

Products

How can pass a reference to a stack variable to a thread?

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48



I'm writing a WebSocket server where a web client connects to play chess against a multithreaded computer AI. The WebSocket server wants to pass a Logger object into the AI code. The Logger object is going to pipe down log lines from the AI to the web client. The Logger must contain a reference to the client connection.

I'm confused about how lifetimes interact with threads. I've reproduced the problem with a Wrapper struct parameterized by a type. The run_thread function tries to unwrap the value and log it.

```
use std::fint::Debug;
use std::thread;
struct Wrapper<T: Debug> {
    val: T,
    }
fin run_thread<T: Debug>(wrapper: Wrapper<T>) {
    let thr = thread::spawn(move | {
        println!(" {?}}", wrapper.val);
    });
    thr.join();
}
fin main() {
    run_thread(Wrapper::<i32> { val: -1 });
}
```

The wrapper argument lives on the stack, and its lifetime doesn't extend past run_thread 's stack frame, even though the thread will be joined before the stack frame ends. I'd could copy the value off the stack:

```
use std::fnr::Debug;
use std::thread;
struct Wrapper<T: Debug + Send> {
    val: T,
}
fn run_thread<T: Debug + Send + 'static>(wrapper: Wrapper<T>) {
    let thr = thread::spawn(move || {
        println!("{:?}", wrapper.val);
    });
    thr.join();
}
fn main() {
    run_thread(Wrapper::<i32> { val: -1 });
}
```

This will not work if $\ T$ is a reference to a big object I don't want copied:

```
use std::fnt::Debug;
use std::thread;
struct Wrapper<T: Debug + Send> {
    val: T,
}
fn run_thread<T: Debug + Send + 'static>(wrapper: Wrapper<T>) {
    let thr = thread::spawn(move || {
        println!(" {:?}", wrapper.val);
    });
    thr.join();
}
fn main() {
    let mut v = Vec::new();
    for i in 0.1000 {
        v.push(i);
    }
    run_thread(Wrapper { val: &v });
}
```

Which results in:

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The only solution I can think of is to use an Arc .

```
use std::fnt::Debug;
use std::sync::Arc;
use std::thread;
struct Wrapper<T: Debug + Send + Sync + 'static> {
    are_val: Arc<T>,
}

fn run_thread<T: Debug + Send + Sync + 'static> (wrapper: &Wrapper<T>) {
    let are_val = wrapper.are_val.clone();
    let thre thread::spawn(move || {
        println!("{:?}", *are_val);
    });

    thr.join();
}

fn main() {
    let mut v = Vec::new();
    for in 0.1000 {
        v.push(i);
    }

    let w = Wrapper { are_val: Arc::new(v) };
    run_thread(&w);
    println!("{}",(*w.are_val)[0]);
}
```

In my real program, it appears that both the Logger and the connection object must be placed in Arc wrappers. It seems annoying that the client is required to box the connection in an Arc when it is internal to the library that the code is parallelized. This is especially annoying because the lifetime of the connection is guaranteed to be greater than the lifetime of the worker threads.

Have I missed something?



The thread support in the standard library allows the created threads to outlive the thread that created them; that's a good thing! However, if you were to pass a reference to a stack-allocated variable to one of these threads, there's no guarantee that the variable will still be valid by the time the thread executes. In other languages, this would allow the thread to access invalid memory, creating a pile of memory safety issues.

Fortunately, we aren't limited to the standard library. At least two crates provide scoped threads — threads that are guaranteed to exit before a certain scope ends. These can ensure that stack variables will be available for the entire duration of the thread:

- crossbean
- <u>scoped-threadpool</u> (legacy)

There are also crates that abstract away the low-level details of "threads" but allow you to accomplish your goals:

• <u>rayon</u>

Here are examples of each. Each example spawns a number of threads and mutates a local vector in place with no locking, no Arc, and no cloning. Note that the mutation has a sleep call to help verify that the calls are happening in parallel.

You can extend the examples to share a reference to any type which implements Sync, such as a Mutex or an Atomic*. Using these would introduce locking, however.

crossbeam

```
use crossbeam; // 0.6.0
    use std::{thread, time::Duration};
    fn main() {
        let mut vec = vec![1, 2, 3, 4, 5];
        crossbeam:scope(|scope|\ \{
             for e in &mut vec {
                 scope.spawn(move [ ] {
                     thread::sleep(Duration::from_secs(1));
         });
}
        })
        .expect("A child thread panicked");
       println!(" {:?}", vec);
rayon
    use rayon::iter::{IntoParallelRefMutIterator, ParallelIterator}; // 1.0.3
   use std::{thread, time::Duration};
   fn main() {
        let mut vec = vec![1, 2, 3, 4, 5];
        vec.par\_iter\_mut().for\_each(|e|\ \{
            thread::sleep(Duration::from_secs(1));
             *e += 1;
   println!("{:?}", vec);
    the client is required to box the connection in an Arc when it is internal to the library that the code is parallelized
Perhaps you can hide your parallelism better then? Could you accept the logger and then wrap it in an Are / Mutex before handing it off to your threads?
Share
Improve this answer
 edited May 25 at 13:17
  answered Sep 24 '15 at 1:26
     Shepmaster
    305k • 59 • 824 • 1083
 Thanks \ so \ much \ for \ your \ reply! \ My \ solution \ was \ to \ make \ the \ Logger \ implement \ Clone \ , and \ have \ a \ field \ with \ type \ Arc<Mutex<Connection>> . Then \ the \ user \ could \ pass \ a \ clone \ of \ the \ logger \ implement \ Clone \ , and \ have \ a \ field \ with \ type \ Arc<Mutex<Connection>> . Then \ the \ user \ could \ pass \ a \ clone \ of \ the \ logger \ field \ with \ type \ Arc<Mutex<Connection>> . Then \ the \ user \ could \ pass \ a \ clone \ of \ the \ logger \ field \ with \ type \ Arc<Mutex<Connection>> . Then \ the \ user \ could \ pass \ a \ clone \ of \ the \ logger \ field \ with \ type \ Arc<Mutex<Connection>> . Then \ the \ user \ could \ pass \ a \ clone \ of \ the \ logger \ field \ pass \ field \ with \ type \ Arc<Mutex<Connection>> . Then \ the \ user \ could \ pass \ a \ clone \ of \ the \ logger \ field \ pass \ pass \ field \ pass \
 to the threaded code. The user can't transfer ownership of the Connection to the threaded code (the user needs it for other purposes), so I don't see that it is possible for the threaded code to
 conveniently do the Arc and boxing on behalf of the user.

    Ned Ruggeri

  Sep 24 '15 at 22:38
 What do you do if the variable you are trying to pass around can't implement Clone/Copy? like a USB device handle from the rusb crate
 @BrandonRos Vec doesn't implement Copy and Clone isn't used in these code examples. The code presented here works fine for such types.
  - Shepmaster
 Jul 3 '20 at 14:30
Your Answer
   Post Your Answer
By clicking "Post Your Answer", you agree to our terms of service, privacy policy and cookie policy
Not the answer you're looking for? Browse other questions tagged multithreading rust reference lifetime or ask your own question.
    The Overflow Blog
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