Parsing

Homework 8 (Left corner, Earley), due 07 June 2021

Laura Kallmeyer

SS 2021, Heinrich-Heine-Universität Düsseldorf

Question 1 (Left Corner Parsing)

Consider the CFG G with non-terminals $N = \{S, A, B\}$, terminals $T = \{a, b\}$, start symbol S and productions $S \to aB \,|\, bA, A \to a \,|\, aS \,|\, bAA, B \to b \,|\, bS \,|\, aBB$.

1. *Given an input word ab, give the Left Corner Recognition trace, i.e, the set of stack triples, for this input. Indicate for each triple the operation that has lead to it together with the number of the antecedent triple and, in case of reduce, the predicted production.*

   All triples have to be listed, not only the successful ones, but taking into account the following length filter as a constraint on possible stack triples: Assume that the length of the prediction stack Γ_{td}, not counting the \$ symbols, must not be greater than the sum of the lengths of the stack Γ_{compl} and of the stack Γ_{lhs}. (This is an assumption that we can make in a ε-free grammar.)

2. *Now compute the relation LC^* on this grammar. And then assume that we make a reduce operation only if the lefthand side symbol Y of the predicted production can be reached from the top of the prediction stack Γ_{td}, X, i.e., $\langle X, Y\rangle \in LC^*$ or, in other words, there is a derivation $X \stackrel{*}{\Rightarrow} Y\alpha$ for some α.*

   Which of the triples of stacks remain in the trace from 1., once this filter is applied?

Solution:

1.

	Γ_{compl}	Γ_{td}	Γ_{lhs}	operation
1.	ab	S	–	
2.	b	B\$S	S	reduce from 1., $S \to aB$
3.	b	\$S	A	reduce from 1., $A \to a$
4.	b	S\$S	A	reduce from 1., $A \to aS$
5.	–	\$B\$S	BS	reduce from 2., $B \to b$
6.	Ab	S	–	move from 3.
7.	–	\$S\$S	BA	reduce from 4., $B \to b$
8.	B	B\$S	S	move from 5.
9.	B	S\$S	A	move from 7.
10.	–	\$S	S	remove from 8.
11.	S	S	–	move from 10.
12.	–	–	–	remove from 11.

2. $LC^* = \{\langle S, S\rangle, \langle A, A\rangle, \langle B, B\rangle\}$

   Remaining items:

	Γ_{compl}	Γ_{td}	Γ_{lhs}	operation
1.	ab	S	–	
2.	b	B\$S	S	reduce from 1., $S \to aB$
5.	–	\$B\$S	BS	reduce from 2., $B \to b$
8.	B	B\$S	S	move from 5.
10.	–	\$S	S	remove from 8.
11.	S	S	–	move from 10.
12.	–	–	–	remove from 11.

Question 2 (Earley Parsing)

Consider the CFG $\langle N, T, P, S\rangle$ with $N = \{S, T\}$, $T = \{a, b\}$, $P = \{S \to TST \,|\, a,\ T \to b \,|\, \varepsilon\}$

1. *Give the chart resulting from an Earley-recognition of ba using the algorithm from slides 6–8.*
2. *How many parse trees does the input "ba" have with this grammar?*

Solution:

1.

2	$S \to TS \bullet T$ $S \to TST\bullet$	$S \to TST\bullet$ $S \to TS \bullet T$ $S \to a\bullet$	$T \to \bullet b$ $T \to \bullet$
1	$S \to T \bullet ST$ $T \to b\bullet$	$S \to T \bullet ST$ $S \to \bullet a$ $S \to \bullet TST$ $T \to \bullet b$ $T \to \bullet$	
0	$S \to T \bullet ST$ $S \to \bullet a$ $S \to \bullet TST$ $T \to \bullet b$ $T \to \bullet$		
	0	1	2

2. Infinitely many.