An Empirical Analysis on the Usage of Asynchronous Code by Rust Developers

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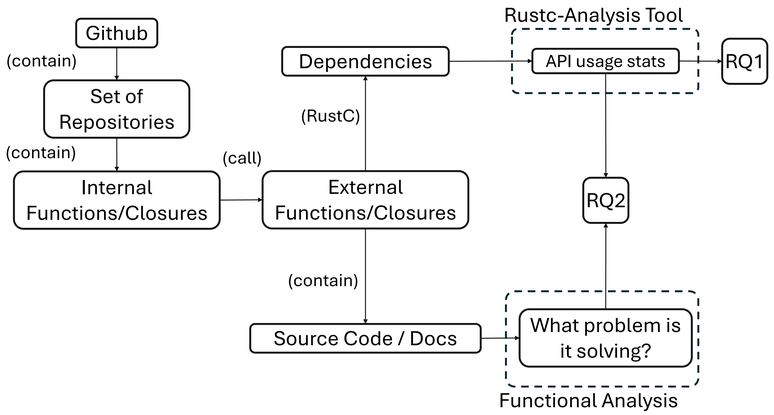
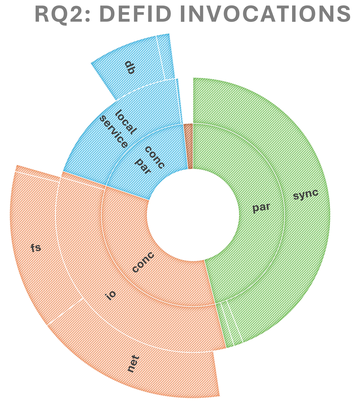
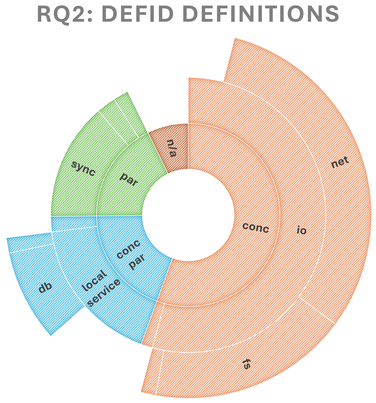
1. Motivation

Asynchronous Rust has seen widespread adoption since its release in 2019, yet little empirical evidence exists regarding how developers use asynchronous APIS and which APIs dominate the ecosystem.

RQ1: what are the most popular runtimes?
RQ2: what functionality do external async APIs provide?







2. Methodology

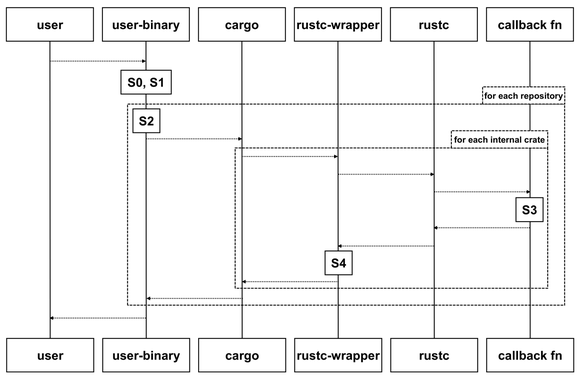
- Presenting Rustc-Analysis
- Analyzing open-source Rust code
- Using the Rust Compiler

- Top 25 GitHub Rust repositories
- 16 successfully analyzed
- 510 internal crates
- 1,649 external crates

3. Rustc-Analysis Tool

- Built on rustc MIR/HIR
- Constructs call graphs
- Extracts async function interaction
- Stores results in DuckDB

- Automatically fetches repositories
- Runs on repositories + hash (reproducible)



4. RQ1: Runtime Popularity

Tokio is dominant runtime across direct usages, indirect usages and crates.io usages.

Futures is a popular alternative also providing executor capabilities, often used with **tokio**.

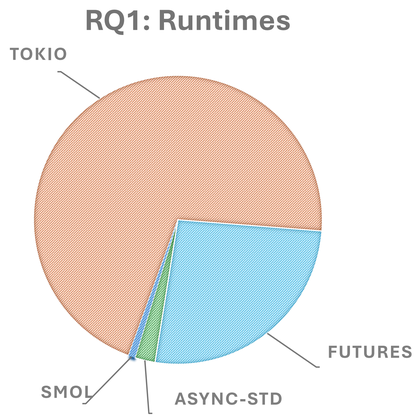
Async-std is significantly less popular and has been discontinued in lieu of **smol**.

5. RQ2: API Functionality

I/O tasks were most common usage of async APIs, namely networking and file-system operations.

Synchronization between concurrent tasks in close second

Local services made up a smaller percentage of async APIs. These local database services and language servers.



6. Key Findings

Tokio is the most widely adopted runtime

Async APIs are primarily used for **networking**, **file-system operations** and **synchronization** between concurrent tasks.

7. Future Work

- Expand dataset beyond 16 repositories
- Analyze internal async functions
- Explore LLM-assisted API categorization

Full Report

Recreation Package

Delft, Netherlands
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