Blazor: .NET in the browser with WebAssembly

Bart Verkoeijen – @bgever

24 Nov 2018 – CodeConf Hong Kong

The coding language for the web

JavaScript

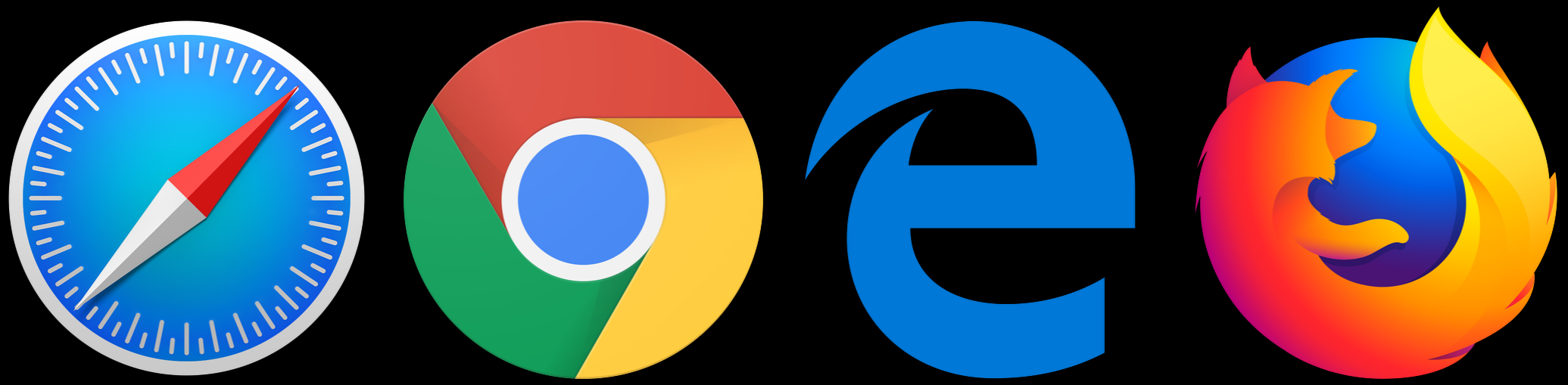
Code for the web with
high-level programming languages

WebAssembly
(wasm)

Major languages supported by WebAssembly

- **C, C++, and Rust**
- **C#/.NET, Go, D, Python, Java, Kotlin, Ruby, PHP**

Supported in all major browsers

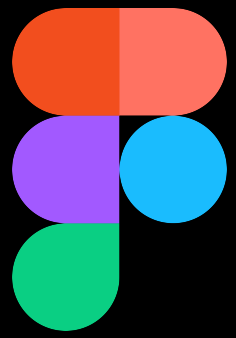


With `asm.js` supports also  **and other older browsers**

What are the benefits?

- Use your **preferred language** to target the web (no JS)
- Leverage **existing tools and libraries** – portability
- Paradigms like **strong typing, functional programming, OOP**
- Better **performance,** faster startup time
- Safe **sand-boxed** environment (browser's same-origin and permissions policies)
- **JavaScript interop** – complement rather than replace

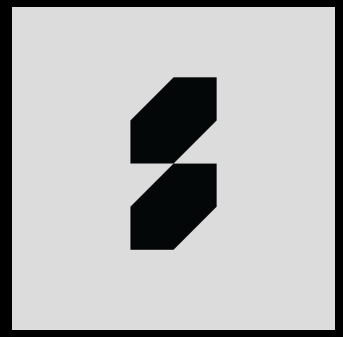
Products using WebAssembly



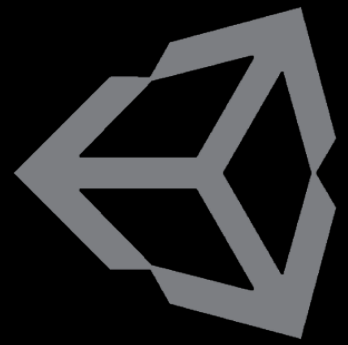
Figma

Google Earth

SketchUp



Soundation



Unity

PSPDFKit

Let’s dive deeper

Designed by a web standards team

- **W3C Community Group**
  www.w3.org/community/webassembly/
  Includes members of all major browsers

- **W3C Working Group**
  www.w3.org/wasm/

Progress

MVP

- **Binary module format for execution**
- **Feature parity with asm.js**

Shipped in major browsers
Oct 2017

After the MVP

- **Threads**
- **Exception handling**
- **Garbage Collection**
- **ECMAScript module integration**
- **…**

https://webassembly.org/docs/future-features/

How the compiler works

ABOUT THE AUTHOR

Lin is an engineer on the Mozilla Developer Relations team. She tinkers with JavaScript, WebAssembly, Rust, and Servo, and also draws code cartoons. More about Lin

may 11, 2017 • 22 comments

An Abridged Cartoon Introduction To WebAssembly

QUICK SUMMARY ↬ *There's a lot of hype about WebAssembly in JavaScript circles today. People talk about how blazingly fast it is, and how it's going to revolutionize web development. But most conversations don't* ***go into the details of why it's fast****. In this article, I want to help you understand what exactly it is about WebAssembly that makes it fast. But first, what is it? WebAssembly is a way of taking code written in programming languages other than JavaScript and running that code in the browser.*

29 min read

Coding, JavaScript, Browsers

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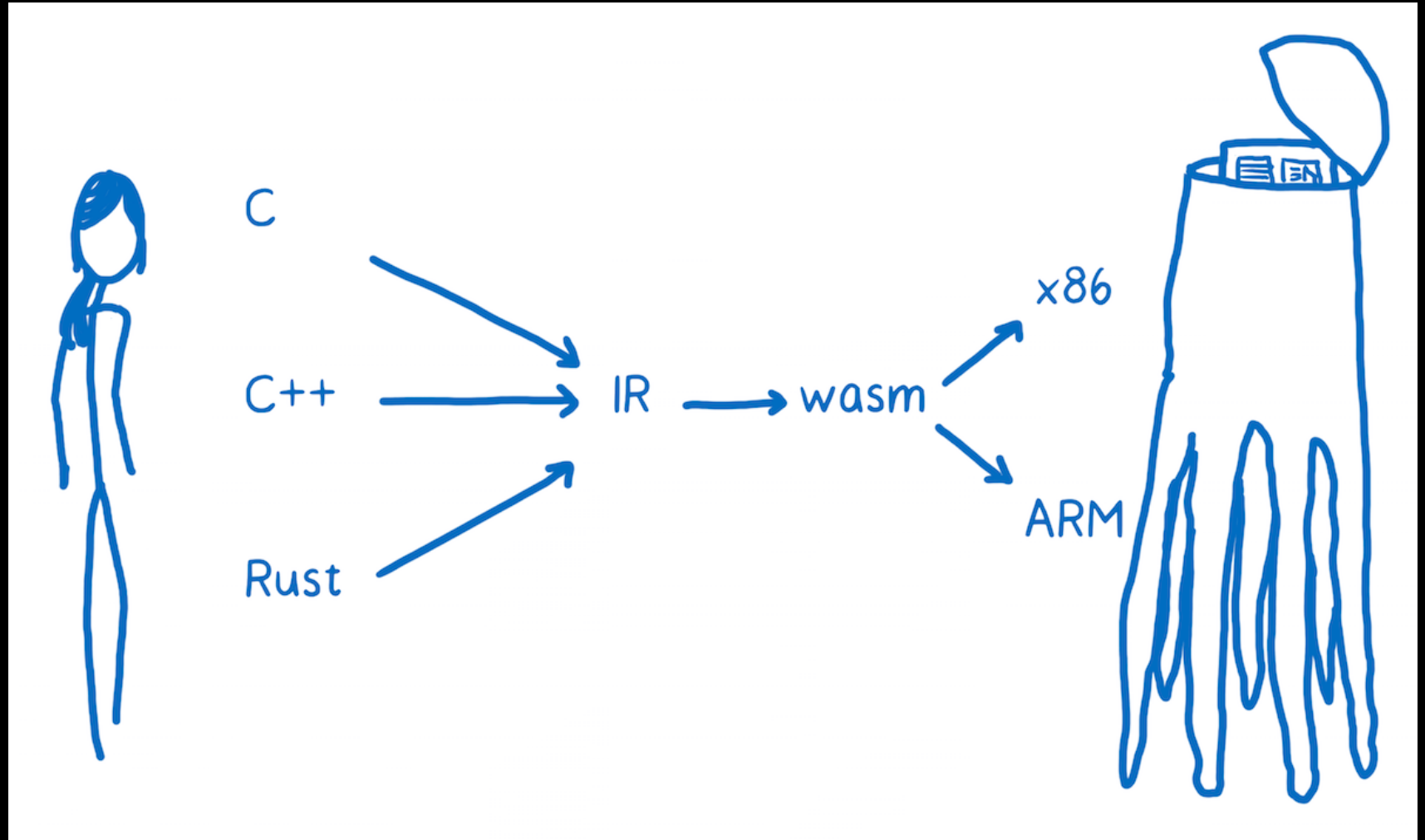
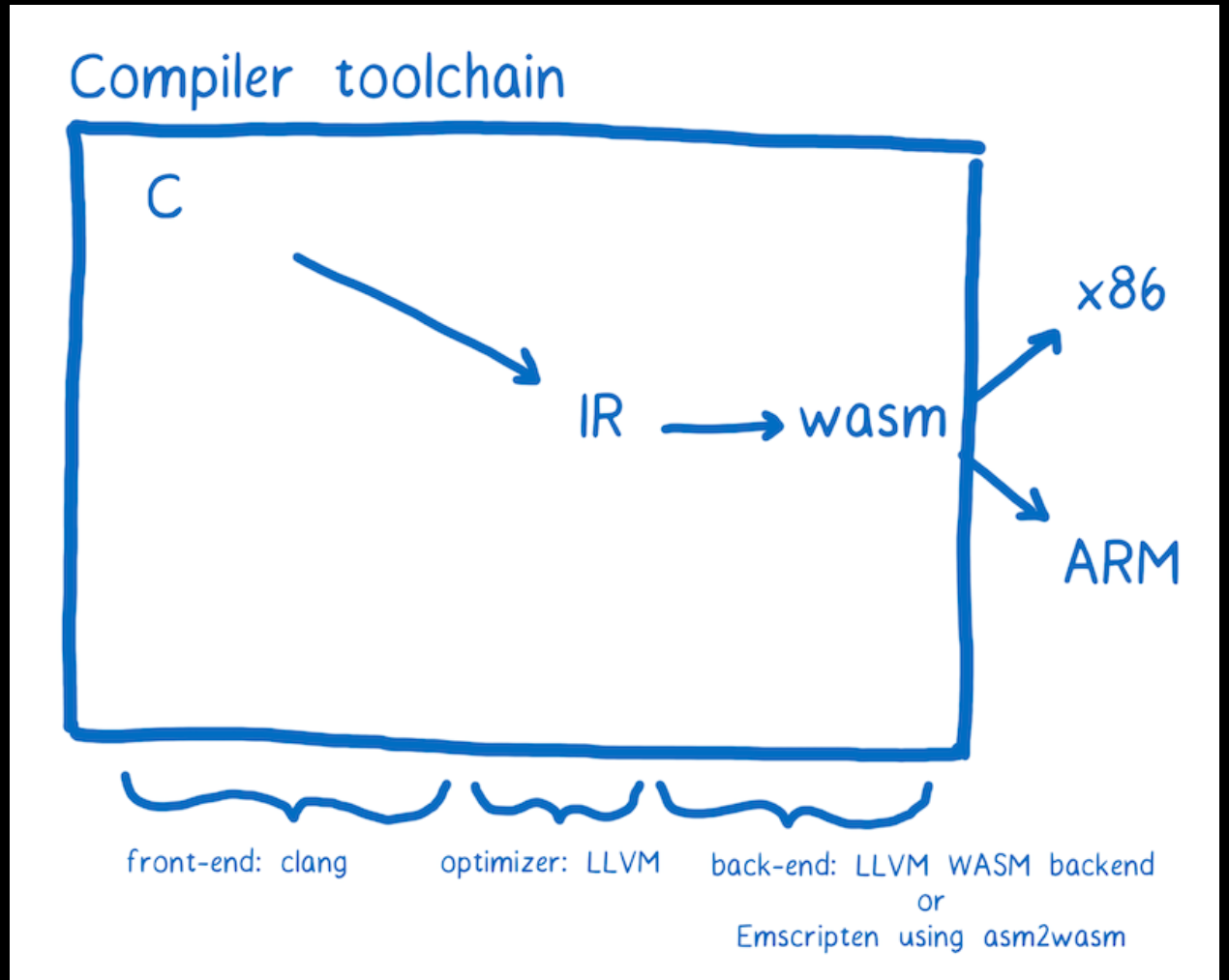
www.smashingmagazine.com/2017/05/abridged-cartoon-introduction-webassembly/

How the compiler works

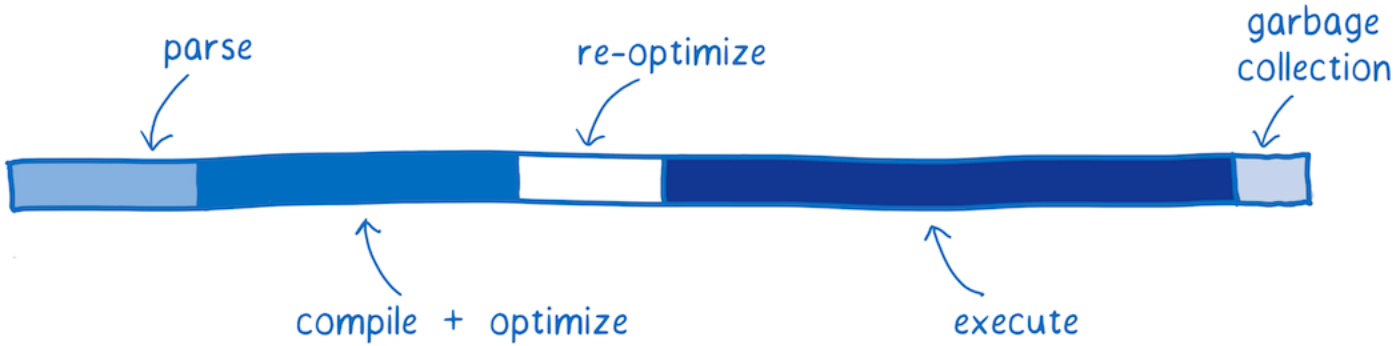


How the compiler works

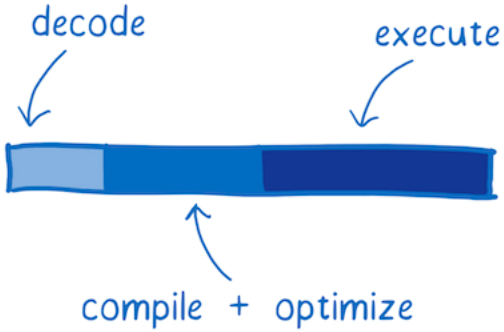


Resource loading

JS



WA



At runtime – Initiating

WIP: `<script type="module">` **or ES2015** `import`**, use loader script**

```
// With streaming support
WebAssembly.instantiateStreaming(
  fetch('simple.wasm'), importObject)
.then(results => { /* Do something with the results! */ });


// WebAssembly 1.0 browsers
fetch('module.wasm’)
.then(response => response.arrayBuffer())
.then(bytes => WebAssembly.instantiate(bytes, importObject))
.then(results => { /* Do something with the results! */ });
```

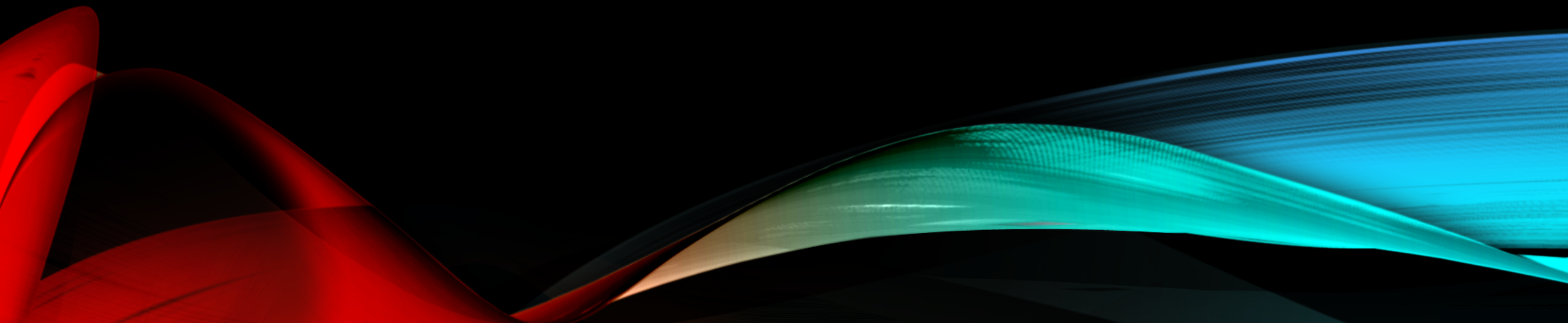
Demo: C to Wasm

Challenges

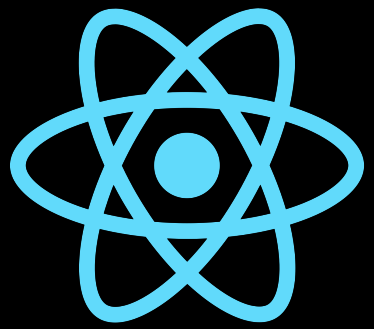
- **No direct access to the DOM**
- **Memory management – numeric**
- **JS interop overhead**
- **Tree shaking**

- Early days – tooling in development
- Debugging
- Multi-treading
- Source maps
- Garbage collection (GC)

.NET in the browser



A story about SPA frameworks



Blazor
(.NET/C#)

Yew
(Rust)

Adding the missing pieces to Wasm

- **DOM & Browser APIs**
- A component model for building composable UI
- Routing
- Layouts
- Forms and validation
- Dependency injection
- JavaScript interop

- Live reloading in the browser during development
- Server-side rendering
- Full .NET debugging both in browsers and in the IDE
- Rich IntelliSense and tooling
- Ability to run on older (non-WebAssembly) browsers via asm.js
- Publishing and app size trimming

Web Apps can't really do *that*, can they? - Steve Sanderson

136,608 views

2.2K 71 SHARE SAVE

Hello WebAssembly

Miguel de Icaza August 9, 2017 runtime

We have been experimenting with a couple of approaches to bring Mono to the web using WebAssembly - a technology that can efficiently and safely execute code in web browsers without being limited to Javascript. Running code written in C or C++ inside the browser has been a big motivator, but most major programming languages have plans to target WebAssembly as a platform.

WebAssembly has been out for a few months on desktop computers and Android, and with the introduction of iOS 11 it will become nearly universal.

We have done some exploratory work to identify what needs to be done to run Mono on the browser. The early experiments are promising, let me talk about those.

Mono supports various execution modes, it ranges from the traditional fully just-in-time compiled, to fully statically compiled with a couple of hybrid modes in between (statically compiled with JIT, and statically compiled with an interpreter).

Today we have two prototypes running in WebAssembly.

ASP.NET Blog

.NET web development and tools at Microsoft

A new experiment: Browser-based web apps with .NET and Blazor

February 6, 2018 by Daniel Roth // 22 Comments

Today I'm excited to announce a new experimental project from the ASP.NET team called Blazor. Blazor is an experimental web UI framework based on C#, Razor, and HTML that runs in the browser via WebAssembly. Blazor promises to greatly simplify the task of building fast and beautiful single-page applications that run in any browser. It does this by enabling developers to write .NET-based web apps that run client-side in web browsers using open web standards.

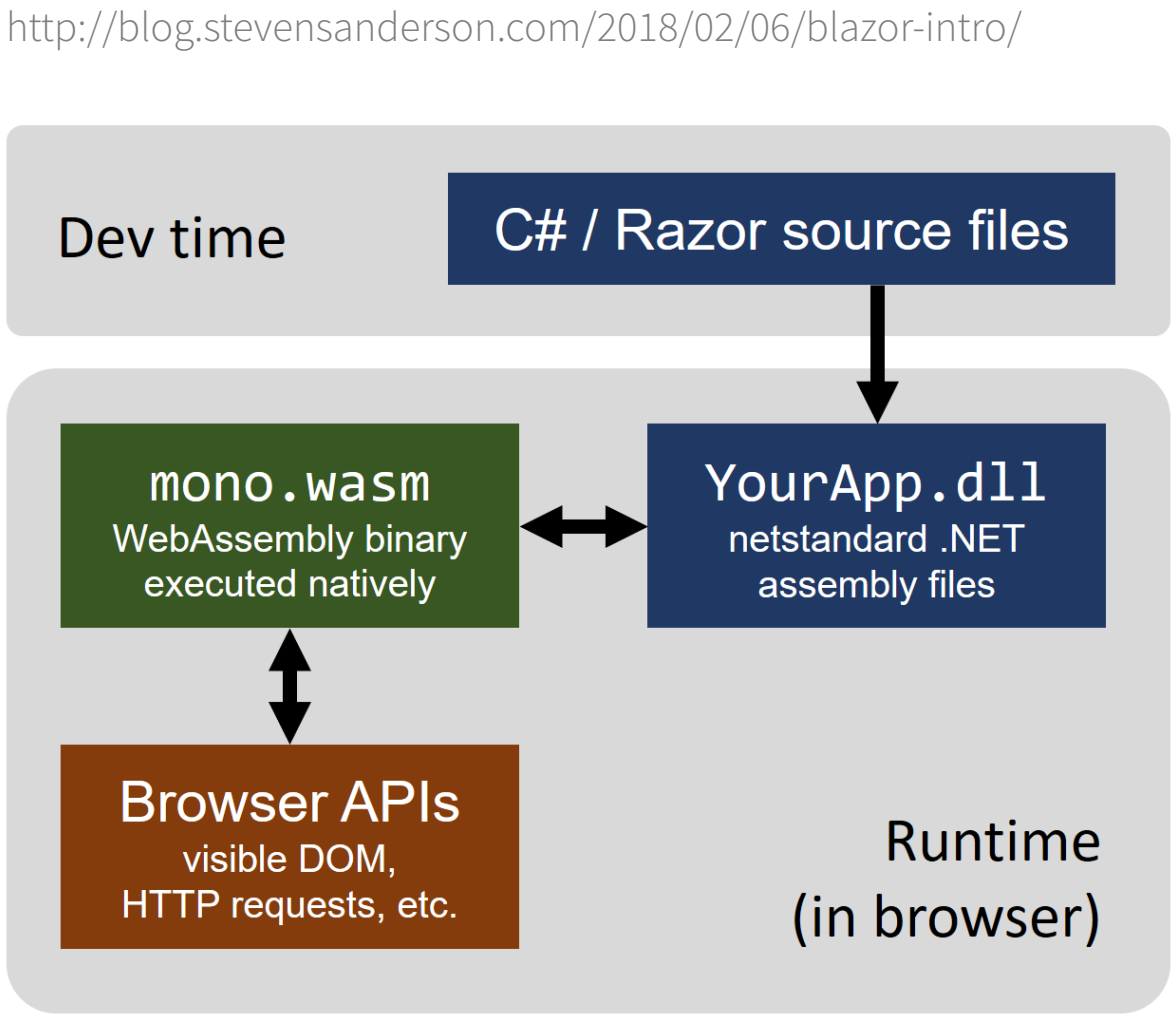
If you already use .NET, this completes the picture: you'll be able to use your skills for browser-based development in addition to existing scenarios for server and cloud-based services, native mobile/desktop apps, and games. If you don't yet use .NET, our hope is that the productivity and simplicity benefits of Blazor will be compelling enough that you will try it.

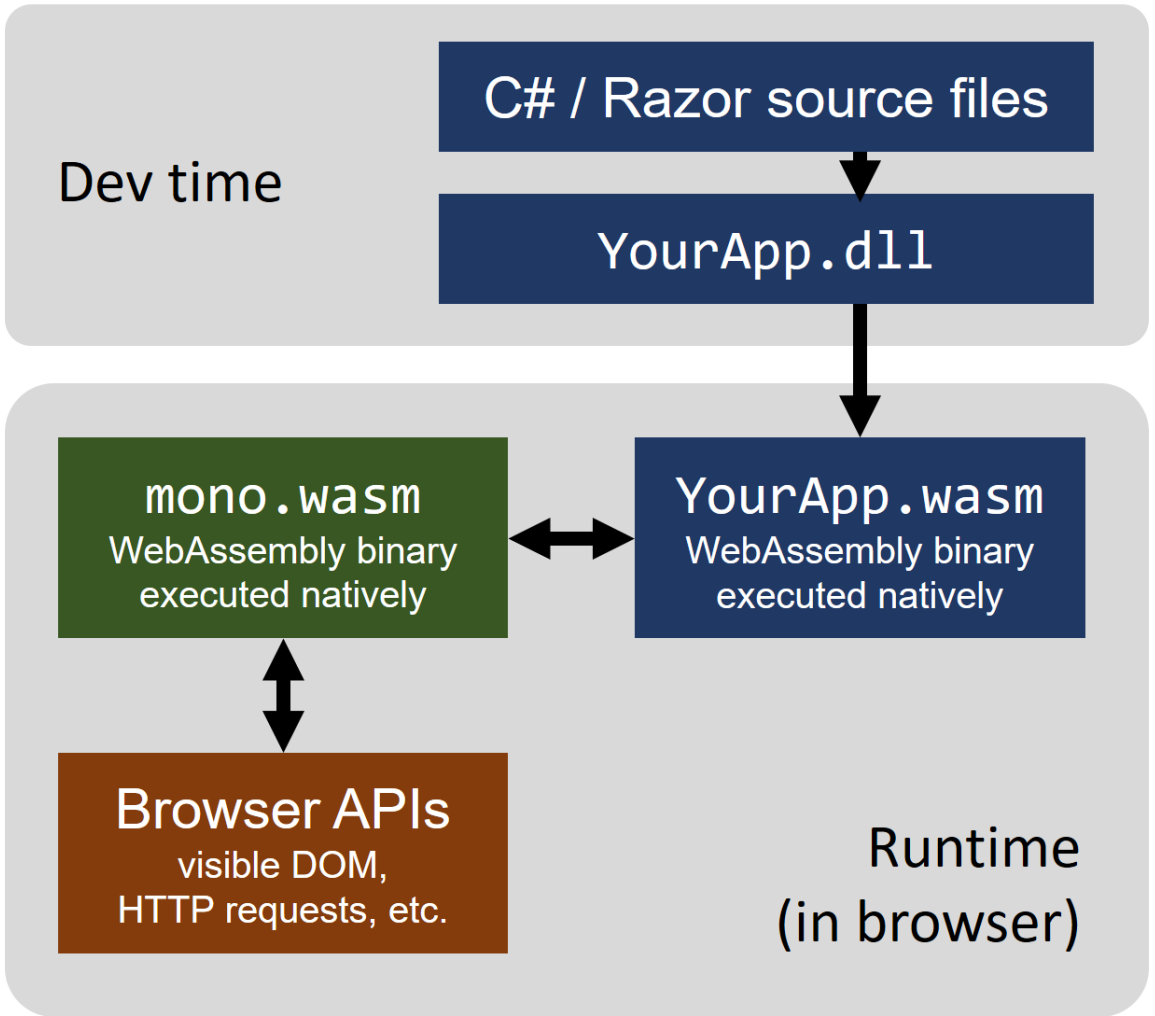
An experiment: Blazor

- **Jun 2017**
  Steve Sanderson showcases Blazor hacky experiment
- **Aug 2017**
  Mono project announces experimental WebAssembly compilation target
- **Nov 2017**
  Steve Sanderson switches Blazor to Mono runtime
- **Feb 2018**
  ASP.NET Team announces that they continue the experiment

Interpreted vs Ahead-of-Time (AOT)

http://blog.stevensanderson.com/2018/02/06/blazor-intro/



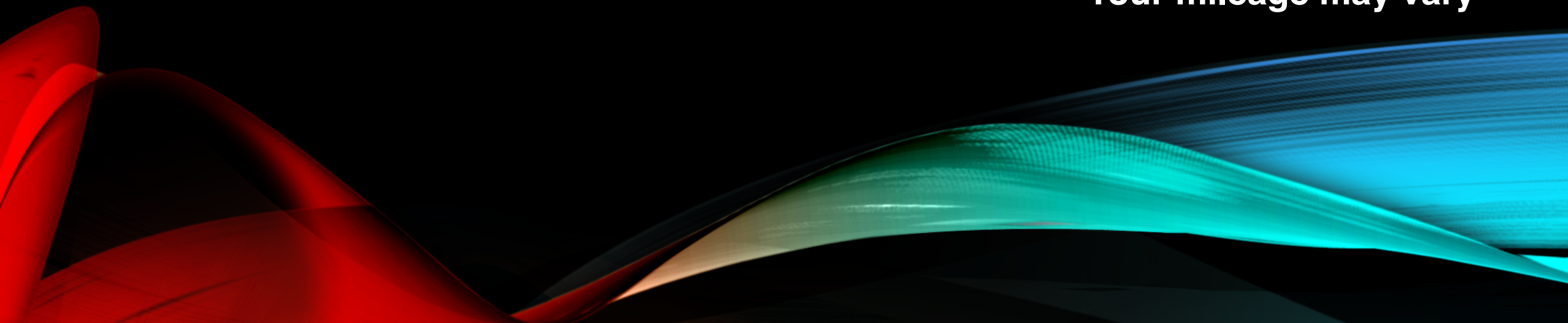


Demo: Blazor

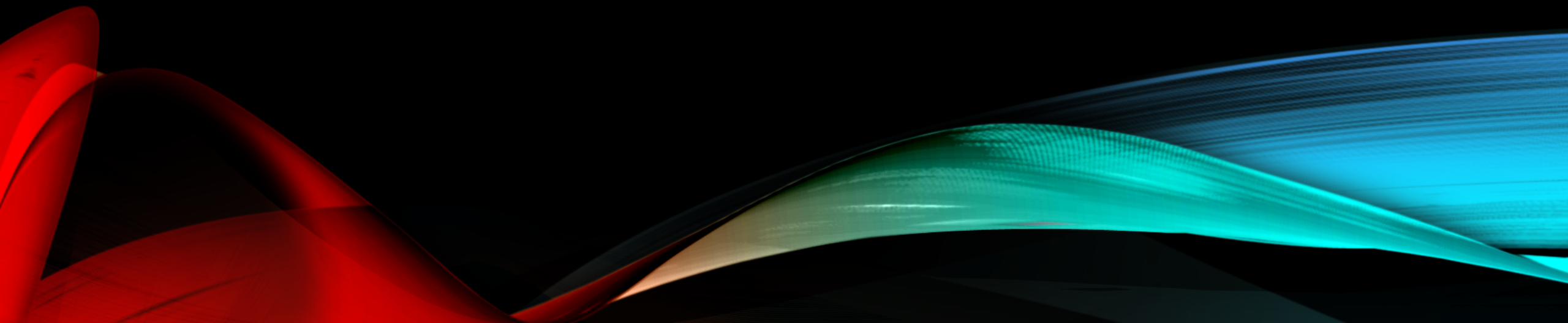
A word about performance

Blazor is still an experiment

Your mileage may vary



Closing thoughts



Further reading

- **WebAssembly**
  www.webassembly.org
- **Lin Clark's An Abridged Cartoon Introduction To WebAssembly**
  www.smashingmagazine.com/2017/05/abridged-cartoon-introduction-webassembly/
- **Steve Sanderson's first Blazor reveal** www.youtube.com/watch?v=MiLAE6HMr10
- **Yew – Rust based SPA framework**
  github.com/DenisKolodin/yew
- **WebAssembly languages**
  github.com/appcypher/awesome-wasm-langs

Thanks for listening

@bgever