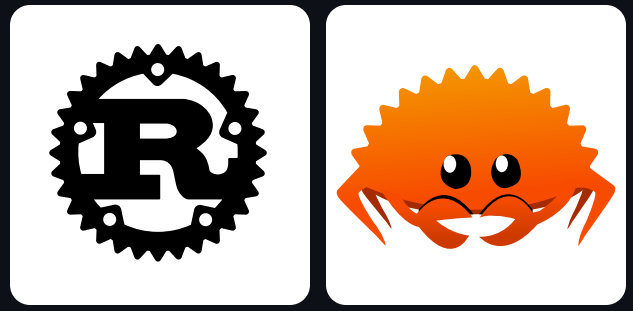
Introduction to the Rust programming Language



Following along The Rust Book from the official source

by: **Simon Lalonde**

For: **IFT-769** (Theoritical concepts CS)

📖 **Project overview -** Going through "The Rust Programming Language"

The Rust Programming Language by Steve Klabnik and Carol Nichols

Book overview:

- Official guide to the Rust programming language
- Covers the basics (syntax, types, functions) + toolchain
- Advanced and Rust-specific features:
  - Ownership, borrowing, lifetimes
  - Unique error handling
  - Concurrency

Klabnik, Steve, and Carol Nichols. The Rust Programming Language. 2nd ed., No Starch Press.

📚 **Theoretical concepts** - Key topics covered

1. Common Programming Concepts (*variables, types, control flow*)
2. Understanding Ownership (*memory management*)
3. Structs, Enums and Pattern Matching
4. Containers/Collections
5. Error Handling
6. Generics, Traits and Lifetimes
7. Functional and OO features
8. Smart pointers and Concurrency
9. Patterns and matching + Advanced features

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Rust Overview

- **Systems programming language** focused on **safety** and **performance**
- TODO

Currently known projects

TODO

Predicted use cases

TODO

Pros and Cons of Rust

PROS:

- **Memory safety**: No null pointers, dangling pointers, or buffer overflows
- **Error handling**: With the `Result` and `Option` types
- **Concurrency**: Safe and efficient with the ownership system
- **Performance**: Comparable to C/C++ with zero-cost abstractions
- **Ecosystem**: Growing with a strong community and package manager (**Cargo**)
- **Helpful compiler**: Provides detailed error messages and warnings

CONS:

- **Learning curve**: Ownership, borrowing, and lifetimes can be challenging
- **Tooling and prevalence**: Not as mature as other languages (C/C++, Python, etc.)
- **Syntax**: Can be verbose and complex compared to other languages

⚙️ Installation and setup

Installation:

1. Install Rust using `rustup` (Rust toolchain installer)

Included toolchain:

- `rustc`: Rust compiler
- `rustup`: Rust toolchain manager
- `rustfmt`: Rust code formatter
- `cargo`: Rust package manager and build tool

Package and library management

- **Crates** are Rust packages that can be shared and reused
- Managed with **Cargo**, the Rust package manager

 **Development environment** - Toolchain overview

Env setup and features:

- Easy install: `curl --proto '=https' --tlsv1.2 -sSf https://sh.rustup.rs | sh`
- Rustup for managing toolchains: `rustup update`
- Included formatter: `rustfmt --check src/main.rs` (dry-run mode)
- Cargo for building and managing projects: `cargo new project_name`
- Quality of life with `rust-analyzer`: LSP, build/debug IDE support etc.

Development environment - Cargo features

Useful Cargo commands when building a project:

- `cargo build` or `cargo run` to compile and run the project. Use `--release` flag for compilation with optimizations inside `target/release/`
- `cargo check`: Check the project for errors without building
- `cargo doc`: Generate documentation for the project
- `cargo clean`: Remove build artifacts
- `cargo update`: Update dependencies
- `cargo fmt`: Format the code according to the Rust style guidelines
- `cargo test`: Run tests in the project

🛠️ **Practical project #0 -** Guessing game

Great way to introduce to the development environment and basic concepts of Rust:

- Common programming concepts (types, funcs, control flow)
- Use of another crate (rand)
- `cargo doc --open` to generate and view documentation

Klabnik, Steve, and Carol Nichols. The Rust Programming Language. 2nd ed., No Starch Press.

🚀 Demo Time!

Simple guessing game CLI app 🎲 (Basics and dev environment features)

THEORY STUFF

TODO

🛠️ **Practical project #1 -** Write an I/O CLI program

Halfway project for a `grep` clone CLI app covers:

1. Code organization (crates, modules)
2. Use of containers and strings
3. Error handling
4. Using traits and lifetimes
5. Testing and documentation

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🛠️ **Practical project #2 -** Building a Multithreaded Web Server

Final Project from the book includes :

1. Learn TCP/IP networking and HTTP
2. Listen to TCP connections on a socket
3. Parse HTTP requests
4. Generate HTTP responses
5. Handle multiple requests concurrently with a thread pool

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THEORY STUFF

TODO