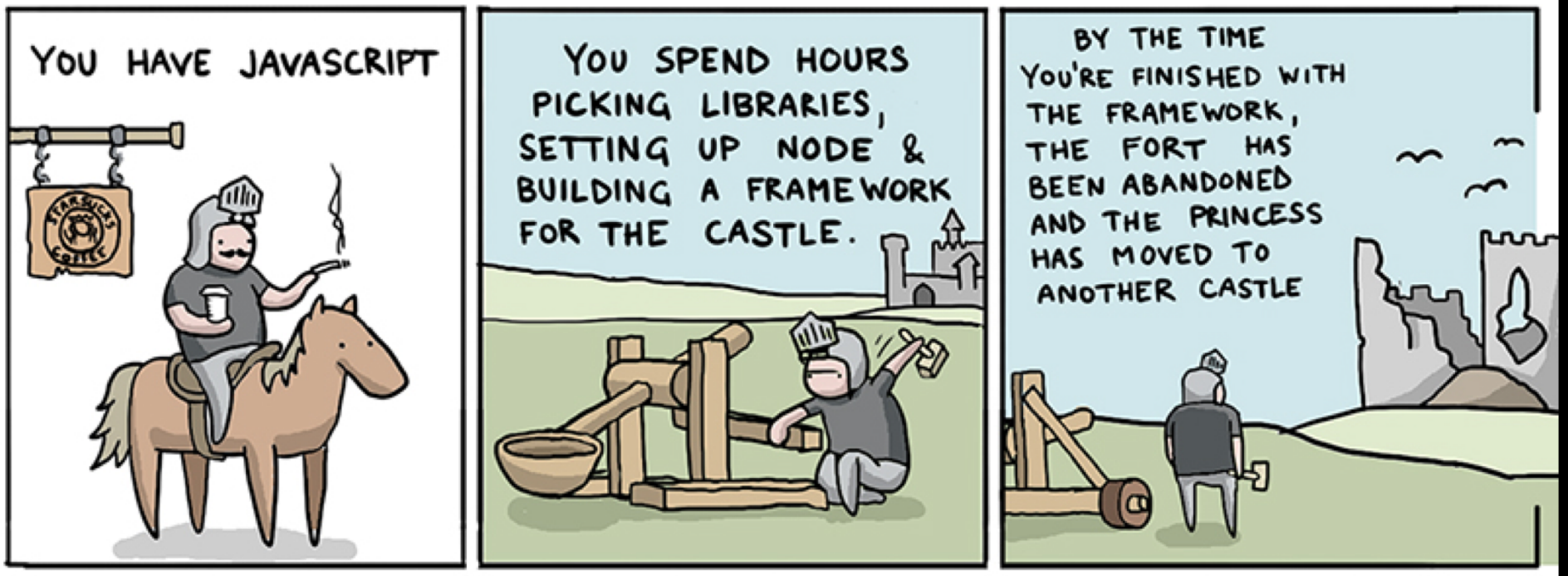
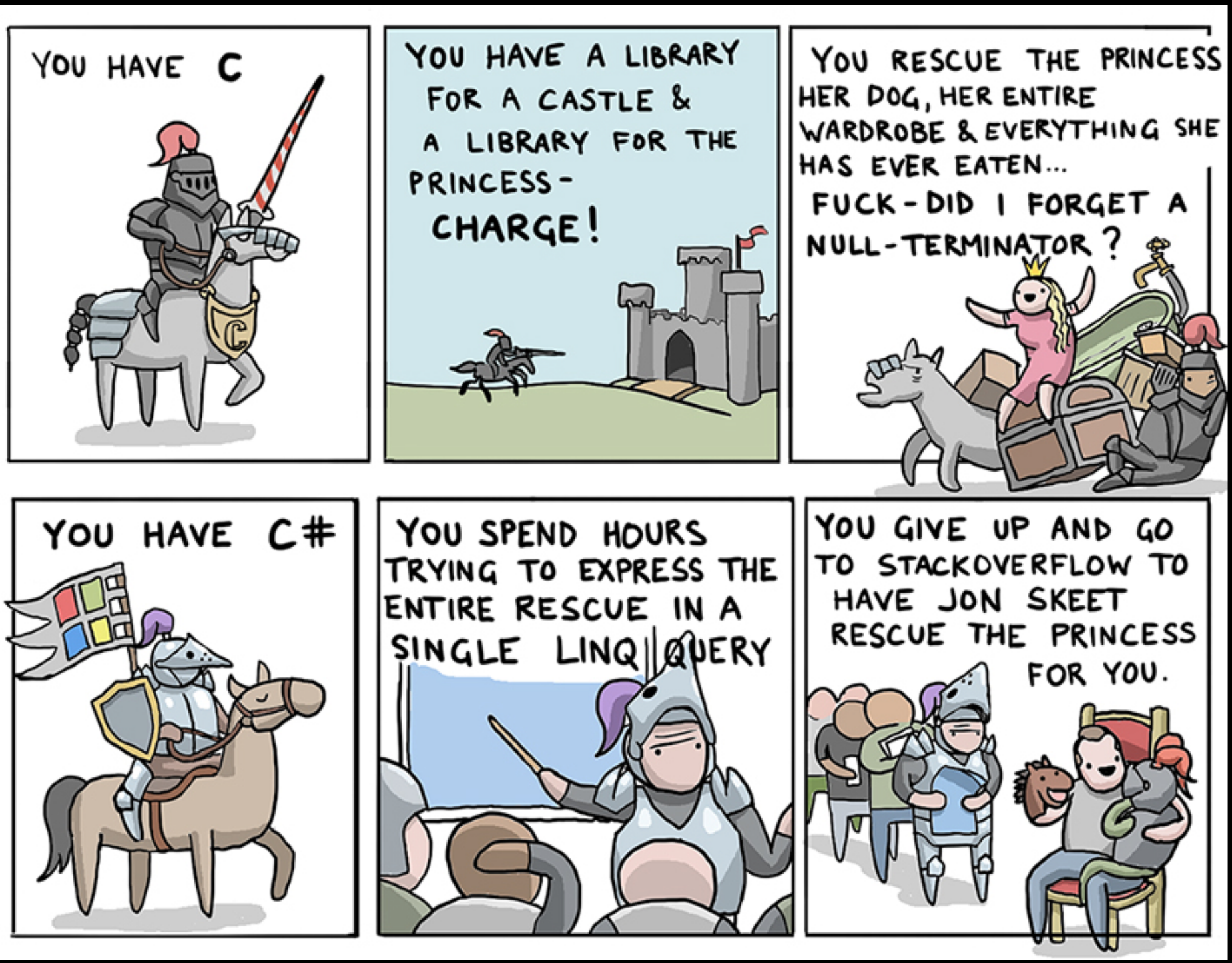
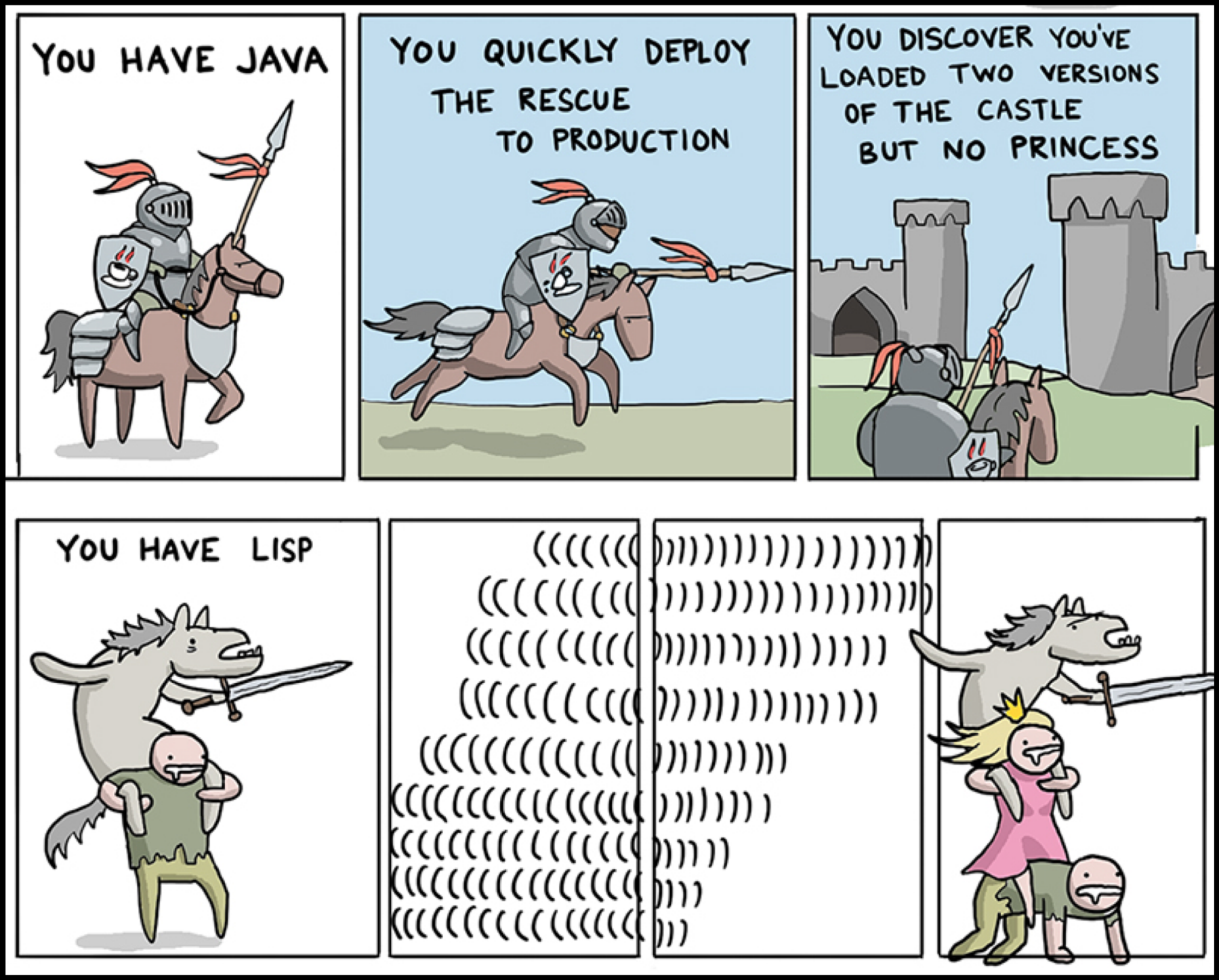
GIT THE PRINCESS!

HOW TO SAVE THE PRINCESS USING 8 PROGRAMMING LANGUAGES

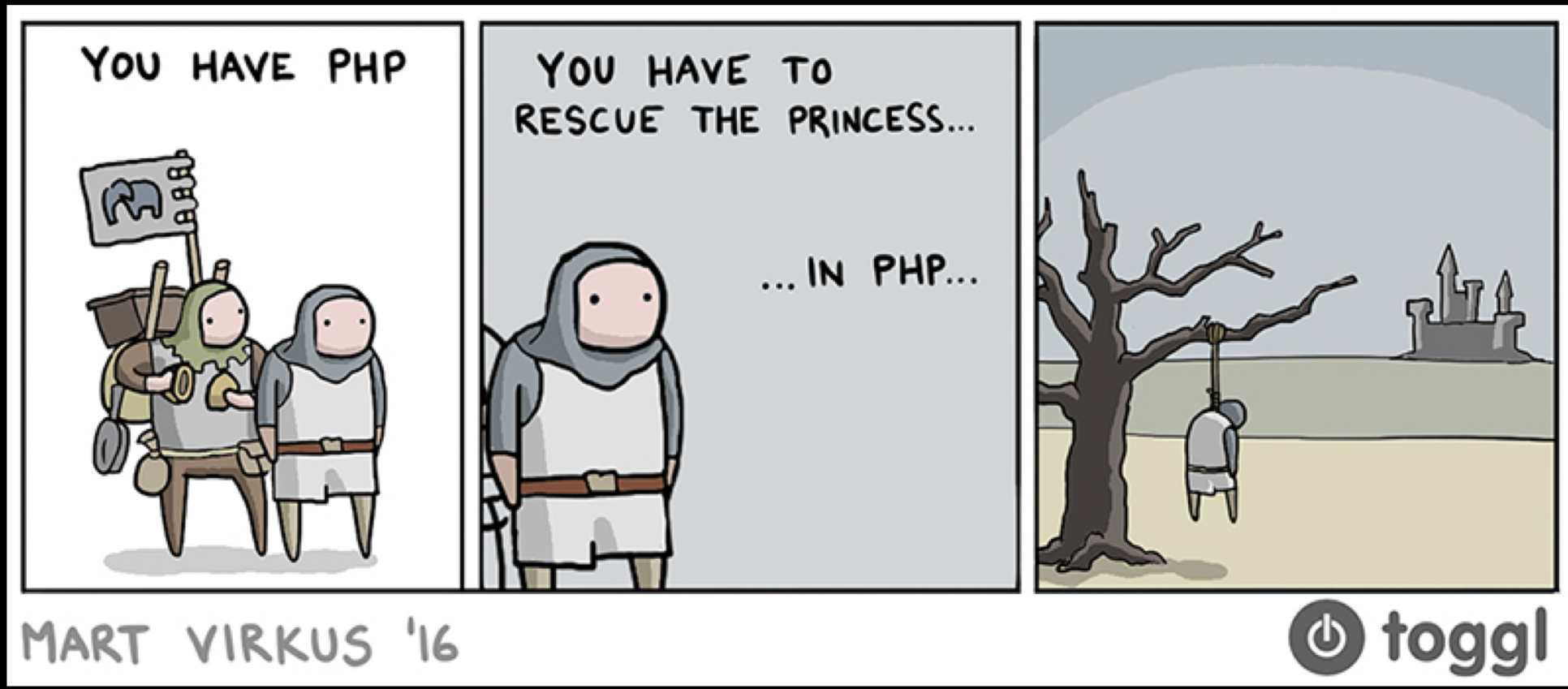
BY toggl Goon Squad




YOU HAVE C
YOU HAVE A LIBRARY FOR A CASTLE & A LIBRARY FOR THE PRINCESS-
CHARGE!
YOU RESCUE THE PRINCESS HER DOG, HER ENTIRE WARDROBE & EVERYTHING SHE HAS EVER EATEN...
FUCK - DID I FORGET A NULL-TERMINATOR?
YOU HAVE C#
YOU SPEND HOURS TRYING TO EXPRESS THE ENTIRE RESCUE IN A SINGLE LINQ QUERY
YOU GIVE UP AND GO TO STACKOVERFLOW TO HAVE JON SKEET RESCUE THE PRINCESS FOR YOU.


YOU HAVE JAVA
YOU QUICKLY DEPLOY THE RESCUE TO PRODUCTION
YOU DISCOVER YOU'VE LOADED TWO VERSIONS OF THE CASTLE BUT NO PRINCESS
YOU HAVE LISP


YOU HAVE GO
WE DON'T SUPPORT FREEING CAPTURED PRINCESSES, WE ALREADY HAVE THESE FREE PRINCESSES IN THE STANDARD LIBR...
...WAIT, IS THIS THE PRINCESS FROM THE JAVA PANEL?
YOU HAVE PASCAL
YOU DECLARE YOUR PRINCESS, CASTLE & RESCUE PLAN
THEN YOU GO FOR A DRINK & FORGET ABOUT THE IMPLEMENTATION


YOU HAVE PHP
YOU HAVE TO RESCUE THE PRINCESS...
...IN PHP...
MART VIRKUS '16
toggl

CS 152: *Programming Language Paradigms*

Syntax, Semantics, and Language Design Criteria

Prof. Tom Austin

San José State University

Lab 1 solution
(in class)

Formally defining a language

Two aspects of a language:

- *Syntax* – structure of a program
- *Semantics* – meaning of a program

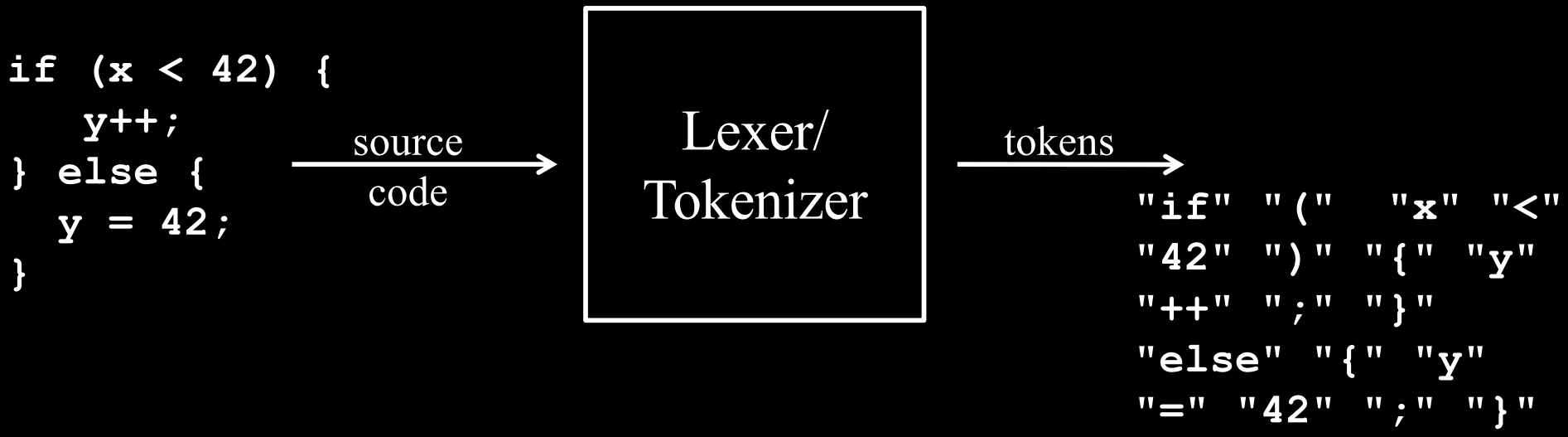
The two parts of syntax

- *Lexemes* or *tokens* – the "words" of the language
- *Grammar* – the way that words can be ordered

How a compiler works

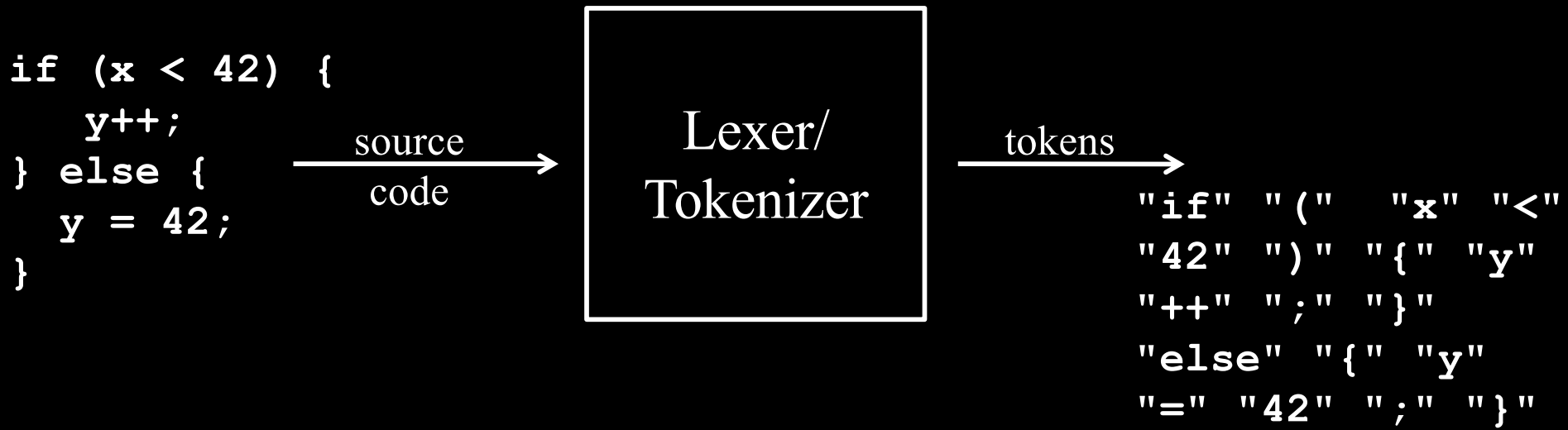
Tokens are the "words"
of the language.

How a compiler works



Tokens are the "words" of the language.

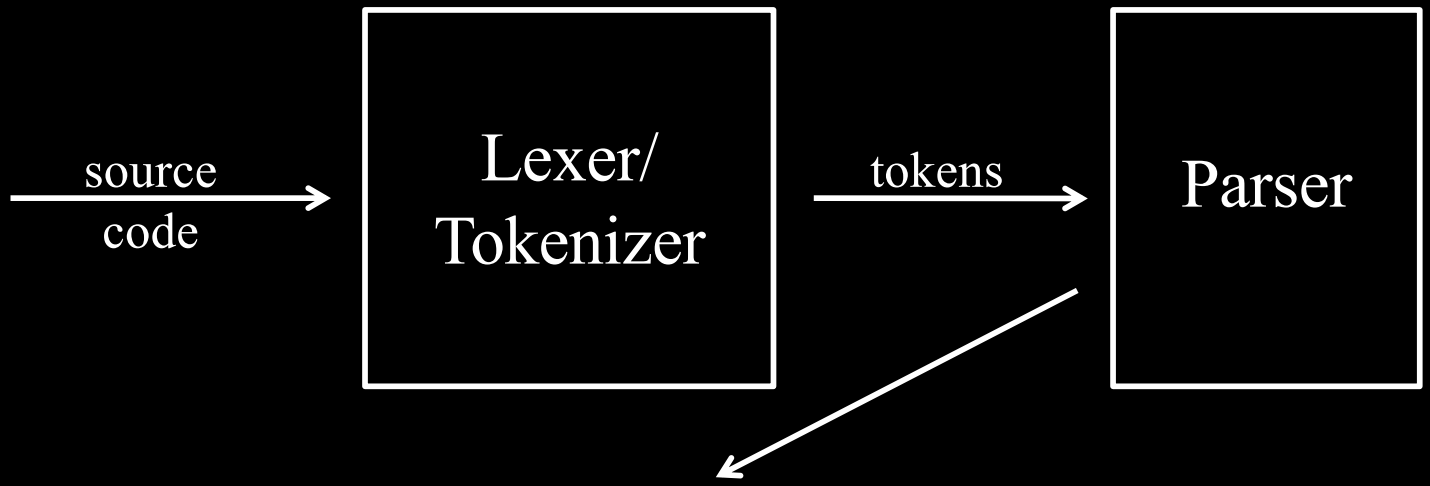
How a compiler works



Types of tokens:

- Identifiers
- Numbers
- Reserved words
- Special characters

How a compiler works

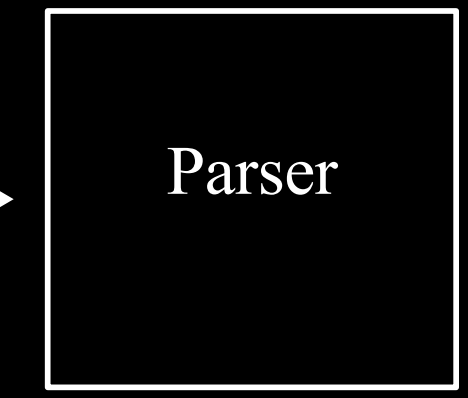


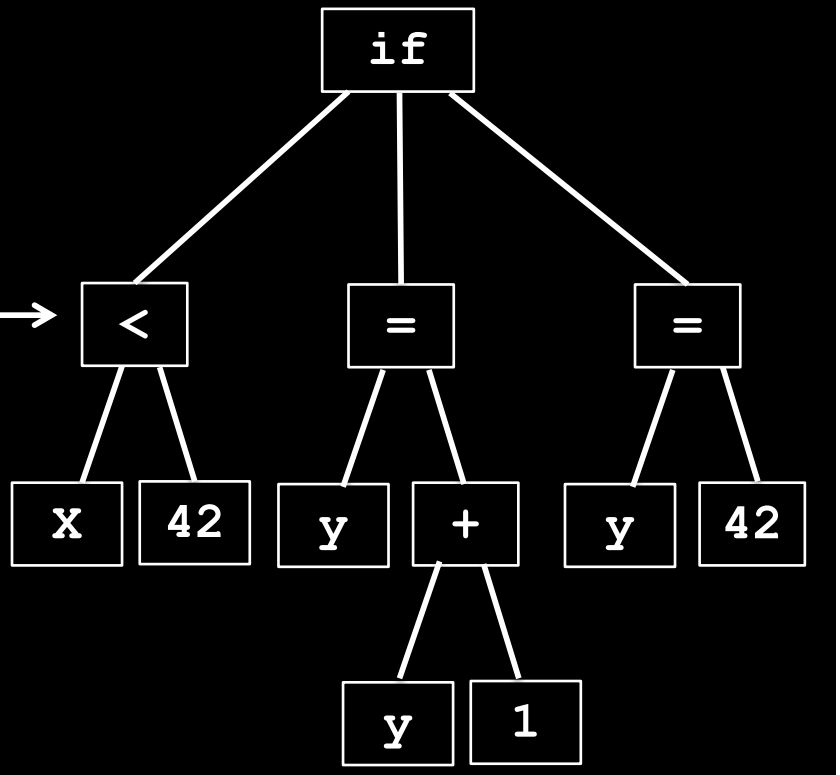
The parser reads tokens to form an *abstract syntax tree.*

Abstract Syntax Tree (AST)

Parsing Example

```
"if" "("  "x" "<"
"42" ")" "{" "y"
"++" ";" "}"
"else" "{" "y"
"=" "42" ";" "}"
```





y++ has disappeared in the AST.
'++' is an example of
syntactic sugar.

Formally defining language syntax

Context-free grammars define the structure of a language.

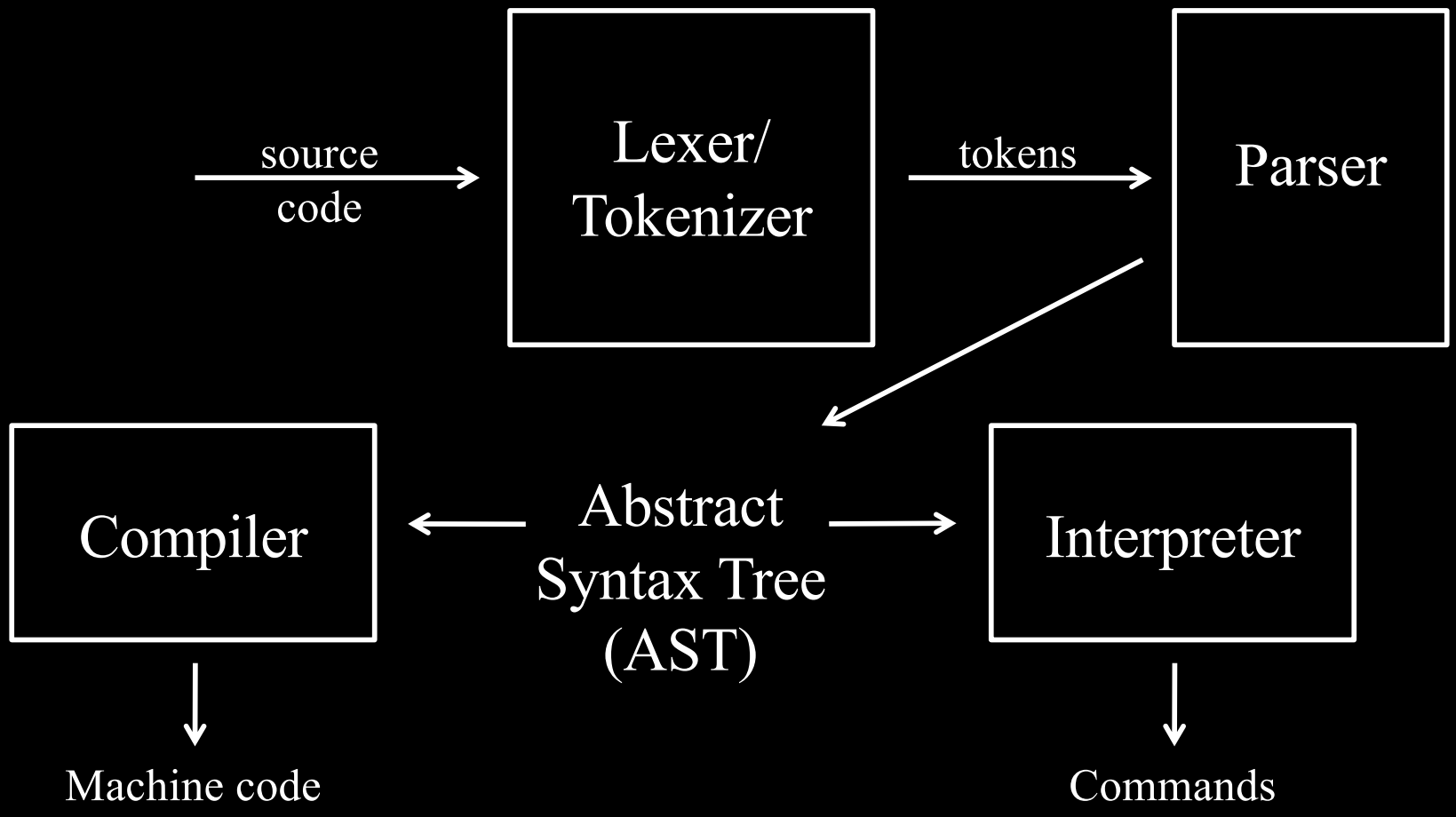
Backas-Naur Form (BNF) is a common notation.

Context-free grammar for math expressions (in BNF notation)

```
<expr> -> <expr> + <term>
        | <expr> - <term>
        | <term>

<term> -> <term> * <factor>
        | <term> / <factor>
        | <factor>
```

How a compiler works



Compilers and interpreters derive *meaning* from ASTs to turn programs into actions.

Covered another day

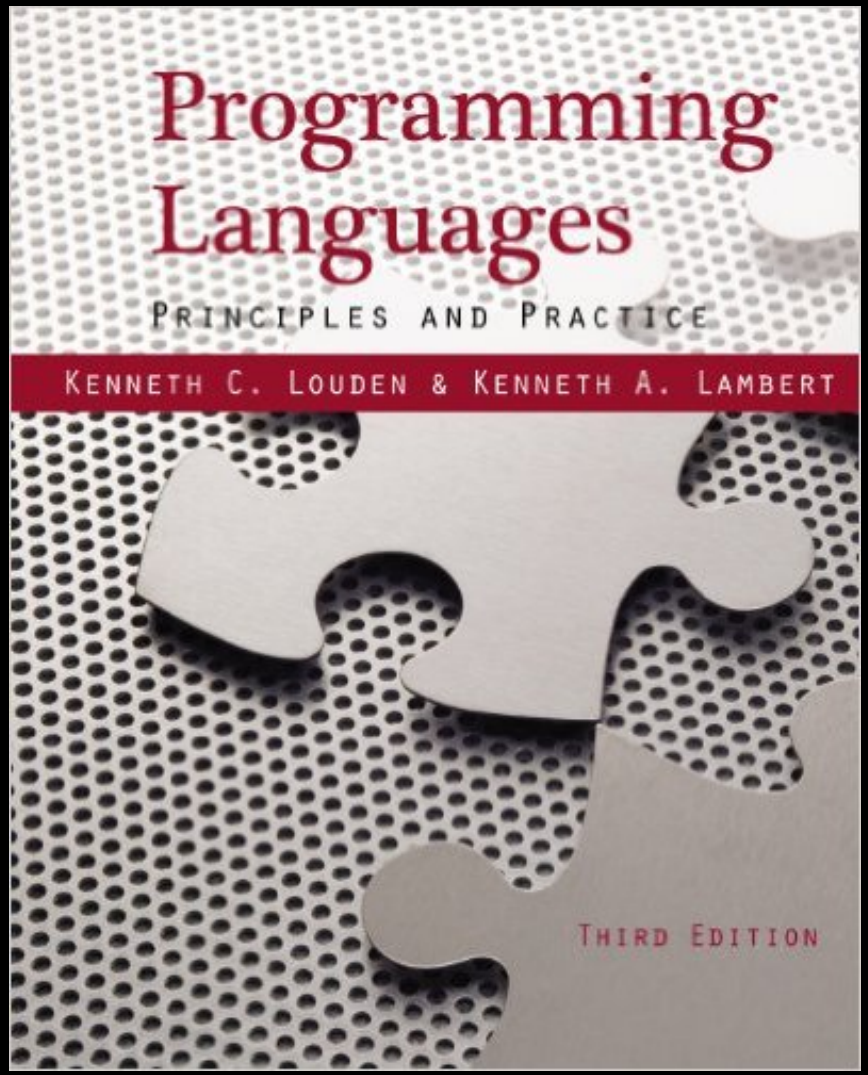
Formally defining language meaning:

- Operational semantics
- Denotational semantics
- Axiomatic semantics

Judging a language

Louden & Lambert's Design Criteria

1. Efficiency
2. Regularity
3. Security
4. Extensibility



Efficiency

- Machine efficiency
  - tips to the compiler
- Programmer efficiency
  - ease of writing programs
  - *expressiveness* (conciseness helps)
- Reliability
  - code maintenance

Efficiency

Java:

```
int i = 10;
String s = "hi";
```

Python:

```
i = 10
s = "hi"
```

- **Machine efficiency:**
  Java offers tips to the compiler
- **Programmer efficiency:**
  Python reduces the amount of typing required

Regularity

- **Generality:**
  - avoid special cases
  - favor general constructs
- **Orthogonal design:**
  - different constructs can be combined with no unexpected restrictions
- **Uniformity**
  - similar things look similar
  - different things look different

Bad uniformity example (PHP): Same things look different

Inconsistent function naming:

- `isset()`
- `is_null()`
- `strip_tags()`
- `stripslashes()`

Bad uniformity example (Pascal): Different things look the same

```
function f : boolean;
  begin
   ...
   f := true;
  end;
```

Security

- Stop programmer errors
  - or handle them gracefully
- Strong typing prevents some run-time errors.
- *Semantically-safe* languages
  - stop executing code violating language definition
  - Contrast array handling by Java and by C/C++

Safety (Java vs. Scheme)

Java:

```
int x = 4;
boolean b = true;
if (b) {
    x++;
} else {
    x = x / "2";
}
```

Scheme:

```
(let ([x 4]
      [b #t])
  (if b
     (+ 1 x)
     (/ x "2")))
```

Extensibility

Allows the programmer to add new language constructs easily.

Macros in Scheme are an example.

Before next class

Read Chapter 6 of *Teach Yourself Scheme*.

Lab 2: More Scheme practice

- Codecheck exercises (links on course webpage)
  - Implement `reverse` function
  - Implement `add-two-lists`
  - Implement `positive-nums-only`
- Using Louden & Lambert's criteria, compare Java & Scheme (or two languages of your choice)