Let’s play with Rust: A Friendly Introduction

@rowdymehul

Rowdy::About();

- A student
- Lives in Nashik
- Founder & President at Infinite Defense Foundation(IDF)
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- Rust Mobilizer
- Tech Blogger

Agenda

1. What is Rust?
2. Why should I use Rust?
3. Install Rust with rustup
4. clippy - the popular Rust static analysis tool
5. Cargo - Rust’s awesome package manager
6. rustfmt - the Rust source code formatting tool
7. Play with Rust: A short demo with kits.
8. How to get in touch with the Rust community?
9. Q/A

What is Rust?

(Baby don't hurt me, don't hurt me, no more)

- Rust is a new systems programming language designed for safety, concurrency, and speed.
- It was originally conceived by Graydon Hoare and is now developed by a team in Mozilla Research and the community.
- Multi-paradigm. Functional, imperative, object-oriented, whenever it makes sense.
- Low-level. Targets the same problem-space as C and C++
- Safe. Lovely, lovely types and pointer lifetimes guard against a lot of errors.

Why do we need a new system programming language?

- State or art programming language
- Solves a lot of common system programming bugs
- Cargo : Rust Package manager
- Improving your toolkit
- Self learning
- It's FUN ...

Where can I get it?

- Prebuilt binaries are available at http://www.rust-lang.org/
- Source code is available from GitHub https://github.com/mozilla/rust
- Kits and resources are available from Rust India GitHub https://github.com/RustIndia/Rust

Rust

- System programming language
- Has great control like C/C++
- Safety and expressive like python

Best things about Rust

- Strong type system
  - Reduces a lot of common bugs
- Borrowing and Ownership
  - Memory safety
  - Freedom from data races
- Zero Cost abstraction

Why should I use Rust?

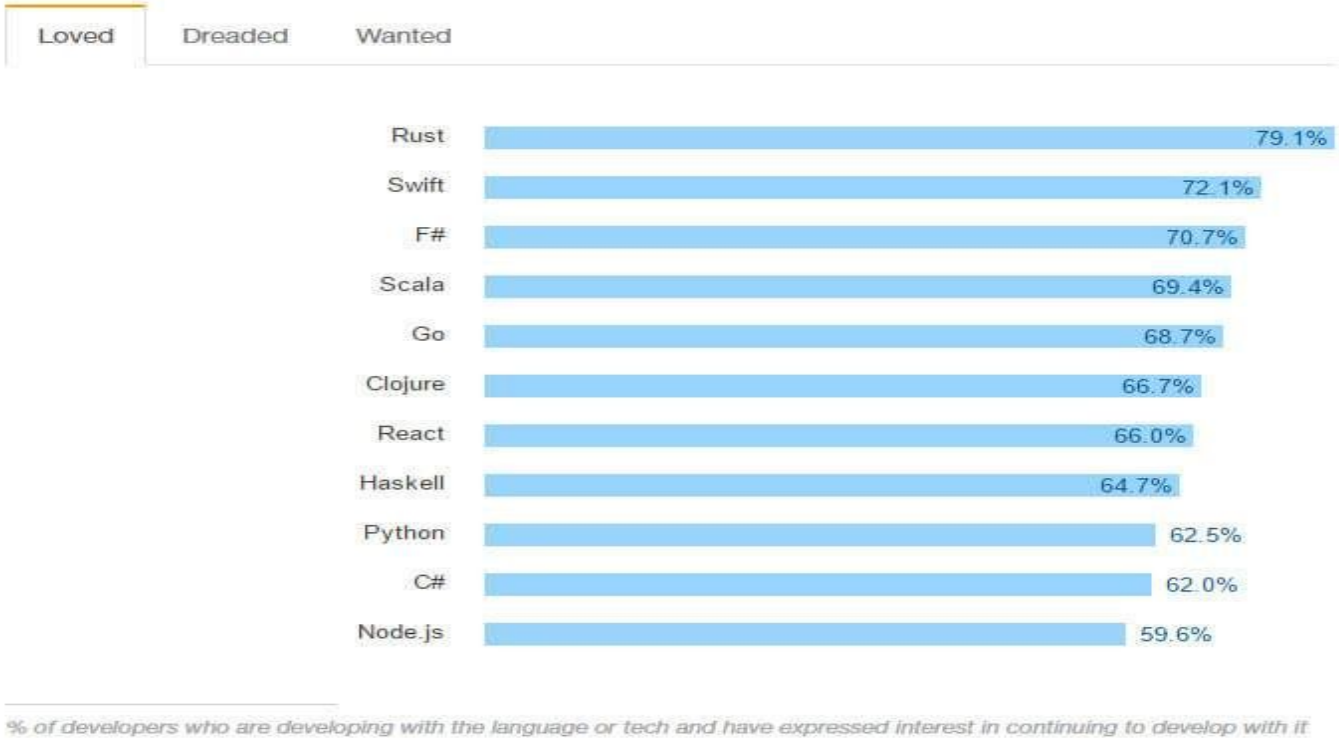
Own Definition :

Rust is a good choice when you’d choose C++. You can also say, “Rust is a systems programming language that pursuing the trifecta: safe, concurrent, and fast.” I would say, Rust is an ownership-oriented programming language.

Firstly, the reason that I've looked into Rust at first.

- Rust is new enough that you can write useful stuff that would have already existed in other languages
- It gives a relatively familiar tool to the modern C++ developers, but in the much more consistent and reliable ways.
- It is low-level enough that you take account of most resources.
- It's more like C++ and Go, less like Node and Ruby
- cargo is awesome. Managing crates just works as intended, which makes a whole lot of troubles you may have in other languages just vanish with a satisfying *poof*.

According to recent The Stack Overflow survey Rust is the most beloved among developers of all programming languages and frameworks.



Credits : https://insights.stackoverflow.com

Install Rust with rustup

Ubuntu / MacOS

- Open your terminal (ctrl + Alt +T)
- curl -sSf https://static.rust-lang.org/rustup.sh | sh

```
1) Proceed with installation (default)
2) Customize installation
3) Cancel installation
1

info: updating existing rustup installation


Rust is installed now. Great!
```

Installing Rust

rustc --version

```
mehul@mehul-Inspiron-3542:~$ rustc --version
rustc 1.11.0 (9b21dcd6a 2016-08-15)
```

cargo --version

Windows

- Go to https://win.rustup.rs/
  - This will download rustup-init.exe
- Double click and start the installation

Cargo, Rust’s Package Manager

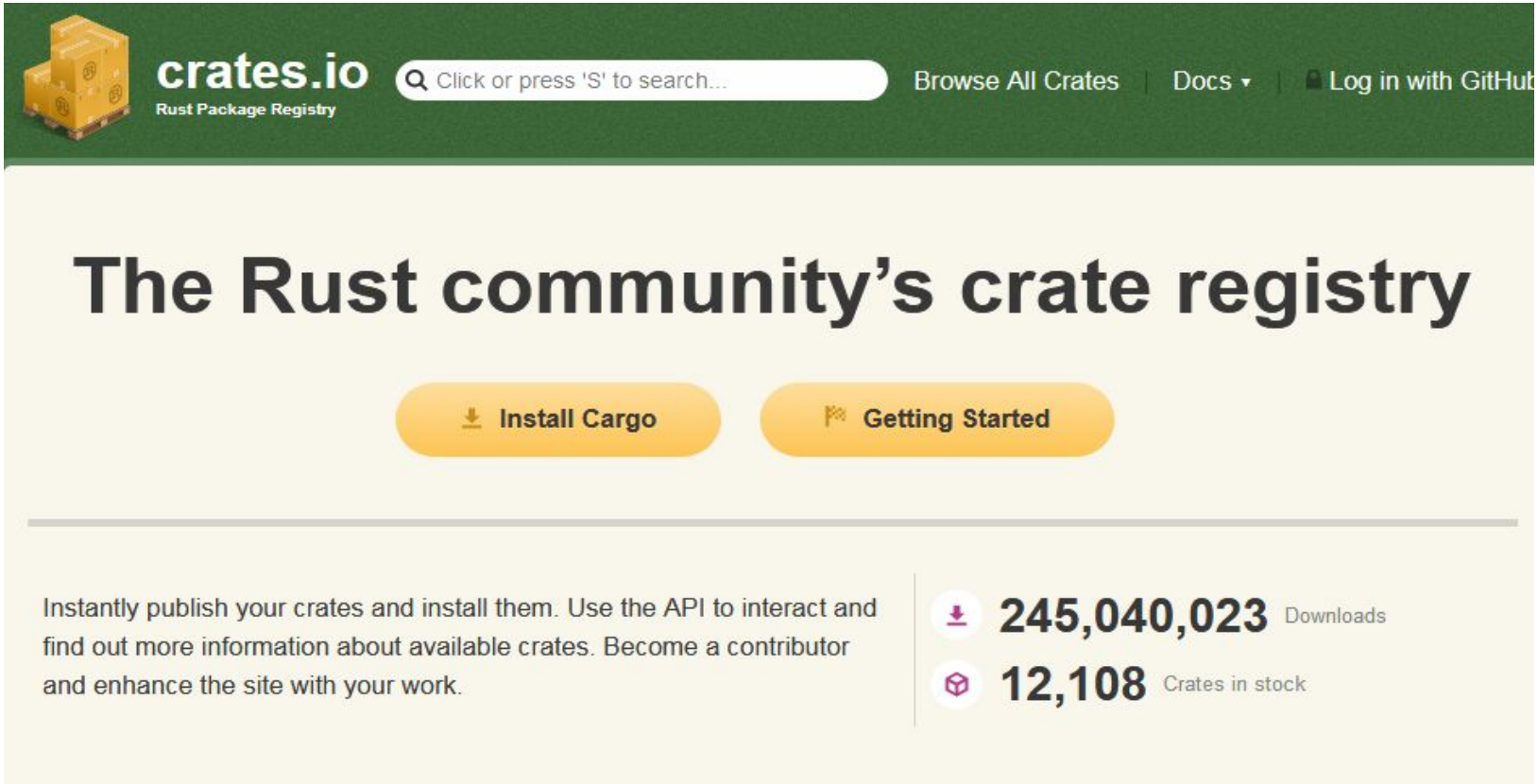
Cargo is a tool that allows Rust projects to declare their various dependencies and ensure that you’ll always get a repeatable build.

To accomplish this goal, Cargo does four things:

- Introduces two metadata files with various bits of project information.
- Fetches and builds your project’s dependencies.
- Invokes rustc or another build tool with the correct parameters to build your project.
- Introduces conventions to make working with Rust projects easier.

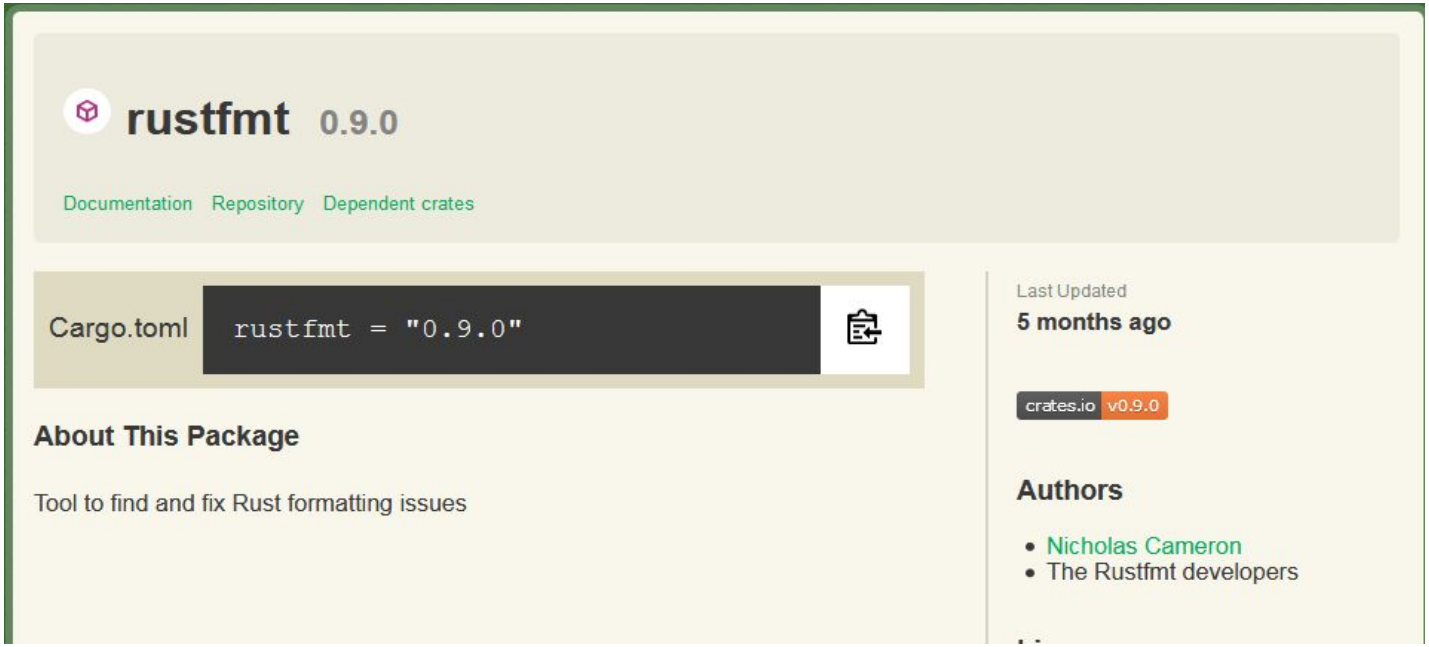
Creating a new project

https://crates.io/



rustfmt

- A tool for formatting Rust code according to style guidelines.



Rust Playground

- A web interface for running Rust code.
- The interface can also be accessed in most Rust-related channels on irc.mozilla.org.
- To use Playbot in a public channel, address your message to it.
  - `<you> playbot: println!("Hello, World");`

    `-playbot:#rust-offtopic- Hello, World`

    `-playbot:#rust-offtopic- ()`

    `<you> playbot: 1+2+3`

    `-playbot:#rust-offtopic- 6`
- You can also private message Playbot your code to have it evaluated. In a private message, don't preface the code with playbot's nickname:
  - `/msg playbot println!("Hello, World");`

Let’s play : https://play.rust-lang.org/

https://play.rust-lang.org

Run ASM LLVM IR MIR Tools Format Clippy Share Mode Debug Release Channel Stable Beta Nightly Config ?

```
fn main() {
    println!("Hello, world!");
}
```

Execution Close

Standard Error

```
Compiling playground v0.0.1 (file:///playground)
 Finished dev [unoptimized + debuginfo] target(s) in 0.45 secs
  Running `target/debug/playground`
```

Standard Output

```
Hello, world!
```

Type System

The traditional Hello World

```
fn main() {
   let greet = “world”;
    println!("Hello {}!”, greet);
}
```

A bit complex example

```
fn avg(list: &[f64]) -> f64 {
    let mut total = 0;
    for el in list{
        total += *el;
    }
    total/list.len() as f64
}
```

HLL version

```
fn avg(list: &[f64]) -> f64 {
    list.iter().sum::<f64>() / list.len() as f64
}
```

Parallel Version (Rayon)

```
fn avg(list: &[f64]) -> f64 {
    list.par_iter().sum::<f64>() / list.len() as f64
}
```

Fold

```
fn avg(list: &[f64]) -> f64 {
    list.par_iter().fold(0., |a,b| a + b) / list.len() as f64
}
```

Primitive Types

bool

```
let bool_val: bool = true;

println!("Bool value is {}", bool_val);
```

char

```
let x_char: char = 'a';

// Printing the character

println!("x char is {}", x_char);
```

i8/i16/i32/i64/isize

```
let num =10;

println!("Num is {}", num);

let age: i32 =40;

println!("Age is {}", age);

println!("Max i32 {}",i32::MAX);

println!("Max i32 {}",i32::MIN);
```

Other Primitive Types

- u8/u16/u32/u64/usize
- f32/f64

Tuples

```
// Declaring a tuple

let rand_tuple = ("Mozilla Science Lab", 2016);

let rand_tuple2 : (&str, i8) = ("Viki",4);

// tuple operations

println!(" Name : {}", rand_tuple2.0);

println!(" Lucky no : {}", rand_tuple2.1);
```

Arrays

```
let rand_array = [1,2,3]; // Defining an array

println!("random array {:?}",rand_array );

println!("random array 1st element {}",rand_array[0] ); // indexing starts with 0

println!("random array length {}",rand_array.len() );

println!("random array {:?}",&rand_array[1..3] ); // last two elements
```

String

```
let rand_string = "I love Mozilla Science <3"; // declaring a random string

println!("length of the string is {}",rand_string.len() ); // printing the length of the string

let (first,second) = rand_string.split_at(7); // Splits in string


let count = rand_string.chars().count(); // Count using iterator count
```

Complex Data structures

struct

```
// define your custom user datatype

struct Circle {

    x : f64,

    radius : f64,

}
```

Rust “Class”

```
impl Circle {

// pub makes this function public which makes it accessible outsite the scope {}

    pub fn get_x(&self) -> f64 {

        self.x

    }

}
```

Traits

- Interfaces
- Operator overloading
- Indicators of behaviour
- Bounds for generic
- Dynamic dispatch

Trait Sample

```
// create a functionality for the datatypes

trait  HasArea {

        fn area(&self) -> f64;

}

// implement area for circle

impl HasArea for Circle {

        fn area(&self) -> f64 {

                3.14 * (self.r *self.r)

        }

}
```

Ownership

In Rust, every value has an “owning scope,” and passing or returning a value means transferring ownership (“moving” it) to a new scope

```rust
fn make_vec() {
    let mut vec = Vec::new(); // owned by make_vec's scope
    vec.push(0);
    vec.push(1);
    // scope ends, `vec` is destroyed
}
```

Example 1

```
fn foo{
    let v = vec![1,2,3];
    let x = v;
    println!("{:?}",v); // ERROR : use of moved value: "v"
}
```

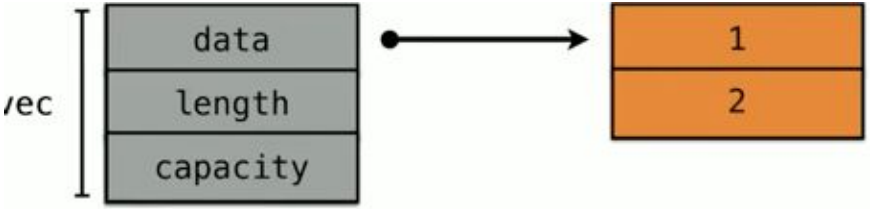
Ownership - Ex 2

```rust
fn make_vec() -> Vec<i32> {
    let mut vec = Vec::new();
    vec.push(0);
    vec.push(1);
    vec // transfer ownership to the caller
}

fn print_vec(vec: Vec<i32>) {
    // the `vec` parameter is part of this scope, so it's owned by `print_vec`

    for i in vec.iter() {
        println!("{}", i)
    }

    // now, `vec` is deallocated
}

fn use_vec() {
    let vec = make_vec(); // take ownership of the vector
    print_vec(vec);       // pass ownership to `print_vec`
}
```

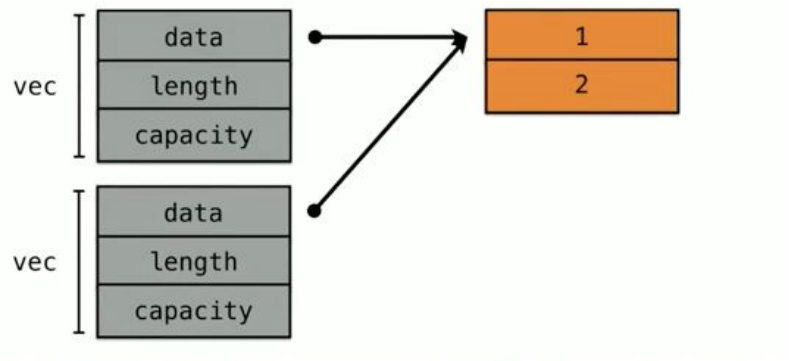
```
fn print(v : Vec<u32>) {
    println!("{:?}", v);
}
fn make_vec() {
    let v = vec![1,2,3];
    print(v);
    print(v); // ERROR : use of moved value: "v"
}
```

Ownership

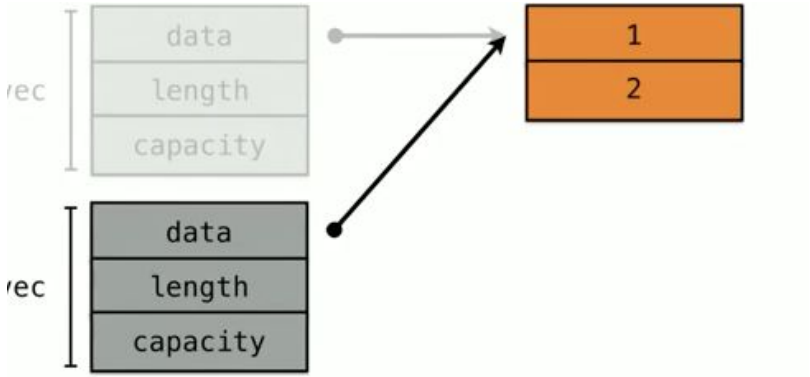
Step 1.



Step 2.

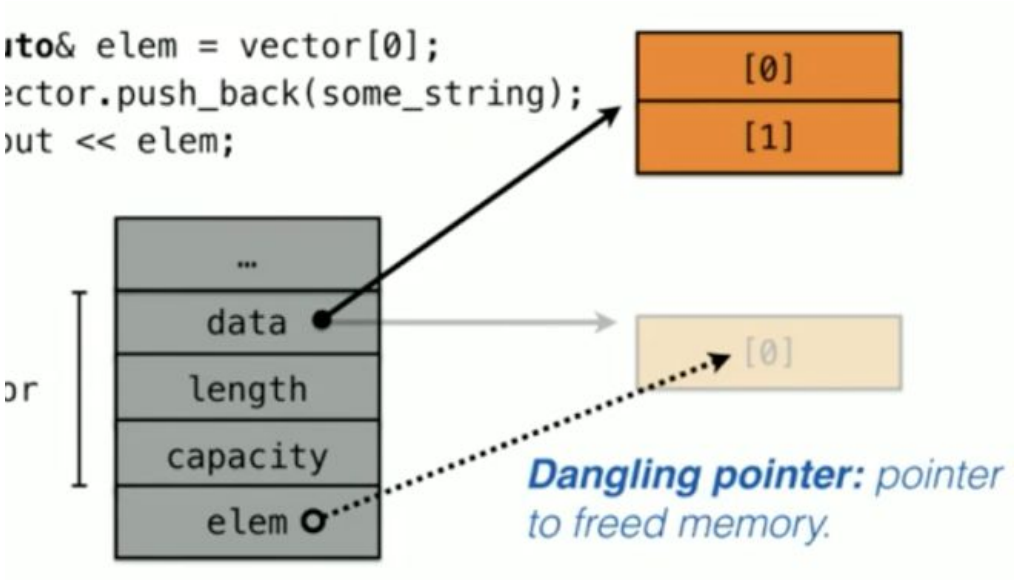


Step 3.



Aliasing

More than one pointer to the same memory



<u>Ownership concepts avoids Aliasing</u>

Borrowing

If you have access to a value in Rust, you can lend out that access to the functions you call

```rust
fn print_vec(vec: &Vec<i32>) {
    // the `vec` parameter is borrowed for this scope

    for i in vec.iter() {
        println!("{}", i)
    }

    // now, the borrow ends
}

fn use_vec() {
    let vec = make_vec();  // take ownership of the vector
    print_vec(&vec);       // lend access to `print_vec`
    for i in vec.iter() {  // continue using `vec`
        println!("{}", i * 2)
    }
    // vec is destroyed here
}
```

Types of Borrowing

There is two type of borrowing in Rust, both the cases aliasing and mutation do not happen simultaneously

- Shared Borrowing (&T)
- Mutable Borrow (&mut T)

&mut T

```
fn  add_one(v: &mut Vec<u32> ) {
        v.push(1)
}
fn foo() {
let mut v = Vec![1,2,3];
add_one(&mut v);
}
```

Rules of Borrowing

- Mutable borrows are exclusive
- Cannot outlive the object being borrowed

Cannot outlive the object being borrowed

```
fn foo{

let mut v = vec![1,2,3];

let borrow1 = &v;

let borrow2 = &v;

add_one(&mut v): // ERROR : cannot borrow ‘v’ as mutuable because

}                                it is also borrowed as immutable
```

Lifetimes

```
let outer;
{
    let v = 1;
    outer = &v; // ERROR: ‘v’ doesn’t live long
}
println!(“{}”, outer);
```

Rain Of Rust - A Global Rust Campaign

Key stats of RainOfRust campaign June 2017:

- 21 offline events across 10 regions globally. Ref
- 4 online meeting which is recorded in Air Mozilla. Ref
- As part of the campaign the RainOfRust has Rust teaching kits which currently has 3 application-oriented activities
- The Github repo has received more than 500+ views in the within a week, Read more

Rain Of Rust - Glimpses

Rain Of Rust - Glimpses

Let’s Meet Friends of Rust!!

(Organizations running Rust in production)

Getting started with Rust community

- Follow all the latest news at Reddit Channel
  - https://www.reddit.com/r/rust/
- Have doubts, post in
  - https://users.rust-lang.org
  - #rust IRC channel
- Want to publish a crate,
  - https://crates.io
- Follow @rustlang in twitter,
  - https://twitter.com/rustlang
- Subscribe to https://this-week-in-rust.org/ newsletter

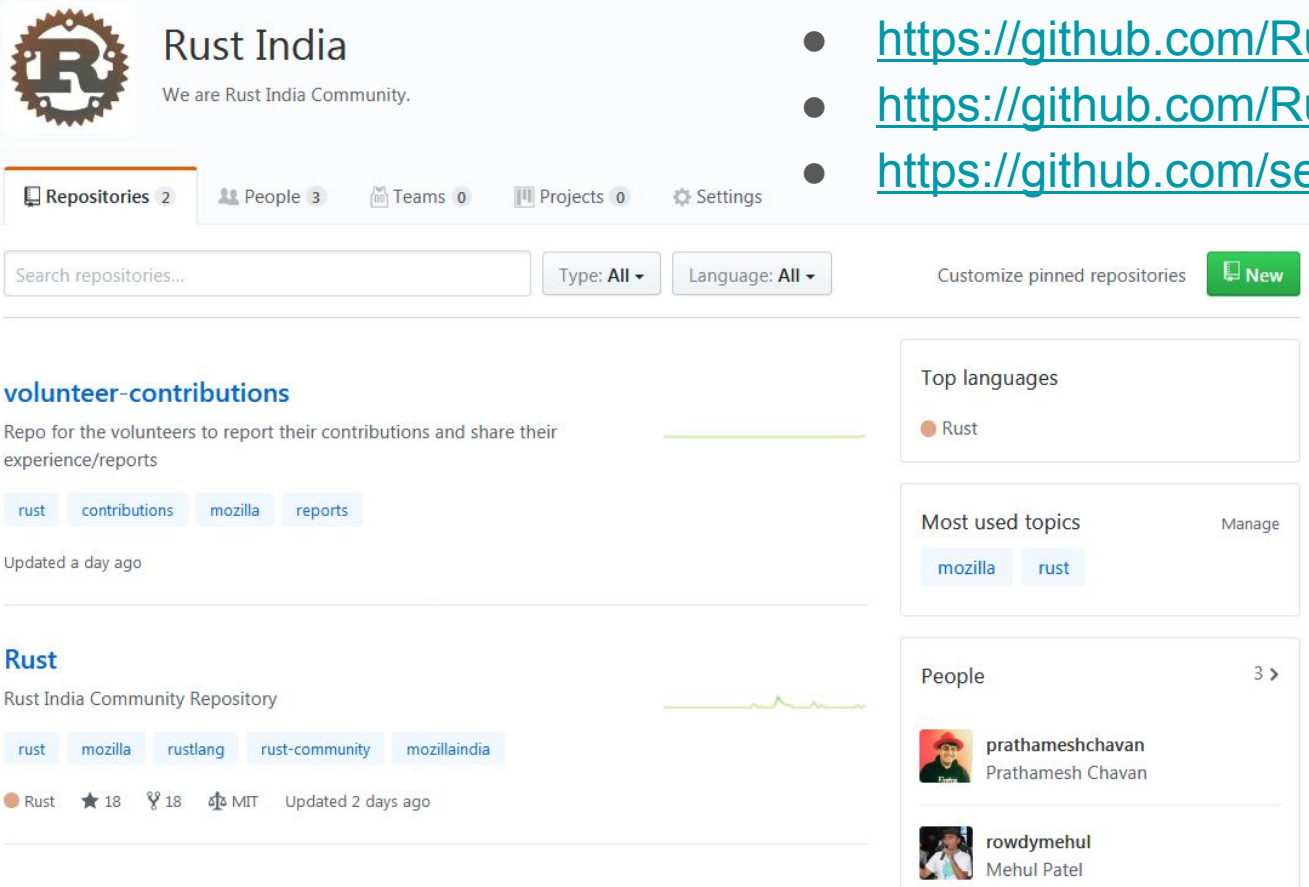
Getting started with Rust community

- Create your rustaceans profile,
  - Fork https://github.com/nrc/rustaceans.org
  - Create a file in data directory with <github_id>.json
    - Ex: rowdymehul.json

```
{
    "name": "Mehul Patel",
    "irc": "rowdymehul",
    "irc_channels": ["rust"],
    "show_avatar": true,
    "email": "iamrowdymehul@gmail.com",
    "discourse": "rowdymehul",
    "reddit": "rowdymehul",
    "twitter": "@rowdymehul",
    "blog": "https://rowdymehul.wordpress.com/",
    "notes": "OpenSource Enthusiast"
}
```

Adopt Rust today !!

Contribute & Join Rust India!



- https://github.com/RustIndia/
- https://github.com/RustIndia/Rust
- https://github.com/servo

Rust and the Future of Systems Programming

Presentation Finished.

Any questions?

References

- Segfault: http://stackoverflow.com/questions/2346806/what-is-a-segmentation-fault
- BufferOverFlow: http://stackoverflow.com/questions/574159/what-is-a-buffer-overflow-and-how-do-i-cause-one
- Rust Website: https://www.rust-lang.org/en-US/
- Community Forum: https://users.rust-lang.org/
- Rust Book: https://doc.rust-lang.org/book/
- Why should I use Rust? https://medium.com/@rowdymehul/31bc292923da
- Unraveling Rust Design: https://dvigneshwer.wordpress.com/2017/02/25/unraveling-rust-design/

Thank You

- Tweet at #RustIndia #RustLang
- Join RustIndia Telegram group