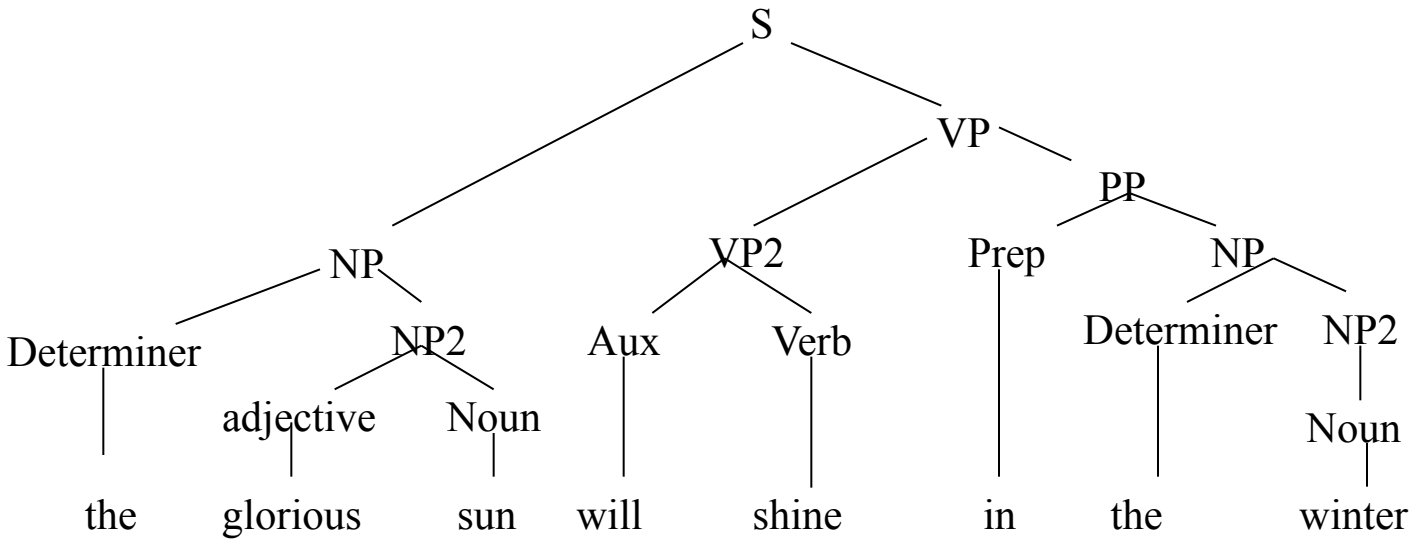
Dependency Grammars, an alternative to CFGs

Dependency Grammars

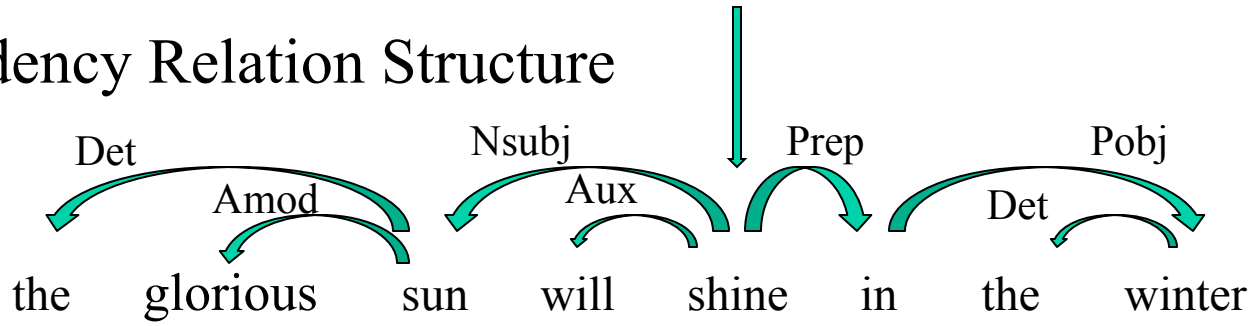
- Dependency grammars offer a different way to represent syntactic structure
  - CFGs represent constituents in a parse tree that can derive the words of a sentence
  - Dependency grammars represent syntactic dependency relations between words that show the syntactic structure
  - Typed dependency grammars 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

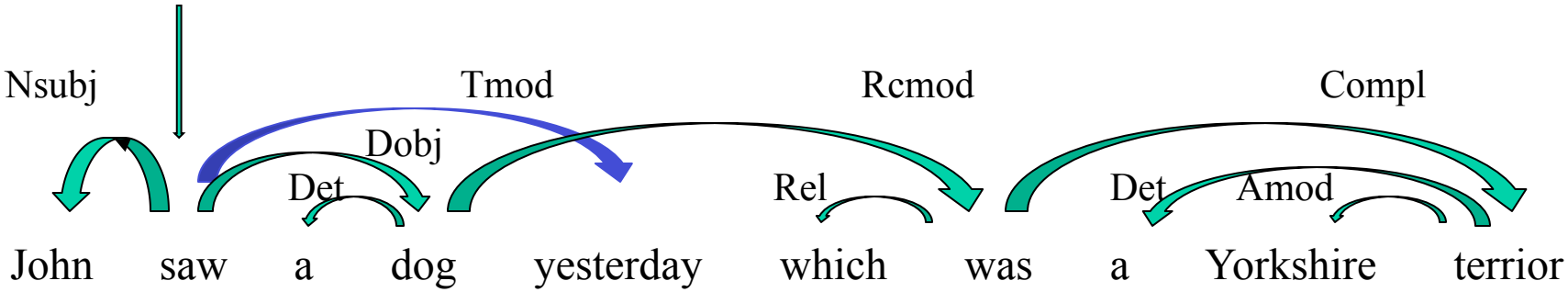
- The set of Grammar Relations has varied in number
  - 48 in the Stanford dependency parser
  - 59 in Minipar, a dependency parser from Dekang Lin
  - 106 in Link, a related link grammar parser from CMU
- The examples on the previous page used those from the Stanford dependency parser
  - De Marneffe,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

Examples of Dependency Relations

Argument Dependencies	Description
nsubj	nominal subject
csubj	clausal subject
dobj	direct object
iobj	indirect object
pobj	object of preposition
Modifier Dependencies	**Description**
tmod	temporal modifier
appos	appositional modifier
det	determiner
prep	prepositional modifier

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.