The Basics of Syntax
Supplementary Readings

The following readings have been posted to the Moodle course site:

- Language Files: Chapter 5 (pp. 194-198, 204-215)
- Language Instinct: Chapter 4 (pp. 74-99)
The System Thus Far

The Fundamental Question:
What are the rules and mental representations that underlie our ability to speak and understand a language?

The Answer Thus Far:

- Mental Representations:
  - A ‘mental lexicon’ listing the morphemes (words and affixes) of the language.
  - For each morpheme, a representation of the phonemes that constitute it.

- The Rules:
  - **Morphology**: Rules for combining morphemes into words.
    - Right Hand Head Rule
  - **Phonology**: Rules affecting how the word is pronounced.
    - The Syllabification Rule
    - The Aspiration Rule
    - (...and a whole bunch more...)
And Now... *Syntax*!

**In This Unit:**
We will explore a third major category of rules and representations, those that concern *sentences*.

**Vocabulary:**
*Syntax* = the (study of the) rules of sentence formation

1. The rules that state **how words can be combined into sentences**.
   The dog chased the cat. * Dog the cat chased the.

2. The rules that state **how different combinations give different meanings**.
   The dog chased the cat. The cat chased the dog.
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**Note:**
- Sometimes the rules in (2) are called ‘**semantics**’
- In this class, we won’t be covering (2), just the rules in (1).
Rules and Categories of Words

Crucial Fact:

- The rules for making sentences don’t refer to specific words (e.g. ‘dog’, ‘run’)
- Rather, they refer to *types* or *categories* of words (e.g. ‘noun’, ‘verb’)
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Illustration: “Dave danced”

1. The rule that forms this sentence isn’t:
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2. Rather, the rule is more like:
   “A sentence can be formed from a noun and a verb”
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- If all we had were rules like (1), we’d need a *ridiculous* number of them (separate rules for ‘cat’, ‘dog’, ‘duck’, ‘desk’?!)
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- Knowing only this, you immediately know that these are all good-sounding sentences:
  - This game is a real **snerd**.
  - Don’t buy that **snerd**.
  - **Snerds** really annoy me.
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- Imagine ‘snerd’ = ‘game that can be won in under 10 hours’
- Knowing only this, you immediately know that these are all good-sounding sentences:
  - This game is a real snerd.
  - Don’t buy that snerd.
  - Snerds really annoy me.
- You also know that these are not good-sounding sentences:
  - * I snerd every weekend.
  - * I play very snerd.
The Generality of Syntactic Rules

Fact:
When speakers learn a new word, they immediately know how to form sentences with it.

Conclusion:
▶ Even though you hadn’t heard ‘snerd’ in a sentence, you knew right away how to use it in sentences.
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- So, knowing how to use ‘snerd’ couldn’t be based in rules specific to ‘snerd’ (cause you weren’t shown any).
- So, the rules for forming sentences don’t refer to specific words (e.g. ‘snerd’), but to categories of words (e.g. ‘noun’)
  - When you learned ‘snerd’, you could tell it was a noun.
  - Knowing this, the rules for nouns in English told you how to form sentences with it.
Syntactic Categories

Crucial Fact:

► The rules for making sentences don’t refer to specific words (e.g. ‘dog’, ‘run’)

► Rather, they refer to types or categories of words (e.g. ‘noun’, ‘verb’)

Vocabulary:

**Syntactic category** (‘lexical category’, ‘part of speech’) = the word categories that the rules of syntax make reference to

► Many of these will be familiar to you from language classes...
Syntactic Categories

**Noun: (N)**

- Examples:
  dog, cat, man, boy, table, death, happiness, snerd
- Main Characteristic:
  Nouns can have “the” appear directly before them: (the dog, the cat, the death, the happiness, the snerd)
Syntactic Categories

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Verb: (V)

- Examples:
  - jump, laugh, run, carry, hit, love, snow, ponder, pwn
- Main Characteristic:
  - Verbs can have “will” appear directly before them:
    - (will jump, will run, will love, will ponder, will pwn)
Syntactic Categories

Noun: (N)

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don, cat, man, boy, table, death, happiness, snerd
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Verbs can have “will” appear directly before them
(will jump, will run, will love, will ponder, will pwn)

Adjective: (A)

► Examples:
happy, tall, little, wonderful, former, ugly, doable
► Main Characteristic:
Adjective can come between “the” and a N
(the happy dog, the former mayor, the doable idea)
Definitions of Noun, Verb, Adjective?

Question:
But wait, didn’t we learn back in grade school that:

- Noun = ‘a person, place or thing’?
- Verb = ‘an action’?
- Adjective = ‘a quality’?
Definitions of Noun, Verb, Adjective?

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Answer:
Those definitions aren’t totally correct:

- Not all verbs describe actions (‘love’, ‘know’)
- Not all adjectives describe qualities (‘former’)
- Saying ‘nouns’ describe ‘things’ is empty: (anything can be a ‘thing’, including actions)
Definitions of Noun, Verb, Adjective?

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Answer:
The correct definitions are in terms of where in a sentence they can go:

- A ‘noun’ can (e.g.) come right after “the”
- A ‘verb’ can (e.g.) come right after “will”
- An ‘adjective’ can (e.g.) come between “the” and a noun.
Some More Syntactic Categories

Here are some more syntactic categories, which may be new to you....

**Determiner**: (D)
- Examples: 
  - the, a, some, every, no, most
- Main Characteristic: (don’t worry about this for now)

**Preposition**: (P)
- Examples: 
  - to, for, of, in, with, over, under, without, inside
- Main Characteristic: (don’t worry about this for now)
Towards Phrase Structure Rules

What We Know So Far:

- Languages have rules for forming sentences.
- The rules don’t refer to specific words, but to word categories.
- The word categories (for now) are: N, V, A, D, P

Now, let’s start figuring out the actual rules!
Towards Phrase Structure Rules

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Opening Observation:
You can form a sentence of English by combining a N and a V.

- Dogs run.
- Boys dance.
- Girls laugh.

A Formal Notation:
S \rightarrow \text{N V}

“A sentence can be formed from a noun followed by a verb”
The Basics of Phrase Structure Rules

A Formal Notation:
S → N V
“A sentence can be formed from a noun followed by a verb”

- Rules in this notation are **phrase structure rules**.
- They look like our earlier morphology rules...
  - Except there is no ‘+’ after the arrow.
  - Because these rules make **phrases**, not words
The Basics of Phrase Structure Rules

A Formal Notation:

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- Rules in this notation are phrase structure rules.
- They look like our earlier morphology rules...
  - Except there is no ‘+’ after the arrow.
  - Because these rules make phrases, not words
- As in our morphology unit, we can use ‘tree structures’ to illustrate the way these rules make larger structures:

```
S
 / \
N   V
/   |
Dogs run
```

```
S
 / \
N   V
/   |
Boys dance
```

```
S
 / \
N   V
/   |
Girls laugh
```

“The noun ‘dogs’ combines with the verb ‘run’ to make a sentence”
Towards Noun Phrases

Observation 1:
- There are many more rules to English syntax besides ‘S → N V’
- There are many sentences that can’t be formed from this rule.

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Observation 2:

All these rules above are getting tedious...
They are also missing an obvious pattern: The Pattern:
Wherever English allows N, it also allows (i) D N, (ii) A N, (iii) D A N.
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Capturing the Pattern:

- English treats all these as ‘the same kind of thing’:
  N   D N   A N   D A N
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- Let’s call this kind of ‘thing’ a **Noun Phrase (NP)**
- The following rules now capture ‘The Pattern’
  - NP → N
  - NP → D N
  - NP → A N
  - NP → D A N
The Noun Phrase

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Capturing the Pattern:

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  N \quad D \ N \quad A \ N \quad D \ A \ N
  \]
- Let’s call this kind of ‘thing’ a **Noun Phrase (NP)**
- The following rules now capture ‘The Pattern’
  
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  &\text{NP} \to \text{D N} \\
  &\text{NP} \to \text{A N} \\
  &\text{NP} \to \text{D A N}
  \end{align*}
  \]
- We can now also simplify our rules for sentences to just these:
  \[
  \begin{align*}
  &\text{S} \to \text{NP V} \\
  &\text{S} \to \text{NP V NP}
  \end{align*}
  \]
Noun Phrases in Tree Structures

Our Phrase Structure Rules

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Our Phrase Structure Rules

**PS Rules for NPs**
- NP → N
- NP → D N
- NP → A N
- NP → D A N

**PS Rules for Sentences**
- S → NP V
- S → NP V NP

We can use tree structures to show how these rules apply to make sentences:

```
S
  NP
    D N
      some dogs

V
```

“Some dogs run”
Noun Phrases in Tree Structures

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We can use tree structures to show how these rules apply to make sentences:

```
S
  +--- NP ---+  +--- V ---+  +--- NP ---+
  |     |     |     |     |
  D     A     chase A     N
   |     |     |     |     |
the young cats old dogs
```

"The young cats chase old dogs"
Noun Phrases in Tree Structures

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We can use tree structures to show how these rules apply to make sentences:

```
S
   /\  \
  NP  V  NP
   /     \
  N  chase D N
  /     /   \
Dogs most  cats
```

“Dogs chase most cats”
## Condensing our Rules for NPs

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Now let's try simplifying our PS rules for NPs a little.
Condensing our Rules for NPs

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Now let’s try simplifying our PS rules for NPs a little.

What These Rules Say:

- An NP has to have a N in it.
- An NP can (but need not) also contain a D and/or an A
- If there is a D, it has to precede the N and any A
- If there is an A, it has to precede the N and follow any D.
Condensing our Rules for NPs

Our Phrase Structure Rules

<table>
<thead>
<tr>
<th>PS Rules for NPs</th>
<th>PS Rules for Sentences</th>
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<tbody>
<tr>
<td>NP → N</td>
<td>S → NP V</td>
</tr>
<tr>
<td>NP → D N</td>
<td>S → NP V NP</td>
</tr>
<tr>
<td>NP → A N</td>
<td></td>
</tr>
<tr>
<td>NP → D A N</td>
<td></td>
</tr>
</tbody>
</table>

Now let’s try simplifying our PS rules for NPs a little.

What These Rules Say:

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We’ll now learn a new notation, which lets us say all this in just one rule.
The Parentheses Notation

Parentheses in PS Rules:
If a PS rule has something in parentheses, that means the thing is *optional*.

- **Illustration:**
  \[ NP \rightarrow (D) (A) N \]
  ‘NP can be made from optional D, optional A, and N’
The Parentheses Notation

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Conclusion:
This one rule (with parentheses) can replace our four earlier rules for NPs.
The Parentheses Notation

Parentheses in PS Rules:
If a PS rule has something in parentheses, that means the thing is optional.

- Illustration:
  \[ NP \rightarrow (D) (A) N \]
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Our New Phrase Structure Rules:

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PS Rules and Words

A Technical Problem for our PS Rules:

- Our PS rules tell us how sentences can be made from smaller phrases / lexical categories:
  - $S \rightarrow NP \ V$
  - $S \rightarrow NP \ V \ NP$
  - $NP \rightarrow (D) \ (A) \ N$

- However, these rules don't link lexical categories to specific words. Nothing in these rules says 'dog' is N, or 'chase' is V.
- So, these rules alone don't make full English sentences. (Only the 'skeleton' of a sentence.)
PS Rules and Words

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- So, these rules alone don’t make full English sentences. (Only the ‘skeleton’ of a sentence.)
PS Rules and the ‘Mental Lexicon’

Question:
What can we add so these ‘skeletons’ become full sentences?

The Mental Lexicon!

Our ‘mental lexicon (dictionary)’ lists for every word:
- How the word is pronounced (it’s phonemic representation)
- What the word means
- The word’s syntactic category (whether it’s a N, V, A, etc.)

A Picture of The Mental Lexicon:

- **Dog**
  - Sound: /dAg/
  - Part of Speech: Noun (N)
  - Meaning: *canis familiaris*

- **Jump**
  - Sound: /Ã2mp/
  - Part of Speech: Verb (V)
  - Meaning: *to leap*
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Key Idea:

- Our mental lexicon can tell us which words can go where in a ‘sentence skeleton’.
- So, the full procedure for making a sentence consults the mental lexicon.
The Procedure for Making Sentences

Step One:
Use the phrase structure rules to make a syntactic tree structure.

S → NP V
NP → A N

S
 / \   
NP   V
 /   
A   N
The Procedure for Making Sentences

Step Two:
Go to the mental lexicon; look for words that match the lexical categories in the tree.

Dog
Sound: /dæɡ/
Part of Speech: Noun (N)
Meaning: *canis familiaris*

Jump
Sound: /dʒʌmp/
Part of Speech: Verb (V)
Meaning: *to leap*

Old
Sound: /owld/
Part of Speech: Adjective (A)
Meaning: Advanced in age
The Procedure for Making Sentences

Step Three:
Insert the words with the matching lexical categories under the lexical category labels in the tree

```
S
 /  |
NP  V
   /|
  A  N  jump
   /|
 old  dogs
```

The Main Point of This:

- Our PS rules alone do not make full sentences of English.
- Our system makes sentences in three steps:
  - The PS rules make syntactic tree (sentence skeleton)
  - The system looks in the lexicon for words matching the categories in the tree
  - The system inserts the words into the tree, under the right category labels
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  / \\
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old  jump  dogs
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Towards Verb Phrases

- We now have the following, simple rules for sentences:
  - \( S \rightarrow \text{NP V} \)
  - \( S \rightarrow \text{NP V NP} \)

- These two rules don’t cover \textit{all} sentences of English:
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- We now have the following, simple rules for sentences:
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Problem:
- Again, all these different rules are getting tedious.
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The Pattern:
All the following combine with NP to make a sentence:

- V
- V P
- V P NP
- V NP
- V NP P
- V NP P NP
## Introducing Verb Phrases

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### Capturing the Pattern:
English treats all these as ‘the same type of thing’:

- $V$
- $V\ P$
- $V\ P\ NP$
- $V\ NP$
- $V\ NP\ P$
- $V\ NP\ P\ NP$
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### Capturing the Pattern:
Let’s call this ‘kind of a thing’ a **Verb Phrase (VP)** (cause there’s always a V in it).

- V
- V P
- V P NP
- V NP
- V NP P
- V NP P NP
Introducing Verb Phrases

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Capturing the Pattern:
We can now use PS rules to state that these are all VPs:

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- V P NP
- V NP
- V NP P
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Capturing the Pattern:

We can now use PS rules to state that these are all VPs:

- $VP \rightarrow V$
- $VP \rightarrow V \ P$
- $VP \rightarrow V \ P \ NP$
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### Capturing the Pattern:

Finally, we can reduce our PS rules for sentences to *just one*:

- $VP \rightarrow V$
- $VP \rightarrow V \ P$
- $VP \rightarrow V \ P \ NP$
- $VP \rightarrow V \ NP$
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Capturing the Pattern:
Finally, we can reduce our PS rules for sentences to just one:

- VP → V
- VP → V P
- VP → V P NP
- VP → V NP
- VP → V NP P
- VP → V NP P NP
- S → NP VP
Simplifying the VP Rules

Our Phrase Structure Rules:

For NPs

NP → (D) (A) N

For Ss

S → NP VP

For VPs

VP → V
VP → V P
VP → V P NP
VP → V NP
VP → V NP P
VP → V NP P NP

Observations:

I A VP has to have a V in it.
I A VP can (but need not) have an NP in it.
I A VP can (but need not) have a P in it.
I If a VP has a P in it, it can have another NP after the P.

Using parentheses, we can say all this in one rule:

VP → V (NP) (P) (NP)
Simplifying the VP Rules

Our Phrase Structure Rules:

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Observations:

- Together, these rules for VP say the following:
  - A VP has to have a V in it.
  - A VP can (but need not) have an NP in it
  - A VP can (but need not) have a P in it
  - If a VP has a P in it, it can have another NP after the P
Simplifying the VP Rules

Our Phrase Structure Rules:

For NPs
NP → (D) (A) N

For Ss
S → NP VP

For VPs
VP → V
VP → V P
VP → V P NP
VP → V NP
VP → V NP P
VP → V NP P NP

Observations:

- Together, these rules for VP say the following:
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- Using parentheses, we can say all this in one rule:
  - VP → V (NP) (P) (NP)
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- These three rules work together with the mental lexicon to create rather complex sentences of English.
Simplifying the VP Rules

Our Phrase Structure Rules:

For NPs
\[ NP \rightarrow (D) (A) N \]

For Ss
\[ S \rightarrow NP \ VP \]

For VPs
\[ VP \rightarrow V (NP) (P) (NP) \]

- These three rules work together with the mental lexicon to create rather complex sentences of English.

```
S
 /   \\
NP   VP
 /     \\
N  V  P
 / \\
Dave fell down
```

“Dave fell down.”
Simplifying the VP Rules

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- These three rules work together with the mental lexicon to create rather complex sentences of English.

```
S
  NP        VP
  A    N    V    NP
  Ugly  cats like D  this  N
  |     |     |     |     |
  |     |     |     |     |
  |     |     |     |     |
```

“Ugly cats like this food.”
Simplifying the VP Rules

Our Phrase Structure Rules:

For NPs: \[ NP \rightarrow (D) (A) N \]
For Ss: \[ S \rightarrow NP \ VP \]
For VPs: \[ VP \rightarrow V (NP) (P) (NP) \]

- These three rules work together with the mental lexicon to create rather complex sentences of English.

```
S
  /\  
 NP  VP
 / \  / \  
 D A N V NP P NP
 / \ / \ / \  
 the old man put A N into D A N
/ \ / \ / \  
broken cups into a wooden box
```

“The old man put broken cups into a wooden box.”
Towards Prepositional Phrases

Fun Fact: Prepositions can also appear inside NPs!

- The boy in the yard jumped.
- The dog outside the fence barked.
- The dog outside barked.
Towards Prepositional Phrases

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Needed Change to PS Rules: \[ NP \rightarrow (D) \ (A) \ N \ (P) \ (NP) \]
Towards Prepositional Phrases

Our Phrase Structure Rules:

For NPs

NP → (D) (A) N (P) (NP)

For Ss

S → NP VP

For VPs

VP → V (NP) (P) (NP)

Towards Prepositional Phrases

Our Phrase Structure Rules:

For NPs

NP → (D) (A) N (P) (NP)

For Ss

S → NP VP

For VPs

VP → V (NP) (P) (NP)

Apparent Pattern:

Wherever English allows P, it also allows P followed by NP

Illustration:

I

The dog

outside

barked

The dog

outside the fence

barked.

I

The dog climbed

down

The dog climbed

down the tree
Towards Prepositional Phrases

Our Phrase Structure Rules:

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Towards Prepositional Phrases

Our Phrase Structure Rules:

For NPs
\[ NP \rightarrow (D) (A) N (P) (NP) \]

For Ss
\[ S \rightarrow NP \ VP \]

For VPs
\[ VP \rightarrow V (NP) (P) (NP) \]

Apparent Pattern:
Wherever English allows P, it also allows P followed by NP

Illustration:

- The dog **outside** barked
  The dog **outside the fence** barked.

- The dog climbed **down**
  The dog climbed **down the tree**.
Introducing Prepositional Phrases

Our Phrase Structure Rules:

**For NPs**
NP → (D) (A) N (P) (NP)

**For Ss**
S → NP VP

**For VPs**
VP → V (NP) (P) (NP)

Apparent Pattern:
Wherever English allows P, it also allows P followed by NP

Capturing the Pattern:
English treats ‘P’ and ‘P NP’ as the same ‘type’ of thing.
Introducing Prepositional Phrases

Our Phrase Structure Rules:

For NPs
NP → (D) (A) N (P) (NP)

For Ss
S → NP VP

For VPs
VP → V (NP) (P) (NP)

Apparent Pattern:
Wherever English allows P, it also allows P followed by NP

Capturing the Pattern:
Let’s call this type of thing a ‘Propositional Phrase’ (PP)
(since there’s always a P in it).
Introducing Prepositional Phrases

Our Phrase Structure Rules:

For NPs  
NP → (D) (A) N (P) (NP)  

For Ss  
S → NP VP  

For VPs  
VP → V (NP) (P) (NP)  

Apparent Pattern:  
Wherever English allows P, it also allows P followed by NP

Capturing the Pattern:  
These rules let us say PP is either P or P followed by NP:

- PP → P
- PP → P NP
Introducing Prepositional Phrases

Our Phrase Structure Rules:

For NPs
NP → (D) (A) N (P) (NP)

For Ss
S → NP VP

For VPs
VP → V (NP) (P) (NP)

Apparent Pattern:
Wherever English allows P, it also allows P followed by NP

Capturing the Pattern:
Using parentheses, these rules can be condensed into one:

- PP → P
- PP → P NP
Introducing Prepositional Phrases

Our Phrase Structure Rules:

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Apparent Pattern:
Wherever English allows P, it also allows P followed by NP

Capturing the Pattern:
Using parentheses, these rules can be condensed into one:

▶ PP → P (NP)
(a PP must have P, and can optionally have NP after P)
# Introducing Prepositional Phrases

**Our Phrase Structure Rules:**

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**For PPs**

PP → P (NP)

**Apparent Pattern:**

Wherever English allows P, it also allows P followed by NP

**Capturing the Pattern:**

Using parentheses, these rules can be condensed into one:

- PP → P (NP)
  - (a PP must have P, and can optionally have NP after P)
Introducing Prepositional Phrases

Our Four Phrase Structure Rules:

\[ S \rightarrow NP \ VP \]
\[ NP \rightarrow (D) \ (A) \ N \ (PP) \]
\[ VP \rightarrow V \ (NP) \ (PP) \]
\[ PP \rightarrow P \ (NP) \]
Introducing Prepositional Phrases

Our Four Phrase Structure Rules:

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

These 4 rules can create very complex sentences of English.
Summary

- **Syntax** = (the study of) the rules of sentence formation
  - These rules give a general recipe for making sentences.
  - They don’t mention specific words (‘cat’, ‘jump’, ‘dog’)
  - Instead, they mention *categories* of words
Summary

Syntax = (the study of) the rules of sentence formation
  - These rules give a general recipe for making sentences.
  - They don’t mention specific words (‘cat’, ‘jump’, ‘dog’)
  - Instead, they mention categories of words

Syntactic category =
  the word-categories that the rules of syntax refer to.
  - Noun (N) dog, cat, table, happiness...
  - Verb (V) jump, sleep, love, think...
  - Adjective (A) tall, ugly, dead, uncool...
  - Determiner (D) the, a, this, many, most...
  - Preposition (P) in, on, to, with, for...
Summary

- Sentences are not just strings of words.
- They have a complex internal structure:
  - Sentences are made out of *phrases*: NPs and VPs.
  - NPs are made out of Ds, As, Ns, and PPs
  - VPs are made out of Vs, NPs and PPs
  - PPs are made out of Ps and NPs
Summary

- Sentences are not just strings of words.
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  - Sentences are made out of *phrases*: NPs and VPs.
  - NPs are made out of Ds, As, Ns, and PPs
  - VPs are made out of Vs, NPs and PPs
  - PPs are made out of Ps and NPs

- We can express these groupings with ‘Phrase Structure (PS) Rules’:
  - $S \rightarrow NP\ VP$
  - $NP \rightarrow (D)\ (A)\ N\ (PP)$
  - $VP \rightarrow V\ (NP)\ (PP)$
  - $PP \rightarrow P\ (NP)$
Summary

Our Four Phrase Structure Rules:

S → NP VP
NP → (D) (A) N (PP)
VP → V (NP) (PP)
PP → P (NP)
Our Four Phrase Structure Rules:

S → NP VP
NP → (D) (A) N (PP)
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Our linguistic systems make sentences by using these PS rules and our ‘mental lexicon’:
Summary

Our Four Phrase Structure Rules:

\[
\begin{align*}
S & \rightarrow \text{NP} \text{ VP} \\
\text{NP} & \rightarrow (\text{D}) \ (\text{A}) \ \text{N} \ (\text{PP}) \\
\text{VP} & \rightarrow \text{V} \ (\text{NP}) \ (\text{PP}) \\
\text{PP} & \rightarrow \text{P} \ (\text{NP})
\end{align*}
\]

Our linguistic systems make sentences by using these PS rules and our ‘mental lexicon’:

- **Step One:** Use PS rules to make a tree structure.

---

Use PS rules to make a tree structure.
Summary

Our Four Phrase Structure Rules:

- S → NP VP
- NP → (D) (A) N (PP)
- VP → V (NP) (PP)
- PP → P (NP)

Our linguistic systems make sentences by using these PS rules and our ‘mental lexicon’:

- Step Two: Find words in mental lexicon that match categories in tree.
Summary

Our Four Phrase Structure Rules:

\[
\begin{align*}
S & \rightarrow \text{NP VP} \\
\text{NP} & \rightarrow (\text{D}) (\text{A}) \text{ N (PP)} \\
\text{VP} & \rightarrow \text{V (NP) (PP)} \\
\text{PP} & \rightarrow \text{P (NP)}
\end{align*}
\]

Our linguistic systems make sentences by using these PS rules and our ‘mental lexicon’:

1. **Step Two:** Find words in mental lexicon that match categories in tree.
   
   - A = ‘angry’
   - N = ‘bees’
   - V = ‘sting’
   - P = ‘on’
   - D = ‘the’
   - N = ‘face’
Summary

Our Four Phrase Structure Rules:

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

Our linguistic systems make sentences by using these PS rules and our ‘mental lexicon’:

- **Step Three:**
  Insert those words into the tree structure, under the appropriate category labels.
  
  - A = ‘angry’
  - N = ‘bees’
  - V = ‘sting’
  - P = ‘on’
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Summary

Our Four Phrase Structure Rules:

S → NP VP
NP → (D) (A) N (PP)
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Our linguistic systems make sentences by using these PS rules and our ‘mental lexicon’:

- **Step Three:**

![Diagram](image_url)

- Angry bees sting on the face