CS 152: *Programming Language Paradigms*

Virtual Machine Lab

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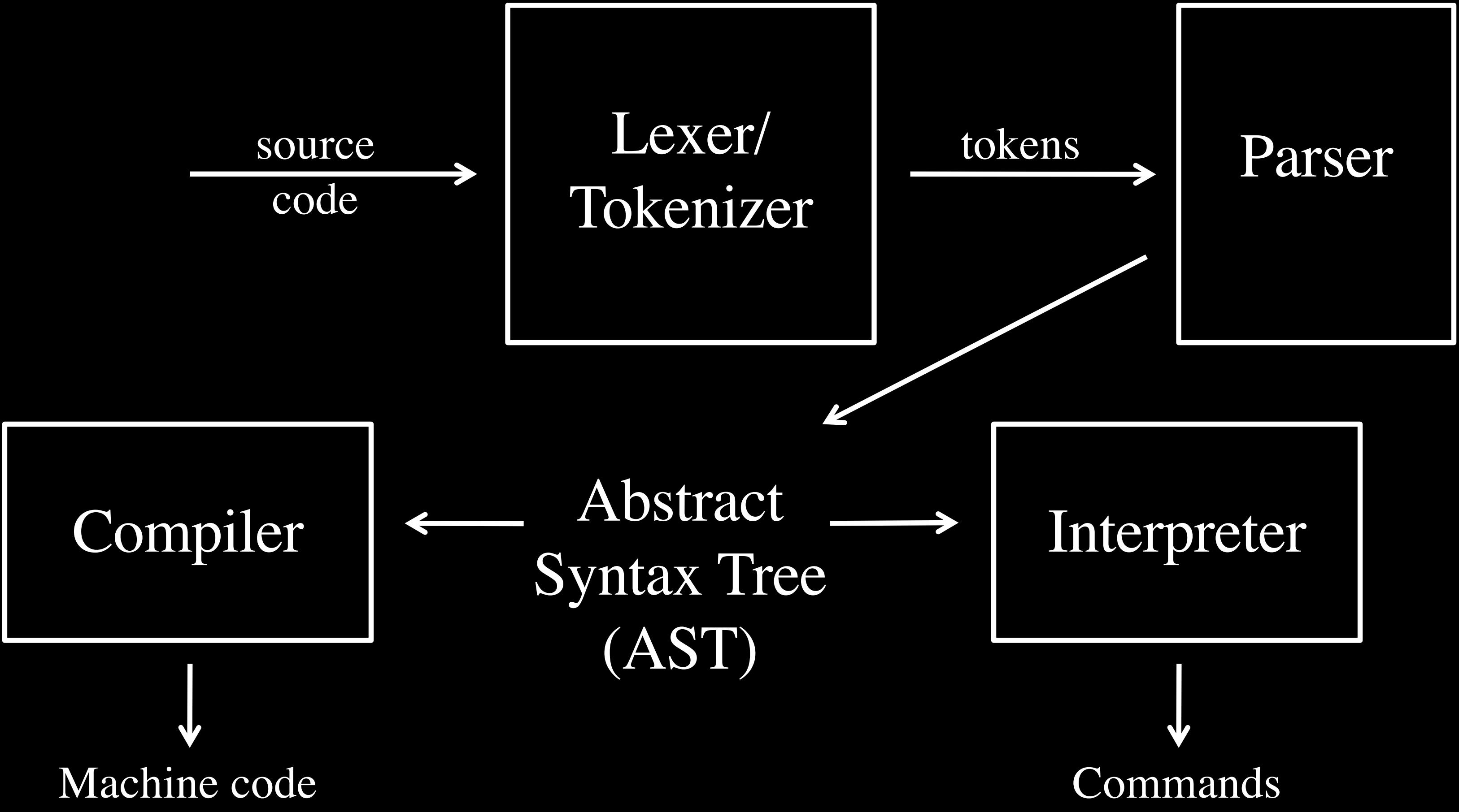
A Review of Compilers



source code

Lexer/ Tokenizer

tokens

Parser

Abstract Syntax Tree (AST)

Compiler

Interpreter

Machine code

Commands

Virtual Machines (VM)

- Code is compiled to *bytecode*
  - low-level
  - platform independent
- The VM interprets bytecode

Lab: Scheme VM

In today's lab, you will implement:

- a compiler for Scheme
- a stack-based VM

Input program

```
(println (+ 2 3 4))
(println (- 13 (* 2 4)))
(println (- 10 4 3))
```

Supported VM Operations

- **PUSH** – adds argument to stack
- **PRINT** – pops & prints top of stack
- **ADD**
  - pops top two elements
  - adds them together
  - places result on stack
- **SUB** – subtraction
- **MUL** – multiplication

Bytecode Output

```
PUSH 2
PUSH 3
ADD
PUSH 4
ADD
PRINT
PUSH 13
PUSH 2
PUSH 4
MUL
SUB
PRINT
PUSH 10
PUSH 4
SUB
PUSH 3
SUB
PRINT
```

Lab – Write a Compiler and a VM

- Starter code is provided.
- `println` is functional.
- Your job: add support for the mathematical operators.

EXTRA CREDIT

Add compiler support for

- if expressions
- boolean variables
- let expressions

Add VM support for

- labels
- Jump (`JMP/JZ/JNZ`) operations
- `STOR/LOAD` operations