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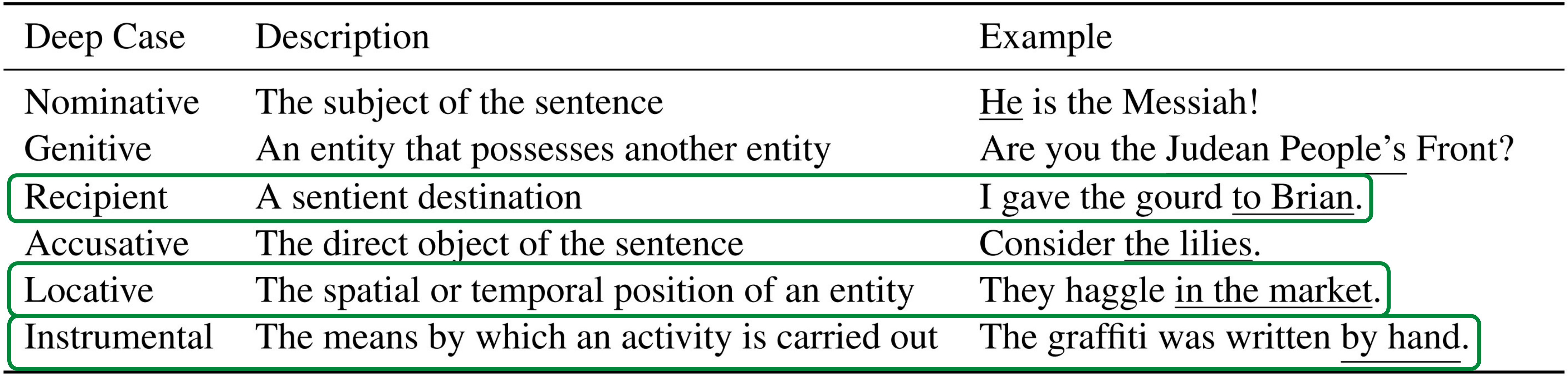
CaMEL: Case Marker Extraction without Labels 🐫

Leonie Weissweiler, Valentin Hofmann,
Masoud Jalili Sabet, Hinrich Schütze

Deep Cases

- Case marks the role of a Noun Phrase (NP) in a given sentence
- Deep Cases (Filmore, 1968) are language-universal and more fine grained



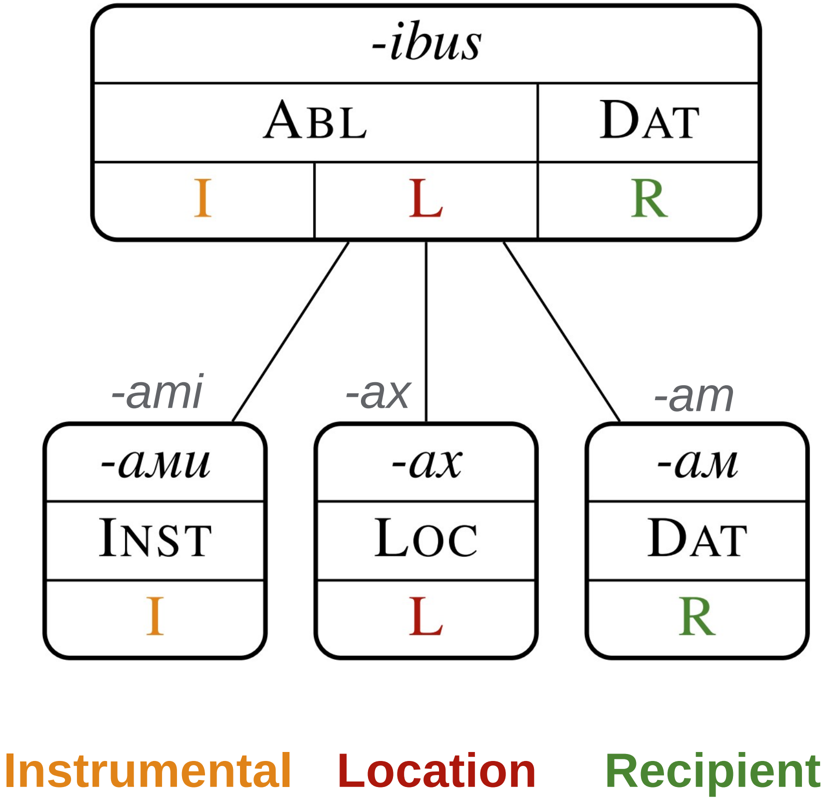
Deep Case	Description	Example
Nominative	The subject of the sentence	He is the Messiah!
Genitive	An entity that possesses another entity	Are you the Judean People's Front?
Recipient	A sentient destination	I gave the gourd to Brian.
Accusative	The direct object of the sentence	Consider the lilies.
Locative	The spatial or temporal position of an entity	They haggle in the market.
Instrumental	The means by which an activity is carried out	The graffiti was written by hand.

Overlapping Case Systems in Parallel Text

Case markers, case systems and deep cases are not mapped one-to-one:

- Case polysemy: one case, several deep cases
- Case homonymy: several cases, one marker
- Case synonymy: one case, several markers

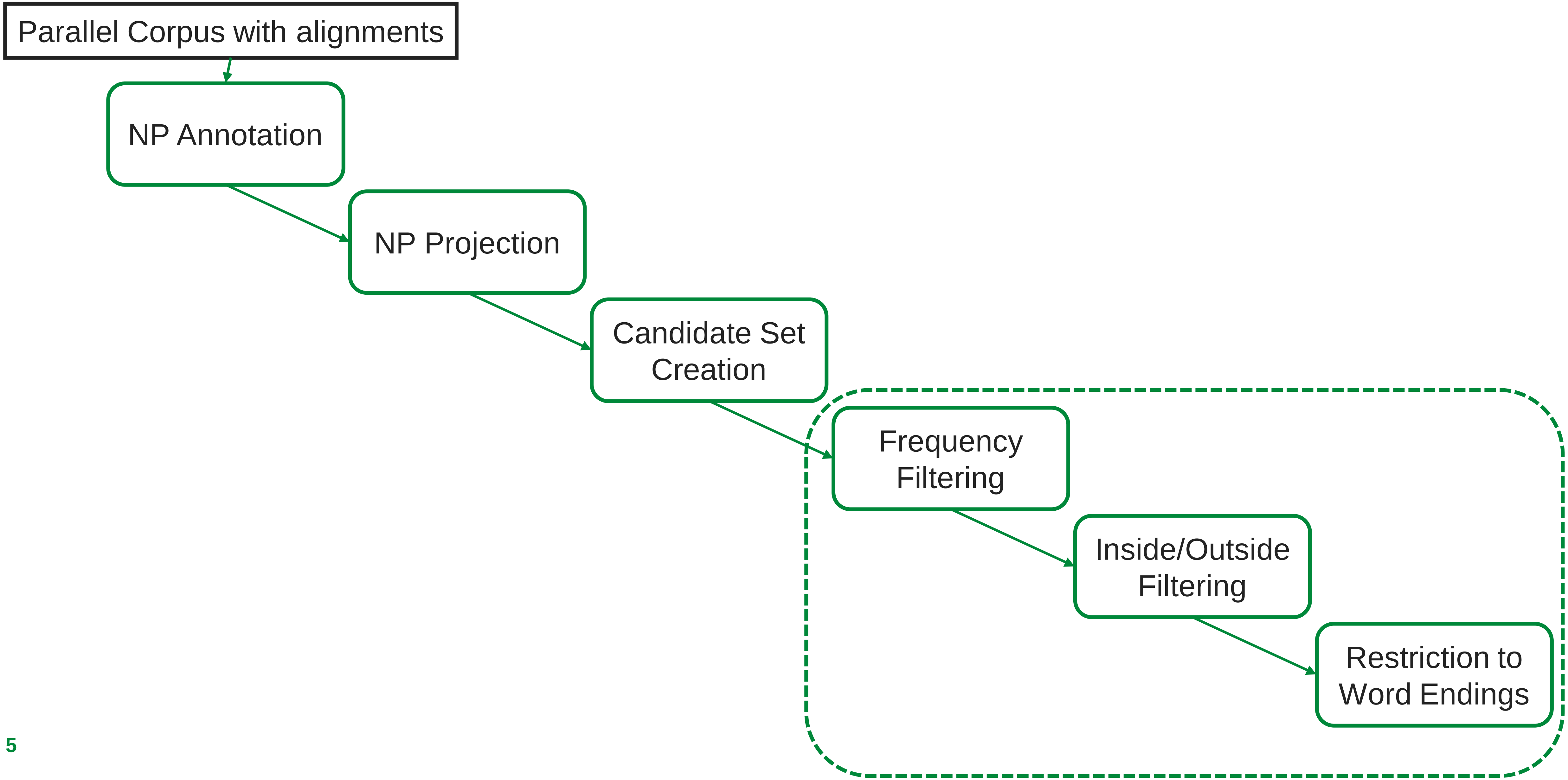
→ **Key idea**: we can gain information about the deep case of an NP involving *–ibus* in a given context by looking at the case markers in its Russian translation



Contributions

- We introduce **CaMEL**: **Ca**se **M**arker **E**xtraction without **L**abels 🐫, the task of extracting the case markers for unannotated parallel text
- We propose a simple method that is efficient, doesn’t require training, and generalises well to new languages
- We automatically construct a silver standard based on UniMorph data and evaluate our method, achieving **45%** average F1 over 19 languages
- We demonstrate two first ways of using the extracted case markers

Our Method



Parallel Corpus with alignments

NP Annotation

NP Projection

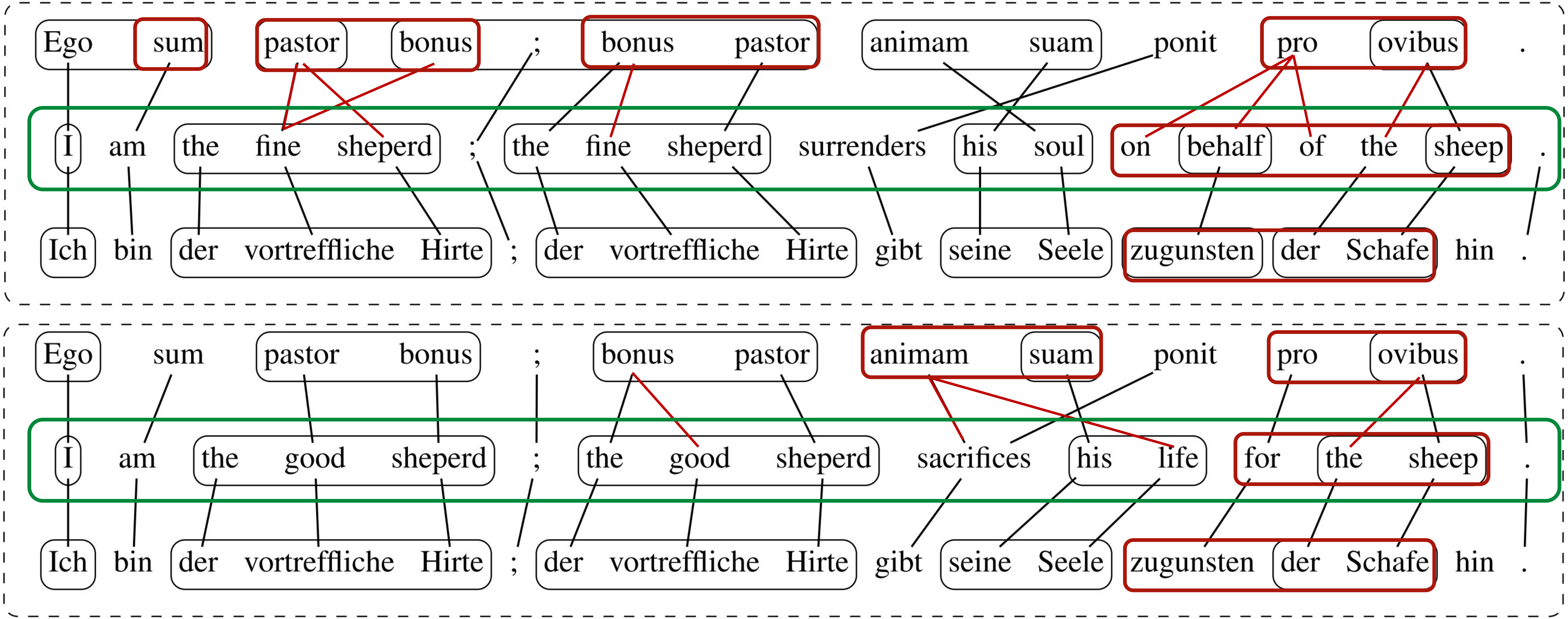
Candidate Set Creation

Frequency Filtering

Inside/Outside Filtering

Restriction to Word Endings

NP Annotation and Projection


Ego sum pastor bonus ; bonus pastor animam suam ponit pro ovibus .
I am the fine sheperd ; the fine sheperd surrenders his soul on behalf of the sheep .
Ich bin der vortreffliche Hirte ; der vortreffliche Hirte gibt seine Seele zugunsten der Schafe hin .
Ego sum pastor bonus ; bonus pastor animam suam ponit pro ovibus .
I am the good sheperd ; the good sheperd sacrifices his life for the sheep .
Ich bin der vortreffliche Hirte ; der vortreffliche Hirte gibt seine Seele zugunsten der Schafe hin .

Candidate Set Creation

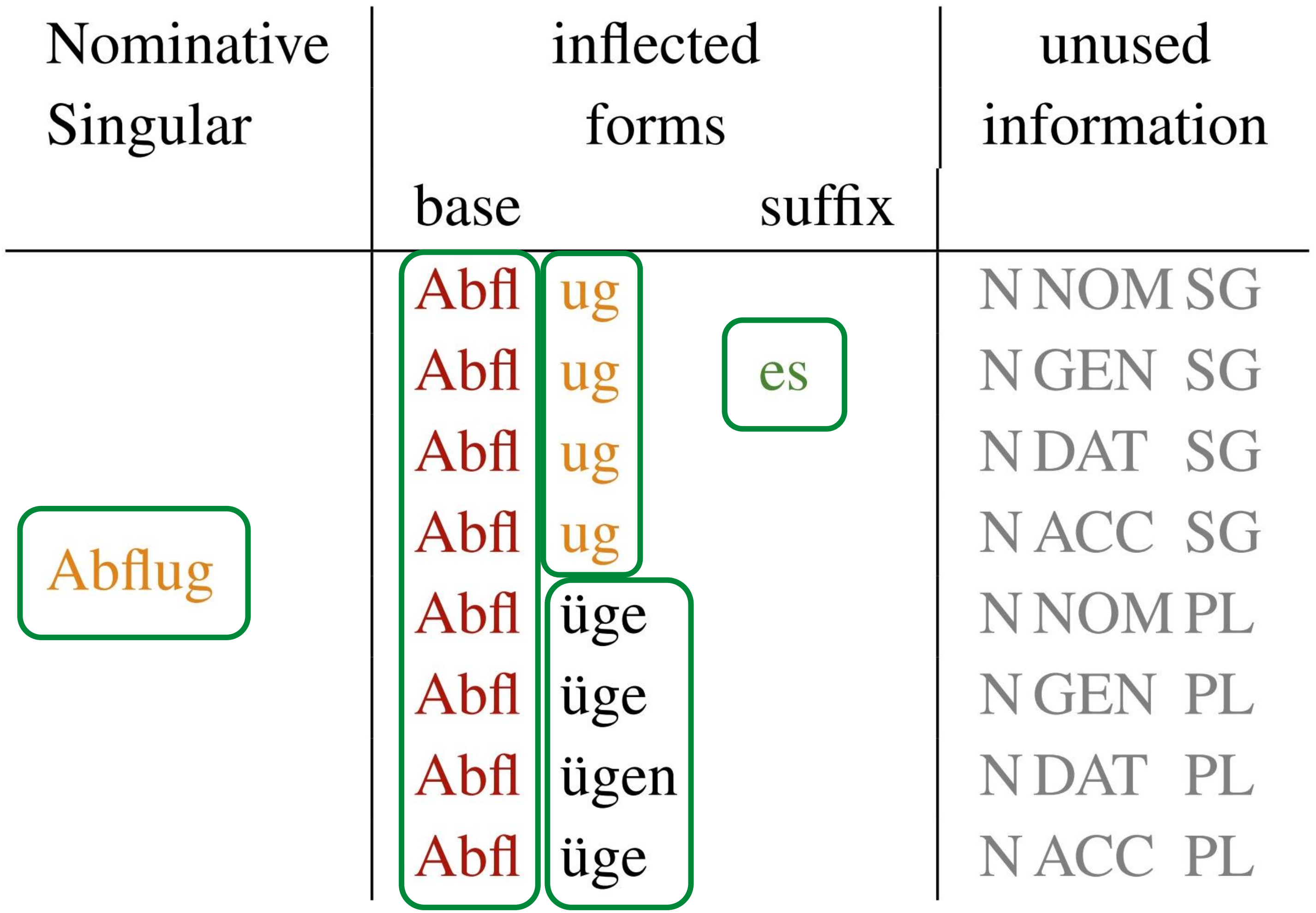
- We now have a frequency list of words inside of NPs and outside of NPs for each language
- We move words with a higher relative frequency inside of NP to I_l and all others to O_l
- From I_l , we generate our candidate set, with all character n-grams from all words in I_l, e.g. *ovibus* 'sheep' → `$ovi`, `ibus$`, but also `$ovibus$` and `i` etc.

Filtering of the Candidate Set

- Frequency Filtering: we filter out all candidates with a frequency lower than a threshold
- Inside/Outside Filtering
  - we conduct a Fisher’s Exact Test on the frequencies of a candidate inside and outside of NPs
  - Question: does this candidate occur more frequently inside than outside of NPs?
  - → use the resulting p-value and odds ratio for filtering
- Restriction to word endings

Silver Standard

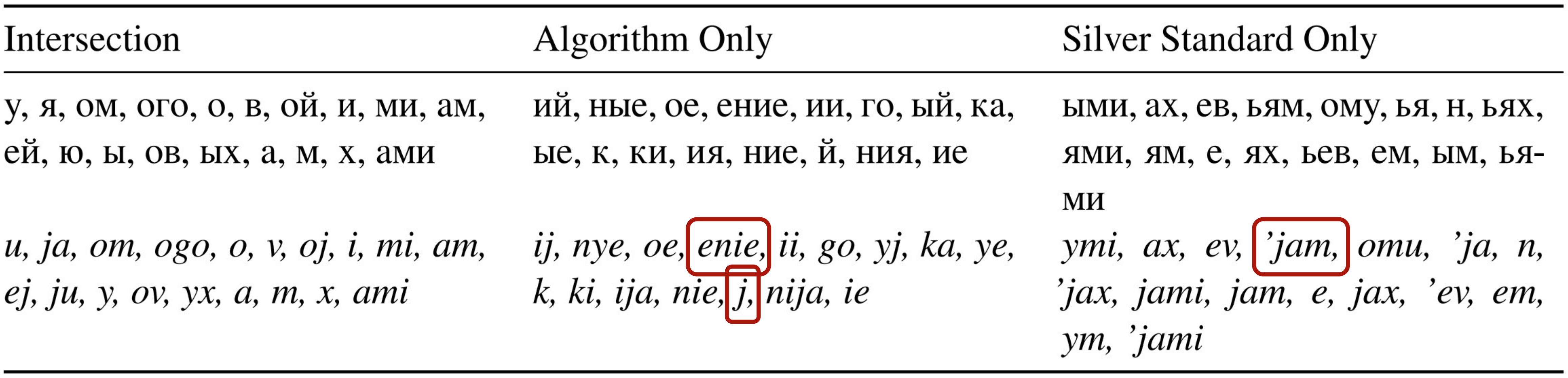
- Automatically created from paradigms in UniMorph
- Covers 19 languages
- Emphasis on precision rather than recall



Nominative Singular	inflected forms			unused information
	base		suffix	
Abflug	Abfl	ug		N NOM SG
	Abfl	ug	es	N GEN SG
	Abfl	ug		N DAT SG
	Abfl	ug		N ACC SG
	Abfl	üge		N NOM PL
	Abfl	üge		N GEN PL
	Abfl	ügen		N DAT PL
	Abfl	üge		N ACC PL

Quantitative Evaluation

We achieve 54% average precision, 41% average recall and 45% average F1 over all 19 languages



Intersection	Algorithm Only	Silver Standard Only
у, я, ом, ого, о, в, ой, и, ми, ам, ей, ю, ы, ов, ых, а, м, х, ами	ий, ные, ое, ение, ии, го, ый, ка, ые, к, ки, ия, ние, й, ния, ие	ыми, ах, ев, ьям, ому, ья, н, ьях, ями, ям, е, ях, ьев, ем, ым, ьями
u, ja, om, ogo, o, v, oj, i, mi, am, ej, ju, y, ov, yx, a, m, x, ami	*ij, nye, oe, enie, ii, go, yj, ka, ye, k, ki, ija, nie, j, nija, ie*	*ymi, ax, ev, ’jam, omu, ’ja, n, ’jax, jami, jam, e, jax, ’ev, em, ym, ’jami*

Manual Qualitative Evaluation

- *domibus* – дворцах/*dvorcax* – **Location**

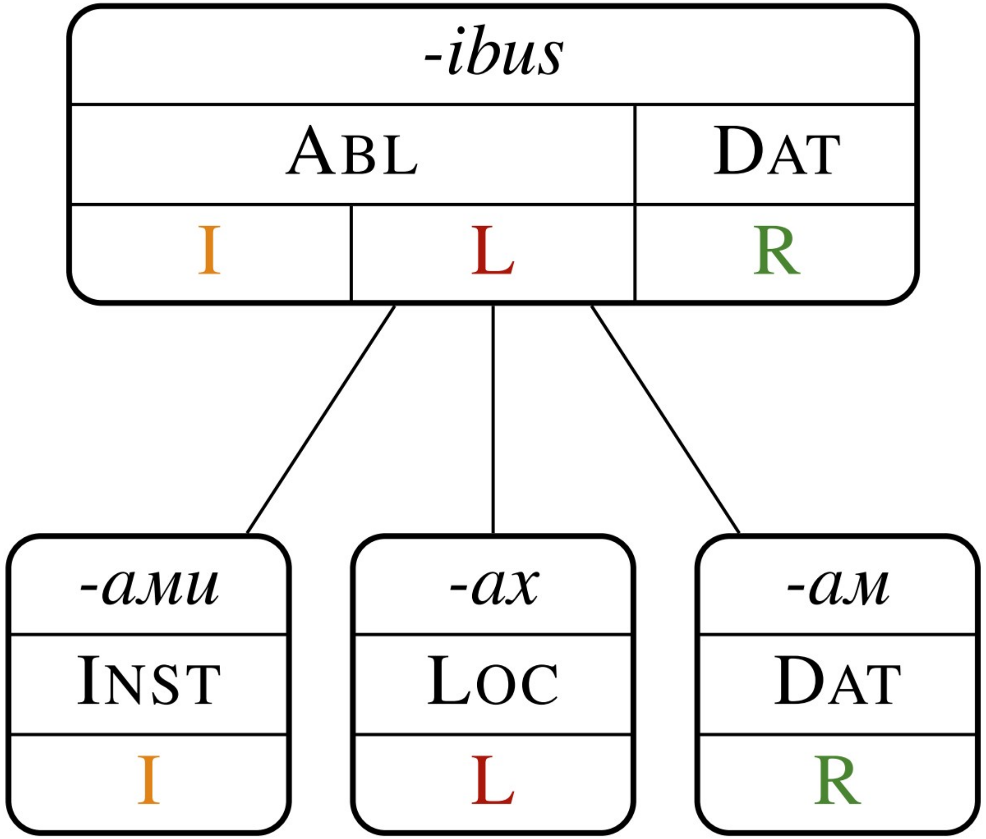
  → ‘in the houses’

- *operibus bonis* – добрыми делами/*dobrymi delami* – **Instrumental**

  → ‘through the good deeds’

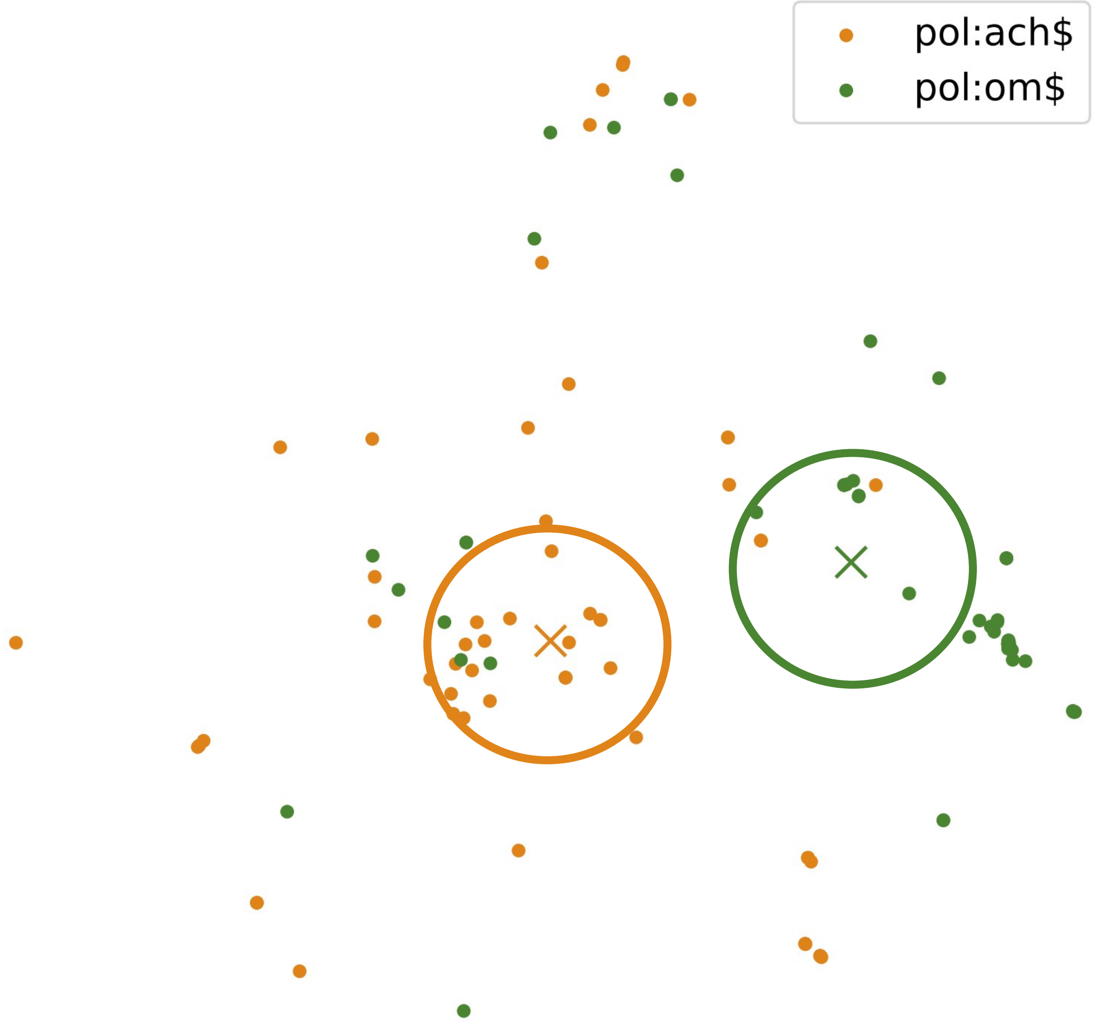
- *patribus* – предкам/*predkam* – **Recipient**

  → ‘for/to the parents’



Semi-Automated Qualitative Evaluation

- Generate NP-word co-ocurrence matrix over the NP vocabulary of all languages
- Reduce with t-SNE
- Here: NPs with Latin –*ibus*, coloured by occurrence of Polish `ach$` (LOC) and `-om$` (DAT)
- → we can cluster NPs semantically by their deep case



Conclusion

We have

- introduced the new task of **Ca**se **M**arker **E**xtraction without **L**abels **CaMEL** 🐫
- compiled an automatically created silver standard for this task covering 19 languages
- presented a simple and efficient method leveraging alignments and achieving 45% average F1
- demonstrated two ways in which the retrieved case markers can be used to investigate deep case

Thank you for listening!

Leonie Weissweiler
Oettingenstraße 67 · 80538 Munich · Germany
weissweiler@cis.lmu.de · www.cis.lmu.de/~weissweiler