WEBASSEMBLY (WASM)

Demo

GOALS

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"Theory"

1. What is WASM?
2. Benefits of WASM in the browser

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Demo

1. Rust library (Collatz Conjecture)
2. Compile to WASM
3. Display Chart of Collatz Sequence

WHAT IS WASM?

- new type of code that can run in modern browsers
- low-level assembly-like language
- compact binary (runs with near-native performance)
- C/C++, C# and Rust can be compiled to WASM
- designed to run alongside JavaScript

BENEFITS OF WASM

1. 🏃‍♀️ PERFORMANCE
   - binary is fast
2. 🛠️ WE CAN USE RUST 💯
   - full control over memory usage (efficiency)
   - no garbage collection
   - no null pointer errors
   - safety

CREATE LIBRARY CRATE

```
# ❌ binary crate
#    src/main.rs
cargo new my_project

# ✅ library crate
#    src/lib.rs
cargo new --lib collatz_wasm
```

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COLLATZ CONJECTURE (1)

```
// choose seed
let seed = ?;

// apply collatz algorithm
// (pseudocode)
if seed.is_even?
    return seed / 2
else // => seed is odd
    return 3 * seed + 1

// set new number as seed and repeat
// => until the sequence repeats
```

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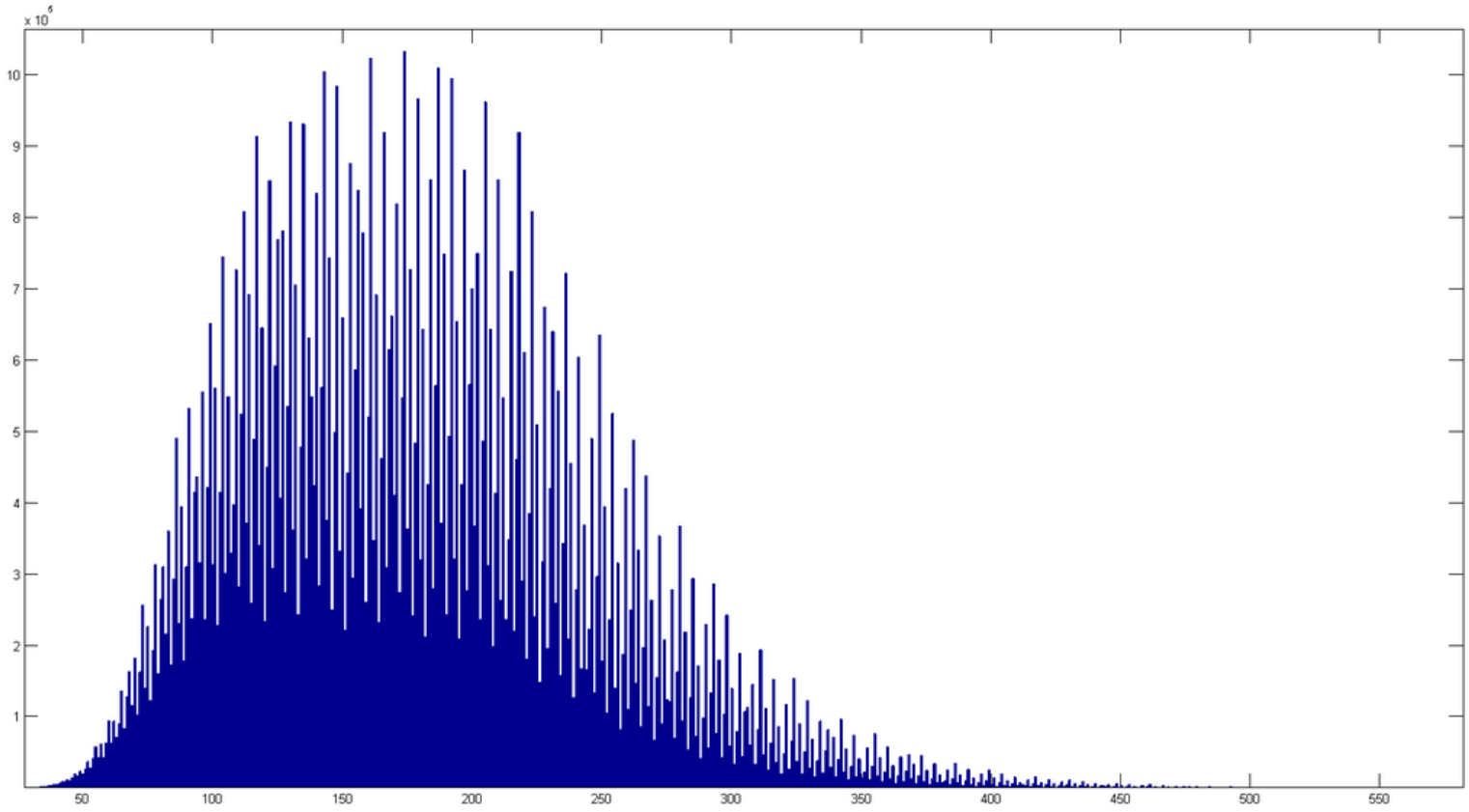
COLLATZ CONJECTURE (2)

```
collatz(4);  // => 4,2,1
collatz(5);  // => 5,16,8,4,2,1
collatz(6);  // => 6,3,10,5,16,8,4,2,1
collatz(7);  // => 7,22,11,34,17,52,26,13,40,20,10,5,16,8,4,2,1
collatz(8);  // => 8,4,2,1
collatz(10); // => 10,5,16,8,4,2,1
collatz(20); // => 20,10,5,16,8,4,2,1
```

COLLATZ CONJECTURE (3)



COLLATZ CONJECTURE IN RUST (1)

```rust
pub fn collatz_next_number(input: i32) -> i32 {
    if input % 2 == 0 { // if input is even
        input / 2
    } else { // if number is odd
        input * 3 + 1
    }
}
```

COLLATZ CONJECTURE IN RUST (1)

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    } else { // if number is odd
        input * 3 + 1
    }
}
```

COLLATZ CONJECTURE IN RUST (2)

```rust
pub fn collatz(seed: i32) -> Vec<i32> {
    // initialize sequence with seed
    let mut sequence: Vec<i32> = vec![seed];
    let mut next_number: i32 = collatz_next_number(seed);
    while !sequence.contains(&next_number) {
        sequence.push(next_number);
        next_number = collatz_next_number(next_number);
    }
    sequence
}
```

COLLATZ CONJECTURE IN RUST (2)

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    while !sequence.contains(&next_number) {
        sequence.push(next_number);
        next_number = collatz_next_number(next_number);
    }
    sequence
}
```

TEST OUR FUNCTION FIRST

```rust
#[cfg(test)]
mod tests {
    use super::*;

    #[test]
    fn correct_sequences_generated() {
        assert_eq!(collatz(4), vec![/*4,2,1*/]);
        assert_eq!(collatz(5), vec![/*5,16,8,4,2,1*/]);
        assert_eq!(collatz(10), vec![/*10,5,16,8,4,2,1*/]);
    }
}
```

Run Tests

```
cargo test
```

TOOLING (1)

wasm-bindgen

```
# allows exporting Rust functionality to JS
# such as classes, functions, etc

# install by adding to Cargo.toml
[dependencies]
wasm-bindgen = "0.2.75"

# build
cargo build
```

TOOLING (1)

Update `src/lib.rs`

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

#[wasm_bindgen]
fn collatz_next_number(input: i32) -> i32 {
    // [...]
}

#[wasm_bindgen]
fn collatz(seed: i32) -> Vec<i32> {
    // [...]
}
```

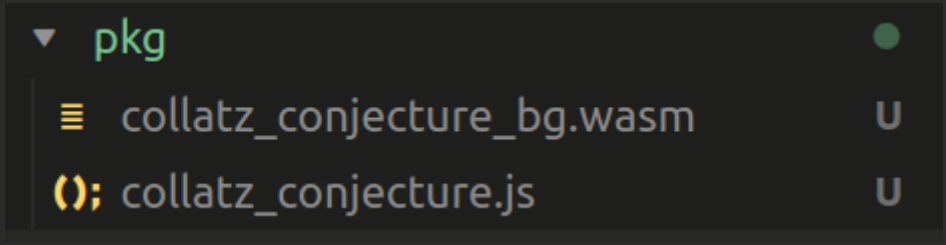
TOOLING (2)

wasm-pack

```
# CLI Tool to bundle rust binaries WASM javascript files

# install instructions
# => https://rustwasm.github.io/wasm-pack/installer/

# bundle your project
wasm-pack build --target web
```



CREATE MINIMAL WEBPROJECT

index.html

```html
<!-- import script -->
<script type="module" src="index.js"></script>
```

index.js

```javascript
import init, {
  collatz,
  collatz_next_number
} from "./pkg/collatz_wasm.js";

init().then(() => {
  const list = collatz(100);
  alert(list);
});
```

FINISHED PROJECT

index.html

index.js

styles.css

THE END

Thanks for your attention 🙏