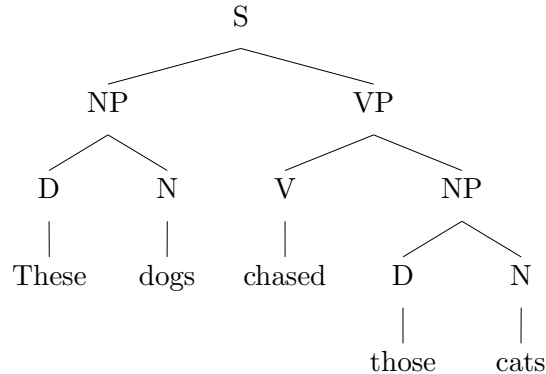# Ambiguous Sentences in English

Background   Linguists use diagrams called trees to represent the groupings of words within sentences. Here is a very simple example:
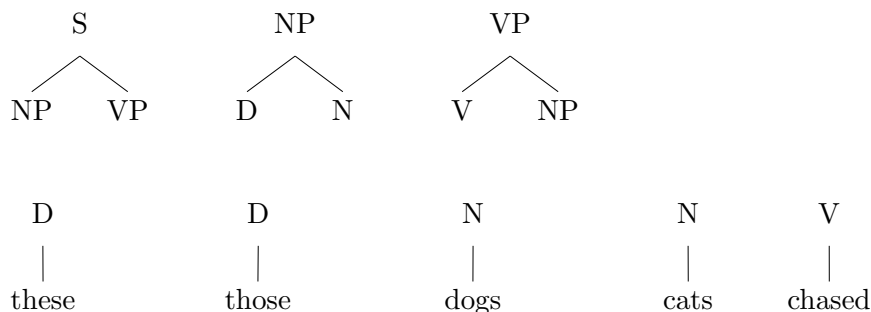
```
                              S
                   ┌──────────┴──────────┐
                  NP                     VP
             ┌─────┴─────┐         ┌──────┴──────┐
             D           N         V            NP
             │           │         │        ┌────┴────┐
                                            D         N
           These       dogs     chased                │
                                          those      cats
```

The tree diagram shows that in the sentence *These dogs chased those cats.* *these* is most closely related to *dogs*, *those* most closely related to *cats* etc.

The abbreviations S, NP, VP, D, N, and V stand for different types of words or groups of words. These abbreviations and a few others we will use in this problem are spelled out here:

S:	sentence
NP:	noun phrase
VP:	verb phrase
PP:	prepositional phrase
N:	noun
V:	verb
P:	preposition
C:	conjunction

When working with trees, linguists write systems of rules (called 'grammars') which describe sets of trees. Each rule in the system is a building block. Any tree which can be constructed out of those building blocks is in the set of trees described by the grammar. For example, the tree given above for *These dogs chased those cats.* requires the following building blocks or rules:

```
        S                 NP                VP
      ┌─┴─┐             ┌──┴──┐          ┌──┴──┐
     NP   VP            D     N          V    NP


     D                 D                 N              N           V
     │                 │                 │              │           │
   these             those             dogs           cats       chased
```

Sometimes, sentences have multiple meanings, and these meanings can be described in terms of different groupings of words, or different trees. For example, the sentence *The tourist saw the astronomer with the telescope.* could mean either of the following things:

1. The tourist used the telescope to see the astronomer.

2. The astronomer that the tourist saw had a telescope.

The difference is whether the prepositional phrase (PP) *with the telescope* is grouped with *saw the astronomer* or just *the astonomer*. We can use tree diagrams to show this difference. (Note that these trees require building blocks beyond the set given above.)

```
                        S
            ┌───────────┴───────────┐
           NP                       VP
         ┌──┴──┐          ┌──────────┴──────────┐
        D      N         VP                      PP
        │      │       ┌──┴──┐                ┌───┴───┐
       the   tourist   V     NP               P       NP
                       │   ┌──┴──┐            │     ┌──┴──┐
                      saw  D     N           with   D     N
                           │     │                  │     │
                          the astronomer           the telescope
```
'The tourist used the telescope to see the astronomer.'

```
                      S
          ┌───────────┴───────────┐
         NP                       VP
       ┌──┴──┐          ┌──────────┴──────────┐
      D      N          V                     NP
      │      │          │          ┌───────────┴───────────┐
     the   tourist     saw        NP                        PP
                               ┌───┴───┐               ┌─────┴─────┐
                              D        N               P           NP
                              │        │               │        ┌──┴──┐
                             the   astronomer         with       D     N
                                                                 │     │
                                                                the telescope
```
'The astronomer that the tourist saw had a telescope.'

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Your tasks   Using the set of building blocks given on this page, draw tree diagrams for each of the following sentences. Some of the sentences have multiple meanings, corresponding to multiple trees. Try to find all of the trees that the set of building blocks can create for each sentence.

1. The mouse and the cat chased the dog.

2. The mouse saw the cat on the mat with the hat.

3. The dog chased the cat and the rabbit with the mouse.

```
      S              VP             VP             PP
    /   \          /    \         /    \         /    \
  NP     VP      V       NP     VP      PP      P      NP


       NP             NP              NP
     /    \         /    \         /   |   \
   D        N     NP      PP     NP    C    NP


    D              V              V              C            P          P
    |              |              |              |            |          |
   the           chased          saw            and          on        with


    N              N              N              N            N
    |              |              |              |            |
   cat            dog            mat           mouse        rabbit
```