

GET THE PRINCESS!

HOW TO SAVE THE PRINCESS
USING 8 PROGRAMMING
LANGUAGES

BY  togg
Goon Squad

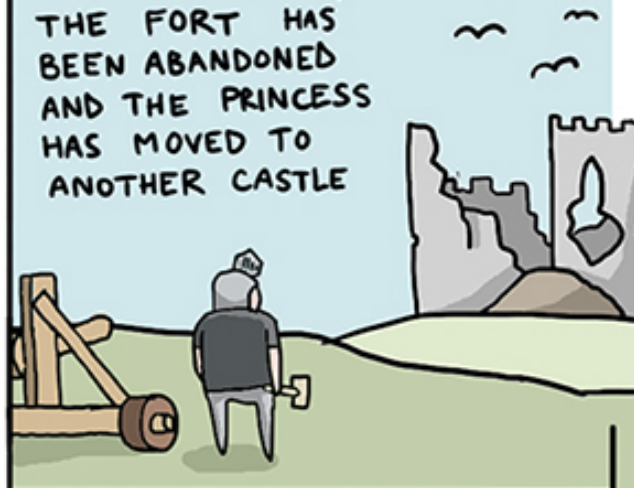
YOU HAVE JAVASCRIPT



YOU SPEND HOURS
PICKING LIBRARIES,
SETTING UP NODE &
BUILDING A FRAMEWORK
FOR THE CASTLE.



BY THE TIME
YOU'RE FINISHED WITH
THE FRAMEWORK,
THE FORT HAS
BEEN ABANDONED
AND THE PRINCESS
HAS MOVED TO
ANOTHER CASTLE



YOU HAVE C



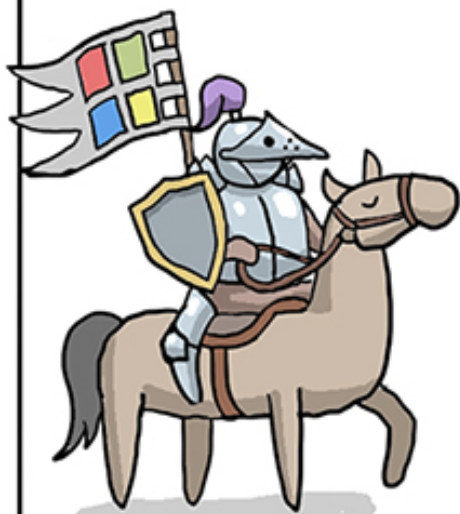
YOU HAVE A LIBRARY
FOR A CASTLE &
A LIBRARY FOR THE
PRINCESS-
CHARGE!



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



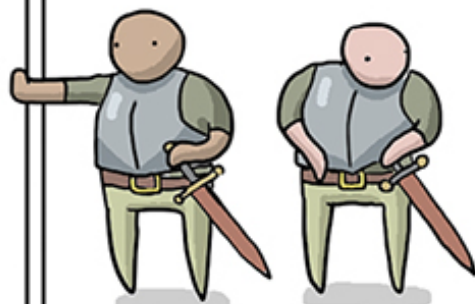
YOU GIVE UP AND GO
TO STACKOVERFLOW TO
HAVE JON SKEET
RESCUE THE PRINCESS
FOR YOU.



YOU HAVE 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

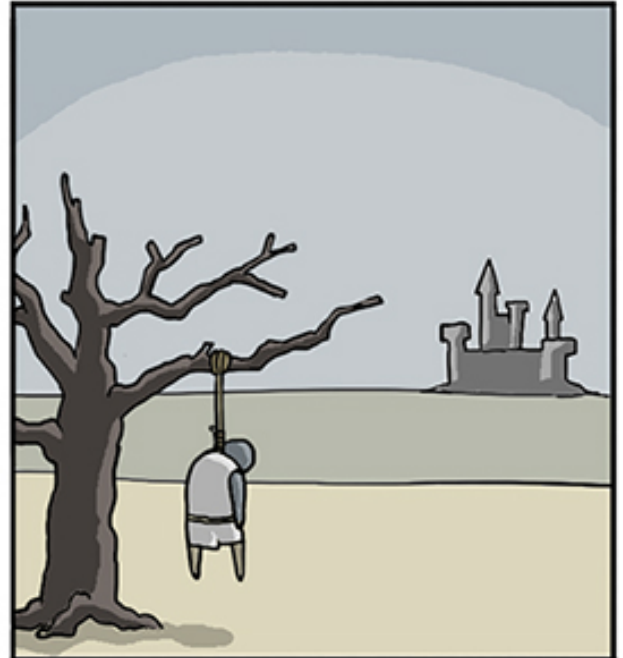


YOU HAVE PHP



YOU HAVE TO
RESCUE THE PRINCESS...

... IN PHP...



MART VIRKUS '16

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

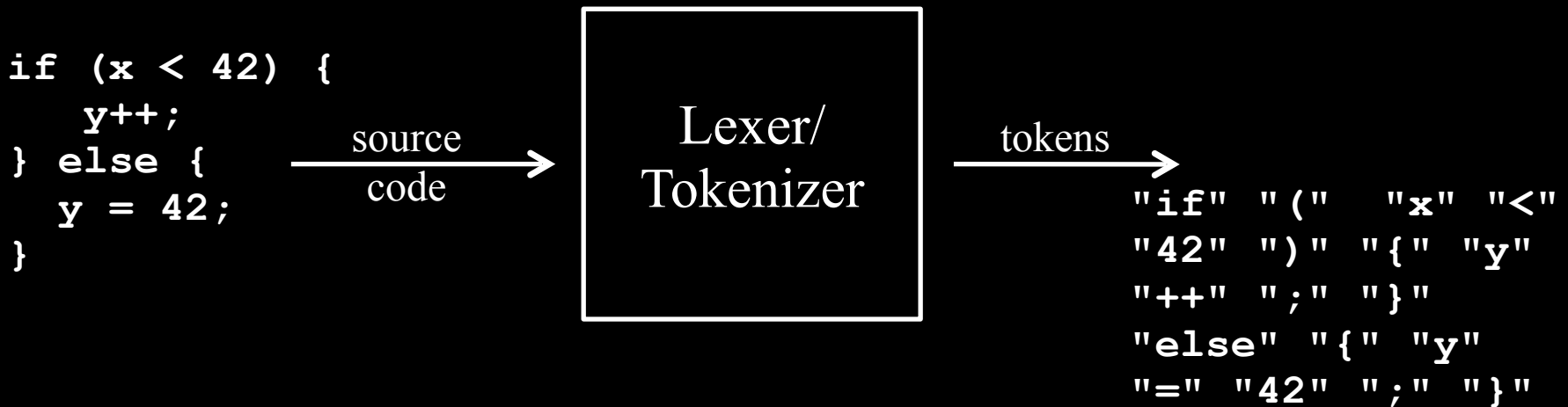
- *Lexemes* or *tokens* – the "words" of the language
- *Grammar* – the way that words can be ordered

How a compiler works



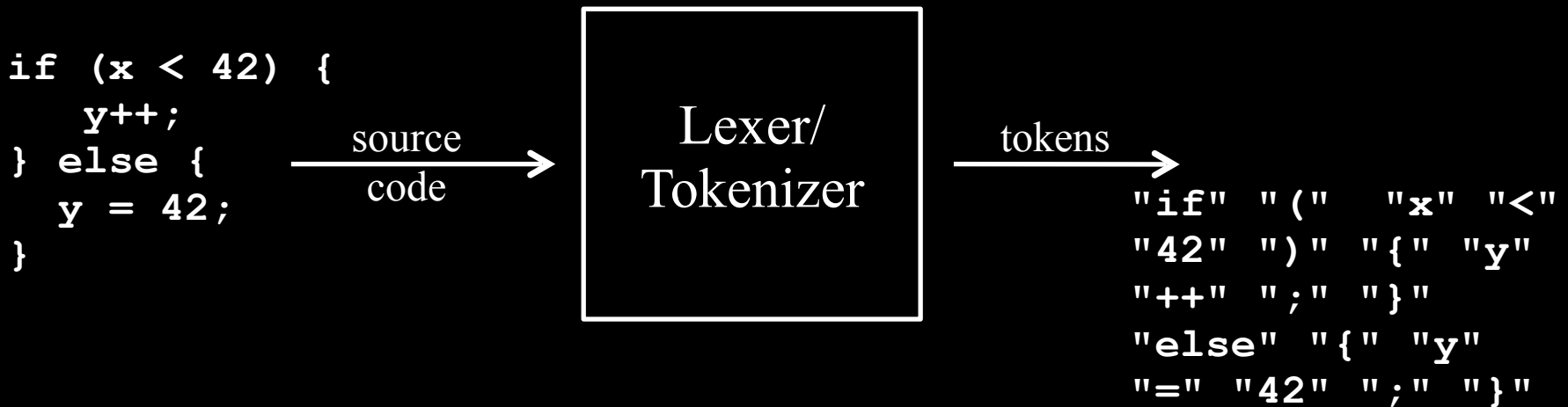
Tokens are the "words" of the language.

How a compiler works



Tokens are the "words"
of the language.

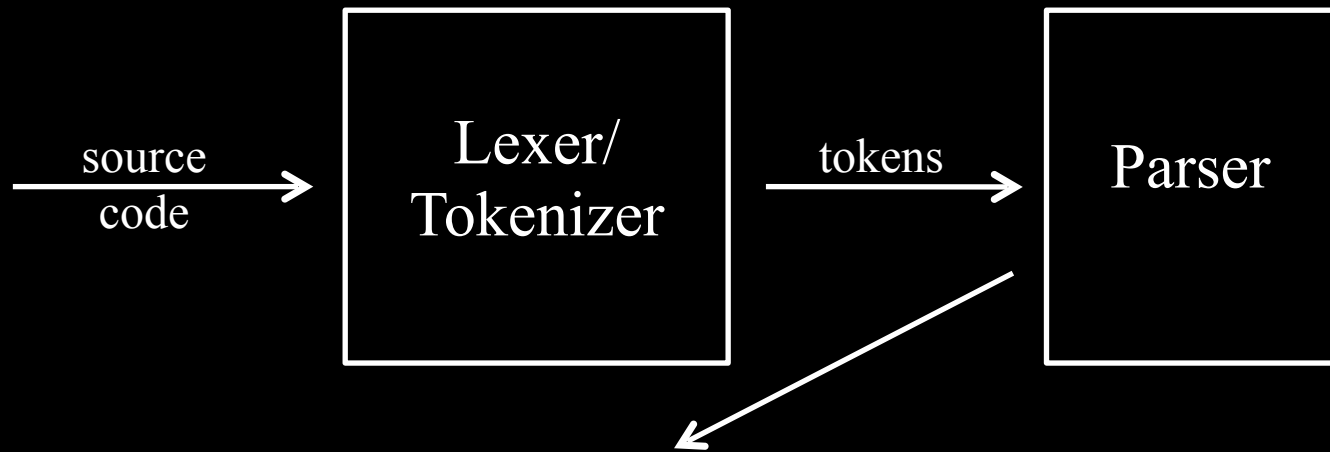
How a compiler works



Types of tokens:

- Identifiers
- Numbers
- Reserved words
- Special characters

How a compiler works

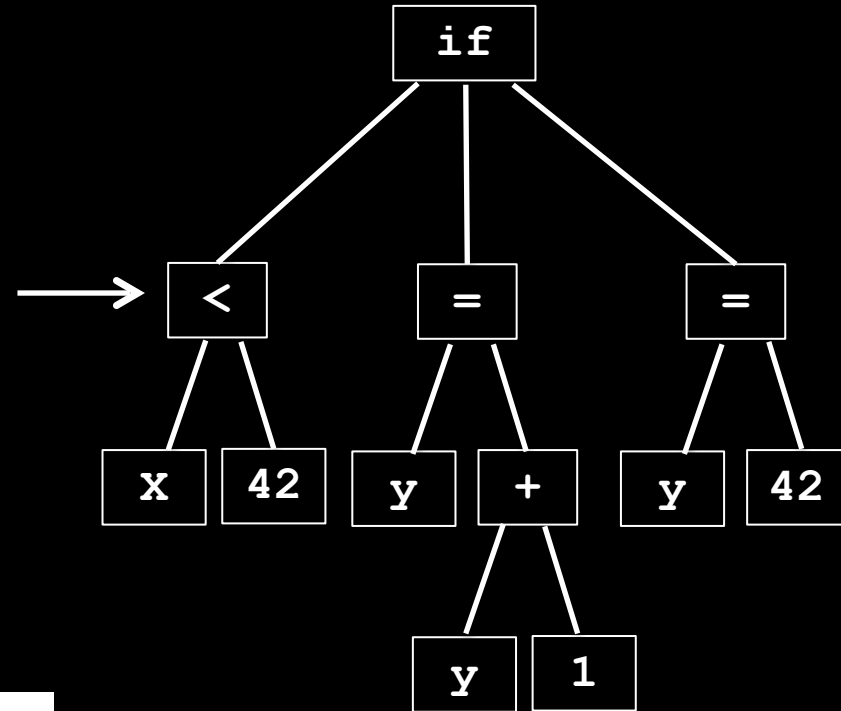
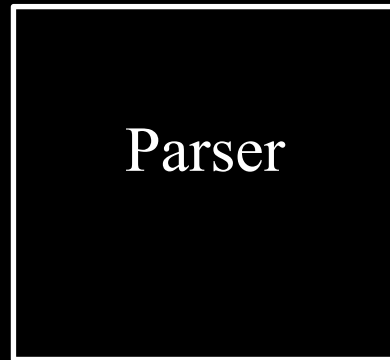


The parser reads tokens to form an *abstract syntax tree*.

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.



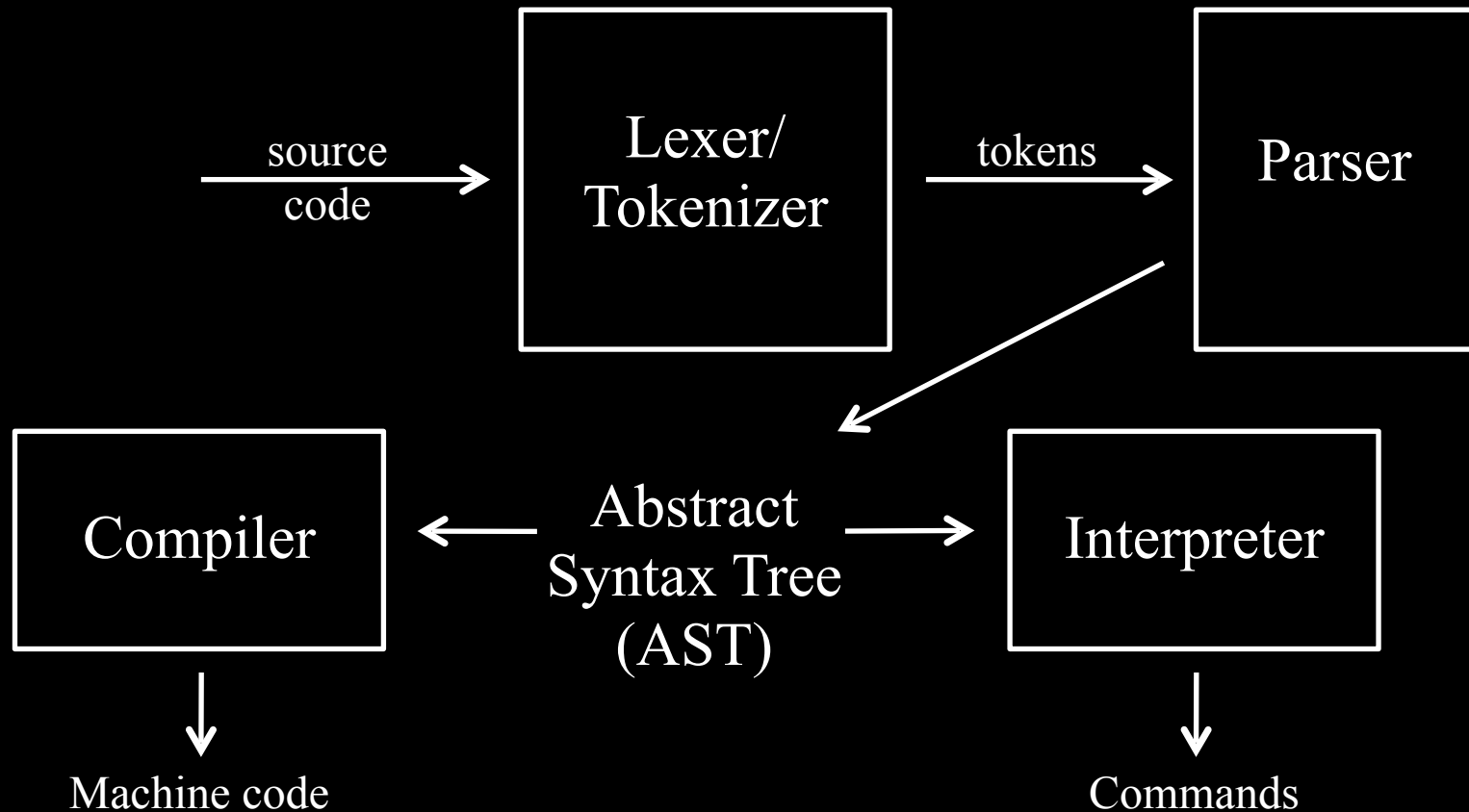
Backus-Naur Form (BNF) is a common notation.

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

$\langle \text{expr} \rangle \rightarrow \langle \text{expr} \rangle + \langle \text{term} \rangle$
 $\quad \quad \quad | \langle \text{expr} \rangle - \langle \text{term} \rangle$
 $\quad \quad \quad | \langle \text{term} \rangle$

$\langle \text{term} \rangle \rightarrow \langle \text{term} \rangle * \langle \text{factor} \rangle$
 $\quad \quad \quad | \langle \text{term} \rangle / \langle \text{factor} \rangle$
 $\quad \quad \quad | \langle \text{factor} \rangle$

How a compiler works



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

Covered another day

Formally defining language meaning:

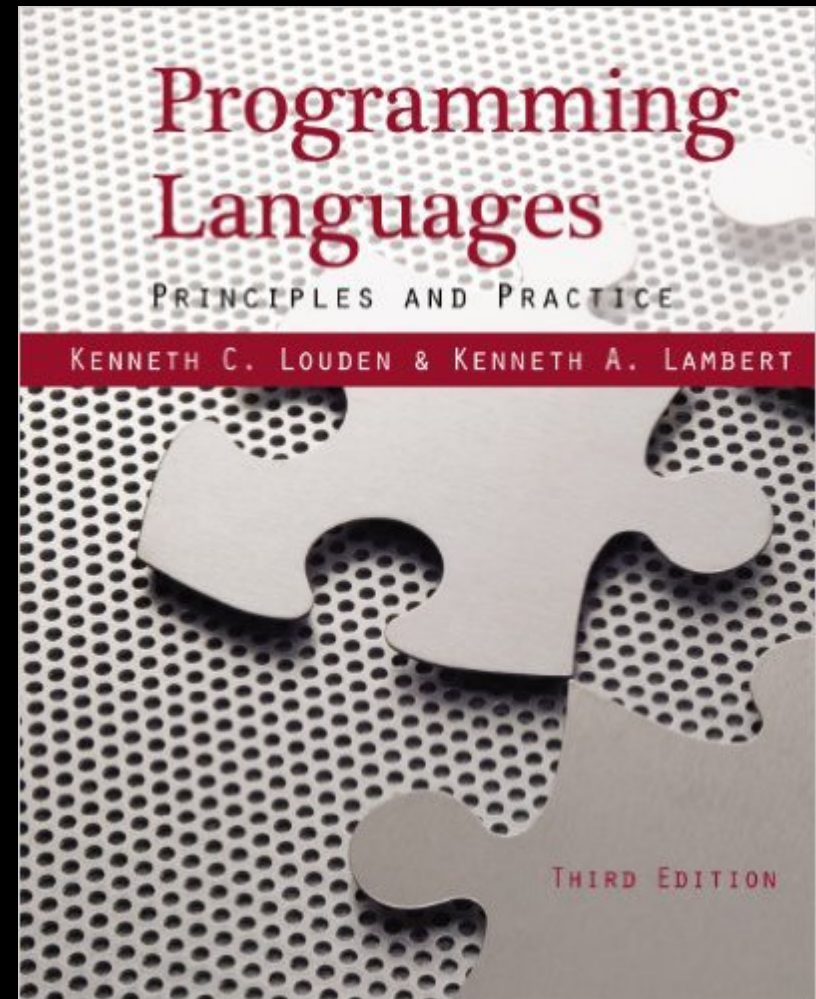
- Operational semantics
- Denotational semantics
- Axiomatic semantics

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()`



PHP

TRAINING WHEELS WITHOUT THE BIKE

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

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



Return value is true

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)