Dependency Grammars and Parsing - Introduction

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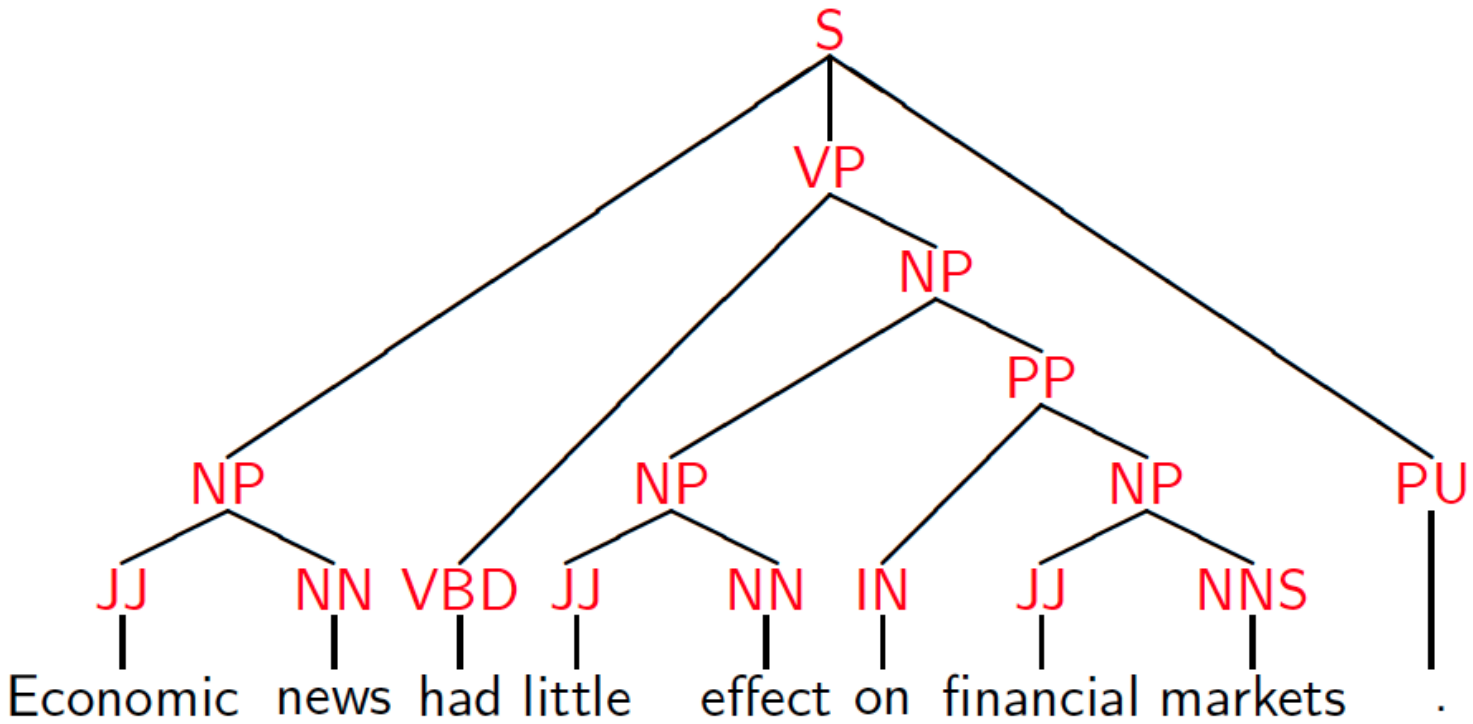
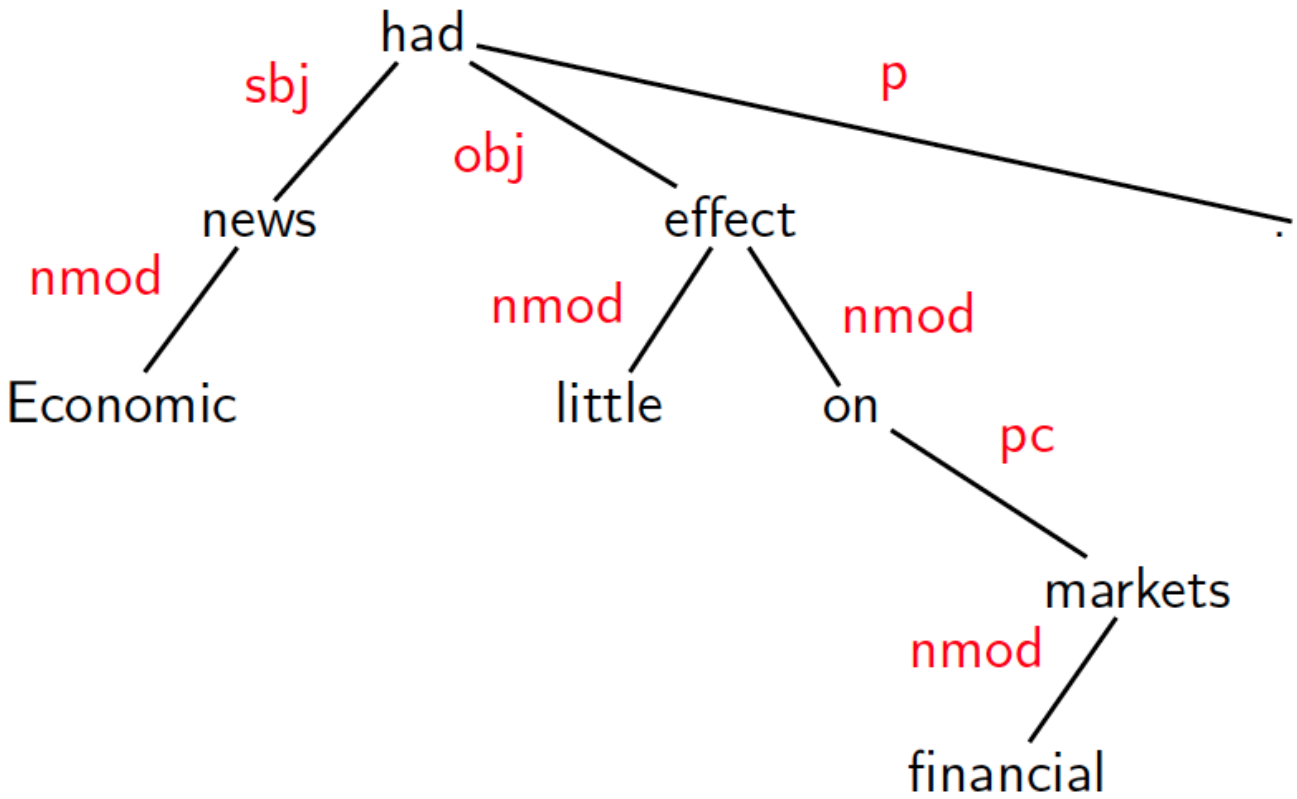
Week 6, Lecture 1

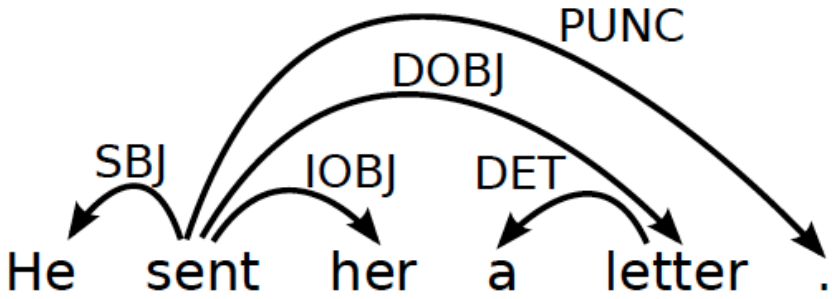
Phrase Structure



Dependency Structure Representation

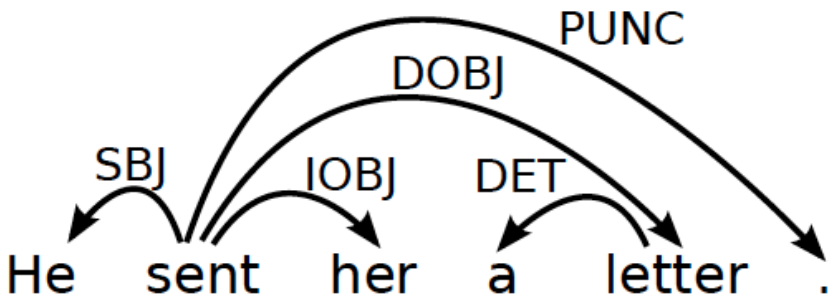


Dependency Structure



- Connects the words in a sentence by putting arrows between the words.
- Arrows show relations between the words and are typed by some grammatical relations.
- Arrows connect a head (governor, superior, regent) with a dependent (modifier, inferior, subordinate).
- Usually dependencies form a tree.

Criteria for Heads and Dependents

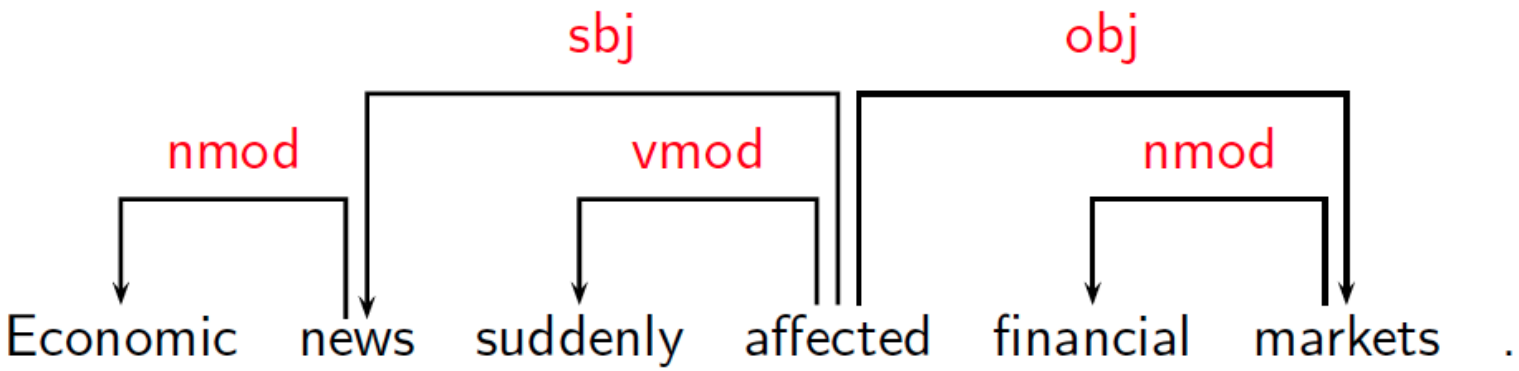


Criteria for a syntactic relation between a head H and a dependent D in a construction C

- H determines the syntactic category of C; H can replace C.
- D specifies H.
- H is obligatory; D may be optional.
- H selects D and determines whether D is obligatory.
- The form of D depends on H (agreement or government).
- The linear position of D is specified with reference to H.

Some Clear Cases

Construction	**Head**	**Dependent**
Exocentric	Verb	Subject (sbj)
	Verb	Object (obj)
Endocentric	Verb	Adverbial (vmod)
	Noun	Attribute (nmod)



Comparison

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Dependency structures explicitly represent

- Head-dependent relations (directed arcs)
- Functional categories (arc labels)

Dependency Graphs

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- Labeled graphs:
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  - Arcs in A are labeled with dependency types.
- Notational convention:
  - Arc (w_i, d, w_j) links head w_i to dependent w_j with label d
  - $w_i \xrightarrow{d} w_j \Leftrightarrow (w_i, d, w_j) \in A$
  - $i \rightarrow j \equiv (i, j) \in A$
  - $i \rightarrow^* j \equiv i = j \vee \exists k : i \rightarrow k, k \rightarrow^* j$

Formal conditions on Dependency Graphs

- G is connected:
  - For every node i there is a node j such that $i \rightarrow j$ or $j \rightarrow i$.
- G is acyclic:
  - if $i \rightarrow j$ then not $j \rightarrow^* i$.
- G obeys the single head constraint:
  - if $i \rightarrow j$ then not $k \rightarrow j$, for any $k \neq i$.
- G is projective:
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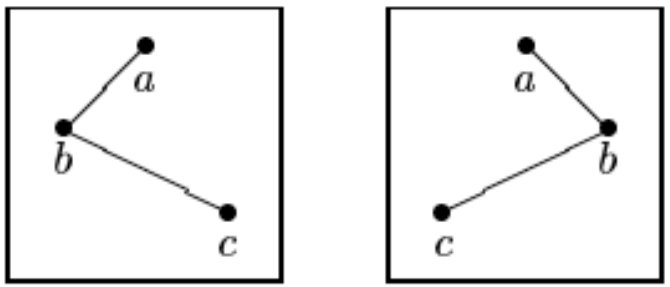
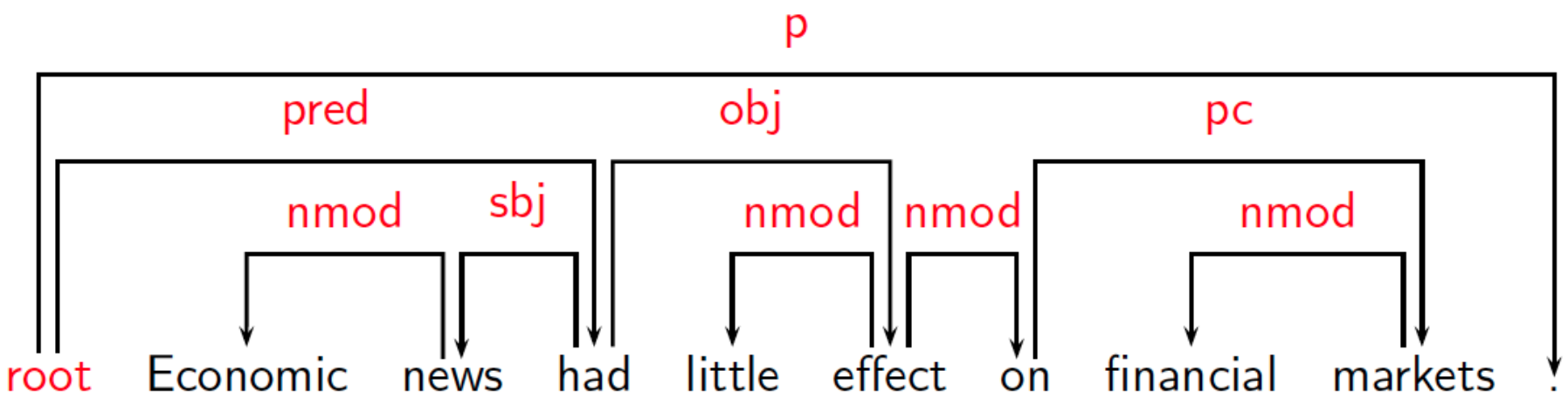


Formal Conditions: Basic Intuitions

Connectedness, Acyclicity and Single-Head

- **Connectedness:** Syntactic structure is complete.
- **Acyclicity:** Syntactic structure is hierarchical.
- **Single-Head:** Every word has at most one syntactic head.
- **Projectivity:** No crossing of dependencies.



Dependency Parsing

Dependency Parsing

- **Input:** Sentence $x = w_1, \ldots, w_n$
- **Output:** Dependency graph G

Parsing Methods

- Deterministic Parsing
- Maximum Spanning Tree Based
- Constraint Propagation Based