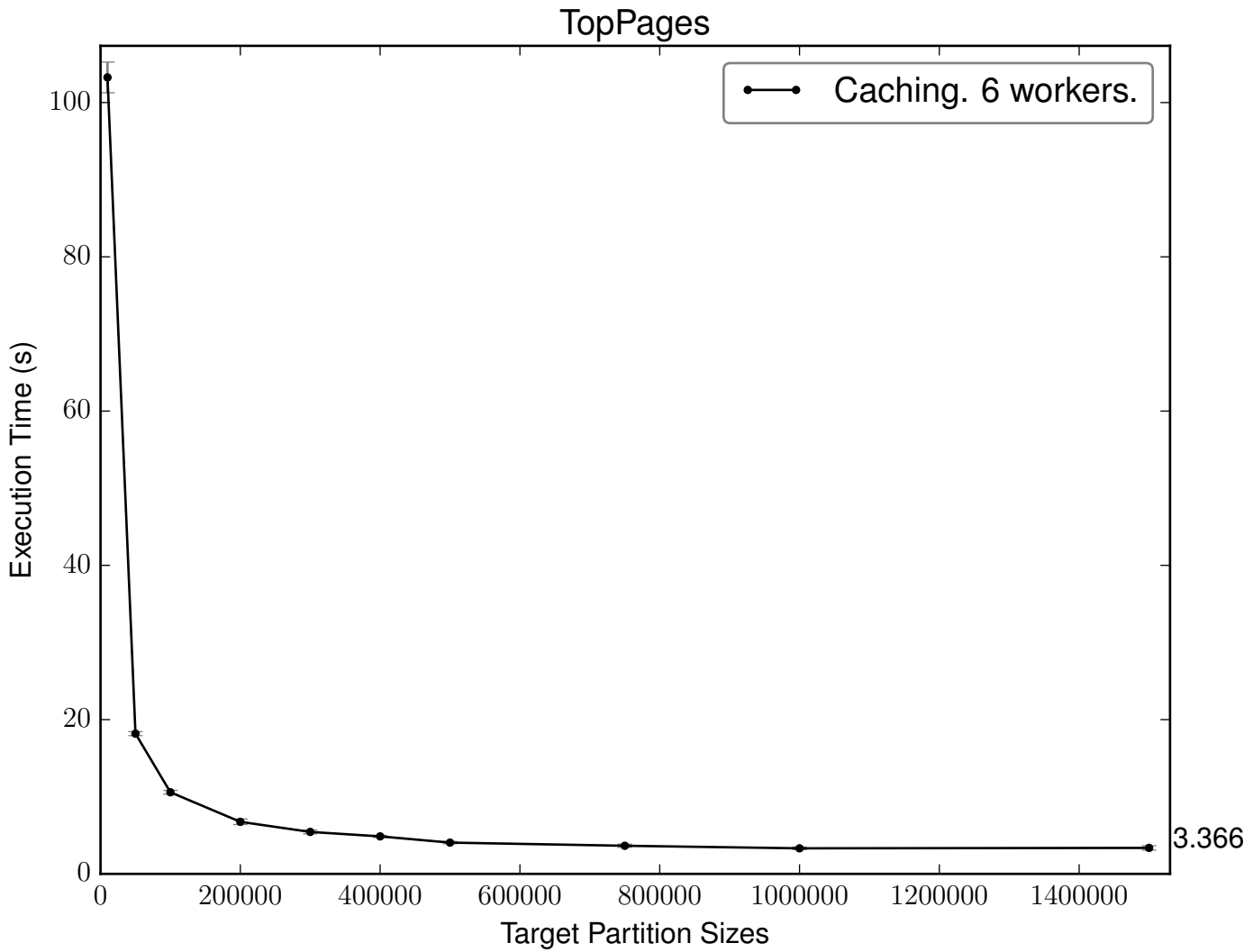


- Caching helps, but what else can be done to lower query execution times?

Empirical Results

Data partitioning.

- Partitions are groups of data executed in a batch.
- Partitions can be executed concurrently.
- Not clear how to partition the intermediate data.
  - Too small: Partition management overhead.
  - Too large: Data is processed in serial.

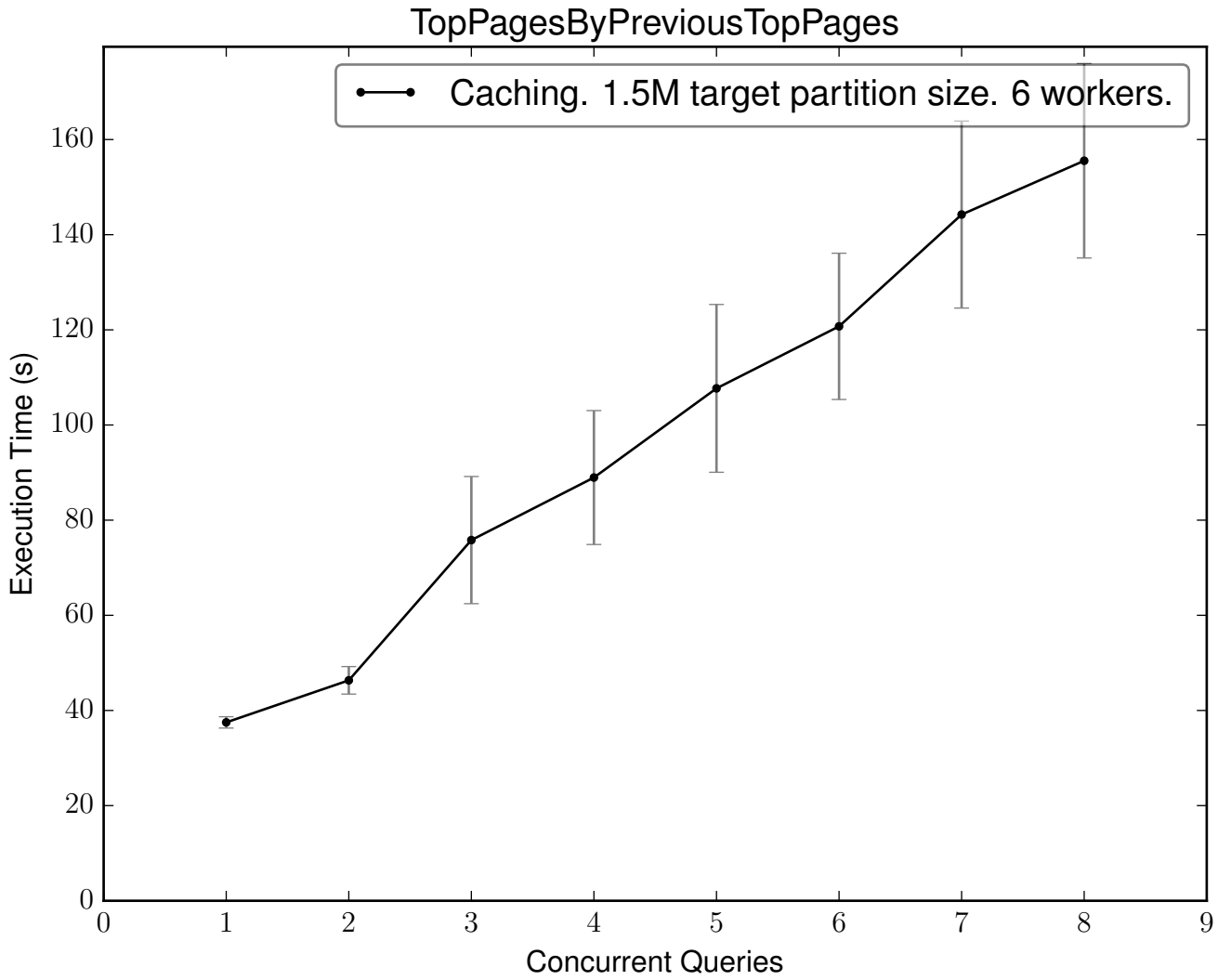


- Targeting 1.5M items in each partition is reasonable.

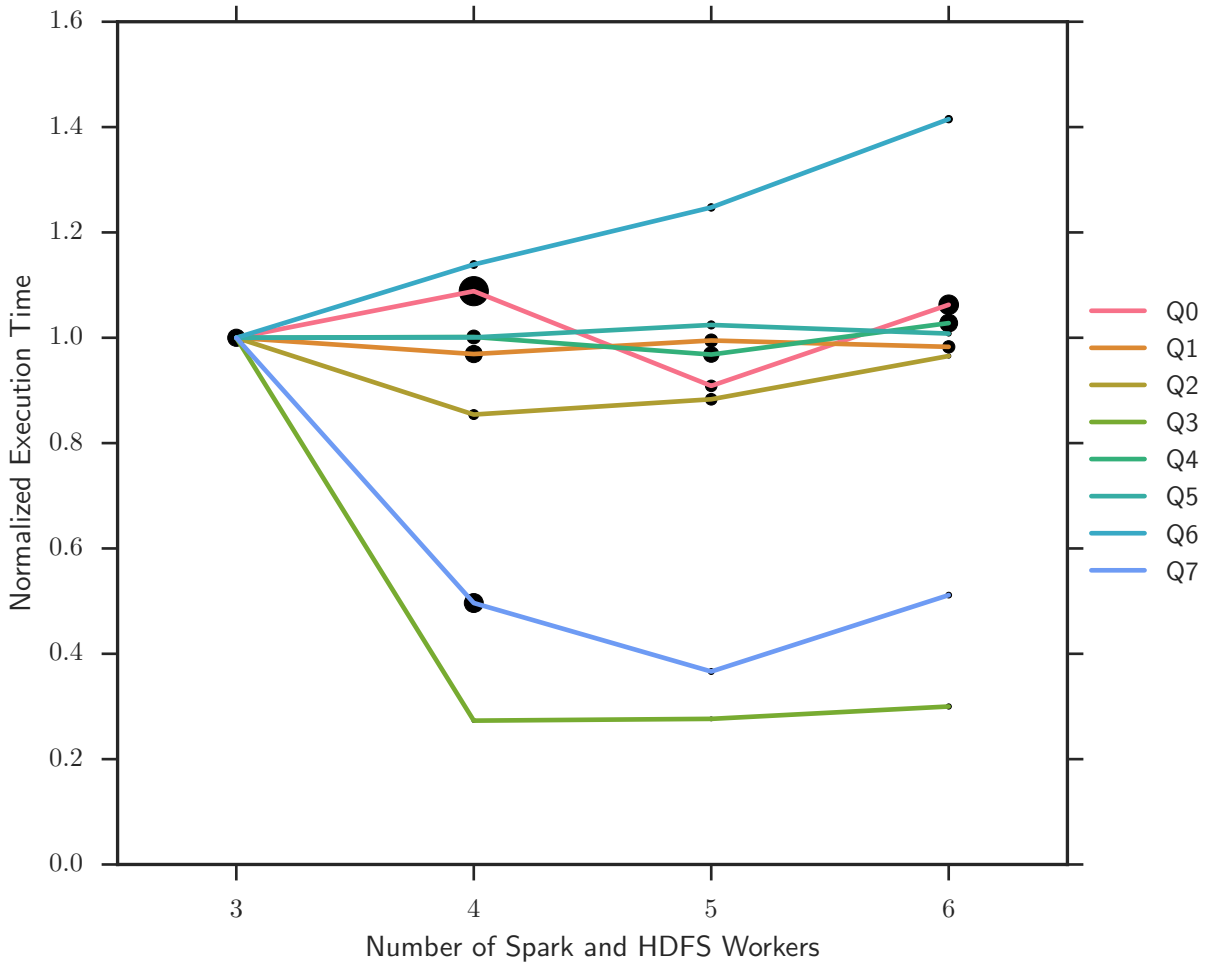
Empirical Results

Benchmarking concurrent queries.

- How much will Spindle's performance degrade if multiple users are utilizing it at the same time?
- Concurrently call the same query on the same data.
- Average execution times.



- Performance better than serializing concurrent requests, but can be improved.



- Further profiling is needed to improve performance as increasing the number of workers.

Future Work

- Lowering query execution time.
  - Goal: Sub-second.
- Automatically tuning parameter exploration space for a given workload.
  - Online/Dynamically
  - Offline
- Results caching for identical queries.
- Data preprocessing to remove redundant computations.
- Distributed filesystem caching with Tachyon.
- Optimized query generation with SparkSQL.

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- We present **Spindle**.
  - **Open-source** prototype analytics processing engine.
  - Sample set of web analytics queries.
  - Interface for parameter tuning.

Spindle Project	`http://github.com/adobe-research/spindle`
Demo	`http://adobe-research.github.io/spindle/`
Brandon Amos	`http://github.com/bamos`
David Tompkins	`http://github.com/DavidTompkins`