From 0 to 100
Working Principles of JavaScript Engines

Oğuz Kılıç | oguzz.kilic@gmail.com

Oğuz KILIÇ

Frontend Developer

https://twitter.com/0guzKilic
https://www.linkedin.com/in/oguzzkilic
oguzz.kilic@gmail.com

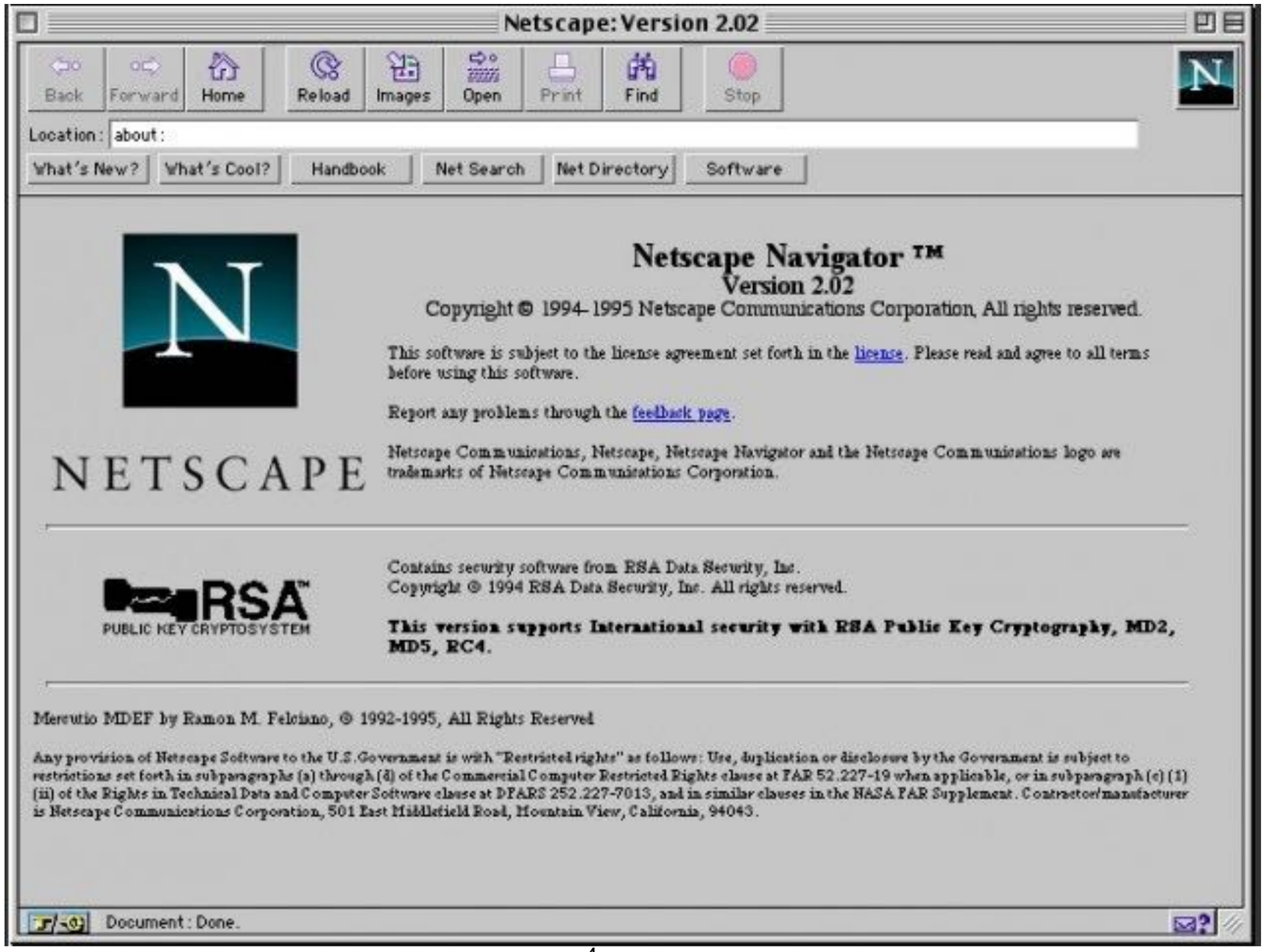
A brief history of JavaScript

Brendan Eich

Creator of JavaScript Language

Mocha

1995

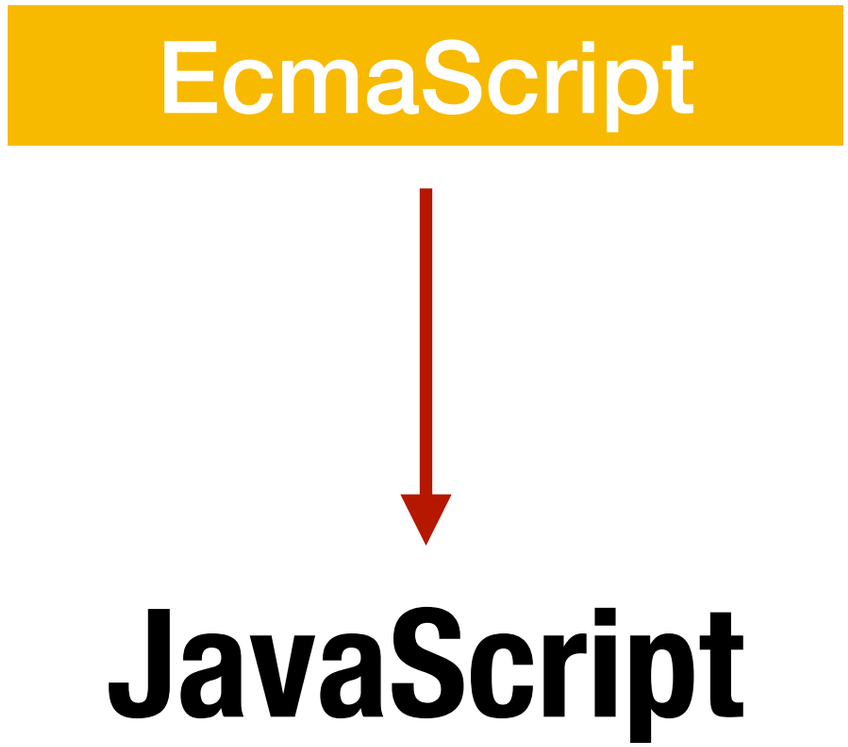

Netscape: Version 2.02
Back
Forward
Home
Reload
Images
Open
Print
Find
Stop
Location : about :
What's New?
What's Cool?
Handbook
Net Search
Net Directory
Software
Netscape Navigator ™
Version 2.02
Copyright © 1994-1995 Netscape Communications Corporation, All rights reserved.
This software is subject to the license agreement set forth in the license. Please read and agree to all terms before using this software.
Report any problems through the feedback page.
Netscape Communications, Netscape, Netscape Navigator and the Netscape Communications logo are trademarks of Netscape Communications Corporation.
NETSCAPE
RSA
PUBLIC KEY CRYPTOSYSTEM
Contains security software from RSA Data Security, Inc.
Copyright © 1994 RSA Data Security, Inc. All rights reserved.
This version supports International security with RSA Public Key Cryptography, MD2, MD5, RC4.
Mercutio MDEF by Ramon M. Felciano, © 1992-1995, All Rights Reserved
Any provision of Netscape Software to the U.S. Government is with "Restricted rights" as follows: Use, duplication or disclosure by the Government is subject to restrictions set forth in subparagraphs (a) through (d) of the Commercial Computer Restricted Rights clause at FAR 52.227-19 when applicable, or in subparagraph (c) (1) (ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.227-7013, and in similar clauses in the NASA FAR Supplement. Contractor/manufacturer is Netscape Communications Corporation, 501 East Middlefield Road, Mountain View, California, 94043.
Document : Done.

LiveScript

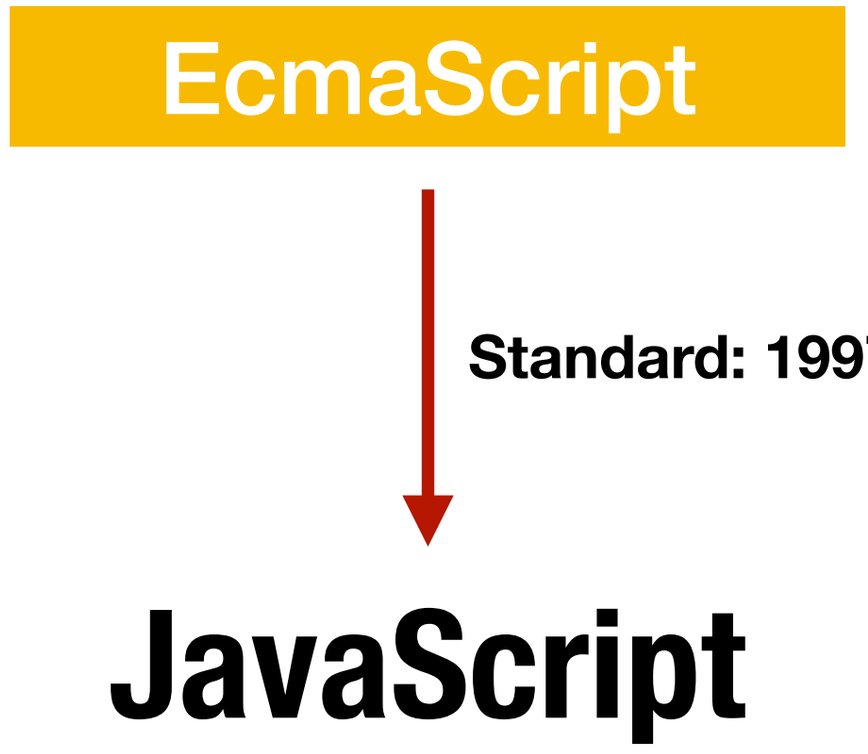
A brief history of JavaScript

EcmaScript

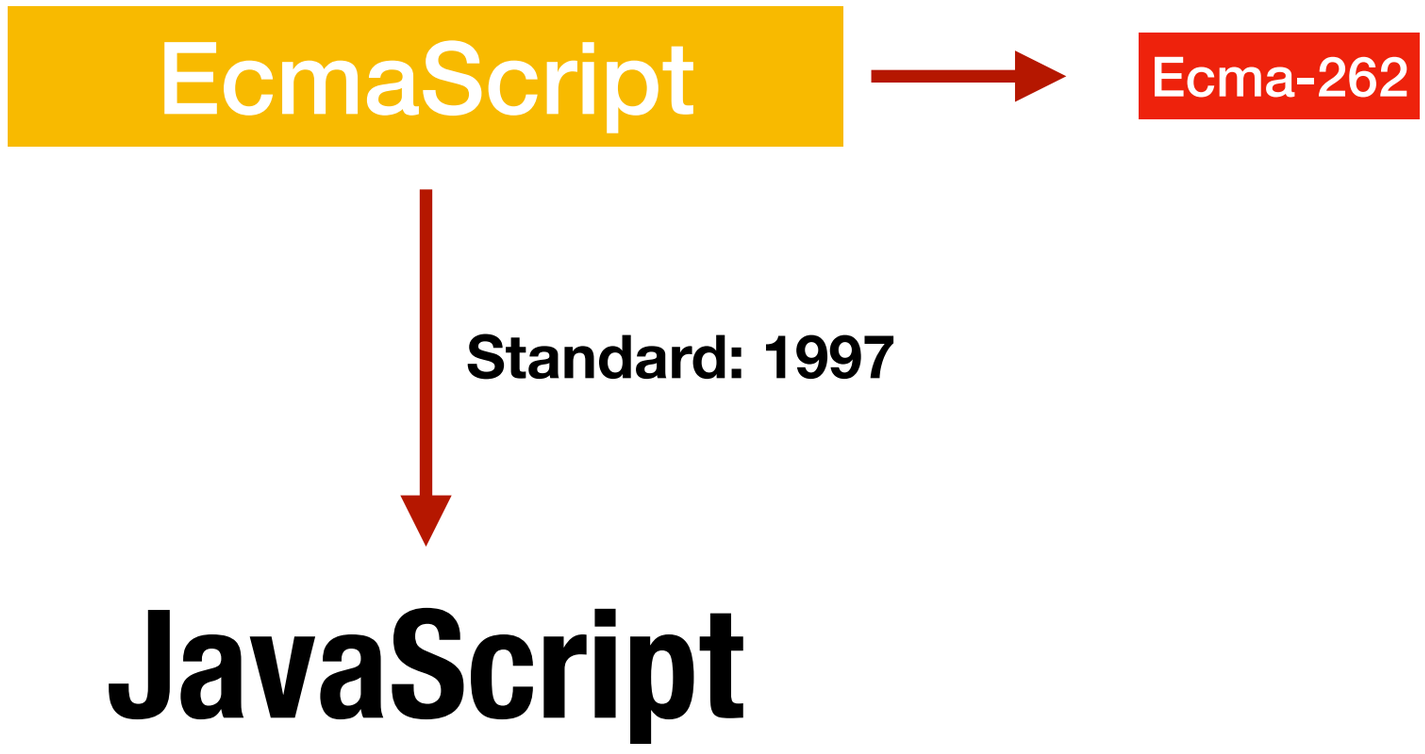
A brief history of JavaScript



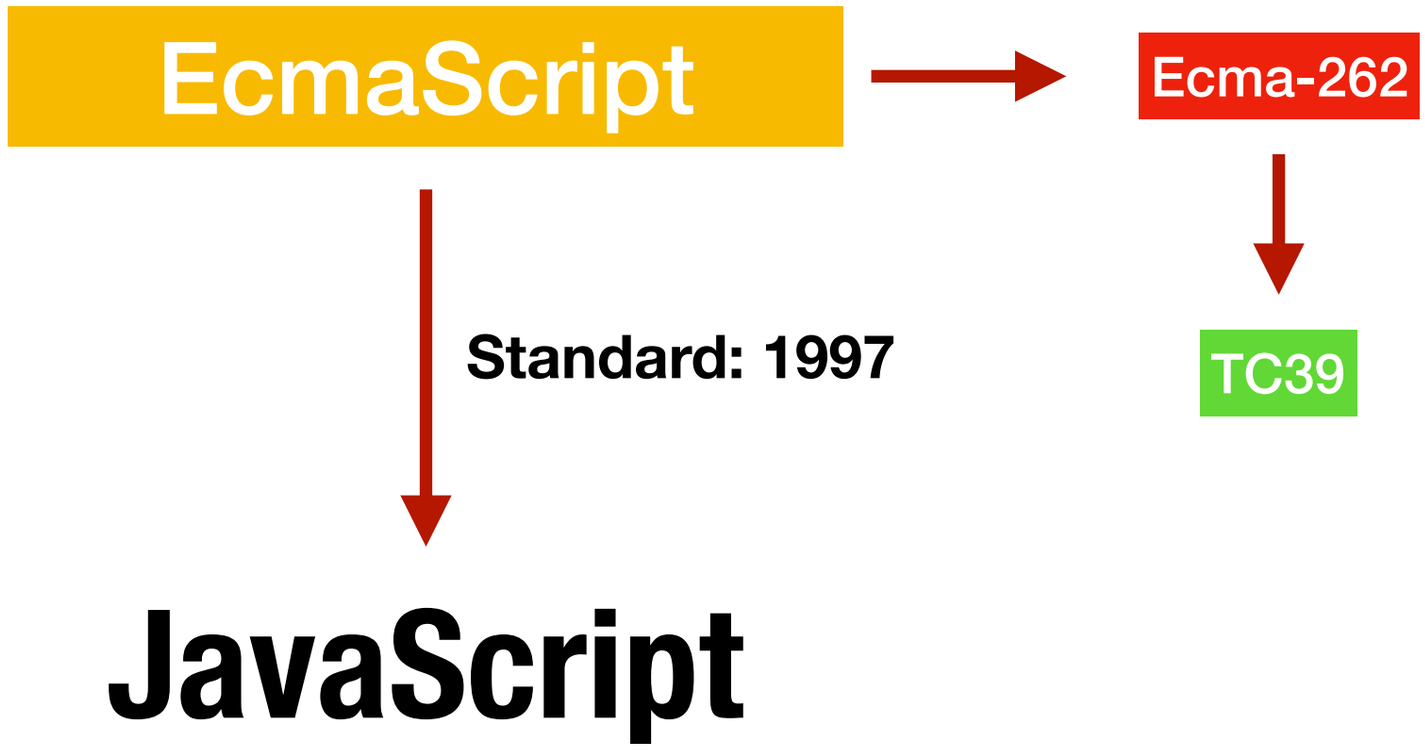
A brief history of JavaScript



A brief history of JavaScript

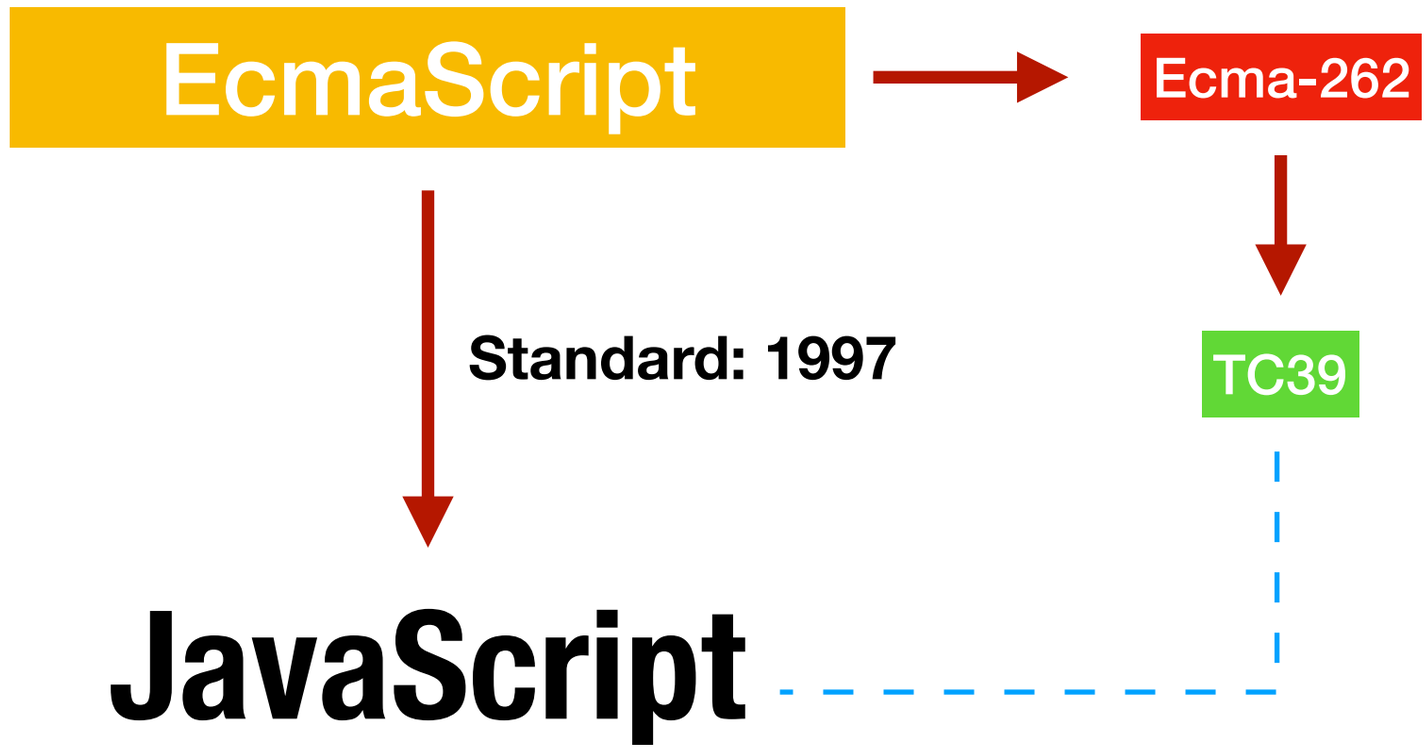


A brief history of JavaScript



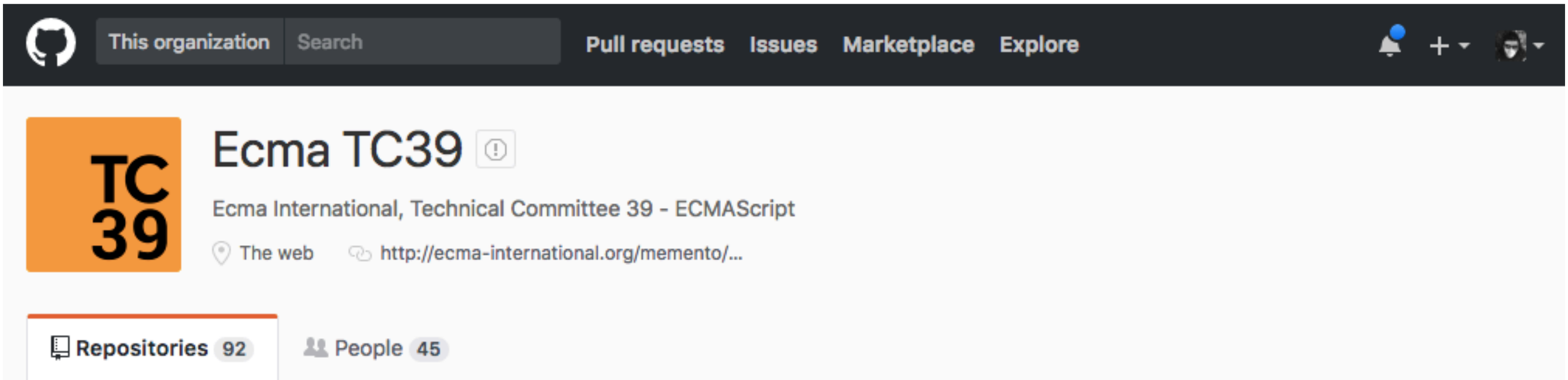
A brief history of JavaScript

http://ecma-international.org/memento/TCs&TGs.htm



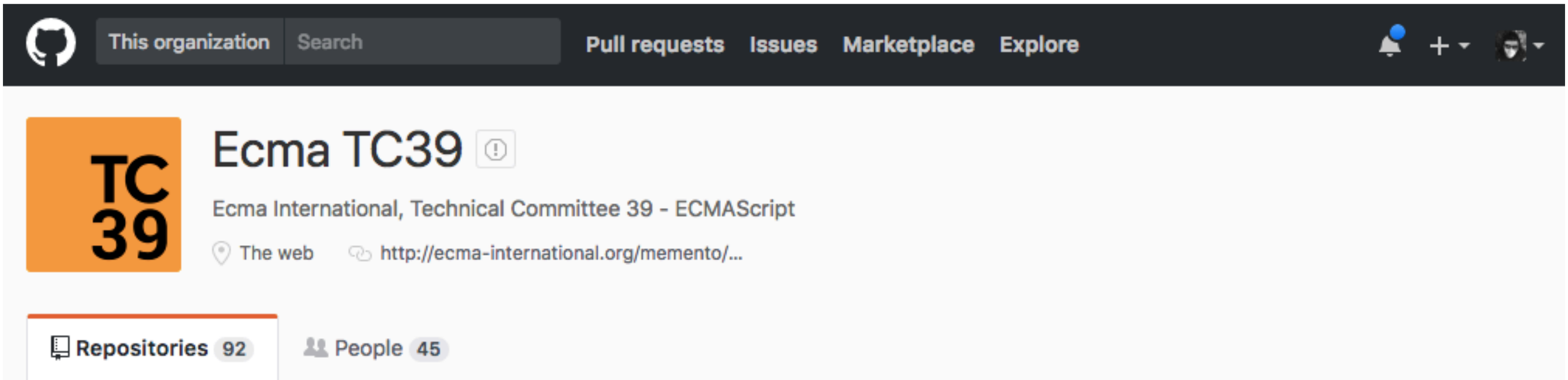
A brief history of JavaScript

https://github.com/tc39



A brief history of JavaScript

https://github.com/tc39



Host Environment

BROWSER

Host Environment
Browser

Goal

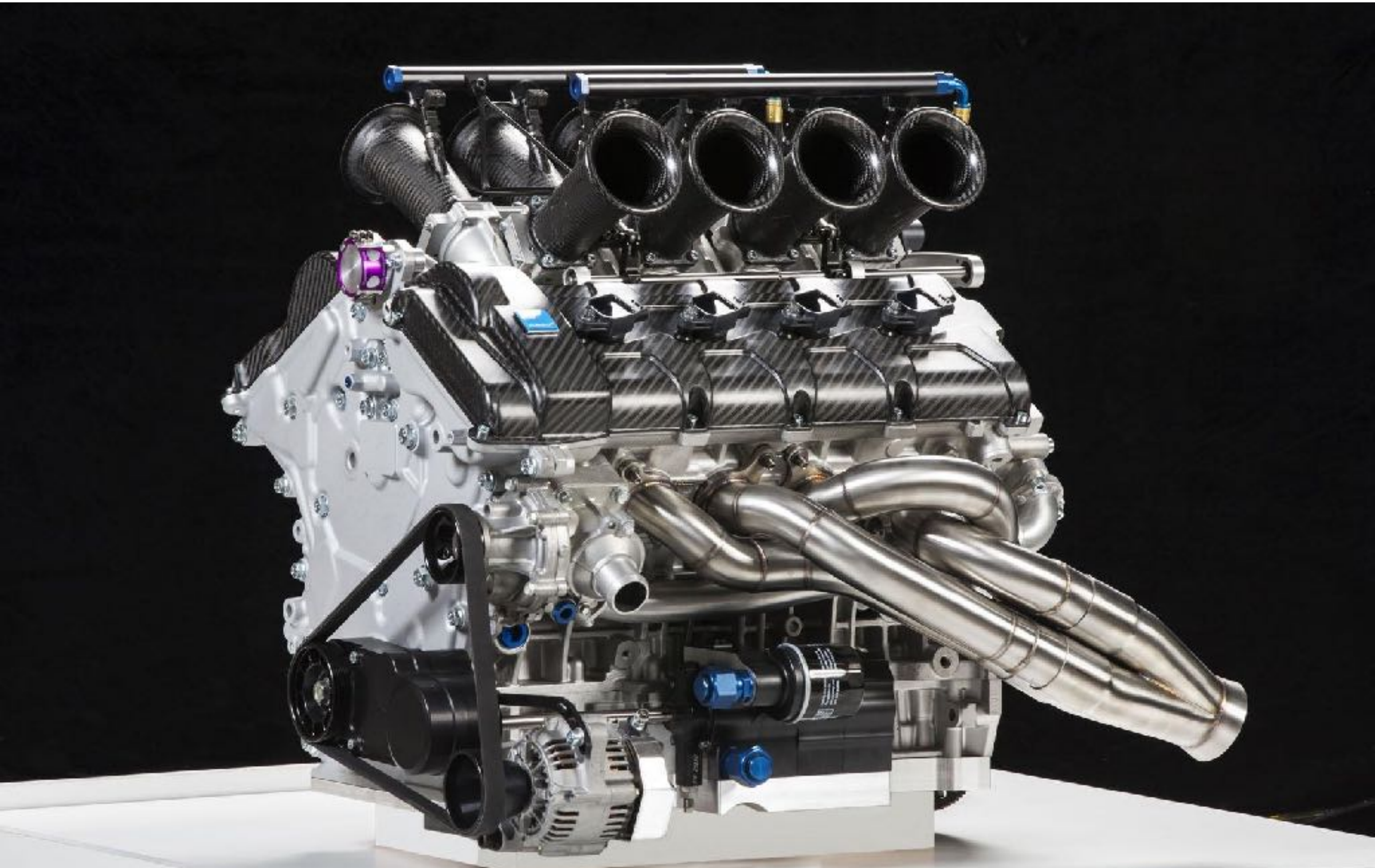
you want to tell the computer what to do

Problem

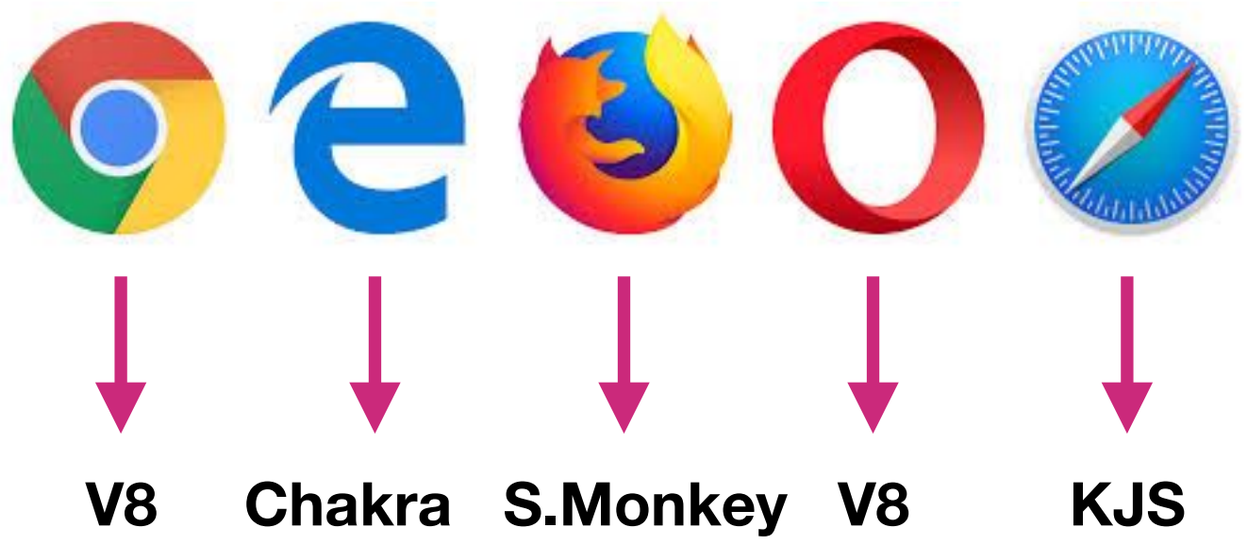
you and the computer speak different languages

Host Environment
Engine

Host Environment
Engine



Host Environment
Engines



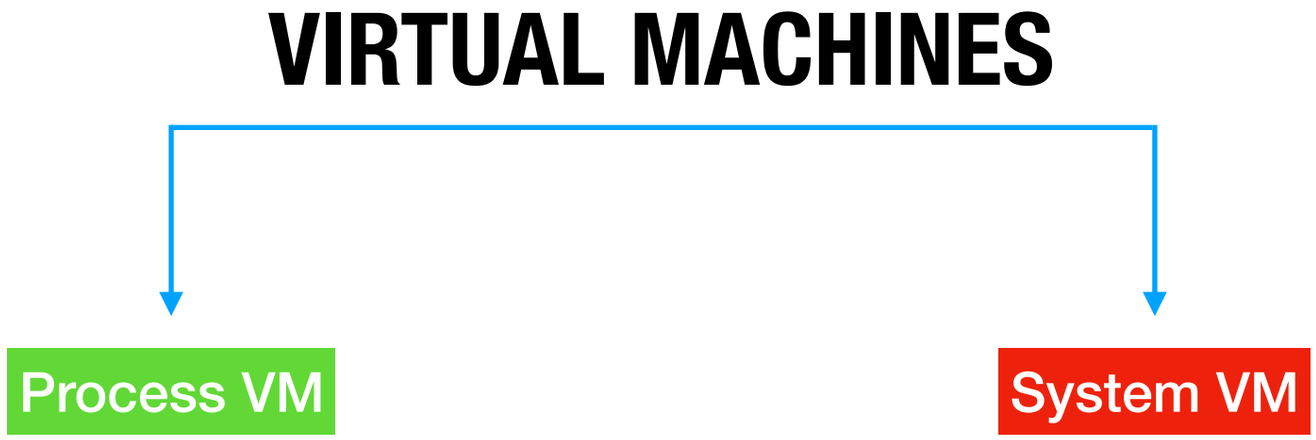
JavaScript Engines

Type

VIRTUAL MACHINES

JavaScript Engines

Type

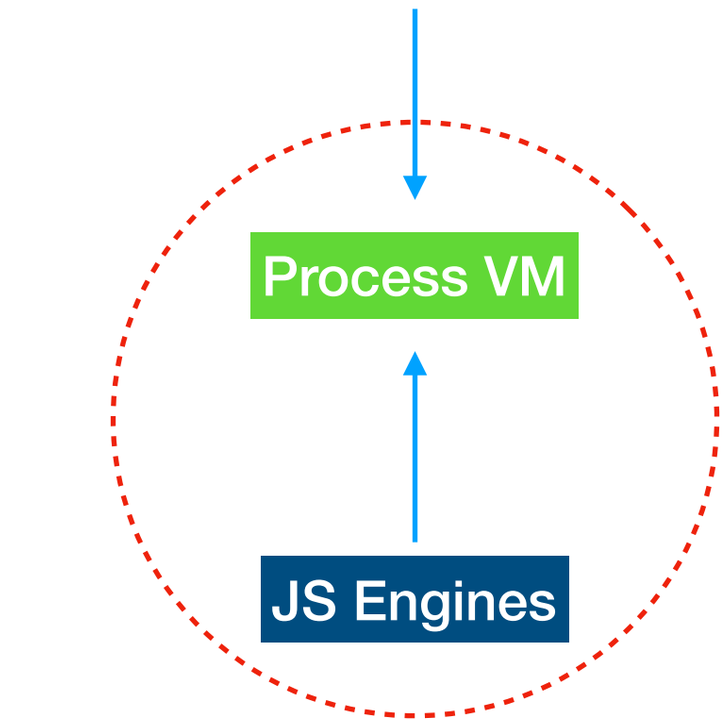


JavaScript Engines

Type

VIRTUAL MACHINES

Process VM


VIRTUAL MACHINES
Process VM
JS Engines

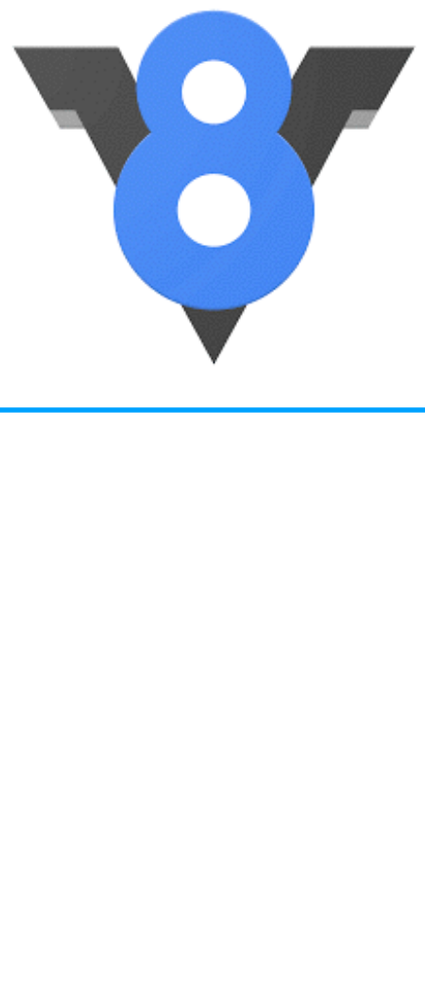
JavaScript Engines
Chrome V8 Engine

Launch with Chrome in 2008

JavaScript Engines
Chrome V8 Engine

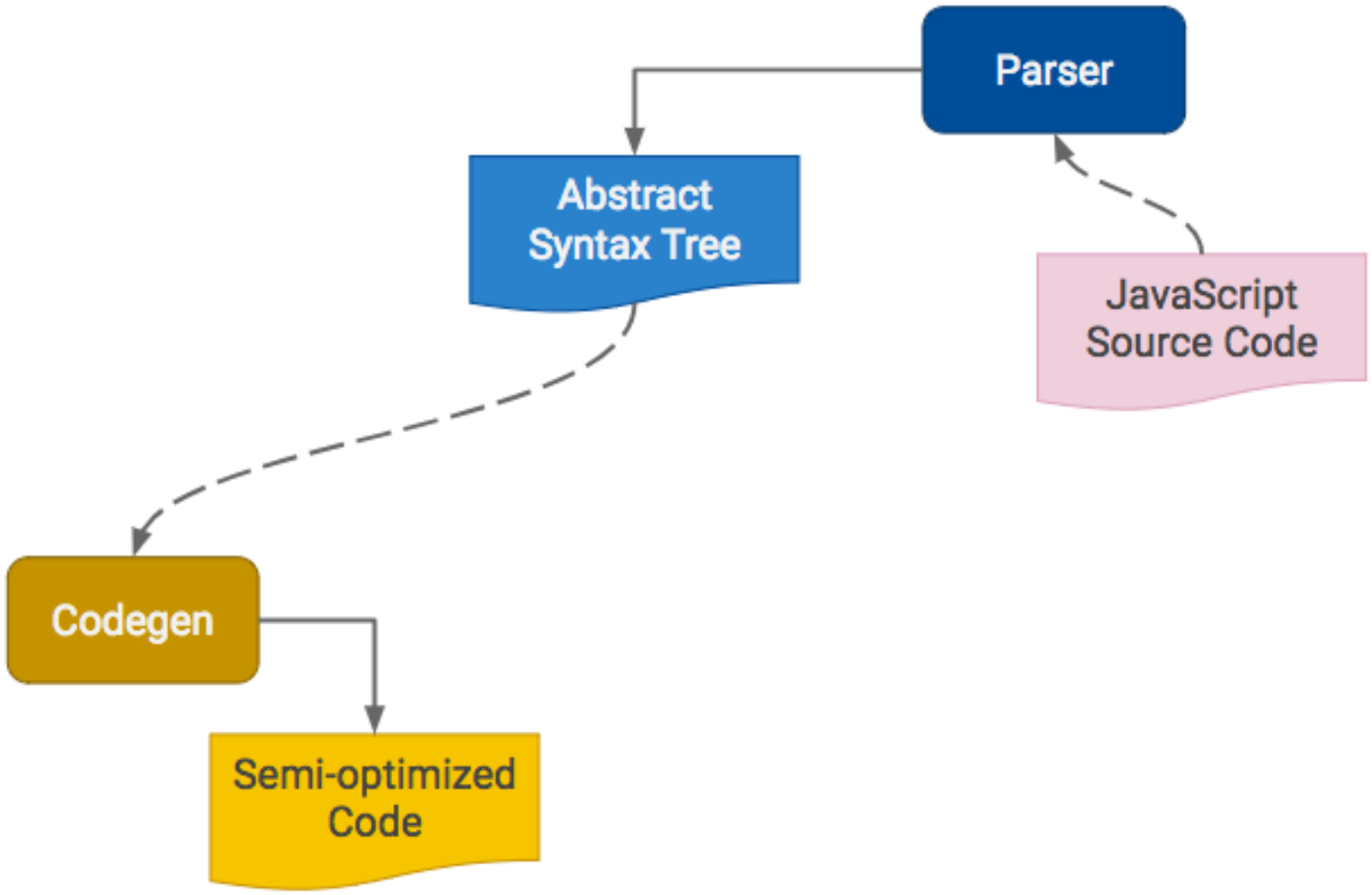
C++

JavaScript Engines
Chrome V8 Engine



V8 Compiler Pipeline
First Pipeline

2008

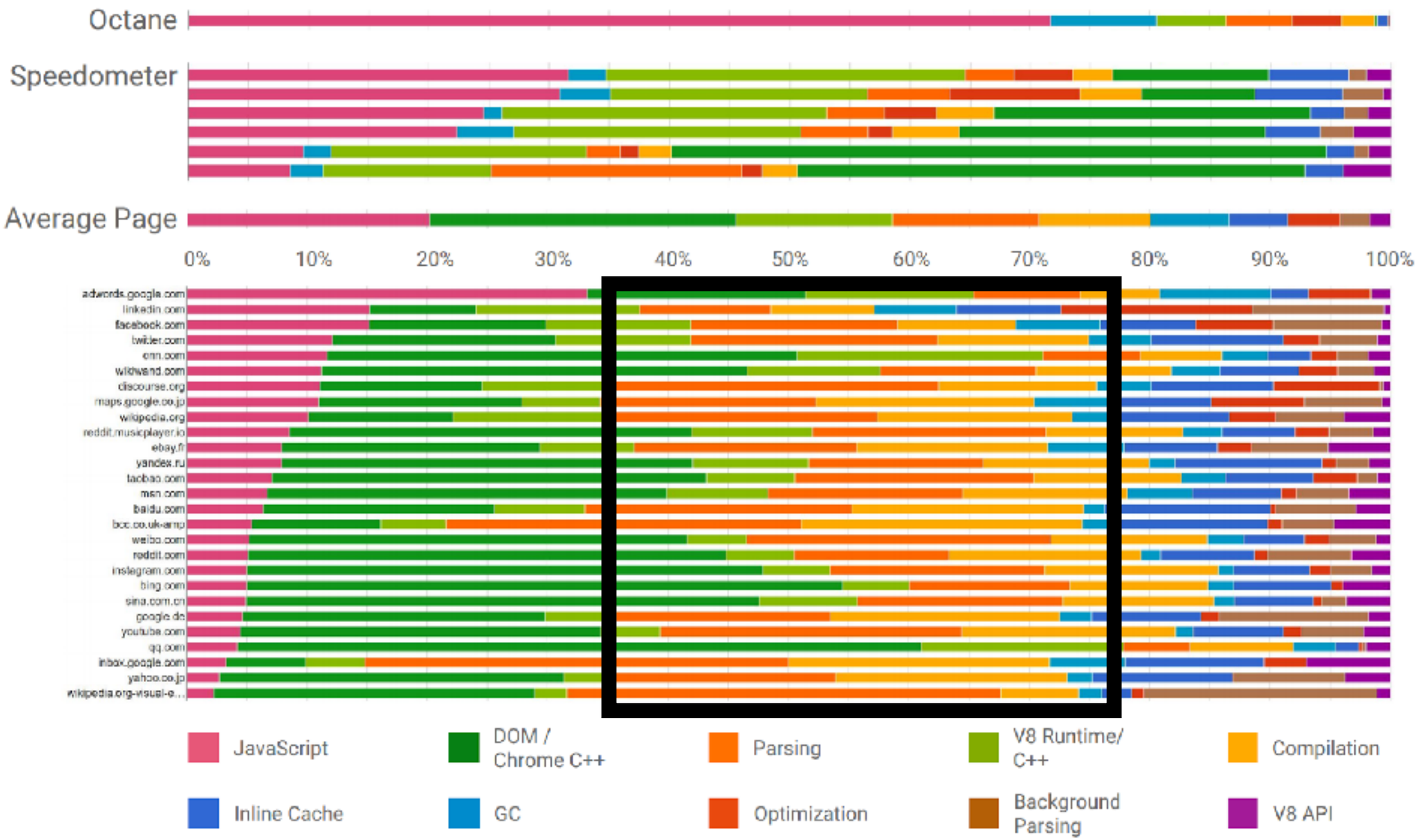


V8 Compiler Pipeline

Parser

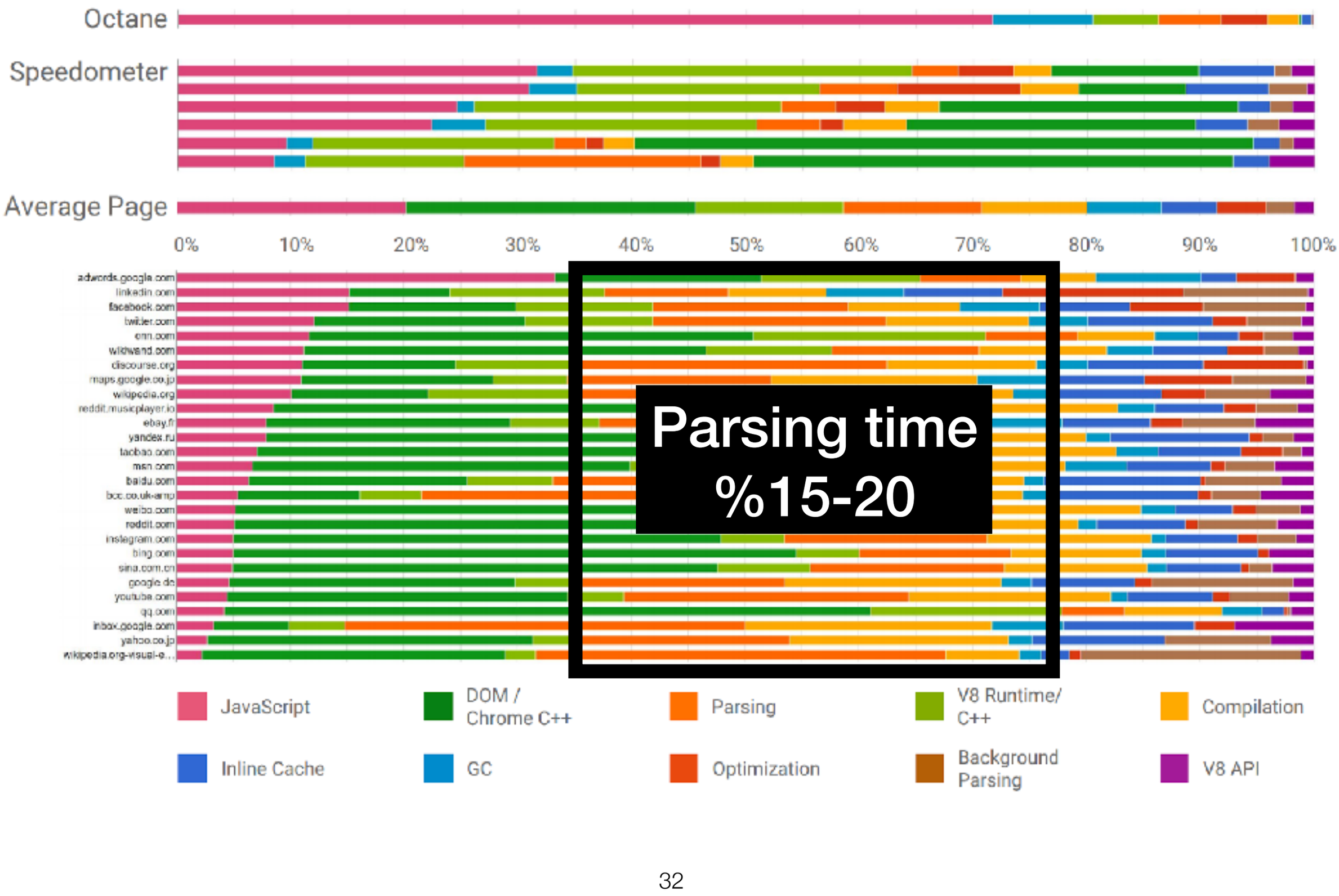
V8 Compiler Pipeline

Parser



V8 Compiler Pipeline

Parser

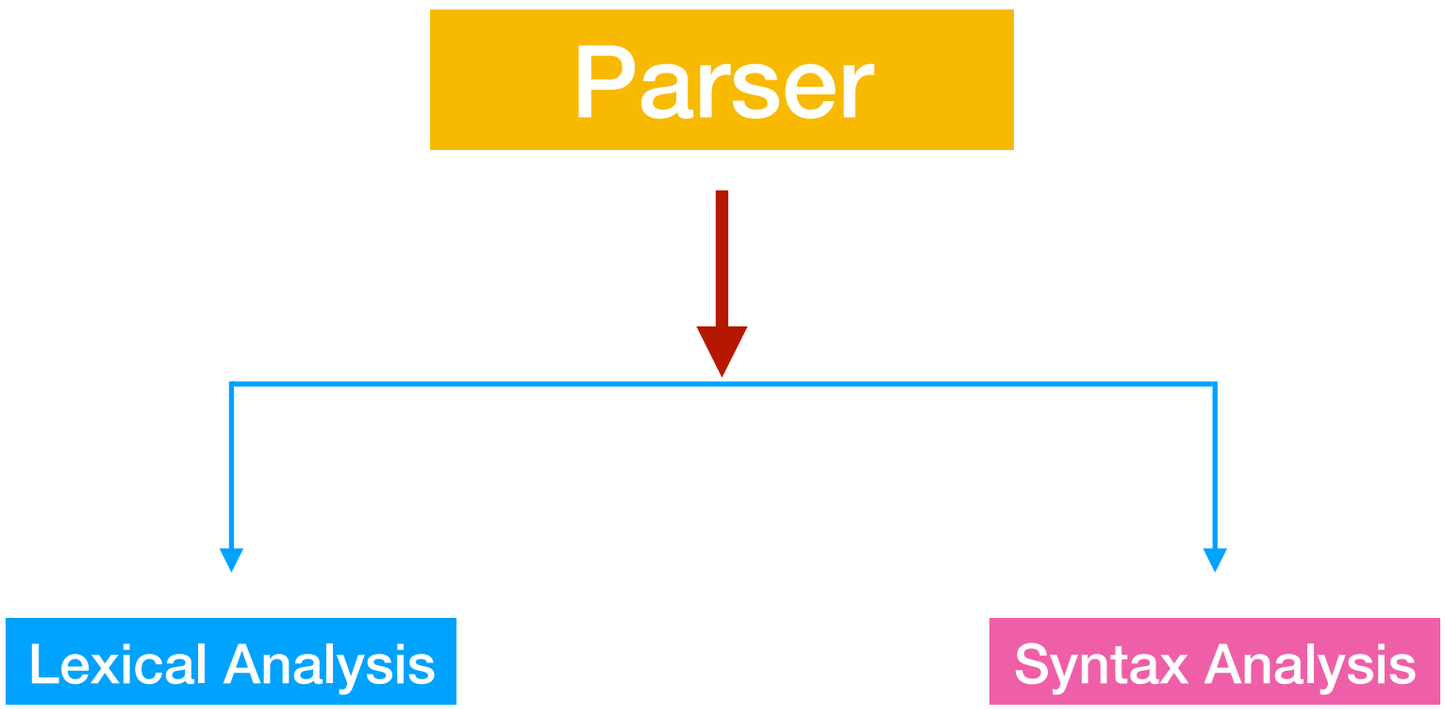


V8 Compiler Pipeline

Parser

V8 Compiler Pipeline

Parser



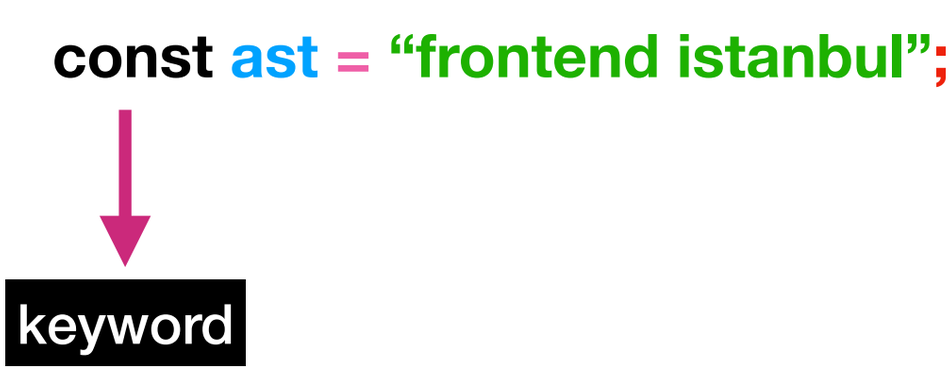
V8 Compiler Pipeline

Parser

```
const ast = “frontend istanbul”;
```

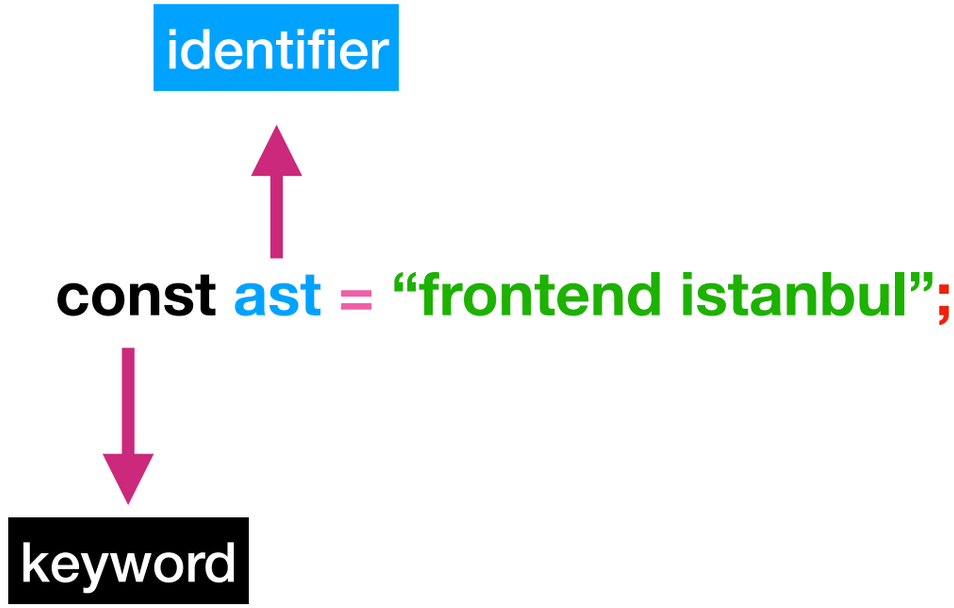
V8 Compiler Pipeline

Parser



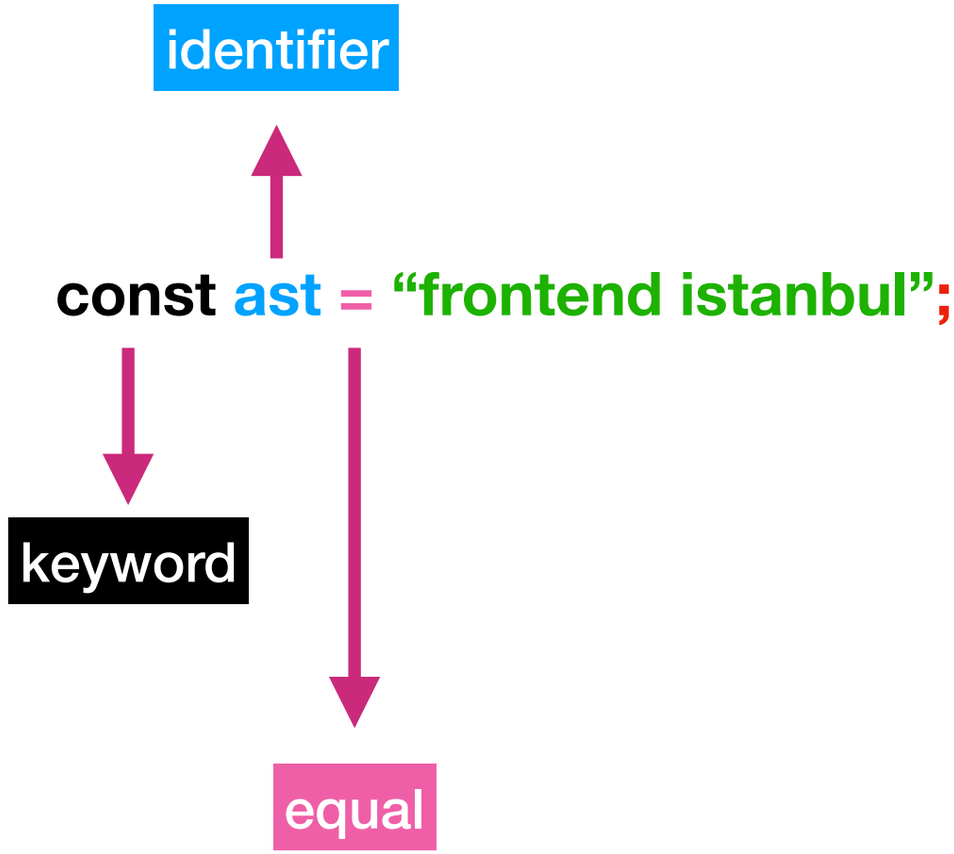
V8 Compiler Pipeline

Parser



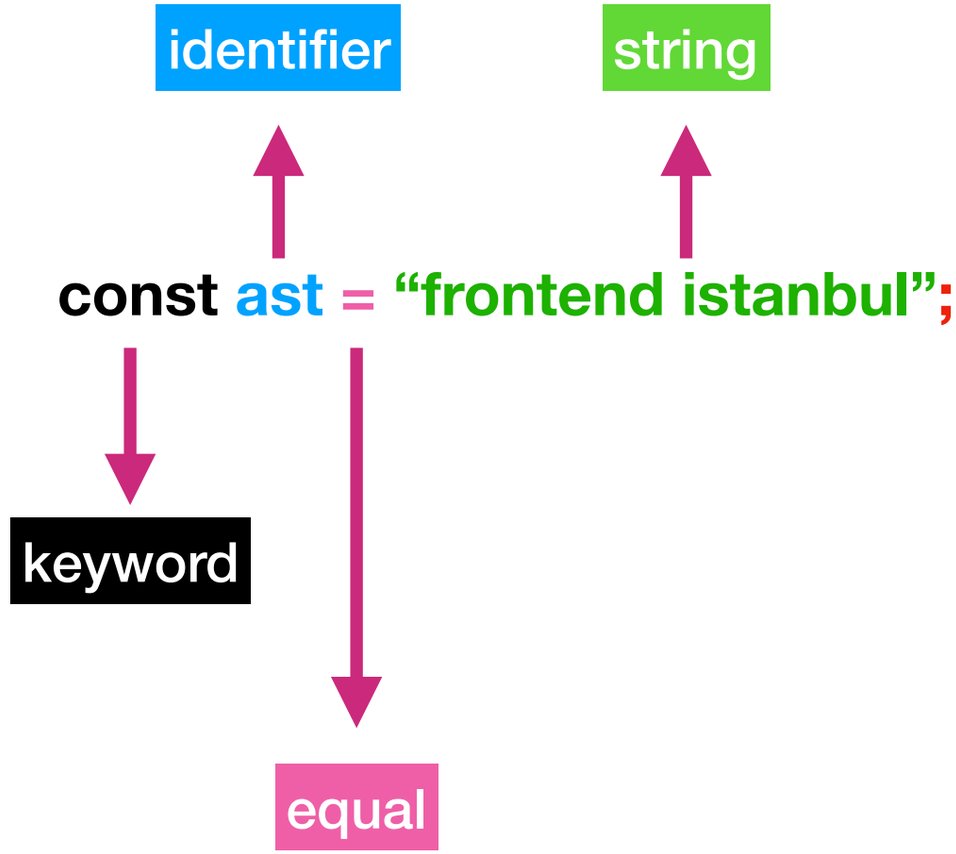
V8 Compiler Pipeline

Parser



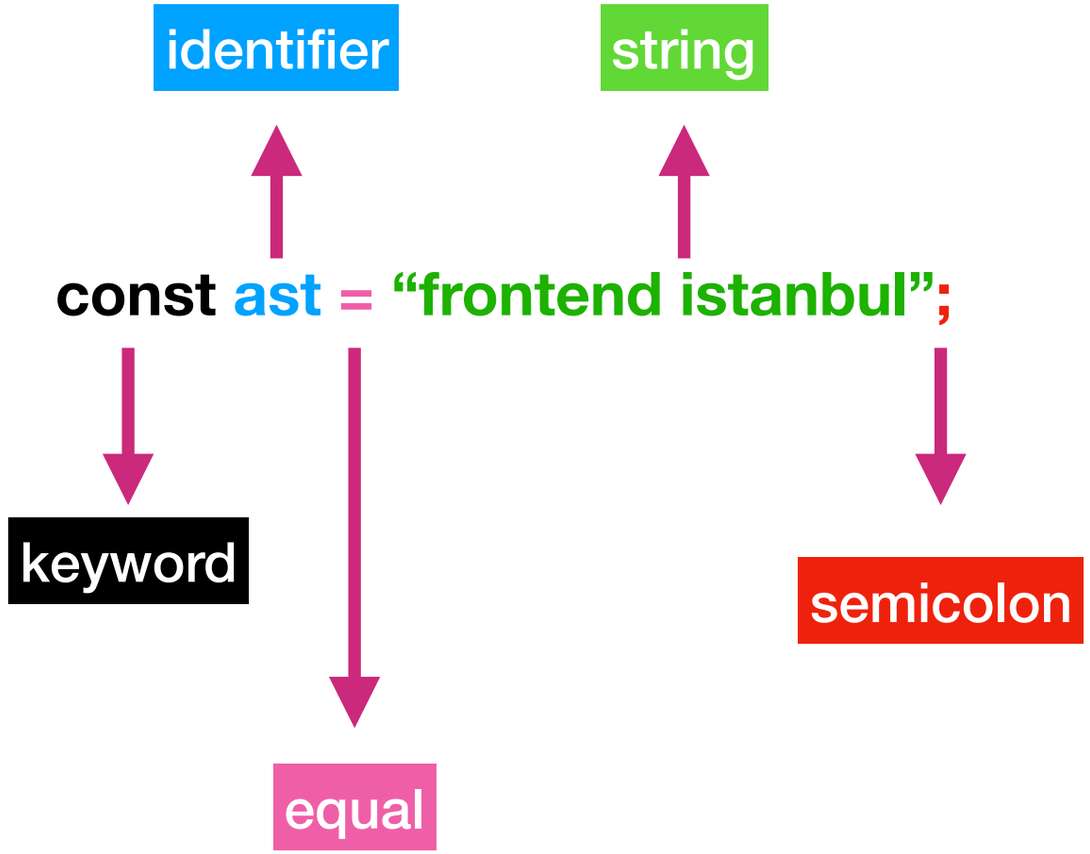
V8 Compiler Pipeline

Parser



V8 Compiler Pipeline

Parser



V8 Compiler Pipeline

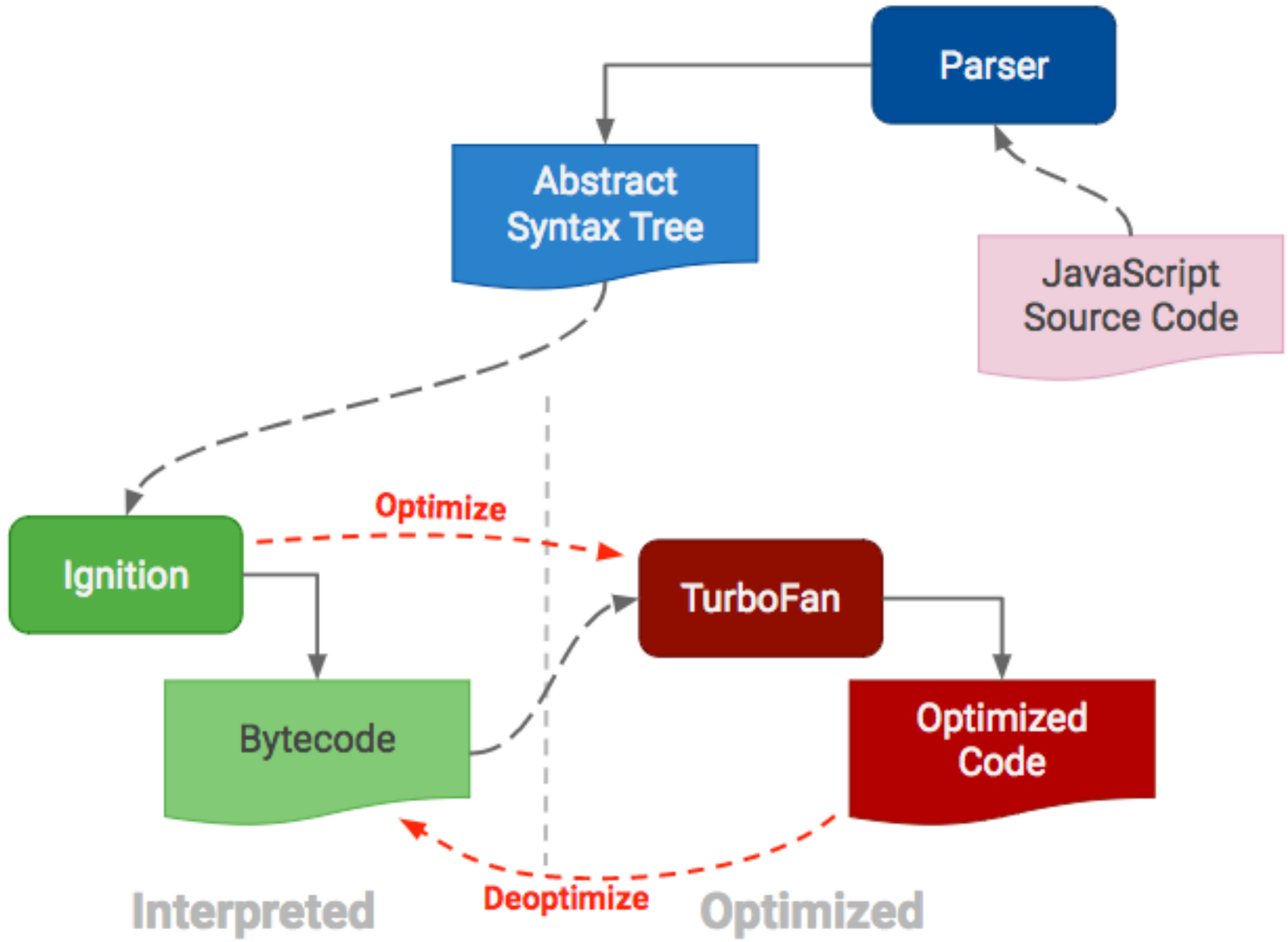
AST - Abstract Syntax Tree

const ast = “frontend istanbul”;


```
{
  "type": "Program",
  "body": [
    {
      "type": "VariableDeclaration",
      "kind": "const",
      "declerations": [
        {
          "type": "VariableDeclaratior",
          "id": {
            "type": "Identifier",
            "name": "ast"
          },
          "init": {
            "type": "Literal",
            "value": "frontend istanbul",
            "raw": "\"frontend istanbul\""
          }
        }
      ]
    }
  ]
}
```

V8 Compiler Pipeline
Last Pipeline

2017



V8 Compiler Pipeline

Interpreter

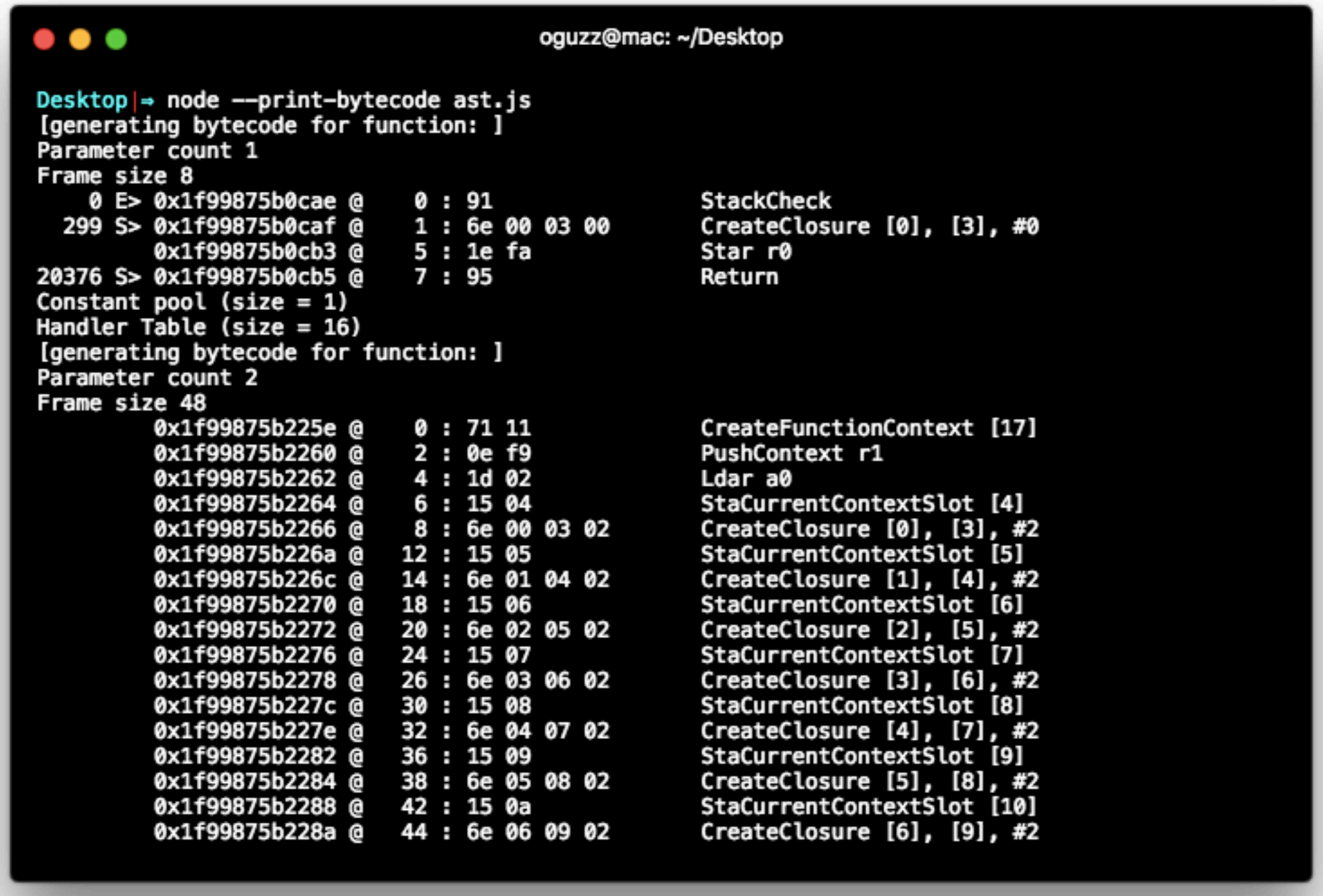
Ignition

written C++

V8 Compiler Pipeline

ByteCode

const ast = “frontend istanbul”;



V8 Compiler Pipeline

JIT Compiler

TurboFan

written C++

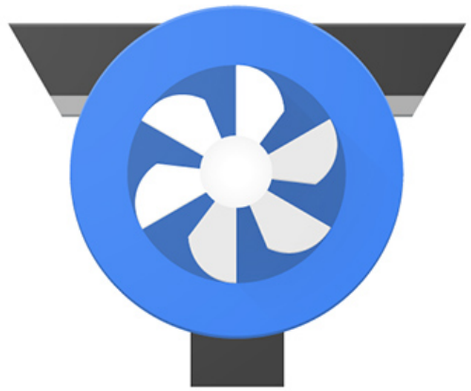
V8 Compiler Pipeline

Turbo Fan

Modern Code Generation Architecture

V8 Compiler Pipeline

Turbo Fan



Modern Code Generation Architecture

Performance

V8 Compiler Pipeline

Turbo Fan

Modern Code Generation Architecture

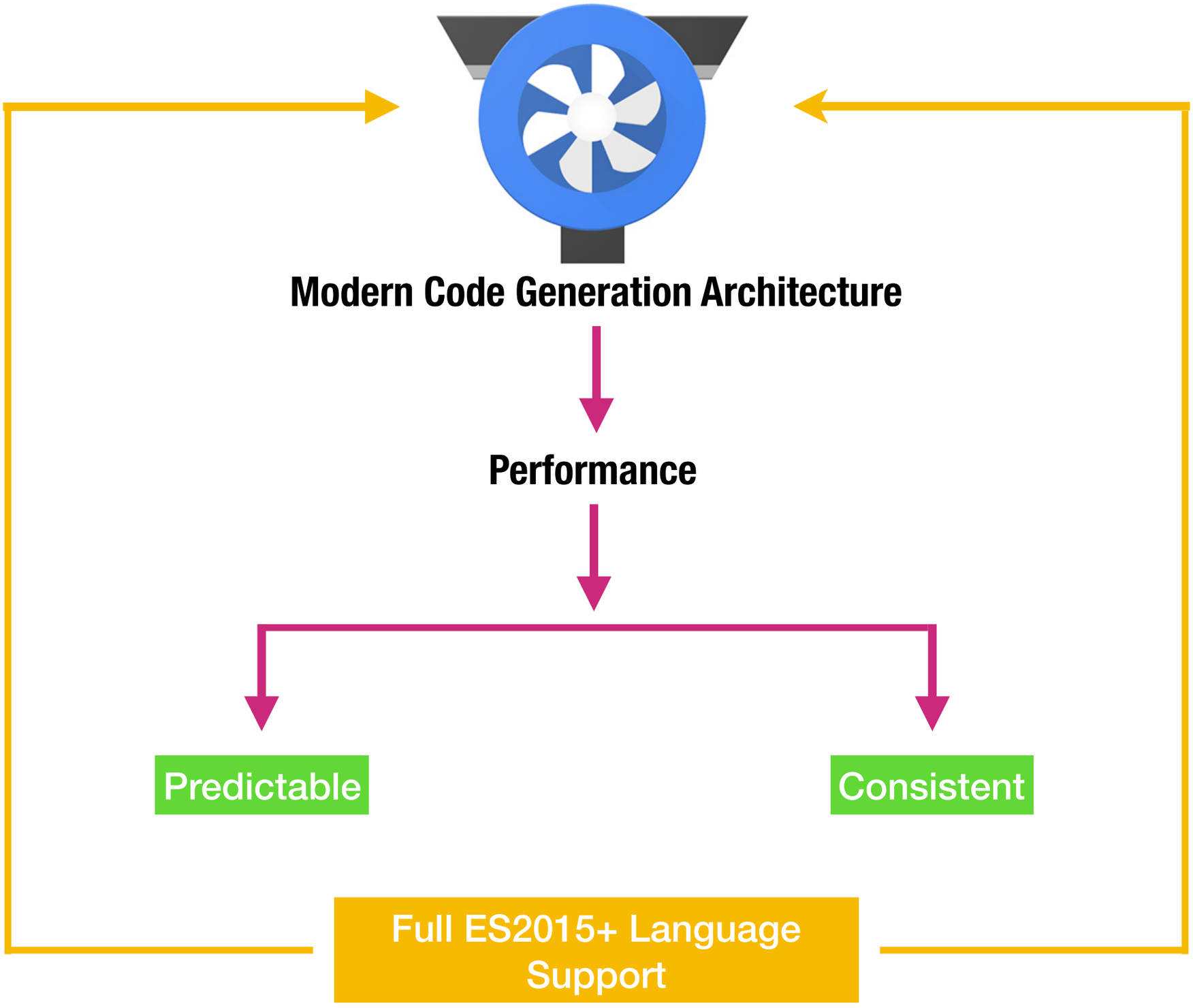
Performance

Predictable

Consistent

V8 Compiler Pipeline

Turbo Fan



V8 Compiler Pipeline

LifeCycle Example

```
const f = (a, b) => a + b * 3;
```

V8 Compiler Pipeline

LifeCycle

```
const f = (a, b) => a + b * 3;
```

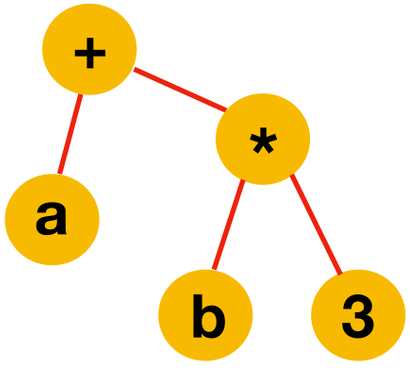
Abstract Syntax Tree

V8 Compiler Pipeline

LifeCycle

```
const f = (a, b) => a + b * 3;
```

Abstract Syntax Tree



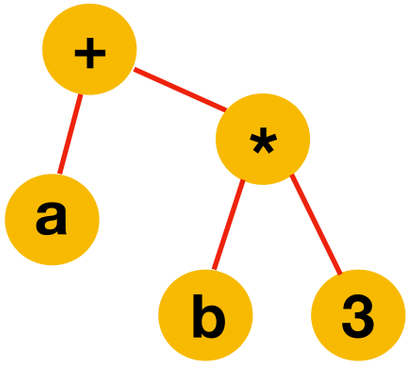
V8 Compiler Pipeline

LifeCycle

```
const f = (a, b) => a + b * 3;
```

Ignition

Abstract Syntax Tree

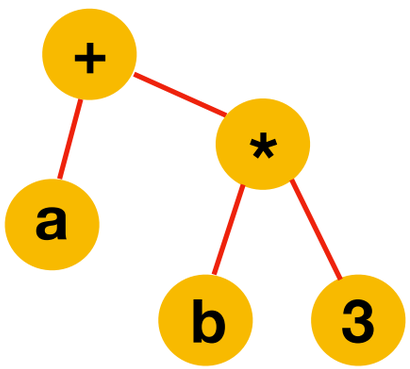


V8 Compiler Pipeline

LifeCycle

```
const f = (a, b) => a + b * 3;
```

Abstract Syntax Tree



Ignition

ByteCode

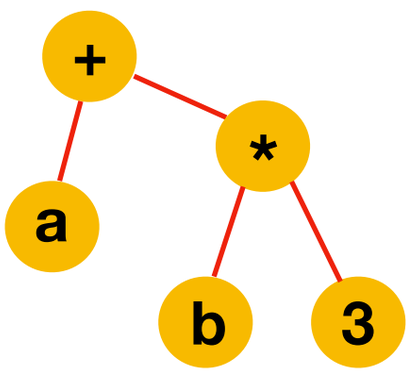
```
0x1f99875b225e @    0 : 71 11
0x1f99875b2260 @    2 : 0e f9
0x1f99875b2262 @    4 : 1d 02
0x1f99875b2264 @    6 : 15 04
0x1f99875b2266 @    8 : 6e 00 03 02
0x1f99875b226a @   12 : 15 05
0x1f99875b226c @   14 : 6e 01 04 02
0x1f99875b2270 @   18 : 15 06
0x1f99875b2272 @   20 : 6e 02 05 02
```

V8 Compiler Pipeline

LifeCycle

```
const f = (a, b) => a + b * 3;
```

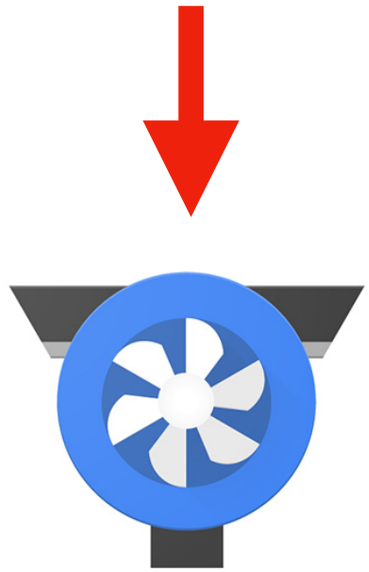
Abstract Syntax Tree



Ignition

ByteCode

```
0x1f99875b225e @    0 : 71 11
0x1f99875b2260 @    2 : 0e f9
0x1f99875b2262 @    4 : 1d 02
0x1f99875b2264 @    6 : 15 04
0x1f99875b2266 @    8 : 6e 00 03 02
0x1f99875b226a @   12 : 15 05
0x1f99875b226c @   14 : 6e 01 04 02
0x1f99875b2270 @   18 : 15 06
0x1f99875b2272 @   20 : 6e 02 05 02
```



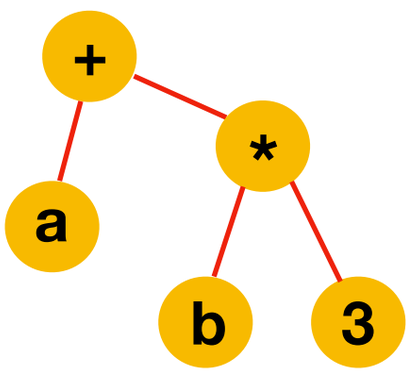
TurboFan

V8 Compiler Pipeline

LifeCycle

```
const f = (a, b) => a + b * 3;
```

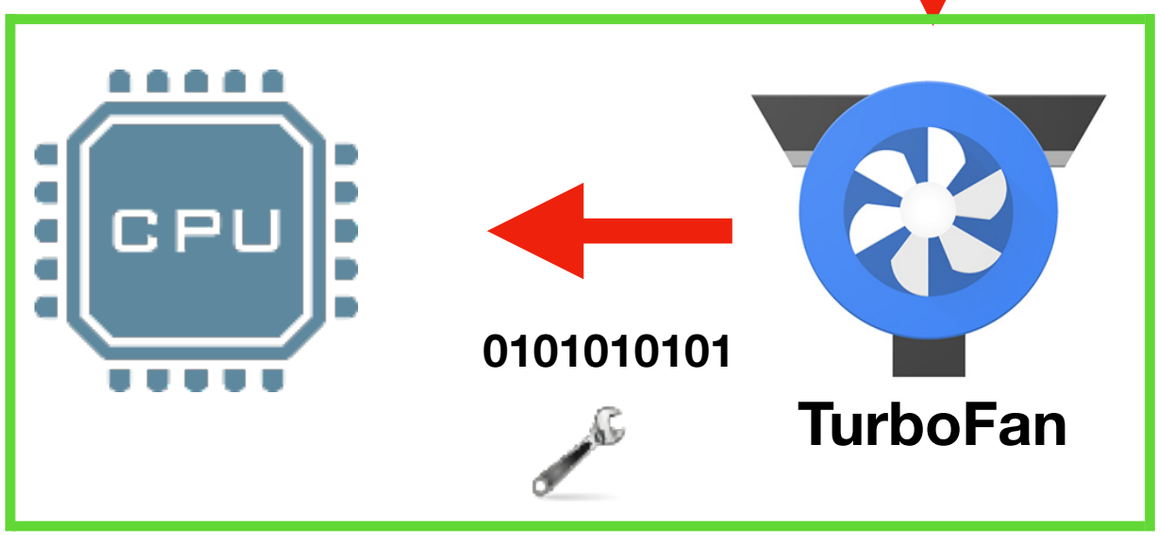
Abstract Syntax Tree



Ignition

ByteCode

```
0x1f99875b225e @    0 : 71 11
0x1f99875b2260 @    2 : 0e f9
0x1f99875b2262 @    4 : 1d 02
0x1f99875b2264 @    6 : 15 04
0x1f99875b2266 @    8 : 6e 00 03 02
0x1f99875b226a @   12 : 15 05
0x1f99875b226c @   14 : 6e 01 04 02
0x1f99875b2270 @   18 : 15 06
0x1f99875b2272 @   20 : 6e 02 05 02
```



Optimization

Optimization = CPU

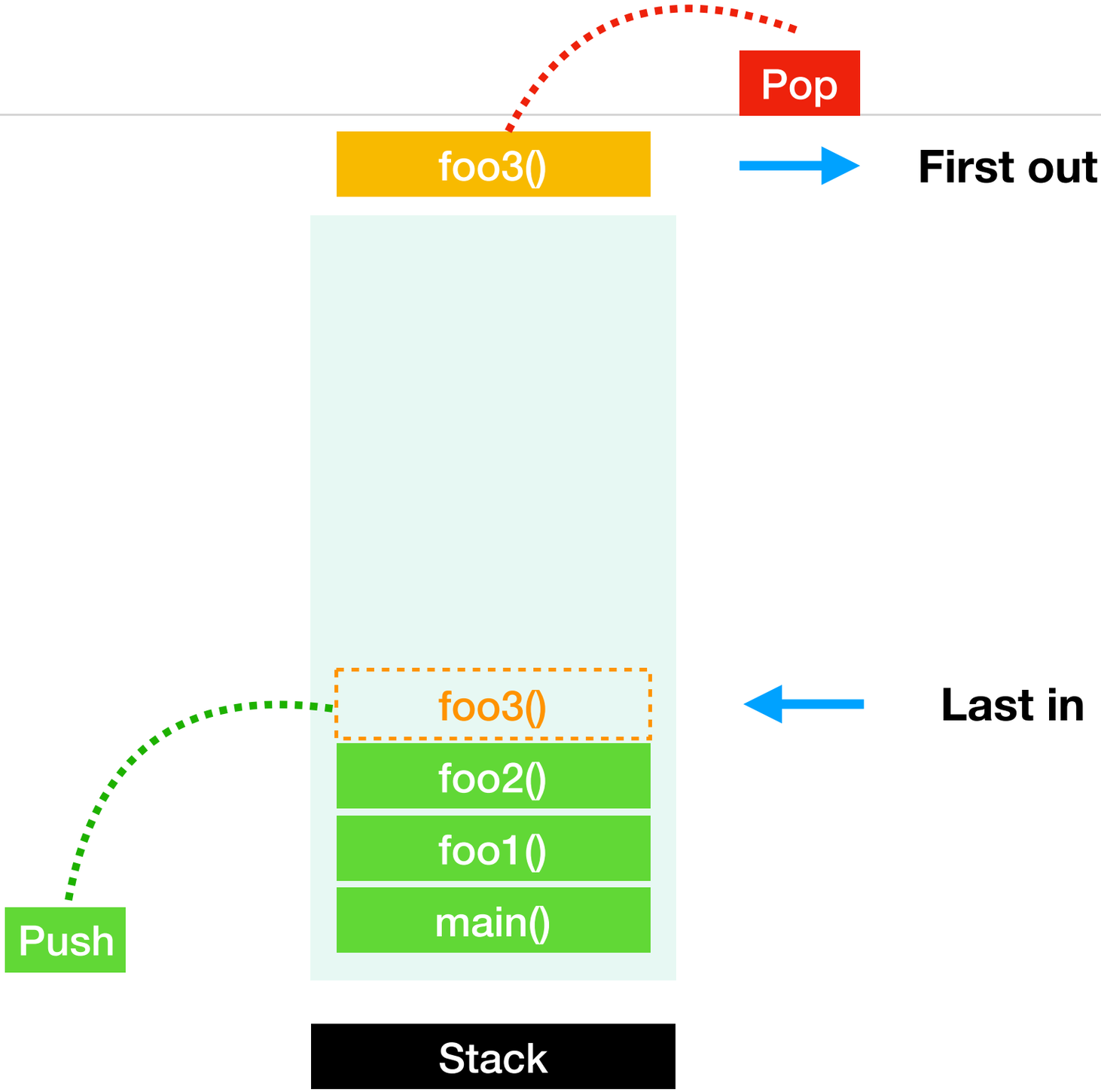
Single-Threaded Language

Concurrency Model

Call Stack

Concurrency Model

Call Stack

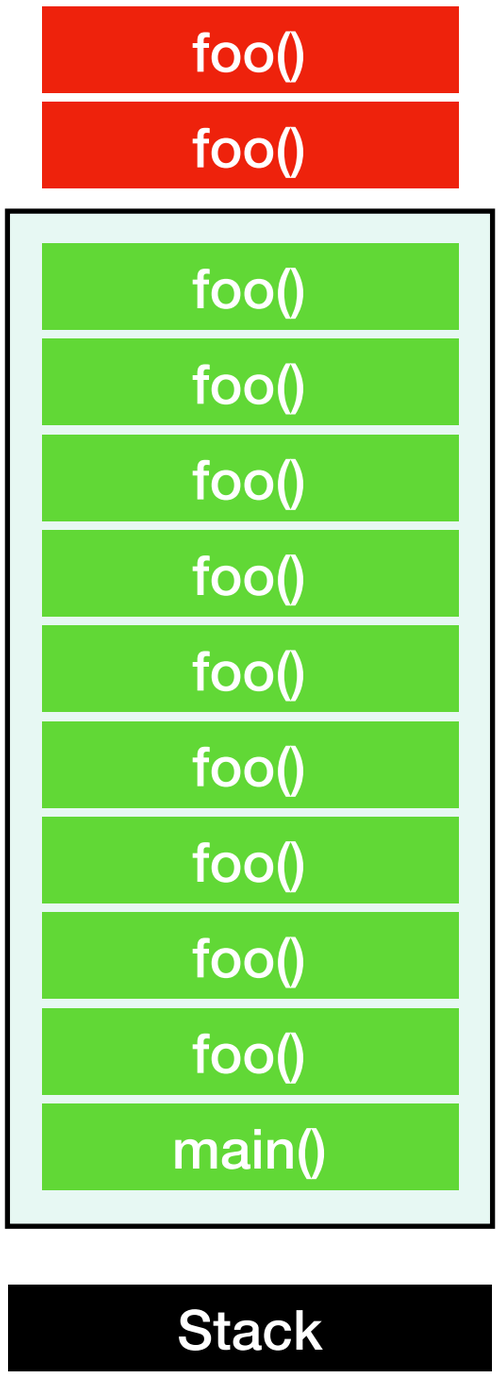


Concurrency Model

Stack Overflow

```
function foo(){
  foo();
}

foo();
```

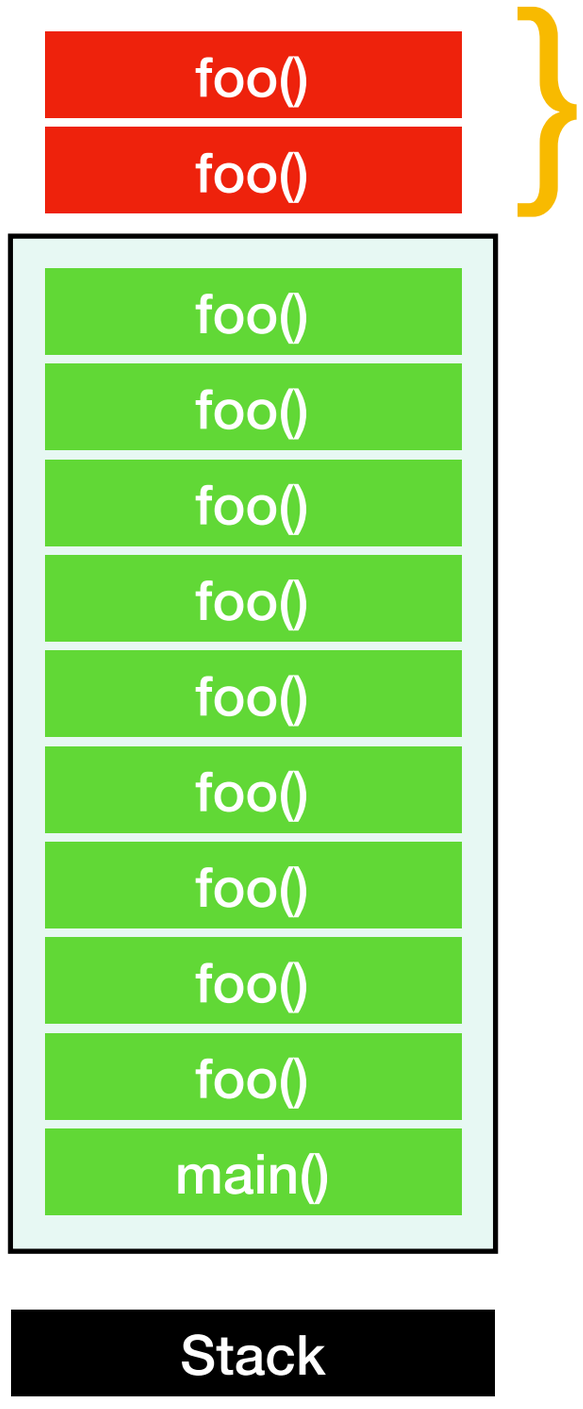


Concurrency Model

Stack Overflow

```
function foo(){
  foo();
}

foo();
```



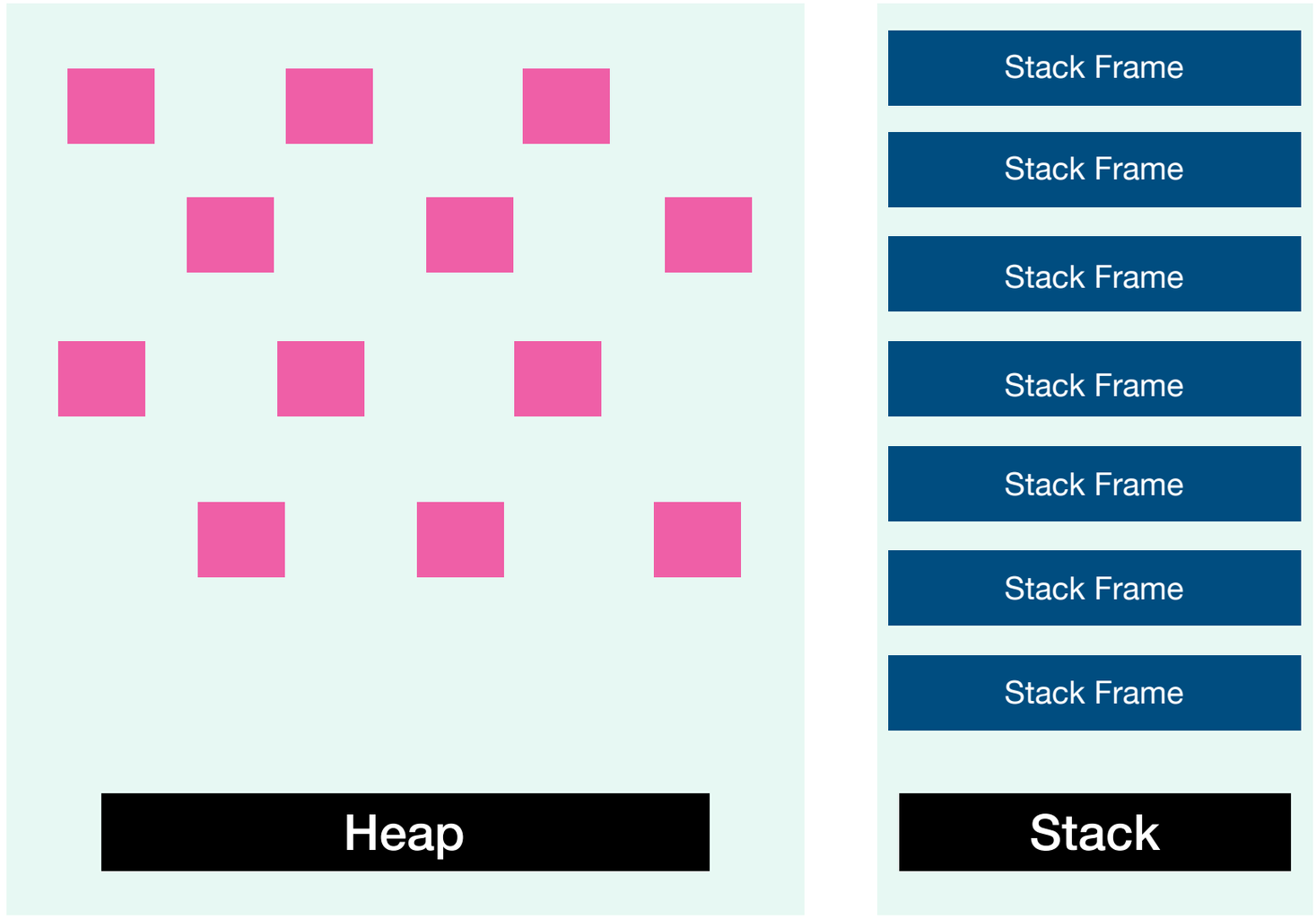
Concurrency Model

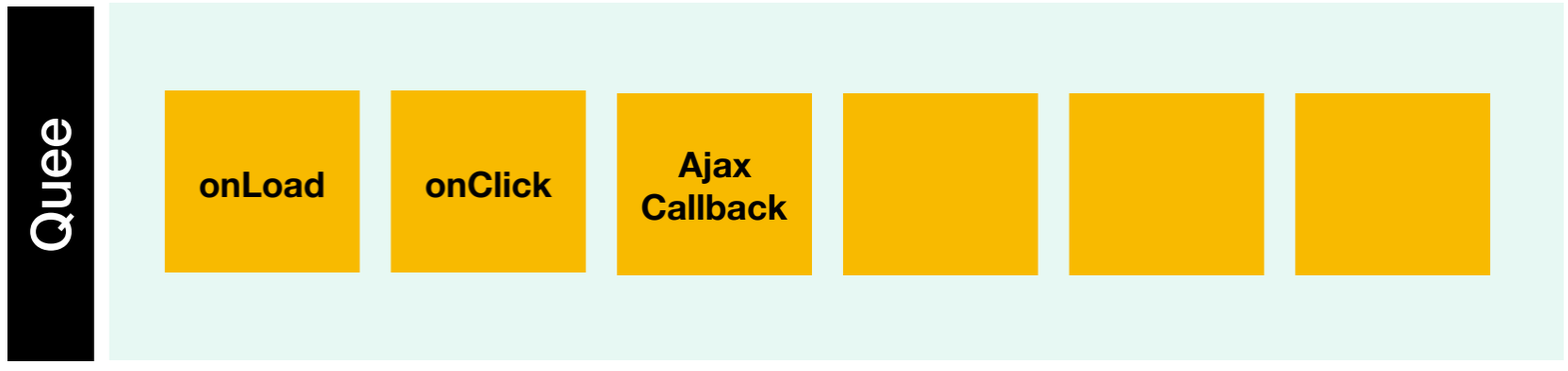
Stack Overflow

```
function foo(){
  foo();
}

foo();
```

Concurrency Model





Garbage Collection

https://medium.com/@oguzkilic

The End

oguzz.kilic@gmail.com