

Script generated by TTT

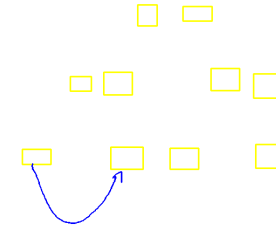
Title: Petter: Compiler Construction (07.05.2020)
- 12: Item Pushdown Automaton

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Duration: 34:15 min

Pages: 10

Chapter 3:
Top-down Parsing



Item Pushdown Automaton – Example

We add another rule $S' \rightarrow S \$$ for initialising the construction:

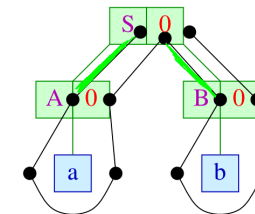
Start state: $[S' \rightarrow \bullet S \$]$
End state: $[S' \rightarrow S \bullet \$]$
Transition relations:

$[S' \rightarrow \bullet S \$]$	ϵ	$[S' \rightarrow \bullet S \$]$	$[S \rightarrow \bullet A B]$
$[S \rightarrow \bullet A B]$	ϵ	$[S \rightarrow \bullet A B]$	$[A \rightarrow \bullet a]$
$[A \rightarrow \bullet a]$	a	$[A \rightarrow a \bullet]$	
$[S \rightarrow \bullet A B]$	$[A \rightarrow a \bullet]$	ϵ	$[S \rightarrow A \bullet B]$
$[S \rightarrow A \bullet B]$	ϵ	$[S \rightarrow A \bullet B]$	$[B \rightarrow \bullet b]$
$[B \rightarrow \bullet b]$	b	$[B \rightarrow b \bullet]$	
$[S \rightarrow A \bullet B]$	$[B \rightarrow b \bullet]$	ϵ	$[S \rightarrow A B \bullet]$
$[S' \rightarrow \bullet S \$]$	$[S \rightarrow A B \bullet]$	ϵ	$[S' \rightarrow S \bullet \$]$

Item Pushdown Automaton – Example

Our example:

$S \rightarrow A B^0$ $A \rightarrow a^0$ $B \rightarrow b^0$



Item Pushdown Automaton – Example

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Start state: $[S' \rightarrow \bullet S \$]$
End state: $[S' \rightarrow S \bullet \$]$
Transition relations:

$[S' \rightarrow \bullet S \$]$	ϵ	$[S' \rightarrow \bullet S \$]$	$[S \rightarrow \bullet AB]$
$[S \rightarrow \bullet AB]$	ϵ	$[S \rightarrow \bullet AB]$	$[A \rightarrow \bullet a]$
$[A \rightarrow \bullet a]$	a	$[A \rightarrow a \bullet]$	
$[S \rightarrow \bullet AB]$	ϵ	$[S \rightarrow A \bullet B]$	
$[S \rightarrow A \bullet B]$	ϵ	$[S \rightarrow A \bullet B]$	$[B \rightarrow \bullet b]$
$[B \rightarrow \bullet b]$	b	$[B \rightarrow b \bullet]$	
$[S \rightarrow A \bullet B]$	ϵ	$[S \rightarrow AB \bullet]$	
$[S' \rightarrow \bullet S \$]$	ϵ	$[S \rightarrow AB \bullet]$	
		$[S' \rightarrow S \bullet \$]$	

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Item Pushdown Automaton – Example

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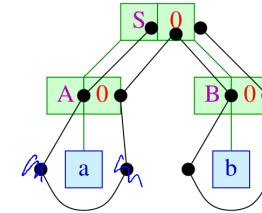
$[S' \rightarrow \bullet S \$]$	ϵ	$[S' \rightarrow \bullet S \$]$	$[S \rightarrow \bullet AB]$
$[S \rightarrow \bullet AB]$	ϵ	$[S \rightarrow \bullet AB]$	$[A \rightarrow \bullet a]$
$[A \rightarrow \bullet a]$	a	$[A \rightarrow a \bullet]$	
$[S \rightarrow \bullet AB]$	ϵ	$[S \rightarrow A \bullet B]$	
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$[B \rightarrow \bullet b]$	b	$[B \rightarrow b \bullet]$	
$[S \rightarrow A \bullet B]$	ϵ	$[S \rightarrow AB \bullet]$	
$[S' \rightarrow \bullet S \$]$	ϵ	$[S \rightarrow AB \bullet]$	
		$[S' \rightarrow S \bullet \$]$	

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Item Pushdown Automaton – Example

Our example:

$S \rightarrow AB^0 \quad A \rightarrow a^0 \quad B \rightarrow b^0$

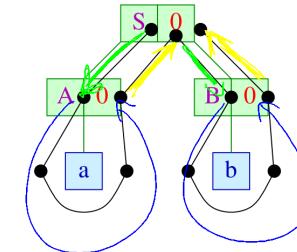


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Item Pushdown Automaton – Example

Our example:

$S \rightarrow AB^0 \quad A \rightarrow a^0 \quad B \rightarrow b^0$



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Item Pushdown Automaton

The item pushdown automaton M_G^L has three kinds of transitions:

- Expansions:** $([A \rightarrow \alpha \bullet B \beta], \epsilon, [A \rightarrow \alpha \bullet B \beta] [B \rightarrow \bullet \gamma])$ for $A \rightarrow \alpha B \beta, B \rightarrow \gamma \in P$
- Shifts:** $([A \rightarrow \alpha \bullet a \beta], a, [A \rightarrow \alpha a \bullet \beta])$ for $A \rightarrow \alpha a \beta \in P$
- Reduces:** $([A \rightarrow \alpha \bullet B \beta] [B \rightarrow \gamma \bullet], \epsilon, [A \rightarrow \alpha B \bullet \beta])$ for $A \rightarrow \alpha B \beta, B \rightarrow \gamma \in P$

Items of the form: $[A \rightarrow \alpha \bullet]$ are also called **complete**
 The item pushdown automaton shifts the bullet around the derivation tree ...

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Item Pushdown Automaton

Example: $S' \rightarrow S \$ \quad S \rightarrow \epsilon \boxed{a} S b$

The transitions of the according Item Pushdown Automaton:

0	$[S' \rightarrow \bullet S \$]$	ϵ	$[S' \rightarrow \bullet S \$] [S \rightarrow \bullet]$
1	$[S' \rightarrow \bullet S \$]$	ϵ	$[S' \rightarrow \bullet S \$] [S \rightarrow \bullet a S b]$
2	$[S \rightarrow \bullet a S b]$	a	$[S \rightarrow a \bullet S b]$
3	$[S \rightarrow a \bullet S b]$	ϵ	$[S \rightarrow a \bullet S b] [S \rightarrow \bullet]$
4	$[S \rightarrow a \bullet S b]$	ϵ	$[S \rightarrow a \bullet S b] [S \rightarrow \bullet a S b]$
5	$[S \rightarrow a \bullet S b] [S \rightarrow \bullet]$	ϵ	$[S \rightarrow a S \bullet b]$
6	$[S \rightarrow a \bullet S b] [S \rightarrow a S \bullet]$	ϵ	$[S \rightarrow a S \bullet b]$
7	$[S \rightarrow a S \bullet b]$	b	$[S \rightarrow a S b \bullet]$
8	$[S' \rightarrow \bullet S \$] [S \rightarrow \bullet]$	ϵ	$[S' \rightarrow S \bullet \$]$
9	$[S' \rightarrow \bullet S \$] [S \rightarrow a S b \bullet]$	ϵ	$[S' \rightarrow S \bullet \$]$

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Item Pushdown Automaton

Discussion:

- The **expansions** of a computation form a **leftmost derivation**
- Unfortunately, the expansions are chosen **nondeterministically**
- For proving correctness of the construction, we show that for every Item $[A \rightarrow \alpha \bullet B \beta]$ the following holds:

$$([A \rightarrow \alpha \bullet B \beta], w) \vdash^* ([A \rightarrow \alpha B \bullet \beta], \epsilon) \quad \text{iff} \quad B \rightarrow^* w$$

- LL-Parsing** is based on the item pushdown automaton and tries to make the expansions deterministic ...

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