

Parsing

Homework 5 (CYK, Shift Reduce), due 25 May 2021 (Tuesday)

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Question 1 (CYK with dotted productions)

Consider the CFG with non-terminals S, T, C , terminals a, b, c , start symbol S and productions $S \rightarrow aT$, $T \rightarrow bTb \mid bT \mid b$.

- Give the chart (the $(n + 1) \times (n + 1)$ -table) that results from CYK parsing with dotted productions for the input $w = bbb$ using

1. the deduction rules from slide 30 (CYK slides)
2. the deduction rules from slide 31 (left-corner prediction, CYK slides)

Keep in mind that these items use start and end indices for spans, not start index and length.

- Is parsing successful? Justify your answer.

Solution:

• 1.	3	$T \rightarrow bTb\bullet$ $T \rightarrow bT\bullet b$	$T \rightarrow bT\bullet b$ $T \rightarrow bT\bullet$	$T \rightarrow b\bullet Tb$ $T \rightarrow b\bullet T, T \rightarrow b\bullet$	$S \rightarrow \bullet aT, T \rightarrow \bullet bTb$ $T \rightarrow \bullet bT, T \rightarrow \bullet b$
	2	$T \rightarrow bT\bullet b$ $T \rightarrow bT\bullet$	$T \rightarrow b\bullet Tb$ $T \rightarrow b\bullet T, T \rightarrow b\bullet$	$S \rightarrow \bullet aT, T \rightarrow \bullet bTb$ $T \rightarrow \bullet bT, T \rightarrow \bullet b$	
	1	$T \rightarrow b\bullet Tb$ $T \rightarrow b\bullet T, T \rightarrow b\bullet$	$S \rightarrow \bullet aT, T \rightarrow \bullet bTb$ $T \rightarrow \bullet bT, T \rightarrow \bullet b$		
	0	$S \rightarrow \bullet aT, T \rightarrow \bullet bTb$ $T \rightarrow \bullet bT, T \rightarrow \bullet b$			
		0	1	2	3
2.	3	$T \rightarrow bT\bullet, T$ $T \rightarrow bTb\bullet$	$T \rightarrow bT\bullet, T$ $T \rightarrow bT\bullet b$	$b, T \rightarrow b\bullet T$ $T \rightarrow b\bullet Tb, T \rightarrow b\bullet, T$	
	2	$T \rightarrow bT\bullet, T$ $T \rightarrow bT\bullet b$	$b, T \rightarrow b\bullet T$ $T \rightarrow b\bullet Tb, T \rightarrow b\bullet, T$		
	1	$b, T \rightarrow b\bullet T$ $T \rightarrow b\bullet Tb, T \rightarrow b\bullet, T$			
	0				
		0	1	2	3

- No, since there is no goal item.

Question 2 (Shift reduce parsing)

1. Consider the same CFG as in the preceding exercise and the input $w = abb$.

Perform a shift-reduce parsing for this input. List the different parser configurations in a table as follows:

	stack	remaining input	production (in case of reduce)	antecedent item
0	ε	abb	–	
1	a	bb	–	0
2	ab	b	–	1

All possibilities must be listed.

2. While using a Top-down parser we had a filter to restrict the Stack size. Is such a Stack restriction also needed/useful for a shift reduce parser? Write down your idea.

Solution:

	stack	remaining input	production (in case of reduce)	antecedent item	
	0	ε	abb	–	
	1	a	bb	–	0
	2	ab	b	–	1
	3	aT	b	$T \rightarrow b$	2
	4	S	b	$S \rightarrow aT$	3
1.	5	abb	ε	–	2
	6	aTb	ε	–	3
	7	Sb	ε	–	4
	8	abT	ε	$T \rightarrow b$	5
	9	aTT	ε	$T \rightarrow b$	6
	10	ST	ε	$T \rightarrow b$	7
	11	aT	ε	$T \rightarrow bT$	8
	12	S	ε	$S \rightarrow aT$	11

2. No, in a shift-reduce parser we don't need a size filter. w is shifted on the stack while, whenever the top of the stack is the rhs of a production in reverse order, this is replaced with the lhs. This means that the sum of the Stack length and the remaining input is at most the length of the input. Because of that the Stack can never grow larger than a given input.