

A decorative graphic on the left side of the slide. It consists of a blue parallelogram and a light green parallelogram, both tilted at an angle. The blue shape is in the foreground, and the green shape is partially behind it. The background of the entire slide is dark blue with subtle diagonal lines.

RUSTikales Rust for beginners



Plan for today



Plan for today

1. Introduction



Plan for today

1. Introduction
2. Rust Installation



Plan for today

1. Introduction
2. Rust Installation
3. Development Environment



Plan for today

1. Introduction
2. Rust Installation
3. Development Environment
4. General Info



1. Introduction

- Welcome in this Rust course!



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- Your life will change forever soon, you will be learning the best language in the world!!!



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 - It's memory safe!
 - It's statically typed!
 - It's fast!
 - Zero Cost Abstraction!



1. Introduction

- Welcome in this Rust course!
- Your life will change forever soon, you will be learning the best language in the world!!!
 - It's memory safe!
 - It's statically typed!
 - It's fast!
 - Zero Cost Abstraction!
- Well, not quite, but you'll see once we get there



1. Introduction

- What will we be learning this semester?



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 - Working with the Rust Compiler `rustc`



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- What will we be learning this semester?
 - Working with the Rust Compiler `rustc`
 - Working with the Rust tool `cargo`
 - `cargo init/new`
 - `cargo build`
 - `cargo run`



1. Introduction

- What will we be learning this semester?
 - Working with the Rust Compiler **rustc**
 - Working with the Rust tool **cargo**
 - Working with IDEs
 - Visual Studio Code + rust-analyzer
 - RustRover



1. Introduction

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 - Basic Rust-Syntax and Rust-specific quirks



1. Introduction

- What will we be learning this semester?
 - Working with the correct tools
 - Basic Rust-Syntax and Rust-specific quirks
 - Basics of Programming
 - Variables
 - Types
 - How do computers execute code?



1. Introduction

- What will we be learning this semester?
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 - Basics of Programming
 - Control Flow
 - `if`
 - `loop`
 - `match`
 - `fn`



1. Introduction

- What will we be learning this semester?
 - Working with the correct tools
 - Basic Rust-Syntax and Rust-specific quirks
 - Basics of Programming
 - Control Flow
 - Data Structures
 - `struct`
 - `enum`



1. Introduction

- What will we be learning this semester?
 - Working with the correct tools
 - Basic Rust-Syntax and Rust-specific quirks
 - Basics of Programming
 - Control Flow
 - Data Structures
 - What makes Rust different from other languages
 - Ownership
 - Borrow Checking
 - Option<T> and Result<T,E>



1. Introduction

- What will we be learning this semester?
 - Working with the correct tools
 - Basic Rust-Syntax and Rust-specific quirks
 - Dipping into advanced-ish topics
 - Traits
 - Generics
 - Third-party libraries



1. Introduction

- What will we be learning this semester?
 - Working with the correct tools
 - Basic Rust-Syntax and Rust-specific quirks
 - Dipping into advanced-ish topics
- What I will **not** cover
 - **unsafe**
 - **async**
 - **Macros**
 - **Multithreading**
 - **Functional Programming**



1. Introduction

- Where can I find resources?
 - Official Rust website:
 - <https://www.rust-lang.org/learn/>
 - Rust Book:
 - <https://doc.rust-lang.org/book/>
 - Rustlings (official Rust exercises):
 - <https://rustlings.cool/>
 - Repo for this course:
 - <https://github.com/pfhaupt/progkurs/>
 - subdirectory **rust-beginner**



2. Rust Installation

2. Rust Installation

Linux/macOS

- Go to `rust-lang.org`
- Click `Get Started`
- Run this command in your terminal

It looks like you're running macOS, Linux, or another Unix-like OS. To download Rustup and install Rust, run the following in your terminal, then follow the on-screen instructions. See ["Other Installation Methods"](#) if you are on Windows.

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

- You may need to also install a linker
 - you'll see later when the example fails
- You're ready to go!

Windows

- Go to `rust-lang.org`
- Click `Get Started`
- Download the Installer

It looks like you're running Windows. To start using Rust, download the installer, then run the program and follow the onscreen instructions. You may need to install the Visual Studio C++ Build tools when prompted to do so. If you are not on Windows see ["Other Installation Methods"](#).

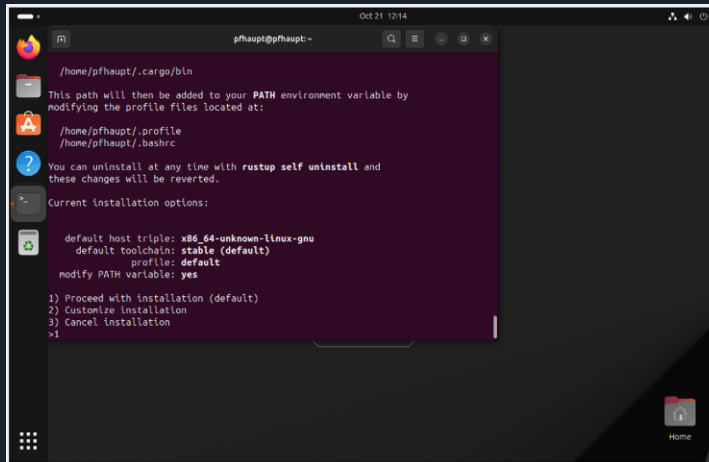
DOWNLOAD RUSTUP-INIT.EXE (32-BIT)

DOWNLOAD RUSTUP-INIT.EXE (64-BIT)

- Run the Installer
- You may need to also install MSVC Tools
 - Installer will tell you, Quick Install is okay
 - Pray that eduroam doesn't blacklist the MSVC Installer again :^)

2. Rust Installation

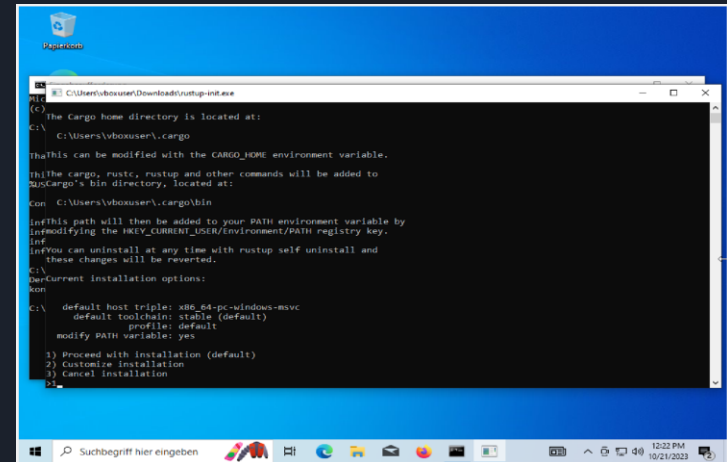
Linux



A terminal window on a Linux system showing the Rust installation process. The prompt is 'pfhaupt@pfhaupt:~'. The output shows the installation of the cargo binary to /home/pfhaupt/.cargo/bin. It explains that this path will be added to the PATH environment variable by modifying the profile files located at /home/pfhaupt/.profile and /home/pfhaupt/.bashrc. It also provides instructions on how to uninstall Rust using 'rustup self uninstall' and lists the current installation options: default host triple: x86_64-unknown-linux-gnu, default toolchain: stable (default), profile: default, and modify PATH variable: yes. The user has selected '1) Proceed with installation (default)'.

```
pfhaupt@pfhaupt:~  
/home/pfhaupt/.cargo/bin  
This path will then be added to your PATH environment variable by  
modifying the profile files located at:  
/home/pfhaupt/.profile  
/home/pfhaupt/.bashrc  
You can uninstall at any time with rustup self uninstall and  
these changes will be reverted.  
Current installation options:  
  
default host triple: x86_64-unknown-linux-gnu  
default toolchain: stable (default)  
profile: default  
modify PATH variable: yes  
  
1) Proceed with installation (default)  
2) Customize installation  
3) Cancel installation  
>1
```

Windows



A Windows command prompt window showing the Rust installation process. The title bar indicates the path 'C:\Users\vbouser\Downloads\rustup-init.exe'. The output shows the Cargo home directory located at C:\Users\vbouser\.cargo. It explains that this path can be modified with the CARGO_HOME environment variable and that the cargo, rustc, rustup, and other commands will be added to the user's bin directory. It also provides instructions on how to uninstall Rust using 'rustup self uninstall' and lists the current installation options: default host triple: x86_64-pc-windows-msvc, default toolchain: stable (default), profile: default, and modify PATH variable: yes. The user has selected '1) Proceed with installation (default)'.

```
C:\Users\vbouser\Downloads\rustup-init.exe  
(c) The Cargo home directory is located at:  
C:\Users\vbouser\.cargo  
This can be modified with the CARGO_HOME environment variable.  
The cargo, rustc, rustup and other commands will be added to  
your user's bin directory, located at:  
C:\Users\vbouser\.cargo\bin  
This path will then be added to your PATH environment variable by  
modifying the HKCU\Current_User\Environment\PATH registry key.  
You can uninstall at any time with rustup self uninstall and  
these changes will be reverted.  
Current installation options:  
  
default host triple: x86_64-pc-windows-msvc  
default toolchain: stable (default)  
profile: default  
modify PATH variable: yes  
  
1) Proceed with installation (default)  
2) Customize installation  
3) Cancel installation  
>1
```

- If you see this, you're almost done! It will now install all necessary tools.
- Restart your terminal/console, and you'll be able to use `rustc` and `cargo`!



2. Rust Installation

- if Installation was successful, you should be able to run the following commands:

```
C:\>rustup --version
rustup 1.27.0 (bbb9276d2 2024-03-08)
info: This is the version for the rustup toolchain manager, not the rustc compiler.
info: The currently active `rustc` version is `rustc 1.76.0 (07dca489a 2024-02-04)`

C:\>cargo --version
cargo 1.76.0 (c84b36747 2024-01-18)

C:\>rustc --version
rustc 1.76.0 (07dca489a 2024-02-04)
```



2. Rust Installation

- if any of those commands failed, we must troubleshoot now



2. Rust Installation

- if any of those commands failed, we must troubleshoot now
- common errors:
 - ``Linker cc not found``
 - Linux → `sudo apt install gcc`
 - macOS → `brew install gcc`
 - Windows → shouldn't happen, the Installer installed the MSVC toolchain :^)
 - eduroam may `block downloading the Installer` → you'd need to `try again at home`



2. Rust Installation

- To test if everything is set up properly, run those commands:
 - Create a directory of your choice
 - Either via File Manager, or Terminal
 - Open that directory in a terminal
 - type in `cargo init test_program`
 - Navigate into that directory with `cd test_program`
 - type in `cargo run`
 - if you see `Hello, world!`, you're ready to go!



3. Development Environment

- Technically it doesn't matter, you could even use Ed, Notepad, Word...



3. Development Environment

- Technically it doesn't matter, you could even use Ed, Notepad, Word...
- There are some IDEs and Editors that make programming [in Rust] easier



3. Development Environment

- Technically it doesn't matter, you could even use Ed, Notepad, Word...
- There are some IDEs and Editors that make programming [in Rust] easier
 - JetBrains RustRover → Free license for students with a TU-email
 - Emacs, Vim → For those who prefer terminal editors
 - Visual Studio Code → What I'll be using



3. Development Environment

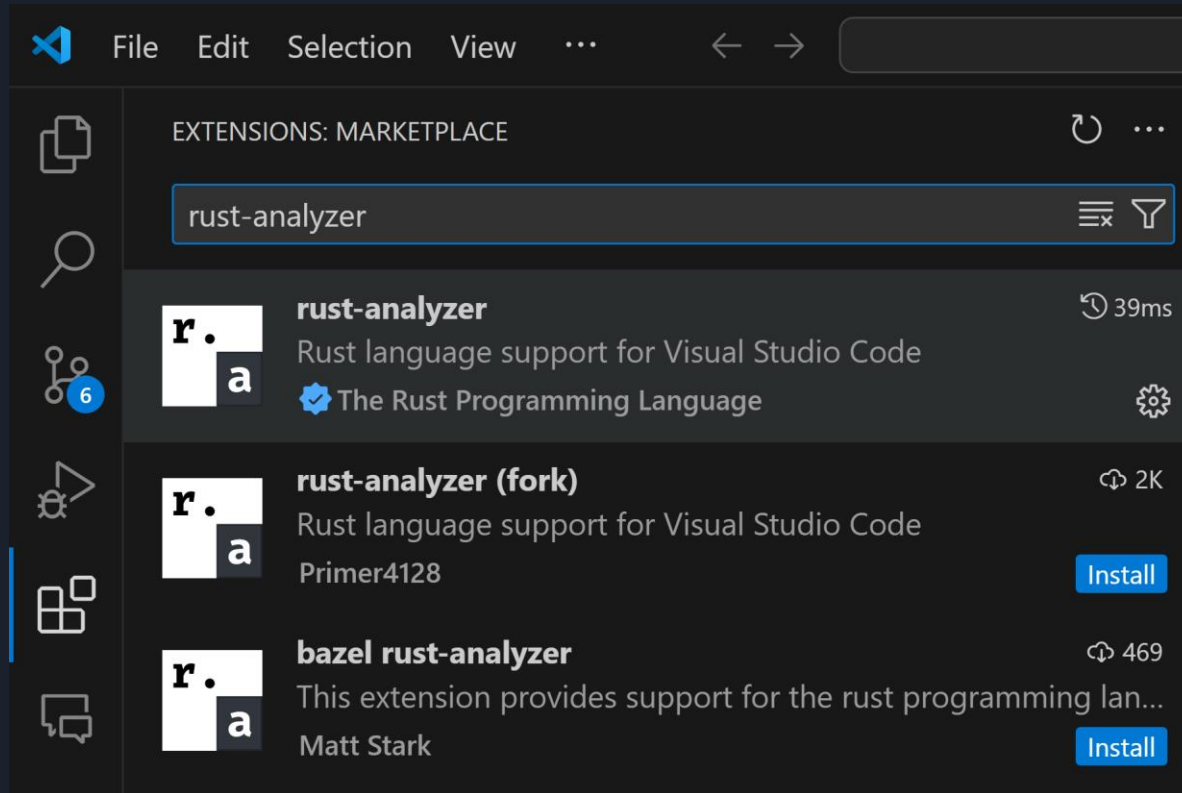
- Technically it doesn't matter, you could even use Ed, Notepad, Word...
- There are some IDEs and Editors that make programming [in Rust] easier
- VSC → <https://code.visualstudio.com/>
 - Windows → Simply follow the Installer
 - Linux → <https://code.visualstudio.com/docs/setup/linux>
 - macOS → <https://code.visualstudio.com/docs/setup/mac>



3. Development Environment

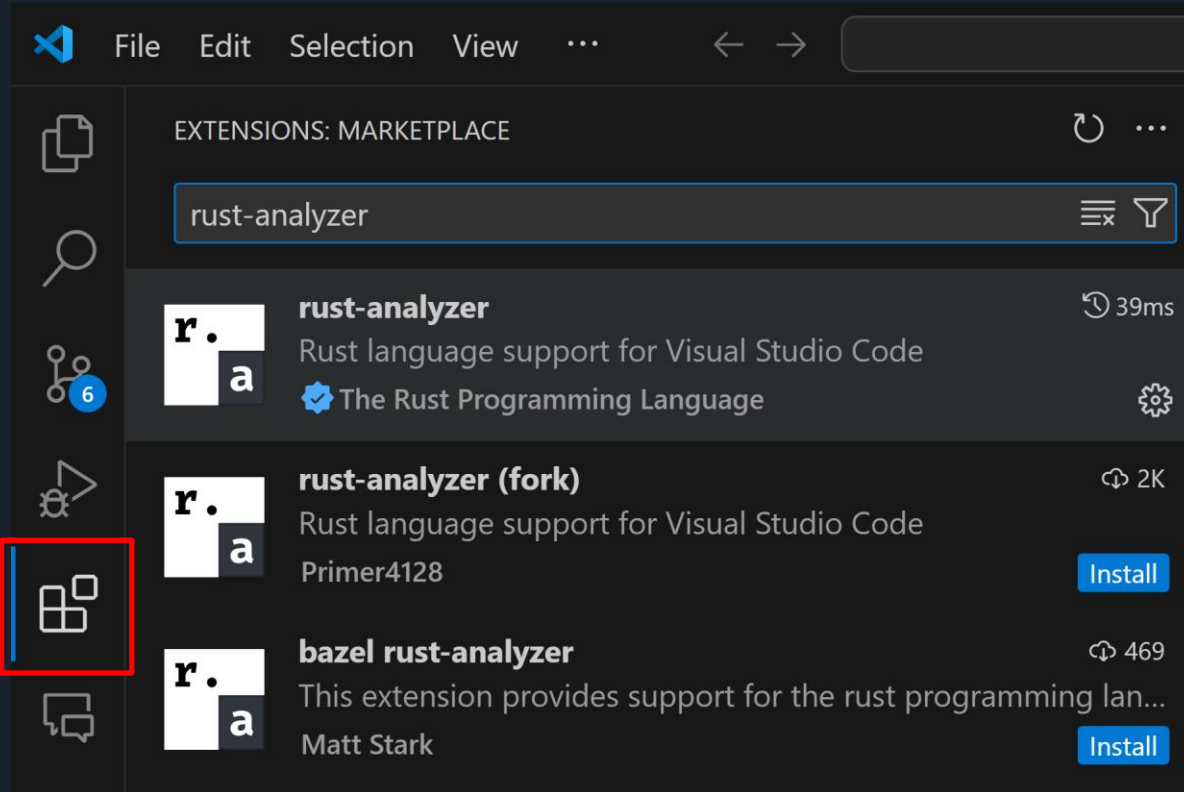
- Visual Studio Code itself does not have builtin Rust-Support, it's just a Text Editor
 - Using plugins and extensions, we can fix that

3. Development Environment



3. Development Environment

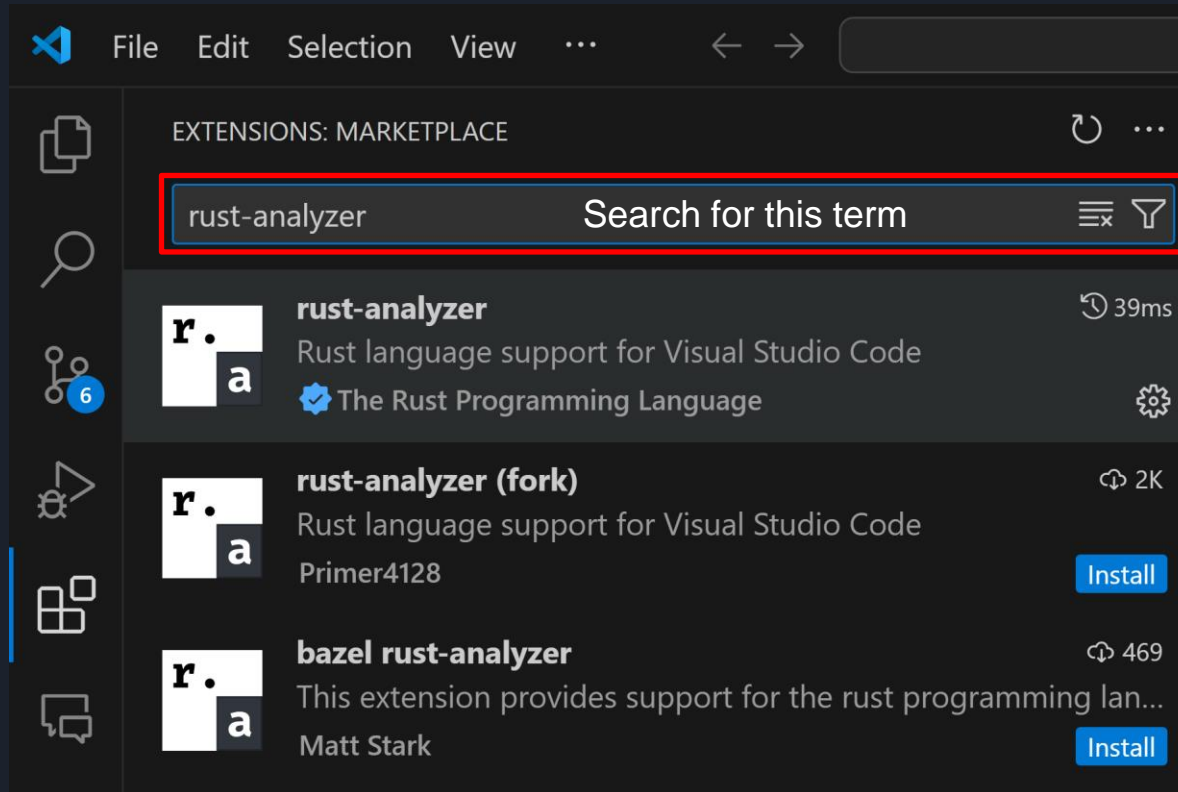
Extensions



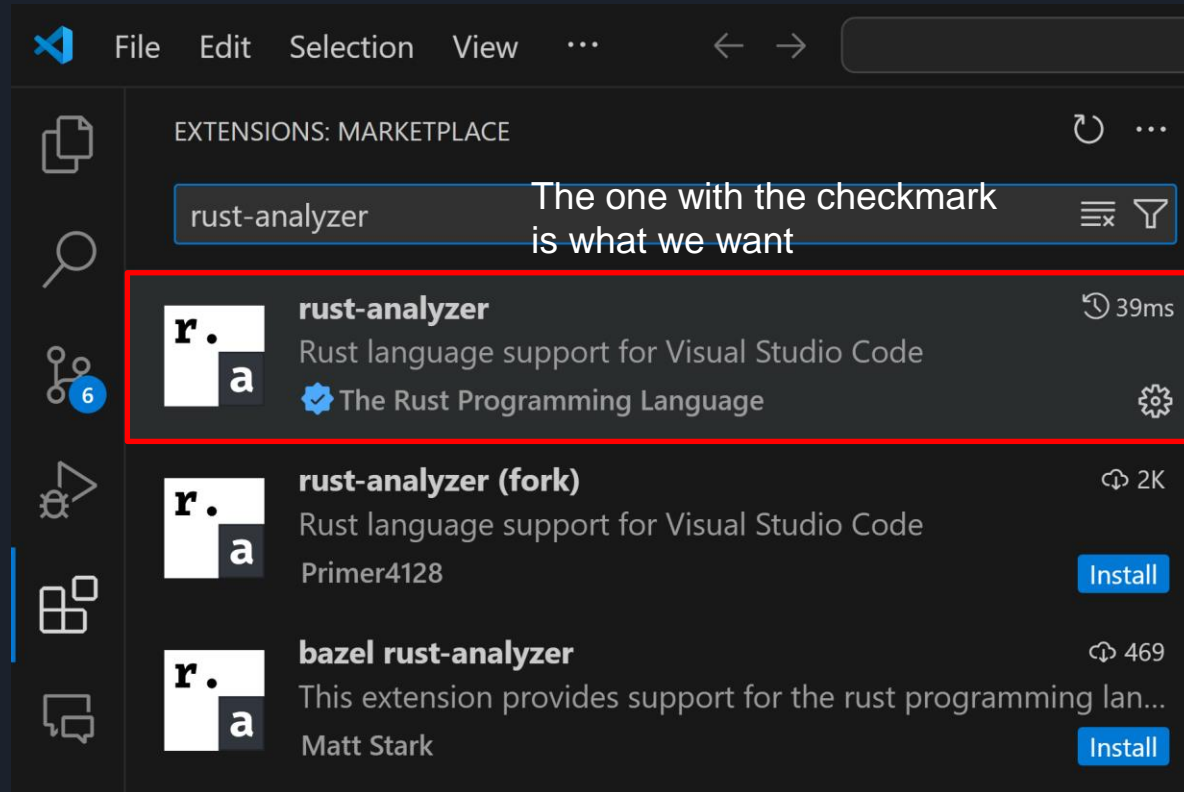
The screenshot shows the Visual Studio Code interface with the 'EXTENSIONS: MARKETPLACE' view. The search bar contains 'rust-analyzer'. The results list three extensions, all featuring the Rust logo (a white 'r' and 'a' on a black square). The first extension, 'rust-analyzer' by 'The Rust Programming Language', is highlighted with a blue background and shows a '39ms' load time. The second extension, 'rust-analyzer (fork)' by 'Primer4128', has a '2K' download count and an 'Install' button. The third extension, 'bazel rust-analyzer' by 'Matt Stark', has a '469' download count and an 'Install' button. On the left sidebar, the 'Extensions' icon (a square with four smaller squares) is highlighted with a red rectangle. The top of the window shows the standard VS Code menu bar (File, Edit, Selection, View, ...) and navigation arrows.

Extension Name	Author	Downloads	Action
rust-analyzer	The Rust Programming Language	39ms	Details
rust-analyzer (fork)	Primer4128	2K	Install
bazel rust-analyzer	Matt Stark	469	Install

3. Development Environment

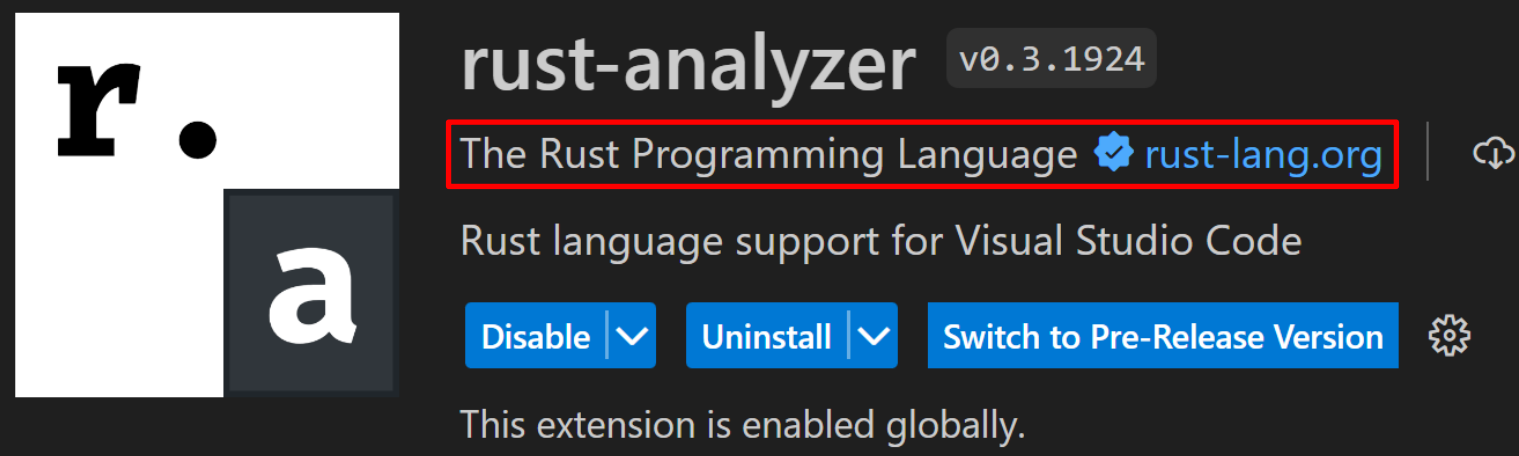


3. Development Environment





3. Development Environment

As extensions can run arbitrary code,
make sure it's the right one :^)




The image shows the Visual Studio Code interface for the 'rust-analyzer' extension. On the left is the extension's logo, which consists of a white square with a black 'r.' and a dark grey square with a white 'a'. To the right of the logo, the text 'rust-analyzer' is displayed in a large, bold, white font, followed by the version number 'v0.3.1924' in a smaller font. Below this, the text 'The Rust Programming Language' is shown in white, followed by a blue checkmark icon and the URL 'rust-lang.org' in blue. This entire line is enclosed in a red rectangular border. To the right of this line is a cloud icon. Below the red-bordered line, the text 'Rust language support for Visual Studio Code' is displayed in white. Underneath this text are three blue buttons: 'Disable' with a downward arrow, 'Uninstall' with a downward arrow, and 'Switch to Pre-Release Version'. To the right of these buttons is a gear icon. At the bottom of the interface, the text 'This extension is enabled globally.' is displayed in white.

rust-analyzer v0.3.1924

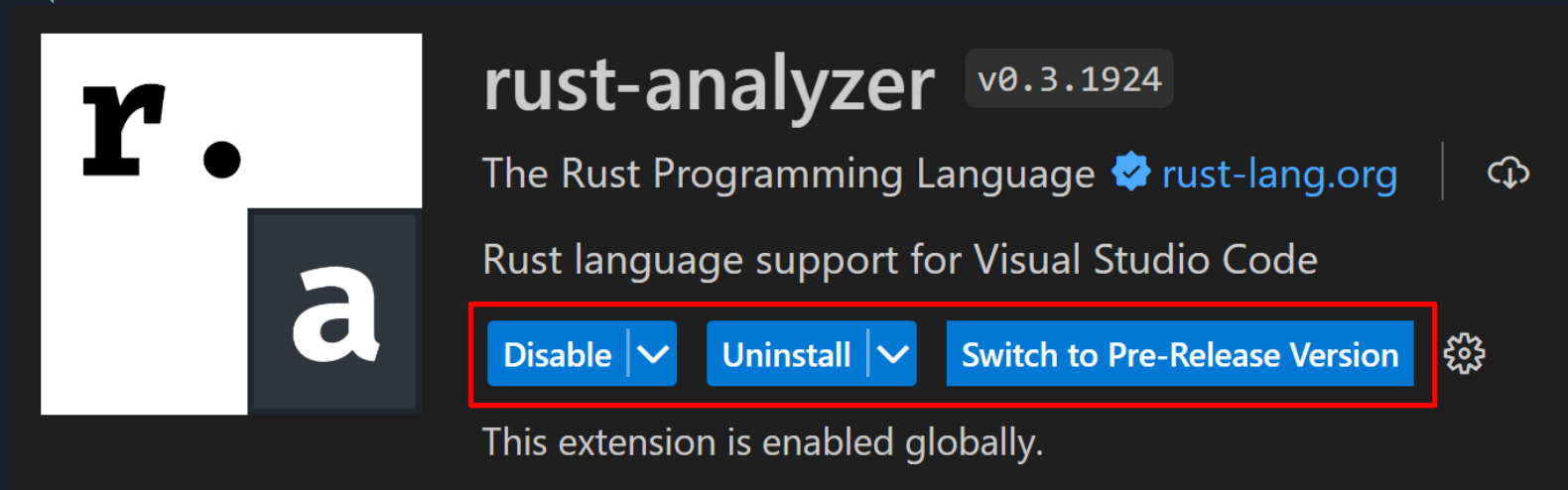
The Rust Programming Language  rust-lang.org | 

Rust language support for Visual Studio Code

[Disable](#) | [Uninstall](#) | [Switch to Pre-Release Version](#) 



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3. Development Environment






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rust-analyzer v0.3.1924

The Rust Programming Language  rust-lang.org | 

Rust language support for Visual Studio Code

Disable |  **Uninstall** |  **Switch to Pre-Release Version** 

This extension is enabled globally.

Somewhere there should be an Install-button
Restart VSC if necessary

3. Development Environment

► Run | Debug

```
fn main() {  
    let a: i32 = 10;  
    let b: &mut i32 = &mut a;  
}
```

cannot mutate immutable
analyzer([E0384](#))

cannot borrow `a` as
declared as mutable
cannot borrow as mutable
[compiler diagnostic](#))

main.rs(17, 9): cannot
borrow as mutable: `mut`

3. Development Environment

We can run our code from within VSC

▶ Run | Debug

```
fn main() {
```

```
    let a: i32 = 10;
```

```
    let b: &mut i32 = &mut a;
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3. Development Environment

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main.rs(17, 9): const
mutable: `mut`

Direct error reporting in our editor,
without compiling ourselves

3. Development Environment

Diagnostics when hovering over the red swiggly lines of death :^)

► Run | Debug

```
fn main() {  
    let a: i32 = 10;  
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main.rs(17, 9): cannot
borrow as mutable
mutable: `mut`



4. General Info

- Slides are available at the mentioned Github repository



4. General Info

- Slides are available at the mentioned Github repository
- I highly recommend using the default `git` way of getting the repository
 - `git` is very important, it's best to start early
 - Because I am still changing slides, regular updates are recommended
 - Initial Step:
 - Go to the Github repository
 - Click the green `Code` button, copy the HTTPS-url to your clipboard
 - Go to a directory of your choice, open the terminal there
 - type in `git clone <paste URL here>`
 - In the future, to get the updated slides:
 - Simply go to that directory (or rather, the `progkurs` directory inside)
 - type in `git pull`
 - You now have access to the current state of all slides and exercises



4. General Info

- Slides are available at the mentioned Github repository
- Every session will be split into three parts
 - Recap of last session
 - New topics
 - Exercises at the end



4. General Info

- Slides are available at the mentioned Github repository
- Every session will be split into three parts
- Exercises and some Code snippets in future slides will be color coded
 - **Green** → 0/3 → We have covered the topic already, should be easy enough
 - **Yellow** → 1/3 → We have just covered the topic, may be hard
 - **Red** → 2/3 → Same as **Yellow**, but trickier
 - **Purple** → 3/3 → We have not covered the topic, but challenges are always fun



4. General Info

- Slides are available at the mentioned Github repository
- Every session will be split into three parts
- Exercises and some Code snippets in future slides will be color coded
- Every session contains a file with exercises called **exercises.md**
 - Exercises will not be fully compared every time
 - Important points will be mentioned in each Recap
 - Example solutions are in a file called **solutions.md**



4. General Info

- Slides are available at the mentioned Github repository
- Every session will be split into three parts
- Exercises and some Code snippets in future slides will be color coded
- Every session contains a file with exercises called **exercises.md**
 - Example solutions are in a file called **solutions.md**
- Participation and Feedback is very important
 - Basic program stands, but my goal is to teach you Rust the best I can
 - Don't understand something? Am I too fast? Did I make any mistakes?
 - Just raise your hand, and we can discuss a topic for a while! ☺



5. Next time

- `rustc` vs `cargo`
- Basic Types
- Variables
- `let` vs `let mut`