#ibminterconnect

Java vs JavaScript for Enterprise Web Applications

Chris Bailey: STSM, IBM Runtime Monitoring

IBM

InterConnect2015

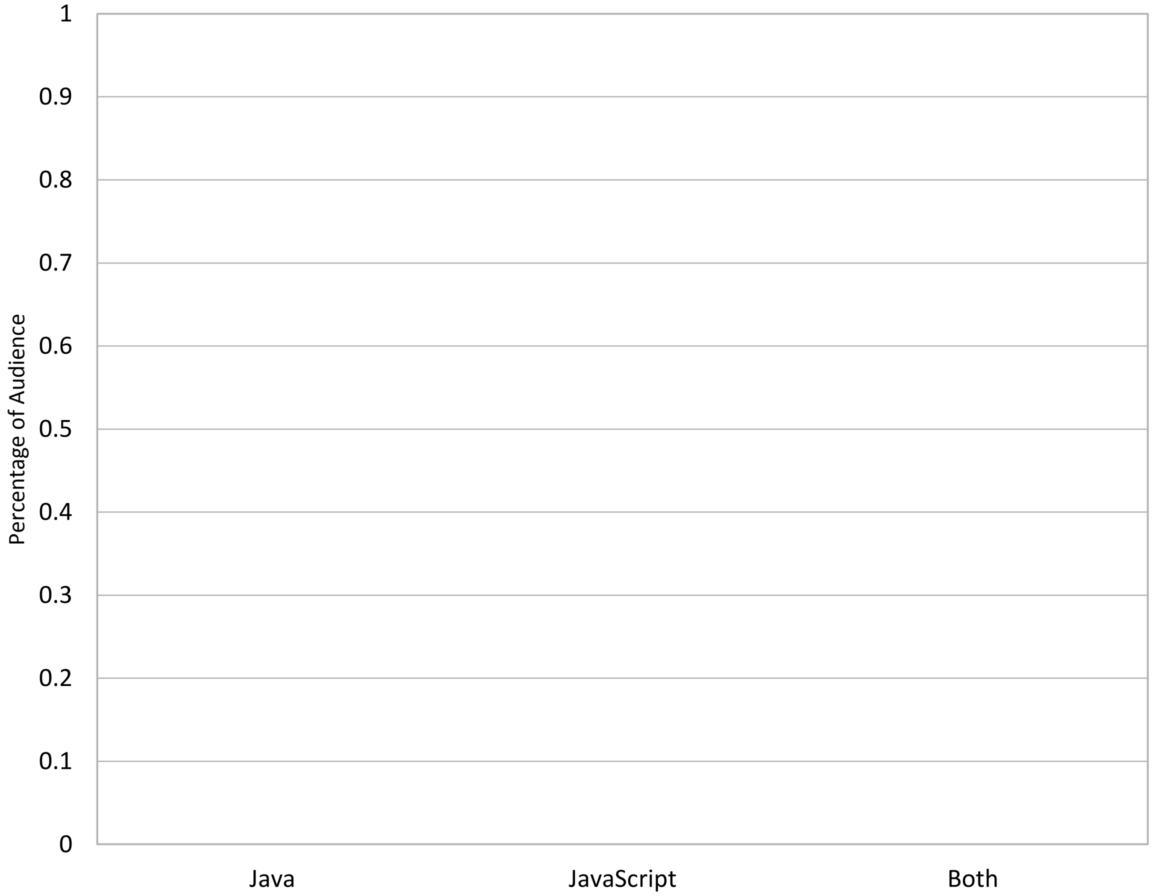
The Premier Cloud & Mobile Conference

February 22 – 26

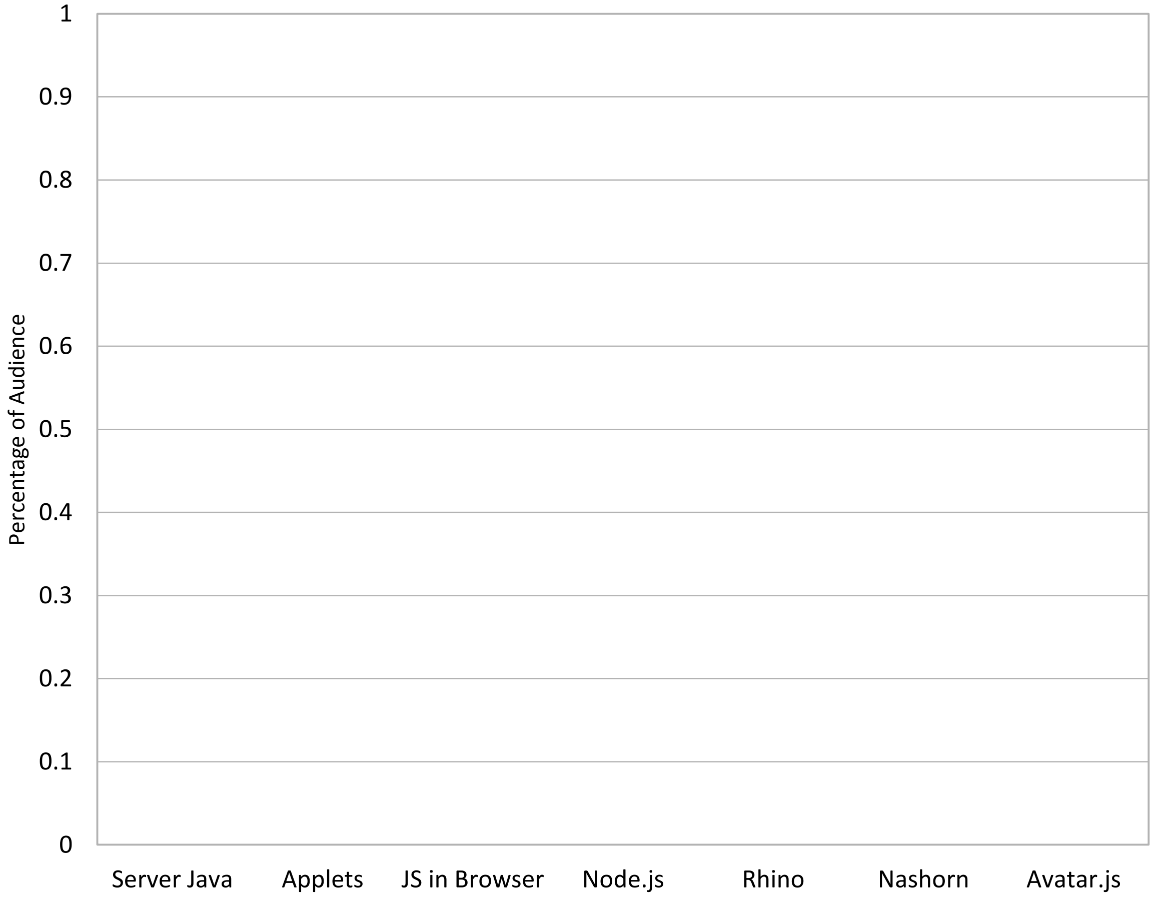
MGM Grand & Mandalay Bay | Las Vegas, Nevada

A Quick Survey

What languages do you use?



What runtimes do you use for them?

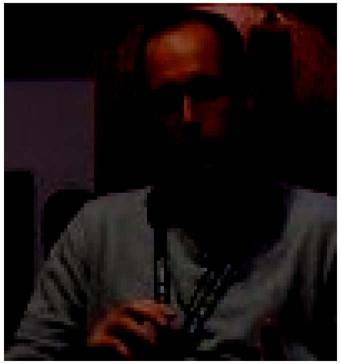


Introduction to the Speakers

- **Chris Bailey**

STSM, IBM Runtime Monitoring and Diagnostics Architect

-14 years working with Java and JVM technologies
-1 year working with Node.js and V8
-6 months working with Ruby and Python



- Recent work focus:

-Java monitoring, diagnostics and troubleshooting
-Java integration into the cloud
-JavaScript monitoring, diagnostics and troubleshooting

- My contact information:

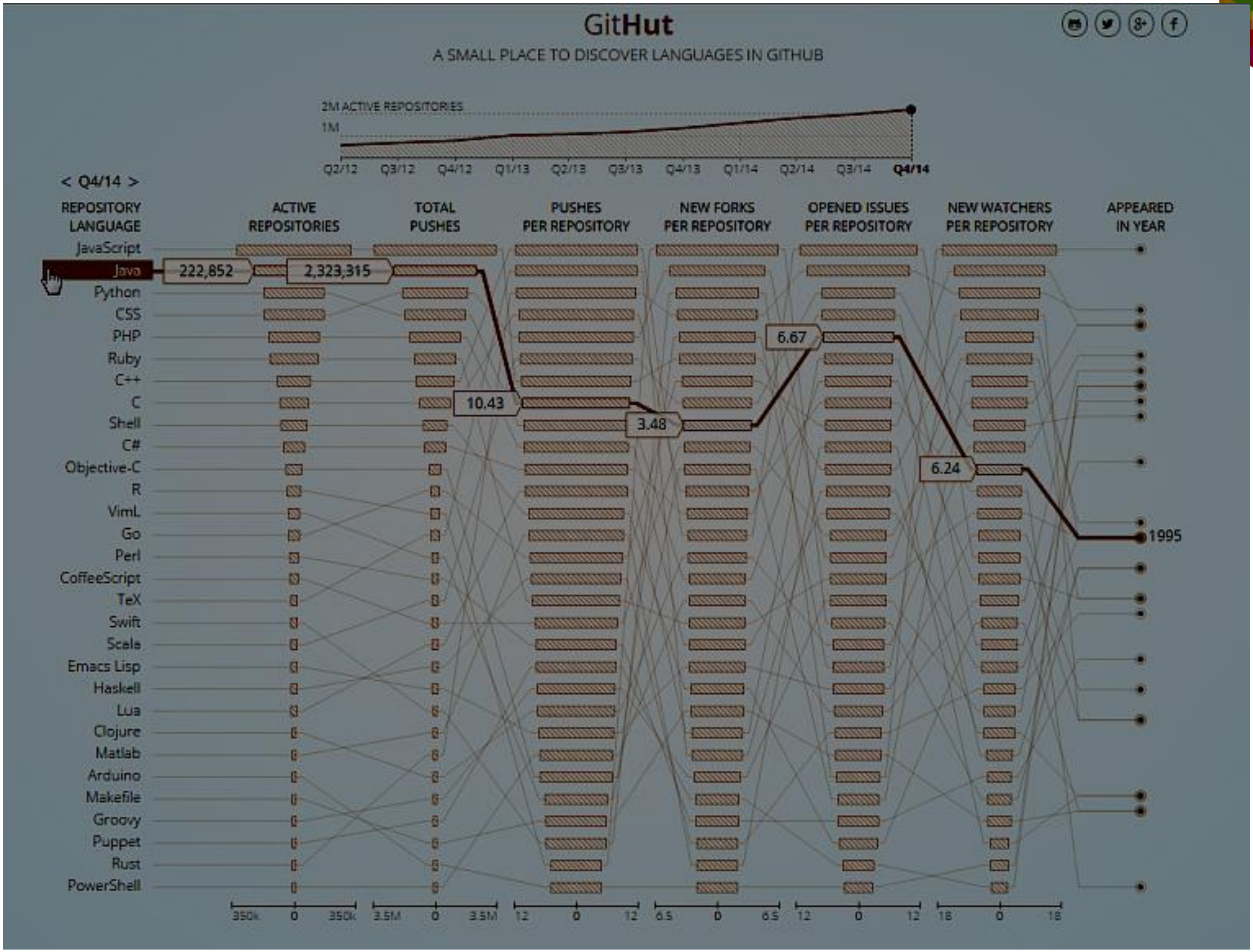
-baileyc@uk.ibm.com
-http://www.linkedin.com/in/chrisbaileyibm
-http://www.slideshare.net/cnbailey/
-@Chris__Bailey

Agenda

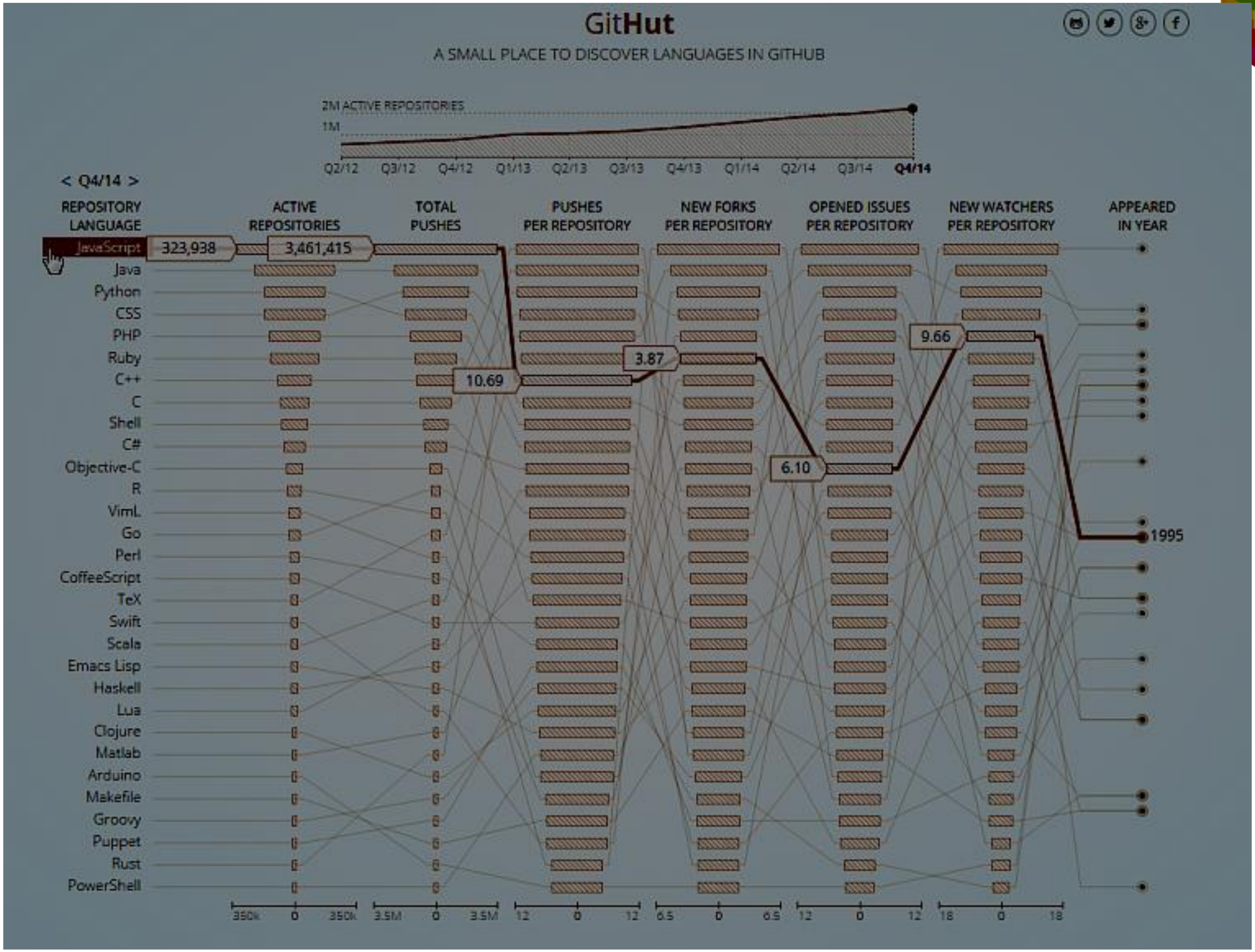
- Language Adoption
- Deployment Modes
- Asynchronous IO
- WebApplication Performance
- Under the Hood
- Enterprise Deployments
- IBM and Node.js

Language Adoption

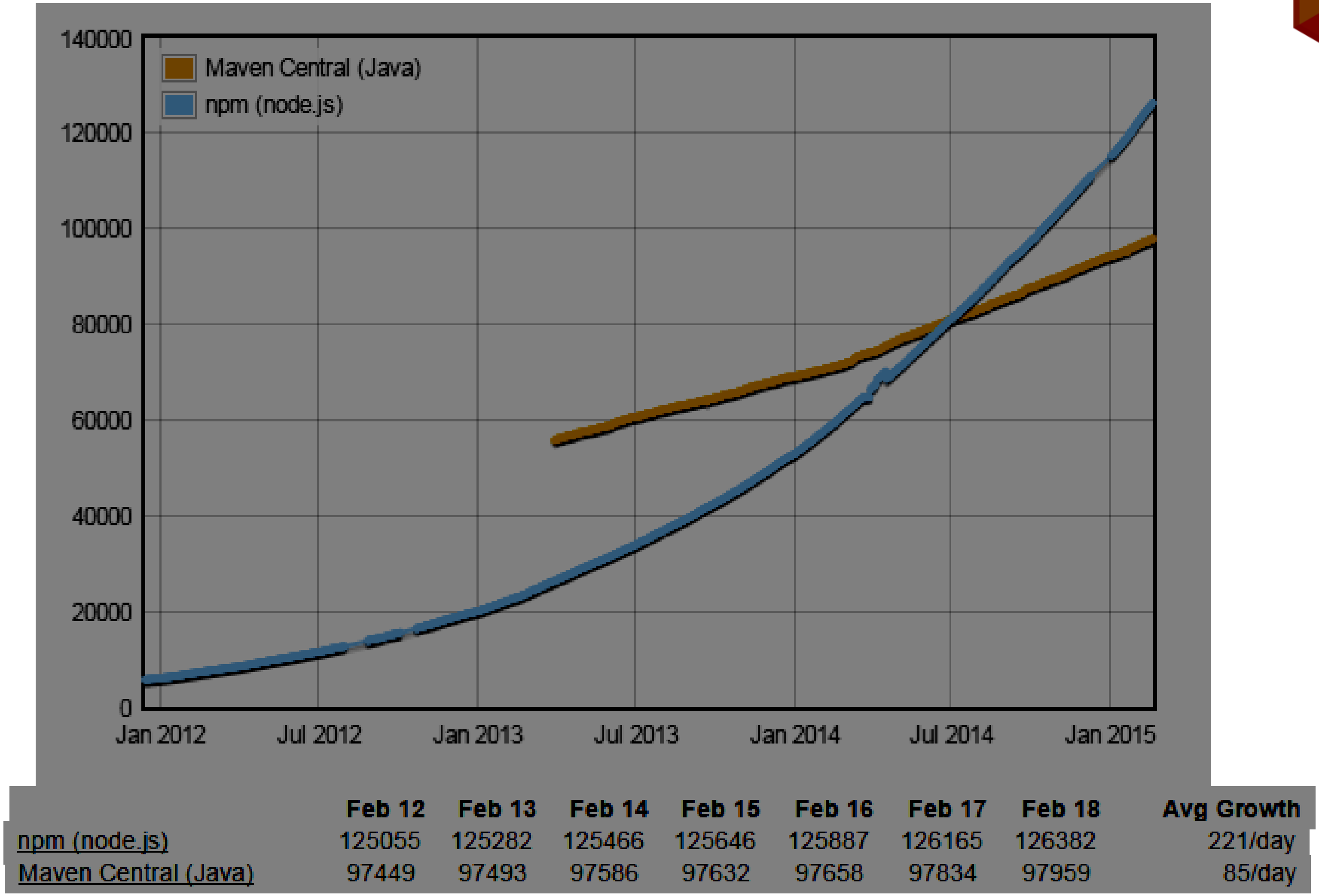
GitHub Adoption: Java



GitHub Adoption: JavaScript

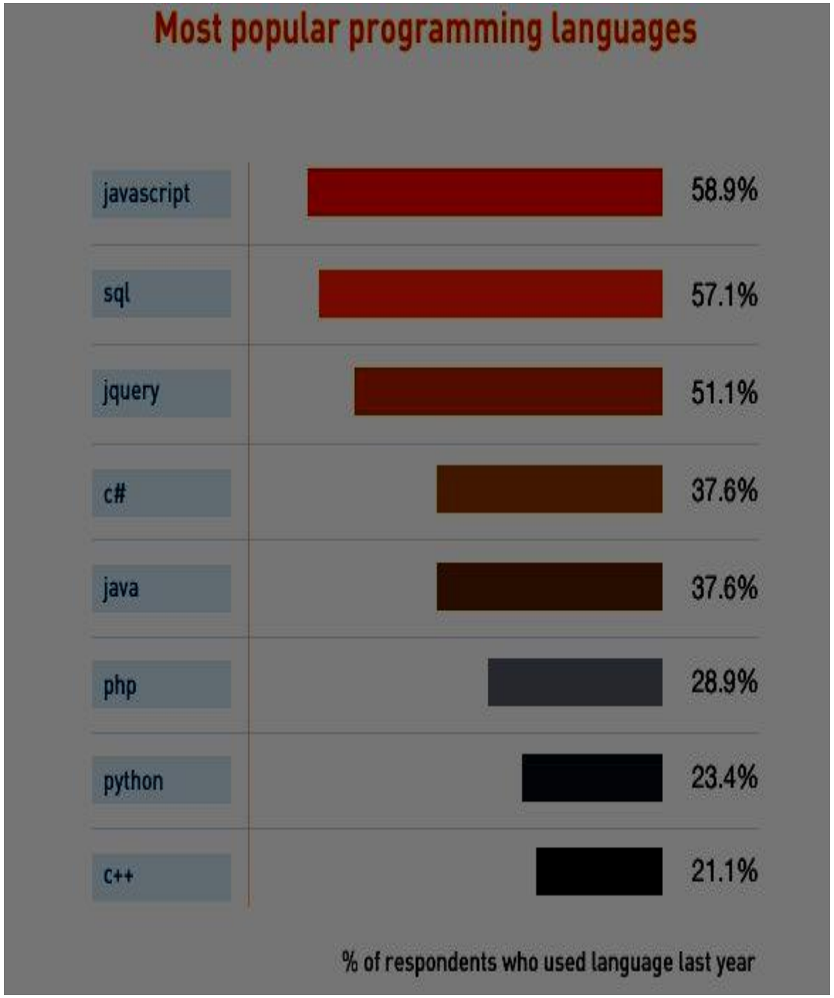


modulecounts.com

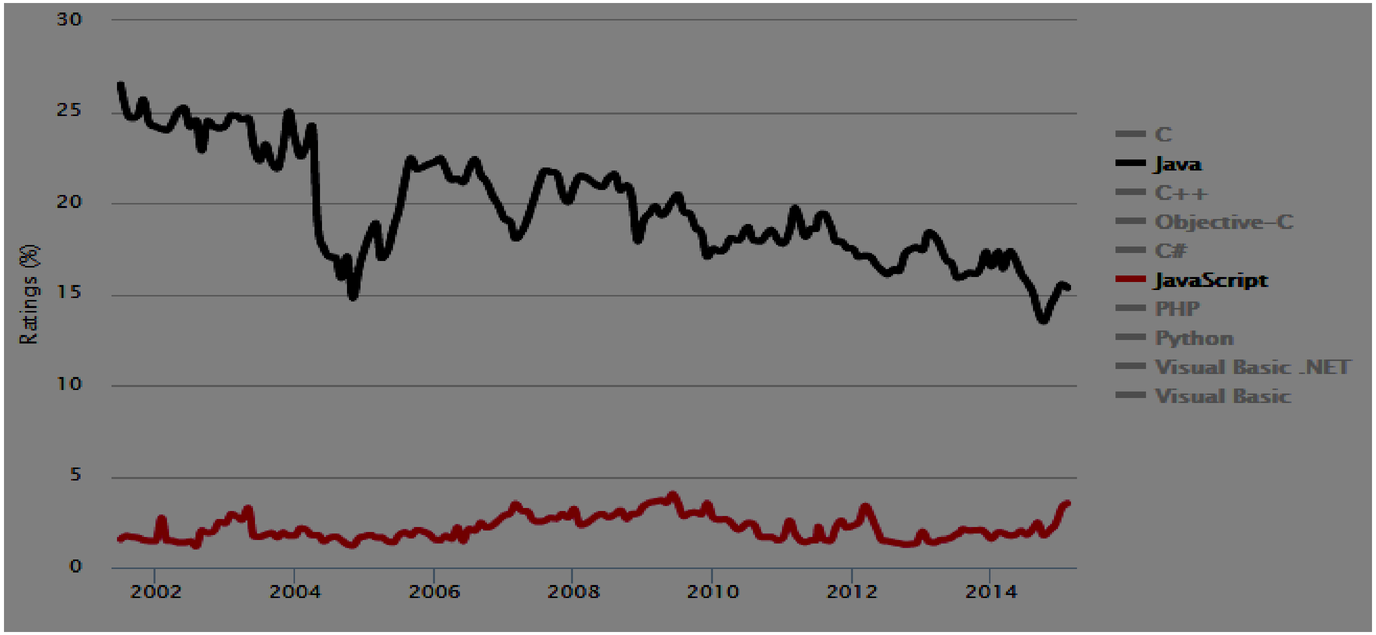


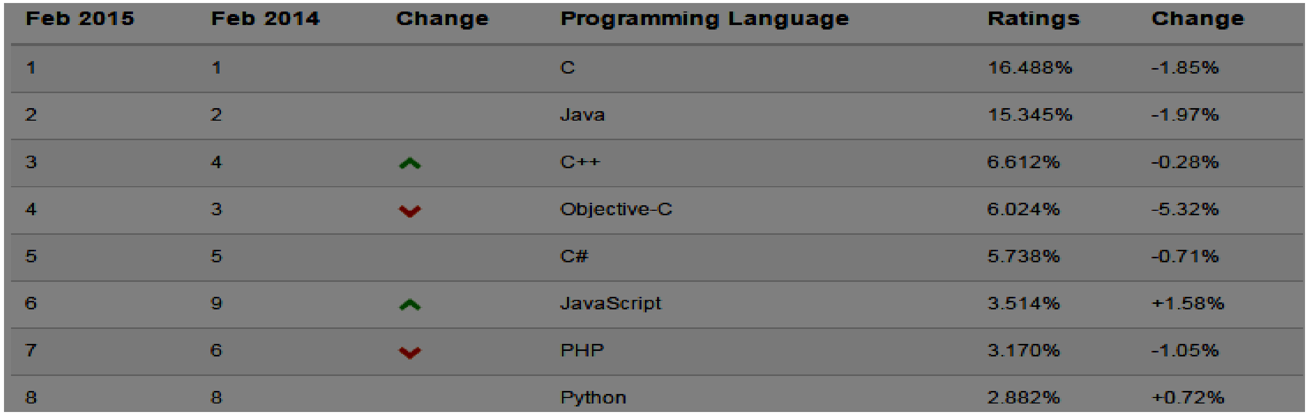
	Feb 12	Feb 13	Feb 14	Feb 15	Feb 16	Feb 17	Feb 18	Avg Growth
npm (node.js)	125055	125282	125466	125646	125887	126165	126382	221/day
Maven Central (Java)	97449	97493	97586	97632	97658	97834	97959	85/day

StackOverflow User Survey



Tiobe Community Programming Index

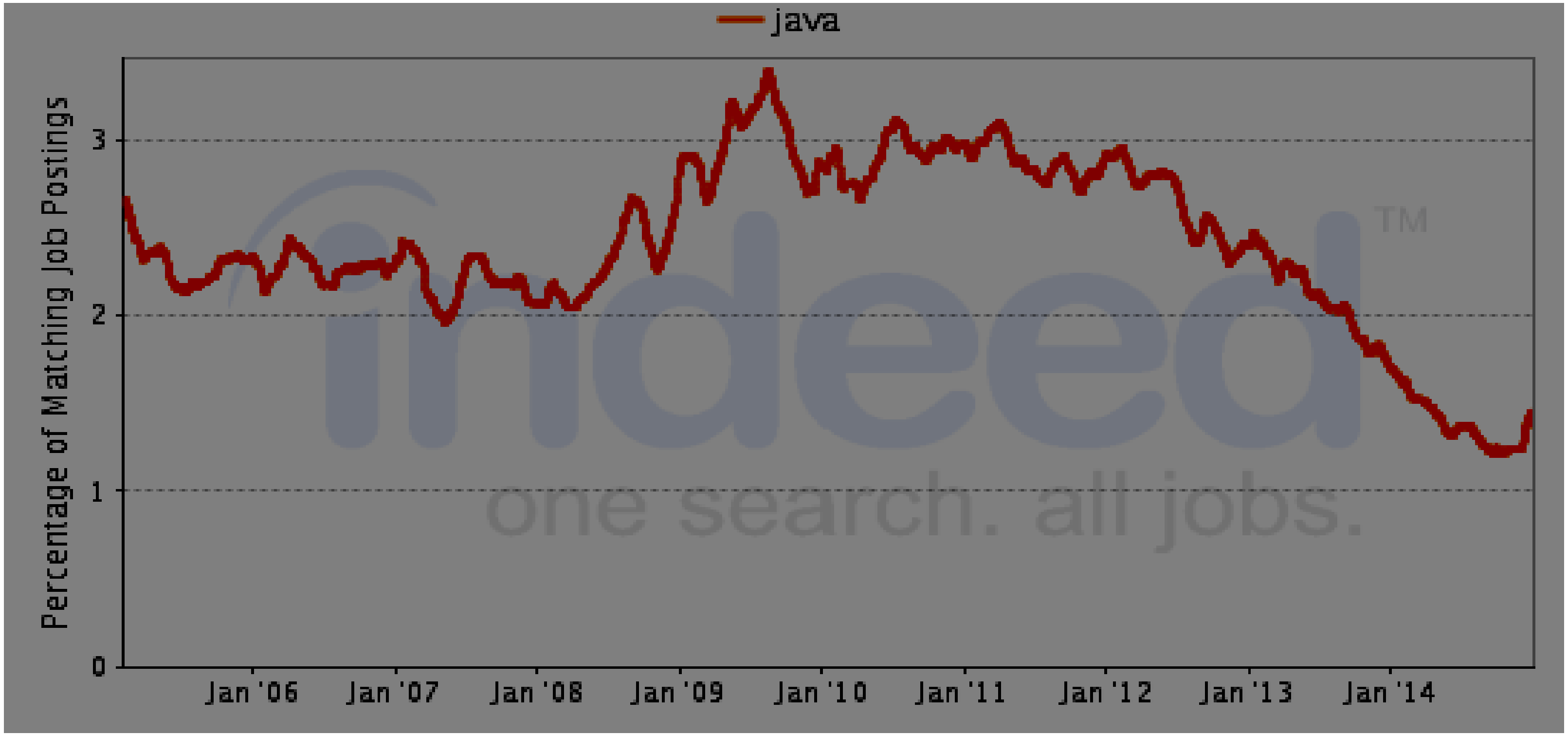




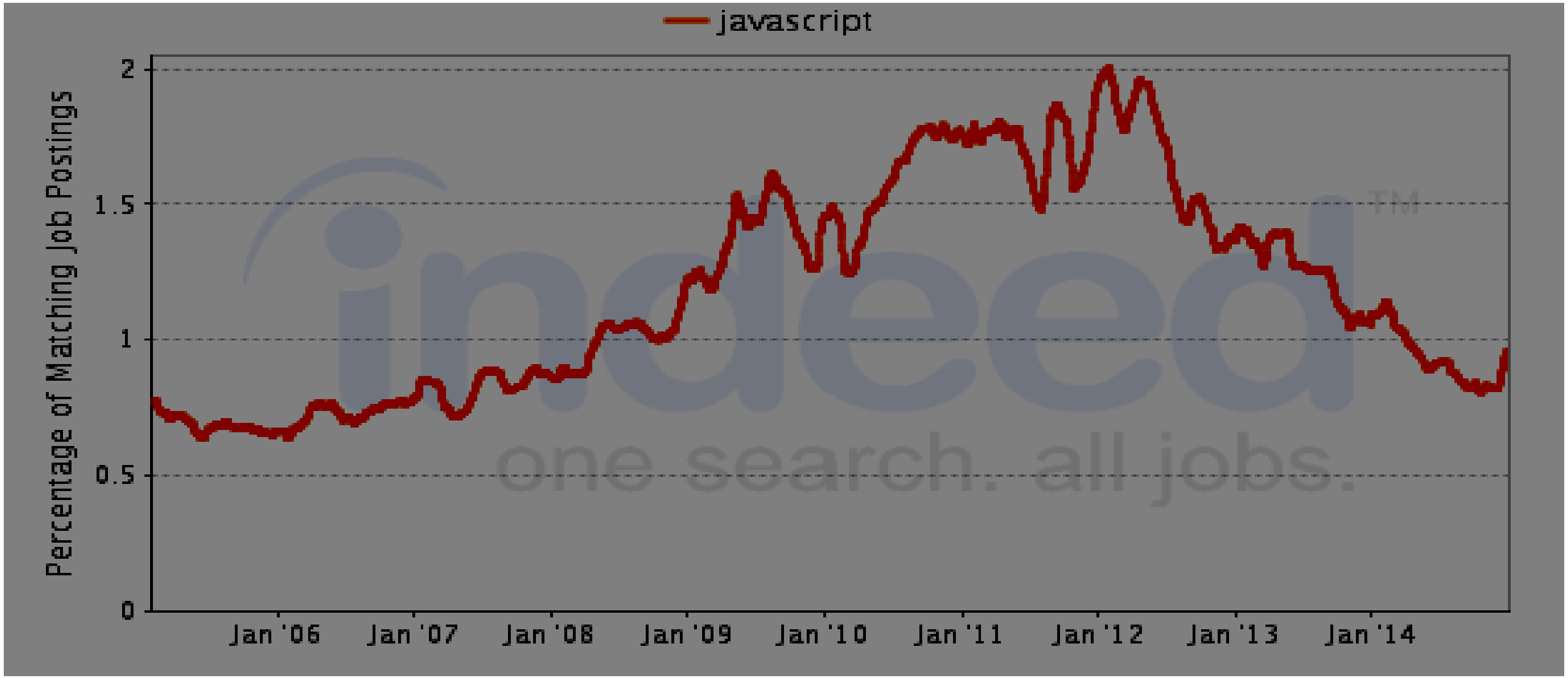
Feb 2015	Feb 2014	Change	Programming Language	Ratings	Change
1	1		C	16.488%	-1.85%
2	2		Java	15.345%	-1.97%
3	4	▲	C++	6.612%	-0.28%
4	3	▼	Objective-C	6.024%	-5.32%
5	5		C#	5.738%	-0.71%
6	9	▲	JavaScript	3.514%	+1.58%
7	6	▼	PHP	3.170%	-1.05%
8	8		Python	2.882%	+0.72%

Ratings based on the number of skilled engineers, courses and third party vendors.

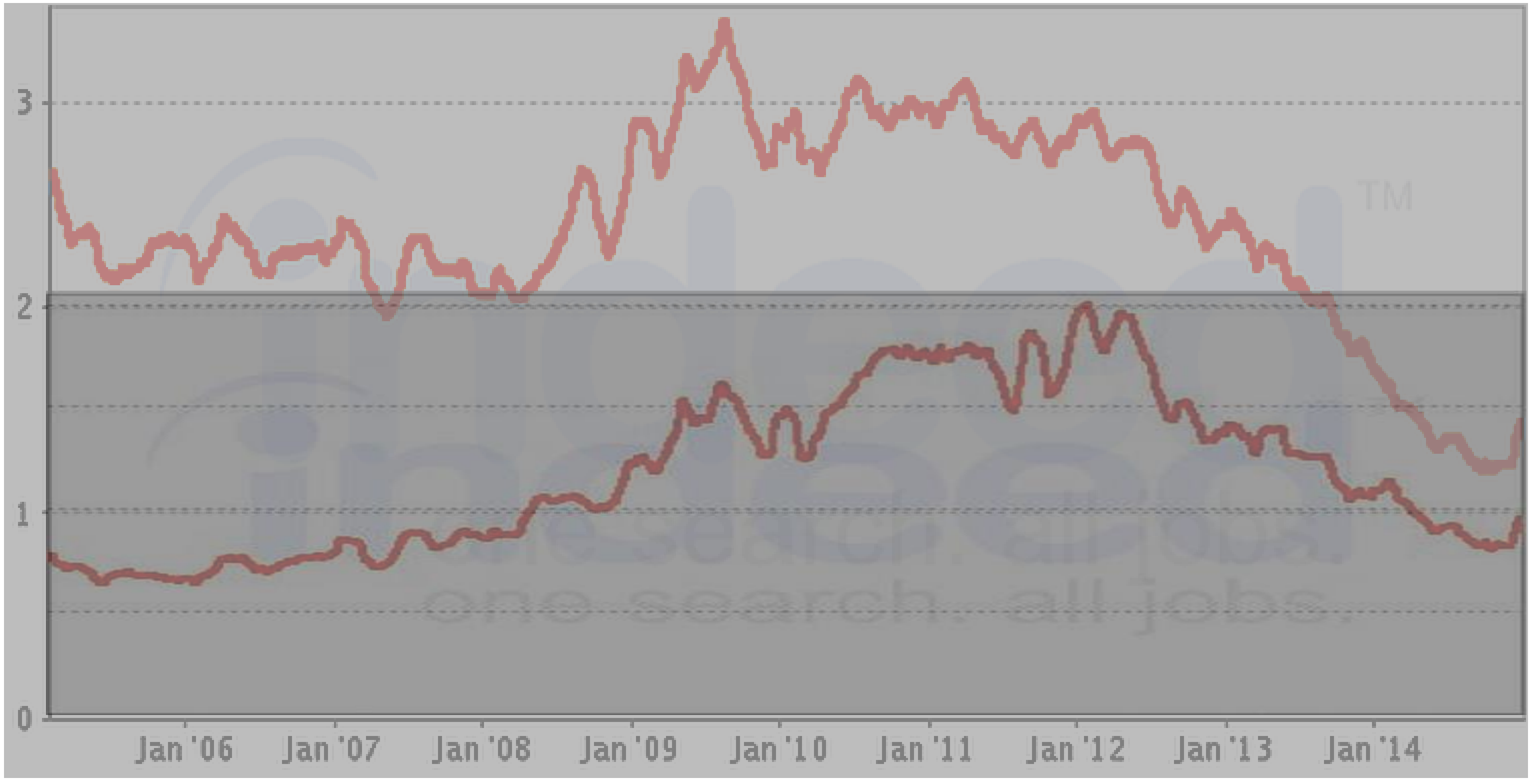
Indeed.com Job Trends: Java



Indeed.com Job Trends: JavaScript



Indeed.com Job Trends



Language Adoption

- JavaScript has a large developer base

-#1 on GitHub with 45% more active repositories than Java
-#1 on modulecounts.com with 29% more NPM modules than Maven
-#1 used language by StackOverflow survey responders
-#6 language on the Tiobe index

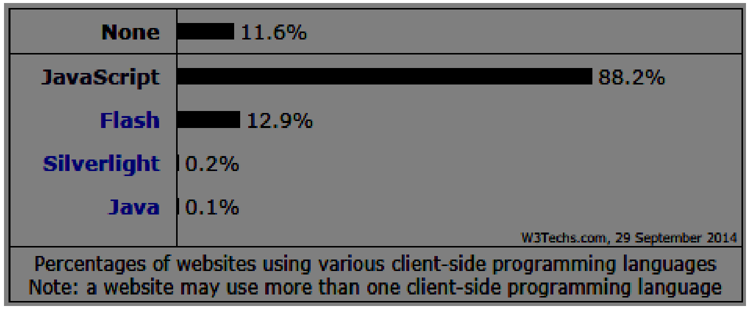
- Java remains hugely relevant, particularly on the server

-#2 on GitHub with 52% more active repositories than the next language
-#3 on modulecounts with 73.8% more modules than the next language
-#2 language on the Tiobe index
-#1 on indeed.com for developer jobs

Deployment Modes

Usage in the browser

- JavaScript is ubiquitous in the browser
  - Supported in every browser
  - Full integration with HTML and CSS



W3Techs.com, 29 September 2014

Percentages of websites using various client-side programming languages
Note: a website may use more than one client-side programming language

- JavaScript is not affected by negative publicity....

CERT | Software Engineering Institute | Carnegie Mellon University

Homeland Security
Sponsored by the DHS Office of Cybersecurity and Communications

***Unless** it is **absolutely necessary** to run Java **in web browsers, disable it** as described below, even after updating to 7u11. This will help mitigate other Java vulnerabilities that may be discovered in the future.*

US-CERT
UNITED STATES COMPUTER EMERGENCY READINESS TEAM

*This and previous Java vulnerabilities have been widely targeted by attackers, and new Java vulnerabilities are likely to be discovered. **To defend against** this and **future** Java **vulnerabilities**, **consider disabling Java in web browsers**…*

Usage on the server

- Java has a long history on the server
  - JPE launched in 1998

- Java has rich platform support:
  - Linux x86, Linux POWER, zLinux
  - Windows, Mac OS, Solaris, AIX, z/OS

- JavaScript is a nascent language on the server
  - Limited platform support – although its growing
  - No API support to interact with the OS
- Part of the browser security model
  - Frameworks like Node.js have changed that.

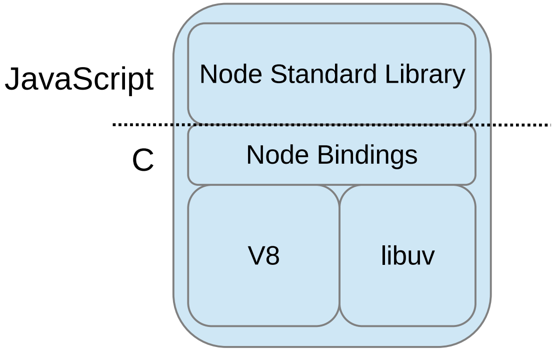
Server Side JavaScript: Node.js

- Single Threaded Event based JavaScript framework

–Uses non-blocking asynchronous I/O

- Wraps the Chrome V8 JavaScript engine with I/O interfaces

–Libuv provides interaction with OS/system



- Designed to build scalable network applications

–Suited for real time delivery of data to distributed client

- Available on a growing set of platforms

-Windows, Linux x86, Linux ARM, Mac OS, Solaris

-Linux POWER, zLinux, AIX

Async I/O Model

Typical approach to I/O

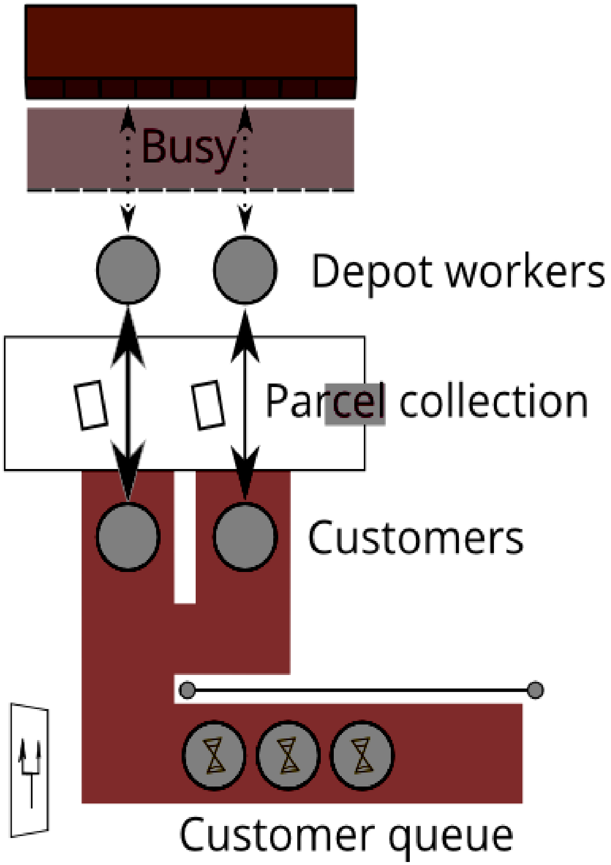
- One thread (or process) per connection
  - Each thread waits on a response
  - Scalability determined by the number of threads

- Each thread:
  - consumes memory
  - is relatively idle

- Number of concurrent customers determined by number of depot workers

- Additional customers wait in a queue with no response

Parcel collection depot



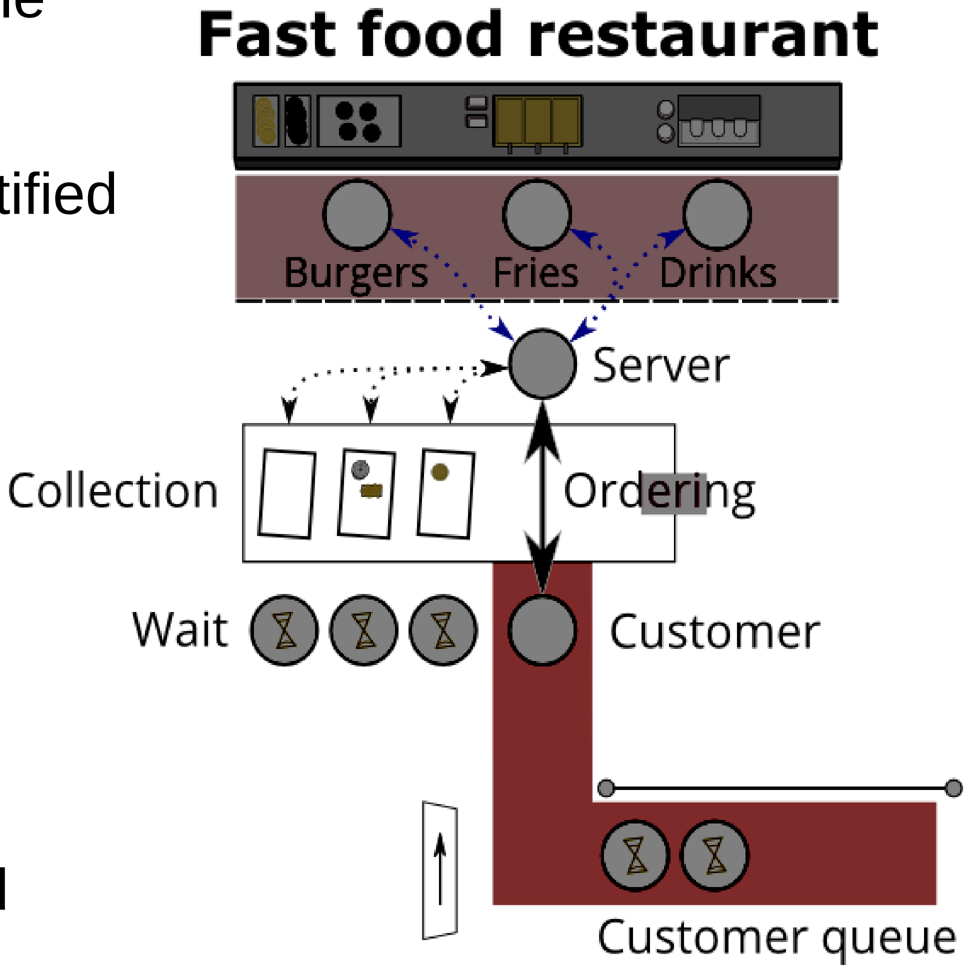
Asycnhronous Non-Blocking I/O

- One thread multiplexes for multiple requests
  - -No waiting for a response
  - -Handles return from I/O when notified

- Scalability determined by:
  - -CPU usage
  - -“Back end” responsiveness

- Number of concurrent customers determined by how fast the food Server can work

- Or until the kitchen gets slammed



Drawbacks of Asynchronous I/O

- Tasks must execute quickly to avoid blocking the event queue
-Analogous to work done under a lock
-Stick to the right jobs, eg, I/O
-Delegate CPU bound tasks to back end processes

- Easy to run out of memory
-No direct bound on amount of parallel work
-Holding state for each piece or work means unbounded memory usage

JavaScript and Asynchronous I/O

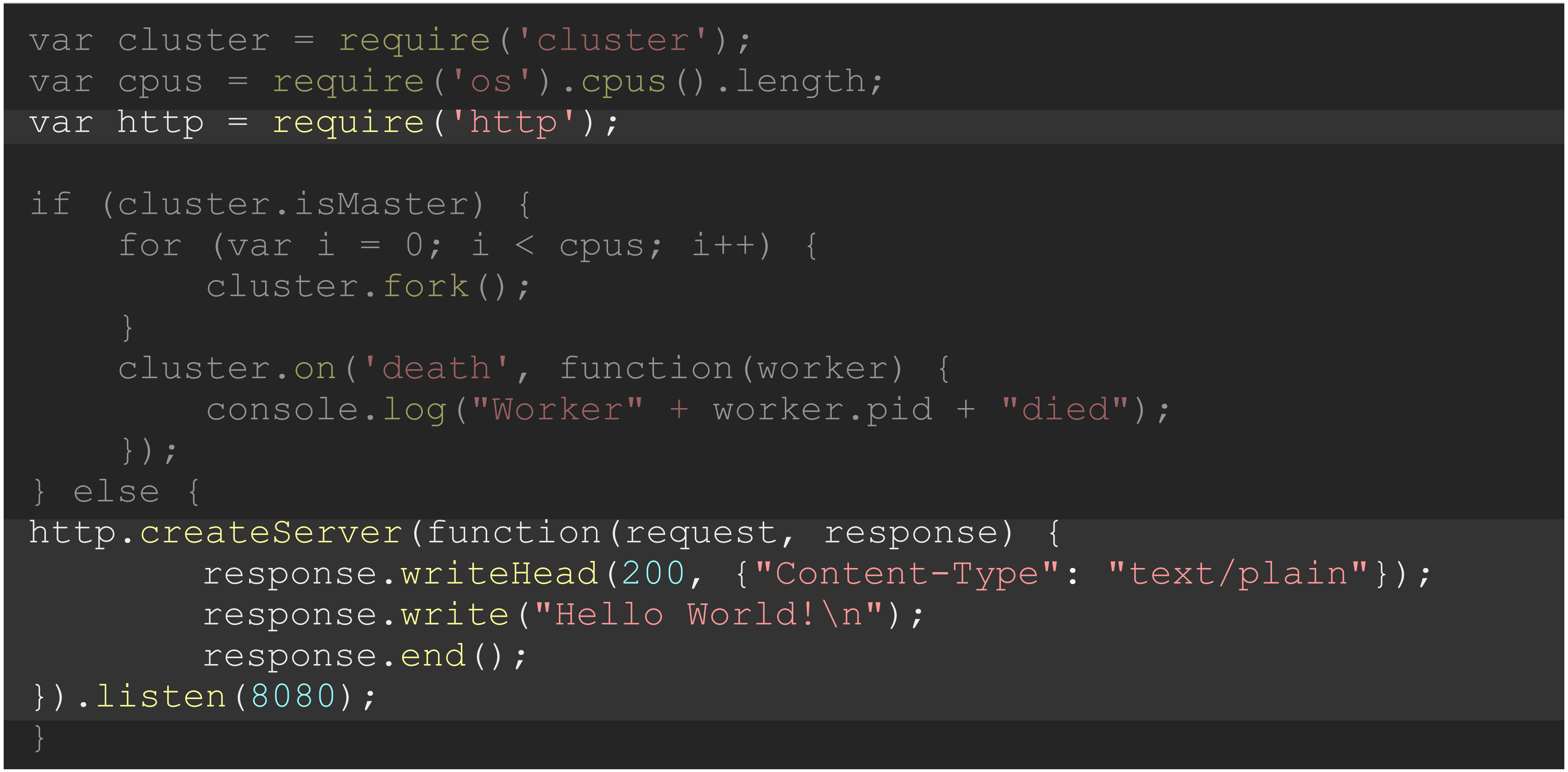
- JavaScript is already event based in the browser
-eg. onClick and onMouseOver events

- First class functions and closures fit well with events
-Easy to create and pass function callbacks
-Easy to execute callbacks in the context of the event

- Node.js execution is based on an event loop
-Asynchronous I/O built in from the ground up

- Node.js execution uses a single thread
-No need to worry about locking or shared data
-Most machines are now multi-CPU, so cluster capabilities are provided

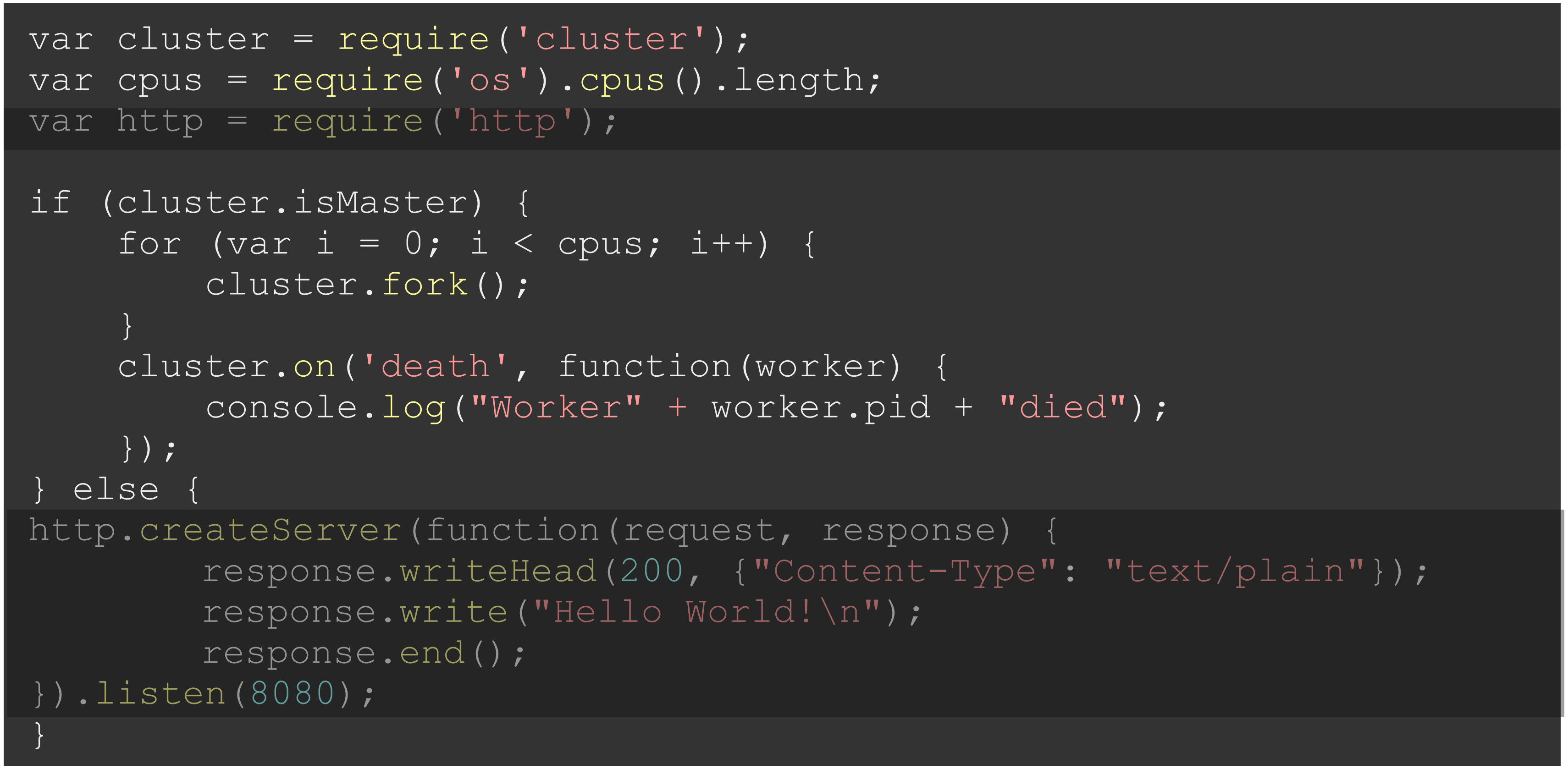
HTTP Server Example



```
var cluster = require('cluster');
var cpus = require('os').cpus().length;
var http = require('http');

if (cluster.isMaster) {
    for (var i = 0; i < cpus; i++) {
        cluster.fork();
    }
    cluster.on('death', function(worker) {
        console.log("Worker" + worker.pid + "died");
    });
} else {
http.createServer(function(request, response) {
        response.writeHead(200, {"Content-Type": "text/plain"});
        response.write("Hello World!\n");
        response.end();
}).listen(8080);
}
```

HTTP Server Example with Clustering



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JavaScript and Asynchronous I/O

- Very little time spent with events on the Event Loop

- Provides good scalability, so should provide great performance for IO bound apps

- Like WebApplications...

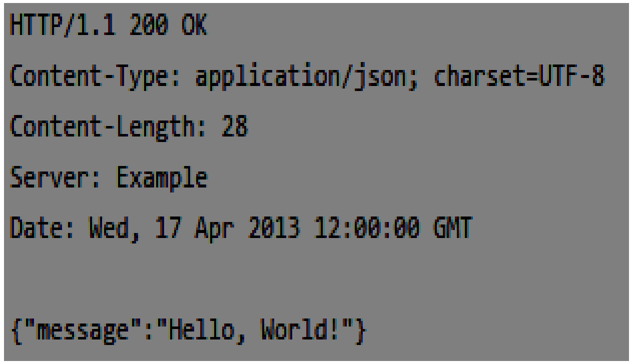
WebApp Performance

JSON Serialization

- JSON serialization of a newly instantiated object

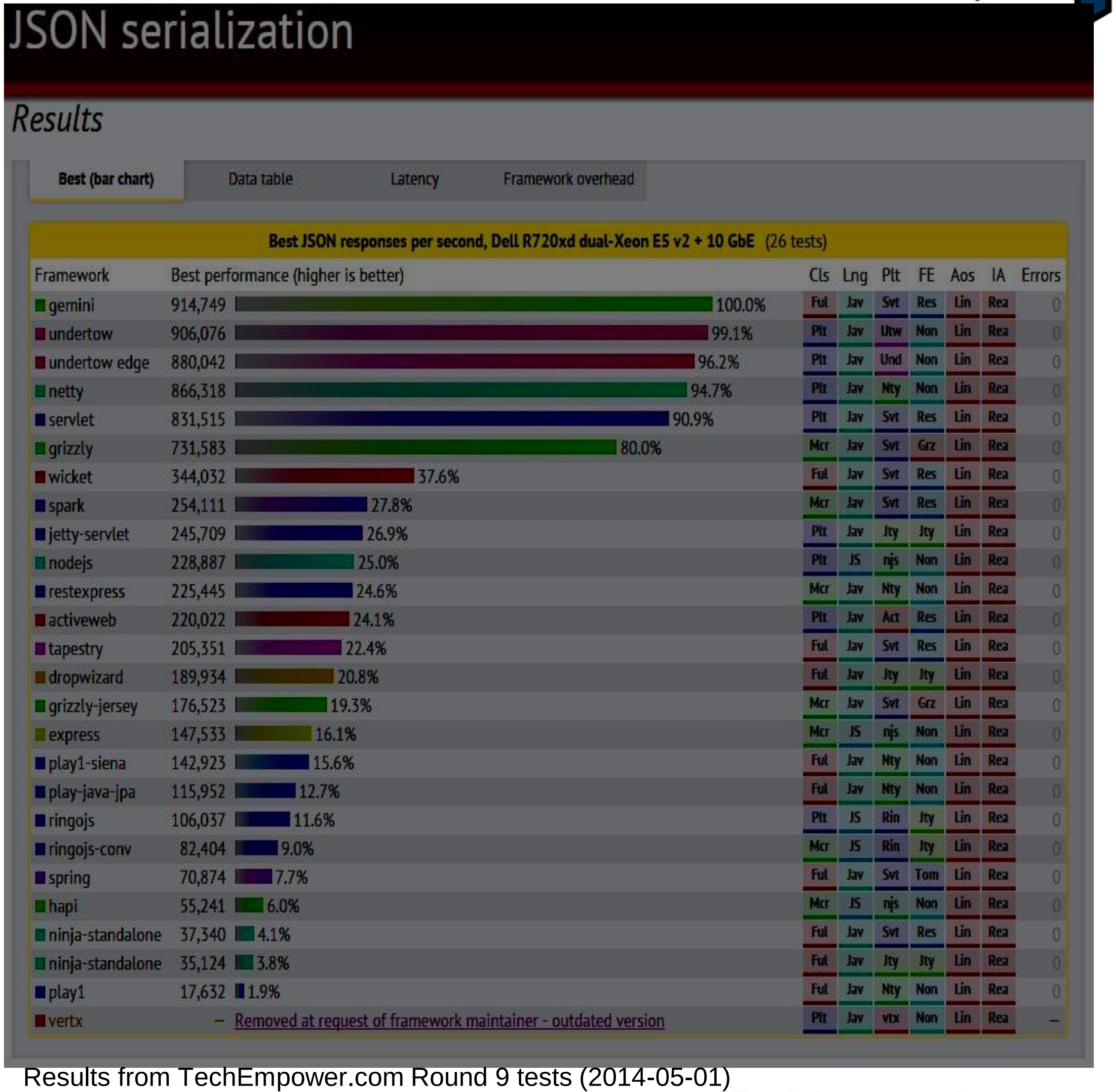
- Maps
-Key of *message*
-Value of *Hello, World!*

- Example response:



```
HTTP/1.1 200 OK
Content-Type: application/json; charset=UTF-8
Content-Length: 28
Server: Example
Date: Wed, 17 Apr 2013 12:00:00 GMT

{"message":"Hello, World!"}
```



JSON serialization

Results

Best JSON responses per second, Dell R720xd dual-Xeon E5 v2 + 10 GbE (26 tests)

Framework	Best performance (higher is better)		Cls	Lng	Plt	FE	Aos	IA	Errors
gemini	914,749	100.0%	Ful	Jav	Svt	Res	Lin	Rea	0
undertow	906,076	99.1%	Plt	Jav	Utw	Non	Lin	Rea	0
undertow edge	880,042	96.2%	Plt	Jav	Und	Non	Lin	Rea	0
netty	866,318	94.7%	Plt	Jav	Nty	Non	Lin	Rea	0
servlet	831,515	90.9%	Plt	Jav	Svt	Res	Lin	Rea	0
grizzly	731,583	80.0%	Mcr	Jav	Svt	Grz	Lin	Rea	0
wicket	344,032	37.6%	Ful	Jav	Svt	Res	Lin	Rea	0
spark	254,111	27.8%	Mcr	Jav	Svt	Res	Lin	Rea	0
jetty-servlet	245,709	26.9%	Plt	Jav	Jty	Jty	Lin	Rea	0
nodejs	228,887	25.0%	Plt	JS	njs	Non	Lin	Rea	0
restexpress	225,445	24.6%	Mcr	Jav	Nty	Non	Lin	Rea	0
activeweb	220,022	24.1%	Plt	Jav	Act	Res	Lin	Rea	0
tapestry	205,351	22.4%	Ful	Jav	Svt	Res	Lin	Rea	0
dropwizard	189,934	20.8%	Ful	Jav	Jty	Jty	Lin	Rea	0
grizzly-jersey	176,523	19.3%	Mcr	Jav	Svt	Grz	Lin	Rea	0
express	147,533	16.1%	Mcr	JS	njs	Non	Lin	Rea	0
play1-siena	142,923	15.6%	Ful	Jav	Nty	Non	Lin	Rea	0
play-java-jpa	115,952	12.7%	Ful	Jav	Nty	Non	Lin	Rea	0
ringojs	106,037	11.6%	Plt	JS	Rin	Jty	Lin	Rea	0
ringojs-conv	82,404	9.0%	Mcr	JS	Rin	Jty	Lin	Rea	0
spring	70,874	7.7%	Ful	Jav	Svt	Tom	Lin	Rea	0
hapi	55,241	6.0%	Mcr	JS	njs	Non	Lin	Rea	0
ninja-standalone	37,340	4.1%	Ful	Jav	Svt	Res	Lin	Rea	0
ninja-standalone	35,124	3.8%	Ful	Jav	Jty	Jty	Lin	Rea	0
play1	17,632	1.9%	Ful	Jav	Nty	Non	Lin	Rea	0
vertx	–	Removed at request of framework maintainer - outdated version	Plt	Jav	vtx	Non	Lin	Rea	–

Results from TechEmpower.com Round 9 tests (2014-05-01)

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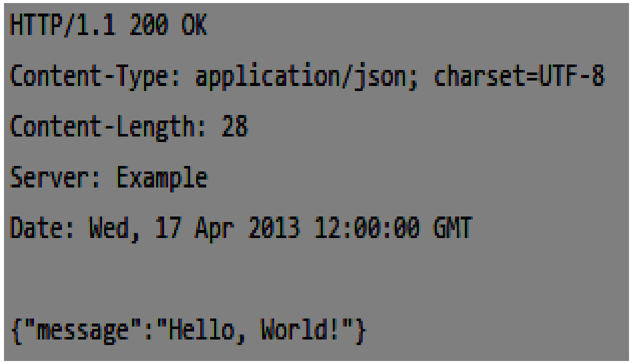

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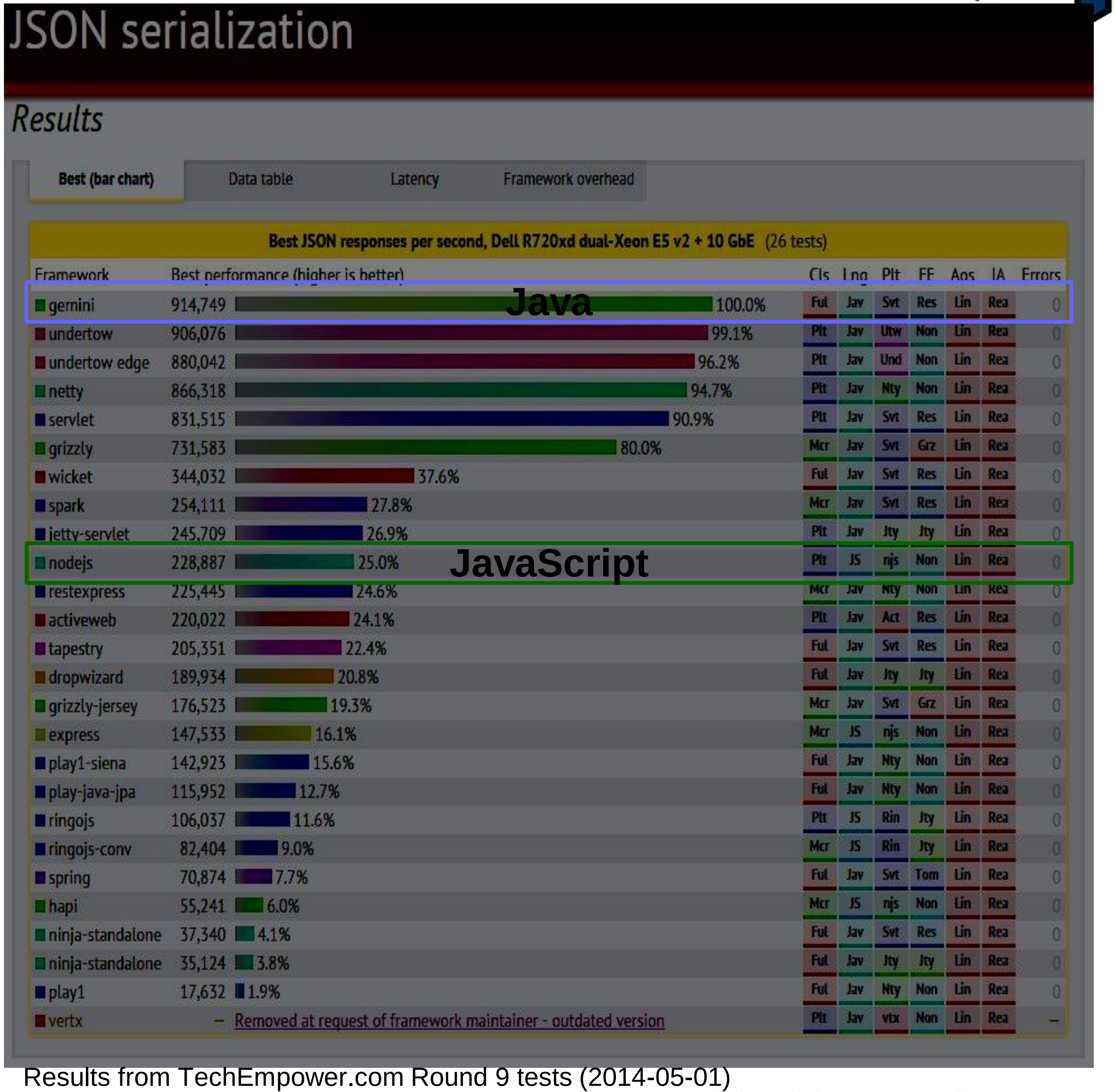

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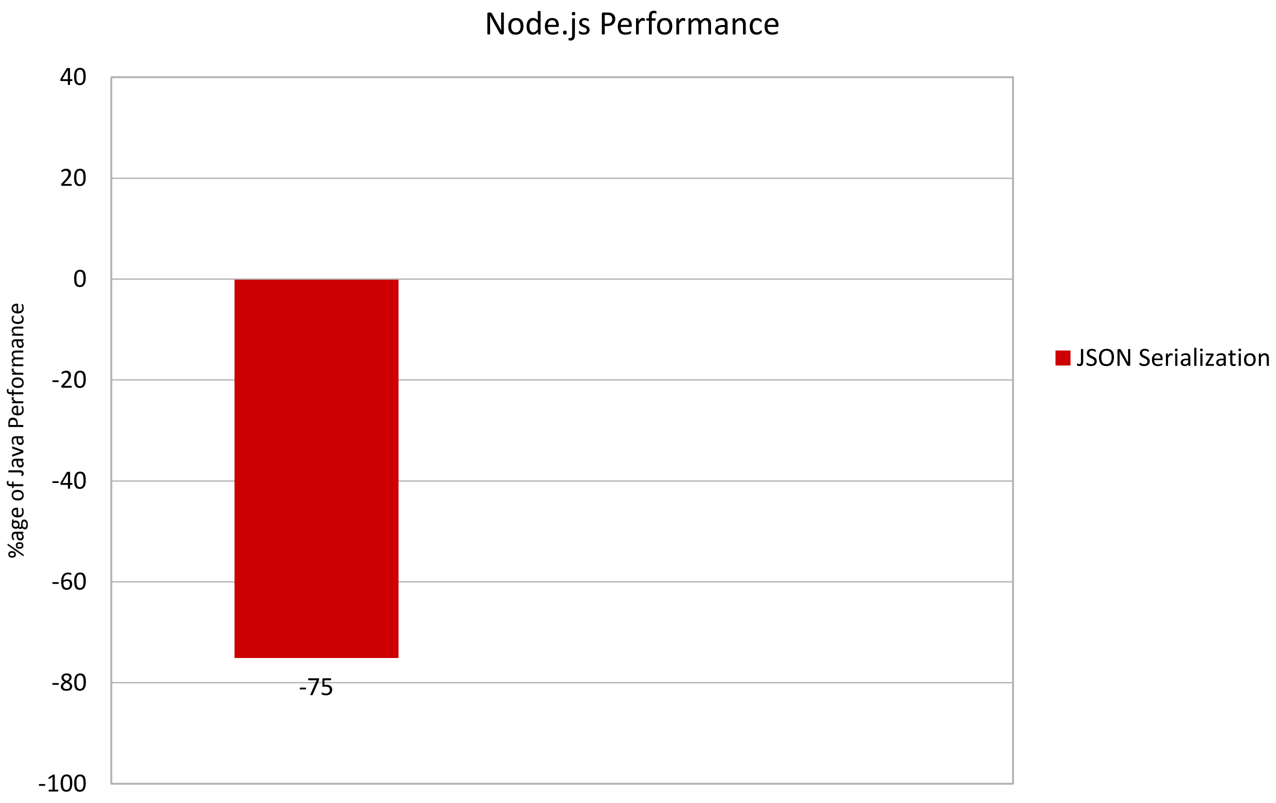
Java

JavaScript

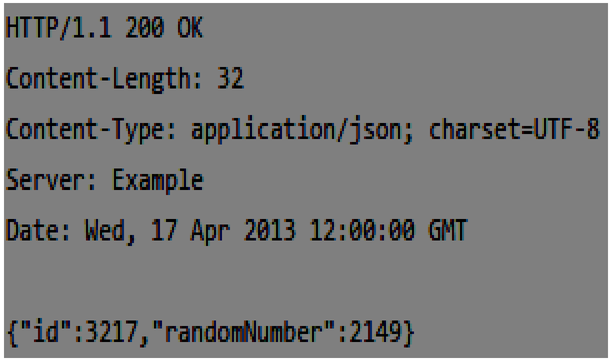
Results from TechEmpower.com Round 9 tests (2014-05-01)

JavaScript WebApp Performance



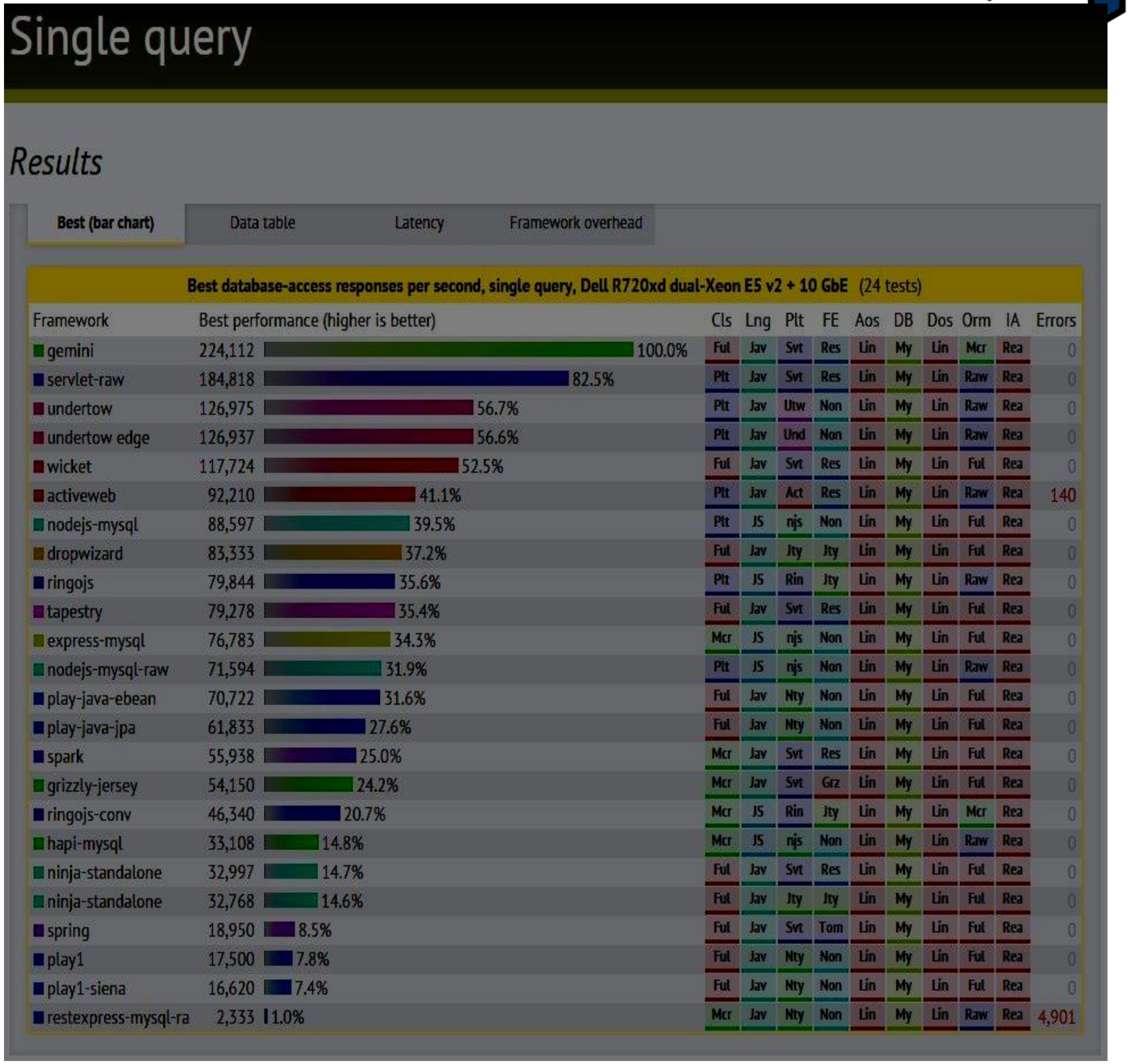
Single Query

- Fetches single row from simple database table
- Row serialized as JSON
- Example response:



```
HTTP/1.1 200 OK
Content-Length: 32
Content-Type: application/json; charset=UTF-8
Server: Example
Date: Wed, 17 Apr 2013 12:00:00 GMT

{"id":3217,"randomNumber":2149}
```



Single query

Results

Best database-access responses per second, single query, Dell R720xd dual-Xeon E5 v2 + 10 GbE (24 tests)

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gemini	224,112	100.0%	Ful	Jav	Svt	Res	Lin	My	Lin	Mcr	Rea	0
servlet-raw	184,818	82.5%	Plt	Jav	Svt	Res	Lin	My	Lin	Raw	Rea	0
undertow	126,975	56.7%	Plt	Jav	Utw	Non	Lin	My	Lin	Raw	Rea	0
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wicket	117,724	52.5%	Ful	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	0
activeweb	92,210	41.1%	Plt	Jav	Act	Res	Lin	My	Lin	Raw	Rea	140
nodejs-mysql	88,597	39.5%	Plt	JS	njs	Non	Lin	My	Lin	Ful	Rea	0
dropwizard	83,333	37.2%	Ful	Jav	Jty	Jty	Lin	My	Lin	Ful	Rea	0
ringojs	79,844	35.6%	Plt	JS	Rin	Jty	Lin	My	Lin	Raw	Rea	0
tapestry	79,278	35.4%	Ful	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	0
express-mysql	76,783	34.3%	Mcr	JS	njs	Non	Lin	My	Lin	Ful	Rea	0
nodejs-mysql-raw	71,594	31.9%	Plt	JS	njs	Non	Lin	My	Lin	Raw	Rea	0
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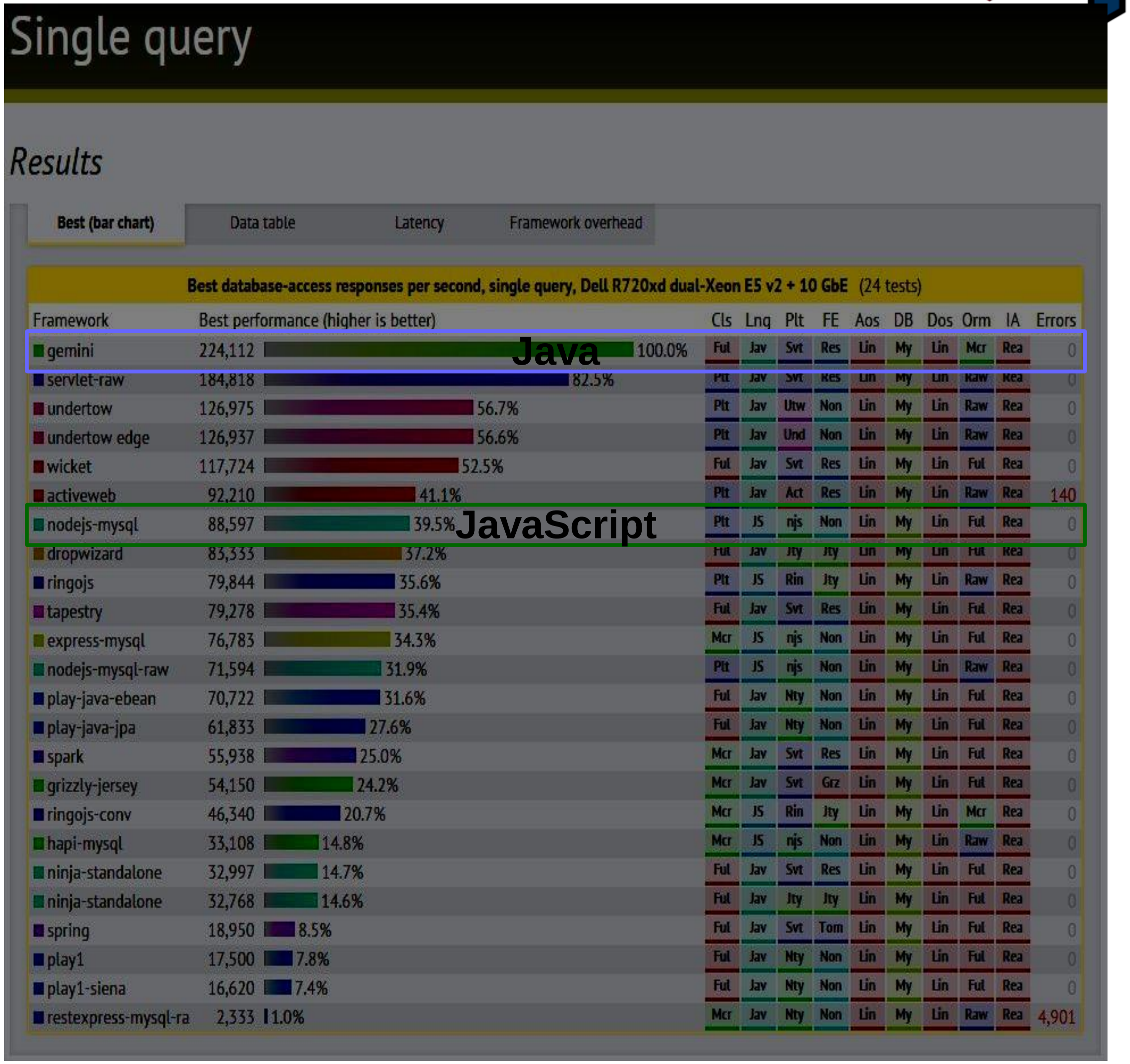
{"id":3217,"randomNumber":2149}
```



Single query

Results

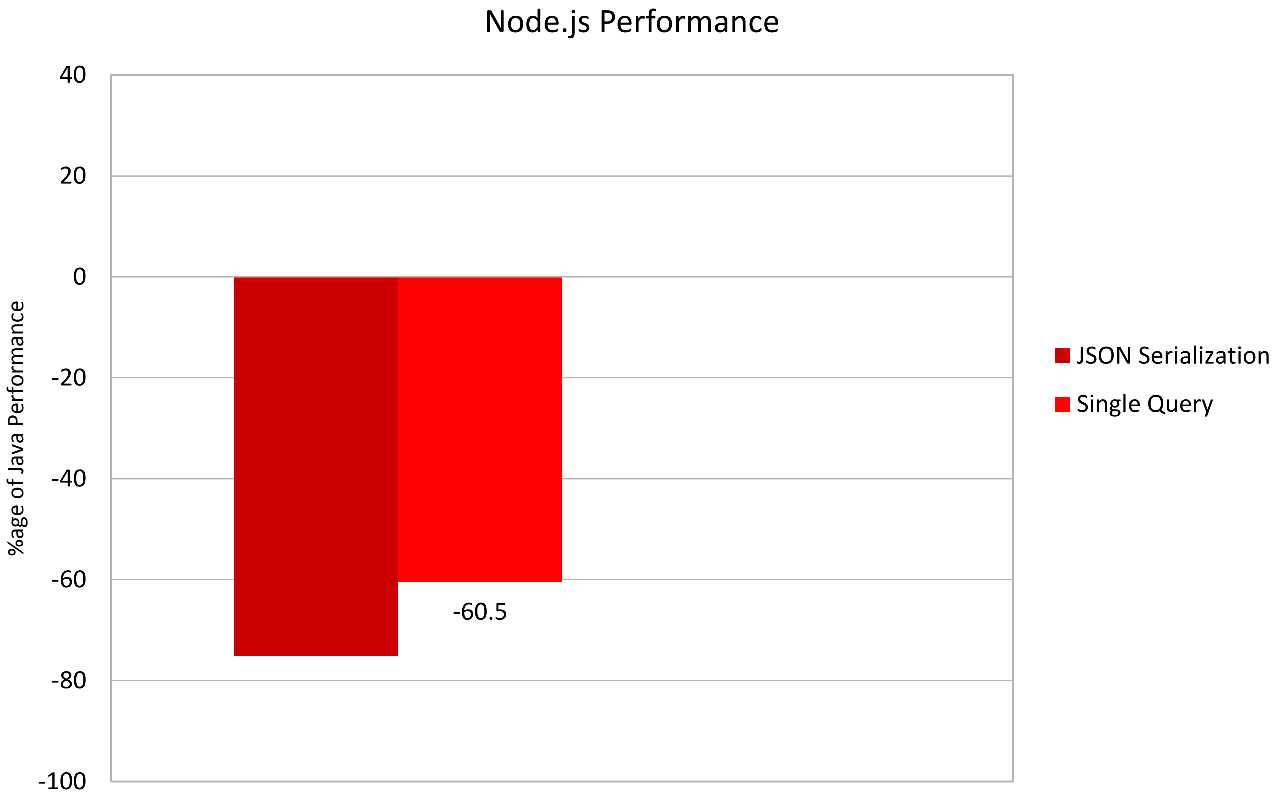
Best (bar chart) | Data table | Latency | Framework overhead

Best database-access responses per second, single query, Dell R720xd dual-Xeon E5 v2 + 10 GbE (24 tests)

Framework	Best performance (higher is better)	Cls	Lng	Plt	FE	Aos	DB	Dos	Orm	IA	Errors
gemini	224,112 100.0%	Ful	Jav	Svt	Res	Lin	My	Lin	Mcr	Rea	0
servlet-raw	184,818 82.5%	Plt	Jav	Svt	Res	Lin	My	Lin	Raw	Rea	0
undertow	126,975 56.7%	Plt	Jav	Utw	Non	Lin	My	Lin	Raw	Rea	0
undertow edge	126,937 56.6%	Plt	Jav	Und	Non	Lin	My	Lin	Raw	Rea	0
wicket	117,724 52.5%	Ful	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	0
activeweb	92,210 41.1%	Plt	Jav	Act	Res	Lin	My	Lin	Raw	Rea	140
nodejs-mysql	88,597 39.5%	Plt	JS	njs	Non	Lin	My	Lin	Ful	Rea	0
dropwizard	83,333 37.2%	Ful	Jav	Jty	Jty	Lin	My	Lin	Ful	Rea	0
ringojs	79,844 35.6%	Plt	JS	Rin	Jty	Lin	My	Lin	Raw	Rea	0
tapestry	79,278 35.4%	Ful	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	0
express-mysql	76,783 34.3%	Mcr	JS	njs	Non	Lin	My	Lin	Ful	Rea	0
nodejs-mysql-raw	71,594 31.9%	Plt	JS	njs	Non	Lin	My	Lin	Raw	Rea	0
play-java-ebean	70,722 31.6%	Ful	Jav	Nty	Non	Lin	My	Lin	Ful	Rea	0
play-java-jpa	61,833 27.6%	Ful	Jav	Nty	Non	Lin	My	Lin	Ful	Rea	0
spark	55,938 25.0%	Mcr	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	0
grizzly-jersey	54,150 24.2%	Mcr	Jav	Svt	Grz	Lin	My	Lin	Ful	Rea	0
ringojs-conv	46,340 20.7%	Mcr	JS	Rin	Jty	Lin	My	Lin	Mcr	Rea	0
hapi-mysql	33,108 14.8%	Mcr	JS	njs	Non	Lin	My	Lin	Raw	Rea	0
ninja-standalone	32,997 14.7%	Ful	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	0
ninja-standalone	32,768 14.6%	Ful	Jav	Jty	Jty	Lin	My	Lin	Ful	Rea	0
spring	18,950 8.5%	Ful	Jav	Svt	Tom	Lin	My	Lin	Ful	Rea	0
play1	17,500 7.8%	Ful	Jav	Nty	Non	Lin	My	Lin	Ful	Rea	0
play1-siena	16,620 7.4%	Ful	Jav	Nty	Non	Lin	My	Lin	Ful	Rea	0
restexpress-mysql-ra	2,333 1.0%	Mcr	Jav	Nty	Non	Lin	My	Lin	Raw	Rea	4,901

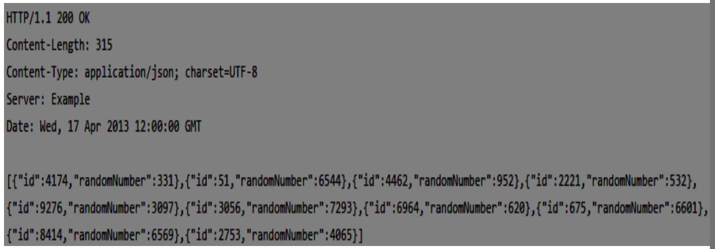
Results from TechEmpower.com Round 9 tests (2014-05-01)

JavaScript WebApp Performance



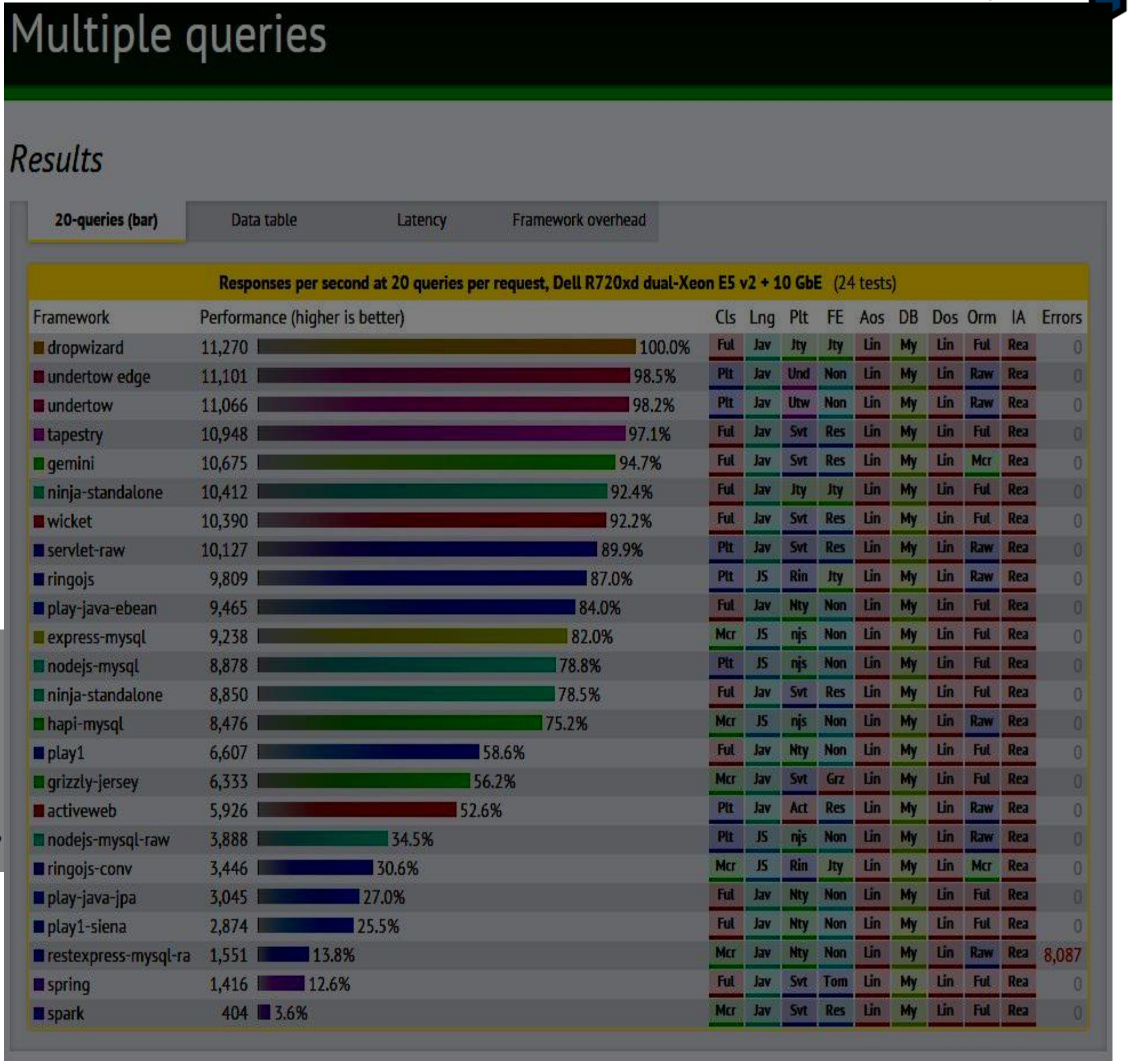
Multiple Queries

- Fetches multiple rows from a simple database table
- Rows serialized as JSON
- Example response:



```
HTTP/1.1 200 OK
Content-Length: 315
Content-Type: application/json; charset=UTF-8
Server: Example
Date: Wed, 17 Apr 2013 12:00:00 GMT

[{"id":4174,"randomNumber":331},{"id":51,"randomNumber":6544},{"id":4462,"randomNumber":952},{"id":2221,"randomNumber":532},
{"id":9276,"randomNumber":3097},{"id":3056,"randomNumber":7293},{"id":6964,"randomNumber":620},{"id":675,"randomNumber":6601},
{"id":8414,"randomNumber":6569},{"id":2753,"randomNumber":4065}]
```



Multiple queries

Results

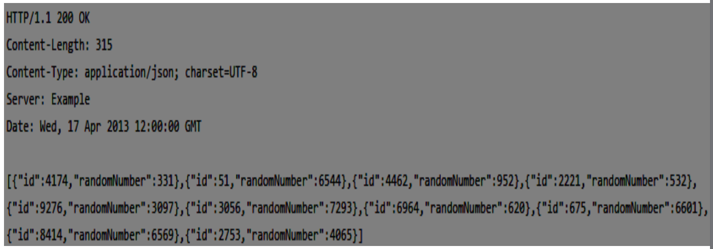
Responses per second at 20 queries per request, Dell R720xd dual-Xeon E5 v2 + 10 GbE (24 tests)

Framework	Performance (higher is better)		Cls	Lng	Plt	FE	Aos	DB	Dos	Orm	IA	Errors
dropwizard	11,270	100.0%	Ful	Jav	Jty	Jty	Lin	My	Lin	Ful	Rea	0
undertow edge	11,101	98.5%	Plt	Jav	Und	Non	Lin	My	Lin	Raw	Rea	0
undertow	11,066	98.2%	Plt	Jav	Utw	Non	Lin	My	Lin	Raw	Rea	0
tapestry	10,948	97.1%	Ful	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	0
gemini	10,675	94.7%	Ful	Jav	Svt	Res	Lin	My	Lin	Mcr	Rea	0
ninja-standalone	10,412	92.4%	Ful	Jav	Jty	Jty	Lin	My	Lin	Ful	Rea	0
wicket	10,390	92.2%	Ful	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	0
servlet-raw	10,127	89.9%	Plt	Jav	Svt	Res	Lin	My	Lin	Raw	Rea	0
ringojs	9,809	87.0%	Plt	JS	Rin	Jty	Lin	My	Lin	Raw	Rea	0
play-java-ebean	9,465	84.0%	Ful	Jav	Nty	Non	Lin	My	Lin	Ful	Rea	0
express-mysql	9,238	82.0%	Mcr	JS	njs	Non	Lin	My	Lin	Ful	Rea	0
nodejs-mysql	8,878	78.8%	Plt	JS	njs	Non	Lin	My	Lin	Ful	Rea	0
ninja-standalone	8,850	78.5%	Ful	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	0
hapi-mysql	8,476	75.2%	Mcr	JS	njs	Non	Lin	My	Lin	Raw	Rea	0
play1	6,607	58.6%	Ful	Jav	Nty	Non	Lin	My	Lin	Ful	Rea	0
grizzly-jersey	6,333	56.2%	Mcr	Jav	Svt	Grz	Lin	My	Lin	Ful	Rea	0
activeweb	5,926	52.6%	Plt	Jav	Act	Res	Lin	My	Lin	Raw	Rea	0
nodejs-mysql-raw	3,888	34.5%	Plt	JS	njs	Non	Lin	My	Lin	Raw	Rea	0
ringojs-conv	3,446	30.6%	Mcr	JS	Rin	Jty	Lin	My	Lin	Mcr	Rea	0
play-java-jpa	3,045	27.0%	Ful	Jav	Nty	Non	Lin	My	Lin	Ful	Rea	0
play1-siena	2,874	25.5%	Ful	Jav	Nty	Non	Lin	My	Lin	Ful	Rea	0
restexpress-mysql-ra	1,551	13.8%	Mcr	Jav	Nty	Non	Lin	My	Lin	Raw	Rea	8,087
spring	1,416	12.6%	Ful	Jav	Svt	Tom	Lin	My	Lin	Ful	Rea	0
spark	404	3.6%	Mcr	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	0

Results from TechEmpower.com Round 9 tests (2014-05-01)

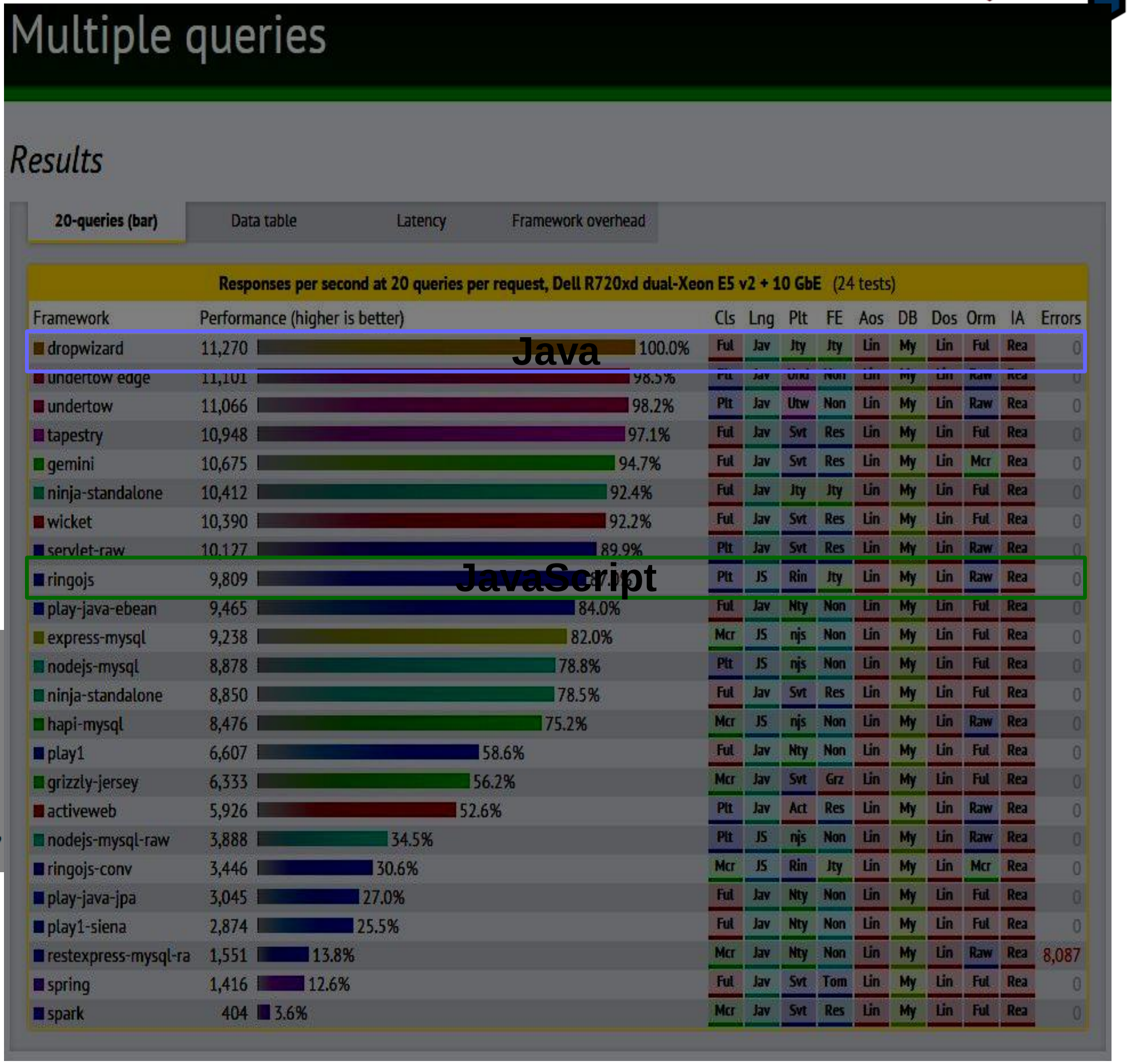
Multiple Queries

- Fetches multiple rows from a simple database table
- Rows serialized as JSON
- Example response:



```
HTTP/1.1 200 OK
Content-Length: 315
Content-Type: application/json; charset=UTF-8
Server: Example
Date: Wed, 17 Apr 2013 12:00:00 GMT

[{"id":4174,"randomNumber":331},{"id":51,"randomNumber":6544},{"id":4462,"randomNumber":952},{"id":2221,"randomNumber":532},
{"id":9276,"randomNumber":3097},{"id":3056,"randomNumber":7293},{"id":6964,"randomNumber":620},{"id":675,"randomNumber":6601},
{"id":8414,"randomNumber":6569},{"id":2753,"randomNumber":4065}]
```



Multiple queries

Results

Responses per second at 20 queries per request, Dell R720xd dual-Xeon E5 v2 + 10 GbE (24 tests)

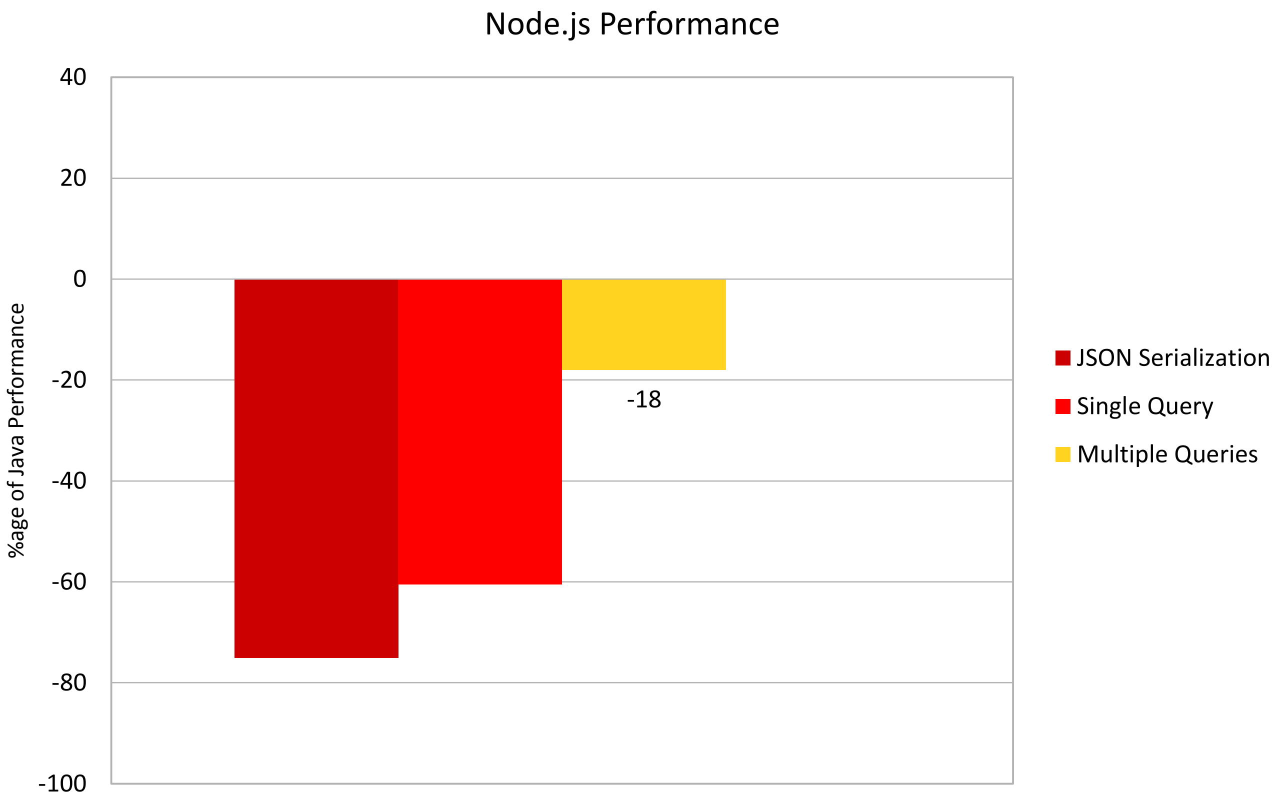
Framework	Performance (higher is better)		Cls	Lng	Plt	FE	Aos	DB	Dos	Orm	IA	Errors
dropwizard	11,270	100.0%	Ful	Jav	Jty	Jty	Lin	My	Lin	Ful	Rea	0
undertow edge	11,101	98.5%	Plt	Jav	Und	Non	Lin	My	Lin	Raw	Rea	0
undertow	11,066	98.2%	Plt	Jav	Utw	Non	Lin	My	Lin	Raw	Rea	0
tapestry	10,948	97.1%	Ful	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	0
gemini	10,675	94.7%	Ful	Jav	Svt	Res	Lin	My	Lin	Mcr	Rea	0
ninja-standalone	10,412	92.4%	Ful	Jav	Jty	Jty	Lin	My	Lin	Ful	Rea	0
wicket	10,390	92.2%	Ful	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	0
servlet-raw	10,127	89.9%	Plt	Jav	Svt	Res	Lin	My	Lin	Raw	Rea	0
ringojs	9,809	87.0%	Plt	JS	Rin	Jty	Lin	My	Lin	Raw	Rea	0
play-java-ebean	9,465	84.0%	Ful	Jav	Nty	Non	Lin	My	Lin	Ful	Rea	0
express-mysql	9,238	82.0%	Mcr	JS	njs	Non	Lin	My	Lin	Ful	Rea	0
nodejs-mysql	8,878	78.8%	Plt	JS	njs	Non	Lin	My	Lin	Ful	Rea	0
ninja-standalone	8,850	78.5%	Ful	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	0
hapi-mysql	8,476	75.2%	Mcr	JS	njs	Non	Lin	My	Lin	Raw	Rea	0
play1	6,607	58.6%	Ful	Jav	Nty	Non	Lin	My	Lin	Ful	Rea	0
grizzly-jersey	6,333	56.2%	Mcr	Jav	Svt	Grz	Lin	My	Lin	Ful	Rea	0
activeweb	5,926	52.6%	Plt	Jav	Act	Res	Lin	My	Lin	Raw	Rea	0
nodejs-mysql-raw	3,888	34.5%	Plt	JS	njs	Non	Lin	My	Lin	Raw	Rea	0
ringojs-conv	3,446	30.6%	Mcr	JS	Rin	Jty	Lin	My	Lin	Mcr	Rea	0
play-java-jpa	3,045	27.0%	Ful	Jav	Nty	Non	Lin	My	Lin	Ful	Rea	0
play1-siena	2,874	25.5%	Ful	Jav	Nty	Non	Lin	My	Lin	Ful	Rea	0
restexpress-mysql-ra	1,551	13.8%	Mcr	Jav	Nty	Non	Lin	My	Lin	Raw	Rea	8,087
spring	1,416	12.6%	Ful	Jav	Svt	Tom	Lin	My	Lin	Ful	Rea	0
spark	404	3.6%	Mcr	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	0

Java

JavaScript

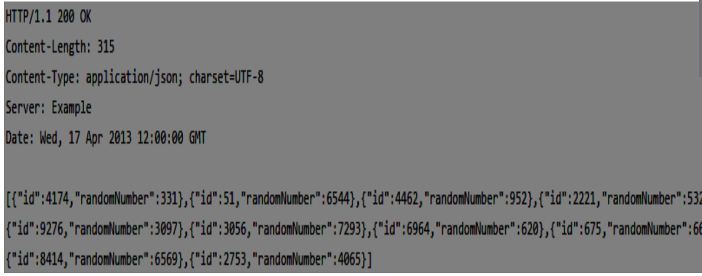
Results from TechEmpower.com Round 9 tests (2014-05-01)

JavaScript WebApp Performance



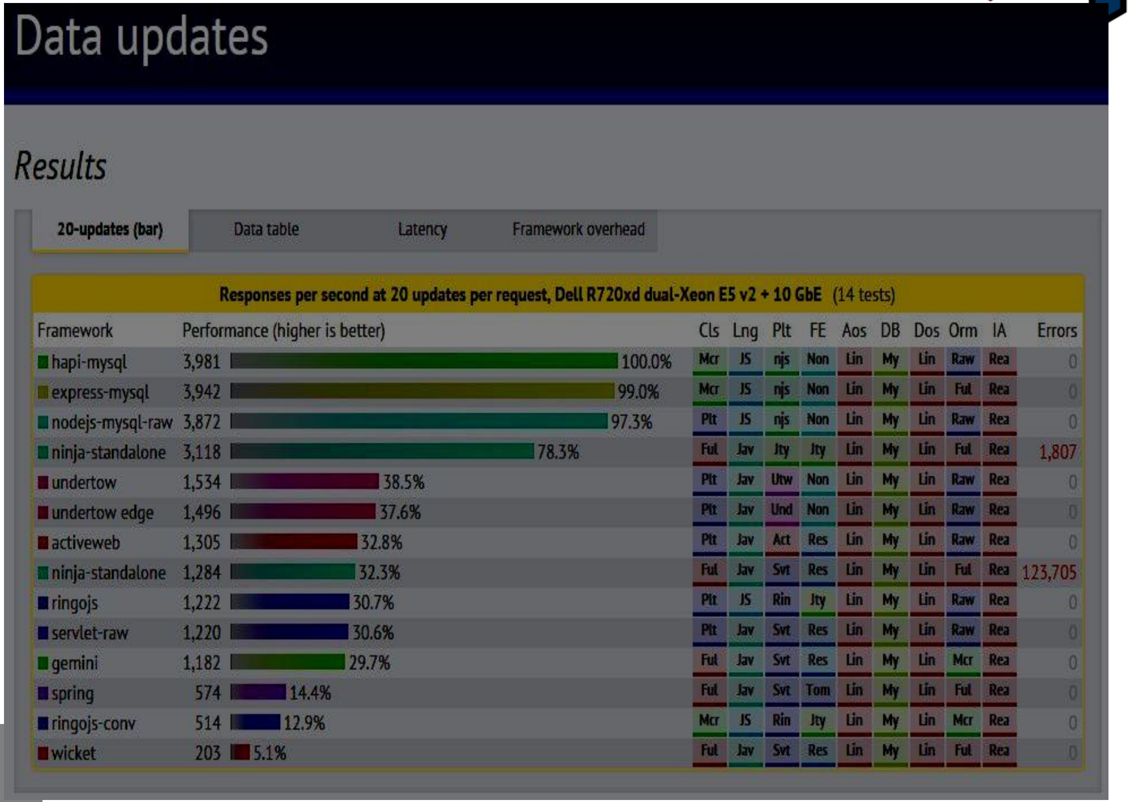
Data Updates

- Fetches multiple rows from a simple database table
- Converts rows to objects and modifies one attribute of each object
- Updates each associated row and serializes as JSON
- Example Response:



```
HTTP/1.1 200 OK
Content-Length: 315
Content-Type: application/json; charset=UTF-8
Server: Example
Date: Wed, 17 Apr 2013 12:00:00 GMT

[{"id":4174,"randomNumber":331},{"id":51,"randomNumber":6544},{"id":4462,"randomNumber":952},{"id":2221,"randomNumber":532},
{"id":9276,"randomNumber":3097},{"id":3056,"randomNumber":7293},{"id":6964,"randomNumber":620},{"id":675,"randomNumber":6601},
{"id":8414,"randomNumber":6569},{"id":2753,"randomNumber":4065}]
```



Data updates

Results

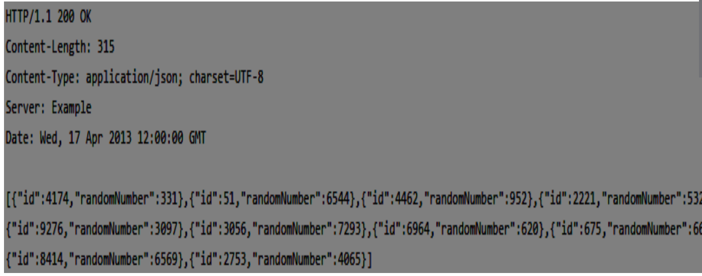
Responses per second at 20 updates per request, Dell R720xd dual-Xeon E5 v2 + 10 GbE (14 tests)

Framework	Performance (higher is better)		Cls	Lng	Plt	FE	Aos	DB	Dos	Orm	IA	Errors
hapi-mysql	3,981	100.0%	Mcr	JS	njs	Non	Lin	My	Lin	Raw	Rea	0
express-mysql	3,942	99.0%	Mcr	JS	njs	Non	Lin	My	Lin	Ful	Rea	0
nodejs-mysql-raw	3,872	97.3%	Plt	JS	njs	Non	Lin	My	Lin	Raw	Rea	0
ninja-standalone	3,118	78.3%	Ful	Jav	Jty	Jty	Lin	My	Lin	Ful	Rea	1,807
undertow	1,534	38.5%	Plt	Jav	Utw	Non	Lin	My	Lin	Raw	Rea	0
undertow edge	1,496	37.6%	Plt	Jav	Und	Non	Lin	My	Lin	Raw	Rea	0
activeweb	1,305	32.8%	Plt	Jav	Act	Res	Lin	My	Lin	Raw	Rea	0
ninja-standalone	1,284	32.3%	Ful	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	123,705
ringojs	1,222	30.7%	Plt	JS	Rin	Jty	Lin	My	Lin	Raw	Rea	0
servlet-raw	1,220	30.6%	Plt	Jav	Svt	Res	Lin	My	Lin	Raw	Rea	0
gemini	1,182	29.7%	Ful	Jav	Svt	Res	Lin	My	Lin	Mcr	Rea	0
spring	574	14.4%	Ful	Jav	Svt	Tom	Lin	My	Lin	Ful	Rea	0
ringojs-conv	514	12.9%	Mcr	JS	Rin	Jty	Lin	My	Lin	Mcr	Rea	0
wicket	203	5.1%	Ful	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	0

Results from TechEmpower.com Round 9 tests (2014-05-01)

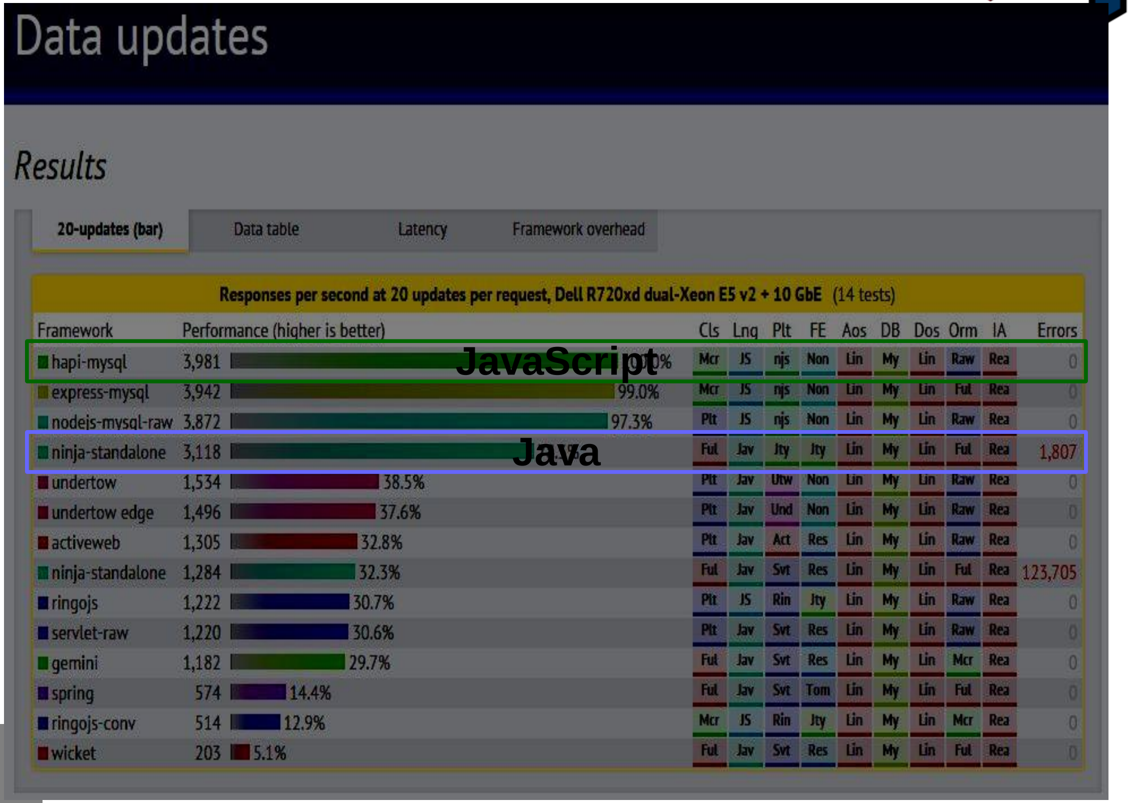
Data Updates

- Fetches multiple rows from a simple database table
- Converts rows to objects and modifies one attribute of each object
- Updates each associated row and serializes as JSON
- Example Response:



```
HTTP/1.1 200 OK
Content-Length: 315
Content-Type: application/json; charset=UTF-8
Server: Example
Date: Wed, 17 Apr 2013 12:00:00 GMT

[{"id":4174,"randomNumber":331},{"id":51,"randomNumber":6544},{"id":4462,"randomNumber":952},{"id":2221,"randomNumber":532},
{"id":9276,"randomNumber":3097},{"id":3056,"randomNumber":7293},{"id":6964,"randomNumber":620},{"id":675,"randomNumber":6601},
{"id":8414,"randomNumber":6569},{"id":2753,"randomNumber":4065}]
```



Data updates

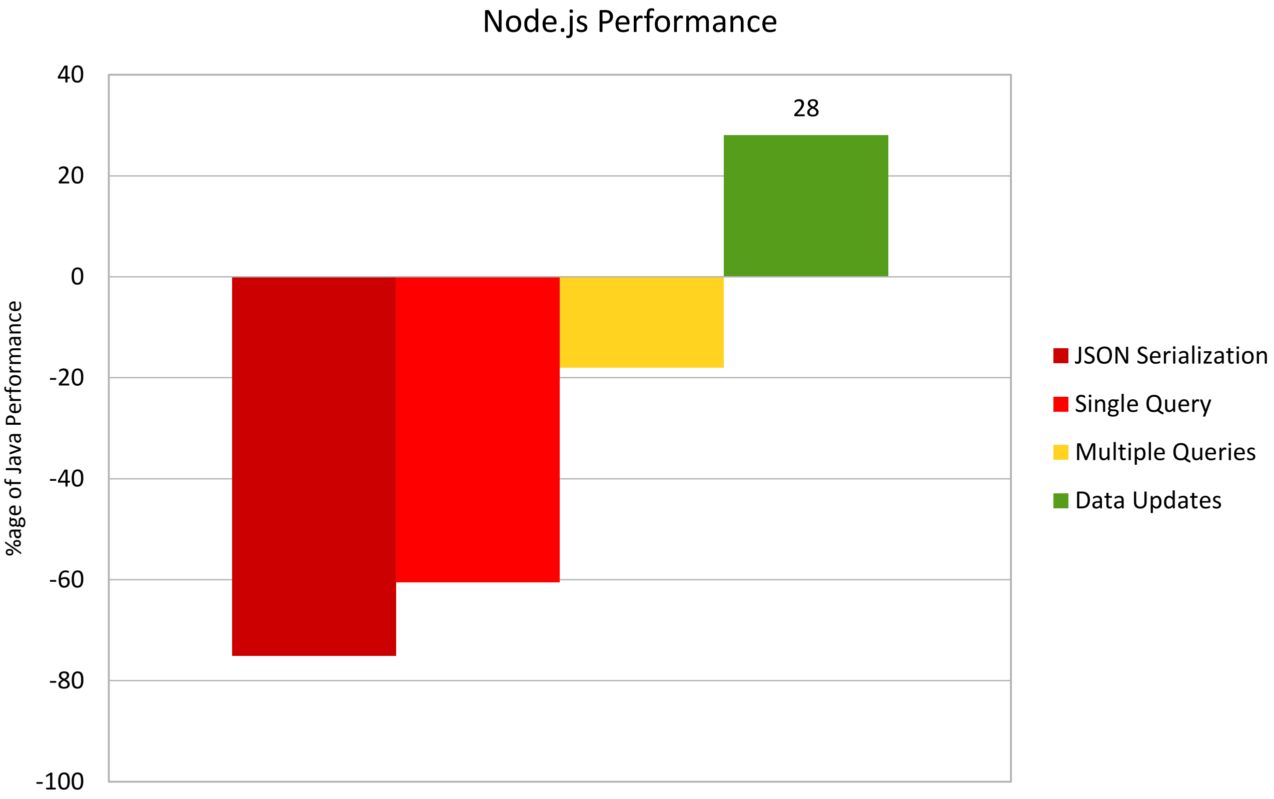
Results

Responses per second at 20 updates per request, Dell R720xd dual-Xeon E5 v2 + 10 GbE (14 tests)

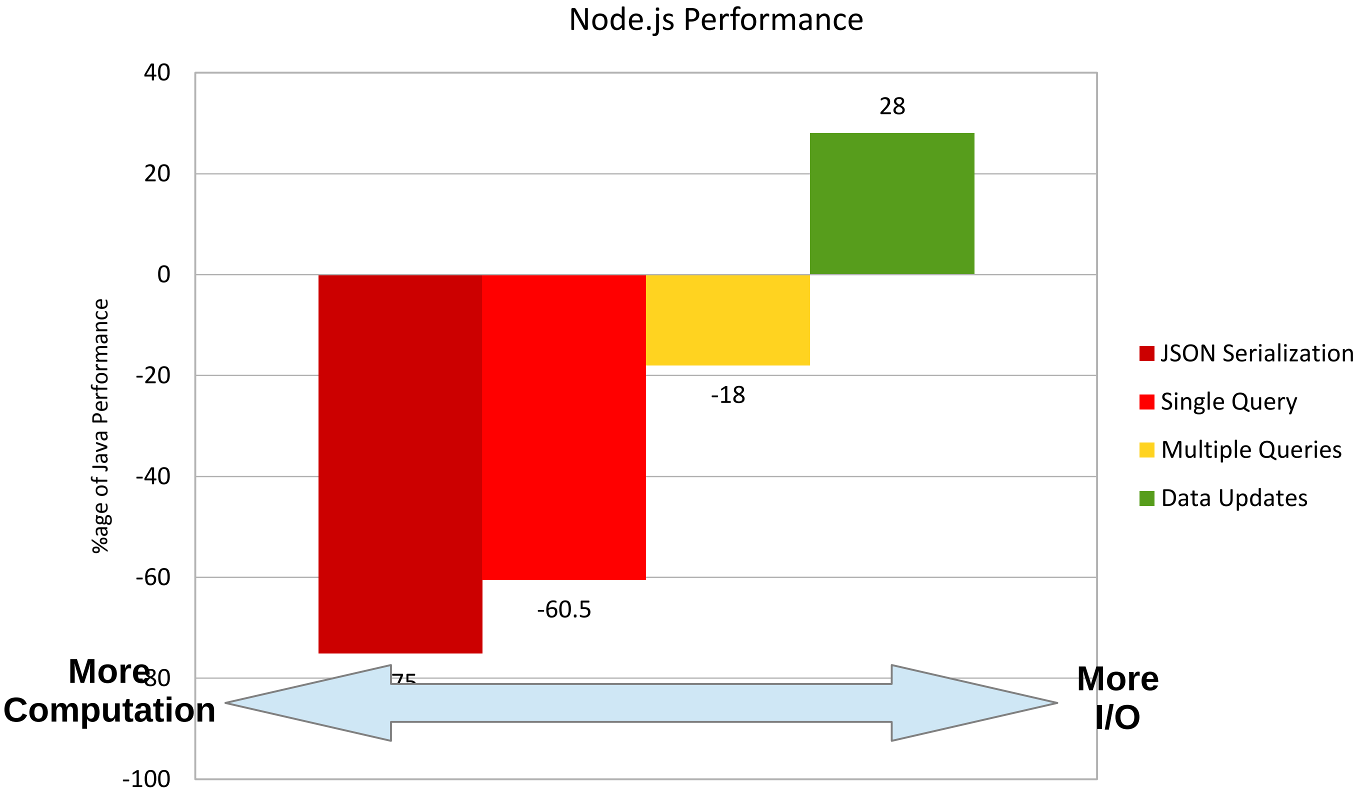
Framework	Performance (higher is better)		Cls	Lng	Plt	FE	Aos	DB	Dos	Orm	IA	Errors
hapi-mysql	3,981	100.0%	Mcr	JS	njs	Non	Lin	My	Lin	Raw	Rea	0
express-mysql	3,942	99.0%	Mcr	JS	njs	Non	Lin	My	Lin	Ful	Rea	0
nodejs-mysql-raw	3,872	97.3%	Plt	JS	njs	Non	Lin	My	Lin	Raw	Rea	0
ninja-standalone	3,118	[illegible]	Ful	Jav	Jty	Jty	Lin	My	Lin	Ful	Rea	1,807
undertow	1,534	38.5%	Plt	Jav	Utw	Non	Lin	My	Lin	Raw	Rea	0
undertow edge	1,496	37.6%	Plt	Jav	Und	Non	Lin	My	Lin	Raw	Rea	0
activeweb	1,305	32.8%	Plt	Jav	Act	Res	Lin	My	Lin	Raw	Rea	0
ninja-standalone	1,284	32.3%	Ful	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	123,705
ringojs	1,222	30.7%	Plt	JS	Rin	Jty	Lin	My	Lin	Raw	Rea	0
servlet-raw	1,220	30.6%	Plt	Jav	Svt	Res	Lin	My	Lin	Raw	Rea	0
gemini	1,182	29.7%	Ful	Jav	Svt	Res	Lin	My	Lin	Mcr	Rea	0
spring	574	14.4%	Ful	Jav	Svt	Tom	Lin	My	Lin	Ful	Rea	0
ringojs-conv	514	12.9%	Mcr	JS	Rin	Jty	Lin	My	Lin	Mcr	Rea	0
wicket	203	5.1%	Ful	Jav	Svt	Res	Lin	My	Lin	Ful	Rea	0

Results from TechEmpower.com Round 9 tests (2014-05-01)

JavaScript WebApp Performance



JavaScript WebApp Performance

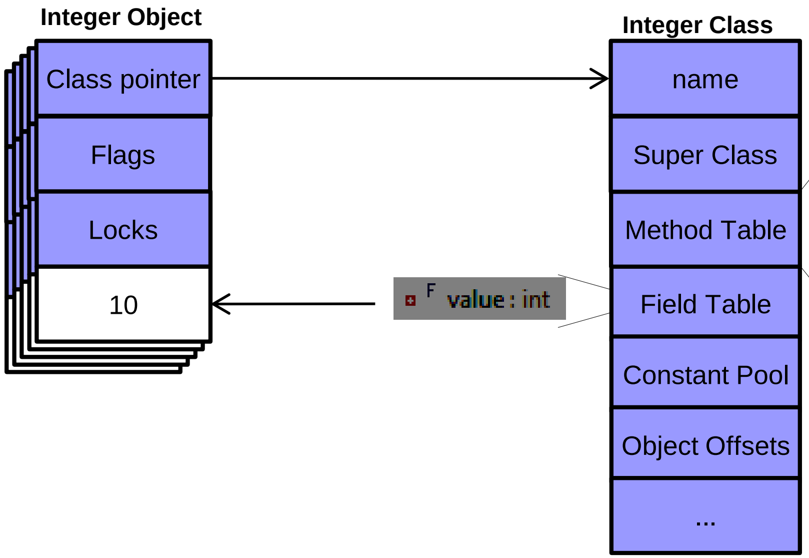


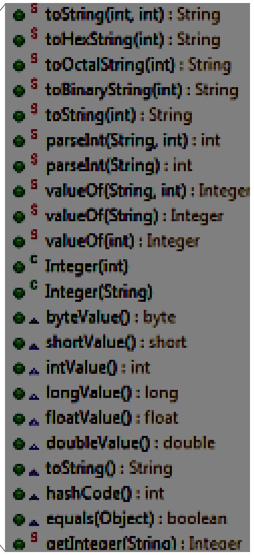
- Computation speed is (much) slower than Java
- I/O speed is higher than Java

Under the Hood

Object Representation: Java

- Java objects are ***fixed*** in size and shape



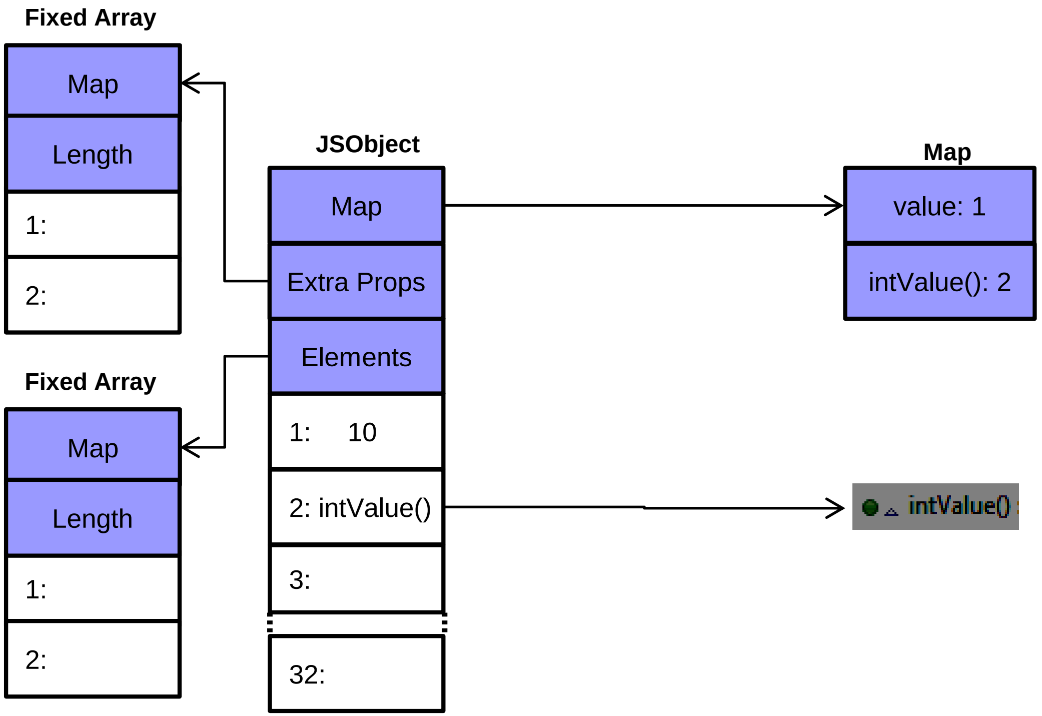


```
toString(int, int) : String
toHexString(int) : String
toOctalString(int) : String
toBinaryString(int) : String
toString(int) : String
parseInt(String, int) : int
parseInt(String) : int
valueOf(String, int) : Integer
valueOf(String) : Integer
valueOf(int) : Integer
Integer(int)
Integer(String)
byteValue() : byte
shortValue() : short
intValue() : int
longValue() : long
floatValue() : float
doubleValue() : double
toString() : String
hashCode() : int
equals(Object) : boolean
getInteger(String) : Integer
```

- Values associated with objects are fixed and typed (known what and where it is)
- Methods associated with objects are fixed and typed (parameters and return types)

Object Representation: JavaScript

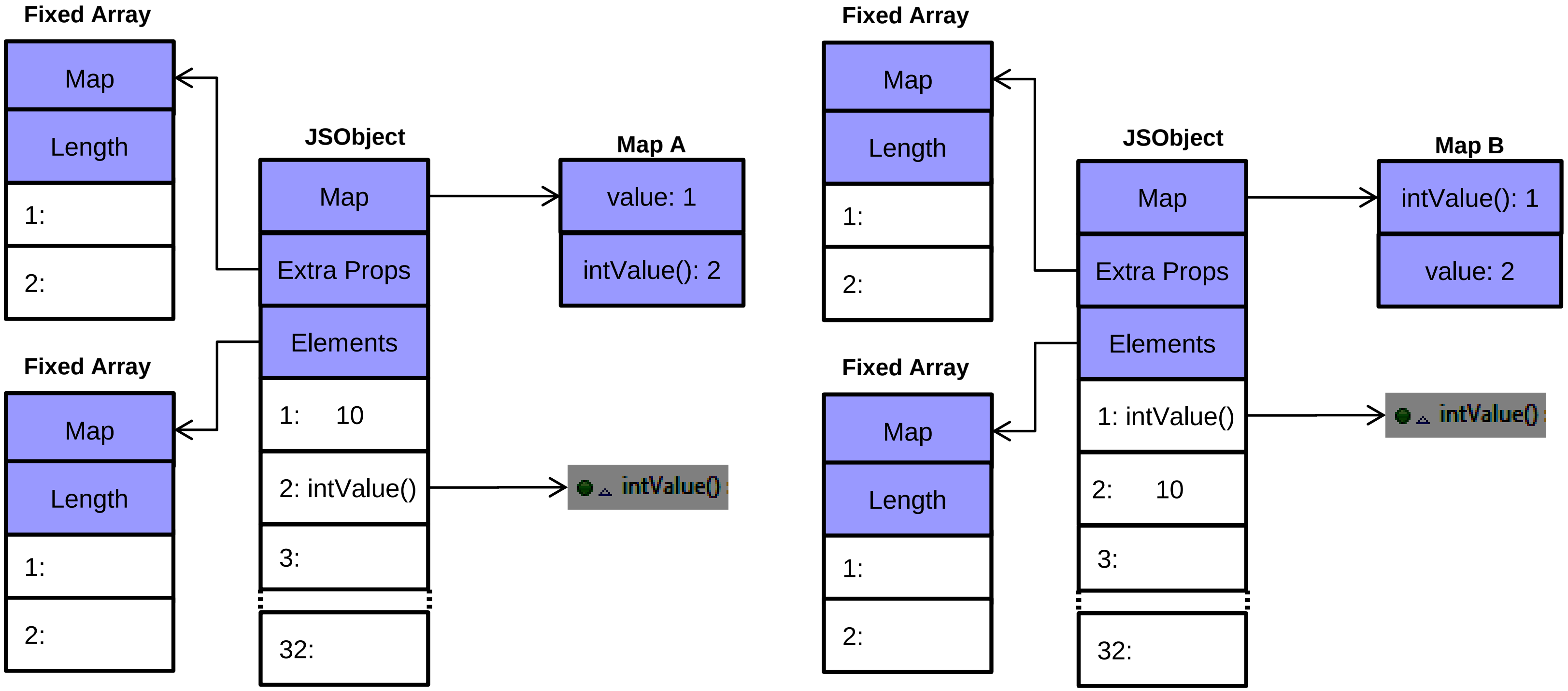
- JavaScript objects are ***dynamic*** in size and shape



- Values associated with objects are dynamic and un-typed
- Methods associated with objects are dynamic and un-typed
  - 32 “slots” exist for method and values with overflow arrays if this is not enough
  - Every “slot” is 64bits as any type of data could be stored there

Object Representation: JavaScript

- Order in which methods and fields are added matters



- Objects are equivalent and equal, but have different Maps and layouts

JIT Compilation

- Functions are stored in JavaScript objects as fields
  - No fixed set of methods for an object

- Objects are not typed, so data much be checked to determine how to handle it

eg. the '+' operator:

- number + number → addition
- string involved? → concatenation
- objects involved? → convert to primitives then addition or concatenation

eg. property load:

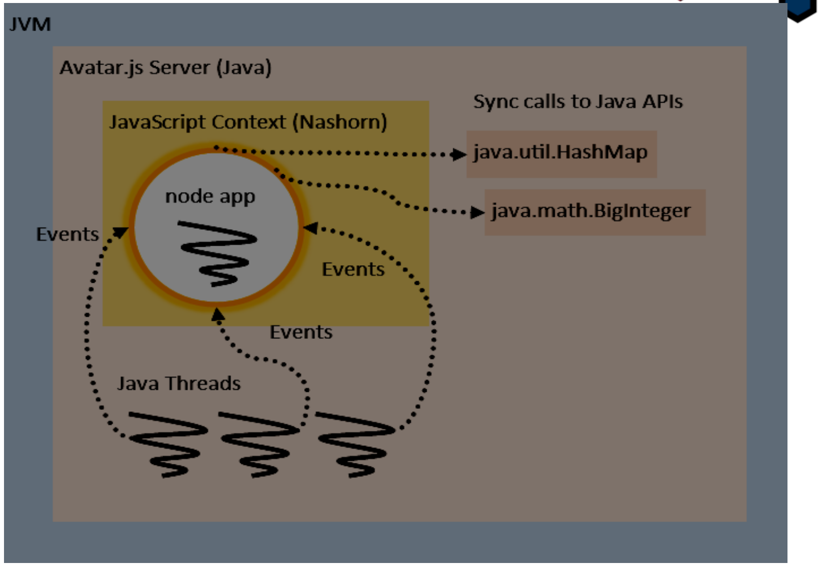
- Load prototype object
- Load getter method
- Load callback function

- Therefore not possible to determine what instructions to use just from the source code

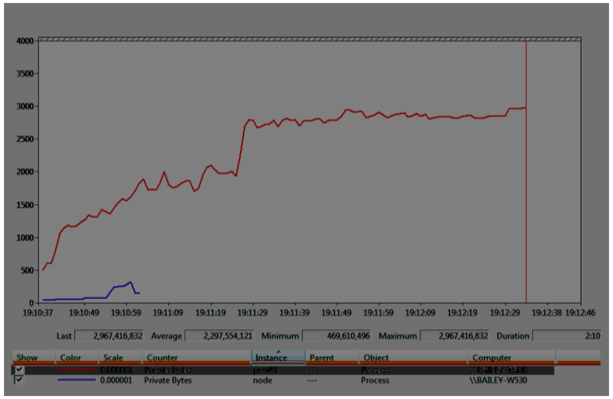
JavaScript on the JVM?

Nashorn and Avatar.js

- Nashorn JavaScript engine delivered in JDK8
  - Utilizes new JVM level features for performance
- Avatar.js provides Node.js support on Nashorn



- Results of “Octane” JavaScript benchmark*:
  - Node.js is 4.8x faster
  - Avatar.js is >10x larger



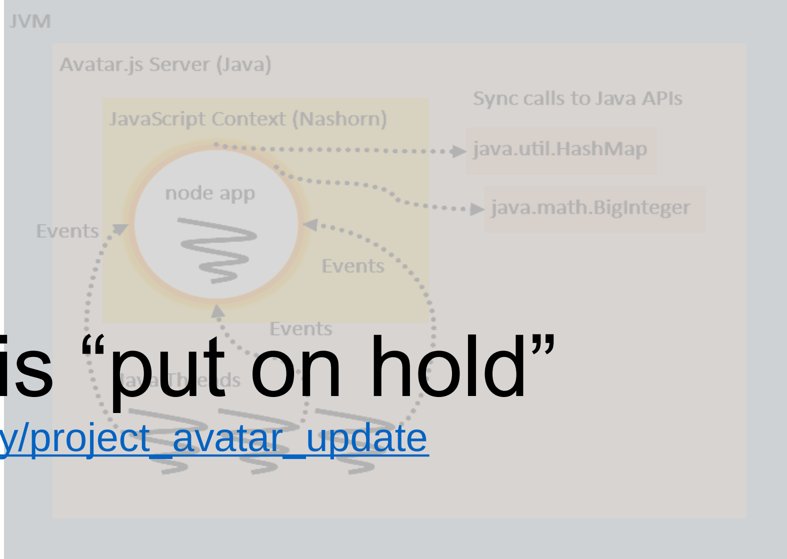
Last 2,967,416,832 Average 2,297,554,121 Minimum 469,610,496 Maximum 2,967,416,832 Duration 2:10

Show	Color	Scale	Counter	Instance	Parent	Object	Computer
☑	🟥	0.000001	Private Bytes	java#3	---	Process	\\BAILEY-W530
☑	🟦	0.000001	Private Bytes	node	---	Process	\\BAILEY-W530

* Using Java 8 pre-u20

Nashorn and Avatar.js

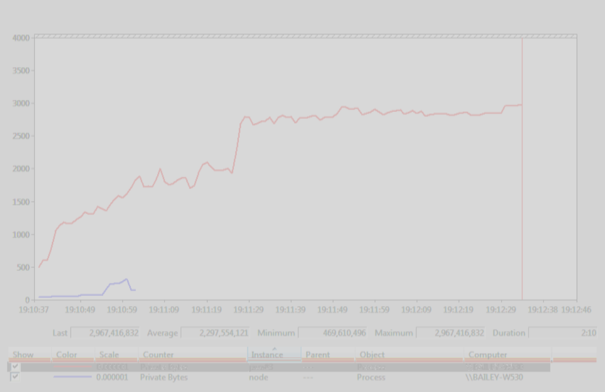
- Nashorn JavaScript engine delivered in JDK8
  - Utilizes new JVM level features for performance
- Avatar.js provides Node.js support on Nashorn



Feb 12th, 2015: Avatar is “put on hold”

https://blogs.oracle.com/theaquarium/entry/project_avatar_update

- Results of “Octane” JavaScript benchmark*:
  - Node.js is 4.8x faster
  - Avatar.js is >10x larger



Last 2,967,416,832 Average 2,297,554,121 Minimum 469,610,496 Maximum 2,967,416,832 Duration 2:10

Show	Color	Scale	Counter	Instance	Parent	Object	Computer
☑	🟥	[illegible]	Private Bytes	[illegible]	---	Process	[illegible]
☑	🟦	0.000001	Private Bytes	node	---	Process	\\BAILEY-W530

* Using Java 8 pre-u40

Enterprise Deployments

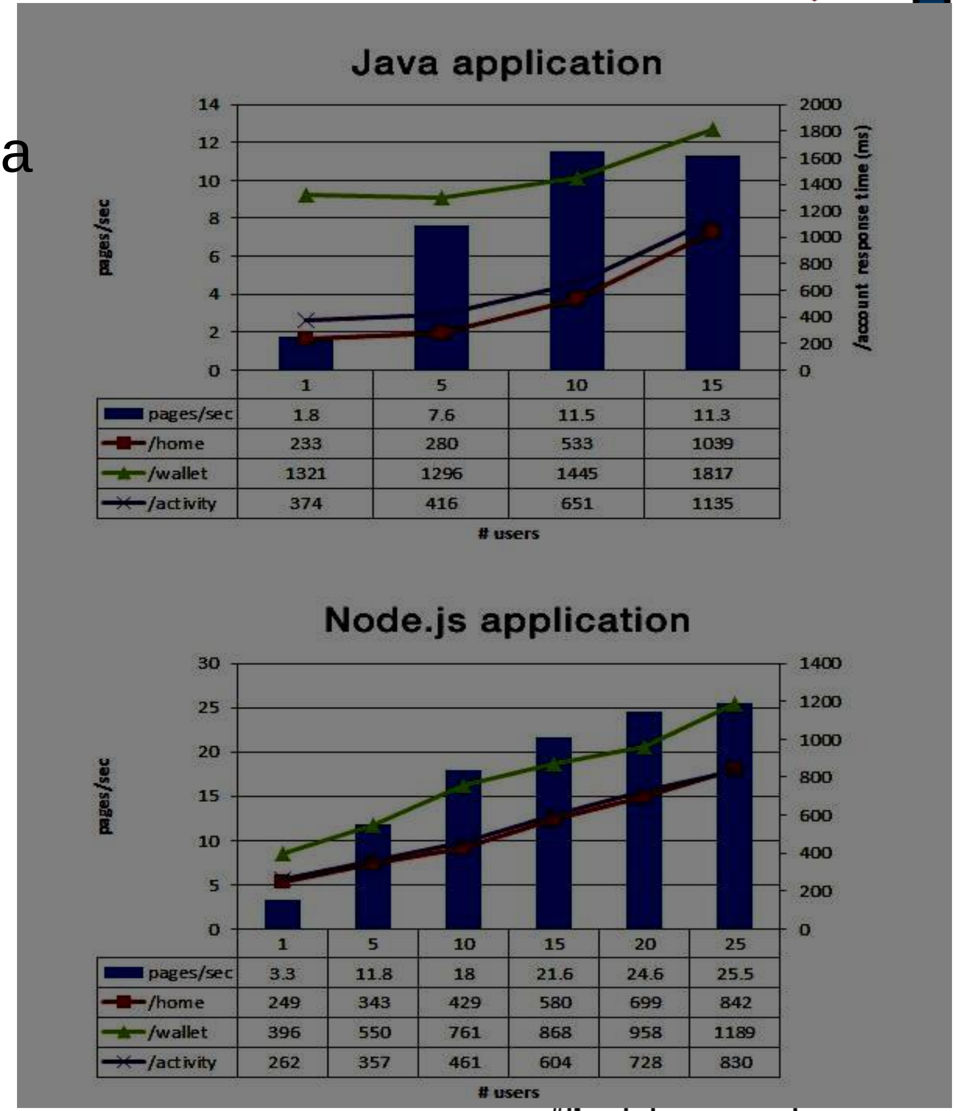
The PayPal Story

PayPal and “Account Overview” Project

- 2013: PayPal evaluates use of Node.js for “Account Overview”
  - Implementation done in both Java and Node.js to compare

- Node.js implementation
  - 50% less development effort
  - 33% fewer lines of code
  - 40% fewer files
  - ~35% faster request response

- **Note:** legacy Java frameworks involved.....



Java application

	1	5	10	15
pages/sec	1.8	7.6	11.5	11.3
/home	233	280	533	1039
/wallet	1321	1296	1445	1817
/activity	374	416	651	1135

Node.js application

	1	5	10	15	20	25
pages/sec	3.3	11.8	18	21.6	24.6	25.5
/home	249	343	429	580	699	842
/wallet	396	550	761	868	958	1189
/activity	262	357	461	604	728	830

The WalMart Story

WalMart experiences Node.js memory leak

- 2013: Eran Hammer (WalMart) discovers 200+MB/day leak
  - Increasing memory usage at 200+MB/day per server

- Application improvements by Eran reduces leak to 8MB/day
  - Lots of progress made
  - But required months of investigation effort

- Identified remaining leak related to HTTP Client Requests
  - Unable to make further progress....

- Node.js runtime development team required to resolve issue
  - 5 core runtime developers/engineers
  - 3 weeks of effort

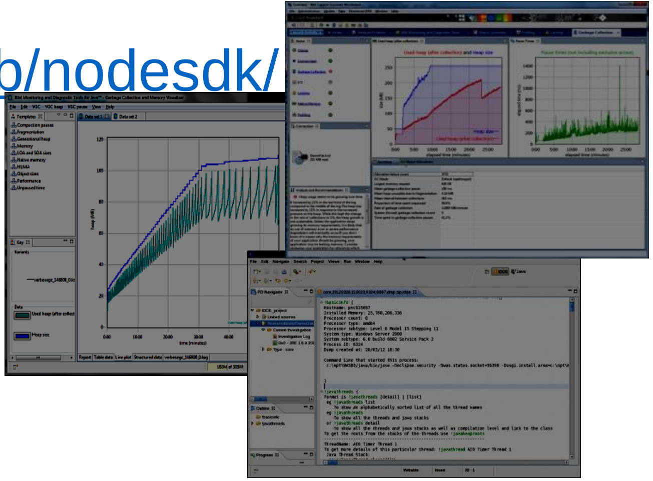
IBM and Node.js

IBM and Node.js

- Node.js Foundation Founding Member
  - Alongside Joyent, Linux Foundation, Microsoft, PayPal and Fidelity

- IBM SDK for Node.js v1.2
  - Open source ports of Google V8 JavaScript engine
    - Support for POWER and zLinux
  - Runtimes available for all platforms to provide consistency
    - AIX, Linux (Intel, POWER, System z, Windows, Mac OS X)
  - http://www.ibm.com/developerworks/web/nodesdk/

- IBM Monitoring and Diagnostics Tools
  - Live monitoring: Health Center
  - GC log analysis: GCMV
  - Dump analysis: IDDE



Summary

- JavaScript has a large amount of interest and is growing
  - Web applications with code sharing between server and browser
  - Async IO and event loop makes it easy to write scalable applications
  - Rich set of APIs available via the npm module ecosystem

- Dynamic nature makes development easier, but introduces challenges
  - Errors typically found during compilation are found at runtime
  - JIT compilation loves certainty, which is removed

- Additional “enterprise-grade” capabilities needed
  - Monitoring/Diagnostics, Security, Internationalization, etc
  - IBM contributing via the newly announce Node Foundation

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