Lexicon extraction in MOLTO

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Overview

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Introduction

Lexicon

- GF lexicon is a part of grammar: we need
  - baseform
  - inflection paradigm
  - valency frame

Use cases

- Converting existing resources to GF lexicons
  - Need to produce mappings from source formats to GF
- Managing terms on TermFactory
  - TermFactory: terminology management platform developed in UHEL
  - Automatic conversion from TermFactory format to GF
  - To be combined with translator's tools

Types of lexicons

Monolingual

Multilingual

- Uni-sense
- Multi-sense

Monolingual lexicons

- Extracted from a monolingual lexicon
- Idiomatic, tailored for each language
- Used as a resource or for a monolingual application

```
DictEng.gf:

    a_priori_Adv = mkAdv "a priori";
    aardvark_N = mkN "aardvark" ;
    ab_initio_Adv = mkAdv "ab initio";
    aback_Adv = mkAdv "aback";
    abactinal_A = mkA "abactinal" ;
    abandon_V2 = mkV2 (mkV "abandon");
```

```
DictGer.gf:

    a_priori_Adv = mkAdv "a priori" ;
    aachener_N = reg2N  "Aachener" "Aachener" masculine ;
    aal_N = reg2N  "Aal" "Aale" masculine ;
    aalfang_N = reg2N  "Aalfang" "Aalfänge" masculine ;
    aasvogel_N = reg2N  "Aasvogel" "Aasvögel" masculine ;
    abaenderbar_A = regA "abänderbar" ;
```

Multilingual lexicons

- Common abstract syntax, concrete syntaxes are translations of it
- Used for multilingual application
- Possible problems
  - Idiomatic POS differences (compound word vs. adjective modifier)
  - Exact word sense matching

```
DictEngGer.gf:

    abandon_V2 = dirV2 (irregV "verlassen" "verlasst"
                               "verließ" "verließe" "verlassen" );
    abase_V2 = dirV2 (irregV "erniedrigen" "erniedrigt"
                             "erniedrigte" "erniedrigte" "erniedrigt");
    abasement_N = mkN "Erniedrigung";
```

Uni-sense lexicons

- Uni-sense: one-to-one correspondence between source and target
- Benefits of uni-sense
  - Lightweight, simple
  - Good results in many cases
    - Carlson and Lindén, 2010: "80 % of the mappings are one-to-one and unproblematic" (Finnish translation of WordNet)
- Problems of uni-sense
  - Arbitrary choice of word sense for the remaining 20 %

Multi-sense lexicons

- Synsets from WordNet, every distinct word sense gets an entry
- Possible to combine with external word sense disambiguation tool
- Example:

```
LinkedDictGer:
    brother_08111676_N = reg2N "Bruder" "Brüder" masculine ;
    brother_08112052_N = reg2N "Bruder" "Brüder" masculine ;
    brother_08112265_N = reg2N "Kamerad" "Kameraden" masculine ;
```

- Format: *lemma*_**senseNumber**_POS
- Sense numbers independent of language

Multi-sense lexicons

Option 1: All synonyms in abstract syntax

- Include every combination of lemma and word sense
  brother_08111676_N
  brother_**08112961**_N
  ...
  buddy_**08112961**_N
- Important for parsing
- Increases the size of the lexicon

Multi-sense lexicons

Option 2: One synonym per word sense

- Include only single word senses, one lemma represents
  brother_08111676_N
  brother_**08112961**_N
  ...
  buddy_**09877951**_N
- Enough for linearization purposes
- Option chosen for LinkedDict.gf

Source formats

Annotated data

- TermFactory RDF
  - Includes necessary information for GF grammars
  - Conversion from TF RDF to GF included in the platform
- WordNet
- Morphological lexicons
  - Bulgarian: OpenOffice spellcheck
  - Finnish: Nykysuomen sanalista by the Institute for the Languages of Finland
  - French: Morphalou
  - Swedish: Folkets lexikon

Source formats

Unannotated data

- Domain ontologies
- Phrase tables
  - Phrase table: Entries of (source chunk, target chunk, probability) for a SMT system
  - Learned from parallel data
  - Experiments for French and German using the phrase tables produced in patent case
- Unannotated word lists
  - Bulgarian: Apertium dictionary
  - Urdu: Waseem Siddiqi's English-Urdu dictionary
  - Various languages: Wiktionary

Combining different sources

- DictEng
  - Lexicon exctracted from Oxford Advanced Learner's Dictionary
  - Valency information extracted from Penn Treebank
  - Manual work with small closed classes: prepositions, irregular verbs
- DictEngBul
  - Valencies from DictEng
  - Inflection paradigms from existing DictBul (whose source is the OpenOffice spellcheck)

Showcases

1. TermFactory: term extraction and conversion to GF
2. WordNet: High-coverage lexicons for robust parsing
3. Phrase tables: domain-specific lexicons for hybrid systems

TermFactory

- TermFactory: Platform for terminology management
- RDF format with GF-specific predicates
- Example for Finnish: language-specific conventions to mark valency, mapped to GF constructors

```
term1:fi-koira-N_-_ont-Dog
      syn:frame "N" ;
      gf:lin "mkN str" ;
      term:hasDesignation exp1:fi-koira-N ;
      term:hasReferent ont0:Dog .

term1:fi-aviomies-N_-_ont-Husband
      syn:frame "jonkun N" ;
      gf:lin "mkN2 (mkN str) (casePrep genitive)" ;
      term:hasDesignation exp1:fi-aviomies-N ;
      term:hasReferent ont0:Husband .

term1:fi-kieltää-V_-_sem-Forbid
      syn:frame "V jotakuta olemasta" ;
      gf:lin "mkV2Vf (mkV str) (casePrep partitive) infElat" ;
      term:hasDesignation exp1:fi-kieltää-V ;
      term:hasReferent sem0:Forbid .
```

TermFactory

- `syn:frame`: user-friendly way to annotate valency
- `gf:lin`: GF constructor
- Mapping from `syn:frame` to `gf:lin`:

```
[] gf:mapping
    [ syn:frame "N" ; gf:lin "mkN str" ] ,
    [ syn:frame "jonkun N" ;
      gf:lin "mkN2 (mkN str) (casePrep genitive)" ],
    [ syn:frame "V jotakuta olemasta" ;
      gf:lin "mkV2Vf (mkV str) (casePrep partitive) infElat" ] .
```

- GF format after conversion:

```
ont_Dog = mkN "koira" ;
ont_Husband = mkN2 (mkN "aviomies") (casePrep genitive) ;
sem_Forbid = mkV2Vf (mkV "kieltää") (casePrep partitive) infElat ;
```

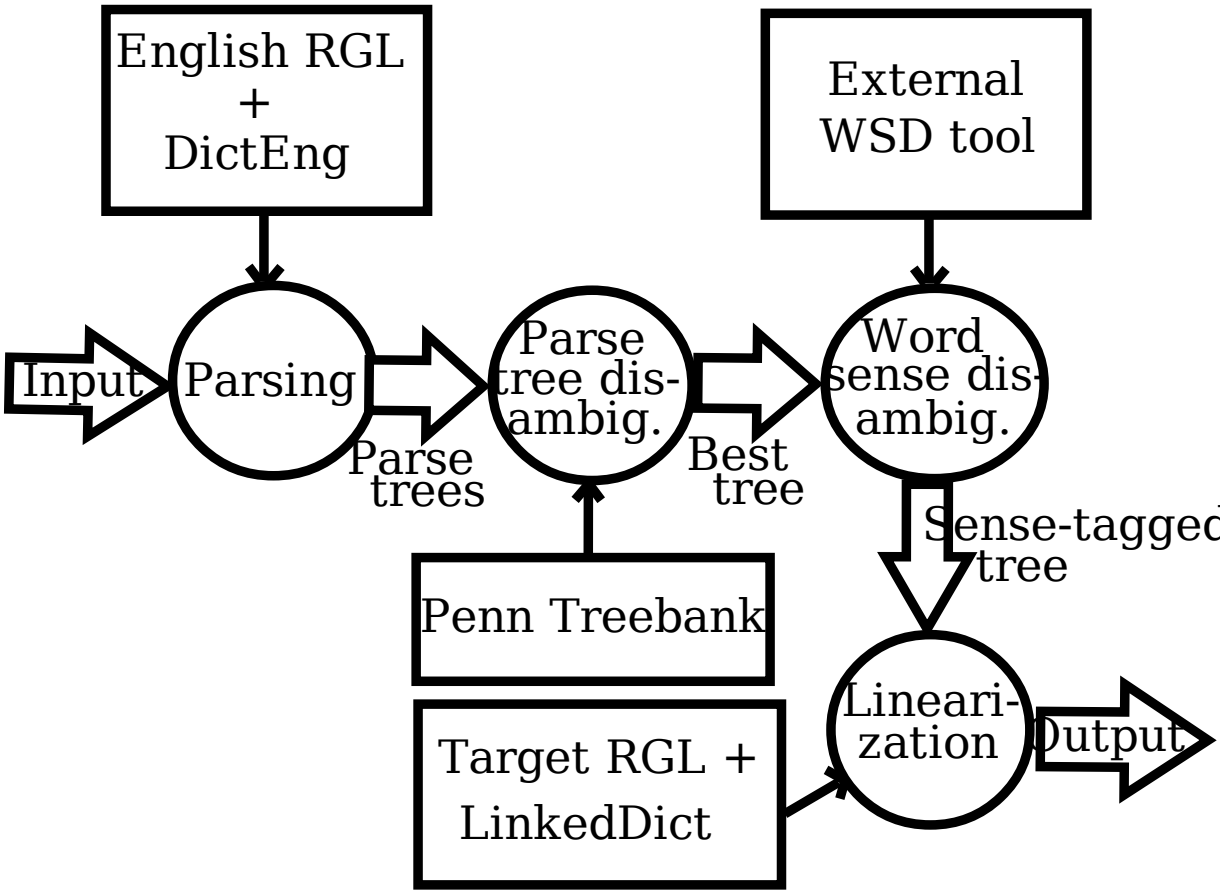
- Demo: to appear in tfs.cc

High-coverage lexicons for robust parsing

Work by Shafqat Mumtaz Virk and K. V. S. Prasad

- Multilingual multi-sense lexicon from WordNets (Hindi and Universal WordNet)
- External word sense disambiguation tool in parsing
- Slight improvement in results for Hindi and German

Parsing and linearization with WSD



Parsing and linearization with WSD

Explanation of the graph:

- Parsing with source language GF resource grammar
- If input is syntactically ambiguous:
  - Multiple parse trees
  - Disambiguation with statistical model built from Penn Treebank data
- Word sense disambiguation of the best tree, with external tool
- Linearization to target language
  - Target language resource grammar
  - Target language LinkedDict

Robust parsing

Work by Krasimir Angelov, Aarne Ranta

- Coverage attained by
  - partial and shallow parsing
  - extended RGL constructions
  - extended lexicon
- Demo and further information in Flagship 3
- Currently only English RGL good enough for parsing
- High-coverage lexicon for Bulgarian, German, Finnish, Hindi, Swedish, Urdu: translations English→*
- Later perhaps translations *↔*
  - Potentially better than SMT that uses English as pivot
- Good for under-resourced languages: SMT needs much more data to produce good results

Phrase tables

Work by Ramona Enache

- Possible to build domain-specific lexicons from unannotated data
- Hybrid systems:
  - get the lexical coverage provided by extensive data
  - maintain the grammaticality provided by RBMT
- Process
  1. English input file
  2. POS-tagging + lemmatization
  3. Lookup in DictEng
  4. Extract valid entries
  5. Obtain translation from (Eng,Ger) phrase-tables
  6. Lookup & Add to DictEngGer

Future work

- Domain-specific tailoring for lexicons
- Better coverage
- More language pairs for robust translation
- Integrating TermFactory to translators' tools

Thank you!