Dependency Syntax

CS 485, Spring 2024
Applications of Natural Language Processing
https://people.cs.umass.edu/~brenocon/cs485_s24/

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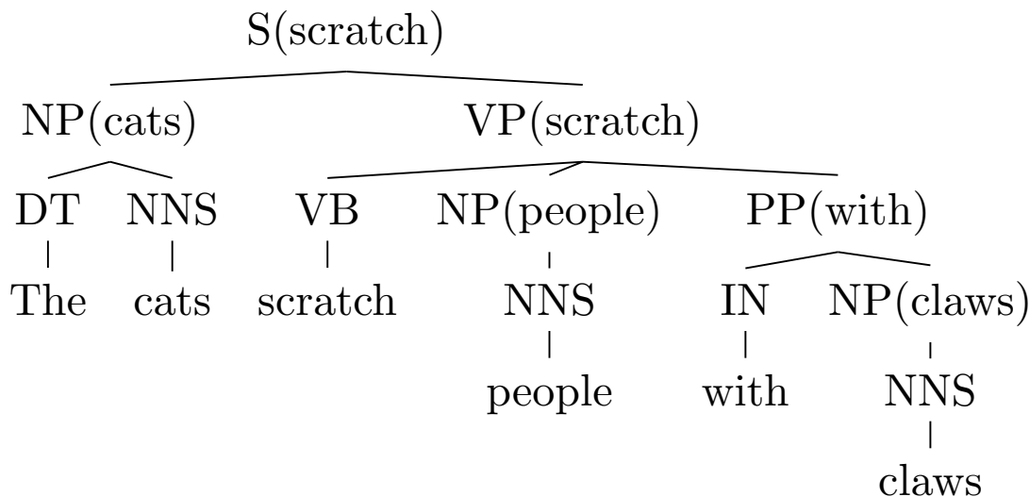
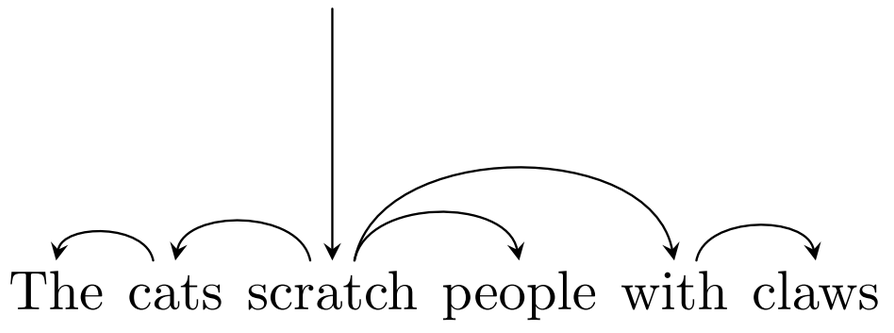
- Project proposals: extended to Monday (during spring break :-/)
- This week's exercise will be made due AFTER spring break

From constituency structure to dependency graphs



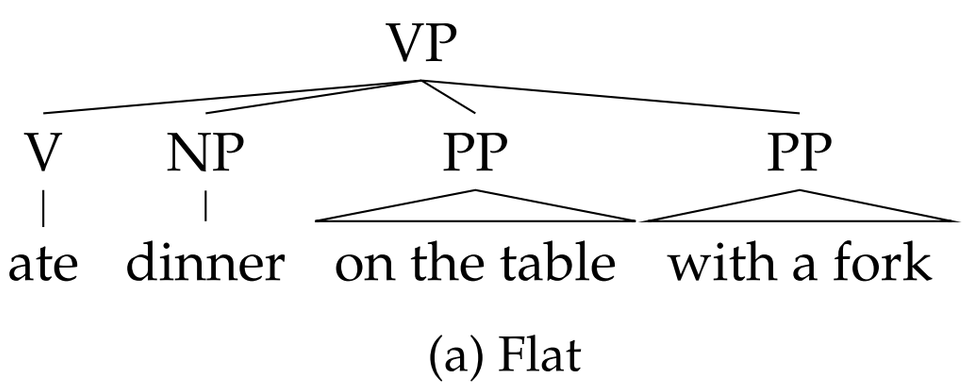
(a) lexicalized constituency parse



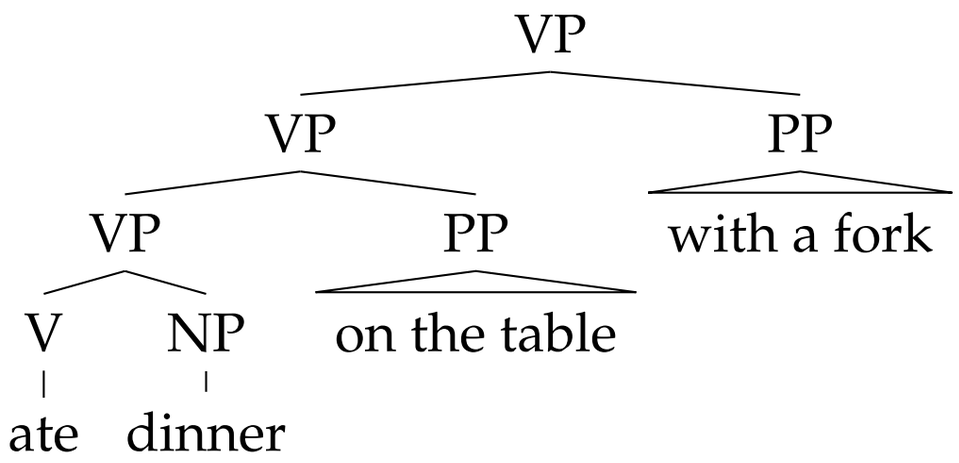
(b) unlabeled dependency tree

Figure 11.1: Dependency grammar is closely linked to lexicalized context free grammars: each lexical head has a dependency path to every other word in the constituent. (This example is based on the lexicalization rules from § 10.5.2, which make the preposition the head of a prepositional phrase. In the more contemporary Universal Dependencies annotations, the head of *with claws* would be *claws*, so there would be an edge *scratch* → *claws*.)

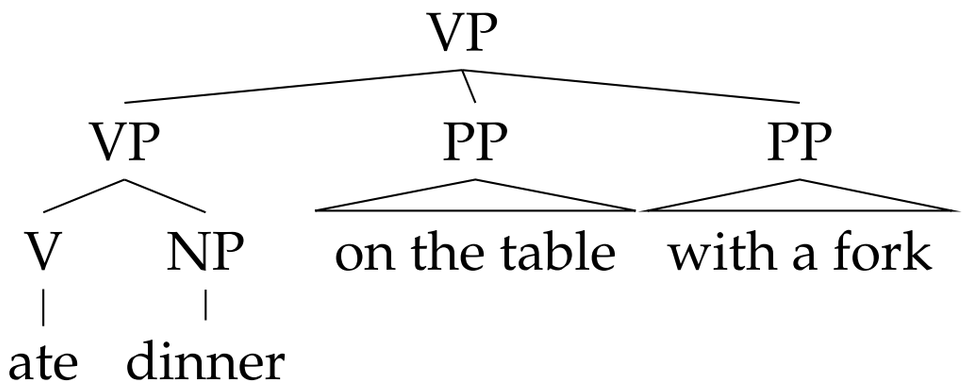
- Dependencies tend to be less specific than constituent structure



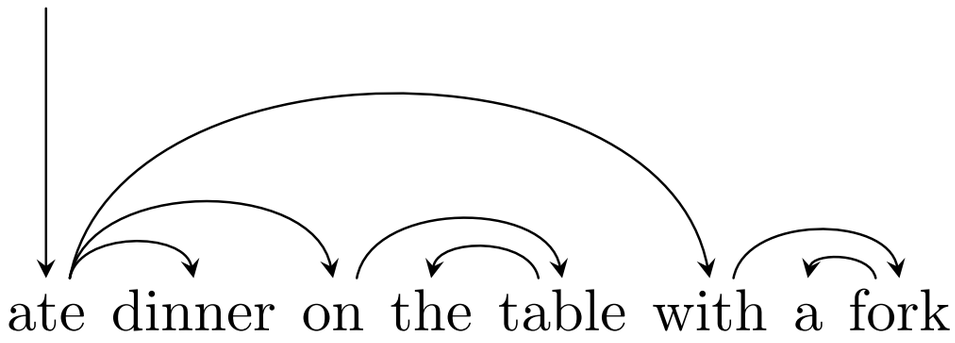
(a) Flat



(b) Two-level (PTB-style)



(c) Chomsky adjunction



(d) Dependency representation

[Example: Jacob Eisenstein]

Headedness for *phrase* relations

- Is a given word X the subject of verb Y?
- Is a given *phrase* X the subject of verb Y?

Universal Dependencies

- Dependency treebanks are available for *many* different languages
  - https://universaldependencies.org/

- Many open-source dependency parsers (and tagging/POS/morphology) trained on them are also widely available; e.g. Stanza, SpaCy, etc.
  - They typically directly predict dependencies with another parsing algorithm (shift-reduce, not CKY)

Dependency applications

- Dependencies can be used as less sparse alternative to n-grams
  - Sometimes helps, sometimes doesn't
- Dependency relations can be selected for semantic relationships

Dependency pattern statistics

Hand-built dependency patterns to get specific semantic relationships between words

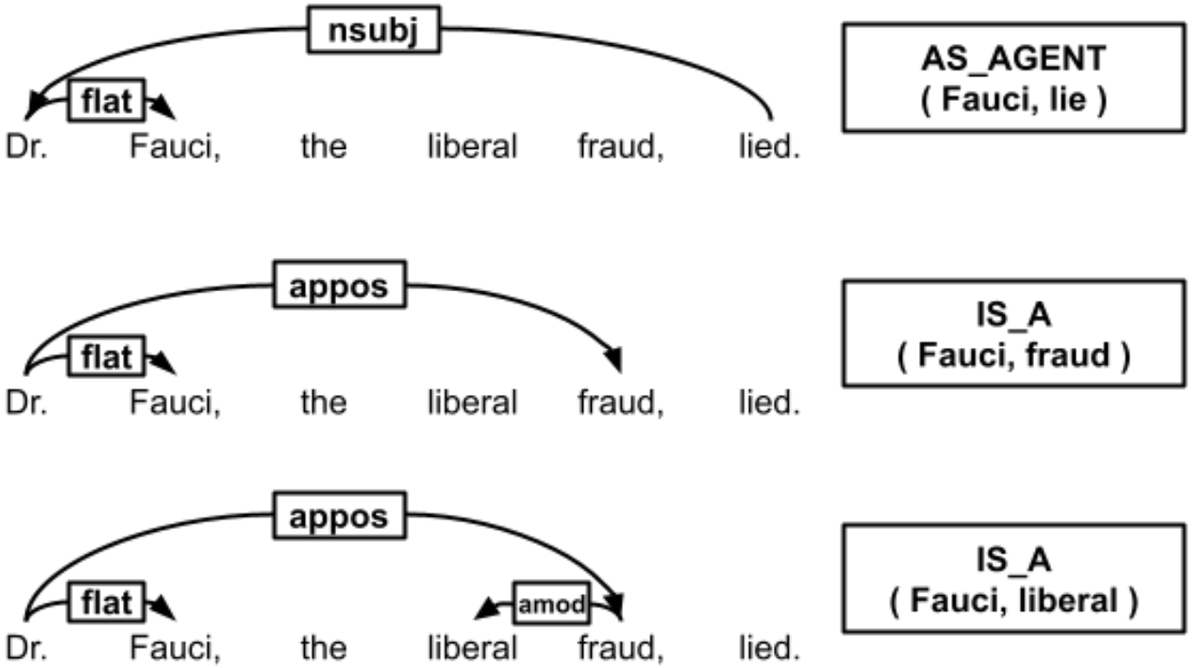


Figure 1: Examples of dependencies and TweetIE's entity attribute extraction system (§4).

4.3.1 IS_A

The IS_A relation covers any nominal or adjectival properties stated to directly pertain to the target entity, represented using the following patterns:[5]

1. target $\overset{\text{nsubj}}{\longleftrightarrow}$ property$_{nom}$
2. property$_{adj}$ $\xrightarrow{\text{nsubj}}$ target
3. target $\overset{\text{appos}}{\longleftrightarrow}$ property$_{nom}$
4. target $\xrightarrow{\text{compound}}$ property$_{nom}$
5. target $\xrightarrow{\text{amod}}$ property$_{adj}$
6. target $\overset{\text{nsubj}}{\longleftrightarrow}$ property$_{nom}$ $\xrightarrow{\text{amod}}$ property$_{adj}$
7. target $\overset{\text{appos}}{\longleftrightarrow}$ property$_{nom}$ $\xrightarrow{\text{amod}}$ property$_{adj}$

[Eggleston and O'Connor, 2022]

Relation	**Trump-Leaning** ($t < -2$)	**Biden-Leaning** ($t > 2$)
IS_A(fauci, *property*$_{\text{nom}}$)	murderer**, joke**, hack*, fraud*, rat*, flip*, idiot, flop, state, prison, fake, jail	nih**, hero, md, director, president
IS_A(fauci, *property*$_{\text{adj}}$)	fake*, little*, deep, liberal, wrong, corrupt	beloved, optimistic, best
AS_AGENT(fauci, *verb*)	sweat**, force**, need*, help*, read*, lie*, know*, let*, not_fund*, not_understand*, flip, predict, write, make, stick, hold, prove, want, not_say, admit, not_get, demand, issue, laugh, state, put, spread, pull	speak**, join*, warn*, throw, not_recommend, offer, provide, respond, consider, debunk, fail, reveal
AS_PATIENT(fauci, *verb*)	not_trust***, screw, prosecute, grill, keep to, arrest, expose, lock, do to, remove, accord to, look like, mean, blast, read	know*, feature, discredit, threaten, worship, join, insult
HAS_A(fauci, *object*)	friend*, nih*, family, mind, hand, ex-employee, involvement, fraud, mask	guidance, time
AS_CONJUNCT(fauci, *conj.*)	gates***, obama**, bill gates*, biden*, brix, cdc, rest, covid, nih, company, government	director, experts

Table 5: TweetIE extractions with at least 20 unique users with a county-level political valence t-statistic outside of [-2, 2]. Results are reported in decreasing absolute value t-statistic. * $|t| > 3$, ** $|t| > 4$, *** $|t| > 5$.

- From geo-located tweets, Mar-Dec 2020

[Eggleston and O'Connor, 2022]