Intro to Rust

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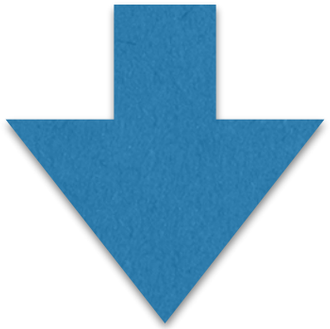
Agenda

- Guessing game - max 1 hr
- Ownership - min 40 min
- Announcements - 5 min

Setup

- rust somewhere around 1.10.0
- cargo (should come with rust)
- terminal
- your favorite text editor
- internet

```
$ cd ~/wherever-you-want
$ cargo new guessing_game --bin
$ cd guessing_game
$ cargo run
```



```
 Compiling guessing_game v0.1.0
   (file:///wherever-you-want/guessing_game)
     Running `target/debug/guessing_game`
Hello, world!
```

Guessing Game

Demo

Generate

- Random number

Input

- Guesses from the user

Output

- Correct
- Secret number is higher
- Secret number is lower

Let’s code!

```
int getRandomNumber()
{
    return 4;  // chosen by fair dice roll.
               // guaranteed to be random.
}
```


MATH IS HARD
LET'S GO SHOPPING!
quickmeme.com

https://crates.io

Search

CARGO

Search

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The Rust community's crate host

Install Cargo

Getting Started

Instantly publish your crates and install them. Use the API to interact and find out more information about available crates. Become a contributor and enhance the site with your work.

56,629,401 Downloads

5,498 Crates in stock

New Crates

- quantum (0.1.0)
- appdirs (0.1.0)

Most Downloaded

- libc (0.2.14)
- winapi (0.2.8)

Just Updated

- json (0.10.0)
- engine-io (0.1.2)

What you learned

- Output values
- Input from stdin
- Var bindings
- Mutability
- Using a crate
- match
- Result
- parse
- loop
- break

Ownership

Memory management

Java

Java

C

C

C

Common memory errors

- Use after free
- Double free
- Null pointers
- Memory leak

string literal:

```
let s = "hello";
```

`String`:

```
let s = String::from("hello");
```

```
fn main() {

}
```

```rust
fn main() {

    let s1 = String::from(
        "hello"
    );

}
```

```rust
println!("s1 is {}", s1);
fn main() {
    println!("s1 is {}", s1);
    let s1 = String::from(
        "hello"
    );
    println!("s1 is {}", s1);
}
println!("s1 is {}", s1);
```

```rust
fn main() {

    let s1 = String::from(
        "hello"
    );
    println!("s1 is {}", s1);
}
```

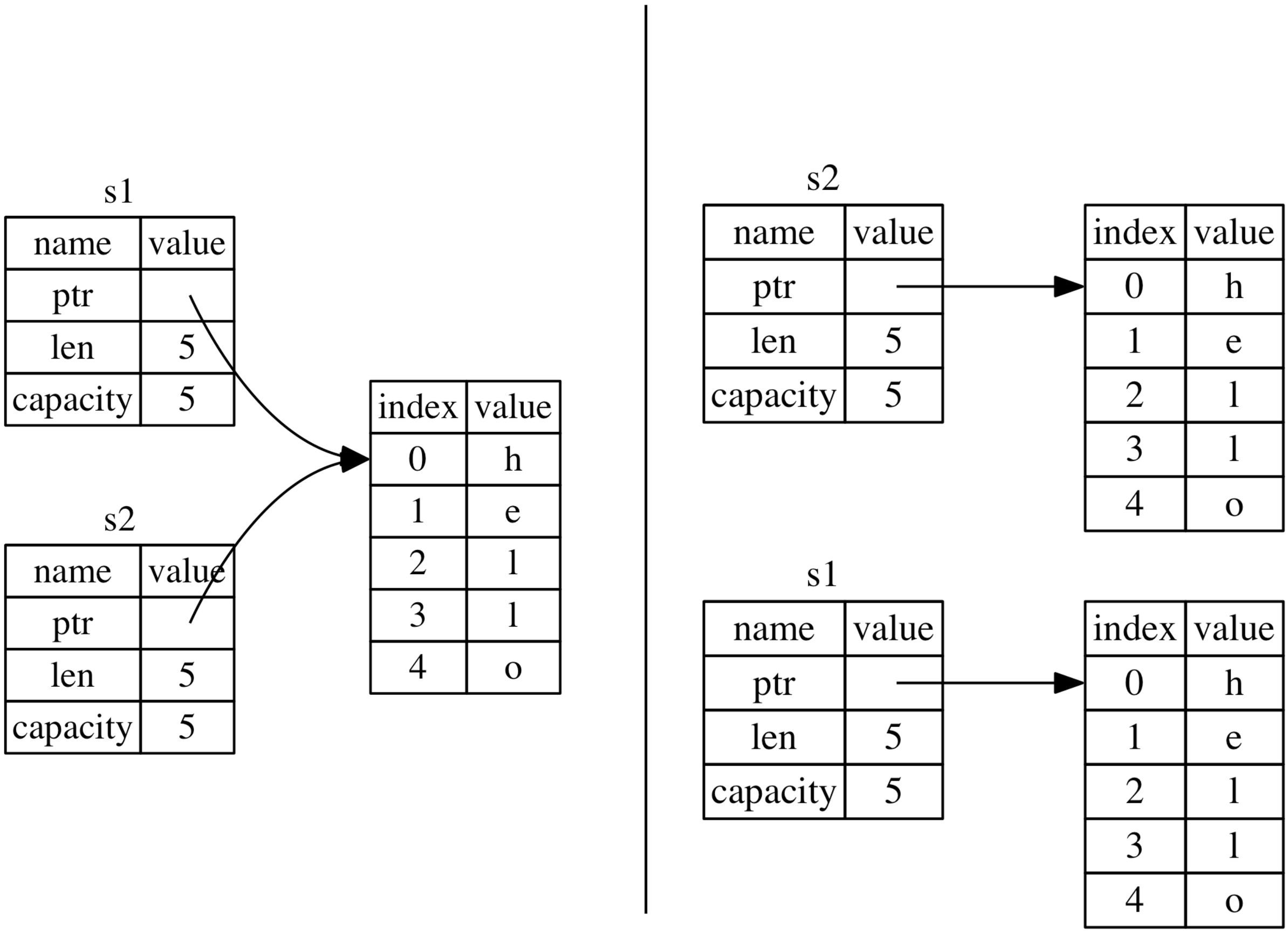
```
fn main() {

    let s1 = String::from(
        "hello"
    );
    println!("s1 is {}", s1);
}
```

s1

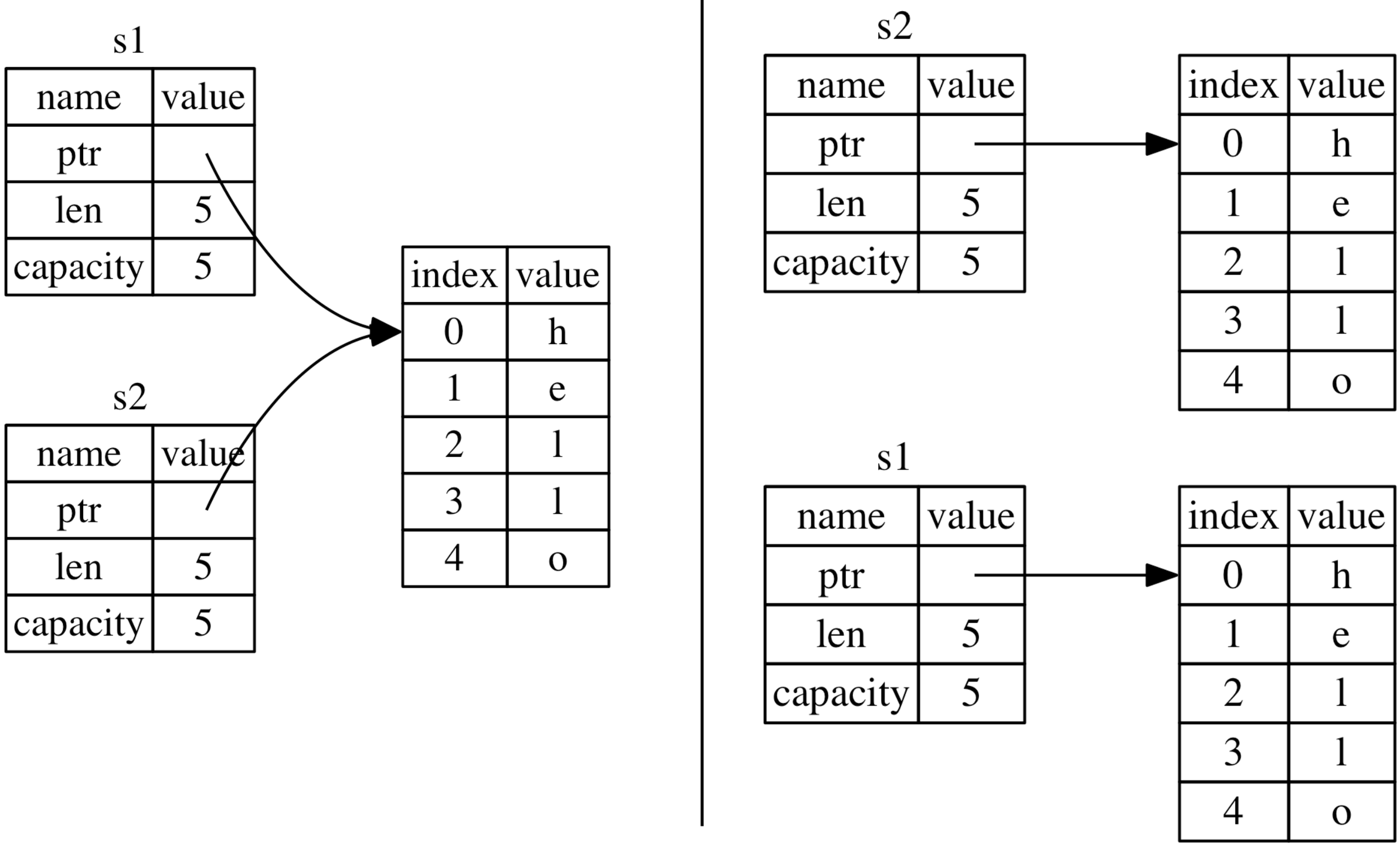
name	value
ptr	
len	5
capacity	5

index	value
0	h
1	e
2	l
3	l
4	o

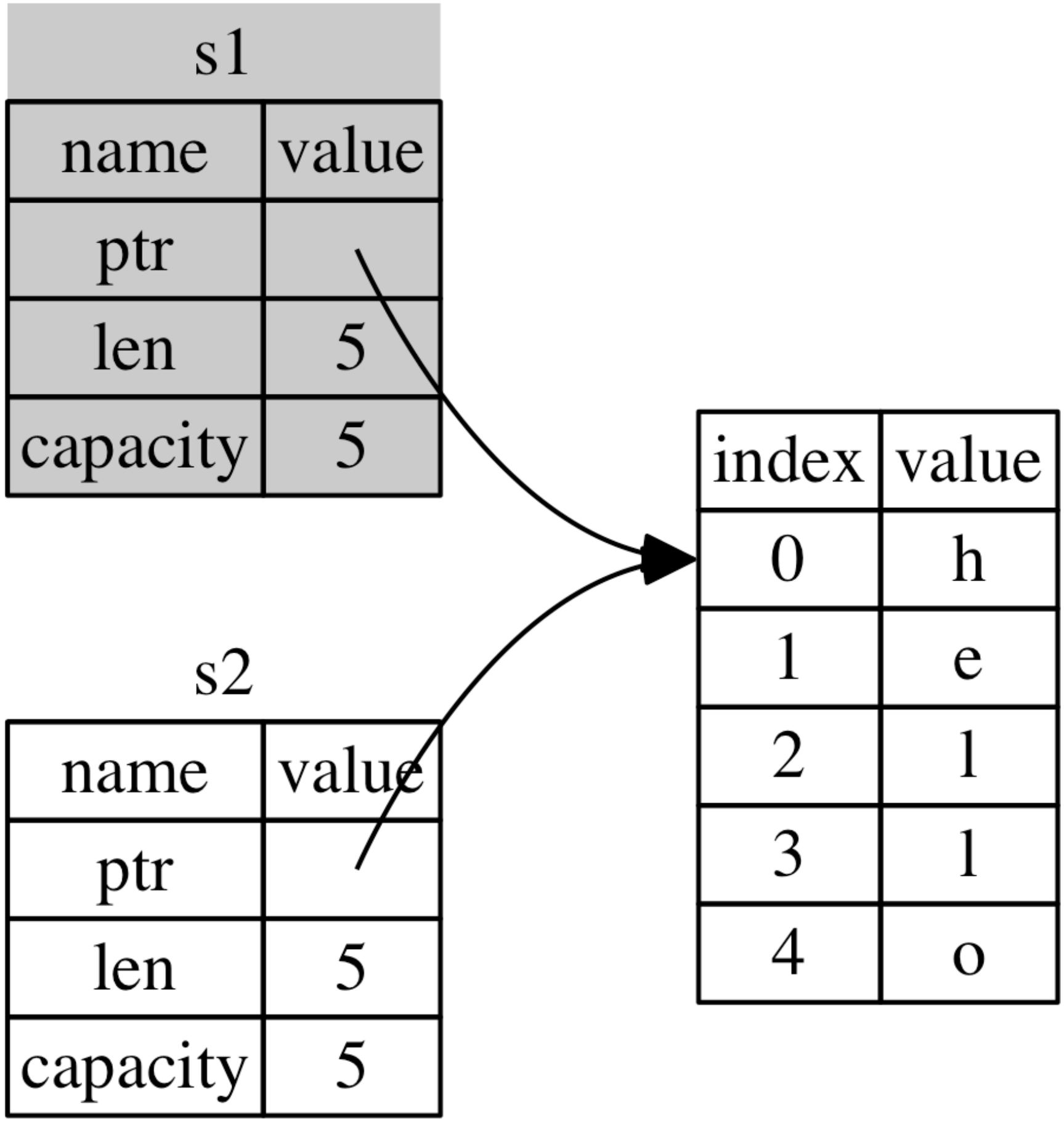
```rust
fn main() {
    let s1 = String::from(
        "hello"
    );

    let s2 = s1;



}
```


s1
name
value
ptr
len
5
capacity
5
s2
name
value
ptr
len
5
capacity
5
index
value
0
h
1
e
2
l
3
l
4
o
s2
name
value
ptr
len
5
capacity
5
index
value
0
h
1
e
2
l
3
l
4
o
s1
name
value
ptr
len
5
capacity
5
index
value
0
h
1
e
2
l
3
l
4
o

Inefficient :(



```
fn main() {
    let s1 = String::from(
        "hello"
    );

    let s2 = s1;


}
```


s1
name
value
ptr
len
5
capacity
5
s2
name
value
ptr
len
5
capacity
5
index
value
0
h
1
e
2
l
3
l
4
o

```rust
fn main() {
    let s1 = String::from(
        "hello"
    );

    let s2 = s1;

    println!("s1 is {}", s1);
```

```
                                  ^^
error: use of moved value: `s1`
```

```rust
}
```

The Ownership Rules

1. Each value in Rust has a variable binding that's called its 'owner'.

2. There can only be one owner at a time.

3. When the owner goes out of scope, the value will be `drop()`ped.

```rust
fn main() {
    let s1 = String::from(
        "hello"
    );
    something(s1);

}

fn something(s: String) {
    println!("i got {}", s);
}
```

```rust
fn main() {
    let s1 = String::from(
        "hello"
    );
    something(s1);

}

fn something(s: String) {
    println!("i got {}", s);
}
```

```rust
fn main() {
    let s1 = String::from(
        "hello"
    );
    something(s1);
    something(s1);
}

fn something(s: String) {
    println!("i got {}", s);
}
```

```rust
fn main() {
    let s1 = String::from(
        "hello"
    );
    something(s1);
    something(s1);
}
```

```
                    ^^
error: use of moved value: `s1`
```

```rust
fn something(s: String) {
    println!("i got {}", s);
}
```

```
fn main() {
    let s1 = String::from(
        "hello"
    );
    something(s1);
    something(s1);
}

fn something(s: String) {
    println!("i got {}", s);
}
```

```
                ^^
error: use of moved value: `s1`
```

SO ANNOYING

```rust
fn main() {
    let s1 = String::from(
        "hello"
    );
    let s1 = something(s1);
    something(s1);
  }

fn something(s: String)->String {
    println!("i got {}", s);
    s
}
```

```
fn main() {
    let s1 = String::from(
        "hello"
    );
    let s1 = something(s1);
    something(s1);
}

fn something(s: String) -> String {
    println!("i got {}", s);
    s
}
```

ALSO

ANNOYING

Borrowing to the rescue!

```rust
fn main() {
    let s1 = String::from(
        "hello"
    );
    something(&s1);
    something(&s1);
}

fn something(s: &String) {
    println!("i got {}", s);
}
```

```rust
fn main() {
    let s1 = String::from(
        "hello"
    );
    something(&s1);
}

fn something(s: &String) {
    s.push_str(", world!");
}
```

```rust
fn main() {
    let s1 = String::from(
        "hello"
    );
    something(&s1);
}

fn something(s: &String) {
    s.push_str(", world!");
}
```

```
    ^^
 error: cannot borrow immutable
borrowed content `*s` as mutable
```

```rust
fn main() {
    let mut s1 = String::from(
        "hello"
    );
    something(&mut s1);
}

fn something(s: &mut String) {
    s.push_str(", world!");
}
```

```rust
fn main() {
    let mut s1 = String::from(
        "hello"
    );
    let r1 = &mut s1;
    let r2 = &mut s1;
}
```

```rust
fn main() {
    let mut s1 = String::from(
        "hello"
    );
    let r1 = &mut s1;
    let r2 = &mut s1;
}
```

```
error: cannot borrow `s1` as
mutable more than once at a time
```

```rust
fn main() {
    let mut s1 = String::from(
        "hello"
    );
    let r1 = &s1;
    let r2 = &s1;
}
```

```rust
fn main() {
    let mut s1 = String::from(
        "hello"
    );
    let r1 = &s1;
    let r2 = &s1;
    let r3 = &mut s1;
}
```

```rust
let mut list = vec![1, 2, 3];
for i in &list {
    println!("i is {}", i);
    list.push(i + 1);
}
```

```
let mut list = vec![1, 2, 3];
for i in &list {
    println!("i is {}", i);
    list.push(i + 1);
}
```

```
^ error: cannot borrow `list`
as mutable because it is also
borrowed as immutable
```

Rules of References

1. At any given time, you may have either, but not both of:
    1. One mutable reference.
    2. Any number of immutable references.
2. References must always be valid.

I LIED TO YOUUUU!

&String isn't idiomatic Rust.

Slices

- Also don't have ownership.
- Reference a contiguous sequence of elements in a collection: string slices, vec slices, etc.

&str

Function to get the 1st word

```
let mut s = String::from("hello world");
```

```
fn first_word(s: &String) ->
```

```
fn first_word(s: &String) -> usize {
    let bytes = s.as_bytes();

    for (i, &byte) in bytes.iter().enumerate() {
        if byte == 32 {
            return i;
        }
    }

    s.len()

}
```

```
let mut s = String::from("hello world");

let end_of_first_word = first_word(&s);

s.clear();

// end_of_first_word is still 5 here…
```

Good news!

```
let s = String::from("hello world");

let hello = &s[0..5];
```

```rust
fn first_word(s: &String) -> &str {
    let bytes = s.as_bytes();

    for (i, &byte) in bytes.iter().enumerate() {
        if byte == 32 {
            return &s[0..i];
        }
    }

    &s[..]
}
```

```rust
let mut s = String::from("hello world");

let first_word = first_word(&s);

s.clear();
```

```
let mut s = String::from("hello world");

let first_word = first_word(&s);

s.clear();
```

```
^ error: cannot borrow `s` as
mutable because it is also
borrowed as immutable
```

string literal:

```
let s = "hello";
```

`String`:

```
let s = String::from("hello");
```

`&str`:

```
let s = "hello";
```

`String`:

```
let s = String::from("hello");
```

```rust
fn something(s: &String) {
    println!("i got {}", s);
}
```

```rust
fn something(s: &str) {
    println!("i got {}", s);
}
```

```rust
let s = "hello";
let t = String::from("hi");
something(s);
something(&t[..]);
```

Further reading

- https://carols10cents.github.io/trpl/
  - We did chapters 2 & 3 today
  - Give me feedback!
- https://doc.rust-lang.org/stable/book/
- http://rust-lang.github.io/book/