



Chapter 3, sections 3.3.5-3.5:  
**Head Rules & Trees**

# Topics of Last Lecture

- Distinctions among the world, models of the world, and descriptions of models
- Typed feature structures as a way of modeling things, and of describing models
- Combining feature structures used as descriptions
- The beginnings of the linguistic type hierarchy

# A little more review

$$\text{NP} = \begin{bmatrix} \textit{phrase} \\ \text{HEAD} & \textit{noun} \\ \text{VAL} & \begin{bmatrix} \text{COMPS} & \textit{itr} \\ \text{SPR} & + \end{bmatrix} \end{bmatrix}$$

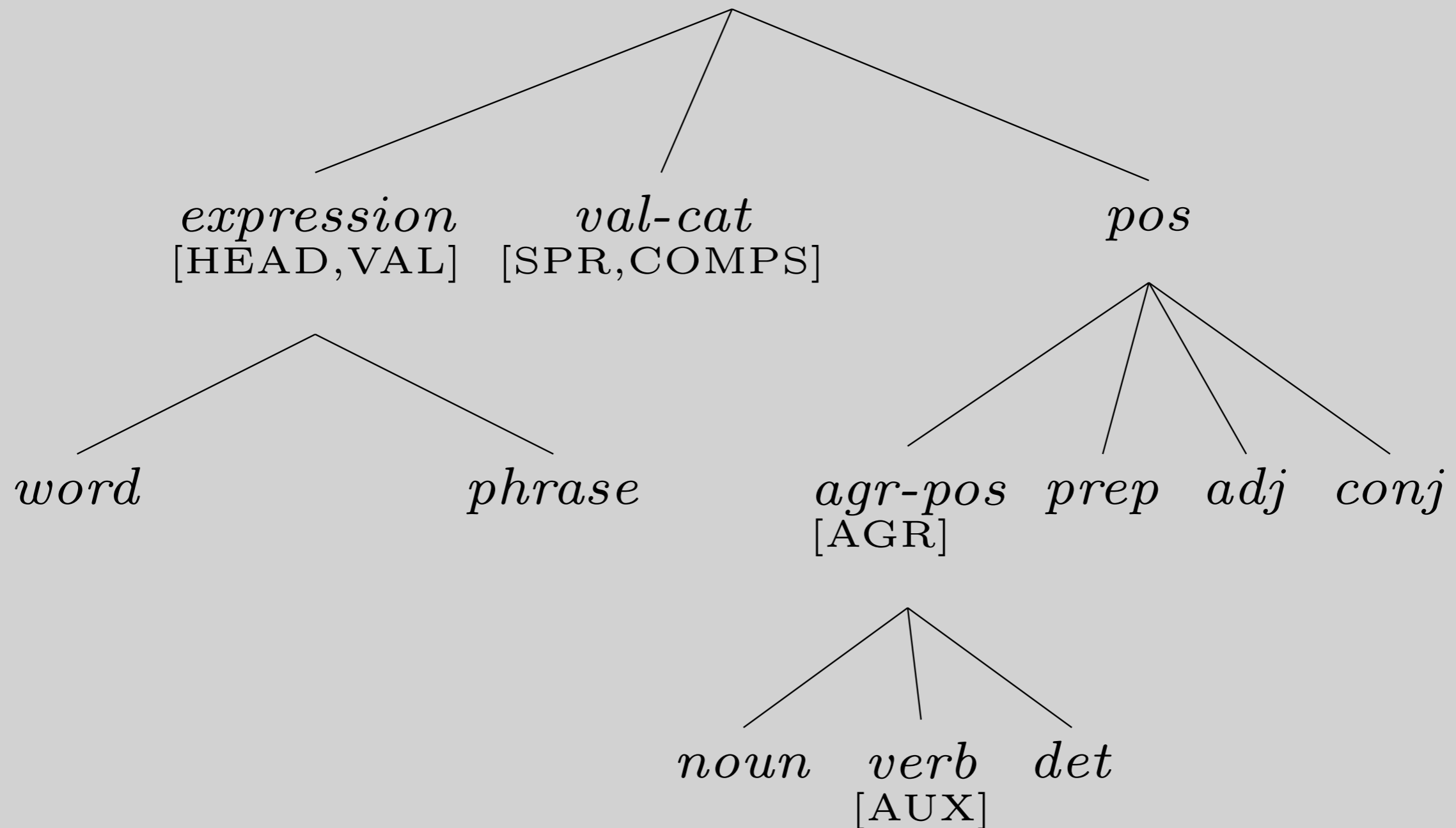
$$\text{NOM} = \begin{bmatrix} \textit{phrase} \\ \text{HEAD} & \textit{noun} \\ \text{VAL} & \begin{bmatrix} \text{COMPS} & \textit{itr} \\ \text{SPR} & - \end{bmatrix} \end{bmatrix}$$

$$\text{S} = \begin{bmatrix} \textit{phrase} \\ \text{HEAD} & \textit{verb} \\ \text{VAL} & \begin{bmatrix} \text{COMPS} & \textit{itr} \\ \text{SPR} & + \end{bmatrix} \end{bmatrix}$$

$$\text{VP} = \begin{bmatrix} \textit{phrase} \\ \text{HEAD} & \textit{verb} \\ \text{VAL} & \begin{bmatrix} \text{COMPS} & \textit{itr} \\ \text{SPR} & - \end{bmatrix} \end{bmatrix}$$

# The Type Hierarchy so far

*feature – structure*



# Reformulating the Grammar Rules I

Head-Complement Rule 1:

$$\left[ \begin{array}{l} \textit{phrase} \\ \text{VAL} \left[ \begin{array}{l} \text{COMPS} \\ \text{SPR} \end{array} \right. \begin{array}{l} \textit{itr} \\ - \end{array} \end{array} \right] \rightarrow \mathbf{H} \left[ \begin{array}{l} \textit{word} \\ \text{VAL} \left[ \begin{array}{l} \text{COMPS} \\ \text{SPR} \end{array} \right. \begin{array}{l} \textit{itr} \\ - \end{array} \end{array} \right]$$

Head Complement Rule 2:

$$\left[ \begin{array}{l} \textit{phrase} \\ \text{VAL} \left[ \begin{array}{l} \text{COMPS} \\ \text{SPR} \end{array} \right. \begin{array}{l} \textit{itr} \\ - \end{array} \end{array} \right] \rightarrow \mathbf{H} \left[ \begin{array}{l} \textit{word} \\ \text{VAL} \left[ \begin{array}{l} \text{COMPS} \\ \text{SPR} \end{array} \right. \begin{array}{l} \textit{str} \\ - \end{array} \end{array} \right] \text{NP}$$

Head Complement Rule 3:

$$\left[ \begin{array}{l} \textit{phrase} \\ \text{VAL} \left[ \begin{array}{l} \text{COMPS} \\ \text{SPR} \end{array} \right. \begin{array}{l} \textit{itr} \\ - \end{array} \end{array} \right] \rightarrow \mathbf{H} \left[ \begin{array}{l} \textit{word} \\ \text{VAL} \left[ \begin{array}{l} \text{COMPS} \\ \text{SPR} \end{array} \right. \begin{array}{l} \textit{dtr} \\ - \end{array} \end{array} \right] \text{NP NP}$$

# Reformulating the Grammar Rules II

Head-Specifier Rule 1:

$$\left[ \begin{array}{l} \textit{phrase} \\ \text{VAL} \left[ \begin{array}{l} \text{COMPS} \quad \textit{itr} \\ \text{SPR} \quad + \end{array} \right] \end{array} \right] \rightarrow \left[ \begin{array}{l} \text{NP} \\ \text{HEAD} \left[ \begin{array}{l} \text{AGR} \quad \boxed{1} \end{array} \right] \end{array} \right] \mathbf{H} \left[ \begin{array}{l} \textit{phrase} \\ \text{HEAD} \left[ \begin{array}{l} \textit{verb} \\ \text{AGR} \quad \boxed{1} \end{array} \right] \\ \text{VAL} \left[ \begin{array}{l} \text{SPR} \quad - \end{array} \right] \end{array} \right]$$

Head-Specifier Rule 2:

$$\left[ \begin{array}{l} \textit{phrase} \\ \text{VAL} \left[ \begin{array}{l} \text{COMPS} \quad \textit{itr} \\ \text{SPR} \quad + \end{array} \right] \end{array} \right] \rightarrow \text{D} \mathbf{H} \left[ \begin{array}{l} \textit{phrase} \\ \text{HEAD} \quad \textit{noun} \\ \text{VAL} \left[ \begin{array}{l} \text{SPR} \quad - \end{array} \right] \end{array} \right]$$

# Reformulating the Grammar Rules III

## Non-Branching NP Rule

$$\left[ \begin{array}{l} \textit{phrase} \\ \text{VAL} \left[ \begin{array}{l} \text{COMPS} \textit{ itr} \\ \text{SPR} \textit{ +} \end{array} \right] \end{array} \right] \rightarrow \mathbf{H} \left[ \begin{array}{l} \textit{word} \\ \text{HEAD} \textit{ noun} \\ \text{VAL} \left[ \begin{array}{l} \text{SPR} \textit{ +} \end{array} \right] \end{array} \right]$$

## Head-Modifier Rule

$$\left[ \begin{array}{l} \textit{phrase} \\ \text{VAL} \left[ \begin{array}{l} \text{COMPS} \textit{ itr} \\ \text{SPR} \textit{ -} \end{array} \right] \end{array} \right] \rightarrow \mathbf{H} \left[ \begin{array}{l} \textit{phrase} \\ \text{VAL} \left[ \begin{array}{l} \text{SPR} \textit{ -} \end{array} \right] \end{array} \right] \text{PP}$$

## Coordination Rule

$$\boxed{1} \rightarrow \boxed{1}^+ \left[ \begin{array}{l} \textit{word} \\ \text{HEAD} \textit{ conj} \end{array} \right] \boxed{1}$$

# Advantages of the New Formulation

- Subject-verb agreement is stipulated only once (where?)
- Common properties of verbs with different valences are expressed by common features (for example?)
- Parallelisms across phrase types are captured (for example?)

# Disadvantages of the New Formulation

- We still have three head complement rules
- We still have two head specifier rules
- We only deal with three verb valences (which ones? what are some others?)
- The non-branching rules don't really do any empirical work
- Others?

# Heads

- Intuitive idea: A phrase typically contains a word that determines its most essential properties, including
  - where it occurs in larger phrases, and
  - what its internal structure is
- This is called the head
- The term “head” is used both for the head word in a phrase and for all the intermediate phrases containing that word
- NB: Not all phrases have heads

# Formalizing the Notion of Head

- Expressions have a feature HEAD
- HEAD's values are of type *pos*
- For HEAD values of type *agr-pos*, HEAD's value also includes the feature AGR
- Well-formed trees are subject to the Head Feature Principle

# The Head Feature Principle

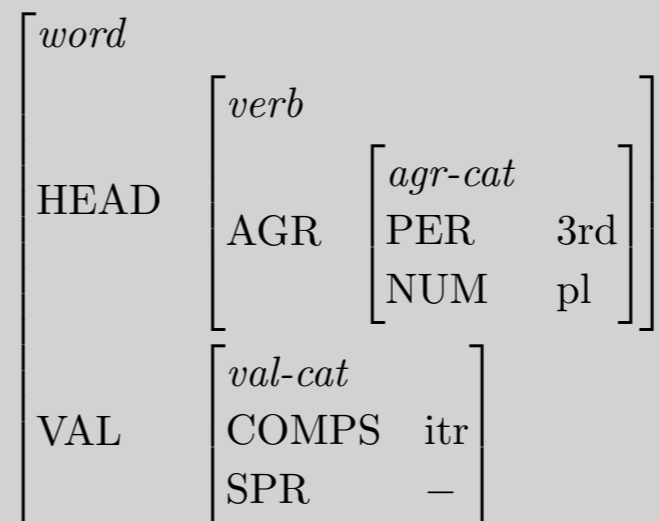
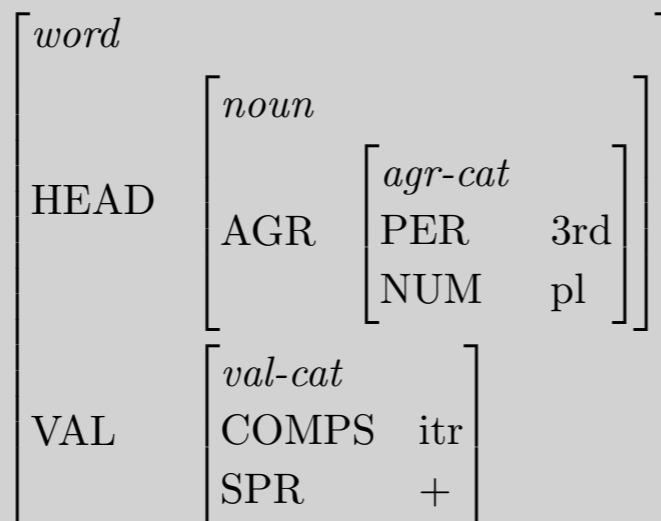
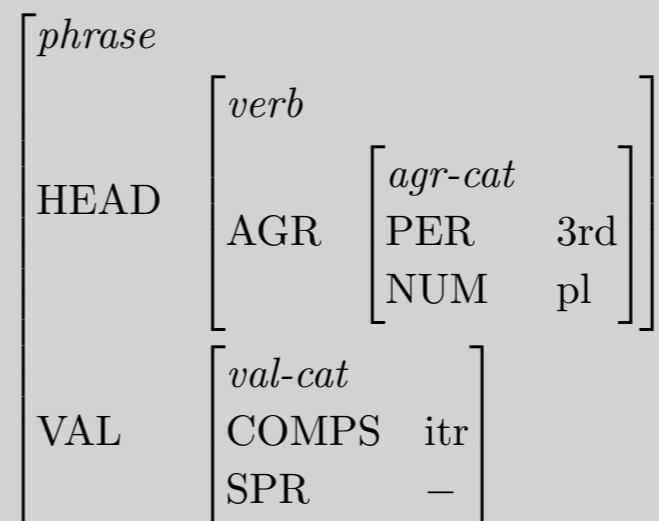
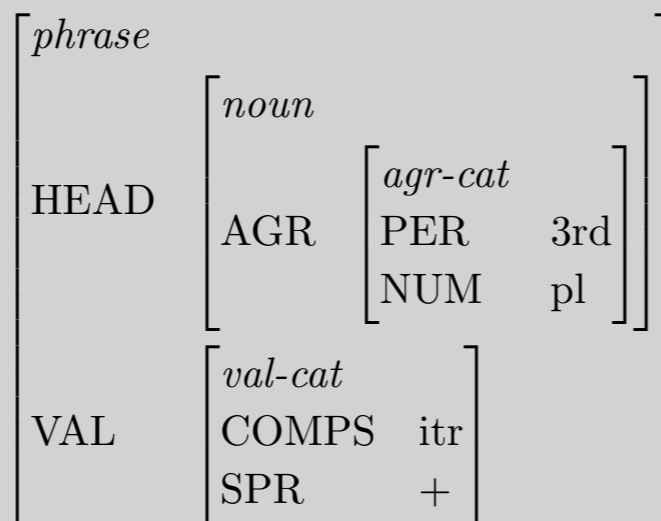
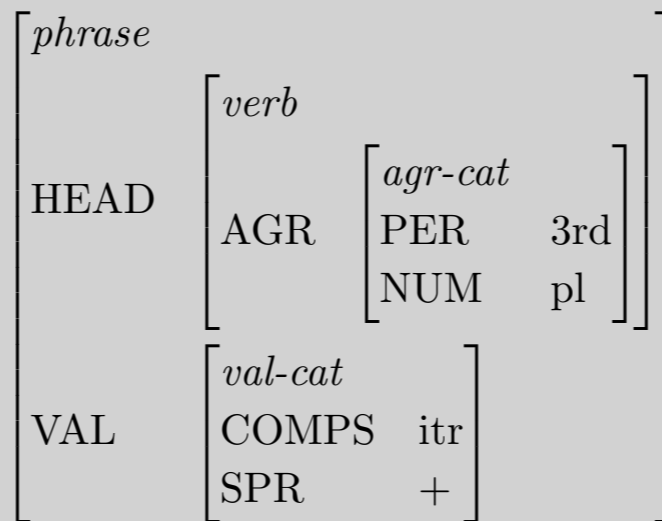
- Intuitive idea: Key properties of phrases are shared with their heads
- The HFP: In any headed phrase, the HEAD value of the mother and the head daughter must be identical.
- Sometimes described in terms of properties “percolating up” or “filtering down”, but this is just metaphorical talk

# A Tree is Well-Formed if ...

- It and each subtree are licensed by a grammar rule or lexical entry
- All general principles (like the HFP) are satisfied.
- NB: Trees are part of our model of the language, so all their features have values (even though we will often be lazy and leave out the values irrelevant to our current point)

Question:

Do phrases that are not headed have  
HEAD features?



they

swim

# A Question:

Since the lexical entry for *swim* below has only [NUM pl] as the value of AGR, how did the tree on the previous slide get [PER 3rd] in the AGR of *swim*?

