


Fast and safe web services with
axum

- About myself
- My way to Rust
- Rust Introduction

About myself

- Tim Eggert
- Working at  **drant** as Staff Engineer & Security Officer
- Recently moved to Baldenhain

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- Tim Eggert
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- Recently moved to Baldenhain
- Looking for a cozy place to talk about tech!

Me trying to make friends

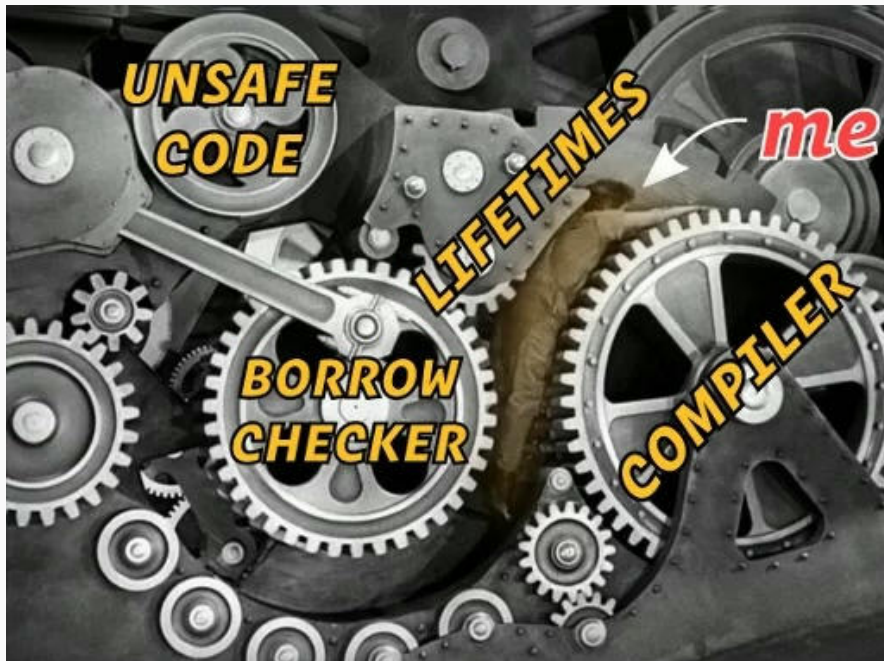


My way to Rust

- Started with dynamic languages (PHP, later Python)
- Sometimes Java, but too verbose...
- Some C++ 11 with type inference (auto)
- Started my Rust journey in 2018

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“A language empowering everyone to build reliable and efficient software.”

— <https://www.rust-lang.org>

Disclaimer: I am a fan of Rust

Overview

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 - Major CPU architectures: x86, ARM,
 - Multiple platforms: Linux, Mac, Windows, Android, Web Assembly, ...
- Widely adopted own documentation standard
- Enterprise features for stability and maintainability

Origins

- Brainchild of Graydon Hoare
- Adopted + Sponsored by Mozilla in 2010
- Decision at Mozilla: Build new Browser Engine (Servo) from scratch based on Rust

Reliability: Memory Safety & Thread Safety

“Rust’s rich type system and ownership model guarantee memory-safety and thread-safety — enabling you to eliminate many classes of bugs at compile-time.”

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Usage / Adoption

- Android
- AWS Lambda (via Firecracker)
- Discord, Dropbox, Cloudflare backend systems
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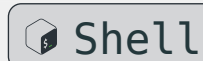
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- Mozilla Servo (browser engine)
- Databases (Meilisearch, Qdrant, ...)
- CLI Tools , Editors, Terminal Emulators, Shells, Language tooling (ruff, uv, ...)
- Deno (nodejs runtime competitor)
- Operating Systems (Redox OS, Linux Kernel)
- Cryptocurrency projects

... and many many more

Hello World

- Install Rust toolchain via rustup.rs:

```
1 curl --proto '=https' --tlsv1.2 -sSf https://sh.rustup.rs | sh
```



- Initiate a new project

```
1 cargo init hello_world  
2 cd hello_world  
3 cargo run
```



Hello World

```
1 fn main() {  
2     println!("Hello World!");  
3 }
```



- Famous choices: Actix Web, Rocket, Warp, Axum

ToDo Example

Initialize project

```
1 cargo init todos
2 cd todos
```



Install dependencies

```
1 cargo add axum
2 cargo add tokio --features full
3 cargo add serde --features derive
4 cargo add uuid --features v4 --features serde
5 cargo add serde_json
```



ToDo Example

Static Axum Server

```
1 use axum::{response::IntoResponse, routing::get, Router};
2
3 #[tokio::main]
4 async fn main() {
5     let app = Router::new().route("/todos", get(list_todos));
6     println!("Server running on http://127.0.0.1:3000");
7     let listener = tokio::net::TcpListener::bind("0.0.0.0:3000").await.unwrap();
8     axum::serve(listener, app).await.unwrap();
9 }
```



ToDo Example

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ToDo Example

handler function to list Todos



```
1 async fn list_todos() -> impl IntoResponse {  
2     // Just return a static string for now  
3     return "Todos";  
4 }
```


ToDo Example

Add a TodoItem type / struct



```
1 use serde::{Deserialize, Serialize};
2 use uuid::Uuid;
3
4 #[derive(Serialize, Deserialize, Clone)]
5 struct TodoItem {
6     id: Uuid,
7     title: String,
8     completed: bool,
9 }
```

ToDo Example

Return static TodoItem as JSON



```
1  use axum::Json;
2
3  async fn list_todos() -> Json<Vec<TodoItem>> {
4      let todo = TodoItem {
5          id: Uuid::new_v4(),
6          title: "First ToDo".into(),
7          completed: false,
8      };
9      return Json(vec![todo]);
10 }
```

ToDo Example

Add shared state



```
1 use tokio::sync::RwLock;  
2  
3 #[derive(Default)]  
4 struct AppState {  
5     todos: RwLock<Vec<TodoItem>>,  
6 }
```

ToDo Example

Add shared state



```
1  use std::sync::Arc;
2
3  #[tokio::main]
4  async fn main() {
5      let state = Arc::new(AppState::default());
6      let app = Router::new()
7          .route("/todos", get(list_todos))
8          .with_state(state);
9      ...
10     axum::serve(listener, app).await.unwrap();
11 }
```

ToDo Example

Use AppState in list handler



```
1 use axum::extract::State;  
2  
3 async fn list_todos(State(state): State<Arc<AppState>>) -> Json<Vec<TodoItem>> {  
4     let todos = state.todos.read().await.clone();  
5     return Json(todos);  
6 }
```

ToDo Example

Add POST /todos



```
1  use std::sync::Arc;
2
3  #[tokio::main]
4  async fn main() {
5      let state = Arc::new(AppState::default());
6      let app = Router::new()
7          .route("/todos", get(list_todos).post(create_todo))
8          .with_state(state);
9      ...
10     axum::serve(listener, app).await.unwrap();
11 }
```

ToDo Example

Add a request type for TodoItem



```
1 #[derive(Serialize, Deserialize, Clone)]
2 struct TodoItemCreateRequest {
3     title: String,
4     completed: bool,
5 }
```

ToDo Example

Add create_todo handler function



```
1  async fn create_todo(  
2      State(state): State<Arc<AppState>>,  
3      Json(payload): Json<TodoItemCreateRequest>,  
4  ) -> Json<TodoItem> {  
5      let mut todos = state.todos.write().await;  
6      let todo = TodoItem {  
7          id: Uuid::new_v4(),  
8          title: payload.title,  
9          completed: payload.completed,  
10     };  
11     todos.push(todo.clone());  
12     Json(todo)  
13 }
```


ToDo Example

Add DELETE /todo/{id}

 Rust

```
1  use axum::routing::delete;
2
3  #[tokio::main]
4  async fn main() {
5      let state = Arc::new(AppState::default());
6      let app = Router::new()
7          .route("/todos", get(list_todos).post(create_todo))
8          .route("/todos/{id}", delete(delete_todo))
9          .with_state(state);
10     ...
11     axum::serve(listener, app).await.unwrap();
12 }
```

ToDo Example

Add DELETE /todo/{id}

 Rust

```
1 use axum::{extract::Path, http::StatusCode};
2
3 async fn delete_todo(
4     Path(id): Path<Uuid>,
5     State(state): State<Arc<AppState>>
6 ) -> StatusCode {
7     let mut todos = state.todos.write().await;
8     if let Some(pos) = todos.iter().position(|todo| todo.id == id) {
9         todos.remove(pos);
10        StatusCode::NO_CONTENT
11    } else {
12        StatusCode::NOT_FOUND
13    }
14 }
```

- Weekly newsletter: “This week in Rust”
- Wide Editor support: (RustRover, VSCode, Emacs, Vim, Zed, ...)