# Willem Vanhulle

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## EXPERIENCE

**OTIV (Remote operation of semi-autonomous rail vehicles)**  Ghent, Belgium
*Mid-level software engineer*  *Apr. 2024 - current*

- **Distributed systems:** Work on a distributed system to operate freight trains remotely. Create a dynamic presence detection system. Create an internal asynchronous iterator / stream toolkit. Create a crucial connectivity monitoring systems that can react to connection loss and engage emergency breaking. Manage real-time audio- and video-streams through GStreamer and WebRTC.
- **Developer tools:** Smooth out integration between the language-server and the Bazel build system. Lead transition from Bazel to the Cargo build system for one team. Write CI/CD pipelines from scratch. Reduced run-time of existing CI pipelines up to 95%. (`Rust`)
- **Mentorship:** Organised trainings on parts of the programming language that are lacking in documentation. Performed thorough code reviews and coached junior colleagues. (`Rust`)
- **Tests:** Write extensive unit tests for new and existing software modules. Implement integration tests based on requirements given by railway companies.
- **Native GUI:** Co-create several immersive, multi-monitor, native user-interfaces. Implement widgets representing streamed data tables. Create a geographical map widget with highlighted train routes and Slint. (`Rust`)
- **Embedded:** Write software modules interfacing with real physical controls of trains such as custom touch-screens, toggles and traction/breaking levers, running on Linux.

**Inbiose (Microbial production of speciality carbohydrates)**  Ghent, Belgium
*Software engineer*  *June 2021 - January 2024*

- **Micro-biotechnology:** Learn science behind cellular cloning of e. coli. bacteria, used for producing sugars with special health benefits. Learn process of fermentation and down-stream processing with ion-exchange and membrane filtering. Get involved in lab activities with lab workers, operators and researchers.
- **Web-development:** Create graphical web-based data collection procedure and application for the down-stream processing department. Create accompanying simple time-series and data-grid visualisation widgets with Svelte. Introduce modern typing as a tool for creating large web applications. (`TypeScript`, `HTML`, `SCSS`)
- **Bio-informatics:** Implement property-based unit tests to verify correctness of batch operations on internal, proprietary genetic data. Extend and maintain internal tools for bio-informatics. (`Python`)
- **Embedded systems:** Supported creation of industrial small-scale microbial fermentation robots. Interfaced with legacy hardware (more than 25 years old) and modern optical industrial sensors. Transitioned from synchronous to asynchronous programming. (`Python`, `Rust`)
- **Data modelling:** Analyse and model internal scientific processes. Model and construct scientific databases in PostgreSQL. Use graph-oriented databases such as Neo4j. (`R`)
- **Mentorship:** Assist electronics engineers in optimising internal embedded programs for Arduino and ESP32 micro-controllers. (`C`)

**CVO (Adult and refugee high-school)**  Leuven, Belgium
*Mathematics guest lecturer*  *Sept. 2020 - Jan. 2021*

- **Teaching:** Mathematics and programming courses and document preparation. (`Python`, `LaTeX`)

## MAJOR PROFESSIONAL PROJECTS

**Emergency breaking mechanism** - OTIV                    *Sept. 2024 - Mar. 2025*

- **Heartbeat monitor:** Detects whether the connection between a remote human operator and a semi-autonomous freight train is still normal.
- **Stream aggregator:** Initialise incoming (and outgoing) pub-sub, TCP data streams for assigned freight trains. Aggregate the streams, detect connection loss, initiate emergency breaking mechanism. Findings on personal blog.

**Fermentation robot** - Inbiose                    *Oct. 2023 - April 2024*

- **Serial communication abstraction layer:** Create a high-level and safe serial API in Rust for operating essential components for a fermentation robot. Implemented thorough error detection and propagation.
- **Fermentation process manager:** Add nutrients and chemicals throughout a 48h biological process for growing e. coli. bacteria. Detect anomalies and stabilise with PID-control.

**Collaborative data-grid** - Inbiose                    *Apr. 2023 - Feb. 2024*

- **Distributed data-frames:** Distributed, database-backed, persisted data-grid.
- **Spreadsheet interface:** Interactive co-operative table view for lab workers to enter chemical process data with columns grouping and multiple cell types, similar to a restricted version of Google Docs.

## HOBBY PROJECTS

**Splitting data streams:** Created a functional asynchronous combinator to split data streams / asynchronous iterators. Run-time agnostic and fully tested. Intended to be used with many, simultaneous splits. Built with low-level asynchronous primitives such as Waker, Poll and Pin. Available as a public crate. (`Rust`)

**Smart plant pot workshop:** Organise and co-lead a workshop on creating a smart plant pot watering system with a Raspberry Pi Pico / ESP32c6 and async Embassy. Integrated USB serial communication and debugging (with JTAG or hardware debug probes), analogue sensing and wireless network notifications. Event at MeetUp. (`Rust`)

## SPOKEN LANGUAGES

**English, Dutch:** Native **French, German:** Intermediate

## PROGRAMMING LANGUAGES

**Rust:** Advanced (2 years). Specialized in complex trait bounds and creating performant asynchronous combinators from scratch. Frameworks used: Axum (web server), Embassy and Tokio (asynchronous runtimes), Zenoh (publish-subscribe), Serde (serialization), Statig (state machines), Prost (protobuf). Limited experience with embedded HALs.

**Coq, Agda, Haskell:** Intermediate (3 years). Used several proof-assistants for formal mathematics (topology) / systems software verification. Following up recent developments in free-time.

**HTML, SASS, TypeScript, JavaScript, SQL:** Advanced (3 years). Express.js back-end, Svelte(Kit) front-end.

**Python:** Advanced (6 years). Bio-informatics with BioPython. End-to-end UI testing. Used property-based testing with Hypothesis (fuzzer).

## Education

**KU Leuven**  Leuven, Belgium
*Preparation program and Master of Science in Theoretical Physics (terminated early)*  *Sep. 2019 – April 2021*

- **Completed courses:** Statistical mechanics, data mining and neural networks, thermodynamics, analytical mechanics, electrodynamics.
- **Volunteering roles:** Guide for international students.

**KU Leuven**  Leuven, Belgium
*Master of Science in Pure Mathematics (Eng.), thesis on functional programming languages*  *Sep. 2017 – June 2019*

- **Completed courses:** Algebra, analysis, discrete mathematics, differential geometry, unified geometry, topology.
- **Volunteering roles:** Coordinator of Groot-Begijnhof Leuven student association.

**VUB**  Brussels, Belgium
*Bachelor of Science in Mathematics, Minor Computer Science, thesis on unsupervised learning*  *Sep. 2013 – Aug. 2017*

- **Completed courses:** Functional programming, algorithms and data-structures, logic, analysis, algebra, philosophy, geometry.
- **Student job:** Mathematics tutor.

## Hobbies

**Community founder:** Founder of "Systems Programming Ghent" (sysghent.be): organise networking events, in-depth talks and workshops in Ghent about systems programming languages such as Rust and C++.

**Play with electronical components:** Order development boards and assemble simple electronical circuits with simple sensors. Some experience with ARM and RISC-V boards such as ESP32c6, Arduino Uno (AVR), Raspberry Pico (RP2040).

**Visit developer conferences:** I go to the developer conferences in Europe to meet colleagues and share my passion.