Matthias Endler

# TESTING IN RUST

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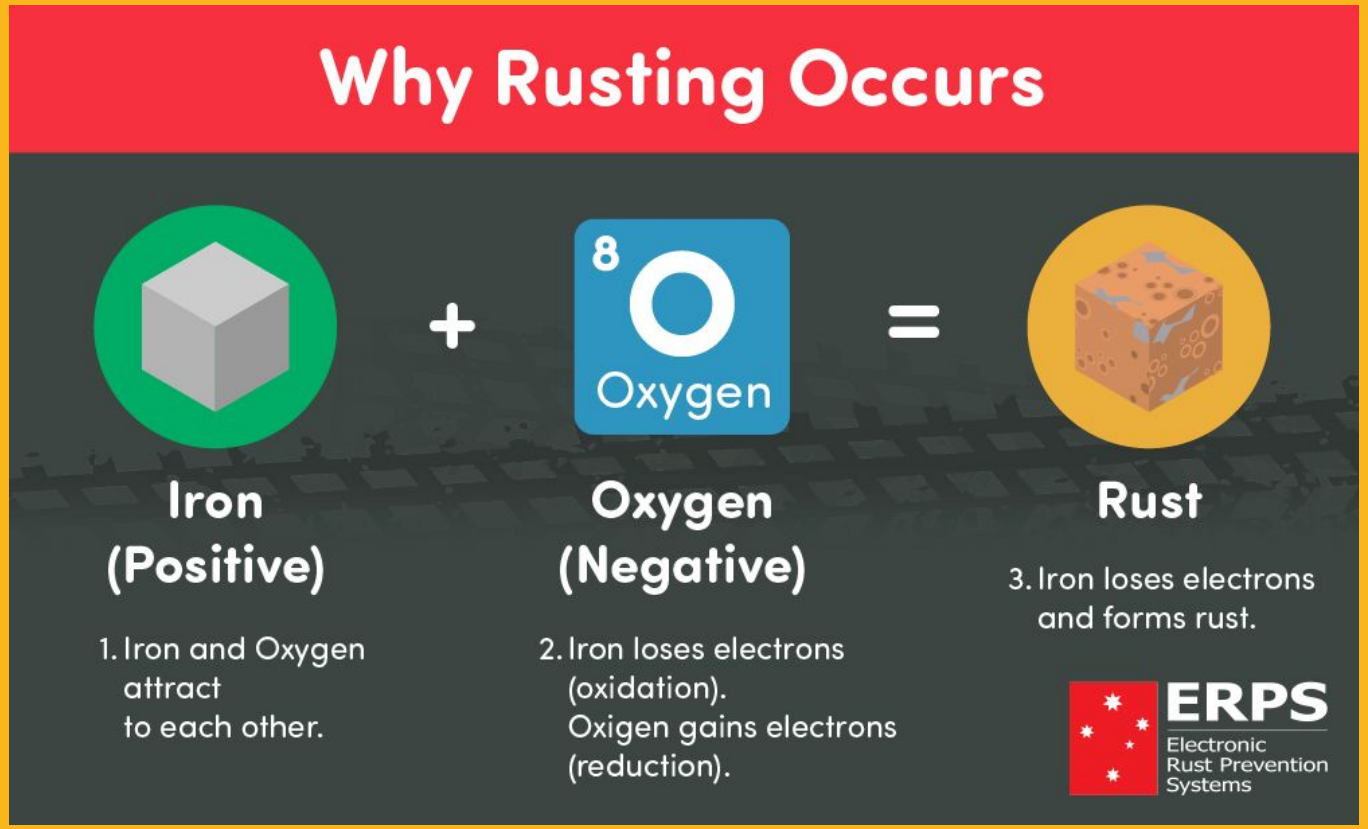
# WHAT IS RUST?




https://www.erps.com.au/what-is-rust

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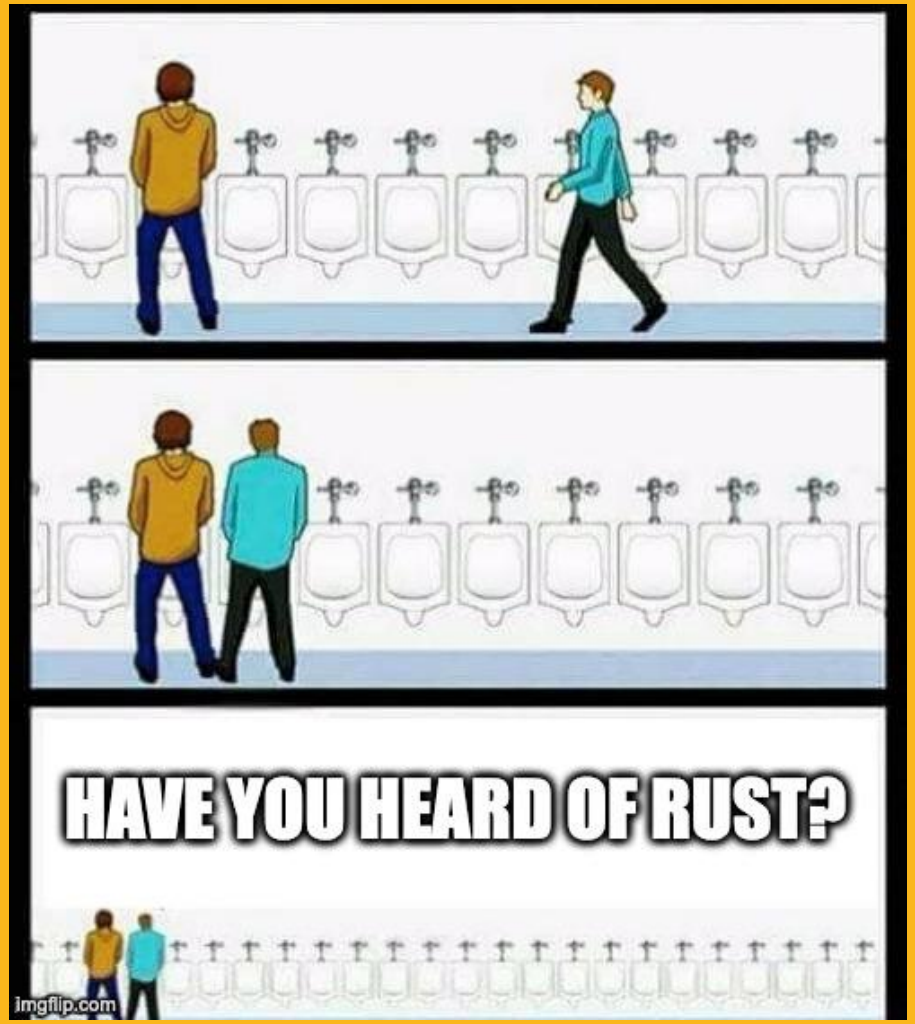


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```rust
use std::collections::HashMap;

fn main() {
    let mut dict = HashMap::new();
    "mississippi".chars().for_each(|char| {
        let item = dict.entry(char).or_insert(0);
        *item += 1;
    });

    println!("{dict:?}");
}
```

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```rust
use std::collections::HashMap;

fn main() {
    let mut dict = HashMap::new();
    "mississippi".chars().for_each(|char| {
        let item = dict.entry(char).or_insert(0);
        *item += 1;
    });

    println!("{dict:?}");
}
```

**OUTPUT:**

```
{'p': 2, 's': 4, 'i': 4, 'm': 1}
```

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Me explaining Rust's ownership & borrowing, lifetimes, generics and expression syntax

You

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```rust
let v = String::from("Hello Rust");
my_function(v);
```

corrode

```rust
let v = String::from("Hello Rust");
my_function(v);
```

corrode

```rust
let v = String::from("Hello Rust");
my_function(v);
my_function(v);
```

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```rust
let v = String::from("Hello Rust");
my_function(v);
my_function(v);
```

```
error[E0382]: use of moved value: `v`
```

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```rust
let v = String::from("Hello Rust");
delete(v);
reuse(v) // bug
```

```
error[E0382]: use of moved value: `v`
```

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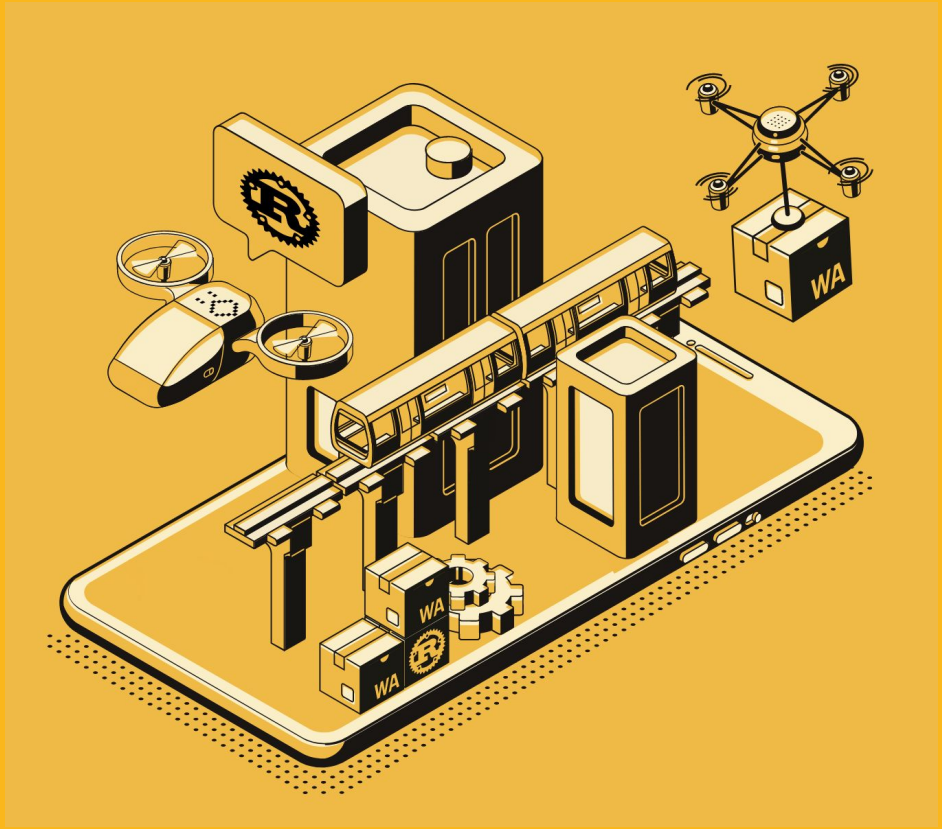
# ABOUT RUST

- **2006** Research project at Mozilla
- **2015** Version 1.0
- **2017** First Rust code in Firefox
- **2021** Rust Foundation
- **2024** 3.7 million Rust users

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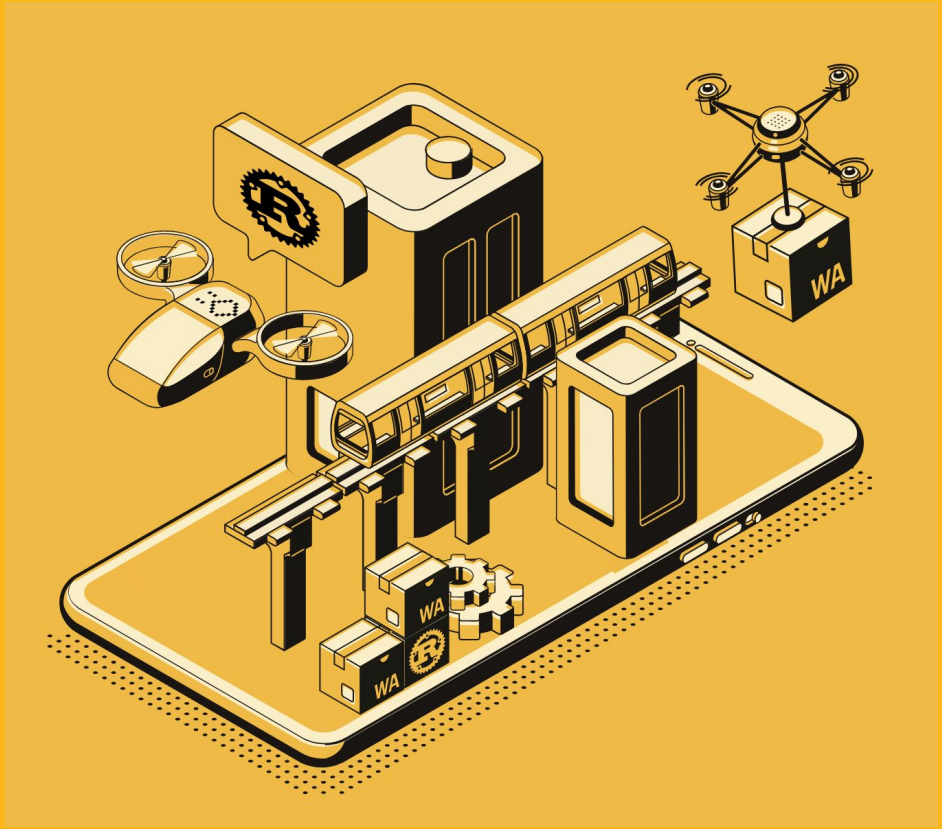
# MY RUST EXPERIENCE

- Using Rust since 2015
- Rust Cologne User Group
- *“Hello Rust”* YouTube channel
- Open Source work
- Rust consultancy
- Rust in production since 2020

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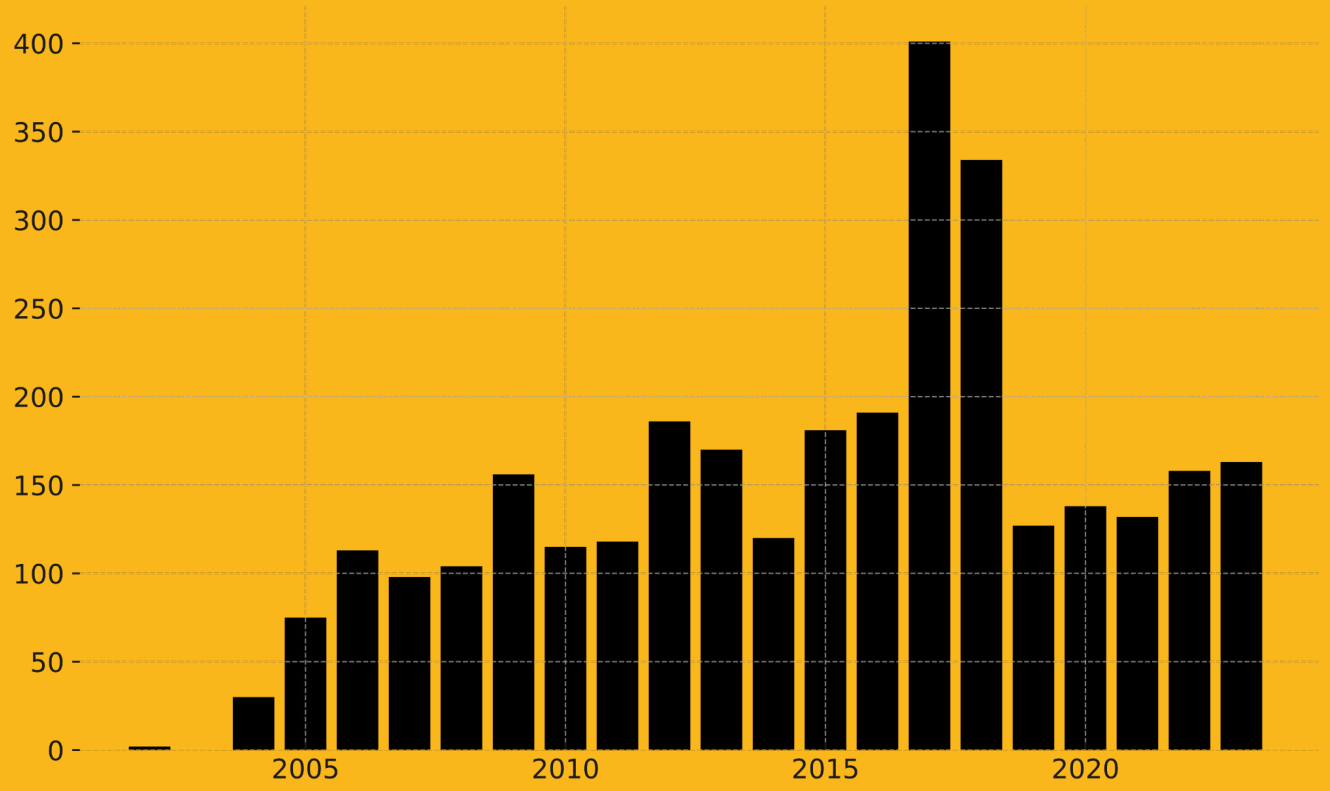
# WHY WAS RUST CREATED?

- C++ code in Firefox had many security issues.
- Multithreaded code is hard to write with C++ (data races).

# VULNERABILITIES IN FIREFOX OVER TIME

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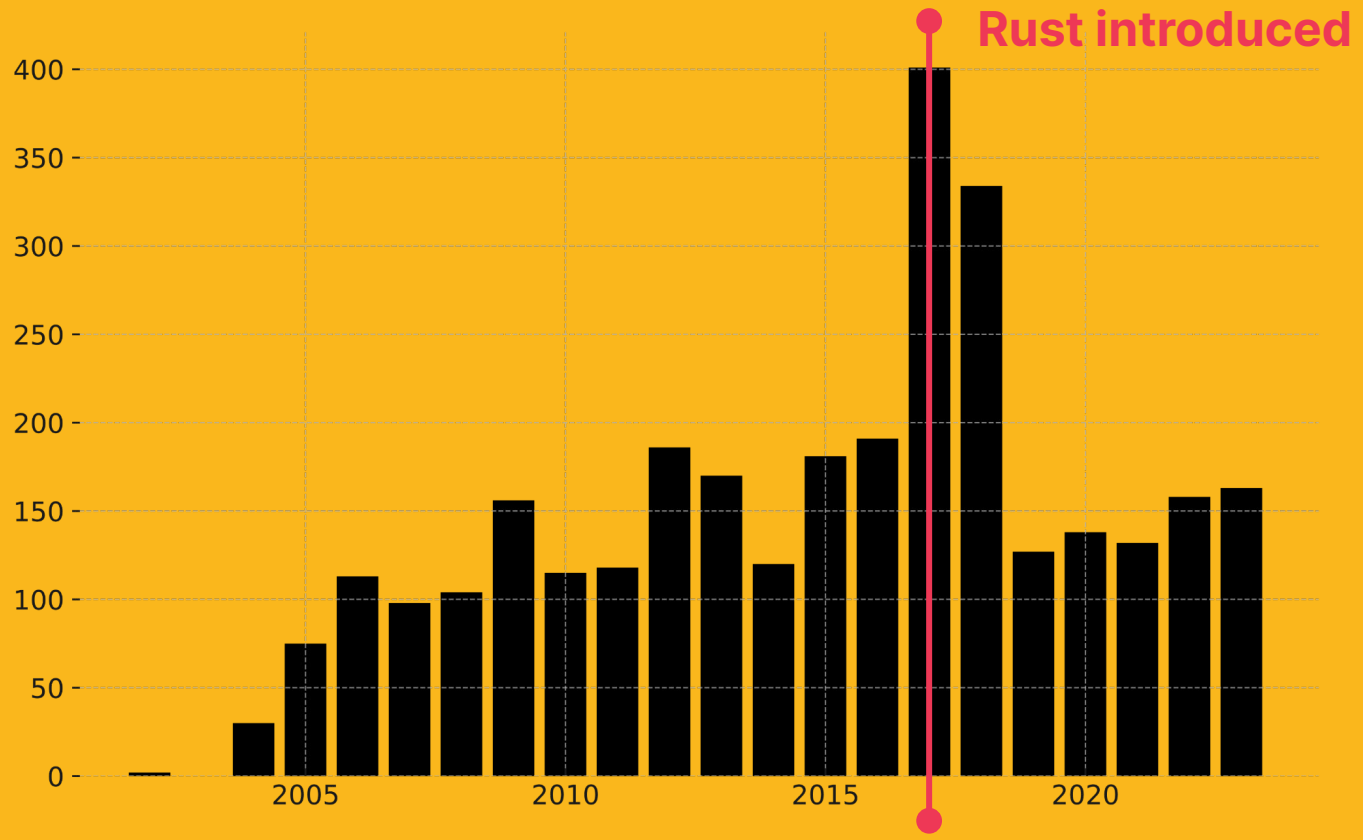
# VULNERABILITIES IN FIREFOX OVER TIME

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SAFETY
PERFORMANCE
RUST DEVELOPER
Did you just take both pills?
imgflip.com

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“

> THE REASON THAT PEOPLE USE RUST IS BECAUSE ACTUALLY IT'S BETTER FOR BUILDING MORE RELIABLE SYSTEMS.

Niko Matsakis, Lead of Rust Language Design Team

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FEBRUARY 26, 2024

# PRESS RELEASE: Future Software Should Be Memory Safe



**Leaders in Industry Support White House Call to Address Root Cause of Many of the Worst Cyber Attacks**

*Read the full report here*

WASHINGTON – Today, the White House Office of the National Cyber Director (ONCD) released a report calling on the technical community to proactively reduce the attack surface in cyberspace. ONCD makes the case that technology manufacturers can prevent entire classes of vulnerabilities from entering the digital ecosystem by adopting memory safe programming languages. ONCD is also encouraging the research community to address the problem of software measurability to enable the development of better diagnostics that measure cybersecurity quality.

The report is titled *"Back to the Building Blocks: A Path Toward Secure and Measurable Software."*

# RUST CAN’T PREVENT LOGIC BUGS

# THAT'S WHERE TESTING COMES IN!

# BUT FIRST, A LITTLE BIT ABOUT YOU

# ABOUT YOU

- Rust experience from 1-5
- Other programming languages
- What do you do?
  - Backend?
  - Embedded?
  - Data Science?
- Expectations about the workshop
  - Contents
  - Hands-on / Hands off?
  - Rust installed?

# WORKSHOP TOPICS

- Testing setup in Rust
- Writing unit tests
- Writing integration tests
- Integration tests vs functional tests
- Documentation tests
- Test doubles: traits vs Mocks
- Test isolation
- Exploratory testing
- The Rust testing ecosystem
- Speeding up tests
- Advanced testing strategies

# QUESTIONS: RIGHT AWAY

# TESTING SETUP IN RUST

# CARGO IS RUST'S SWISS ARMY KNIFE

```
cargo --help

Commands:
    build, b    Compile the current package
    check, c    Analyze the current package and report errors
    clean       Remove the target directory
    doc, d      Build this packages and its dependencies documentation
    new         Create a new cargo package
    init        Create a new cargo package in an existing directory
    add         Add dependencies to a manifest file
    remove      Remove dependencies from a manifest file
    run, r      Run a binary or example of the local package
    test, t     Run the tests
    bench       Run the benchmarks
    update      Update dependencies listed in Cargo.lock
    search      Search registry for crates
    publish     Package and upload this package to the registry
    install     Install a Rust binary
    uninstall   Uninstall a Rust binary
```

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# CARGO IS THE TOOL FOR RUNNING TESTS

```
cargo --help

Commands:
    build, b    Compile the current package
    check, c    Analyze the current package and report errors
    clean       Remove the target directory
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    publish     Package and upload this package to the registry
    install     Install a Rust binary
    uninstall   Uninstall a Rust binary
```

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# UNIT TESTS

# UNIT TESTS ARE NEXT TO CODE

```
1  > pub fn is_prime(n: u64) -> bool {···
11    }
12
13    #[cfg(test)]
14  > mod tests {···
30    }
```

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# SIMPLE EXAMPLE CODE

```
pub fn is_prime(n: u64) -> bool {
    if n < 2 {
        return false;
    }
    for i: u64 in 2..n {
        if n % i == 0 {
            return false;
        }
    }
    true
}
```

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# UNIT TESTS

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

    #[test]
    fn test_is_prime() {
        assert_eq!(is_prime(0), false);
        assert_eq!(is_prime(1), false);
        assert_eq!(is_prime(2), true);
        assert_eq!(is_prime(3), true);
        assert_eq!(is_prime(4), false);
        assert_eq!(is_prime(5), true);
        assert_eq!(is_prime(6), false);
        assert_eq!(is_prime(7), true);
        assert_eq!(is_prime(8), false);
        assert_eq!(is_prime(9), false);
    }
}
```

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# RUNNING UNIT TESTS

```
~/C/c/w/testing >>> cargo test
   Compiling testing v0.1.0 (/Users/mendler/Code/corrode/workshops/testing)
    Finished test [unoptimized + debuginfo] target(s) in 0.28s
     Running unittests src/lib.rs (target/debug/deps/testing-12004ce4ce0e713d)

running 1 test
test tests::test_is_prime ... ok

test result: ok. 1 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s

   Doc-tests testing

running 0 tests

test result: ok. 0 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s
```

# UNIT TESTS

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

    #[test]
    fn test_is_prime() {
        assert_eq!(is_prime(0), false);
        assert_eq!(is_prime(1), false);
        assert_eq!(is_prime(2), true);
        assert_eq!(is_prime(3), true);
        assert_eq!(is_prime(4), false);
        assert_eq!(is_prime(5), true);
        assert_eq!(is_prime(6), false);
        assert_eq!(is_prime(7), true);
        assert_eq!(is_prime(8), false);
        assert_eq!(is_prime(9), false);
    }
}
```

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# UNIT TESTS

```rust
#[test]
fn test_is_prime() {
    let cases: Vec<(u64, bool)> = vec![
        (0, false),
        (1, false),
        (2, true),
        (3, true),
        (4, false),
        (5, true),
        (6, false),
        (7, true),
        (8, false),
        (9, false),
    ];

    for (n: u64, expected: bool) in cases {
        assert_eq!(is_prime(n), expected);
    }
}
```

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# UNIT TESTS

```rust
#[test]
fn test_is_prime() {
    let primes: [u64; 5] = [2, 3, 5, 7];

    for n: &u64 in primes.iter() {
        assert!(is_prime(*n));
    }
}

#[test]
fn test_is_not_prime() {
    let not_primes: [u64; 6] = [0, 4, 6, 8, 9, 10];

    for n: &u64 in not_primes.iter() {
        assert!(!is_prime(*n));
    }
}
```

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# UNIT TESTS

```
#[test]
fn test_is_prime() {
    let primes: [u64; 4] = [2, 3, 5, 7];

    for n: u64 in primes.into_iter() {
        assert!(is_prime(n));
    }
}

#[test]
fn test_is_not_prime() {
    let not_primes: [u64; 6] = [0, 4, 6, 8, 9, 10];

    for n: u64 in not_primes.into_iter() {
        assert!(!is_prime(n));
    }
}
```

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# INTEGRATION TESTS

“

TO TEST THE FUNCTIONALITY OF A GROUP OF DIFFERENT MODULES AND UNDERSTAND HOW THEY INTERACT WITH EACH OTHER

Definition Integration Test

https://www.practitest.com/resource-center/article/functional-test-vs-integration-test/

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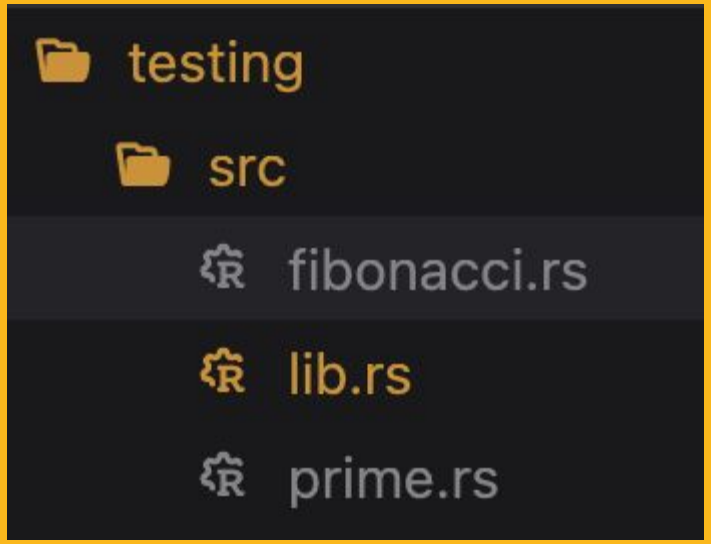
# LET'S EXTEND OUR FILE TREE



# LET'S ADD ANOTHER FUNCTION

```
pub fn fibonacci(n: u64) -> u64 {
    if n == 0 {
        return 0;
    }
    if n == 1 {
        return 1;
    }
    let mut a: u64 = 0;
    let mut b: u64 = 1;
    let mut c: u64 = 0;
    for _ in 2..=n {
        c = a + b;
        a = b;
        b = c;
    }
    c
}
```

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# MAKE MODULES PUBLIC

src/lib.rs

```rust
pub mod fibonacci;
pub mod prime;
```

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# TESTS/INTEGRATION.RS

tests/integration.rs

```rust
use testing::fibonacci::fibonacci;
use testing::prime::is_prime;
```

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# TESTS/INTEGRATION.RS

tests/integration.rs

```rust
use testing::fibonacci::fibonacci;
use testing::prime::is_prime;

#[test]
fn test_fibonacci_is_prime() {…
}
```

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# TESTS/INTEGRATION.RS

tests/integration.rs

```rust
use testing::fibonacci::fibonacci;
use testing::prime::is_prime;

#[test]
fn test_fibonacci_is_prime() {
    let fib_is_prime: [(u64, u64, bool); 4] = [
        (0, 0, false),
        (1, 1, false),
        (2, 1, false),
        (3, 2, true),
    ];

    for (n: u64, fib: u64, prime: bool) in fib_is_prime.into_iter() {
        dbg!(n, fib, prime);
        assert_eq!(fibonacci(n), fib);
        assert_eq!(is_prime(fibonacci(n)), prime);
    }
}
```

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# CARGO TEST

```
~/C/c/w/testing >>> cargo test
   Compiling testing v0.1.0 (/Users/mendler/Code/corrode/workshops/testing)
    Finished test [unoptimized + debuginfo] target(s) in 0.38s
     Running unittests src/lib.rs (target/debug/deps/testing-12004ce4ce0e713d)

running 3 tests
test fibonacci::tests::test_fibonacci ... ok
test prime::tests::test_is_prime ... ok
test prime::tests::test_is_not_prime ... ok

test result: ok. 3 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s

     Running tests/integration.rs (target/debug/deps/integration-527b3a6d16ab00ec)

running 1 test
test test_fibonacci_is_prime ... ok
```

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# CARGO TEST

```
~/C/c/w/testing >>> cargo test
   Compiling testing v0.1.0 (/Users/mendler/Code/corrode/workshops/testing)
    Finished test [unoptimized + debuginfo] target(s) in 0.38s
     Running unittests src/lib.rs (target/debug/deps/testing-12004ce4ce0e713d)

running 3 tests
test fibonacci::tests::test_fibonacci ... ok
test prime::tests::test_is_prime ... ok
test prime::tests::test_is_not_prime ... ok

test result: ok. 3 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s

     Running tests/integration.rs (target/debug/deps/integration-527b3a6d16ab00ec)

running 1 test
test test_fibonacci_is_prime ... ok
```

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# INTEGRATION TESTS
# VS
# FUNCTIONAL TESTS

“

TO TEST THE FUNCTIONALITY OF A GROUP OF DIFFERENT MODULES AND UNDERSTAND HOW THEY INTERACT WITH EACH OTHER

Definition Integration Test

https://www.practitest.com/resource-center/article/functional-test-vs-integration-test/

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“

TO VERIFY THE SOFTWARE IS FUNCTIONING AS IT SHOULD IN A REAL-LIFE SITUATION, AND ALSO MEETS THE USER REQUIREMENTS

Definition Functional Test

https://www.practitest.com/resource-center/article/functional-test-vs-integration-test/

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# FUNCTIONAL TESTS IN RUST

- Live in the `tests/` folder
- Same semantics as integration tests
- But the focus is on real-world scenarios

# DOCUMENTATION TESTS

# CARGO IS RUST'S SWISS ARMY KNIFE

```
cargo --help

Commands:
    build, b    Compile the current package
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    search      Search registry for crates
    publish     Package and upload this package to the registry
    install     Install a Rust binary
    uninstall   Uninstall a Rust binary
```

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# RUNNING CARGO DOC

testing — zsh

```
~/C/c/w/testing ❯❯❯ cargo doc --document-private-items --no-deps --open
```

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# RUNNING CARGO DOC

testing
0.1.0

All Items

Modules

Crates
testing

Click or press 'S' to search, '?' for more options...

?

Crate testing

source · [-]

Modules

fibonacci
prime

corrode

# RUNNING CARGO DOC

testing
0.1.0

In
testing::prime

Functions

is_prime

Click or press 'S' to search, '?' for more options...

?

Function testing::prime::is_prime

source · [-]

```
pub fn is_prime(n: u64) -> bool
```

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# DOCS?

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# OUR PREVIOUS `is_prime` EXAMPLE

src/prime.rs

```rust
pub fn is_prime(n: u64) -> bool {
    if n < 2 {
        return false;
    }
    for i: u64 in 2..n {
        if n % i == 0 {
            return false;
        }
    }
    true
}

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

    #[test]
    fn test_is_prime() {
        let primes: [u64; 4] = [2, 3, 5, 7];

        for n: u64 in primes.into_iter() {
            assert!(is_prime(n));
        }
    }

    #[test]
    fn test_is_not_prime() {
        let not_primes: [u64; 6] = [0, 4, 6, 8, 9, 10];

        for n: u64 in not_primes.into_iter() {
            assert!(!is_prime(n));
        }
    }
}
```

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# MOVE TESTS TO DOC TESTS

src/prime.rs › mod tests

```rust
/// Check if a number is prime
///
/// # Examples
/// ```
/// use testing::prime::is_prime;
/// assert!(!is_prime(0));
/// assert!(is_prime(2));
/// assert!(is_prime(3));
/// assert!(!is_prime(4));
/// ```
pub fn is_prime(n: u64) -> bool {
    if n < 2 {
        return false;
    }
    for i: u64 in 2..n {
        if n % i == 0 {
            return false;
        }
    }
    true
}
```

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# MOVE TESTS TO DOC TESTS

testing
0.1.0

In
testing::prime

Functions

is_prime

Click or press 'S' to search, '?' for more options...

## Function testing::prime::is_prime

source · [-]

```
pub fn is_prime(n: u64) -> bool
```

[-] Check if a number is prime

### Examples

```
use testing::prime::is_prime;
assert!(!is_prime(0));
assert!(is_prime(2));
assert!(is_prime(3));
assert!(!is_prime(4));
```

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# HIDE LINES IN DOC TEST

src/prime.rs › mod tests

```rust
/// # Examples
/// ```
/// # use testing::prime::is_prime;
/// assert!(!is_prime(0));
/// assert!(is_prime(2));
/// assert!(is_prime(3));
/// assert!(!is_prime(4));
/// ```
pub fn is_prime(n: u64) -> bool {
    if n < 2 {
        return false;
    }
    for i: u64 in 2..n {
        if n % i == 0 {
            return false;
        }
    }
    true
}
```

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# MOVE TESTS TO DOC TESTS

testing
0.1.0

In
testing::prime

Functions

is_prime

Click or press 'S' to search, '?' for more options...

## Function testing::prime::is_prime

source · [-]

```
pub fn is_prime(n: u64) -> bool
```

[-] Check if a number is prime

### Examples

```
assert!(!is_prime(0));
assert!(is_prime(2));
assert!(is_prime(3));
assert!(!is_prime(4));
```

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# TEST DOUBLES

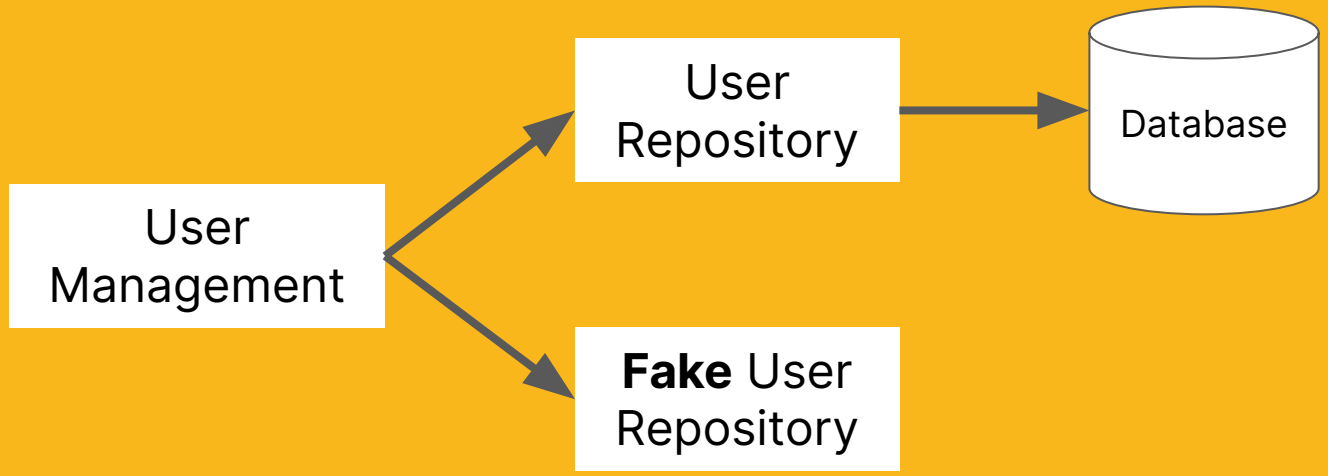
# EXAMPLE

# YOU CAN USE TRAITS FOR TEST DOUBLES

# WHAT ARE TRAITS?

- Traits are like interfaces
- A struct can implement multiple traits

# EXAMPLE

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# EXAMPLE

```rust
use crate::Result;

/// Repository trait.
///
/// This trait defines the basic operations that a repository should implement.
pub trait Repository<T> {
    /// Get all entities from the repository.
    fn find_all(&self) -> Result<Vec<T>>;
    /// Find an entity by its id.
    fn find_by_id(&self, id: i32) -> Result<Option<T>>;
}
```

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# EXAMPLE

```
16 > impl Repository<User> for UserRepository {···
53   }
```

```
  #[cfg(test)]
> impl Repository<User> for FakeUserRepository {···
  }
```

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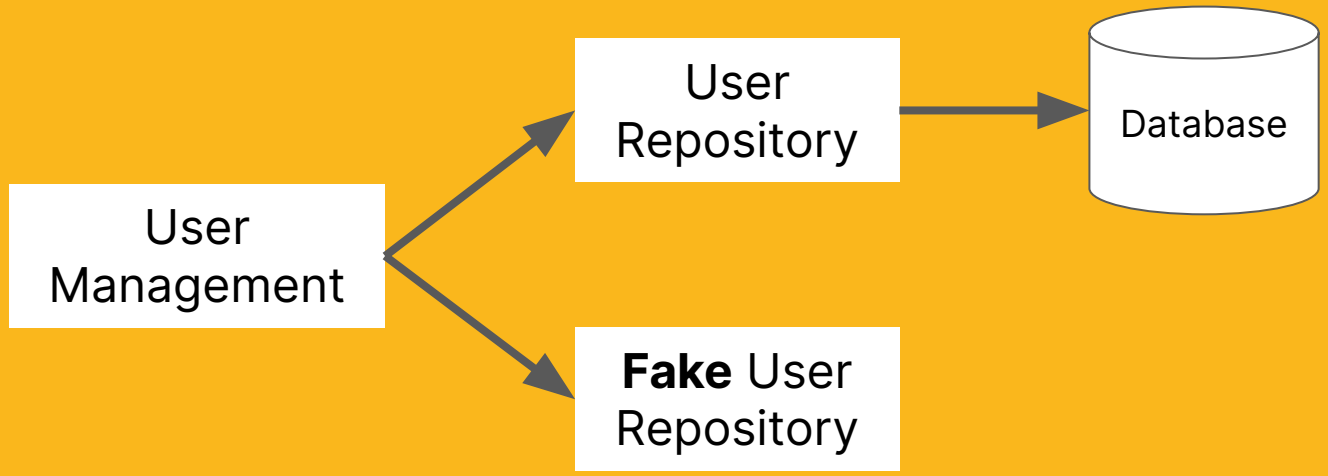
# EXAMPLE

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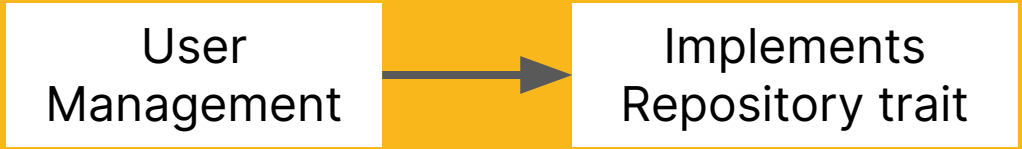
# EXAMPLE



# EXAMPLE

SEE DETAILS IN SAMPLE REPOSITORY

# TIPS AND TRICKS

# TIP 1: YOU CAN RETURN RESULT FROM TESTS

```
#[test]
fn some_function() -> Result<(), String> {
    assert_eq!(some_fallible_function("foo")?, 1);
    Ok(())
}
```

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# TIP 2: YOU CAN IGNORE FAILING TESTS

```
#[test]
fn some_test_which_currently_fails() {
    todo!()
}
```

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# TIP 2: YOU CAN IGNORE FAILING TESTS

```
#[test]
#[ignore]
fn some_test_which_currently_fails() {
    todo!()
}
```

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# TIP 2: YOU CAN TEST FOR PANICS

```
#[test]
#[should_panic]
fn test_panic() {
    panic!("This test should panic");
}
```

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# TIP 3: `#[cfg(test)]` IS SUPER HELPFUL

```rust
struct Foo {
    x: i32,
}

// Normal implementation of Foo
impl Foo {
    // ...
}
```

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# TIP 3: `#[cfg(test)]` IS SUPER HELPFUL

```rust
// Additional functionality for Foo only available in tests
#[cfg(test)]
impl Foo {
    fn random_number() -> i32 {
        42
    }

    fn special_foo_constructor() -> Foo {
        Foo { x: 42 }
    }
}
```

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# TIP 3: `#[cfg(test)]` IS SUPER HELPFUL

```rust
#[test]
fn test_foo() {
    assert_eq!(Foo::random_number(), 42);

    let foo: Foo = Foo::special_foo_constructor();
    assert_eq!(foo.x, 42);
}
```

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# TEST ISOLATION

# TYPICAL THINGS TO ISOLATE

- File system
- Network
- `stdio`/`stderr`

# TYPICAL THINGS TO ISOLATE

1. File system → `tempdir` crate
2. Network → `mockito` crate
3. `stdio`/`stderr` → `assert_cmd` crate

# WHY IS USING THE FILE SYSTEM IN TESTS A BAD IDEA?

- Race conditions between tests
- Not reproducible
- Cleanup could be forgotten
- Differences between file systems
- Security issues

# USE THE TEMPFILE CRATE INSTEAD

```rust
use tempfile::tempfile;
use std::io::{self, Write};

// Create a file inside of `std::env::temp_dir()`.
let mut file = tempfile()?;

writeln!(file, "Brian was here. Briefly.")?;
```

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# WHY SHOULDN'T YOU DEPEND ON THE NETWORK IN YOUR TESTS?

- Servers can be down
- Slow tests
- Servers can rate limit you
- Servers can block you
- Overloading the network
- Flaky tests are the result
- Hard to test edge-cases and error conditions

```rust
#[cfg(test)]
mod tests {
  #[test]
  fn test_something() {
    // Request a new server from the pool
    let mut server = mockito::Server::new();

    // Use one of these addresses to configure your client
    let host = server.host_with_port();
    let url = server.url();

    // Create a mock
    let mock = server.mock("GET", "/hello")
      .with_status(201)
      .with_header("content-type", "text/plain")
      .with_header("x-api-key", "1234")
      .with_body("world")
      .create();

    // Any calls to GET /hello beyond this line will respond with 201, the
    // `content-type: text/plain` header and the body "world".

    // You can use `Mock::assert` to verify that your mock was called
    // mock.assert();
  }
}
```

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# WHY SHOULDN'T YOU DEPEND ON `stdio` IN YOUR TESTS?

- `stdio` is often used for command-line tools
- Writing tests for CLI tools is quite tough to do manually

# USE THE ASSERT_CMD CRATE INSTEAD

```rust
use assert_cmd::Command;

let mut cmd = Command::cargo_bin("bin_fixture").unwrap();
let assert = cmd
    .arg("-A")
    .env("stdout", "hello")
    .env("exit", "42")
    .write_stdin("42")
    .assert();
assert
    .failure()
    .code(42)
    .stdout("hello\n");
```

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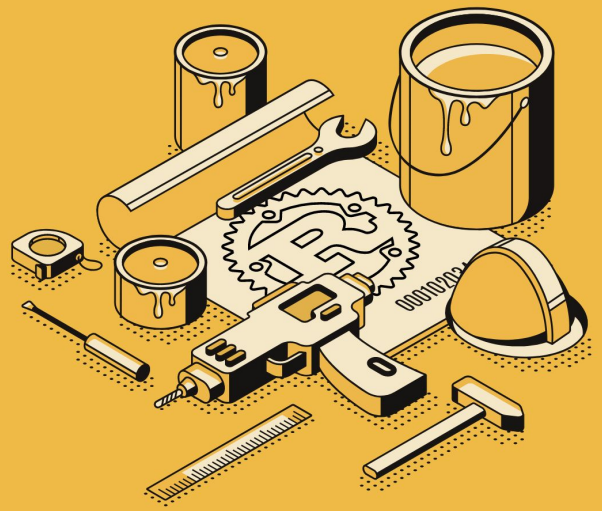
# SPEEDING UP TESTS

# TIPS FOR SPEEDING UP TESTS

- Unit tests > integration tests
- Use a single compilation unit for integration tests
- Try `cargo nextest` for ~60% faster text execution

RUST INSIGHTS

# TIPS FOR FASTER RUST COMPILE TIMES



https://corrode.dev/blog/tips-for-faster-rust-compile-times/#test-execution

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# THE RUST TESTING ECOSYSTEM

# “TABLE-BASED” TESTING

- `rstest`
- `test-case`

# RSTEST EXAMPLE

```rust
#[test]
fn test_fibonacci() {
    assert_eq!(fibonacci(0), 0);
    assert_eq!(fibonacci(1), 1);
    assert_eq!(fibonacci(2), 1);
    assert_eq!(fibonacci(3), 2);
    assert_eq!(fibonacci(4), 3);
    assert_eq!(fibonacci(5), 5);
    assert_eq!(fibonacci(6), 8);
    assert_eq!(fibonacci(7), 13);
    assert_eq!(fibonacci(8), 21);
    assert_eq!(fibonacci(9), 34);
    assert_eq!(fibonacci(10), 55);
}
```

```rust
#[rstest]
#[case(0, 0)]
#[case(1, 1)]
#[case(2, 1)]
#[case(3, 2)]
#[case(4, 3)]
#[case(5, 5)]
#[case(6, 8)]
#[case(7, 13)]
#[case(8, 21)]
#[case(9, 34)]
#[case(10, 55)]
fn fibonacci_test(#[case] input: u64, #[case] expected: u64) {
    assert_eq!(expected, fibonacci(input))
}
```

# RSTEST EXAMPLE

```rust
#[rstest]
#[case(0, 0)]
#[case(1, 1)]
#[case(2, 1)]
#[case(3, 2)]
#[case(4, 4)]
#[case(5, 5)]
#[case(6, 8)]
#[case(7, 13)]
#[case(8, 21)]
#[case(9, 34)]
#[case(10, 55)]
fn fibonacci_test(#[case] input: u64, #[case] expected: u64) {
    assert_eq!(expected, fibonacci(input))
}
```

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# RSTEST EXAMPLE

```
---- exercises::test_tables::tests::fibonacci_test::case_05 stdout ----
thread 'exercises::test_tables::tests::fibonacci_test::case_05' panicked at src/exercises/test_tables.rs:19:9:
assertion `left == right` failed
  left: 4
 right: 3
```

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# EXPLORATORY TESTING

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# RUST TESTING ECOSYSTEM

- `quickcheck`
- `proptest`

# pretty_assertions

```
thread 'main' panicked at 'assertion failed: `(left == right)`

Diff < left / right > :
 Some(
     Foo {
<        lorem: "Hello World!",
>        lorem: "Hello Wrold!",
         ipsum: 42,
         dolor: Ok(
<            "hey",
>            "hey ho!",
         ),
     },
 )

', examples/standard_assertion.rs:20:5
```

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# QUESTIONS?

# SURVEY: EXPECTATIONS MET?

# BREAK

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# WELCOME BACK!
# LET’S DO SOME PRACTICAL EXERCISES

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# FINAL NOTES

# ADVANCED TESTING STRATEGIES

- The following architectures work great with testing
  - Hexagonal architecture
  - Onion Architecture
  - Ports and Services

Read more at https://alexis-lozano.com/hexagonal-architecture-in-rust-1/

# TEST COVERAGE

```
cargo tarpaulin --out Html
```

# BENCHMARK TESTS

- Criterion
- Divan

# THANK YOU

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# OTHER WORKSHOPS

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# LEARNING RUST BY COUNTING WORDS

**Voraussetzungen:** Grundlegende Programmierkenntnisse

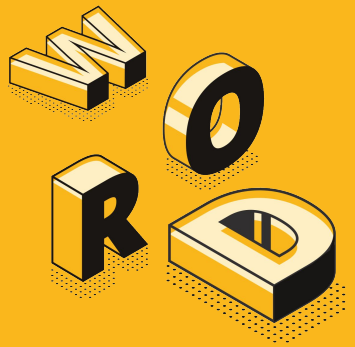
**Dauer:** 8 Stunden, verteilt auf zwei Sitzungen à 4 Stunden

**Lernumgebung:** Die Teilnahme erfolgt in der Regel remote, für größere Gruppen auch vor Ort.

**Kursmaterial:** Präsentation, Dokumentation, Codebeispiele, Live-Betreuung

**Lernziele:** Rust-Grundlagen, cargo, Fehlerbehandlung, Tests

**Sprache:** Englisch oder Deutsch

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# WRITE YOURSELF A SHELL IN RUST

**Voraussetzungen:** Grundlegende Rust-Kenntnisse

**Dauer:** 8 Stunden, verteilt auf zwei Sitzungen à 4 Stunden

**Lernumgebung:** Die Teilnahme erfolgt in der Regel remote, für größere Gruppen auch vor Ort.

**Kursmaterial:** Präsentation, Dokumentation, Codebeispiele, Live-Betreuung

**Lernziele:** Idiomatischer Code, Testing, Design-Patterns, Erweiterte Konzepte (Lifetimes, Parsing, Prozesskontrolle)

**Sprache:** Englisch oder Deutsch

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# Rust in Production Podcast

corrode.dev/podcast

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## SEASON 02

| | |
|---|---|
| **Thunderbird** with Brendan Abolivier | 2024-05-30 S02 E03 |
| **AMP** with Carter Schultz | 2024-05-16 S02 E02 |
| **curl** with Daniel Stenberg | 2024-05-02 S02 E01 |

## SEASON 01

| | |
|---|---|
| **Season Finale** | 2024-03-07 S01 E07 |
| **Sentry** with Arpad Borsos | 2024-02-22 S01 E06 |
| **Tweede Golf** with Folkert de Vries | 2024-02-08 S01 E05 |
| **Arroyo** with Micah Wylde | 2024-01-25 S01 E04 |
| **Apollo** with Nicolas Moutschen | 2024-01-11 S01 E03 |
| **PubNub** with Stephen Blum | 2023-12-28 S01 E02 |
| **InfluxData** with Paul Dix | 2023-12-14 S01 E01 |
| **Teaser** | 2023-12-11 S01 E00 |

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# Rust in Production Podcast

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