COMP6991 23T1

Unsafe Rust

Recap:
Memory safety

What if we *need* low-level access?

Unsafe Rust

Building blocks of unsafe Rust

> The `unsafe` keyword

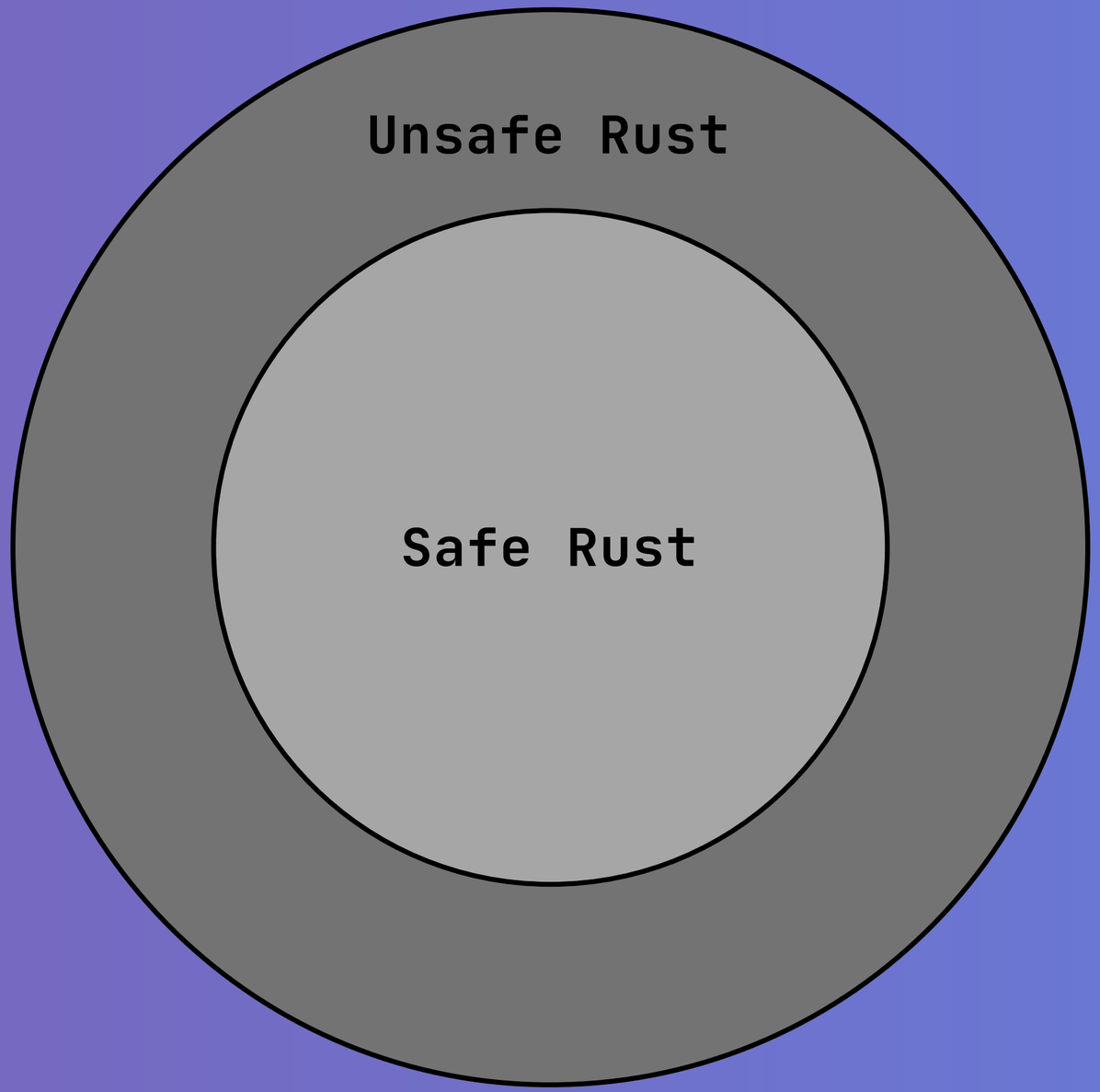
> *const T, *mut T

> std::ptr::*

> std::alloc::*

> std::ffi::*

> (sometimes) `PhantomData`



Why segment the language?

The advantages of safe Rust

i.e. restricting the language

> Memory safe by default!

> No undefined behaviour

> A relative low complexity

> Quality diagnostics

> Optimisation

The advantages of unsafe Rust

i.e. wizardly powers

> Low-level control

> Raw system access

> Fine-grained optimisation in pathological cases

> Reasoning that the compiler cannot

The disadvantages of safe Rust

i.e. restricting the language

> Not flexible enough for all use cases

> e.g. not many would write a (kernel) device driver in Python

The disadvantages of unsafe Rust

i.e. wizardly powers

> Threatens most advantages of safe Rust
> e.g.
  > Memory unsafety
  > Undefined behaviour
> Very high complexity

Maintain guarantees of safe Rust…

…without limiting language capability?

Unsafe implementations behind safe abstractions

Safe Rust code

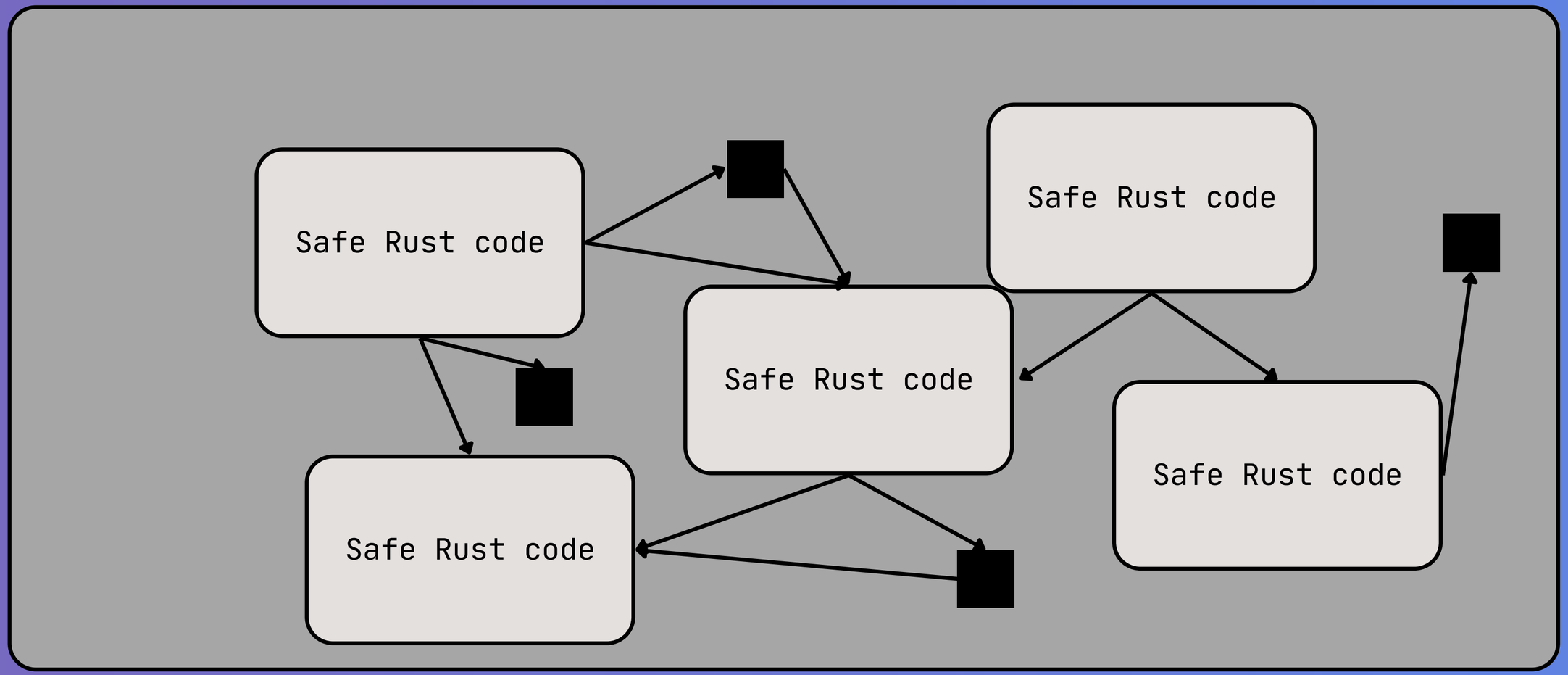
Cover

Safety checks pass!
> type inference
> type checking
> trait solving
> borrowck
> etc.

Safety checks fail!

Give diagnostic to user

Anatomy of a Rust program



Inside the black box

Unsafe superpowers

1. Dereference raw pointers
2. Call unsafe functions
3. Implement unsafe traits

4. Read/write a mutable or external static variable (???)
5. Accessing a field of a union, other than to assign to it (???)

With great power comes great responsibility

https://doc.rust-lang.org/reference/behavior-considered-undefined.html

Aside: UB in C

https://blog.regehr.org/archives/1520

http://www.open-std.org/jtc1/sc22/wg14/www/docs/n1548.pdf#page=571

Tomorrow

Let's make a (usually sound) Vec!

Checking unsafe code

> Miri
  > https://github.com/rust-lang/miri

> Sanitizers
  > https://doc.rust-lang.org/nightly/unstable-book/compiler-flags/sanitizer.html

> With concurrency: Loom
  > https://docs.rs/loom/latest/loom/