



Análise Sintáctica

Compiladores, Aula Nº 16
João M. P. Cardoso

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Analizador Sintáctico Descendente

- Mecanismo Central
 - Autómato Pushdown, que implementa
 - Parser Shift-reduce

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Autômato Push-Down

- Constituído por
 - Pilha Pushdown (pode conter terminais e não-terminais)
 - Controlo por um autômata de estados finitos
- Pode realizar uma de três acções:
 - Shift:
 - Desloca símbolo corrente da entrada para a pilha
 - Reduce:
 - Se o(s) símbolo(s) no topo da pilha “casa(m)” RHS de alguma das produções da gramática
 - Pop (retirar) esses símbolos da pilha
 - Push não-terminal do LHS para a pilha
 - Aceita a entrada como pertencendo à linguagem

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Exemplo: Parser Shift-Reduce

Pilha

$Expr \rightarrow Expr Op Expr$
 $Expr \rightarrow (Expr)$
 $Expr \rightarrow - Expr$
 $Expr \rightarrow num$
 $Op \rightarrow +$
 $Op \rightarrow -$
 $Op \rightarrow *$

String de entrada

num	*	(num	+	num)
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Exemplo: Parser Shift-Reduce

$Expr \rightarrow Expr \ Op \ Expr$
 $Expr \rightarrow (Expr)$
 $Expr \rightarrow - \ Expr$
 $Expr \rightarrow num$
 $Op \rightarrow +$
 $Op \rightarrow -$
 $Op \rightarrow *$

num	*	(num	+	num)
-----	---	---	-----	---	-----	---

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Exemplo: Parser Shift-Reduce

$Expr \rightarrow Expr \ Op \ Expr$
 $Expr \rightarrow (Expr)$
 $Expr \rightarrow - \ Expr$
 $Expr \rightarrow num$
 $Op \rightarrow +$
 $Op \rightarrow -$
 $Op \rightarrow *$

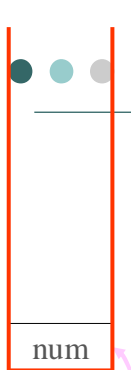
SHIFT

num	*	(num	+	num)
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Exemplo: Parser Shift-Reduce



num

SHIFT

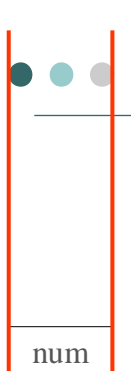
$Expr \rightarrow Expr \text{ Op } Expr$
 $Expr \rightarrow (Expr)$
 $Expr \rightarrow - Expr$
 $Expr \rightarrow num$
 $Op \rightarrow +$
 $Op \rightarrow -$
 $Op \rightarrow *$

*	(num	+	num)
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Exemplo: Parser Shift-Reduce



num

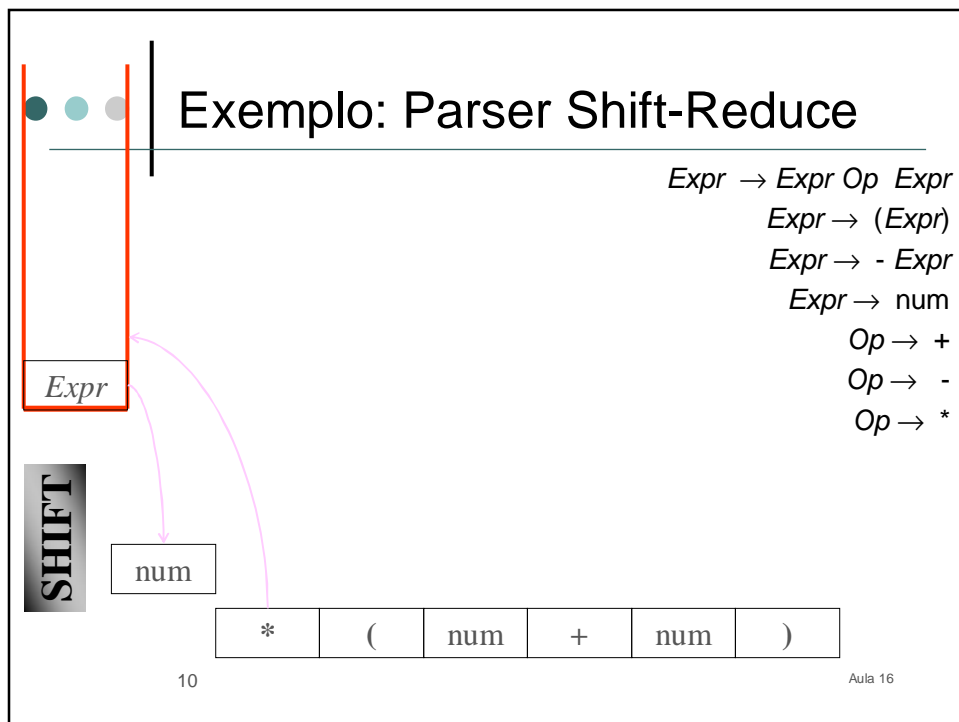
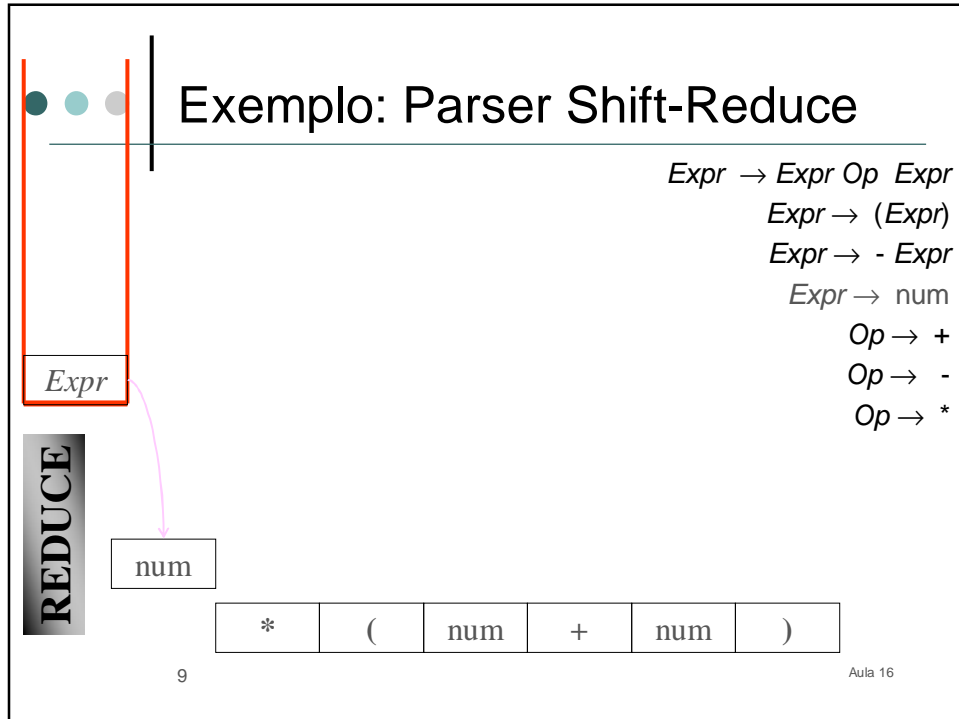
REDUCE

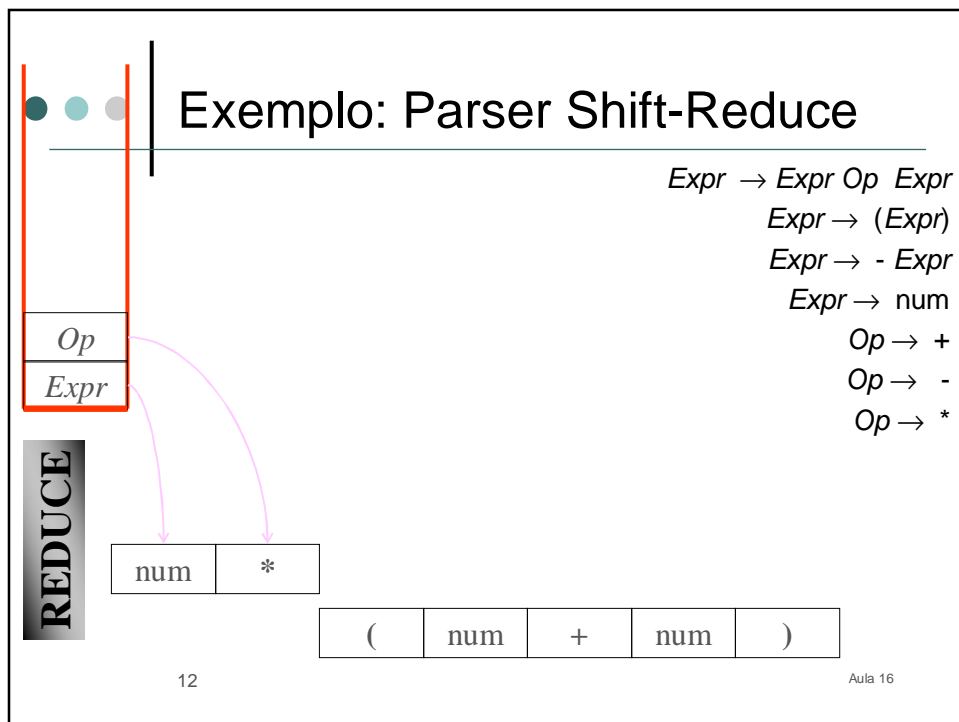
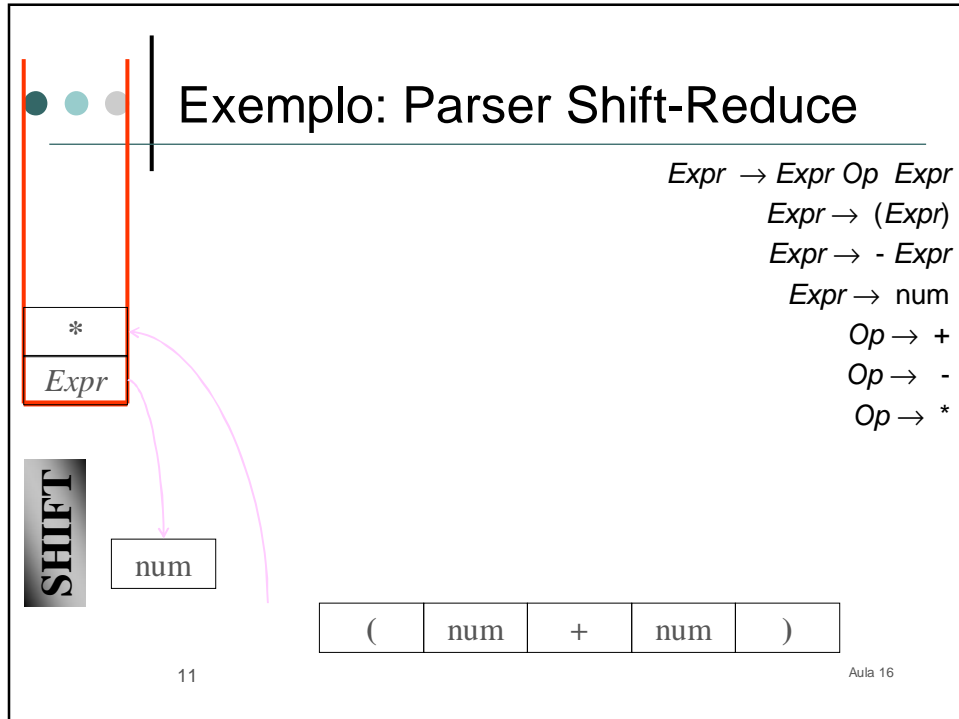
$Expr \rightarrow Expr \text{ Op } Expr$
 $Expr \rightarrow (Expr)$
 $Expr \rightarrow - Expr$
 $Expr \rightarrow num$
 $Op \rightarrow +$
 $Op \rightarrow -$
 $Op \rightarrow *$

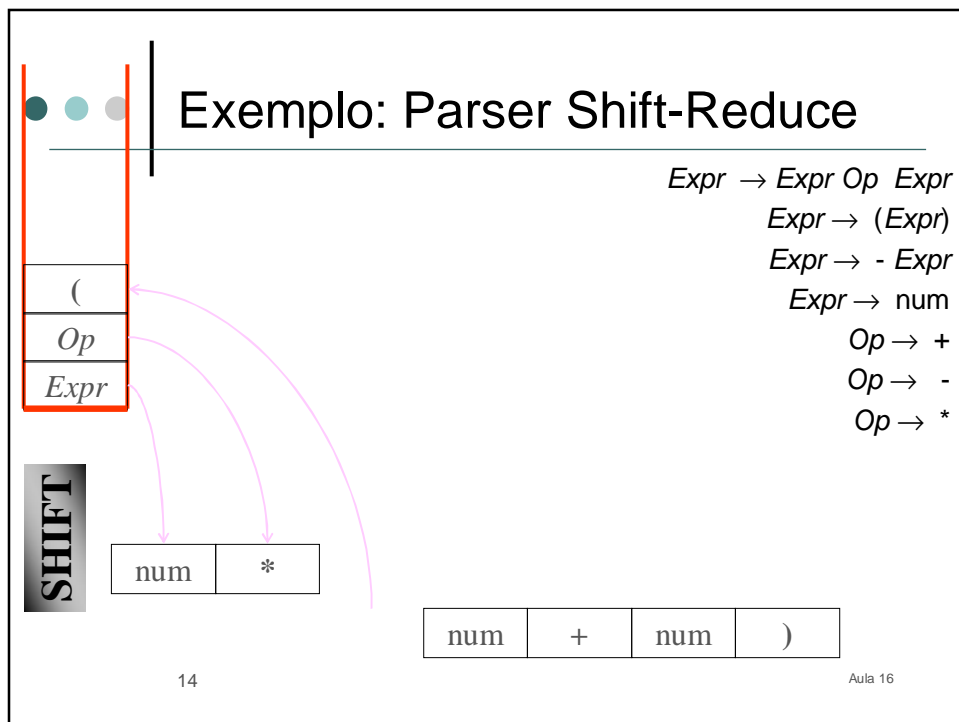
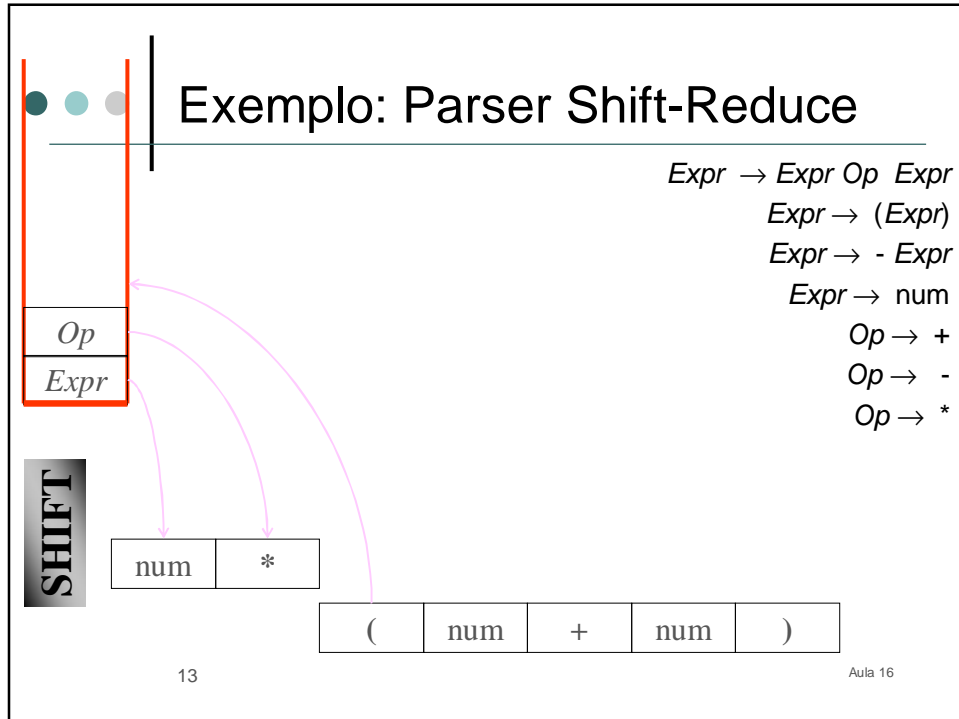
*	(num	+	num)
---	---	-----	---	-----	---

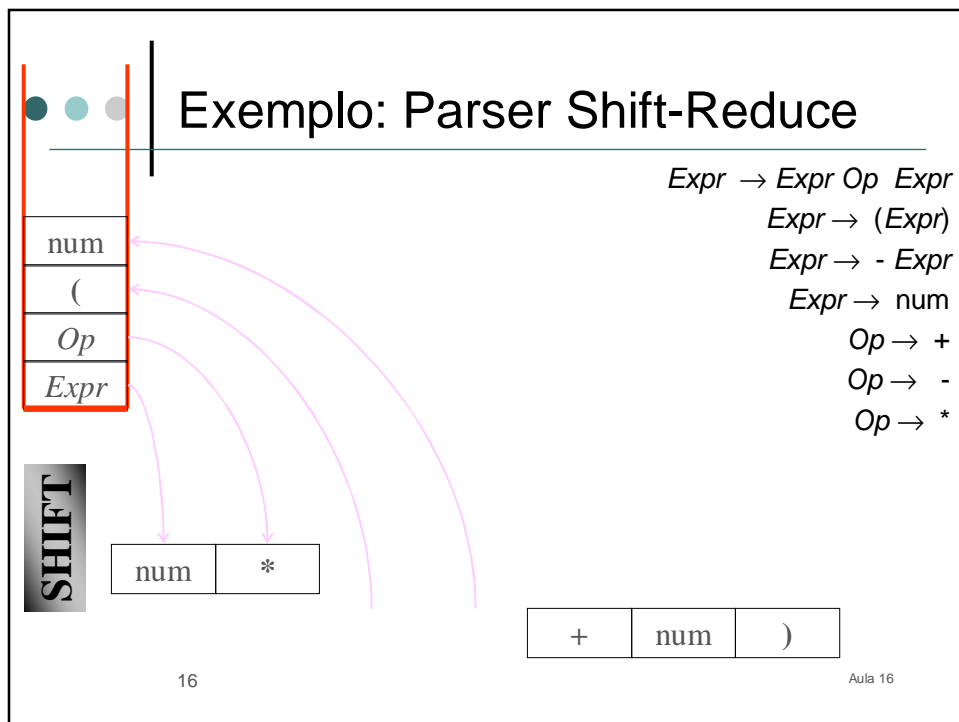
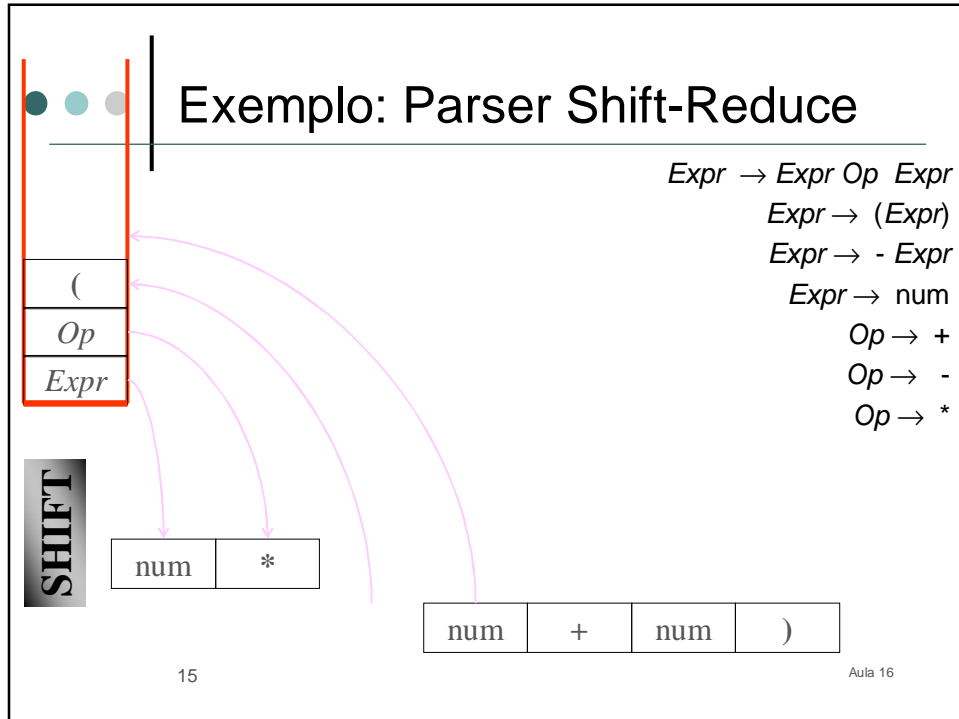
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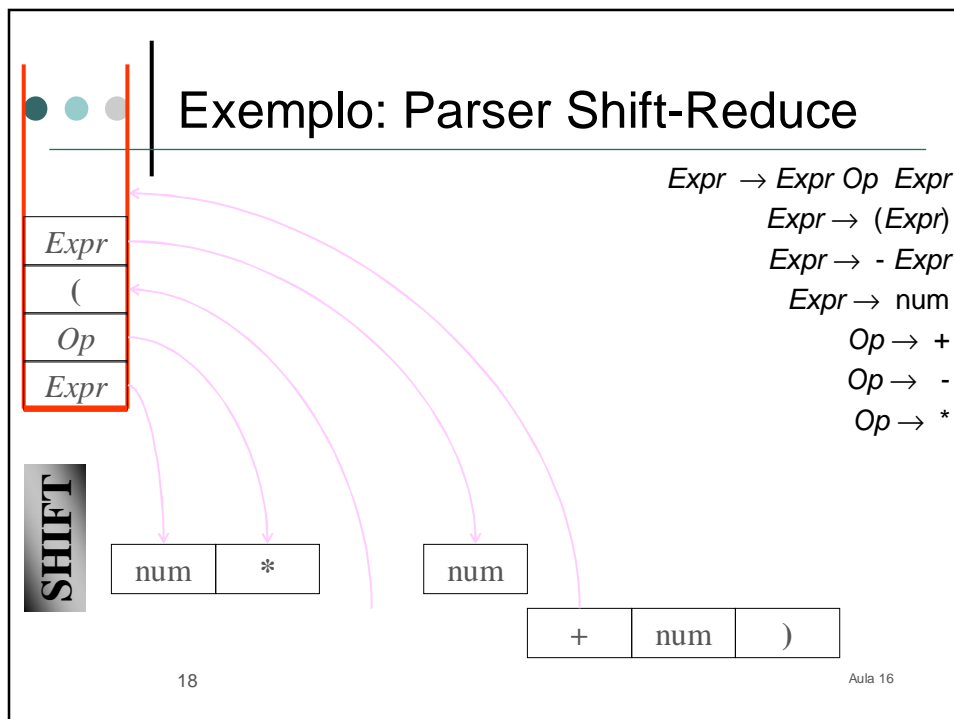
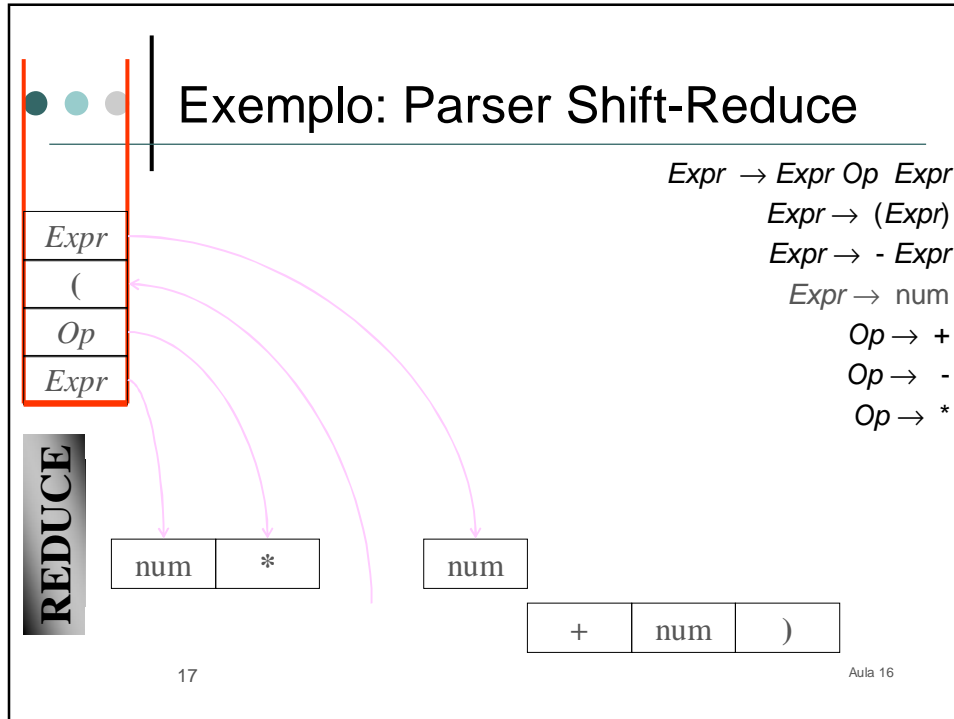
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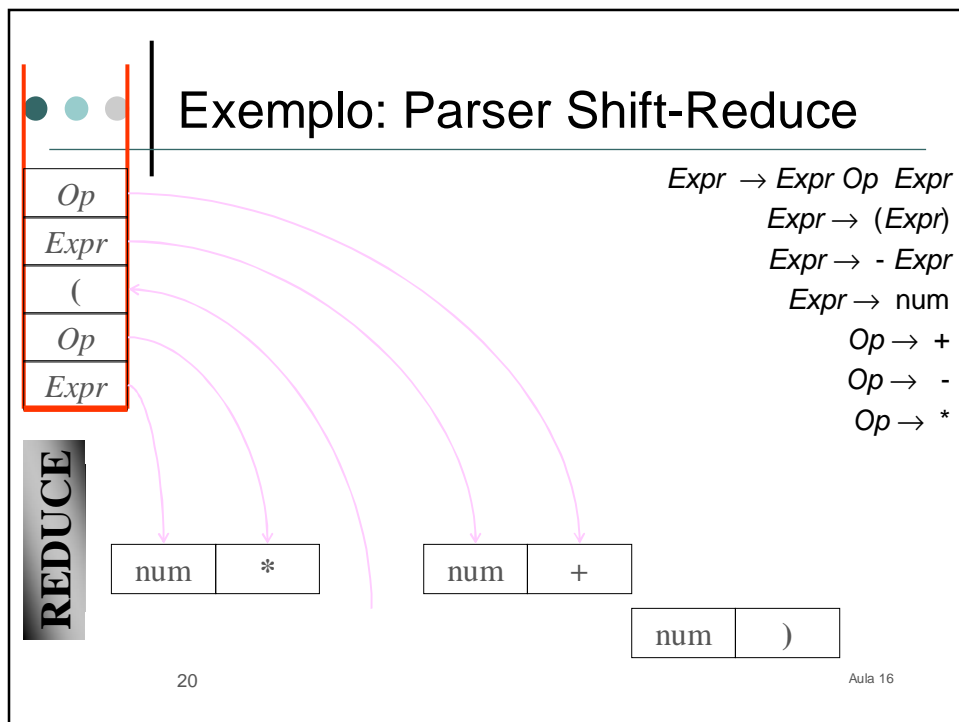
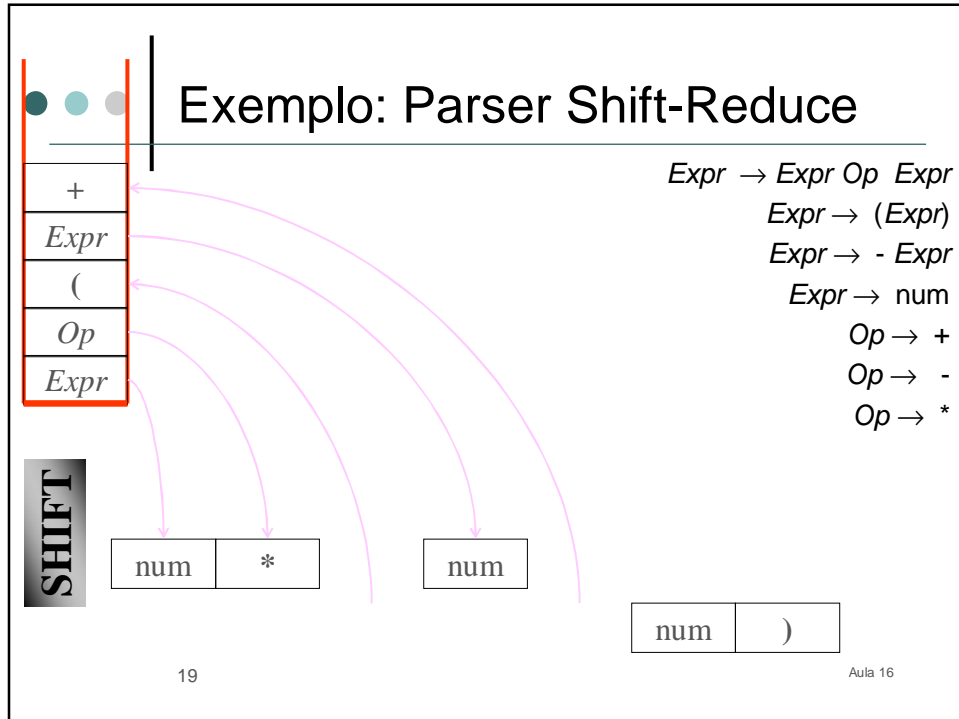


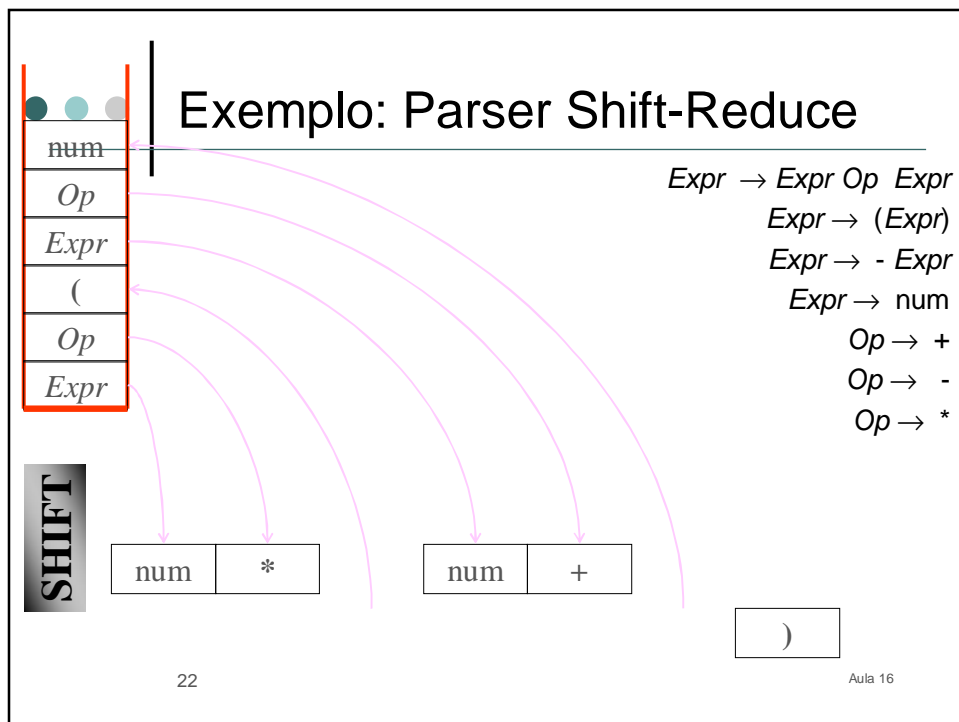
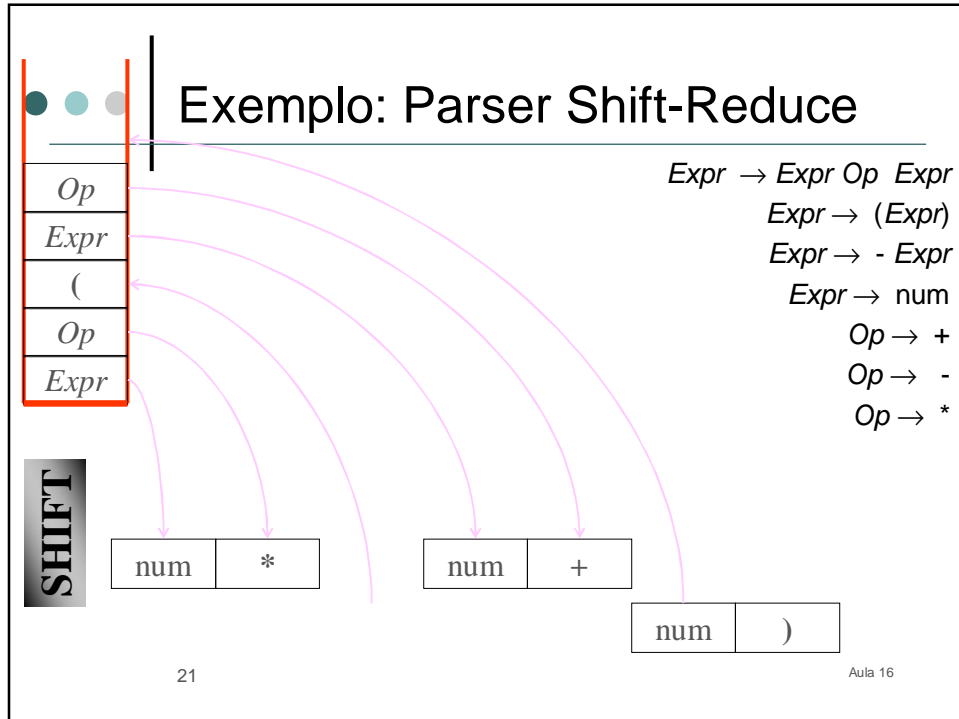


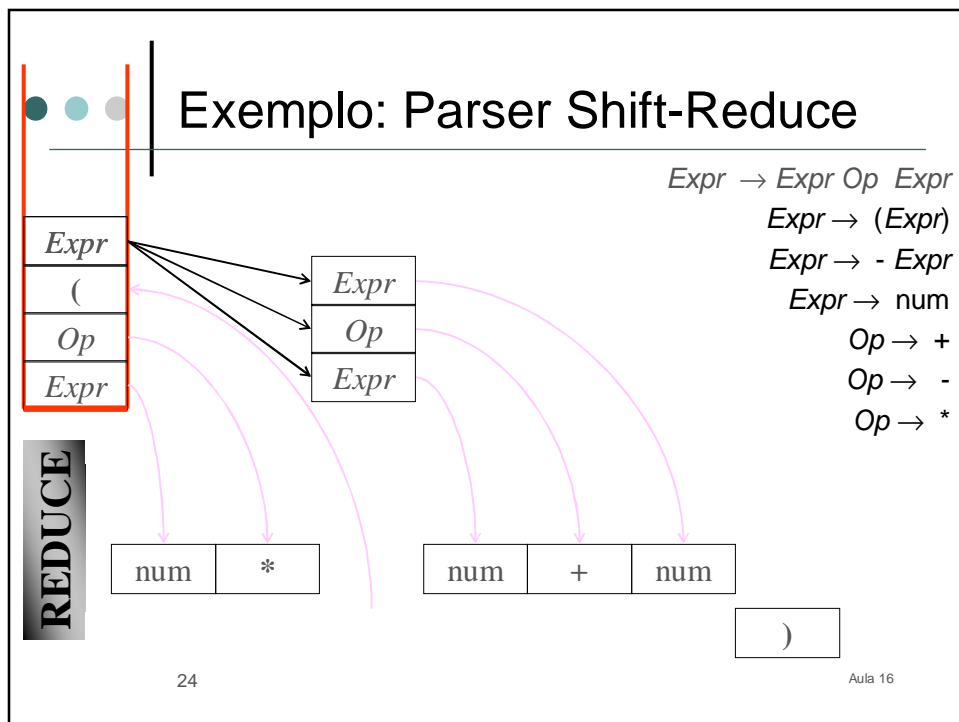
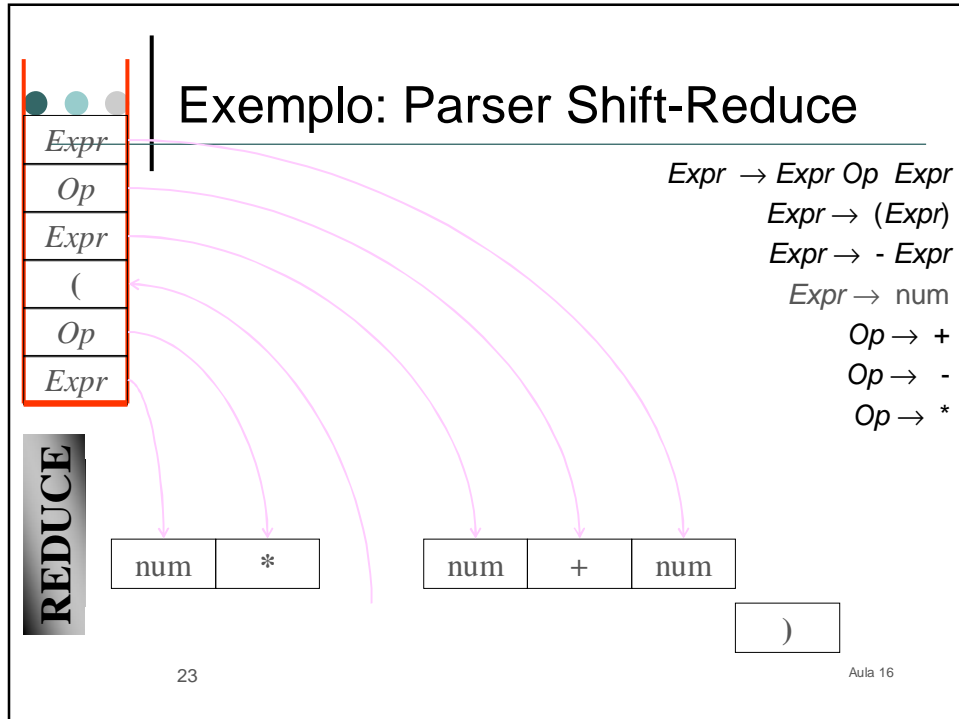


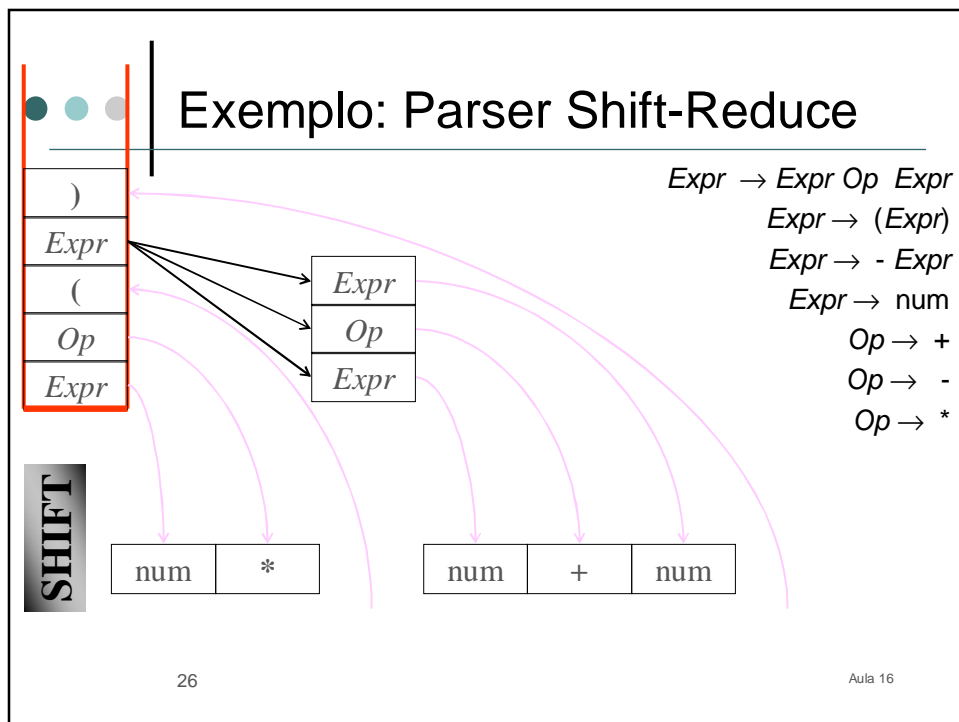
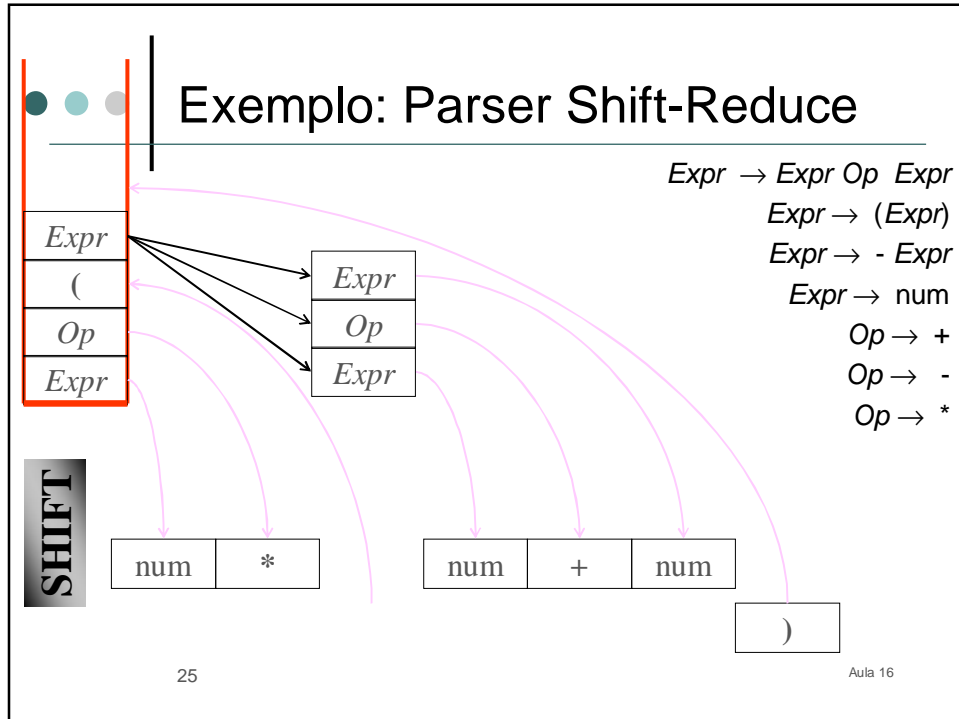












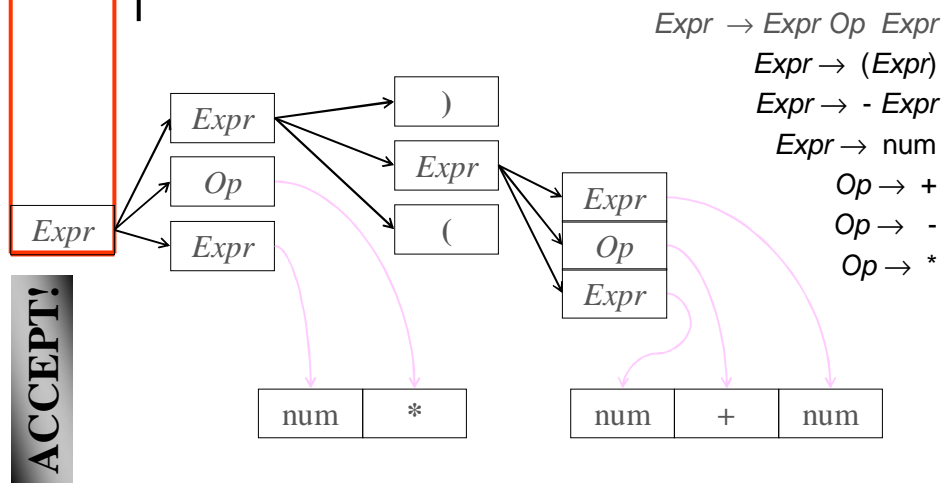
$$Op \rightarrow *$$


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$$Op \rightarrow *$$


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Exemplo: Parser Shift-Reduce



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Conflitos que podem Ocorrer

- Conflito Reduce/Reduce
 - O topo da pilha pode “casar” com RHS de produções múltiplas
 - Qual a produção a utilizar na redução?
- Conflito Shift/Reduce
 - Pilha pode “casar” com RHS da produção
 - Mas esse pode não ser o “casamento” correcto
 - Pode ser necessário deslocar a entrada e encontrar mais tarde uma redução diferente

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Conflitos

- o Gramática Original
- o Nova Gramática

$Expr \rightarrow Expr Op Expr$

$Expr \rightarrow (Expr)$

$Expr \rightarrow - Expr$

$Expr \rightarrow num$

$Op \rightarrow +$

$Op \rightarrow -$

$Op \rightarrow *$

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$Expr \rightarrow Expr Op Expr$

$Expr \rightarrow Expr - Expr$

$Expr \rightarrow (Expr)$

$Expr \rightarrow Expr -$

$Expr \rightarrow num$

$Op \rightarrow +$

$Op \rightarrow -$

$Op \rightarrow *$

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Conflitos

$Expr \rightarrow Expr Op Expr$

$Expr \rightarrow Expr - Expr$

$Expr \rightarrow (Expr)$

$Expr \rightarrow Expr -$

$Expr \rightarrow num$

$Op \rightarrow +$

$Op \rightarrow -$

$Op \rightarrow *$

num	-	num
-----	---	-----

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Conflitos

num - num

$Expr \rightarrow Expr \text{ Op } Expr$
 $Expr \rightarrow Expr - Expr$
 $Expr \rightarrow (Expr)$
 $Expr \rightarrow Expr -$
 $Expr \rightarrow num$
 $Op \rightarrow +$
 $Op \rightarrow -$
 $Op \rightarrow *$

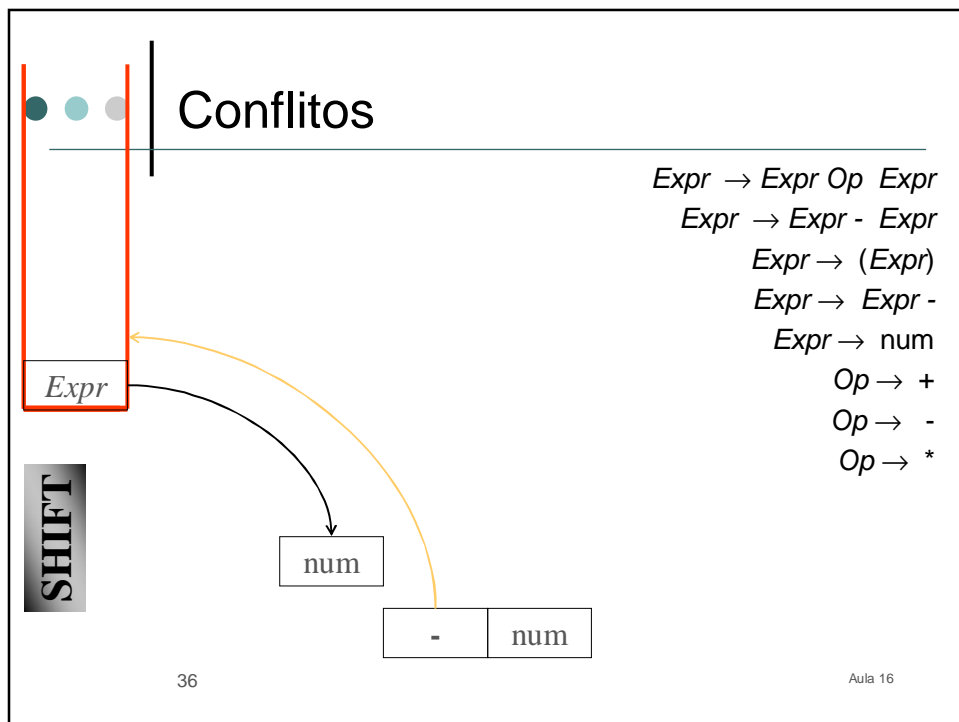
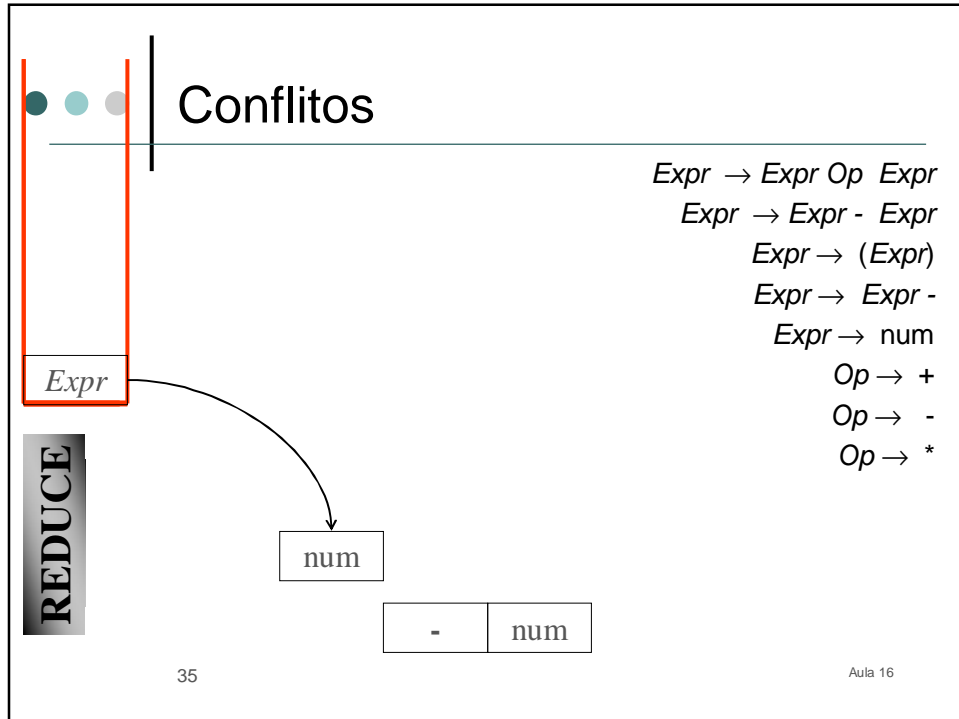
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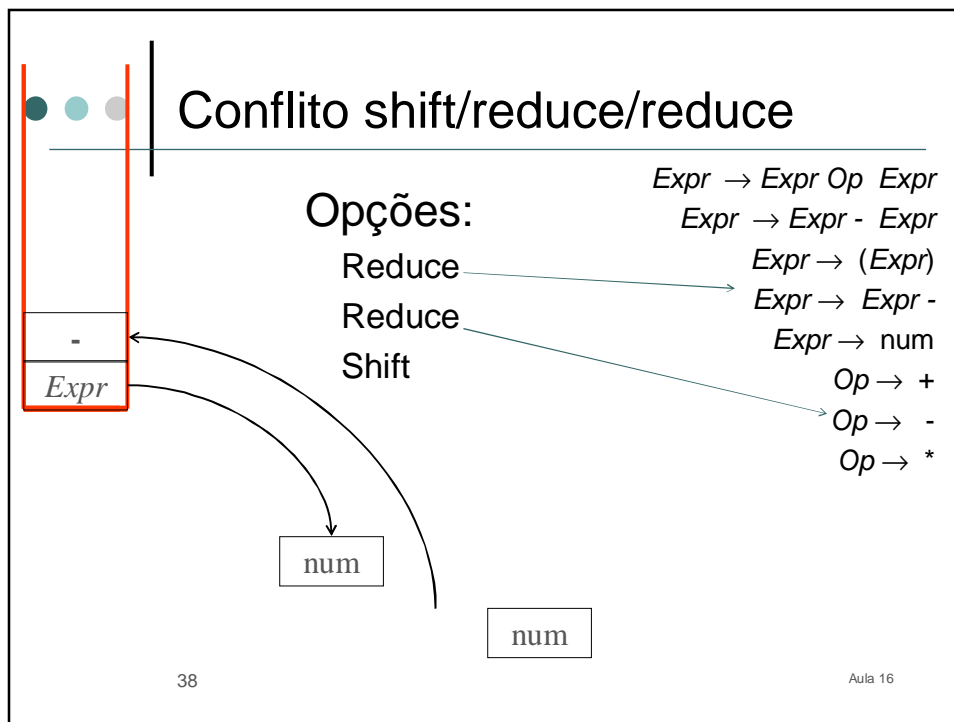
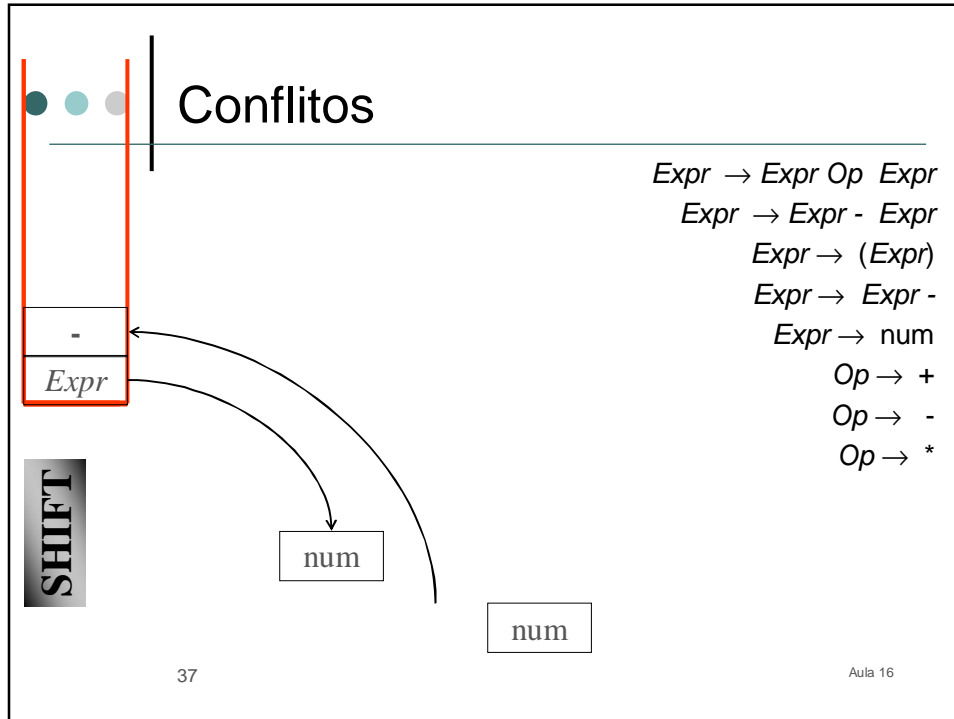
Conflitos

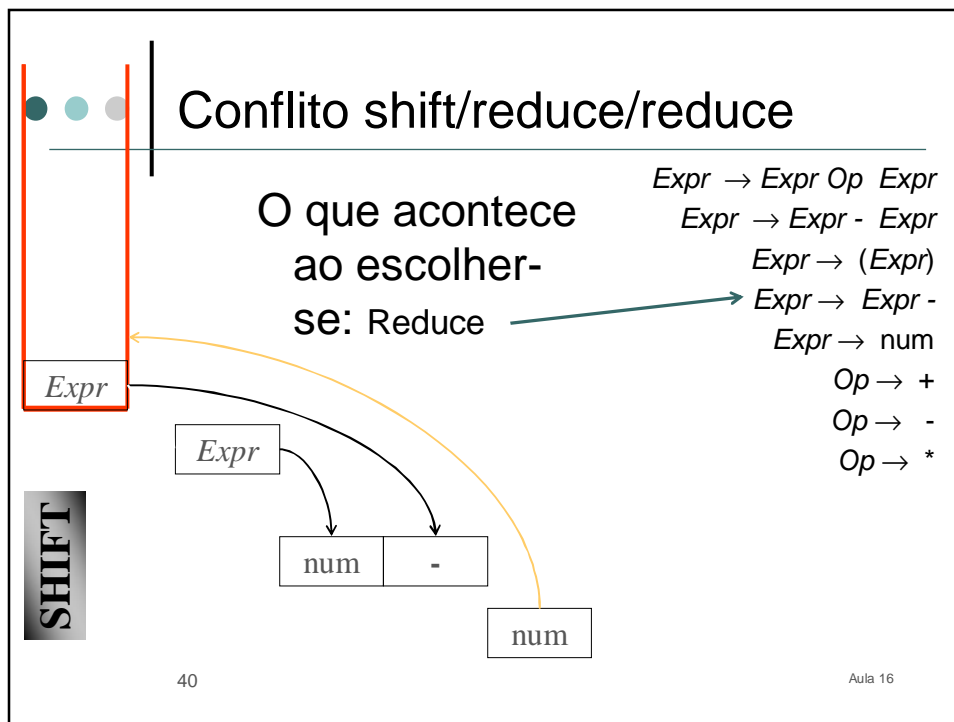
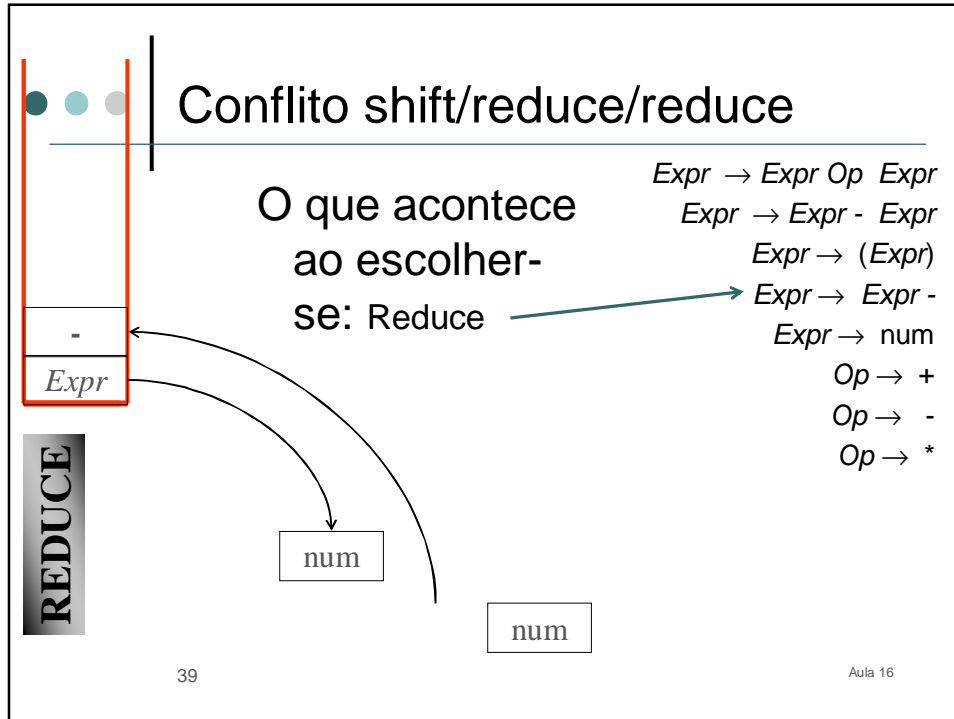
- num

$Expr \rightarrow Expr \text{ Op } Expr$
 $Expr \rightarrow Expr - Expr$
 $Expr \rightarrow (Expr)$
 $Expr \rightarrow Expr -$
 $Expr \rightarrow num$
 $Op \rightarrow +$
 $Op \rightarrow -$
 $Op \rightarrow *$

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Conflito shift/reduce/reduce

O que acontece ao escolher-se: Reduce

Expr → *Expr* Op *Expr*
Expr → *Expr* - *Expr*
Expr → (*Expr*)
Expr → *Expr* -
Expr → num
Op → +
Op → -
Op → *

SHIFT

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Conflito shift/reduce/reduce

O que acontece ao escolher-se: Reduce

Expr → *Expr* Op *Expr*
Expr → *Expr* - *Expr*
Expr → (*Expr*)
Expr → *Expr* -
Expr → num
Op → +
Op → -
Op → *

REDUCE

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Conflito shift/reduce/reduce

O que acontece ao escolher-se: Reduce

FAILS!

$Expr \rightarrow Expr Op Expr$
 $Expr \rightarrow Expr - Expr$
 $Expr \rightarrow (Expr)$
 $Expr \rightarrow Expr -$
 $Expr \rightarrow num$
 $Op \rightarrow +$
 $Op \rightarrow -$
 $Op \rightarrow *$

Diagram illustrating a conflict in a shift/reduce parser. The stack contains two *Expr* items. The input buffer contains *num*, *-*, and *num*. Arrows show the stack being reduced to *Expr* and then to *num*, which conflicts with the input. A vertical bar on the left indicates the stack state, and a red box highlights the conflict area.

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Conflito shift/reduce/reduce

Qualquer uma destas opções resulta:

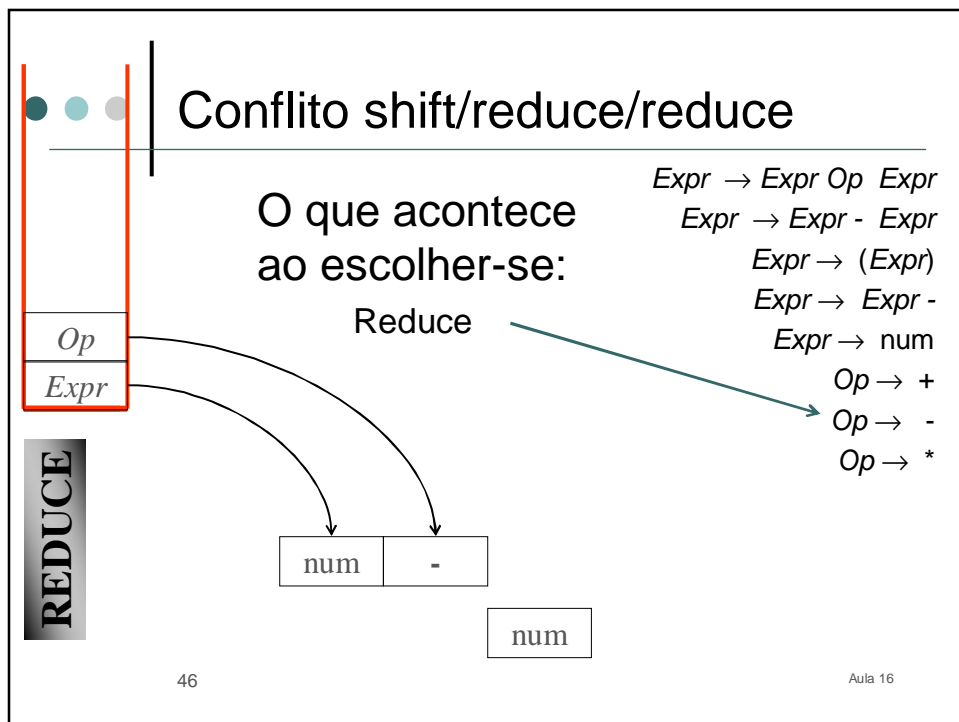
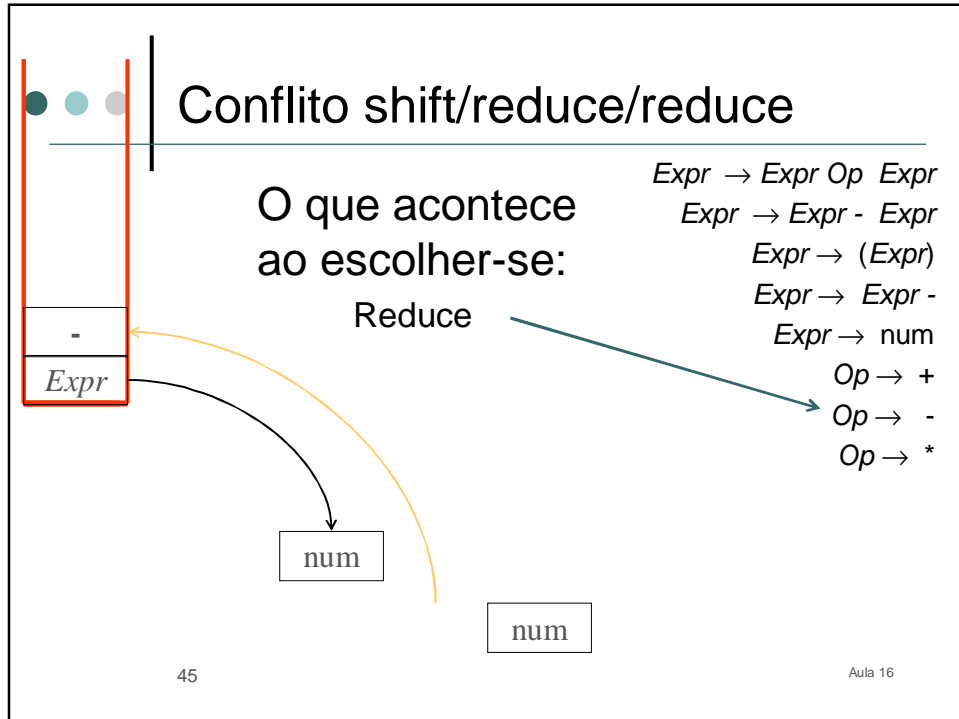
Reduce
Shift

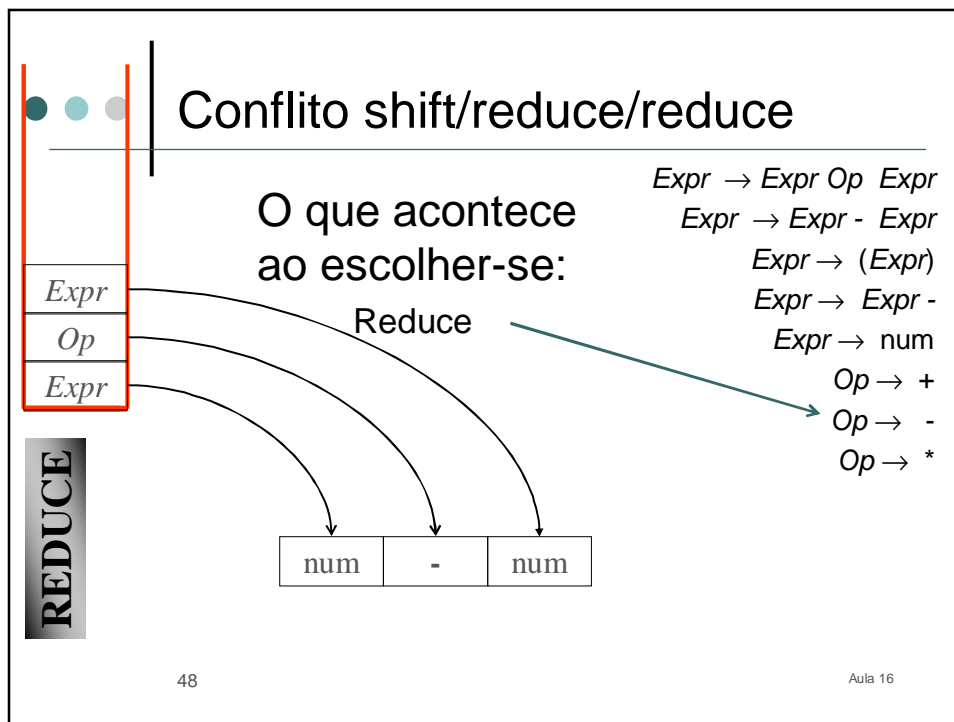
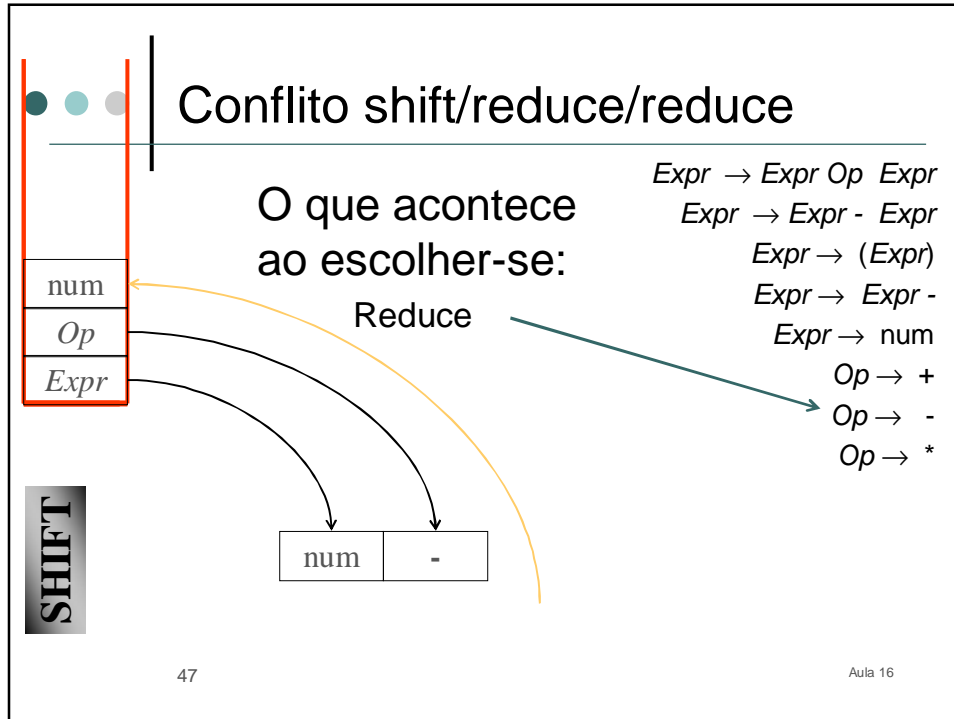
$Expr \rightarrow Expr Op Expr$
 $Expr \rightarrow Expr - Expr$
 $Expr \rightarrow (Expr)$
 $Expr \rightarrow Expr -$
 $Expr \rightarrow num$
 $Op \rightarrow +$
 $Op \rightarrow -$
 $Op \rightarrow *$

Diagram illustrating a conflict in a shift/reduce parser. The stack contains a *-* operator and an *Expr* item. The input buffer contains *num* and *num*. Arrows show the stack being reduced to *Expr* and then to *num*, which conflicts with the input. A vertical bar on the left indicates the stack state, and a red box highlights the conflict area.

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Conflito shift/reduce/reduce

O que acontece ao escolher-se:

Expr

Expr
Op
Expr

Reduce

num - num

REDUCE

$Expr \rightarrow Expr \text{ Op } Expr$
 $Expr \rightarrow Expr - Expr$
 $Expr \rightarrow (Expr)$
 $Expr \rightarrow Expr -$
 $Expr \rightarrow num$
 $Op \rightarrow +$
 $Op \rightarrow -$
 $Op \rightarrow *$

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Conflito shift/reduce/reduce

O que acontece ao escolher-se:

Expr

Expr
Op
Expr

Reduce

num - num

ACCEPT

$Expr \rightarrow Expr \text{ Op } Expr$
 $Expr \rightarrow Expr - Expr$
 $Expr \rightarrow (Expr)$
 $Expr \rightarrow Expr -$
 $Expr \rightarrow num$
 $Op \rightarrow +$
 $Op \rightarrow -$
 $Op \rightarrow *$

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Conflitos

O que acontece ao escolher-se:

Shift

num

num

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$Expr \rightarrow Expr \text{ Op } Expr$
 $Expr \rightarrow Expr - Expr$
 $Expr \rightarrow (Expr)$
 $Expr \rightarrow Expr -$
 $Expr \rightarrow num$
 $Op \rightarrow +$
 $Op \rightarrow -$
 $Op \rightarrow *$

Conflitos

O que acontece ao escolher-se:

Shift

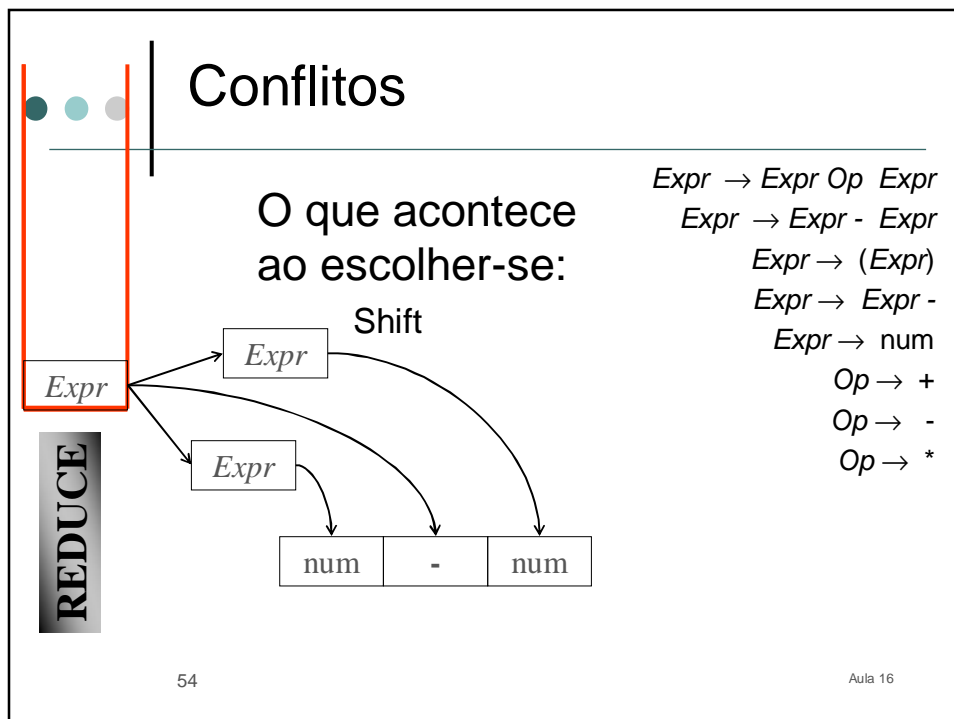
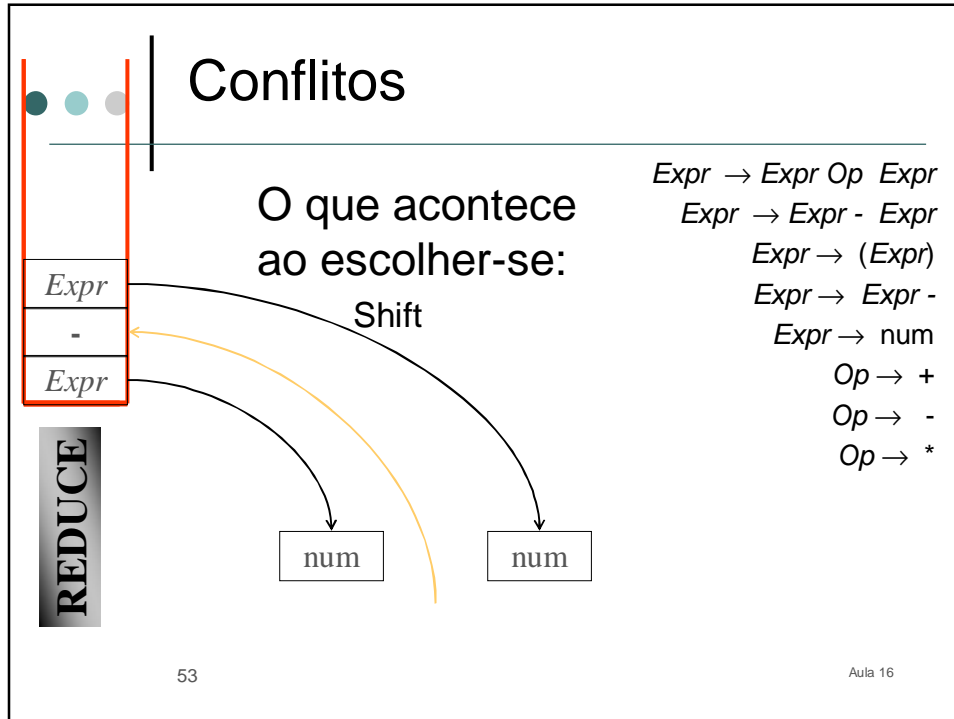
num

num

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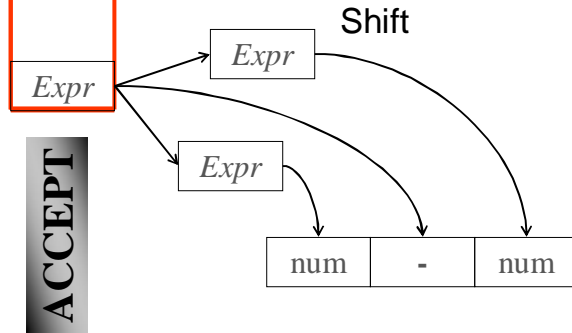
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$Expr \rightarrow Expr \text{ Op } Expr$
 $Expr \rightarrow Expr - Expr$
 $Expr \rightarrow (Expr)$
 $Expr \rightarrow Expr -$
 $Expr \rightarrow num$
 $Op \rightarrow +$
 $Op \rightarrow -$
 $Op \rightarrow *$



Conflitos

O que acontece
ao escolher-se:



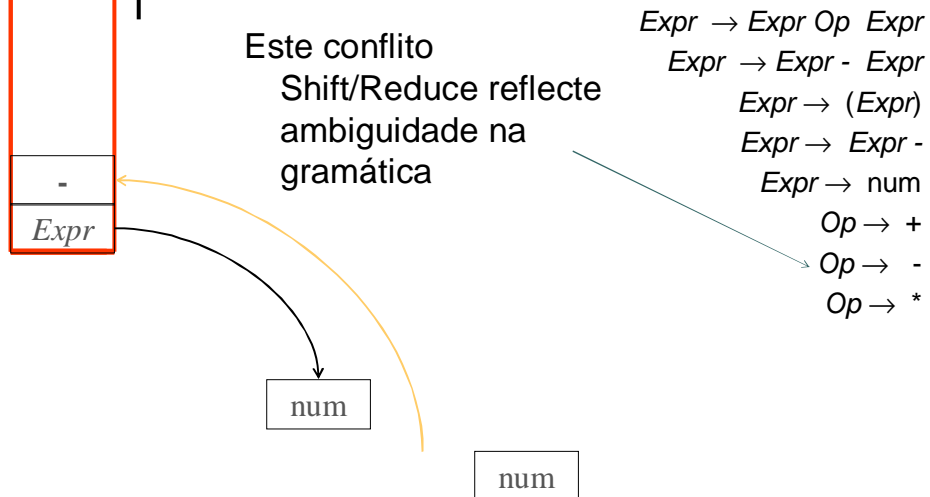
$Expr \rightarrow Expr \text{ Op } Expr$
 $Expr \rightarrow Expr - Expr$
 $Expr \rightarrow (Expr)$
 $Expr \rightarrow Expr -$
 $Expr \rightarrow num$
 $Op \rightarrow +$
 $Op \rightarrow -$
 $Op \rightarrow *$

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Conflito Shift/Reduce/Reduce

Este conflito
Shift/Reduce reflecte
ambiguidade na
gramática



$Expr \rightarrow Expr \text{ Op } Expr$
 $Expr \rightarrow Expr - Expr$
 $Expr \rightarrow (Expr)$
 $Expr \rightarrow Expr -$
 $Expr \rightarrow num$
 $Op \rightarrow +$
 $Op \rightarrow -$
 $Op \rightarrow *$

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