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Dear Google, Let’s Harden JavaScript

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2024-02-12

How JavaScript can evolve to better support Hardened JavaScript

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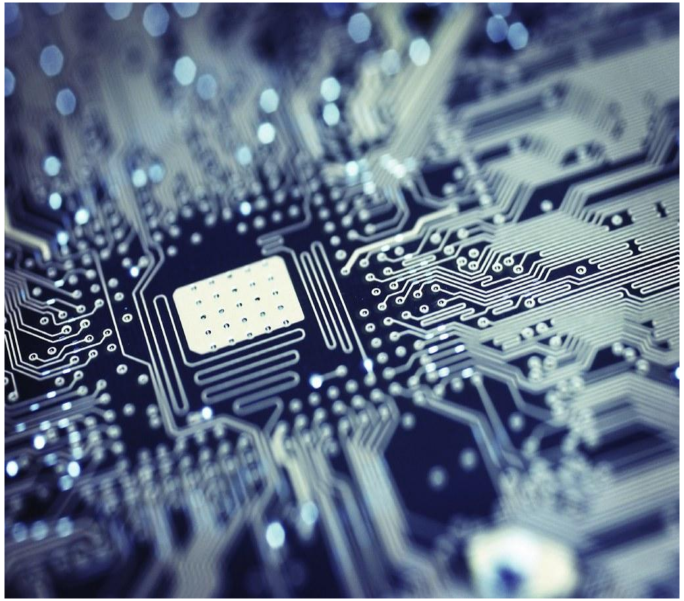
Dear Google,

- What is **Hardened JavaScript**?
- Why do we need it?
- How do we emulate it?
- Limits to faithful emulation
- How can JavaScript evolve to better support Hardened JavaScript?



Hardened JavaScript

It’s just JavaScript, plus:

- Lockdown
- Harden
- Compartment

Does:

- Integrity
- Multi-tenant
- API defensibility

Doesn’t (alone):

- Availability (Denial of Service)
- Side-channel (Spectre/Meltdown) resistance

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Example

```
lockdown();

const compartment = new Compartment();
harden(compartment.globalThis);

const SafeFunction = compartment.globalThis.Function;

const search = harden(query => {
  const match = new SafeFunction('item', query);
  const matches = [];
  for (const item of database.items()) {
    if (match(harden(item))) {
      matches.push(item);
    };
  }
  return harden(matches);
});
```

Why do we need Hardened JavaScript

That *any* JavaScript program consists of code that represents the interests of any single party is a rapidly deteriorating fiction.

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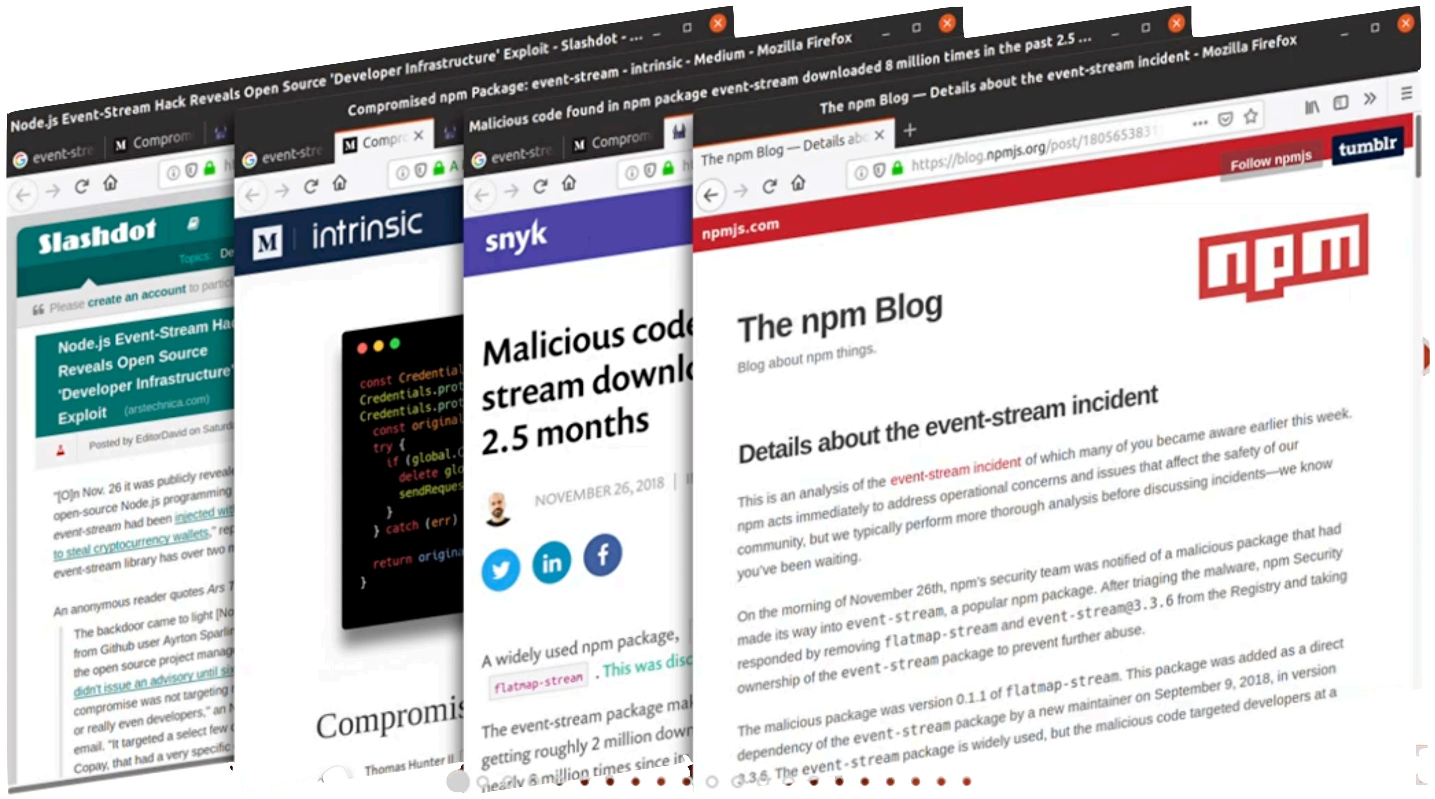
Why do we need HardenedJS

- Supply Chain Defense
- Decentralization / Mashups
- Smart Contracts
- Host Emulation



Node.js Event-Stream Hack Reveals Open Source 'Developer Infrastructure' Exploit - Slashdot - ...

Slashdot

Please create an account to partic

Node.js Event-Stream Hac
Reveals Open Source
'Developer Infrastructure'
Exploit (arstechnica.com)

Posted by EditorDavid on Saturd

"[O]n Nov. 26 it was publicly reveal
open-source Node.js programming
event-stream had been injected wit
to steal cryptocurrency wallets," rep
event-stream library has over two m

An anonymous reader quotes Ars T

The backdoor came to light [No
from Github user Ayrton Sparlin
the open source project manag
didn't issue an advisory until six
compromise was not targeting t
or really even developers," an N
email. "It targeted a select few
Copay, that had a very specific

Compromised npm Package: event-stream - intrinsic - Medium - Mozilla Firefox

intrinsic

```
const Credential
Credentials.prot
Credentials.prot
  const original
  try {
    if (global.c
      delete glo
      sendReques
    }
  } catch (err)

  return origina
}
```

Compromis

Thomas Hunter II

Malicious code found in npm package event-stream downloaded 8 million times in the past 2.5 ...

snyk

Malicious code
stream downl
2.5 months

NOVEMBER 26, 2018

A widely used npm package, flatmap-stream. This was disc

The event-stream package mal
getting roughly 2 million dow
nearly 8 million times since in

The npm Blog — Details about the event-stream incident - Mozilla Firefox

https://blog.npmjs.org/post/180565383

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The npm Blog

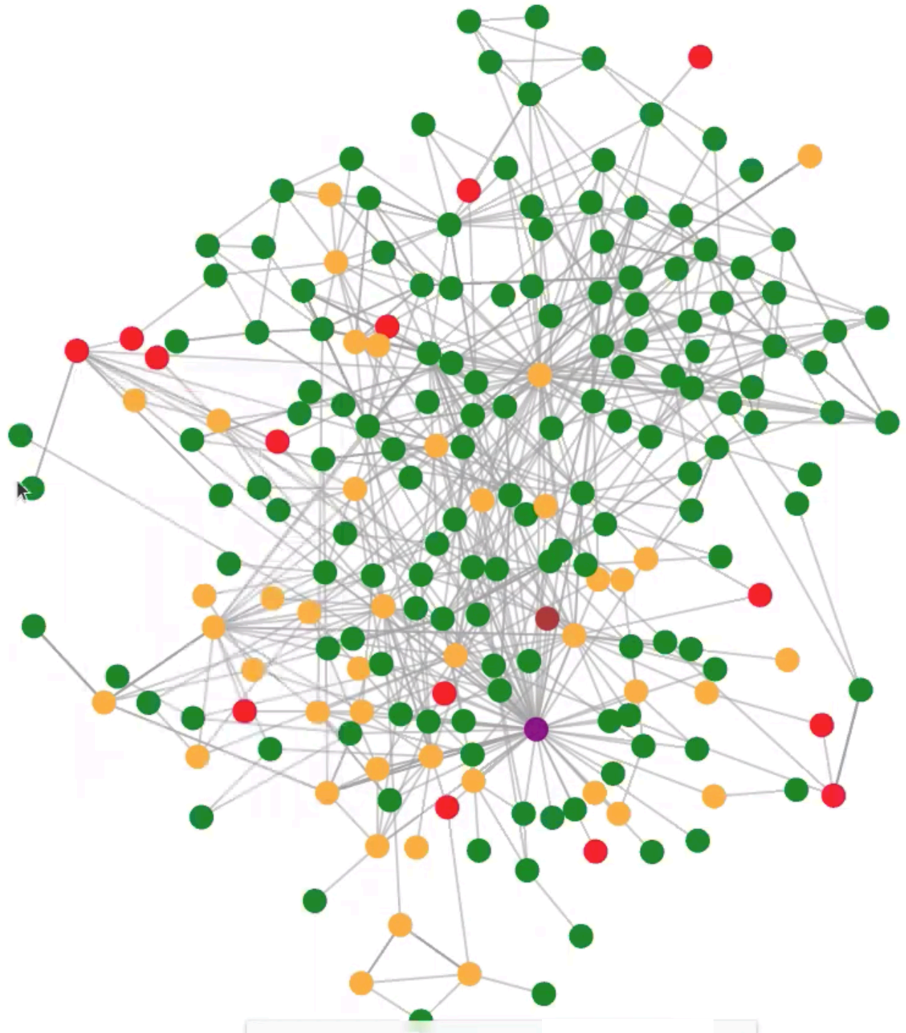
Blog about npm things.

Details about the event-stream incident

This is an analysis of the event-stream incident of which many of you became aware earlier this week. npm acts immediately to address operational concerns and issues that affect the safety of our community, but we typically perform more thorough analysis before discussing incidents—we know you've been waiting.

On the morning of November 26th, npm's security team was notified of a malicious package that had made its way into `event-stream`, a popular npm package. After triaging the malware, npm Security responded by removing `flatmap-stream` and `event-stream@3.3.6` from the Registry and taking ownership of the `event-stream` package to prevent further abuse.

The malicious package was version 0.1.1 of `flatmap-stream`. This package was added as a direct dependency of the `event-stream` package by a new maintainer on September 9, 2018, in version 3.3.6. The `event-stream` package is widely used, but the malicious code targeted developers at a



Emulating Hardened JavaScript Today

- `with`
- `eval`
- `Proxy`
- Sloppy mode

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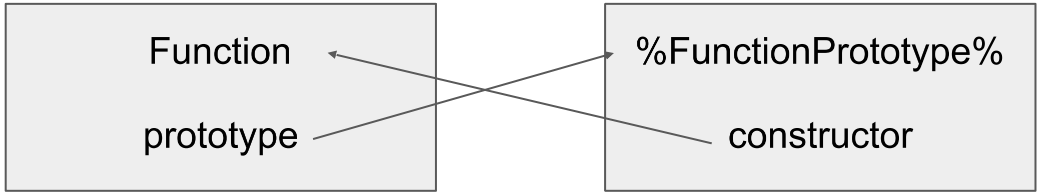
The Device

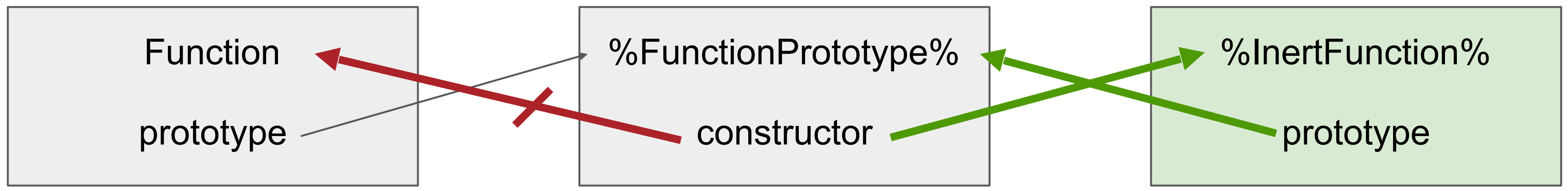
```
const makeEval = Function(`
  with (this.scopeTerminator) {
    with (this.globalObject) {
      with (this.moduleLexicals) {
        with (this.evalScope) {
          ${globalObjectOptimizer} // const {a,b,c} = this.globalObject;
          ${moduleLexicalOptimizer} // const {d,e,f} = this.moduleLexicals;
          return function(/* source */) {
            'use strict';
            return eval(arguments[0]); // censored: eval, import, HTML comments
          };
        }
      }
    }
  }
`);
```

Shared Intrinsics



```
new Function("return 42") instanceof Function
    new Function.constructor("return 42")
```

Lockdown Shared Intrinsics



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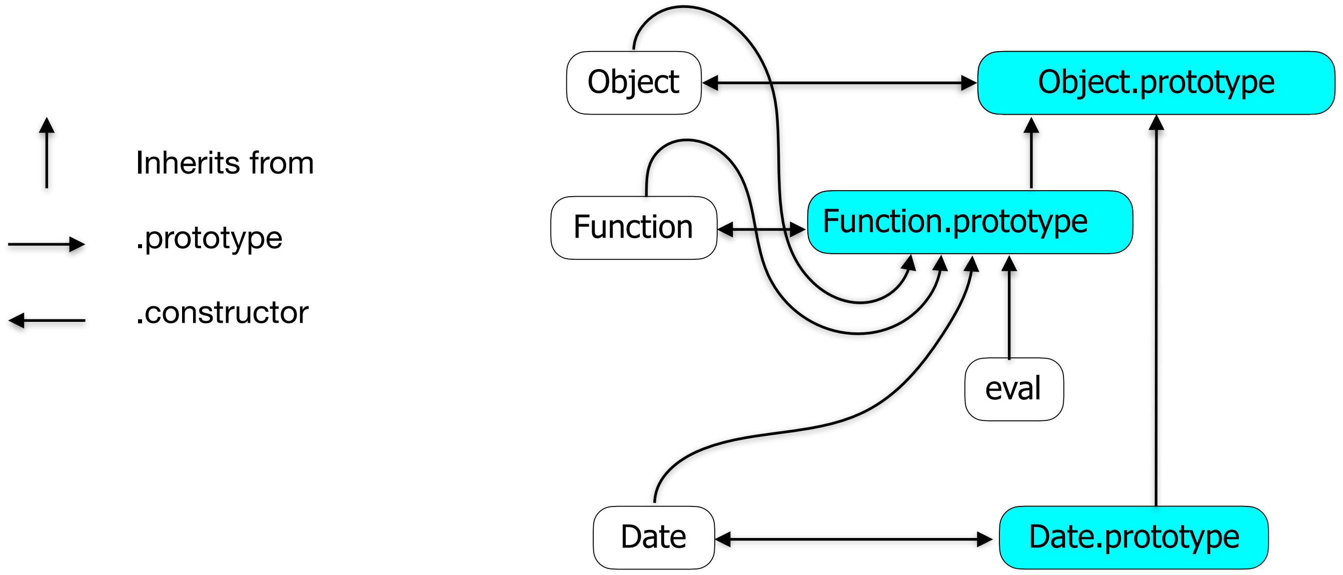
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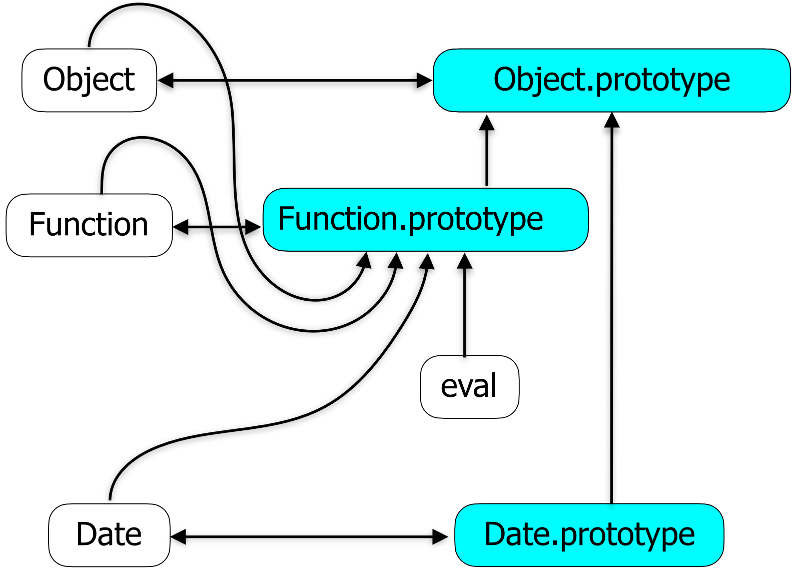
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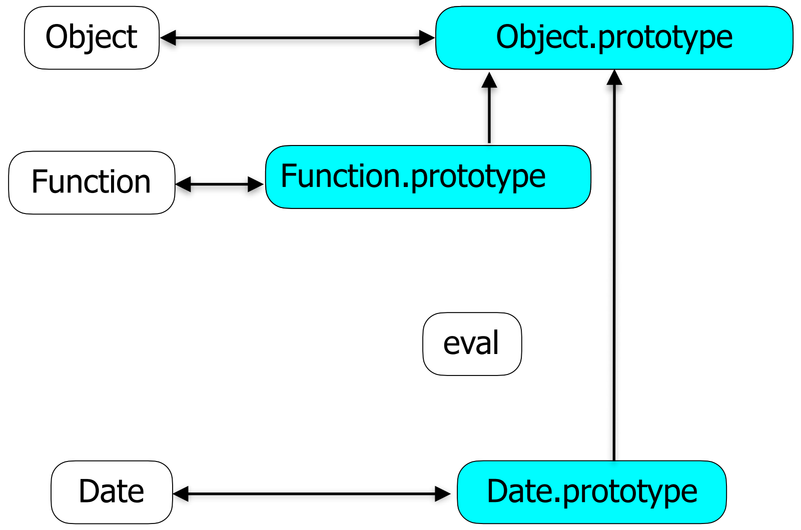
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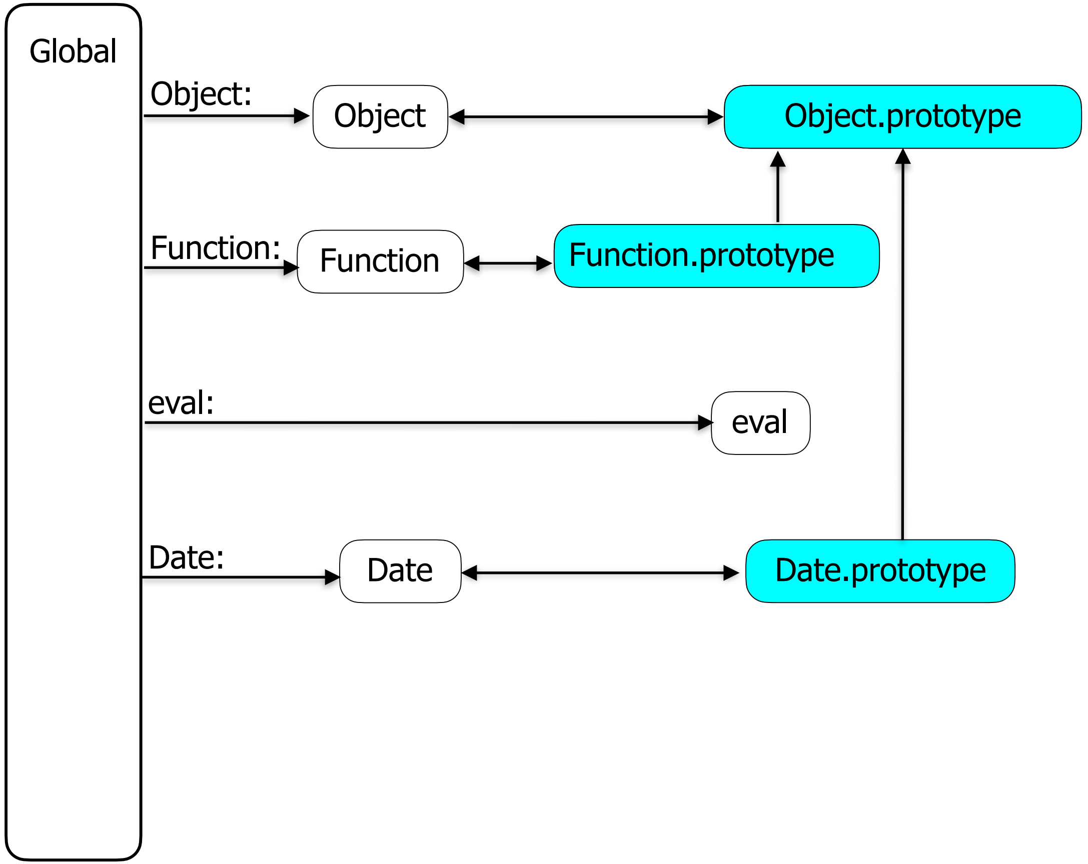
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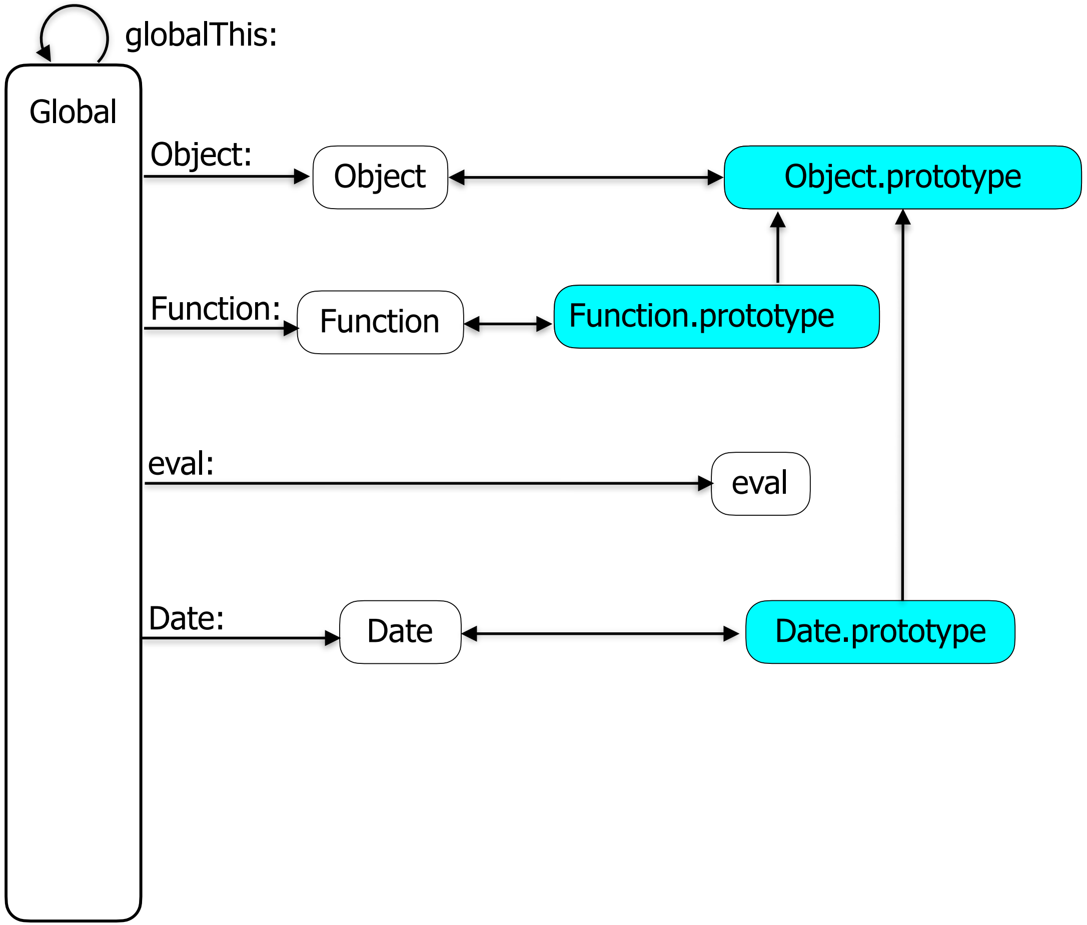
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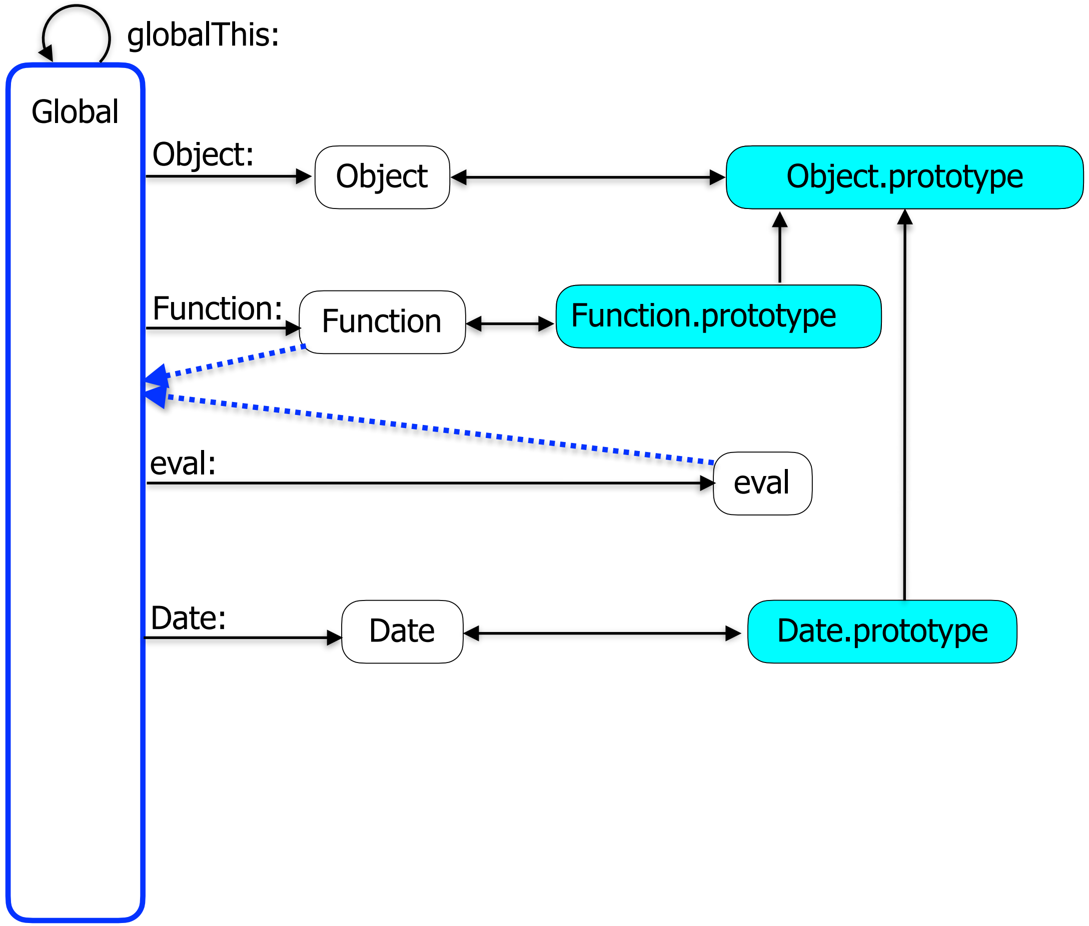
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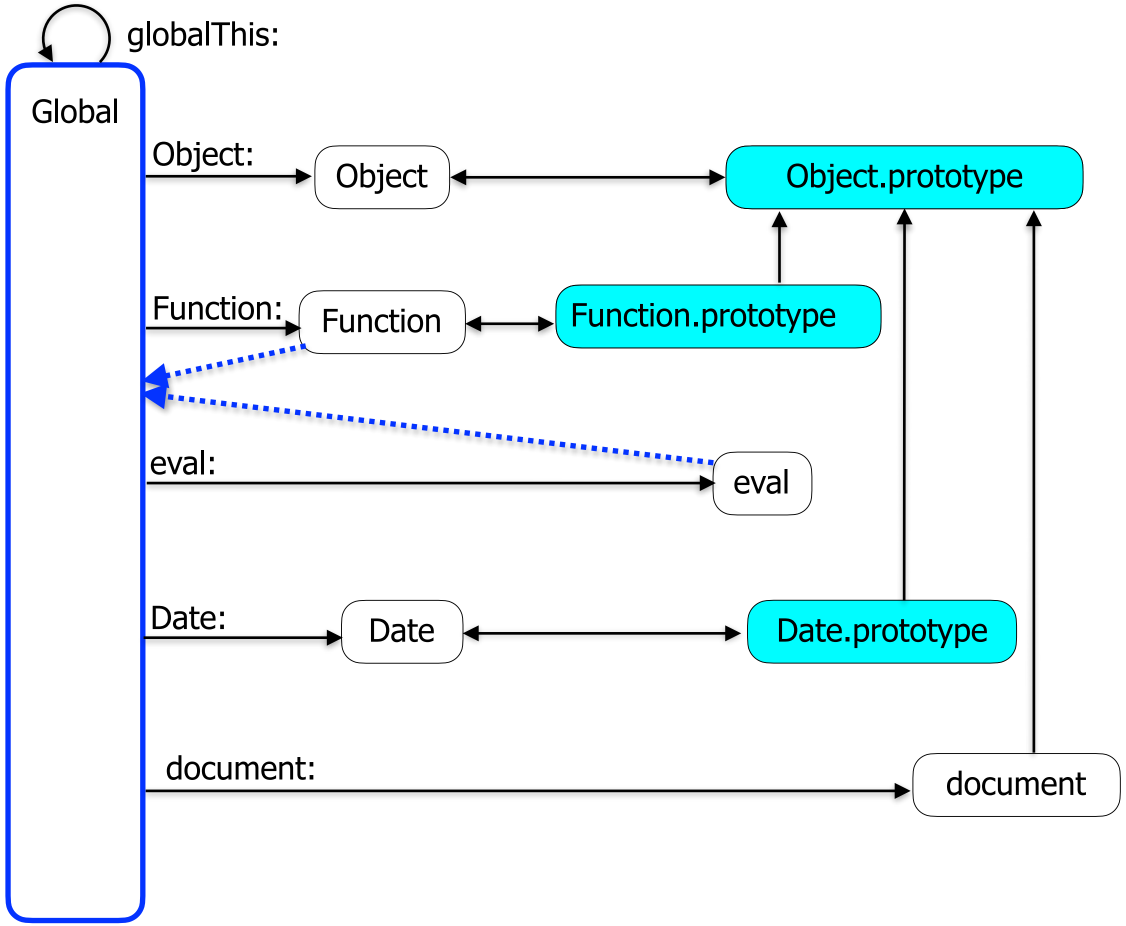
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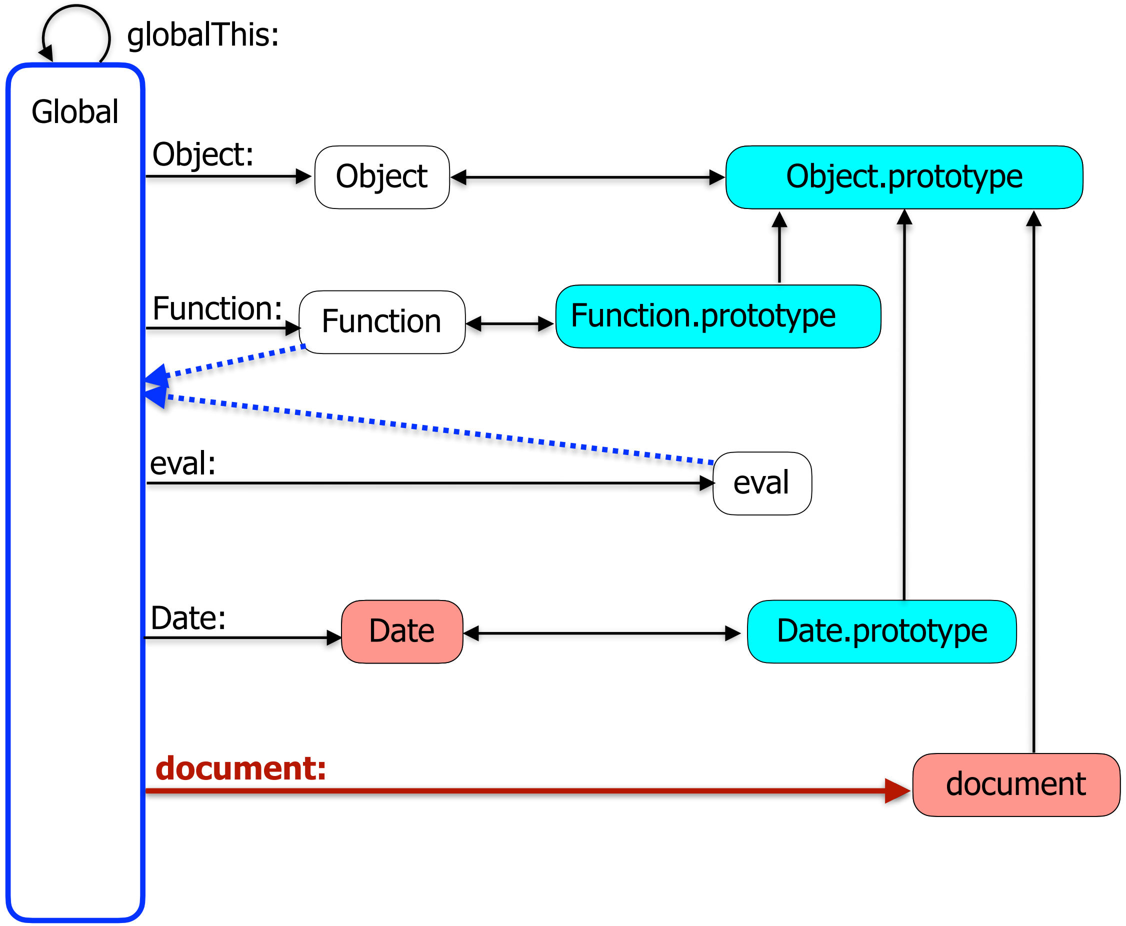
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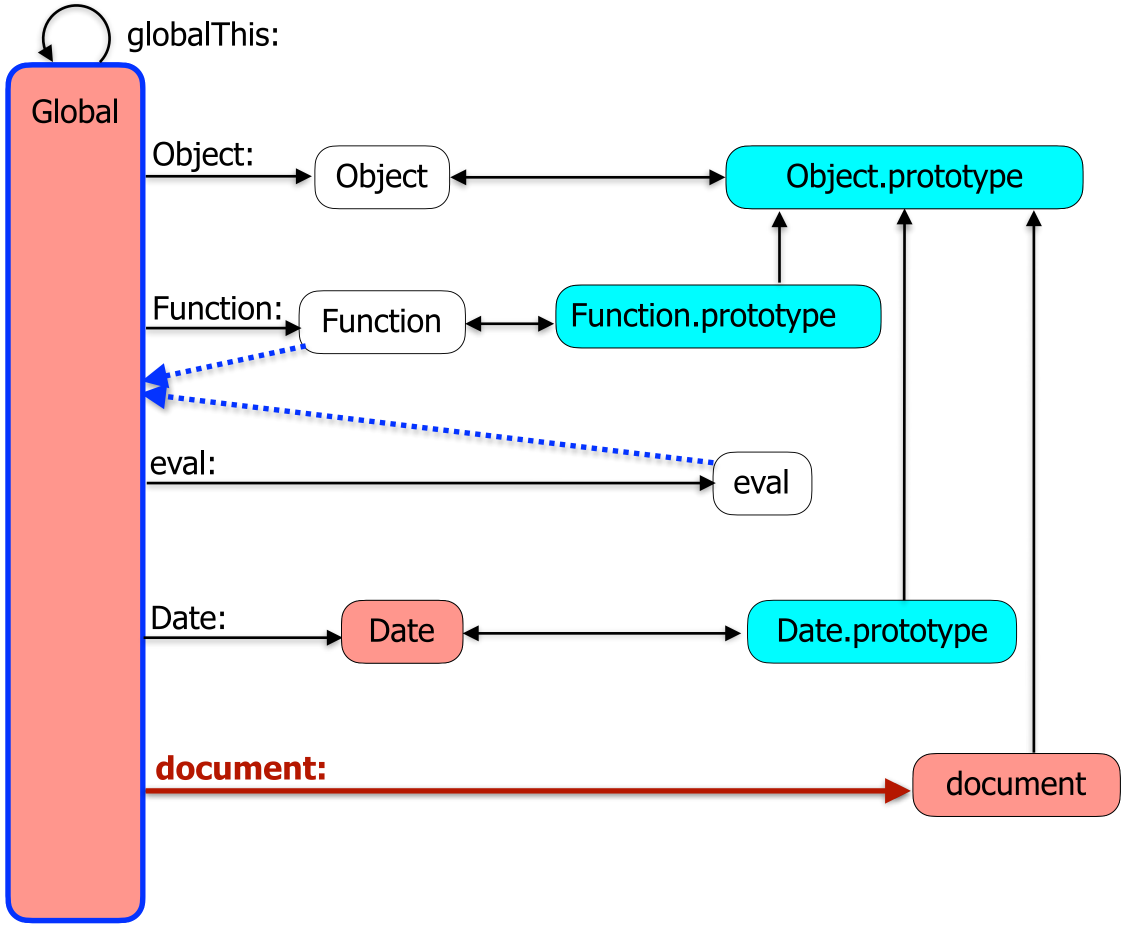
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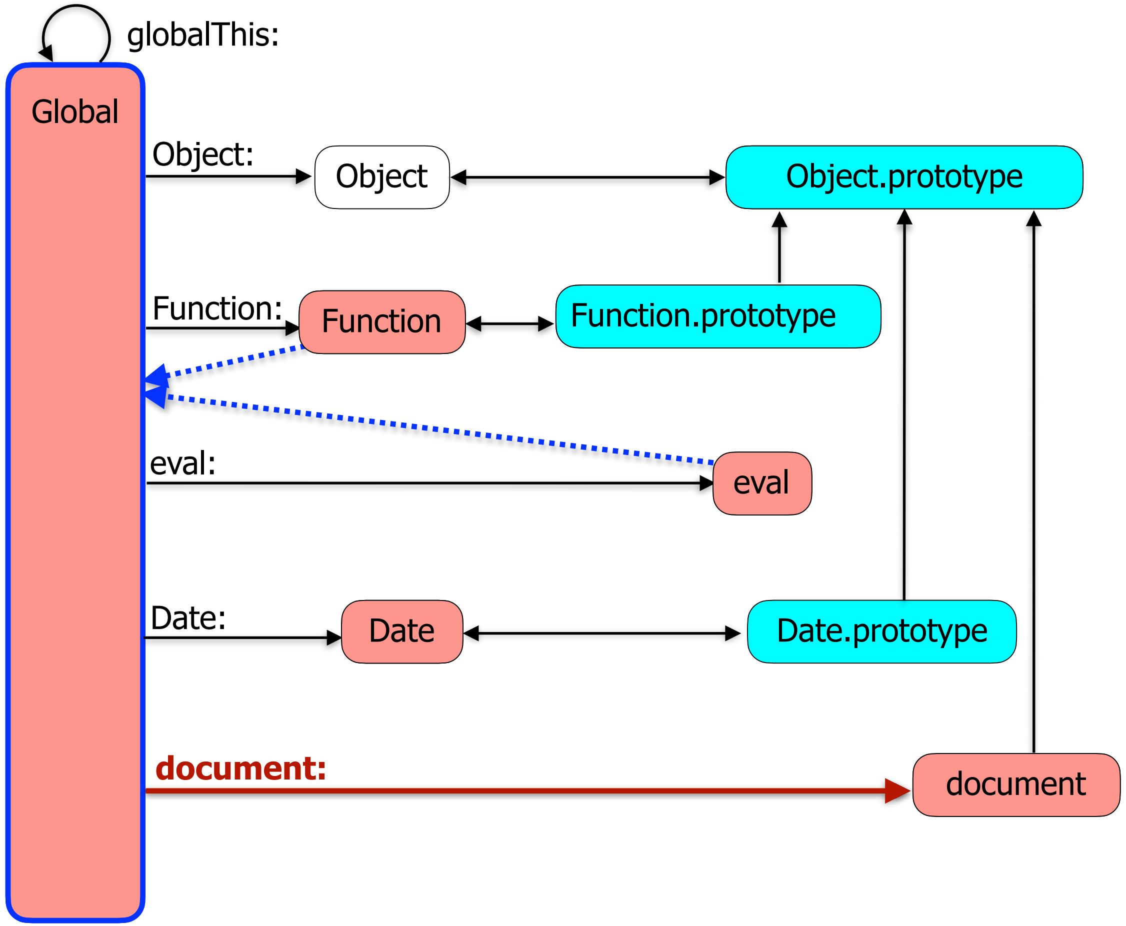
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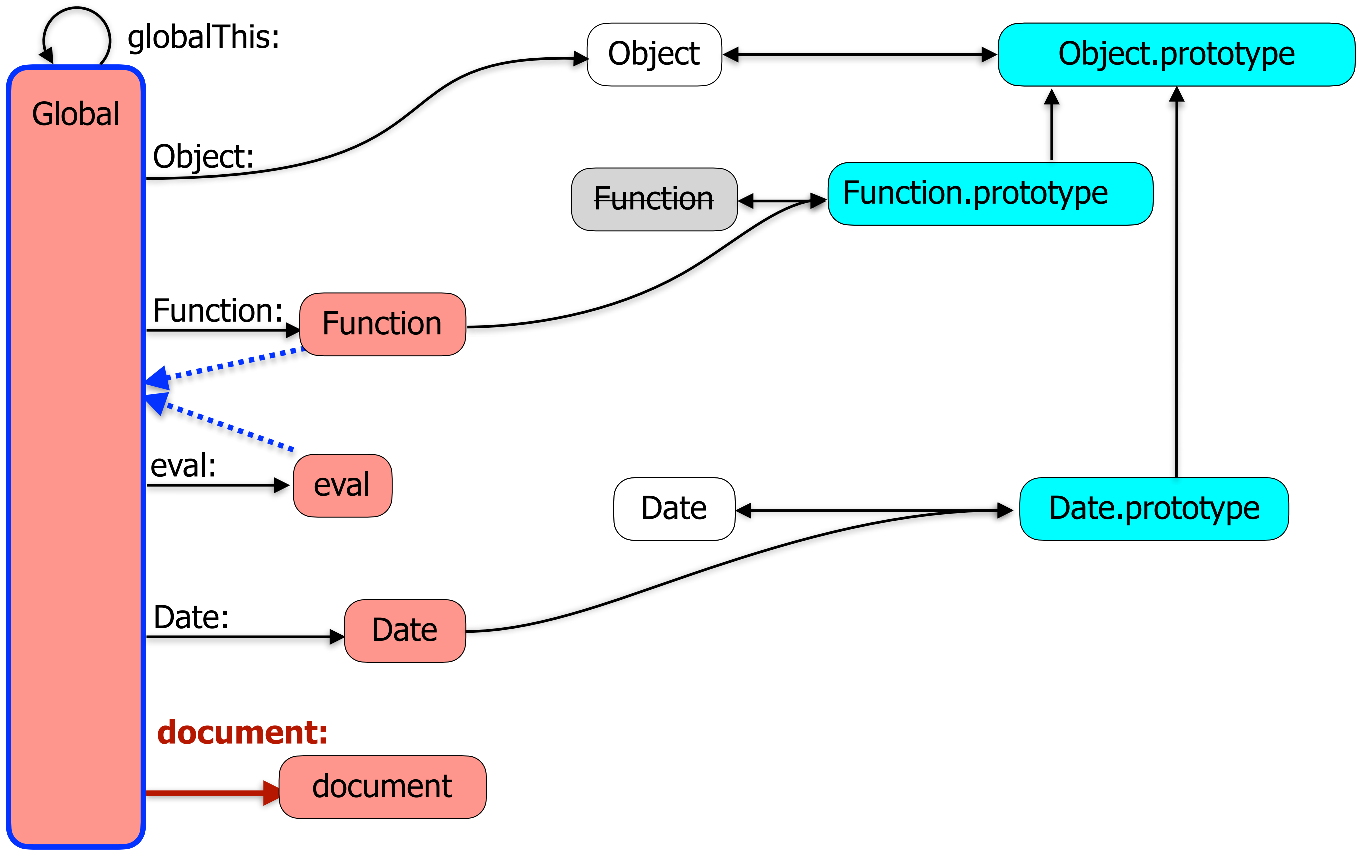
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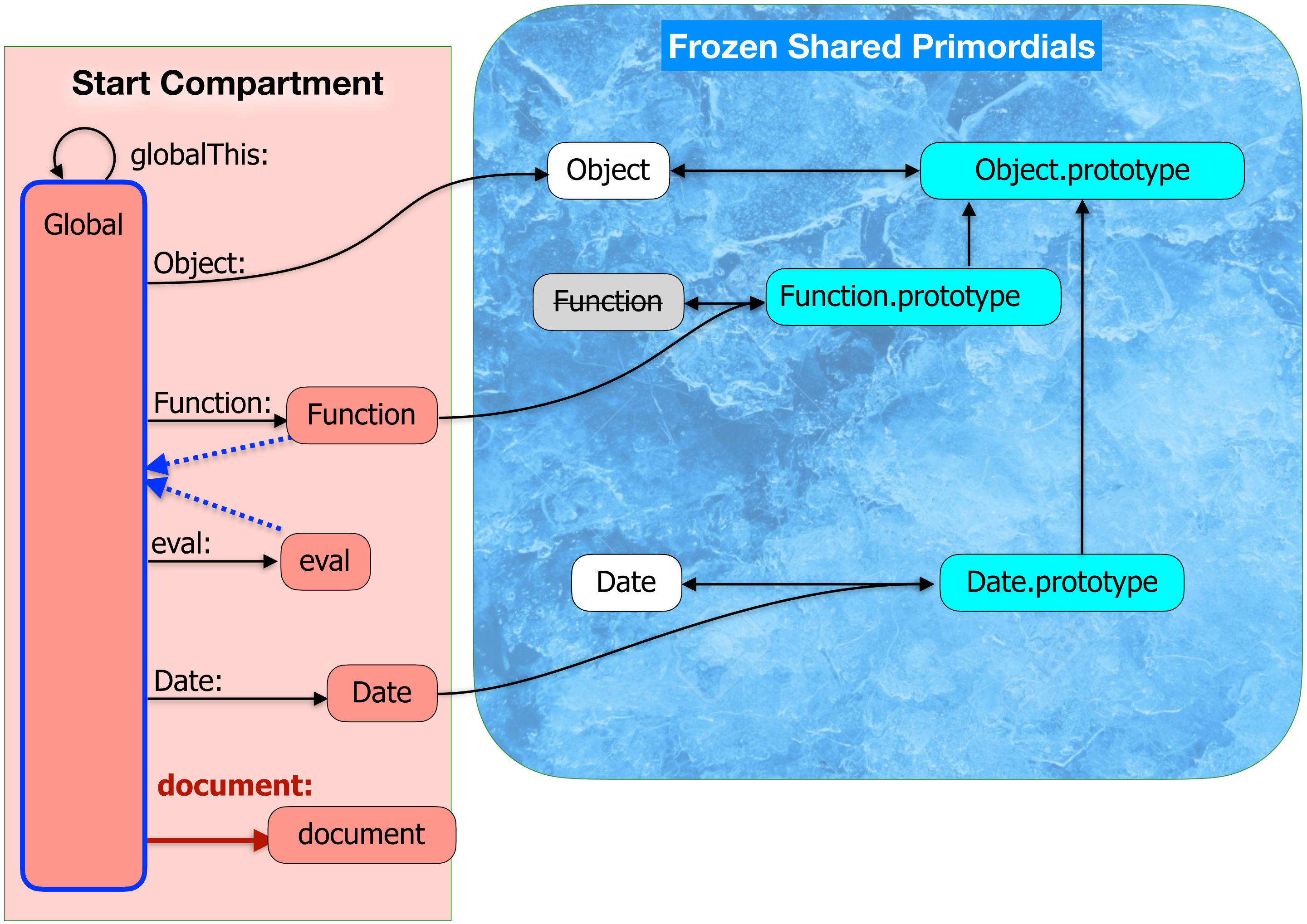
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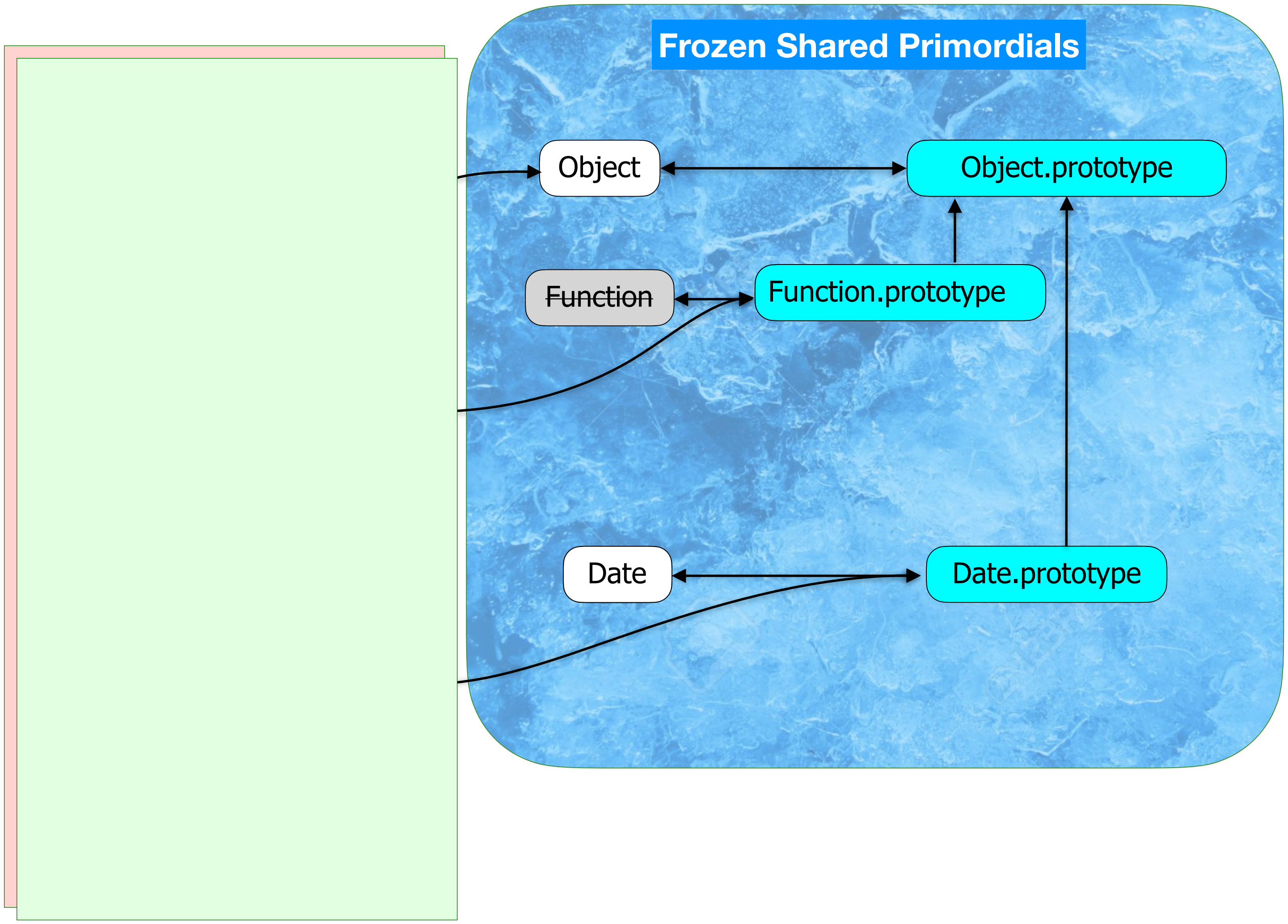
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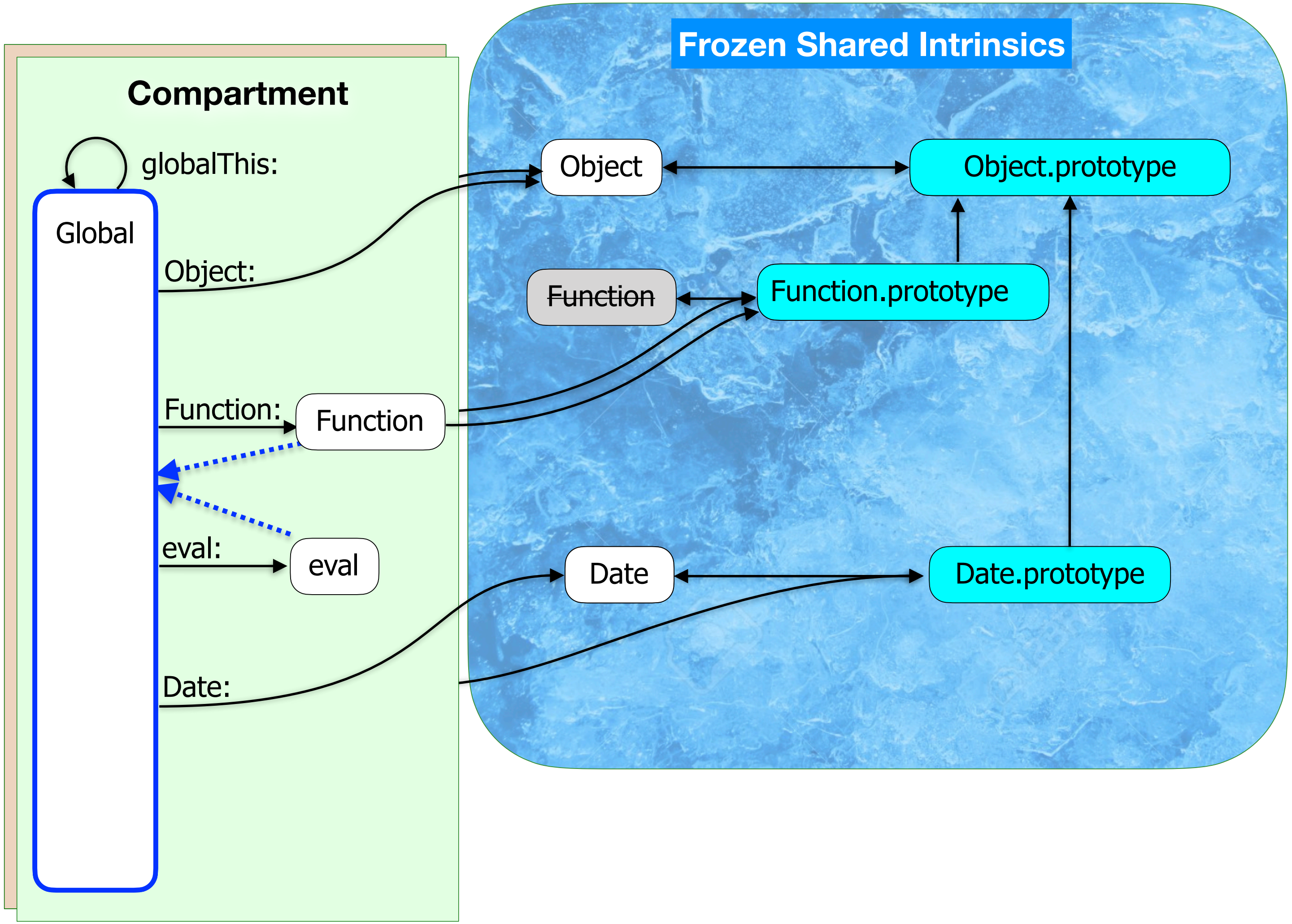
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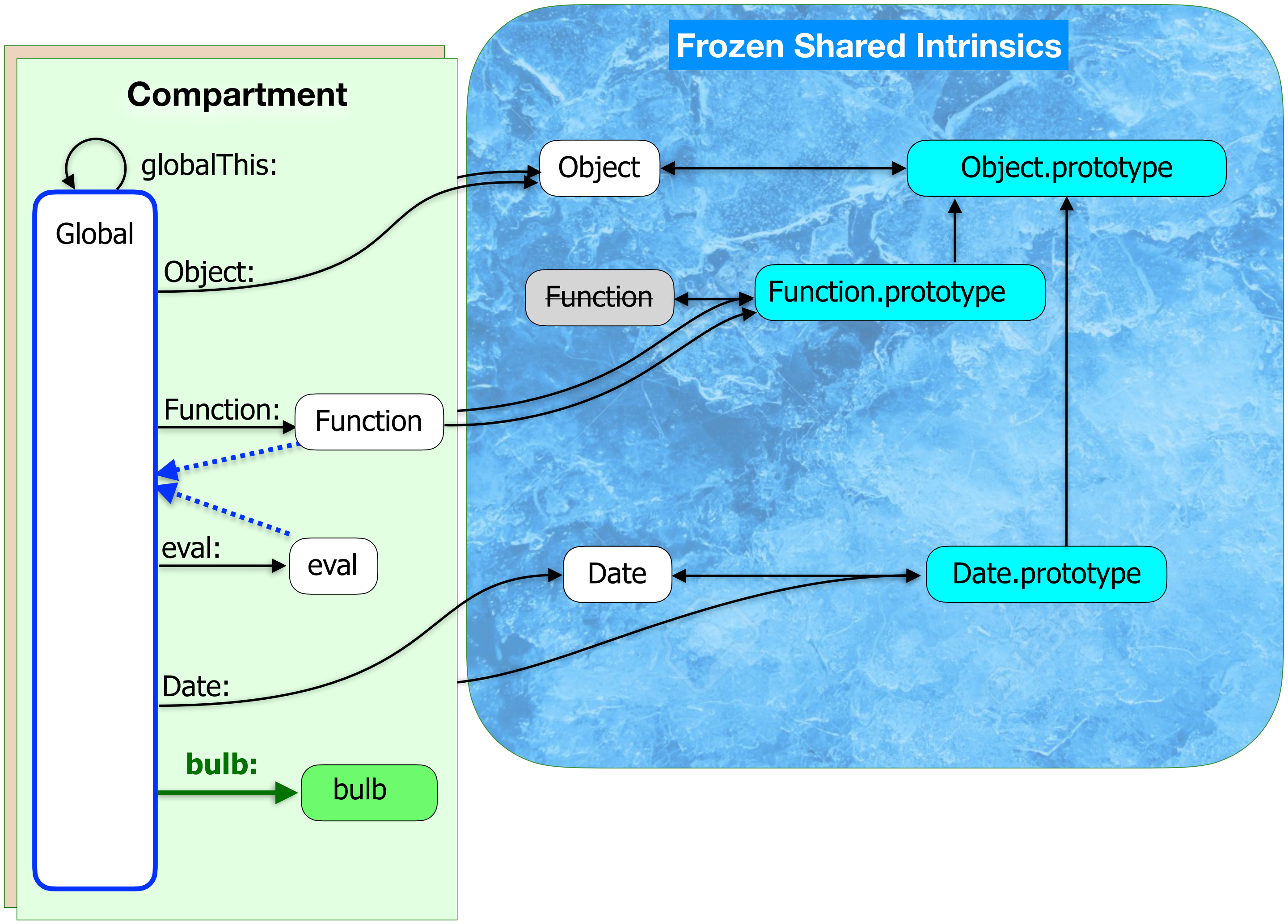
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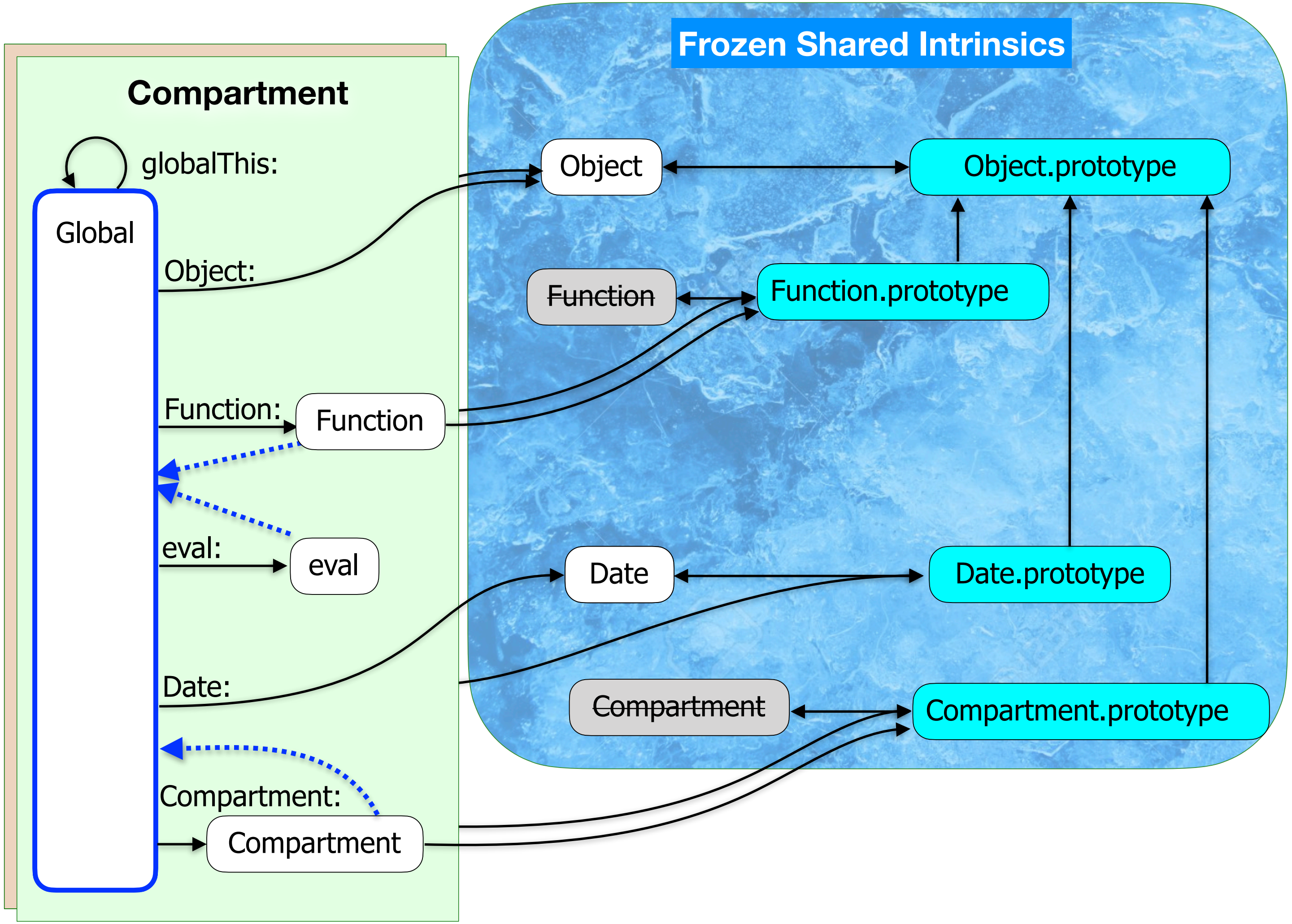
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Taming of the Realm

- Tame RegExp constructor
- Tame Function constructors
- Disable Math.random
- Disable Date.now
- %SharedSymbol% snapshot
- &c

Caveats, Provisos, and Quid Pro Quos

A Hardened JavaScript shim admits an astonishing body of existing JavaScript, but a native implementation can admit even more.

Limitations of the emulation

- **Property override mistake**
- Censorship of eval, import, import.meta, and HTML comment **syntax**
- Revelation of module lexicals scope object
- Limitations to typeof

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Property Override Mistake

```
lockdown();

const x = {};
x.constructor = function () {};
x.toString = function () { return 'x'; };

Cannot assign to read only property 'constructor' of
object '[object Object]'
```

How can JavaScript Improve HardenedJS

Native implementations of Hardened JavaScript can confine nearly any JavaScript program.

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How JavaScript can grow to help

- Override integrity level
- Evaluators
- Module Harmony
- Please, move the stack back to Error prototype.

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Dear Google,

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- How do we emulate it?
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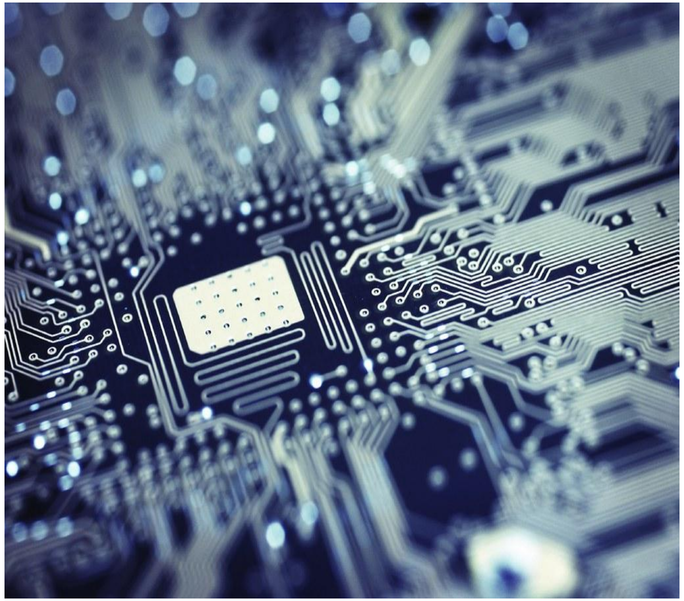
- How can JavaScript evolve to better support Hardened JavaScript?



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References

- SES (Hardened JavaScript shim)
- TC39 Compartments Proposal

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