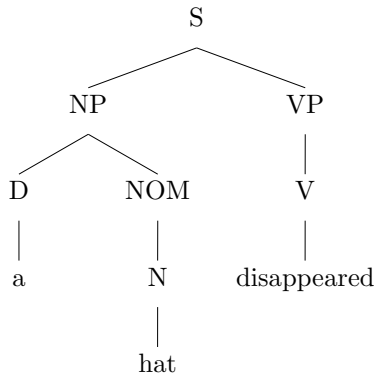
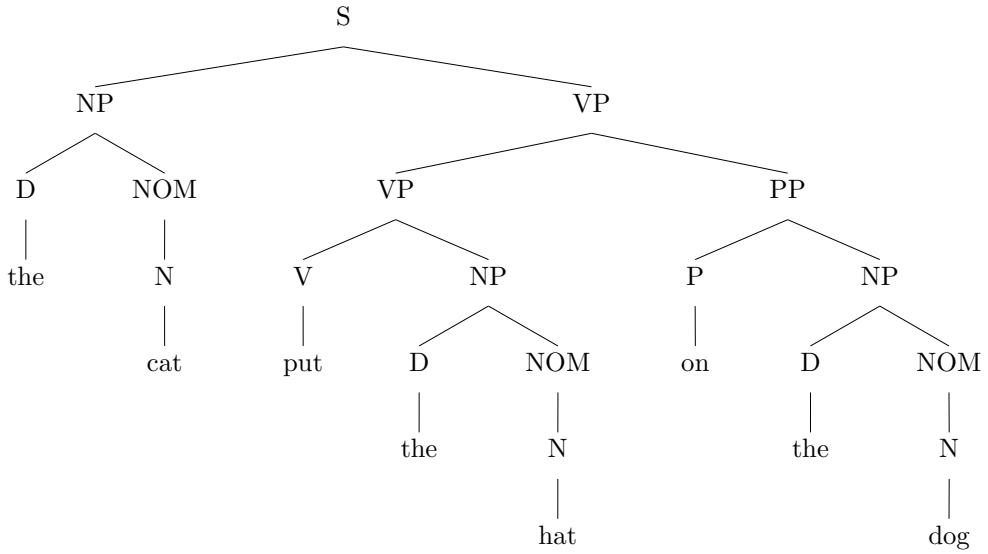
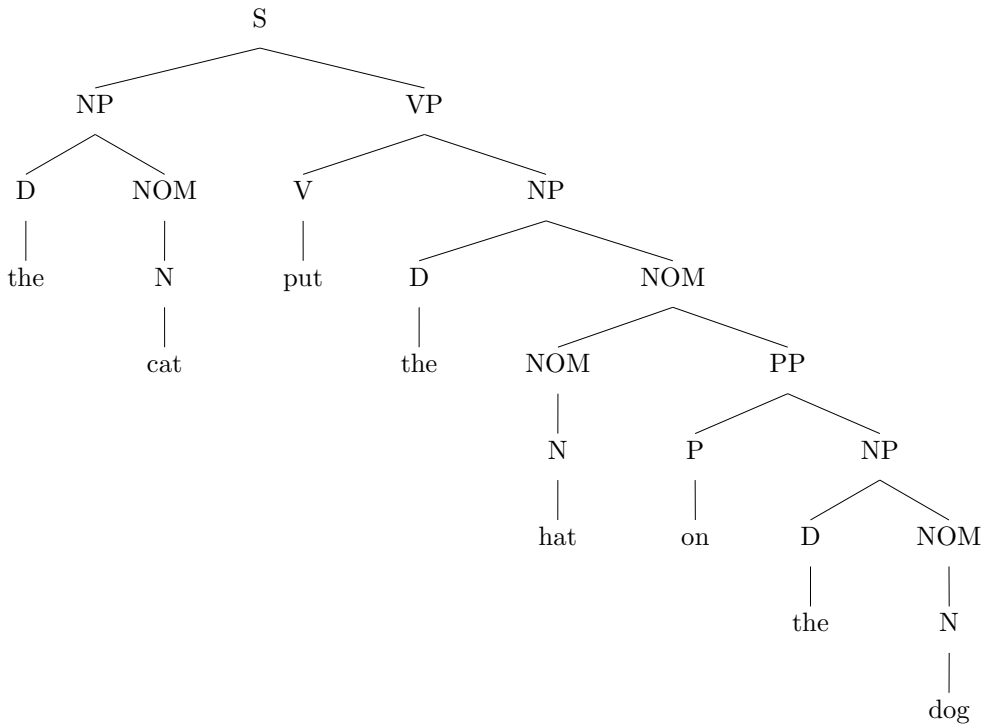
Chapter 2, Problem 1: More Practice with CFG

A. • A hat disappeared.



B. • The cat put the hat on the dog.





This sentence is not in fact ambiguous in English. This is because *put* actually requires both an NP and a PP:

(1)*The cat put the hat.

Therefore, the second structure (with the PP *on the dog* modifying the NOM *hat*) should not be licensed. In order to do this, we need a way of encoding in the grammar the requirements of *put*. See section 2.7.2.

Other sentences that are ambiguous according to this grammar and in fact are:

(2) a. The cat admired the hat on the dog.
b. The cat and the dog and the woman disappeared.

C. Here are three such sentences:

(i) The man put a hat on.
(ii) The cat the man admired disappeared.
(iii) With the man, the woman admired the dog.

D. (i) A preposition (*on*) must be followed by an NP in this grammar.
(ii) This grammar can't generate an NP with an S in it, like *the cat the man admired*.
(iii) This grammar doesn't allow a PP to start a sentence.

E. Here are three such sentences:

- *A dog put.
- *A dog disappeared a cat.
- *Dog relied with hat.

F. (i) Split the VP rule into a family of rules, say:

VP → IV
VP → TV NP
VP → TPV NP PP
...

Then *put* could be assigned to the category TPV (transitive-preposition-verb).

(ii) The verb *disappear* could be assigned to the category IV.

(iii) Somehow, *rely* has to be assigned to a category that requires a following PP whose P will be *on*. This will require subdividing the PP rules as well, so that one of them will expand a category like ON-PP as ON-P NP (with *on* being the only preposition assigned to the category ON-P). This could be done as follows ('...' indicates other kinds of PP expansions we might need):

ON-PP → ON-P NP
[...]-PP → [...]-P NP
VP → RELY-V NP ON-PP
...

There's another problem in the third example cited in part E. The grammar allows an NP to consist of just the singular noun *hat*. We need revise so as to make sure that singular nouns can only co-occur with a determiner, while plural nouns can co-occur with a determiner or stand alone in the NP. Again, splitting rules and multiplying categories is a way to do this in CFG:

NP → D NOM-SG
NP → (D) NOM-PL
NOM-SG → NOM-SG PP
NOM-PL → NOM-PL PP
NOM-SG → N-SG
NOM-PL → N-PL

We would also need to make these changes (among others) to get the grammar to account for subject-verb agreement in this grammar (see section 2.7.3). However, things are in fact more complicated still, as we will need to distinguish a third kind of noun ('mass' nouns) which are singular, but can occur without a determiner:

(3) Furniture is expensive.

This topic will be addressed in Chapter 4.

G. The grammar admits infinitely many sentences.

H. Even without the coordination schema (and its Kleene plus), the grammar would admit infinitely many sentences, because of the recursion contained in the NOM, NP and PP rules. That is, the NOM rule introduces a PP (optionally), and the PP rule introduces an NP, which introduces a NOM. So these three rules can apply arbitrarily often in the analysis of a single sentence, allowing for infinitely many possibilities.

(4) The cat admired the hat with the woman on the roof in the dog ...