# Lesson 3 - Solana resources / Rust

## Solana News

### Outage Report for 30 / 9 /22

See report

### Solana U

If you are a student you can apply to become an ambassador to host events or build projects

## Solana Community

See resources page
This details their telegram / discord channels etc.
There are many meetup groups available worldwide

### Hacker House

In 2022 there were hackathons hosted in many cities
Lisbon Hacker House starts on 1st Nov

# Solana Command Line Tools

See the guide
You can

- Use Solana's Install Tool (Simplest option)
- Download Prebuilt Binaries
- Build from Source
- Use Homebrew

## Wallets

You can use different types of wallets
In the homework we will create a file system wallet for you to use with the command line tools, and also show a browser extension wallet.

## Faucets

There is a faucet that you can use to get SOL for the test networks, there are many others.

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# Introduction to Rust

## Core Features

Memory safety without garbage collection
Concurrency without data races
Abstraction without overhead

## Variables

Variable bindings are immutable by default, but this can be overridden using the `mut` modifier

```
let x = 1;
let mut y = 1;
```

## Types

Data Types -Rust book

The Rust compiler can infer the types that you are using, given the information you already gave it.

## Scalar Types

A *scalar* type represents a single value. Rust has four primary scalar types:

- integers
- floating-point numbers
- booleans
- characters

## Integers

For example

```
u8, i32, u64
```

## Floating point

Rust also has two primitive types for floating-point numbers, which are numbers with decimal points. Rust's floating-point types are `f32` and `f64`, which are 32 bits and 64 bits in size, respectively. The default type is `f64` because on modern CPUs it's roughly the same speed as `f32` but is capable of more precision. All floating-point types are signed.

## boolean

The boolean type or bool is a primitive data type that can take on one of two values, called true and false . (size of 1 byte)

## char

`char` in Rust is a unique integral value representing a Unicode Scalar value
Note that unlike C, C++ this cannot be treated as a numeric type.

## Other scalar types

### usize

`usize` is pointer-sized, thus its actual size depends on the architecture your are compiling your program for

As an example, on a 32 bit x86 computer, `usize = u32`, while on x86_64 computers, `usize = u64`.

`usize` gives you the guarantee to be always big enough to hold any pointer or any offset in a data structure, while `u32` can be too small on some architectures.

Rust states the size of a type is not stable in cross compilations except for primitive types.

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## Compound Types

Compound types can group multiple values into one type.

- tuples
- arrays
- struct

### Tuples

Example

```
fn main() {
    let x: (i32, f64, u8) = (500, 6.4, 1);

    let five_hundred = x.0;

    let six_point_four = x.1;

    let one = x.2;
}
```

### Struct

```
// struct size: 56
struct User {
    name: String,  // primitive size: 24
    age: u32,      // primitive size: 8
    email: String, // primitive size: 24
}
```

### Collections

- Vectors
  `let names = vec!["Bob", "Frank", "Ferris"];`
  We will cover these in more detail later

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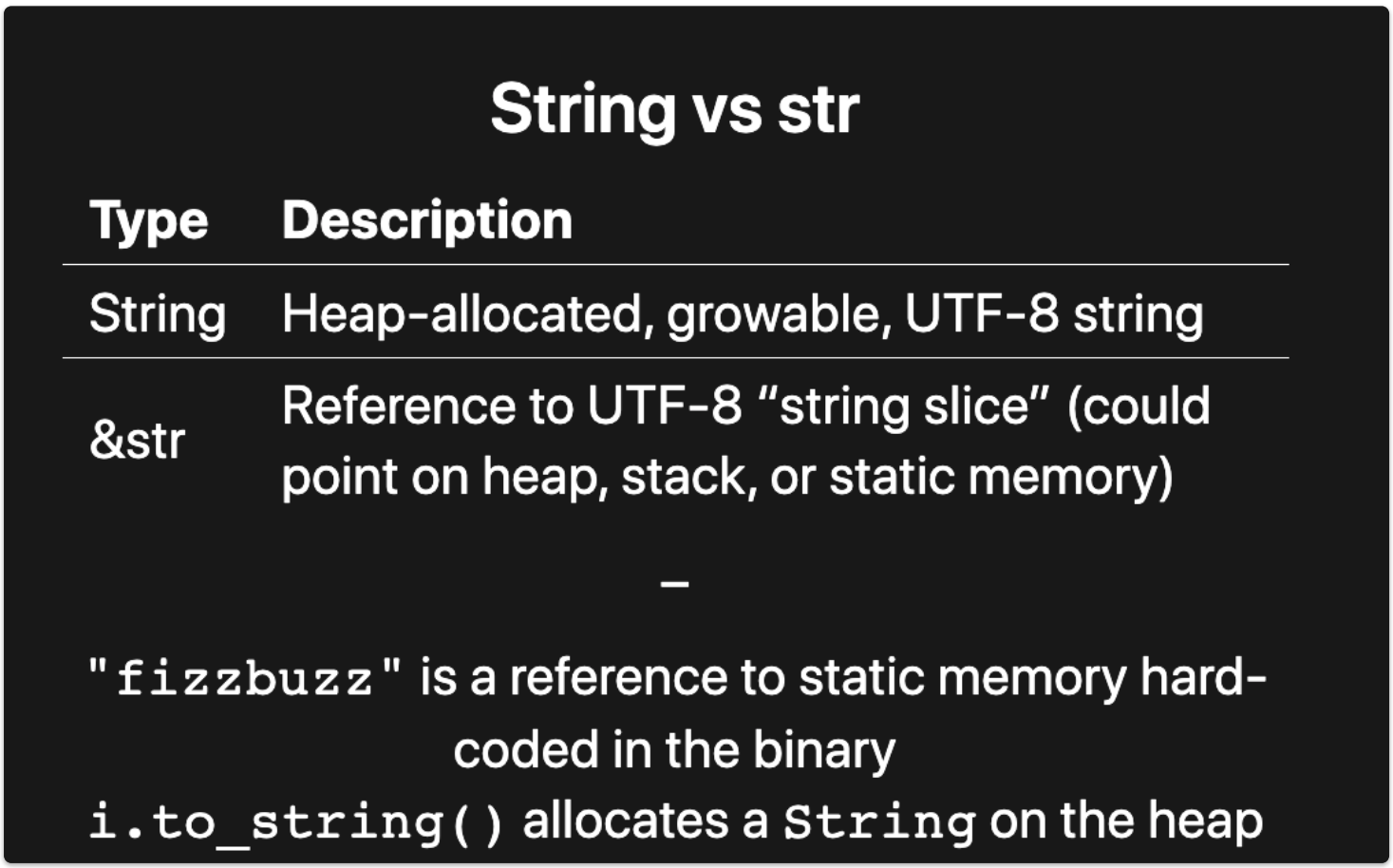
## Strings

Based on UTF-8 - Unicode Transformation Format

Two string types:

- &str a view of a sequence of UTF8 encoded dynamic bytes, stored in binary, stack or heap. Size is unknown and it points to the first byte of the string
- String: growable, mutable, owned, UTF-8 encoded string. Always allocated on the heap. Includes capacity ie memory allocated for this string.

A String literal is a string slice stored in the application binary (ie there at compile time).




*String vs &str - StackOverflow*
*Rust overview - presentation*
*Let's Get Rusty - Strings*

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## Arrays

Rust book definition of an array:

*"An array is a collection of objects of the same type `T`, stored in contiguous memory. Arrays are created using brackets `[]`, and their length, which is known at compile time, is part of their type signature `[T; length]`."*

### Array features:

- An array declaration allocates sequential memory blocks.
- Arrays are static. This means that an array once initialized cannot be resized.
- Each memory block represents an array element.
- Array elements are identified by a unique integer called the subscript/ index of the element.
- Populating the array elements is known as array initialization.
- Array element values can be updated or modified but cannot be deleted.

### Array declarations

```
//Syntax1: No type definition
let variable_name = [value1,value2,value3];

let arr = [1,2,3,4,5];

//Syntax2: Data type and size specified
let variable_name:[dataType;size] = [value1,value2,value3];

let arr:[i32;5] = [1,2,3,4,5];

//Syntax3: Default valued array
let variable_name:[dataType;size] = default_value_for_elements,size];

let arr:[i32;3] = [0;3];

// Mutable array
let mut arr_mut:[i32;5] = [1,2,3,4,5];

// Immutable array
let arr_immut:[i32;5] = [1,2,3,4,5];
```

### Rust book definition of a slice:

Slices are similar to arrays, but their length is not known at compile time. Instead, a slice is a two-word object, the first word is a pointer to the data, and the second word is the length of the slice. The word size is the same as usize, determined by the processor architecture eg 64 bits on an x86-64.

*Arrays - TutorialsPoint*
*Arrays and Slices - RustBook*

## Numeric Literals

The compiler can usually infer the type of an integer literal, but you can add a suffix to specify it, e.g. `42u8`
It usually defaults to i32 if there is a choice of the type.

Hexadecimal, octal and binary literals are denoted by prefixes
`0x` , `0o`, and `0b` respectively

To make your code more readable you can use underscores with numeric literals
e.g.
1_234_567_890

## ASCII code literals

Byte literals can be used to specify ASCII codes
e.g
`b'C'`

## Conversion between types

Rust is unlike many languages in that it rarely performs implicit conversion between numeric types, if you need to do that, it has to be done explicitly.
To perform casts between types you use the `as` keyword
For example

```
let a  = 12;
let b = a as usize;
```

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## Functions

Functions are declared with the `fn` keyword, and follow familiar synax for the parameters and function body.

```
fn my_func(a: u32) -> bool {

    if a == 0 {
        return false;
    }

    a == 7
}
```

As you can see the final line in the function acts as a return from the function
Typically the return keyword is used where we are leaving the function before the end.

### Loops

Range:

- inclusive start, exclusive end
  `for n in 1..101 {}`

- inclusive end, inclusive end
  `for n in 1..=101 {}`

  - inclusive end, inclusive end, every 2nd value

```
for n in (1..=101).step_by(2){}
```

## Printing

```
println!("Hello, world!");

println!("{:?} tokens", 19);
```

## Installing Rust

The easiest way is via rustup
See Docs

### Mac / Linux

```
curl --proto '=https' --tlsv1.2 https://sh.rustup.rs -sSf | sh
```

Windows
See details here
download and run `rustup-init.exe`.

Other methods

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## Cargo

See the docs

Cargo is the rust package manager, it will

- download and manage your dependencies,
- compile and build your code
- make distributable packages and upload them to public registries.

Some common cargo commands are (see all commands with --list):
build, b Compile the current package
check, c Analyse the current package and report errors, but don't build object files
clean Remove the target directory
doc, d Build this package's and its dependencies' documentation
new Create a new cargo package
init Create a new cargo package in an existing directory
add Add dependencies to a manifest file
run, r Run a binary or example of the local package
test, t Run the tests
bench Run the benchmarks
update Update dependencies listed in Cargo.lock
search Search registry for crates
publish Package and upload this package to the registry
install Install a Rust binary. Default location is $HOME/.cargo/bin
uninstall Uninstall a Rust binary

See 'cargo help ' for more information on a specific command.

## Useful Resources

We will look at Solana specific development resources next week

Rustlings
Rust by example
Rust Lang Docs
Rust Playground

Rust Forum
Rust Discord