WebAssembly

Or: How I tried to write a web app without using Javascript

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Overview

Disclaimers

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I'm not an expert in web development. Things I say in this talk could be wrong.

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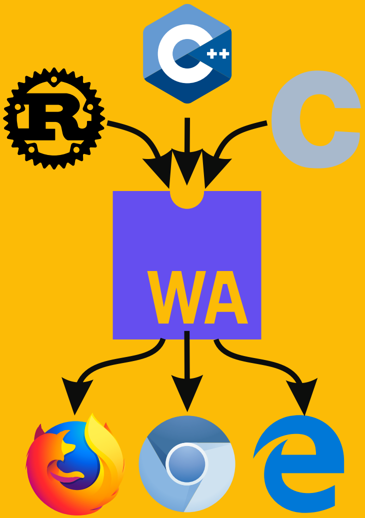
This talk might contain rants about Javascript and other web technologies.

What is WebAssembly?

From the Website

WebAssembly (abbreviated Wasm) is a binary instruction format for a stack-based virtual machine. Wasm is designed as a portable target for compilation of high-level languages like C/C++/Rust, enabling deployment on the web for client and server applications.

What is WebAssembly?



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According to the Website:

- Efficient and fast
- Safe
- Part of the open web platform
- Open and debuggable

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```
get_local 0
i64.const 0
i64.eq
if i64
  i64.const 1
else
  get_local 0
  get_local 0
  i64.const 1
  i64.sub
  call 0
  i64.mul
end
```

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My Opinion:

- Write your web code in a usable language
- Use Code from non web libraries
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- Avoid the use of Javascript. *Almost.*

History

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- 2016 - Definition of core features and Browser Preview with different implementations
- March 2017 - Cross-browser consensus and end of Browser Preview
- February 2018 - Three public working drafts for the Core Specification, JavaScript Interface, and Web API published.

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Minimum Viable Product (MVP)

WebAssembly is currently in the status of a MVP. Version 1.0 *works* in all major browsers

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Future Work

- Stabilize LLVM backend
- Multi-threading
- Garbage collection
- Everything else...

How it works

Machine Model

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Execution

WebAssembly can currently only be executed through a specific Javascript API. It is planned to add the possibility to use Wasm as a script module directly in the future.

A Small Function

```
(module
  (func $f (param f64) (result f64)
    get_local 0
    f64.const 1
    f64.lt
    if (result f64)
      f64.const 1
    else
      get_local 0
      get_local 0
      f64.const 1
      f64.sub
      call $f
      f64.mul
    end)
  (export "f" (func $f)))
```

A Small Example

Javascript

```
fetch('demo.wasm').then(response =>
    response.arrayBuffer()
).then(buffer =>
    WebAssembly.instantiate(buffer)
).then(({module, instance}) =>
    console.log(instance.exports.f(5))
);
```

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- Innovative memory management system
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Factorial in Rust

```
fn fac(n : u32) {
    if n == 0 {
        1
    } else {
        n * fac(n-1)
    }
}
```

The Ecosystem for Rust

Compile target

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What do we need to make it useful?

- Some way of making the file run in our browser
- Accessing common WebAPI functions (DOM manipulation, events, ...)
- Interop with other Javascript code

Two Choices

Wasm-Bindgen

Cargo-Web / Stdweb

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- Very rapid development
- Aims at providing a tight integration between Javascript and Rust

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- Unofficial Wasm toolkit, but has been around a bit longer
- Supports Rust's native but also the emscripten build
- Still actively developed but slower
- Aims at providing a tool to write a full-Rust web app.

Wasm-Bindgen

Deployment Options

bundler	Suitable for loading in bundlers like Webpack
web	Directly loadable in a web browser
nodejs	Loadable via require as a Node.js module

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Wasm-Pack

Can magically pack your whole code and publish it to the npm repositories...

Wasm-Bindgen Hello World

src/main.rs

```rust
use wasm_bindgen::prelude::*;

#[wasm_bindgen]
extern "C" {
    fn alert(s: &str);
}

#[wasm_bindgen]
pub fn greet(name: &str) {
    alert(&format!("Hello, {}!", name));
}
```

index.html

```
<html>
  <body>
    <script type="module">
      import init, { greet } from './pkg/hello.js';

      async function run() {
        await init();
        greet("Michael");
      }
      run();
    </script>
  </body>
</html>
```

Accessing the DOM

```
#[wasm_bindgen(start)]
pub fn main() -> Result<(), JsValue> {
    let window = web_sys::window().unwrap();
    let document = window.document().unwrap();
    let body = document.body().unwrap();

    let val = document.create_element("p")?;
    val.set_inner_html("Hello from Rust!");
    body.append_child(&val)?;

    Ok(())
}
```

State of the Art

- Low level access to nearly all browser and Javascript APIs via the web-sys and js-sys crates.
- replacing some functions in your Javascript code with Rust is easy.
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The Future

The WebAssembly Working Group is currently working on *glue* which is intended to provide increasingly higher level abstractions for all use cases.

Where to go from here

- WebAssembly Main Site: https://webassembly.org/
- Rust and WebAssembly: https://rustwasm.github.io/
- Learn Rust: https://doc.rust-lang.org/book/