Syntactic Theory

Lecture 5a (12.12.2006)

PD Dr.Valia Kordoni

Email: kordoni@coli.uni-sb.de

http://www.coli.uni-saarland.de/~kordoni/courses/ws06-07/ST06-07/

Lexical-Functional Grammar (LFG)

Ronald M. Kaplan. 1995. The Formal Architecture of Lexical-Functional Grammar. In Dalrymple, M., Kaplan, R. M., Maxwell, J. T. III, Zaenen, A. (eds.), *Formal Issues in Lexical-Functional Grammar*, pp. 1-21, 1995. CSLI/University of Chicago Press

The Formal Architecture of Lexical-Functional Grammar Overview

- LFG has evolved from previous computational, linguistic, and psycholinguistic research;
- LFG provides a simple set of devices for describing the common properties of all human languages and the particular properties of individual languages;
- LFG postulates two levels of syntactic representation for a sentence, a constituent structure (c-structure) and a functional structure (f-structure);

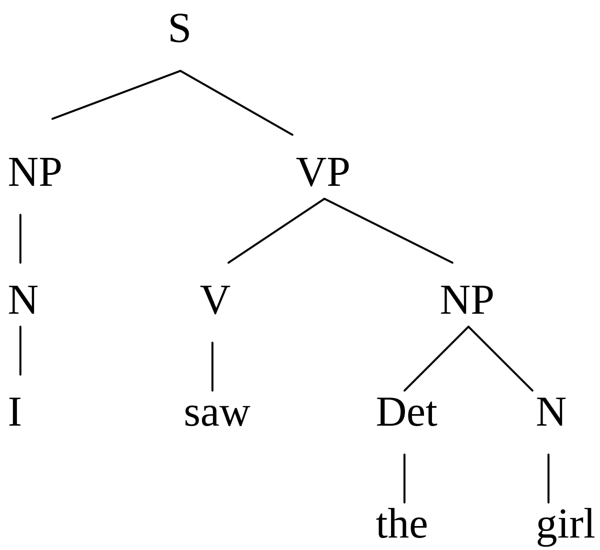
The Formal Architecture of Lexical-Functional Grammar Overview (continue)

- The c- and the f-structures of LFG are related by a piecewise correspondence that permits the properties of the abstract functional structure to be defined in terms of configurations of constituent structure phrases;
- The basic architecture of LFG crucially separates the three notions of **structure, structural description, and structural correspondence**;
- Finally, LFG has been recently extended in ways that enhance its ability to express certain kinds of linguistic generalizations while remaining compatible with the underlying architecture.

The Formal Architecture of Lexical-Functional Grammar
LFG: the basics

- The c-structure is a phrase-structure tree that serves as the basis for phonological interpretation;
- The f-structure is a hierarchical attribute-value matrix that represents underlying grammatical relations;
- The c-structure is assigned by the rules of a context-free phrase structure grammar;
- Functional annotations on those rules are instantiated to provide a formal description of the f-structure;
- The smallest f-structure satisfying those constraints is the grammatically appropriate f-structure.

The Formal Architecture of Lexical-Functional Grammar
Elementary Structures



N: set of nodes, L: set of category labels
M: N => N
< ⊆ N x N
λ: N => L

SUBJ	PRED	´pro`
	PERS	1
	NUM	SG
TENSE	PAST	
PRED	´see[(↑ SUBJ), (↑ OBJ)]`	
OBJ	PRED	´girl`
	DEF	+
	PERS	3
	NUM	SG

A: set of atomic symbols, S: set of semantic forms
F = (A =>$_f$ F ∪ A ∪ S)

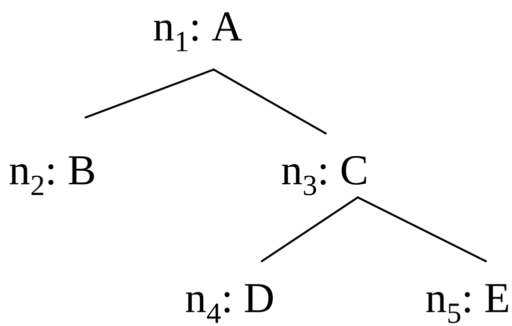
The Formal Architecture of Lexical-Functional Grammar
Elementary Structures

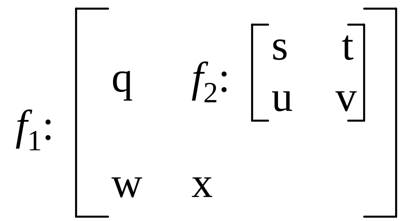
- F-structures are defined recursively: they are hierarchical finite functions mapping from elements in a set of symbols to values which can be symbols, subsidiary f-structures, or semantic forms such as `see<SUBJ, OBJ>´;

The Formal Architecture of Lexical-Functional Grammar
Descriptions of structures

- In LFG structures are assigned by *descriptive* methods;
- Each word or phrase provides only some of the information that goes into defining an appropriate abstract representation. That information interacts with features of other words to uniquely identify what the abstract properties might be;
- That is: the constraints on grammatical representations are distributed in partial and piecemeal form throughout a sentence;
- The descriptive method accommodates most naturally to this modular situation, since partial information can be assembled by a simple conjunction of constraints.

The Formal Architecture of Lexical-Functional Grammar
Descriptions of Structures





(f a) = v if f <a v> ∈ f, where f is an f-structure
and a is an atomic symbol

$M(n_2) = n_1$
$\lambda(n_1) = A$
$\lambda(n_2) = B$
$M(n_3) = n_1$
$\lambda(n_3) = C$
$n_2 < n_3$

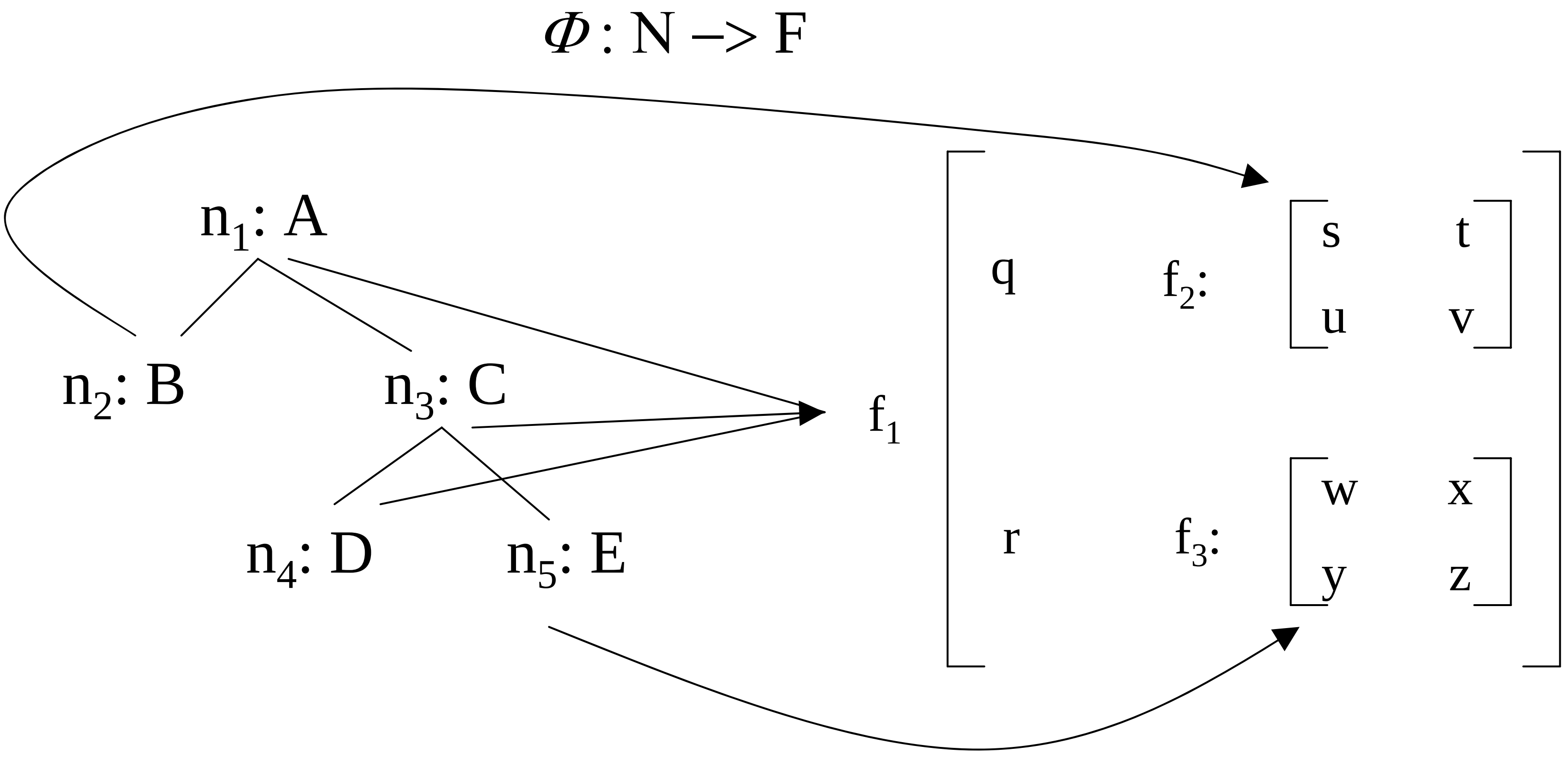
$M(n_4) = n_3$
$M(n_5) = n_3$
$\lambda(n_4) = D$
$\lambda(n_5) = E$
$n_4 < n_5$

$(f_1\ q) = f_2$
$(f_2\ s) = t$
$(f_2\ u) = v$
$(f_1\ w) = x$

The Formal Architecture of Lexical-Functional Grammar
Descriptions of structures

- Structures can be easily described by listing their properties and relations;
- Conversely, given a consistent description, the structures that satisfy this description may be discovered - but not always;
- For the simple functional domain of f-structures, descriptions that involve only equality and functional application can be solved by an attribute-value merging or unification operator, or other techniques that apply to the quantifier-free theory of equality.

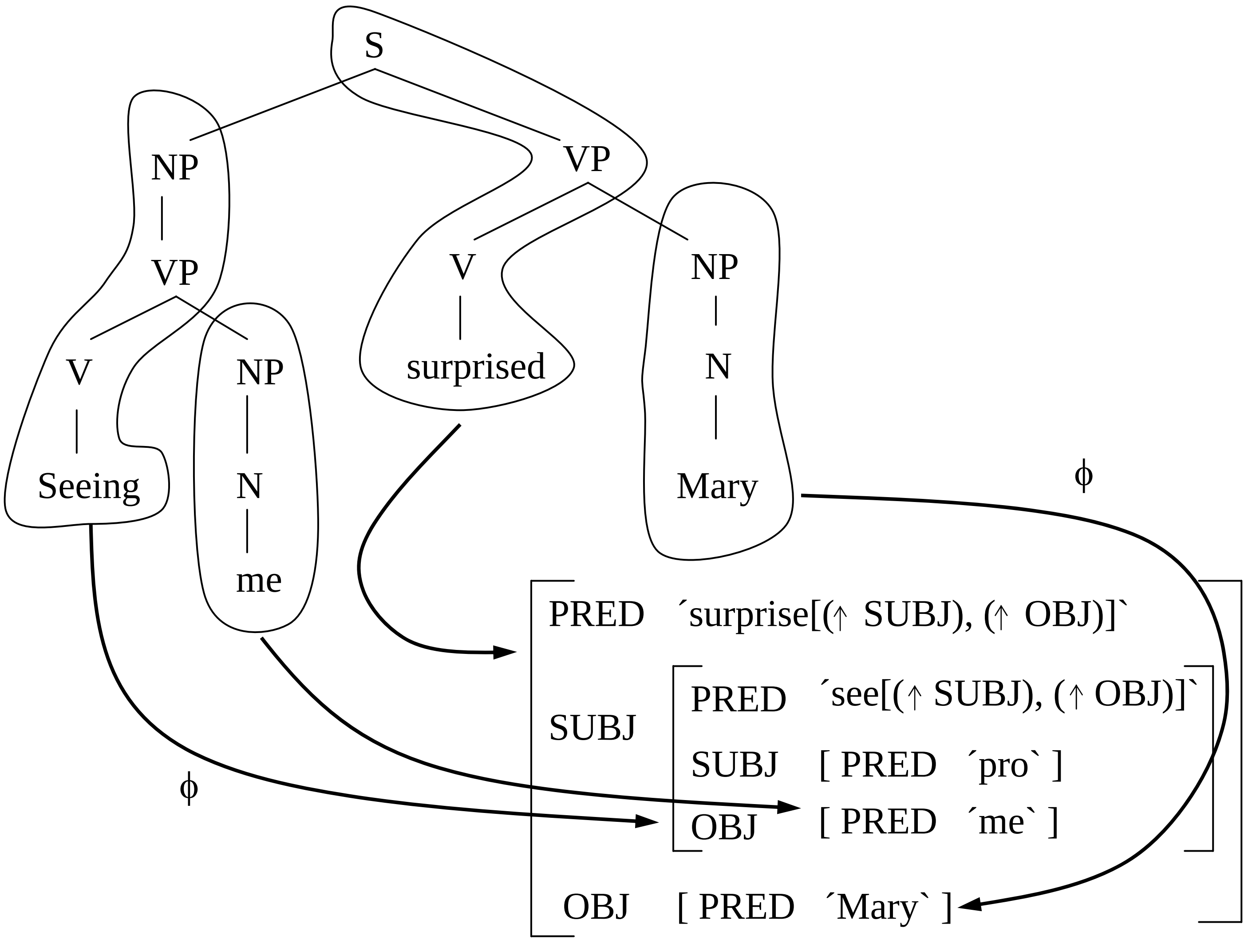
The formal architecture of Lexical Functional Grammar
Structural Correspondences



The Formal Architecture of Lexical-Functional Grammar
Structural Correspondences

- The element-wise structural correspondence allows the mother-daughter relationships in the tree to constrain the function-application properties in the f-structure;
- A structural correspondence is a function but it is not required to be **one-to-one**. Many-to-one configurations appear in many linguistic analyses: lexical heads and their dominating phrasal categories usually map to the same f-structure; another example comes from discontinuous constituents, functional units whose properties are carried by words in noncontiguous parts of the string;
- A structural correspondence also need not be **onto**

The Formal Architecture of Lexical-Functional Grammar
Structural Correspondences



The Formal Architecture of Lexical-Functional Grammar
Structural Correspondences

- Phrasally-based theories typically postulate an empty node on the tree side in order to represent the fact that there is a **dummy** understood subject because subjects (and predicate-argument relations) are represented in those theories by particular node configurations;
- In LFG, given that the notion of **subject** is defined in the range of correspondence, we need not postulate empty nodes in the tree;
- Instead, the f-structure´s description, derived from the tree relations of the gerund in the c-structure, can have an equation that specifies directly that the subject´s predicate is an anaphoric pronoun, with no node in the tree that it corresponds to = **null anaphors**.

The Formal Architecture of Lexical-Functional Grammar Structural Correspondences: Recap

- The LFG formalism presented by Kaplan and Bresnan (1982) is based on the architectural notions of **structure**, **structural description**, and **structural correspondence**;
- Within the framework, particular notational conventions are chosen to suppress unnecessary detail and make it more convenient to express certain common patterns of description;
- That is: the allowable c-structures for a sentence are specified by the rewriting rules of a context-free grammar - augmented by a Kleene-closure operator for repetitive expansions;

The Formal Architecture of Lexical-Functional Grammar
Structural Correspondences: Recap (continue)

- The description of an appropriate f-structure is derived from functional annotations attached to the c-structure rules;
- The interpretation of functional annotations is defined by a special instantiation procedure that relies implicitly on the c-structure to f-structure correspondence;

The Formal Architecture of Lexical-Functional Grammar Structural Correspondences: Interpretation of Functional Annotations

- S ---> NP VP

  $(\phi(M(n))\ \text{SUBJ}) = \phi(n)$ $\quad (\phi(M(n)) = \phi(n)$

- The f-structure corresponding to the NP´s mother applies to SUBJ to give the f-structure corresponding to the NP;
- The f-structure corresponding to the mother of the VP, namely the S node, is also the f-structure corresponding to the VP;
- The conjunction of these constraints across the whole c-structure, with actual nodes substituted for the generic *n*, is the desired f-structure description.

The Formal Architecture of Lexical-Functional Grammar Structural Correspondences: Interpretation of Functional Annotations

- $(\uparrow \text{SUBJ}) = \downarrow$
- „the matching NP node´s mother´s f-structure´s subject is the matching node´s f-structure“;
- The symbol $\uparrow$ abbreviates the complex term (ϕ(M(n)), the composition of the structural correspondence with the mother function;
- The symbol $\downarrow$ stands for ϕ(n), the f-structure corresponding to the matching node;
- The method of generating range descriptions by analyzing and matching the properties of domain structures is called **description by analysis**

The Formal Architecture of Lexical-Functional Grammar

Extending the description language

- Intersection and complementation operators in the c-structure rules;

- *f*-precedence relation;

- Functional Uncertainty

The Formal Architecture of Lexical-Functional Grammar
Extending the Configuration of Correspondences