Ambiguity

Syntactic Ambiguity in English

Sentence
Noun Phrase — Verb Phrase — Subordinate Clause

Programs must be written for people to read

1Preface of Structure and Interpretation of Computer Programs
by Harold Abelson and Gerald Sussman with Julie Sussman

Syntax Trees

Program (noun)
a series of coded software instructions

Program (verb)
provide a computer with coded instructions

Program must be written for people to read

must (verb)
be obliged to

must (noun)
dampness or mildew

Definitions from the New Oxford American Dictionary
Representing Syntactic Structure

A Tree represents a phrase:
- **tag** -- What kind of phrase (e.g., S, NP, VP)
- **branches** -- Sequence of Tree or Leaf components

A Leaf represents a single word:
- **tag** -- What kind of word (e.g., N, V)
- **word** -- The word

**Example:**
- cows = Leaf('N', 'cows')
- intimidate = Leaf('V', 'intimidate')
- S, NP, VP = 'S', 'NP', 'VP'
- Tree(S, [Tree(NP, [cows]), Tree(VP, [intimidate, Tree(NP, [cows])])])

Context-Free Grammar Rules

A grammar rule describes how a tag can be expanded as a sequence of tags or words

**Grammar Example:**
- S → NP VP
- NP → N
- N = cows
- VP → V NP
- V → intimidate

Exhaustive Parsing

Expand all tags recursively, but constrain words to match input

**Constraint:**
A Leaf must match the input word

(Demo)
Scoring a Tree Using Relative Frequencies

Not all syntactic structures are equally common

```
S  -->  NP  VP
     25372

NP  -->  NN
    4358

VP  -->  VBZ  NP
     3160

NP  -->  JJ  NNS
      2526
```

teacher strikes idle kids

Rule frequency per 100,000 tags

<table>
<thead>
<tr>
<th>Rule</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>S  --&gt;  NP  VP</td>
<td>25372</td>
</tr>
<tr>
<td>NP  --&gt;  NN</td>
<td>4358</td>
</tr>
<tr>
<td>VP  --&gt;  VBZ</td>
<td>3160</td>
</tr>
</tbody>
</table>

Translation

Syntactic Reordering

English  $\rightarrow$ Yoda-English

```
S  -->  NP  VP
     25372

NP  -->  NN
    4358

VP  -->  VBZ  NP
     3160

NP  -->  JJ  NNS
      2526
```

Help you, I can!

Yes! Mm!

When 900 years old you reach, look as good, you will not. Hm.