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

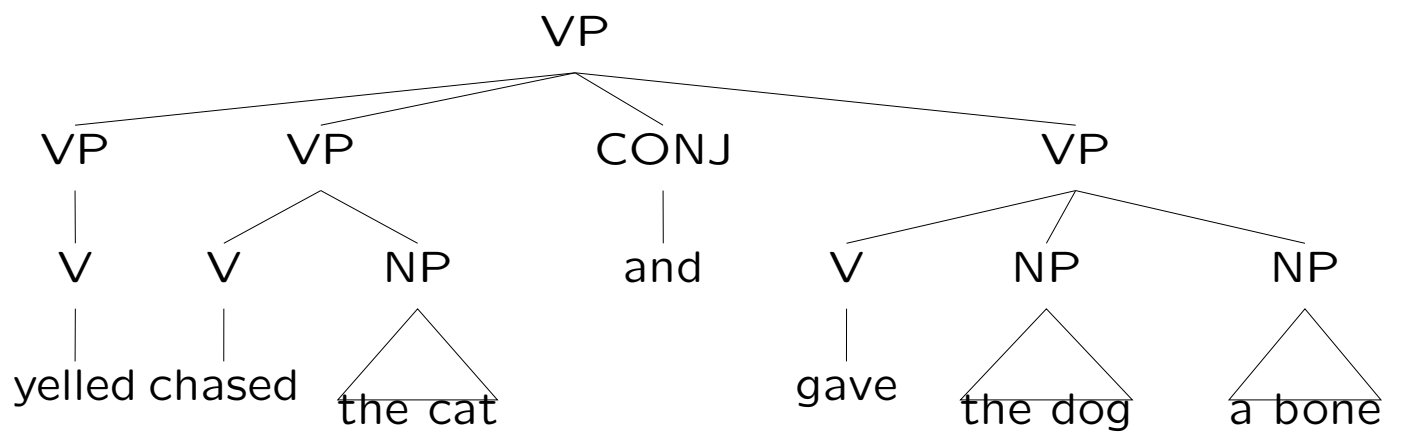V: attack, ate, watched

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.

$$X \rightarrow X^{+} \ \text{CONJ} \ X.$$

VP

VP   VP   CONJ   VP

V   V   NP   and   V   NP   NP

yelled chased   the cat   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 → (D) NOM

NOM → N

NOM → NOM PP

Coordinate NOMs

```
                          NP
                 _____/  _____
                D                    NOM
                |            _____/ | _____
               no         NOM       CONJ        NOM
                        __/ \__       |        __/ \__
                       N      PP      or      N      PP
                       |     /\               |     /\
                   painting /__\           drawing /__\
                          by Miro                by Klee
```
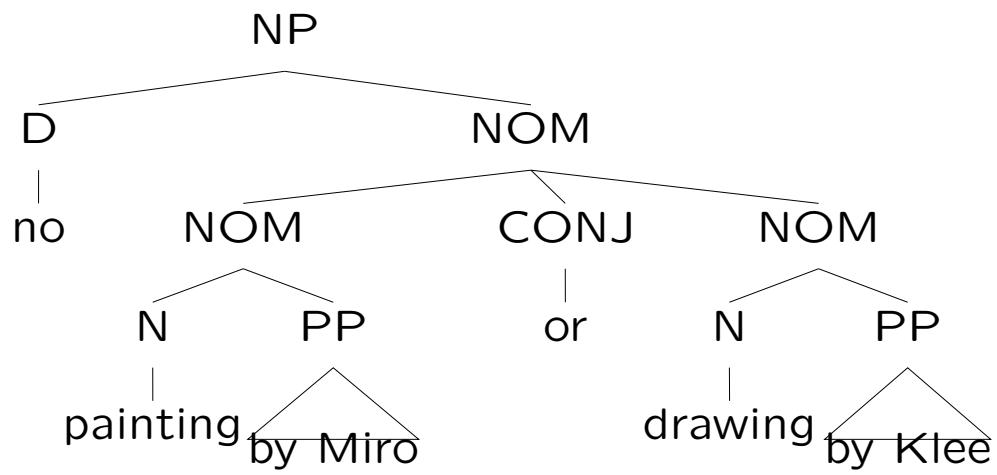
Summary of Rules

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

A Simple Sentence

```
                      S
              ┌───────┴───────┐
             NP              VP
          ┌───┴───┐      ┌────┴────┐
          D      NOM     V        NP
          │       │      │         │
         the      N     like      NOM
                  │                 │
                 cats               N
                                    │
                                  Sandy
```
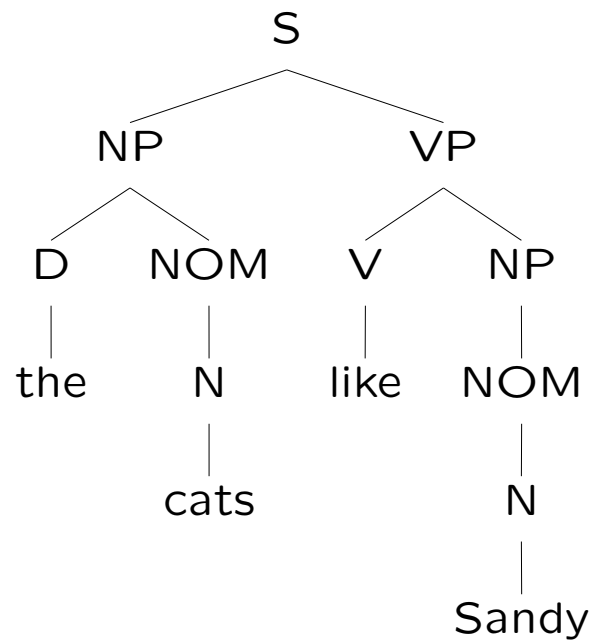
What's Wrong with Simple CFGs? 1

Different subclasses occur in different contexts

Kim disappeared (*the book).

Einstein proved *(the theorem).

We put *(the book) *(on the shelf).

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:**

    VP → [V+,VAL 1]

    VP → [V+,VAL 2] NP

    VP → [V+,VAL 3] NP PP

- **Lexicon:**

    [V+,VAL 1]: disappear, die,...

    [V+,VAL 2]: prove,

    [V+,VAL 3]: put,...

What's Wrong with Simple CFGs? 3

Unnatural Hypothetical Phrase Structure Rules

VP $\rightarrow$ P NP

NP $\rightarrow$ PP S

WWW CFG? 4: Discontinuous Dependencies

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:

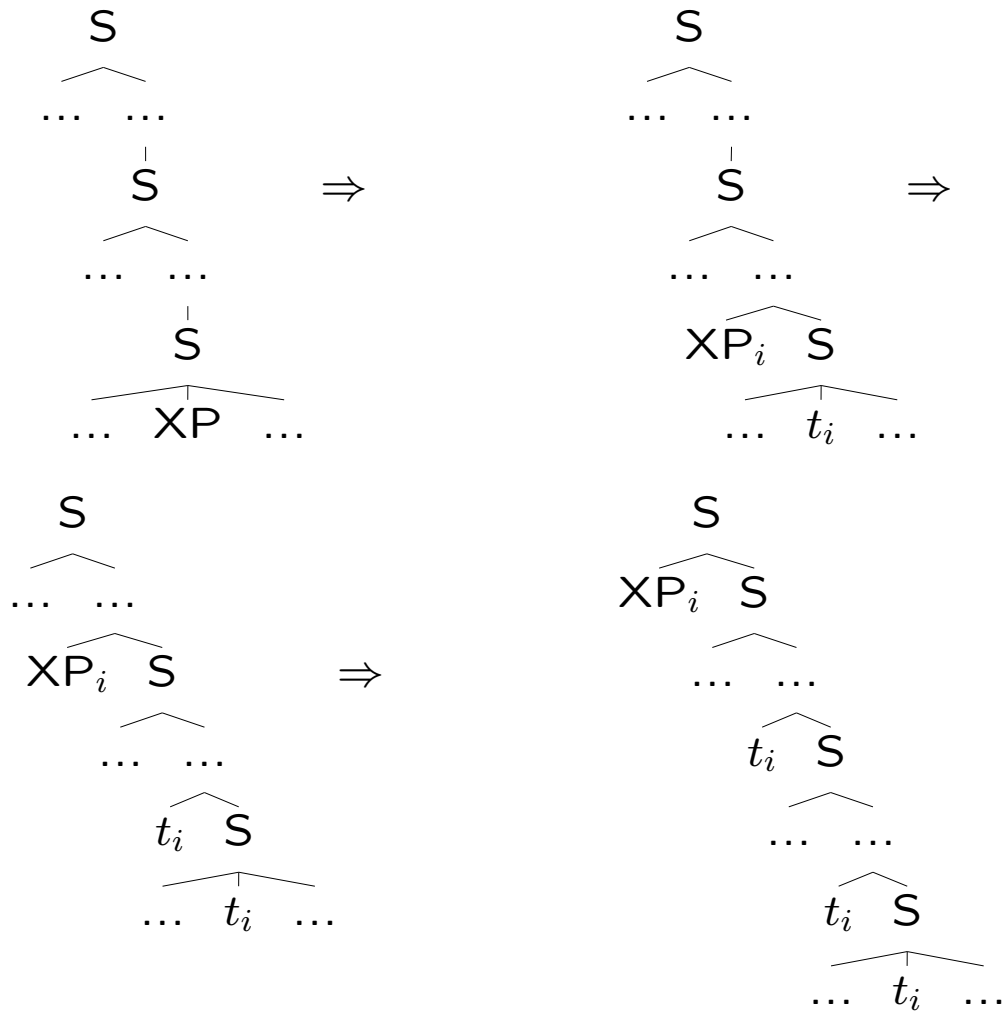 The more you smoke __ , the less you feel the
  pain __ .

- *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 ···

$\Rightarrow$

S
··· ···
S
··· ···
XP_i S
··· t_i ···

$\Rightarrow$

S
··· ···
XP_i S
··· ···
t_i S
··· t_i ···

$\Rightarrow$

S
XP_i S
··· ···
t_i S
··· ···
t_i S
··· t_i ···

Feature-Based Grammars

S
[GAP { }]

NP   S
[CAT ①]   [GAP {①}]

...   ...

S
[GAP {①}]

...   ...

S
[GAP {①}]

...   NP   ...
[CAT ①]
[GAP {①}]

___