Rust Fundamentals

Basics of Rust
Part IV

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RustCourse
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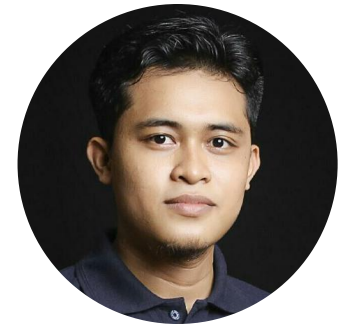

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Open sourceror. Namely Rust, Python, and Emacs.

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Course. Not talk!

Follow along!

- Rust Playground
- Exercises

▶ Show hints

Structs

```
struct Person {
    name: String,
    age: u8,
}

fn main() {
    let mut peter = Person {
        name: String::from("Peter"),
        age: 27,
    };
    println!("{} is {} years old", peter.name, peter.age);

    peter.age = 28;
    println!("{} is {} years old", peter.name, peter.age);
```

- Unlike tuple, nordered field.
- Unlike tuple, Each piece of filed must have a name.
- Add more meaning to the data. No need to remember tuple number.

Field Init Shorthand

```
fn build_user(email: String, username: String) → User {
    User {
        active: true,
-        username: username,
-        email: email,
+        username,
+        email,
        sign_in_count: 1,
    }
}
```

- If parameter names and the struct field names are exactly the same.
- Less boilerplate.

Struct Update Syntax

```
fn main() {
    let user2 = User {
        email: String::from("another@example.com"),
        ..user1
    };
}
```

- ... specifies that the remaining fields should have the same value as the fields in the given instance.
- struct update syntax uses `=` like an assignment; it moves the data.

Tuple Structs

```
struct Color(i32, i32, i32);
struct Point(i32, i32, i32);

fn main() {
    let black = Color(0, 0, 0);
    let origin = Point(0, 0, 0);
}
```

- If naming each field as in a regular struct would be verbose or redundant.
- Give the whole tuple a name.

Newtypes

```
struct PoundsOfForce(f64);

fn compute_thruster_force() → PoundsOfForce {
    todo!("Ask a rocket scientist at NASA")
}

fn main() {
    let force = compute_thruster_force();
}
```

- Encode additional information about the value in a primitive
- `PhoneNumber(String)` ensures the value is pre-validated, eliminating the need for validation on each use.

Unit-Like Structs Without Any Fields

```
struct AlwaysEqual;

fn main() {
    let subject = AlwaysEqual;
}
```

- Useful when working with traits.

Constructors

```
#[derive(Debug)]
struct Person {
    name: String,
    age: u8,
}

impl Person {
    fn new(name: String, age: u8) -> Person {
        // Some input processing and validation here.
        Person { name, age }
    }
}

fn main() {
    let bilbo = Person::new("Bilbo".to_string(), 27);
    println!("{bilbo:?}"); // debug print
}
```

```
impl Person {
-    fn new(name: String, age: u8) → Person {
+    fn new(name: String, age: u8) → Self {
        Person { name, age }
    }
}
```

- `new()` is just a convention.
- `Self` is alias of current struct name.
- Less code to refactor.

```rust
struct Person {
    name: String,
    age: u8,
}

impl Person {
    fn new(name: String, age: u8) -> Self {
        Person { name, age }
    }
    fn bot(name: String) -> Person {
        Person { name, age: 0 }
    }
}
```

- Multiple constructor is possible.
- Multiple impl Blocks is possible.

Default values

```
impl Default for Person {
    fn default() → Self {
        Self {
            name: "Bot".to_string(),
            age: 0,
        }
    }
}

fn main() {
    let person: Person = Default::default();
}
```

Enums

```
enum IpAddr {
    V4(String),
    V6(String),
}

let home = IpAddr::V4("127.0.0.1".to_string());
let loopback = IpAddr::V6("::1".to_string());
```

- Collect set of values under one type.
- Any IP address can be either a V4 or V6, **but not both at the same time.**
- The name of each enum variant also becomes a function that constructs an instance of the enum.
- Methods on enums is possible (just like struct).

Variant Payloads

```
enum Message {
    Quit,
    Move { x: i32, y: i32 },
    Write(String),
    ChangeColor(i32, i32, i32),
}
```

- We can put data directly into each enum variant.
- Each variant can have different types and amounts of associated data (More flexible than struct).

Option and Result

```
enum Option<T> {
    Some(T),
    None
}
```

```
enum Result<T, E> {
    Ok(T),
    Err(E)
}
```

- The `Option<T>` enum and its variants are so useful that it's even included in the prelude.
- The compiler won't let us use an `Option<T>` value as if it were definitely a valid value.

Methods

```rust
struct Person {
    name: String,
}

impl Person {
    fn say_hello(&self) {
        println!("Hello, my name is {}", self.name);
    }
}

fn main() {
    let peter = Person {
        name: String::from("Peter"),
    };
    peter.say_hello();
}
```

- `self` represents the instance of the struct the method is being called on.
- It's very rare to use `self`. `&self` is more common.
- it is `self: Self` under the hood.
- Method receiver: `&self`, `&mut self`, `self`, `mut self`.

Pattern Matching

```
fn main() {
    let input = 'x';

    match input {
        'q'                   ⇒ println!("Quitting"),
        'a' | 's' | 'w' | 'd' ⇒ println!("Moving around"),
        '0'..='9'             ⇒ println!("Number input"),
        _                     ⇒ println!("Something else"), // Catch-All Patterns (must be last!)
    }
}
```

- Think of a match expression as being like a coin-sorting machine.
- `if` expression needs to return a Boolean value, `match` can return any type.
- An arm has two parts: a pattern and some code.
- Matches Are Exhaustive: the arms' patterns must cover all possibilities.

Destructuring Enums

```
enum Result {
    Ok(i32),
    Err(String),
}

fn divide_in_two(n: i32) -> Result {
    if n % 2 == 0 {
        Result::Ok(n / 2)
    } else {
        Result::Err(format!("cannot divide {n} into two equal parts"))
    }
}

fn main() {
    let n = 100;

    match divide_in_two(n) {
        Result::Ok(half) => println!("{n} divided in two is {half}"),
        Result::Err(msg) => println!("sorry, an error happened: {msg}"),
    }
```

Destructuring Structs

```
struct Foo {
    x: (u32, u32),
    y: u32,
}

#[rustfmt::skip]
fn main() {
    let foo = Foo { x: (1, 2), y: 3 };

    match foo {
        Foo { x: (1, b), y } => println!("x.0 = 1, b = {b}, y = {y}"),
        Foo { y: 2, x: i }   => println!("y = 2, x = {i:?}"),
        Foo { y, .. }        => println!("y = {y}, other fields were ignored"),
    }
}
```

- Can bind to the parts of the values.

Destructuring Arrays

```
#[rustfmt::skip]
fn main() {
    let triple = [0, -2, 3];
    println!("Tell me about {triple:?}");

    match triple {
        [0, y, z] ⇒ println!("First is 0, y = {y}, and z = {z}"),
        [1, ..]   ⇒ println!("First is 1 and the rest were ignored"),
        _         ⇒ println!("All elements were ignored"),
    }
}
```

Match Guards

```
#[rustfmt::skip]
fn main() {
    let pair = (2, -2);
    println!("Tell me about {pair:?}");

    match pair {
        (x, y) if x == y     => println!("These are twins"),
        (x, y) if x + y == 0 => println!("Antimatter, kaboom!"),
        (x, _) if x % 2 == 1 => println!("The first one is odd"),
        _                    => println!("No correlation..."),
    }
}
```

`if let` expressions

```
let config_max = Some(3u8);
if let Some(max) = config_max {
    println!("The maximum is configured to be {max}");
}
```

```
let config_max = Some(3u8);
match config_max {
    Some(max) ⇒ println!("The maximum is configured to be {max}"),
    _ ⇒ (),
}
```

- Get rid of `_ ⇒ ()`
- A less verbose way to handle values that match one pattern while ignoring the rest.
- Lose the exhaustive checking that match enforces.
- Can have `else`.

`while let` expressions

```
fn main() {
    let v = vec![10, 20, 30];
    let mut iter = v.into_iter();

    while let Some(x) = iter.next() {
        println!("x: {x}");
    }
}
```

Credits 🌟

- Mo's (mo8it) Comprehensive Rust 🦀
- rustlings 🦀