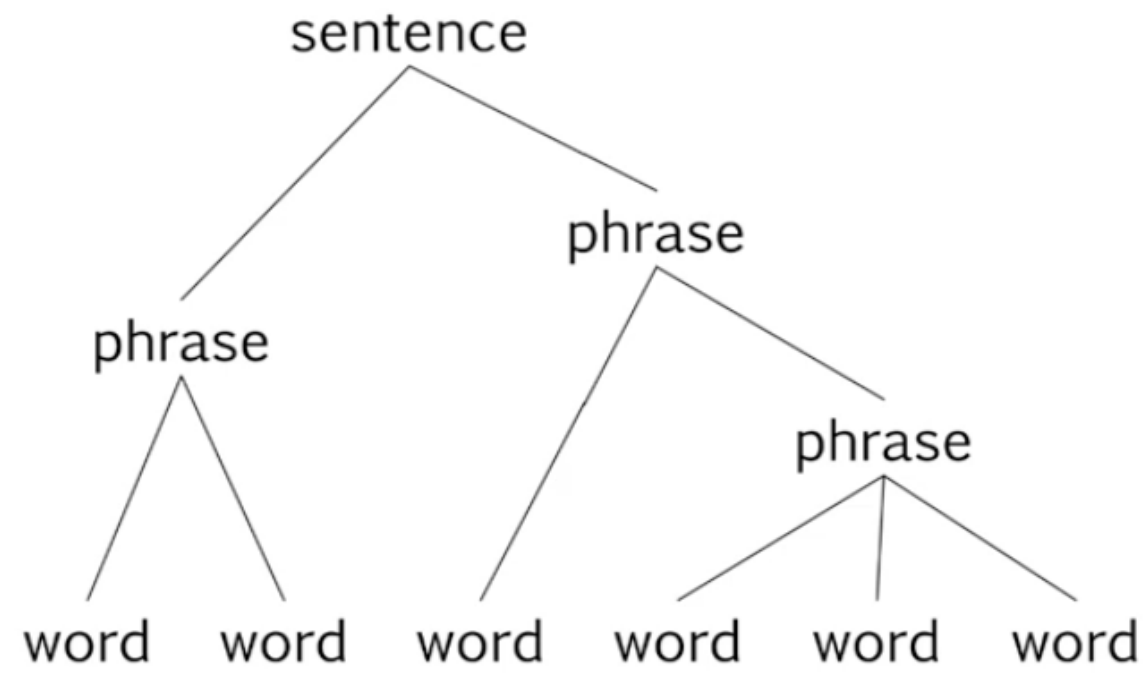# X-bar Schema

Parameswari Krishnamurthy

PS Rules

- Phrase Structure Grammar provide rules for three types of constituents: clauses, phrases and words.

- S   -> NP VP   N -> {John, Mary, Sam, Khan, Ram}
- VP - > V   V -> {read, come, see, love}
- VP - > V NP   P -> {of, on, in, to}
- VP -> V NP PP
- NP -> N
- NP -> Det N
- NP -> N PP
- NP -> Det AP N S
- PP   -> P NP

```
                    sentence
                   /        \
                  /          \
            phrase            phrase
           /     \           /      \
          /       \         /        \
         /         \       /        phrase
        /           \     /         / |  \
       /             \   /         /  |   \
    word   word    word   word  word  word
```

Inadequacy of PS rules

- [S [NP A boy] [VP met a girl]]
- [NP [N cows]]
- [NP [Det a] [N cow]]
- [VP [V reading] [NP the book]]
- [VP [V reading] [NP the book] [PP in the class]]

- A phrase may also include one or more phrases or   clauses.

the girl who came late

1) [The big book of poems with the blue cover] is on the table.

The structure our NP rule NP → (D) (AdjP+) N (PP+) assigns to this is:

2)

```
                          NP
        ┌──────┬─────┬────┬──────────┬──────────────┐
        D     AdjP    N   PP                      PP
        the    △    book  ╱│          ╱──────────╲
              big                of poems   with the blue cover
```
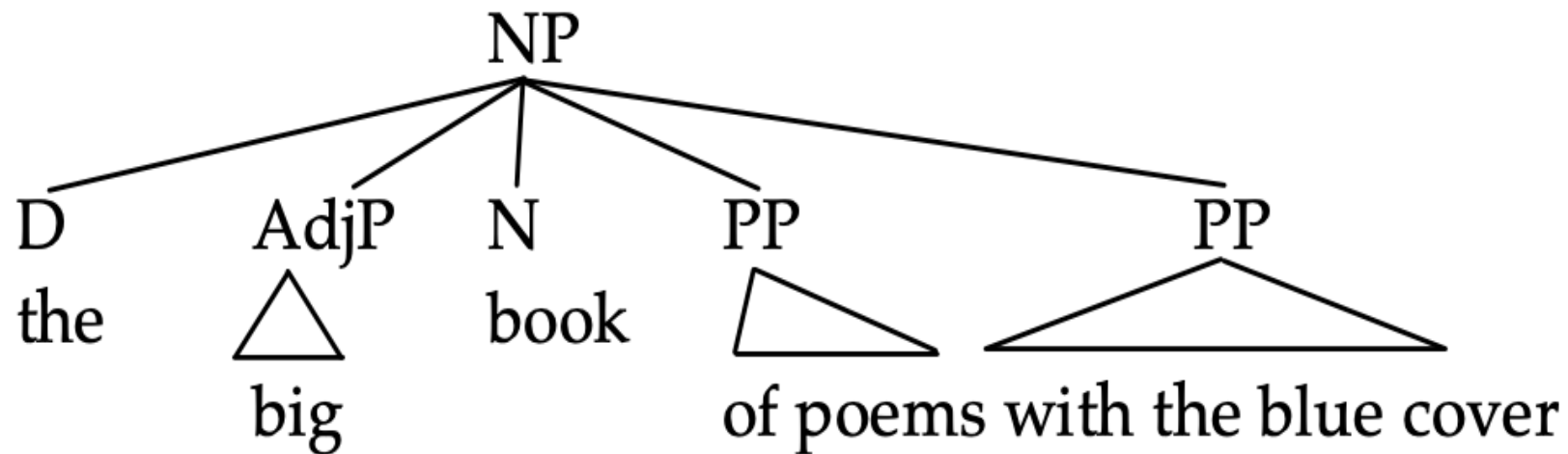
- this a flat structure.
- The PP *of poems* and the PP *with the blue cover* are on the same level hierarchically;
- there is no distinction between them in terms of dominance or c-command
  - One element c-commands another if it is within the same clause and it doesn't directly dominate the other element.
    - For example, in the sentence "She saw him", "She" c-commands "him" because "She" is within the same clause and it doesn't directly dominate "him".
    - However, "him" doesn't c-command "She" because "him" is not in a position to dominate "She".

C-command

Definition

- There are many definitions for the term. Let's begin with a commonly used one.

- A c-commands B if
  - the first branching node that dominates A also dominates B; and
  - A does not dominate B, and B does not dominate A.
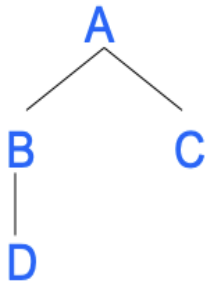
Dominance

- Imagine entities A, B and C.

The lines connecting the nodes B, C to A indicate a part-whole relationship (or any asymmetrical relationship)
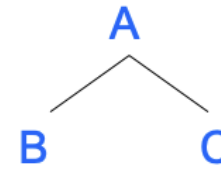
A dominates B and C. B does not dominate C. C does not dominate B. Neither B nor C dominates A.

- Suppose A stands in some **asymmetrical** relationship with B and C. For instance, A is composed of B and C.

Branching

- A is a node that branches into B and C. A is a **branching** node.
- B immediately dominates nothing else but D. B does not branch. B is not a branching node.

Recall ...

- A **c-commands** B if
  - the **first branching node** that dominates A also dominates B; and
 - A **does not dominate** B, and B **does not dominate** A.

C-command

- Any node A c-commands node B, no matter how many layers of structure there may be, as long as
  - The first branching node that dominates A also dominates B; and
  - A does not dominate B, and B does not dominate A.

Using c-command

- In syntax for example, reflexives (herself, himself, themselves, etc) and reciprocals (each other) are always c-commanded by their antecedent.
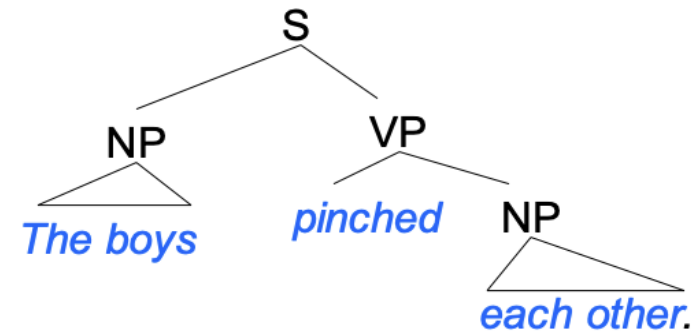
- 3) I bought the big [book of poems with the blue cover] not the small [one].

- 4) I bought the big [book of poems] with the blue cover not the small [one] with the red cover.

NP
D
the
N'$_1$
AP
big
N'$_2$
N'$_3$
PP
N
book
PP
of poems
with the blue cover
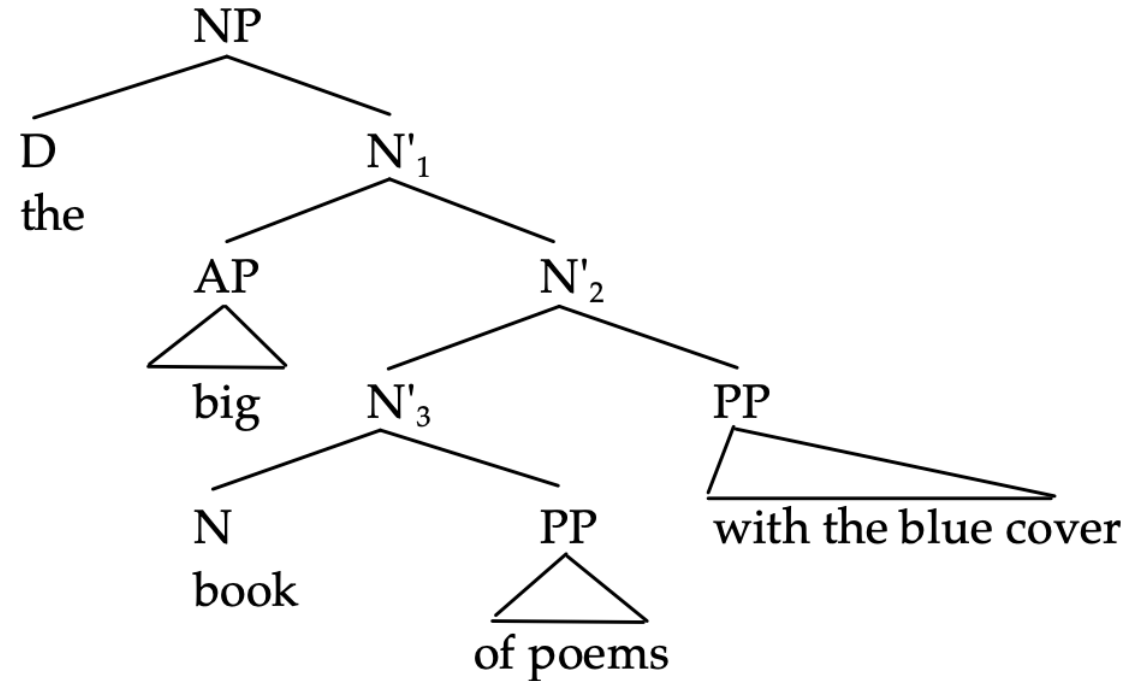
Two tests

- Replacement (One –replacement, do-so)
- Conjunction

I want [$_{NP}$ this [$_{N'}$ big book of poems with the red cover]] not [$_{NP}$ that [$_{N'}$ one]].
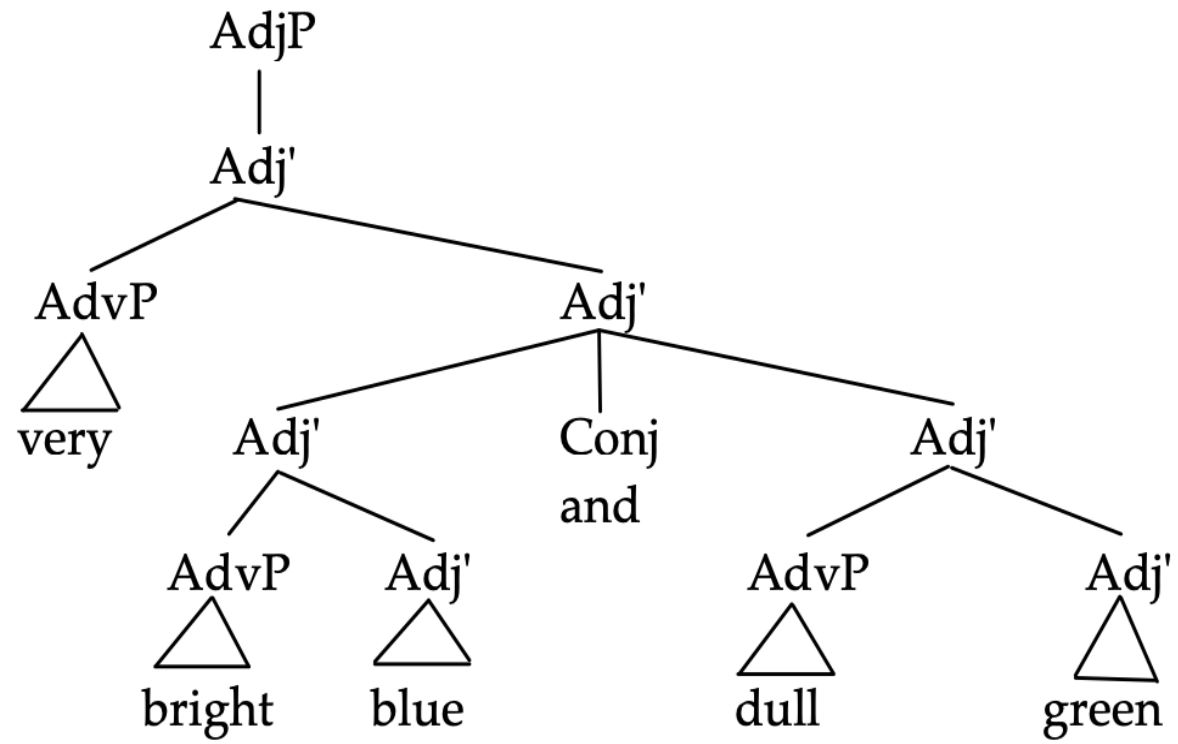
I [eat beans] with a fork but Janet [does (so)] with a spoon.

Calvin is [the [dean of humanities] and [director of social sciences]].
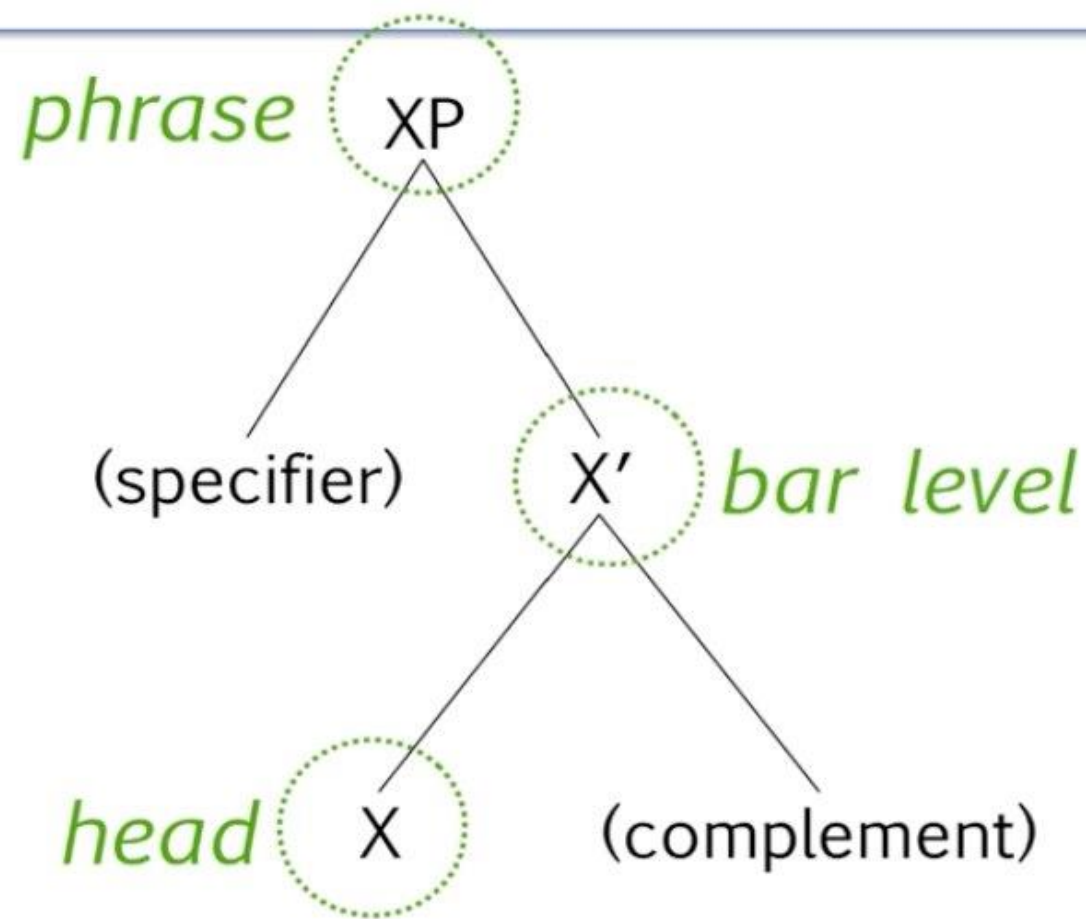Give me [the [blue book] and [red binder]].
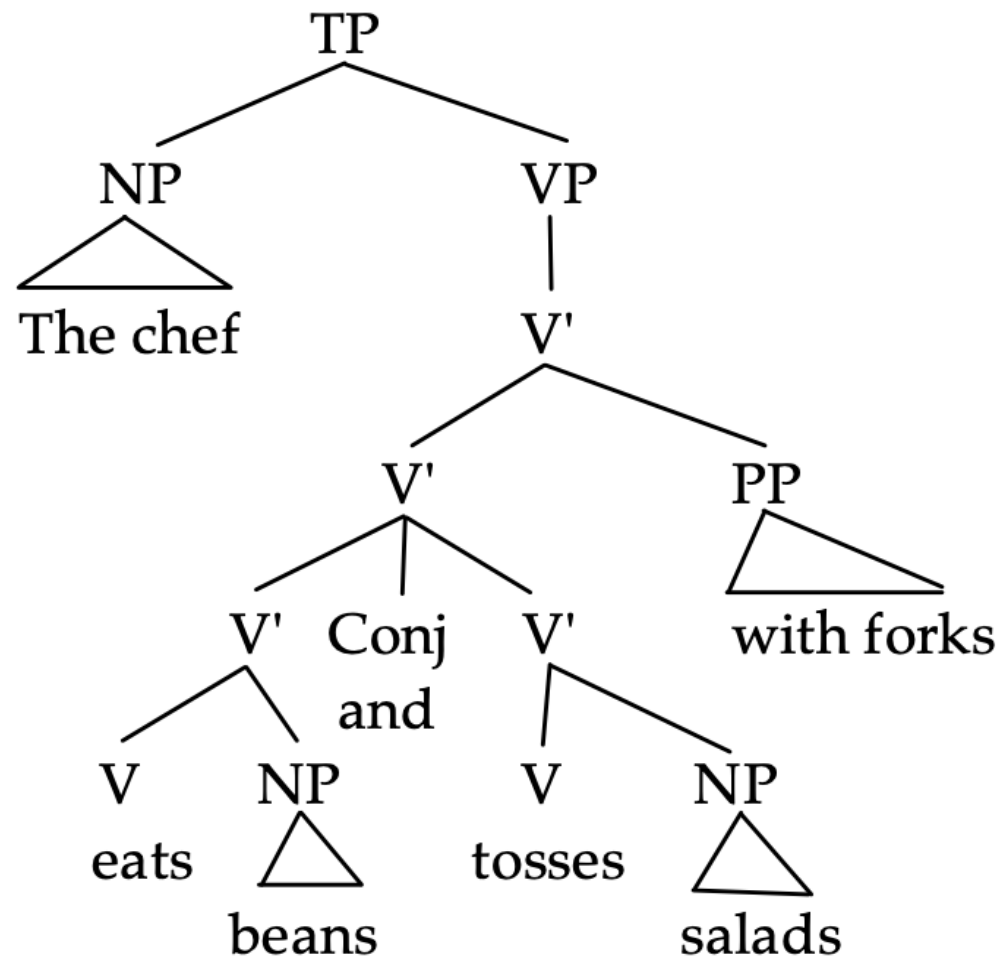
AdjP

X-bar Syntax

- X-bar is a theory of phrase structure which attempts to identify syntactic features common to all languages.
- The theory claims that there are certain structural similarities among all phrasal categories of all languages.
- Phrase structure concerns the hierarchical left to right relationships between syntactic categories.
- The letter X is used to signify an arbitrary lexical category for the head of the phrase in order to allow a generic description.
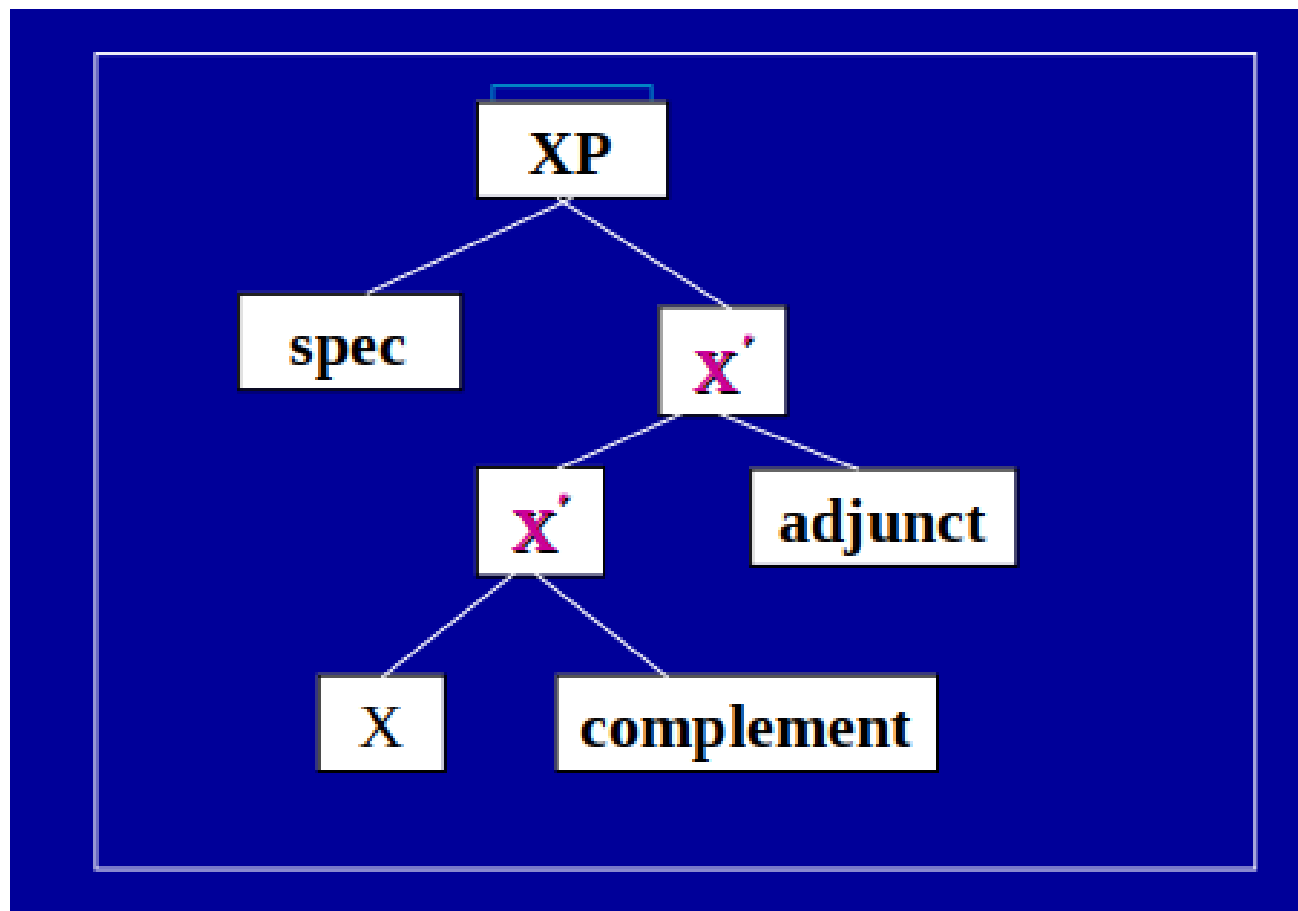- The theory applies both to phrasal constituents and to clausal constituents

X-bar theory makes the simple proposal that :

✓every phrase in every sentence in every language is organized the same way.

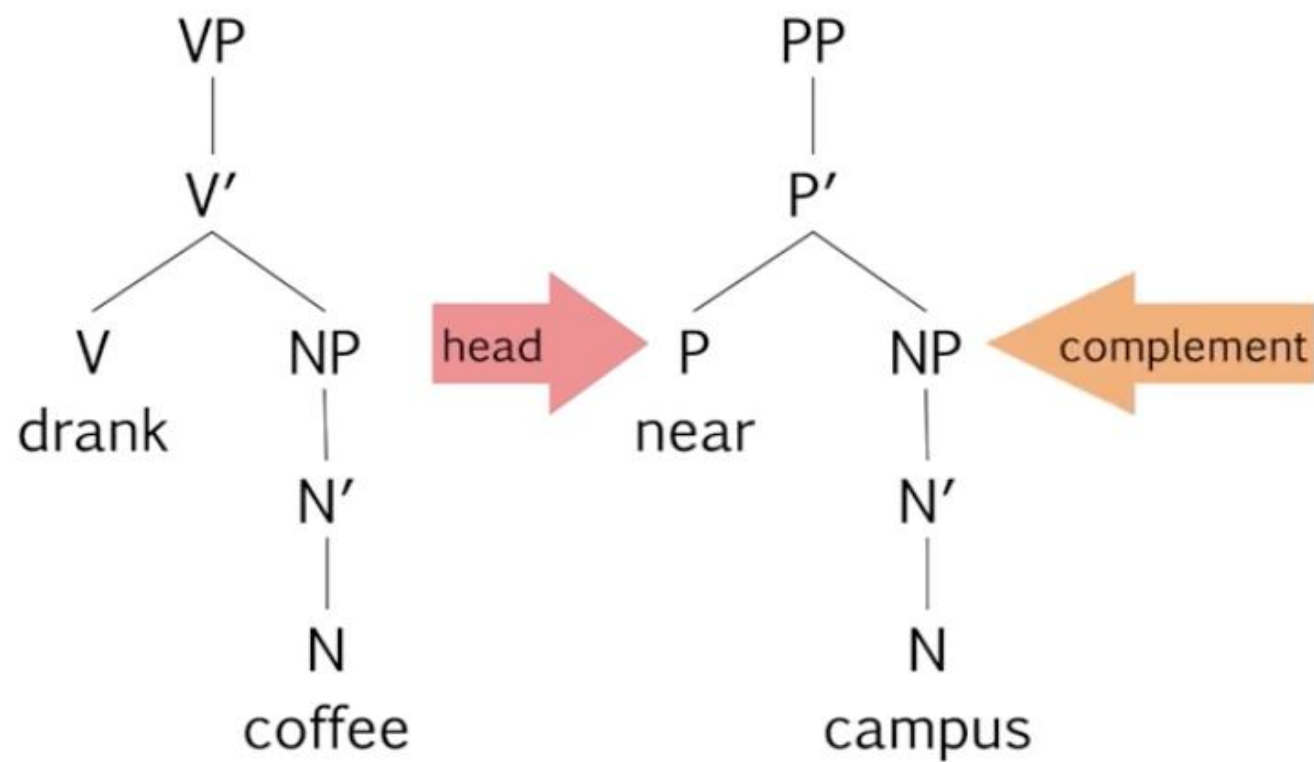✓Every phrase has a head, and each phrase might contain other phrases in the complement or specifier position.

How a phrase is organized

X-bar Schema
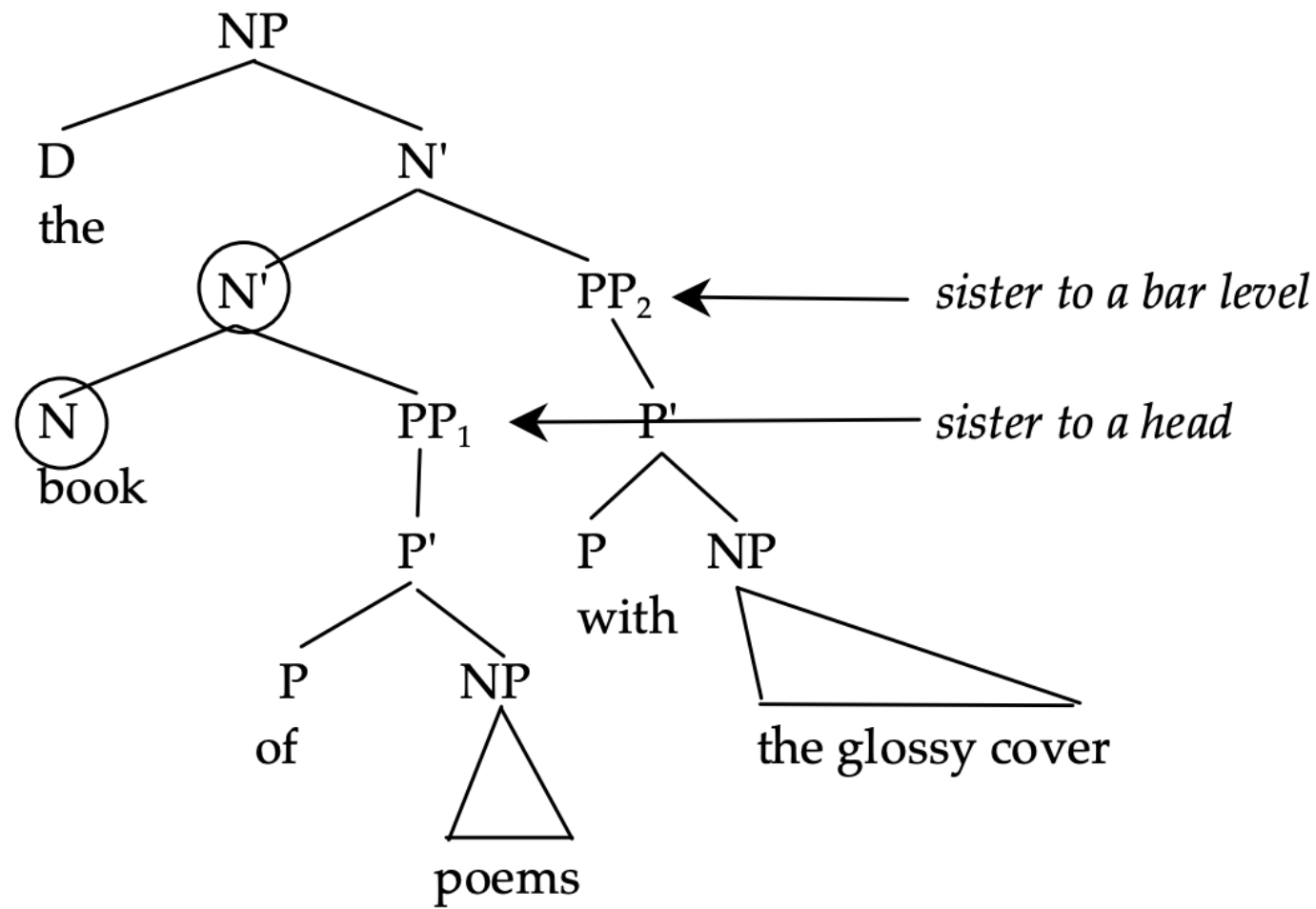
Some phrases have complements.

NP
├─ D
│ the
└─ N'
   ├─ (N')
   │ ├─ (N)
   │ │ book
   │ └─ PP₁
   │   └─ P'
   │   ├─ P
   │   │ of
   │   └─ NP
   │   poems
   └─ PP₂ ← *sister to a bar level*
      └─ P' ← *sister to a head*
         ├─ P
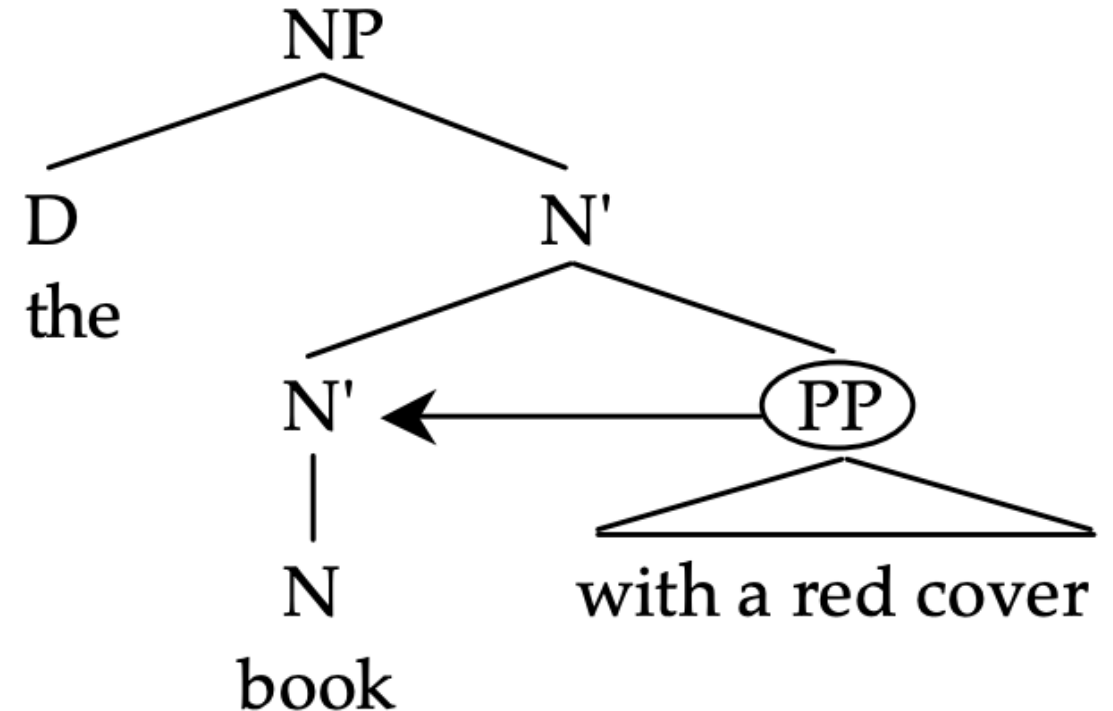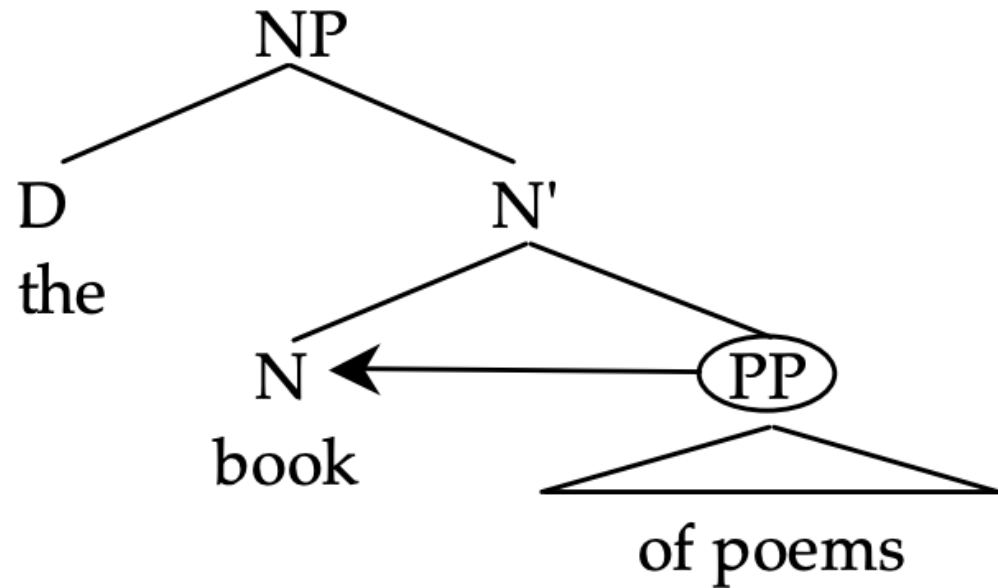   │ with
         └─ NP
            the glossy cover

Adjunct: An XP that is a sister to a single bar level (N', V', A', or P') and a daughter of a single bar level (N', V', A', or P').

Complement: An XP that is a sister to a head (N, V, A, P), and a daughter of a single bar level (N', V', A', or P').

Complement vs. Adjuncts

- the book of poems.   Vs.   the book with a red cover

Features of X-bar Syntax

- XP is the maximal projection.
- X' is the intermediate level.
- XP contains a head type - X
- There can only be one head .
- Phrases are projection of their head.

Endocentric Construction

- Phrases are endocentric , i.e., the category of the phrase is that of the head.

- Endocentric construction is a construction that contains a head, which is the single obligatory element in the construction, and one or more optional elements subordinate to the head.

- Example:

-         a good boy

Features of X-bar Syntax

This is uniform across languages

"all phrases are endocentric across all categories and across all languages."

PS rules have 4 components

- Specifier
- Head
- Complement
- Adjunct

This is language universal

Head and Complement

Head of a phrase is obligatory

Complements and Heads are in sister relation

Position of the complements vary from language to language, e.g.,

English: picture of Einstine

Hindi: आइंस्टाइन की तस्वीर [aainstain kee tasveer]
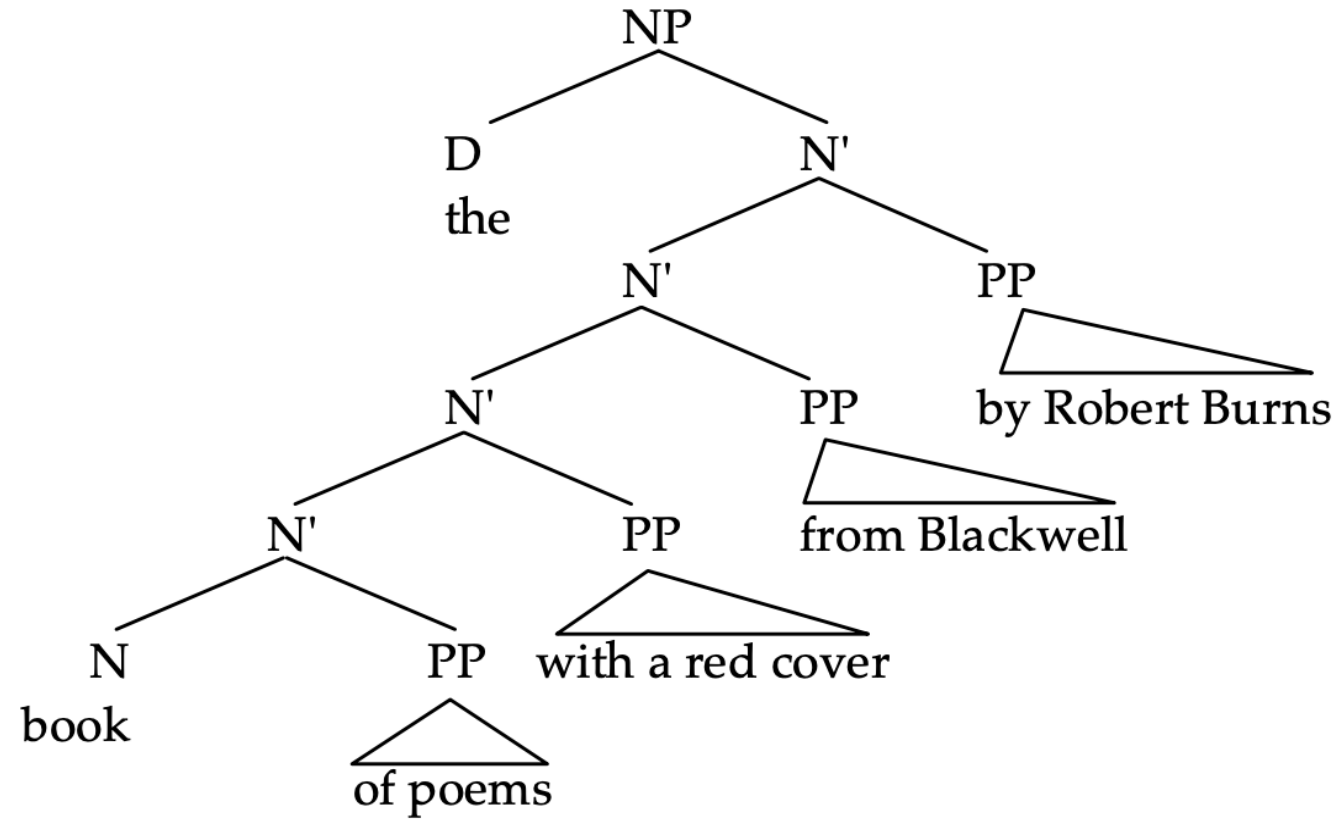
Specifier and Adjunct

- Consider the sentence,
- their rejection   of the agreement last week

      head   complement

- What is *their a*nd *last week* ?
- their is the Specifier (spec) and last week is the Adjunct.

X-bar Schema

- By assumption X-bar schema is universal across languages.
- In practice all nodes have binary branching.
- Corollary of Uniformity: Across syntactic categories comp, spec and adjunct bears the same configurational relationship to the head.
- English: [VP [V` eat cake]]
- 　　　　　　 [NP [N` picture of Einstein]]
- Hindi:　 [VP [V` rotee khaayee]]
- 　　　　　　 [NP [N` vah lamba ladaka]]

the book [of poems] [with a red cover] [from Blackwell] [by Robert Burns]
head   *complement*   *adjunct*   *adjunct*   *adjunct*

NP
├─ D
│ the
└─ N'
   ├─ N'
   │ ├─ N'
   │ │ ├─ N'
   │ │ │ ├─ N
   │ │ │ │ book
   │ │ │ └─ PP
   │ │ │   of poems
   │ │ └─ PP
   │ │   with a red cover
   │ └─ PP
   │   from Blackwell
   └─ PP
      by Robert Burns

Complement Vs Adjuncts

Related to the facts that the number of adjuncts is unlimited, but only one complement is allowed,

complements are always adjacent to the head,

you can usually reorder adjuncts with respect to one another,

but you can never reorder a complement with the adjuncts

a) the book of poems with a red cover from Blackwell by Robert Burns
b) the book of poems from Blackwell with a red cover by Robert Burns
c) the book of poems from Blackwell by Robert Burns with a red cover
d) the book of poems by Robert Burns from Blackwell with a red cover
e) the book of poems by Robert Burns with a red cover from Blackwell
f) the book of poems with a red cover by Robert Burns from Blackwell
g) *the book with a red cover of poems from Blackwell by Robert Burns
h) *the book with a red cover from Blackwell of poems by Robert Burns
i) *the book with a red cover from Blackwell by Robert Burns of poems
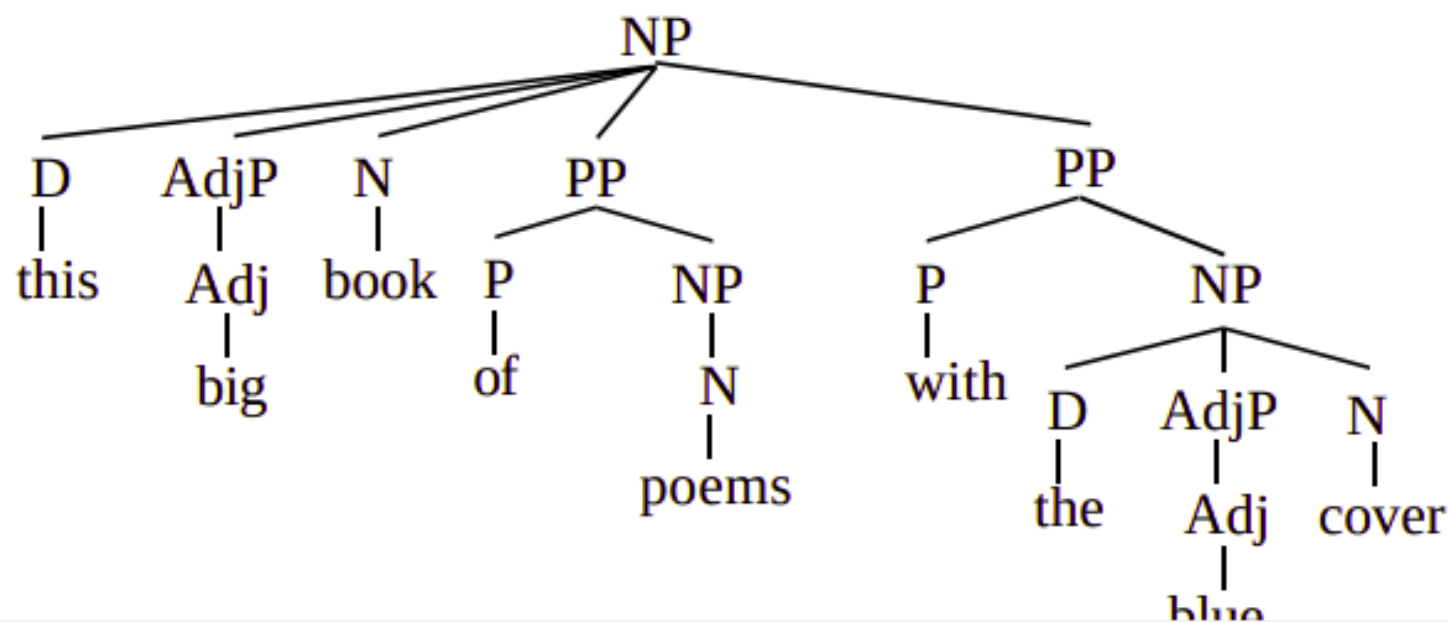   (etc.)

Back to the trees: X-bar Theory

- Consider our current NP rule:
  - **NP: (D) (AdjP+) N (PP+)**
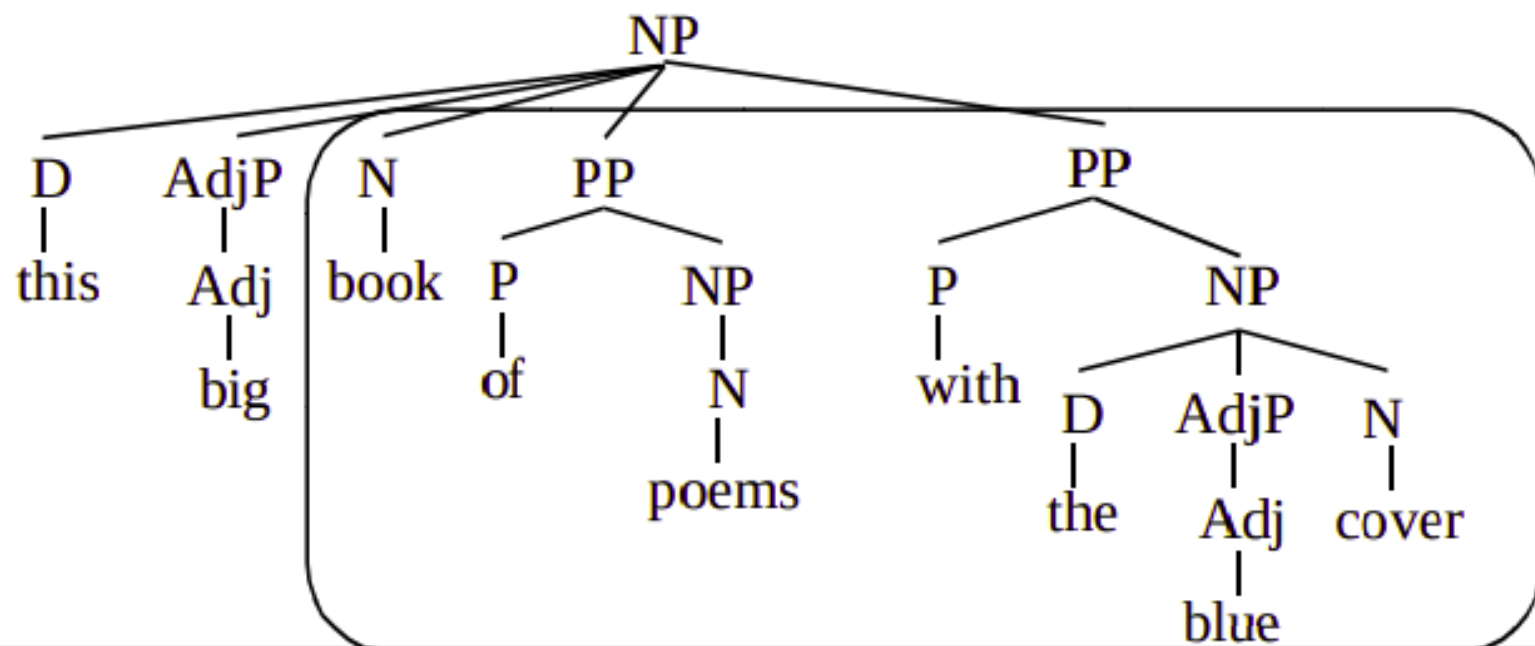- This yields a "flat structure" where all of the components of DP c-command each other.
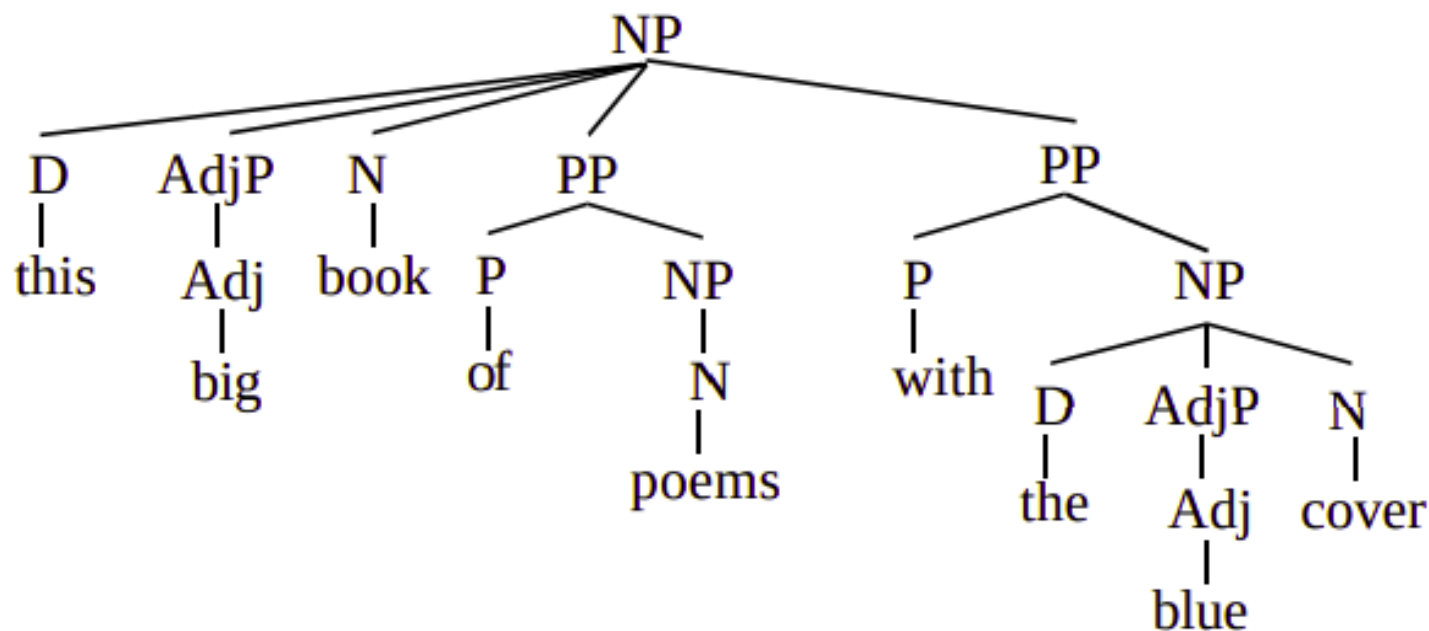
X-bar Theory: NP

- I bought this big book of poems with the blue cover.
- You bought this small one.

X-bar Theory: NP

- We can substitute *one* for *book of poems with the blue cover*, which should mean *book of poems with the blue cover* is a constituent, but it isn't in our structure.

X-bar Theory: NP

- We need to break up our NP rule; instead of
  - **NP: (D) (AdjP+) N (PP+)**
- We have:
  - **NP: (D) N′**
  - **N′ : AdjP N′**
  - **N′ : N′ PP**
  - **N′ : N (PP)**
- Notice that these yield the same results on the surface (note the recursion and the optionality) but produce different structures (in terms of constituency).
- Notice also that under these rules, any node of NP has no more than two daughters (binary branching).

X-bar Theory: VP

- **VP: (AdvP+) V ({NP/CP}) (PP+) (AdvP+)**

- I quickly left after Mary did so.

- I left quickly after Mary did so.

- I ate the pizza with gusto and Mary did so with quiet reserve.

- I ate the pizza with gusto immediately and Mary did so later.

X-bar Theory: VP

- Again, it looks like we need to break our rule into parts using V′ (for which *do so* can substitute).
  - **VP: (AdvP+) V ({NP/CP}) (PP+) (AdvP+)**
- To:
  - **VP: V′**
  - **V′ : AdvP V′**
  - **V′ : V′ PP**
  - **V′ : V′ AdvP**
  - **V′ : V ({NP/CP})**
- Again, this is the (almost) same on the *surface*, but yields a different *structure*. And again, binary.
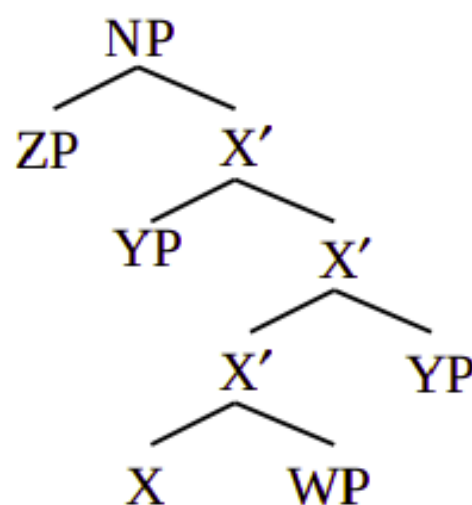
X-bar theory

- The phrase which is immediately dominated by XP (designated ZP here) is the *specifier*.

- A phrase dominated by X′ and the sister of X′ is an *adjunct*.

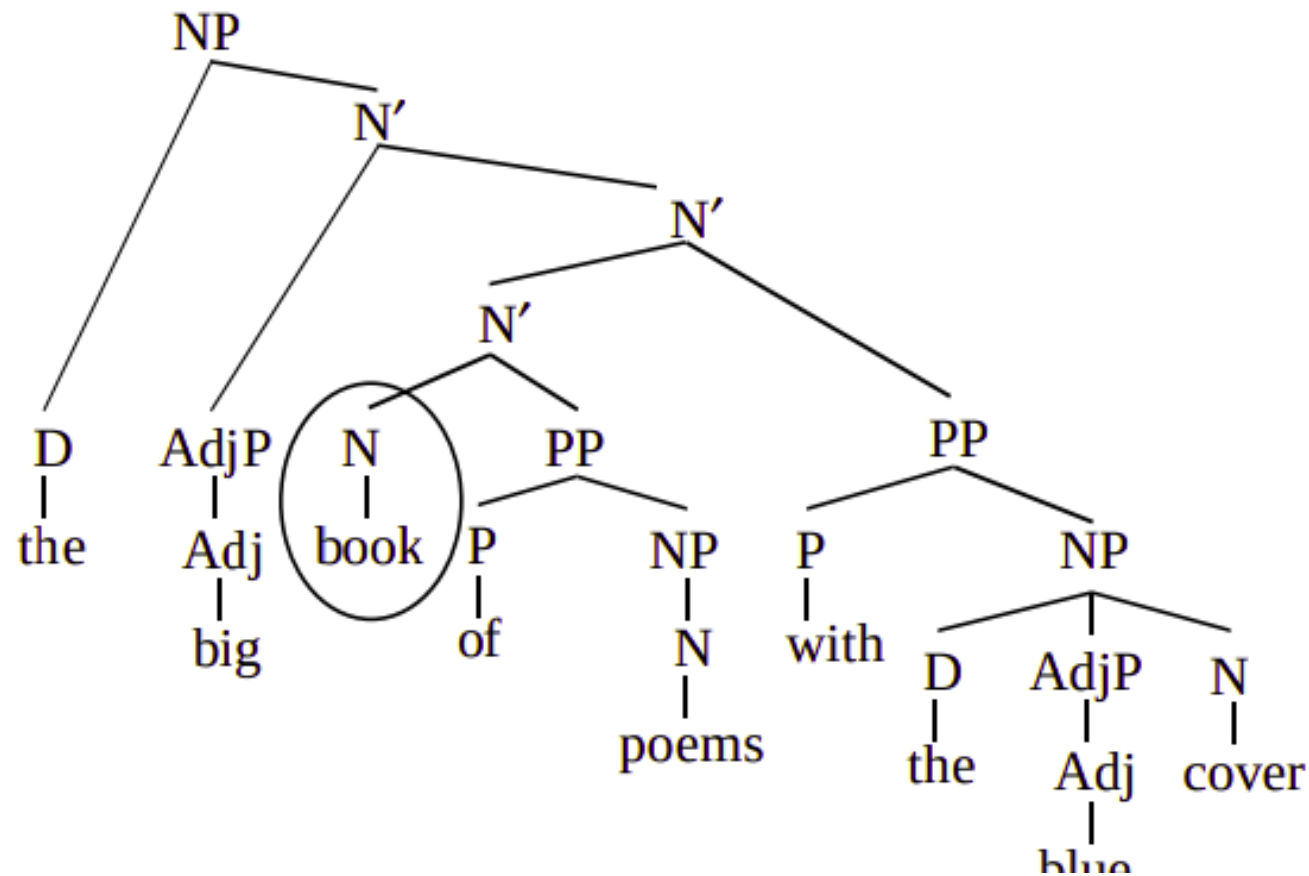- The phrase which is sister to X is the *complement*.
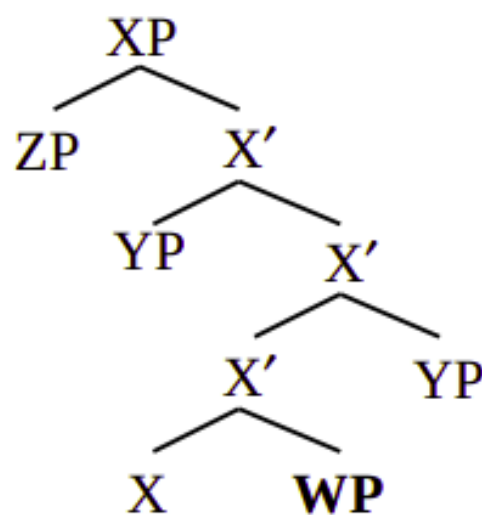
X-bar theory

- We have posited a structural difference between complements (WP here, of which there is only one) and adjuncts (YP here, of which there can be any number), and so we should expect to find that they behave differently.
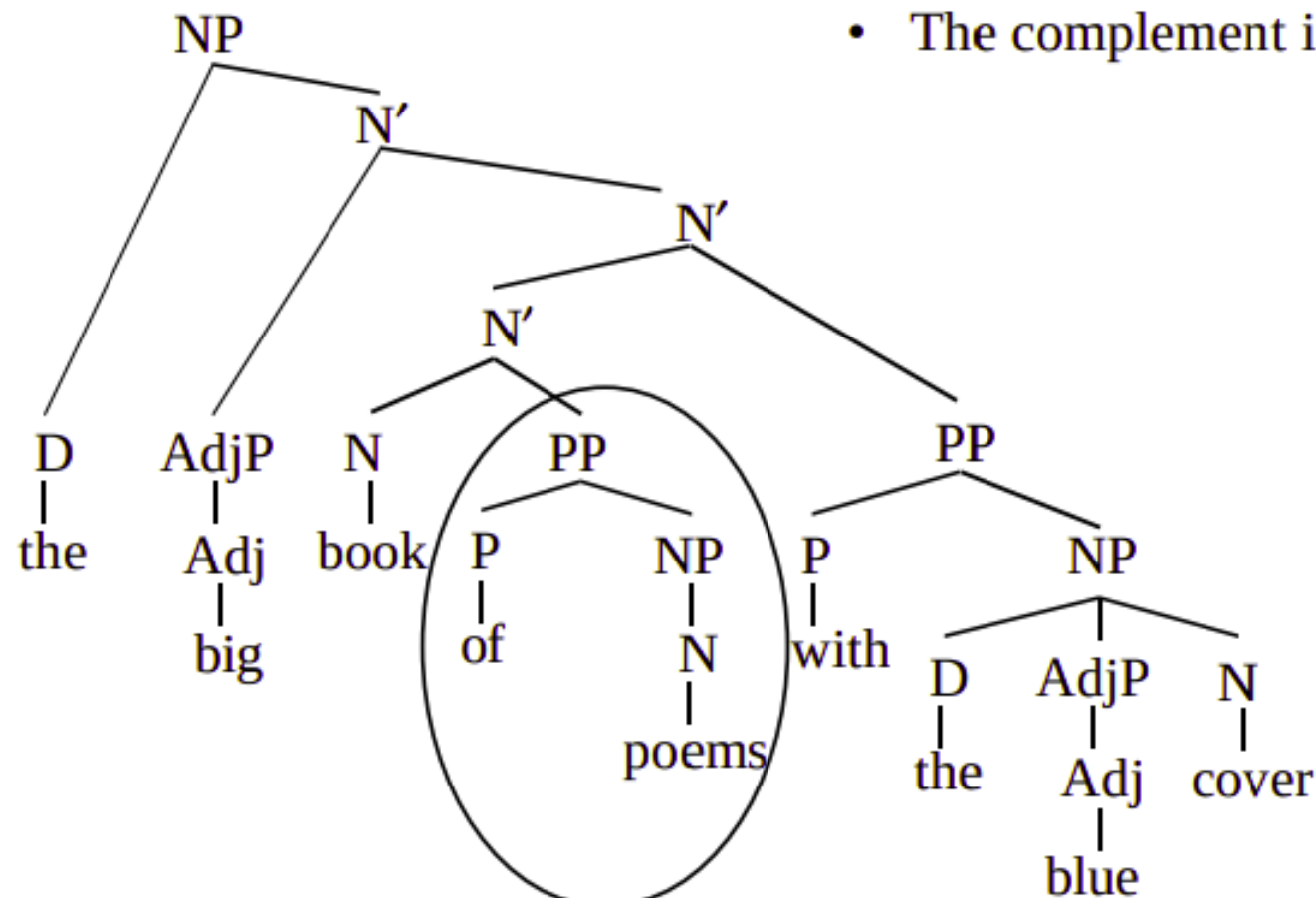
- Consider NP…

X-bar Theory: NP

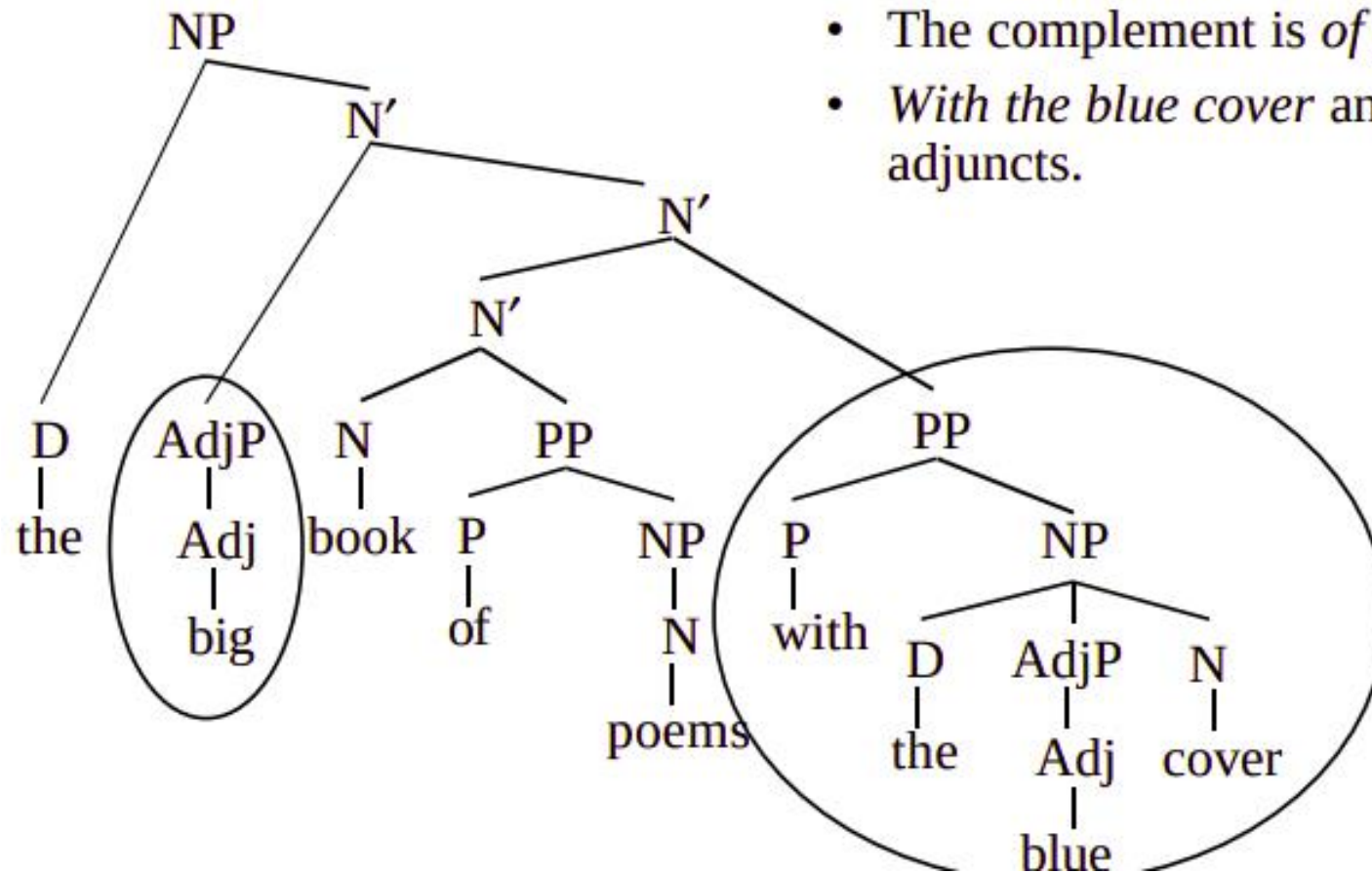- The head of this NP is *book*.

X-bar Theory: NP

- The head of this NP is *book*.
- The complement is *of poems*.
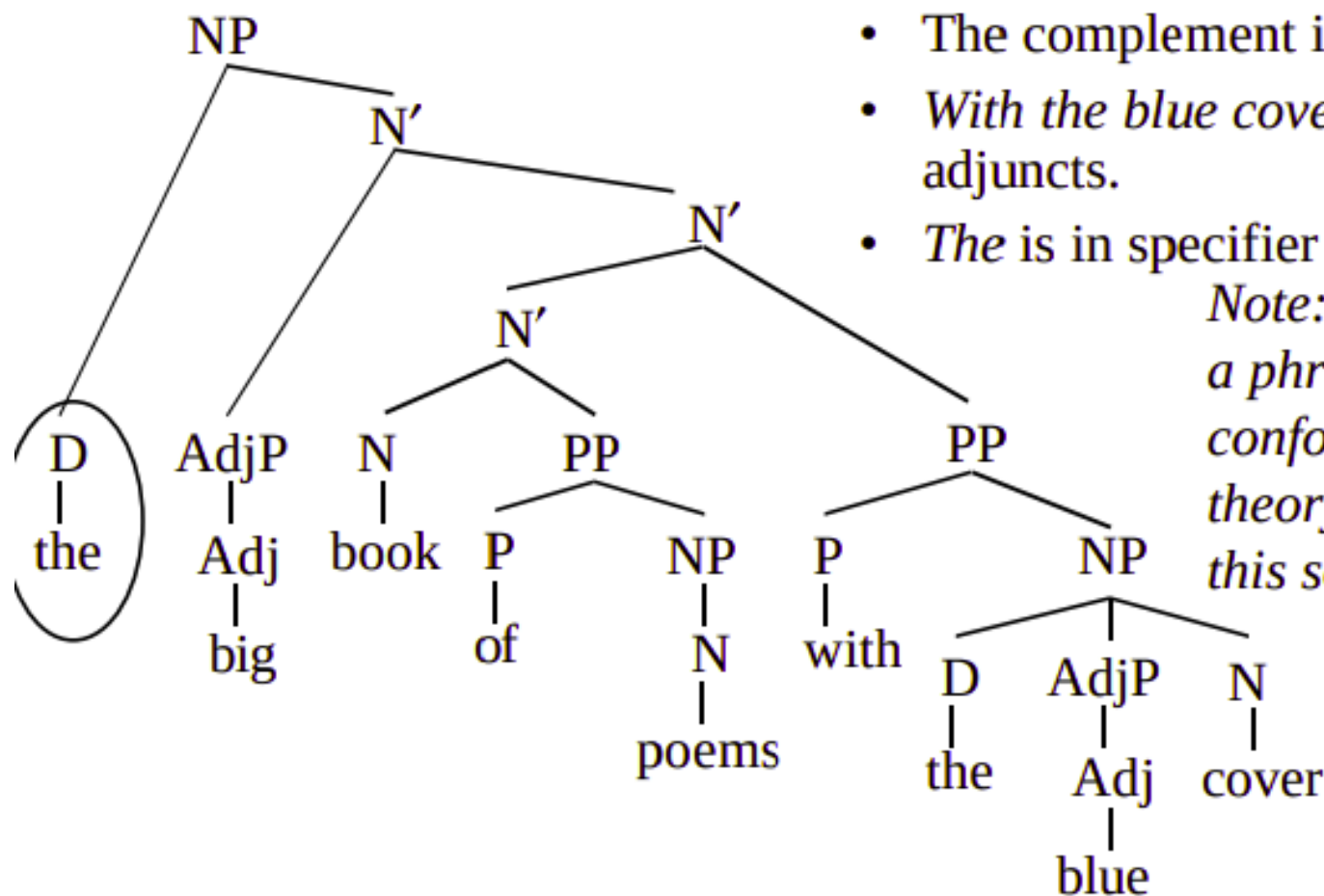
X-bar Theory: NP

- The head of this NP is *book*.
- The complement is *of poems*.
- *With the blue cover* and *big* are adjuncts.

X-bar Theory: NP

- The head of this NP is *book*.
- The complement is *of poems*.
- *With the blue cover* and *big* are adjuncts.
- *The* is in specifier position.

Note: D here is not a phrase; it does not conform to X-bar theory. We will fix this soon.

X-bar theory: NP

- The *complement* of a head (e.g., *of poems* in *a book of poems*) tends to feel more intimately related to the head. Compare *a book on the table*.
- The complement of N in English is almost always introduced by the preposition *of*.
- X-bar theory allows for only one complement, and indeed in NP we cannot have two *of*-PPs of this sort:
  - *The book of poems of fiction
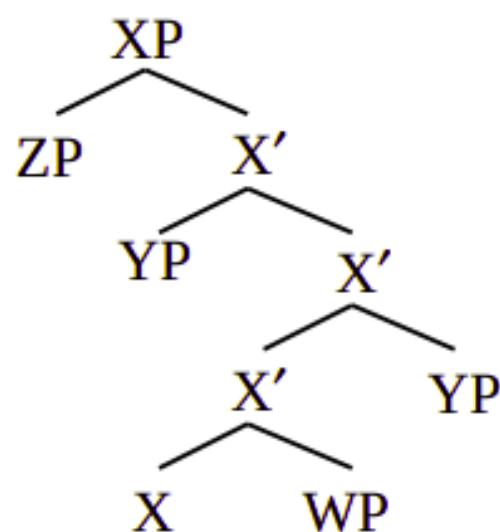   - Cf. The book of poems and of fiction

X-bar theory: NP

- An *adjunct*, on the other hand, feels more "optional"
  - A book on the table
- X-bar theory allows for any number of adjuncts (not just one, like with complements).
  - The book with the blue cover on the third shelf about C++
- Adjuncts can generally be re-ordered freely.
  - The book with the blue cover about C++ on the third shelf
  - The book about C++ with the blue cover on the third shelf
  - The book about C++ on the third shelf with the blue cover
  - The book on the third shelf with the blue cover about C++
  - The book on the third shelf about C++ with the blue cover

X-bar theory: NP

- X-bar structure also predicts that the complement PP of an NP must be *first*; it cannot be re-ordered with respect to adjunct PPs.
    - The book <u>of poems</u> with the blue cover on the third shelf
    - *The book with the blue cover <u>of poems</u> on the third shelf
    - *The book on the third shelf <u>of poems</u> with the blue cover
    - *The book with the blue cover on the third shelf <u>of poems</u>

```
            XP
           /  \
         ZP    X'
              /  \
            YP    X'
                 /  \
               X'    YP
              /  \
             X    WP
```

X-bar theory: NP

- Other tests differentiate adjuncts and complements too.
- Conjoining two elements of a given category yields an element of the same category; if conjunction is possible the two conjuncts are of the same category.
- You cannot conjoin a complement and an adjunct PP (where could it go in the structure?), although you can conjoin complements and you can conjoin adjuncts:
  - The book of poems and of essays
  - The book with the blue cover and with the red spine
  - *The book of poems and with the red spine

- **Sentences:**
- The dog chased the cat.
- I loved [the policeman] [intensely] [with all my heart].
- Despite the rain, Sarah went for a walk in the park.
- John and Mary cooked dinner together.
- The teacher who spoke at the conference impressed everyone with her knowledge.
- The old house at the end of the street needs renovation
- The baker said that his bread smelled glorious (Note: " that " is C, it is dominated by CP)
- John asked Paul that if Alyssa put peanuts in his ear on Thursday (Note: (Note: " if " is C, it is dominated by CP)

Movement

- Consider the relation between a verb and its object:

- According to X-bar theory, an object is the complement to V (sister to V, daughter of V').

- This means that no specifier or adjunct can intervene between the complement and the head (if they did, the object would no longer be a complement).

The following sentence is from Modern Irish Gaelic, this is a Verb-Subject-Object (VSO) word order language:

1) Phóg Máire an lucharachán.
   Kissed Mary the leprechaun
   "Mary kissed the leprechaun."

In this sentence, the subject (a specifier) intervenes between the verb and the object; this sentence cannot be generated by X-bar theory. (Try to draw a tree where the specifier intervenes between the head and the complement – it's impossible.)
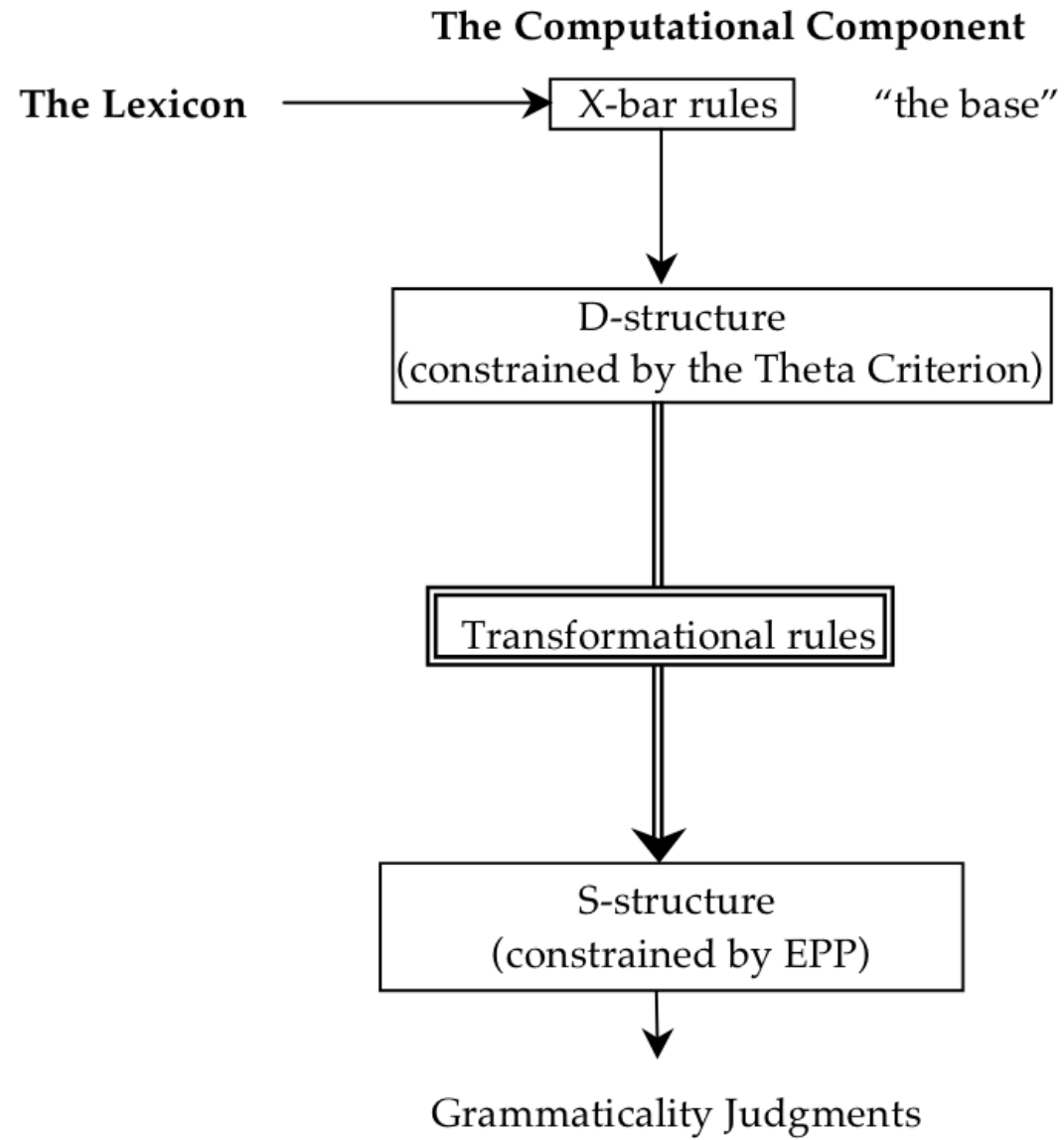
Now consider the following sentence from French:

2) Je mange souvent des   pommes.
   I eat   often   of.the apples
   "I often eat apples."

Souvent "often" intervenes between the verb and the object. If *souvent* is an adjunct it is appearing between a head and its complement. X-bar theory can't draw the tree for this one either.

- In sum, X-bar theory undergenerates, it does not produce all the possible grammatical sentences in a language.
- Chomsky proposed that what was needed was a set of rules that change the structure (in very limited ways) generated by phrase structure rules.
  - These rules are called transformational rules.
- Transformations take the output of X-bar rules (and other transformations) and change them into different trees.

The Computational Component

The Lexicon $\longrightarrow$ | X-bar rules | "the base"

$\downarrow$

| D-structure
(constrained by the Theta Criterion) |

| Transformational rules |

| S-structure
(constrained by EPP) |

$\downarrow$

Grammaticality Judgments

grammatical sentences

- X-bar theory and the lexicon conspire together to generate trees.
- This conspiracy is called *the base*.
- The result of this tree generation is a level we call *D-structure* (Deep Structure).
  - The Theta Criterion: Each argument is assigned one and only one theta role
- D-structure is then subject to the transformational rules.
- The output of a transformational rule is called the S-structure of a sentence.
- The S-structure is filtered by the EPP, which ensures that the sentence has a subject. Extended Projection Principle (EPP) All clauses must have subjects.