Rhino & RingoJS: JavaScript on the JVM

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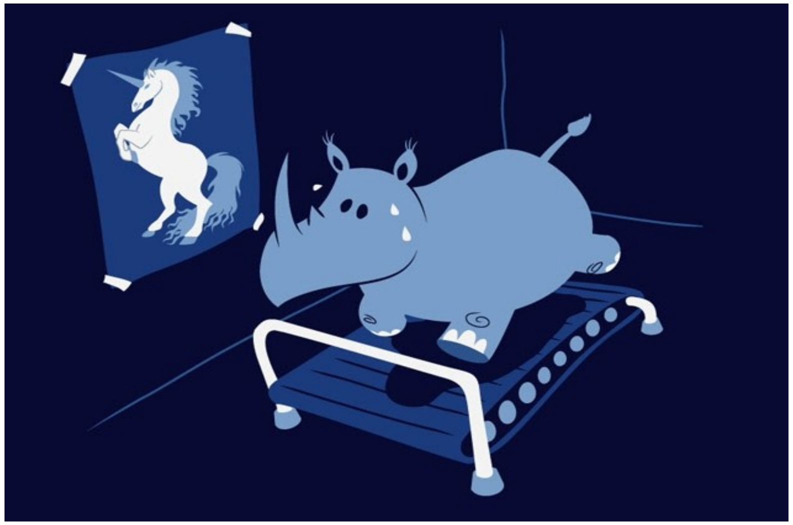


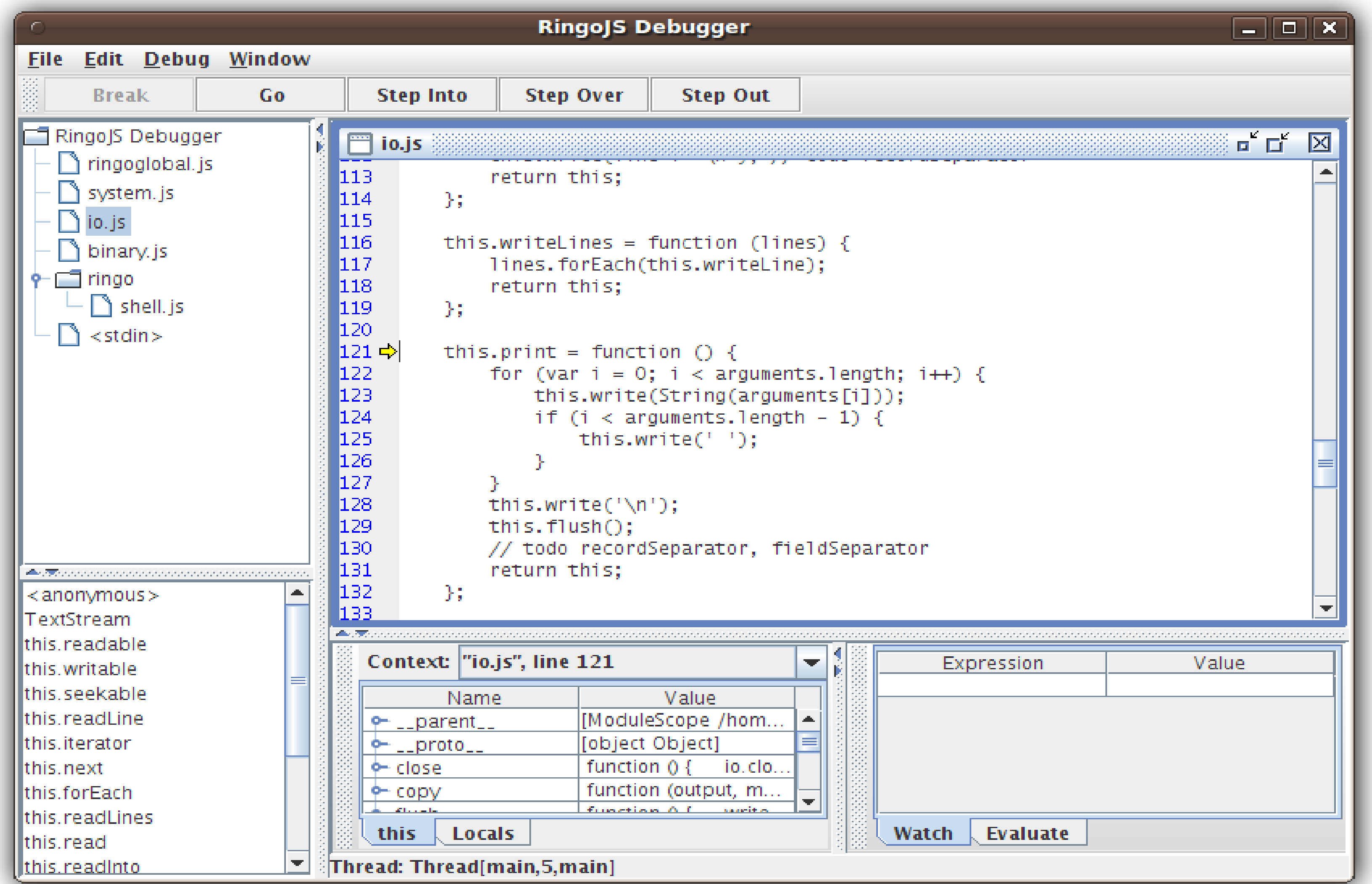
"Overall, JavaScript as a system programming language feels a lot like Lisp must have for the programming generation before mine: **minimal syntax, very powerful and orthogonal core abstractions**, and (dare I say it) not much type-checking or busy-work to get in your way."

C. Scott Ananian (litl)
http://cananian.livejournal.com/58744.html

Rhino and RingoJS

- **Rhino**
  - Started at Netscape in 1997
  - Part of Navigator port to Java
  - Mozilla project
- **RingoJS**
  - Started by me in 2009
  - Provide the parts missing for real world software development, especially web applications

Rhino and RingoJS



```
        return this;
    };

    this.writeLines = function (lines) {
        lines.forEach(this.writeLine);
        return this;
    };

    this.print = function () {
        for (var i = 0; i < arguments.length; i++) {
            this.write(String(arguments[i]));
            if (i < arguments.length - 1) {
                this.write(' ');
            }
        }
        this.write('\n');
        this.flush();
        // todo recordSeparator, fieldSeparator
        return this;
    };
```

```
<anonymous>
TextStream
this.readable
this.writable
this.seekable
this.readLine
this.iterator
this.next
this.forEach
this.readLines
this.read
this.readInto
```

Name	Value
__parent__	[ModuleScope /hom...
__proto__	[object Object]
close	function () { io.clo...
copy	function (output, m...

Thread: Thread[main,5,main]

Rhino

- Robust, optimized codebase
- but showing its age
- very complete
    - interpreter mode
    - compiled mode
    - debugger
    - follows ECMAScript spec rigorously
    - implements JS 1.7 (almost 1.8)
    - implements most of ECMAScript 5

Optimimization

- Rhino used to be one of the faster JVM languages
- But not much movement in the last few years
- Browser JS implementations have roared past Rhino

InvokeDynamic

- Rémi probably told you all about it
- John Rose (Oracle): "Thundering Rhinos" at JavaOne 2010

  http://blogs.sun.com/jrose/entry/javaone_in_2010

4x speedup of Richards benchmark (part of V8 benchmark suite) within 50% of V8 by manually editing bytecode

JavaScript objects...

- ... are hashtables

  ```
  var x = {foo: 3}
  ```

  no notion of classes

  ```
  x["baz"] = 7;
  ```

- ... have prototypes

  ```
  function Foo() {...}
  Foo.prototype.bar = 3;
  var y = new Foo();

  var y = Object.create
  ```

How to implement JS objects?

- Obvious solution: hashtables
  - works, but rather slow
- Ideally JS properties are mapped to Java fields
  - easy for the simple case
  - fails for common cases (multiple scripts, dynamic code...)
- Rhino hack: idgen

idgen – custom property handling in Rhino

- Used for built-in types (Object, Array, Function)
- Requires pre-processing of code:

```
// #generated# Last update: 2007-05-09 08:15:15 EDT
        L0: { id = 0; String X = null; int c;
            L: switch (s.length()) {
            case 4: X="name";id=Id_name; break L;
            case 5: X="arity";id=Id_arity; break L;
            case 6: X="length";id=Id_length; break L;
            case 9: c=s.charAt(0);
                if (c=='a') { X="arguments";id=Id_arguments; }
                else if (c=='p') { X="prototype";id=Id_prototype; }
                break L;
            }
            if (X!=null && X!=s && !X.equals(s)) id = 0;
            break L0;
        }
// #/generated#
```

- Not faster anymore

Rhino-opt

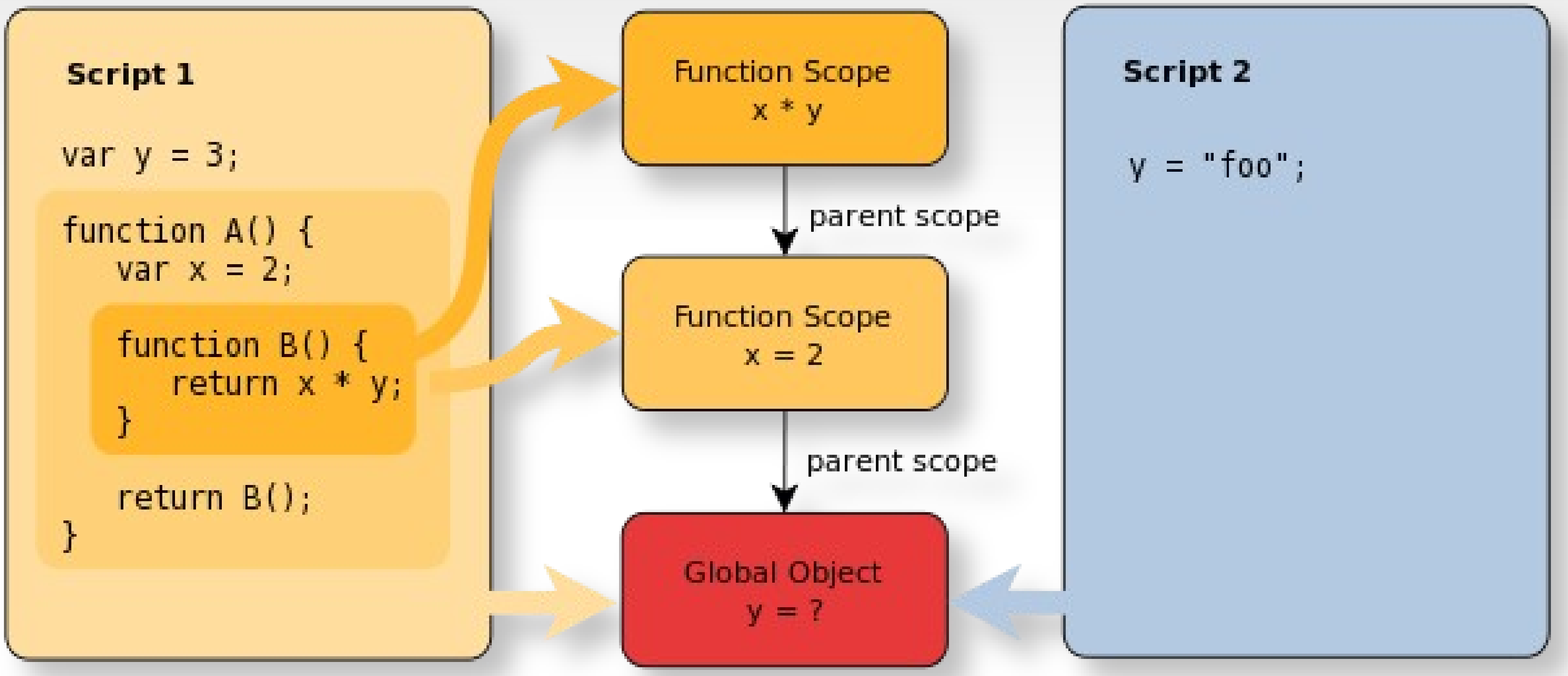
Experimental Rhino branch

https://github.com/hns/rhino-opt

Various branches:

- companion-scopes
- native-callsites
- non-object-this

Anatomy of a running JS program

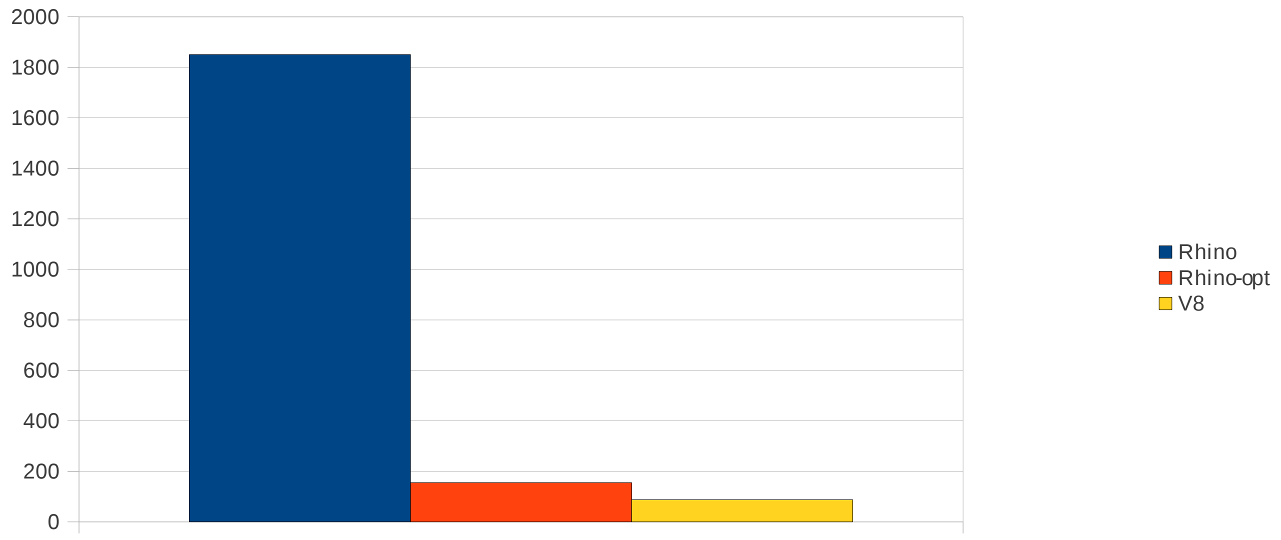


```
var y = 3;

function A() {
   var x = 2;

   function B() {
      return x * y;
   }

   return B();
}
```

```
y = "foo";
```

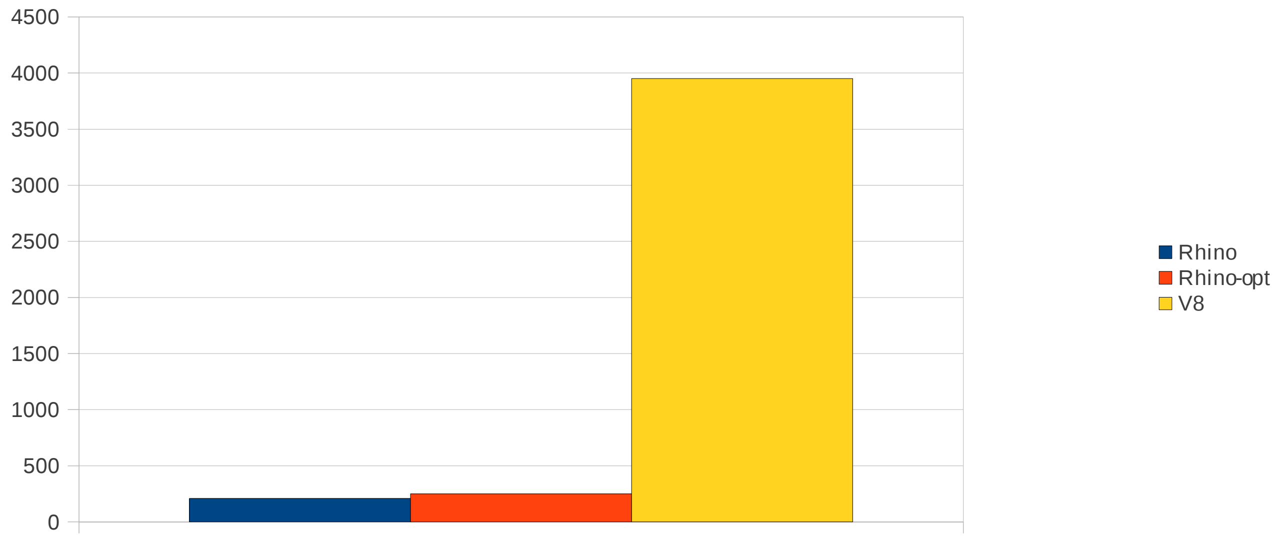
companion-scopes

```
function outer(x) {
    var y;
    for (var i = 0; i < 10000000; i++) {
        y = inner();
    }
    function inner() {
        return x;
    }
    return inner();
}
```



companion-scopes

Unfortunately, improvement is not very relevant for Google V8 Benchmark, which is heavy on objects/classes, not scopes.



Generic mapping of JS objects to Java class

- Use "mixed" approach
  - Generate custom Java classes for JS objects
  - But still allow dynamic property access
- Store Rhino property slots as Java fields
- Generate bytecode to access Java field if defined

RingoJS

Adds features to Rhino for real-world application development

- Modules
- Packages
- Filesystem
- Testing
- HTTP

and much more

CommonJS

- Started by Kevin Dangoor in 01/2009
- Good inital progress
- Stalled above sync/async divide
- Ratified standards for Modules, Packages, Web Server API
- Proposals for binary data, IO, filesystem

Example: reading lines from a file

```
var fs = require("fs");
var txt = fs.read("git/ringojs/README.md");
```

Example: reading lines from a file

```
var fs = require("fs");
var file = fs.open("git/ringojs/README.md");

var lines = [line for each (line in file)];

lines.filter(function(line) {
   return line.indexOf("build") > -1
}).map(String.toUpperCase).join("\n");
```

POSIX

- Borrowed functionality from JRuby (jnr-posix) - thank you!
- Provides features for getting/setting file permissions and ownership, handling symbolic links.

Web App: JSGI

- A web application is a JavaScript function that takes a request object and returns a response object

```
function app(request) {
    return {
        status: 200,
        headers: {},
        body: ["hello world"]
    };
}
```

- Similar to Rack (Ruby) and WSGI (Python), not Java Servlets

Asynchronous JSGI

- Non-standard extension
- Works with Jetty Continuations/Servlet 3.0

```
function app(request) {
    var response = defer();
    setTimeout(function() {
        response.resolve({
            status: 200,
            headers: {},
            body: ["hello world"]
        });
    }, 2000);
    return response;
}
```

Accessing Java

- LiveConnect: direct mapping between Java and JavaScript

```
var file = new java.io.File("test.txt")
f.exists()
f.getName()
```

- Easy, natural mapping for 97% of cases
- Except:
  - method overloads
  - creating Java arrays

Implementing Java interfaces

```
obj = {
   run: function () {
      print("\nrunning");
   }
}
r = new java.lang.Runnable(obj)
t = new java.lang.Thread(r)
t.start()
```

Implementing Java interfaces

```
impl = function () {
  print("running");
}
new java.lang.Thread(impl).start()
```

JavaAdapter

- Allows subclassing in addition to implementing interfaces
- Allows implementing multiple interfaces
- More verbose

```
JavaAdapter(
     javaIntfOrClass,
     [javaIntf, ..., javaIntf,]
     javascriptObject)
```

- Classes must have zero-arg constructor

Using Java's Security Framework

- Scripts can have CodeSource
- Scripts can execute PrivilegedAction on behalf of untrusted code

```
privileged(function() {
    ...
}
```

- Unsolved issues due to dynamic nature of JavaScript

Thanks!