COMP6991 23T3

Rust Basics

Live Example

HELLO, WORLD!

Live Example

LINES

let statements

> BINDINGS

> MUTABILITY

> SHADOWING

> ASIDE: CONSTANTS

Basic types

> INTEGER TYPES (FIXED, ARCH)

> FLOATING POINT TYPES

> BOOLEAN

> CHARACTER

Compound types

> TUPLES, ARRAYS

> STRUCTS, ENUMS

> ASIDE: PERVASIVE MUTABILITY

> ASIDE: UNIT

Expression vs Statement

> VALUE PRODUCTION

> IMPLICATIONS ON NESTING

> ITEM DECLARATIONS

> LET STATEMENTS

> EXPRESSION STATEMENTS

Functions

> PARAMETERS

> RETURN VALUES

> EARLY-RETURN

> EXPRESSION-RETURN

If expressions

> BRANCHING

> WHAT IS A VALID CONDITION?

> AS AN EXPRESSION

> TERNARY IF?

Looping

> LOOP

> WHILE

> FOR

> EARLY TERMINATION

> LOOP BREAK VALUE

Ownership

e.g. String, Vec

> ONE OWNER

> TRANSFER OF OWNERSHIP (MOVE)

> DROP (VS GC? RC?)

> ESCAPE HATCH: CLONE

Copy

e.g. `i32`, `bool`, `char`

> DOES NOT FOLLOW OWNERSHIP

> VALUE SEMANTICS

> SIMPLE SCALAR TYPES

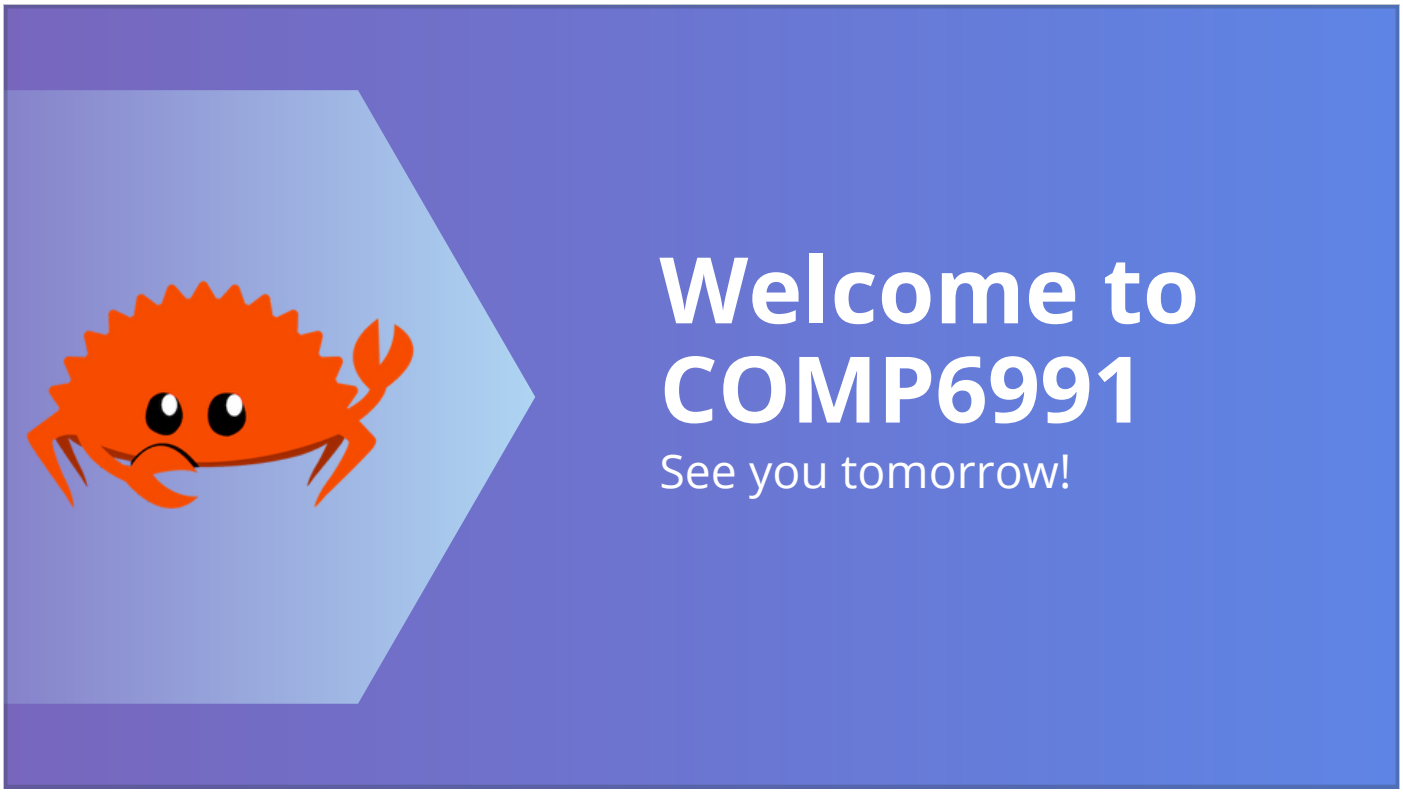
> TUPLES? ARRAYS?

> STRUCTS? ENUMS?

Ownership x fn

> PASSING OWNERSHIP INTO A FN

> OWNERSHIP OUT OF A FN


Welcome to
COMP6991
See you tomorrow!

Match

> PATTERN MATCHING

> EXHAUSTIVENESS

> CATCH-ALL

> EXAMPLE: MATCH OPTION<T>

> EXAMPLE: MATCH RESULT<T, E>

Live Example

OPTIONAL VALUES

Rust
Option<T>

NON-MAGIC TYPE

NO IMPLICIT NULLABILITY

NO IMPLICIT UNWRAPPING

UNWRAP NONE => UNWIND

C

```
<type> *
```

COMPILER BUILT-IN (MAGIC)

IMPLICIT POINTER NULLABILITY

UNWRAP ON * AND ->

DEREFENCE NULL => UB

ROBUST PROGRAMS MUST BE DEFENSIVE!

C++17
`std::optional<T>`

- SIMILAR TO RUST OPTION
- NON-MAGIC TYPE
- IMPLICIT POINTER NULLABILITY
- UNWRAP NULLOPT => UB

Java
Optional<T>

SIMILAR TO RUST OPTION

NON-MAGIC TYPE

IMPLICIT OBJECT NULLABILITY

UNWRAP EMPTY => UNWIND

OPTIONAL<T> CAN BE NULL!

Golang
`* <type>`

SIMILAR TO C

COMPILER BUILT-IN (MAGIC)

IMPLICIT POINTER NULLABILITY

DEREFERENCE NULL => CRASH

USING POINTERS CAN BE PAINFUL

Python
None

ANY VALUE IN PYTHON CAN BE NONE

IMPLICIT UNWRAP EVERYWHERE

UNWRAP NONE => UNWIND

LIFE ON THE EDGE!

Question

WHAT DOES AN "OPTIONAL VALUE" EVEN REPRESENT?

This function may not produce an output

```
fn string_to_int(string: &str) -> Option<i32> {
    // ...
}
```

This function may not require an input

```
fn int_to_string(int: i32, base: Option<u32>) -> String {
    // ...
}
```

This type may not hold some data

```
struct Student {
    zid: u32,
    name: String,
    wam: Option<f64>,
}
```

Question

HOW DOES LANGUAGE DESIGN MAKE WRITING ROBUST PROGRAMS EASIER?

Tony Hoare's billion dollar mistake

“I call it my billion-dollar mistake. It was the invention of the null reference in 1965. At that time, I was designing the first comprehensive type system for references in an object oriented language (ALGOL W). My goal was to ensure that all use of references should be absolutely safe, with checking performed automatically by the compiler. But I couldn't resist the temptation to put in a null reference, simply because it was so easy to implement. This has led to innumerable errors, vulnerabilities, and system crashes, which have probably caused a billion dollars of pain and damage in the last forty years.”

Watch talk on InfoQ

Hope you enjoy(ed) workshop 1!

See you next week!