A Simple Grammar

Rules:
S → NP VP
NP → (D) A* N PP*
VP → V (NP) (PP)
PP → P NP

Lexicon:
D: the, some
A: big, brown, old
N: birds, fleas, dog, hunter
V: attack, ate, watched
P: for, beside, with
The Coordination Schema

A neighbor yelled, chased the cat, and gave the dog a bone.

Kim, Sandy, and Lee left the room.

Every man, woman, and child should listen.

\[ X \rightarrow X^+ \text{ CONJ } X. \]
They yelled and chased the cat, and gave the dog a bone.
Prepositional Phrases

- The fool yelled at noon.
- This disease gave Leslie a fever in Rome.
- A tourist in Rome laughed.
- A tourist yelled at noon and at midnight, in Rome and in Paris.

\[
PP \rightarrow P \ NP
\]
\[
VP \rightarrow VP \ PP
\]
Noun Phrases

The love of my life and mother of my children would never do such a thing.

The museum displayed no painting by Miro or drawing by Klee.

NP $\rightarrow$ (D) NOM

NOM $\rightarrow$ N

NOM $\rightarrow$ NOM PP
Coordinate NOMs

NP
  D
    no
  NOM
    NOM
      CONJ
      NOM
        N
        PP
        painting
        by Miro
      or
      NOM
        N
        PP
        drawing
        by Klee
Summary of Rules

\[
\begin{align*}
S & \rightarrow NP \ VP \\
NP & \rightarrow (D) \ NOM \\
VP & \rightarrow V \ (NP) \ (NP) \\
NOM & \rightarrow N \\
NOM & \rightarrow NOM \ PP \\
VP & \rightarrow VP \ PP \\
PP & \rightarrow P \ NP \\
X & \rightarrow X^+ \ CONJ \ X
\end{align*}
\]
A Simple Sentence

S
   NP       VP
      D      V       NP
     the     like     cats
      N      NOM      N
          Sandy
What’s Wrong with Simple CFGs? 1

Different subclasses occur in different contexts

Kim disappeared (*the book).

Einstein proved *(the theorem).

We put *(the book) *(on the shelf).
What’s Wrong with Simple CFGs? 2

Nothing! Just need categories of finer grain.

• **Rules:**

  VP → IV
  VP → TV NP
  VP → PTV NP PP

• **Lexicon:**

  IV: disappear, die,…
  TV: prove,
  PTV: put,…
Better Implementation of this Idea: 
Syntactic Features

- **Rules:**
  
  \[
  \begin{align*}
  VP &\rightarrow [V^+, VAL \ 1] \\
  VP &\rightarrow [V^+, VAL \ 2] \ NP \\
  VP &\rightarrow [V^+, VAL \ 3] \ NP \ PP
  \end{align*}
  \]

- **Lexicon:**
  
  \[
  \begin{align*}
  [V^+, VAL \ 1]: &\text{ disappear, die,...} \\
  [V^+, VAL \ 2]: &\text{ prove,} \\
  [V^+, VAL \ 3]: &\text{ put,...}
  \end{align*}
  \]
What’s Wrong with Simple CFGs? 3

Unnatural Hypothetical Phrase Structure Rules

\[
\begin{align*}
\text{VP} & \rightarrow \ P \ NP \\
\text{NP} & \rightarrow \ PP \ S
\end{align*}
\]
They like bagels.

*They like.

Bagels, they like __ .

Bagels, I think they like __ .

Bagels, I think they said they like __ .
Discontinuous Dependencies 2

They talked to the head of the school

*They talked to.

The head of the school, they talked to __ .

The head of the school, they said they talked to __ .
More Long-Distance Discontinuous Dependencies

- *Wh*-relatives:
  
  the book [[in which] you’ll find the answer __ ]
  
  the book [that Sandy says she liked __ ]

- *Wh*-Interrogative Clauses:

  [Who(se books)] do you think Sandy likes __ best?
  
  I know [who(se books)] you think Sandy likes __ best.

- *Wh*-Exclamatives

  [What slobs] Robin and his merry men turned out to be __ !
More Long-Distance Discontinuous Dependencies

- Adverb preposing:
  
  [On Tuesday], (I think) you can go to the store __ .

- More-the-merrier-constructions:

  The more you smoke __ , the less you feel the pain __ .

- It-clefts:
  
  It was [[Sandy] that Kim wanted to visit __ ].

- Comparatives:

  Sandy ate more bagels than they thought Kim had eaten __ .
Transformational Grammars

```
S  ⇒  S
  ...
S  ⇒  XP ...
S ...

S  ⇒  XP S
  ...
S  ⇒  t_i ...
S ...
```

```
S  ⇒  XP_i S
  ...
S  ⇒  t_i ...
S ...

S  ⇒  XP_i S
  ...
S  ⇒  t_i S
  ...
S ...
```