Tree Adjoining Grammars
Exercises

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Exercise 1 (07.01.2016) *Consider the TAG consisting of the two trees α and β:*
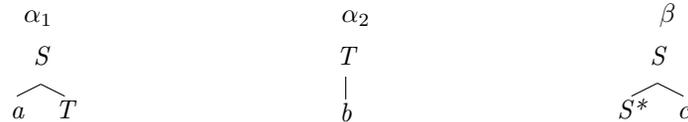
Give the trace of the CYK parse (the version from the course slides) of $w = abc$, i.e., a list of all successful items that get generated. Explain for each item, by which operation it is obtained and from which antecedent items.

Solution:

	Item	Rule
1.	$[\alpha_1, 1_\top, 0, -, -, 1]$	lex-scan (a)
2.	$[\alpha_2, 1_\top, 1, -, -, 2]$	lex-scan (b)
3.	$[\beta, 2_\top, 2, -, -, 3]$	lex-scan (c)
4.	$[\beta, 1_\top, 0, 0, 2, 2]$	foot-predict
5.	$[\alpha_2, \epsilon_\bot, 1, -, -, 2]$	move-unary from 2.
6.	$[\alpha_2, \epsilon_\top, 1, -, -, 2]$	null-adjoin from 5.
7.	$[\alpha_1, 2_\top, 1, -, -, 2]$	substitute 6.
8.	$[\alpha_1, \epsilon_\bot, 0, -, -, 2]$	move binary from 1. and 7.
9.	$[\alpha_1, \epsilon_\top, 0, -, -, 2]$	null-adjoin from 8.
10.	$[\beta, \epsilon_\bot, 0, 0, 2, 3]$	move-binary from 3. and 4.
11.	$[\beta, \epsilon_\top, 0, 0, 2, 3]$	null-adjoin from 10.
12.	$[\alpha_1, \epsilon_\top, 0, -, -, 3]$	adjoin 11. in 8.

Exercise 2 (07.01.2016) *Consider the following language:*

$$L = \{w \mid w \in \{a, b, c, d, e\}^*, |w|_a = |w|_b = |w|_c = |w|_d = |w|_e\}$$

($|w|_x$ gives the number of times x occurs in w.)

Show that L is not a TAL.
Hint: Intersect L with a suitable regular language. You can assume that we have already shown that $L_5 = \{a^n b^n c^n d^n e^n \mid n \geq 0\}$ is not a TAL.

Solution: We assume that L is a TAL. Then, since TALs are closed under intersection with regular languages, $L \cap L(a^* b^* c^* d^* e^*) = L_5$ must be a TAL as well. This is not the case, therefore our intial assumption that L is a TAL is false.