

Ex: FOLLOW sets calculation

$S \rightarrow A \mathbf{b}$

$A \rightarrow \mathbf{a} \mid B \mid \epsilon$ $flws_0$:

$B \rightarrow \mathbf{b} \mid \epsilon$

S	$\epsilon, \mathbf{b}$
A	
B	

$flws_1$:

S	$\epsilon, \mathbf{b}$
A	$\mathbf{a}$
B	

$flws_2$:

S	$\epsilon, \mathbf{b}$
A	$\mathbf{a}$
B	$\mathbf{b}$

$flws_3$:

S	$\epsilon, \mathbf{b}$
A	$\mathbf{a}$
B	$\mathbf{b}$

FIRST:

S	$\mathbf{a}, \mathbf{b}$
A	$\mathbf{a}, \mathbf{b}, \epsilon$
B	$\mathbf{b}, \epsilon$

Putting it all together (cont.)

- Consider:

$$\begin{aligned}
 E &\rightarrow T E' \\
 E' &\rightarrow \epsilon \mid + E \\
 T &\rightarrow P T' \\
 T' &\rightarrow \epsilon \mid * T \\
 P &\rightarrow \text{id} \mid (E)
 \end{aligned}$$

- We have previously calculated:

FIRST:

E	id, (
E'	•, +
T	id, (
T'	•, *
P	id, (

FOLLOW:

E	eof,)
E'	eof,)
T	+, eof,)
T'	+, eof,)
P	+, eof,)

Putting it all together (cont.)

- Calculate set F for each right-hand side:

$$F_{E,1} = \{ \text{id}, (\}$$

$$F_{E',1} = \{ \bullet, \text{eof},) \} \quad F_{E',2} = \{ + \}$$

$$F_{T,1} = \{ \text{id}, (\}$$

$$F_{T',1} = \{ \bullet, +, \text{eof},) \} \quad F_{T',2} = \{ * \}$$

$$F_{P,1} = \{ \text{id} \} \quad F_{P,2} = \{ (\}$$

- Is this grammar LL(1)?

Yes. For each non-terminal A ,
all $F_{A,i}$ are disjoint.

Another example: FIRST sets

$S \rightarrow A B A \mid c C$

$A \rightarrow a \mid \epsilon$

$B \rightarrow b D \mid \epsilon$

$C \rightarrow A D \mid b$

$D \rightarrow a A \mid c$

FIRSTS(ABA)



*firsts*₀:

<i>S</i>	
<i>A</i>	
<i>B</i>	
<i>C</i>	
<i>D</i>	

*firsts*₁:

<i>S</i>	<i>c</i>
<i>A</i>	<i>a, ∅</i>
<i>B</i>	<i>b, ∅</i>
<i>C</i>	<i>b</i>
<i>D</i>	<i>a, c</i>

*firsts*₂:

<i>S</i>	<i>a, b, ∅, c</i>
<i>A</i>	<i>a, ∅</i>
<i>B</i>	<i>b, ∅</i>
<i>C</i>	<i>a, c, b</i>
<i>D</i>	<i>a, c</i>



*firsts*₃:

<i>S</i>	<i>a, b, ∅, c</i>
<i>A</i>	<i>a, ∅</i>
<i>B</i>	<i>b, ∅</i>
<i>C</i>	<i>a, c, b</i>
<i>D</i>	<i>a, c</i>

Another example (cont.): FOLLOW sets

$S \rightarrow A B A \mid c C$

$A \rightarrow a \mid \epsilon$

$B \rightarrow b D \mid \epsilon$

$C \rightarrow A D \mid b$

$D \rightarrow a A \mid c$

FIRST:

S	a, b, •, c
A	a, •
B	b, •
C	a, b, c
D	a, c

$$F_{S,1} = \text{FIRST}(ABA) \cup \text{FOLLOW}(S) = \{a, b, \epsilon, \text{eof}\}$$

$$F_{S,2} = \text{FIRST}(cA) = \{c\}$$

$$F_{A,1} = \text{FIRST}(a) = \{a\}$$

$$F_{A,2} = \text{FIRST}(\epsilon) \cup \text{FOLLOW}(A) = \{\epsilon, a, b, c, \text{eof}\}$$

$flws_0$:

S	eof
A	
B	
C	
D	

$flws_1$:

S	eof
A	a, b, eof, c
B	a, eof
C	eof
D	

$flws_2$:

S	eof
A	a, b, eof, c
B	a, eof
C	eof
D	a, eof

=

$flws_3$:

S	eof
A	a, b, eof, c
B	a, eof
C	eof
D	a, eof

Consider aba:

