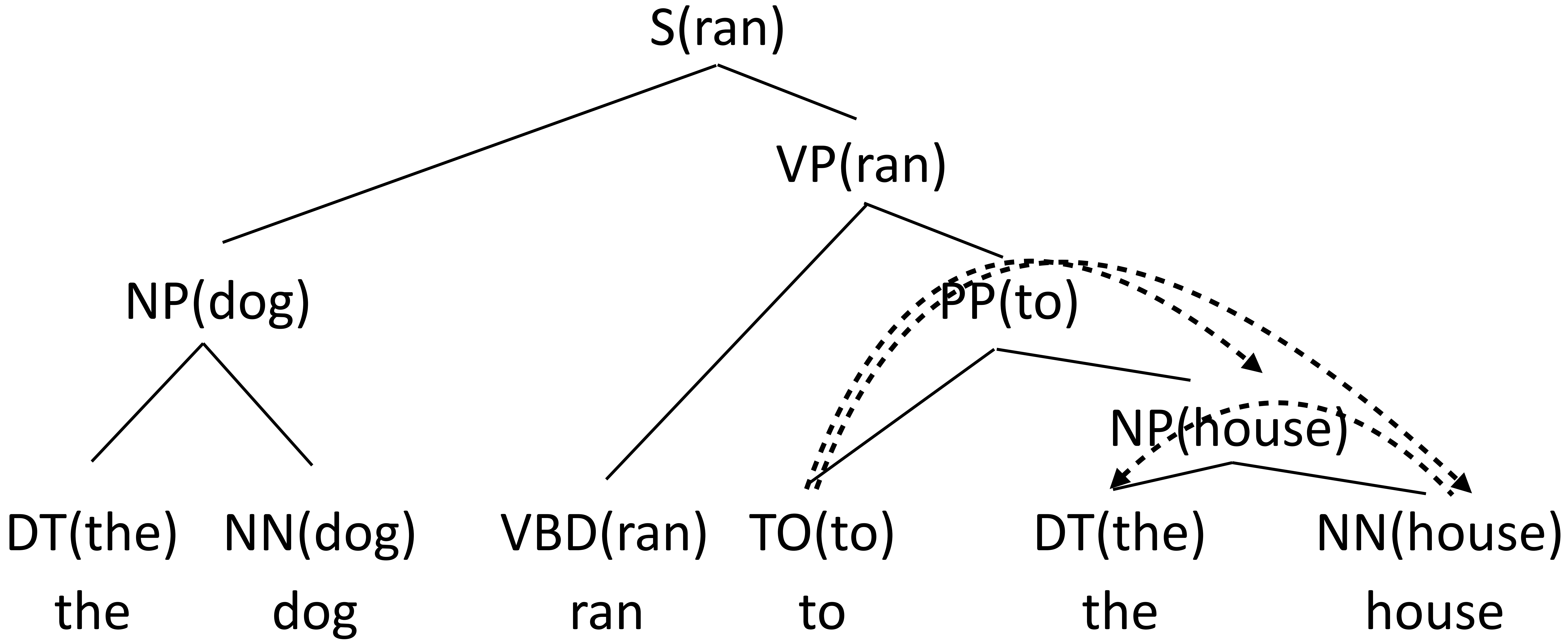
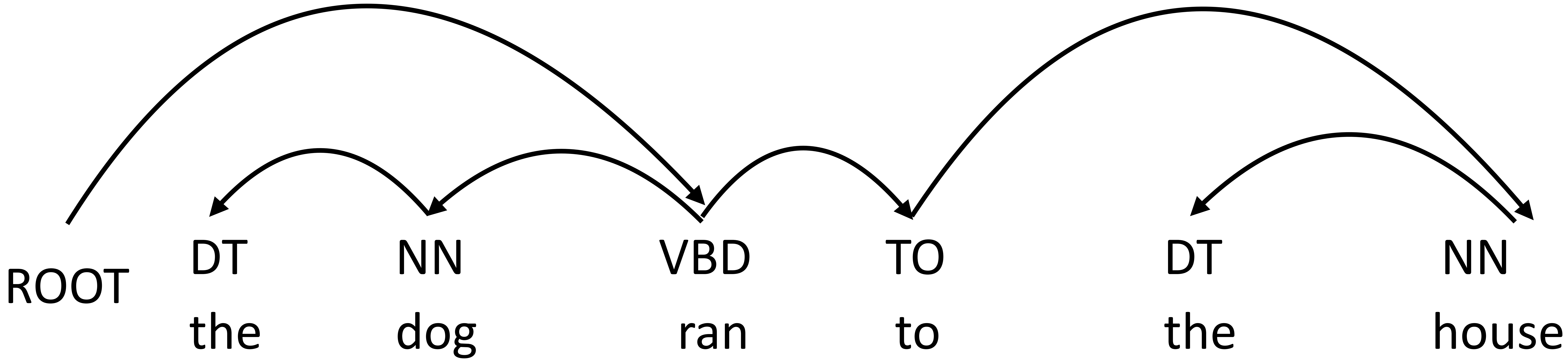
Lexicalized Parsing



Dependency Parsing

- Dependency syntax: syntactic structure is defined by these arcs
  - Head (parent, governor) connected to dependent (child, modifier)
  - Each word has exactly one parent except for the ROOT symbol, dependencies must form a directed acyclic graph



ROOT

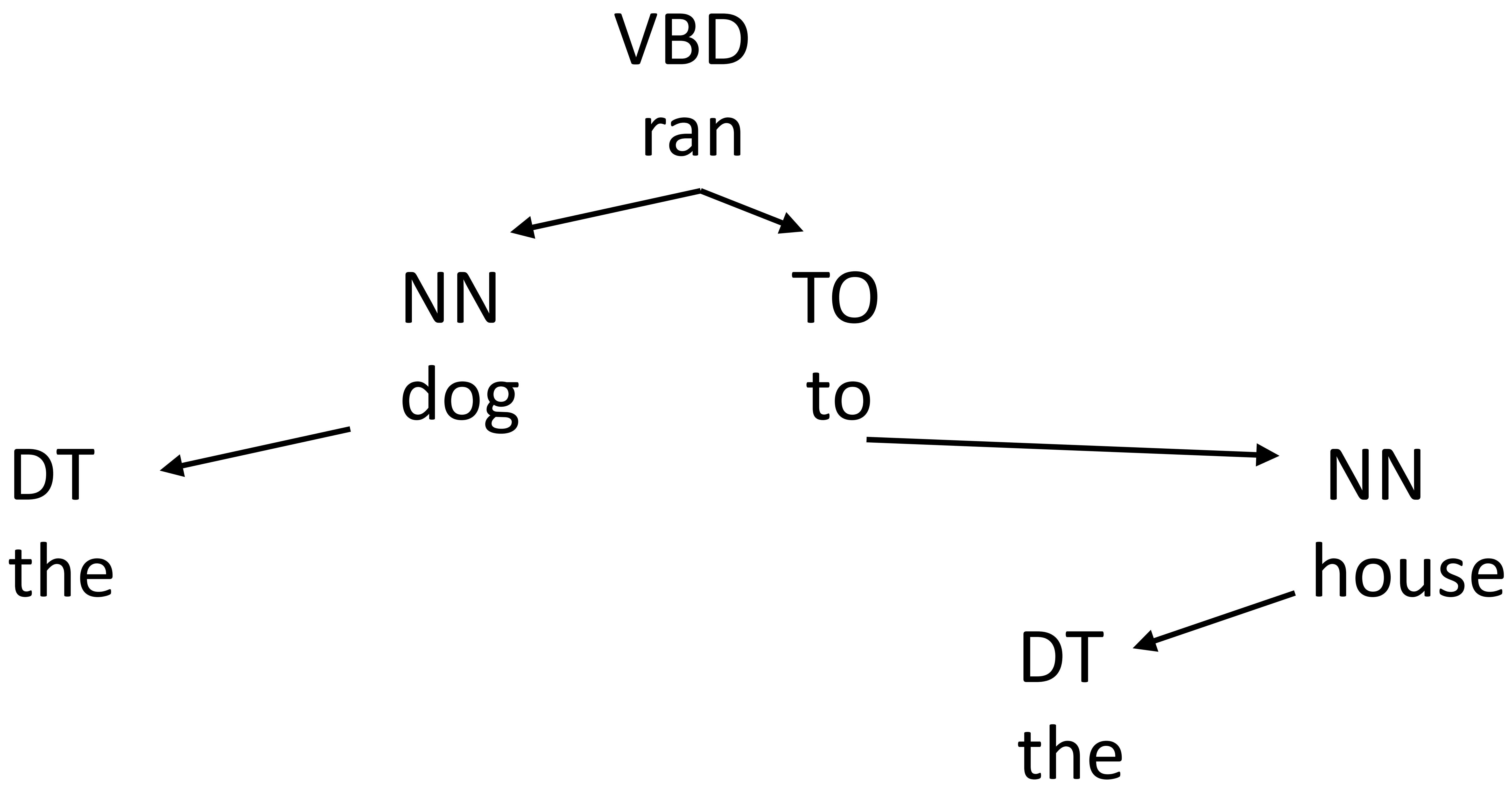
DT NN VBD TO DT NN

the dog ran to the house

- POS tags same as before, often run a tagger first as preprocessing

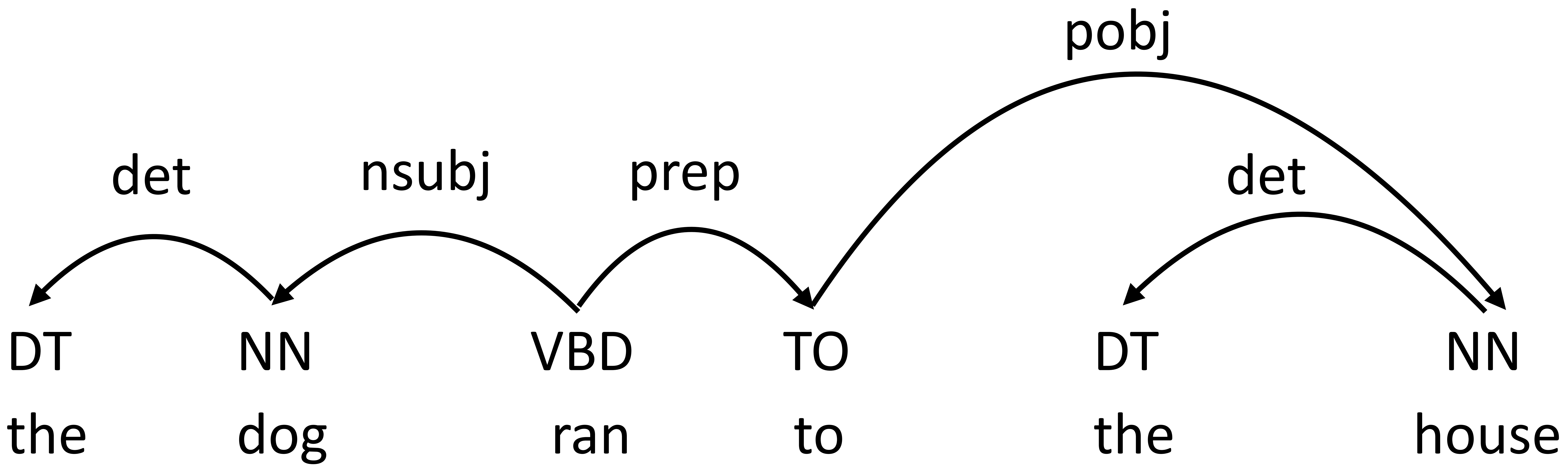
Dependency Parsing

- Still a notion of hierarchy! Subtrees often align with constituents



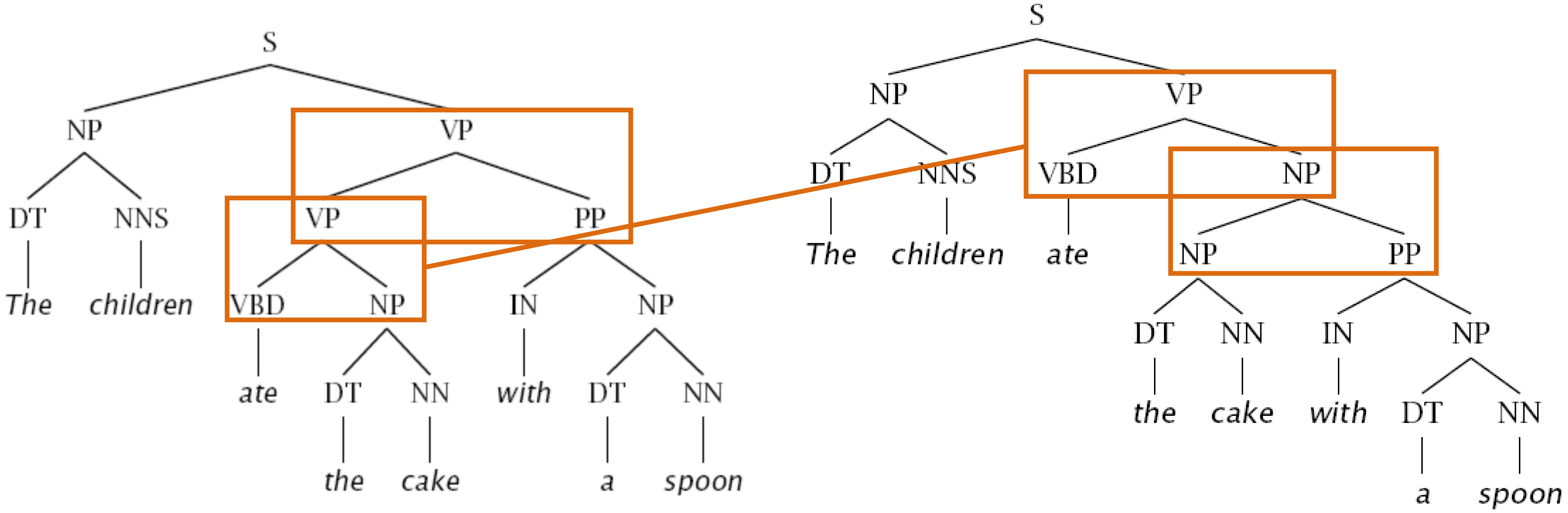
Labeled Dependency Parsing

- Can label dependencies according to syntactic function
- Major source of ambiguity is in the structure, so we focus on that more (labeling separately with a classifier works pretty well)

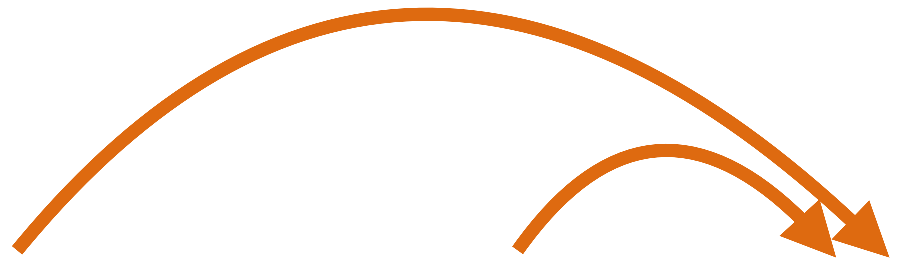


Dependency vs. Constituency

- Constituency: several rule productions need to change



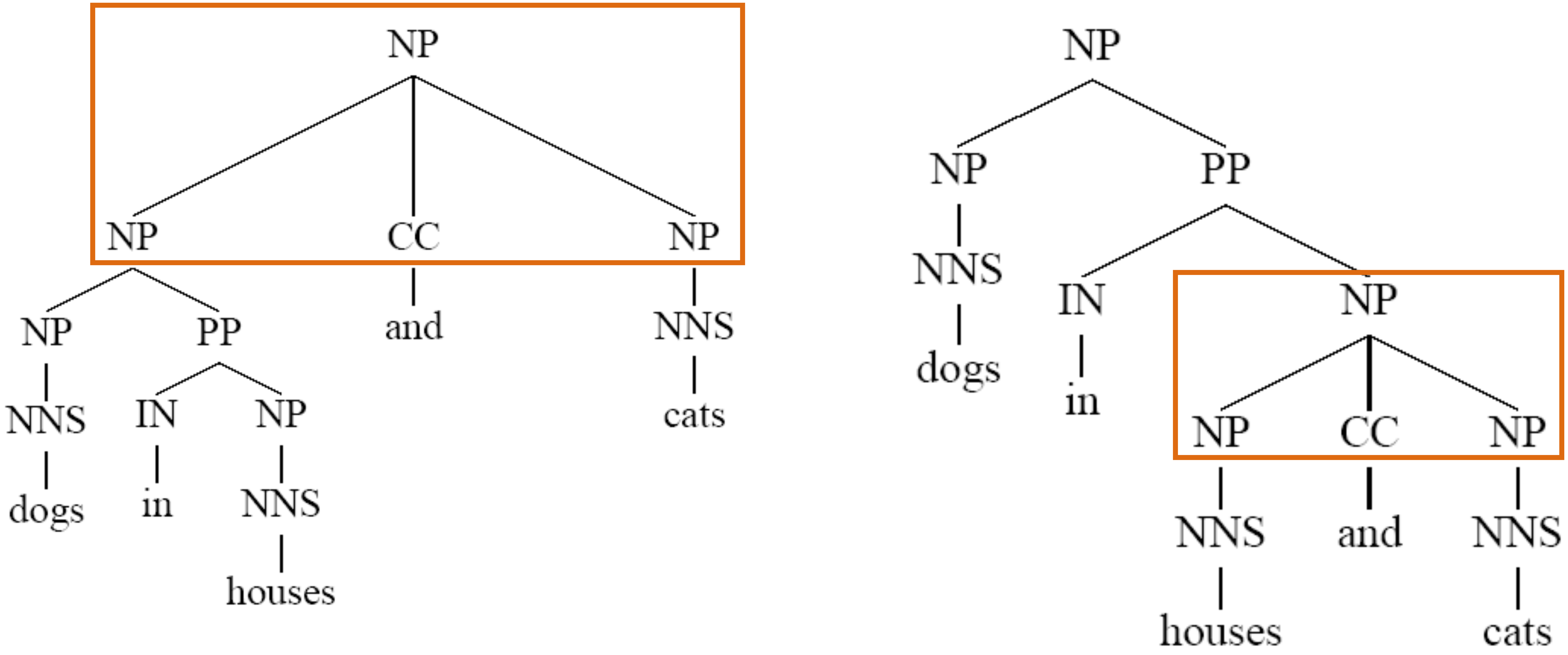
- Dependency: one parent differs



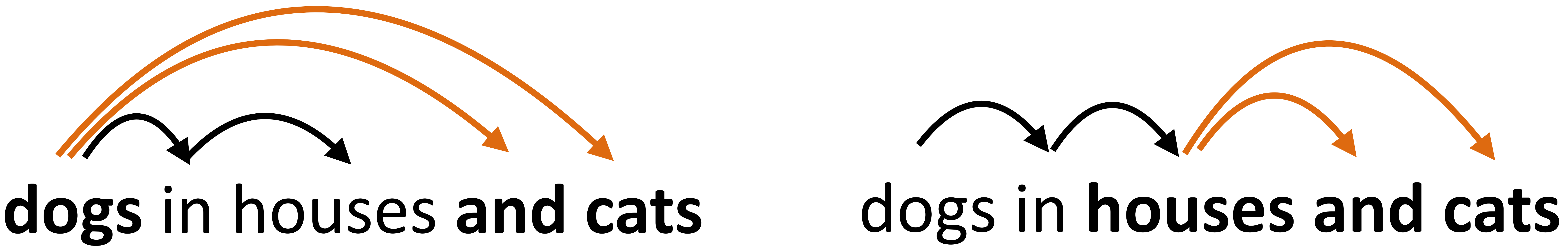
the children ate the cake with a spoon

Dependency vs. Constituency

- Constituency: ternary rule NP -> NP CC NP



- Dependency: first item is the head. Doesn't really make sense



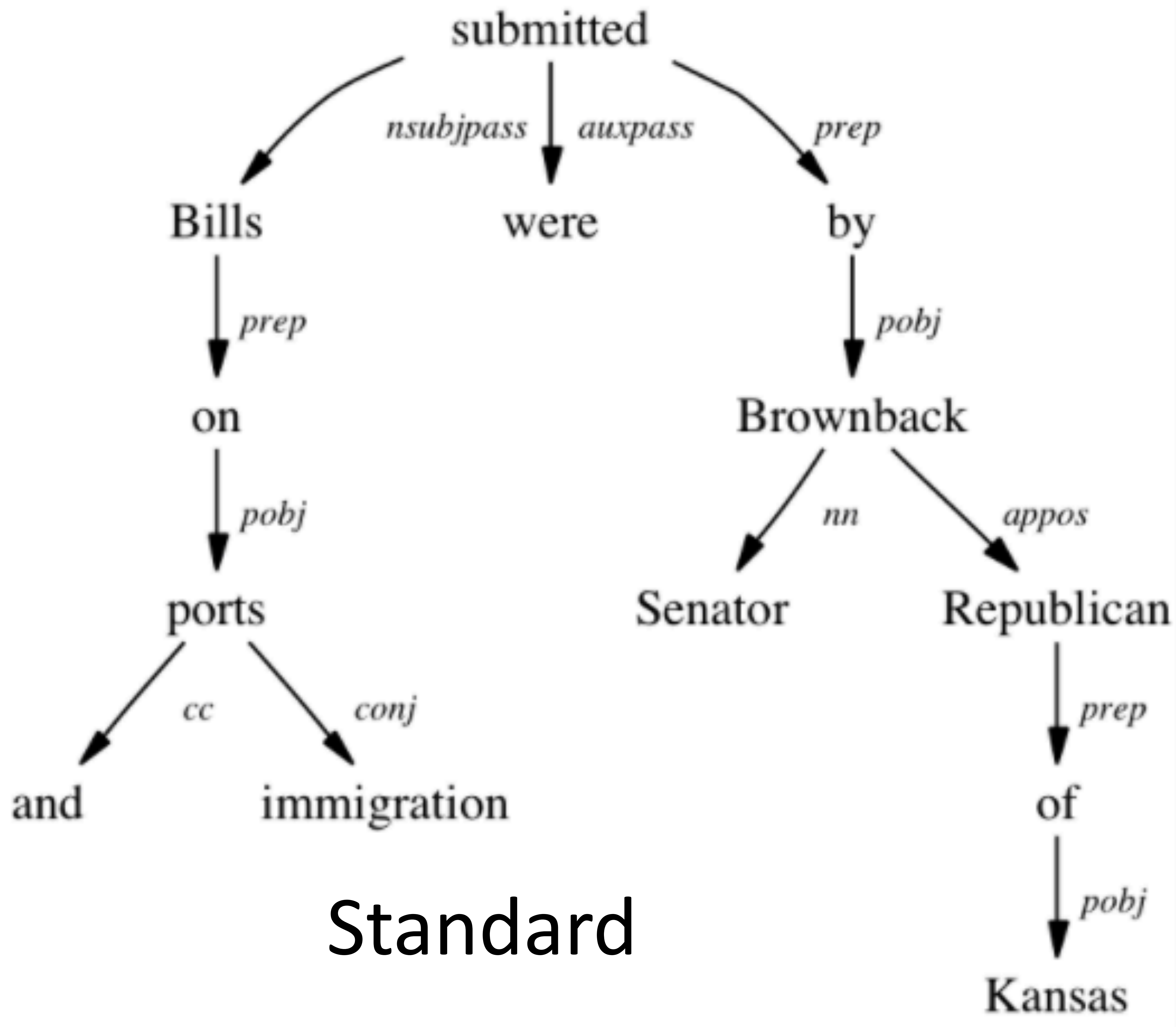
dogs in houses **and cats** dogs in **houses and cats**

[dogs in houses] and cats dogs in [houses and cats]

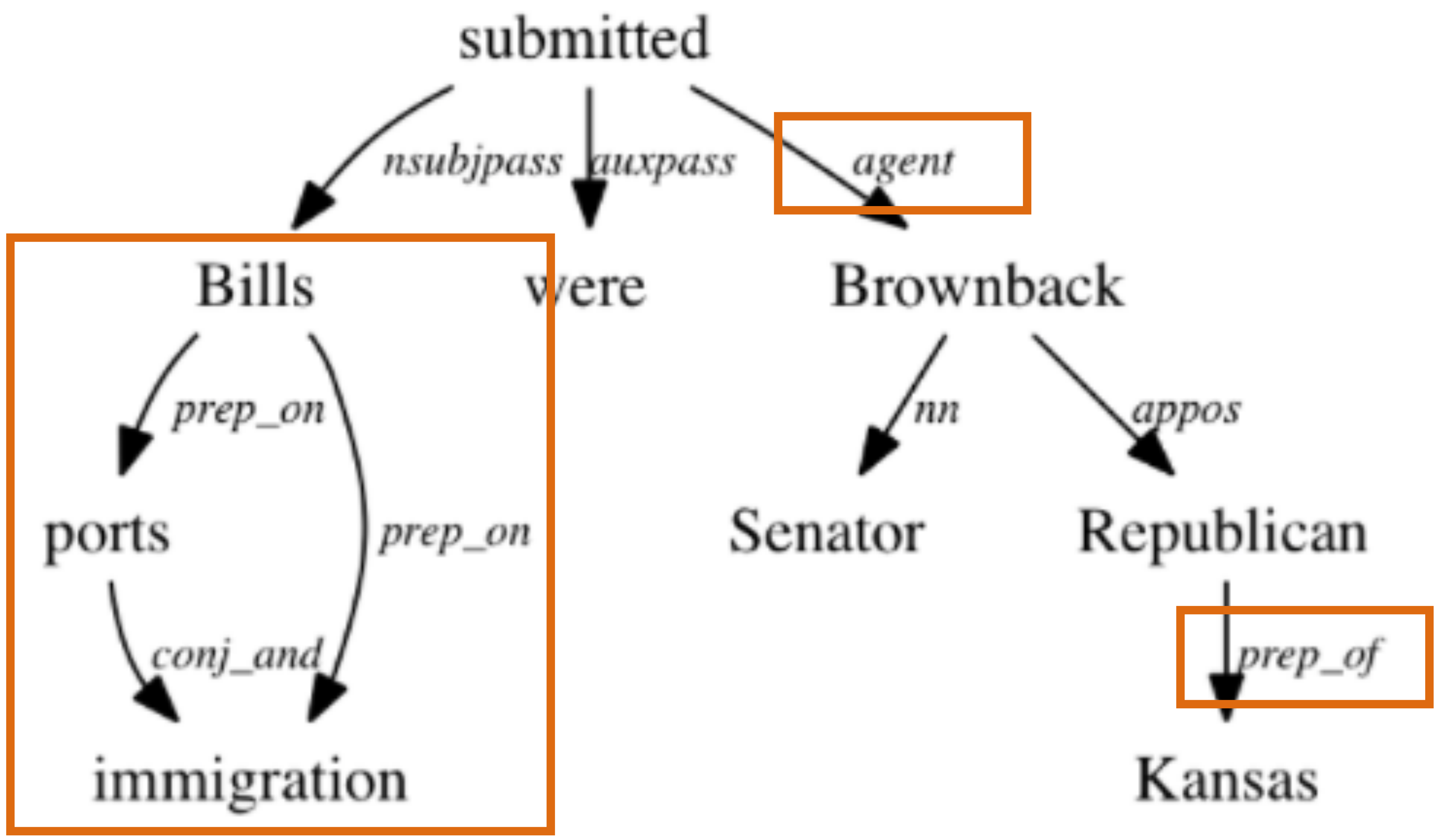
Stanford Dependencies

- Designed to be practically useful for relation extraction

Bills on ports and immigration were submitted by Senator Brownback, Republican of Kansas



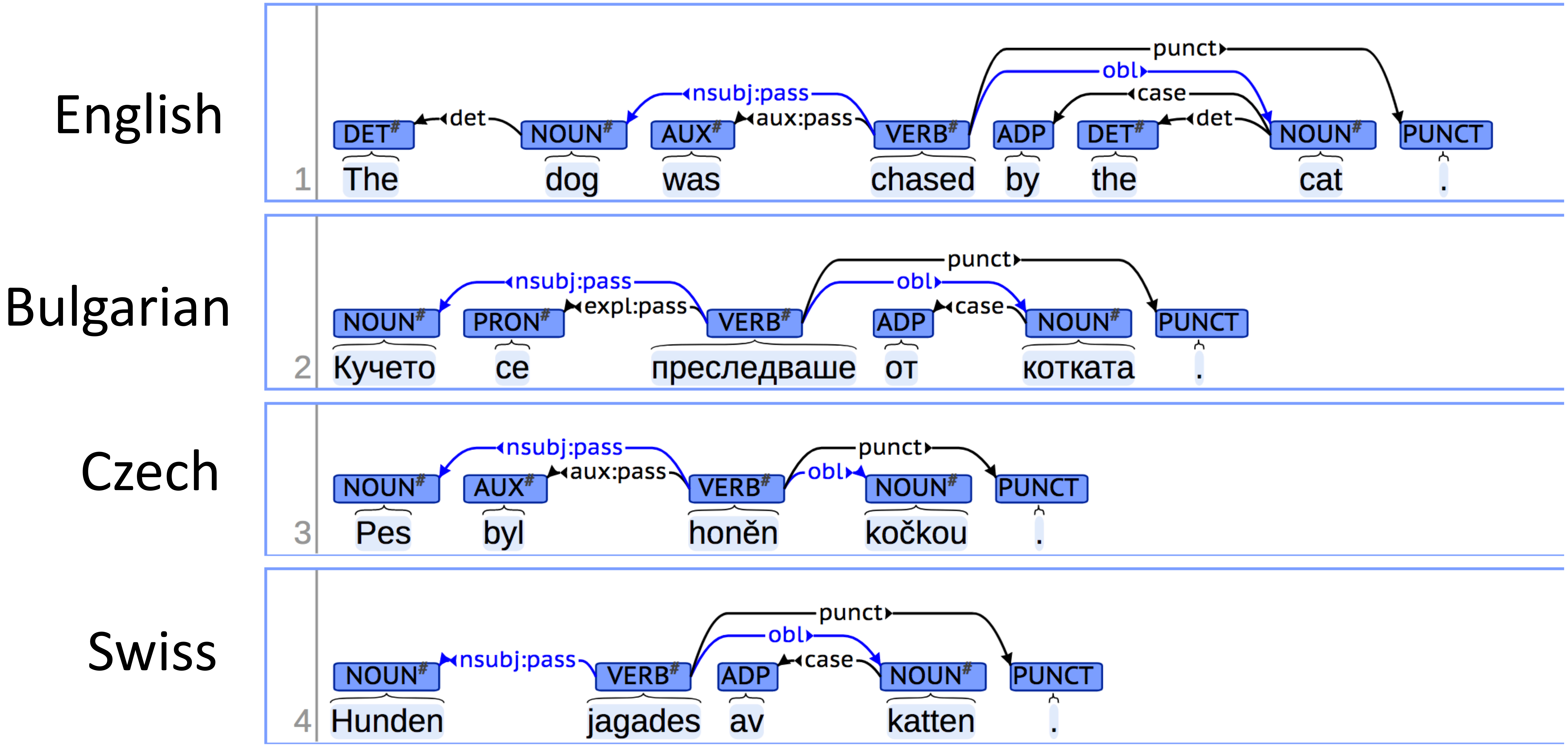
Standard



Collapsed

Universal Dependencies

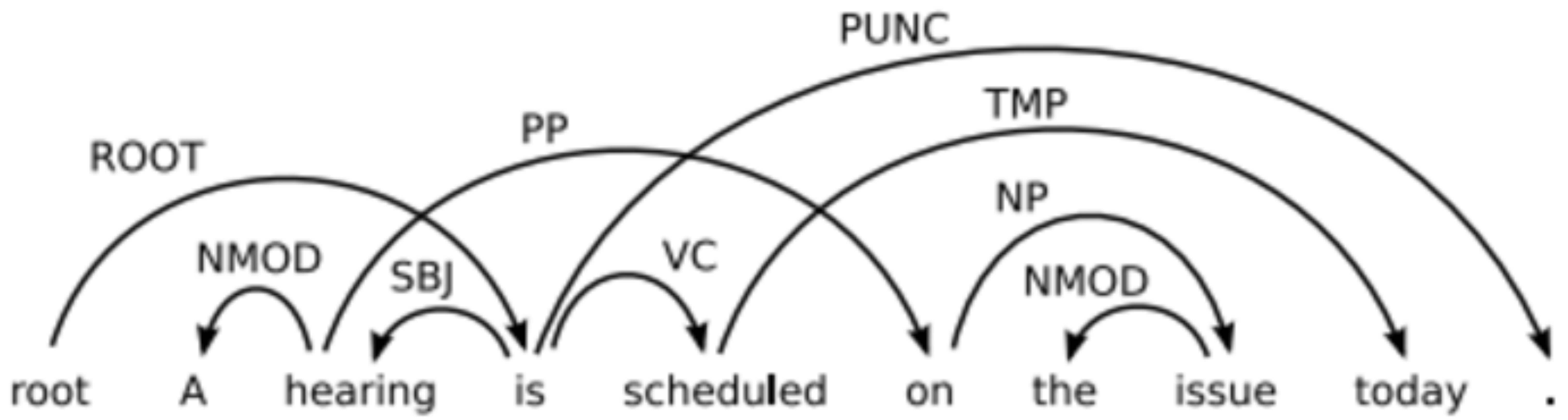
- Annotate dependencies with the same representation in many languages



- Dependencies are more portable cross-lingually: languages with free word order are not well handled by constituency

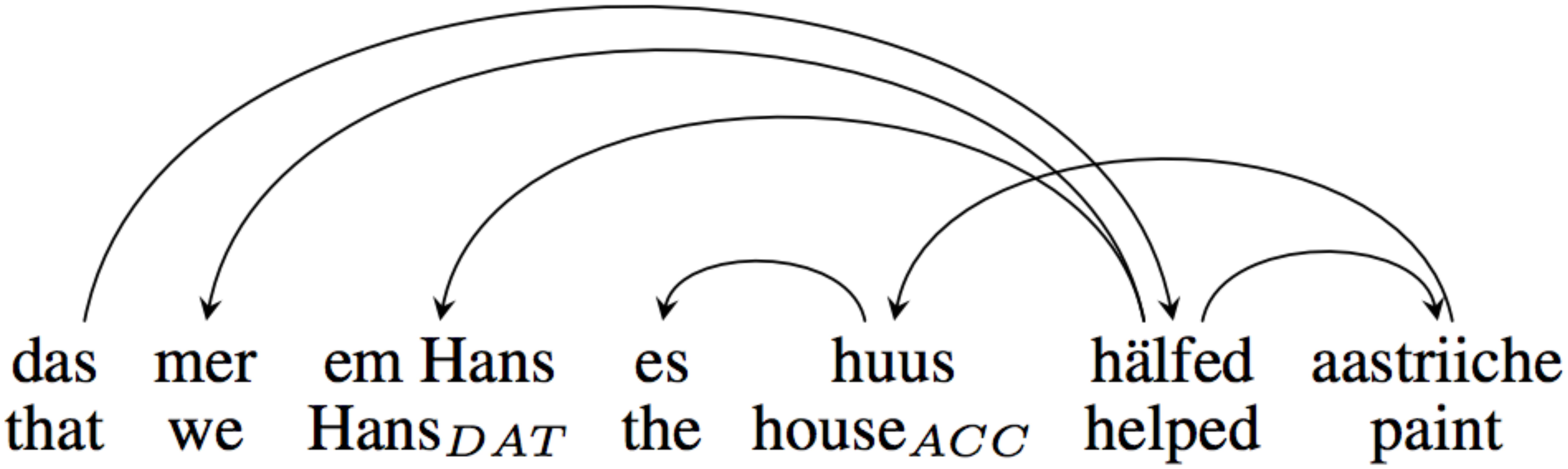
Projectivity

- Any subtree is a contiguous span of the sentence <-> tree is *projective*
- Equivalent to drawing the structure and having no crossing arcs
- Crossing arcs / nonprojective:



credit: Language Log

Projectivity



das mer em Hans es huus hälfed aastriiche

that we Hans$_{DAT}$ the house$_{ACC}$ helped paint

- Swiss German example: X said [that we helped Hans paint the house]

- Many trees in other languages are nonprojective

	Arabic	Czech	Danish
Projective	1297 (88.8)	55872 (76.8)	4379 (84.4)
Sentences	1460	72703	5190

Pitler et al. (2013)