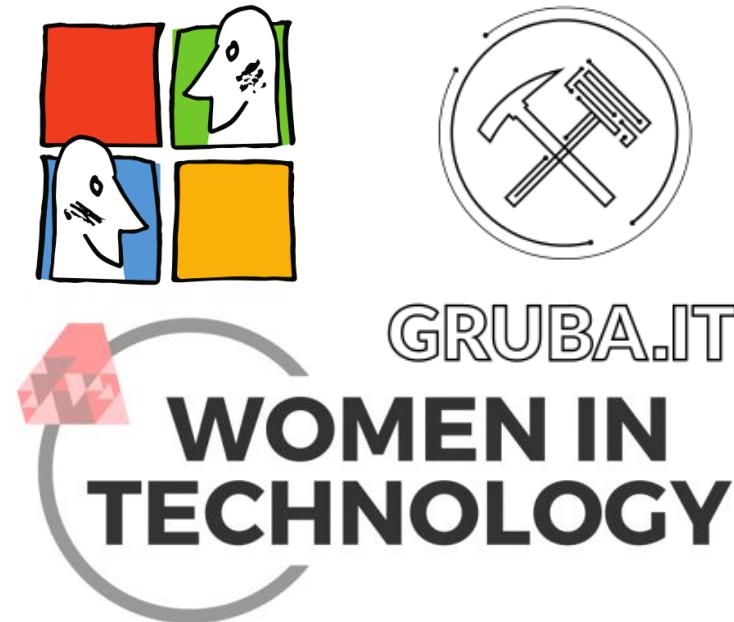


WebAssembly and .NET

Joanna Lamch

2019





Who am I?

Joanna Lamch

JLamch@gmail.com

JLamch.net

ProgramistkaIKot.pl

Microsoft fangirl
Developer C#

.NET Framework 1.1

15 years (+ overtime)

Xamarin

SIENN

Community

Śląska Grupa Microsoft
Women In Technology
Gruba.IT





RATIONALTECHS.COM

Event Storming Praktycznie

Rational Techs
wraz z SIENN

zapraszają na

BEZPŁATNE

warsztaty

Gdzie?

Siedziba SIENN
ul. Wagonowa 2
we Wrocławiu

Kiedy?

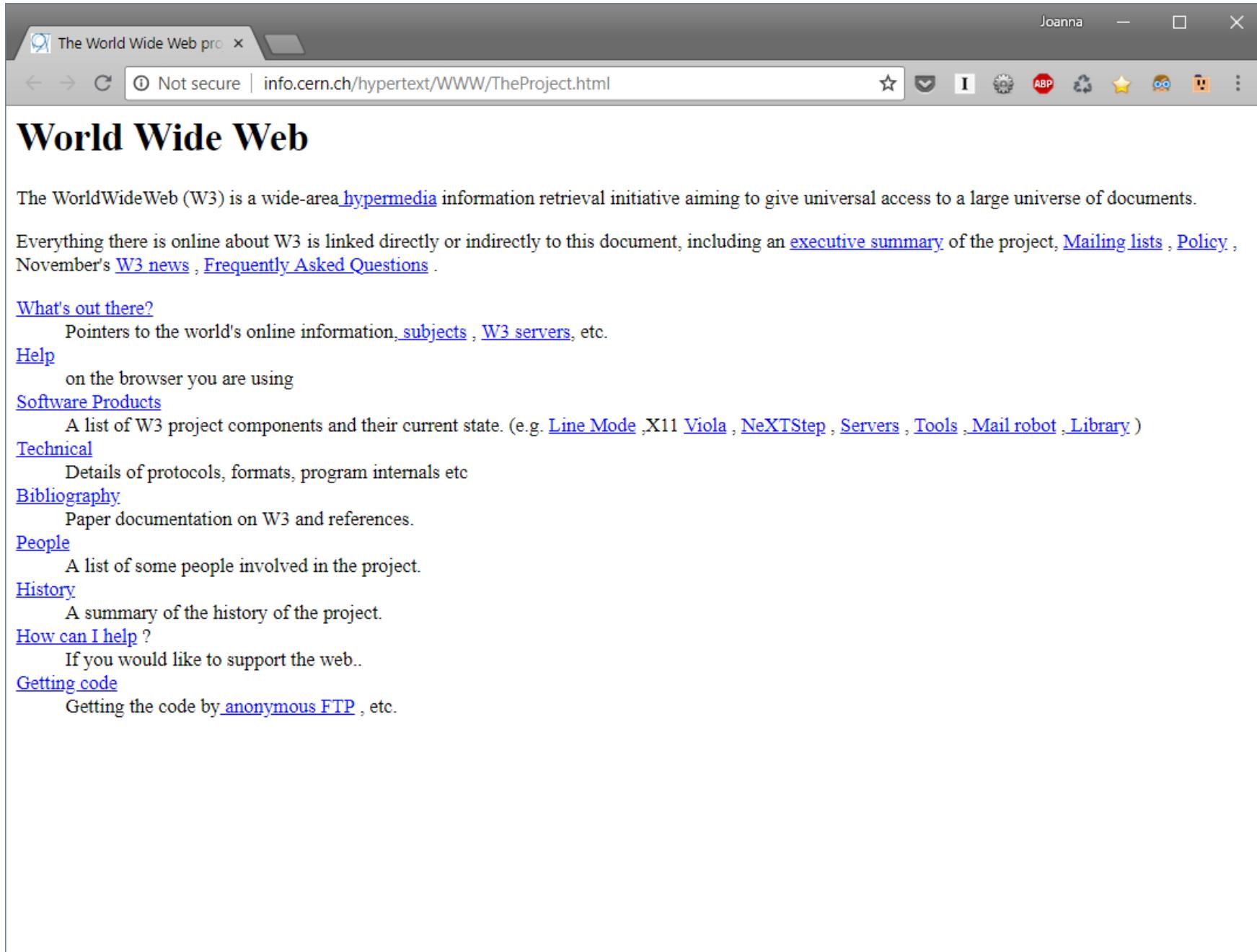
29.05 (środa)
17:45-20:15

Zapisy: rationaltechs@gmail.com

SIENN®

Back in the days...

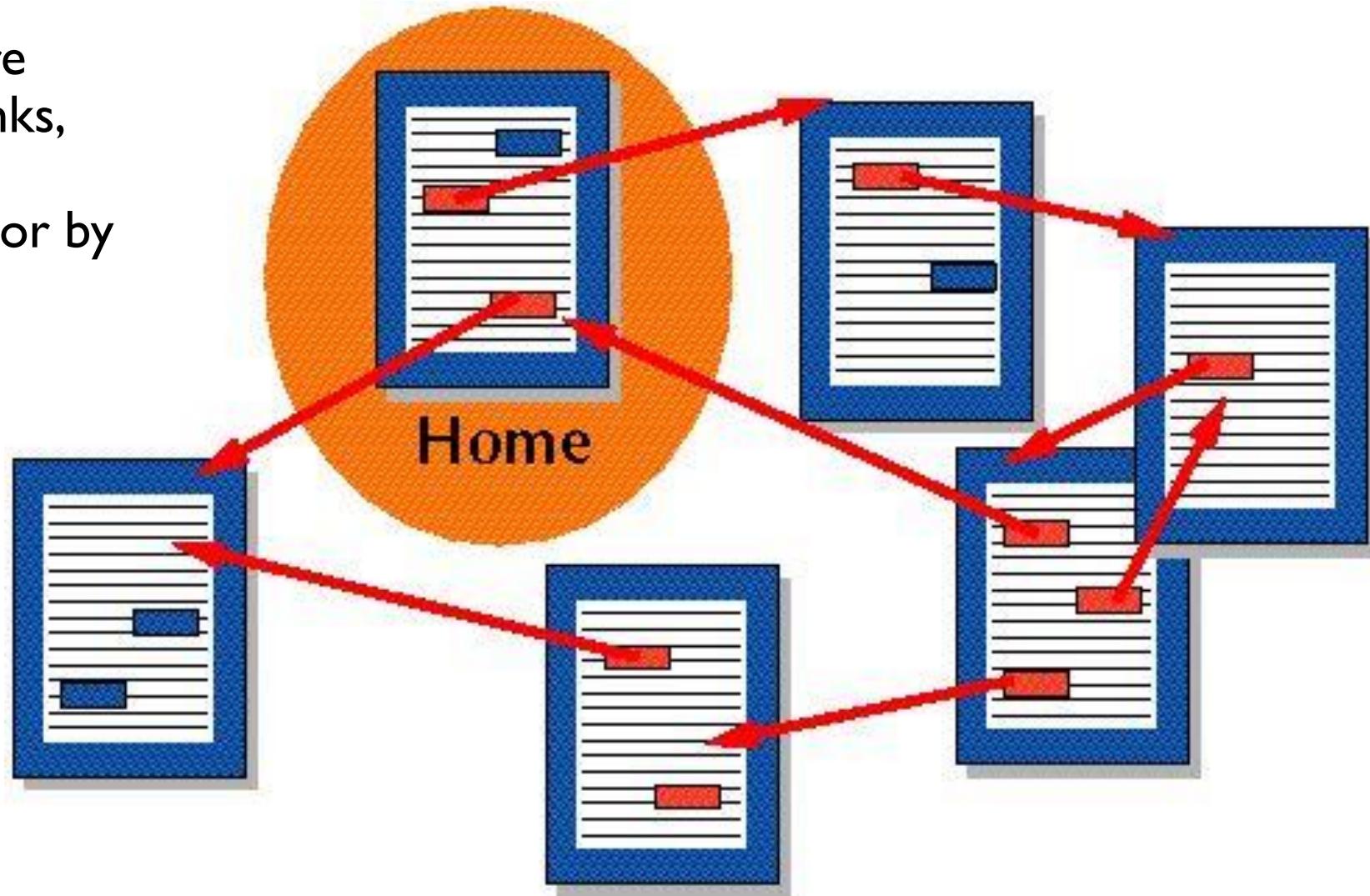




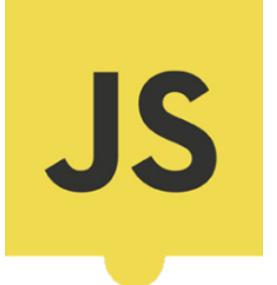
1991

Hypertext, HTML, HTTP

Hypertext documents are interconnected by hyperlinks, which are activated by a mouseClick, keypress set or by touching the screen



JavaScript

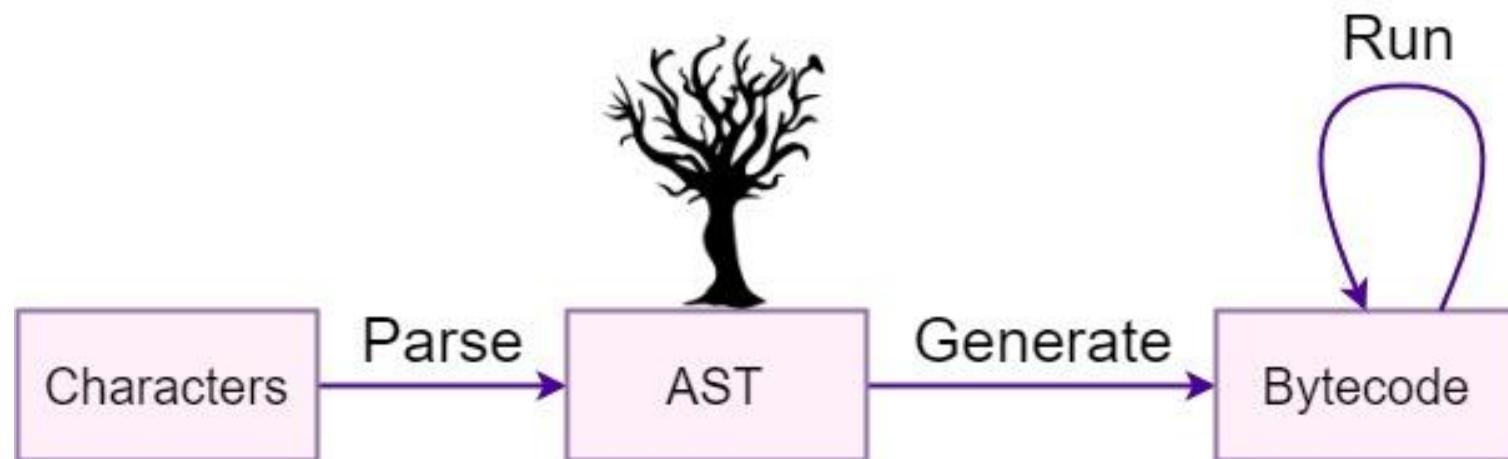
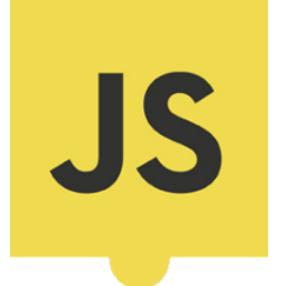


created in 10 days in May 1995, by Brendan Eich for Netscape

Adding interactivity to HTML pages

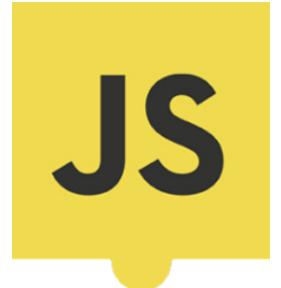
1995

JavaScript



1995

JavaScript



1995

Other plugins

Java Applets [1997]



ActiveX [1996]

Flash [1996]

Silverlight [2007]

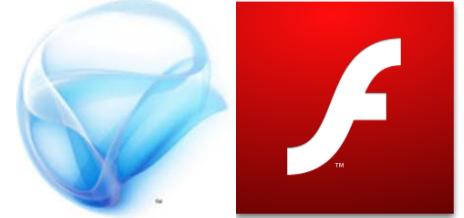
1996+

Other plugins

Java Applets [1997]



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Flash [1996]

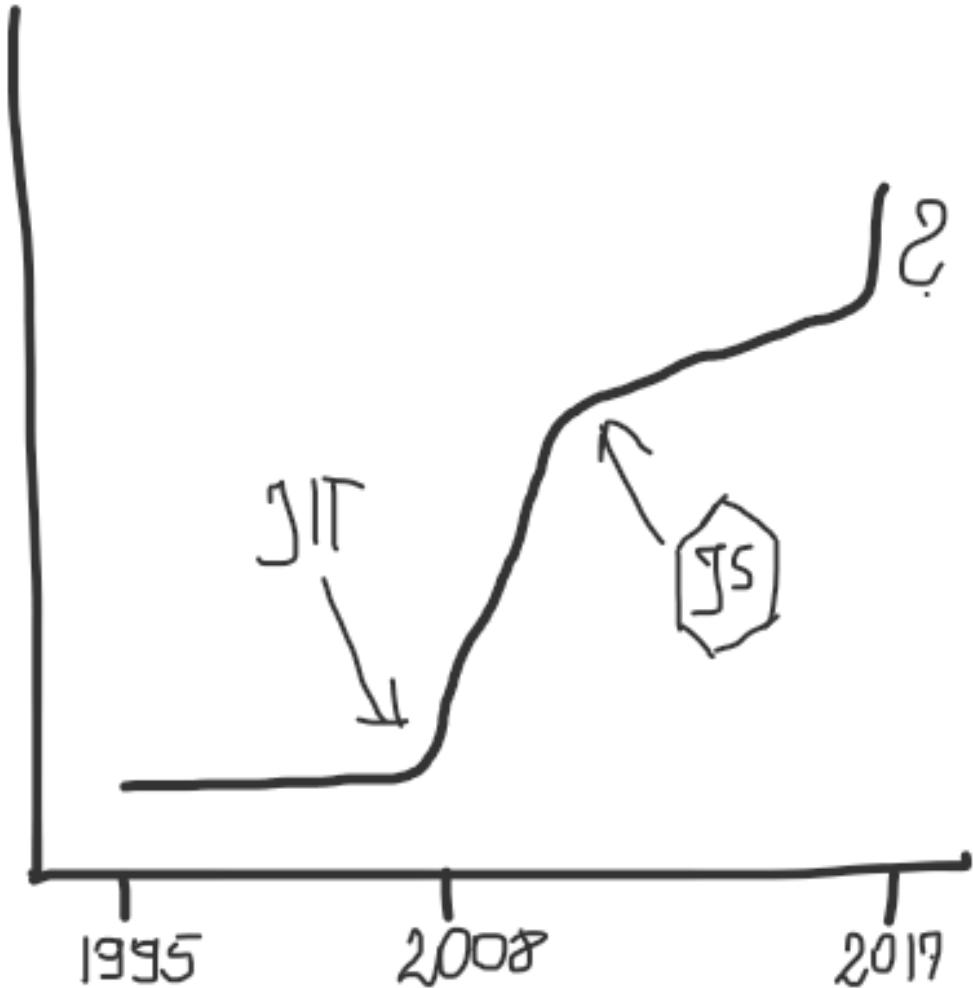
All of them are deprecated
or will be deprecated soon



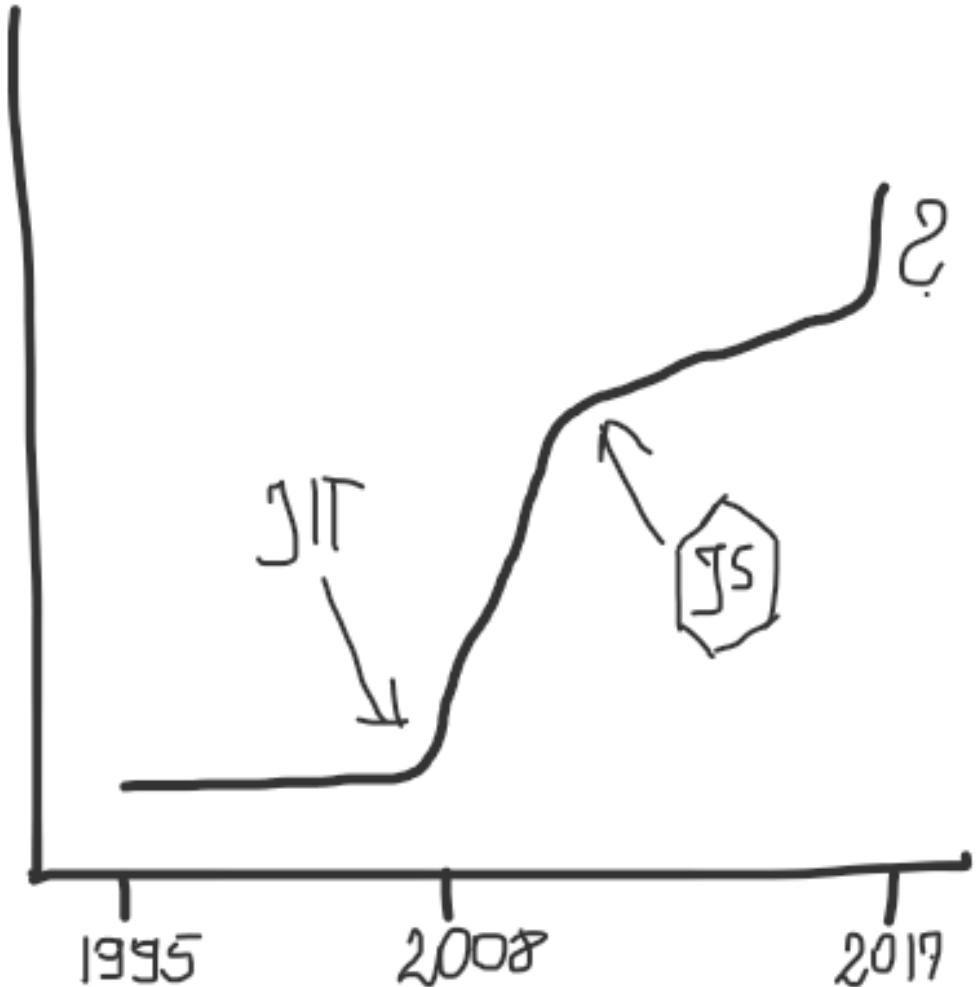
Silverlight [2007]

1996+

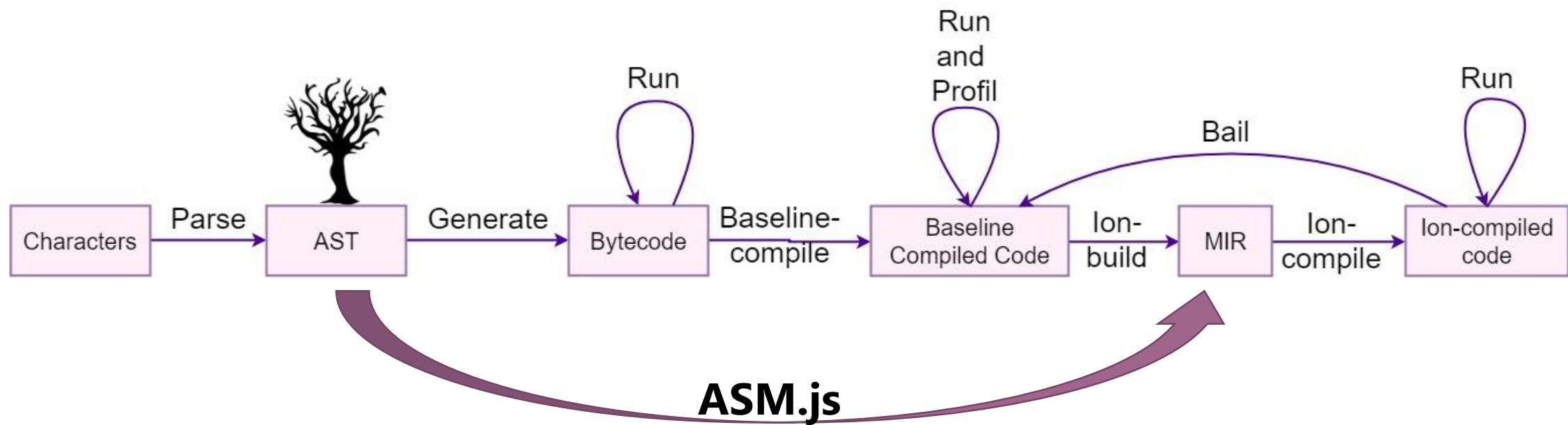
Browser performance wars (2008+)



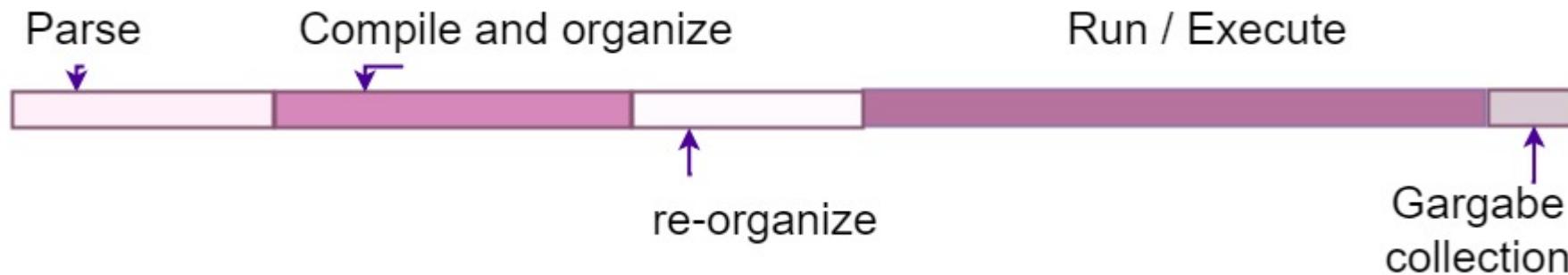
Browser performance wars (2008+)



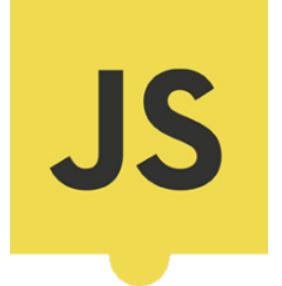
Browser performance wars (2008+)



Browser performance wars (2008+)



Todays JavaScript



Different way the same language

there is a LOT of JavaScript

JavaScript is the language of the Web

But it's not very good Assembly Language
(still human readable simple language)

Todays JavaScript

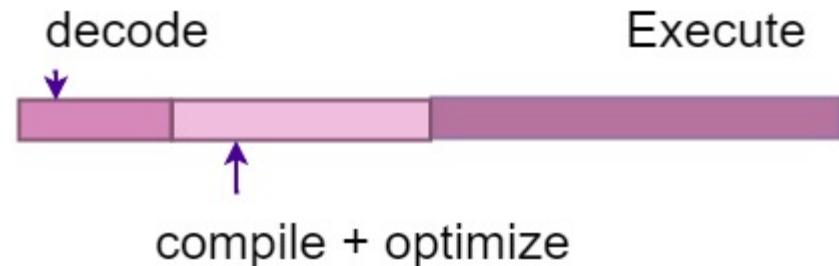
JS



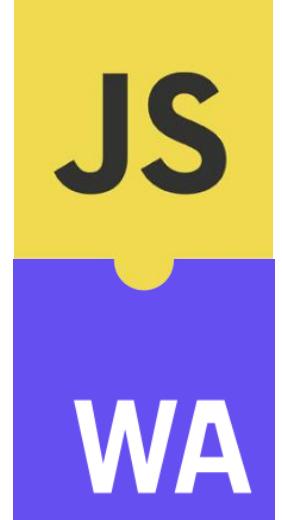
WebAssembly What? Why?

A new low-level **binary** format **for the web** (WASM)

It's a bytecode for web / compilation target => maximized performance

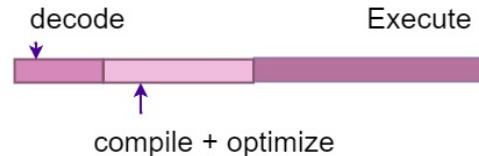


WebAssembly What? Why?



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WebAssembly **is not designed to replace JS**, but to coexist

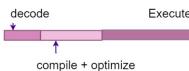
Sandboxed runtime in JS virtual machine

Security it runs locally in JS VM

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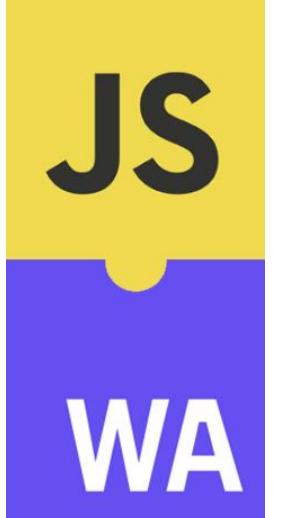


WebAssembly is **not designed to replace JS**, but to coexist

Sandboxed runtime in JS virtual machine

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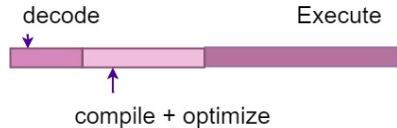
Supported in all big browsers
– W3C open specification



WebAssembly What? Why?

A new low-level **binary** format **for the web** (WASM)

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WebAssembly **is not designed to replace JS**, but to coexist

Sandboxed runtime in JS virtual machine

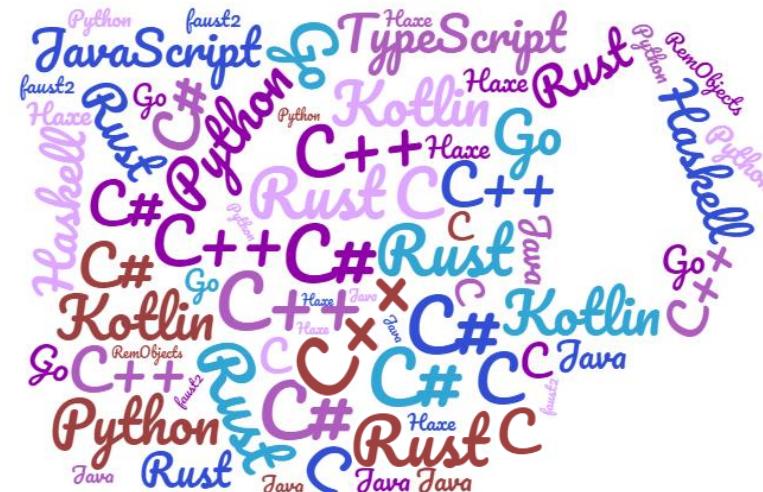
Security it runs locally in JS VM

Supported in **all** big browsers – W3C open specification

Compiled from **other languages**



WASM opens possibilities for other languages



Rust JavaScript Kotlin C# Kotlin
Haskell Go TypeScript Go Haxe C Python
Kotlin RemObjects

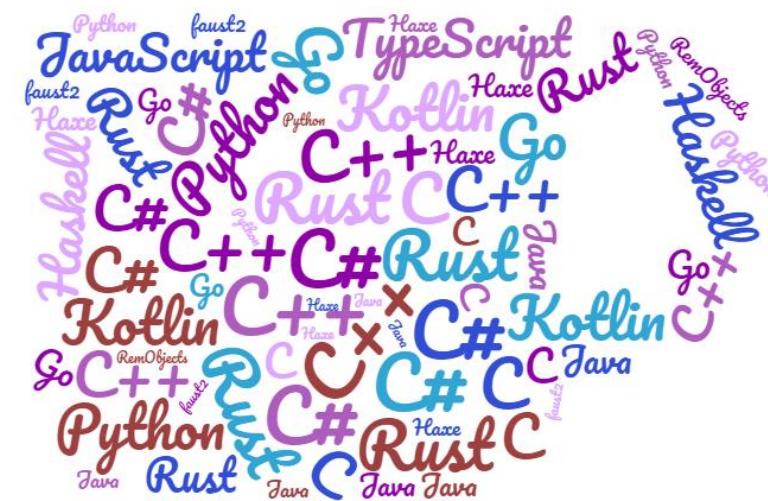
WASM opens possibilities for other languages

Rust

C++

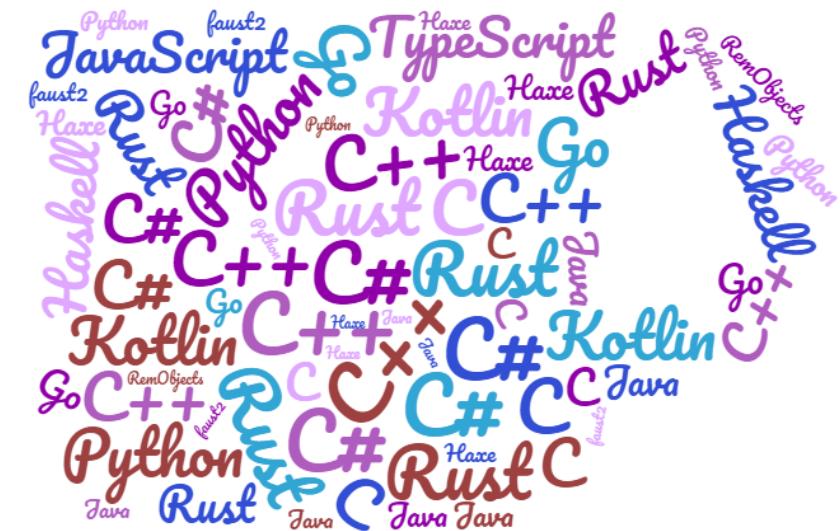
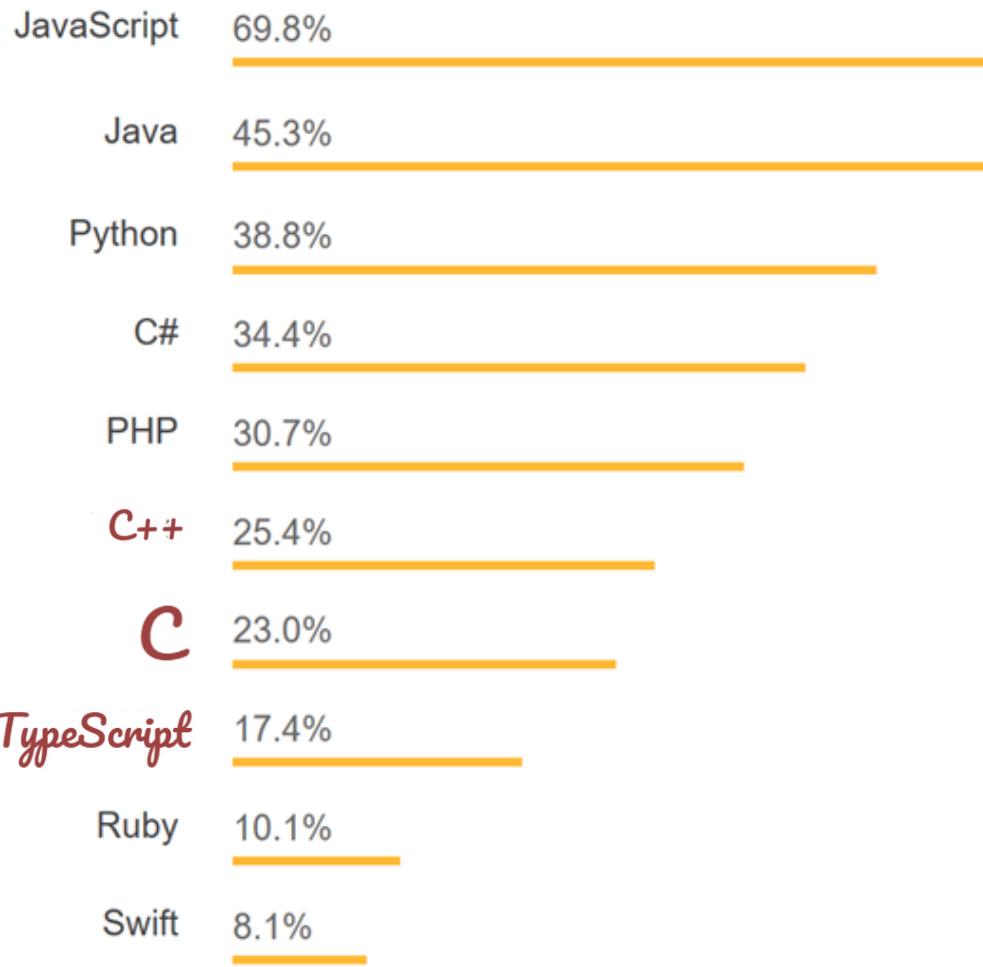
C

TypeScript



Rust JavaScript Kotlin C# Kotlin
Haskell Go Kotlin TypeScript Go Haxe C Python
RemObjects RemObjects

WASM opens possibilities for other languages



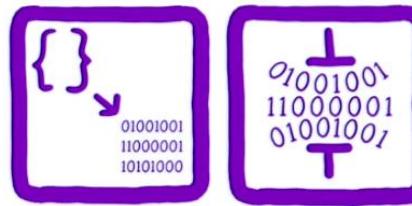
Rust Rust JavaScript Kotlin C# Kotlin X Python
Haskell Go TypeScript Go Haxe C Python



WebAssembly current state: MVP

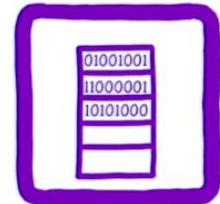
- Compilation target

Binary so compact



- 4 types, 67 instructions,
stack machine

- Linear memory



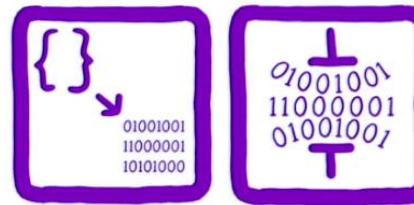
- Fast execution



WebAssembly current state: MVP

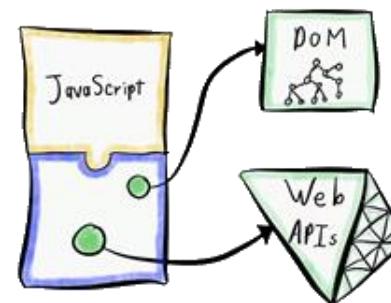
- Compilation target

Binary so compact

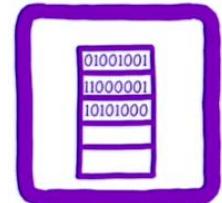


- 4 types, 67 instructions, stack machine

- No Web APIs, DOM access/manipulation



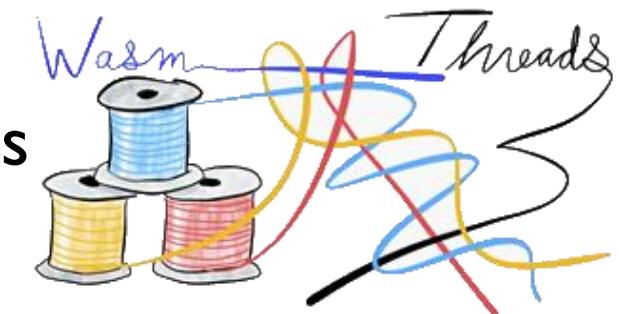
- Linear memory



- Fast execution or not so fast
not so fast load



- no Threads



WebAssembly How?



emscripten

```
$emcc -s WASM=1 -o example.js example.cpp
```

↳ executes the **Emscripten** compiler ↳ name our output file

↳ Emscripten outputs WebAssembly - switch ↳ input file

WebAssembly studio C/Rust/TypeScript

The image displays two side-by-side screenshots of the WebAssembly Studio web application. Both screenshots show a dark-themed interface with a header bar containing the 'WebAssembly Studio' logo, a search bar with the URL 'https://webassembly.studio', and various navigation and tool icons.

Left Screenshot (build.ts):

- File Structure:** Shows files like README.md, build.ts (selected), package.json, main.html, main.js, and main.rs.
- Code Editor:** Displays the contents of build.ts, which uses Gulp and the @wasm/studio-util library to build a WebAssembly file from a TypeScript source.
- Output:** Shows 'Output (1)' with the number 1.
- Problems:** Shows 'Problems (0)'.

Right Screenshot (main.ts):

- File Structure:** Shows files like README.md, assembly/main.ts (selected), tsconfig.json, gulpfile.js, package.json, setup.js, main.html, and main.js.
- Code Editor:** Displays the contents of main.ts, which defines an external function sayHello, declares a namespace console with logi and log functions, and exports an add function.
- Output:** Shows 'Output (2)' with the numbers 1 and 2.
- Problems:** Shows 'Problems (0)'.

Demo

<http://mbebenita.github.io/WasmExplorer/>

<https://wasdk.github.io/WasmFiddle/>

<https://webassembly.studio/>



WasmExplorer

The screenshot shows the WasmExplorer interface with the following components:

- C++11 -Os**: The input code area containing the following C++ code:

```
1 float add(float a, float b){  
2     return a+b;  
3 }
```
- COMPILE**: A button to compile the C++ code.
- Wat**: The WebAssembly text representation of the compiled code, starting with:

```
1 (module  
2   (table 0 anyfunc)  
3   (memory $0 1)  
4   (export "memory" (memory $0))  
5   (export "_Z3addff" (func $_Z3addff))  
6   (func $_Z3addff (; 0 ;) (param $0 f32) (param  
7       $1 f32) (result f32)  
8       (f32.add  
9           (get_local $0)  
10          (get_local $1)  
11      )  
12  )  
13 )
```
- ASSEMBLE**: A button to assemble the code.
- DOWNLOAD**: A button to download the code.
- Firefox x86 Assembly**: A section showing the assembly output for Firefox x86, which is identical to the WebAssembly assembly above, indicating a direct translation.
- Table View**: A table showing memory and function details:

Memory	Start	End	Size	Type
memory	0x00000000	0x00000001	1	1
function	0x00000000	0x0000000e	15	15

<https://bit.ly/2JkqFYt>

WasmExplorer

Firefox x86 Assembly



wasm-function[0]:

```
sub rsp, 8          ; 0x000000 48 83 ec 08
addss xmm0, xmm1   ; 0x000004 f3 0f 58 c1
nop               ; 0x000008 66 90
add rsp, 8          ; 0x00000a 48 83 c4 08
ret                ; 0x00000e c3
```

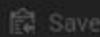
C main.c

JS main.js

WA main.wasm



C main.c



```
1  fetch('../out/main.wasm').then(response =>
2    response.arrayBuffer()
3  )
4  .then(bytes => WebAssembly.instantiate(bytes)).then(result=> {
5    instance= result.instance;
6    document.getElementById("container").textContent = "Result: " +
7      + instance.exports.add(19.19, 23.23);
8  }).catch(console.error);
9
```

```
1  #include <stdio.h>
2  #include <sys/uio.h>
3  #include <math.h>
4  #define WASM_EXPORT __attribute__((visibility("default")))
5
6  WASM_EXPORT
7  int main() {
8    return 42;
9  }
10
11 WASM_EXPORT
12 double add(float a, float b){
13   float f=a+b;
14   float num = floor(100*f)/100;
15   return f;
16 }
17
18
```

≡ Output (50)

```
41 [info]: Task build is completed
42 [info]: Task build is running...
43 [info]: Task build is completed
44 [info]: Task build is running...
45 [info]: Task build is completed
46 Downloading Project ...
47 Project Zip CREATED
48 [info]: Task build is running...
49 [info]: Task build is completed
50
```

Result: 42.41999816894531

C main.c

[Save](#)

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C main.c

JS main.js

WA main.wasm

Save

C main.c

Save

README.md
build.ts
package.json
src
main.c
main.html
main.js
out
main.wasm

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C main.c

```
1 fetch
2   res
3 }
4 .then
5   ins
6   doc
7   + i
8 }).ca
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```

main.c

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README.md

TS build.ts

{ package.json

src

C main.c

main.html

JS main.js

out

main.wasm

≡ Output

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C main.c

JS main.js

WA main.wasm



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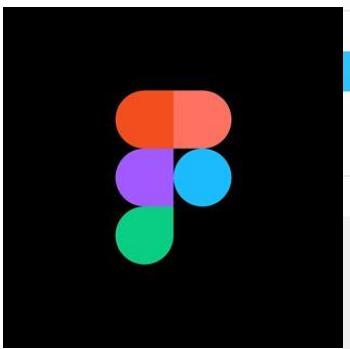
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WASM in real world



Figma

<https://www.figma.com> # App Screens/Profile 9

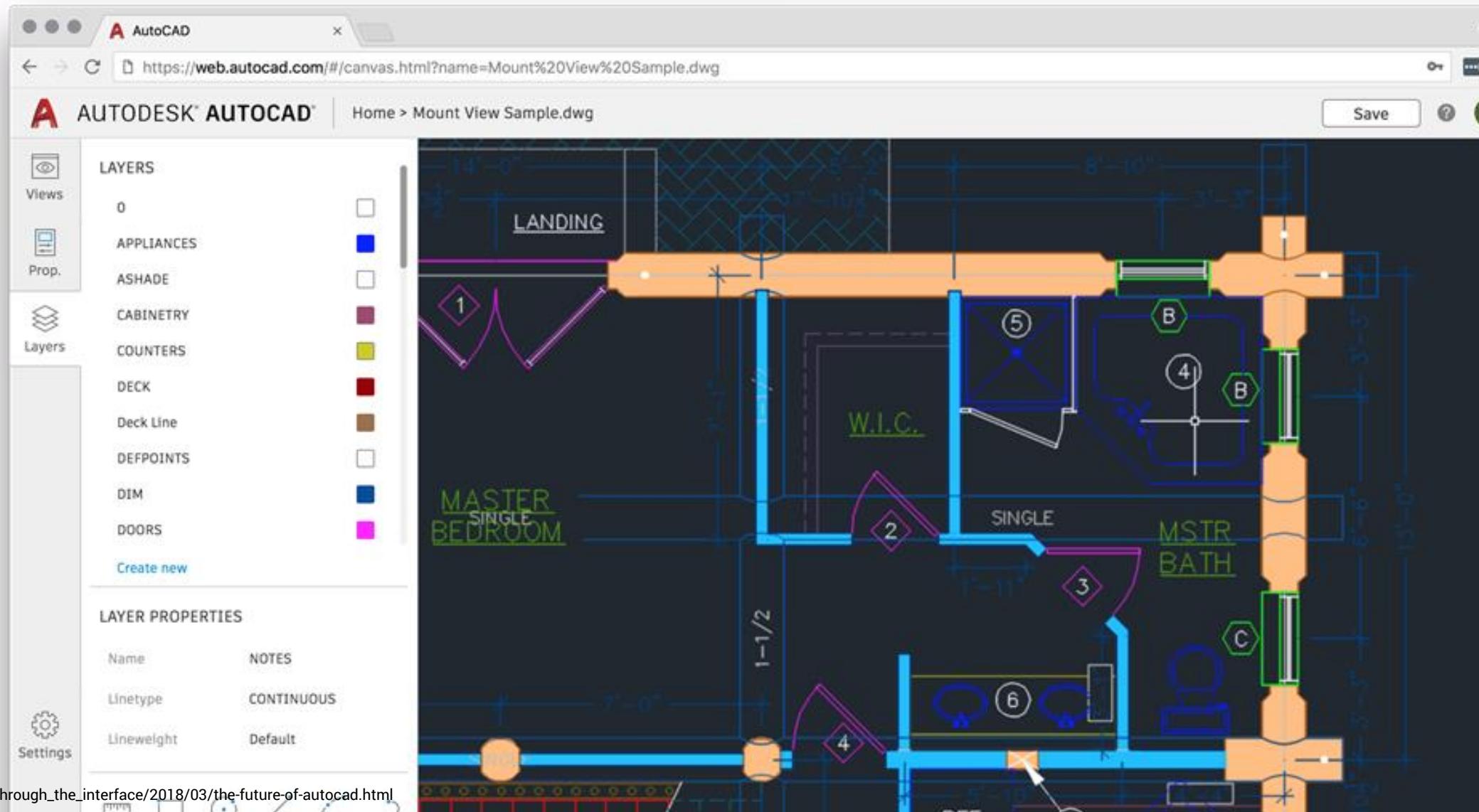
<https://www.youtube.com/watch?v=KfIglLChfk>

A collage of screenshots from various Figma projects and interfaces, demonstrating the use of WebAssembly (WASM) in real-world applications. The images include:

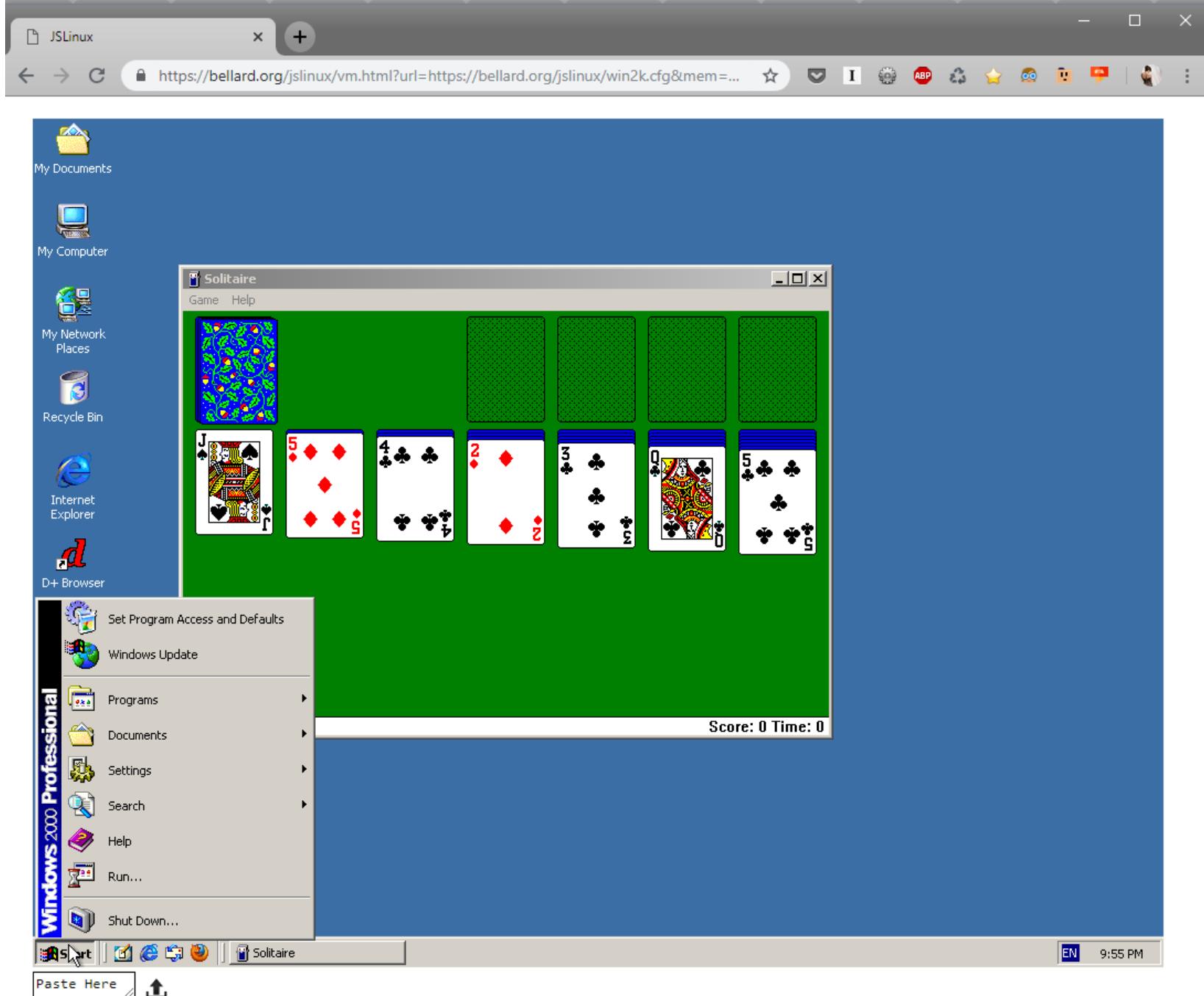
- A mobile navigation bar with "Read first!" and "Mobile templates 2 of 8".
- A map interface showing a route from "Your location" to "Rockefeller Center, San Francisco".
- A search results page for "Events in San Francisco, California" with cards for "1. The History of Fonts" and "2. The Whiteboy Allstars / Mike Coach Band".
- A calendar interface showing events like "Martin Luther Day" and "Prior Event".
- A "Taskapp" interface with a grid of tasks and a sidebar.
- A "Masonry cards" interface with cards for "Awesome Things" and "I am so glad to add additional light and modern Material Design theme".
- A "Switter" interface showing tweets from users like "Maria Vanucci" and "Paula Shushko".
- A "Trello cards" interface showing cards for "Completed Projects" and "Current Projects".
- A "Trello variant" interface showing cards for "Current Projects" and "Priorities".
- A "Trello masonry" interface showing cards for "Experience" and "Architectures".
- A "Airbnb" interface showing a listing for "Building To Sp...".

WASM in real world

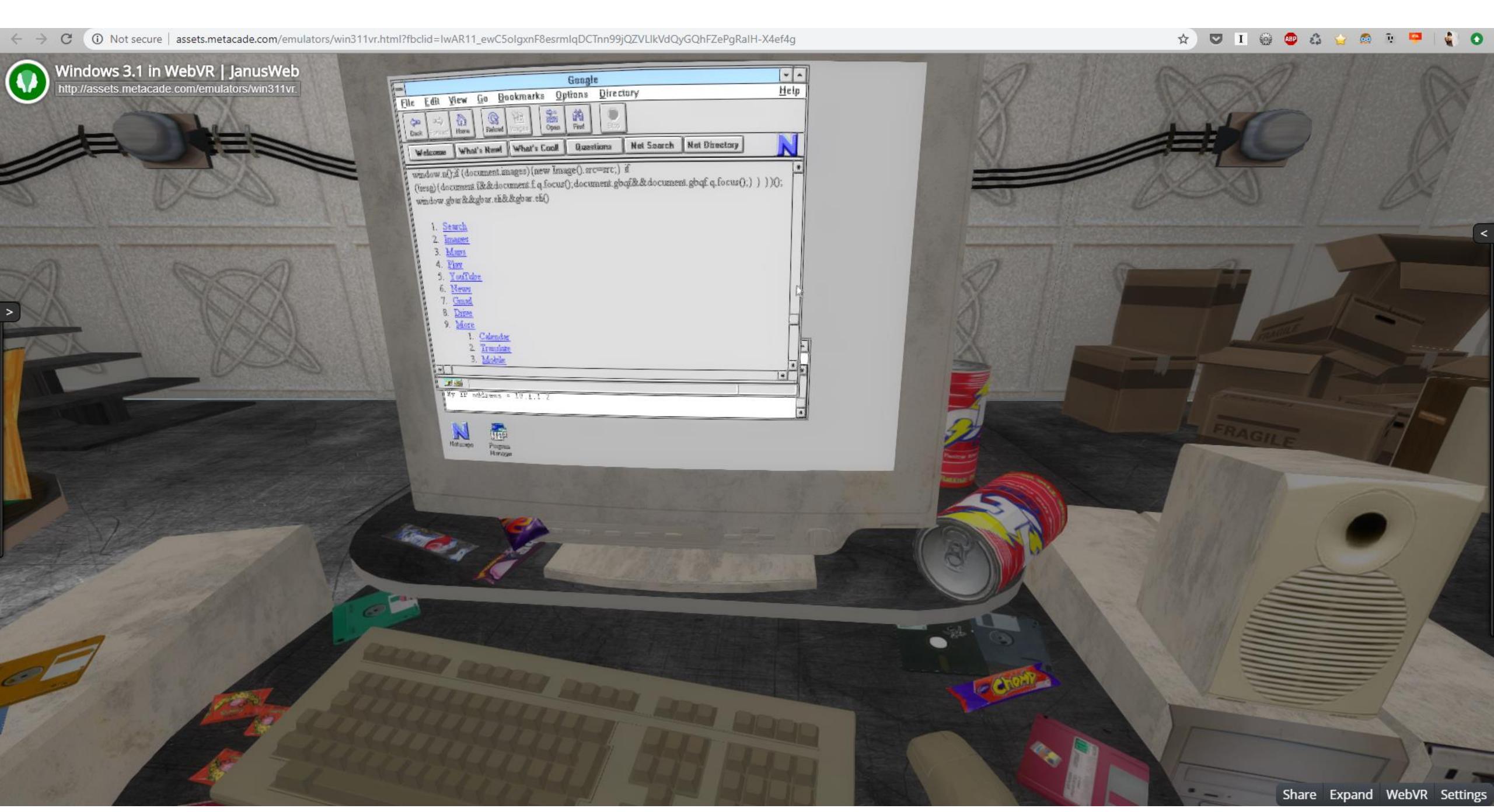
A







<https://bellard.org/jslinux/vm.html?url=https://bellard.org/jslinux/win2k.cfg&mem=192&graphic=1&w=1024&h=768>



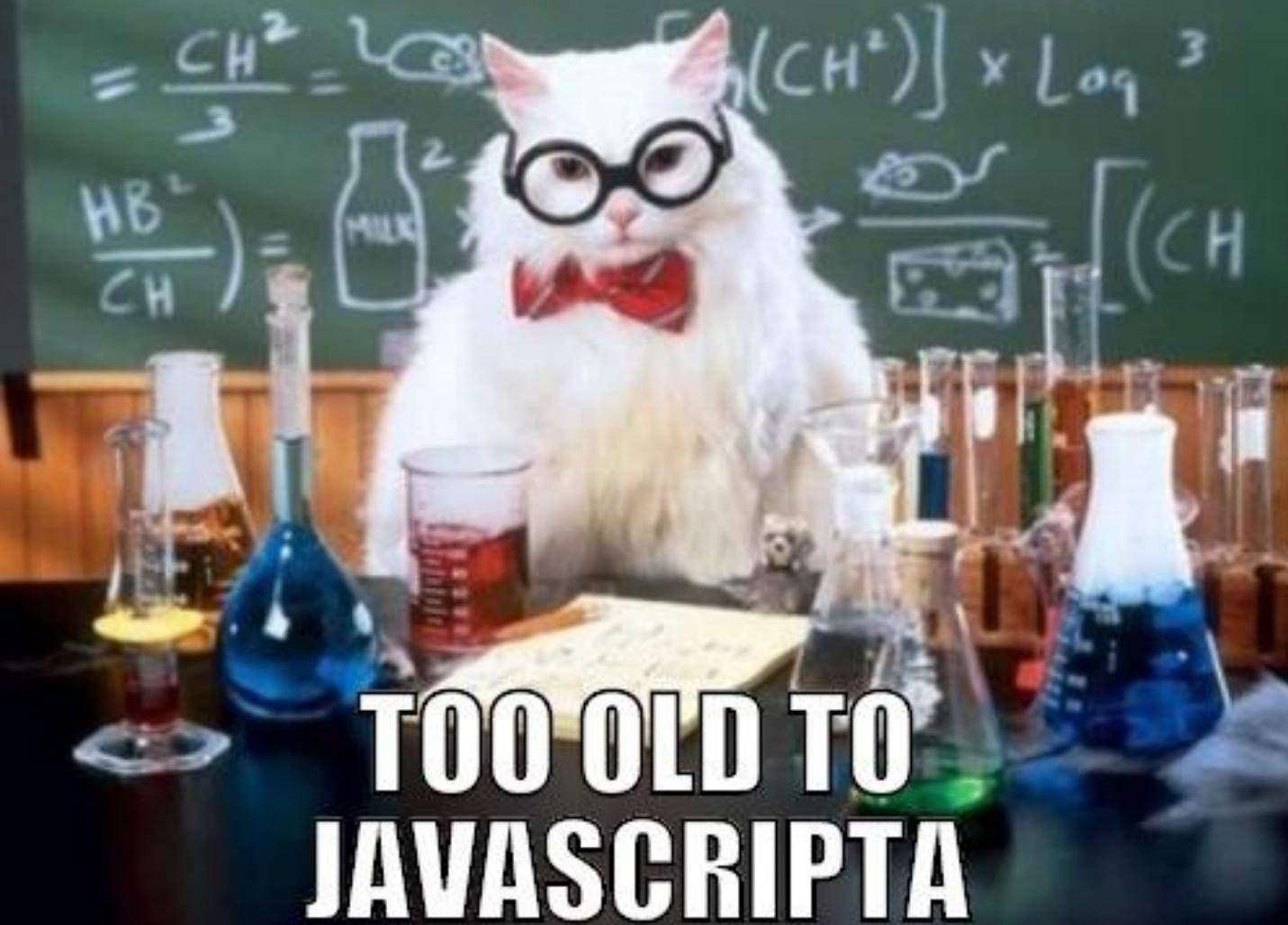
Windows 3.1 in WebVR | JanusWeb

http://assets.metacade.com/emulators/win311vr.html?fbclid=IwAR11_ewC5olgxnF8esrmlqDCTnn99jQZVLIkVdQyGQhFZePgRalH-X4ef4g

Share Expand WebVR Settings

http://assets.metacade.com/emulators/win311vr.html?fbclid=IwAR11_ewC5olgxnF8esrmlqDCTnn99jQZVLIkVdQyGQhFZePgRalH-X4ef4g

TOO JOUNG TO DIE



TOO OLD TO JAVASCRIPTA



Why use .NET for browser apps?

Stable, mature, productive:

.NET Standard, MSBuild

Fast, scalable, reliable:

.NET Core for backend services

Modern languages:

Innovations in C#, F#, Razor

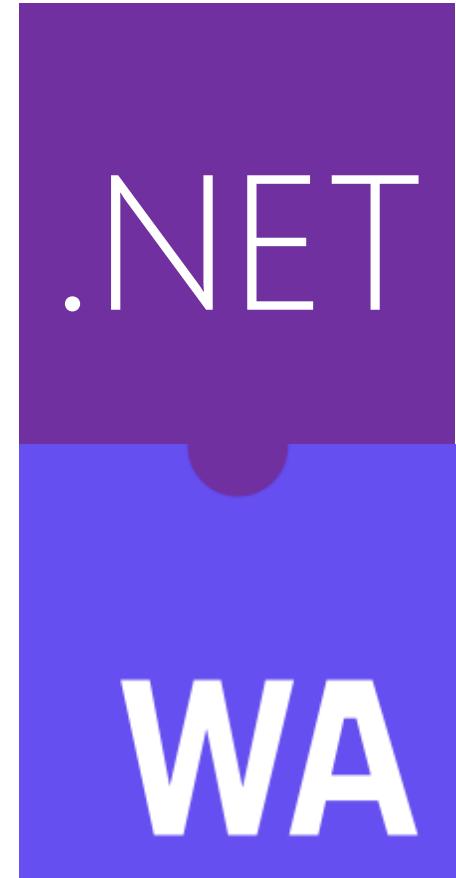
First-rate dev tools:

Visual Studio, IntelliSense

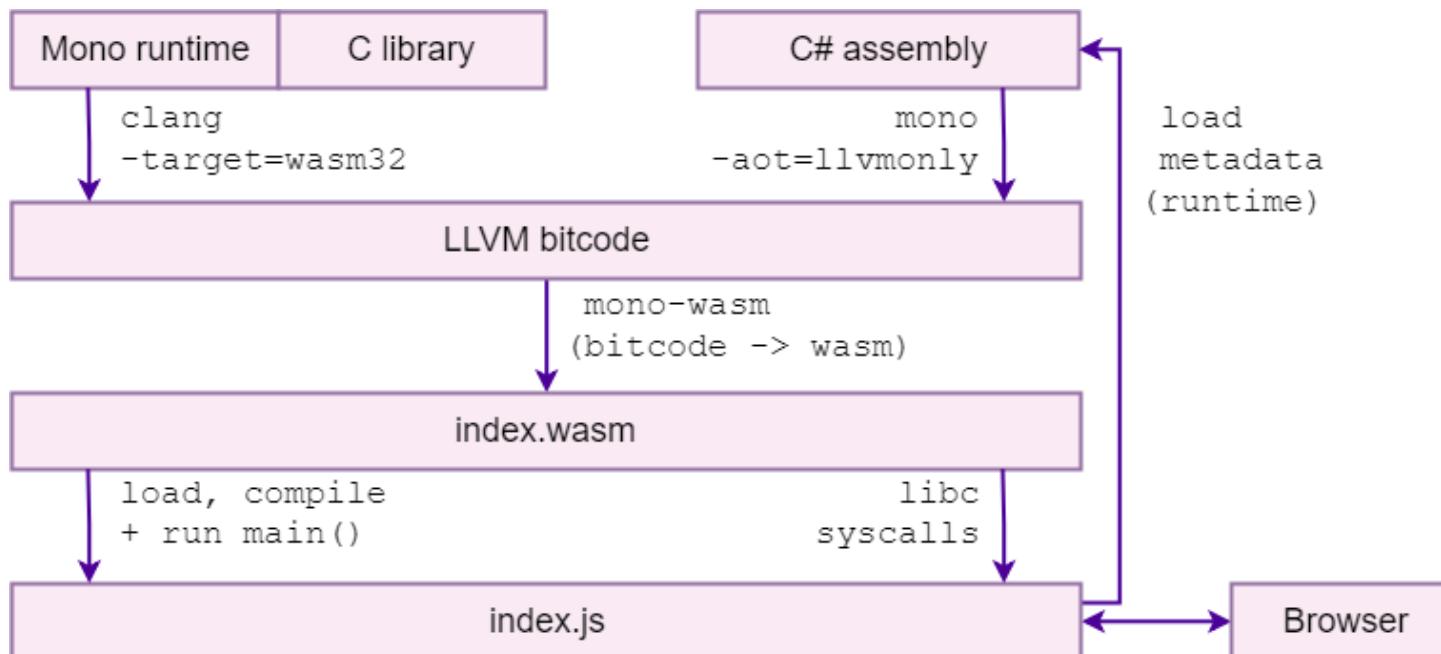
Solid foundation to build on

Leverage existing skills and knowledge

Because We can



C# in wasm ? Mono !



<https://github.com/migueldeicaza/mono-wasm>

https://www_mono-project.com/news/2018/09/11/csharp-jit/

<https://twitter.com/migueldeicaza/status/1039639597435641856>



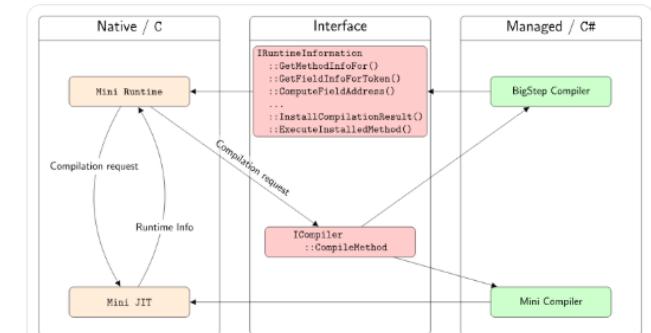
Miguel de Icaza
@migueldeicaza

Following

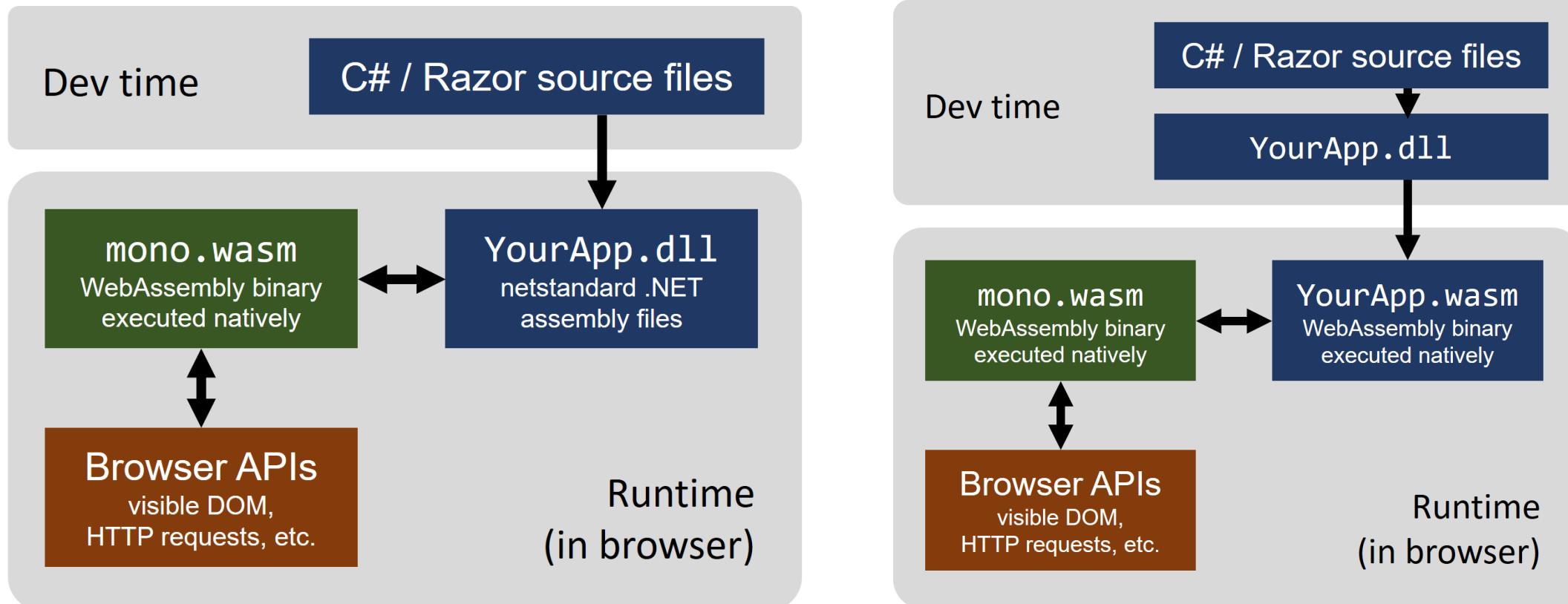
Mono now allows the code generation engine (for JIT and AOT) to be replaced. Not only replaced, but replaced with C# or F# code!

No more low-level, error-prone, unsafe C code!

Details here: mono-project.com/news/2018/09/11/csharp-jit/ ...



Interpreter mode vs AOT compiled



XAML for desktop app



XAML standard is ready

XAML for desktop app



XAML standard is ready and dead

XAML for desktop app

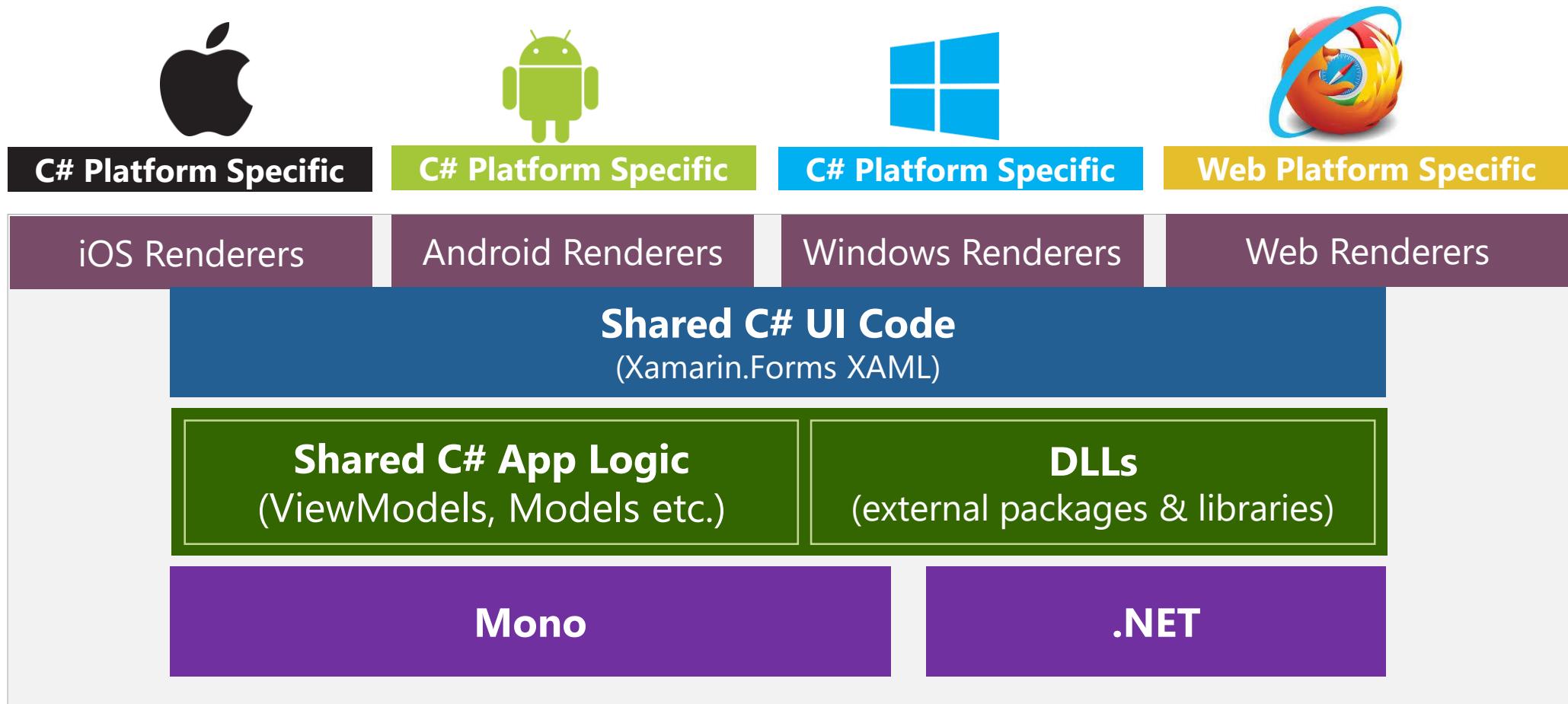


XAML standard is ready and dead

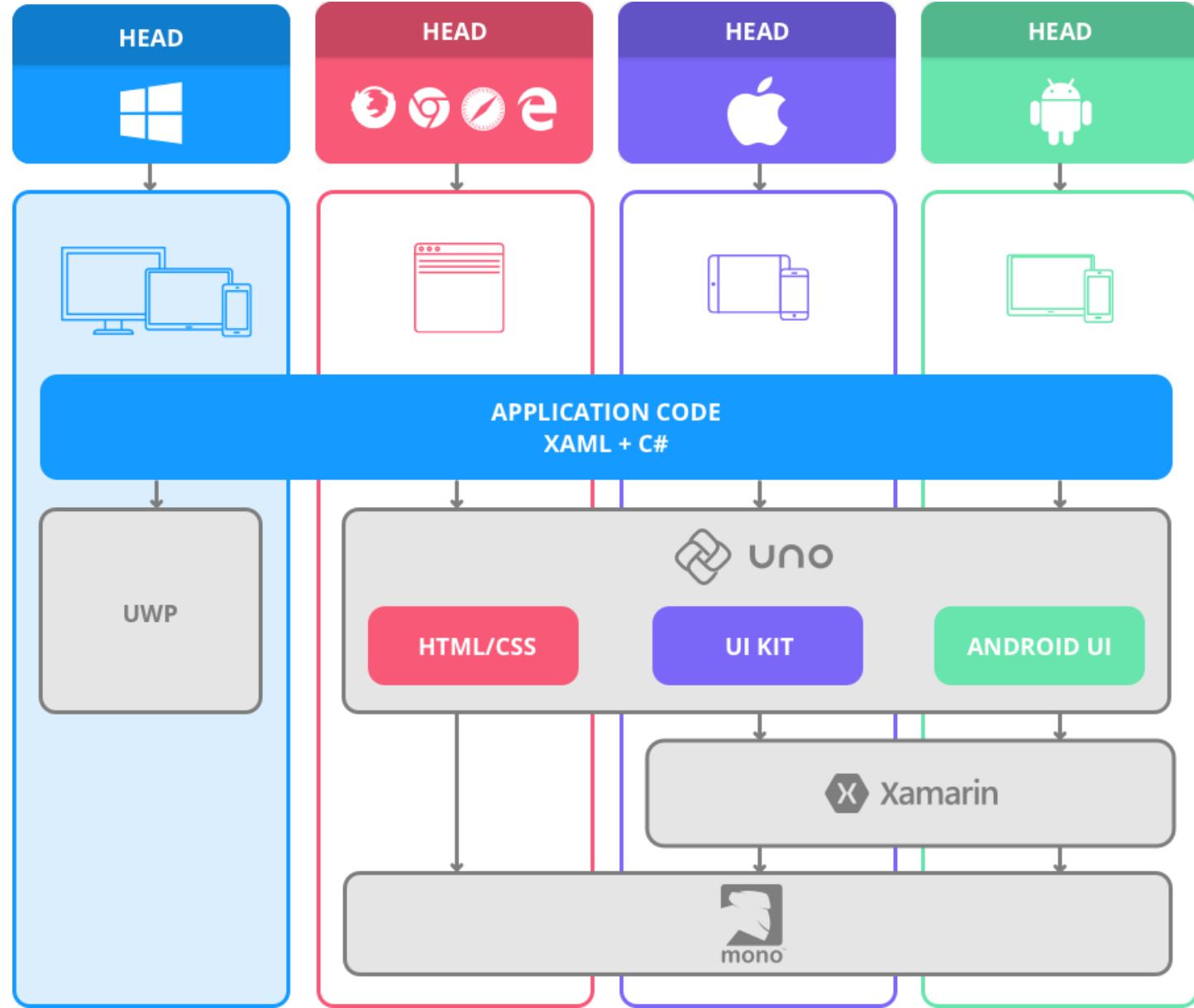
- Xamarin.Forms
- UWP
- Silverlight
- WPF

}

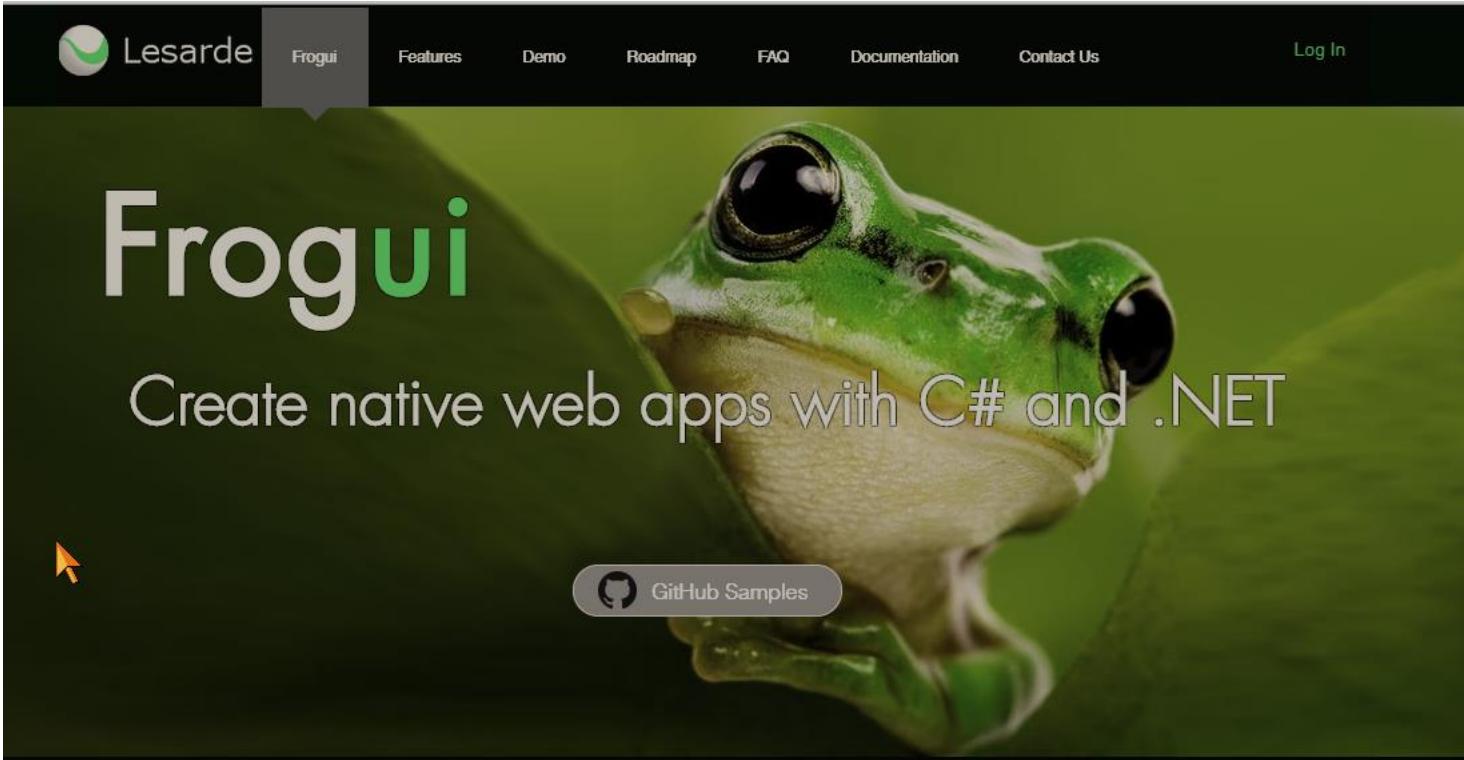
Ooui



UNO



FrogUI



The screenshot shows the homepage of the Frogui website. At the top, there's a dark navigation bar with the 'Lesarde' logo, a 'Frogui' button (which is highlighted in grey), and links for 'Features', 'Demo', 'Roadmap', 'FAQ', 'Documentation', 'Contact Us', and 'Log In'. The main content area features a large, close-up image of a green tree frog. Overlaid on the left side of the image is the word 'Frogui' in a large, white, sans-serif font. Below it, the text 'Create native web apps with C# and .NET' is displayed in a smaller, white, sans-serif font. In the bottom-left corner of the image, there's a small orange cursor icon pointing towards a 'GitHub Samples' button. This button has a dark grey rounded rectangle with a white outline, containing a GitHub logo icon and the text 'GitHub Samples'. The bottom portion of the page has a black background with white text. It starts with a paragraph about Frogui being a UI framework for building native client web apps using C#, .NET, and Visual Studio. It then says the API is based on WPF and Silverlight but modernized for modern browsers.

Frogui is a revolutionary UI framework that allows developers familiar with C#, .NET and Visual Studio to build *native* client web apps using their existing skills, with no need to learn or use JavaScript or any other web technology.

The API is strongly based on WPF and Silverlight so will feel immediately familiar, but has been modernized to leverage the immense power of modern browsers.

<https://www.lesarde.com/>



Blazor? Razor components ?

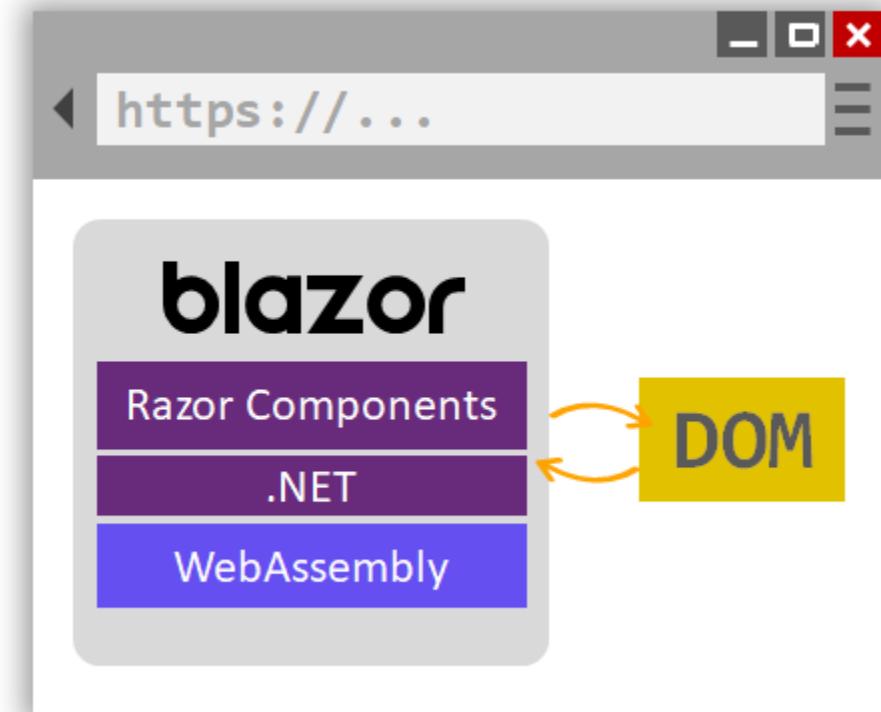
Blazor

For information about using Blazor, see [blazor.net](#).

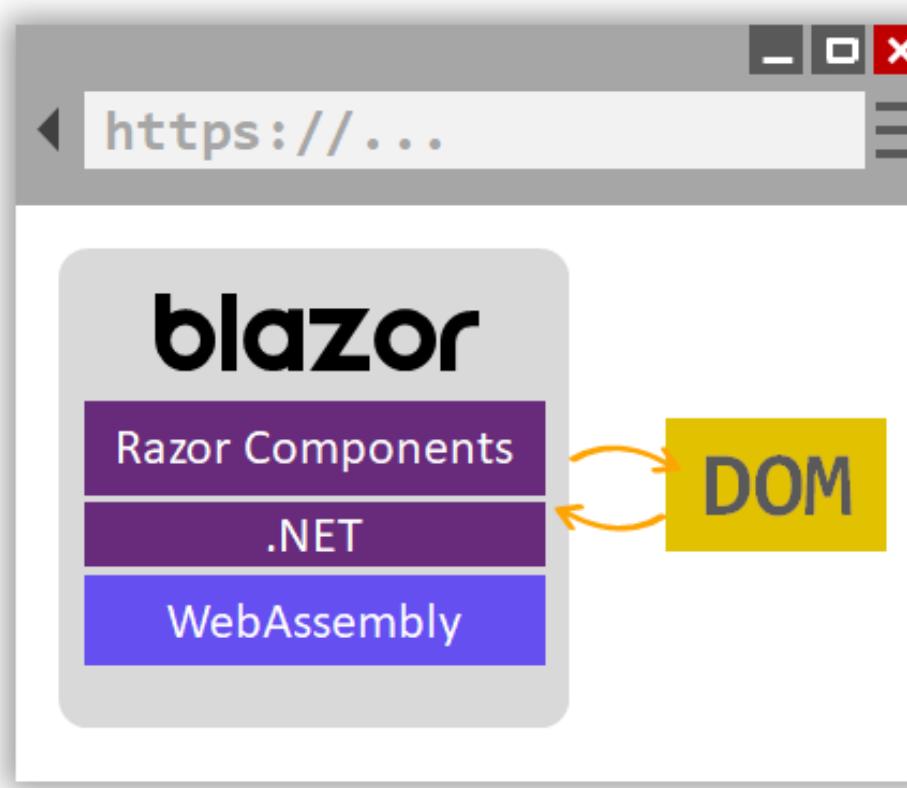
Sources moved

Almost all the sources for Blazor and the Razor Components programming model have moved [here](#) in the central ASP.NET Core repo. We are also in the process of migrating open issues from here to there.

This is in preparation for shipping Razor Components as a built-in feature of ASP.NET Core 3.0. Note: *client-side Blazor remains experimental while we continue to work on making the WebAssembly runtime complete.*



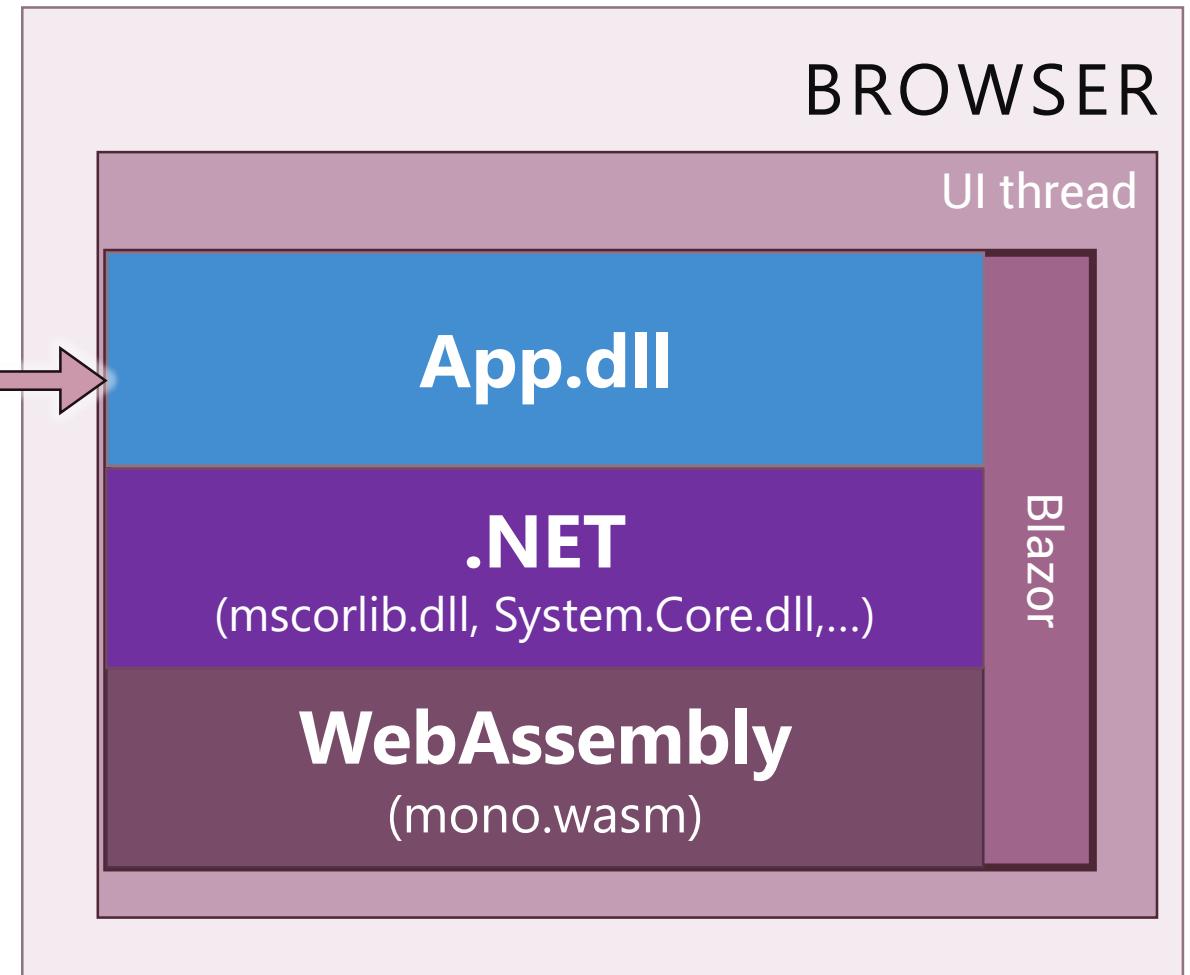
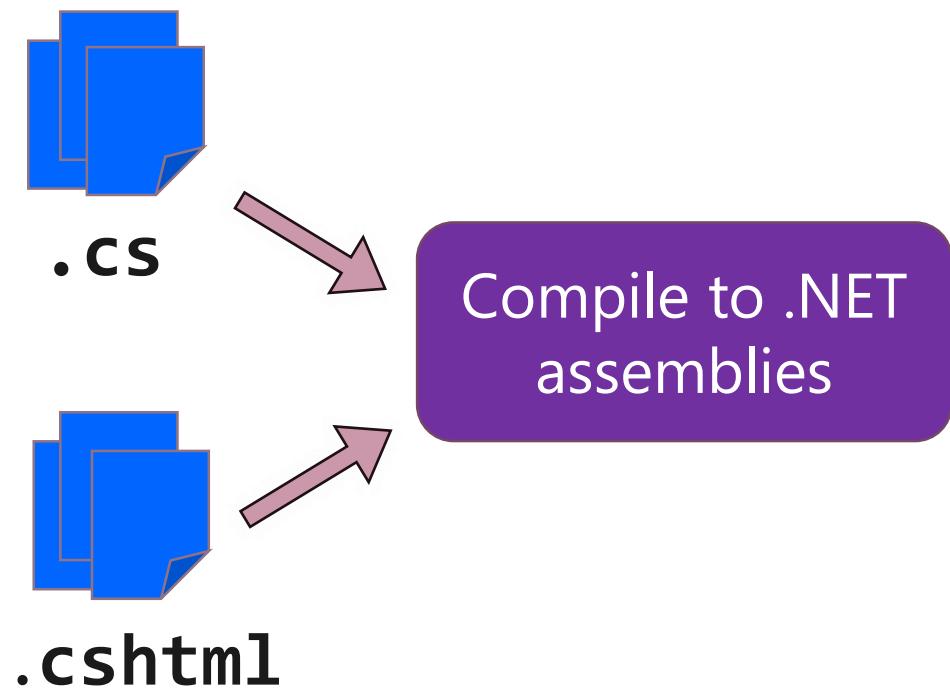
Blazor



This is in preparation for shipping Razor Components as a built-in feature of ASP.NET Core 3.0. Note: client-side Blazor remains experimental while we continue to work on making the WebAssembly runtime complete.

<https://github.com/aspnet/AspNetCore/issues/8931>

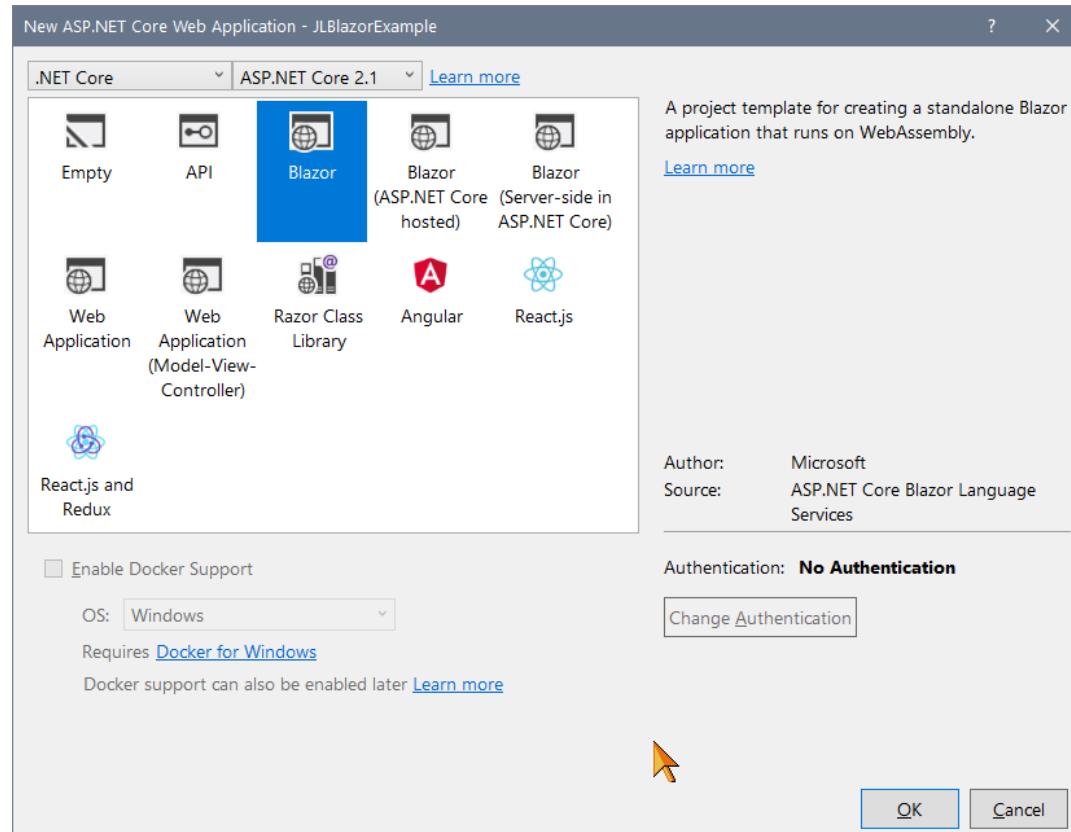
Blazor client-side



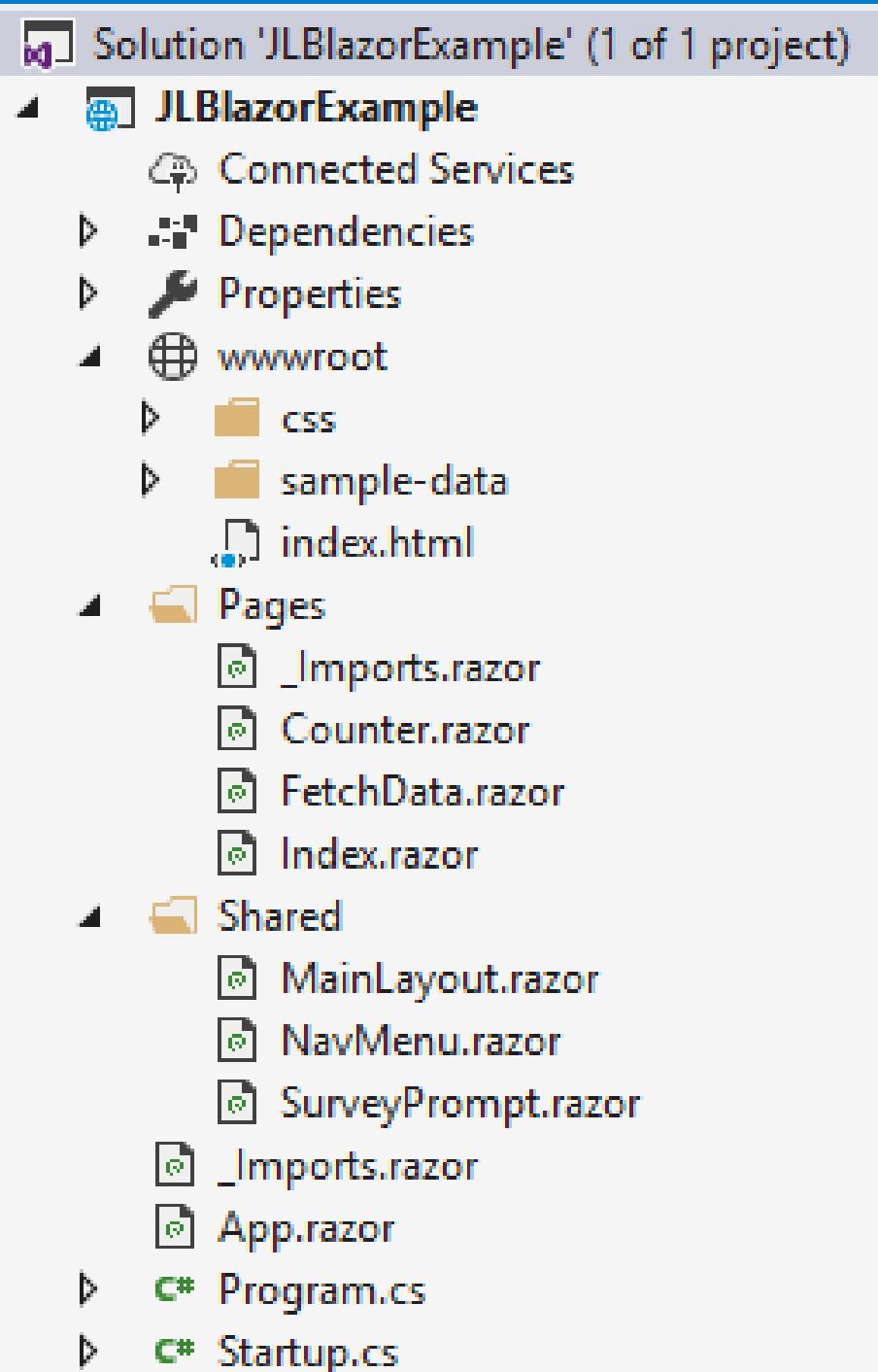
Blazor new project

Razor Component	razorcomponent	[C#]	Web/ASP.NET
Razor Page	page	[C#]	Web/ASP.NET
MVC ViewImports	viewimports	[C#]	Web/ASP.NET
MVC ViewStart	viewstart	[C#]	Web/ASP.NET
Blazor (server-side)	blazorserverside	[C#]	Web/Blazor
Blazor (ASP.NET Core hosted)	blazorhosted	[C#]	Web/Blazor/Hosted
Blazor Library	blazorlib	[C#]	Web/Blazor/Library
Blazor (client-side)	blazor	[C#]	Web/Blazor/Standalone
ASP.NET Core Empty	web	[C#], F#	Web/Empty
ASP.NET Core Web API	webapi	[C#], F#	Web/WebAPI
Razor Class Library	razorclasslib	[C#]	Web/Razor/Library/Razor Class Library

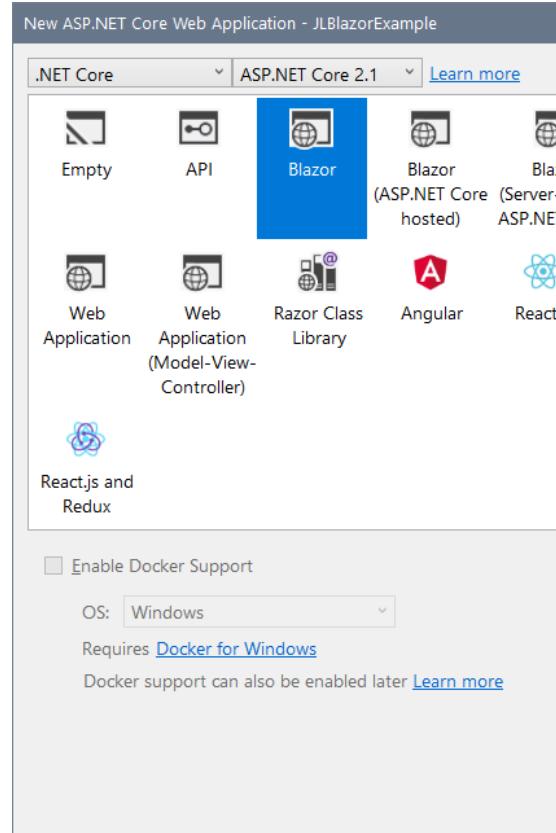
Blazor client-side



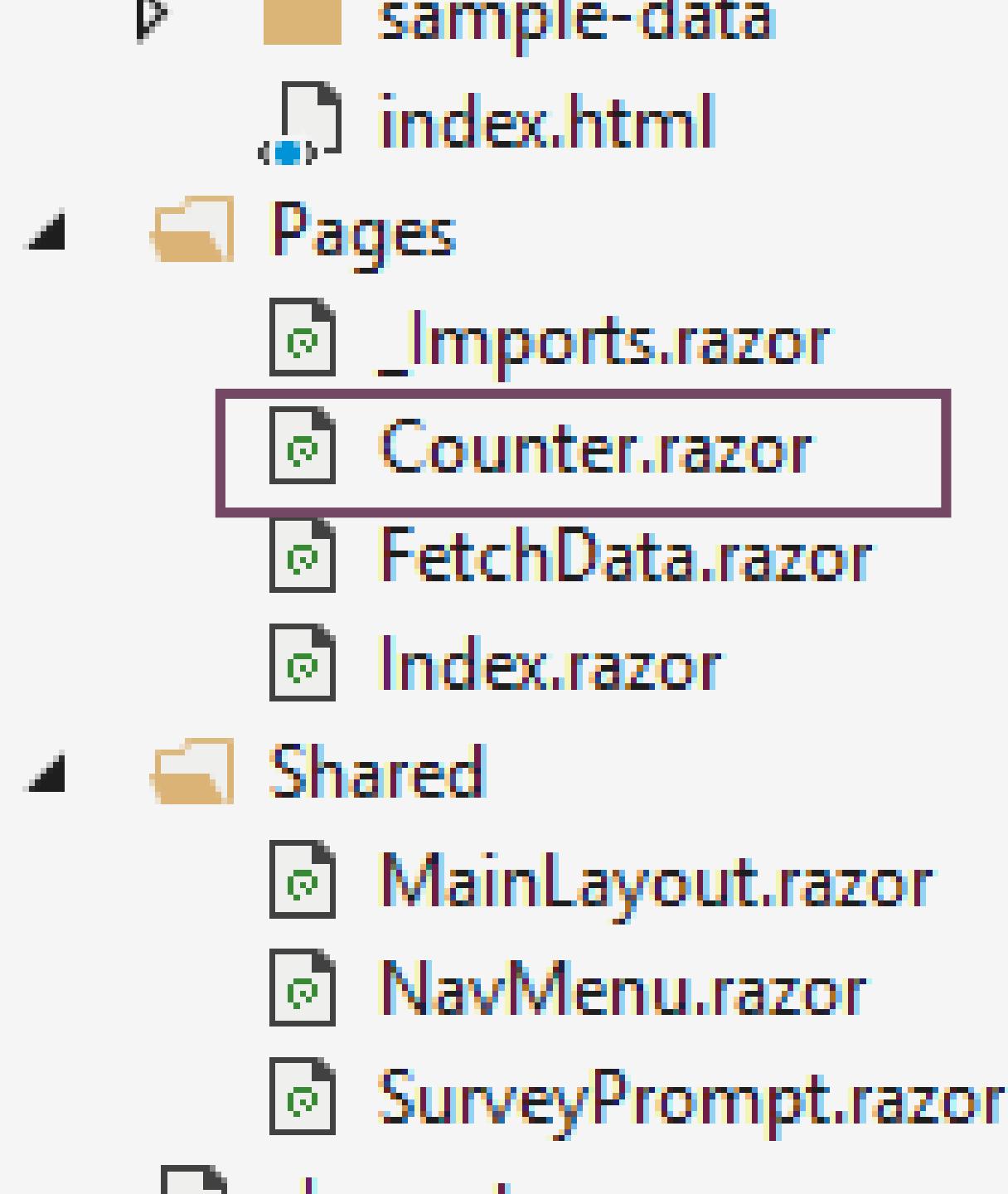
```
C:\Projects> dotnet new blazor -n  
JLBlazorExample
```



Blazor client



C:\Projects> dotnet





JLBlazorExample

Home

Counter

Fetch data

Hello, world!

Welcome to your new app.



How is Blazor working for you? Please take our [brief survey](#) and tell us what you think.

Blazor: Sample

```
@page "/counter"
@inject HttpClient

<h1>Counter</h1>
<input type="number" bind="IncrementAmount" />
<p>Current count: @currentCount</p>
<button class="btn btn-primary" onclick="@IncrementCount">Click me</button>

@functions {
    int currentCount = 0;
    int IncrementAmount { get; set; } = 1;

    void IncrementCount()
    {
        currentCount += IncrementAmount;
    }
}
```

Blazor: Routing

```
@page "/counter"
@inject HttpClient

<h1>Counter</h1>
<input type="number" bind="IncrementAmount" />
<p>Current count: @currentCount</p>
<button class="btn btn-primary" onclick="@IncrementCount">Click me</button>

@functions {
    int currentCount = 0;
    int IncrementAmount { get; set; } = 1;

    void IncrementCount()
    {
        currentCount += IncrementAmount;
    }
}
```

Blazor: Razor template

```
@page "/counter"
@inject HttpClient

<h1>Counter</h1>
<input type="number" bind="IncrementAmount" />
<p>Current count: @currentCount</p>
<button class="btn btn-primary" onclick="@IncrementCount">Click me</button>

@functions {
    int currentCount = 0;
    int IncrementAmount { get; set; } = 1;

    void IncrementCount()
    {
        currentCount += IncrementAmount;
    }
}
```

Blazor: C#

```
@page "/counter"
@inject HttpClient

<h1>Counter</h1>
<input type="number" bind="IncrementAmount" />
<p>Current count: @currentCount</p>
<button class="btn btn-primary" onclick="@IncrementCount">Click me</button>

@functions {
    int currentCount = 0;
    int IncrementAmount { get; set; } = 1;

    void IncrementCount()
    {
        currentCount += IncrementAmount;
    }
}
```

Blazor: One way data binding

```
@page "/counter"
@inject HttpClient

<h1>Counter</h1>
<input type="number" bind="IncrementAmount" />
<p>Current count: @currentCount</p>
<button class="btn btn-primary" onclick="@IncrementCount">Click me</button>

@functions {
    int currentCount = 0;
    int IncrementAmount { get; set; } = 1;

    void IncrementCount()
    {
        currentCount += IncrementAmount;
    }
}
```

Blazor: Two way data binding

```
@page "/counter"
@inject HttpClient

<h1>Counter</h1>
<input type="number" bind="IncrementAmount" />
<p>Current count: @currentCount</p>
<button class="btn btn-primary" onclick="@IncrementCount">Click me</button>

@functions {
    int currentCount = 0;
    int IncrementAmount { get; set; } = 1;

    void IncrementCount()
    {
        currentCount += IncrementAmount;
    }
}
```

Blazor: Event binding

```
@page "/counter"
@inject HttpClient

<h1>Counter</h1>
<input type="number" bind="IncrementAmount" />
<p>Current count: @currentCount</p>
<button class="btn btn-primary" onclick="@IncrementCount">Click me</button>

@functions {
    int currentCount = 0;
    int IncrementAmount { get; set; } = 1;

    void IncrementCount()
    {
        currentCount += IncrementAmount;
    }
}
```

Blazor: Using

```
@page "/counter"
@inject HttpClient

<h1>Counter</h1>
<input type="number" bind="IncrementAmount" />
<p>Current count: @currentCount</p>
<button class="btn btn-primary" onclick="@IncrementCount">Click me</button>

@functions {
    int currentCount = 0;
    int IncrementAmount { get; set; } = 1;

    void IncrementCount()
    {
        currentCount += IncrementAmount;
    }
}
```

JavaScript interop

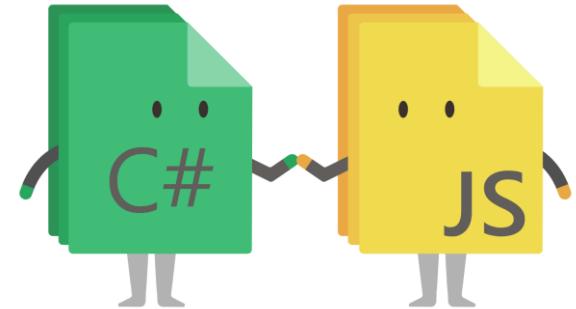
```
<button onclick="@CallDoSomething">Do something</button>
```

```
<script>
    function doSomething(message) {
        console.log(message);
        return true;
    }

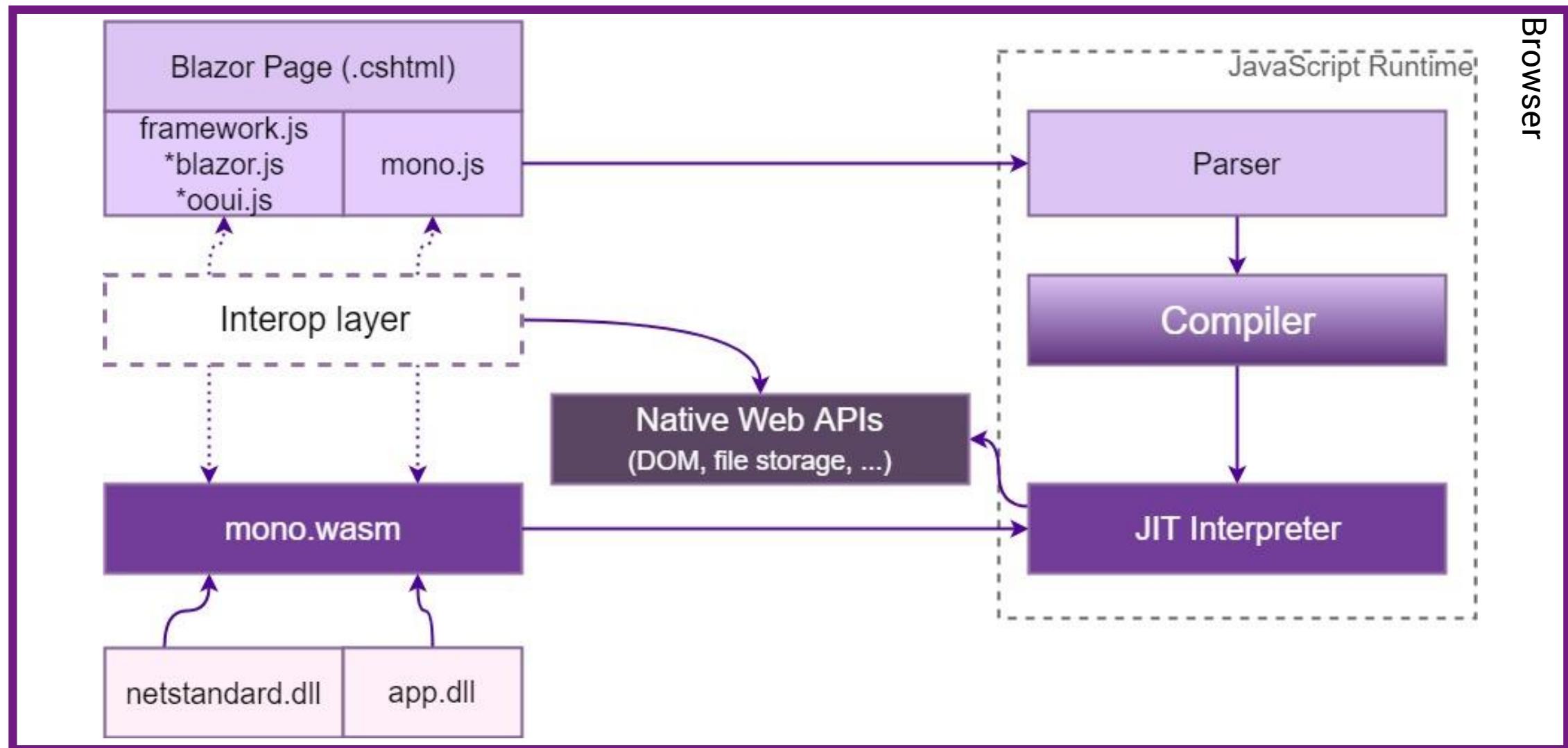
```

```
    Blazor.registerFunction('doSomething', doSomething);
</script>
```

```
@functions {
    public void CallDoSomething()
    {
        RegisteredFunction.Invoke<bool>("doSomething", "Hello World");
    }
}
```



WASM + C#



Blazor sample in browser

The screenshot shows a browser window titled "JLBlazorExample" at the URL "localhost:64814". The page displays a "Hello, world!" message and a navigation menu with "Home" and "Counter" options. Below the page content is a Network tab from a developer tools interface, showing a list of requests and their details. The table includes columns for Stan (Status), Metoda (Method), Domena (Domain), Plik (File), Przycz... (Reason), Typ (Type), Przesłano (Sent), Rozmiar (Size), and various timing metrics. Most requests are 200 OK status, with some 304 Not Modified and 404 Not Found entries. The "Sieć" (Network) tab is selected. At the bottom of the interface, there is a summary of 24 requests, total transfer of 4,29 MB / 291,75 KB, a duration of 1,31 s, and a note about DOMContentLoaded: 239 ms and load: 244 ms.

Stan	Metoda	Domena	Plik	Przycz...	Typ	Przesłano	Rozmiar	0 ms	320 ms	640 ms	960 ms	1,28 s	1,61 ^
304	GET	localhost:64814	/		document	html	0	426 B	5 ms				
304	GET	localhost:64814	bootstrap.min.css		stylesheet	css	0	141,49 KB	6 ms				
304	GET	localhost:64814	site.css		stylesheet	css	0	2,20 KB	7 ms				
304	GET	localhost:64814	blazor.webassembly.js		script	js	0	0 B	6 ms				
304	GET	localhost:64814	open-iconic-bootstrap.min.css		stylesheet	css	0	9,17 KB	4 ms				
304	GET	localhost:64814	blazor.boot.json		fetch	json	0	590 B	3 ms				
200	GET	localhost:64814	favicon.ico		img	html	0	426 B					
304	GET	localhost:64814	mono.js		script	js	0	0 B	3 ms				
304	GET	localhost:64814	mono.wasm		fetch	wasm	0	1,83 MB	3 ms				
200	GET	localhost:64814	JLBlazorExample.dll		xhr	octet-stream	7,19 KB	16 KB		6 ms			
304	GET	localhost:64814	JL.GameOfLife.Core.dll		xhr	octet-stream	0	12 KB		6 ms			
200	GET	localhost:64814	Microsoft.AspNetCore.Blazor.Browser.dll		xhr	octet-stream	14,76 KB	28,50 KB		7 ms			
200	GET	localhost:64814	Microsoft.AspNetCore.Blazor.dll		xhr	octet-stream	40,32 KB	91 KB		10 ms			
200	GET	localhost:64814	Microsoft.AspNetCore.Blazor.TagHelper... .xhtml		xhr	octet-stream	2,42 KB	5 KB		4 ms			
200	GET	localhost:64814	Microsoft.Extensions.DependencyInjection.Injecti... .xhtml		xhr	octet-stream	11,89 KB	26,50 KB		7 ms			
200	GET	localhost:64814	Microsoft.Extensions.DependencyInjection.Injecti... .xhtml		xhr	octet-stream	20,44 KB	42 KB		7 ms			
200	GET	localhost:64814	System.Net.Http.dll		xhr	octet-stream	31,82 KB	65,50 KB		8 ms			
304	GET	localhost:64814	JL.GameOfLife.Core.pdb		xhr	octet-stream	0	3,34 KB		4 ms			
200	GET	localhost:64814	JLBlazorExample.pdb		xhr	octet-stream	1,87 KB	2,36 KB					
200	GET	localhost:64814	Microsoft.JSInterop.dll		xhr	octet-stream	20,67 KB	40,50 KB					
200	GET	localhost:64814	Mono.WebAssembly.Interop.dll		xhr	octet-stream	3,15 KB	6 KB					
304	GET	localhost:64814	mscorlib.dll		xhr	octet-stream	0	1,56 MB					
200	GET	localhost:64814	System.Core.dll		xhr	octet-stream	137,22 KB	334 KB					



 bootstrap.min.css	stylesheet	css	0	141,49 KB
 site.css	stylesheet	css	0	2,20 KB
 blazor.webassembly.js	script	js	0	0 B
 open-iconic-bootstrap.min.css	stylesheet	css	0	9,17 KB
 blazor.boot.json	fetch	json	0	590 B
 favicon.ico	img	html	0	426 B
 mono.js	script	js	0	0 B
 mono.wasm	fetch	wasm	0	1,83 MB
 JLBlazorExample.dll	xhr	octet-stream	7,19 KB	16 KB
 JL.GameOfLife.Core.dll	xhr	octet-stream	0	12 KB
 Microsoft.AspNetCore.Blazor.Browser.dll	xhr	octet-stream	14,76 KB	28,50 KB
 Microsoft.AspNetCore.Blazor.dll	xhr	octet-stream	40,32 KB	91 KB
 Microsoft.AspNetCore.Blazor.TagHelper...	xhr	octet-stream	2,42 KB	5 KB

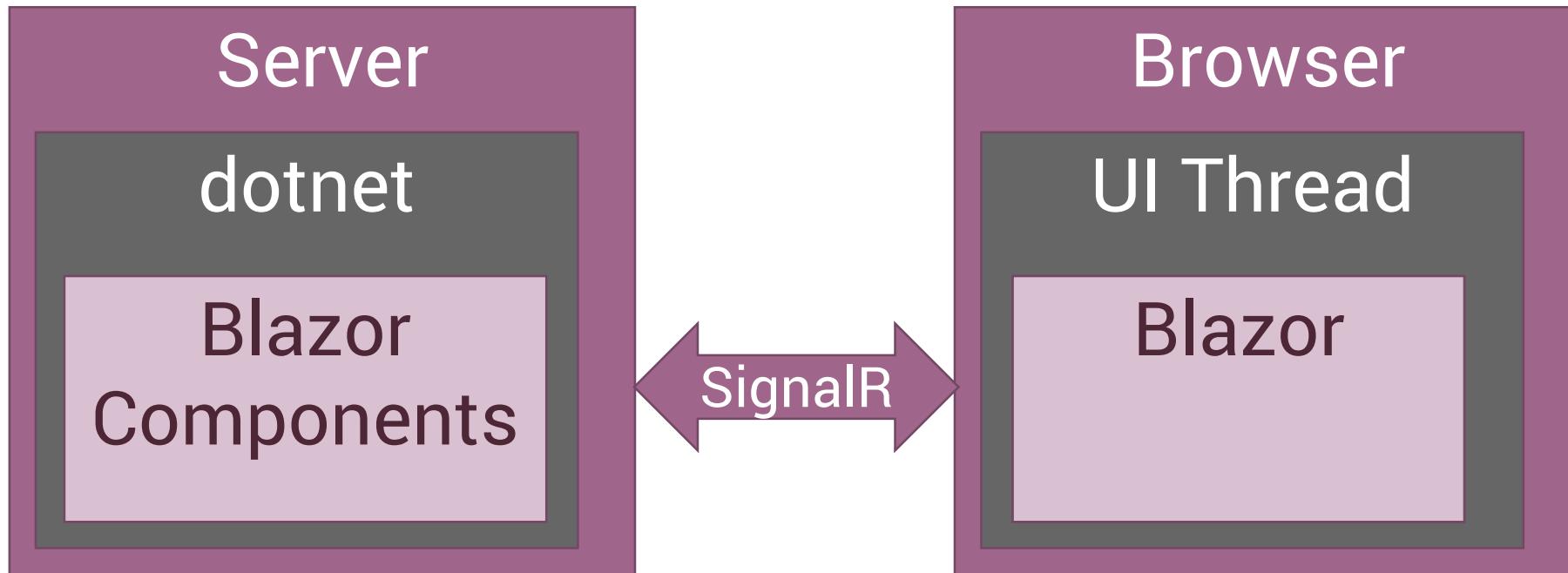
 bootstrap.min.css	stylesheet	css	0	141,49 KB
 site.css	stylesheet	css	0	2,20 KB
 blazor.webassembly.js	script	js	0	0 B
 open-iconic-bootstrap.min.css	stylesheet	css	0	9,17 KB
 blazor.boot.json	fetch	json	0	590 B
 favicon.ico	img	html	0	426 B
 mono.js	script	js	0	0 B
 mono.wasm	fetch	wasm	0	1,83 MB
 JLBlazorExample.dll	xhr	octet-stream	7,19 KB	16 KB
 JL.GameOfLife.Core.dll	xhr	octet-stream	0	12 KB
 Microsoft.AspNetCore.Blazor.Browser.dll	xhr	octet-stream	14,76 KB	28,50 KB
 Microsoft.AspNetCore.Blazor.dll	xhr	octet-stream	40,32 KB	91 KB
 Microsoft.AspNetCore.Blazor.TagHelper...	xhr	octet-stream	2,42 KB	5 KB

 bootstrap.min.css	stylesheet	css	0	141,49 KB
 site.css	stylesheet	css	0	2,20 KB
 blazor.webassembly.js	script	js	0	0 B
 open-iconic-bootstrap.min.css	stylesheet	css	0	9,17 KB
 blazor.boot.json	fetch	json	0	590 B
 favicon.ico	img	html	0	426 B
 mono.js	script	js	0	0 B
 mono.wasm	fetch	wasm	0	1,83 MB
 JLBlazorExample.dll	xhr	octet-stream	7,19 KB	16 KB
 JL.GameOfLife.Core.dll	xhr	octet-stream	0	12 KB
 Microsoft.AspNetCore.Blazor.Browser.dll	xhr	octet-stream	14,76 KB	28,50 KB
 Microsoft.AspNetCore.Blazor.dll	xhr	octet-stream	40,32 KB	91 KB
 Microsoft.AspNetCore.Blazor.TagHelper...	xhr	octet-stream	2,42 KB	5 KB

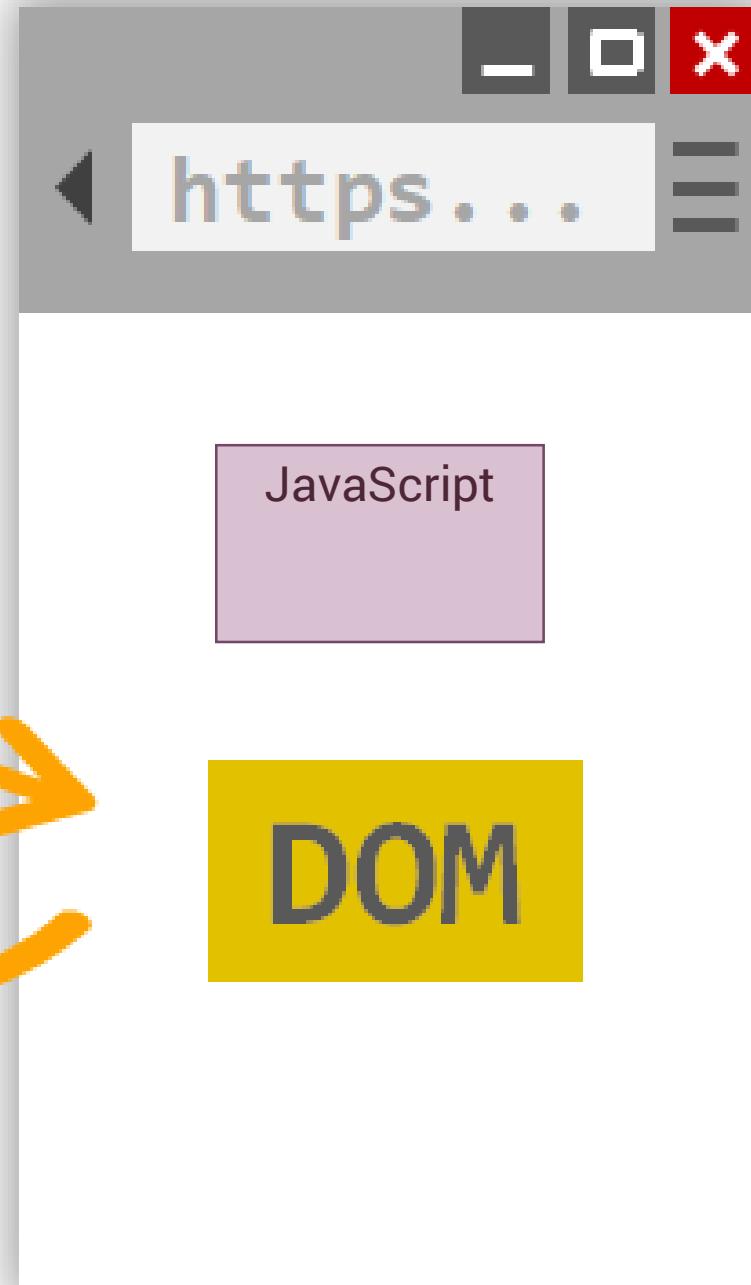
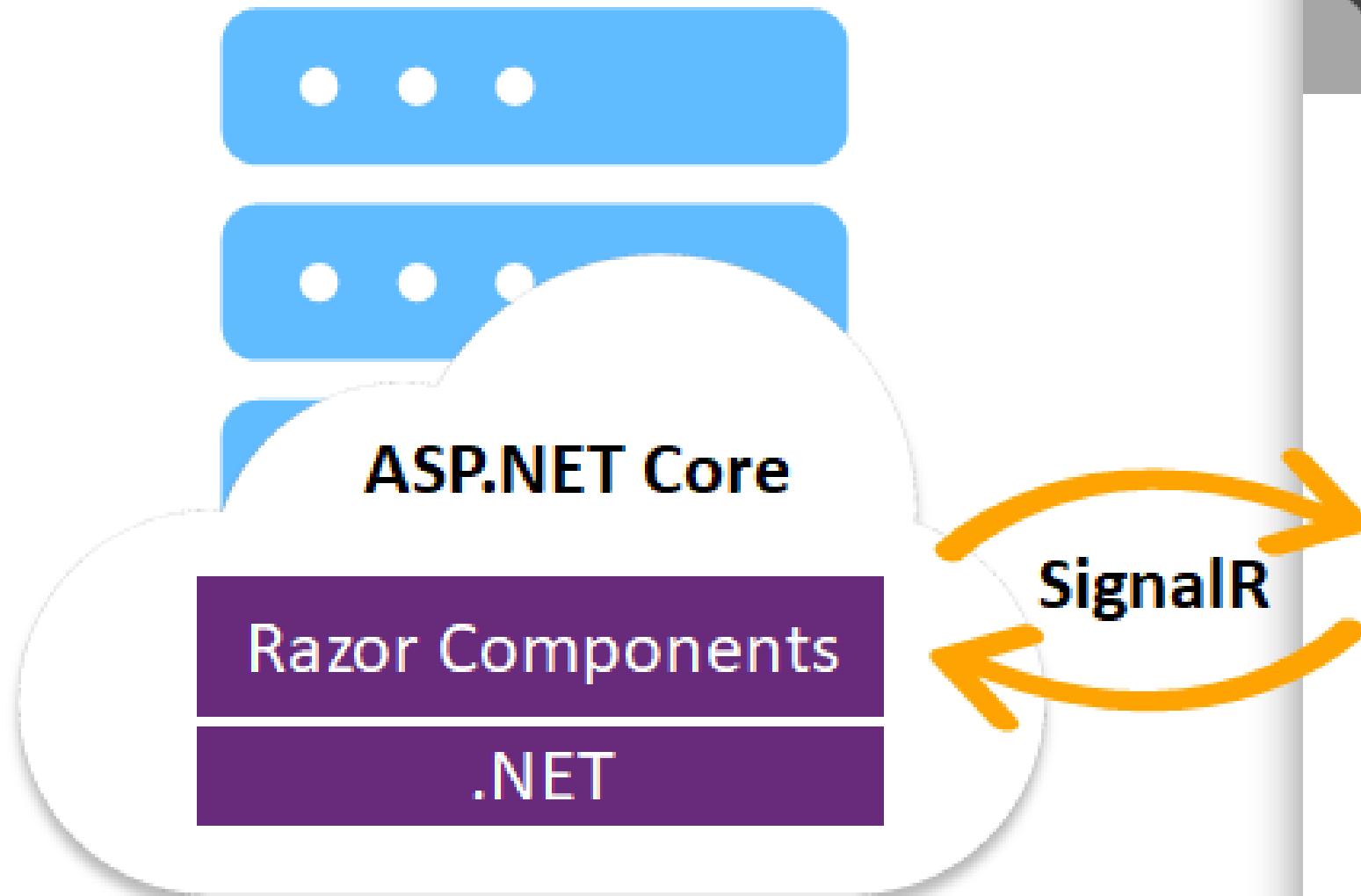
 bootstrap.min.css	stylesheet	css	0	141,49 KB
 site.css	stylesheet	css	0	2,20 KB
 blazor.webassembly.js	script	js	0	0 B
 open-iconic-bootstrap.min.css	stylesheet	css	0	9,17 KB
 blazor.boot.json	fetch	json	0	590 B
 favicon.ico	img	html	0	426 B
 mono.js	script	js	0	0 B
 mono.wasm	fetch	wasm	0	1,83 MB
 JLBlazorExample.dll	xhr	octet-stream	7,19 KB	16 KB
 JL.GameOfLife.Core.dll	xhr	octet-stream	0	12 KB
 Microsoft.AspNetCore.Blazor.Browser.dll	xhr	octet-stream	14,76 KB	28,50 KB
 Microsoft.AspNetCore.Blazor.dll	xhr	octet-stream	40,32 KB	91 KB
 Microsoft.AspNetCore.Blazor.TagHelper...	xhr	octet-stream	2,42 KB	5 KB

 bootstrap.min.css	stylesheet	css	0	141,49 KB
 site.css	stylesheet	css	0	2,20 KB
 blazor.webassembly.js	script	js	0	0 B
 open-iconic-bootstrap.min.css	stylesheet	css	0	9,17 KB
 blazor.boot.json	fetch	json	0	590 B
 favicon.ico	img	html	0	426 B
 mono.js	script	js	0	0 B
 mono.wasm	fetch	wasm	0	1,83 MB
 JLBlazorExample.dll	xhr	octet-stream	7,19 KB	16 KB
 JL.GameOfLife.Core.dll	xhr	octet-stream	0	12 KB
 Microsoft.AspNetCore.Blazor.Browser.dll	xhr	octet-stream	14,76 KB	28,50 KB
 Microsoft.AspNetCore.Blazor.dll	xhr	octet-stream	40,32 KB	91 KB
 Microsoft.AspNetCore.Blazor.TagHelper...	xhr	octet-stream	2,42 KB	5 KB

Let's switch elements places



Blazor server-side

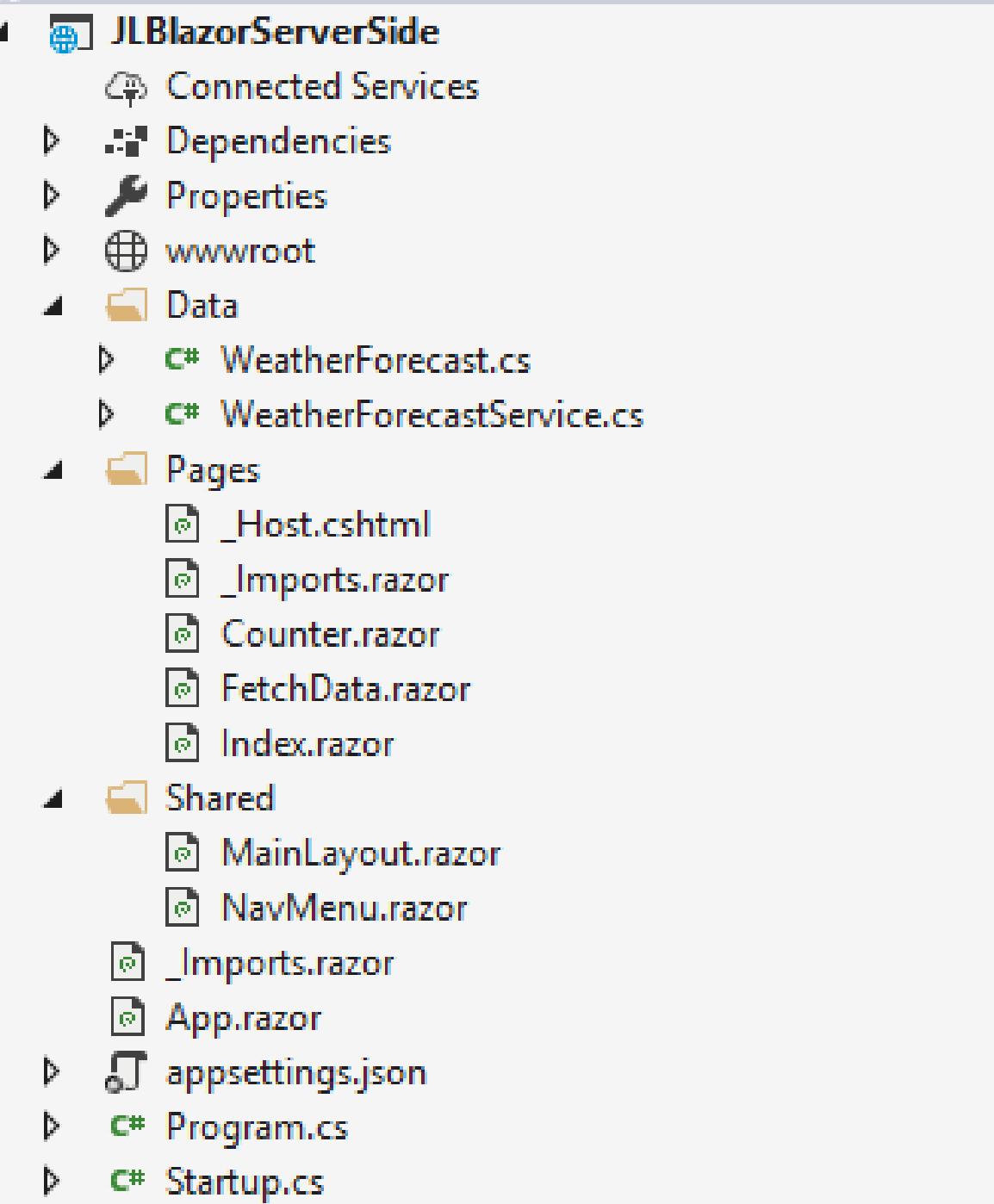


Blazor server-side

```
C:\Projects> dotnet new  
blazorserver -n  
JLBlazorServerSide
```

Blazor server-side

```
C:\Projects> dotnet  
blazorserverside  
JLBlazorServerSide
```



Solution 'JLBlazorExample' (1 of 1 project)

- ▶ JLBlazorExample
 - ▶ Connected Services
 - ▶ Dependencies
 - ▶ Properties
 - ▶ wwwroot
 - ▶ css
 - ▶ sample-data
 - ▶ index.html
 - ▶ Pages
 - ▶ _Imports.razor
 - ▶ Counter.razor
 - ▶ FetchData.razor
 - ▶ Index.razor
 - ▶ Shared
 - ▶ MainLayout.razor
 - ▶ NavMenu.razor
 - ▶ SurveyPrompt.razor
 - ▶ _Imports.razor
 - ▶ App.razor
 - ▶ C# Program.cs
 - ▶ C# Startup.cs

JLBlazorServerSide

- ▶ Connected Services
- ▶ Dependencies
- ▶ Properties
- ▶ wwwroot
- ▶ Data
 - ▶ C# WeatherForecast.cs
 - ▶ C# WeatherForecastService.cs
- ▶ Pages
 - ▶ _Host.cshtml
 - ▶ _Imports.razor
 - ▶ Counter.razor
 - ▶ FetchData.razor
 - ▶ Index.razor
- ▶ Shared
 - ▶ MainLayout.razor
 - ▶ NavMenu.razor
 - ▶ _Imports.razor
 - ▶ App.razor
- ▶ appsettings.json
- ▶ C# Program.cs
- ▶ C# Startup.cs

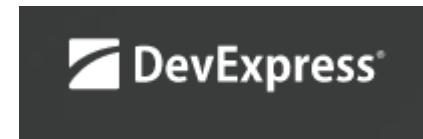
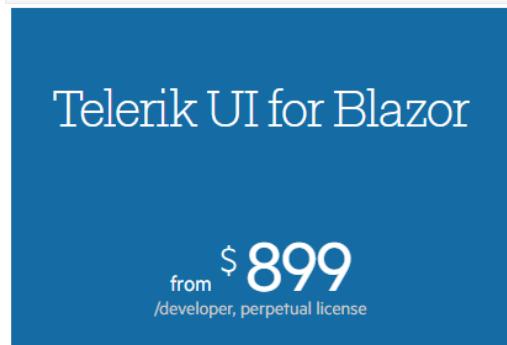
```
public class Program { //Blazor client side
    public static IWebAssemblyHostBuilder CreateHostBuilder(string[] args) =>
        BlazorWebAssemblyHost.CreateDefaultBuilder().UseBlazorStartup<Startup>();
}

public class Program { //Blazor server side
    public static IHostBuilder CreateHostBuilder(string[] args) =>
        Host.CreateDefaultBuilder(args).ConfigureWebHostDefaults(webBuilder =>
            {webBuilder.UseStartup<Startup>();});
}

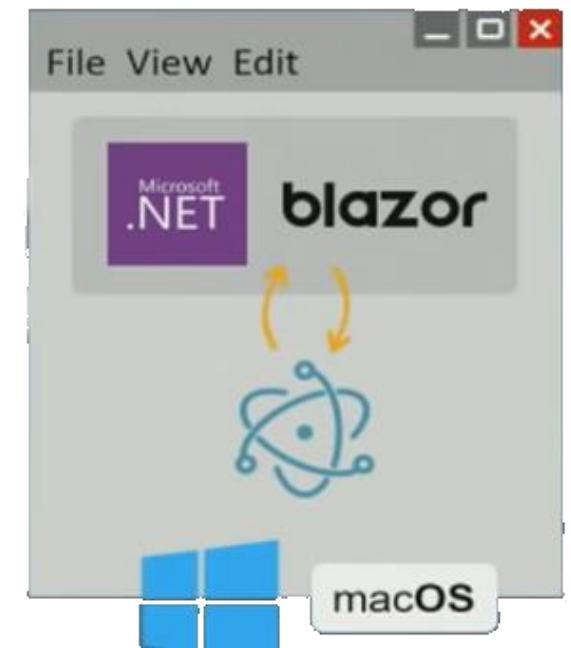
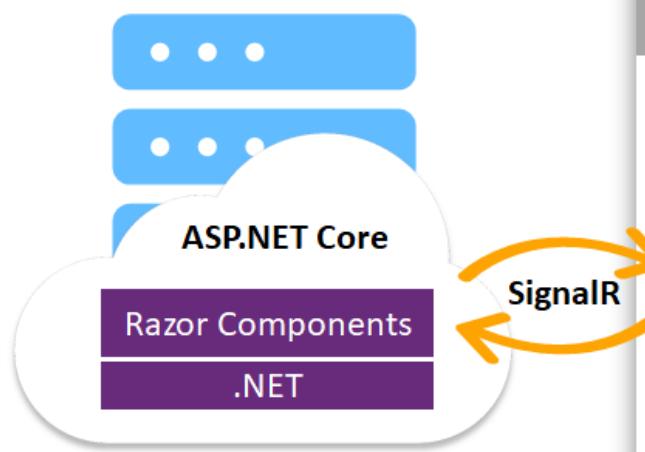
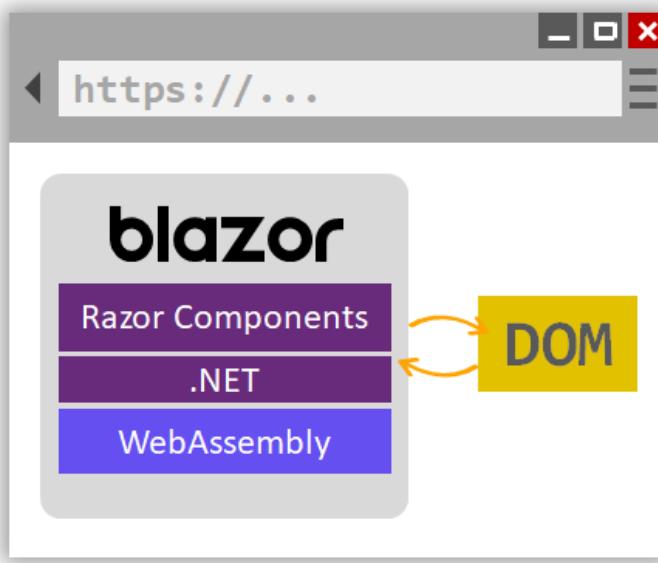
public class Startup {
    public void ConfigureServices(IServiceCollection services) {
        services.AddRazorPages();
        services.AddServerSideBlazor();
        services.AddSingleton<WeatherForecastService>();
    }
}
```

UI component ecosystem

+ Add Product			
Product Name	Unit Price ↑	Units In Stock	
Product30	\$94.20	30	<button>Edit</button> <button>Delete</button>
Product31	\$97.34	31	<button>Edit</button> <button>Delete</button>
Product32	\$100.48	32	<button>Edit</button> <button>Delete</button>
Product33	103.62	36	<button>Update</button> <button>Cancel</button>
Product34	\$106.76	34	<button>Edit</button> <button>Delete</button>
Product35	\$109.90	35	<button>Edit</button> <button>Delete</button>
Product36	\$113.04	36	<button>Edit</button> <button>Delete</button>
Product37	\$116.18	37	<button>Edit</button> <button>Delete</button>



Blazor: possibilities



<https://www.youtube.com/watch?v=qrf3OrLHeFI>

Steve Sanderson - Blazor, a New .NET Single Page Application Framework | Øredev 2018

What's the future?



What WebAssembly are next to?

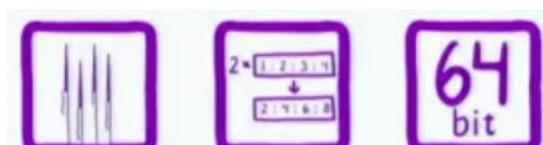


Loadtime improvements

- streaming compilation
- tiered compilation
- implicit HTTP caching
- other improvements

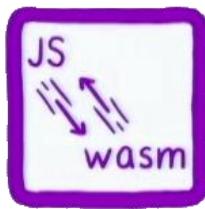
Making use of modern Hardware

- threading
- SIMD
- wasm 64bit

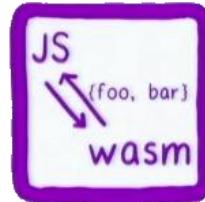


What WebAssembly are next to?

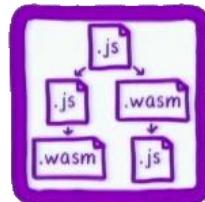
- fast calls
JS <~> wasm



- easy and fast
data exchange



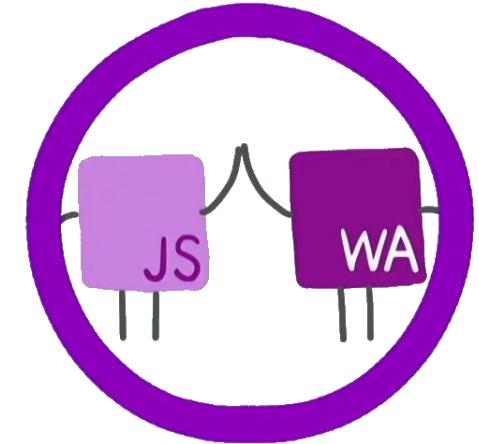
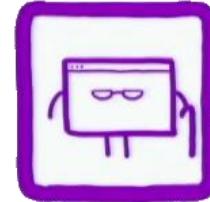
- ES module
integration



- toolchain integration
like npm or webpack



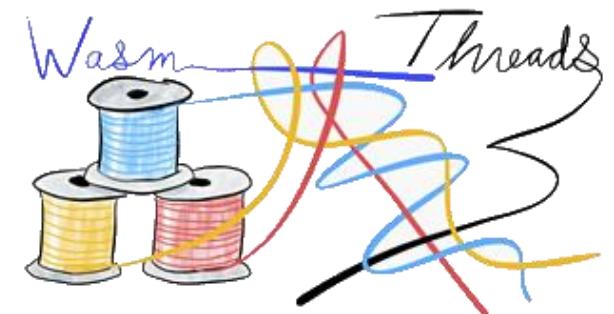
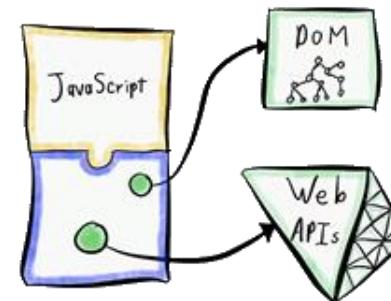
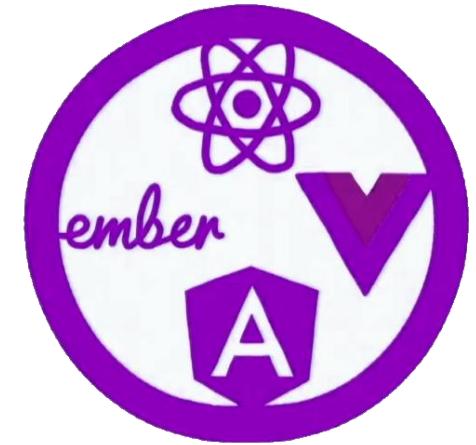
- backward compatibility



What WebAssembly are next to?

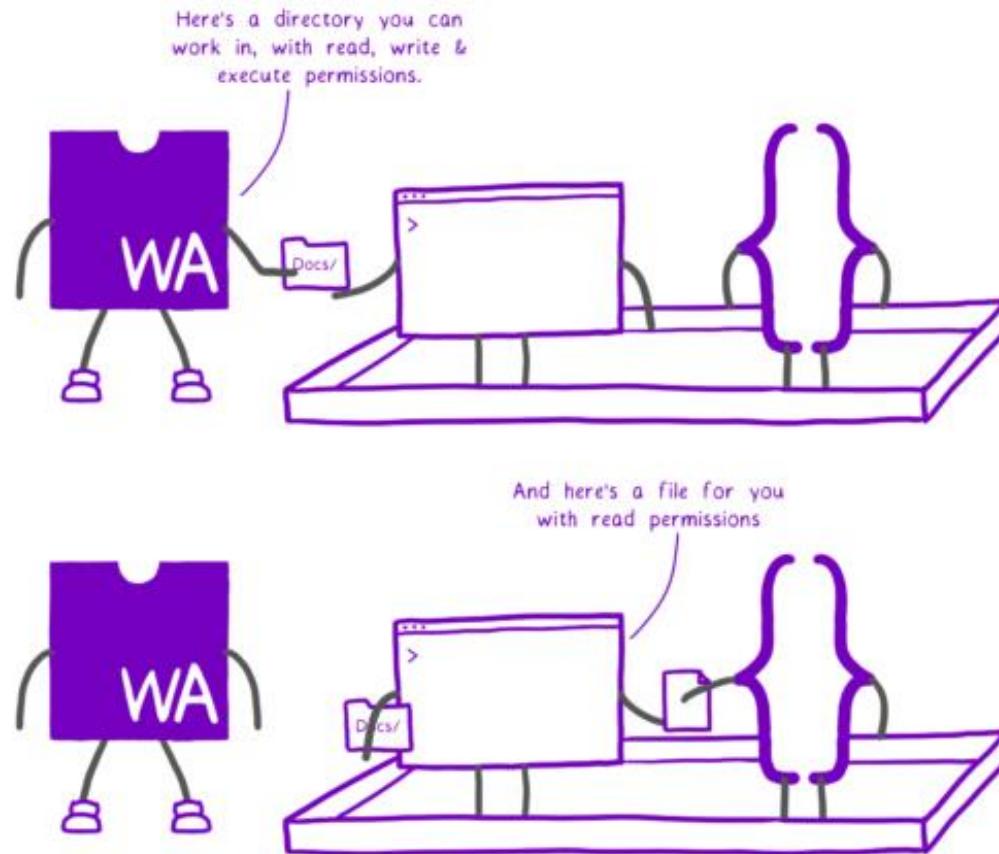
High level language features

- GC integration
- Exception handling
- Debugging
- Tail calls

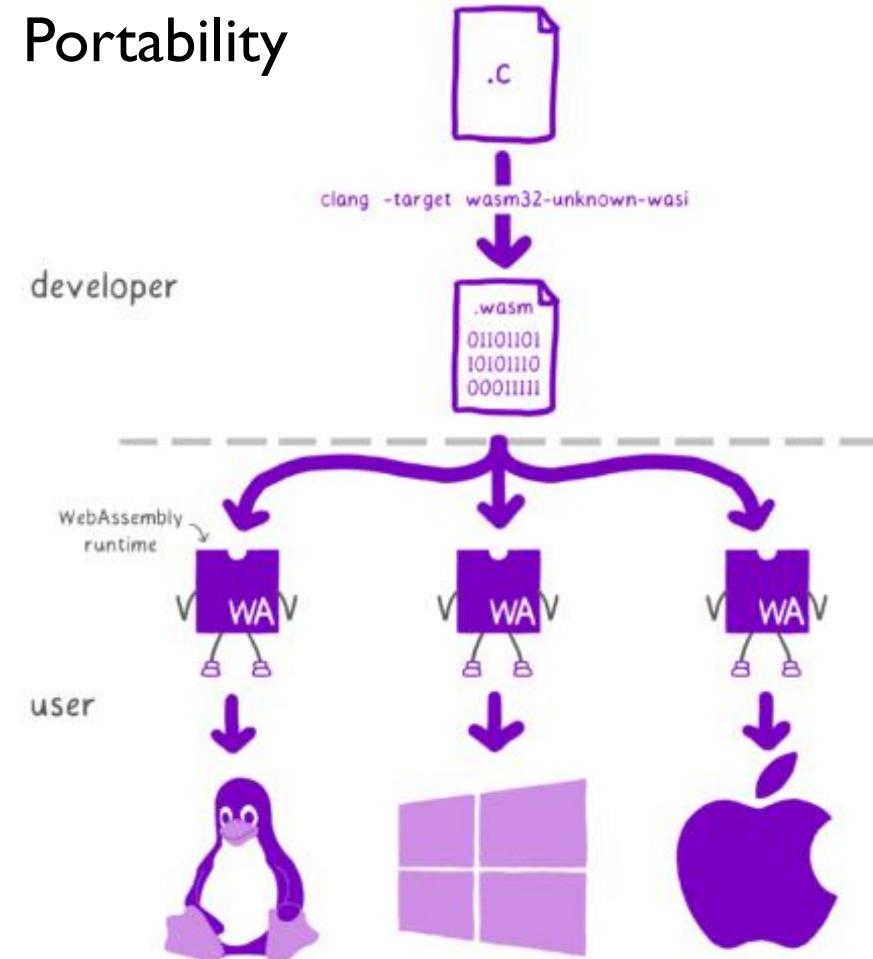


WASI – WebAssembly System Interface

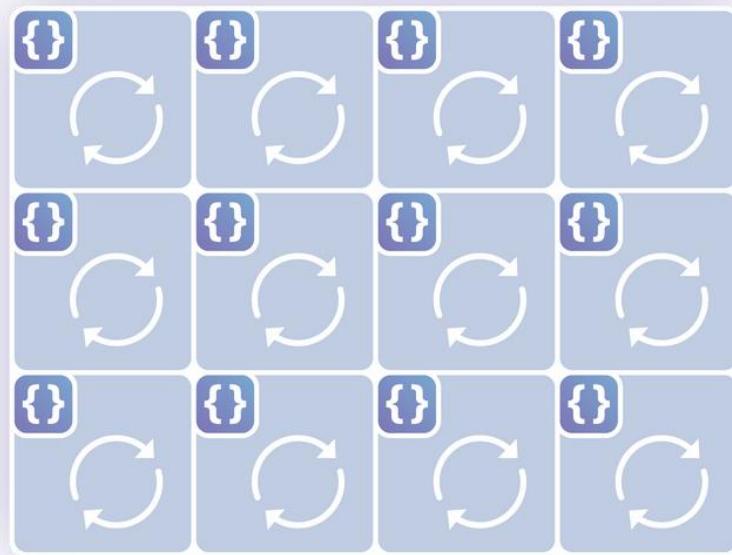
Security



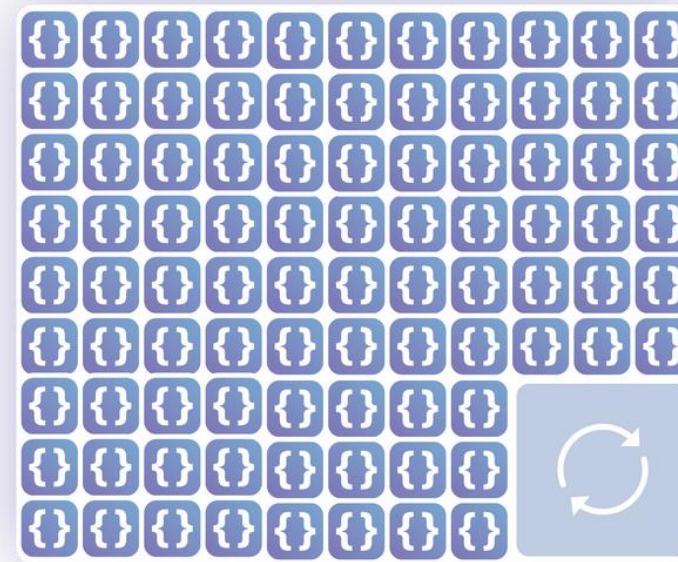
Portability



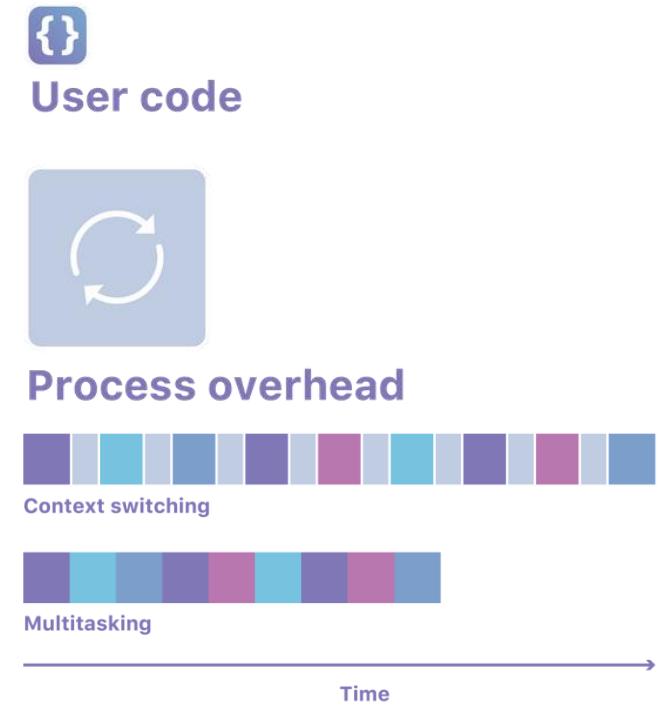
CloudFlare



Virtual machine



Isolate model

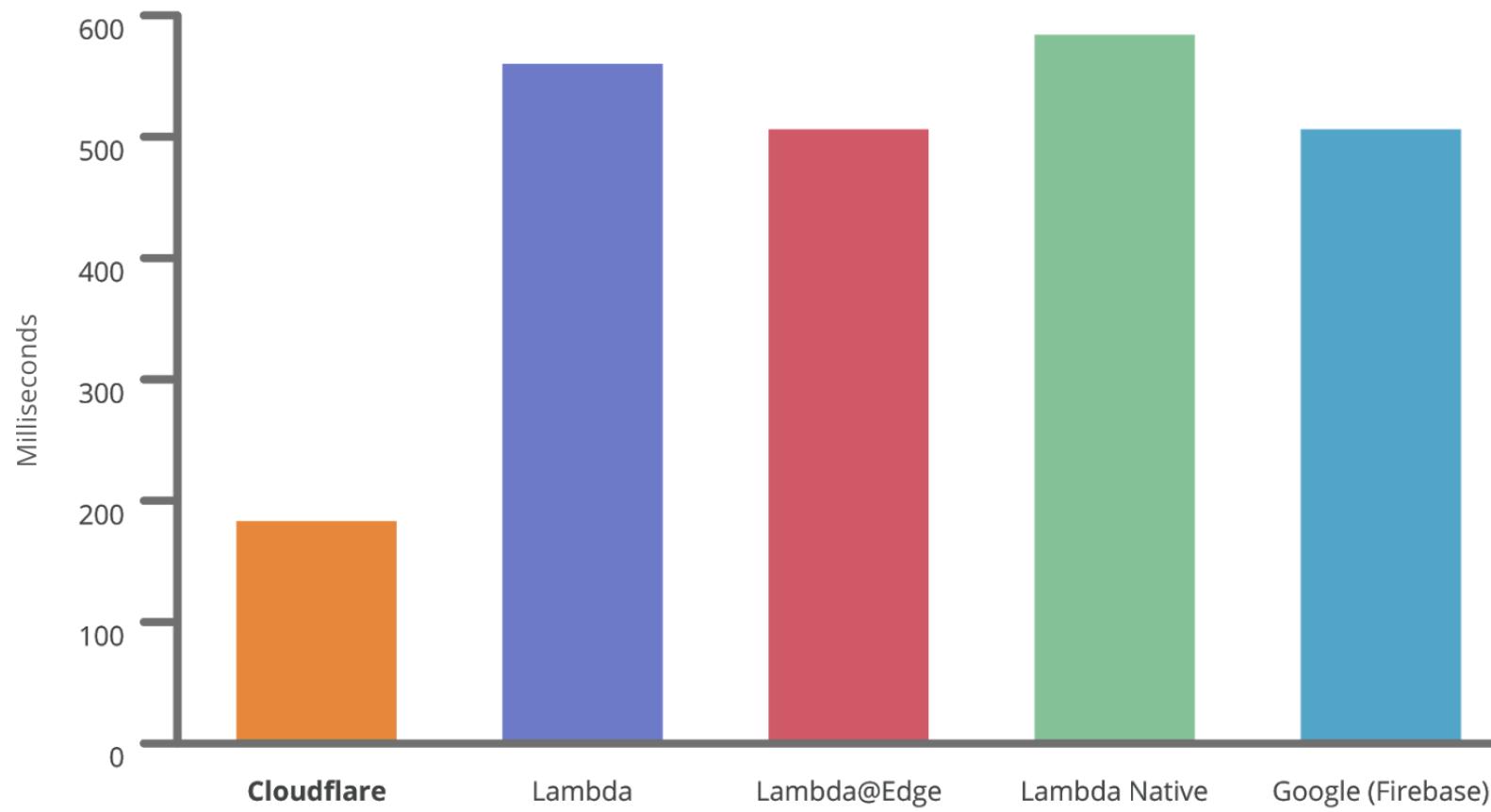


<https://blog.cloudflare.com/cloud-computing-without-containers/>
<https://www.youtube.com/watch?v=A9SydP1CcZU>

CloudFlare no more cold starts?



Request response time for primary serverless providers



So WebAssembly?

Possibilities

Flexibility
Diversity

Cross-platform

Promise of bright tomorrow for todays projects

Questions??



THANKS



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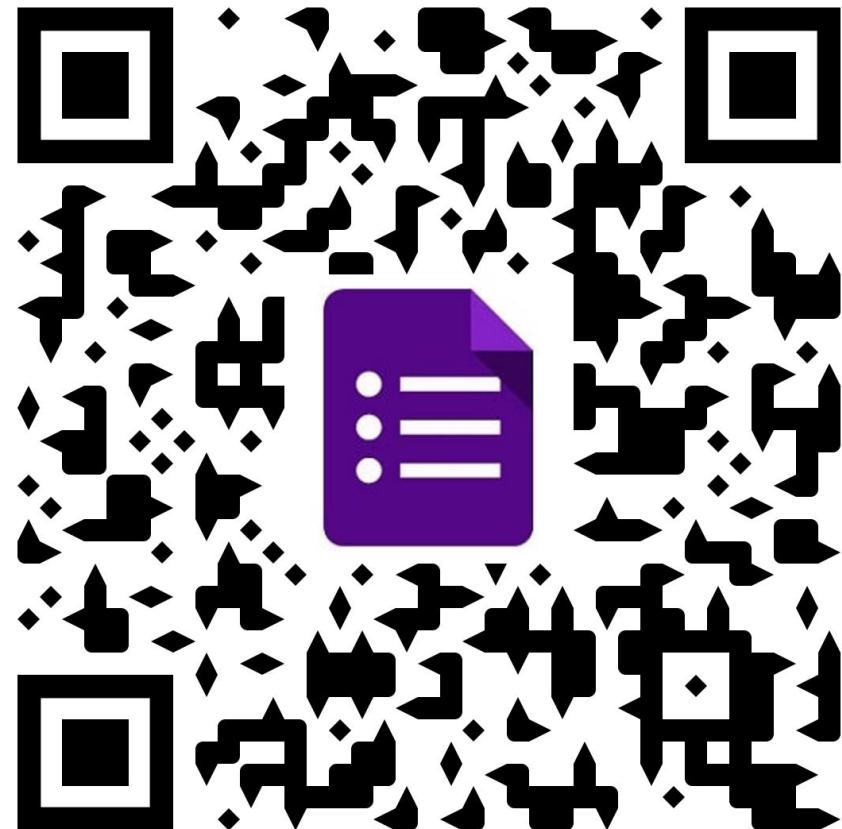
ProgramistkaKot.pl



- Ankieta

Działanie pociąga za sobą koszty i ryzyko, ale o wiele mniejsze niż te, które wiążą się z wygodną bezczynnością.

- Będzie mi miło móc ulepszyć moją prezentację dzięki Twoim komentarzom, dlatego proszę Cię o wypełnienie ankiety, bądź kontakt mailowy.



• Bibliografia

- <https://webassembly.org/docs/high-level-goals/>
- <https://www.smashingmagazine.com/2017/05/abridged-cartoon-introduction-webassembly/>
- https://www.youtube.com/watch?v=HktWin_LPf4&feature=youtu.be
- <https://www.youtube.com/watch?v=pBYqen3B2gc>
- <https://www.youtube.com/watch?v=BnYq7JapeDA>
<https://www.youtube.com/watch?v=kS29TT4wk44&feature=youtu.be>
- <https://github.com/mbasso/awesome-wasm>
- <https://github.com/migueldeicaza/mono-wasm>
- <https://superkotlin.com/kotlin-and-webassembly/>
- <https://medium.com/@mumarov/how-to-get-started-with-kotlin-native-and-web-assembly-baa2813f0d9>
- <https://github.com/DenisKolodin/yew>
- <https://www.mergeconflict.fm/89>
- <https://dotnetrocks.com/?show=1539>
- <https://dotnetrocks.com/?show=1540>
- <https://dotnetrocks.com/?show=1537>
- <https://www.hanselman.com/blog/NETAndWebAssemblyIsThisTheFutureOfTheFrontend.aspx>
<https://hacks.mozilla.org/2018/04/sneak-peek-at-webassembly-studio/>
- https://github.com/migueldeicaza/mono-wasm?WT.mc_id=-blog-scottha
- <https://blog.scottlogic.com/ceberhardt/>
- <https://blog.logrocket.com/working-with-the-blazor-javascript-interop-3c2a8d0eb56c>
<https://s3.amazonaws.com.mozilla-games/ZenGarden/EpicZenGarden.html>
<https://blog.logrocket.com/working-with-the-blazor-javascript-interop-3c2a8d0eb56c>

