Embedded TDD

For Cambridge Software Crafters

13 March 2024

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Logistics and Wifi

🚽 Behind the main screen to the right of the corridor.

🛜 Wifi is **The Bradfield Centre** password is **Ca3Br1d5e**

🚨 We do not expect alarms. Assume a fire alarm is real and make your way to the car park.

Slides and code available on Github

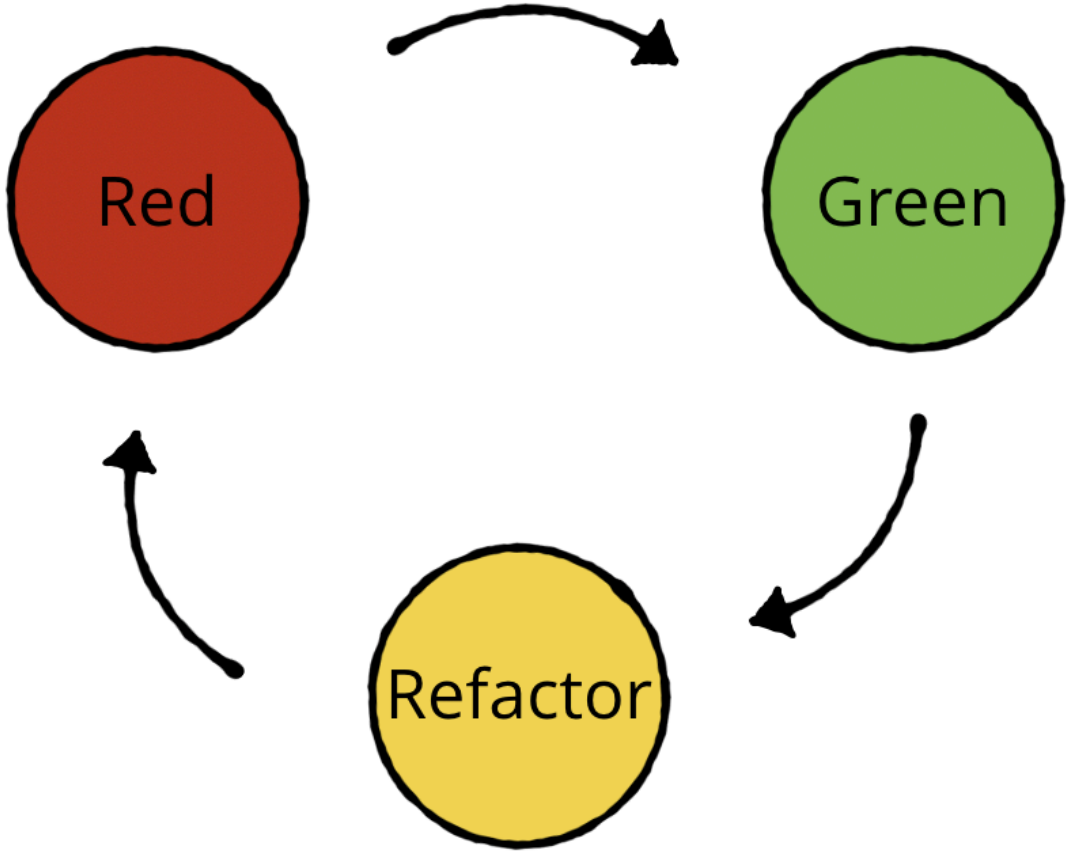
github.com/bricef/embedded-tdd-katas

Plan for this evening

1. Intro
2. What is "Embedded"
3. Embedded craftsmanship
4. Using Replit
5. LED Driver Kata
6. Recap

Why this talk?

TDD Refresh



TDD Loop

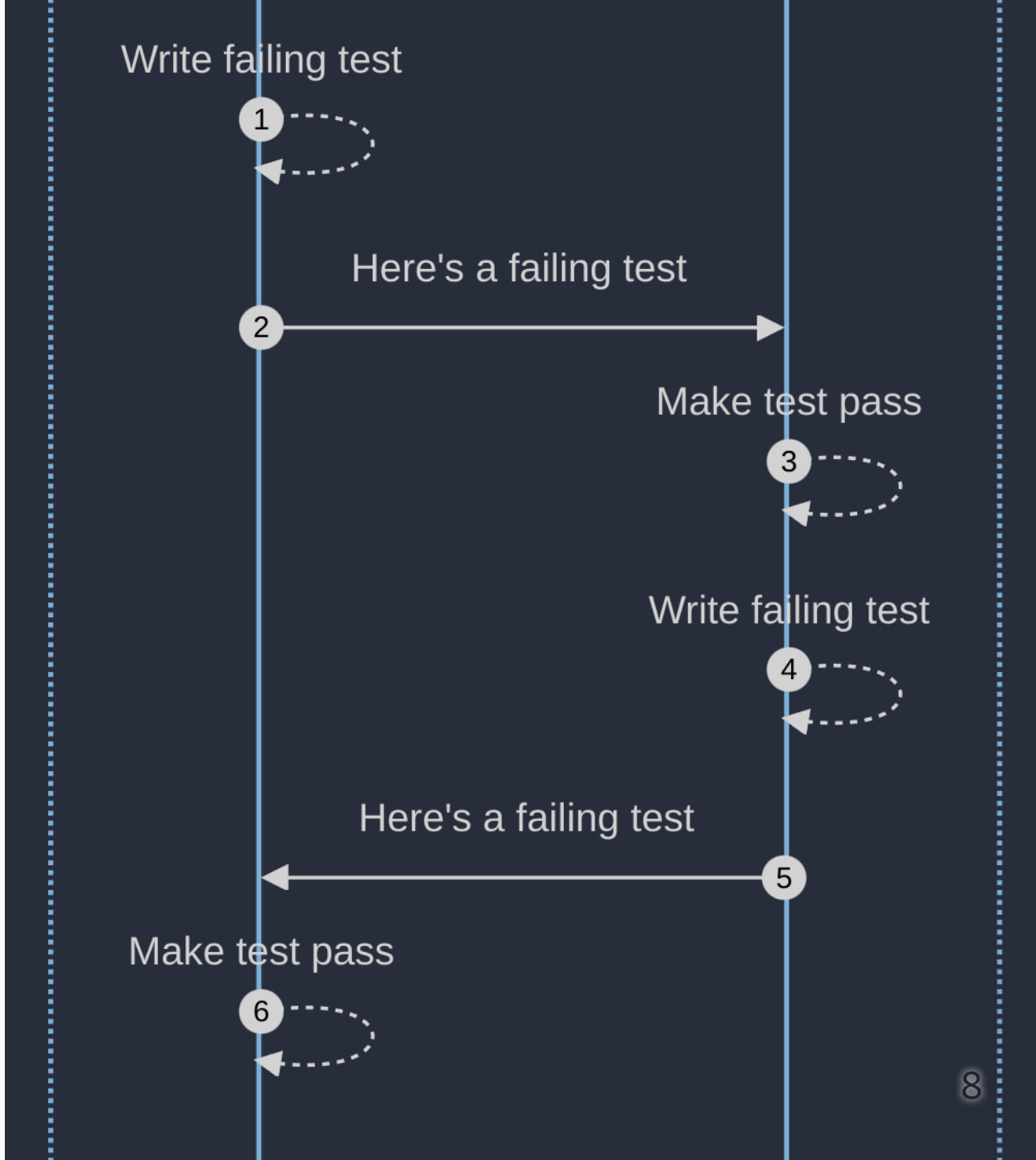
Write a failing test

Make the test pass

Refactor the code

```
1   TEST(LedDriver, ArrangeActAssertExample){
2
3       // Arrange
4       LedDriver_Create(&virtualLeds);
5
6       // Act
7       LedDriver_TurnOn(4);
8
9       // Assert
10      TEST_ASSERT_EQUAL_HEX16(0x08, virtualLeds);
11
12      //Teardown
13      LedDriver_Destroy();
14  }
```

Ping Pong TDD



What is "Embedded"

Embedded constraints

- Resource constraints (RAM, CPU)
- Lack of standard libraries
- No or limited filesystem
- Limited Interface (serial? UART, SWI)
- No Operating System
- No standard library
- Direct hardware access
- Lack of MMU/PMMU

Special pains

- Late hardware delivery
- Hardware scarcity
- Hardware bugs
- Long target compile times
- Long target setup and upload time
- Compiler licenses

Let's get the party started!

(also, let's download dependencies whilst we talk!)

Using Replit

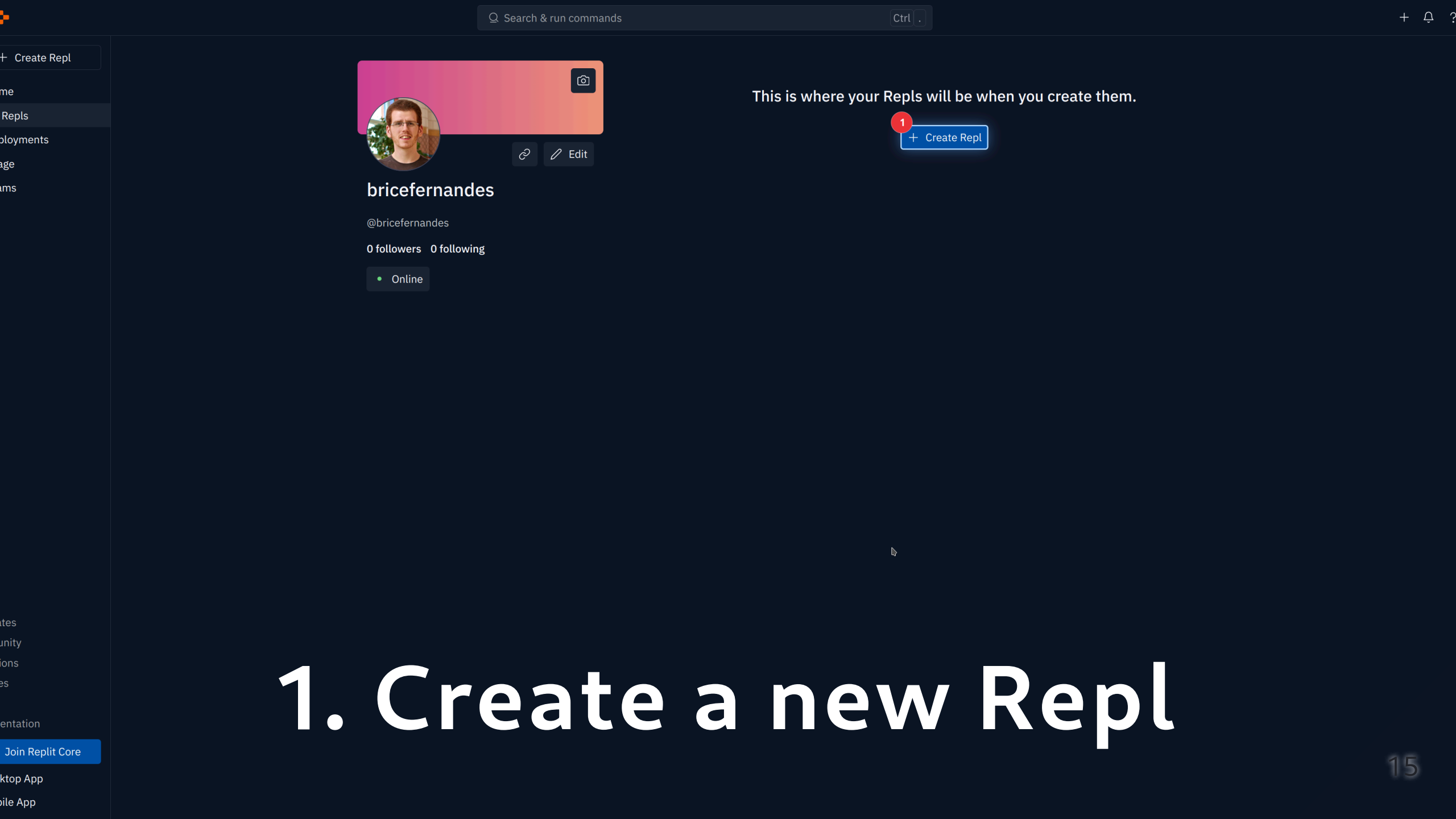
Create a replit.com account

(use a throwaway email if you'd like)

Idea to software, fast

Build software collaboratively with the power of AI, on any device, without spending a second on setup

Start creating


Search & run commands
Ctrl .
Create Repl
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Repls
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ams
Edit
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@bricefernandes
0 followers 0 following
Online
This is where your Repls will be when you create them.
1
Create Repl
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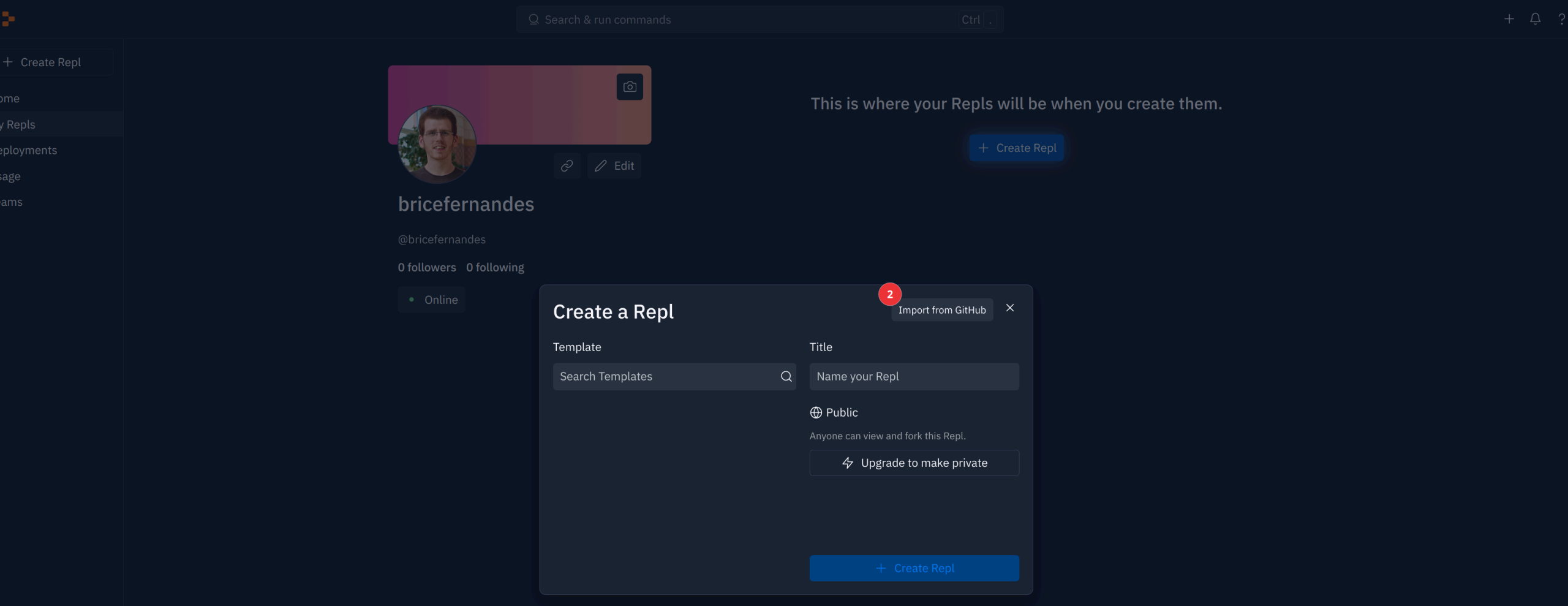
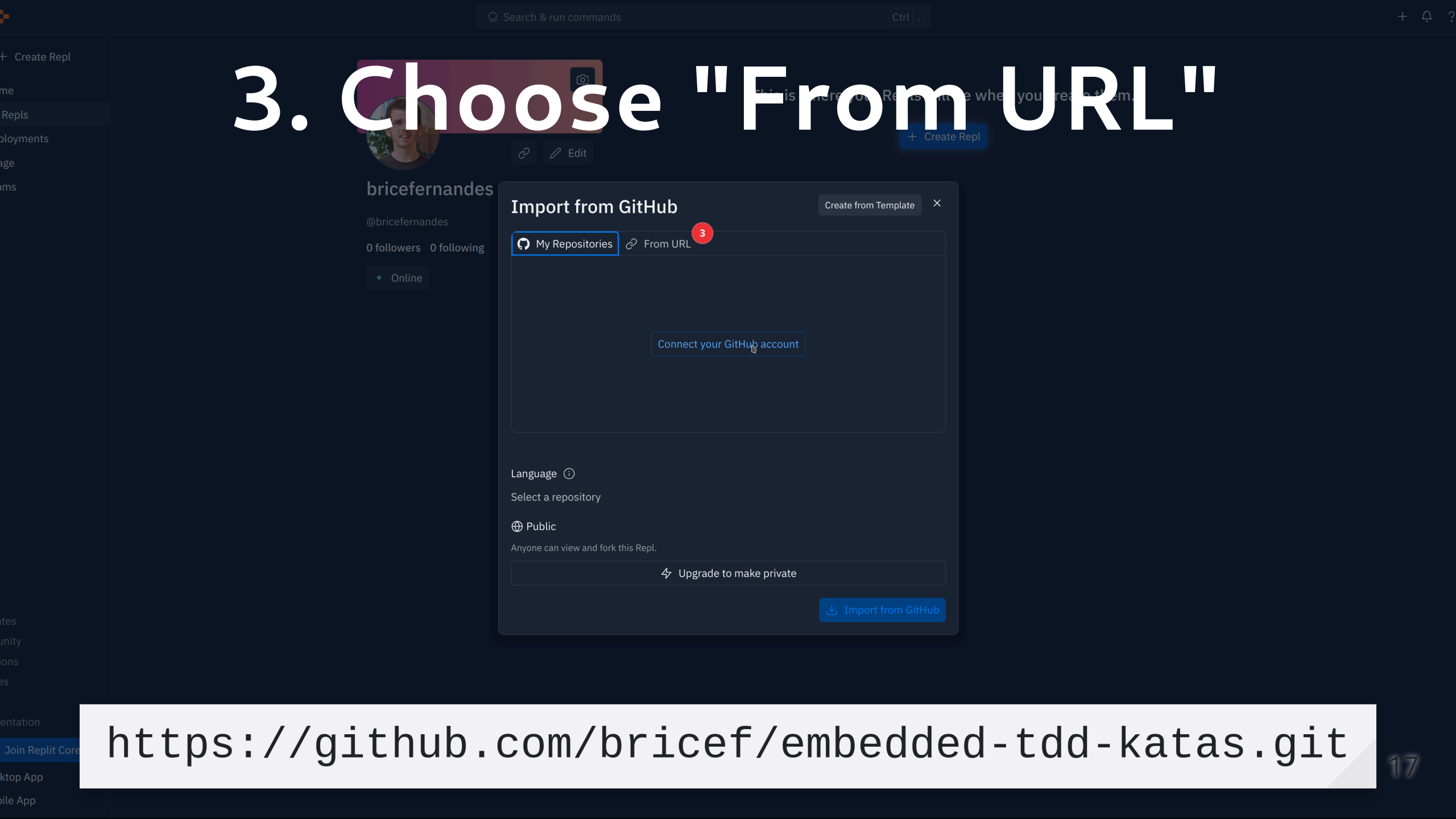
1. Create a new Repl



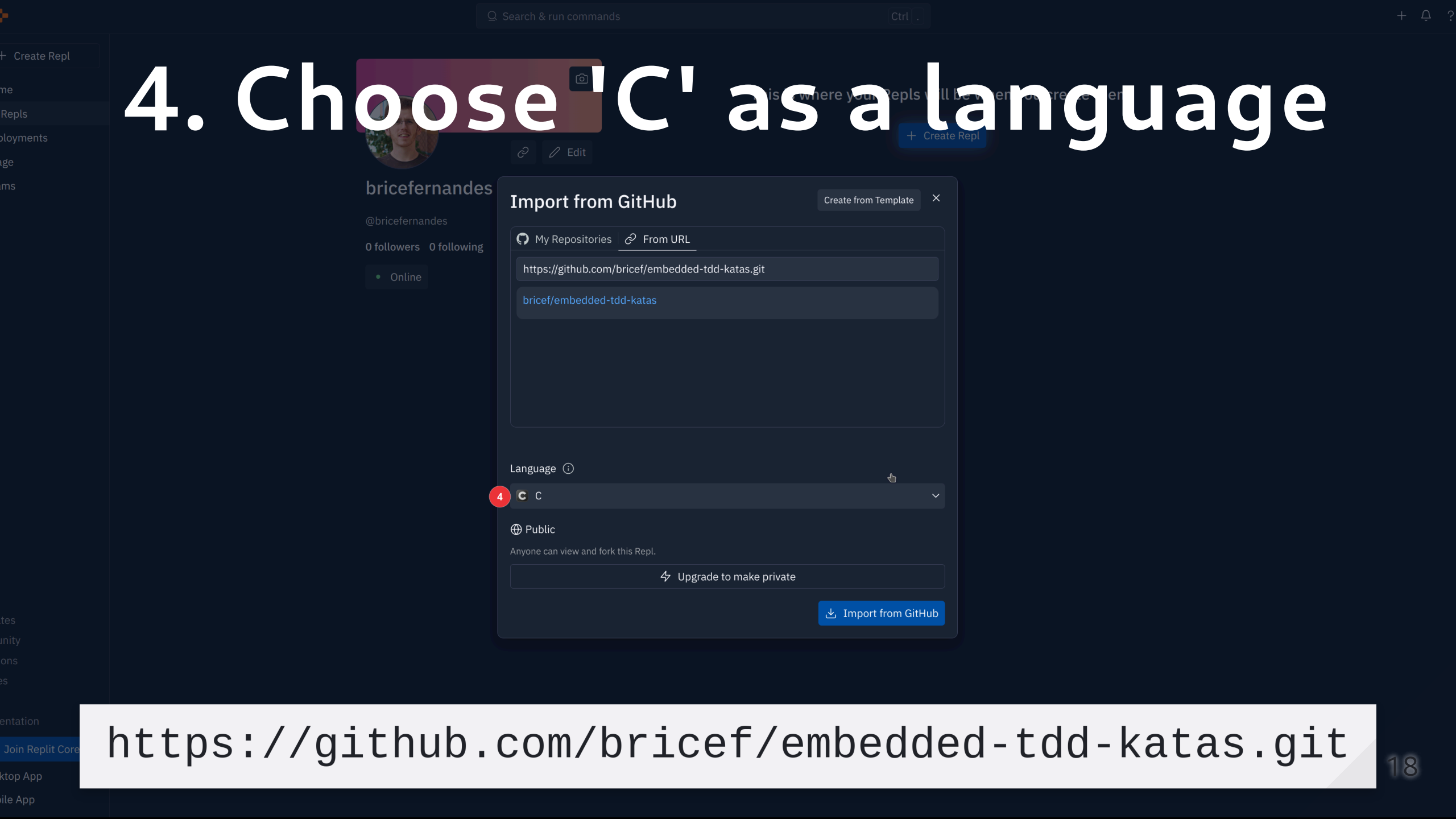
2. Import from Github

3. Choose "From URL"



https://github.com/bricef/embedded-tdd-katas.git

4. Choose 'C' as a language



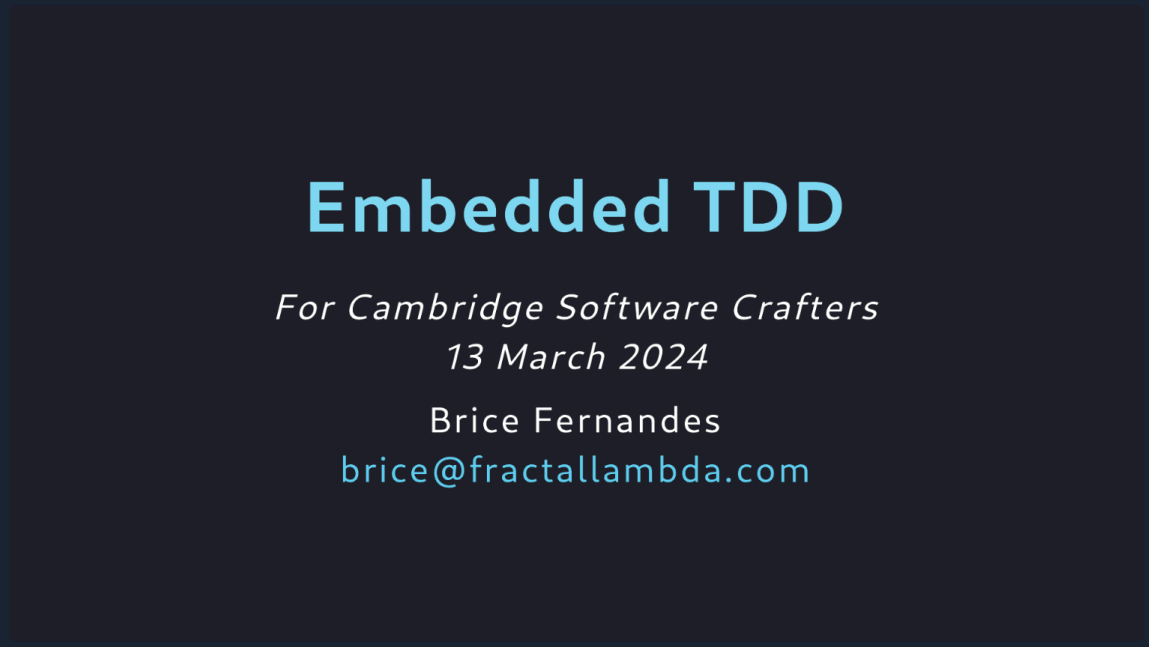
https://github.com/bricef/embedded-tdd-katas.git

README.md

README.md

Open in Editor

Embedded TDD Katas



About

This talk was created for Cambridge Software Crafters and delivered there in Mach 2024.

Colophon

This talk is built in Marp and the PDF can be built from source by running `make` from the `Talk` folder.

License

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Configure Repl

.replit

Configure the Compile Command

This is optional, and is executed before your run command.

make -s

Configure the Run Command

./main

Not sure what to do?

Done

Console

Shell

Results of your code will appear here when you Run the project.

Join Replit Core

Local alternative

If you're confident in your local toolchain

Clone the repository locally:

```
$ git clone https://github.com/bricef/embedded-tdd-katas.git
```

Run the setup script

Open a shell in Replit, then run

```
$ cd Code
$ ./setup.sh
```

Now we wait for dependencies to get downloaded...

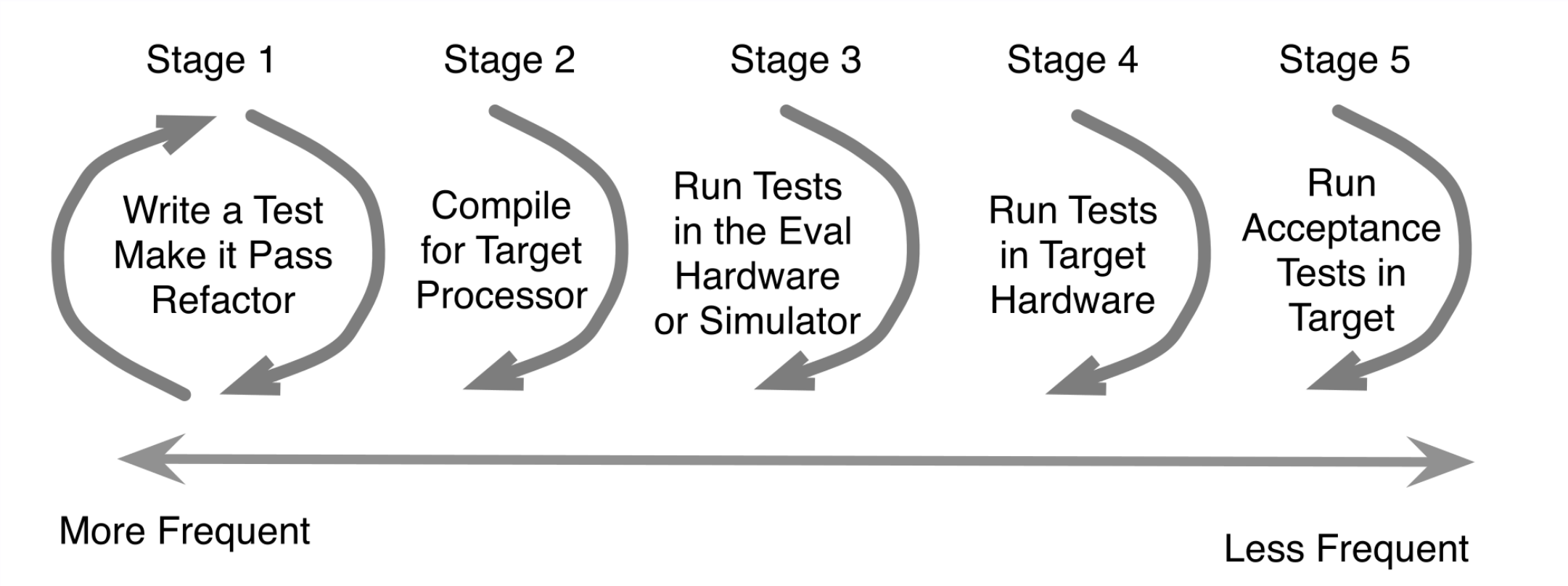
Whilst we wait...

Embedded Strategy

Dual targeting

- Dual targeting
  - Simulate hard-to-duplicate conditions
  - Get around target bottleneck
  - Running the test suite locally
  - Automated CI

Embedded TDD Cycles



Automated HW tests

- There's no reason why you can't create an automated harness that runs the unit test on test devices.
- There's no reason why your CI builds couldn't use HW tests. Including cloud runners!
- You might want to ship tests in production devices as part of a HW self-test suite.

We won't go into depth in this topic tonight.

Test Doubles

- Crititcal for embedded
- Mock the HAL
- Mock the clock

How to Mock?

In order of preference

1. Link time substitution
   (Requires appropriate code structure)
2. Function pointer substitution
3. Syntactic substitution (preprocessor)

Combine at will...

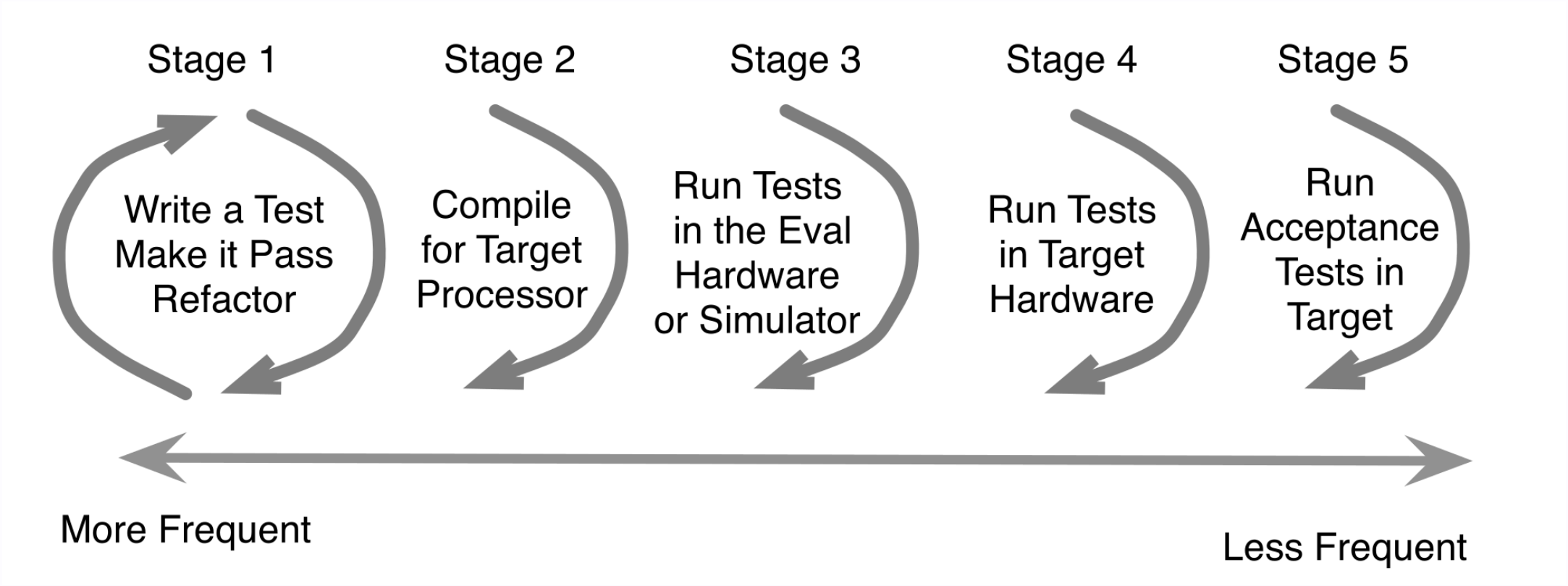
Simulators

Allow testing compiled target code in CI.

Run entire test suite.

Go hand-in-hand with Test Doubles.

TDD Test Cycles



Craftsmanship fundamentals still matter

SOLID

1. Single Responsibility Principle
2. Open Closed Principle
3. Liskov Substitution Principle
4. Interface Segregation Principle
5. Dependency Inversion Priciple


KEEP CALM
IT'S DEMO TIME

The Katas

LED Driver Kata

Look at `KATA.md` in `Code/src/leddriver`

Recap

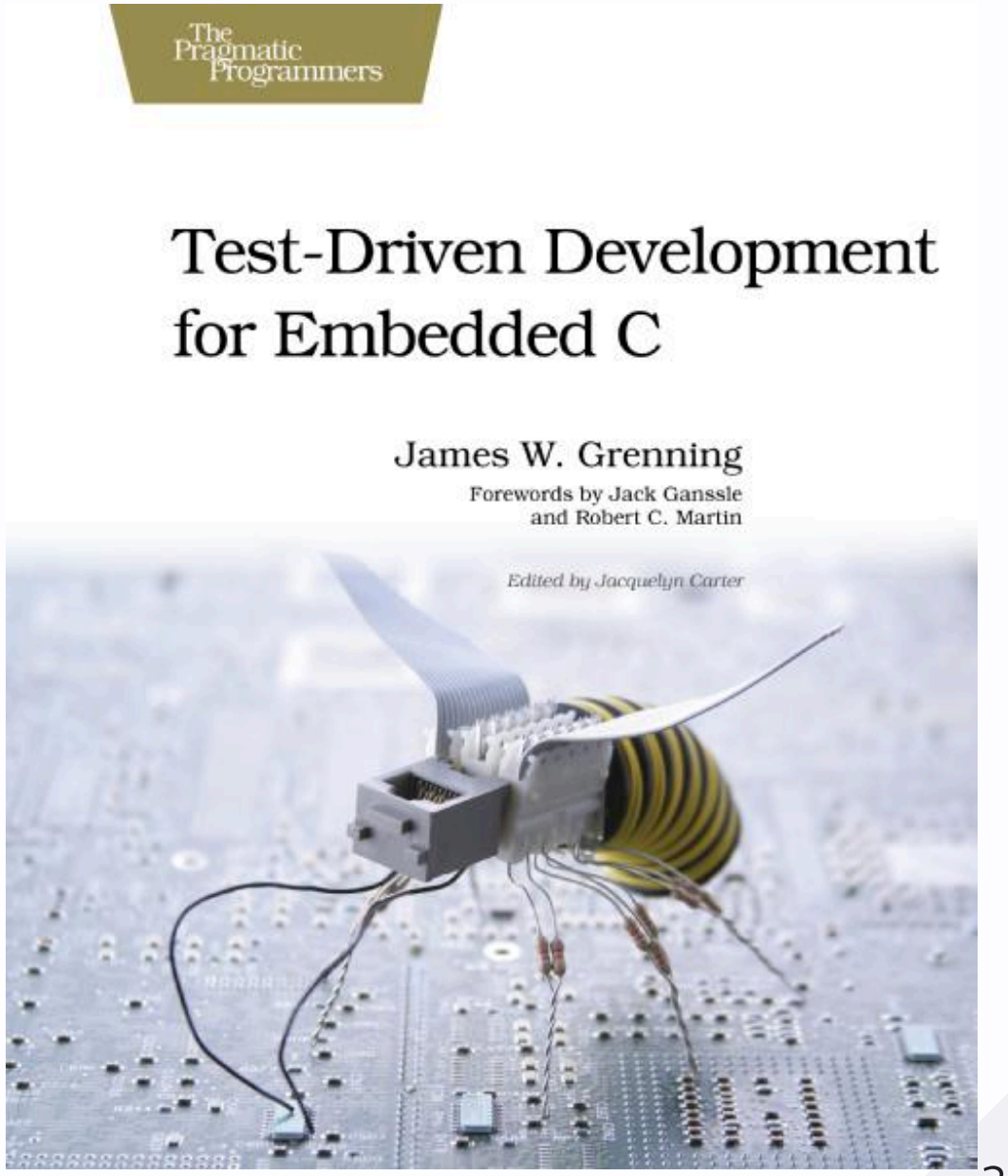
What we learnt

1. TDD is possible and *useful* for embedded software.
2. Embedded TDD strategies make the process easier.
3. Dual targeting is worth it.

(C is fun, maybe?)

Further Reading

- TDD for Embedded C
- ThrowTheSwitch.org
- Unity Test Framework



Thank you 🙏

Q&A ❓

I'm available for contracting

brice@fractallambda.com

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