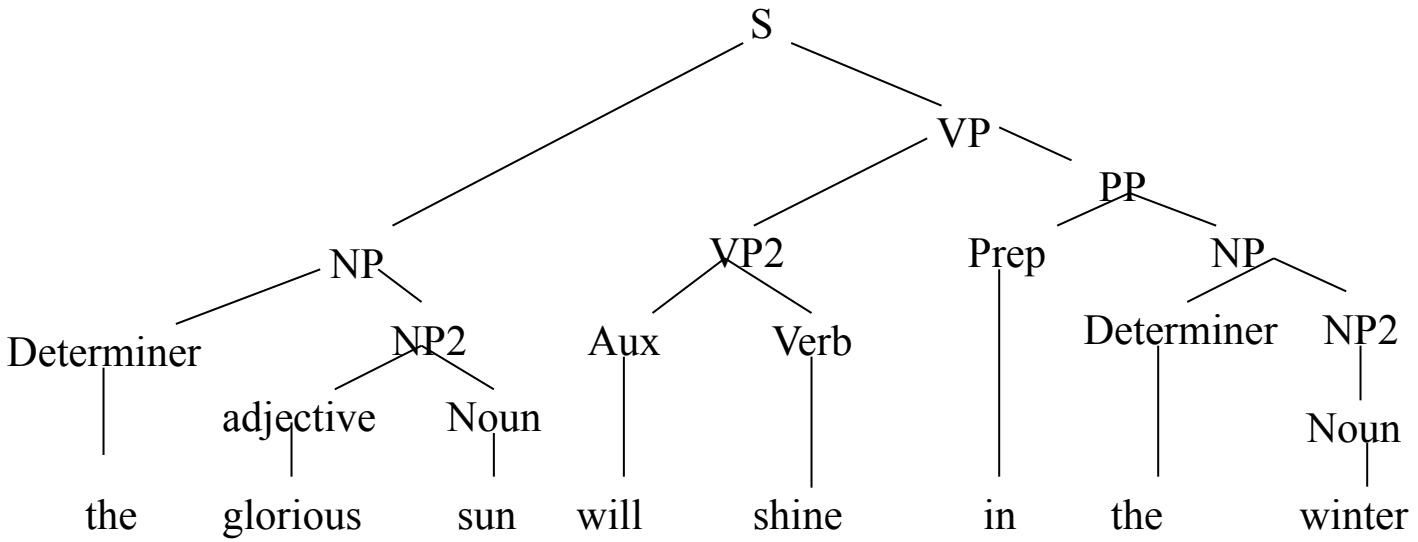
Dependency Grammars, an alternative to CFGs

Dependency Grammars

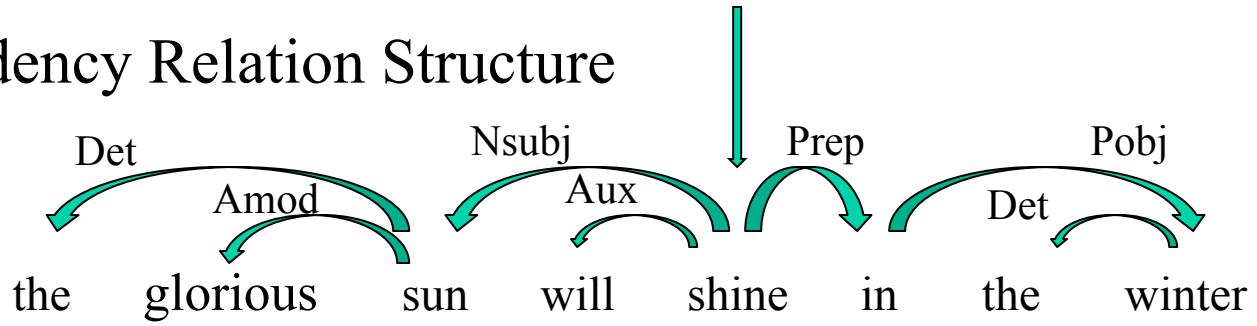
- Dependency grammars offer a different way to represent syntactic structure
  - CFGs represent constituents in a parse tree that can derive the words of a sentence
  - Dependency grammars represent syntactic dependency relations between words that show the syntactic structure
  - Typed dependency grammars label those relations as to what the syntactic structure is
- Syntactic structure is the set of relations between a word (aka the head word) and its dependents.

Examples

- Context Free Grammar Tree Structure



- Dependency Relation Structure



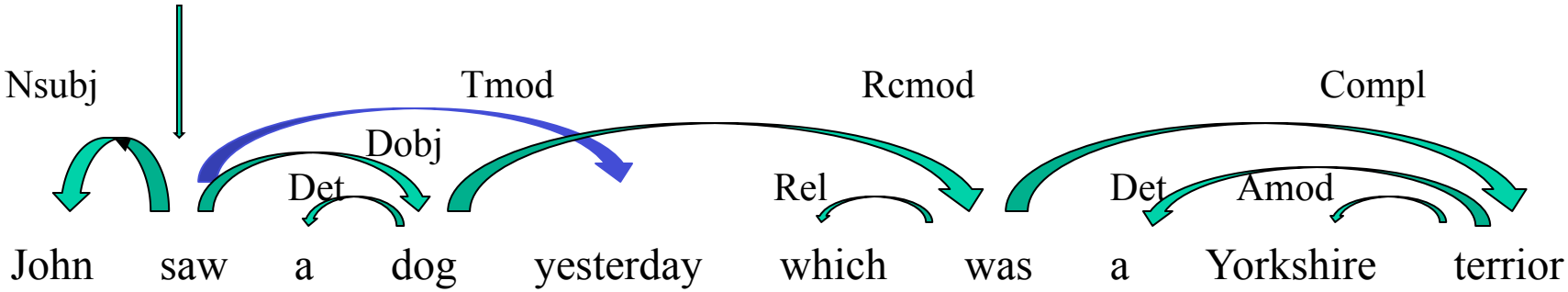
Note that the head word of a sentence is the verb.

Dependency Relations

- The set of Grammar Relations has varied in number
  - 48 in the Stanford dependency parser
  - 59 in Minipar, a dependency parser from Dekang Lin
  - 106 in Link, a related link grammar parser from CMU
- The examples on the previous page used those from the Stanford dependency parser
  - De Marneffe, MacCartney and Manning, Generating Typed Dependency Parses from Phrase Structure Parses, LREC (Language Resources and Evaluation Conference), 2006.

Projective vs. Non-Projective

- In the dependency graph as depicted in the previous example, with the words in sentence order, if no arcs cross, then it is a projective tree
- If there are crossing arcs, then it is a non-projective tree



- CoNLL (Conference on Natural Language Learning) 2006 had dependency parsing as the shared task on 13 languages, not including English. Out of the languages which had non-projective sentences in the treebanks, from 0.5% to 5% of the sentences were non-projective.
- Non-projective trees are a problem for parsing, not for expressive power of the grammar.

Dependency Grammar vs. CFG

- Dependency grammars and CFGs are strongly equivalent
  - Generate the same sentences and make the same structural analysis
    - Haim Gaifman, 1965, “Dependency systems and phrase structure systems”.

- Provided that the CFGs are restricted in that one word or phrase can be designated as its “head”
  - This restriction also accepted by linguists in X-bar theory
    - Proposed by Chomsky and further developed by Ray Jackendoff, 1977, “X-bar-Syntax: A Study of Phrase Structure”
  - Note that the head of a noun phrase is a noun, the head of a verb phrase is a verb, etc.