Emerging Language **Tools** to Track JavaScript **Quality** and **Performance**

@ariyahidayat


Sencha


JS


Qt

Front-end development **team**

Single-page applications

Composable Tools

Source Transformation

Cyclomatic Complexity

Execution Tracing

Custom Linting

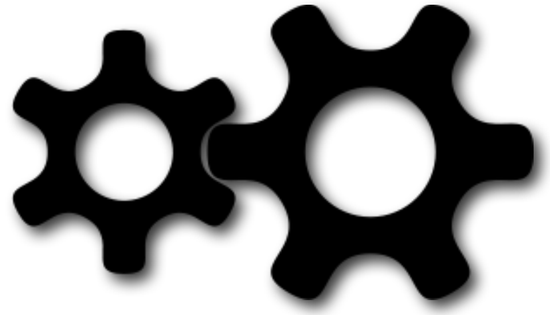
Code Coverage

Every tool is open-source

Tweak/customize/run with it!

There are links (everywhere) to detailed articles/blog posts

Composable Tools



This is the  Philosophy

Write programs that **do one thing** and do it well.

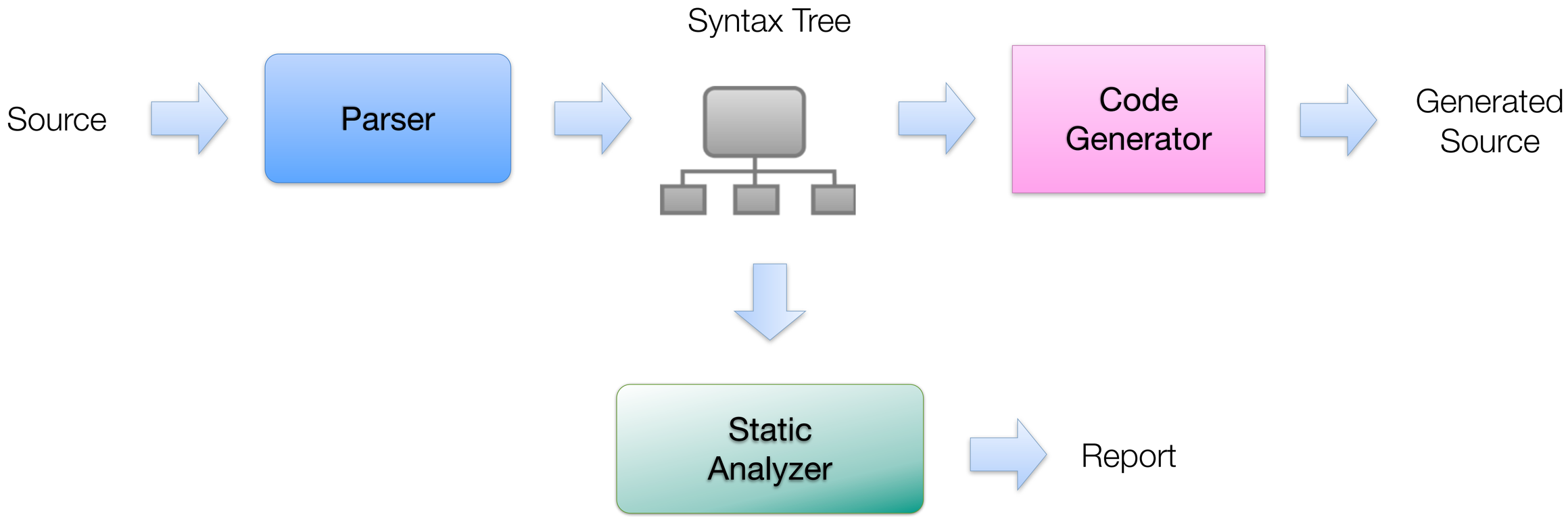
Write programs to **work together**.

Write programs to **handle text streams**,

because that is a universal interface.

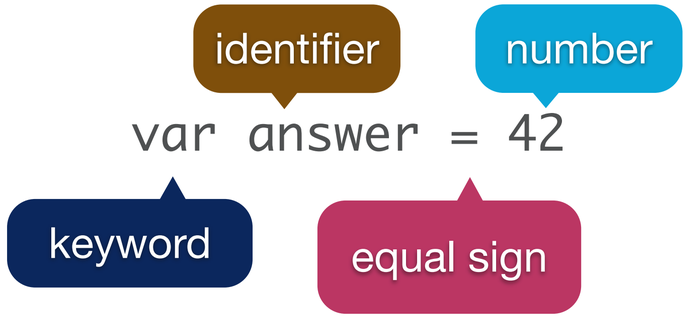
Doug McIlroy, the inventor of Unix pipes and one of the founders of the Unix tradition

Building Blocks → Tools

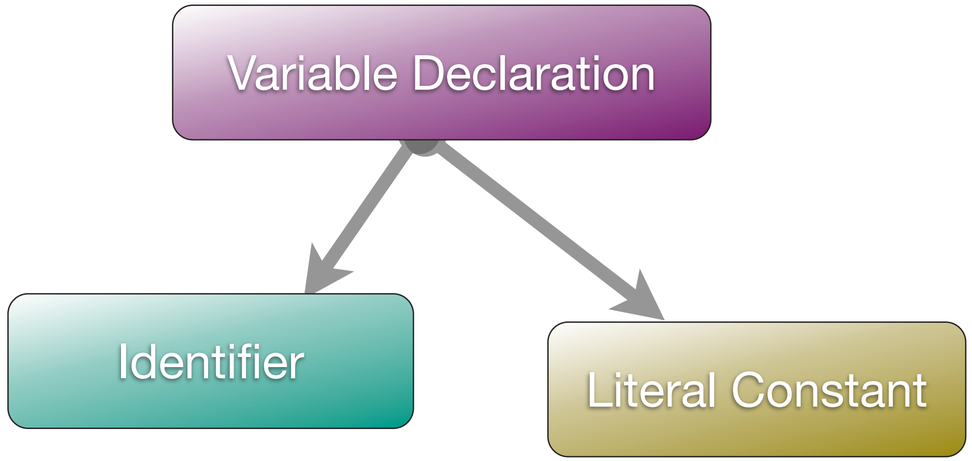


Parser

Tokenization → Tokens



Parsing → Syntax Tree



Syntax Tree


```
var answer = 42;
```

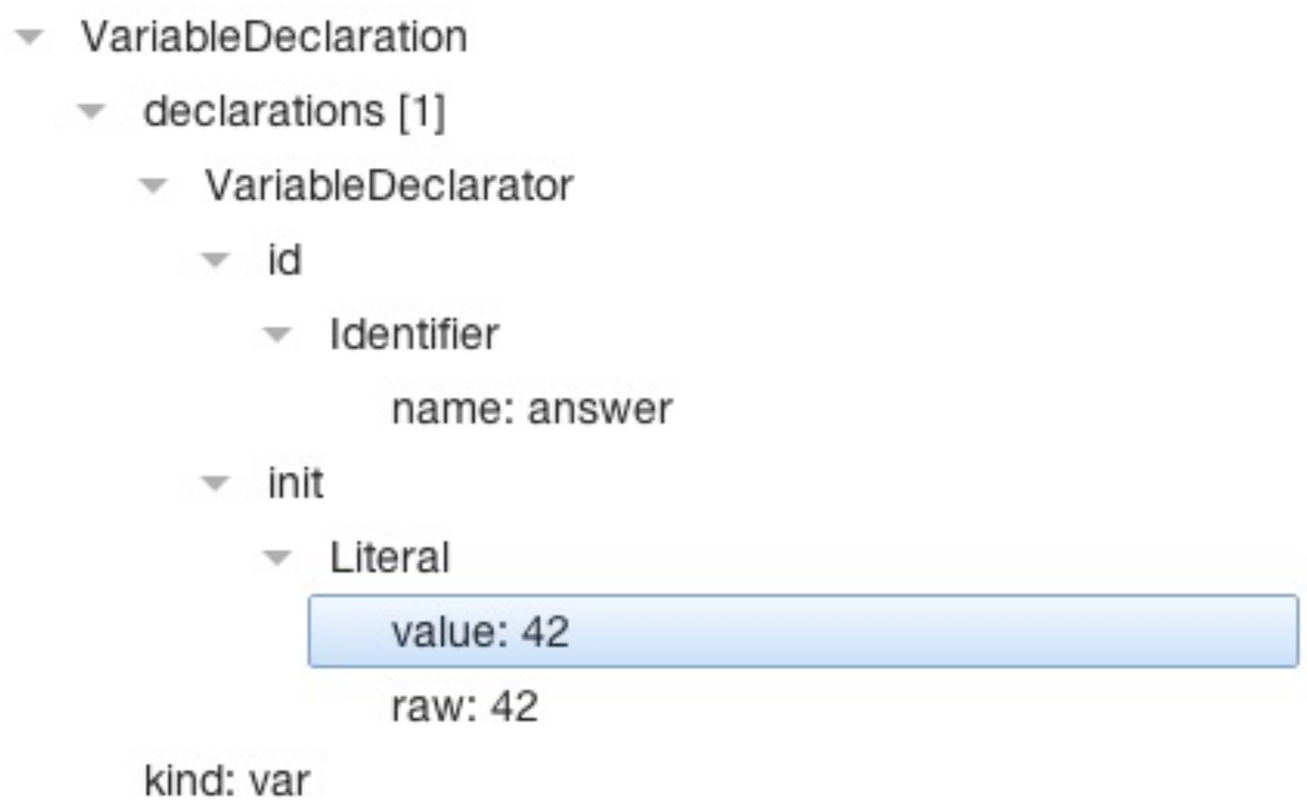
Terms → ECMAScript 5.1 Specification

```
{
    type: "Program",
    body: [
        {
            type: "VariableDeclaration",
            declarations: [
                {
                    type: "VariableDeclarator",
                    id: {
                        type: "Identifier",
                        name: "answer"
                    },
                    init: {
                        type: "Literal",
                        value: 42,
                        raw: "42"
                    }
                }
            ],
            kind: "var"
        }
    ]
}
```

Syntax Visualization

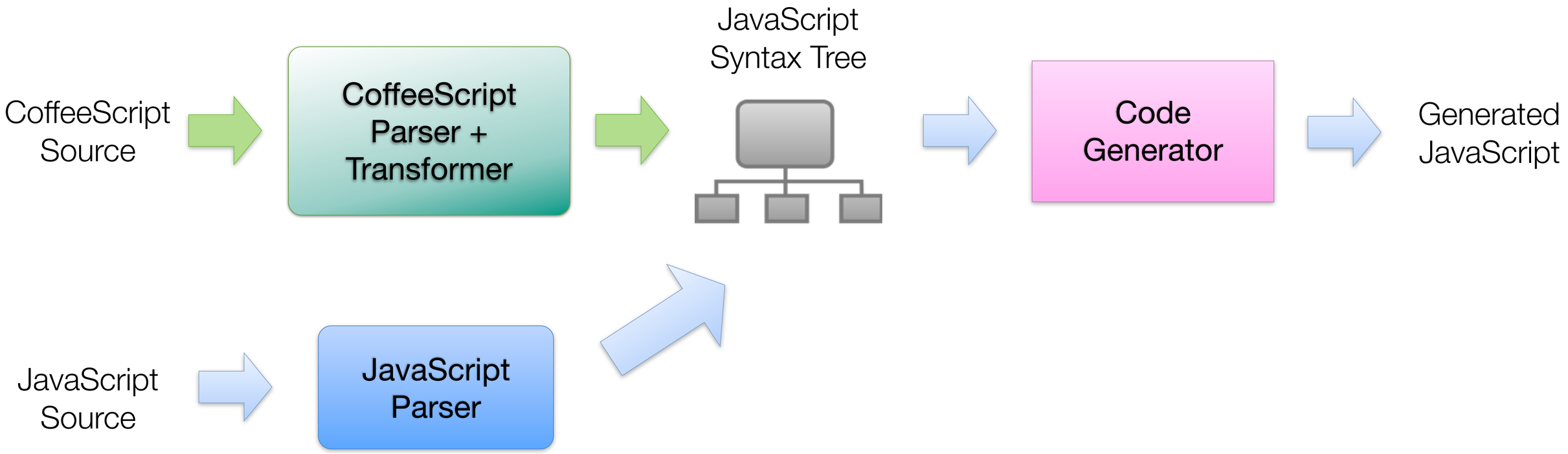
http://esprima.org/demo/parse.html

Try online!

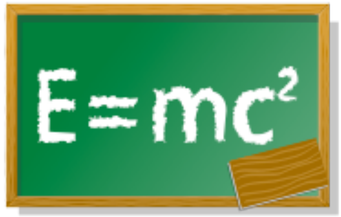


Execution Visualization

Another Case Study: CoffeeScriptRedux



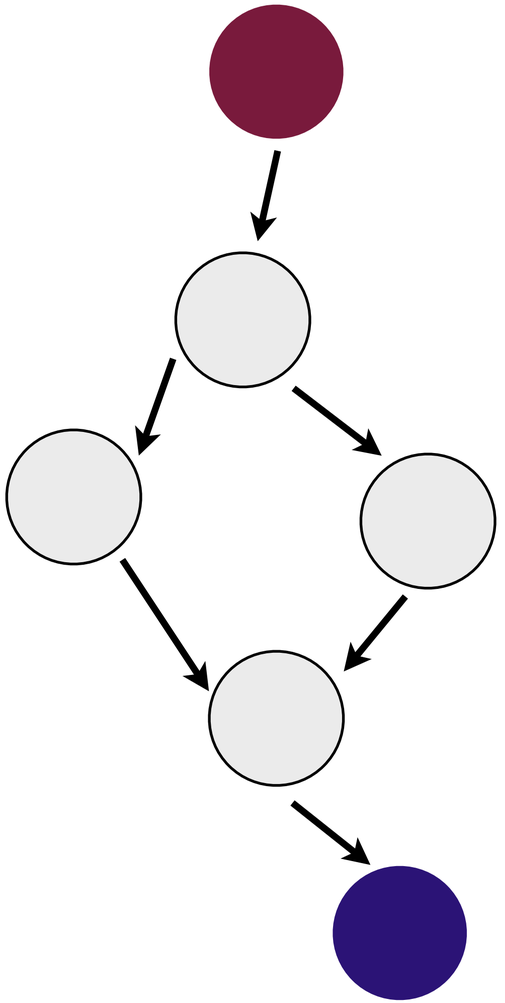
1. Code Complexity



McCabe Cyclomatic Complexity

```
if (true) "foo"; else "bar";
```

Cyclomatic Complexity = **2**



Control Flow Graph

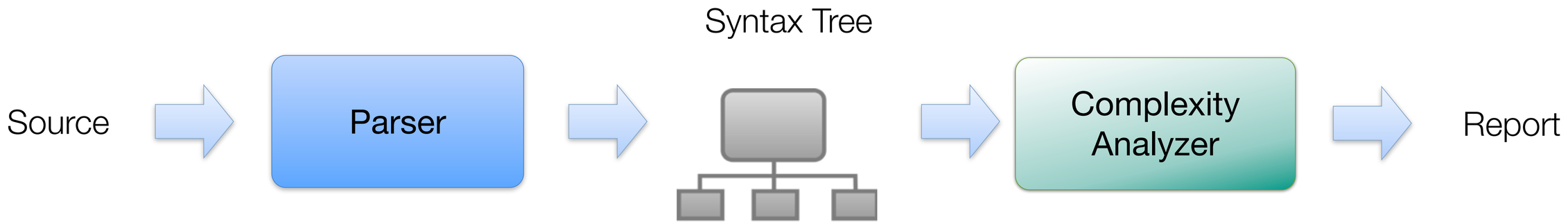
6 edges

6 nodes

1 exit

JSComplexity

http://jscomplexity.org/



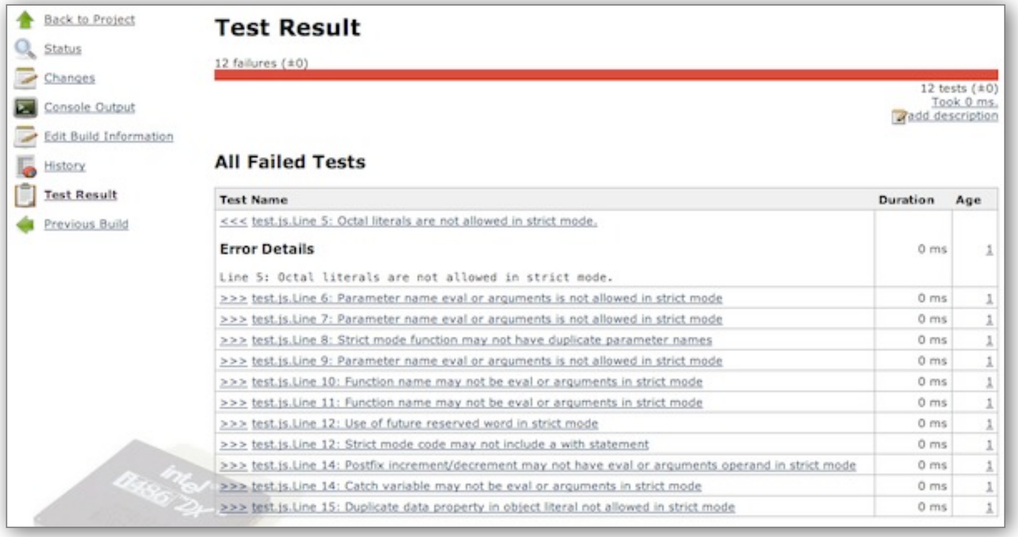
Most Complex Functions

```
var cr = require('complexity-report'),
    content = require('fs').readFileSync('index.js', 'utf-8'),
    list = [];

cr.run(content).functions.forEach(function (entry) {
    list.push({ name: entry.name, value: entry.complexity.cyclomatic });
});

list.sort(function (x, y) {
    return y.value - x.value;
});

console.log('Most cyclomatic-complex functions:');
list.slice(0, 6).forEach(function (entry) {
    console.log(' ', entry.name, entry.value);
});
```

Continuous Monitoring of Complexity

```
198 > esprima@1.1.0-dev analyze-complexity /home/travis/build/ariya/esprima
199 > node tools/list-complexity.js
200
201 Most cyclomatic-complex functions:
202    scanComment 21
203    skipComment 19
204    scanRegExp 17
205    parsePrimaryExpression 14
206    scanNumericLiteral 14
207    parse 14
208
209 > esprima@1.1.0-dev check-complexity /home/travis/build/ariya/esprima
210 > node node_modules/complexity-report/src/cli.js --maxcc 21 --silent -l -w
    esprima.js
211
212
```

Post-Commit vs Pre-Commit



JUnit XML + Jenkins

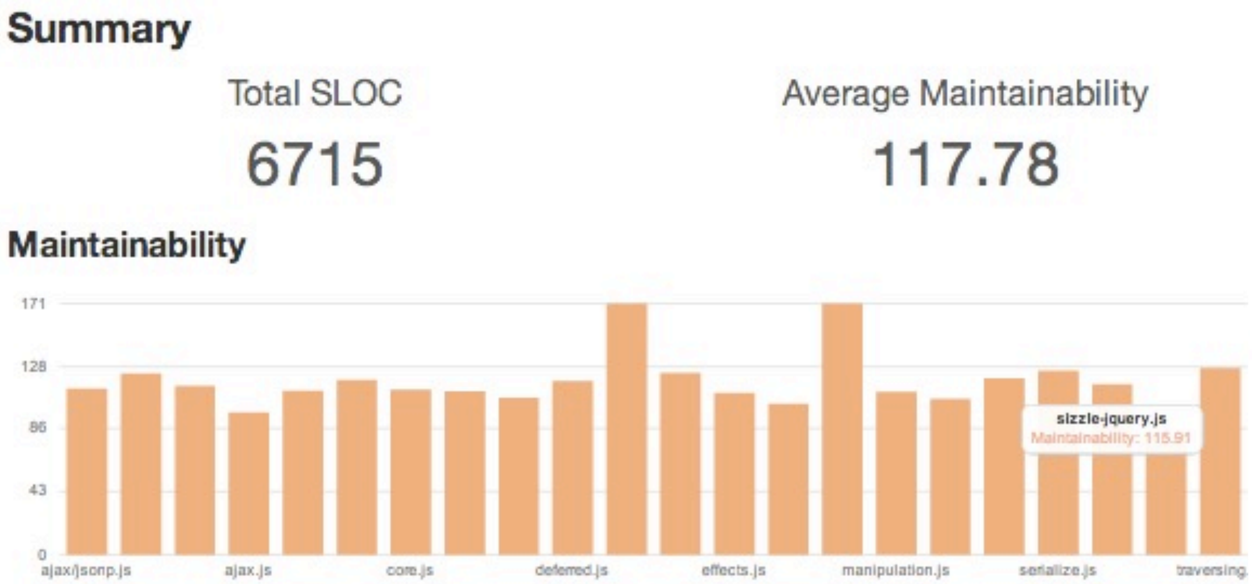
```
files=$(git diff-index --name-only HEAD |
grep -P '\.js$')
for file in $files; do
  esvalidate $file
  if [ $? -eq 1 ]; then
    echo "Syntax error: $file"
    exit 1
  fi
done
```

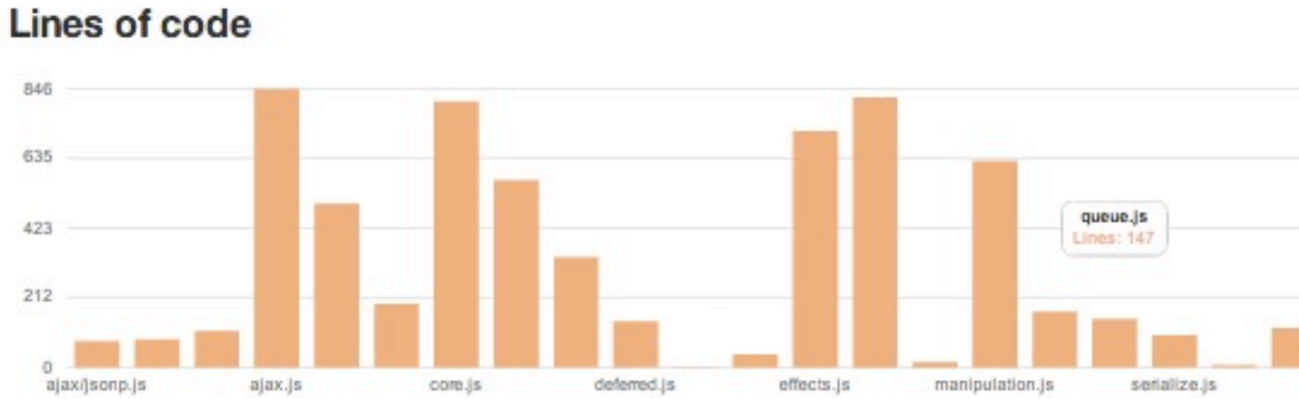
Git Precommit Hook

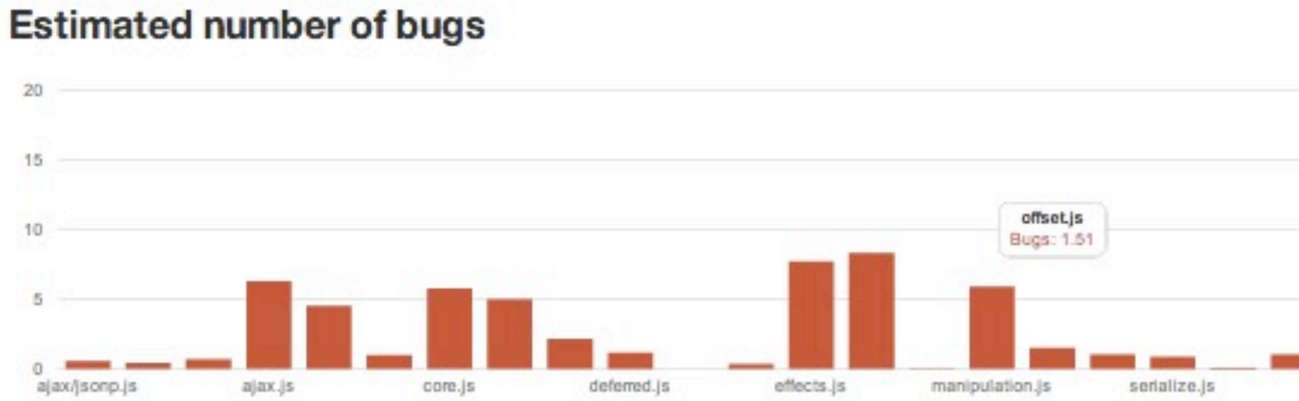
http://ariya.ofilabs.com/2012/03/git-pre-commit-hook-and-smoke-testing.html

Complexity Visualization with Plato

https://github.com/jsoverson/plato



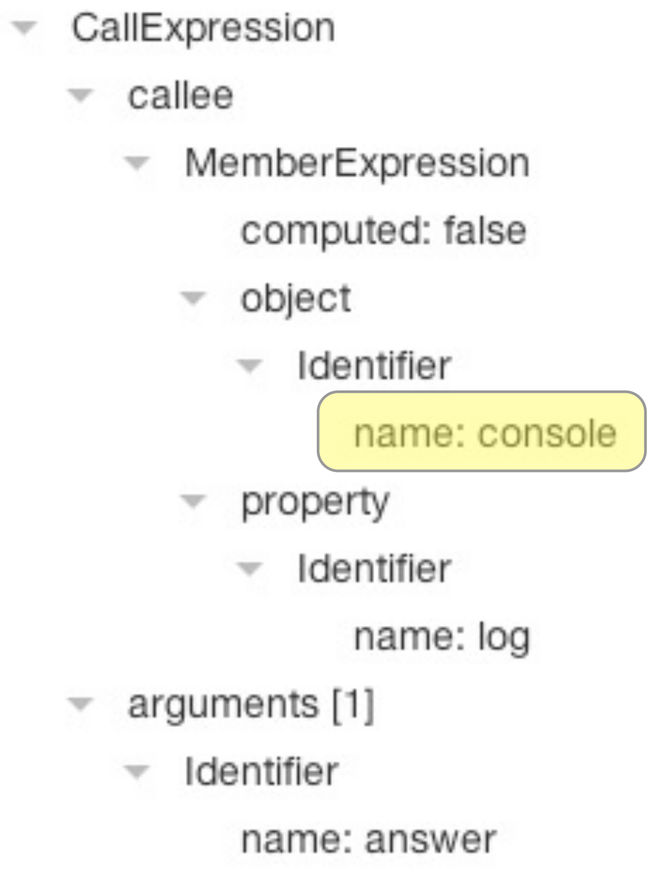




https://ariya.ofilabs.com/2013/01/javascript-code-complexity-visualization.html

2. Custom Linting

Stray Logging




```
function detect_console(code) {

  function check(node) {
    if (node.type === 'CallExpression') {
      if (node.callee.type === 'MemberExpression') {
        if (node.callee.object.name === 'console') {
          alert('console call at line', node.loc.start.line);
        }
      }
    }
  }

  var tree = esprima.parse(code, { loc: true });
  estraverse.traverse(tree, { enter:check });
}
```

Application Structure

```
MyApp.create('MyApp.Person', {
    name: 'Joe Sixpack',
    age: 42,

    constructor: function(name) {},

    walk: function(steps) {}
    run: function(steps) {}

});
```

Metadata

```
{
    objectName: 'MyApp.Person',
    functions: ['walk', 'run'],
    properties: ['name', 'age']
}
```

Library-Aware Verification

```
var MyView = Backbone.View.extend({

  tagName:  "p",

  events: {
    "click .foo"    : "clickFoo"
  },

  clikFoo: function() {
    // do something
  }

});
```

“Boolean Trap”

Obfuscated choice

```
var volumeSlider = new Slider(false);
```

Double-negative

```
component.setHidden(false);
filter.setCaseInsensitive(false);
```

Can you make up your mind?

```
treeItem.setState(true, false);
```

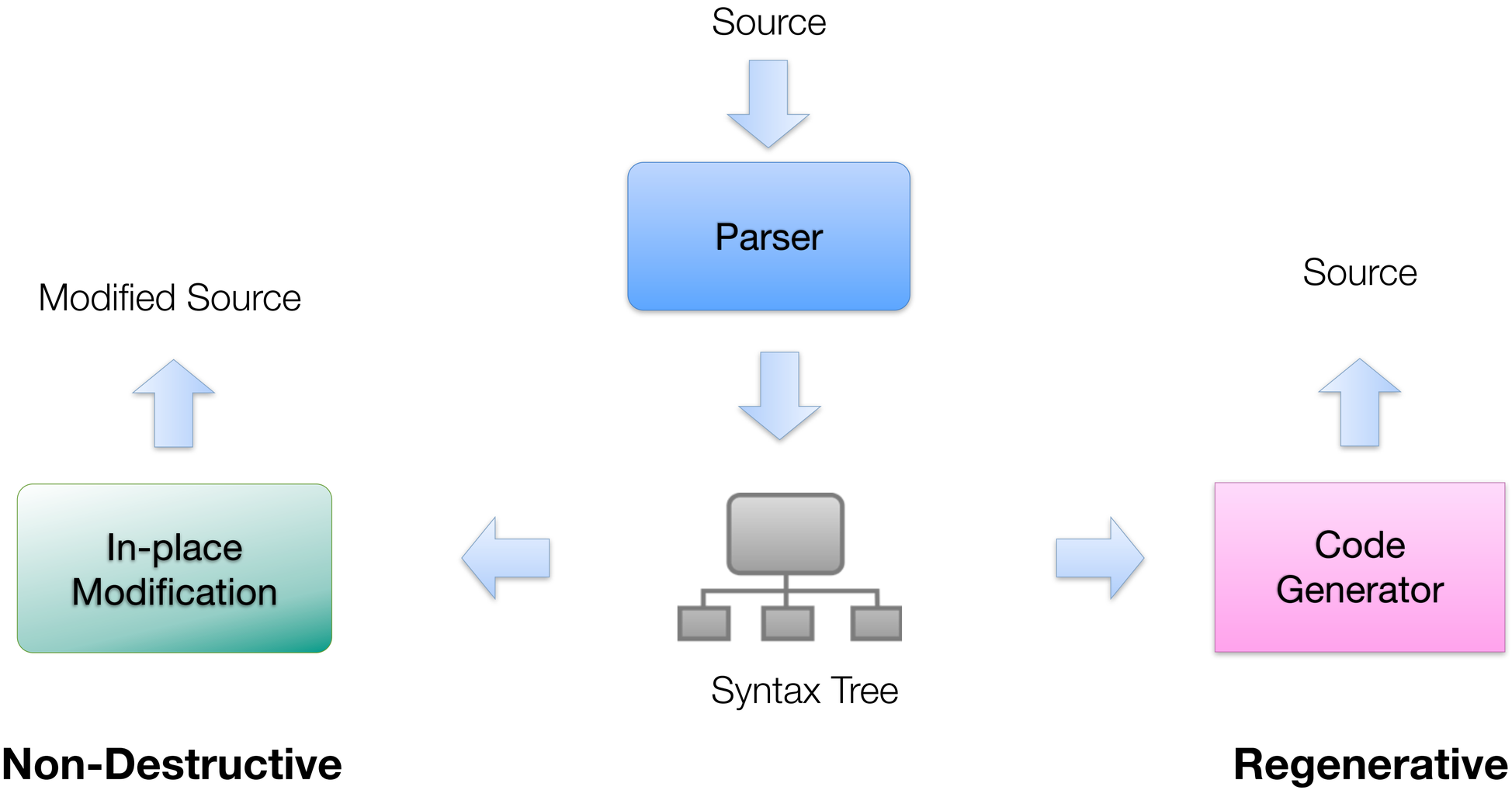
The more the merrier?

```
event.initKeyEvent("keypress", true, true, null, null,
    false, false, false, false, 9, 0);
```

http://ariya.ofilabs.com/2012/06/detecting-boolean-traps-with-esprima.html

3. Source Transformation

Non-Destructive vs Regenerative



String Literal Quotes

```
console.log("Hello")
```

```
console.log('Hello')
```

List of tokens

```
[
    { type: "Identifier", value: "console", range: [0, 7] },
    { type: "Punctuator", value: ".", range: [7, 8] },
    { type: "Identifier", value: "log", range: [8, 11] },
    { type: "Punctuator", value: "(", range: [11, 12] },
    { type: "String", value: "\"Hello\"", range: [12, 19] },
    { type: "Punctuator", value: ")", range: [19, 19] }
]
```

Rename Refactoring

http://esprima.org/demo/rename.html

Try online!

```
1  function isHexDigit(ch) {
2    return '0123456789abcdefABCDEF'.indexOf(ch) >= 0;
3  }
```

```
1  function isHexDigit(digit) {
2    return '0123456789abcdefABCDEF'.indexOf(digit) >= 0;
3  }
```

http://ariya.ofilabs.com/2013/04/rename-refactoring-for-javascript-code.html

Lexical Block Scope

https://github.com/olov/defs

New in ECMAScript 6

```
function f() {
  let j = data.length;
  console.log(j, 'items');
  for (let i = 0; i < j; ++i) {
    let j = data[i] * data[i];
    console.log(j); // squares
  }
}
```

```
function f() {
  var j = data.length;
  console.log(j, 'items');
  for (var i = 0; i < j; ++i) {
    var j$0 = data[i] * data[i];
    console.log(j$0); // squares
  }
}
```

4. Execution Tracing

Timing	Prepare the stopwatch Mark the start and the end
Sampling	Periodically check which function is being executed
Tracing	Track all function calls and exits

Fast = Enough?

Address Book Application

```
Bob
Alice
Dan
Chuck
...
```

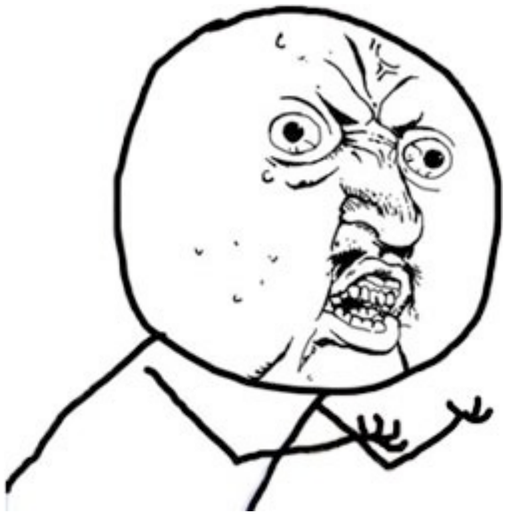
→ **Sort** →

```
Alice
Bob
Chuck
Dan
...
```

How's the speed?

2 ms to sort 10 contacts

Bubble Sort ???



```
Array.prototype.swap = function (i, j) {
    var k = this[i]; this[i] = this[j]; this[j] = k;
}

function sort(list) {
    var items = list.slice(0), swapped = false, p, q;
    for (p = 1; p < items.length; ++p) {
        for (q = 0; q < items.length - p; ++q) {
            if (items[q + 1] < items[q]) {
                items.swap(q, q + 1);
                swapped =true;
            }
        }
        if (!swapped) break;
    }
    return items;
}
```

Run-time Complexity

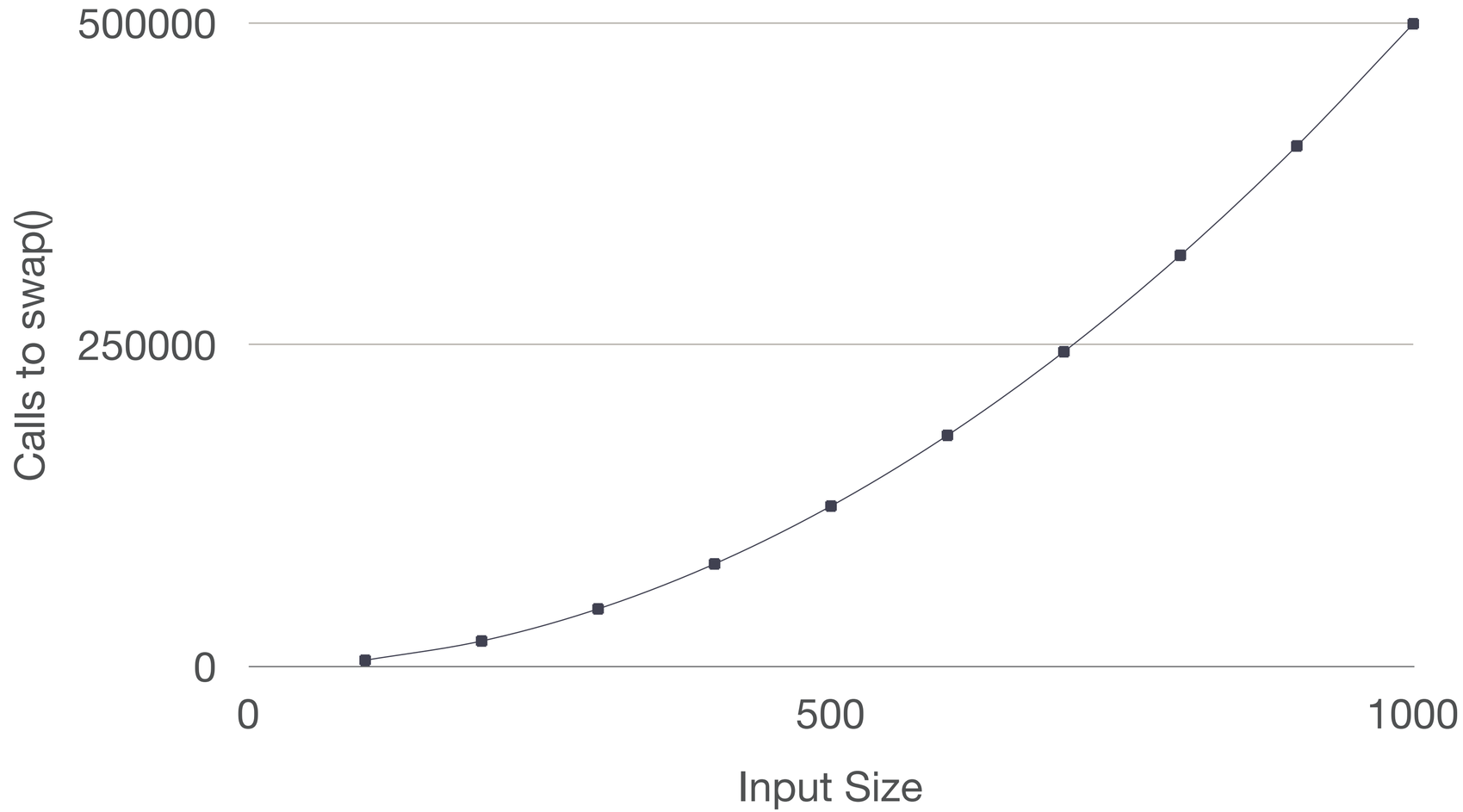
http://esprima.org/demo/functiontrace.html

Try online!

```
Array.prototype.swap = function (i, j) {
    var k = this[i]; this[i] = this[j]; this[j] = k;
}
```

```
Array.prototype.swap = function (i, j) {
Log({ name: 'Array.prototype.swap', lineNumber: 1, range: [23, 94] });
    var k = this[i]; this[i] = this[j]; this[j] = k;
}
```

Run-time Analysis

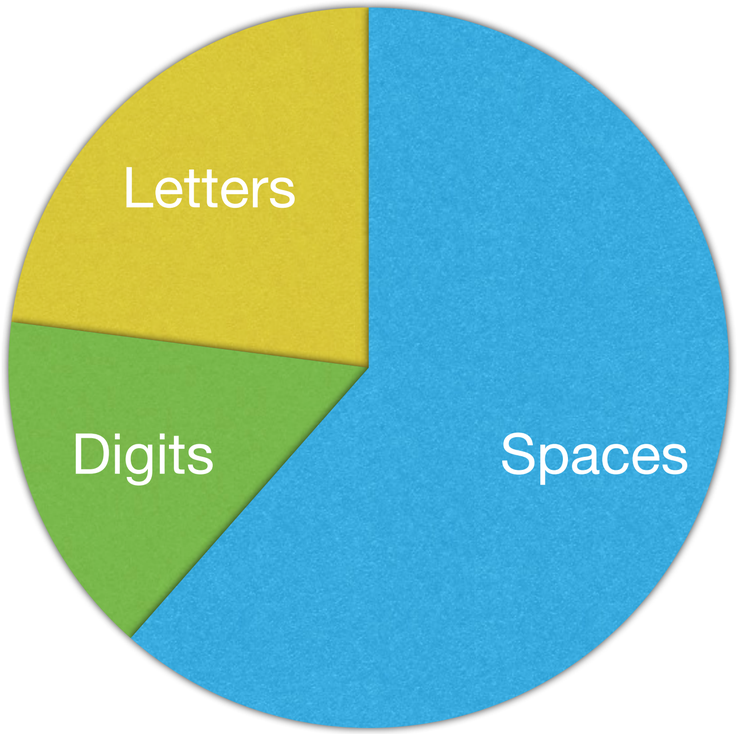


http://ariya.ofilabs.com/2012/01/scalable-web-apps-the-complexity-issue.html

Profile-Guided Optimization

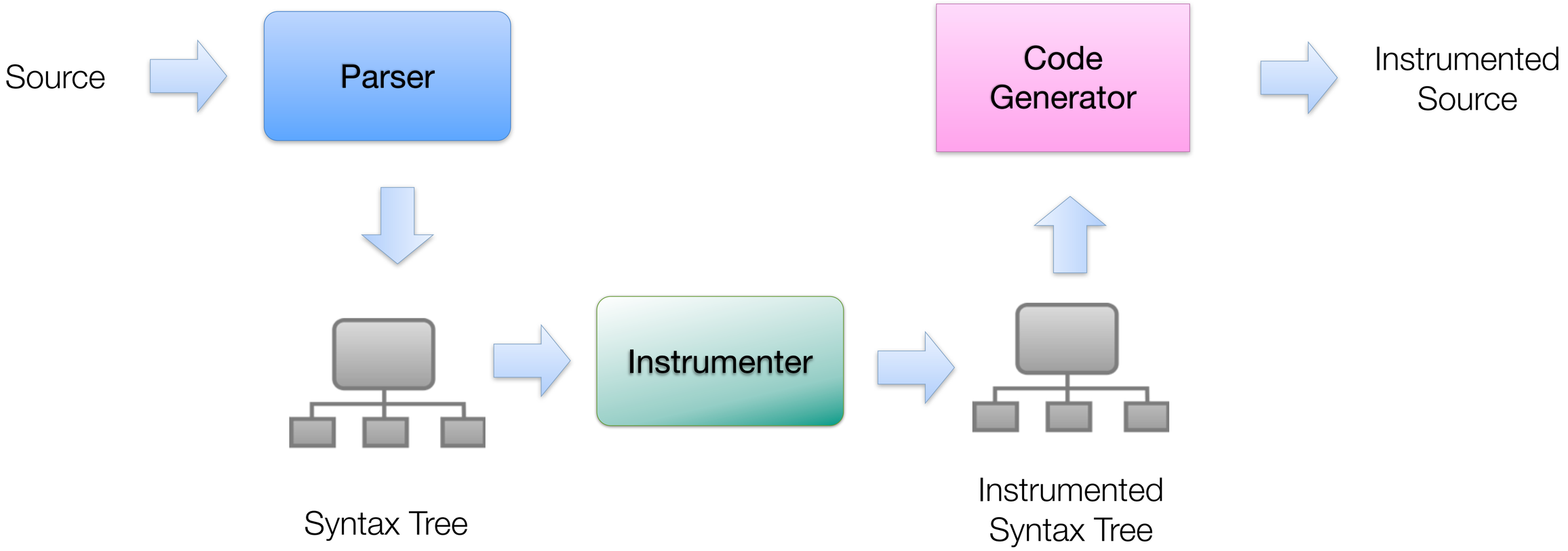
```
function isDigit(ch) {
    return '0123456789'.indexOf(ch) >= 0;
}
```

```
function isDigit(ch) {
    return ch !==' ' &&
        '0123456789'.indexOf(ch) >= 0;
}
```



5. Code Coverage

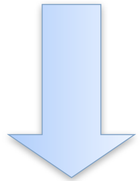
Code Instrumentation



Istanbul Coverage Tool

http://gotwarlost.github.io/istanbul/

```
var answer = 42;
alert(answer);
```



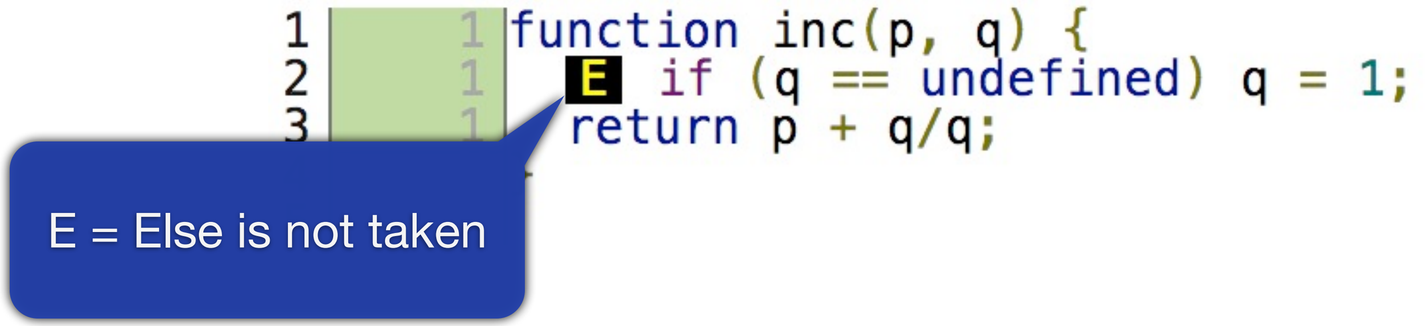
Can be used with Jasmine, QUnit, Mocha, Buster.JS, Karma (née Testacular), Intern

```
var __cov_l$4m7m$L464yvav5F$qhNA = __coverage__['hello.js'];
__cov_l$4m7m$L464yvav5F$qhNA.s['1']++;
var answer = 42;
__cov_l$4m7m$L464yvav5F$qhNA.s['2']++;
alert(answer);
```

http://ariya.ofilabs.com/2012/12/javascript-code-coverage-with-istanbul.html

Branch Coverage

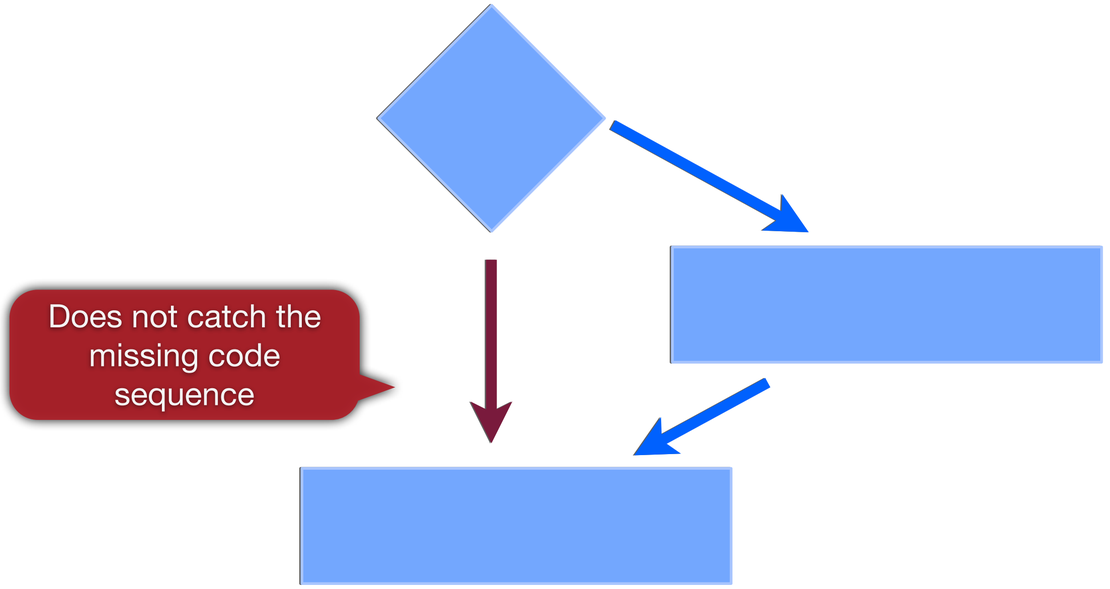
```
function inc(p, q) {
    if (q == undefined) q = 1;
    return p + q/q;
}
assert("inc(4) must give 5", inc(4) == 5);
```



Latent Trap of Statement-only Tracing

```
function inc(p, q) {
    if (q == undefined) q = 1;
    return p + q/q;
}

assert("inc(4) must give 5", inc(4) == 5);
```

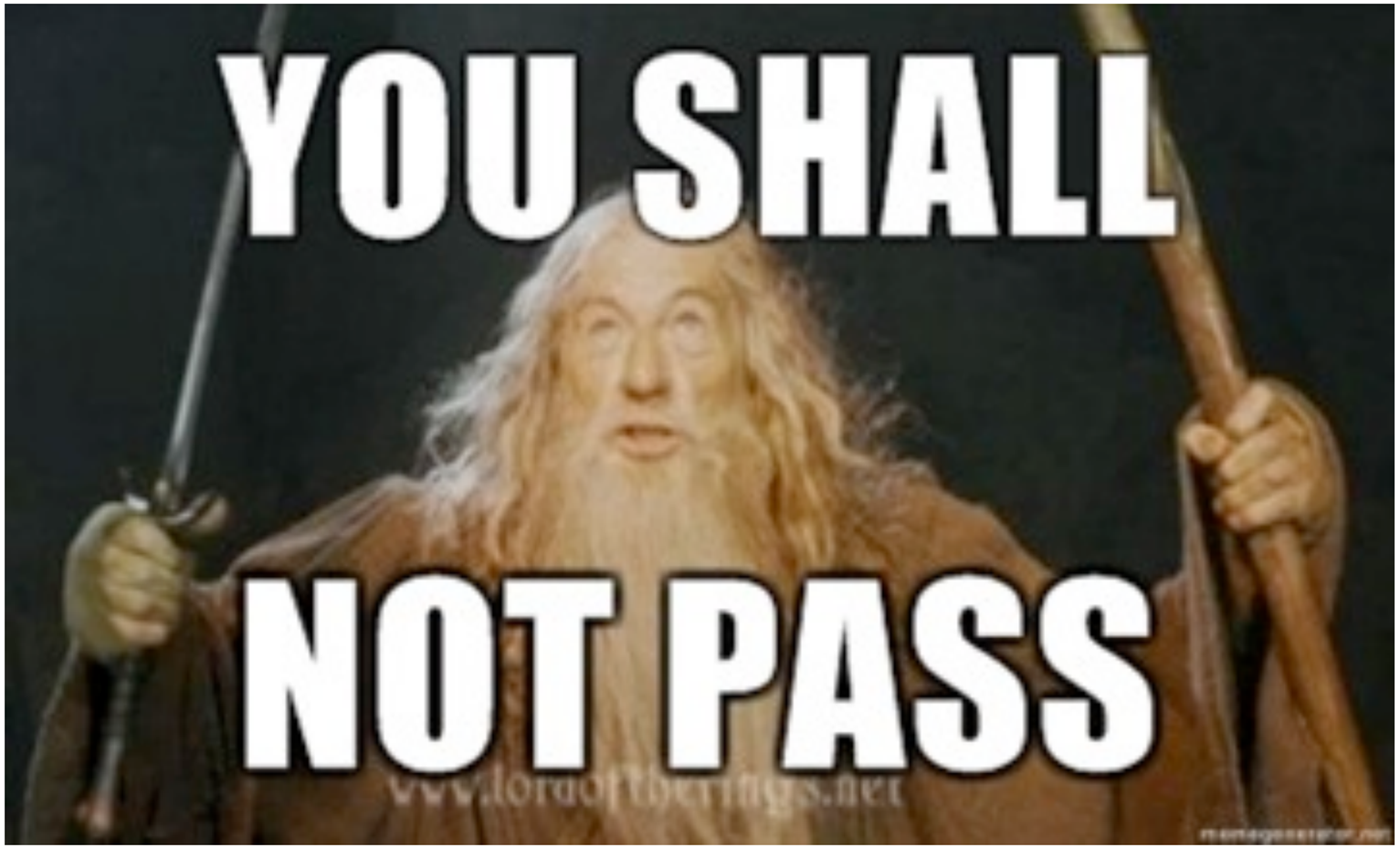
6 lines | 6 run | 0 missing



Coverage Thresholds

```
istanbul check-coverage --statement -5 --branch -3 --function 100
```

```
Tests: 19   Failures: 0
================================================================================
Writing coverage object [/home/ariya/dev/esrefactor/coverage/coverage.json]
Writing coverage reports at [/home/ariya/dev/esrefactor/coverage]
================================================================================

=============================== Coverage summary ===============================
Statements   : 98.13% ( 105/107 )
Branches     : 93.55% ( 58/62 )
Functions    : 100% ( 12/12 )
Lines        : 98.11% ( 104/106 )
================================================================================
 > istanbul check-coverage --branch -3

/usr/local/node/lib/node_modules/istanbul/lib/cli.js:31
        throw ex; // turn it into an uncaught exception
              ^
ERROR: Uncovered count for branches (4) exceeds threshold (3)
```


YOU SHALL
NOT PASS

If you think JSLint hurts your feelings,
wait until you use Istanbul.

@davglass

...I gave you my heart

But the very next day you gave it away...

Final Words

Composable Tools

Source Transformation

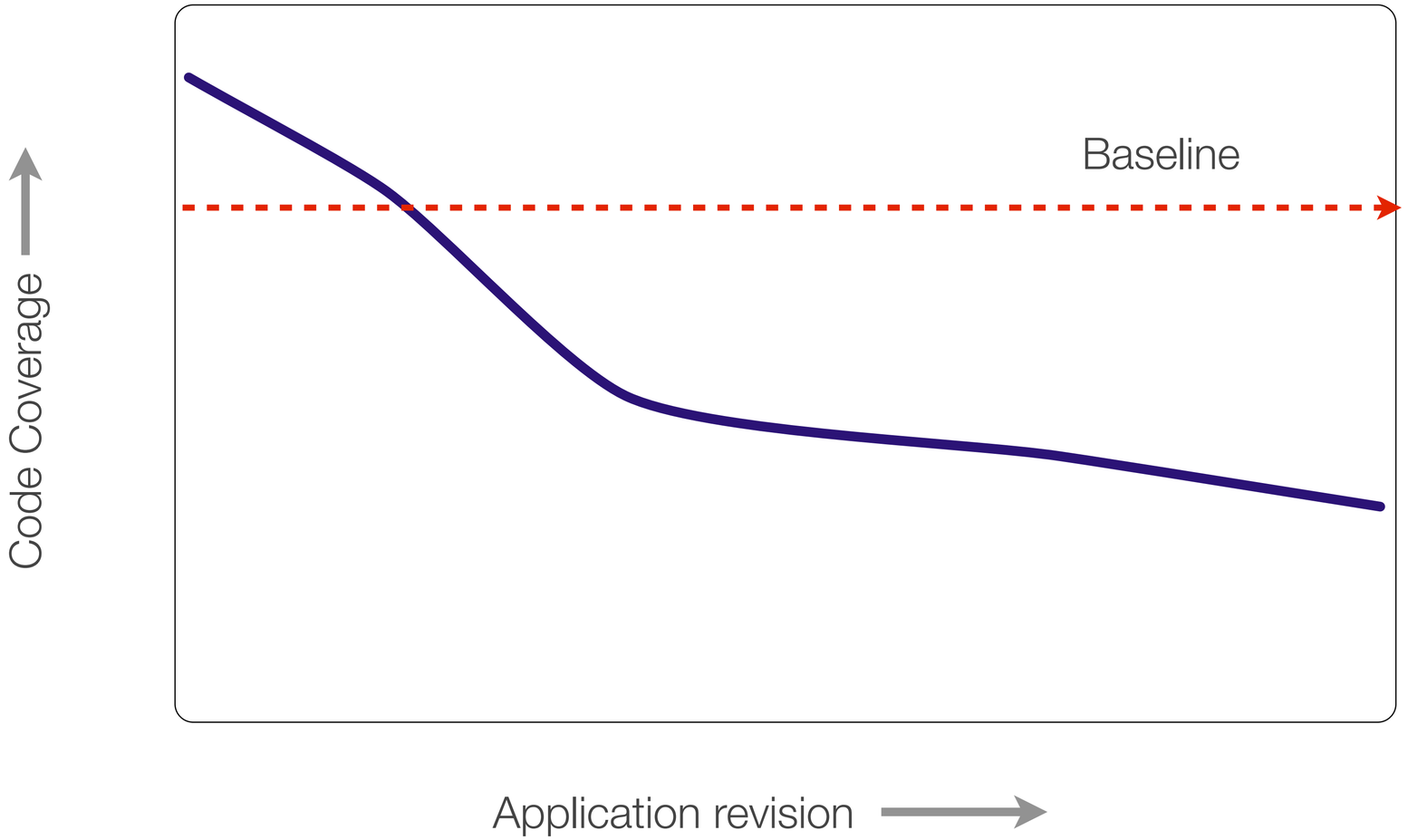
Cyclomatic Complexity

Execution Tracing

Custom Linting

Code Coverage

Two-Dimensional Metrics



Build **composable** tools

Automate any tedious parts of code review

Incorporate **code quality metrics** to the dashboards

Her five-year mission: to explore strange new worlds, to seek out new lifeforms and new civilizations;
to analyze code where no one has analyzed before.

Thank You

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ariya.ofilabs.com/highlights

@ariyahidayat

speakerdeck.com/ariya

Credits: Some artworks are from http://openclipart.org

Goodies

Composable Tools

Profile-Guided Optimization

Defensive Strategies

Code Coverage

Cyclomatic Complexity

Source Transformation

Custom Linting

Execution Tracing

Polluting Variables

```
var height;
// some fancy processing
heigth = 200;
```

Leaks to global

https://github.com/kesla/node-leaky

```
test.js:3
heigth = 200;
^
LeakError: global leak
detected: heigth
```

http://ariya.ofilabs.com/2012/11/polluting-and-unused-javascript-variables.html

Unused Variables

Declared but not used

```
var height;
// some fancy processing
heigth = 200;
```

https://github.com/Kami/node-unused

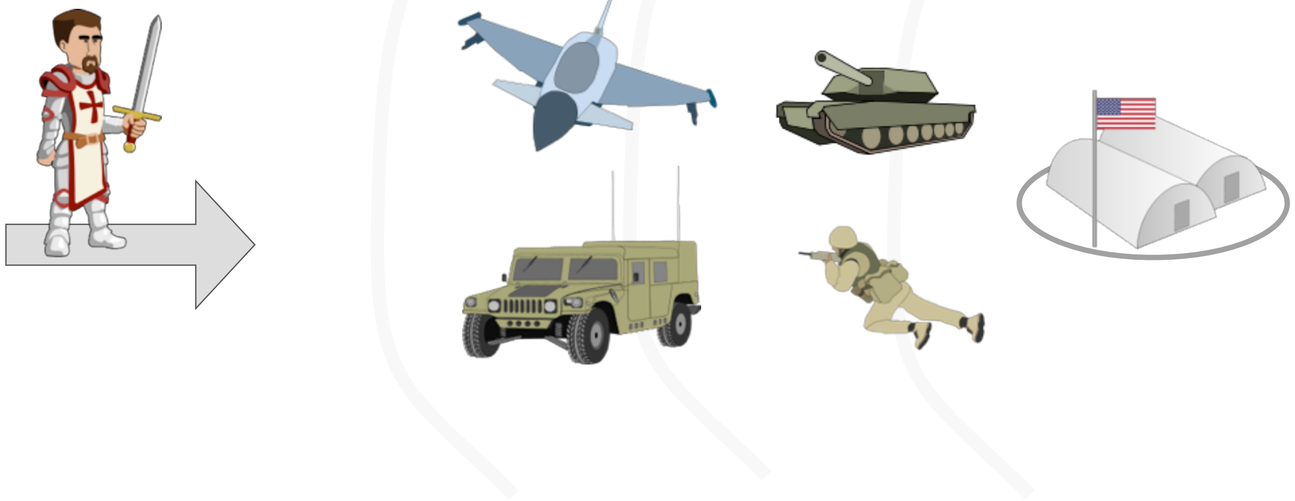
```
test.js
      height - on line 1
```

http://ariya.ofilabs.com/2012/11/polluting-and-unused-javascript-variables.html

Profile-Guided Optimization

Defensive Strategies

Multi-Layer Defense



Code Editor

Smoke Tests

Build Tasks

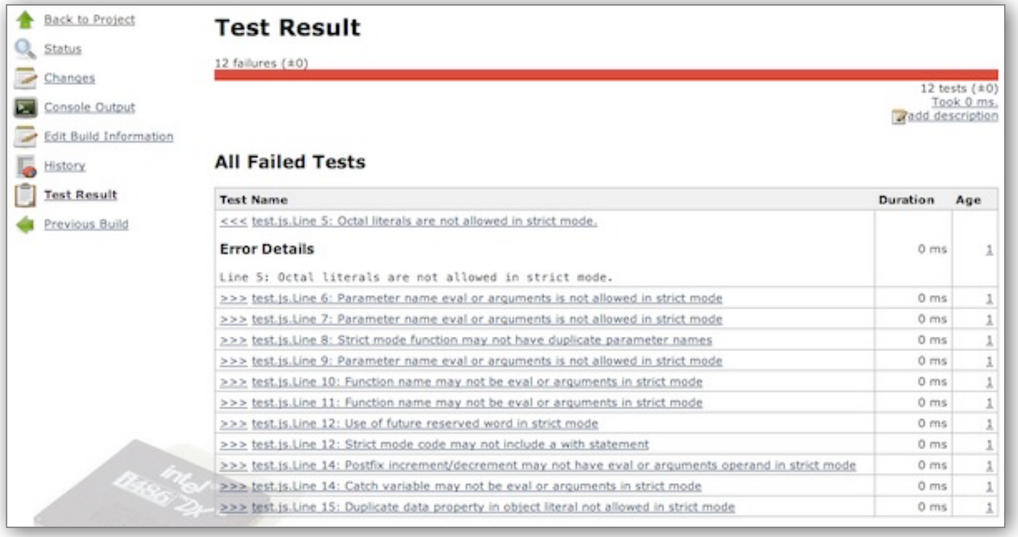
Pull Request

VCS Hooks

CI Server

http://ariya.ofilabs.com/2012/12/quality-code-via-multiple-layers-of-defense.html

Post-Commit vs Pre-Commit



JUnit XML + Jenkins

```
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grep -P '\.js$')
for file in $files; do
  esvalidate $file
  if [ $? -eq 1 ]; then
    echo "Syntax error: $file"
    exit 1
  fi
done
```
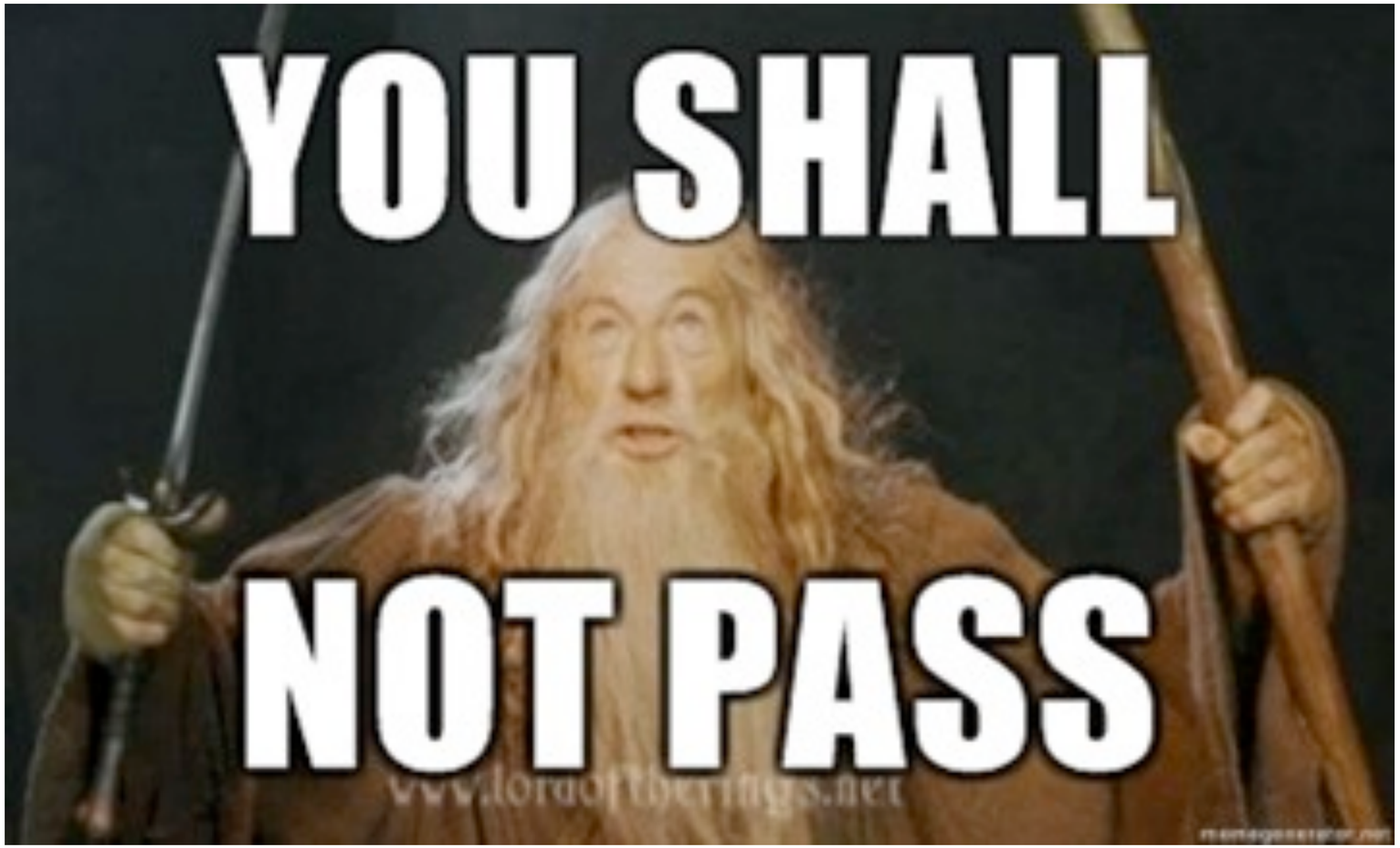

Git Precommit Hook

http://ariya.ofilabs.com/2012/03/git-pre-commit-hook-and-smoke-testing.html


YOU SHALL
NOT PASS