Parsing Beyond CFG
Homework 6: Tree Insertion Grammar (TIG)

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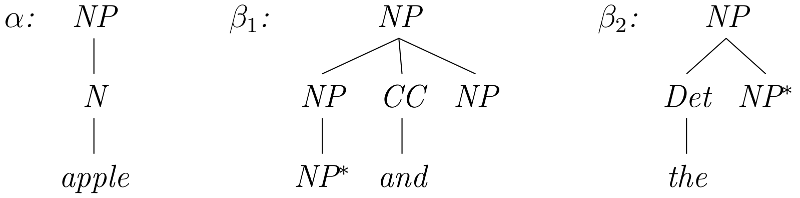
Question 1 *Consider the following set of initial trees and auxilary trees:*

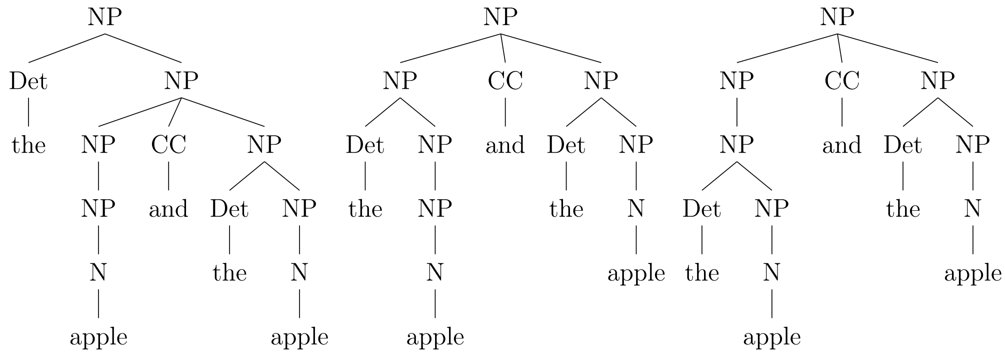


Consinder a string "the apple and the apple". What are the derived trees that one obtains for that string

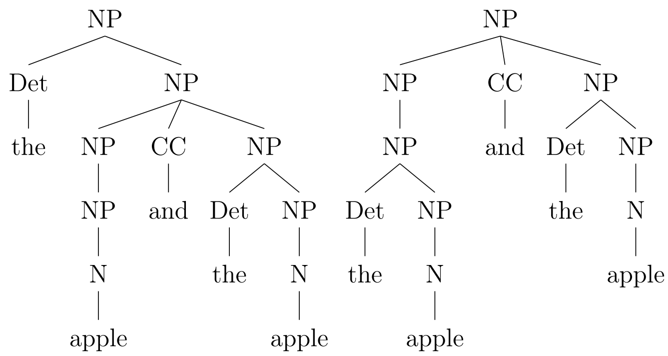
1. *if the grammar is considered a TAG?*
2. *if the grammar is considered a TIG?*

Solution:

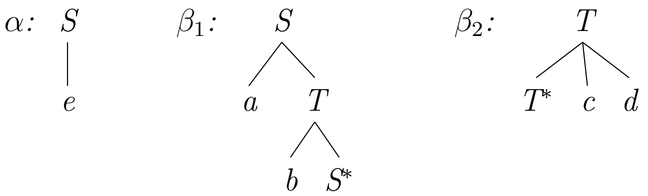
1.



2.



Question 2 *Consider the following set of initial trees and auxilary trees:*



What is the string language of this grammar

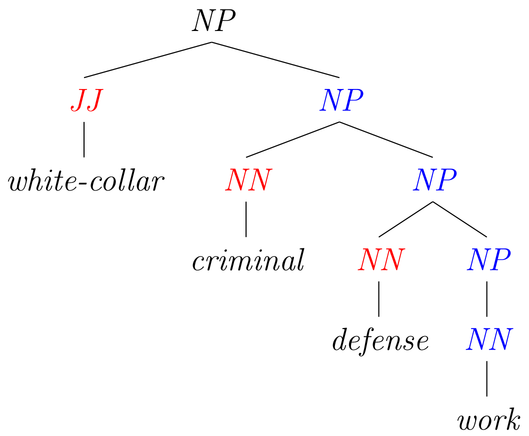
1. *if the grammar is considered a TAG?*
2. *if the grammar is considered a TIG?*

Solution:

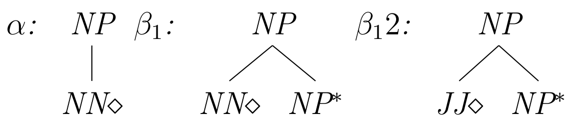
1. $\{(ab)^n e (cd)^m \mid$ either $n = m = 0$ or $n \geq 1\}$

2. $\{(ab)^n e \mid n \geq 0\}$

Question 3 *Consider the grammar we extracted in the last homework for the following binarized NP subtree:*



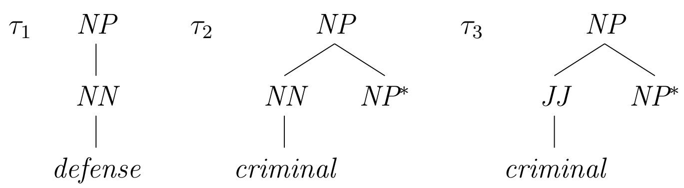
The supertags are as follows:



1. *In the preceding homework, this was supposed to be a TAG. But it can also be considered a TIG. Why is that possible?*

2. *Now consider the input "criminal defense", assuming that "criminal" can be both JJ and NN, while "defense" has always POS tag NN. If the POS tag is the only indication for choosing elementary trees anchored by our input token, which are then the lexicalized elementary trees that we obtain for this input?*

3. *Now use the following three lexicalized trees and perform an Earley parsing of "criminal defense", based on these elementary trees.*

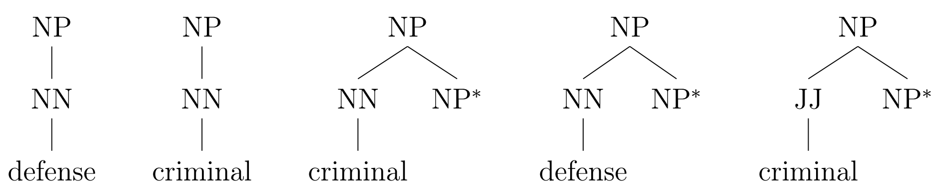


Notate nodes as $\langle \tau, p \rangle$ where τ is the name of the tree, p the position of the node in question. List ***all*** *items and, furthermore, for items that can be obtained by several different rule applications, list all the antecedent item sets (this is agenda-based chart parsing, no item gets created more than once).*

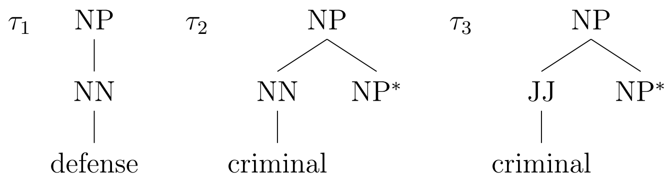
id	*item*	*operation, antecedent items*
1	$[\langle \tau_1, \varepsilon \rangle \to \bullet \langle \tau_1, 1 \rangle, 0, 0]$	*initialization*
2	$[\langle \tau_2, \varepsilon \rangle \to \bullet \langle \tau_2, 1 \rangle\ \langle \tau_2, 2 \rangle, 0, 0]$	*PredictLeftAdjunction, 1*
3	$[\langle \tau_3, \varepsilon \rangle \to \bullet \langle \tau_3, 1 \rangle\ \langle \tau_3, 2 \rangle, 0, 0]$	*PredictLeftAdjunction, 1*
4	$[\langle \tau_1, 1 \rangle \to \bullet \langle \tau_1, 11 \rangle, 0, 0]$	*MoveDown, 1*
	...	

Solution:

1. The auxiliary trees are both left auxiliary trees, therefore the grammar satisfies the constraints on TIG.

2. 

3.



id	item	operation, antecedent items
1	$[\langle\tau_1,\varepsilon\rangle \to \bullet\langle\tau_1,1\rangle, 0, 0]$	initialization
2	$[\langle\tau_2,\varepsilon\rangle \to \bullet\langle\tau_2,1\rangle\ \langle\tau_2,2\rangle, 0, 0]$	PredictLeftAdjunction, 1
3	$[\langle\tau_3,\varepsilon\rangle \to \bullet\langle\tau_3,1\rangle\ \langle\tau_3,2\rangle, 0, 0]$	PredictLeftAdjunction, 1
4	$[\langle\tau_1,1\rangle \to \bullet\langle\tau_1,11\rangle, 0, 0]$	MoveDown, 1
5	$[\langle\tau_2,1\rangle \to \bullet\langle\tau_2,11\rangle, 0, 0]$	MoveDown, 2
6	$[\langle\tau_3,1\rangle \to \bullet\langle\tau_3,11\rangle, 0, 0]$	MoveDown, 3
7	$[\langle\tau_2,1\rangle \to \langle\tau_2,11\rangle\bullet, 0, 1]$	LexScan, 5
8	$[\langle\tau_3,1\rangle \to \langle\tau_3,11\rangle\bullet, 0, 1]$	LexScan, 6
9	$[\langle\tau_2,\varepsilon\rangle \to \langle\tau_2,1\rangle \bullet \langle\tau_2,2\rangle, 0, 1]$	CompleteNode, 2, 7
10	$[\langle\tau_3,\varepsilon\rangle \to \langle\tau_3,1\rangle \bullet \langle\tau_3,2\rangle, 0, 1]$	CompleteNode, 3, 8
11	$[\langle\tau_2,\varepsilon\rangle \to \langle\tau_2,1\rangle\langle\tau_2,2\rangle\bullet, 0, 1]$	ScanFoot, 9
12	$[\langle\tau_3,\varepsilon\rangle \to \langle\tau_3,1\rangle\langle\tau_3,2\rangle\bullet, 0, 1]$	ScanFoot, 10
13	$[\langle\tau_1,\varepsilon\rangle \to \bullet\langle\tau_1,1\rangle, 0, 1]$	Adjoin, either 1, 11 or 1, 12
14	$[\langle\tau_2,\varepsilon\rangle \to \bullet\langle\tau_2,1\rangle\ \langle\tau_2,2\rangle, 1, 1]$	PredictLeftAdjunction, 14
15	$[\langle\tau_3,\varepsilon\rangle \to \bullet\langle\tau_3,1\rangle\ \langle\tau_3,2\rangle, 1, 1]$	PredictLeftAdjunction, 14
16	$[\langle\tau_1,1\rangle \to \bullet\langle\tau_1,11\rangle, 1, 1]$	MoveDown, 13
17	$[\langle\tau_2,1\rangle \to \bullet\langle\tau_2,11\rangle, 1, 1]$	MoveDown, 14
18	$[\langle\tau_3,1\rangle \to \bullet\langle\tau_3,11\rangle, 1, 1]$	MoveDown, 15
19	$[\langle\tau_1,1\rangle \to \langle\tau_1,11\rangle\bullet, 1, 2]$	LexScan, 16
20	$[\langle\tau_1,\varepsilon\rangle \to \langle\tau_1,1\rangle\bullet, 0, 2]$	CompleteNode, 13, 15, goal item!