Multilingual Parsing from Raw Text to Universal Dependencies

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Overall Plan

1. Basic notions of dependency grammar and dependency parsing
2. Graph-based and transition-based dependency parsing
3. Advanced graph-based parsing techniques
4. Advanced transition-based parsing techniques
5. Neural network techniques in dependency parsing
6. Multilingual parsing from raw text to universal dependencies

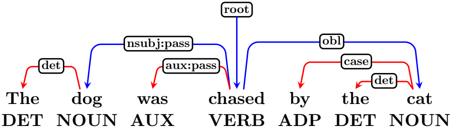
Parsing vs. Grammar

- Dependency parsing models are linguistically atheoretical
  - No assumptions about head-dependent criteria (structure)
  - No assumptions about linguistic categories (labels)
  - May be limited to some formal class of dependency trees
- Is this good or bad?
  - Practically useful when dealing with heterogeneous data sets
  - Prevents full exploitation of linguistic annotation
- Linguistics for parsers: $h \xrightarrow{?} d$

Universal Dependencies

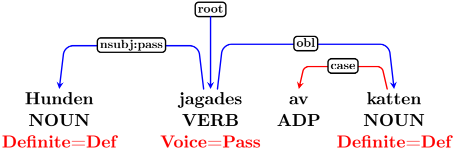
- Dependency annotation is consistent across languages
  - Allows meaningful comparisons across languages
  - Facilitates cross-lingual approaches to parsing
- Dependency annotation is based on a linguistic theory
  - Grammatical relations between content words
  - Function words specify content words
  - Special relations for coordination, MWEs, etc.
- Parsers can learn to handle more than one relation

Universal Dependencies



The dog was chased by the cat

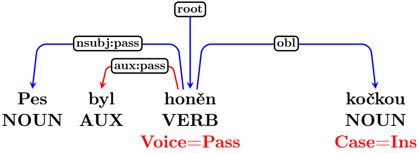
DET NOUN AUX VERB ADP DET NOUN



Hunden jagades av katten

NOUN VERB ADP NOUN

Definite=Def Voice=Pass Definite=Def



Pes byl honěn kočkou

NOUN AUX VERB NOUN

Voice=Pass Case=Ins

Dependency Parsing Shared Tasks

- CoNLL 2006 (13 langs: ar, cs, bg, da, de, es, ja, nl, pt, sl, sv, tr, zh)
- CoNLL 2007 (10 langs: ar, ca, cs, el, en, eu, hu, it, tr, zh)

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- CoNLL 2017 (45 languages + surprise + end-to-end parsing)

What is new?

- Cross-linguistically consistent annotation
  - Facilitates comparison across languages
  - Enables cross-lingual and universal approaches
  - Surprise languages at test time
- From raw text to universal dependencies
  - No gold segmentation or annotation

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  - Too small
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- New parallel test set (DFKI, Google and others):
  - 15–20 languages

Additional Data

- Just one “closed” track
- Registered participants were asked for suggestions

- CommonCrawl + word embeddings
- Word Atlas of Language Structures (WALS)
- Wikipedia Dumps
  - Wikipedia word vectors (90 languages) by Facebook
- Opus Parallel Corpora
- WMT 2016 Parallel + Monolingual Data
- Apertium + Giellatekno Morphological Analyzers
- French Treebank UD v2 conversion

Multi-Language and Multi-Domain

- English language
  - **UD English** *(Web Treebank)*: blog, social, reviews
    - 205K train, 25K dev, 25K test
  - **UD English LinES:** fiction, nonfiction (sw localization), spoken
    - 50K train, 17K dev, 16K test
  - **UD English ParTUT:** legal, news, wiki
    - 26K train, 12K dev, 12K test
  - **UD English DGPT:** nonfiction/legal (EuroParl), news, wiki
    - roughly 20K test only!
- You can train one model for all if you want
- But they are different domains!

- Main system score:
  - Macro-average LAS across all test sets (not languages)

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- A real-world scenario
- No gold-standard processing available in the test data

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  - If your parser needs it
  - Exception: predicted morphology for surprise languages

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  - Exception: predicted morphology for surprise languages
- Parsing

Baseline Models

- UDPipe (ÚFAL): trained segmenter, tagger+lemmatizer, parser
- Pre-processed test data (except syntax) directly availabtle
- Just use that if you don't have anything better

- SyntaxNet / ParseySaurus (Google)

- No interest in surprise languages?
- Use simple delexicalized parser

Evaluation Metrics

- Align system-output tokens to gold tokens

Al-Zaman : American forces killed Shaikh Abdullah al-Ani, the preacher at the mosque in the town of Qaim, near the Syrian border.

GOLD:	**Al**	**-**	**Zaman**	**:**	**American**	**forces**	**killed**	**Shaikh**
OFFSET:	**0-1**	**2**	**3-7**	**9**	**11-18**	**20-25**	**27-32**	**34-39**

- All characters except for whitespace match => easy align!

SYSTEM:	**Al-Zaman**	**:**	**American**	**forces**	**killed**	**Shaikh**
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Evaluation Metrics

- Align system-output tokens to gold tokens

Die Kosten sind definitiv auch im Rahmen.

GOLD:	**Die**	**Kosten**	**sind**	**definitiv**	**auch**	**im**	**Rahmen**	**.**
SPLIT:	**Die**	**Kosten**	**sind**	**definitiv**	**auch**	**in dem**	**Rahmen**	**.**
OFFSET:	**0-2**	**4-9**	**11-14**	**16-24**	**26-29**	**31-32**	**34-39**	**40**

- Corresponding but not identical spans?
- Find longest common subsequence

SYSTEM:	**Kosten**	**sind**	**definitiv**	**auch**	**im**	**Rahmen**	**.**
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  - $node : Integer \rightarrow Node$
  - $align : SystemNode \rightarrow GoldNode$
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- Cannot align? No point for attachment!
- Wrong sentence boundary?
  - one or more wrong relations

Labeled Attachment Score

- Correct relation ... alignment of parent equals parent of alignment, and the universal prefix of dependency relation types match on both sides

- Precision: $P = \frac{\#correctRelations}{\#systemNodes}$
- Recall: $R = \frac{\#correctRelations}{\#goldNodes}$

- LAF (labeled attachment F_1-score): $LAF = \frac{2PR}{P+R}$

UD-specific Weighted Metric (Experimental)

- Relations between content words are more important cross-linguistically
- Attachment of function word = morphology in other languages
- Weighted scoring of correct relations:
  - **Weight = 1** for *root, nsubj, obj, iobj, csubj, ccomp, xcomp, obl, vocative, expl, dislocated, advcl, advmod, discourse, nmod, appos, nummod, acl, amod, conj, fixed, flat, compound, list, parataxis, orphan, goeswith, reparandum, dep*
  - **Weight = 0** for *aux, case, cc, clf, cop, det, mark*
  - **Weight = 0** for *punct*

More information at:

`http://universaldependencies.org/conll17/`