



O'REILLY®

Velocity

Web Performance
and Operations

CONFERENCE

 Santa Clara, CA

 June 18–20, 2013

velocityconf.com

[#velocityconf](https://twitter.com/velocityconf)

Emerging Language Tools to Track JavaScript Quality and Performance

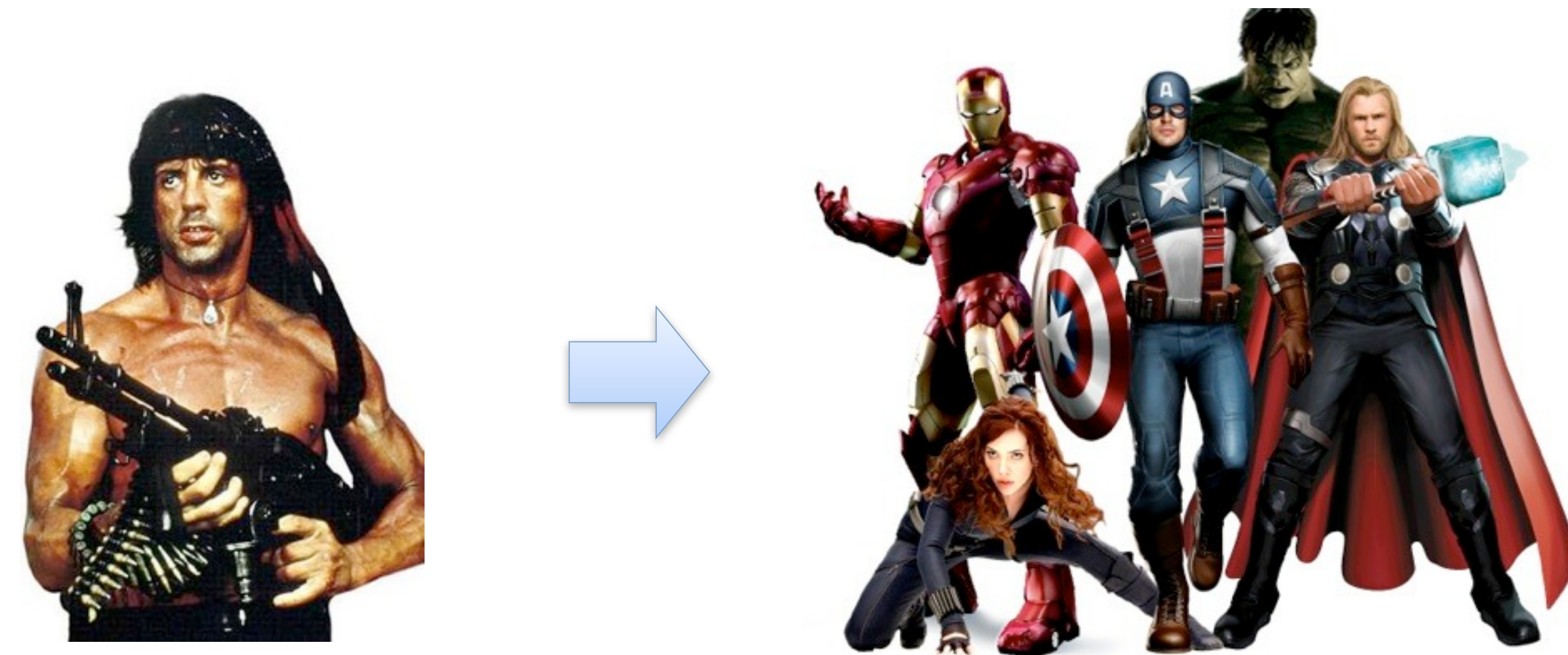


@ariyahidayat



Front-end development team

Single-page applications



Composable Tools

Source Transformation

Cyclomatic Complexity

Execution Tracing

Custom Linting

Code Coverage

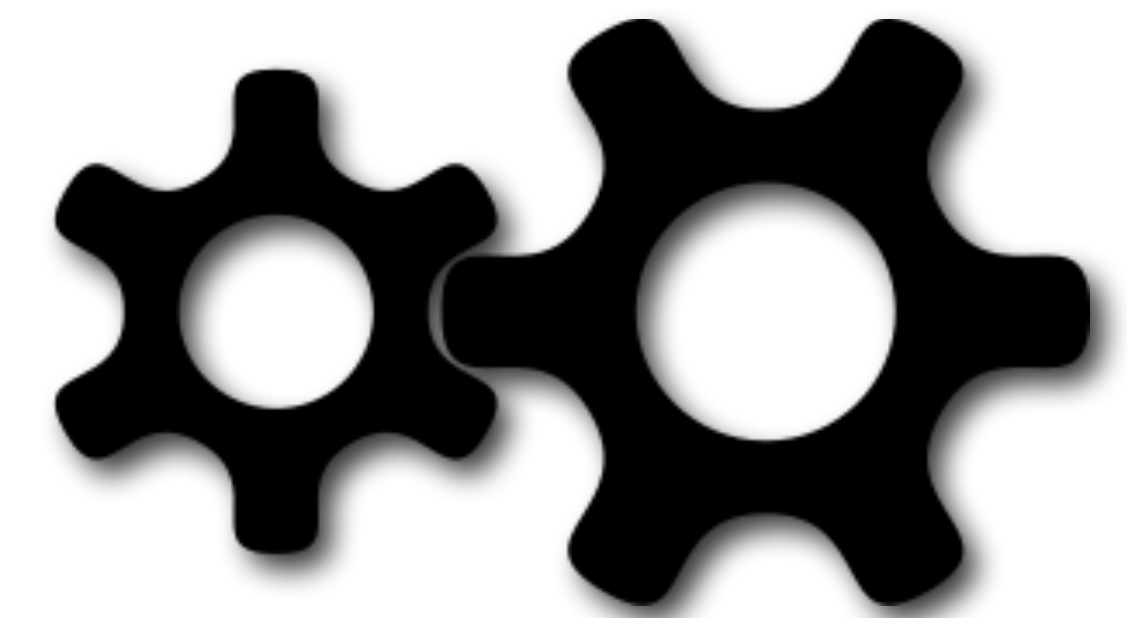
Every tool is open-source
Tweak/customize/run with it!



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



Composable Tools



This is the Philosophy

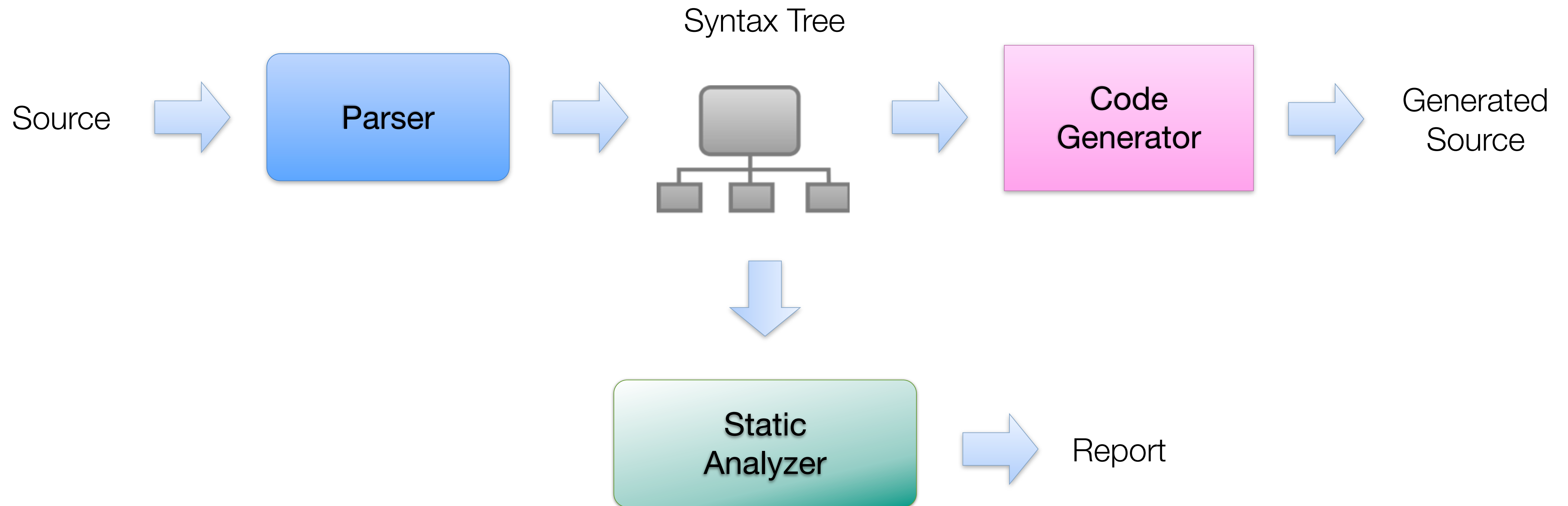
Write programs that **do one thing** and do it well.

Write programs to **work together**.

Write programs to **handle text streams**,
because that is a universal interface.

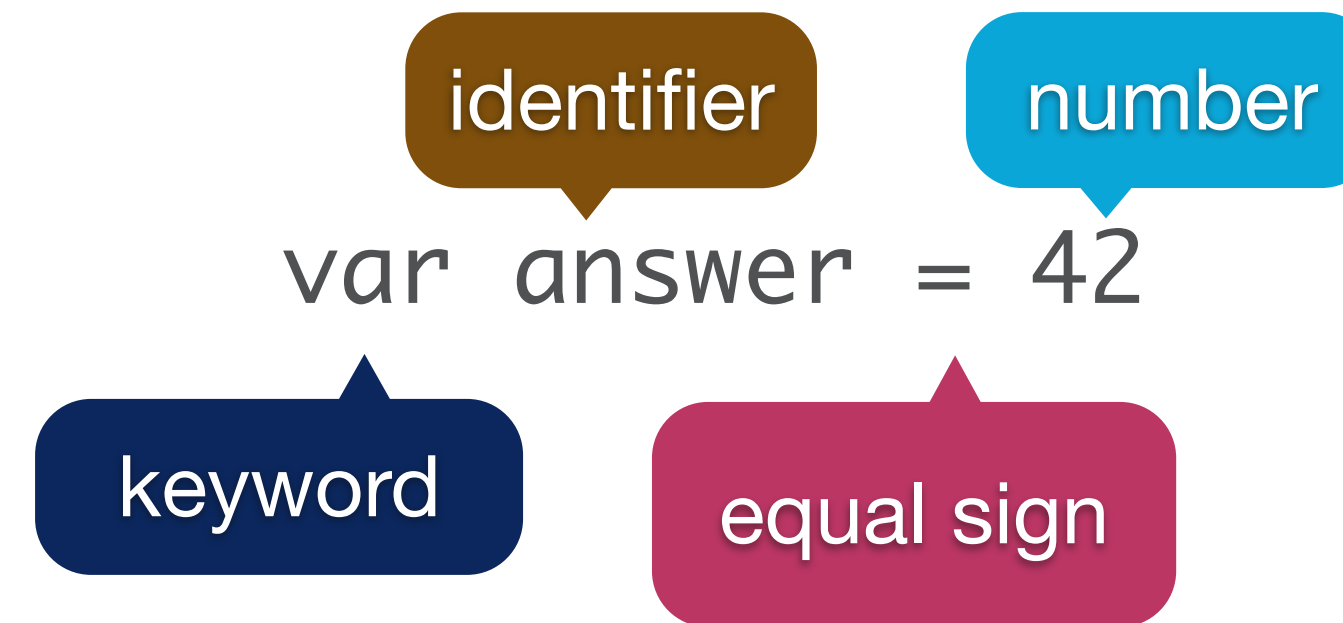
Doug McIlroy, the inventor of Unix pipes and
one of the founders of the Unix tradition

Building Blocks → Tools

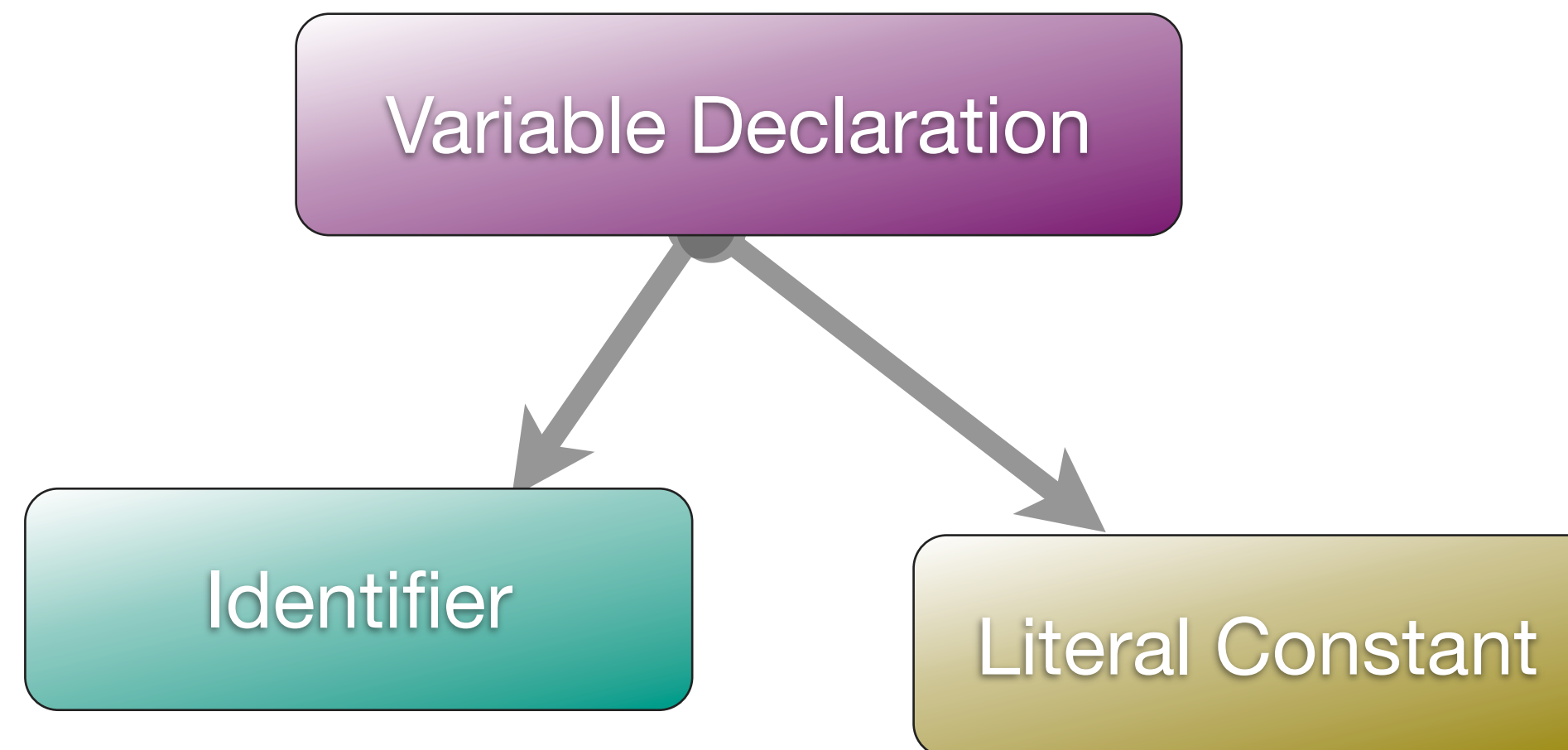


Parser

Tokenization → Tokens



Parsing → Syntax Tree



Syntax Tree

```
var answer = 42;
```

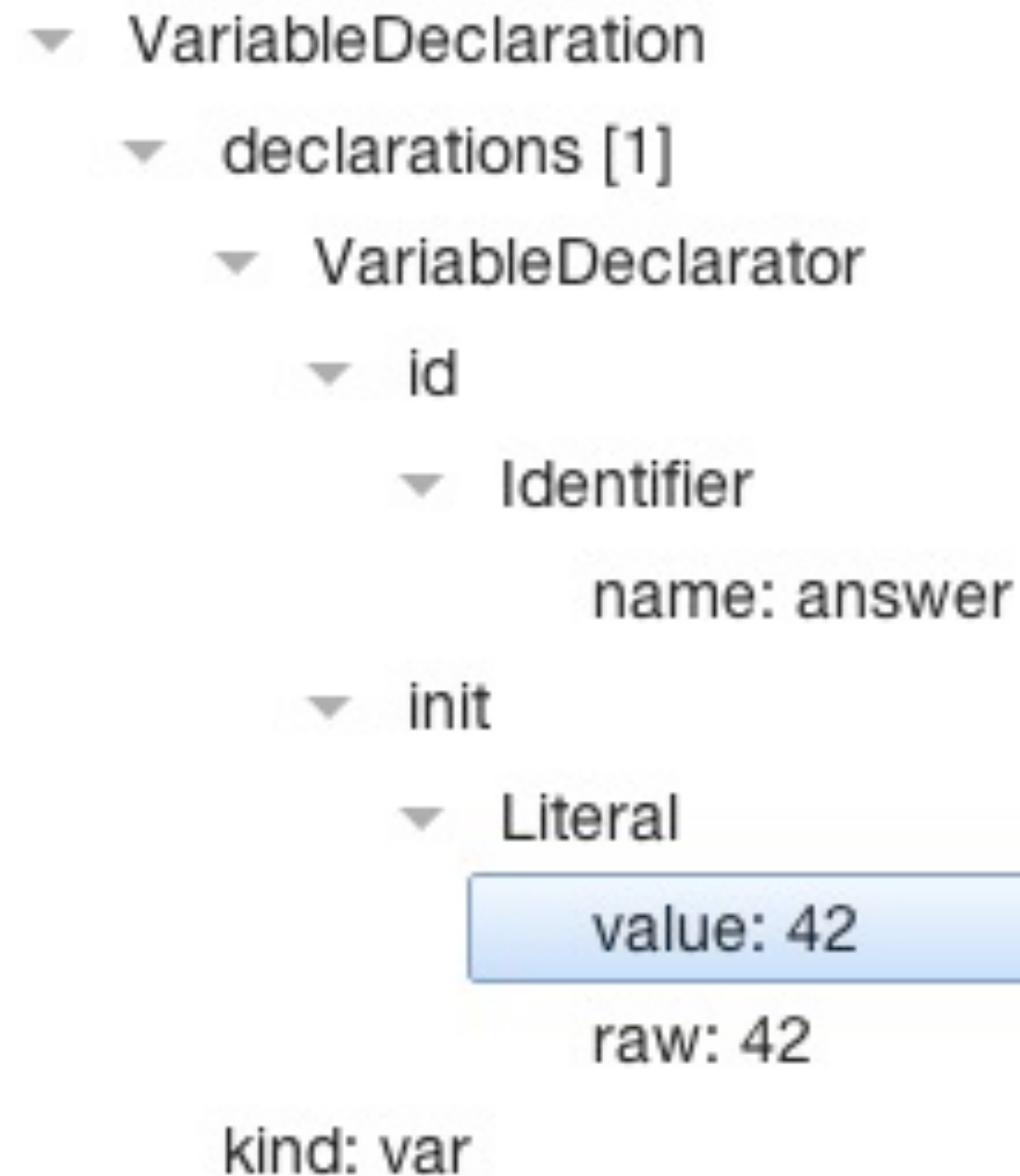
Terms → ECMAScript 5.1 Specification

```
{
  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

Load Example:

```
var sum = 0;  
for (var i = 0; i < 10; ++i) {  
  sum += i;  
}
```

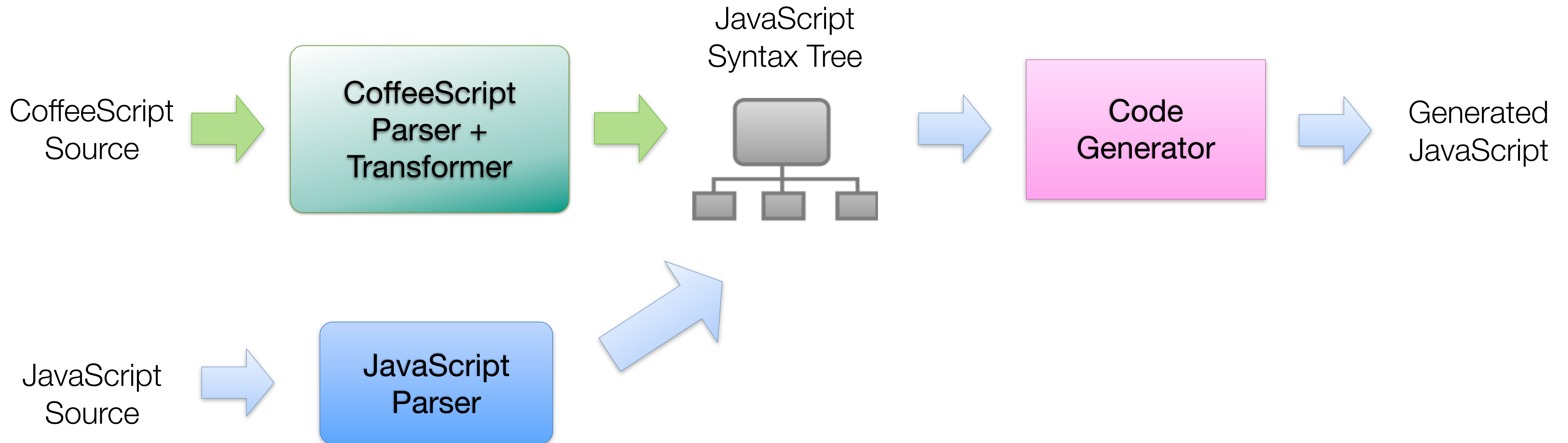
Environment

sum → 36
i → 9

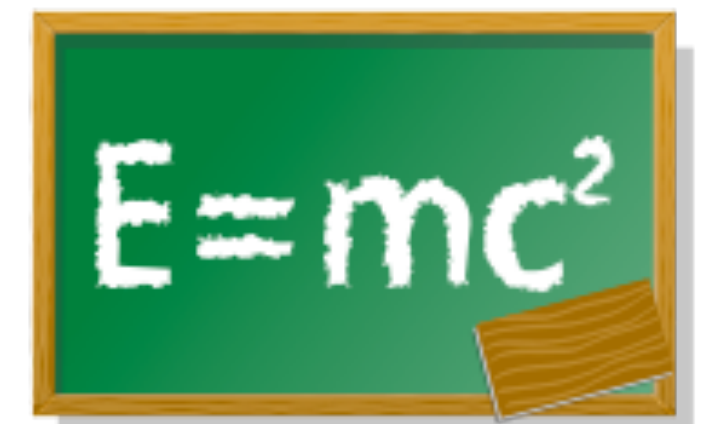
Expression Stack

Program
ForStatement
BinaryExpression
Identifier 'i' → [object
Object]

Another Case Study: CoffeeScriptRedux



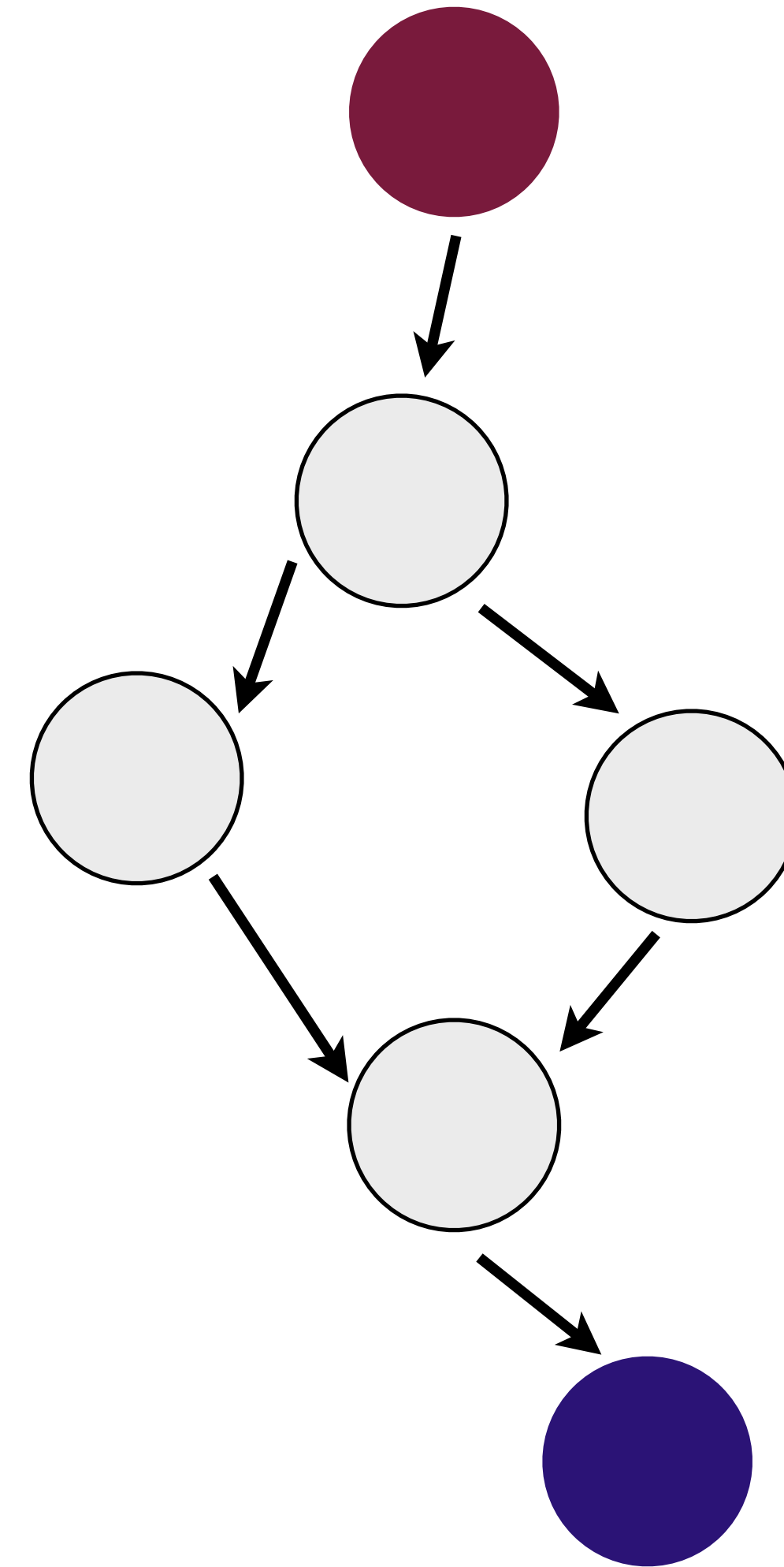
1. Code Complexity



McCabe Cyclomatic Complexity

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

Cyclomatic Complexity = **2**

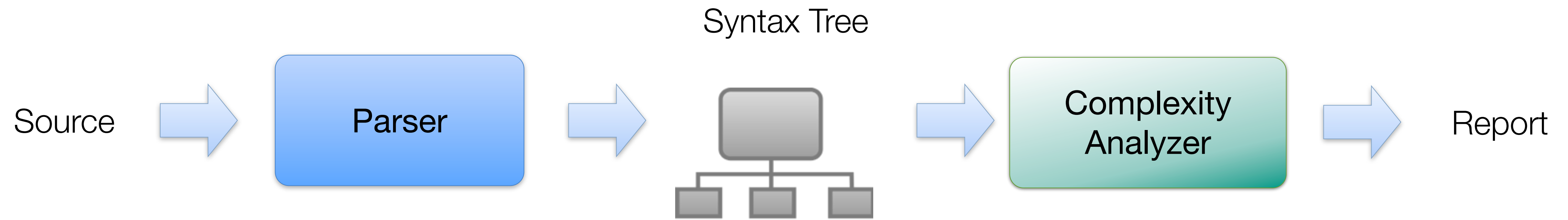


Control Flow Graph

6 edges

6 nodes

1 exit



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



The screenshot shows the Jenkins 'Test Result' page. A red progress bar at the top indicates '12 failures (#0)' out of '12 tests (#0)'. Below this, a table lists 'All Failed Tests'. Each entry includes the test name, duration (0 ms), and age (1). The test names are all related to strict mode errors in JavaScript, such as 'Octal literals are not allowed in strict mode' and 'Parameter name eval or arguments is not allowed in strict mode'.

Test Name	Duration	Age
<<< test.js:Line 5: Octal literals are not allowed in strict mode.	0 ms	1
>>> test.js:Line 6: Parameter name eval or arguments is not allowed in strict mode	0 ms	1
>>> test.js:Line 7: Parameter name eval or arguments is not allowed in strict mode	0 ms	1
>>> test.js:Line 8: Strict mode function may not have duplicate parameter names	0 ms	1
>>> test.js:Line 9: Parameter name eval or arguments is not allowed in strict mode	0 ms	1
>>> test.js:Line 10: Function name may not be eval or arguments in strict mode	0 ms	1
>>> test.js:Line 11: Function name may not be eval or arguments in strict mode	0 ms	1
>>> test.js:Line 12: Use of future reserved word in strict mode	0 ms	1
>>> test.js:Line 12: Strict mode code may not include a with statement	0 ms	1
>>> test.js:Line 14: Postfix increment/decrement may not have eval or arguments operand in strict mode	0 ms	1
>>> test.js:Line 14: Catch variable may not be eval or arguments in strict mode	0 ms	1
>>> test.js:Line 15: Duplicate data property in object literal not allowed in strict mode	0 ms	1

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

Complexity Visualization with Plato

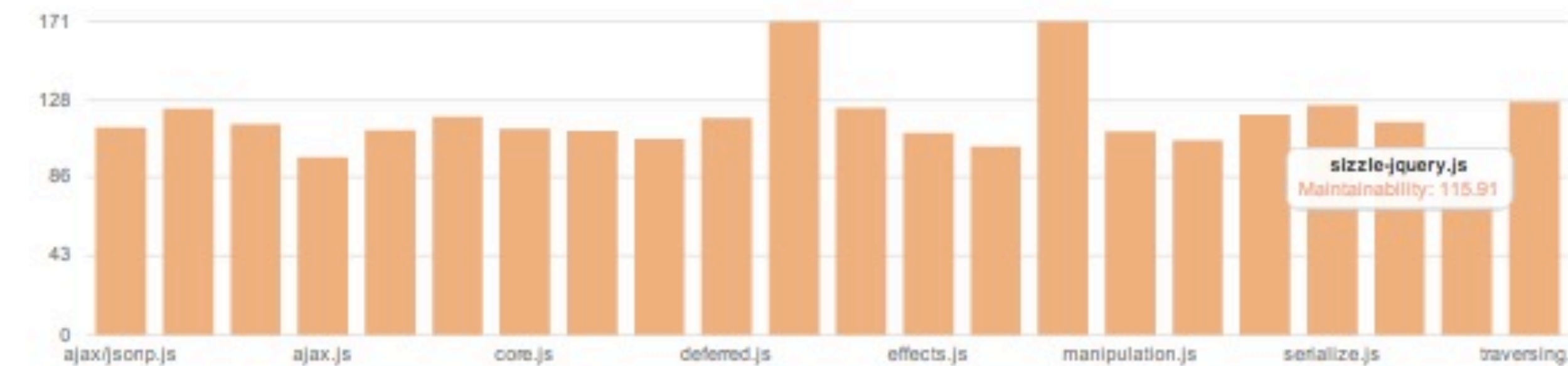
<https://github.com/jsoverson/plato>

Summary

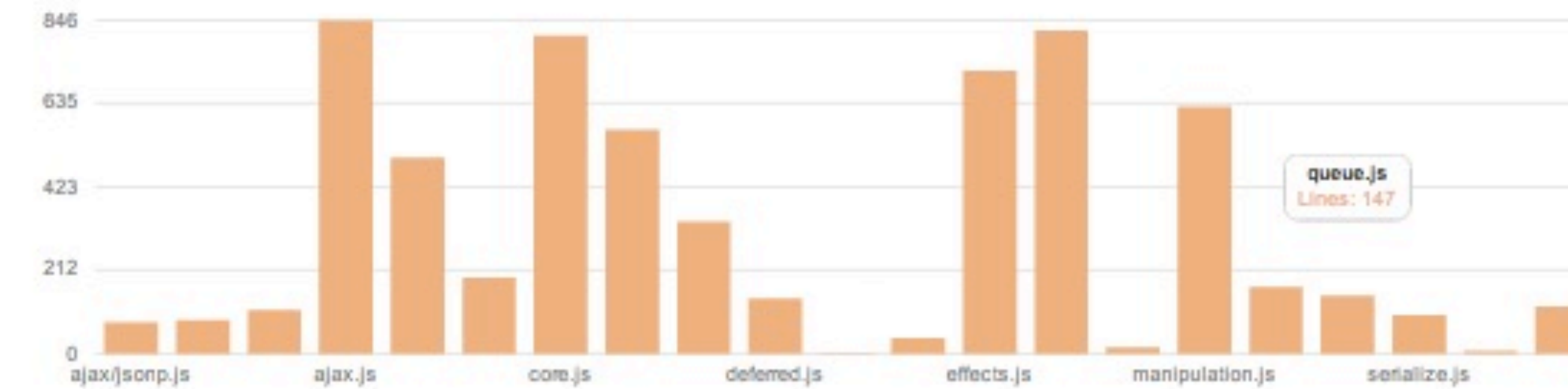
Total SLOC
6715

Average Maintainability
117.78

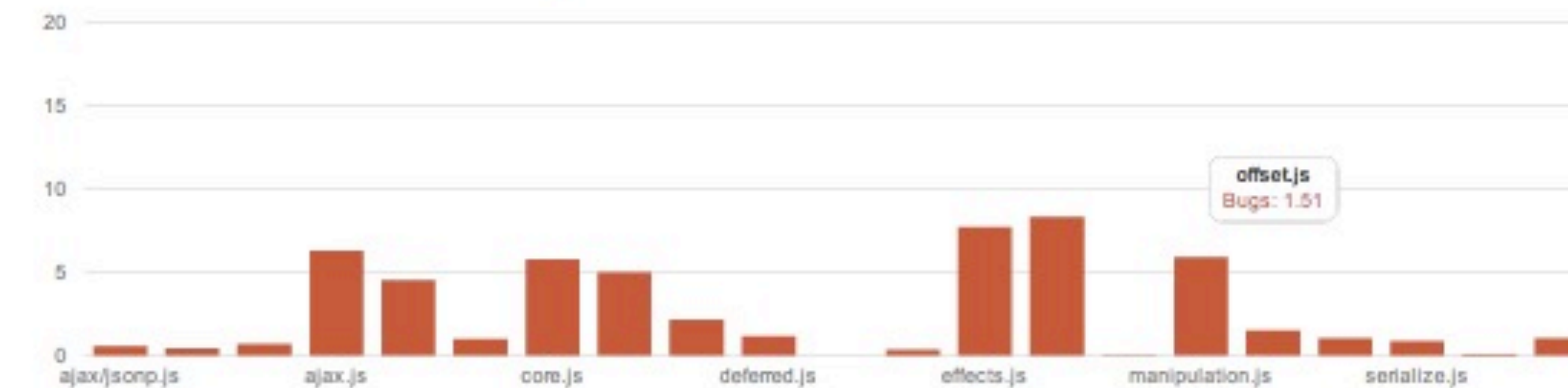
Maintainability



Lines of code



Estimated number of bugs

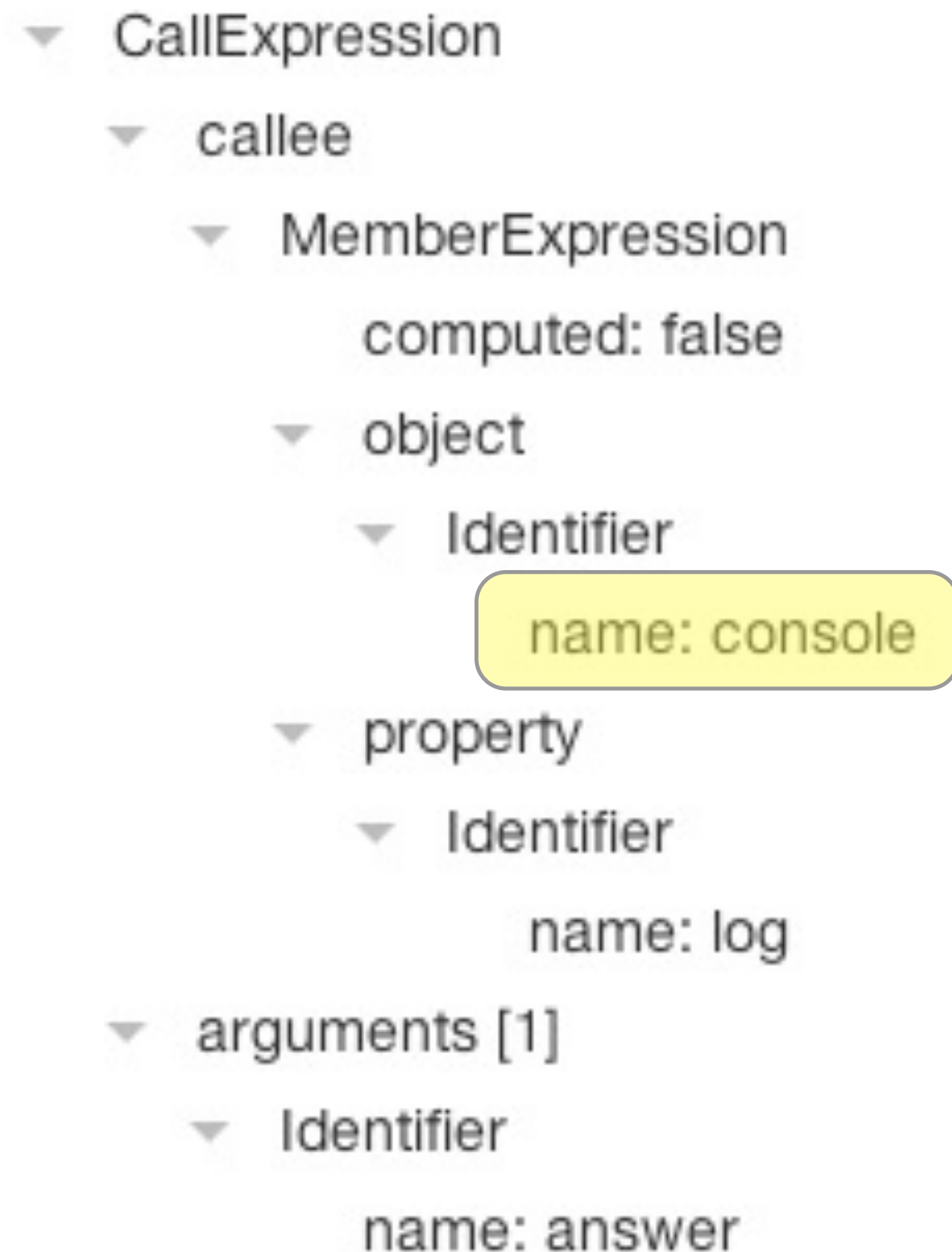


<https://ariya.ofilabs.com/2013/01/javascript-code-complexity-visualization.html>

2. Custom Linting



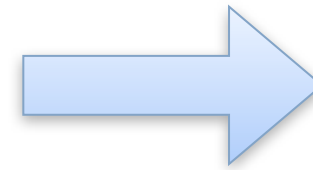
Stray Logging



```
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"  
  },  
  clickFoo: 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);
```

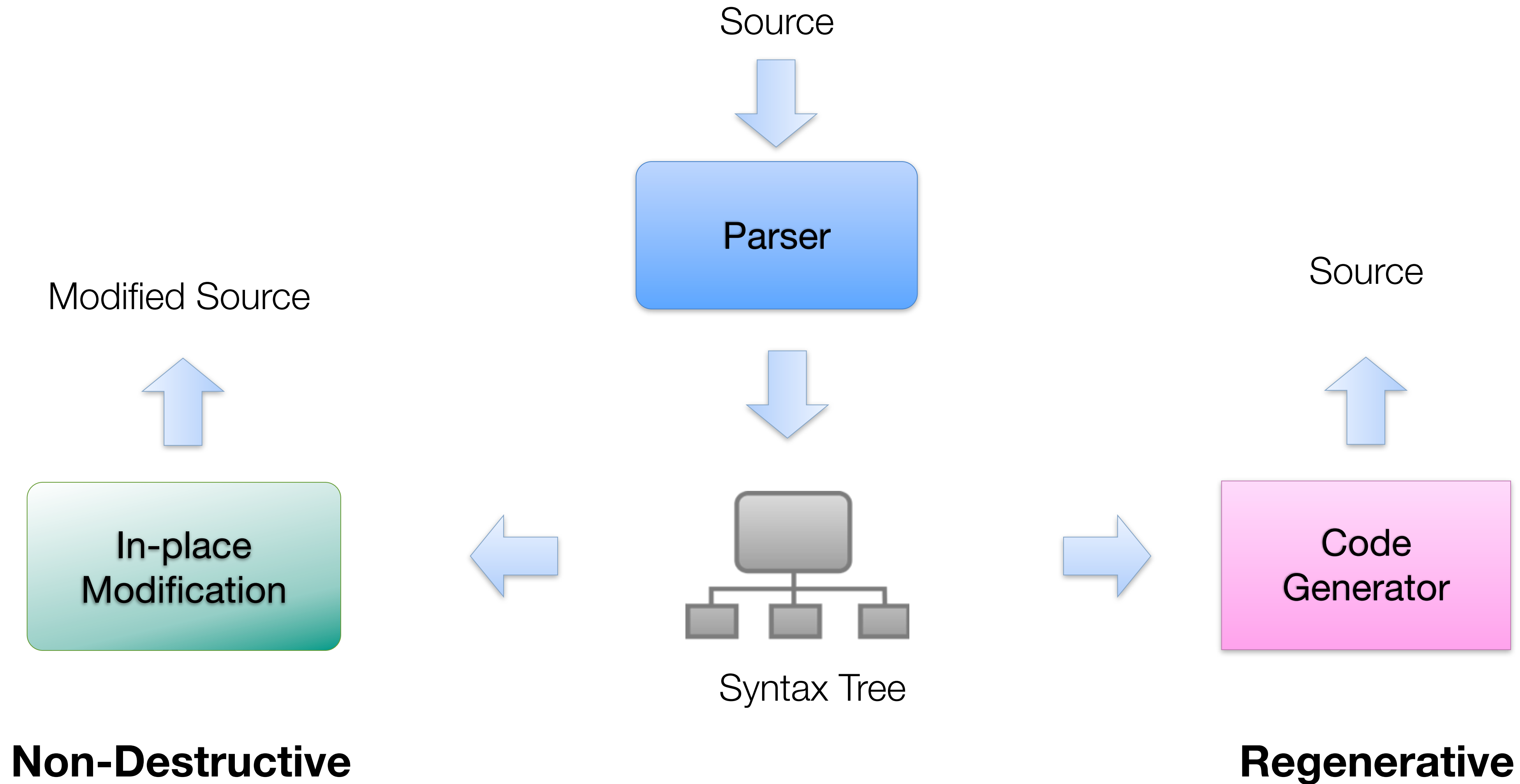
The more the merrier?

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

3. Source Transformation

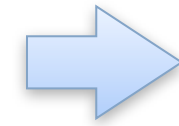


Non-Destructive vs Regenerative



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 }
```

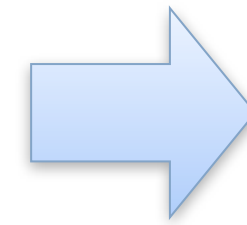
```
1 function isHexDigit(digit) {  
2   return '0123456789abcdefABCDEF'.indexOf(digit) >= 0;  
3 }
```

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

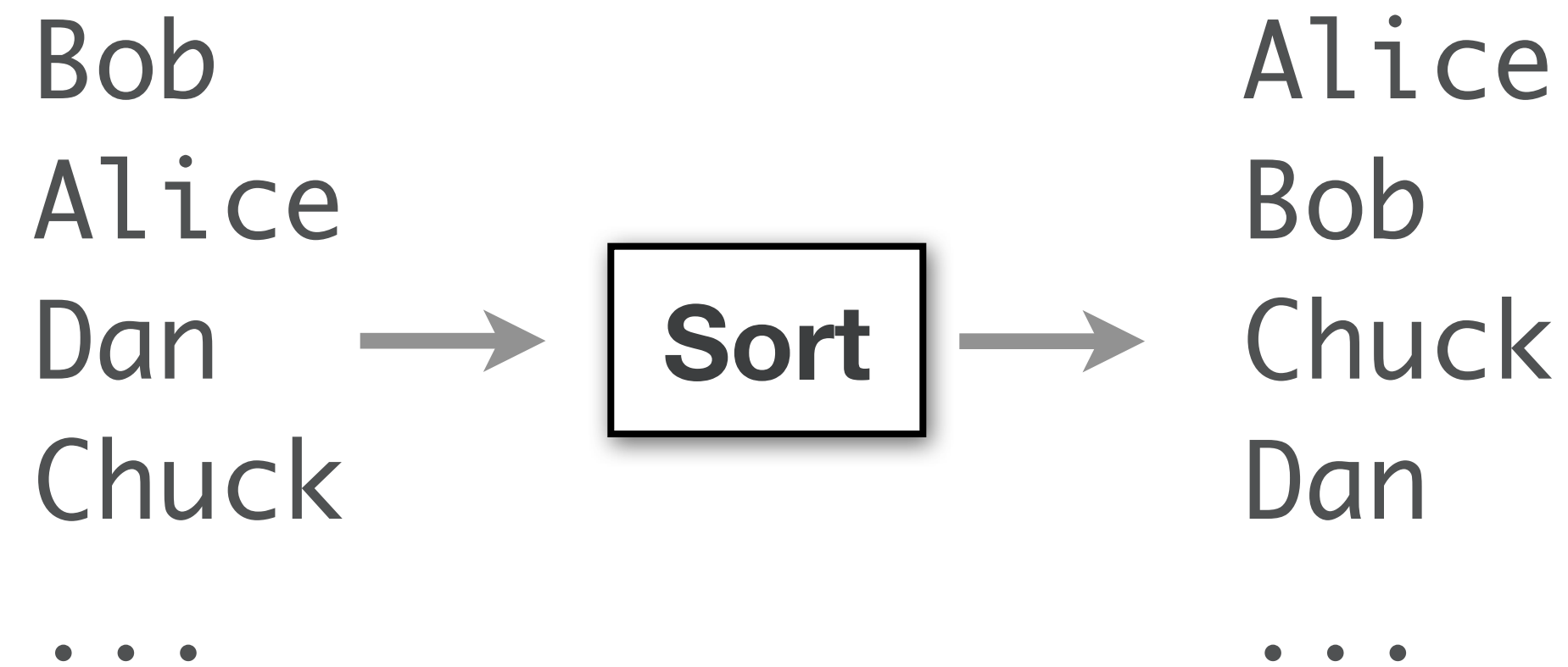
Tracing

Track all function calls and exits

Fast = Enough?



Address Book Application



How's the speed?

2 ms to sort 10 contacts

Bubble Sort ???



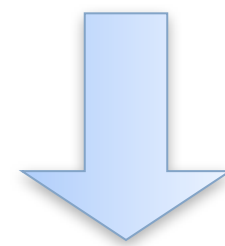
```
Array.prototype.swap = function (i, j) {  
    var k = this[i]; this[i] = this[j]; this[j] = k;  
}  
  
function sort(list) {  
    var items = list.slice(0), swapped = false, p, q;  
    for (p = 1; p < items.length; ++p) {  
        for (q = 0; q < items.length - p; ++q) {  
            if (items[q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

Run-time Complexity

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

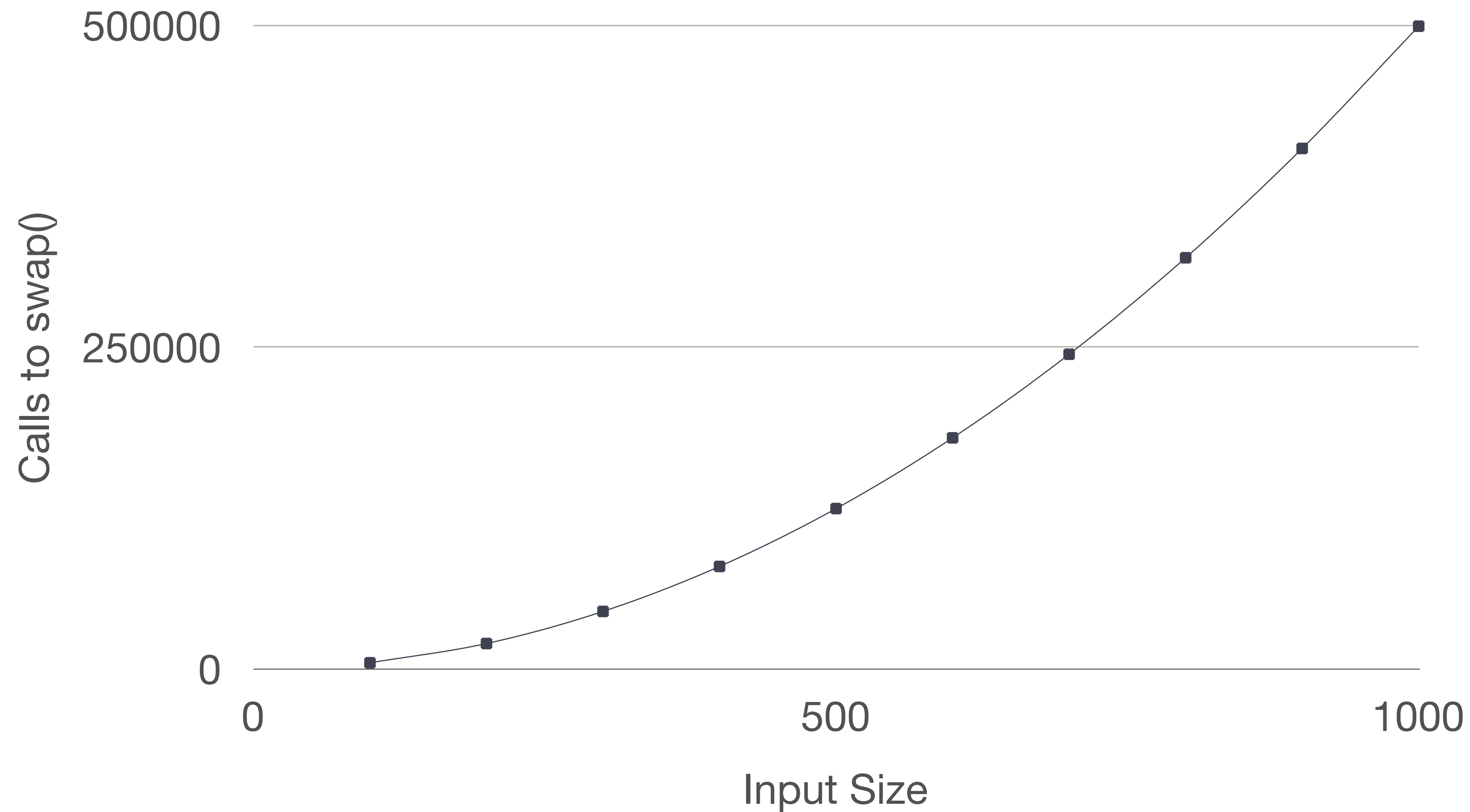
Try online!

```
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;  
}
```

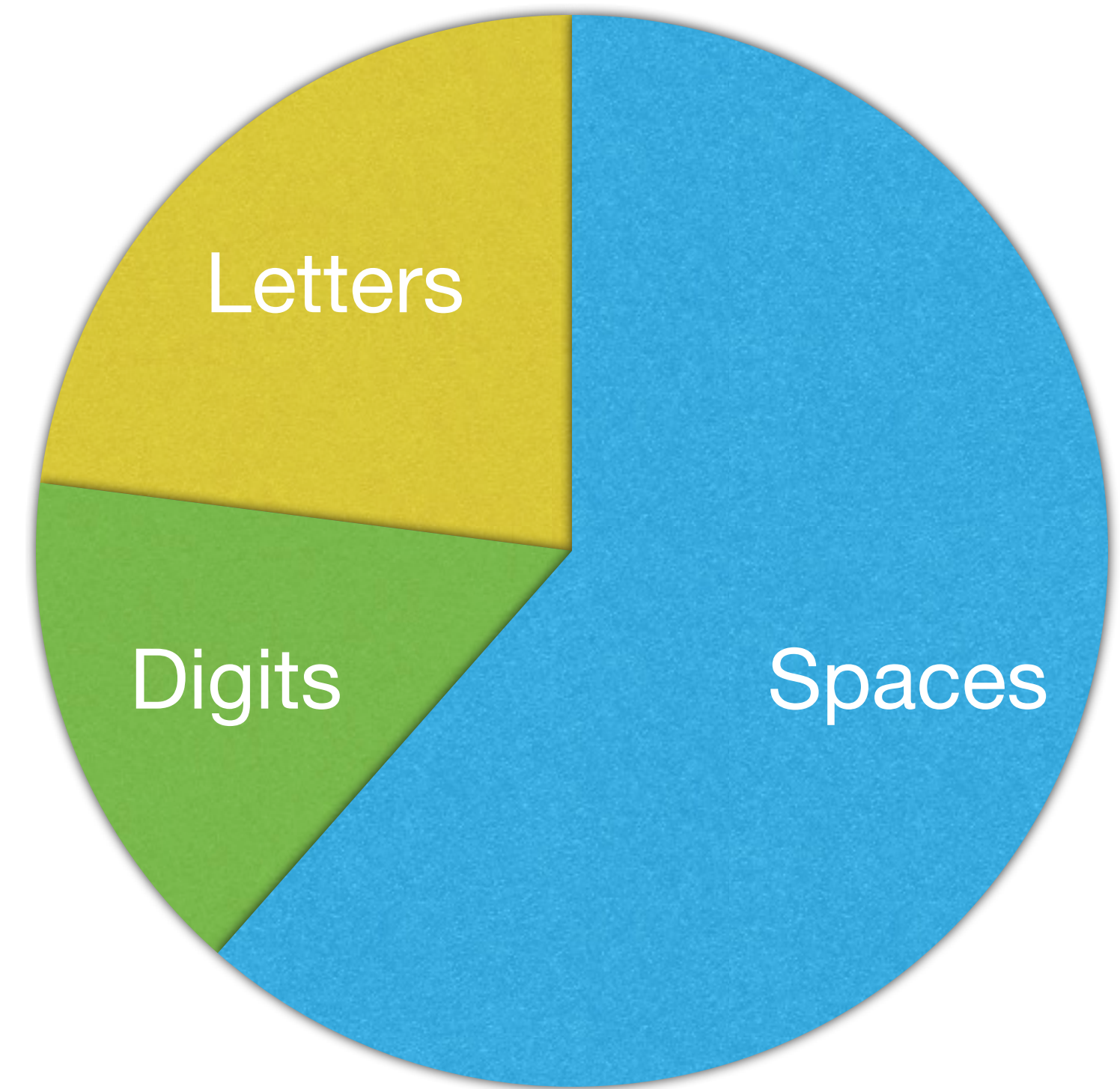
Run-time Analysis



Profile-Guided Optimization

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

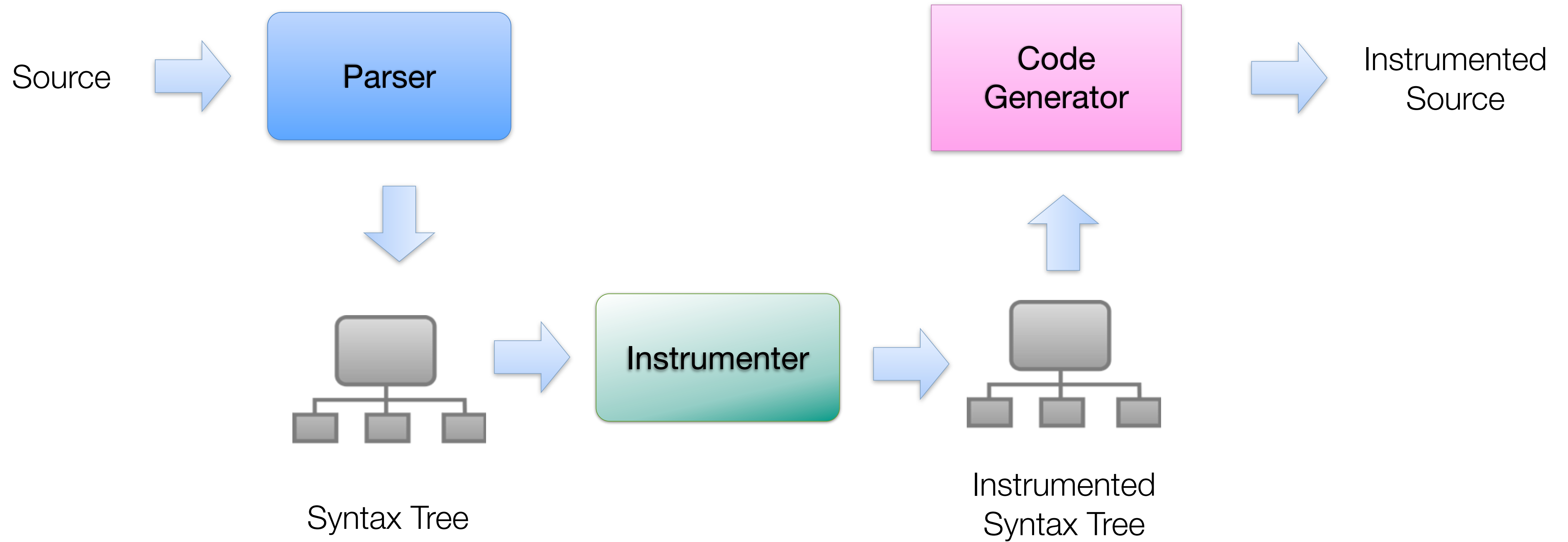
```
function isDigit(ch) {  
    return ch !== ' ' &&  
           '0123456789'.indexOf(ch) >= 0;  
}
```



5. Code Coverage



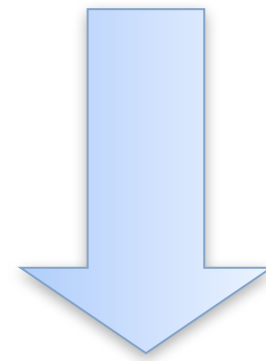
Code Instrumentation



Istanbul Coverage Tool

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

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



```
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);
```

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

Branch Coverage

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

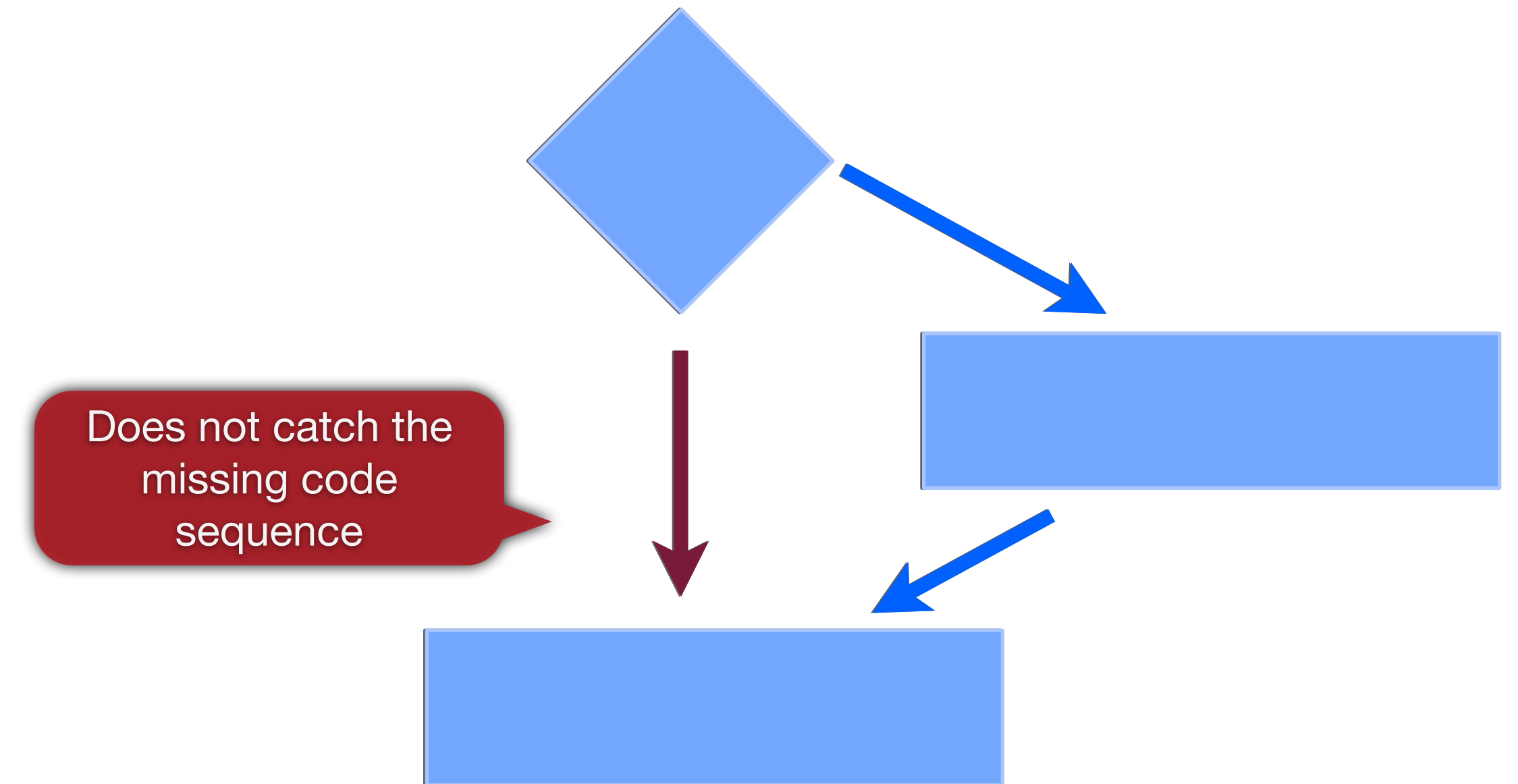
```
1 1 function inc(p, q) {  
2 1   E if (q == undefined) q = 1;  
3 1   return p + q/q;  
   }
```

E = Else is not taken

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

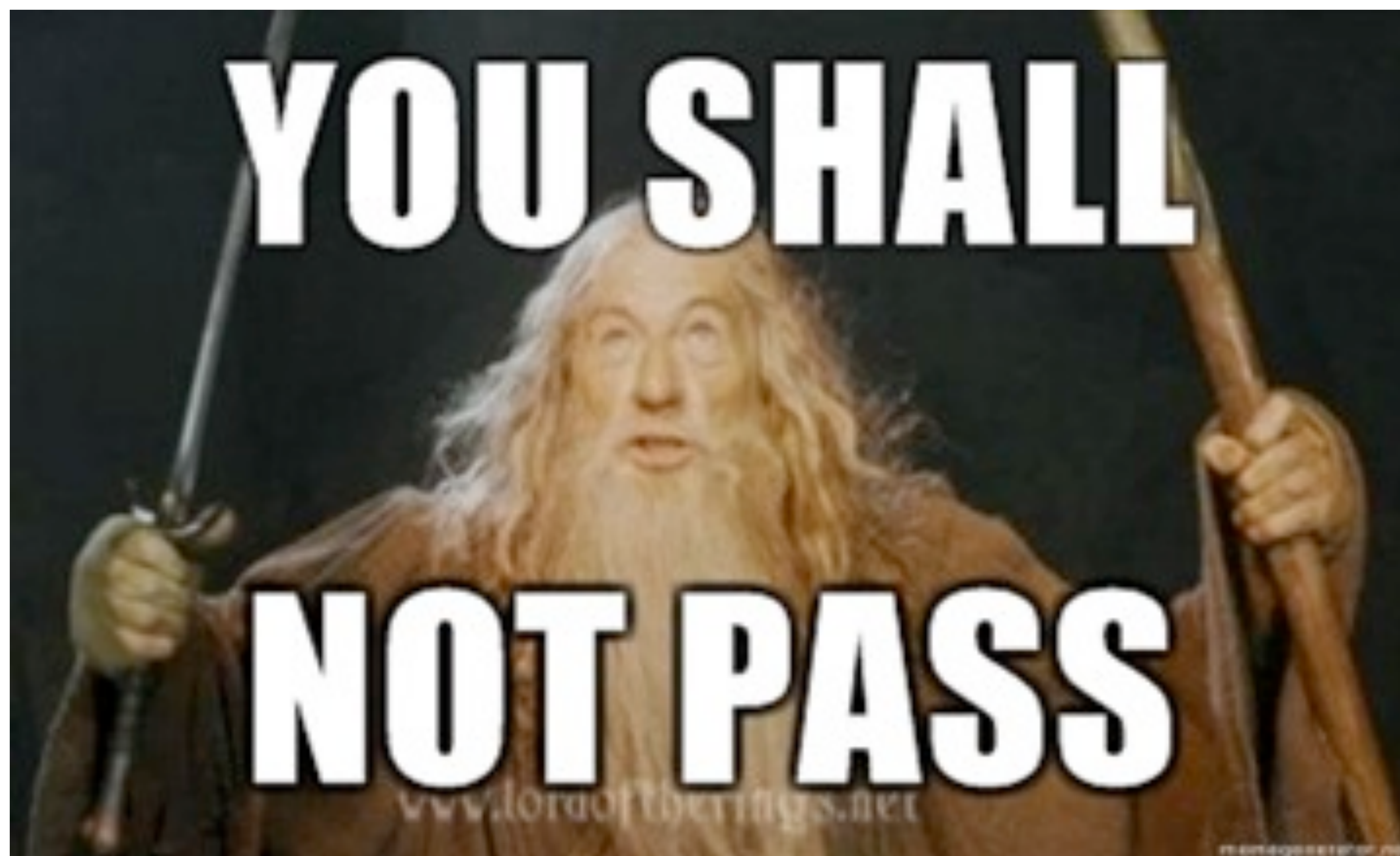
```
istanbul check-coverage --statement -5 --branch -3 --function 100
```

```
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)
```

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

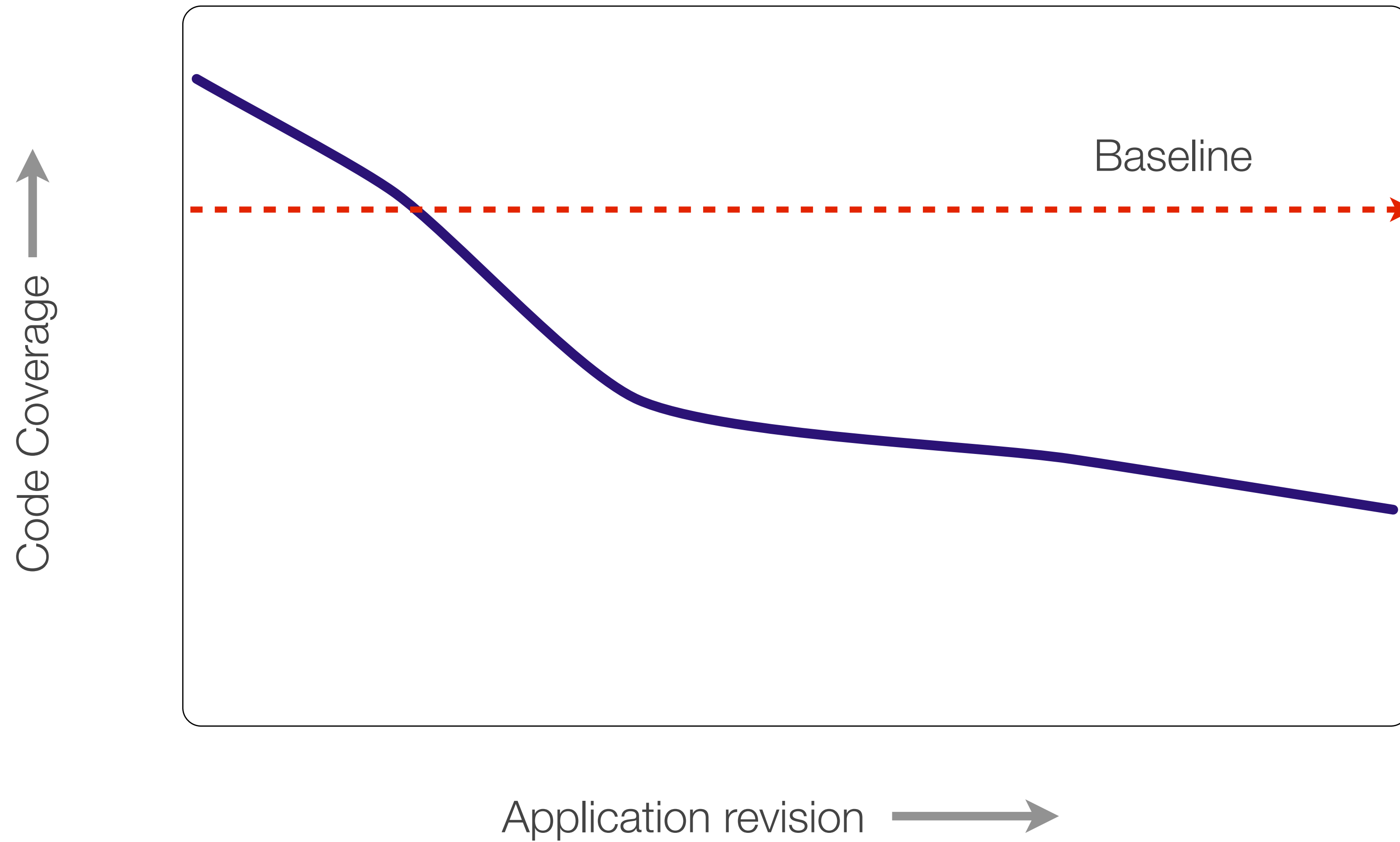
Cyclomatic Complexity

Execution Tracing

Custom Linting

Code Coverage

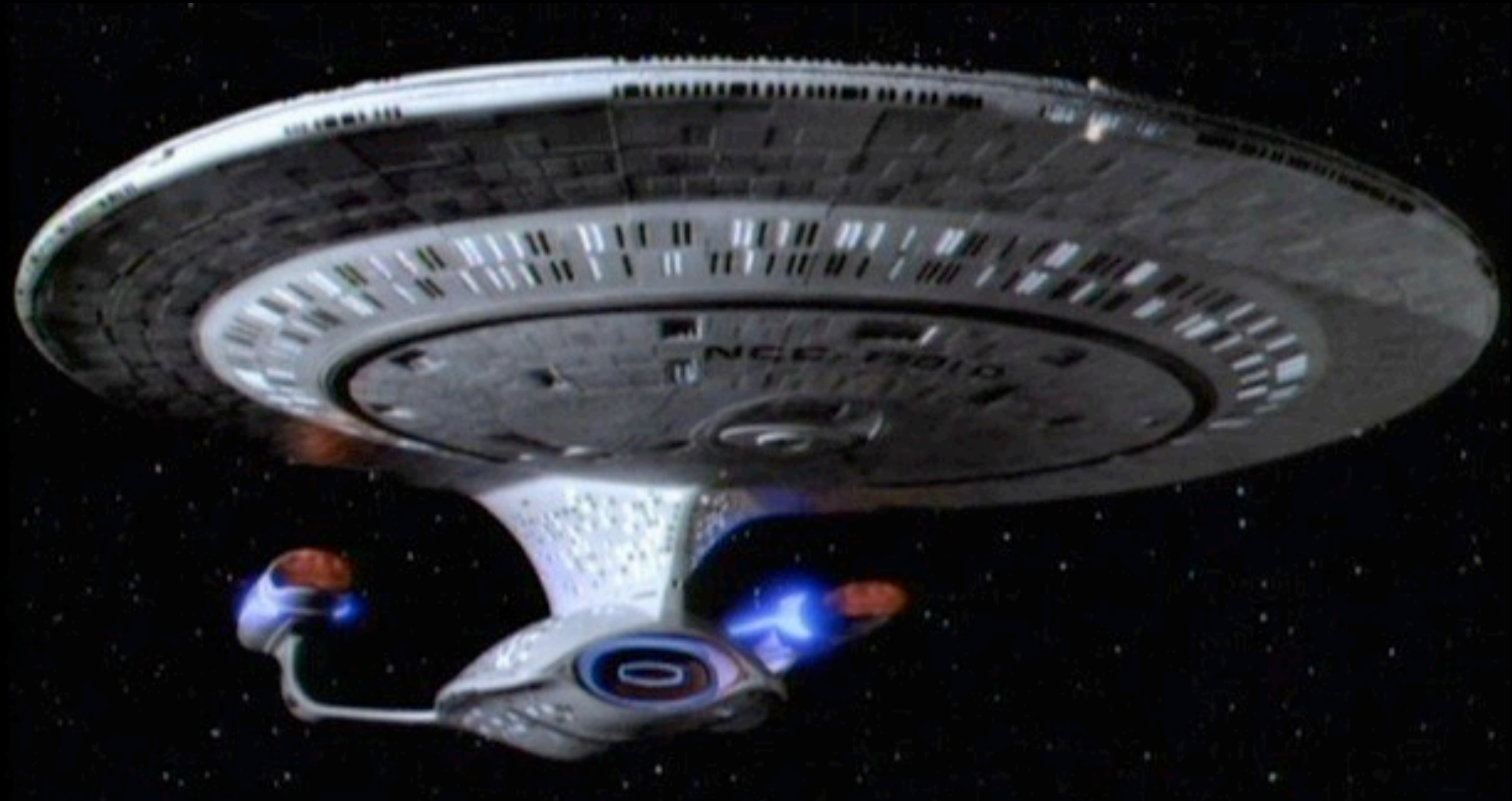
Two-Dimensional Metrics



Build **composable** tools

Automate any tedious parts of code review

Incorporate **code quality metrics** to the dashboards

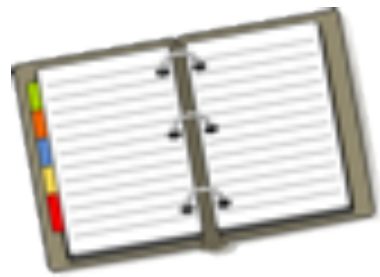


Her five-year mission: to explore strange new worlds, to seek out new lifeforms and new civilizations;
to analyze code where no one has analyzed before.

Thank You



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ariya.ofilabs.com/highlights



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speakerdeck.com/ariya

