The Future of Source Maps

June 3rd, 2024

This talk

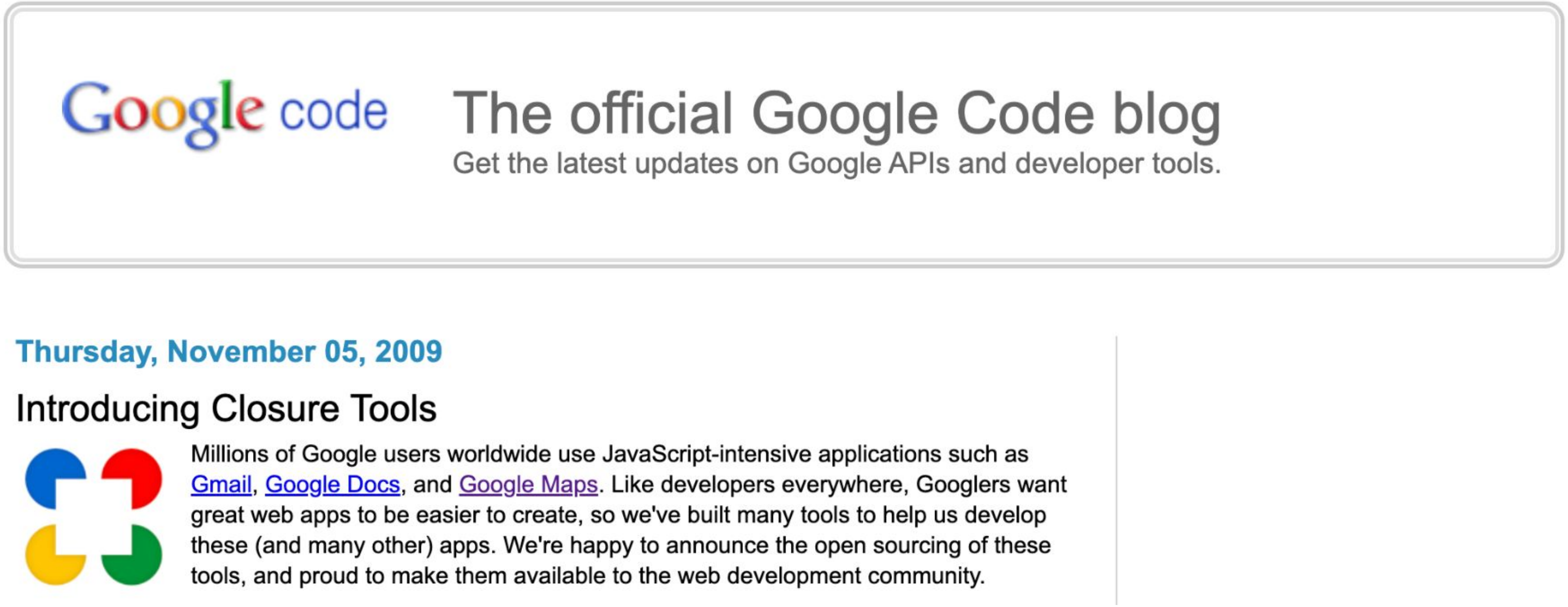
1. History of source maps
2. Anatomy of a source map
3. What is (and isn’t encoded)
4. How do debuggers work (regex, babel)
5. New proposals
    a. Scopes proposal
    b. Debug IDs
    c. Range mappings
6. Get involved!

About me

- Jon Kuperman
- Engineer at Bloomberg
- TC39
- Co-convenor of the source map task group

Sorry, this is a million years old!

When were source maps created?



The official Google Code blog

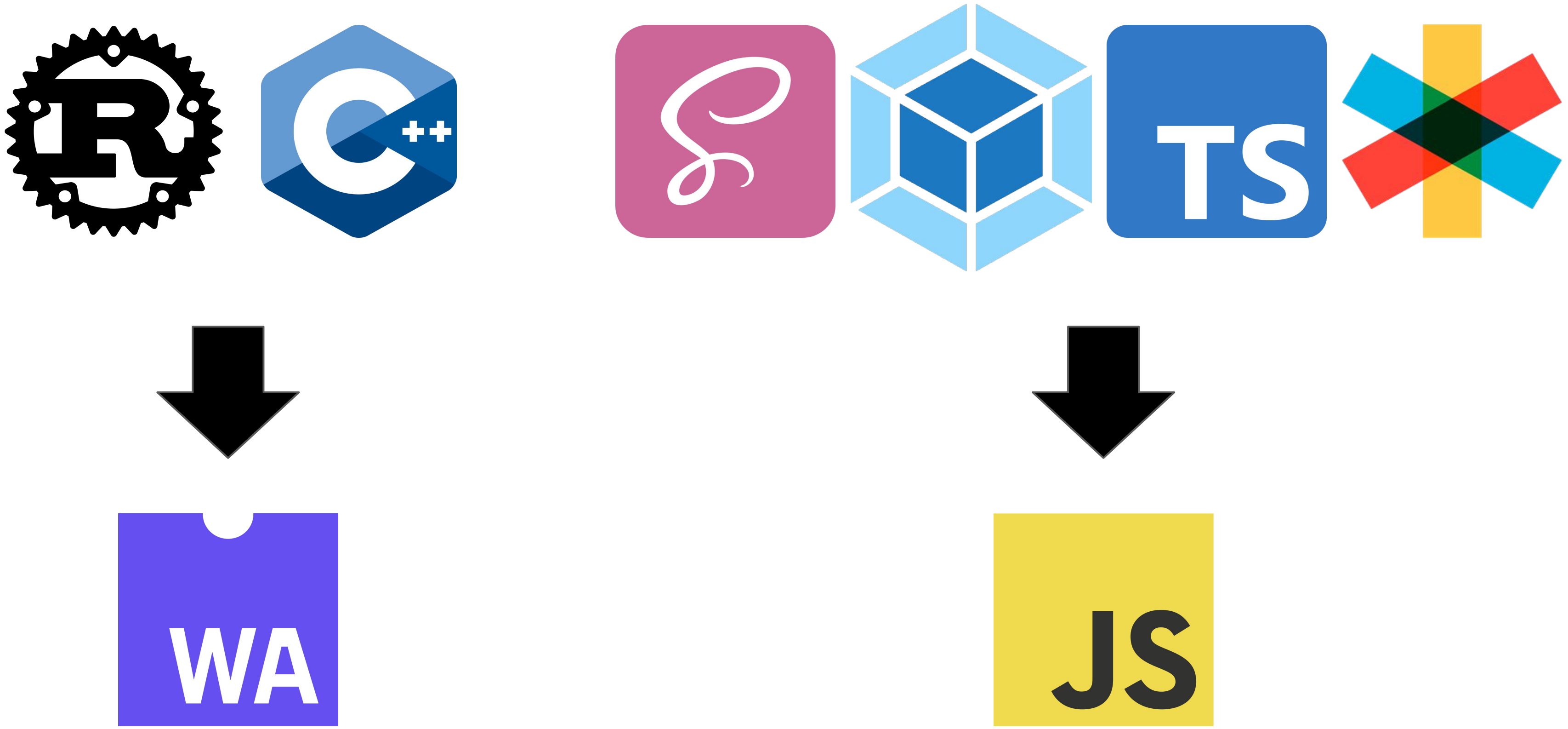
Get the latest updates on Google APIs and developer tools.

Thursday, November 05, 2009

Introducing Closure Tools

Millions of Google users worldwide use JavaScript-intensive applications such as Gmail, Google Docs, and Google Maps. Like developers everywhere, Googlers want great web apps to be easier to create, so we've built many tools to help us develop these (and many other) apps. We're happy to announce the open sourcing of these tools, and proud to make them available to the web development community.

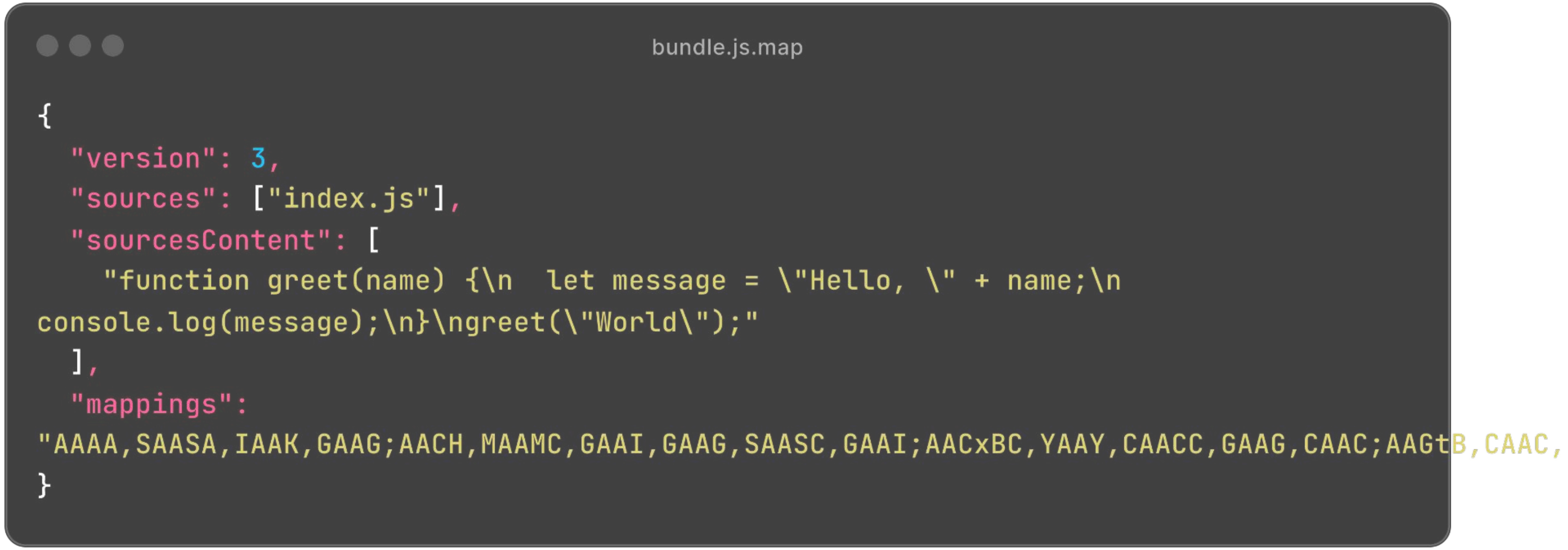
Why do we need source maps?



What are source maps?

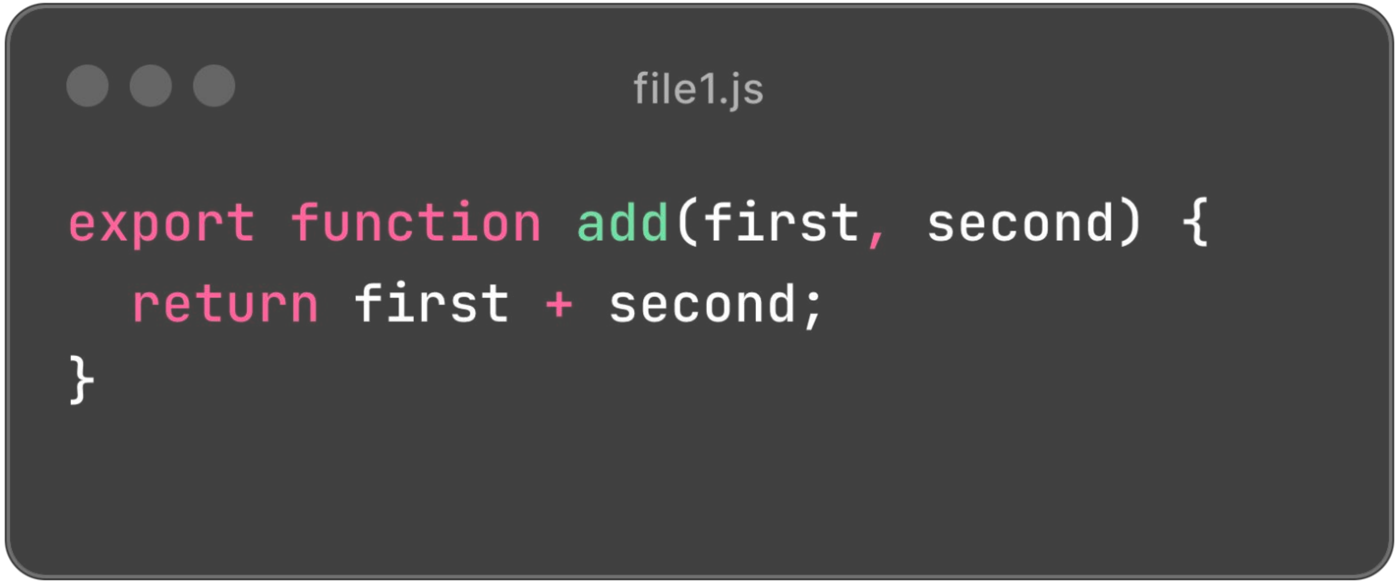
- JSON objects
- Link between generated code and source code
- Created by “**generators**” (esbuild, webpack, SWC)
- Used by “**consumers**” (Chrome, Firefox, Replay.io)
- Also used by “**error monitoring tools**” (Sentry)

Anatomy of a source map

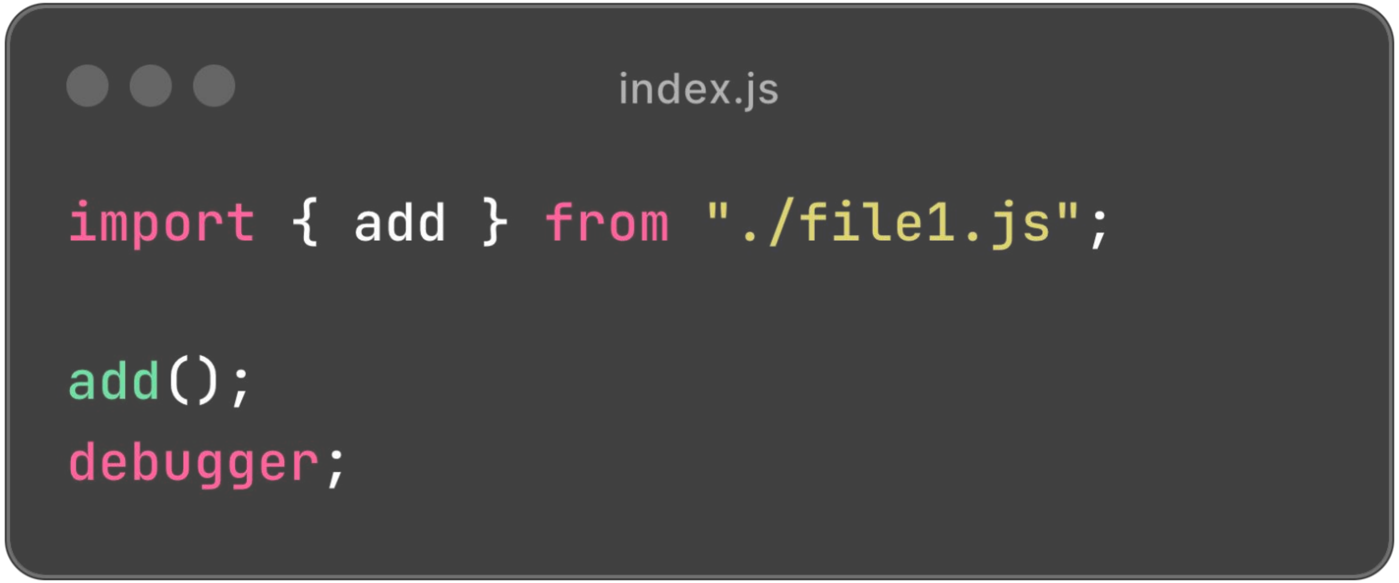


```
{
  "version": 3,
  "sources": ["index.js"],
  "sourcesContent": [
    "function greet(name) {\n  let message = \"Hello, \" + name;\n
console.log(message);\n}\ngreet(\"World\");"
  ],
  "mappings":
"AAAA,SAASA,IAAK,GAAG;AACH,MAAMC,GAAI,GAAG,SAASC,GAAI;AACxBC,YAAY,CAACC,GAAG,CAAC;AAGtB,CAAC,
}
```

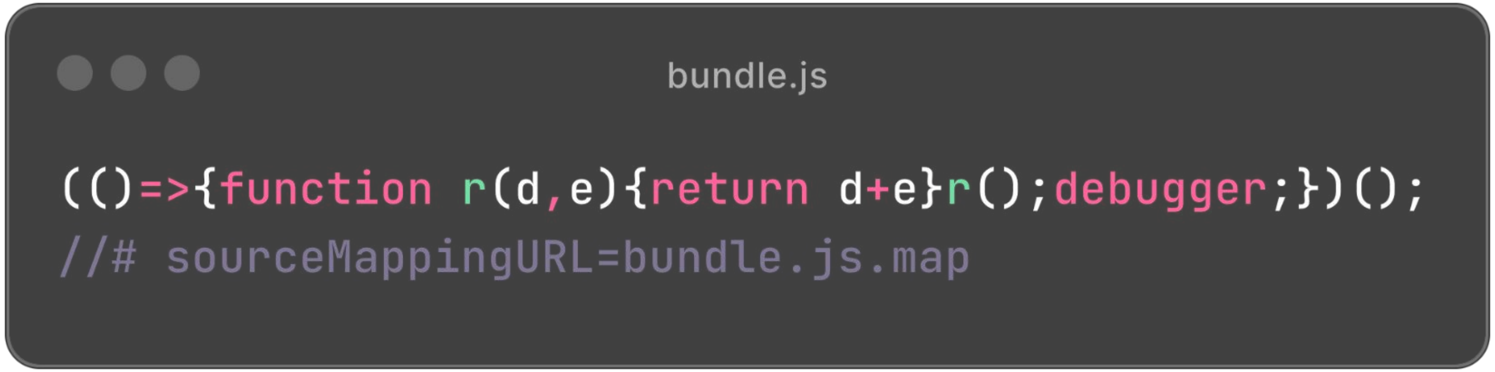
How do generators work?



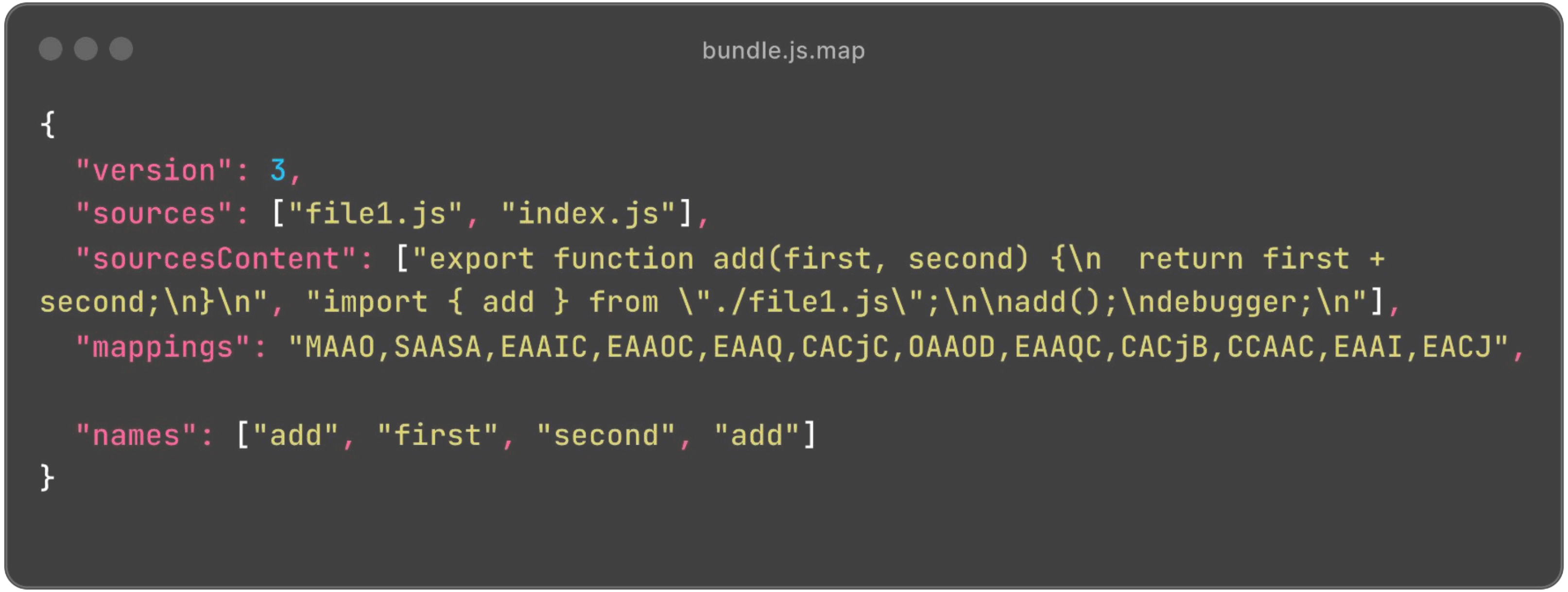
```js
export function add(first, second) {
  return first + second;
}
```



```
import { add } from "./file1.js";

add();
debugger;
```



```
(()=>{function r(d,e){return d+e}r();debugger;})();
//# sourceMappingURL=bundle.js.map
```

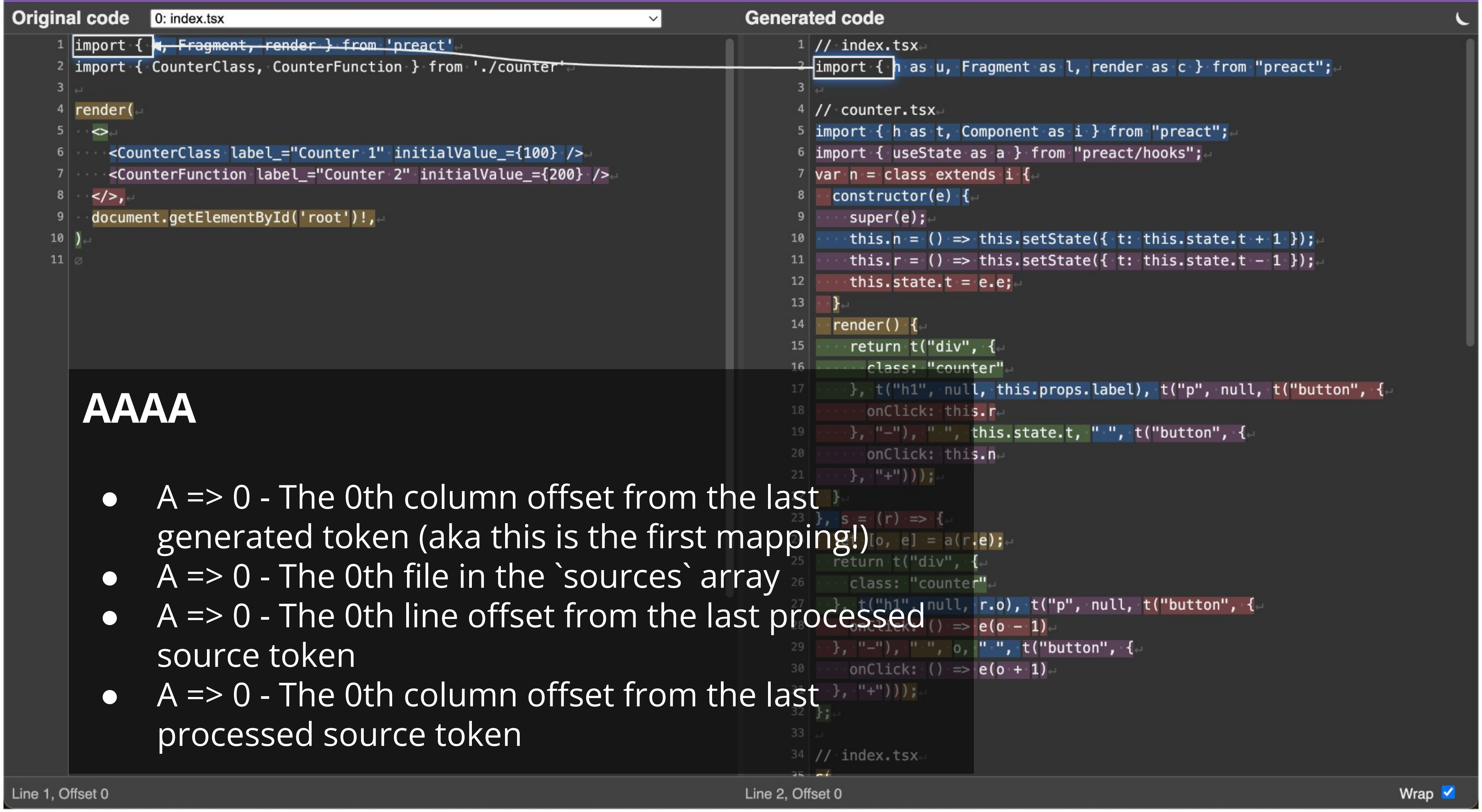


```
{
  "version": 3,
  "sources": ["file1.js", "index.js"],
  "sourcesContent": ["export function add(first, second) {\n  return first +
second;\n}\n", "import { add } from \"./file1.js\";\n\nadd();\ndebugger;\n"],
  "mappings": "MAAO,SAASA,EAAIC,EAAOC,EAAQ,CACjC,OAAOD,EAAQC,CACjB,CCAAC,EAAI,EACJ",

  "names": ["add", "first", "second", "add"]
}
```

Mappings

VLQ encoding is used in source maps to efficiently encode integers. Each segment in the mappings string is VLQ-encoded. Here's a quick rundown of how it works:

- For each **token** in the generated file
- Capture its **line** and **column** (relative to the last generated token)
- Capture the source files **index** in the sources array
- Capture the **line** and **column** for the matching source file (relative to the last source token)



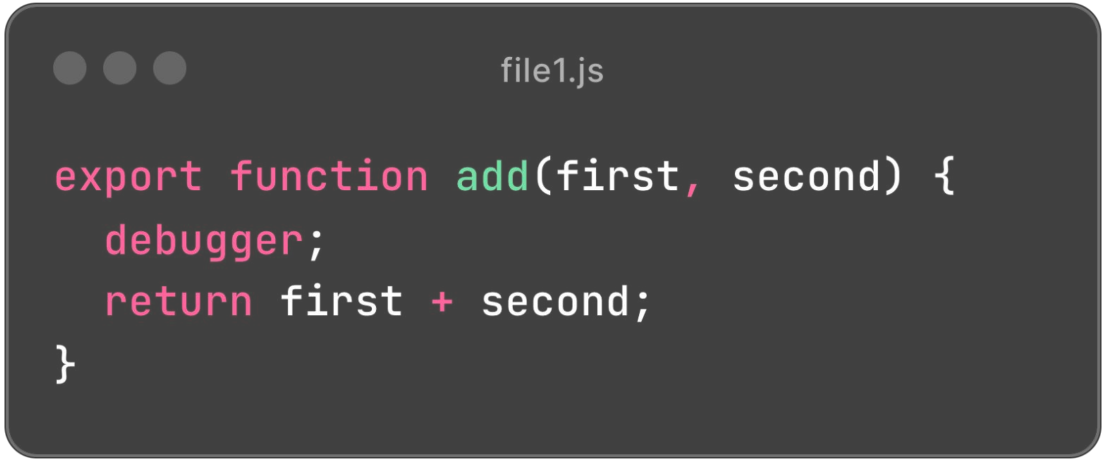
```
import { h, Fragment, render } from 'preact'
import { CounterClass, CounterFunction } from './counter'

render(
  <>
    <CounterClass label_="Counter 1" initialValue_={100} />
    <CounterFunction label_="Counter 2" initialValue_={200} />
  </>,
  document.getElementById('root')!,
)
```

```
// index.tsx
import { h as u, Fragment as l, render as c } from "preact";

// counter.tsx
import { h as t, Component as i } from "preact";
import { useState as a } from "preact/hooks";
var n = class extends i {
  constructor(e) {
    super(e);
    this.n = () => this.setState({ t: this.state.t + 1 });
    this.r = () => this.setState({ t: this.state.t - 1 });
    this.state.t = e.e;
  }
  render() {
    return t("div", {
      class: "counter"
    }, t("h1", null, this.props.label), t("p", null, t("button", {
      onClick: this.r
    }, "-"), " ", this.state.t, " ", t("button", {
      onClick: this.n
    }, "+")));
  }
}, s = (r) => {
    [o, e] = a(r.e);
  return t("div", {
    class: "counter"
  }, t("h1", null, r.o), t("p", null, t("button", {
    onClick: () => e(o - 1)
  }, "-"), " ", o, " ", t("button", {
    onClick: () => e(o + 1)
  }, "+")));
};

// index.tsx
```

AAAA

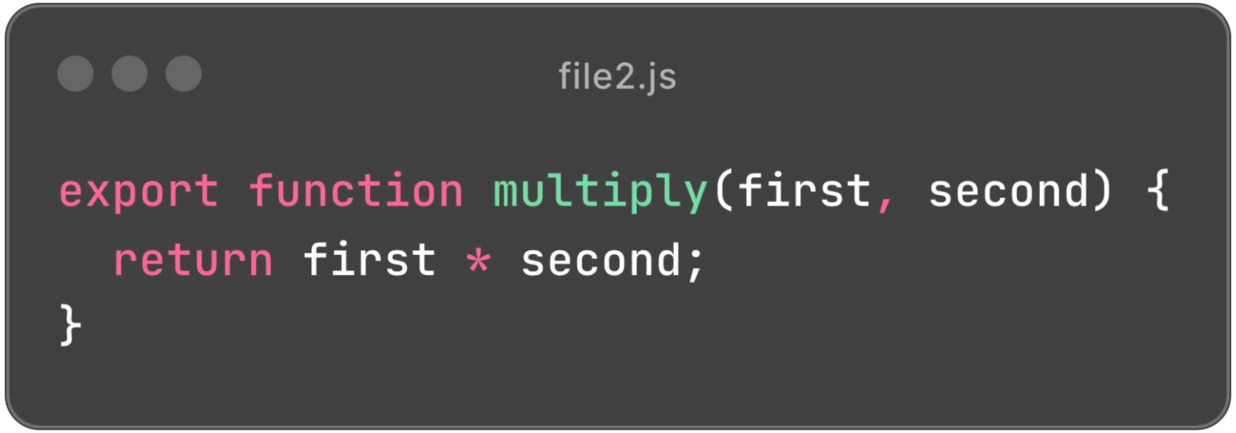
- A => 0 - The 0th column offset from the last generated token (aka this is the first mapping!)
- A => 0 - The 0th file in the `sources` array
- A => 0 - The 0th line offset from the last processed source token
- A => 0 - The 0th column offset from the last processed source token

How do debuggers work?



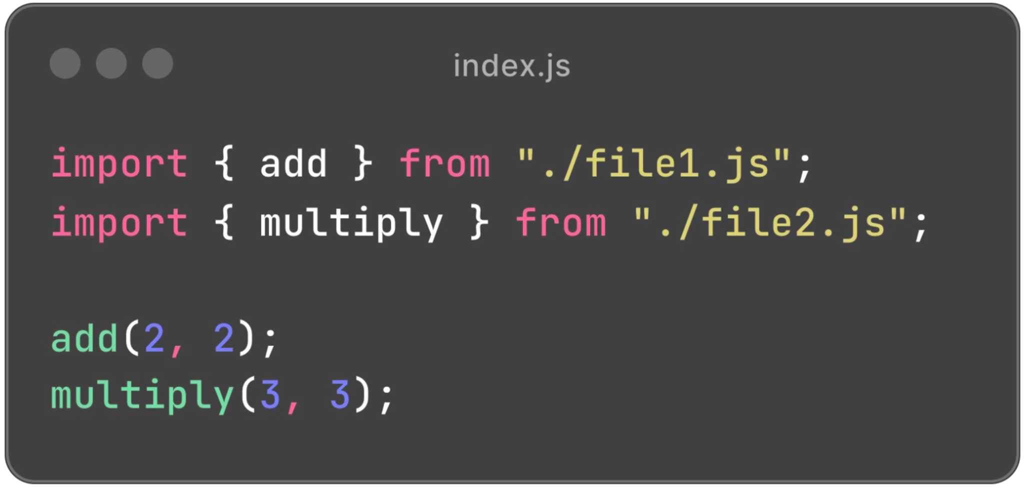
```
export function add(first, second) {
  debugger;
  return first + second;
}
```

How do debuggers work?


file2.js

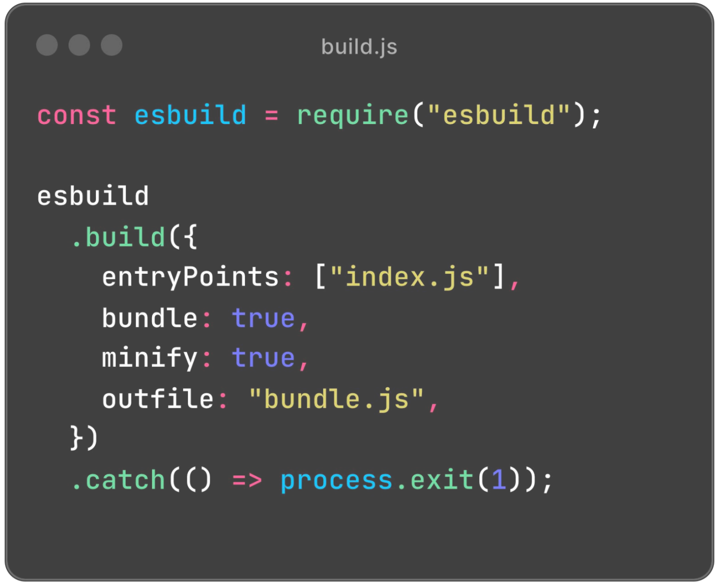
```
export function multiply(first, second) {
  return first * second;
}
```

How do debuggers work?


index.js

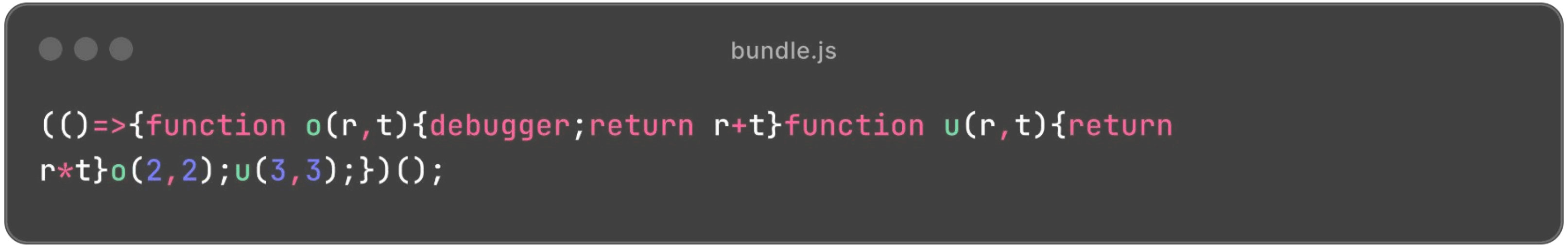
```
import { add } from "./file1.js";
import { multiply } from "./file2.js";

add(2, 2);
multiply(3, 3);
```

How do debuggers work?

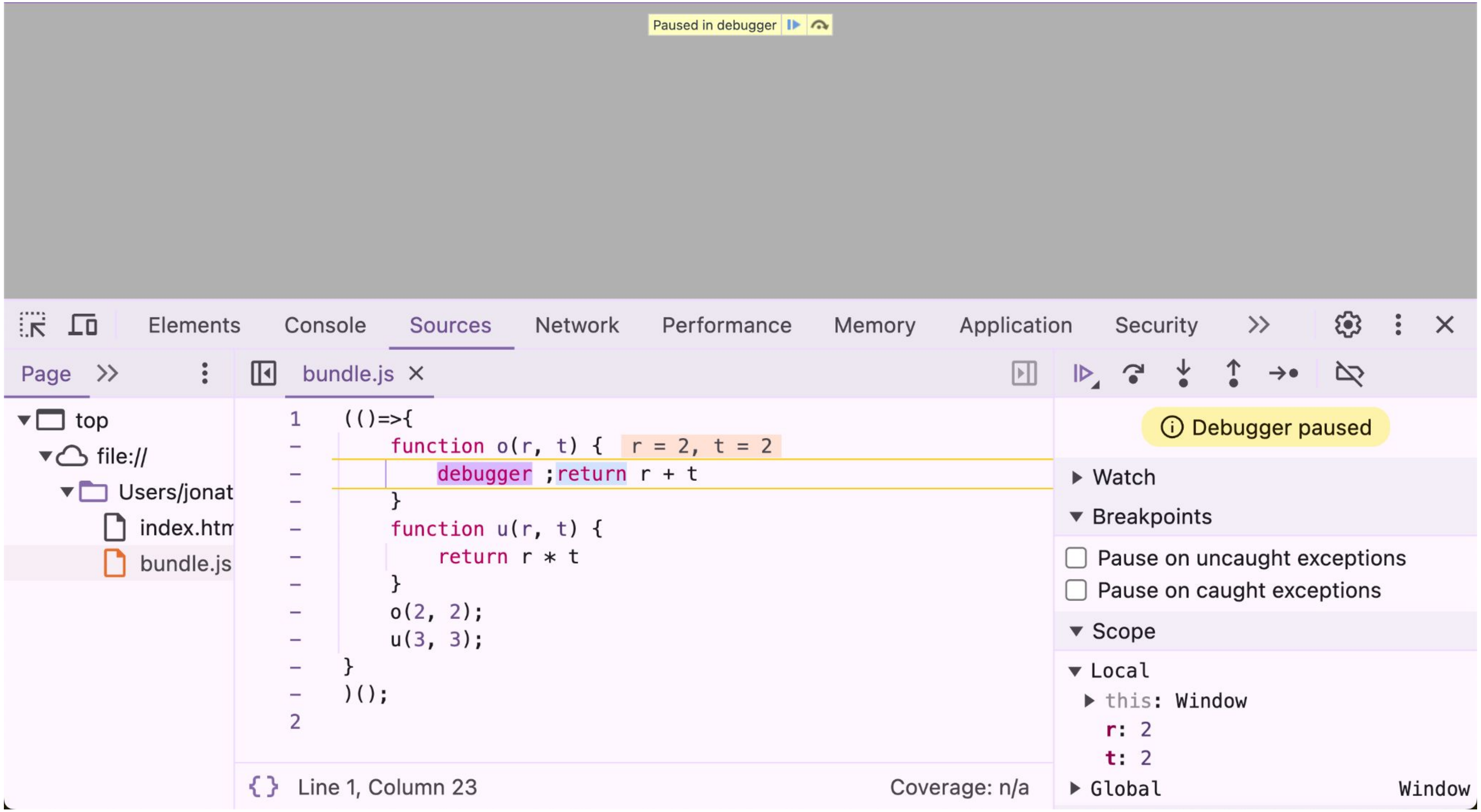

build.js

```
const esbuild = require("esbuild");

esbuild
  .build({
    entryPoints: ["index.js"],
    bundle: true,
    minify: true,
    outfile: "bundle.js",
  })
  .catch(() => process.exit(1));
```

How do debuggers work?


bundle.js

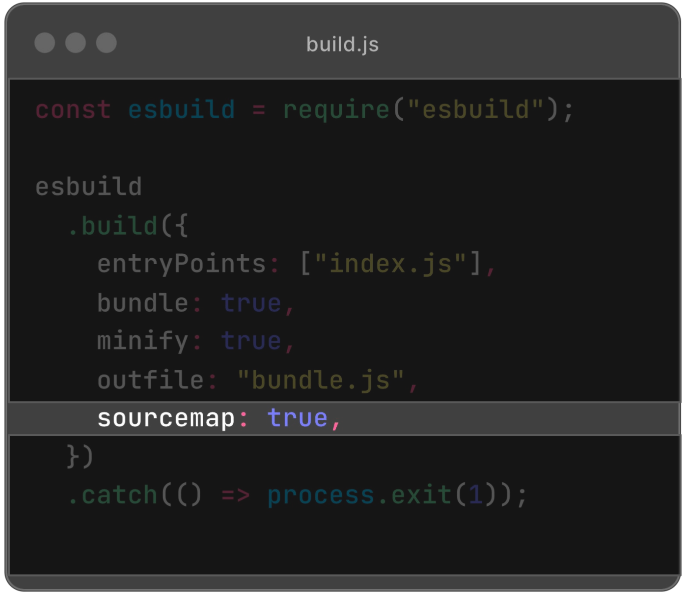
```
(()=>{function o(r,t){debugger;return r+t}function u(r,t){return
r*t}o(2,2);u(3,3);})();
```



```
(()=>{
    function o(r, t) {  r = 2, t = 2
        debugger ;return r + t
    }
    function u(r, t) {
        return r * t
    }
    o(2, 2);
    u(3, 3);
}
)();
```

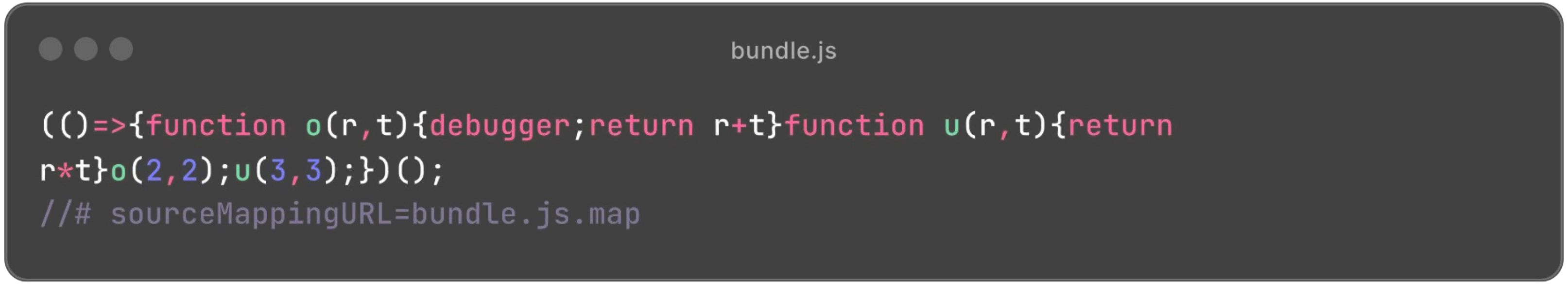
```
this: Window
r: 2
t: 2
```

How do debuggers work?



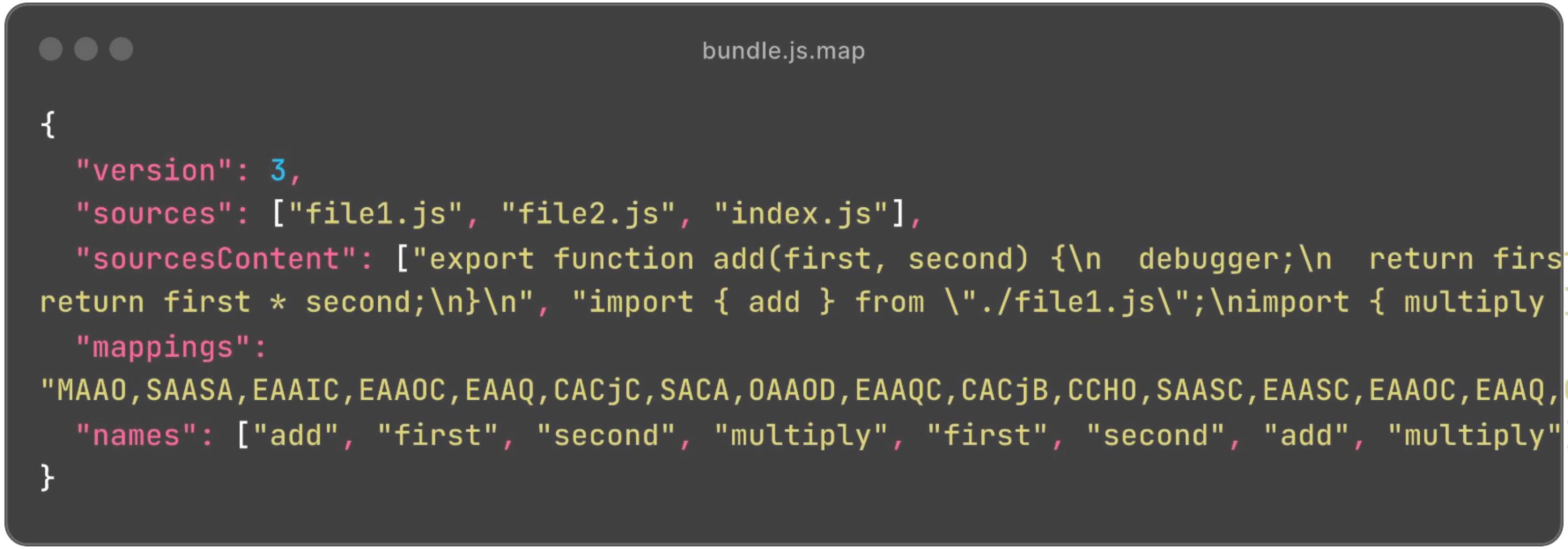
```
const esbuild = require("esbuild");

esbuild
  .build({
    entryPoints: ["index.js"],
    bundle: true,
    minify: true,
    outfile: "bundle.js",
    sourcemap: true,
  })
  .catch(() => process.exit(1));
```

How do debuggers work?

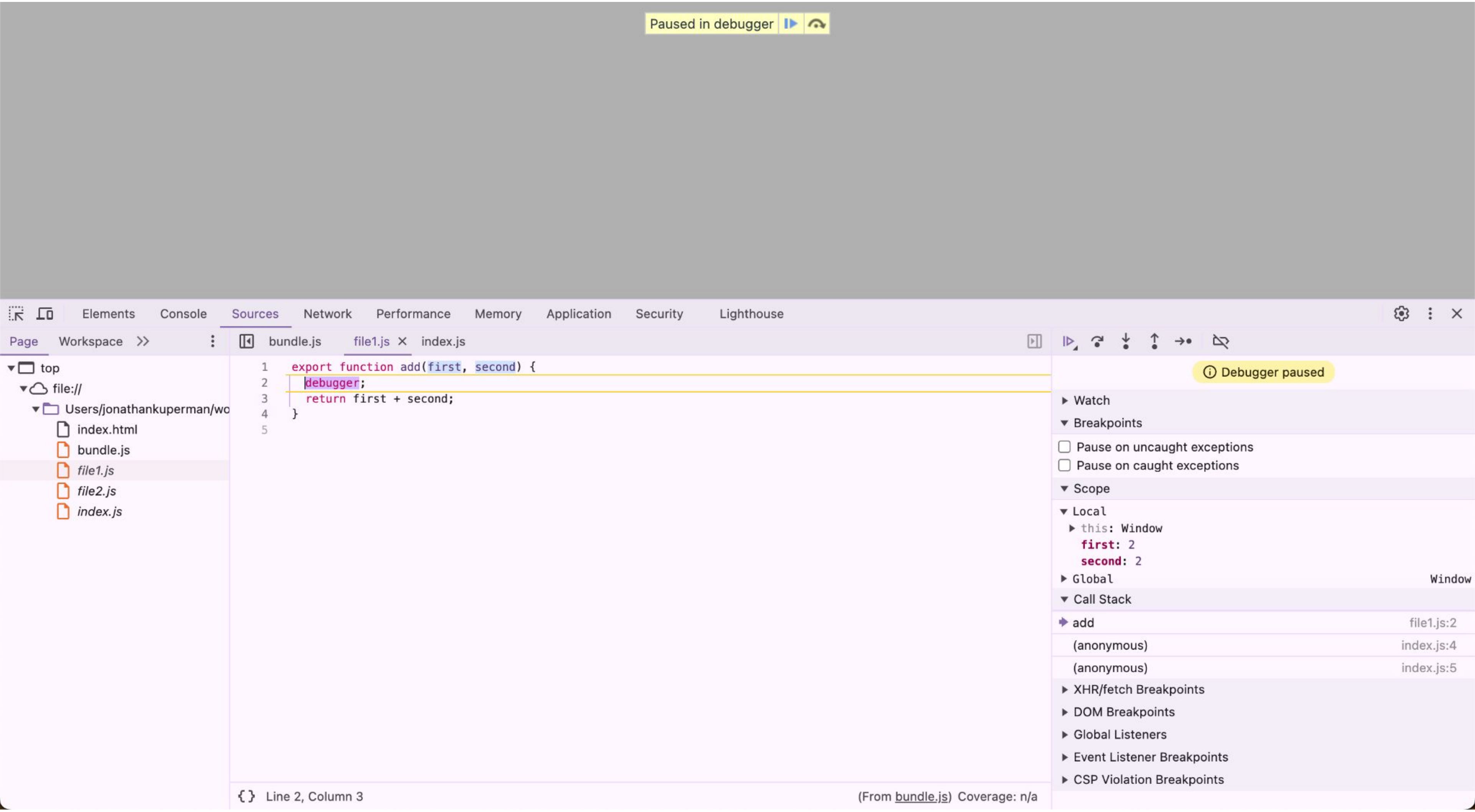

bundle.js

```
(()=>{function o(r,t){debugger;return r+t}function u(r,t){return
r*t}o(2,2);u(3,3);})();
//# sourceMappingURL=bundle.js.map
```

How do debuggers work?


bundle.js.map

```
{
  "version": 3,
  "sources": ["file1.js", "file2.js", "index.js"],
  "sourcesContent": ["export function add(first, second) {\n  debugger;\n  return first + sec
return first * second;\n}\n", "import { add } from \"./file1.js\";\nimport { multiply } from
  "mappings":
"MAAO,SAASA,EAAIC,EAAOC,EAAQ,CACjC,SACA,OAAOD,EAAQC,CACjB,CCHO,SAASC,EAASC,EAAOC,EAAQ,CACtC,O
  "names": ["add", "first", "second", "multiply", "first", "second", "add", "multiply"]
}
```

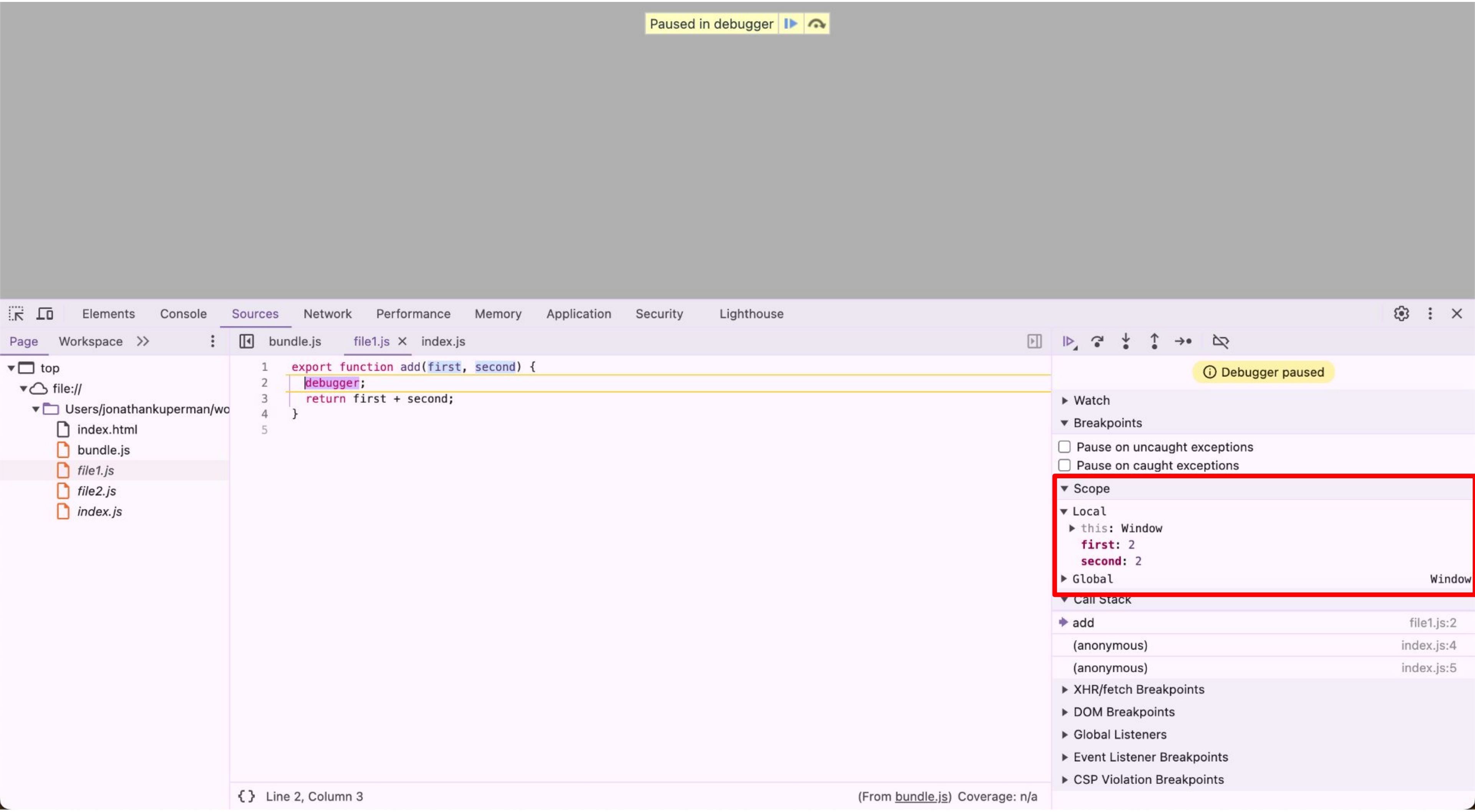


```
export function add(first, second) {
  debugger;
  return first + second;
}
```

```
Local
  this: Window
  first: 2
  second: 2
Global                                   Window
```

add	file1.js:2
(anonymous)	index.js:4
(anonymous)	index.js:5

Line 2, Column 3 (From bundle.js) Coverage: n/a



```
export function add(first, second) {
  debugger;
  return first + second;
}
```

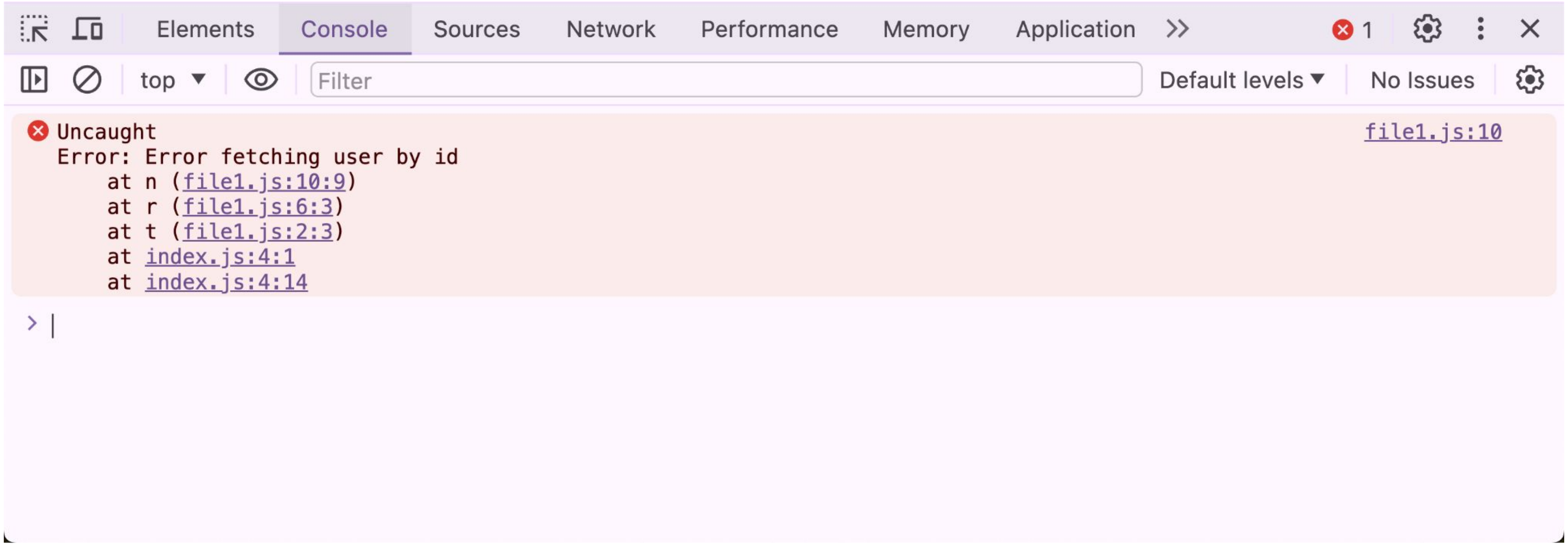
```
▼ Local
  ▶ this: Window
    first: 2
    second: 2
▶ Global                                    Window
```

add	file1.js:2
(anonymous)	index.js:4
(anonymous)	index.js:5

Consumers try to offer great experiences

- Chrome Devtools uses Regular Expressions
- Firefox runs Babel on the source files
- Scopes are hard to implement!

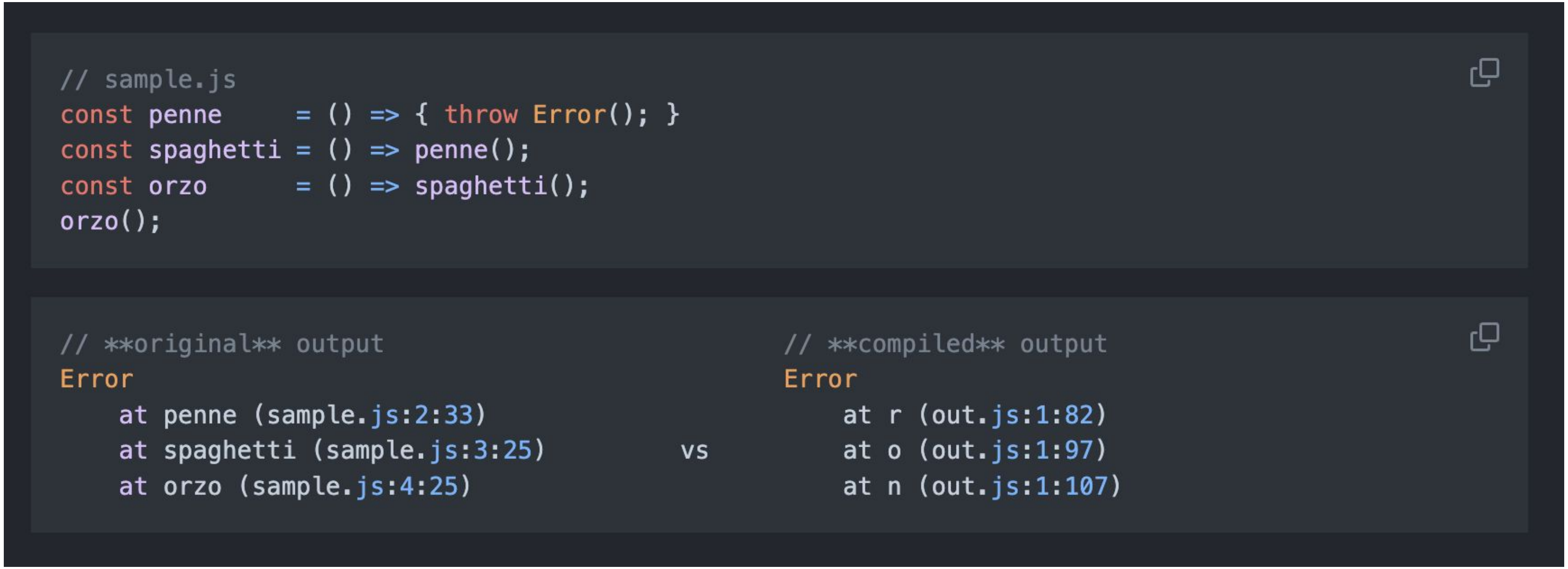
Stack traces are even harder…



```
Uncaught                                                          file1.js:10
Error: Error fetching user by id
    at n (file1.js:10:9)
    at r (file1.js:6:3)
    at t (file1.js:2:3)
    at index.js:4:1
    at index.js:4:14
```

Bloomberg's Pasta Source Maps

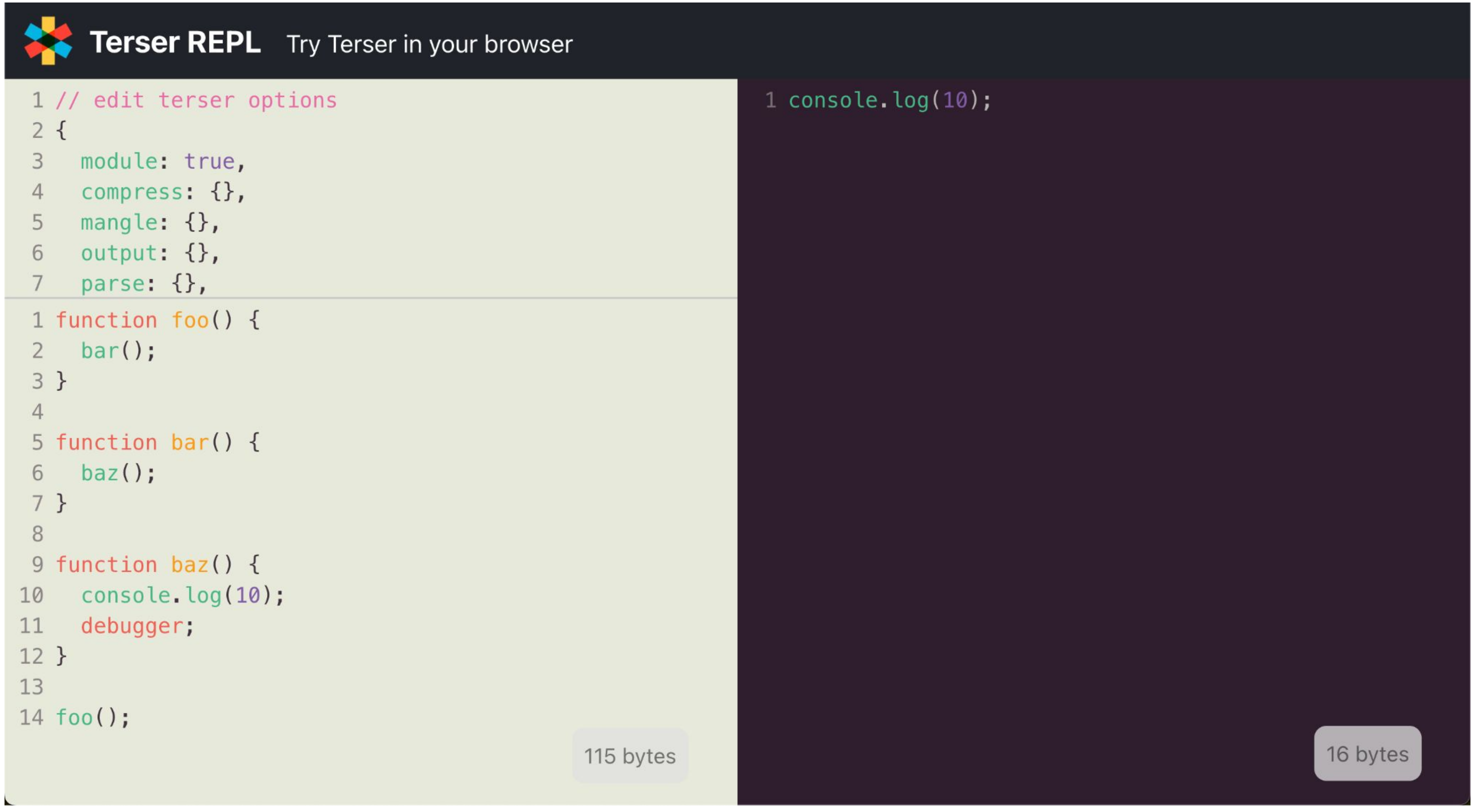
x_com_bloomberg_sourcesFunctionMappings



```
// sample.js
const penne     = () => { throw Error(); }
const spaghetti = () => penne();
const orzo      = () => spaghetti();
orzo();
```

```
// **original** output                          // **compiled** output
Error                                            Error
    at penne (sample.js:2:33)                        at r (out.js:1:82)
    at spaghetti (sample.js:3:25)          vs        at o (out.js:1:97)
    at orzo (sample.js:4:25)                         at n (out.js:1:107)
```

It’s not just names



```
// edit terser options
{
  module: true,
  compress: {},
  mangle: {},
  output: {},
  parse: {},
```

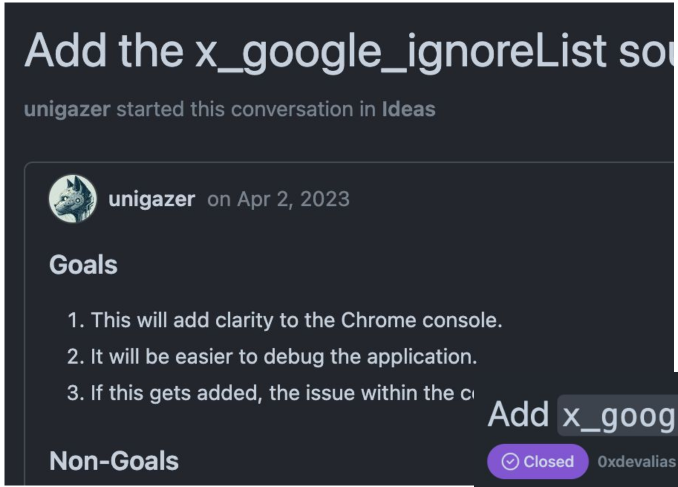
```
function foo() {
  bar();
}

function bar() {
  baz();
}

function baz() {
  console.log(10);
  debugger;
}

foo();
```

115 bytes

```
console.log(10);
```

16 bytes

Difficult to move forward



Add the x_google_ignoreList so

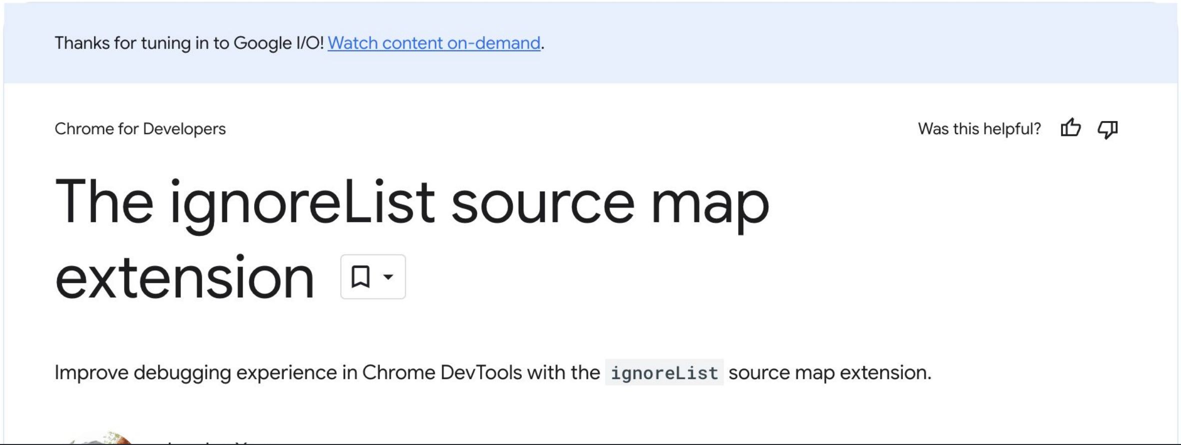
unigazer started this conversation in Ideas

unigazer on Apr 2, 2023

Goals

1. This will add clarity to the Chrome console.
2. It will be easier to debug the application.
3. If this gets added, the issue within the c

Non-Goals



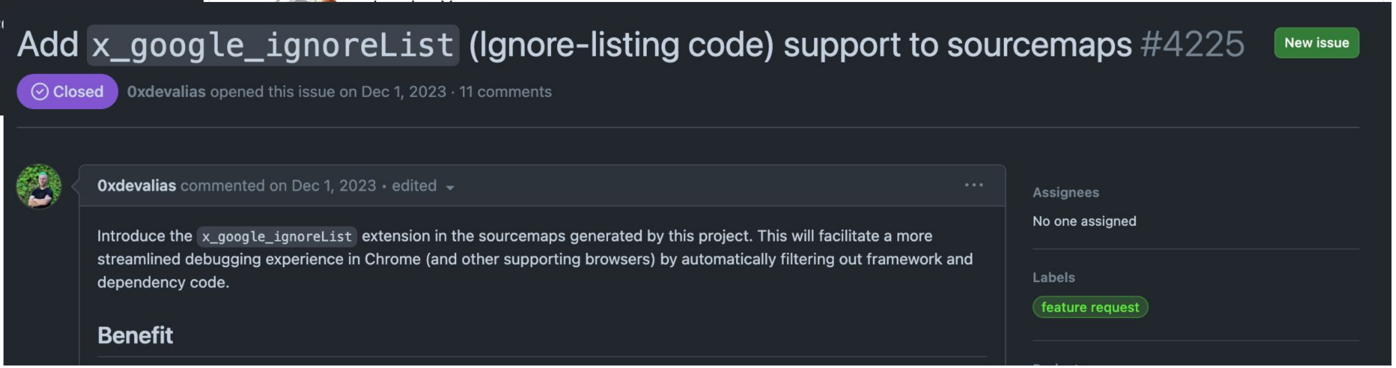
Thanks for tuning in to Google I/O! Watch content on-demand.

Chrome for Developers

Was this helpful?

The ignoreList source map extension

Improve debugging experience in Chrome DevTools with the `ignoreList` source map extension.



Add `x_google_ignoreList` (Ignore-listing code) support to sourcemaps #4225

New issue

Closed 0xdevalias opened this issue on Dec 1, 2023 · 11 comments

0xdevalias commented on Dec 1, 2023 • edited

Introduce the `x_google_ignoreList` extension in the sourcemaps generated by this project. This will facilitate a more streamlined debugging experience in Chrome (and other supporting browsers) by automatically filtering out framework and dependency code.

Benefit

Assignees

No one assigned

Labels

feature request

The Future of Source Maps

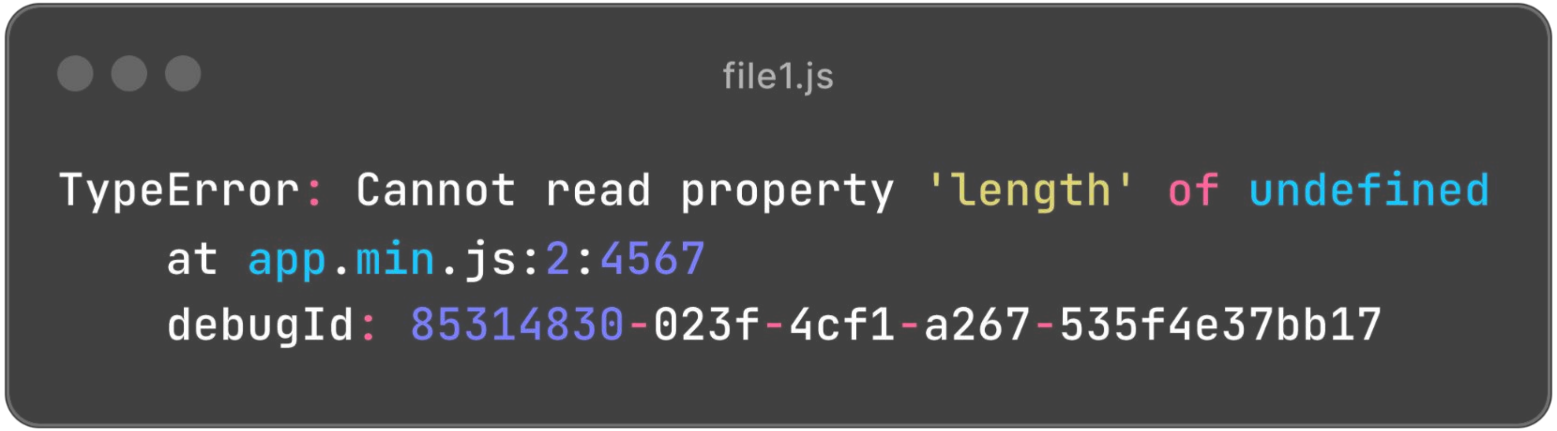
- Formed a task group underneath the TC39 umbrella
- Improve the specification
- Embed scope information
- Embeds function and variable names
- Add Debug IDs
- Add Range Mappings

Scopes Proposal

- **Inline Functions**: Reconstruct and step through inlined functions.
- **Variable Mapping**: Map renamed/erased variables back to original names.
- **Scope Reconstruction**: Rebuild original and hidden scopes.
- **New Fields**:
    - **originalScopes**: Describes original code scopes.
    - **generatedRanges**: Describes generated code scopes and bindings.

Debug IDs

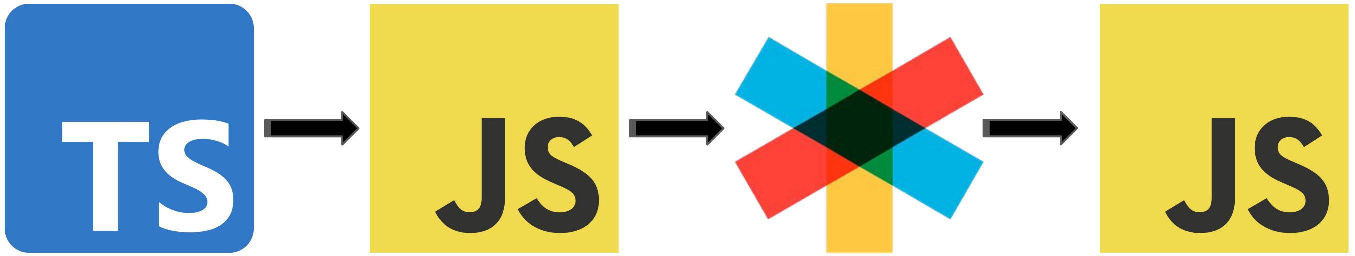
- Multiple source maps
- Outdated source maps
- Stack traces



```
TypeError: Cannot read property 'length' of undefined
    at app.min.js:2:4567
    debugId: 85314830-023f-4cf1-a267-535f4e37bb17
```

Range Mappings

https://github.com/tc39/source-map/blob/main/proposals/range-mappings.md



Current participants

- Bloomberg
- Google
- JetBrains
- Meta
- Microsoft
- Mozilla
- Replay.io
- Sentry
- And more!

Come get involved!

- Already a TC39 member?
  - Join our Matrix chat! https://matrix.to/#/#tc39-tg4:matrix.org
  - Find our events on the TC39 calendar
  - Read out CONTRIBUTING guide https://github.com/tc39/source-map/blob/main/CONTRIBUTING.md
- Not a TC39 member yet?
  - Join our matrix chat and message me (jkup) - I’ll help you get involved!

Thank you!