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.

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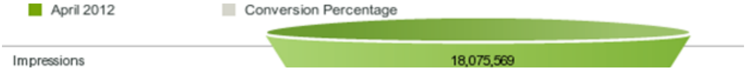

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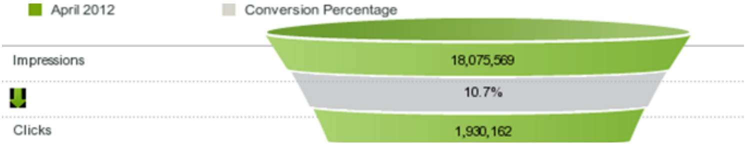

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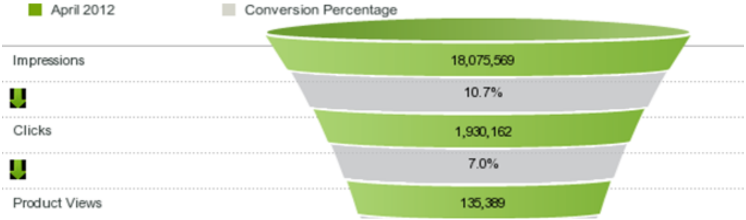

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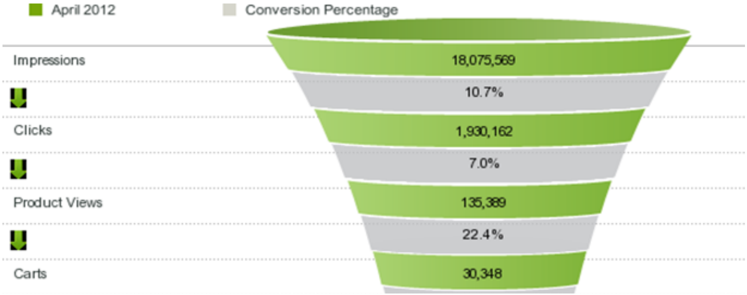

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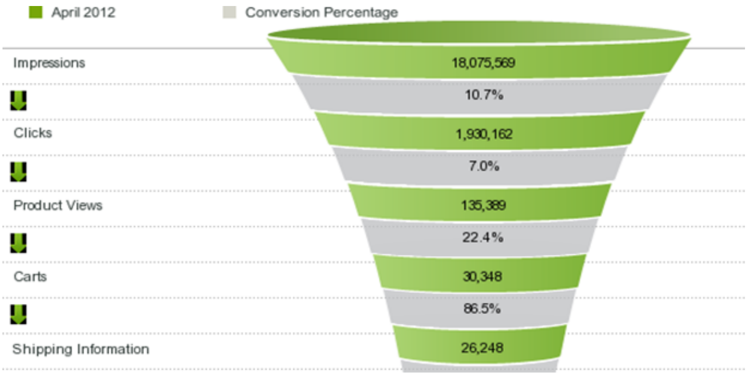

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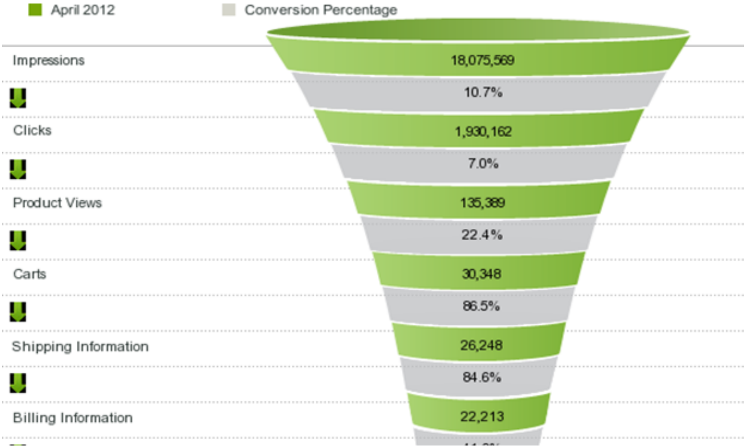

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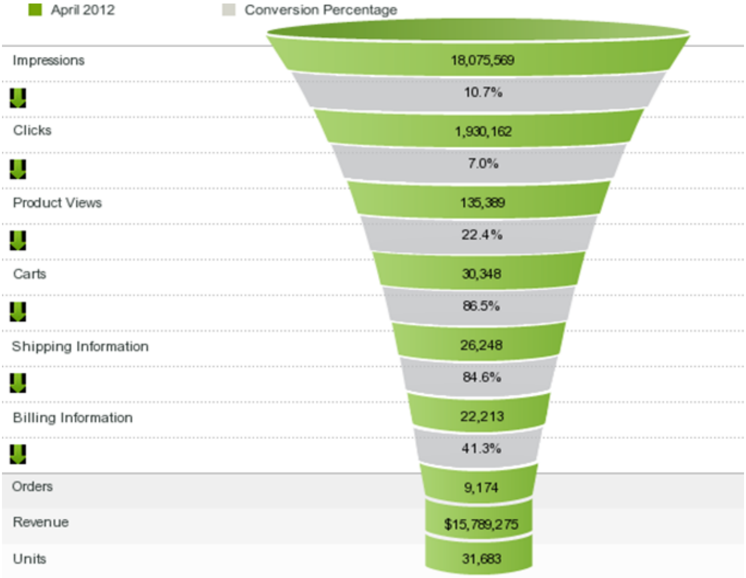

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- Goal: Low-latency query execution time.

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What is Spindle?

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`http://server/query`

Spindle Architecture

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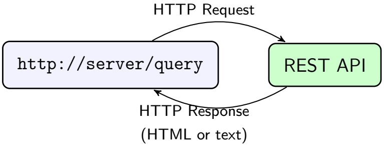

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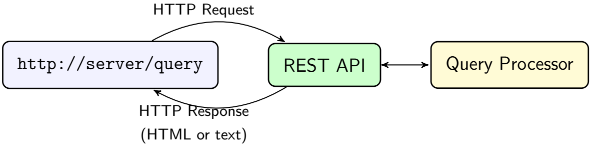

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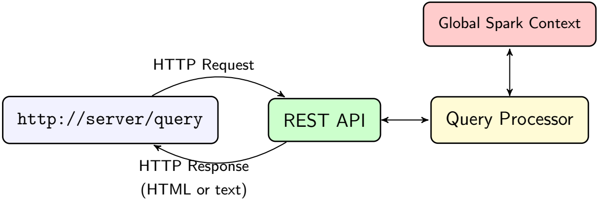

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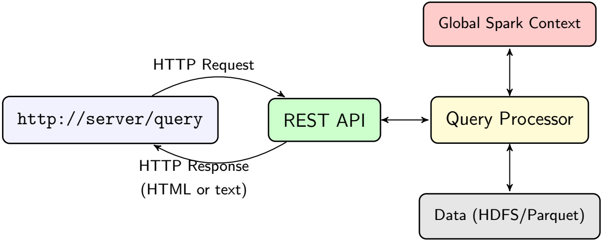

Spindle Architecture

Features.

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- Experimental setup: Representative set of analytics queries.

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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.

Spindle Architecture

Queries.

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		Q0	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Columns	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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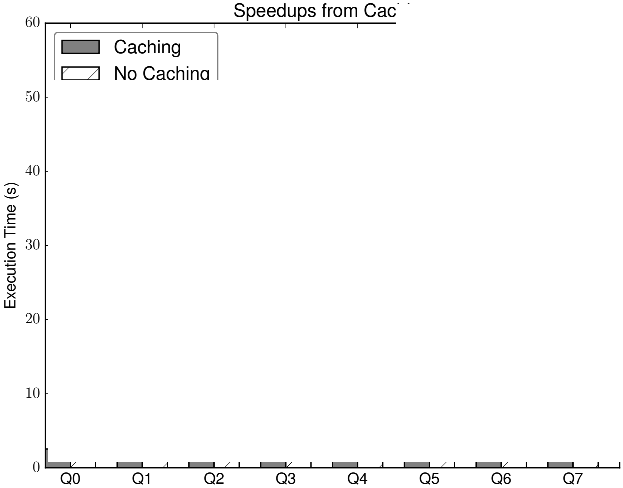
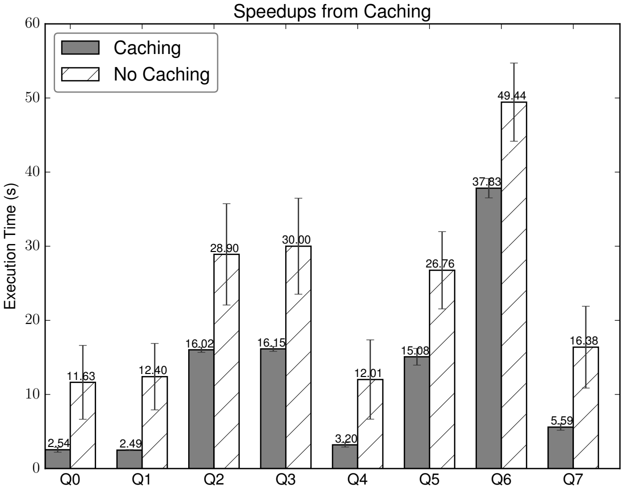
- **Question:** How does caching in-memory improve performance?


Speedups from Cac
Caching
No Caching
Execution Time (s)
60
50
40
30
20
10
0
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7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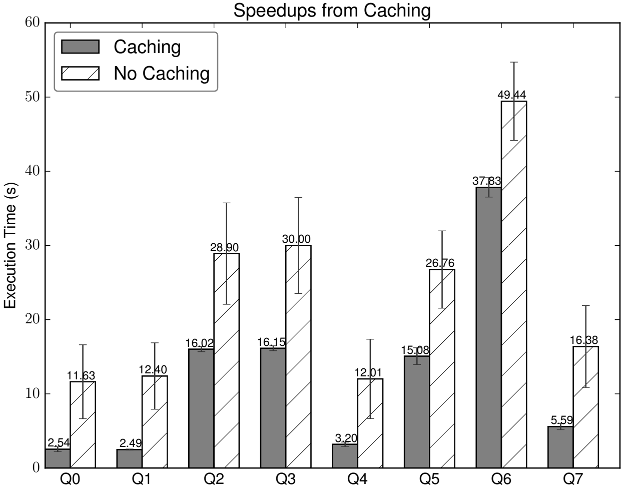
0
10
20
30
40
50
60
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
2.54
11.63
2.49
12.40
16.02
28.90
16.15
30.00
3.20
12.01
15.08
26.76
37.83
49.44
5.59
16.38



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

Empirical Results

Data partitioning.

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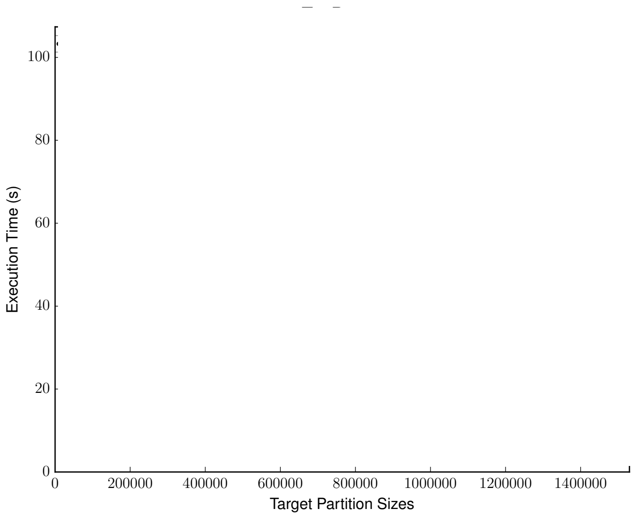
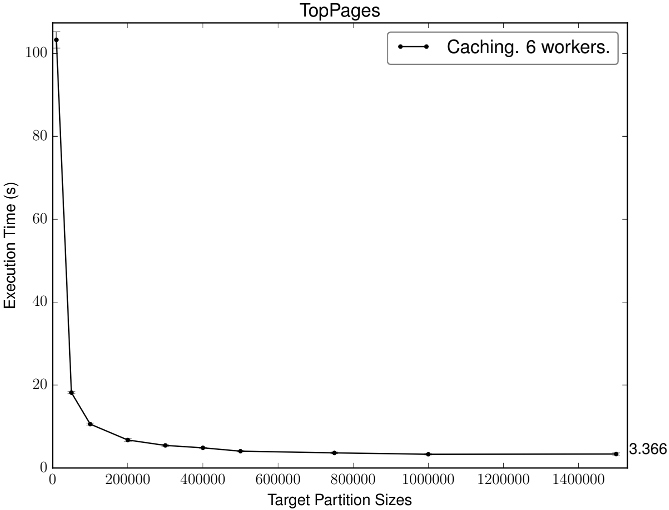
- Not clear how to partition the intermediate data.
  - Too small: Partition management overhead.
  - Too large: Data is processed in serial.


Execution Time (s)
0
20
40
60
80
100
Target Partition Sizes
0
200000
400000
600000
800000
1000000
1200000
1400000



- Targeting 1.5M items in each partition is reasonable.

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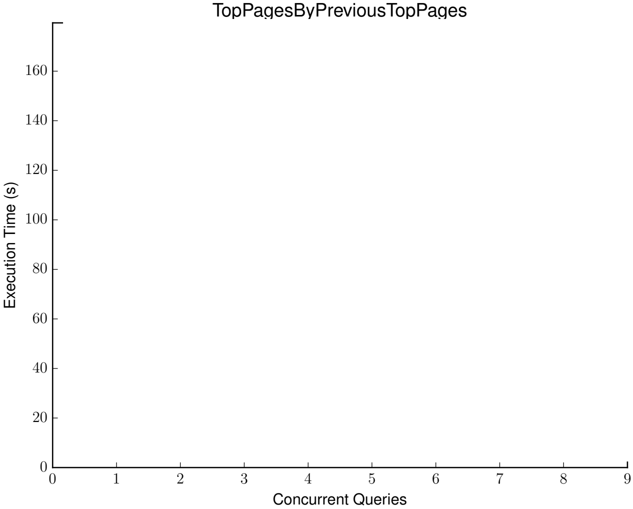
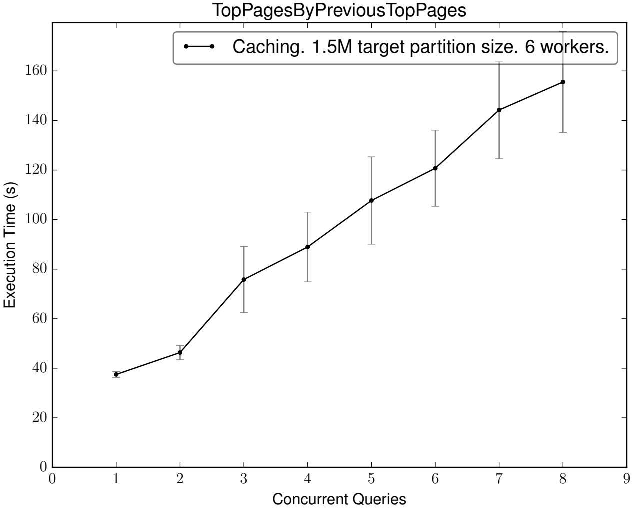
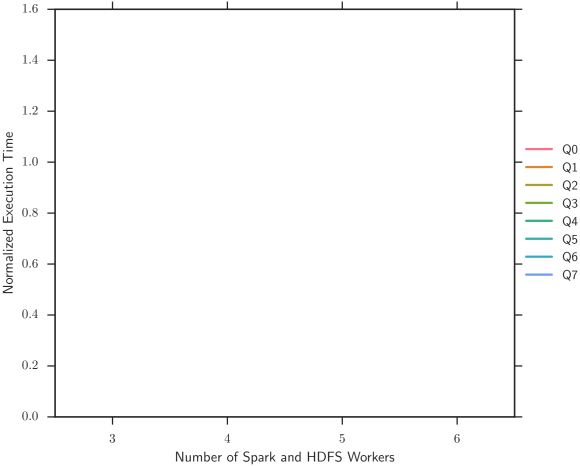
Benchmarking concurrent queries.

- 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.

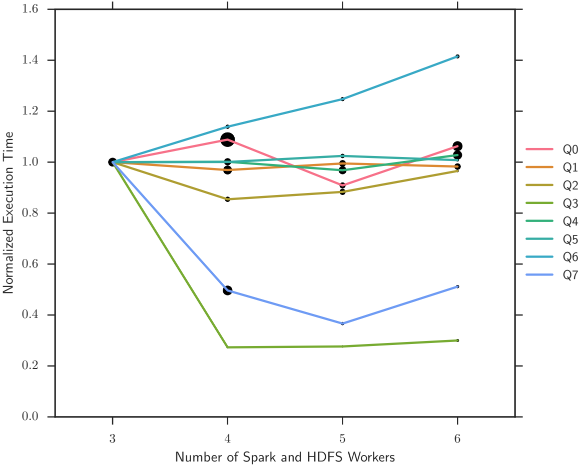

TopPagesByPreviousTopPages
Execution Time (s)
0
20
40
60
80
100
120
140
160
0
1
2
3
4
5
6
7
8
9
Concurrent Queries



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



1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Normalized Execution Time
3
4
5
6
Number of Spark and HDFS Workers
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7



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

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