Theoretical homework #3, TTTV 2017

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Exercise 1

```
S -> NP VP
NP -> DT NN
NP -> NP CC NP
NP-> NP PP
NP -> NN CC NN NN
PP -> IN NP
VP -> VBD NP
VP -> VBD NP PP
```

Exercise 2

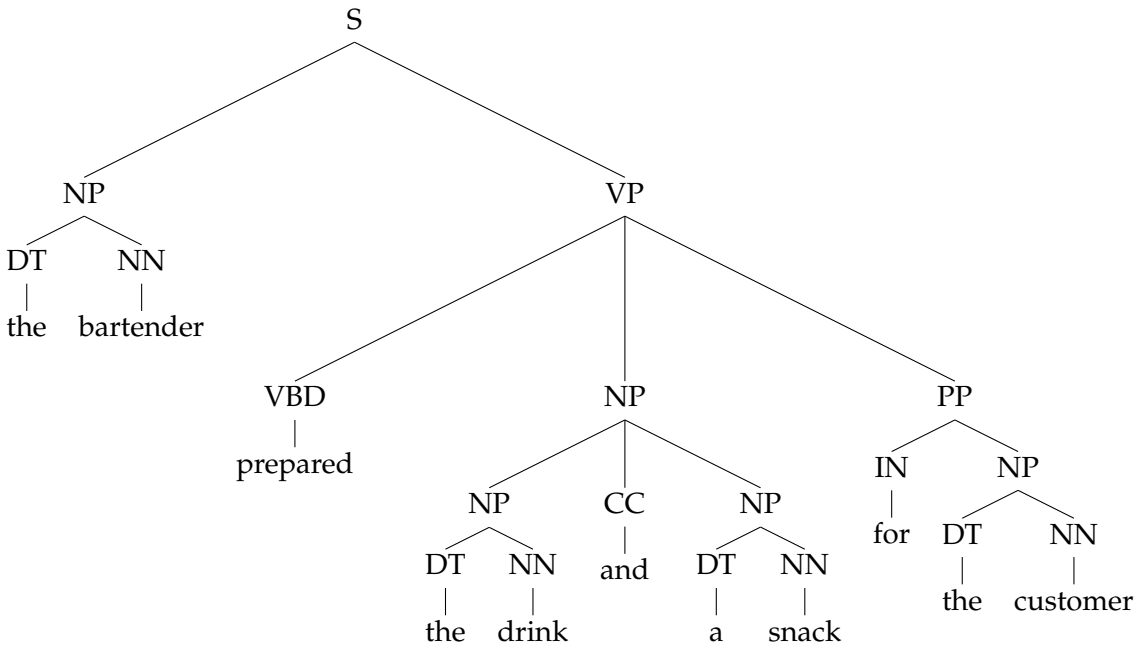
1. Yes, 2. Coordination ambiguity, because
   1) the bartender prepared [a drink] and [a snack for the customer]
   2) the bartender prepared [a drink and a snack] for the customer

2. Yes, 2. Coordination ambiguity, because
   1) the bartender prepared [a drink with tequila] and [orange juice]
   2) the bartender prepared a drink with [tequila and orange juice]

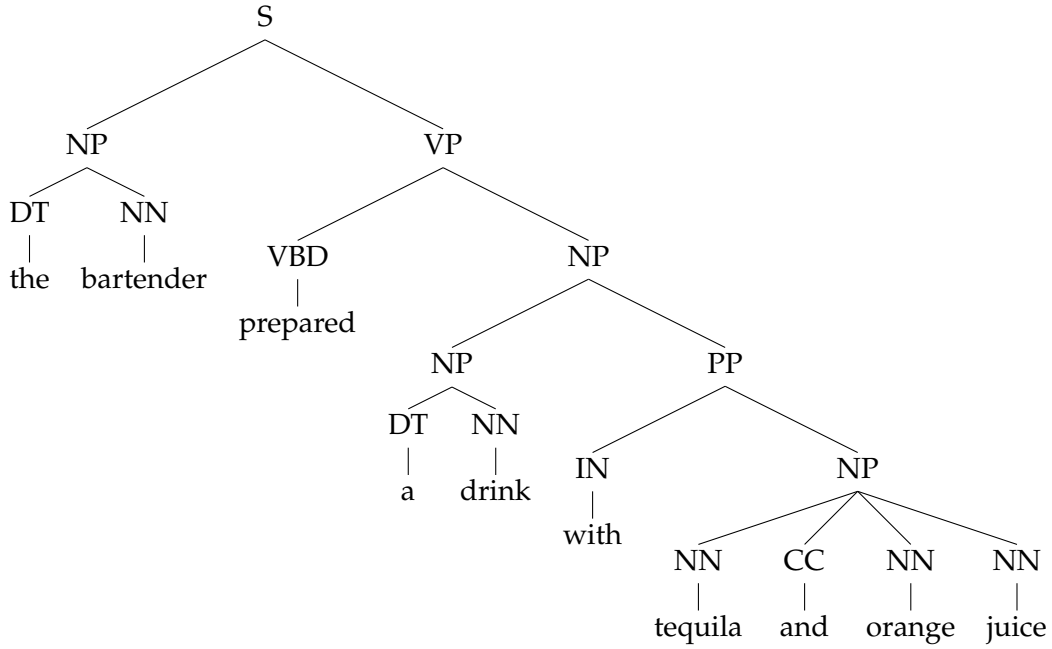
3. Yes, 2. More coordination ambiguity:
   1) the customer ordered [[the drink of the day] and [a tosti]]
   2) the customer ordered [the drink] [of the day and a tosti]

Exercise 3

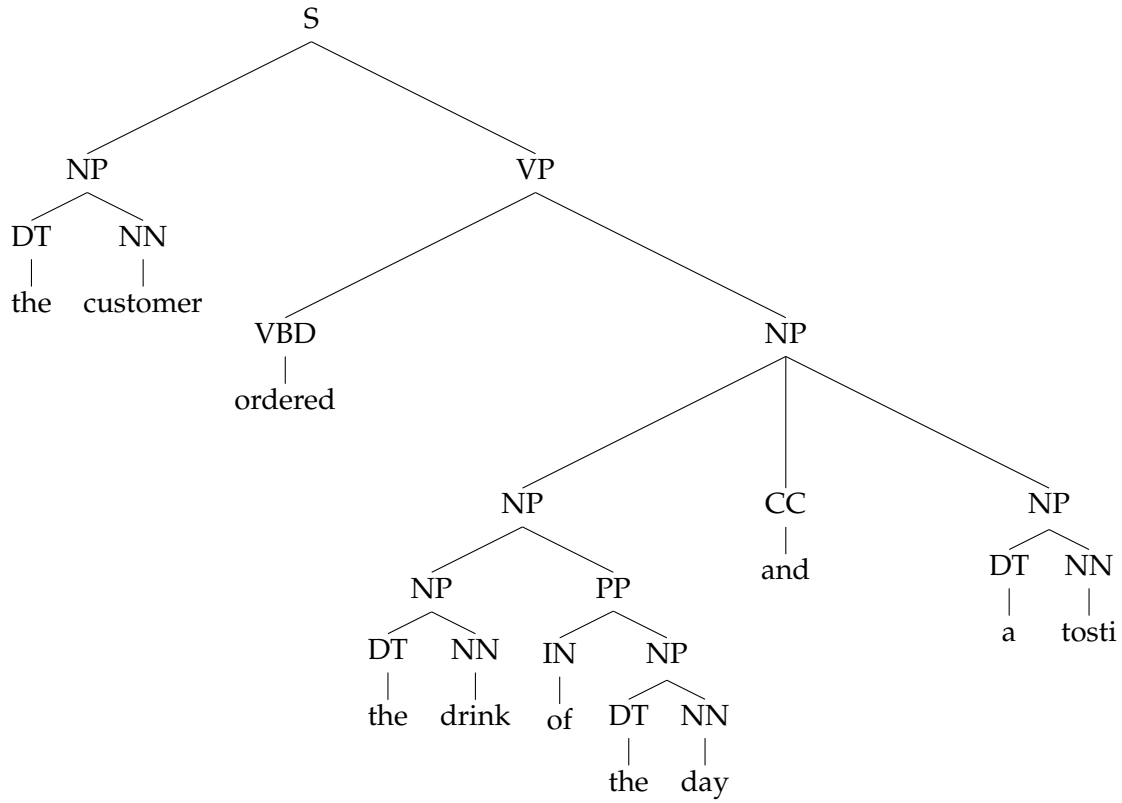
Tree 1:



Tree 2:



Tree 3:



S $\rightarrow$ NP VP [3/3 = 1]
How often does the rule A $\rightarrow \beta$ occur : 3
Total number of occurences of A on LHS in the treebank: 3

NP $\rightarrow$ DT NN [10/15 = 2/3]
How often does the rule A $\rightarrow \beta$ occur : 10
Total number of occurences of A on LHS in the treebank: 15

NP$\rightarrow$NP CC NP [2/15]
How often does the rule A $\rightarrow \beta$ occur : 2
Total number of occurences of A on LHS in the treebank: 15

NP$\rightarrow$NP PP [2/15]
How often does the rule A $\rightarrow \beta$ occur : 2
Total number of occurences of A on LHS in the treebank: 15

NP$\rightarrow$NN CC NN NN [1/15]
How often does the rule A $\rightarrow \beta$ occur : 1
Total number of occurences of A on LHS in the treebank: 15

PP$\rightarrow$IN NP [3/3 = 1]
How often does the rule A $\rightarrow \beta$ occur : 3
Total number of occurences of A on LHS in the treebank: 3

VP$\rightarrow$VBD NP [2/3]
How often does the rule A $\rightarrow \beta$ occur : 2

Total number of occurences of A on LHS in the treebank: 3

VP→VBD NP PP [1/3]
How often does the rule A → β occur : 3
Total number of occurences of A on LHS in the treebank: 3

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S -> NP VP           [1]
NP -> DT NN          [2/3]
NP -> NP CC NP       [2/15]
NP-> NP PP           [2/15]
NP -> NN CC NN NN    [1/15]
PP -> IN NP          [1]
VP -> VBD NP         [2/3]
VP -> VBD NP PP      [1/3]
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Exercise 4

Stanford tree: 1 * (2/3) * (1/3) * (2/3) * 1 * (1/15) = 4/405 = 0.009877
Our tree: 1 * (2/3) * (2/3) * (2/15) * (2/3) * 1 * (1/15) = 16/6075 = 0.002633

As expected, the probabilities are different. The Stanford parser chose the tree that is most likely to correspond to the meaning of the sentence. We can not be sure of this because the grammar that the Stanford parser uses probably has different probabilities from ours.

Exercise 5

Precision = correct consituents of tree / number of constituents in tree
Recall = number of correct constituents parse tree / number of constituents golden tree
F-measure = 2 * P * R / (P + R)

P(tree 1) = 1
R(tree 1) = 1
F(tree 1) = 1
(The tree is the same as the gold standard tree for this sentence.)

P(tree 2) = 5 / 6
R(tree 2) = 5 / 7
F(tree 2) = $\frac{2*(5/6)*(5/7)}{((5/6)+(5/7))} = \frac{10}{13} \approx 0.769$
(The incorrect constituent was the VP → VBD NP PP instead of VP → VBD NP)

P(tree 3) = 8 / 9
R(tree 3) = 8 / 9
F(tree 3) = $\frac{2*(8/9)*(8/9)}{(8/8)+(8/9)} \approx 0.889$
(The incorrect constituent was the NP → NP PP. This causes a deeper NP → NP CC NP too.)