

# **HG4041 Theories of Grammar**

## **Long Distance Dependencies**

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Lecture 11

Location: HSS SR3

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# Schedule

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<b>Lec.</b>	<b>Topic</b>		<b>Reading</b>	<b>Problems</b>
1	Introduction (HPSG)		SWB 1–2	1:1
2	Feature Structures		SWB 3	3:1, 3
3	Complex Feature Values		SWB 4	4:1, 5, 6
4	Semantics		SWB 5–6	5:1; 6:1, 3, 4, 5
5	Binding		SWB 7	7:1, 2
6	The Structure of the Lexicon	<b>Mid-term</b>	SWB 8	8:1, 2, 6
7	Realistic Grammar		SWB 9	9:1
8	Passive		SWB 10	10: 1, 3
9	Dummies and Idioms		SWB 11	11:1, 3, 4
10	Raising and Control		SWB 12	12:1, 2, 4, 6
11	Long Distance Dependencies	<b>Final</b>	SWB 14	14: 1, 2, 3
12	Wrap-up	<b>Project Presentations</b>	SWB 16	
	<b>Research Paper</b>			
	due two weeks after presentations			

# Overview

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- Some examples of long-distance dependencies
- What is new and different about it
- Broad outlines of our approach
- Details of our approach
- Subject extraction
- Coordinate Structure Constraint

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# Long Distance Dependencies

# Overview

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- Some examples of the phenomenon
- What is new and different about it
- Broad outlines of our approach
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# Examples

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➤ **Grammatical:**

- (1) *Did you find something?*
- (2) *Tell me you talked to someone!*

➤ **wh-questions:**

- (3) *What did you find?*
- (4) *Tell me who you talked to*

➤ **relative clauses:**

- (5) *the item that I found*
- (6) *the guy who(m) I talked to*

➤ **Ungrammatical:**

- (7) *did you find*
- (8) *you talked to*

➤ **topicalization:**

- (9) *The manual, I can't find.*
- (10) *Chris, you should talk to.*

➤ **easy-adjectives:**

- (11) *My house is easy to find.*
- (12) *Pat is hard to talk to.*

## What these have in common

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- There is a **gap**: nothing following *find* and *to*, even though both normally require objects.
- Something that fills the role of the element missing from the gap occurs at the beginning of the clause.
- We use topicalization and easy-adjectives to illustrate the phenomenon:
  - (13) *The manual, I can't find \_\_\_\_\_*
  - (14) *Chris is easy to talk to \_\_\_\_\_*

## Gaps and their fillers can be far apart

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(15) *The solution to this problem, Pat said that someone claimed you thought I would never find \_\_\_\_\_.*

(16) *Chris is easy to consider it impossible for anyone but a genius to try to talk to \_\_\_\_\_.*

➤ Fillers often have syntactic properties associated with their gaps

(17) a. *Him, I haven't met \_\_\_\_\_.*

b. *\*He, I haven't met \_\_\_\_\_.*

(18) a. *The scissors, Pat told us \_\_\_\_\_ were missing.*

b. *\*The scissors, Pat told us \_\_\_\_\_ was missing.*

(19) a. *On Pat, you can rely \_\_\_\_\_ .*

b. *\*To Pat, you can rely \_\_\_\_\_.*

➤ That's why we call them **long distance dependencies**



## Other relevant facts

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- Various languages show morphological marking on the verbs or complementizers of clauses between the filler and the gap.
- Psycholinguistic evidence indicates increased processing load in the region between filler and gap.

## A Rough Sketch of Our Approach

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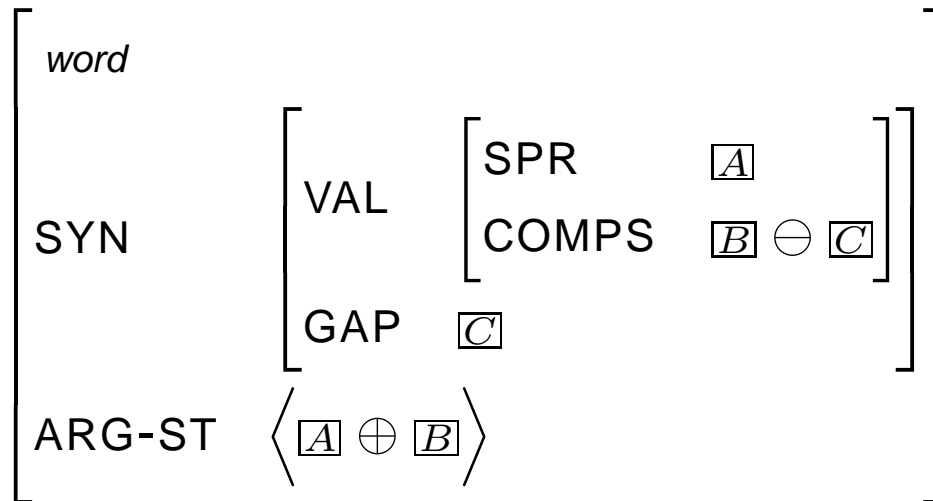
- A feature GAP records information about a missing constituent.
- The GAP value is passed up the tree by a new principle.
- A new grammar rule expands S as a filler followed by another S whose GAP value matches the filler.
- Caveat: Making the details of this general idea work involves several complications.
- The core idea comes from Gazdar (1981)

## The Feature GAP

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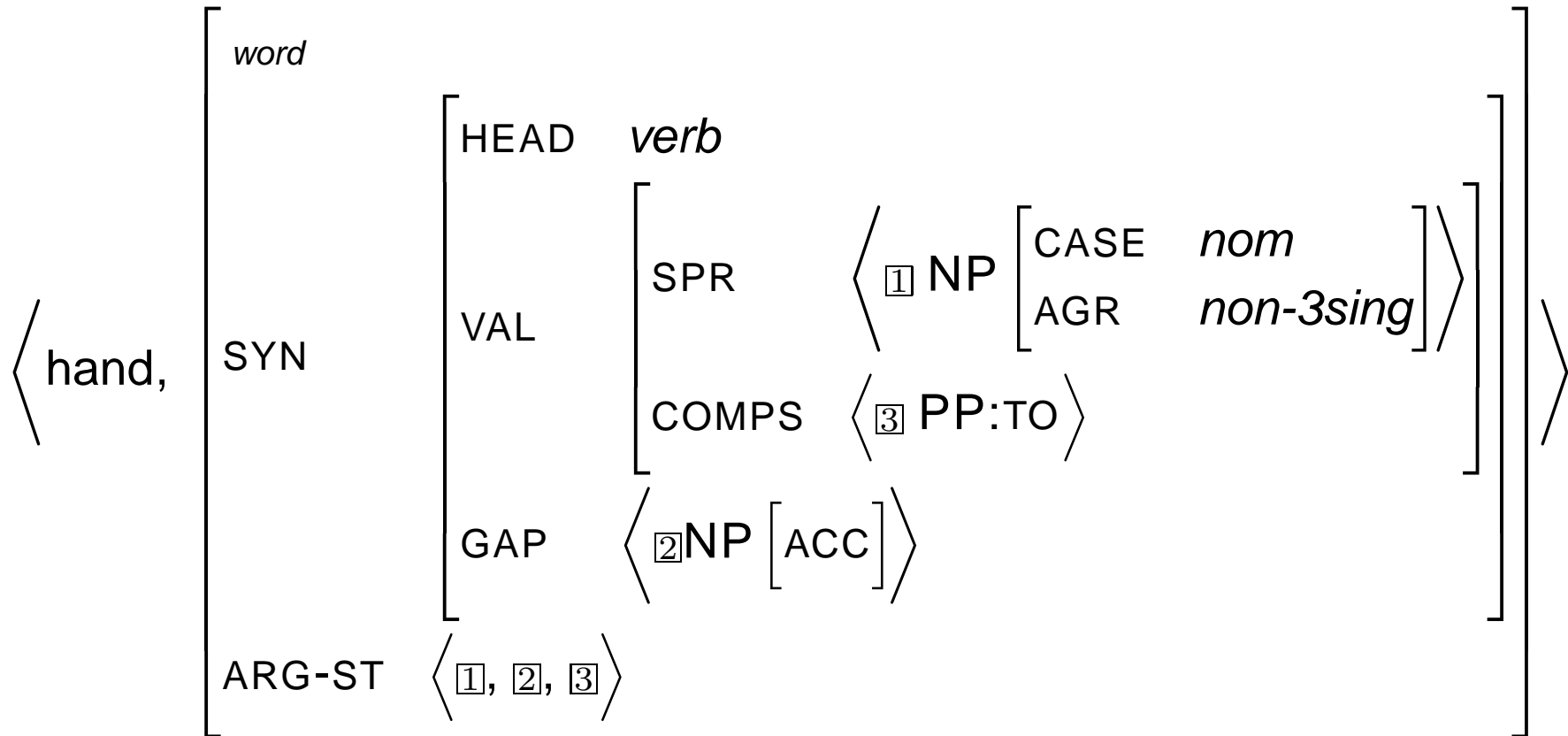
- Like valence features and ARG-ST, GAP's value is a list of feature structures (often empty). You can have multiple gaps.
- Subject gaps are introduced by a lexical rule.
- Non-subject gaps are introduced by revising the Argument Realization Principle.

## The Revised ARP

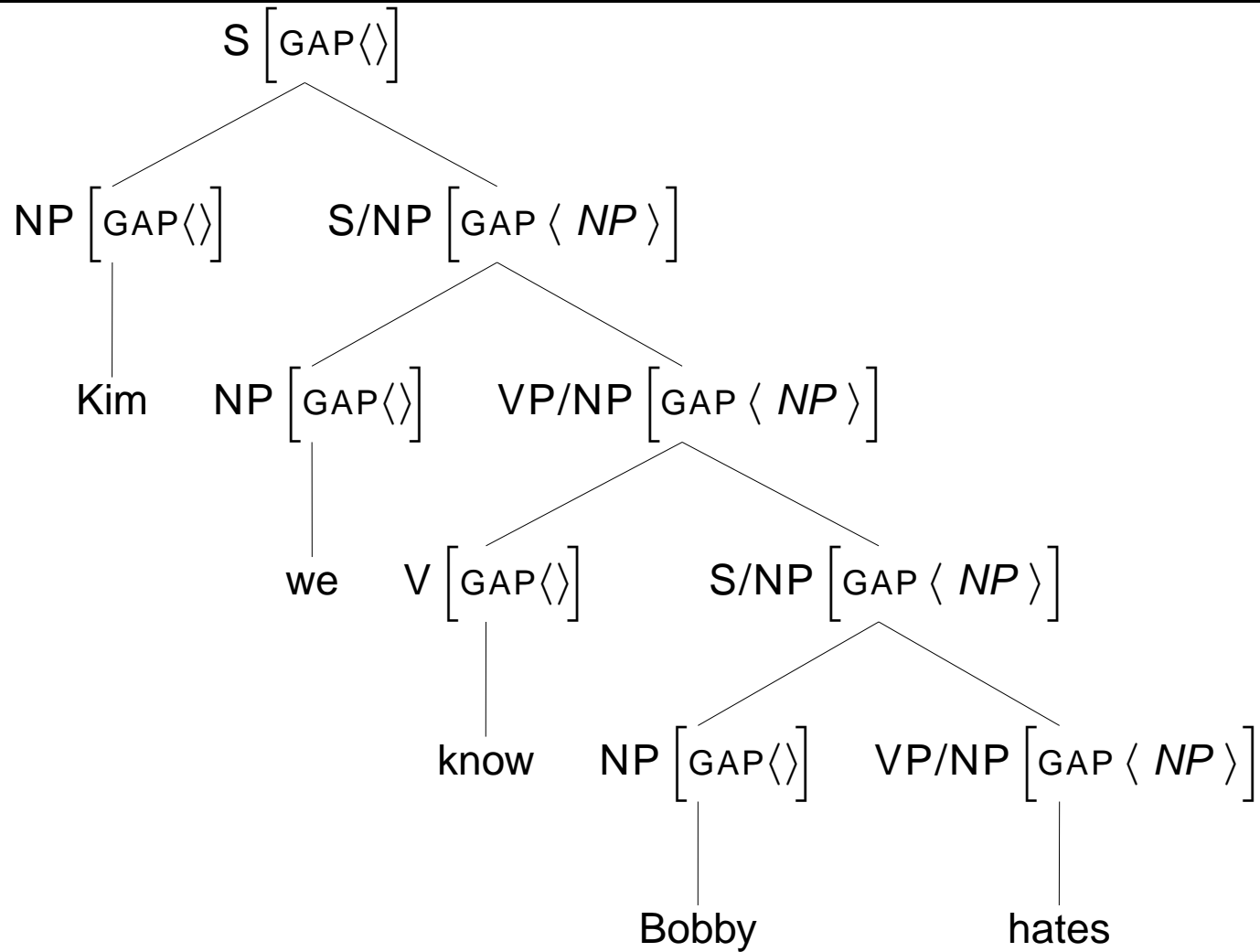


- $\ominus$  is a kind of list subtraction
  - it's not always defined (the sublist must exist on the main list)
  - when defined, it's not always unique
- The ARP now says the non-SPR arguments are distributed between COMPS and GAP.

# A Word with a Non-Empty GAP Value



# How We Want GAP to Propagate



## What GAP Propagation should do

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- Pass any GAP values from daughters up to their mothers,  
... **except** when the filler is found.
- For topicalization, we can write the exception into the grammar rule
- For **easy**-adjectives, the NP that corresponds to the gap is the subject, which is introduced by the Head-Specifier Rule.
- Since specifiers are not generally gap fillers, we can't write the gap-filling into the HSR.

## Our Solution to this Problem

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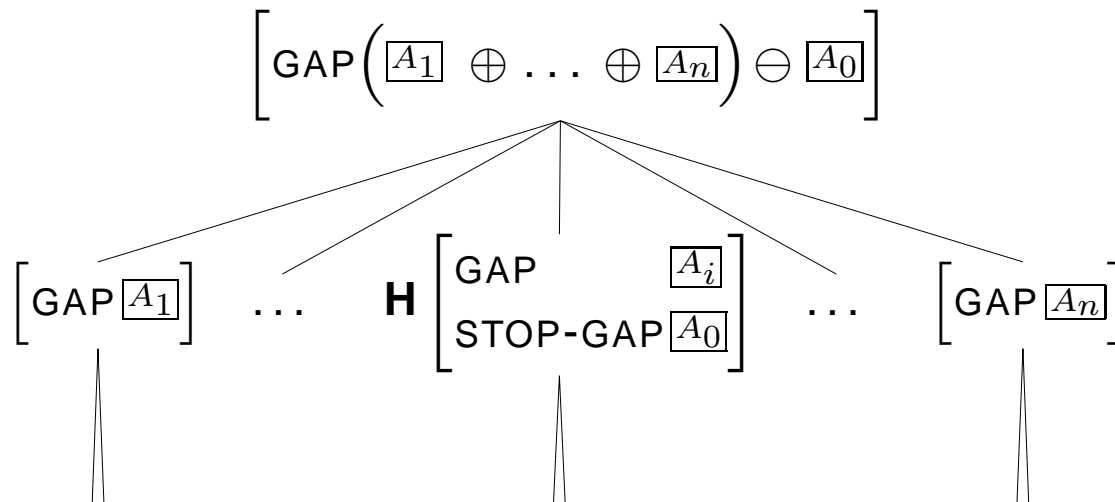
- For **easy**-adjectives, we treat the adjective formally as the filler, marking its SPR value as coindexed with its GAP value.
- We use a feature STOP-GAP to trigger the emptying of the GAP list.
  - STOP-GAP stops gap propagation
  - **easy**-adjectives mark STOP-GAP lexically
  - a new grammar rule, the **Head-Filler Rule** mentions STOP-GAP



# The GAP Principle

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A local subtree  $\Phi$  satisfies the GAP Principle with respect to a headed rule if and only if  $\Phi$  satisfies:



## How does STOP-GAP work?

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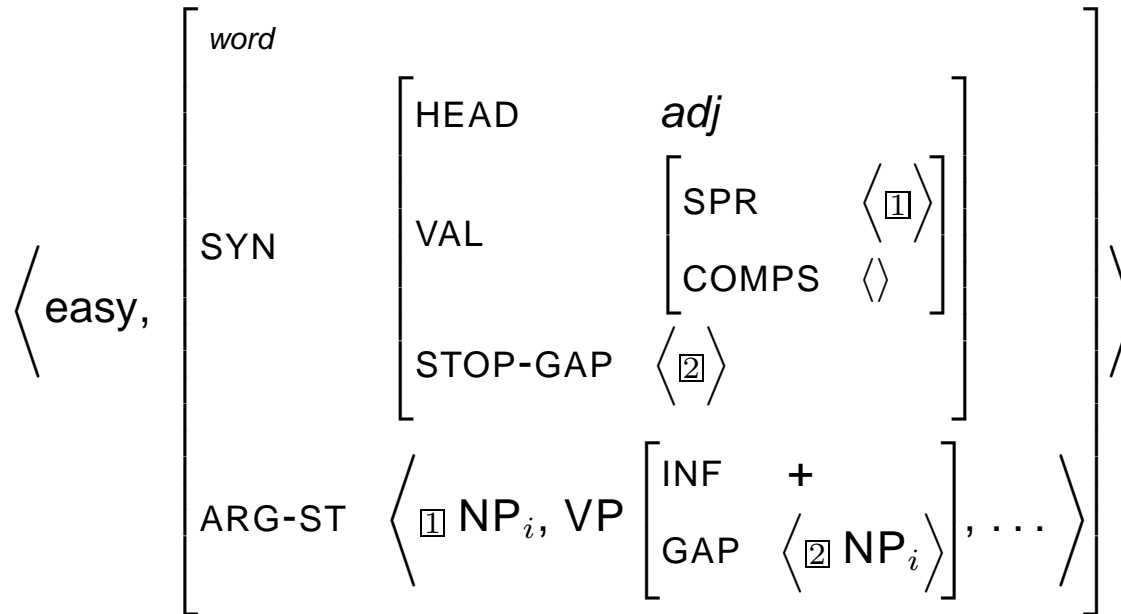
- STOP-GAP is empty almost everywhere
- When a gap is filled, STOP-GAP is nonempty, and its value is the same as the gap being filled.
- This blocks propagation of that GAP value, so gaps are only filled once.
- The nonempty STOP-GAP values come from two sources:
  - a stipulation in the Head-Filler Rule
  - lexical entries for *easy*-adjectives
- No principle propagates STOP-GAP

## The Head-Filler Rule

$$\left[ \textit{phrase} \right] \rightarrow \boxed{1} \left[ \text{GAP} \ \langle \rangle \right] \mathbf{H} \left[ \begin{array}{l} \text{HEAD} \quad \textit{verb} \\ \text{VAL} \quad \left[ \begin{array}{l} \text{SPR} \quad \langle \rangle \\ \text{COMPS} \quad \langle \rangle \end{array} \right] \\ \text{GAP} \quad \langle \boxed{1} \rangle \\ \text{STOP-GAP} \quad \langle \boxed{1} \rangle \end{array} \right]$$

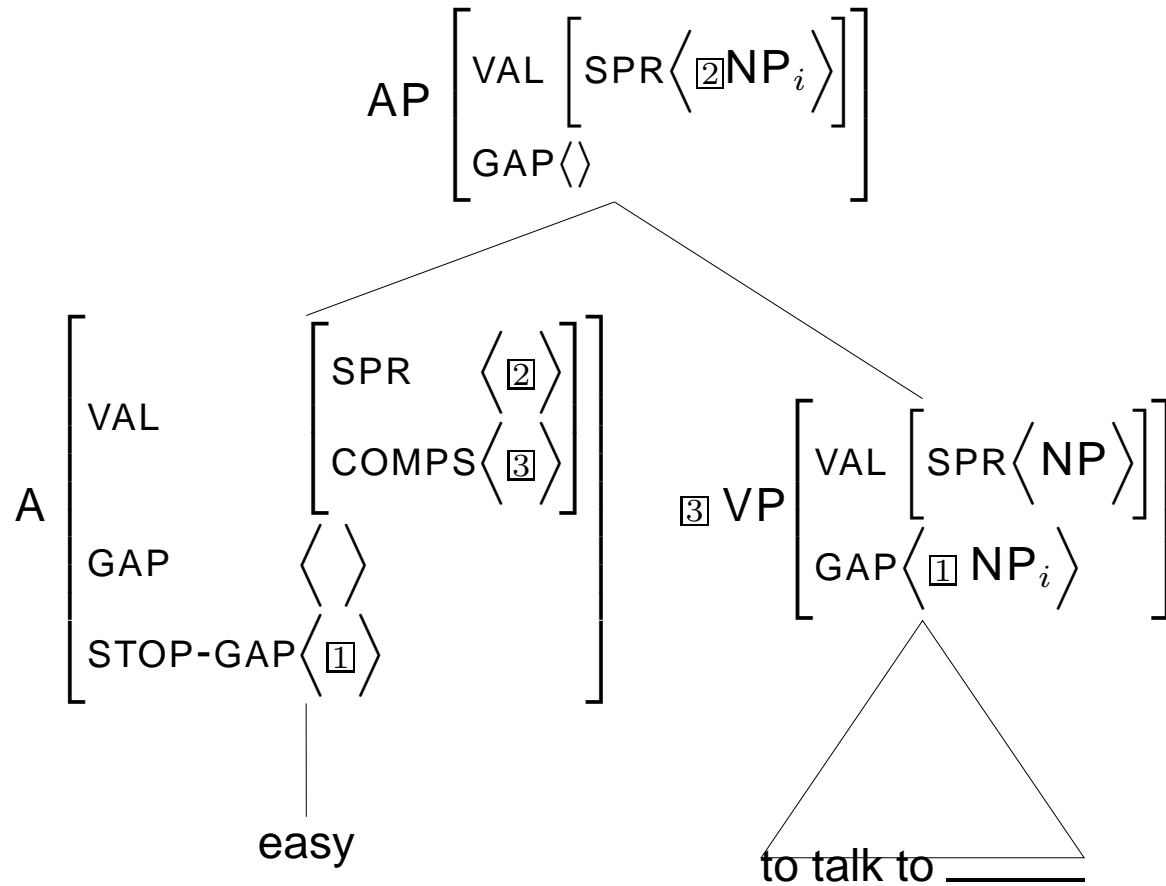
- This only covers gap filling in Ss
- The filler has to be identical to the GAP value
- The STOP-GAP value is also identical
- The GAP Principle ensures that the mother's GAP value is the empty list

## Gap Filling with *easy*-Adjectives



- Because STOP-GAP and GAP have the same value, that value will be subtracted from the mother's GAP value.
- The first argument is coindexed with the GAP value, accounting for the interpretation of the subject as the filler.

# A Tree for *easy to talk to* \_\_\_\_\_



## STOP-GAP Housekeeping

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- Lexical entries with nonempty STOP-GAP values (like *easy*) are rare, so STOP-GAP is by default empty in the lexicon.
- Head-Specifier and Head-Modifier rules need to say [STOP-GAP < >]
- Lexical rules preserve STOP-GAP values.

## GAP Housekeeping

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Q The initial symbol must say [GAP <> ]. Why?

A To block *\*Pat found* and *\*Chris talked to* as stand-alone sentences.

Q The Imperative Rule must propagate GAP values. Why?

A It's not a headed rule, so the effect of the GAP Principle must be replicated

A Imperatives can have gaps:

*This book, put on the top shelf!*

## Sentences with Multiple Gaps

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➤ Famous examples:

(20) *This violin, sonatas are easy to play \_\_\_\_\_ on \_\_\_\_\_.*

(21) *\*Sonatas, this violin is easy to play \_\_\_\_\_ on \_\_\_\_\_.*

➤ Our analysis gets this:

- The subject of **easy** is coindexed with the first element of the GAP list.
- The Head-Filler rule only allows one GAP remaining.

➤ There are languages that allow multiple gaps more generally.



## Where We Are

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➤ **filler-gap** structures:

(22) *The solution to this problem, nobody understood \_\_\_\_\_*

(23) *That problem is easy to understand \_\_\_\_\_*

- The feature GAP encodes information about missing constituents
- Modified ARP allows arguments that should be on the COMPS list to show up in the GAP list
- GAP values are passed up the tree by the GAP Principle

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- The feature STOP-GAP signals where GAP passing should stop
  - The Head-Filler Rule matches a filler to a GAP and (via STOP-GAP) empties GAP
  - Lexical entries for *easy*-adjectives require a gap in the complement, coindex the subject with the gap, and (via STOP-GAP) empty GAP on the mother

## More Phenomena filler ...

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- Sentences with subject gaps
- Gaps in coordinate constructions

## Subject Gaps

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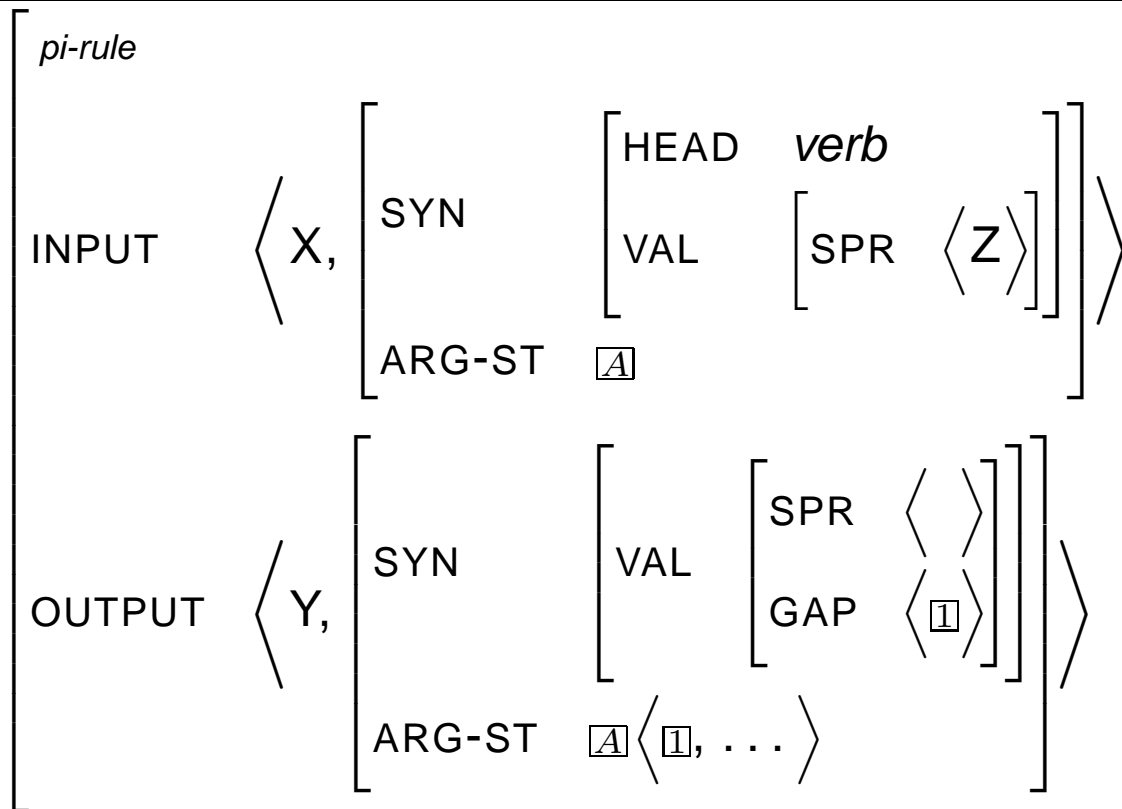
➤ The ARP revision only allowed missing complements.

➤ But gaps occur in subject position, too:

(24) *This problem, everyone thought \_\_\_\_\_ was too easy.*

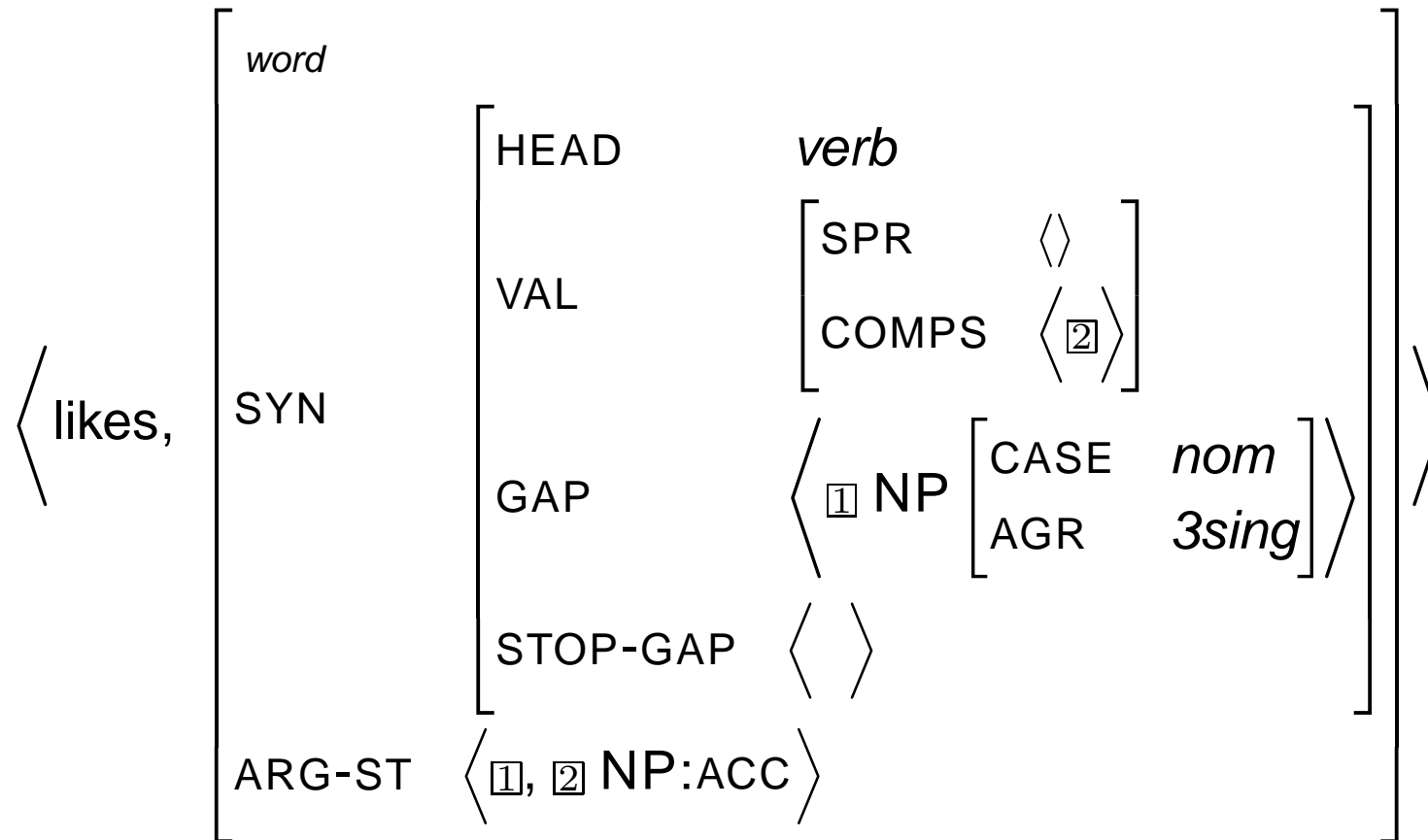
➤ We handle these via a lexical rule that, in effect, moves the contents of the SPR list into the GAP list

## The Subject Extraction Lexical Rule



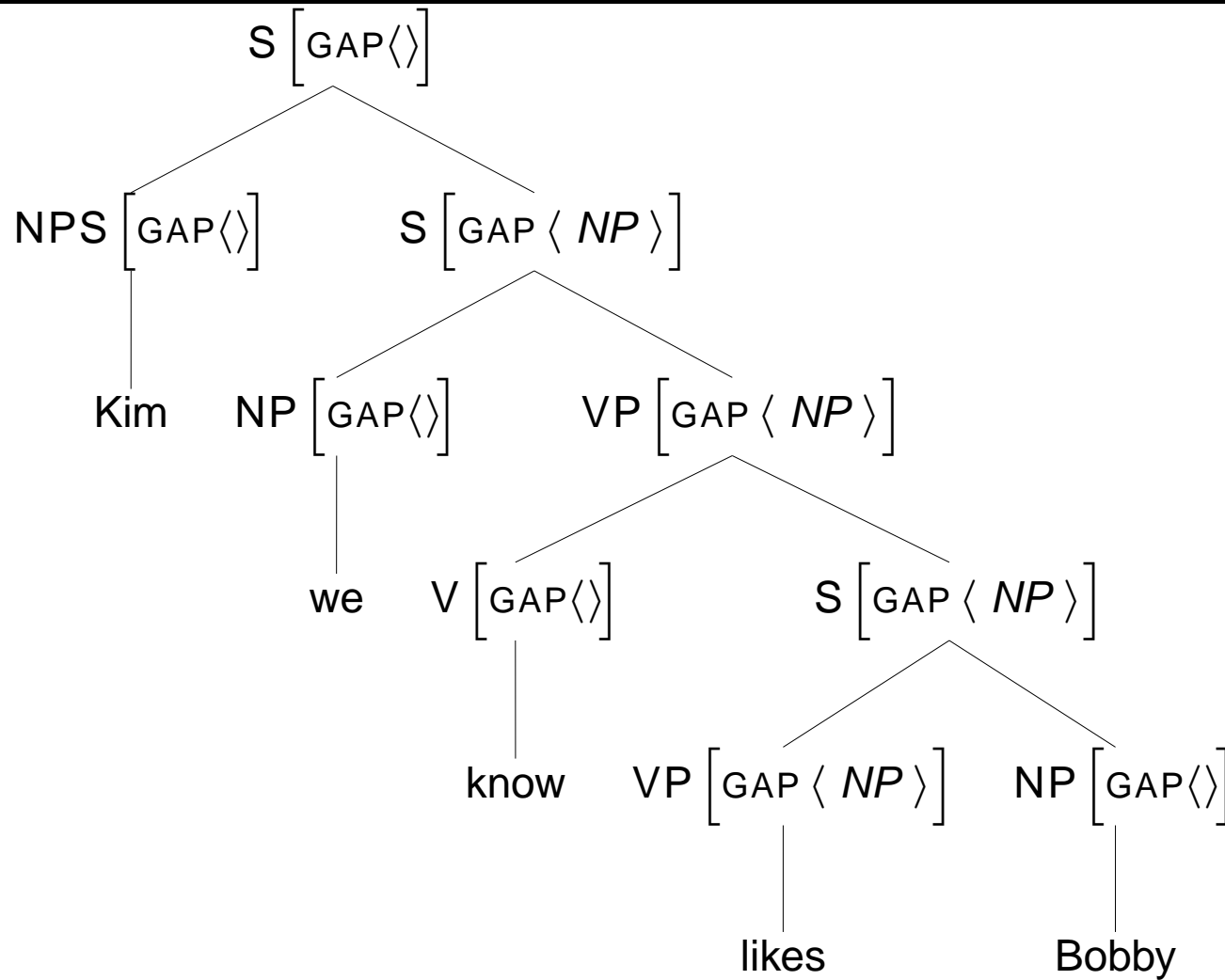
- NB: This says nothing about the phonology, because the default for pi-rules is to leave the phonology unchanged.

## A Lexical Sequence This Licenses



➤ Note that the ARP is satisfied

# A Tree with a Subject Gap



# Island Constraints

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- There are configurations that block filler-gap dependencies, sometimes called **islands**
- Trying to explain them has been a central topic of syntactic research since the mid 1960s
- We'll look at just one, Ross's so-called **Coordinate Structure Constraint**
- Loose statement of the constraint: a constituent outside a coordinate structure cannot be the filler for a gap inside the coordinate structure.



## Coordinate Structure Constraint Examples

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- (25) *\*This problem, nobody finished the extra credit and \_\_\_\_\_*
- (26) *\*This problem, nobody finished \_\_\_\_\_ and the extra credit.*
- (27) *\*This problem, nobody finished \_\_\_\_\_ and started the extra credit.*
- (28) *\*This problem, nobody started the extra credit and finished \_\_\_\_\_*
- (29) *This problem, everybody started \_\_\_\_\_ and nobody finished \_\_\_\_\_*

- In a coordinate structure,
- no conjunct can be a gap (**conjunct constraint**)
  - no gap can be contained in a conjunct if its filler is outside of that conjunct (element constraint)
- ... unless each conjunct has a gap that is paired with the same filler (**across-the-board exception**)

## These observations cry out for explanation

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- In our analysis, the conjunct constraint is an immediate consequence: individual conjuncts are not on the ARG-ST list of any word, so they can't be put on the GAP list
- The element constraint and ATB exception suggest that GAP is one of those features (along with VAL and FORM) that must agree across conjuncts.
- Note: There is no ATB exception to the conjunct constraint.

(30) *\*This problem, you can compare only \_\_\_\_\_ and \_\_\_\_\_.*

## Our Coordination Rule, so far

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$$\begin{bmatrix} \text{VAL} & \bar{0} \\ \text{IND} & s_0 \end{bmatrix} \rightarrow \begin{bmatrix} \text{VAL} & \bar{0} \\ \text{IND} & s_1 \end{bmatrix} \cdots \begin{bmatrix} \text{VAL} & \bar{0} \\ \text{IND} & s_{n-1} \end{bmatrix} \left[ \begin{array}{l} \text{HEAD} \quad \textit{conj} \\ \text{IND} \quad s_0 \\ \text{RESTR} \quad \langle \left[ \text{ARGS} \quad \langle s_1, \dots, s_{n-1}, s_n \rangle \right] \rangle \end{array} \right] \begin{bmatrix} \text{VAL} & \bar{0} \\ \text{IND} & s_n \end{bmatrix}$$

- Recall that we have tinkered with what must agree across conjuncts at various times.
- Now we'll add GAP to the things that conjuncts must share

## Our Final Coordination Rule

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$$\begin{bmatrix} \text{VAL} & \boxed{0} \\ \text{IND} & s_0 \\ \text{GAP} & \boxed{A} \end{bmatrix} \rightarrow \begin{bmatrix} \text{VAL} & \boxed{0} \\ \text{IND} & s_1 \\ \text{GAP} & \boxed{A} \end{bmatrix} \dots \begin{bmatrix} \text{VAL} & \boxed{0} \\ \text{IND} & s_{n-1} \\ \text{GAP} & \boxed{A} \end{bmatrix} \left[ \begin{array}{l} \text{HEAD} \quad \textit{conj} \\ \text{IND} \quad s_0 \\ \text{RESTR} \quad \langle \left[ \text{ARGS} \quad \langle s_1, \dots, s_{n-1}, s_n \rangle \right] \rangle \end{array} \right] \begin{bmatrix} \text{VAL} & \boxed{0} \\ \text{IND} & s_n \\ \text{GAP} & \boxed{A} \end{bmatrix}$$

- We've just added GAP to all the conjuncts and the mother.
- This makes the conjuncts all have the same gap (if any)
- Why do we need it on the mother?

## Closing Remarks on LDDs

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- This is a huge topic; we've only scratched the surface
- There are many more kinds of LDDs, which would require additional grammar rules
- There are also more island constraints, which also need to be explained
- Our account of the coordinate structure constraint (based on ideas of Gazdar) is a step in the right direction, but it would be even better to explain why certain features must agree across conjuncts.

# Overview of LDD

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- Some examples of the phenomenon
- What is new and different about it
- Broad outlines of our approach
- Details of our approach
- Subject extraction
- Coordinate Structure Constraint

## P1: A Tree with a Gap

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Draw a tree for (31). Use abbreviations for the node labels, and show the value of GAP on all nodes. Show the value of STOP-GAP on any node where it is non-empty.

(31) *This baby, I know that they handed a toy to \_\_\_\_\_*

## P2: Blocking Filled Gaps

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Examples (i) and (ii) are well-formed, but example (iii) is ungrammatical:

- (i) *Pat thinks that I rely on some sort of trick.*
- (ii) *This mnemonic, Pat thinks that I rely on.*
- (iii) \**This mnemonic, Pat thinks that I rely on some sort of trick.*

Explain in detail why the mechanisms that license (i) and (ii) do not also permit (iii).



## P3: Subject Gaps

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This problem is to make sure you understand how our analysis accounts for examples like (32).

- (32) i. *Which candidates do you think like oysters on the half-shell?*  
ii. *That candidate, I think likes oysters on the half-shell.*

- A. Sketch the family of lexical sequences for *likes* that is the input to the Subject Extraction Lexical Rule.
- B. Sketch the family of lexical sequences for *likes* that is the corresponding output of the Subject Extraction Lexical Rule.
- C. Sketch the tree for the sentence in (32ii). Use abbreviations for node labels, but show the value of GAP on all nodes and the value of STOP-GAP on any node where it is non-empty. You may abbreviate the structure over the NP *oysters on the half-shell* with a triangle.

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D. Does our analysis correctly predict the contrast between (32ii) and 33?

(33) \**Those candidates, I think likes oysters on the half-shell.*

Explain why or why not.

## Acknowledgments and References

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- Course design and slides borrow heavily from Emily Bender's course:  
*Linguistics 566: Introduction to Syntax for Computational Linguistics*  
<http://courses.washington.edu/ling566>