Thread pools and iterators

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About

Timetable

- now => Talk
- 20:00 => Questions
- 20:10 => Happy hacking
- 21:00 => Closing
- tomorrow => ???
- the day after => Parallelize the World!

About:me

Hi my name is Stefan and I do Computer Science.

I organze

- RustFest.eu Paris: Tentatively May 26th & 27th (but don't book yet!) with impldays (around the weekend)
- Meetups in and around Zürich
- Illuminox.ch (Swiss alps in July 2018)

Some of my side projects

- rust threadpool
- Son of Grid Engine (SGE) interface
- run your own infrastructure - DNS, VPN, Web, ...

What we will learn tonight

- The different modes of execution
- Single vs. Multi Threading
- How to synchronize pools
- How to translate linear code into parallel code

Modes of execution

Programming is ...

... about solving problems

Examples:

- Copy data
- Enhance audio
- Distribute messages
- Store data
- Prepare thumbnails

Key is understanding the problem

Single thread

How to do more than one thing at the time?

- Linear if tasks are short enough
- Polling
- Event driven (select/epoll)
- Hardware SIMD

Multi Threading

Let's add another level of abstraction

- spawn / join: handle lists of JoinHandles
- pools
  - job queue (the one we look at)
  - Workstealing (rayon)
  - futures

New problems: synchronization and communication

Implementation

Send and Sync

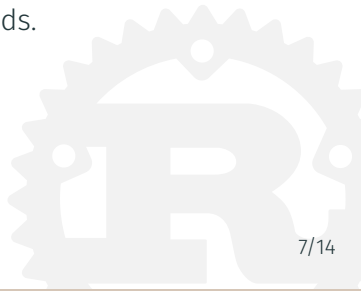
Rusts ”pick three” (safety, speed, concurrency)

`Trait std::marker::Send`

Types that can be transferred across thread boundaries.

`Trait std::marker::Sync`

Types for which it is safe to share references between threads.



Crates

Let's add another level of abstraction

- spawn / join: handle lists of JoinHandles
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New problems: synchronization and communication

Examples

Channel

```
use threadpool::ThreadPool; use std::sync::mpsc::channel;

let n_workers = 4; let n_jobs = 8;
let pool = ThreadPool::new(n_workers);

let (tx, rx) = channel();
for _ in 0..n_jobs {
    let tx = tx.clone();
    pool.execute(move || {
        tx.send(1).expect("channel will be there");
    });
}
drop(tx);

assert_eq!(rx.iter().take(n_jobs).fold(0, |a, b| a + b), 8);
```

Code to iterators

Collect from channnel

v_len stores how many elements

```
for _ in 0..v_len {
  if let Some(pi) = rx.recv().unwrap() {
    g.pictures.push( pi );
  } else {
    // Abort because of some error in the thread
    return;
  }
}
```

Collect from channnel

```
for pi in rx.iter() {
  if let Some(pi) = pi {
    g.pictures.push( pi );
  } else {
    // Abort because of some error in the thread
    return;
  }
}
```

Collect from channnel

```
rx.iter().for_each(|pi| {
  if let Some(pi) = pi {
    g.pictures.push( pi );
  } else {
    // Abort because of some error in the thread
    return;
  }
});
```

Collect from channnel

```
g.pictures = rx.iter().map(|pi| {
  if let Some(pi) = pi {
    Ok( pi )
  } else {
    // Abort because of some error in the thread
    Err( () )
  }
}).collect::<Result<Vec<PictureInfo>, ()>>().unwrap();
```

Some pitfalls

TcpStream with SGE array jobs

Question: How many connections will each client open

```
peer_streams = map.values()
    .filter(|s| s.is_some())
    .map(|s| s.unwrap())
    .map(|(addr, data_port)|
        TcpStream::connect(
            SocketAddr::new(addr, data_port)))
    .filter(|s| s.is_ok())
    .map(|s| s.unwrap())
    .collect();
```

Questions (max 10min)

Workshop time

Thank you for your attention!

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Happy hacking! Please ask questions!

Slides: `https://github.com/dns2utf8/thread-pools-and-iterators`