Building Bilingual Multiwords Expressions from Parallel Text

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Background

- A **multiword expression** (MWE) is a set of at least two words, the meaning of which does not result from composing the meaning of the components

Background

- Important for:
  - machine translation
  - information extraction
  - semantic analysis

Background

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  - **machine translation**
  - information extraction
  - semantic analysis

Tool

- Grammatical Framework (GF)

  - type-theoretical grammar formalism

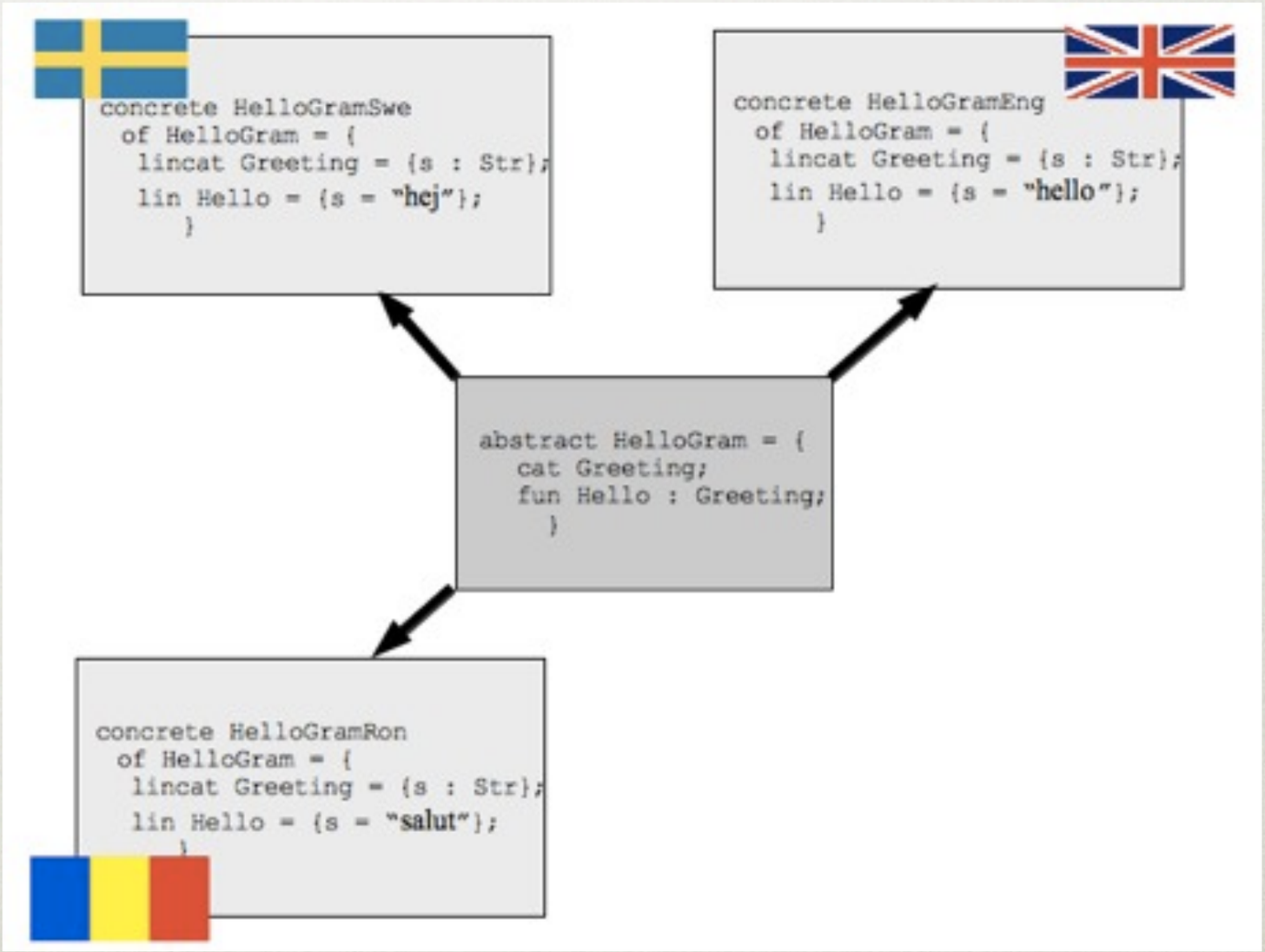
  - dependently-typed functional language for grammar programming

Grammatical Framework

- A GF grammar is
  - an abstract component describing the semantics
  - a number of concrete components mapping the semantics to target languages

Grammatical Framework

Example:



Grammatical Framework

- GF Resource Library

  - abstract grammar - basic syntactic constructions of natural language(predication, complementation, etc) + test lexicon

  - 24 concrete grammars

    - corresponding to languages of the world

    - in addition to syntactical constructions, they feature paradigms for inflectional morphology

Grammatical Framework

GF Resource Grammar:

- computational grammar for the language
- general-purpose
- can be used as a library for domain-specific grammars

Grammatical Framework

GF grammars for natural languages:

- syntactically-correct

- precise w.r.t the semantic from the abstract

- rule-based translation systems between any pair of languages for which a concrete description exists

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Grammatical Framework

Problems with GF grammars:

- usually built manually

- strict coverage

- compositional translation systems (literal)

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Automated GF Grammars

Building GF grammars in a more automated manner

- from examples

- extracting multilingual single-word lexicons from parallel corpus (phrase tables)

Grammatical Framework

Problems with GF grammars:

- **usually built manually**

- strict coverage

- **compositional translation systems (literal)**

GF and MWEs

GF-style definition for (bilingual) MWEs:

The pair (m1, m2), where:

- at least one of them contains at least two words

- m1 is a (possible) translation of m2

- the translation is not obtained compositionally

=> in most cases, at least one of them is a MWE(according to the first definition)

GF and MWEs

GF-style definition for MWEs:

Example:

- how old are you?/quelle âge as-tu? *(what age do you have?)*

- what is your name?/ comment t-appelles tu? *(how do you call yourself?)*

GF and MWEs

A special case of MWEs emerged -

Compound words

- carboxylic acid/karboxylsyra (Swe)
- blood substitute/blutersatz (Ger)

GF and MWEs

Advantages

- generate all other declension forms and map them

  carboxilic acids/karboxylsyror

- generalize relational MWEs

  how old is your daughter?/quelle âge a ta fille ?

GF and Compounds

- General method
- Use case: English + German
  - Domains: biomedical patents, Europarl
  - Additional constraints:
    - NPs
    - extract from phrase-tables

GF and Compounds

General method

- German rules for compounding, specified as new grammar:

  + w1 + lowercase(w2)
  + w1 + ‘s’ + lowercase(w2)

  ...

GF and Compounds

General method

- extract candidate pairs from phrase tables

+ above a confidence threshold

+ English parses as NP

+ one word for German

GF and Compounds

General method

- greedy algorithm for splitting the German word in the smallest number of constituents that appear in the monolingual dictionary (based on Wiktionary)

GF and Compounds

General method

- use the pair of parse trees to create an entry in a static dictionary

GF and Compounds

Example

abdominal surgery / Bauchchirurgie

+ 2 words English, 1 word German

+ English parses as NP

+ German word not found in dictionary

- first split: Bauchch + irurgie

- ...

- found Bauch + Chirurgie as best match

GF and Compounds

Evaluation

hard to measure precision and recall for large phrase tables due to lack of grammaticality

=> parse with TAG parser, keep NP-only English bits and their German counterparts

GF and Compounds

Evaluation

- 91% of the English phrases parsed in GF

- 73% of the German compounds matched (more rules, proper names)

GF and bilingual MWEs

General method

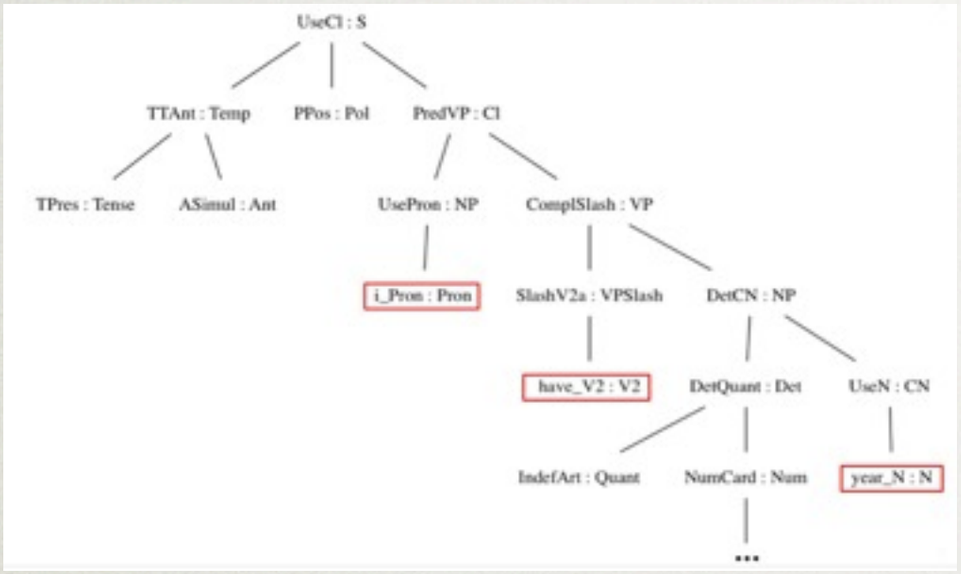
- parse pairs of sentences

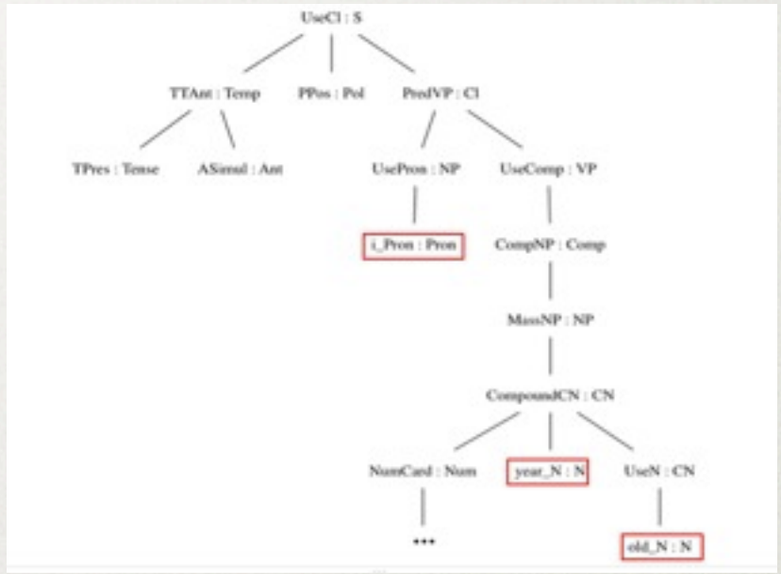
- get trees with least edit distance

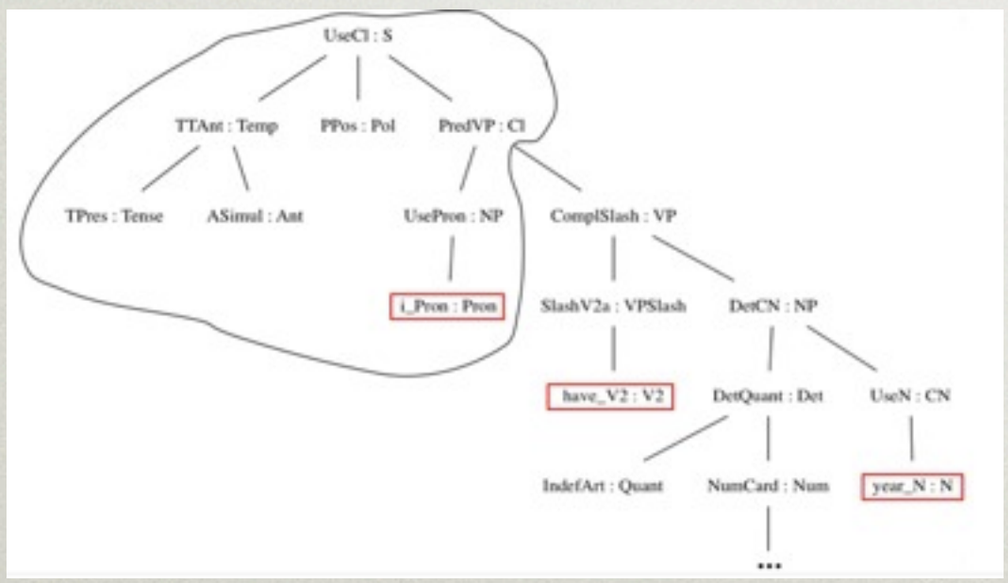
- prune top-down to find differences

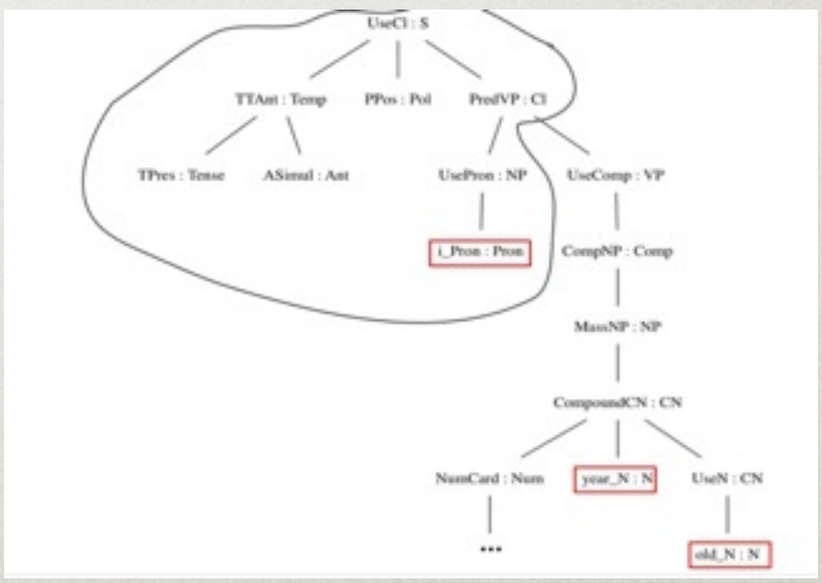
- generalize bottom-up when applicable

GF and bilingual MWEs









GF and bilingual MWEs

Evaluation

- hard to on free text, because of the lack of robustness and quality of existing bilingual GF lexicons

GF and bilingual MWEs

Evaluation

- used to extend grammar semi-automatically from simpler parallel data like **tourist phrases** (Wikitravel)

GF and bilingual MWEs

Future work

- extract MWE from free text, not via phrase tables - can capture discontinuous constituents

- express boundaries for non-compositionality *(kick the bucket/ the bucket was kicked by him)*

- infer compound formation for new words, based on analyzing collected data

- evaluate impact on GF-driven machine translation

Thank you for your attention!