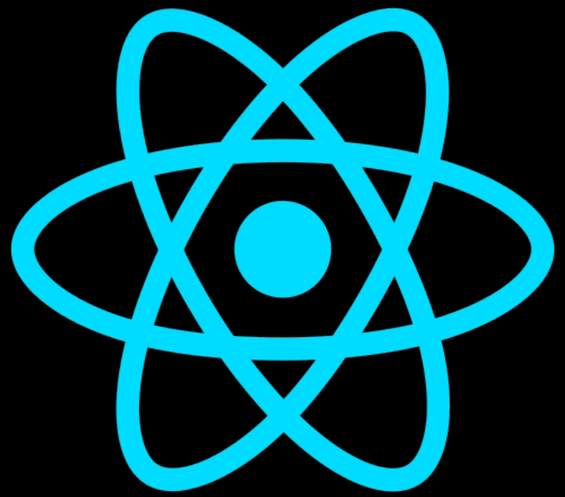
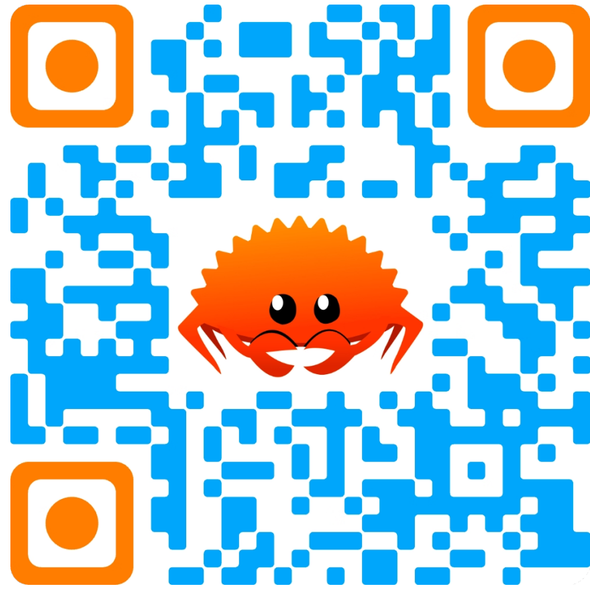
A SOY DEV'S FIRST FORAY INTO RUST

By Manik Rana



AGENDA

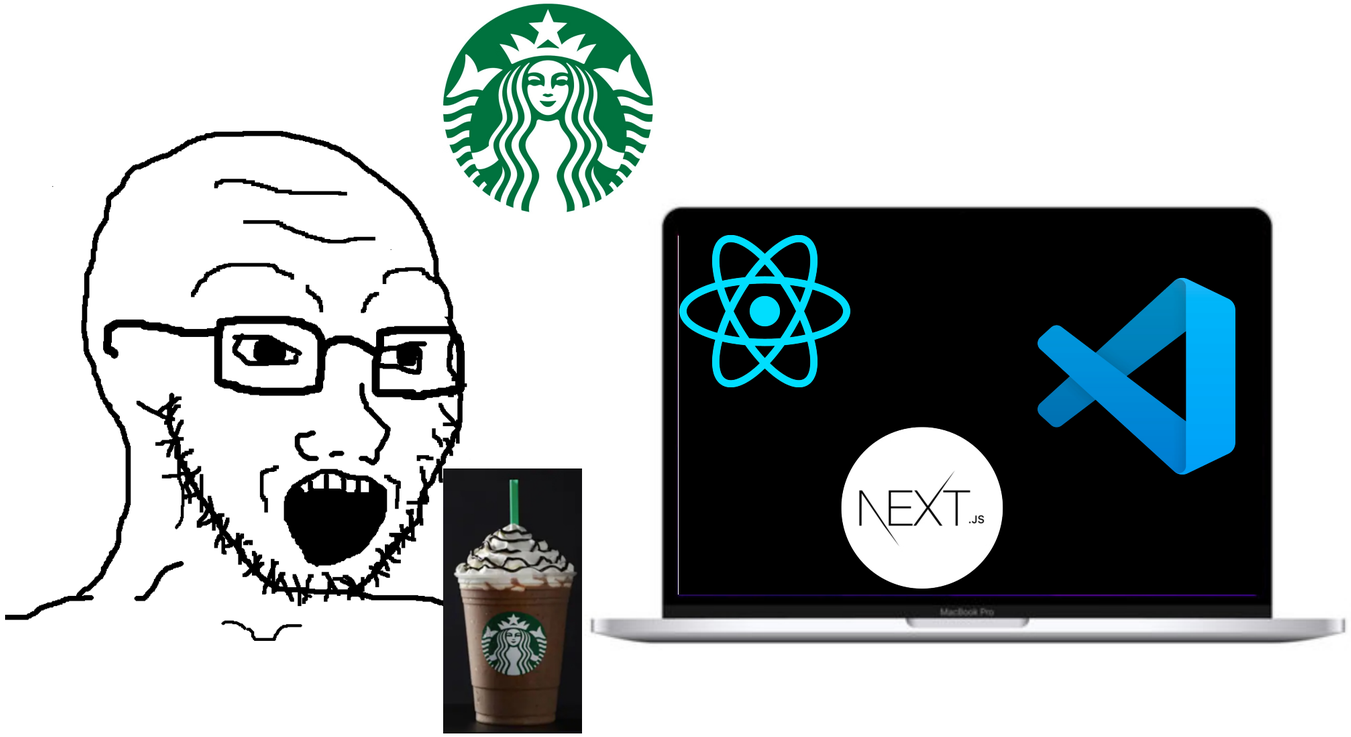
- Hi, I'm Manik
- Advent of Code (and failing)
- Building a TCP Echo Server (and failing)
- ~~Intro to Tauri~~
- ~~Making your own Tauri App~~



slides and code

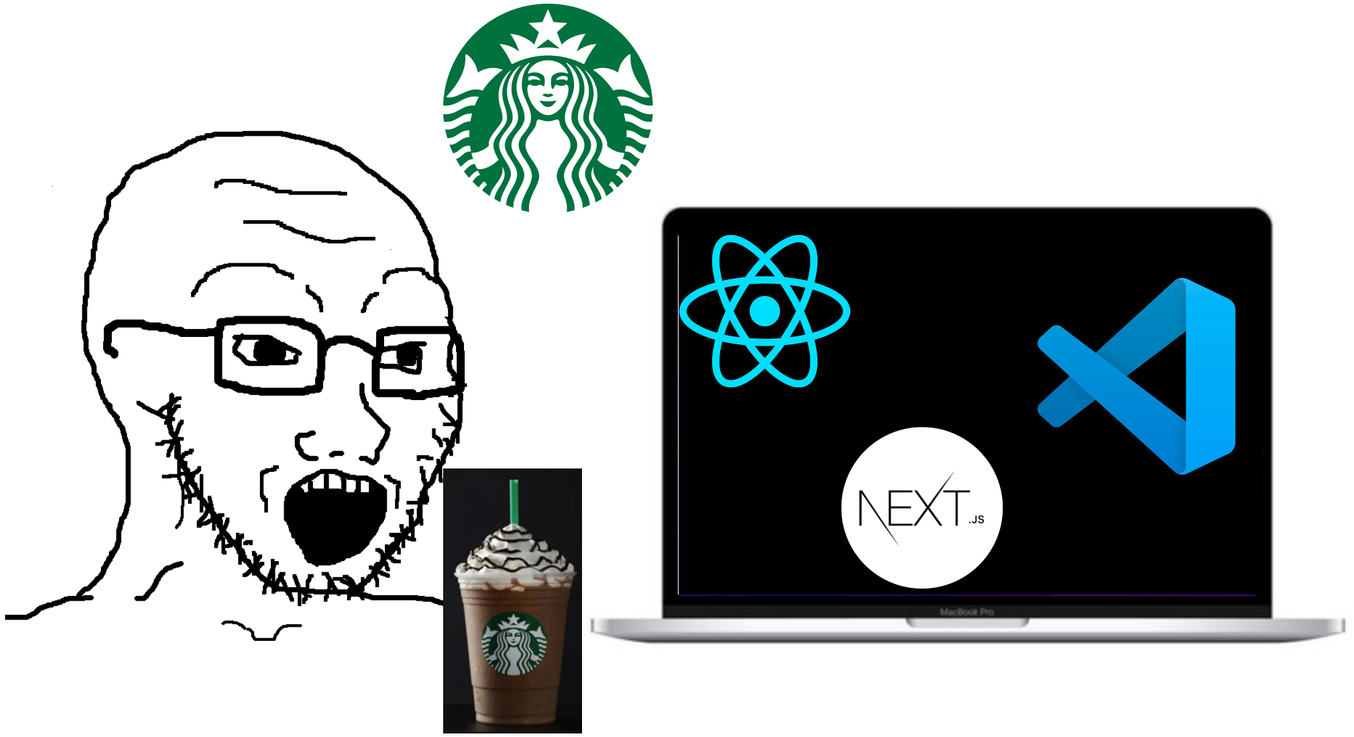
HI, I'M MANIK

- Background:
  - Mostly a soy dev (React, Nextjs, Python)
  - I watch a lot of Primeagen
  - Dogs are awesome

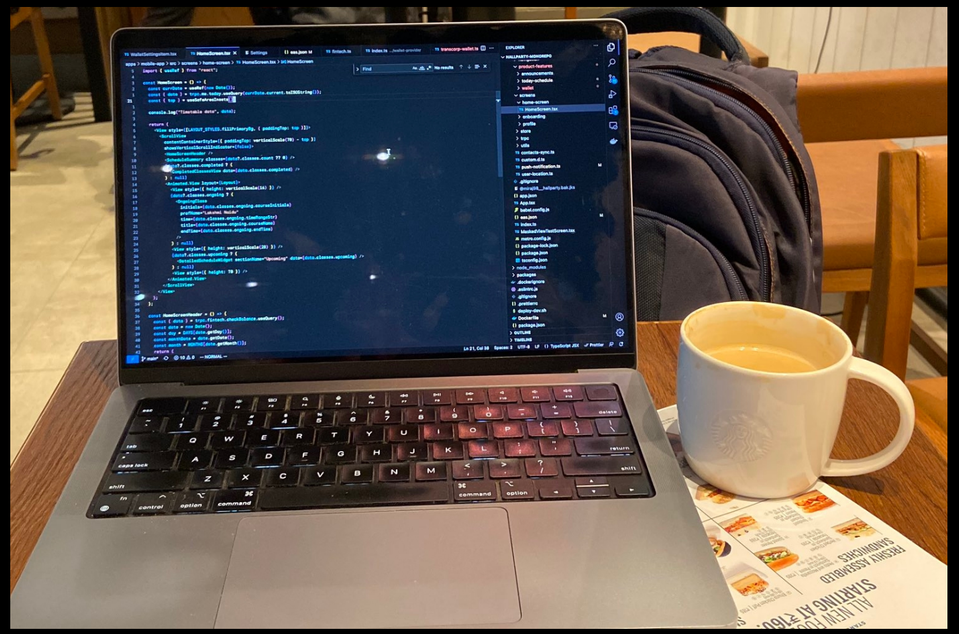


HI, I'M MANIK

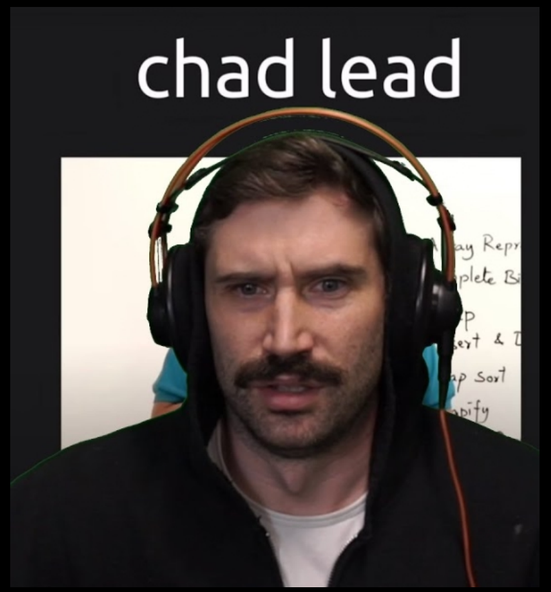
- I'm here cause I've been banging my head against a wall trying to write rust and I don't want that to happen to you



SO WHY RUST

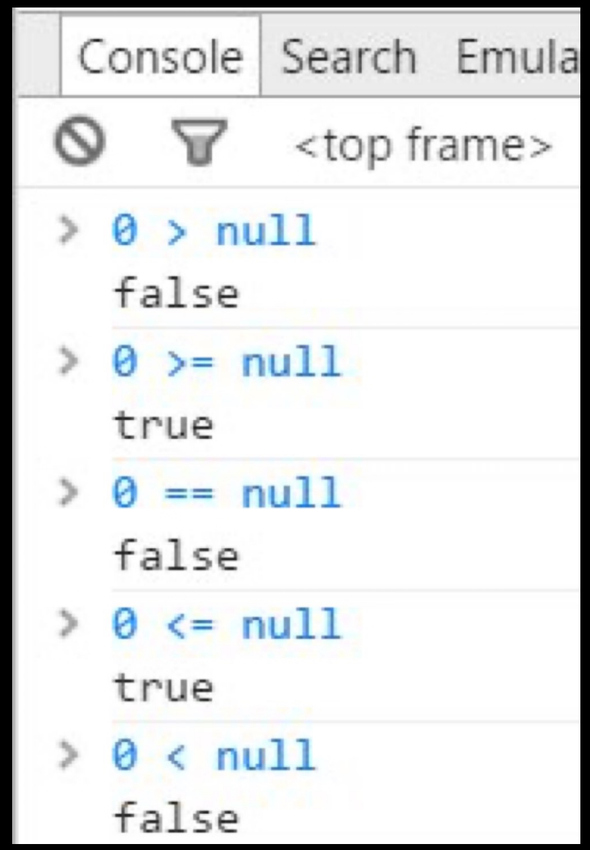


ME



WHAT IM TRYING TO BE

SO WHY RUST



what???

SO WHY RUST

lmao

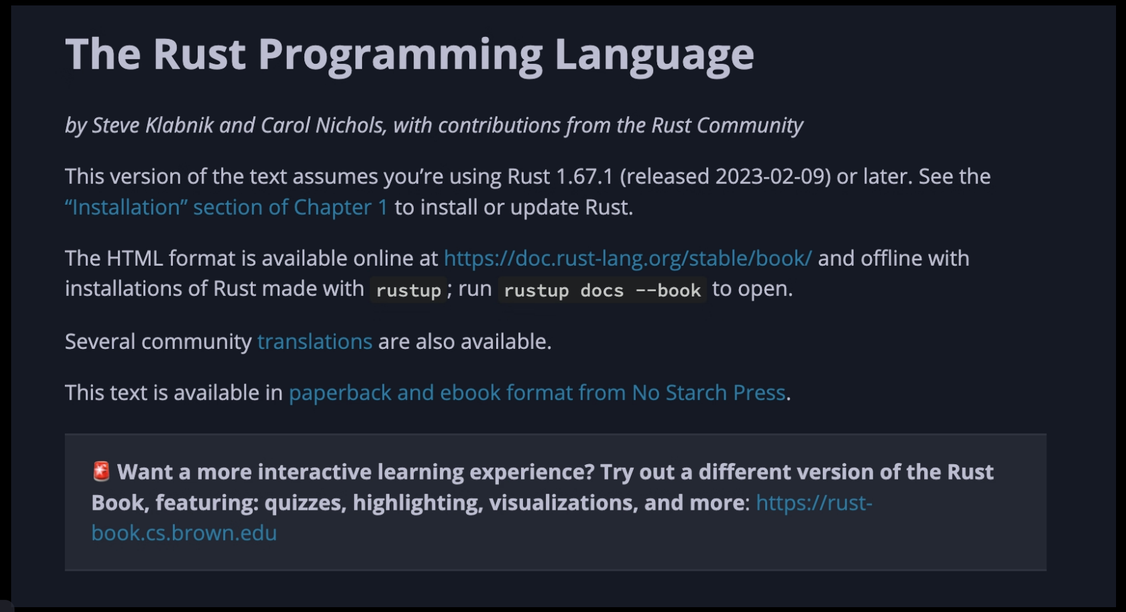
what???

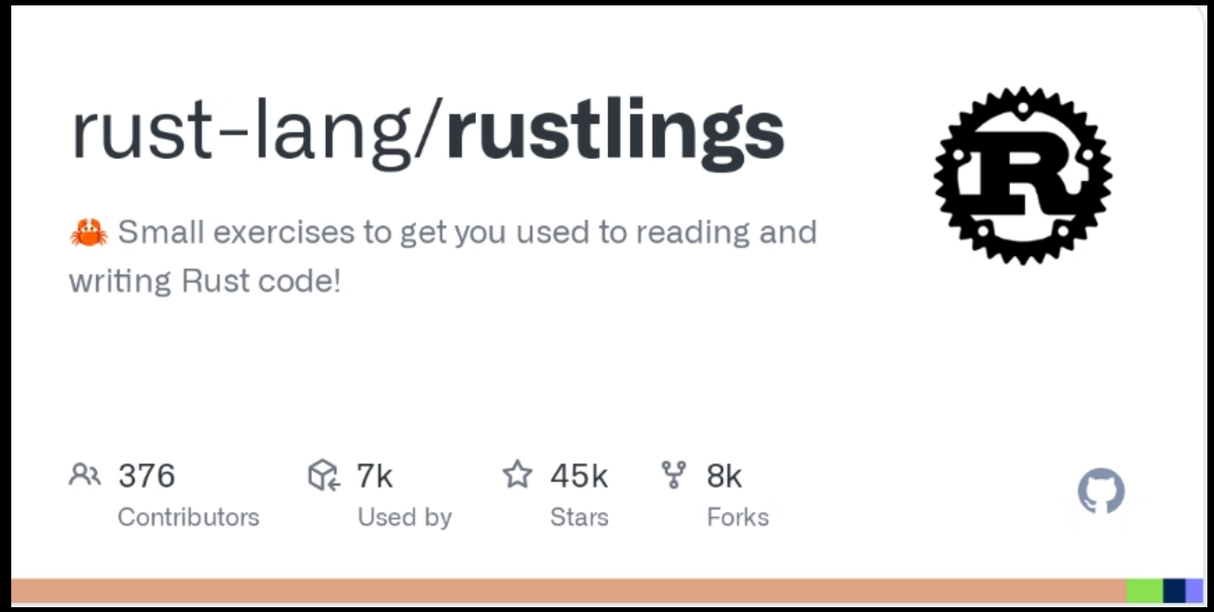
`x <= y` is generally equivalent to `x < y || x == y`, except for a few cases:

- When one of `x` or `y` is `null`, and the other is something that's not `null` and becomes 0 when coerced to numeric (including `0`, `0n`, `false`, `""`, `"0"`, `new Date(0)`, etc.): `x <= y` is `true`, while `x < y || x == y` is `false`.
- When one of `x` or `y` is `undefined`, and the other is one of `null` or `undefined`: `x <= y` is `false`, while `x == y` is `true`.
- When `x` and `y` are the same object that becomes `NaN` after the first step of Less than (such as `new Date(NaN)`): `x <= y` is `false`, while `x == y` is `true`.
- When `x` and `y` are different objects that become the same value after the first step of Less than: `x <= y` is `true`, while `x < y || x == y` is `false`.

SO HOW RUST

- The Rust Book https://doc.rust-lang.org/book/
  - Everything you need to learn rust
- Rustlings https://github.com/rust-lang/rustlings
  - Learn rust by solving exercises
- MIT's Rust book: https://shorturl.at/jrG57





SO WHEN RUST

- This month I tried solving Advent of Code
  - It was a disaster

BASIC SETUP

main function

- Reads input txt
- calls solution function
- prints output

```
cargo run —bin part1.rs
```

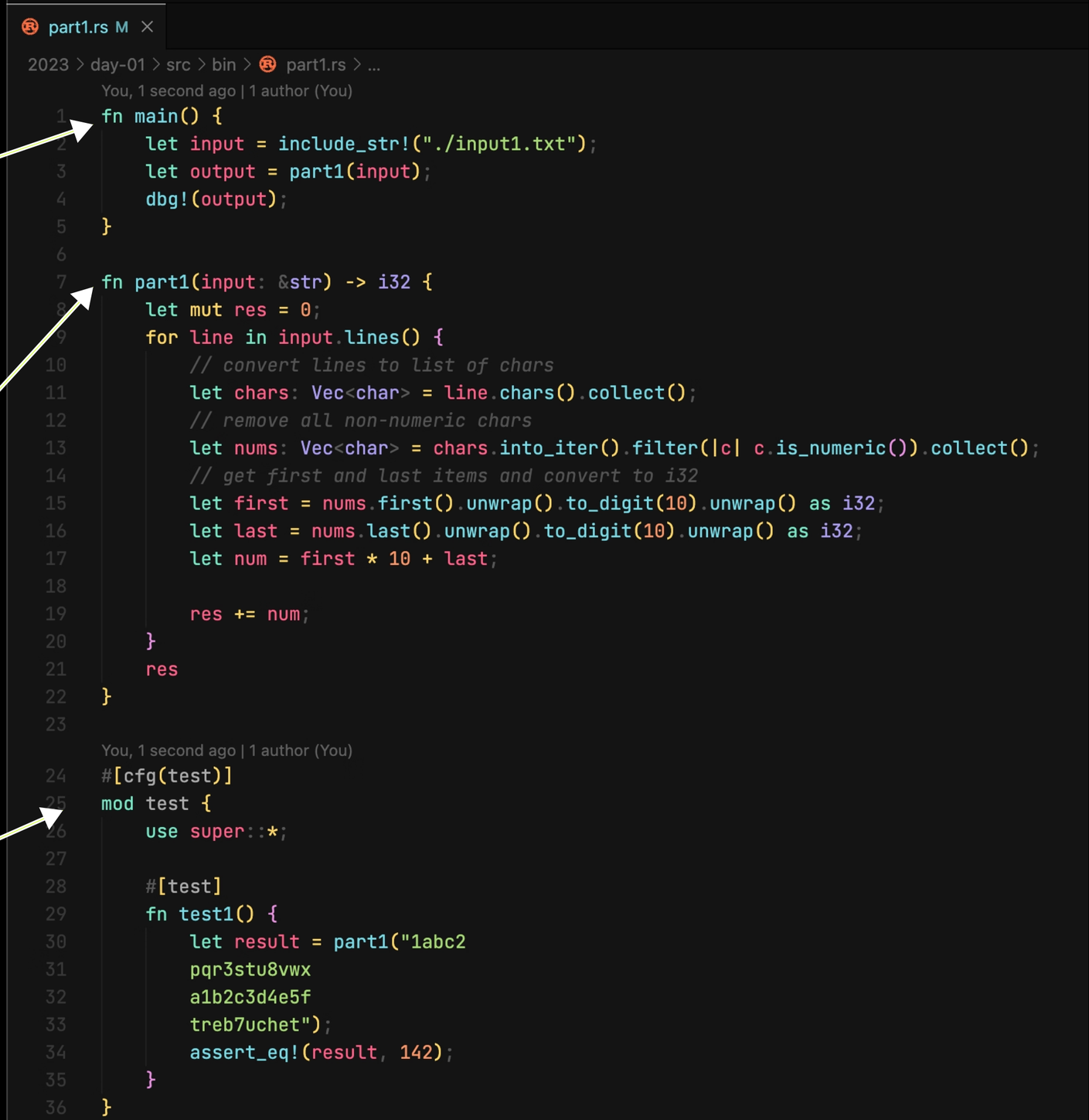
solution

- magic goes here

test

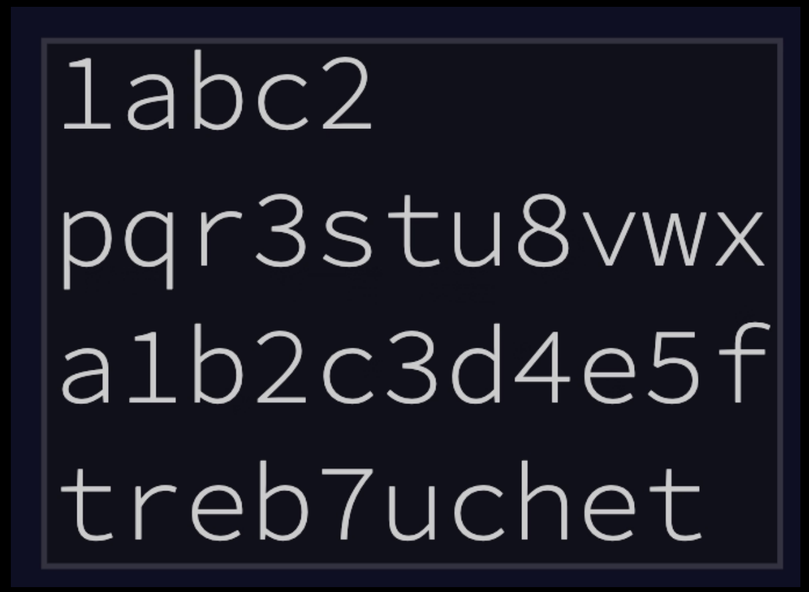
- runs a unit test by calling

```
cargo test —bin part1.rs
```

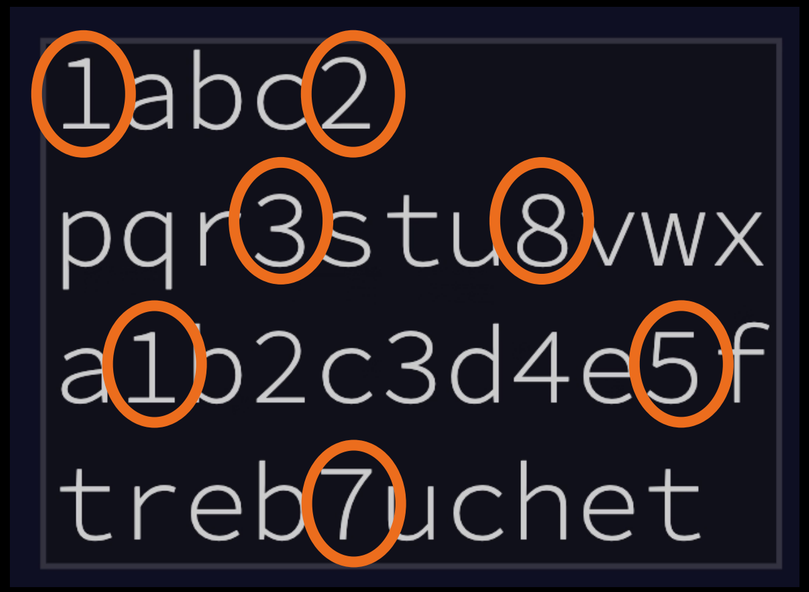


AOC DAY 1 RECAP

- Get the first and last number from each line of the input
- Convert it into a 2 digit number
- Add up all the numbers



sample input



numbers

12
38
15
77

142

output

BASIC SOLUTION

```rust
fn part1(input: &str) -> i32 {
    let mut res = 0;
    for line in input.lines() {
        // convert lines to list of chars
        let chars: Vec<char> = line.chars().collect();
        // remove all non-numeric chars
        let nums: Vec<char> = chars.into_iter().filter(|c| c.is_numeric()).collect();
        // get first and last items and convert to i32
        let first = nums.first().unwrap().to_digit(10).unwrap() as i32;
        let last = nums.last().unwrap().to_digit(10).unwrap() as i32;
        let num = first * 10 + last;

        res += num;
    }
    res
}
```

WHAT ARE THESE?

```rust
fn part1(input: &str) -> i32 {
    let mut res = 0;
    for line in input.lines() {
        // convert lines to list of chars
        let chars: Vec<char> = line.chars().collect();
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        let last = nums.last().unwrap().to_digit(10).unwrap() as i32;
        let num = first * 10 + last;

        res += num;
    }
    res
}
```

WHAT ARE THESE?

- `.into_iter()` lets you iterate over data, regardless of its type
- `.collect()` transforms an iterator into a collection, collecting all the items from the iterator. It's a general-purpose function that's used at the end of a chain of iterator functions.
- `.unwrap()` In Rust, "unwrapping" something means to say, "Give me the result of the computation, and if there was an error, panic and stop the program". - MIT rust book

`.unwrap()` and `Option<T>`

- Rust doesn't have nullable types.
- Rust uses the null-safe type `Option<T>`. Rust's pointer types must always point to a valid location; there are no "null" references.
- With `Option`, catch the failure instead of calling `panic!`

```
// get first and last items and convert to i32
let first: Option<&char> = nums.first();
```

```
let first: &char = nums.first().unwrap();
```

```
core::option
pub enum Option<T> {
    None,
    Some(T),
}
```

- Unwrap either gets the value or panics

WOW THAT WAS A LOT OF RUST

EVEN MORE RUST

- I also made a TCP echo server
- Requirements:
  - Implement TCP Echo Service from RFC 862
  - handle at least 5 simultaneous clients

RFC 862

TCP Based Echo Service

One echo service is defined as a connection based application on TCP. A server listens for TCP connections on TCP port 7. Once a connection is established any data received is sent back. This continues until the calling user terminates the connection.

```rust
#[tokio::main]
async fn main() -> io::Result<()> {
    // Bind the listener to the address
    let listener = TcpListener::bind("0.0.0.0:8080").await?;

    println!("Server listening on: {}", &listener.local_addr()?);

    loop {
        match listener.accept().await {
            Ok((mut socket, addr)) => {
                tokio::spawn(async move { echo(&mut socket, addr).await });
            }
            Err(e) => println!("Error accepting connection: {}", e),
        }
    }
}
```

Rust has Async!

```rust
#[tokio::main]
async fn main() -> io::Result<()> {
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                tokio::spawn(async move { echo(&mut socket, addr).await });
            }
            Err(e) => println!("Error accepting connection: {}", e),
        }
    }
}
```

async allows tasks to run concurrently or in a non-blocking manner.

ASYNC AWAIT, FUTURES

In Rust, the Future trait represents a computation that may not have completed yet but will eventually produce a result or an error.

It defines two associated types:

- Output (the type of the eventual result)
- Poll (a method used to drive the computation towards completion).

`async fn` implicitly return futures

```
...
pub trait Future {
    type Output;

    // Required method
    fn poll(self: Pin<&mut Self>, cx: &mut Context<'_>) -> Poll<Self::Output>;
}
```


Always has been
Wait, its all
W3Schools
https://www.w3schools.com › js › js_promise
JavaScript Promises
?

VALID ✅

```rust
async fn hello() -> String {
    // Sleep for 2 seconds
    sleep(Duration::from_secs(2)).await;

    // Return "Hello world"
    "Hello world".to_string()
}
```

This is valid code that the compiler won't complain about

INVALID ❌

```rust
async fn main() {
    let result = hello().await;
    println!("{}", result);
}
```

Can't run async functions in main without a runtime

VALID ✅

```rust
async fn hello() -> String {
    // Sleep for 2 seconds
    sleep(Duration::from_secs(2)).await;

    // Return "Hello world"
    "Hello world".to_string()
}
```

VALID ✅

```rust
use tokio::time::sleep;

#[tokio::main]
async fn main() {
    let result = hello().await;
    println!("{}", result);
}
```

Rust now has a runtime for
async functions

TOKIO

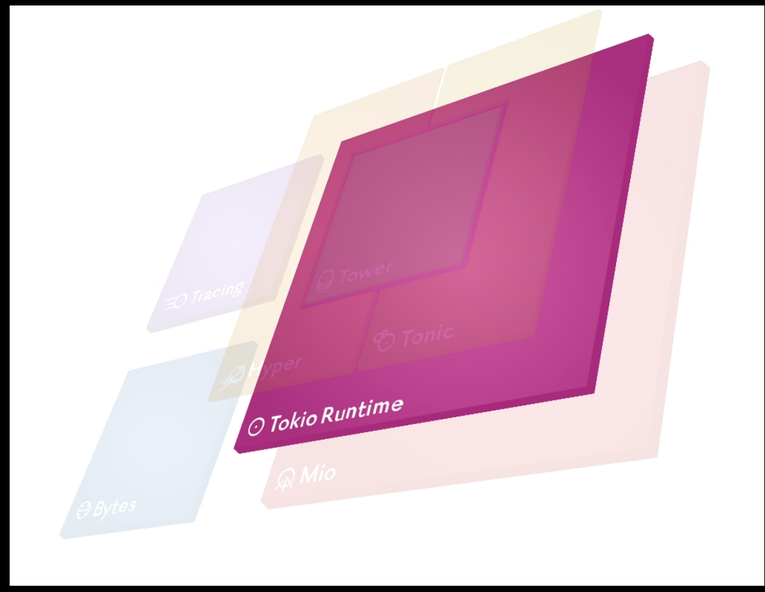
Tokio is an asynchronous runtime for Rust.

It provides the building blocks needed for writing network applications.

Rust itself has support for asynchronous programming through its async and await syntax, allowing you to write asynchronous code using the async fn and .await constructs.

However, asynchronous I/O requires more than just language-level support; it also needs an asynchronous runtime to handle scheduling, managing tasks, and handling I/O efficiently.

This is where tokio comes in.



Learn Tokio by doing: https://tokio.rs/tokio/tutorial

OK, BACK TO THE ECHO SERVER

```rust
#[tokio::main]
async fn main() -> io::Result<()> {
    // Bind the listener to the address
    let listener = TcpListener::bind("0.0.0.0:8080").await?;

    println!("Server listening on: {}", &listener.local_addr()?);

    loop {
        match listener.accept().await {
            Ok((mut socket, addr)) => {
                tokio::spawn(async move { echo(&mut socket, addr).await });
            }
            Err(e) => println!("Error accepting connection: {}", e),
        }
    }
}
```

bind a TCP Listner to localhost:8080 to handle incoming connections

await incoming connections in a loop

call the echo function on accepted socket

```rust
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async fn main() -> io::Result<()> {
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    println!("Server listening on: {}", &listener.local_addr()?);

    loop {
        match listener.accept().await {
            Ok((mut socket, addr)) => {
                tokio::spawn(async move { echo(&mut socket, addr).await });
            }
            Err(e) => println!("Error accepting connection: {}", e),
        }
    }
}
```

Gives the echo fn access to the outer lexical environment

```rust
async fn echo(socket: &mut TcpStream, address: SocketAddr) -> io::Result<()> {
    println!("New client: {}", address);

    let mut buffer = [0; 1024]; // Buffer to read/write data

    println!("Connected: {}", address);

    loop {
        let bytes_read = match socket.read(&mut buffer).await {
            Ok(n) if n == 0 => break, // End of stream
            Ok(n) => n,
            Err(e) => {
                eprintln!("Failed to read from socket: {}", e);
                return Err(e);
            }
        };

        match socket.write_all(&buffer[..bytes_read]).await {
            Ok(_) => {} // Data successfully written
            Err(e) => {
                eprintln!("Failed to write to socket: {}", e);
                return Err(e);
            }
        }
    }

    println!("Closed connection: {}", address);
    Ok(())
}
```

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        }
    }

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}
```

A TCP Receive Window is a buffer that temporarily stores incoming data on each side of a TCP connection. TCP buffers data because it doesn't know when the application will read it

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    loop {
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A TCP Receive Window is a buffer that temporarily stores incoming data on each side of a TCP connection. TCP buffers data because it doesn't know when the application will read it

for each request, we will read the socket (TcpStream).

If we read nothing, we close the connection

```rust
async fn echo(socket: &mut TcpStream, address: SocketAddr) -> io::Result<()> {
    println!("New client: {}", address);

    let mut buffer = [0; 1024]; // Buffer to read/write data

    println!("Connected: {}", address);

    loop {
        let bytes_read = match socket.read(&mut buffer).await {
            Ok(n) if n == 0 => break, // End of stream
            Ok(n) => n,
            Err(e) => {
                eprintln!("Failed to read from socket: {}", e);
                return Err(e);
            }
        };

        match socket.write_all(&buffer[..bytes_read]).await {
            Ok(_) => {} // Data successfully written
            Err(e) => {
                eprintln!("Failed to write to socket: {}", e);
                return Err(e);
            }
        }
    }

    println!("Closed connection: {}", address);
    Ok(())
}
```

A TCP Receive Window is a buffer that temporarily stores incoming data on each side of a TCP connection. TCP buffers data because it doesn't know when the application will read it

for each request, we will read the socket (TcpStream)

If we read nothing, we close the connection

write all bytes in the buffer that have been read back to the client socket

close the connection

FULL SERVER CODE

```rust
use tokio::net::{TcpListener, TcpStream};
use tokio::io::{AsyncReadExt, AsyncWriteExt};
use std::net::SocketAddr;
use std::io;

#[tokio::main]
▶ Run | Debug
async fn main() -> io::Result<()> {
    // Bind the listener to the address
    let listener: TcpListener = TcpListener::bind("0.0.0.0:8080").await?;

    println!("Server listening on: {}", &listener.local_addr()?);

    loop {
        match listener.accept().await {
            Ok((mut socket: TcpStream, addr: SocketAddr)) => {
                tokio::spawn(future: async move { echo(&mut socket, address: addr).await });
            }
            Err(e: Error) => println!("Error accepting connection: {}", e),
        }
    }
} fn main
```

```rust
async fn echo(socket: &mut TcpStream, address: SocketAddr) -> io::Result<()> {
    println!("New client: {}", address);

    let mut buffer: [u8; 1024] = [0; 1024]; // Buffer to read/write data

    println!("Connected: {}", address);

    loop {
        let bytes_read: usize = match socket.read(buf: &mut buffer).await {
            Ok(n: usize) if n == 0 => break, // End of stream
            Ok(n: usize) => n,
            Err(e: Error) => {
                eprintln!("Failed to read from socket: {}", e);
                return Err(e);
            }
        };

        match socket.write_all(src: &buffer[..bytes_read]).await {
            Ok(_) => {} // Data successfully written
            Err(e: Error) => {
                eprintln!("Failed to write to socket: {}", e);
                return Err(e);
            }
        }
    }

    println!("Closed connection: {}", address);
    Ok(())
} fn echo
```

Try Pitch

You don't have to use tokio and async/await,
you can use threadpools with Rayon like in this example or build your own threadpool

OK, WOW
THAT WAS A LOT

LETS CHILL

FUN FACT: I'M GETTING BRACES TMR

SO WHAT DID WE COVER?

- How I setup rust for solving AoC.
- Dissecting AoC day 1
- .unwrap() .collect() .into_iter() and other weird stuff like no nulls in Rust
- Async/Await in Rust with Tokio
- Building a TCP echo service the rust book also covers this

liked TCP servers? Try Protohackers

AGENDA

BUT WHERE DID I FAIL?

- Hi, I'm Manik
- Advent of Code (and failing)
- Building a TCP Echo Server (and failing)
- ~~Intro to Tauri~~
- ~~Making your own Tauri App~~

FIN