The Rust Programming Language

Pramode C.E

`http://pramode.net`

January 16, 2018

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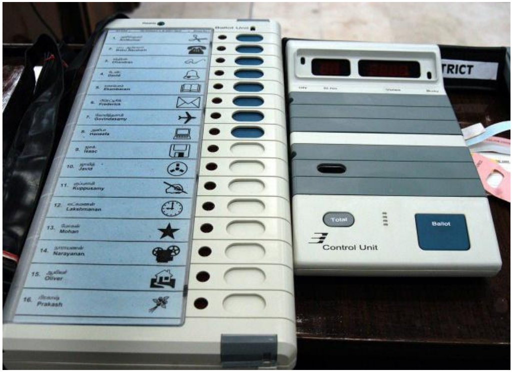
"WE HAVE TO GO OUT FOR DINNER. THE REFRIGERATOR ISN'T SPEAKING TO THE STOVE."

Audi A3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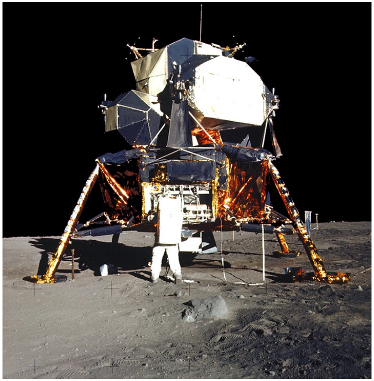


What is common to all these?

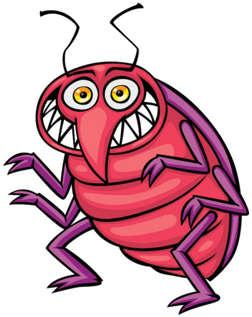
0 1 1 0 1 1 0 1 1 0 1 1 0 0 0 1 1 0 ...

A lot of code ...

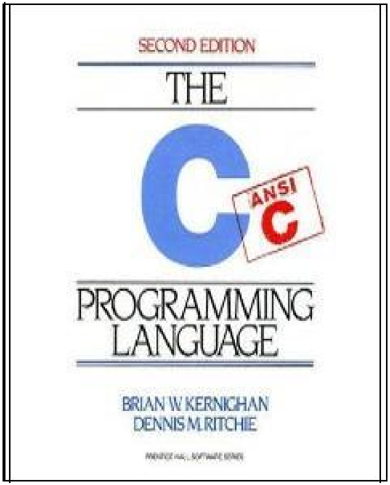
- Cardiac Pacemaker: 80,000 lines of code
- MRI Scanner: 70 lakh lines
- Boeing 787 dreamliner: 70 lakh lines
- Ford GT(Car): 100 lakh lines
- Light bulb: ??
- Door lock: ??
- Oven: ??

Ref: http://www.informationisbeautiful.net/visualizations/million-lines-of-code/

With code comes bugs ...



Code bugs can kill ... and create havoc!


SECOND EDITION
THE
C
ANSI C
PROGRAMMING LANGUAGE
BRIAN W. KERNIGHAN
DENNIS M. RITCHIE

What comes to your mind when you think of C?

SPEED

Bộ-Viện
Võ-Trận Đại-Việt

C Evil Spirits

- Buffer overflow / off-by-one errors
- Null dereferencing
- Use-after-free
- Memory leaks
- Dangling Pointers
- Undefined Behaviours

C Evil Spirits

```
int main()
{
    int a[3];
    a[0] = 1; a[3] = 10;

    return 0;
}
```

C Evil Spirits

```
int main()
{
    char a[5];
    strcpy(a, "hello");

    return 0;
}
```

C Evil Spirits

"The second big thing each student should learn is: How can I avoid being burned by Cs numerous and severe shortcomings? This is a development environment where only the paranoid can survive" John Regehr — http://blog.regehr.org/archives/1393

OUR DEVICES ARE NOW 100% SECURE.
HOW DID YOU DO THAT?
I TURNED THEM ALL OFF.
© D.Fletcher for CloudTweaks.com

Bugs!

Bugs!

Morris Worm: 1988 https://en.wikipedia.org/wiki/Morris_worm

Bugs!

How to smash the stack for fun and profit: 1996
http://phrack.org/issues/49/14.html#article

The most recent MacOS release fixed 32 vulnerabilities caused due to memory safety (https://support.apple.com/en-us/HT208221).

The Most recent Google Chrome release fixed 10 memory safety issues (https://chromereleases.googleblog.com/2017/10/stable-channel-update-for-desktop.html) and Firefox fixed 38 (https://www.mozilla.org/en-US/security/advisories/mfsa2017-24/).

Google's OSS-Fuzz and Project Zero have uncovered a large number of memory safety related vulnerabilities.

The Promise of Rust

- Guaranteed Memory SAFETY without using Garbage Collection
- As fast as C/C++
- Can write OS kernels, embedded systems code
- High level abstractions like algebraic data types / pattern matching with very little performance overhead
- Minimal run-time
- Easy interfacing with C
- Threads without data races

Ref: https://www.rust-lang.org/

The Promise of Rust

- Graydon Hoare started working on Rust in 2006
- Mozilla became interested - idea was to use it in the experimental Servo browser engine project
- Rust becomes an official Mozilla project
- Several major design changes before hitting v1.0 in May 2015. Language stabilizes
- Regular six week release cycle. Stable and Nightly "channels"

Installation

Visit: https://rustup.rs/

Documentation

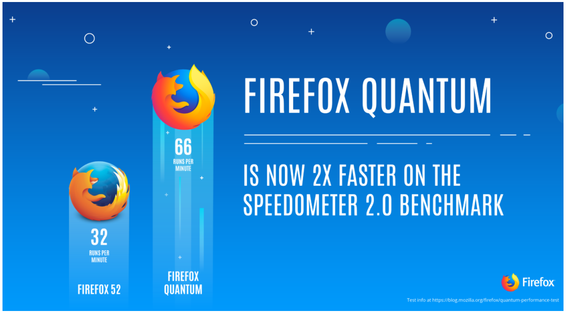
- Official "book" (2nd edition): https://doc.rust-lang.org/book/second-edition/
- Rust By Example: http://rustbyexample.com/
- O'Reilly book: http://shop.oreilly.com/product/0636920040385.do

Who is using it?

Remember, Rust is just a 2 year old baby!

- Organizations running Rust in Production: https://www.rust-lang.org/en-US/friends.html
- Mozilla, for the Servo project.
- Dropbox story: http://www.wired.com/2016/03/epic-story-dropboxs-exodus-amazon-cloud-empire/
- Coursera is using Rust: https://building.coursera.org/blog/2016/07/07/rust-docker-in-production-coursera/

Who is using it?



Who is using it?

Interesting Projects

- Servo: the secure, parallel browser engine from Mozilla:https://servo.org/
- Redox OS: Unix-like microkernel OS written in Rust: https://www.redox-os.org/
- Tock OS: an embedded OS for microcontrollers written in Rust: http://www.tockos.org/about/

Rust, the most loved programming language (stackoverflow devloper survey, 2016):
http://stackoverflow.com/research/developer-survey-2016

Some limitations

- Complex language.
- Library ecosystem not yet mature.
- Use of "unsafe" under the hood.
- Slow compilation.

About this workshop

This workshop is divided into 3 parts:

- Simple
- Cool
- Hard (and Cool!)

The Simple parts

- We will quickly look at: variables, control structures, function basics, basic types etc.

The Cool parts

- Algebraic Data types
- Pattern Matching
- Generics and Traits
- Iterators
- Closures
- Cargo

and some other things ...

The Hard(and Cool) Parts

This is the *core* of Rust - where the real innovation comes in.

- Systems programming basics - understanding buffer overflows, use-after-free, memory leaks, dangling pointers etc.
- Ownership and move semantics
- Borrowing
- Lifetimes
- Unsafe Rust

Let's dive into code!