Conversions between dependencies & constituencies

L715: Seminar on: Data manipulation for parser improvement

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Introduction

We are going to focus on dependency & constituency conversions

- Mostly in the direction of: constituency $\mapsto$ dependency
  - Parser evaluation: dependencies are argued to better capture important aspects of evaluation (e.g., Lin 1995)
  - Dependency parsing has become increasingly popular (linear time algorithms, closeness to semantics, multi-linguality, ...)
    - But constituency treebanks were developed first (at least for English)
  - Even for PCFGs, dependency information can help the parsing model (e.g., Collins 1999)

We'll focus on English ...

Earlier work on conversions

- Magerman (1994); Collins (1999) developed rules to identify the head of a constituent in the PTB

  (1) NP → DT NN*

  (2) VP → VBD* NP

  (3) S → NP VP*

  - *head percolation table*: priority lists to identify the head in each type of constituent
- Yamada and Matsumoto (2003): modified the table
- PENN2MALT (Nivre 2006): reimplementation of Yamada and Matsumoto (2003)
  - plus: defined arc labeling rules
  - See figures 1 & 2 in Johansson and Nugues (2007)

Extending conversions to be more semantic

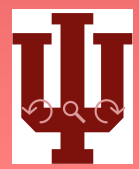
Johansson and Nugues (2007)

Goal: improve upon previous methods by making dependencies which intreface better with semantics

- richer set of labels
- better treatment of long-distance phenomena
  - PTB-II contains information on *wh*-movement, topicalization, *it*-clefts, expletives, & gapping
  - older conversions do not use such information

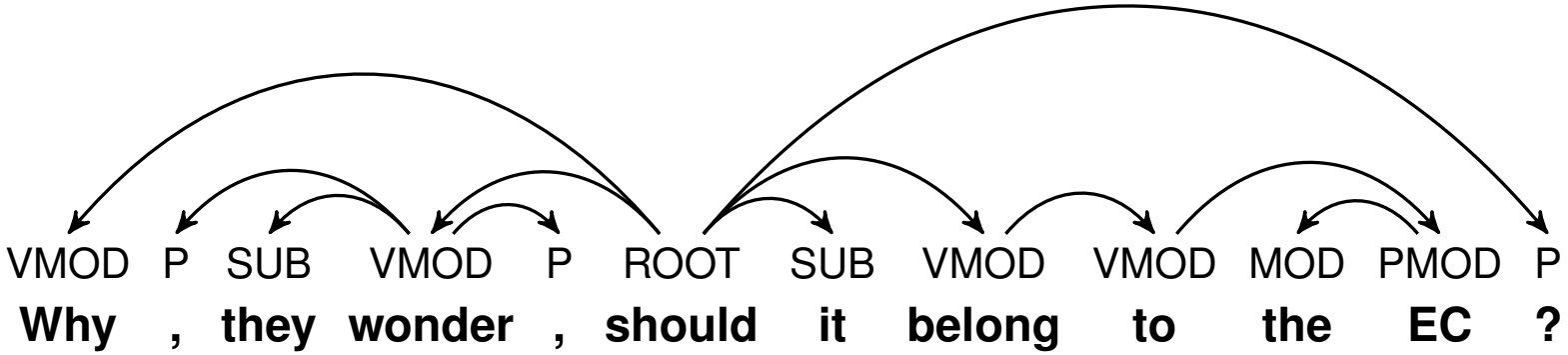
Make use of extended structure in PTB-II

- The conversion procedure will illustrate a number of issues facing any parser or any annotation scheme

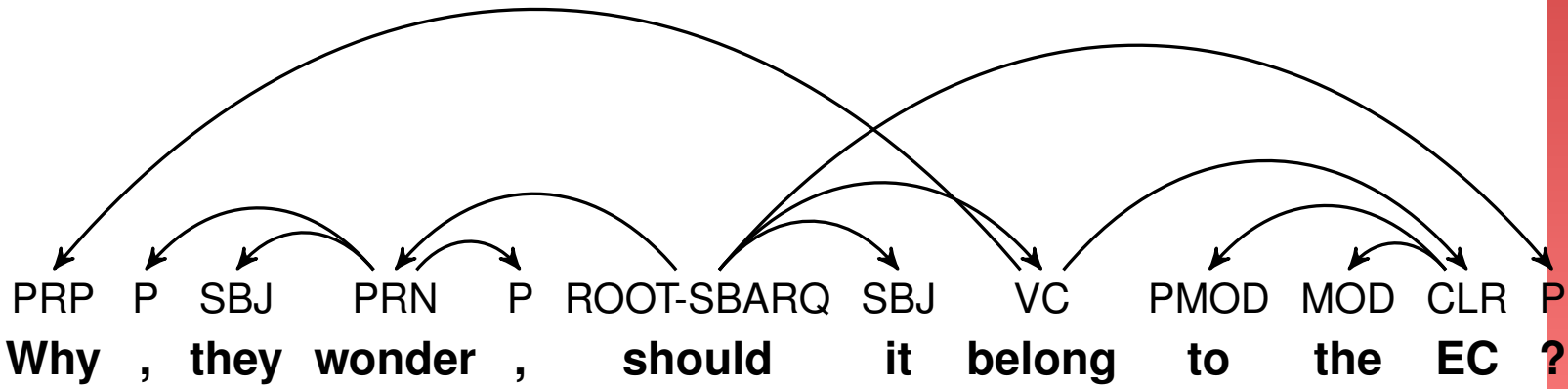


New procedure

PENN2MALT:



New conversion (LTH):



New procedure (2)

1. Modify dependency links
   - e.g., PENN2MALT misses relation between *belong* and *Why*
2. Richer set of dependency labels
   - e.g., PENN2MALT only used SBJ and PRD from PTB-II grammatical function labels

Heuristically deepening NPs

Need to add internal structure to NPs: PTB has flat structure

- e.g., flat NP of *other small apparel makers*
- ... but not every word is truly dependent on the head noun (*makers*)

Heuristics:

- certain adverbs (e.g., *quite*) are joined with consecutive adjective to form ADJP
- certain words in coordinated NPs (e.g., *and Sons*) provide clues as to bracketing
- words with identical POS around a conjunction assumed to be coordinated (e.g., *small and venomous snake*)

nb: see also Vadas and Curran (2007) for NP deepening

Head rule modifications

Head rules from before are adapated

- make use of the context of phrases
- make use of grammatical functions
  - e.g., SQ ← VBZ VBD VBP VB MD VP ***-PRD*** VP SQ

See table 1 in the paper

Head rule modifications (2)

- Coordinated phrases
  - Leftmost conjunct is consistently the head & all other conjuncts/conjunctions are children of the first conjunct
  - Conjunction-as-head would better capture premodifier ambiguities, but “this is usually not preferred since it makes parsing more difficult”
- PPs, subordinate & relative clauses
  - Preposition (subordinating conjunction, relativizer) is treated as a case marker
  - i.e., they are dependents, and the main contentful word is the head

Modification of arc labeling rules

Grammatical functions from Penn

Used 17 of 21 grammatical function labels to label dependency relations

- properties may be combined (e.g., LOC-PRD-TPC)
- excluded ones reflecting structural properties & not grammatical functions (e.g., HLN (headline))

Modification of arc labeling rules

Inferred labels

Most edges in PTB have no label, so they must be inferred

- Objects includes clause complements (S, SBAR): different from previous approaches
- Distinguish OBJ from IOBJ
- Distinguish types of ROOTs: ROOT-S, ROOT-SBARQ, ROOT-SQ, ROOT-FRAG

If the inference fails, DEP is returned

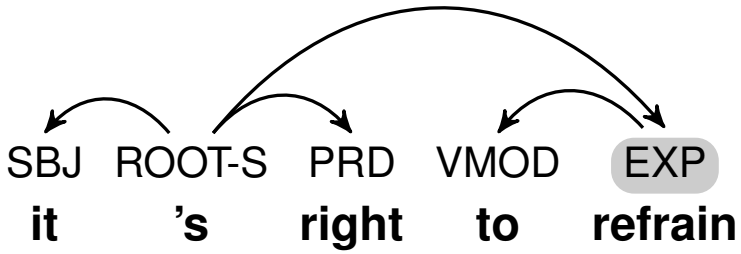
(See Algorithm 1 for more details)

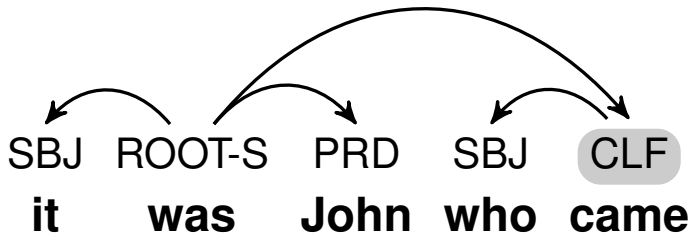
Structural labels

Expeltives & clefts

EXP (expletive) and CLF (cleft) are structural labels, but represent complex constructions

- result in a fronted *it*
- handled different in PTB, but similarly after conversion



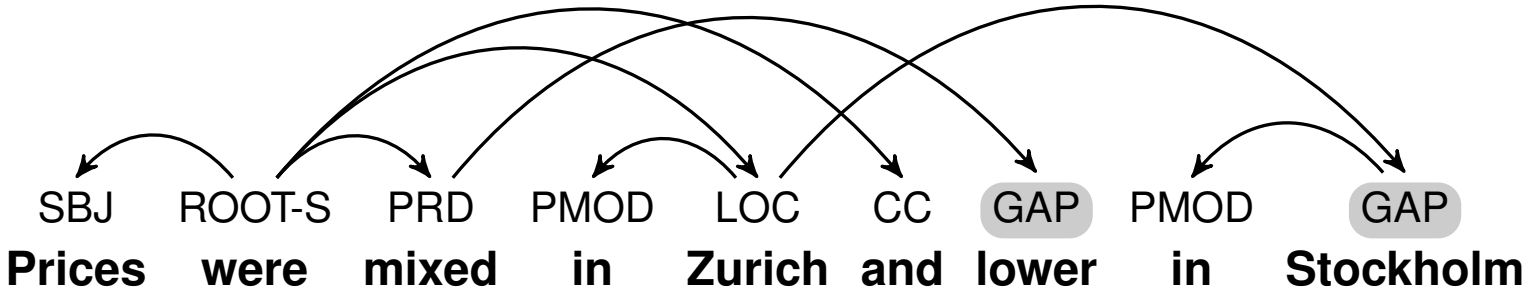


Structural labels

Gapping

Gapping involves a verb elided in a coordinate structure

- Secondary edges are used in the PTB to account for this



Relinking of secondary edges

Secondary edges used for a variety of purposes in PTB

- When they represent a “deep governor”, they are useful as dependency arcs (close to semantics)
  - e.g., *T* (trace of *wh* & topicalization), *ICH* (discontinuous constituent)
  - Such cases are relinked (unless cyclicity is introduced)
- *RNR* (right node raising), e.g., *a U.S. and a Soviet naval vessel*
  - Of the two secondary edges, only the first one is used for conversion

Conversion introduces nonprojectivity: 6.17% of the sentences

Experiments

Impact on parsing performance

Parsing is more difficult with the new conversion:

- links can now be nonprojective
- more function tags (e.g., PENN2MALT does not distinguish temporal & locative adjuncts)
- "linking words" (e.g., prepositions) do not attach to the verb
  - MSTParser cannot use grandchildren features & thus loses lexical information

	MaltParser		MSTParser	
	LAS	UAS	LAS	UAS
PENN2MALT	90.30%	91.36%	92.04%	93.06%
LTH	87.63%	90.54%	86.92%	91.64%

Experiments

Impact on semantic role classification

Semantic role classification displays a different trend, illustrating the usefulness of this conversion:

Method	Accuracy
PENN2MALT	64.3%
LTH	72.5%

Granularity of edge labels makes a difference

- e.g., in the RECEIVING frame, grammatical functions express twice as many semantic roles ... see table 6

Robust conversion

Choi and Palmer (2010)

Problem: conversion tools are highly tailored to a specific annotation scheme

- do not work well on other corpora
- **Goal:** improve conversion portability

Specifically, they work with the OntoNotes data

- POS tags not in the original PTB (e.g., EDITED, META)
- Sometimes depart from PTB conventions (e.g., inserting NML phrases, separating hyphenated words)

Practial effect:

- Fewer unnecessary non-projective dependencies
- Fewer unclassified dependencies
- Improved parser accuracy (across corpora)

Head-percolation rules

They designed a new set of head-percolation rules

- incorporates new tags, e.g.,

  META r VP;NP;*

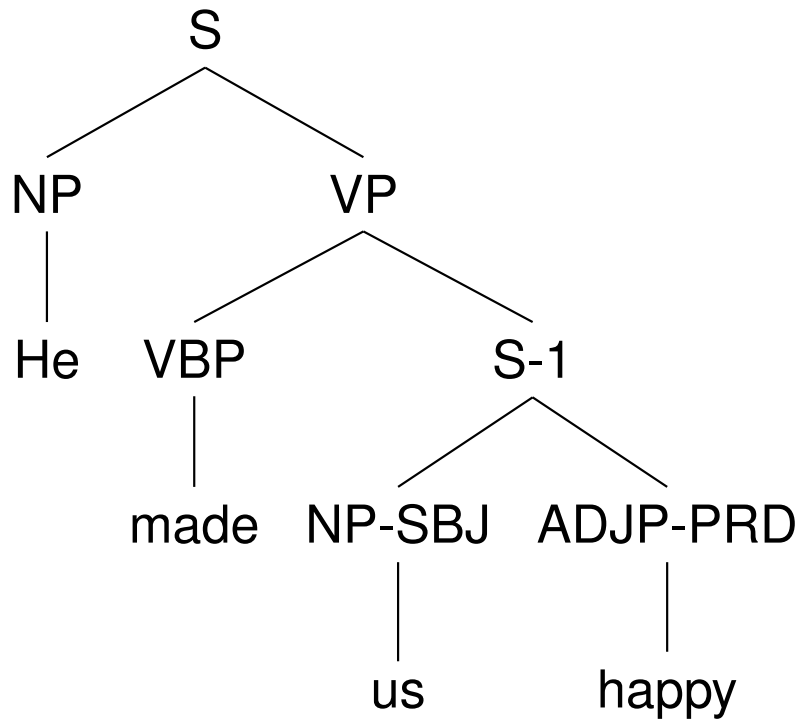
- Makes greater use of function tags: in addition to PRD, use SBJ (subject) and TPC (topic)

  VP l TO;MD;VB*;VP;*-SBJ;*-TPC;*-PRD;
  NN;NNS;NP;QP;JJ*;ADJP;*

- Minor modifications to some rules: e.g., rule for ADJP now gives higher priority to adjectives than nouns

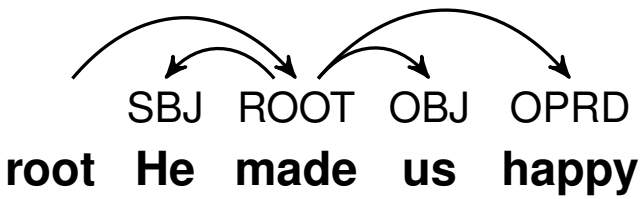
Small clauses

Small clause treatment in the PTB:

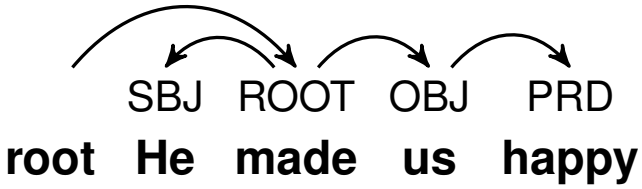


Small clauses (2)

LTH:



Choi & Palmer:



- Latter approach meshes better with PropBank, where "*us happy* is annotated as a single argument of *made*"
  - harder to derive a constituent from LTH approach
- nb: both approaches are linguistically valid (cf. coordination treatments)

Function tags

14 function tags are used to create dependency labels

- LTH converts joined tags (e.g., LOC-TMP) into unique tags
- Choi & Palmer select one tag from a joined pair
  - e.g., LOC-TMP $\mapsto$ LOC
  - based on the notion that parsers do not often get joined tags correct (cf. *external criteria*)

Precendence table:

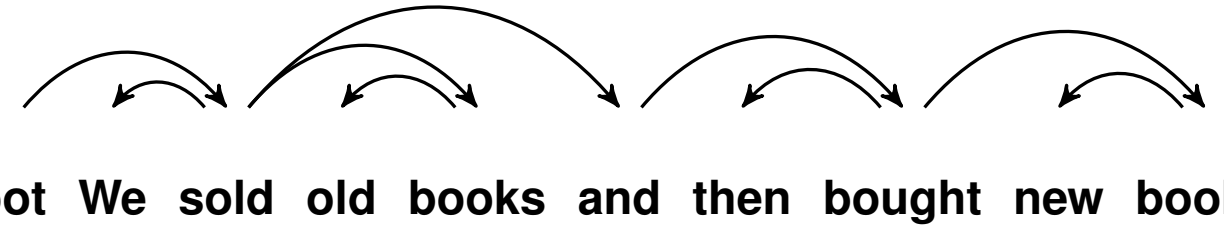
$$\text{DTV|EXT|LGS|SBJ} > \text{LOC} > \text{BNF|DIR|MNR|PRP|TMP} > \text{SEZ|VOC} > \text{PRD} > \text{ADV}$$

$$\text{IGNORE} ::= \text{CLF|CLR|ETC|HLN|IMP|NOM|PUT|TPC|TTL|UNF}$$

Coordination

Take a right-branching approach for coordination

- Difficulty: does a phrase contain coordination?
  - contains UCP, a child annotated with a function tag (ETC), or at least one conjunction (CC) or CONJP
  - "Even if there is a conjunction, if either the left or the right conjunct does not appear within the same phrase, we do not consider there to be a coordination"



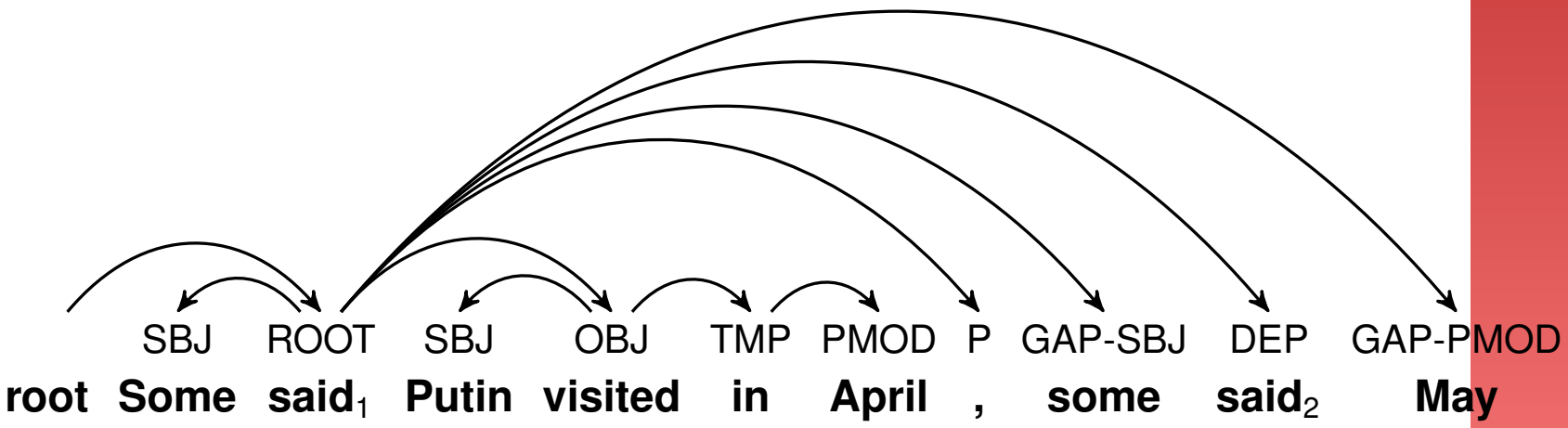
Note in the algorithm (p. 59) that SKIP defines POS tags which are skipped to find the correct conjuncts

Gapping relations

Parsers perform poorly on gapping constructions

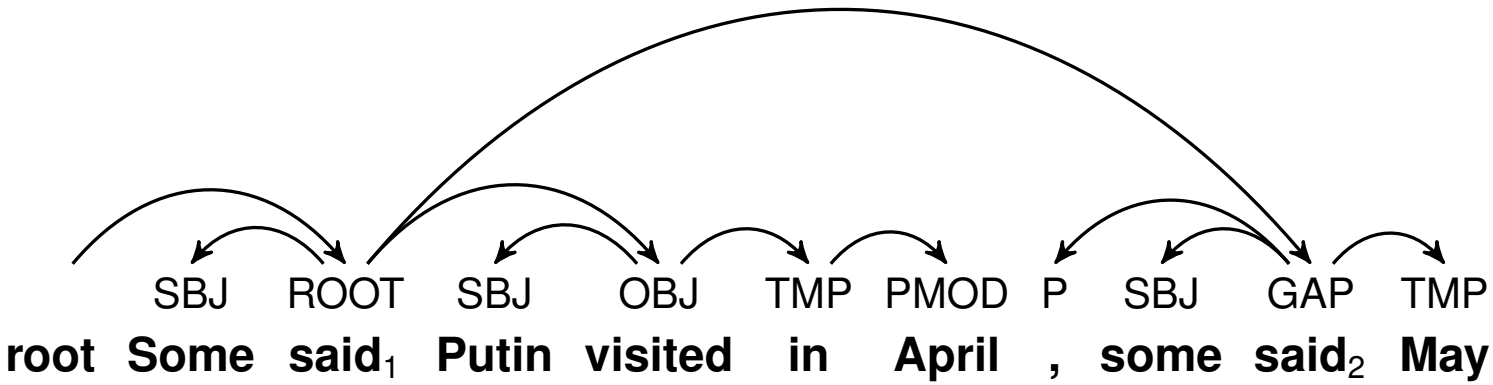
- LTH tends to give flat structures with long-distance dependencies
- ... which parsers generally get wrong

LTH:

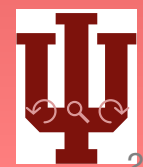


Gapping relations (2)

Choi & Palmer:



- Parsers can now learn more local relations
- The GAP relation allows one to recover the original representation



Empty category mappings

Right node raising is treated slightly differently by Choi & Palmer

- remove link between first conjunct and object
- eliminates non-projective dependencies, but keeps semantic interpretation recoverable

root I know his admiration for and trust in you

Evaluation

- Non-projective dependencies go from 0.82% (LTH) to 0.73% (table 4)
  - largely due to *RNR* treatment
- Unclassified dependencies go from 2.20% (LTH) to 0.60% (table 5)

Parsing accuracy also increases (tables 6 & 7), as does accuracy on semantic dependencies (tables 8 & 9)

References

Choi, Jinho D. and Martha Palmer (2010). Robust Constituent-to-Dependency Conversion for English. In *Proceedings of the Ninth International Workshop on Treebanks and Linguistic Theories (TLT-9)*. Tartu, Estonia, pp. 55–66.

Collins, Michael (1999). Head-Driven Statistical Models for Natural Language Parsing. Ph.D. thesis, University of Pennsylvania, Philadelphia, PA.

Johansson, Richard and Pierre Nugues (2007). Extended Constituent-to-dependency Conversion for English. In *Proceedings of NODALIDA 2007*. Tartu, Estonia.

Lin, Dekang (1995). A Dependency-Based Method for Evaluating Broad-Coverage Parsers. In *Proceedings of IJCAI-95*. pp. 1420–1425.

Magerman, David (1994). Natural language parsing as statistical pattern recognition. Ph.D. thesis, University of Pennsylvania.

Nivre, Joakim (2006). *Inductive Dependency Parsing*. Springer Verlag.

Vadas, David and James Curran (2007). Adding Noun Phrase Structure to the Penn Treebank. In *Proceedings of ACL-07*. Prague, pp. 240–247.

Yamada, Hiroyasu and Yuji Matsumoto (2003). Statistical dependency analysis with support vector machines. In *Proceedings of the 8th International Workshop on Parsing Technologies (IWPT-03)*. Nancy, France.