Get [your friends] started with Rust

SERVERLESS WASM by Second State

A Jamstack hello world

Image processing

AI inference

RUST CHINA CONF 2020

首届中国 Rust 开发者大会

2020.12.26–27 深圳

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Rust China Conf 2020

Shenzhen, China

2020conf.rustcc.cn

Rust and WebAssembly

A match made in the cloud
云中的浪漫

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Rust + WebAssembly ~ Java + JVM

Plenty of room at the bottom

Plenty of Room at the Bottom

Richard P. Feynman
(Dated: Dec. 1959)

This is the transcript of a talk presented by Richard P. Feynman to the American Physical Society in Pasadena on December 1959, which explores the immense possibilities afforded by miniaturization.

I imagine experimental physicists must often look with envy at men like Kamerlingh Onnes, who discovered a field like low temperature, which seems to be bottomless and in which one can go down and down. Such a man

can easily be adjusted in size as required by the photo-engraving, and there is no question that there is enough room on the head of a pin to put all of the Encyclopaedia Brittanica.

a.k.a Moore’s Law

Plenty of room at the top

REVIEW

There's plenty of room at the Top: What will drive computer performance after Moore's law?

Charles E. Leiserson[1], Neil C. Thompson[1,2,*], Joel S. Emer[1,3], Bradley C. Kuszmaul[1,†], Butler W. Lampson[1,4], Daniel Sanchez[1], Tao B. Schardl[1]

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– Hide authors and affiliations

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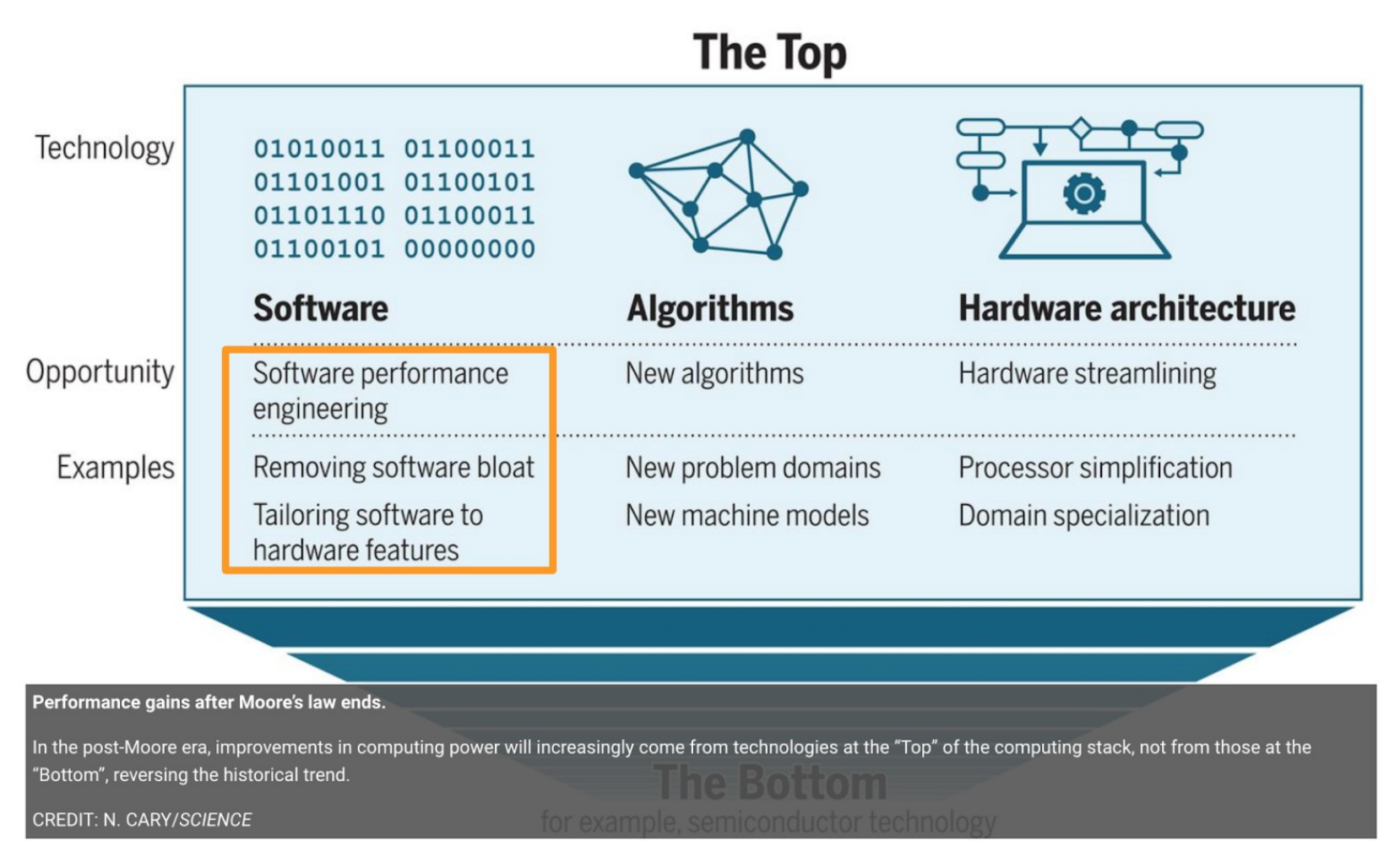
DOI: 10.1126/science.aam9744

Software performance engineering

60,000x performance gain by rewriting Python with C



Performance gains after Moore's law ends.

In the post-Moore era, improvements in computing power will increasingly come from technologies at the "Top" of the computing stack, not from those at the "Bottom", reversing the historical trend.

CREDIT: N. CARY/*SCIENCE*

Rust is highly performant

Language	Time (sec)	Memory (mb)
C++ Gcc	1.94	1.0
Rust	2.16	4.8
Java	4.03	513.8
LuaJIT	12.61	1.0
Lua 5.1	182.74	1.0
Python	314.79	4.9

Developers love Rust

Report: Rust is the most beloved programming language for five years running

Latest News Published: May 29th, 2020 - Jakub Lewkowicz

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Rust continues to maintain its spot as the most beloved of programming languages among professional developers. For the firth year in a row, the Stack Overflow Developer Survey found a majority of developers who are currently using it (86%) say that they are interested in continuing to develop with it.

But, cloud native is not machine native

"I think there is a world market for maybe five computers."

Thomas Watson, president of IBM, 1943

But he was off by 4 …

We need to optimize for the world computer!

Lessons from Java

- Server-side computing has its own requirements
  - Isolation and safety
  - Security
  - Cross platform compatibility
- Programming language trend matters
  - Developer productivity
- The 10-year cycles
  - “Reinventing the wheels” vs “Don’t make me eat the elephant again”

Jamstack and serverless

The modern way to build [websites & apps] that delivers better performance

- Statically generated web pages distributed via CDN
  - Markup for UI
  - JavaScript for interactions
- APIs for the backend services
  - Serverless functions and databases

Solomon Hykes @solomonstre · Mar 28, 2019

If WASM+WASI existed in 2008, we wouldn't have needed to created Docker. That's how important it is. Webassembly on the server is the future of computing. A standardized system interface was the missing link. Let's hope WASI is up to the task!

Solomon Hykes
@solomonstre

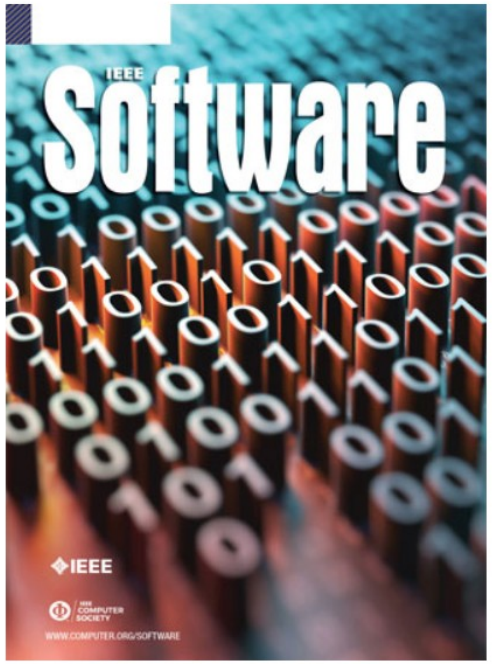
Co-founder of Docker. He/him. I follow lots of people because I have a lot to learn.

WebAssembly is more abstract than Docker

- Hypervisor VM and microVMs (e.g., AWS Firecracker)
- Application containers (e.g., Docker)
- High level language VMs (e.g., JVM, Ruby / Python runtimes, v8, WebAssembly)

WebAssembly vs Docker

- WebAssembly is 100x faster at cold start
- WebAssembly is 10% to 50% faster at execution time
  - AOT compiler could be faster than native
- WebAssembly has a much smaller footprint
- WebAssembly has a modern security model
- WebAssembly is composible
- WebAssembly integrates into popular frameworks



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A Lightweight Design for High-Performance Serverless Computing

PrePrints pp. 0-0,
DOI Bookmark: 10.1109/MS.2020.3028991

Keywords

Runtime, Cloud Computing, FAA, Containers, Benchmark Testing, Servers, Virtual Machining

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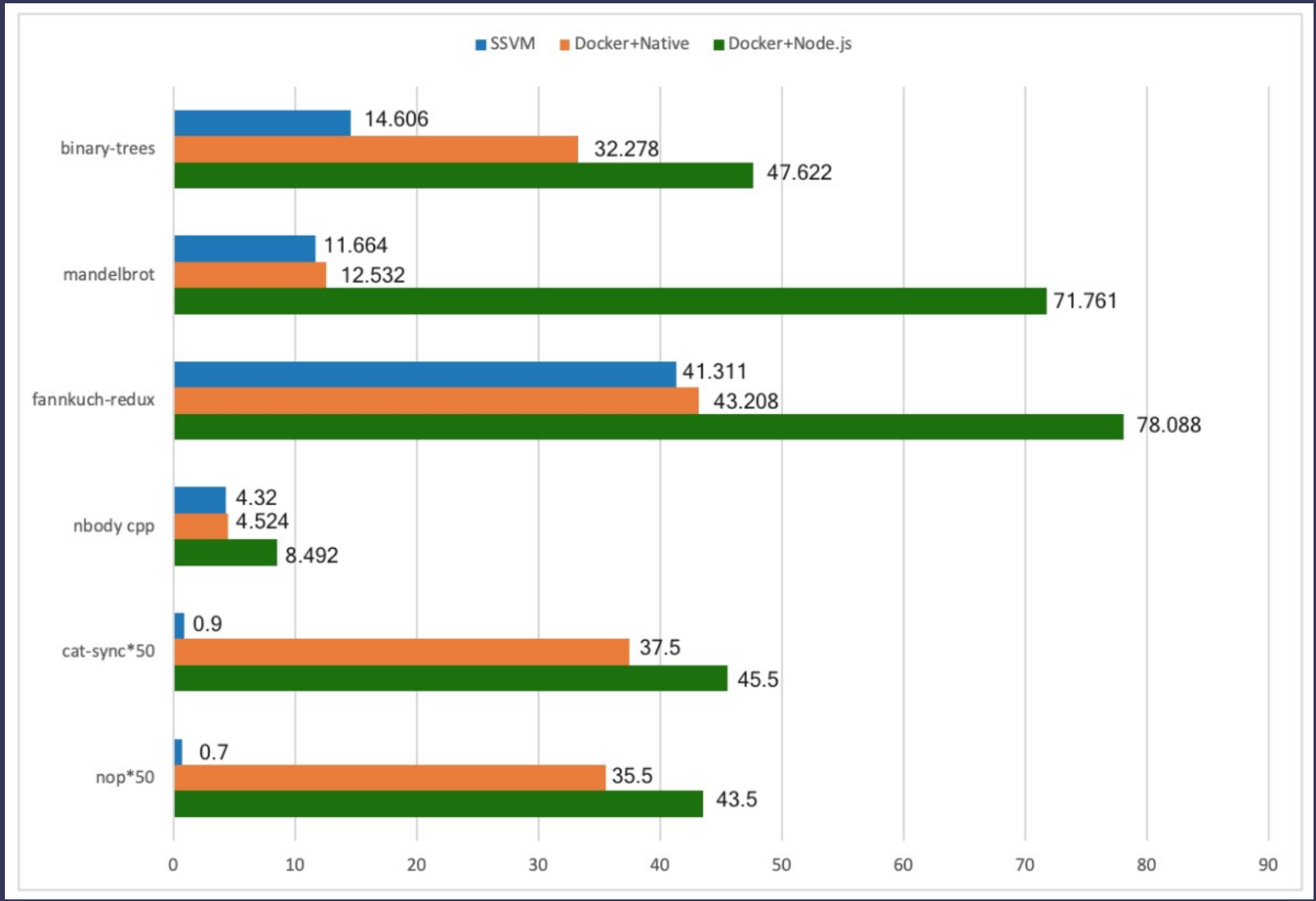

SSVM
Docker+Native
Docker+Node.js
binary-trees
14.606
32.278
47.622
mandelbrot
11.664
12.532
71.761
fannkuch-redux
41.311
43.208
78.088
nbody cpp
4.32
4.524
8.492
cat-sync*50
0.9
37.5
45.5
nop*50
0.7
35.5
43.5
0
10
20
30
40
50
60
70
80
90

WebAssembly and Rust

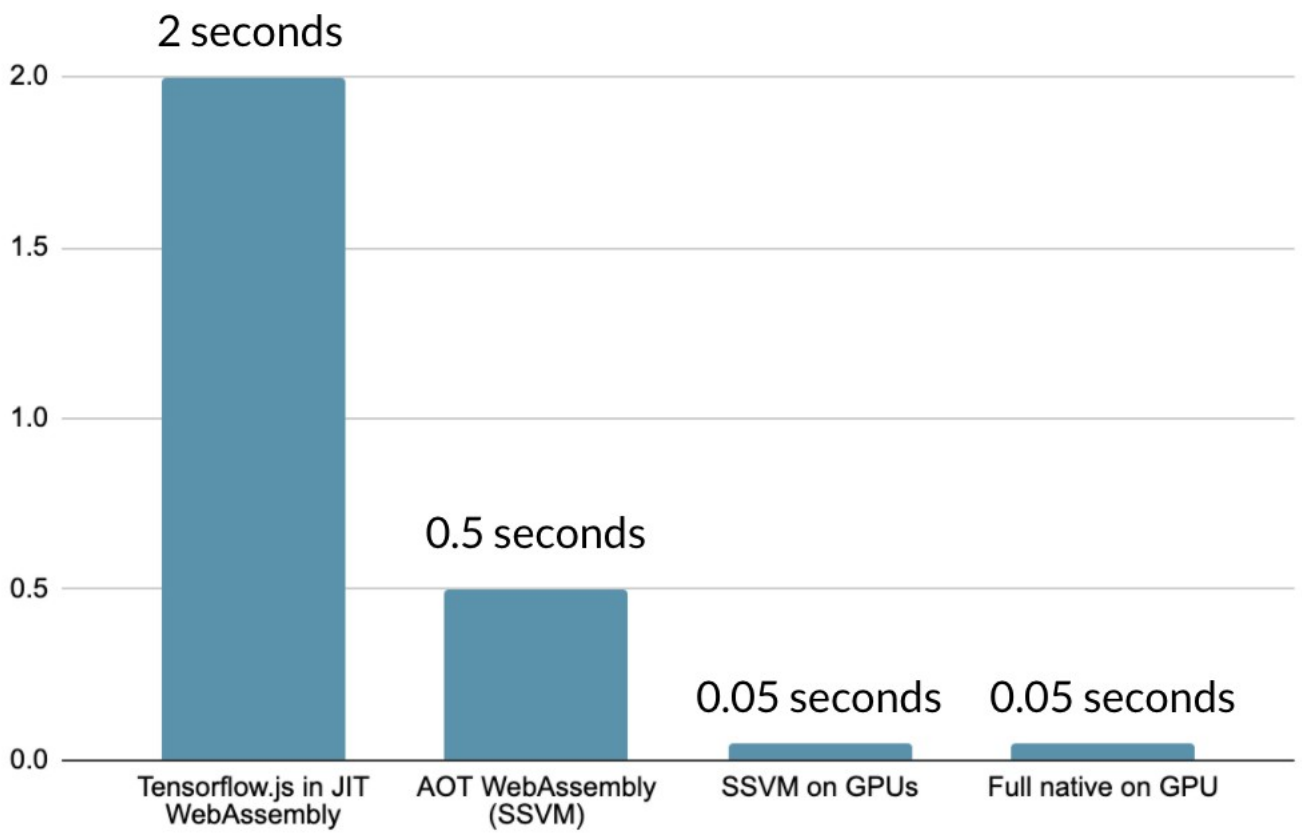
- Rust
  - Performance
  - Developer productivity
  - Memory safety
- WebAssembly
  - Performance
  - Isolation and sandbox
  - Security
  - Cross platform

WebAssembly is a first class compiler target for the Rust toolchain.

WebAssembly Systems Interface (WASI)

- Safe access to the file system, I/O, _start(), environment variables, command line arguments, and other standard library API
- WASI for sockets and network
- WASI for GPU or ASIC-enabled tensorflow (by SSVM)
- WASI for storage (by SSVM)
- WASI for precise usage metering (by SSVM)
- WASI for native commands and threads (by SSVM)
- WASI for Ethereum

A WASI-like API for Tensorflow



WASI Tensorflow for image classification

```rust
#[wasm_bindgen]
pub fn infer(image_data: &[u8]) -> String {
    let img = image::load_from_memory(image_data).unwrap().to_rgb();
    let resized = image::imageops::thumbnail(&img, 224, 224);
    let mut flat_img: Vec<f32> = Vec::new();
    for rgb in resized.pixels() {
        flat_img.push(rgb[0] as f32 / 255.);
        flat_img.push(rgb[1] as f32 / 255.);
        flat_img.push(rgb[2] as f32 / 255.);
    }
```

WASI Tensorflow for image classification

```
let model_data: &[u8] = include_bytes!("mobilenet_v2_1.4_224_frozen.pb");
let labels = include_str!("imagenet_slim_labels.txt");

let mut session = ssvm_tensorflow_interface::Session::new(model_data, ssvm_tensorflow_interface::ModelType::TensorFlow);
session.add_input("input", &flat_img, &[1, 224, 224, 3])
       .add_output("MobilenetV2/Predictions/Softmax")
       .run();
let res_vec: Vec<f32> = session.get_output("MobilenetV2/Predictions/Softmax");
```

WASI Tensorflow for image classification

```
let mut i = 0;
let mut max_index: i32 = -1;
let mut max_value: f32 = -1.0;
while i < res_vec.len() {
    let cur = res_vec[i];
    if cur > max_value {
        max_value = cur;
        max_index = i as i32;
    }
    i += 1;
}
```

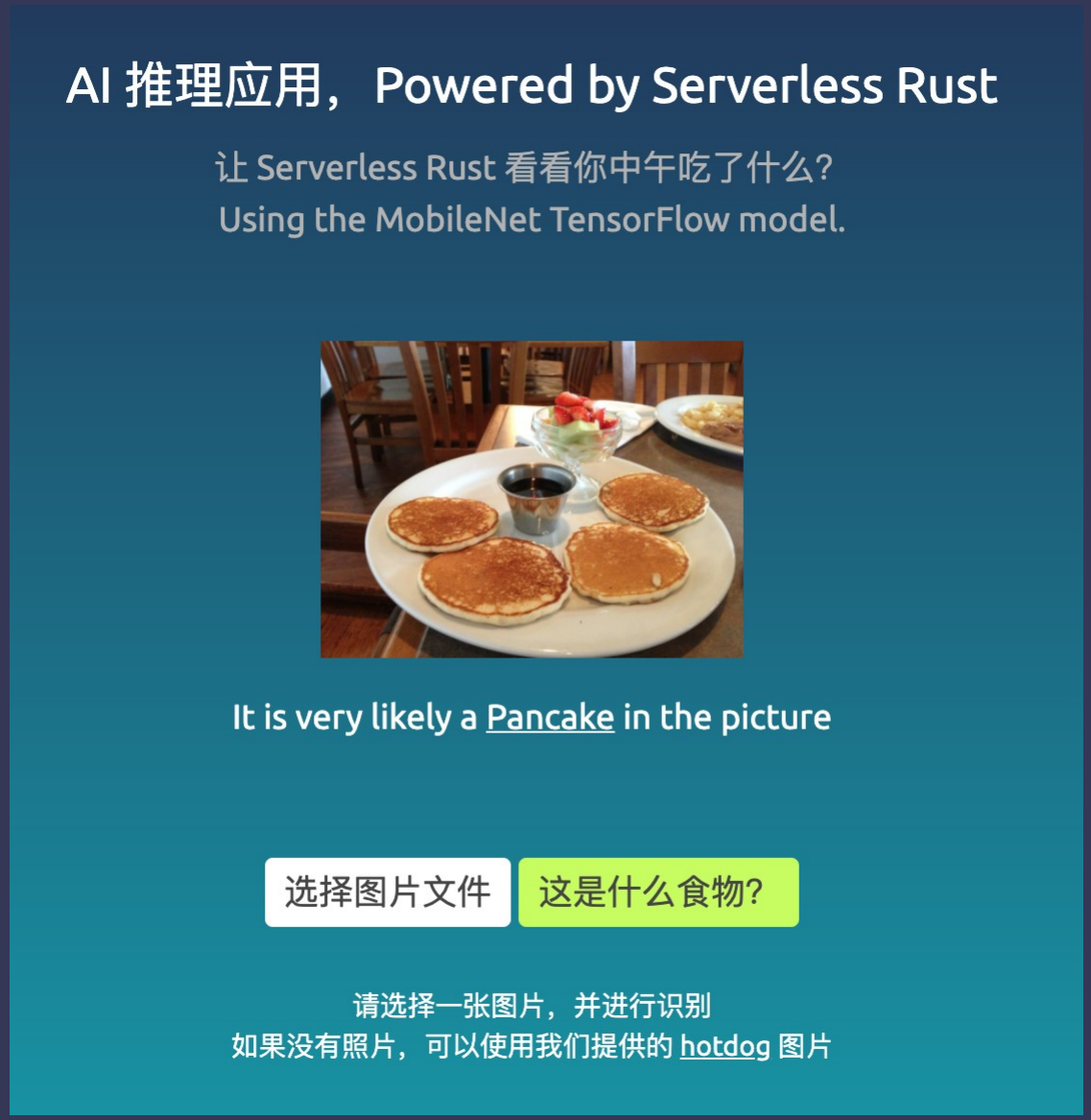
WASI Tensorflow for image classification

```
let mut confidence = "low";
if max_value > 0.75 {
    confidence = "very high";
} else if max_value > 0.5 {
    confidence = "high";
} else if max_value > 0.2 {
    confidence = "medium";
}

let mut label_lines = labels.lines();
for _i in 0..max_index {
  label_lines.next();
}
let ret: (String, String) = (label_lines.next().unwrap().to_string(), confidence.to_string());
```

Try it out!

https://www.secondstate.io/rustchinaconf/



It is your turn now!

用 Rust 写 Serverless 函数

Challenge #1 用 Rust 写一个 serverless function

Prize: Serverless Rust Swag by Second State

Challenge #2 用 Rust 写 AI as a service 云函数

Prize: Keychron K2 Wireless Mechanical Keyboard (Version 2)

Challenge #3 将 SSVM 扩展到更多应用场景与平台

Prize: Mac mini (M1 Chip)

Thank you!
https://www.SecondState.io/