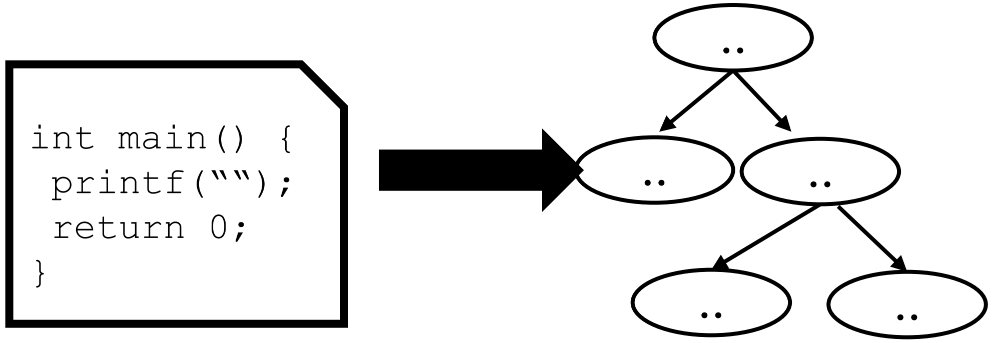
CSE110A: Compilers



```
int main() {
 printf(“”);
 return 0;
}
```

Topics:

Right / Left Derivations

Some Definitions

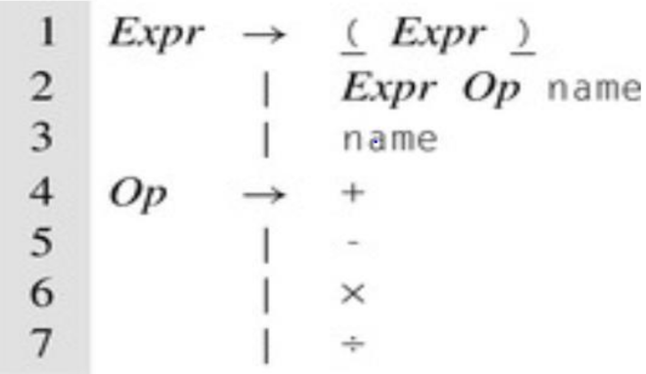
Context Free Grammar: Formally, a context-free grammar *G* is a quadruple (*T*, *NT*, *S*, *P*) where: T is a set of terminals, NT is a set of non-terminals, S is a Start symbol, and P a set of Productions all for language L(G).

Ambiguity: A grammar *G* is *ambiguous* if some sentence in *L*(*G*) has more than one rightmost (or leftmost) derivation.

Sentential Form: a string of symbols that occurs as one step in a valid derivation

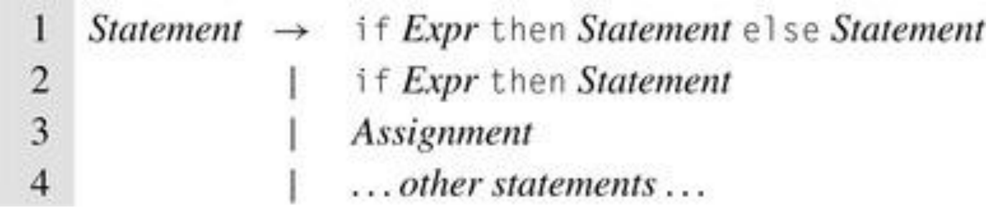
Derivation: a sequence of rewriting steps that begins with the grammar's start symbol and ends with a sentence in the language

Sentence: a string of symbols that can be derived from the rules of a grammar, i.e. a sentential form without non-terminals.



1	*Expr*	→	(*Expr*)
2		|	*Expr* *Op* name
3		|	name
4	*Op*	→	+
5		|	-
6		|	×
7		|	÷

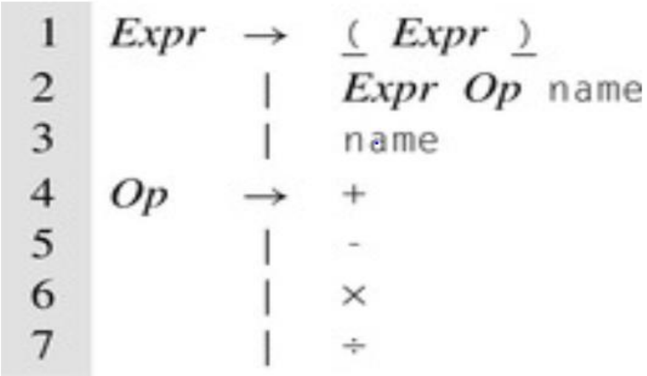
BNF grammar for Expressions



1	*Statement*	→	if *Expr* then *Statement* else *Statement*
2		|	if *Expr* then *Statement*
3		|	*Assignment*
4		|	*. . . other statements . . .*

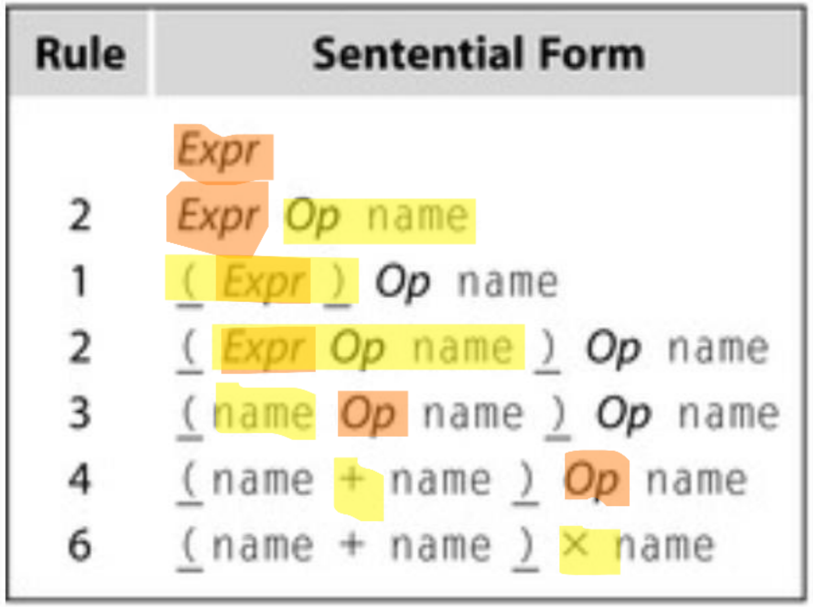
Classical ambiguous grammar from Algol 60

Leftmost and Rightmost Derivations



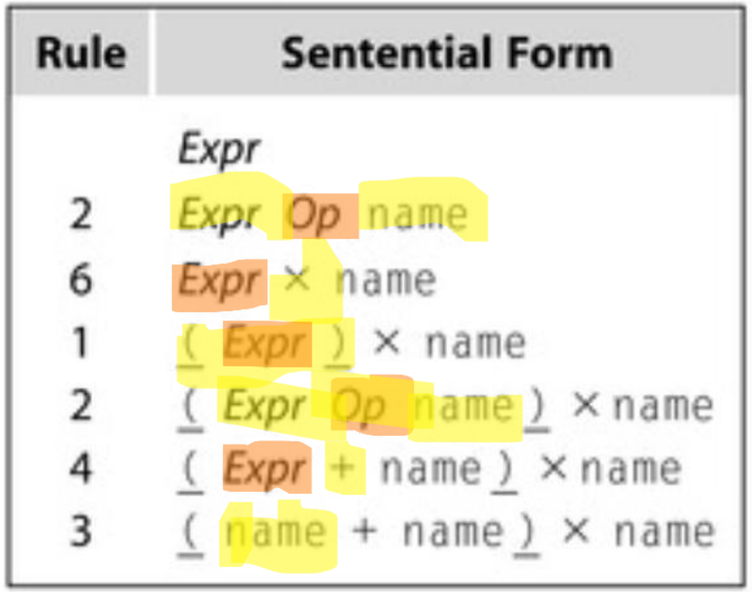
1	*Expr*	→	(*Expr*)
2		|	*Expr* *Op* name
3		|	name
4	*Op*	→	+
5		|	-
6		|	×
7		|	÷

Note that leftmost derivations tend to be right associative
Rightmost derivations left associative.



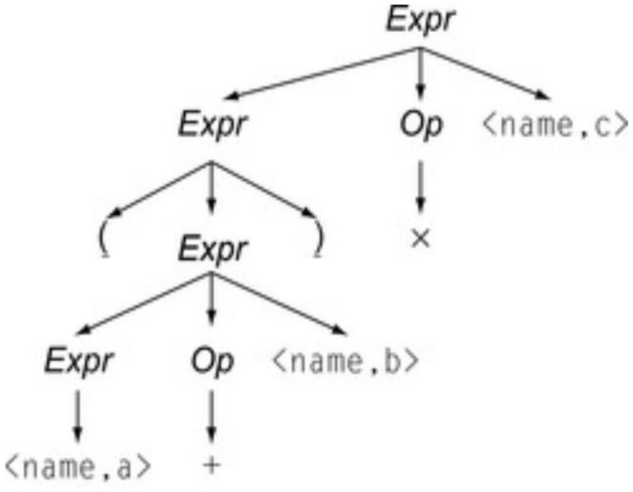
Rule	Sentential Form
	Expr
2	*Expr* *Op* name
1	(*Expr*) *Op* name
2	(*Expr* *Op* name) *Op* name
3	(name *Op* name) *Op* name
4	(name + name) *Op* name
6	(name + name) × name

Leftmost Derivation of (a + b) x c



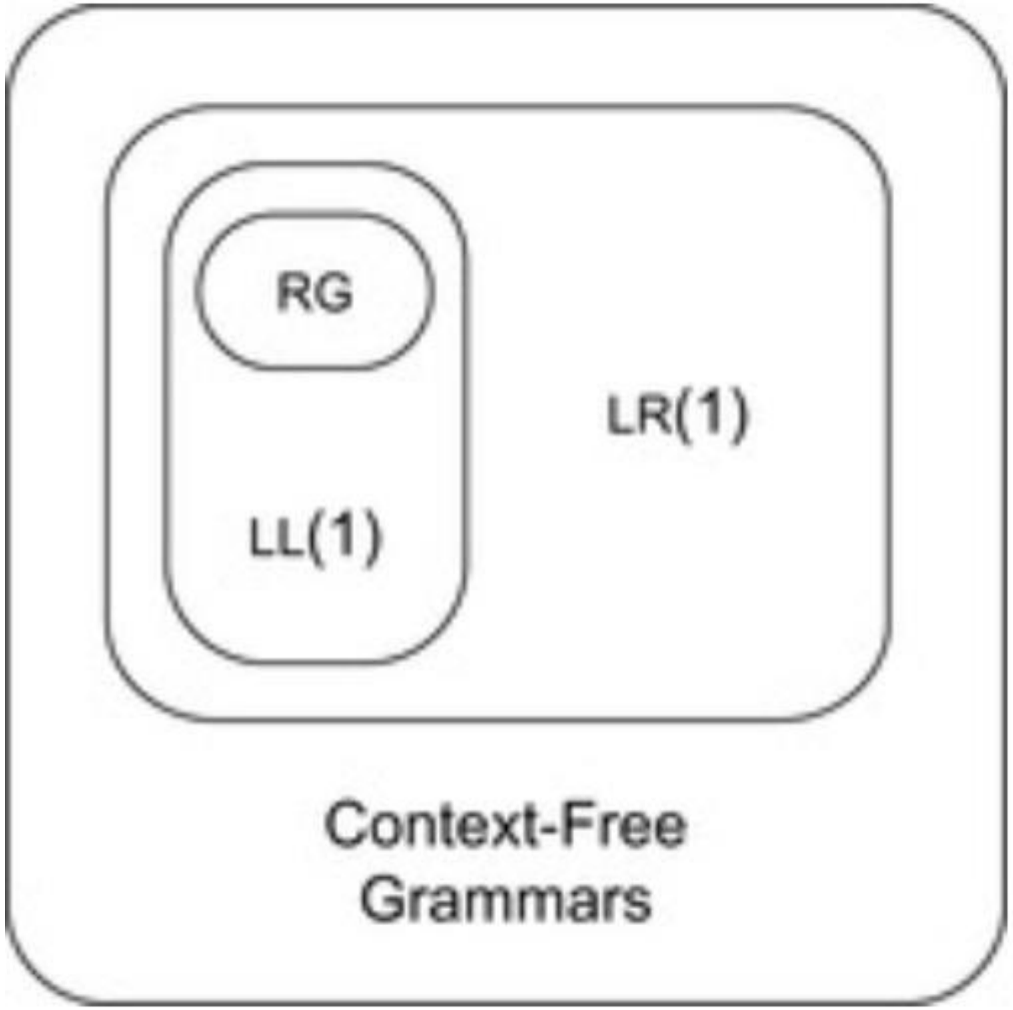
Rule	Sentential Form
	Expr
2	*Expr* *Op* name
6	*Expr* × name
1	(*Expr*) × name
2	(*Expr* *Op* name) × name
4	(*Expr* + name) × name
3	(name + name) × name

Rightmost Derivation of (a + b) × c



Corresponding Parse Tree

CFG Hierarchy Based on Difficulty of Parsing Grammars



RG: Regular languages

LL(1): Left-to-Right Left-Derivation (Top-Down)

LR(1): Left-to-Right, Right Derivation in Reverse (Bottom-Up)

The 1 indicates 1 token look-ahead