

# 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.
- SSID: **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.



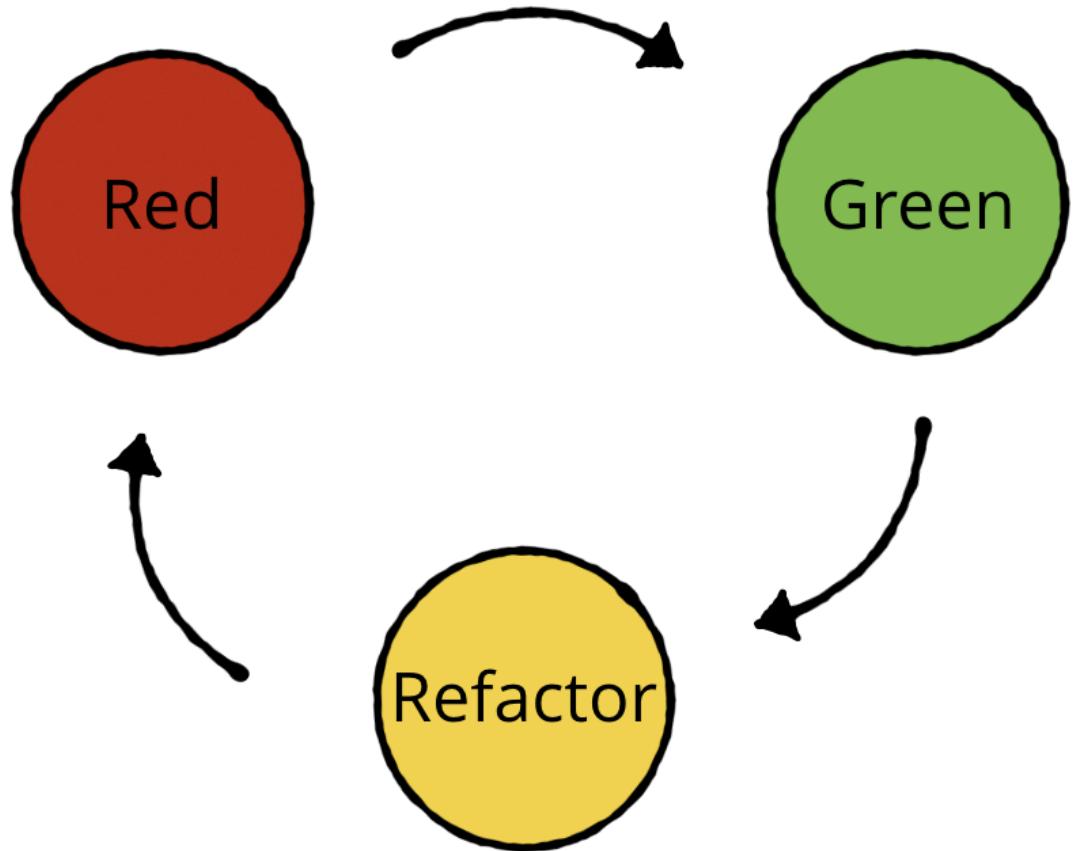
Slides and code available on Github  
[github.com/bricef/embedded-tdd-katas](https://github.com/bricef/embedded-tdd-katas)

# Plan for this evening

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

# Why this talk?

# TDD Refresh

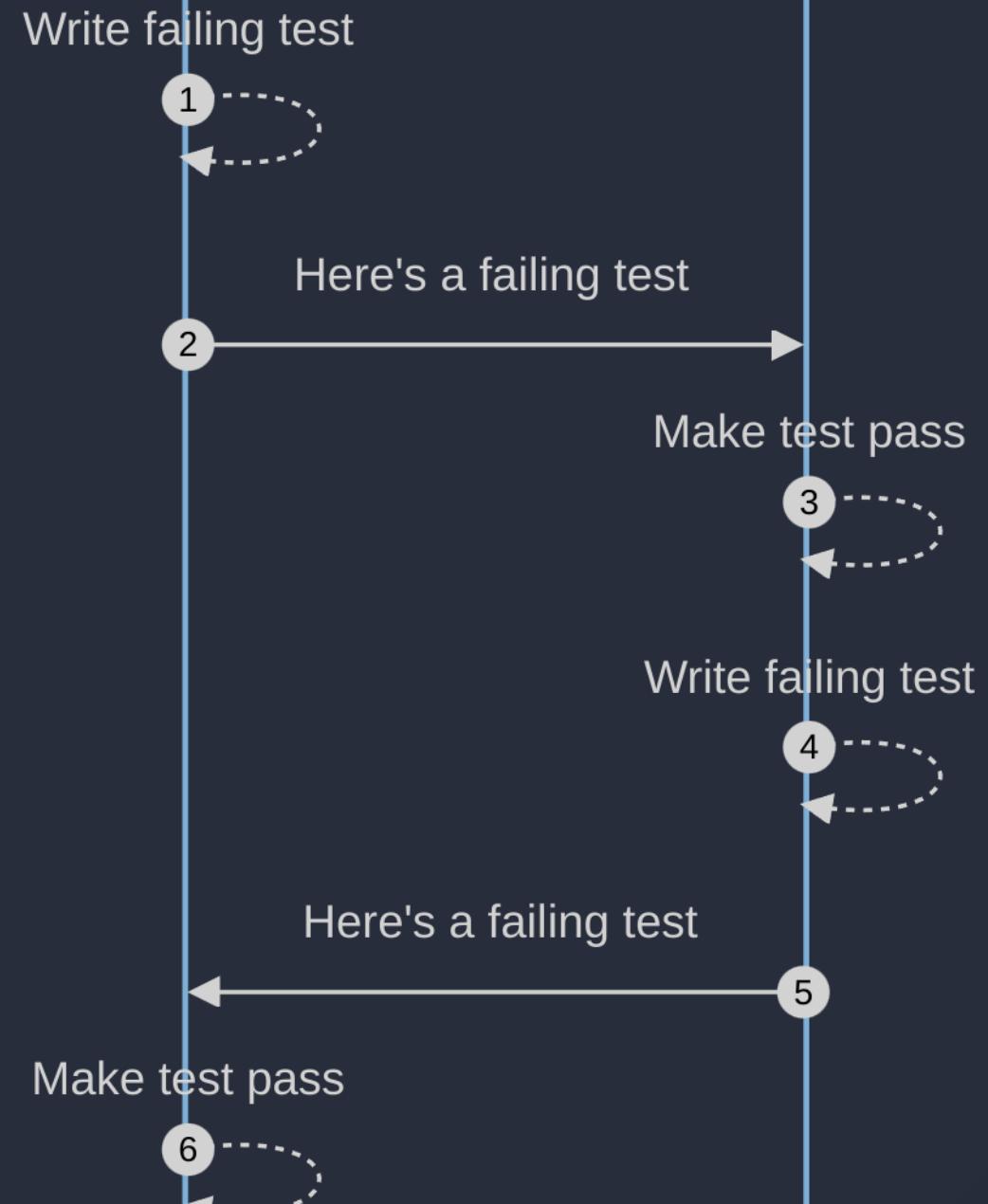


# TDD Loop

**Write a failing test**  
**Make the test pass**  
**Refactor the code**

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

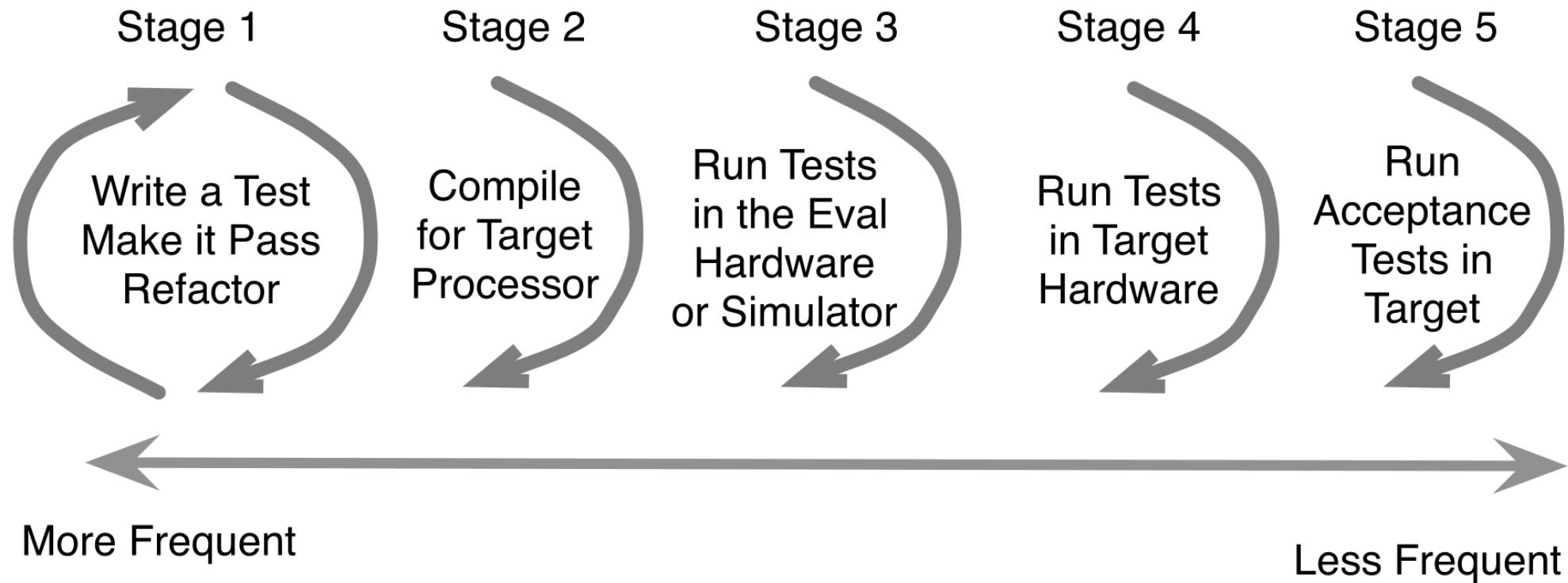
- Late hardware delivery
- Hardware scarcity
- Hardware bugs
- Long target compile times
- Long target setup and upload time
- Compiler licenses

# 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

- Critical 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...

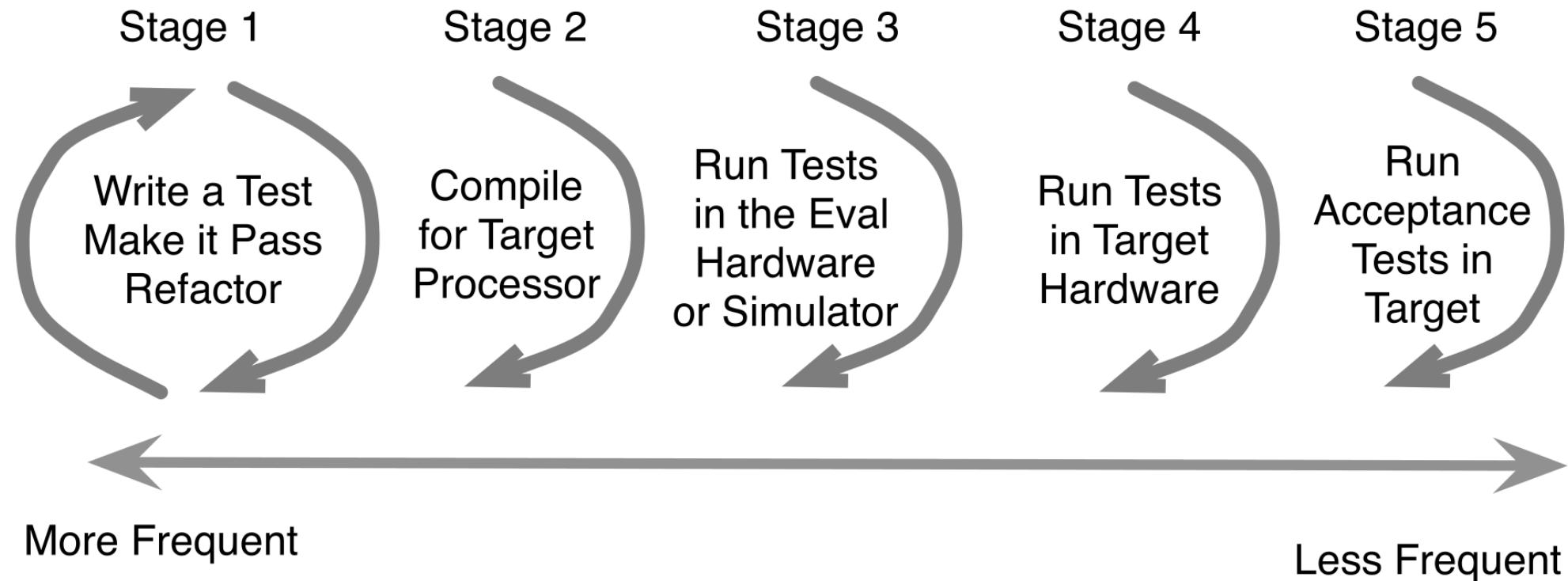
# Simulators

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

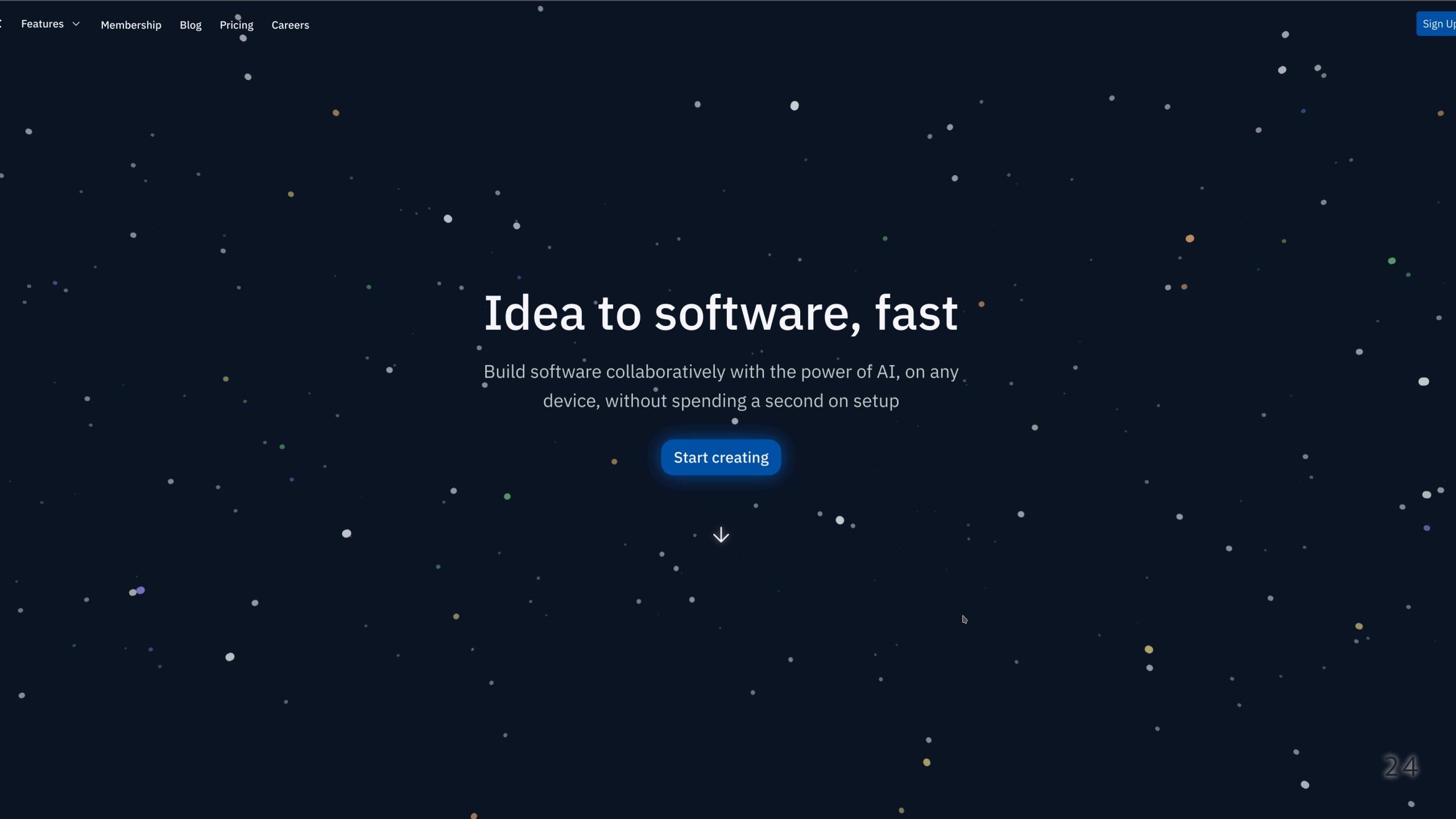
1. Single Responsibility Principle
2. Open Closed Principle
3. Liskov Substitution Principle
4. Interface Segregation Principle
5. Dependency Inversion Principle



Let's get the party started!

# Using Replit

Create a [replit.com](https://replit.com) account  
(use a throwaway email if you'd like)





Search & run commands

Ctrl .

+ ?

+ Create Repl

me

Repls

Deployments

Page

Teams

Notes

Community

Jobs

Events

Presentation

Join Replit Core

Desktop App

Mobile App



bricefernandes

@bricefernandes

0 followers 0 following

• Online

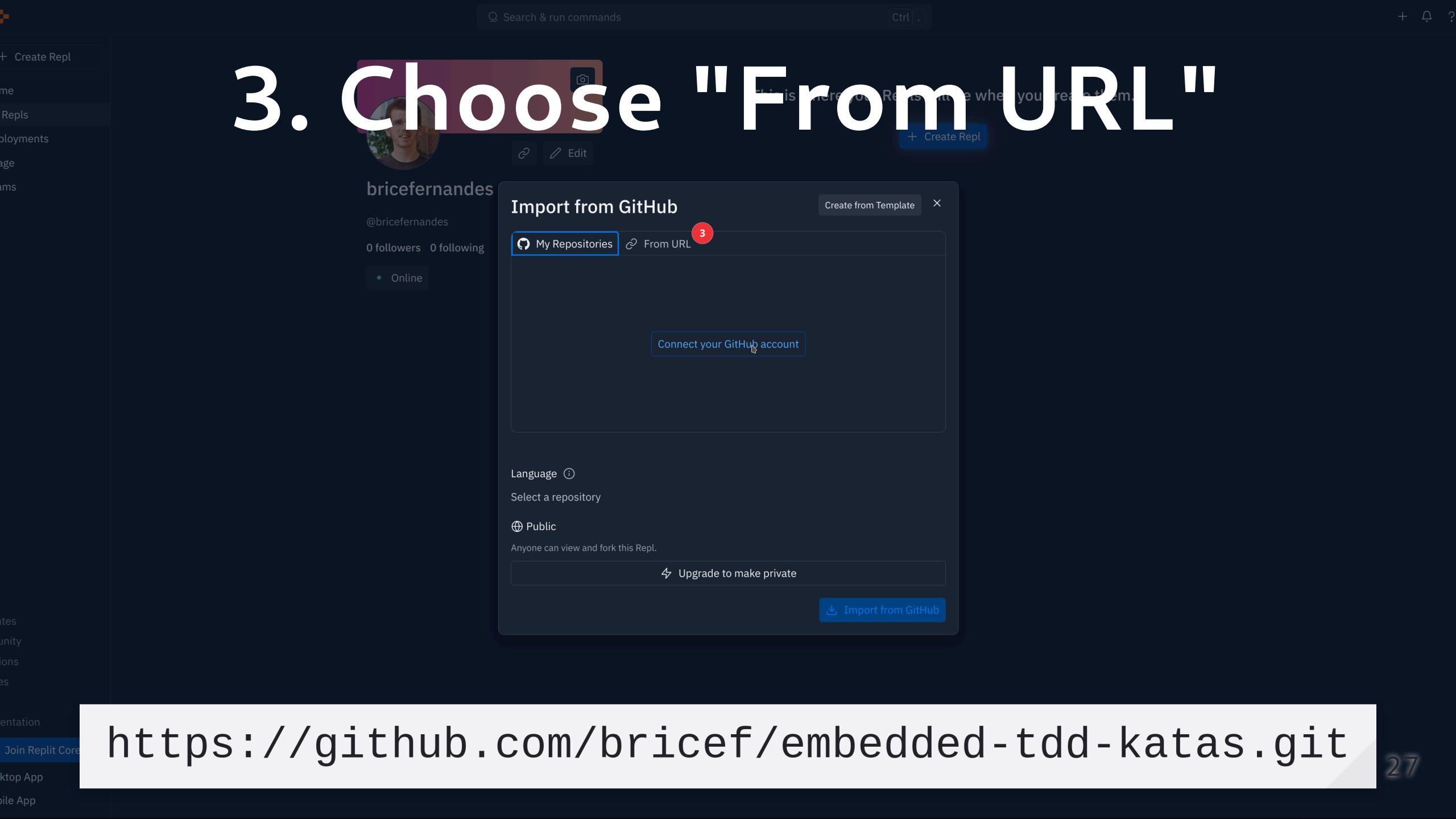
This is where your Repls will be when you create them.

1  
+ Create Repl

# 1. Create a new Repl

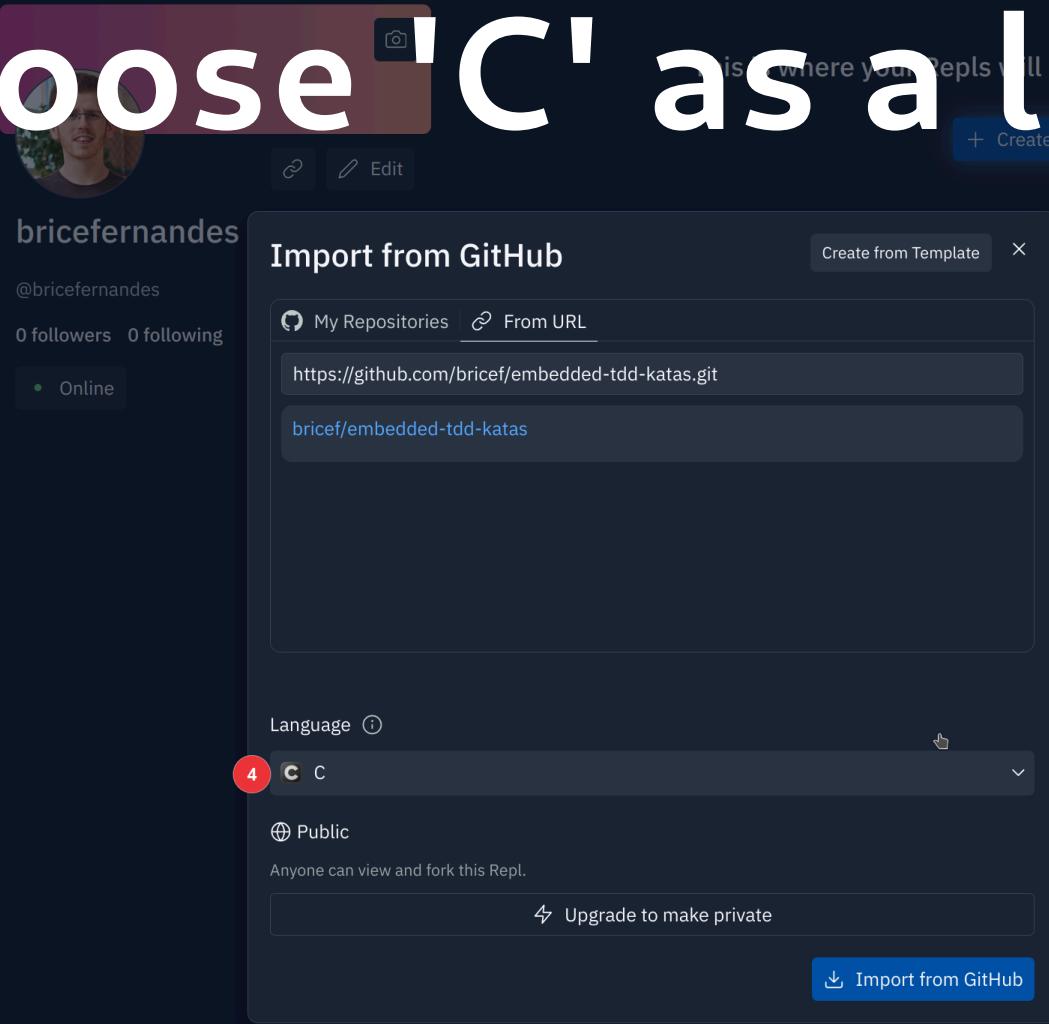
The screenshot shows the Replit interface. At the top, there's a search bar labeled "Search & run commands" and a "Ctrl . ." key binding. On the far right, there are icons for a plus sign, a bell, and a question mark. The left sidebar has a "Create Repl" button and several collapsed sections like "Repls", "Deployments", "Code", and "Blogs". The main area shows a user profile for "bricefernandes" with a picture, edit and camera icons, and a "Create Repl" button. Below the profile, it says "This is where your Repls will be when you create them." and "Create Repl". The user stats are 0 followers and 0 following, and they are listed as "Online". A central modal window titled "Create a Repl" is open. It has a "Template" section with a search bar and a "Title" section with a placeholder "Name your Repl". There's a "Public" checkbox (unchecked) with the note "Anyone can view and fork this Repl.", a "Upgrade to make private" button, and a "Create Repl" button at the bottom. A red circle with the number "2" is visible in the top right corner of the modal.

## 2. Import from Github



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

# 4. Choose 'C' as a language



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

embeded-tdd-katas (1) Run Invite Deploy ?

README.md Open in Editor

# Embedded TDD Katas

## Embedded TDD

*For Cambridge Software Crafters*  
13 March 2024

Brice Fernandes  
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### 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

Unless otherwise specified the slides and code in this repository by Brice Fernandes are licensed under CC BY-SA 4.0

 [Unsupported image](#)  [Unsupported image](#)  [Unsupported image](#)

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 Run

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

Join Replit Core X

29

# Local alternative

If you're confident in your local toolchain

Clone the repository locally:

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

KEEP CALM



IT'S DEMO TIME <sup>31</sup>

# The Katas

# LED Driver Kata

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

# Interrupt Kata

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

# 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

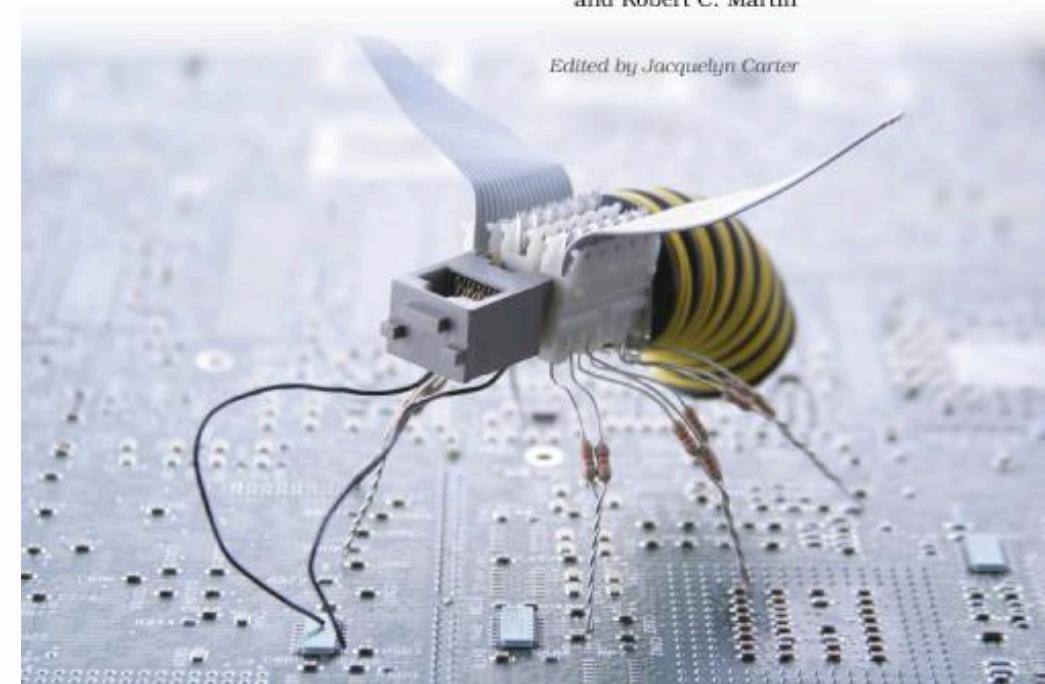
- TDD for Embedded C
- ThrowTheSwitch.org
- Unity Test Framework

## Test-Driven Development for Embedded C

James W. Grenning

Forewords by Jack Ganssle  
and Robert C. Martin

*Edited by Jacquelyn Carter*



Thank you 🙏

Q&A ?

I'm available for contracting  
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