Implement your own programming language with Rust in one hour

Wojciech Polak
Wrocław Rust Meetup #8

Wrocław, February 2019

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Who am I?

Rust Developer for the last 4 months.

Previously .NET

Amateur PL enthusiast

Check your requirements

- How does your language look like? Design it.
- Do you want native (compiled), or interpreted?
- Static types or maybe dynamic?
- Embedded (like LUA)?
  Foreign Function Call (C libraries)?
- OOP/Functional/Procedural style?
- Multithreading?

Popular knowledge resources

- /r/ProgrammingLanguages and /r/Compilers
- Crafting Interpreters - online book
- “An Incremental Approach to Compiler Construction” - Ghuloum
- “Modern compiler implementation in C” - Appel
- “Types and Programming Languages” - Pierce

Popular tools

- **LLVM** - Most popular compiler backend - Rust uses it.
  Nice tutorial in C / Ocaml: https://llvm.org/docs/tutorial
  Rust bindings are still WIP.

- **Cranelift** - compiler backend **written in Rust.**
  Designed for WASM codes generation.
  https://github.com/CraneStation/simplejit-demo

- **C language** - as a compilation target
  JS language - as a compilation target

- **Pest** - parsing library for PEG (Parsing Expression Grammars) for Rust.
  https://github.com/pest-parser/pest

Language for this talk

- LISP(ish) syntax - to avoid operator precedence
- Functional
- Dynamic types (no typechecker)
  Integers, booleans, functions, lists
- With stack based byte code interpreter and compiler
- Primitive error handling

“Onion” approach

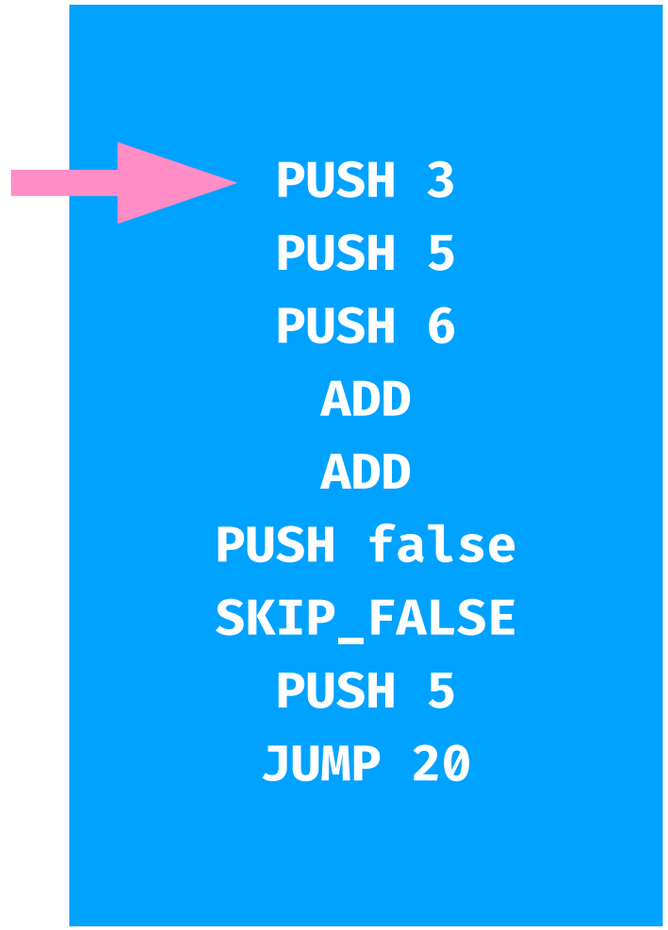
- We start with very simple subset of language
- Write some integration/unit tests.
- “Make it compile and run”
- Add new, more advanced feature, repeat process
- Each cycle takes from 10 minutes to maximum 1 week
- Nice, strong feedback loop

1. Integers and basics of VM.

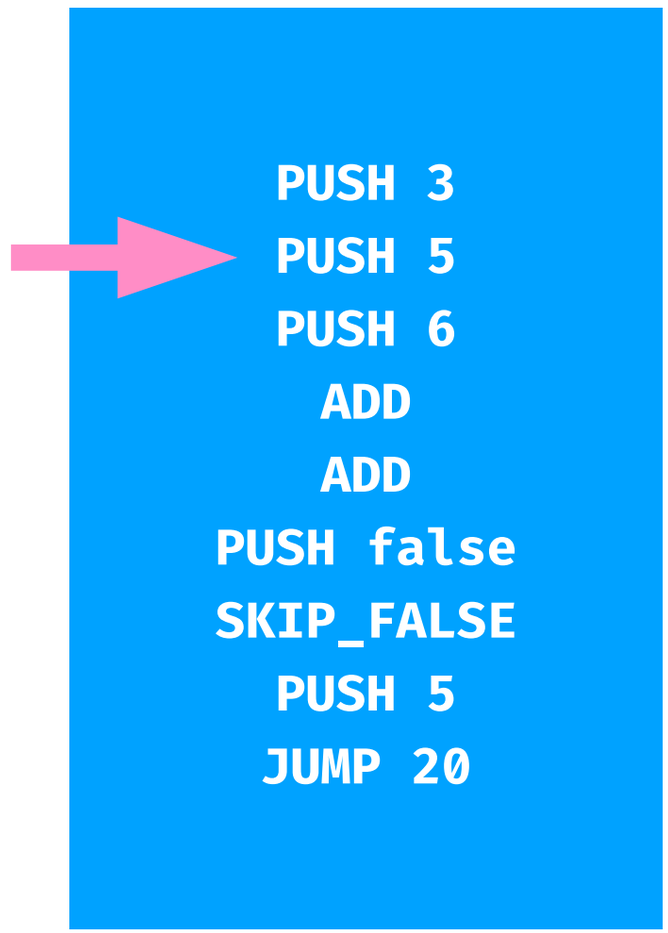
```
(+ 3 5 6)
(if false 5 6)
(* 124 (+ 3 34)
8)
```

```
PUSH 3
PUSH 5
PUSH 6
ADD
ADD
PUSH false
SKIP_FALSE
PUSH 5
JUMP 20
```

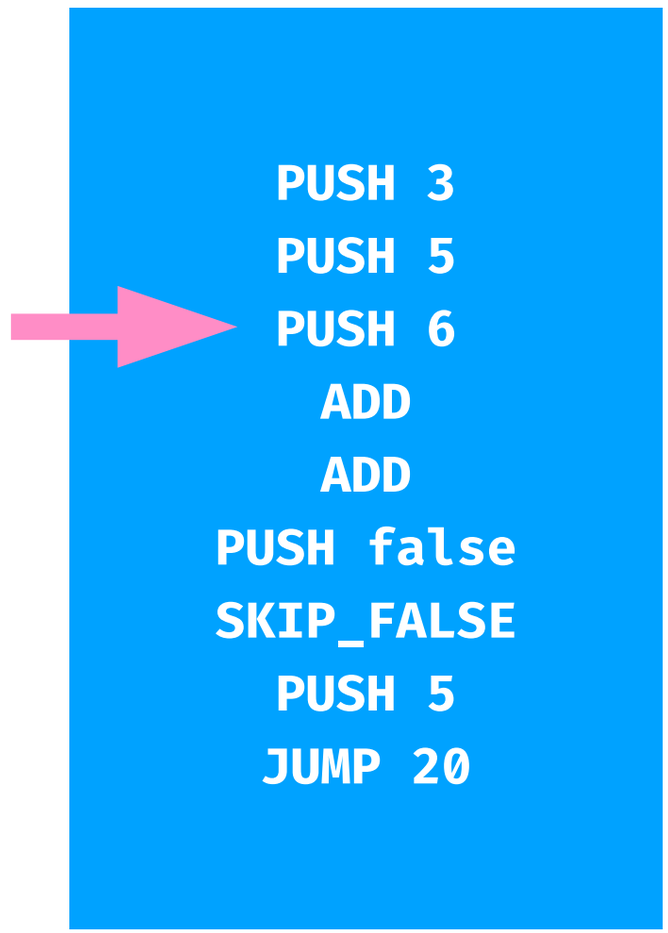
Virtual Machine



Virtual Machine



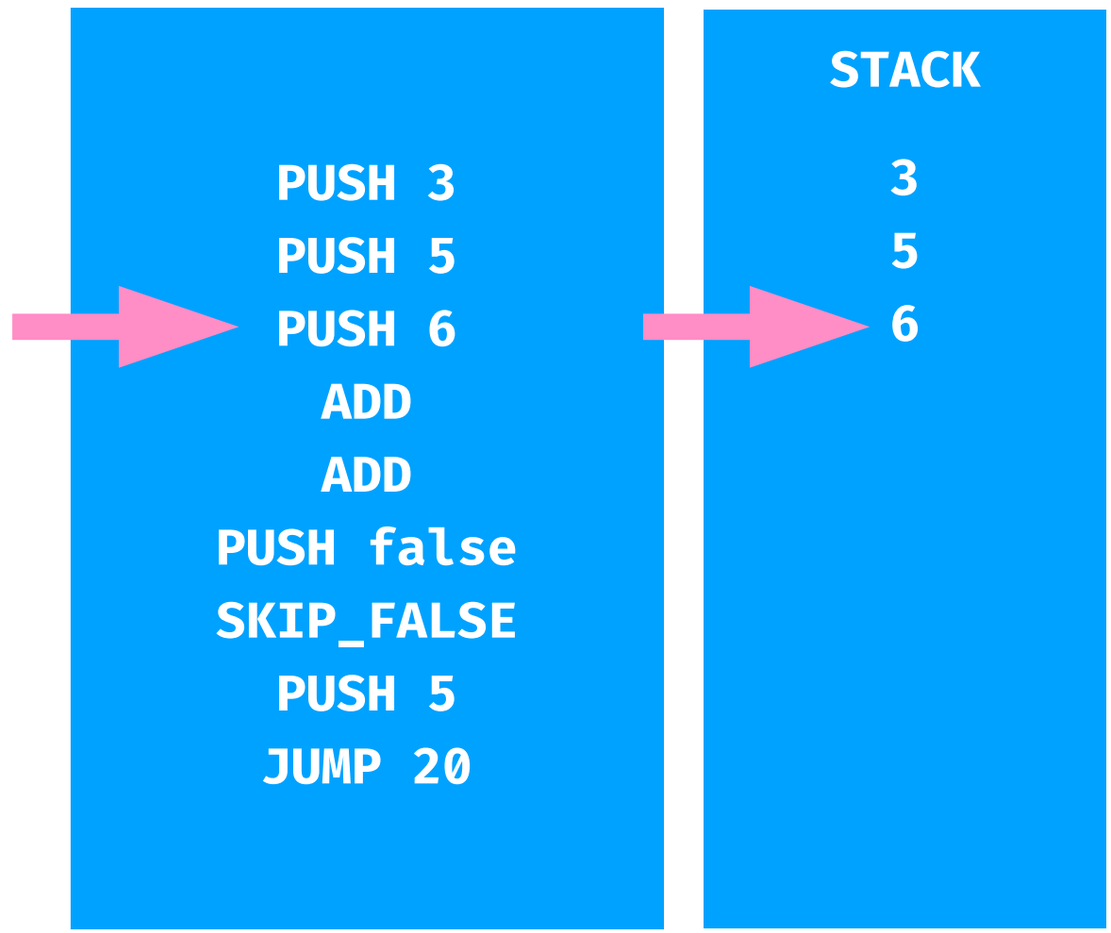
Virtual Machine



1. Implementation

- Dependencies:
  - Pest - parsing library
  - Test Case Derive - for `#[test_case()]` macro attribute https://crates.io/crates/test-case-derive

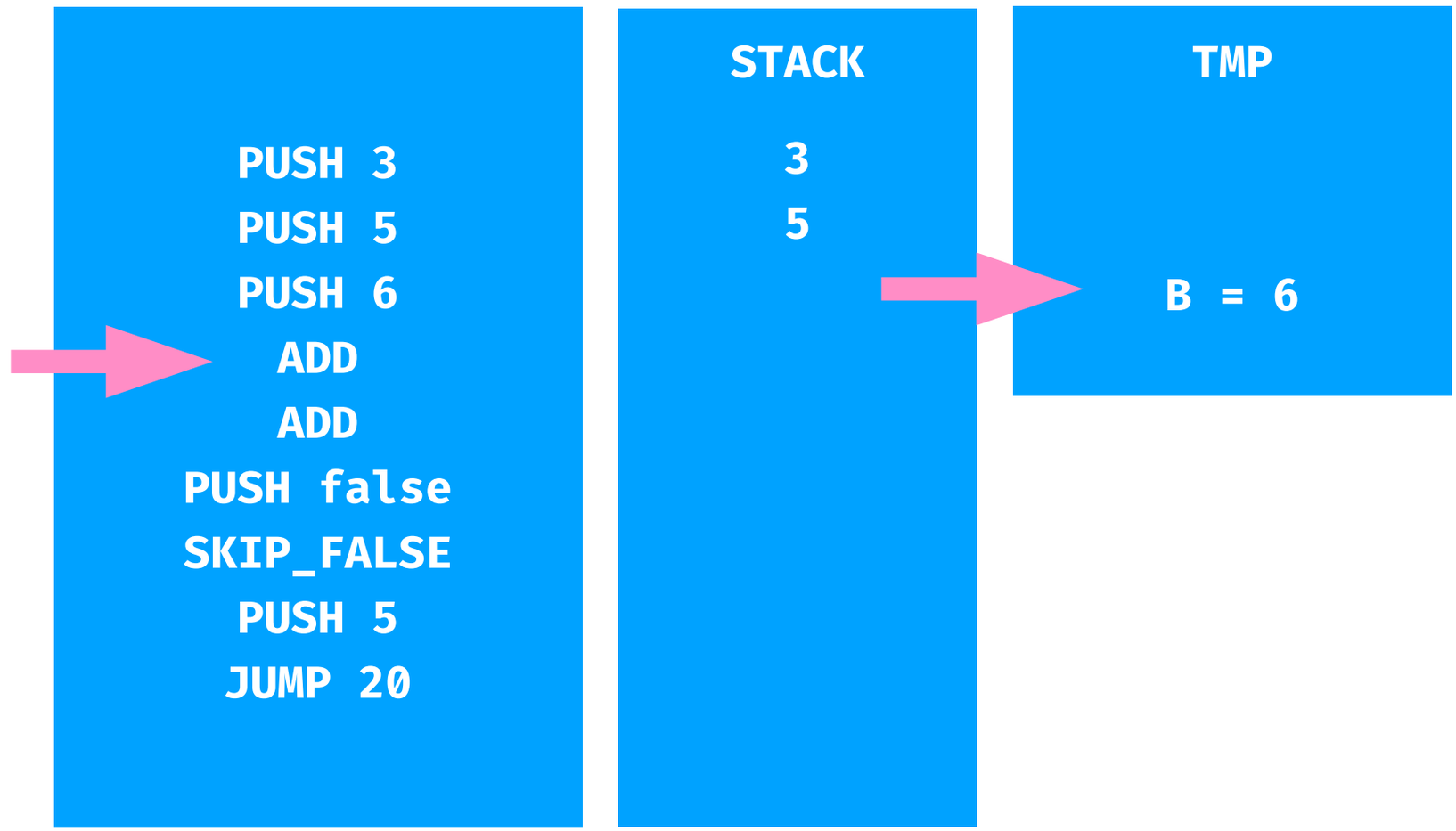
Virtual Machine



2. Binary operations

Let’s add some things!

Virtual Machine



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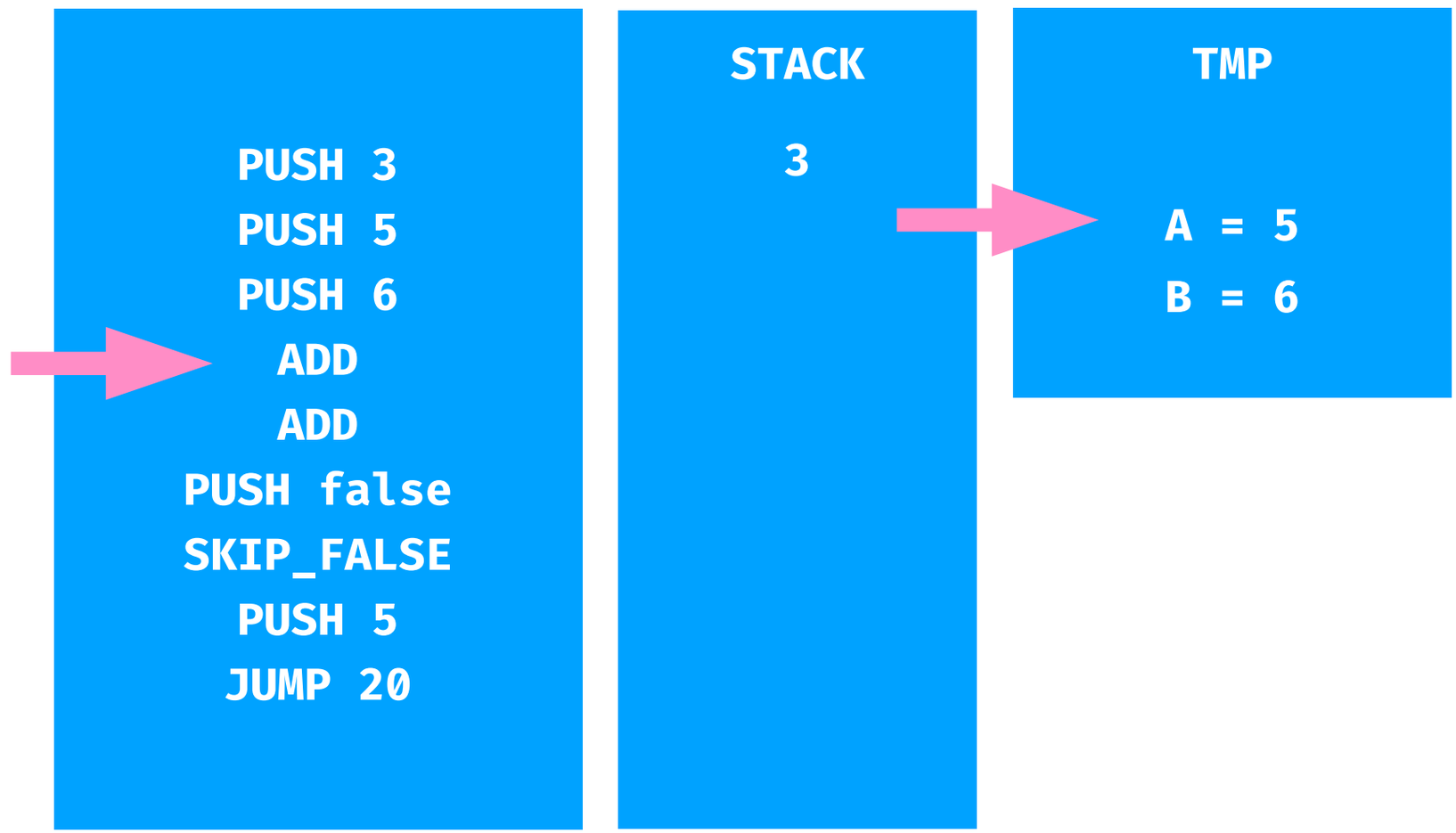

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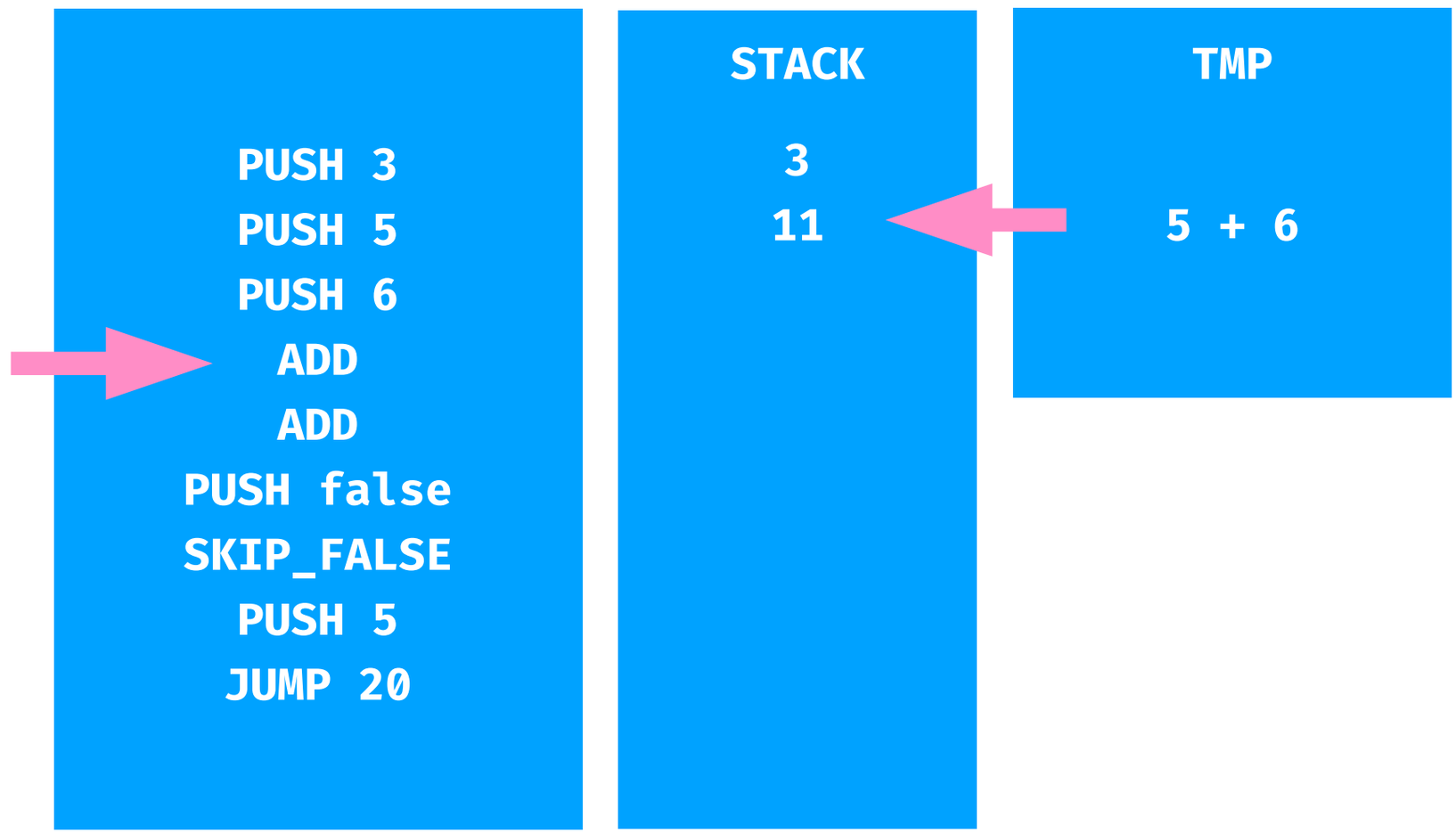

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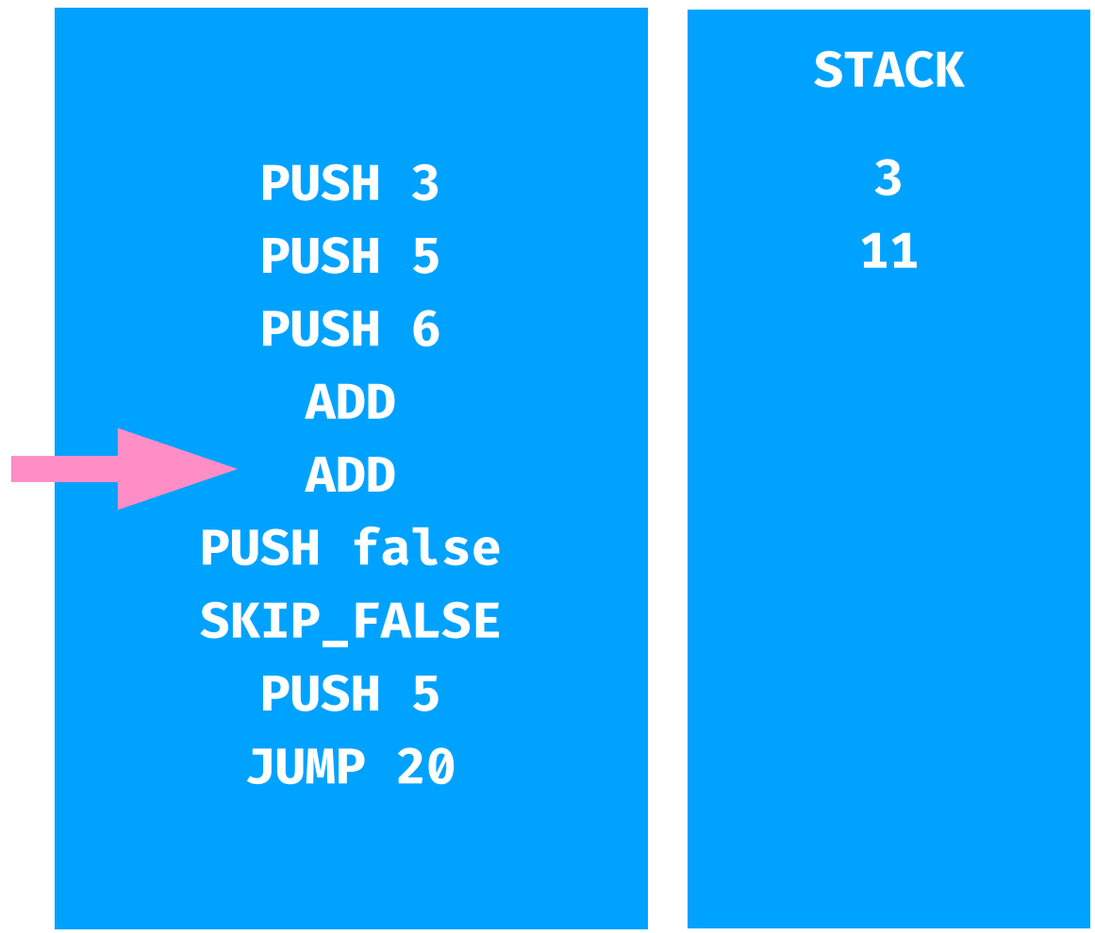
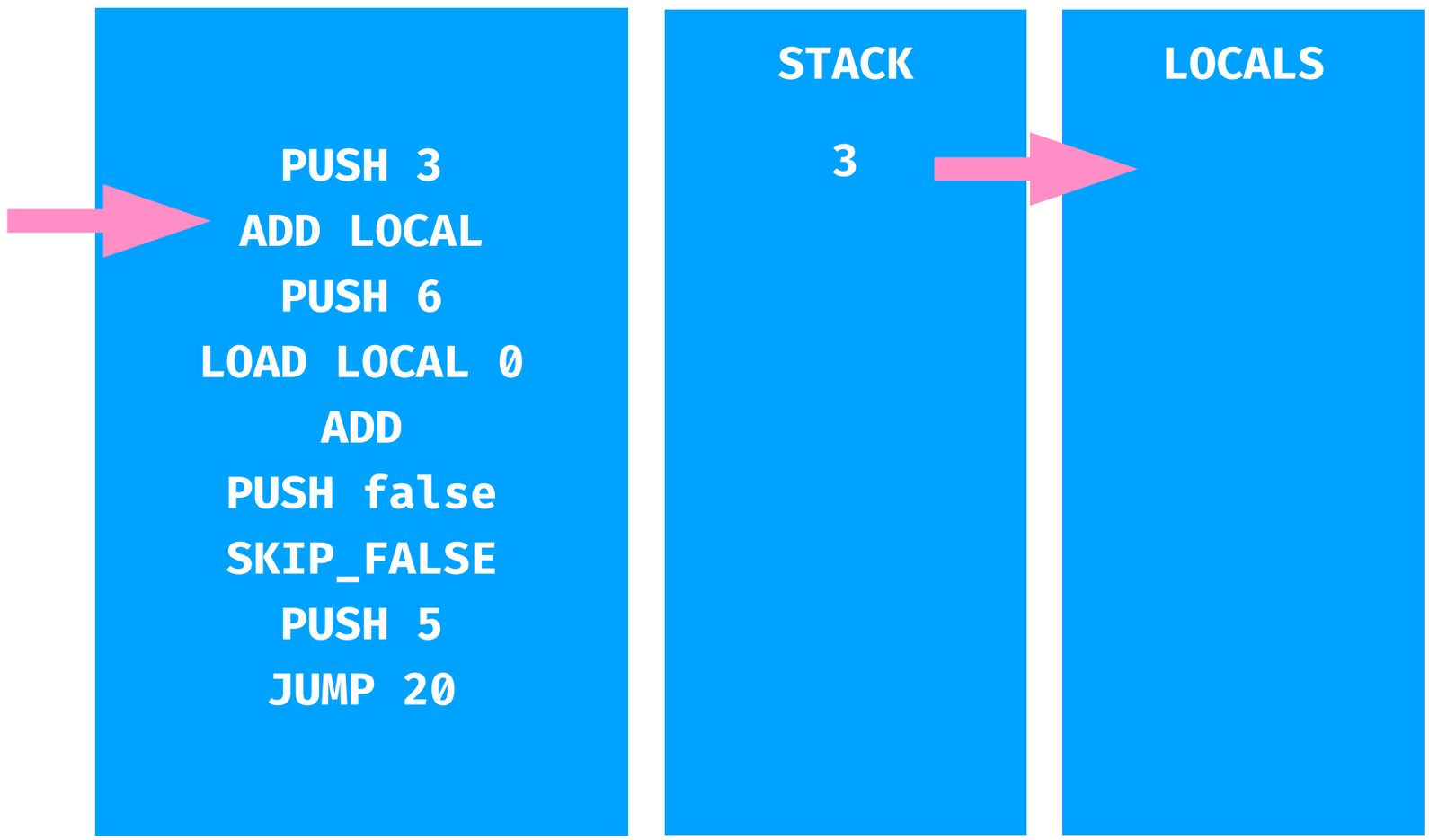


3. Local variables

Virtual Machine



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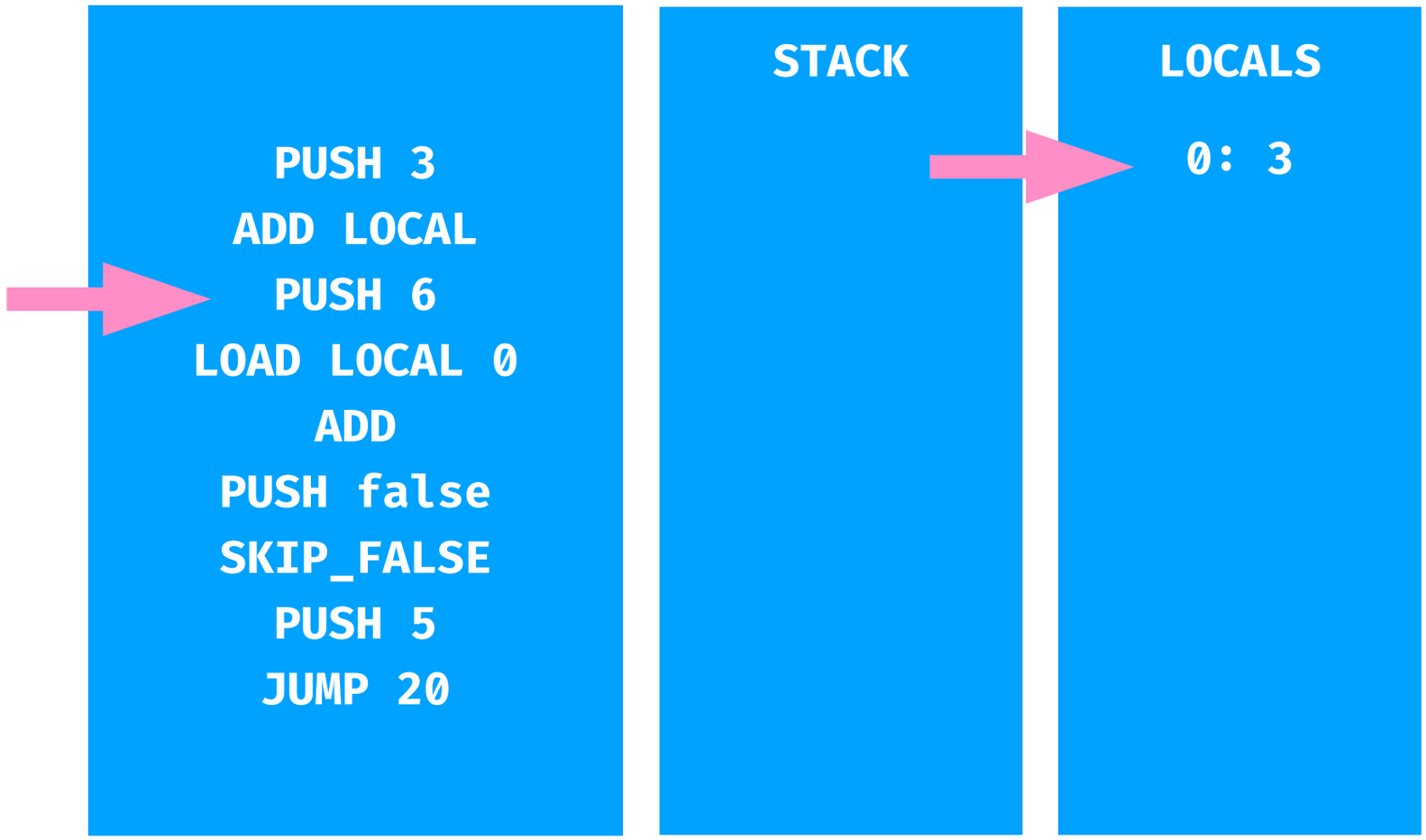

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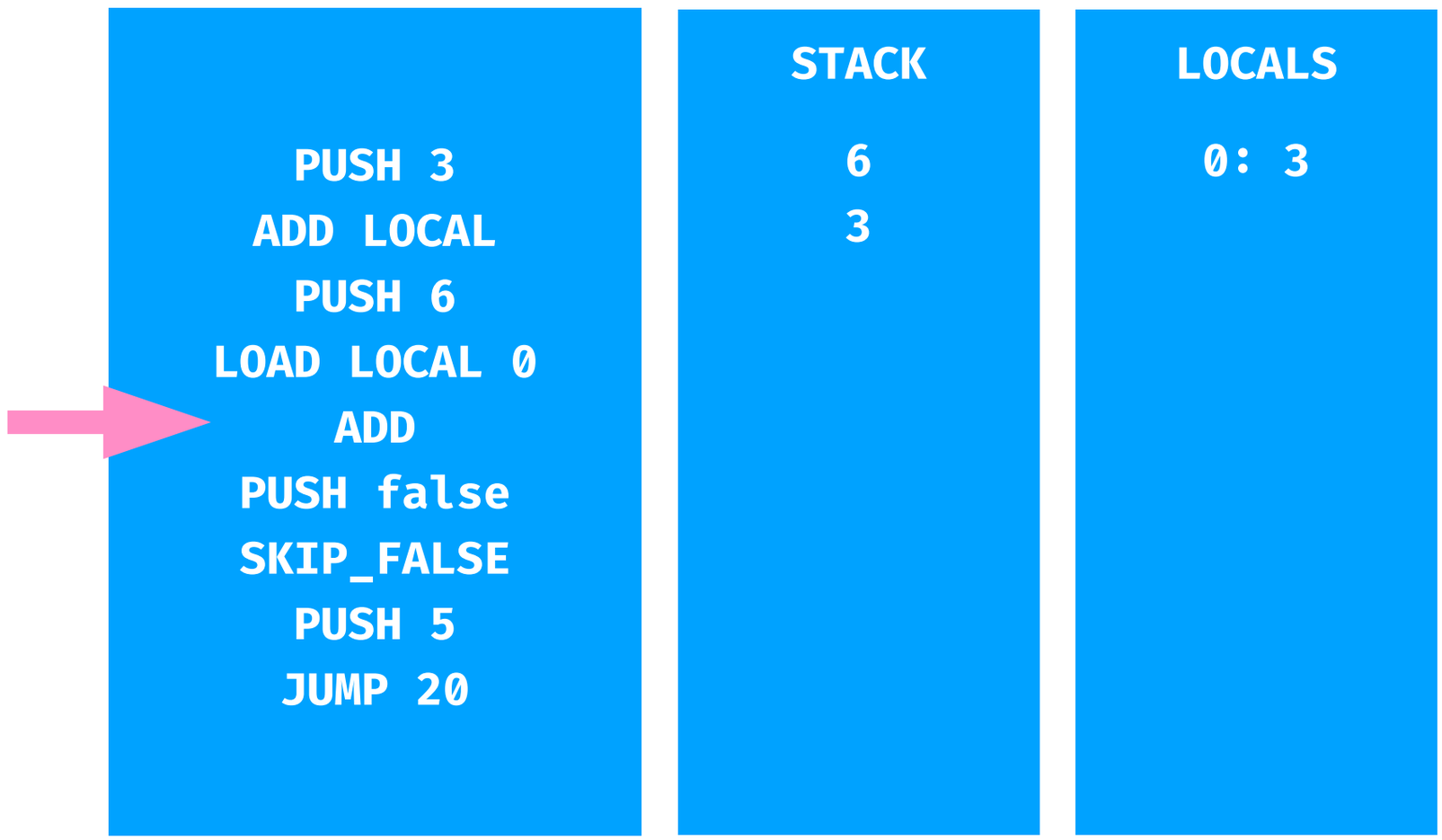
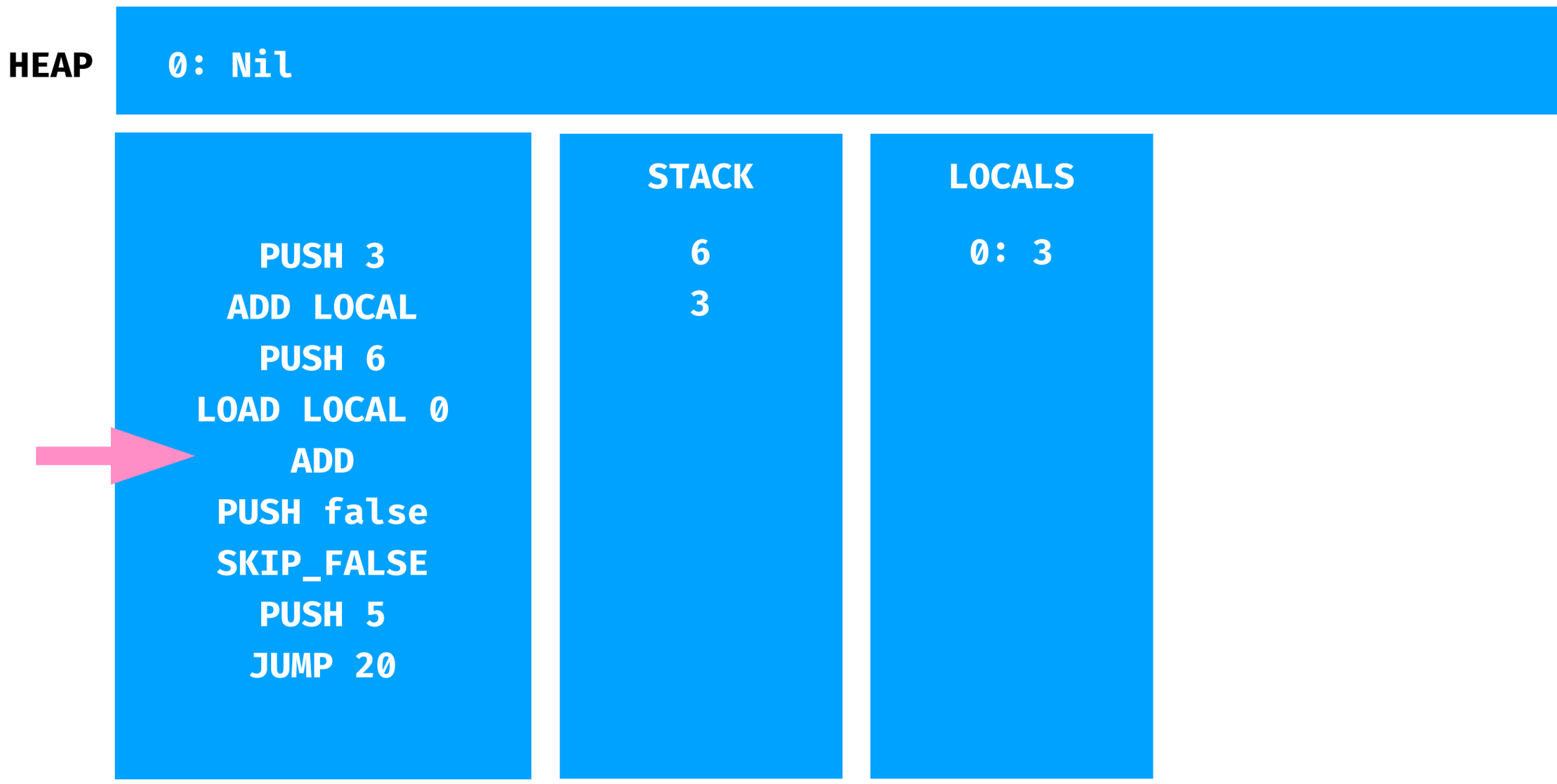


4. Conditional Expressions

5. Lists

Virtual Machine



Virtual Machine

HEAP

```
0: Nil   1: Cons(5, ptr(0))
```

```
PUSH 3
ADD LOCAL
PUSH 6
LOAD LOCAL 0
ADD
PUSH false
SKIP_FALSE
PUSH 5
JUMP 20
```

STACK

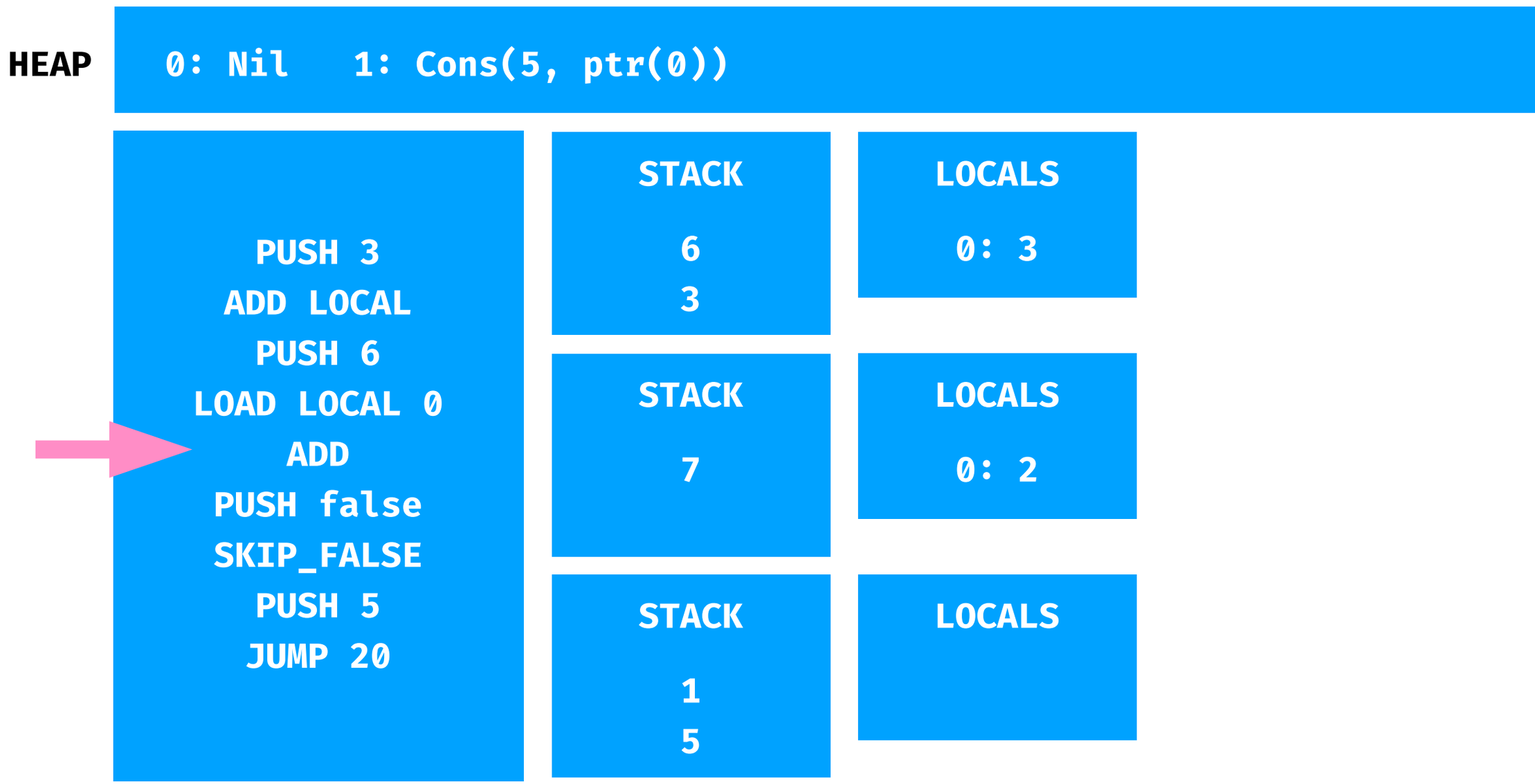
```
6
3
```

LOCALS

```
0: 3
```

6. Functions

Virtual Machine



What’s next?

Endless possibilities

Thank you!

Q&A

“How to implement type theory in an hour”

https://vimeo.com/286652934

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