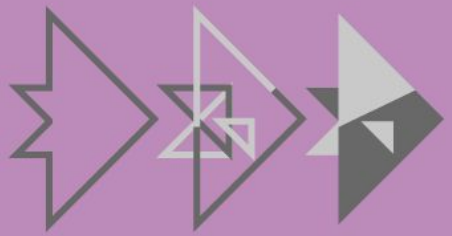
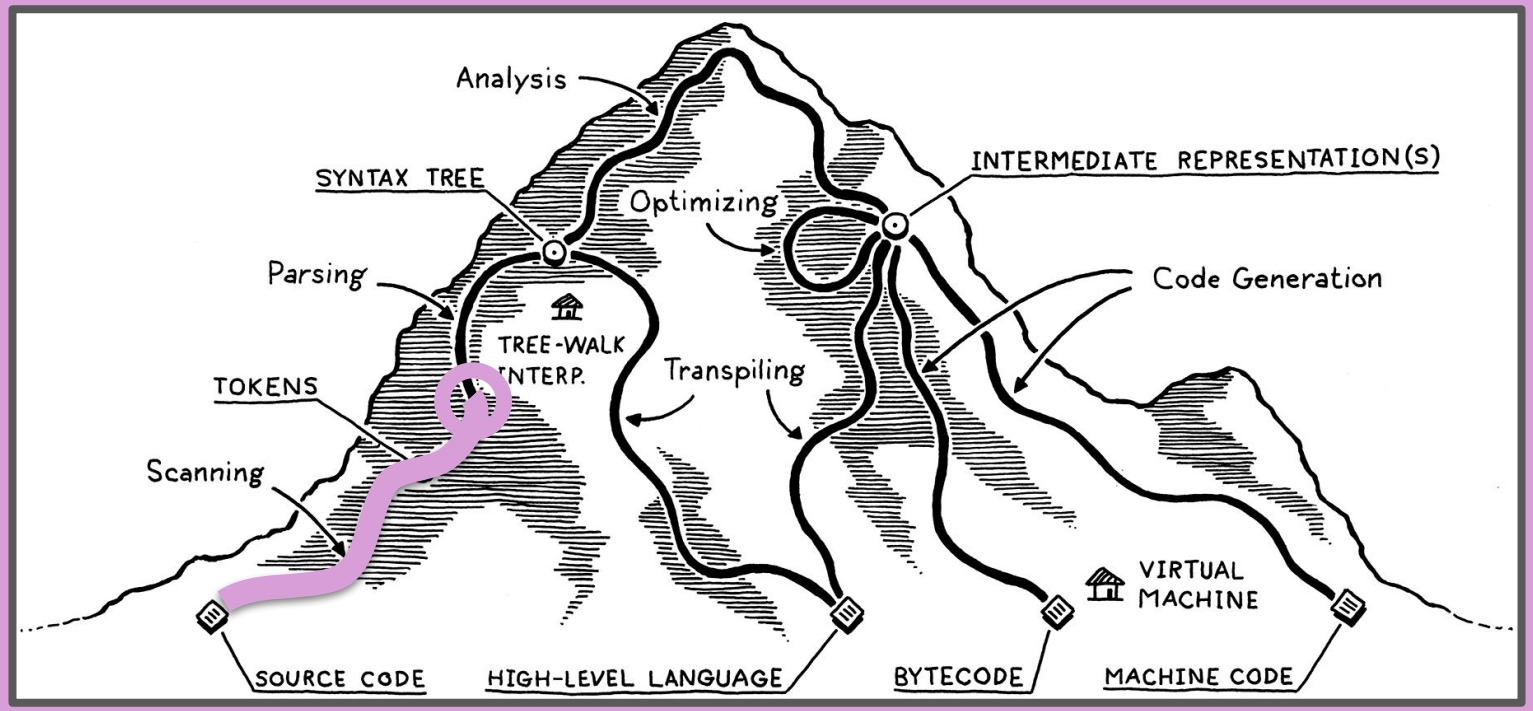
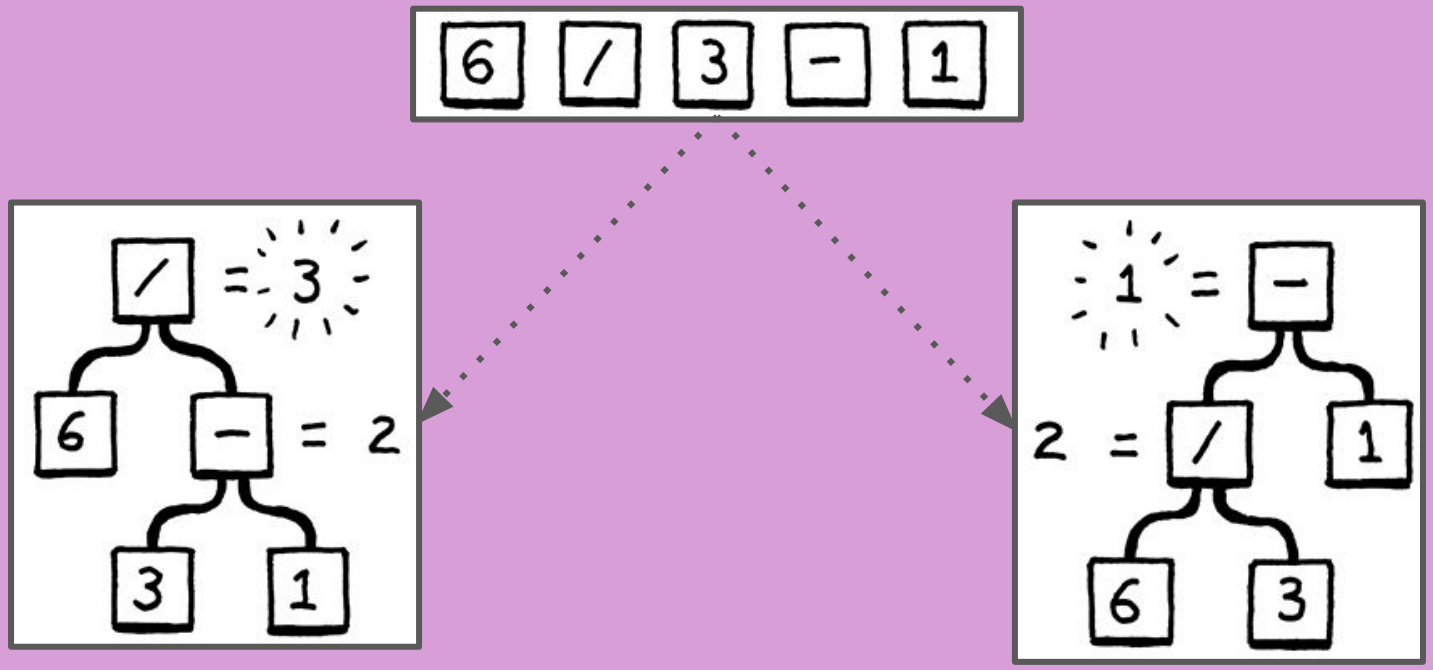


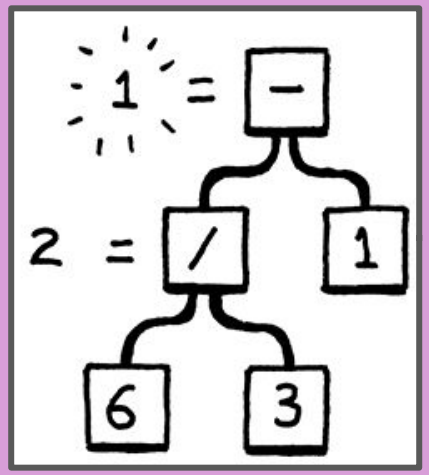
CMPSC 201: PROGRAMMING LANGUAGES


Analysis
SYNTAX TREE
Optimizing
INTERMEDIATE REPRESENTATION(S)
Parsing
Code Generation
TREE-WALK
INTERP.
TOKENS
Transpiling
Scanning
VIRTUAL
MACHINE
SOURCE CODE
HIGH-LEVEL LANGUAGE
BYTECODE
MACHINE CODE

Precedence



Precedence

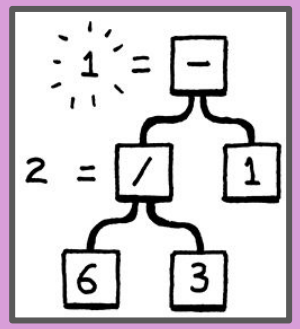


(6 / 3) - 1

Agreed upon order of operations; higher-order operators happen first.

Precedence vs. Associativity

Precedence



Agreed upon order of operations; higher-order operators happen first.

Associativity

```
5 - 3 - 1
```

```
(5 - 3) - 1
```

How operators of the *same precedence* are grouped in the absence of clear grouping

Precedence vs. Associativity

Precedence

```
8 / 2 / ( 2 / 2 )
```

Associativity

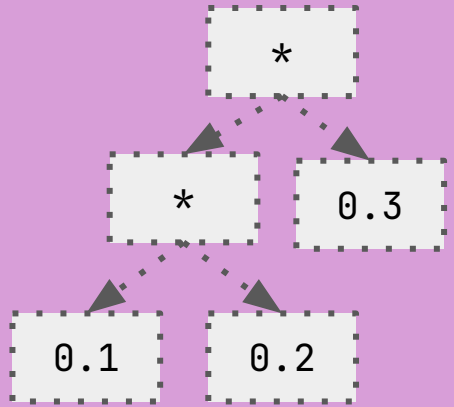
```
8 / 2 / 2 / 2
```

Associativity?

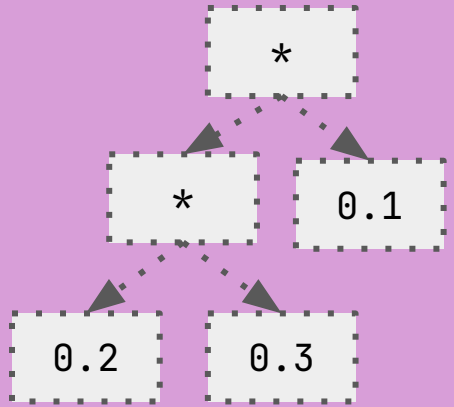
Lox is left-associative. But does it matter?

Consider:

```
print 0.1 * 0.2 * 0.3;
```



(0.1 * 0.2) * 0.3



0.1 * (0.2 * 0.3)

Associativity vs. Assignment

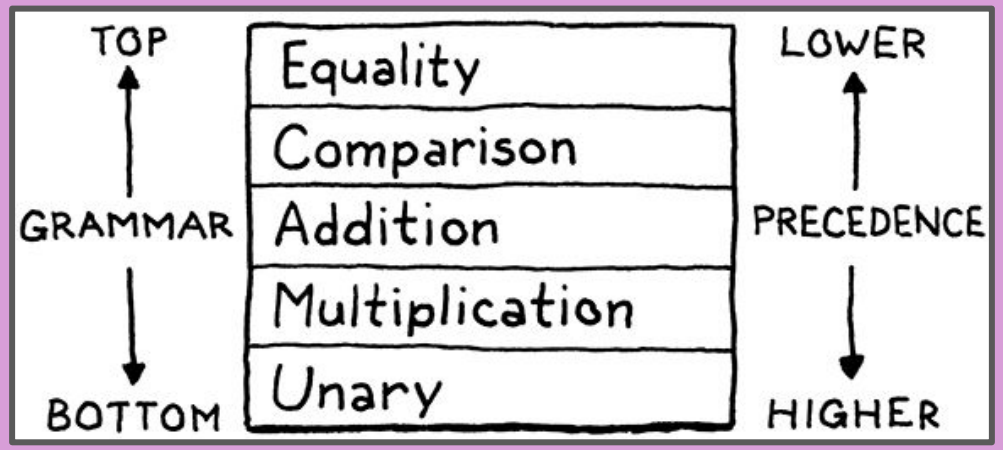
Associativity vs. Assignment

Expression	Steps		Valid?
`a = b = c`	`b = c`	`a = b`	✓
`(a = b) = c`	`?`	`?`	✗
`a < b < c`	`b < c`	`a < b`	✓
	`(a < b) and (b < c)`		

Precedence, Associativity, Assignment

Precedence	Associativity	Assignment
Agreed upon order of operations; higher-order operators happen first	How operators of the same precedence are grouped in the absence of clear grouping	Order in which expressions are evaluated such that a production rule can only ever produce one unambiguous outcome
Implemented at the level of the grammar	Implemented by the order of the grammar productions	Implemented language-wide

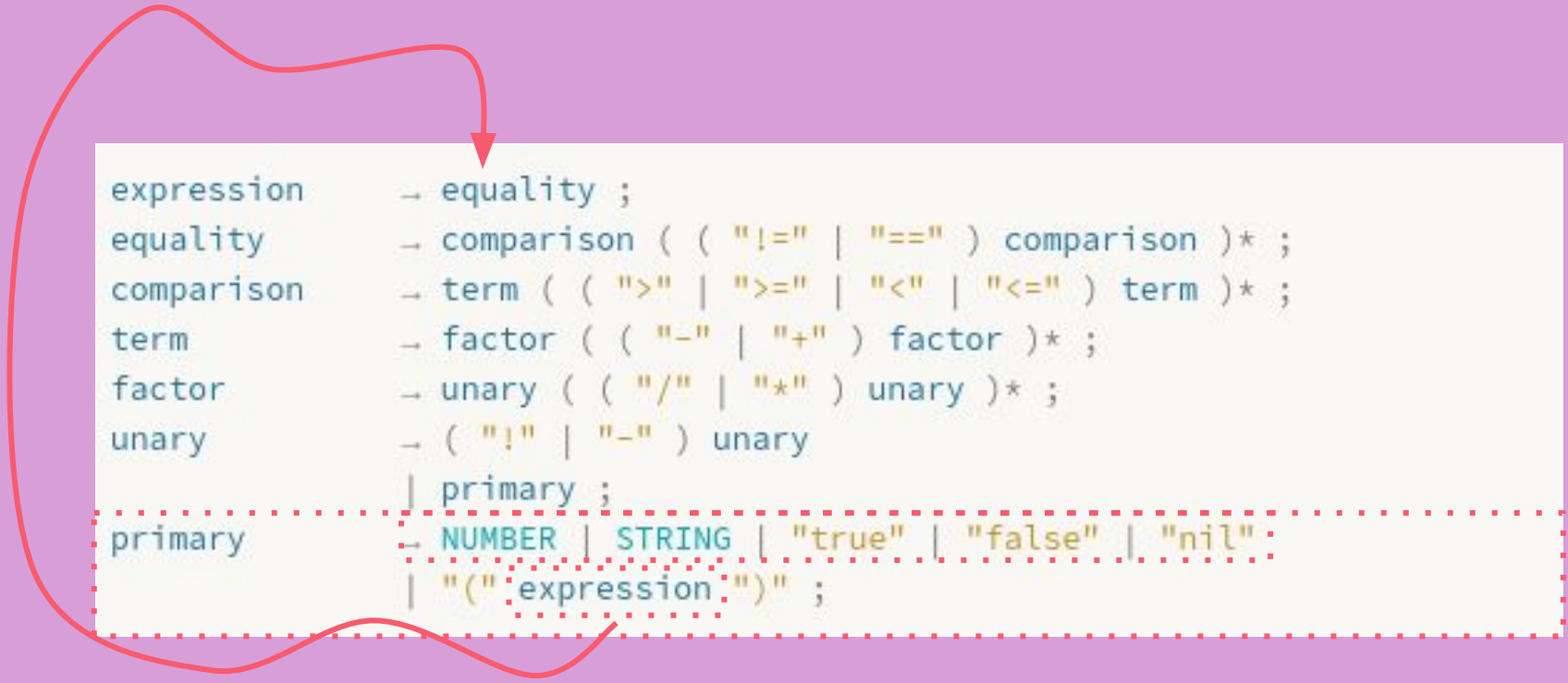
Effect of precedence on Lox



Lox and precdence

Functions	Function bodies
expression	→ equality ;
equality	→ comparison (("!=" | "==") comparison)* ;
comparison	→ term ((">" | ">=" | "<" | "<=") term)* ;
term	→ factor (("-" | "+") factor)* ;
factor	→ unary (("/" | "*") unary)* ;
unary	→ ("!" | "-") unary | primary ;
primary	→ NUMBER | STRING | "true" | "false" | "nil" | "(" expression ")" ;

Lox and precdence



Lox, associatvity and precedence