Ambiguous Grammars

Definitions

- If a grammar has more than one leftmost derivation for a single *sentential form*, the grammar is *ambiguous*
- If a grammar has more than one rightmost derivation for a single sentential form, the grammar is *ambiguous*
- The leftmost and rightmost derivations for a sentential form may differ, even in an unambiguous grammar
  - However, they must have the same parse tree!

Classic example — the *if-then-else* problem

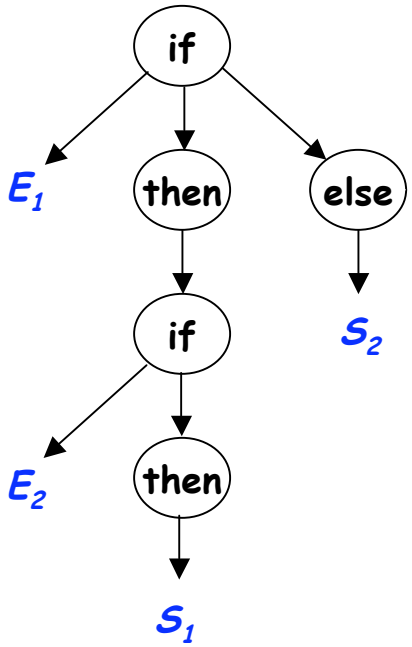
Stmt → if *Expr* then *Stmt*
| if *Expr* then *Stmt* else *Stmt*
| *… other stmts …*

This ambiguity is entirely grammatical in nature

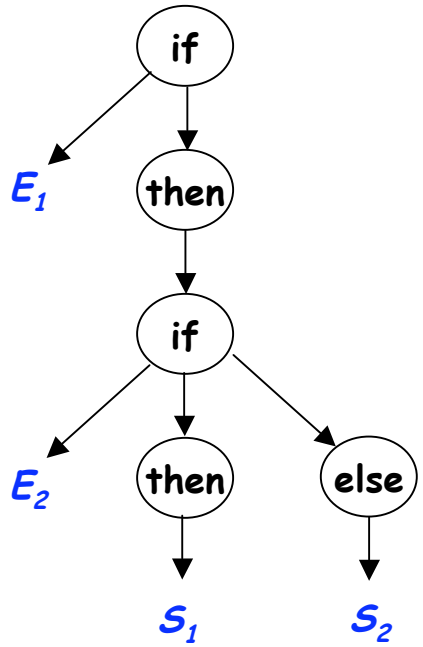
Ambiguity

This sentential form has two derivations

if $Expr_1$ then if $Expr_2$ then $Stmt_1$ else $Stmt_2$



production 2, then production 1



production 1, then production 2

Ambiguity

Removing the ambiguity

- Must rewrite the grammar to avoid generating the problem
- Match each else to innermost unmatched if *(common sense rule)*

1	*Stmt*	→	if *Expr* then *Stmt*
2		|	if *Expr* then *WithElse* else *Stmt*
3		|	*Other Statements*
4	*WithElse*	→	if *Expr* then *WithElse* else *WithElse*
5		|	*Other Statements*

With this grammar, example has only one rightmost derivation

Intuition: once into *WithElse*, we cannot generate an unmatched else

… a final if without an else can only come through rule 2 …

Ambiguity

if $Expr_1$ then if $Expr_2$ then $Stmt_1$ else $Stmt_2$

Rule	Sentential Form
—	*Stmt*
1	if *Expr* then *Stmt*
2	if *Expr* then if *Expr* then *WithElse* else *Stmt*
3	if *Expr* then if *Expr* then *WithElse* else S_2
5	if *Expr* then if *Expr* then S_1 else S_2
?	if *Expr* then if E_2 then S_1 else S_2
?	if E_1 then if E_2 then S_1 else S_2

some other production

This grammar has only one rightmost derivation for the example