Multilingual Information Extraction for Intelligence Purposes

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1 | Introduction - I

- Processing of human language as a critical capability in many future military applications (cf. [Steeneken, 1996]).
- Content analysis/extraction of free-form texts is important for any information operation of the Network Centric Warfare (NCW) concept (cf. [NCW, 2001], p. 5-15).
- This can be realized through Information Extraction (IE) which is a natural language processing technique (cf. [Appelt, 1999], [Hecking, 2004a]).

1 | Introduction - II

- Specific problem: content extraction of intelligence reports
- ZENON project version 1: The overall objective is to realize experimental systems for (partial) *content extraction of HUMINT reports* from the KFOR deployment of the Bundeswehr and to realize a possibility to evaluate the formal representation of the content.
- For the realization of the IE module 4,498 English HUMINT reports are available; KFOR corpus: 800 annotated reports
- ZENON system version 1 can only process documents in English

1 | Introduction - III

- ZENON system version 2: IE result from two different languages will be combined; ongoing work
- This will allow the analyst to access information from texts written in different languages without knowing these languages.
- In version 2 the language *Dari* is used as the second one.
- Two official languages of Afghanistan: Dari, Pashtu; operational area of the German Bundeswehr
- Also: a word-to-word-translation to further support the analyst.

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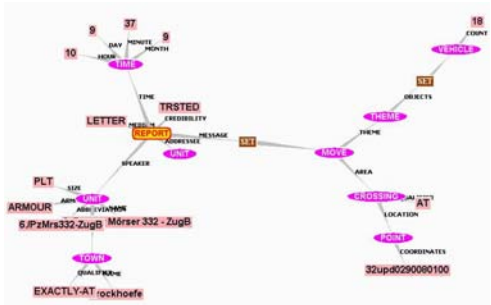
The ZENON version 1 research system:

- The Information Extraction (IE) technology is used for the content extraction.
- The information about the actions and named entities are identified from each sentence and the content of the sentences are formally represented in typed feature structures.
- These structures can be combined and presented in a graphically navigatable *Entity-Action-Network*.



2 | ZENON System Vers. 1 - III

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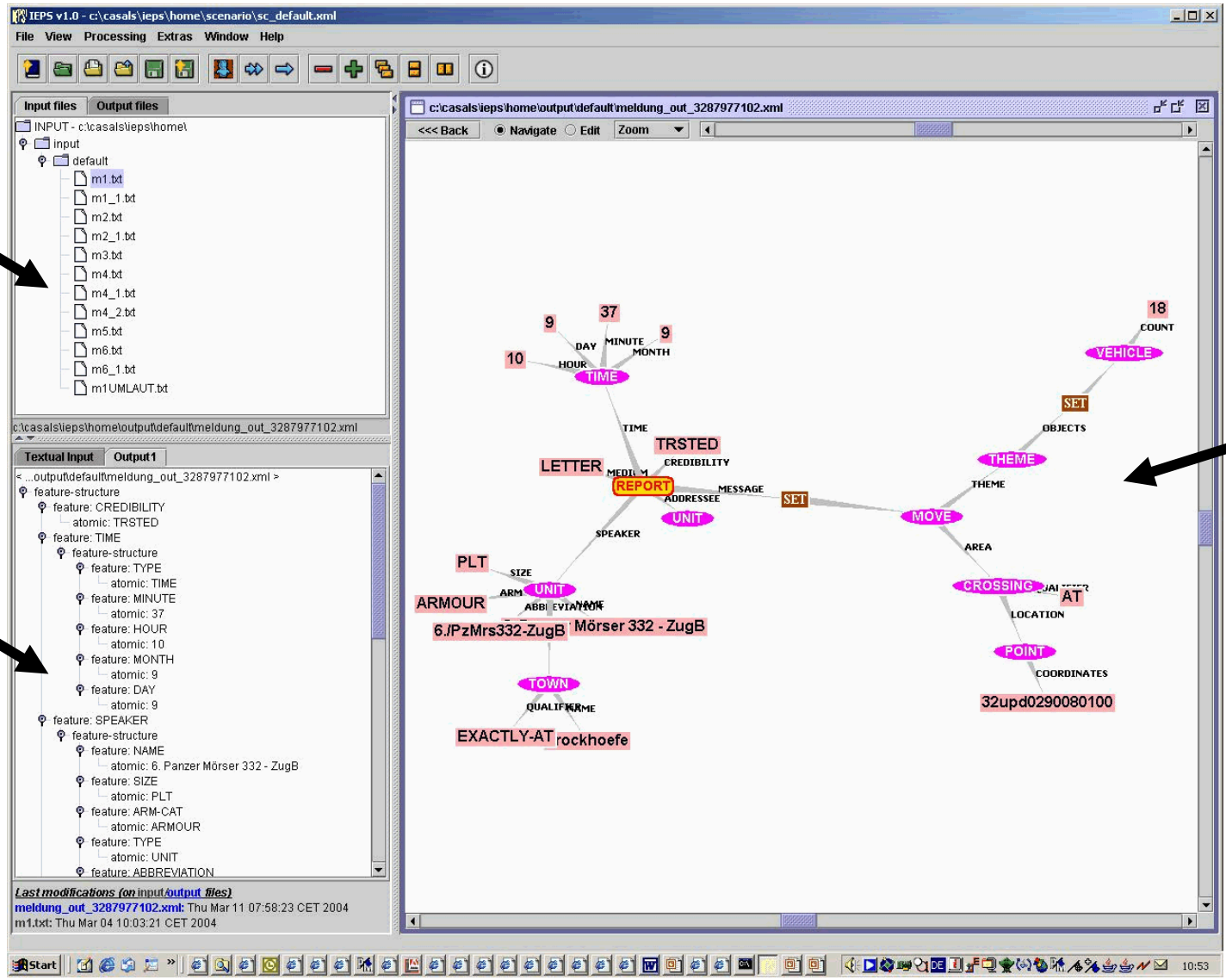
input files

formal output

graphical output



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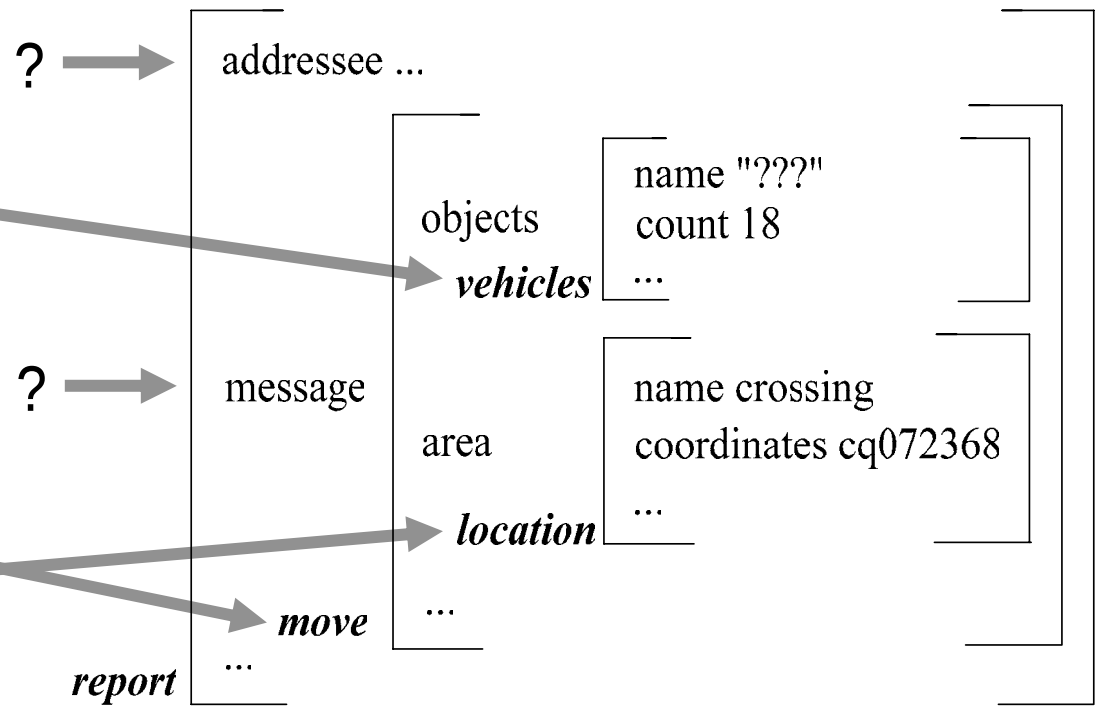
„... in TUZLA:
10.20 a.m.
18 vehicles
- 8 with attached ZIS–3 and 1 with attached T 12 - march

at road crossing (CQ 072368) south of MILESKIJ (CQ 0737) to the north.“

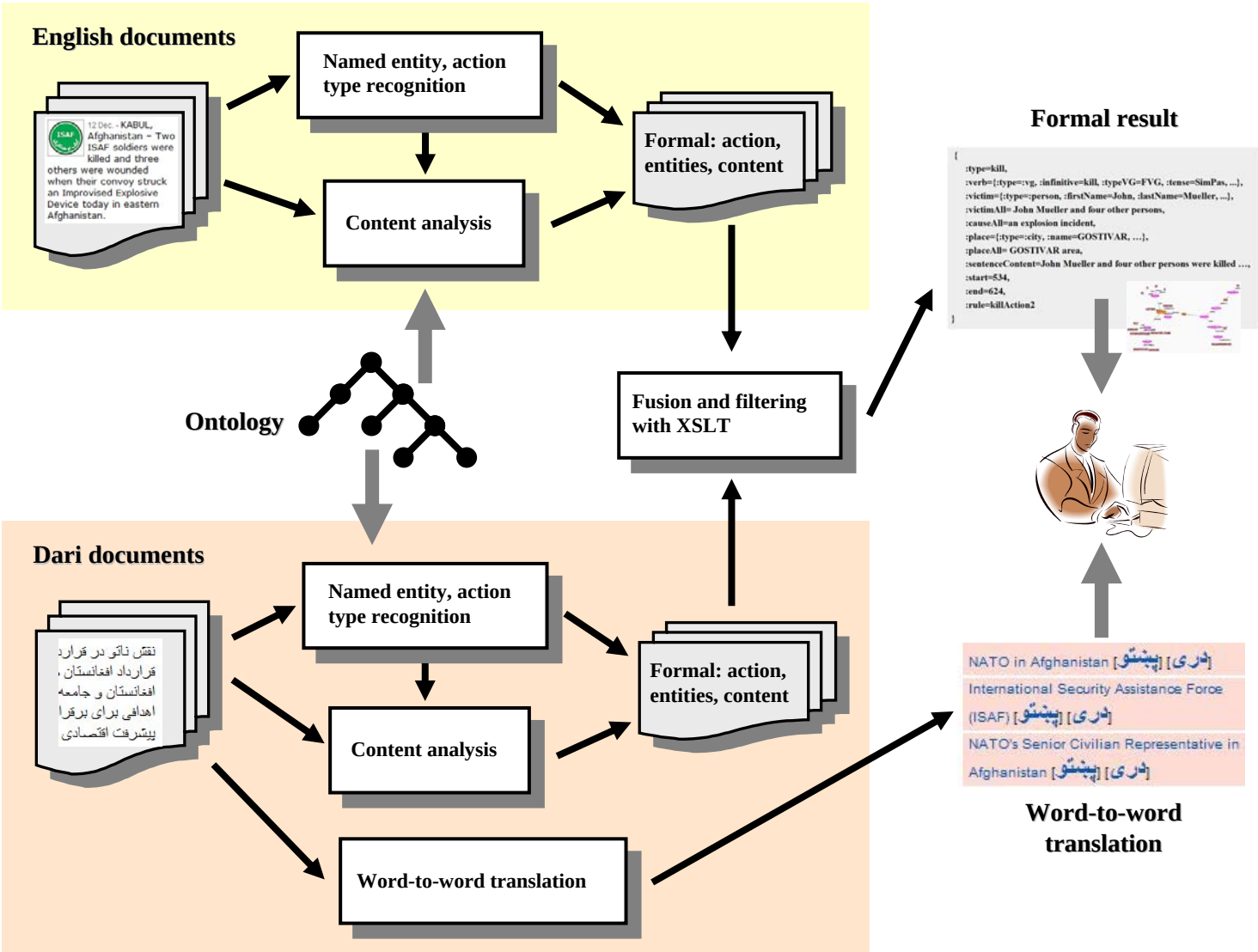


- Information extraction (IE) is the task of identifying, collecting and normalizing information from natural language text.
- Relevant information about the Who, What, When, etc. is looked for.
- The information of interest is described through domain-specific lexicon rules and patterns called *templates*.
- During the IE task these templates are filled with the collected information.
- The templates are domain and task specific, i.e. for each new task and domain they must be newly created.

- Technical basis of the information extraction:
  - extensive linguistic knowledge
    - general and application-specific lexica
    - general and/or application-specific phrase grammars
    - general (and/or application-specific) clauses and sentence grammars
  - cascaded transducers, i.e. finite state automaton that reads from the input and writes to the output
  - only application-relevant parts of the texts are analyzed through transducers (shallow parsing techniques)

- Multilingual (as well as multi-source) information extraction is an actual research topic
- Main idea of multilingual information extraction: extraction of information about a specific entity and/or action from documents written in different languages
- Hypothesis: using information written in different languages gives more accurate intelligence results

3 | Multilingual IE - Main idea



- For the Dari language natural language processing functionality was realized in a master thesis (cf. [Schwerdt, 2007a]).
- Components of the Dari application: *Dari Document Reset, Dari Tokenizer, Dari Sentence Splitter, Dari Gazetteer, Dari Grammar, Dari VP Chunker*.
- Dari Gazetteer (lists of names): *city_afgh* (28), *city_world* (126), *country_world* (171), *days* (7), *female_names* (708), *male_names* (829), *months* (12), *numbers* (11), *ordinals* (10), *province_afgh* (34).
- Rules for named entity recognition

3 | Multilingual IE - Dari processing ... - II

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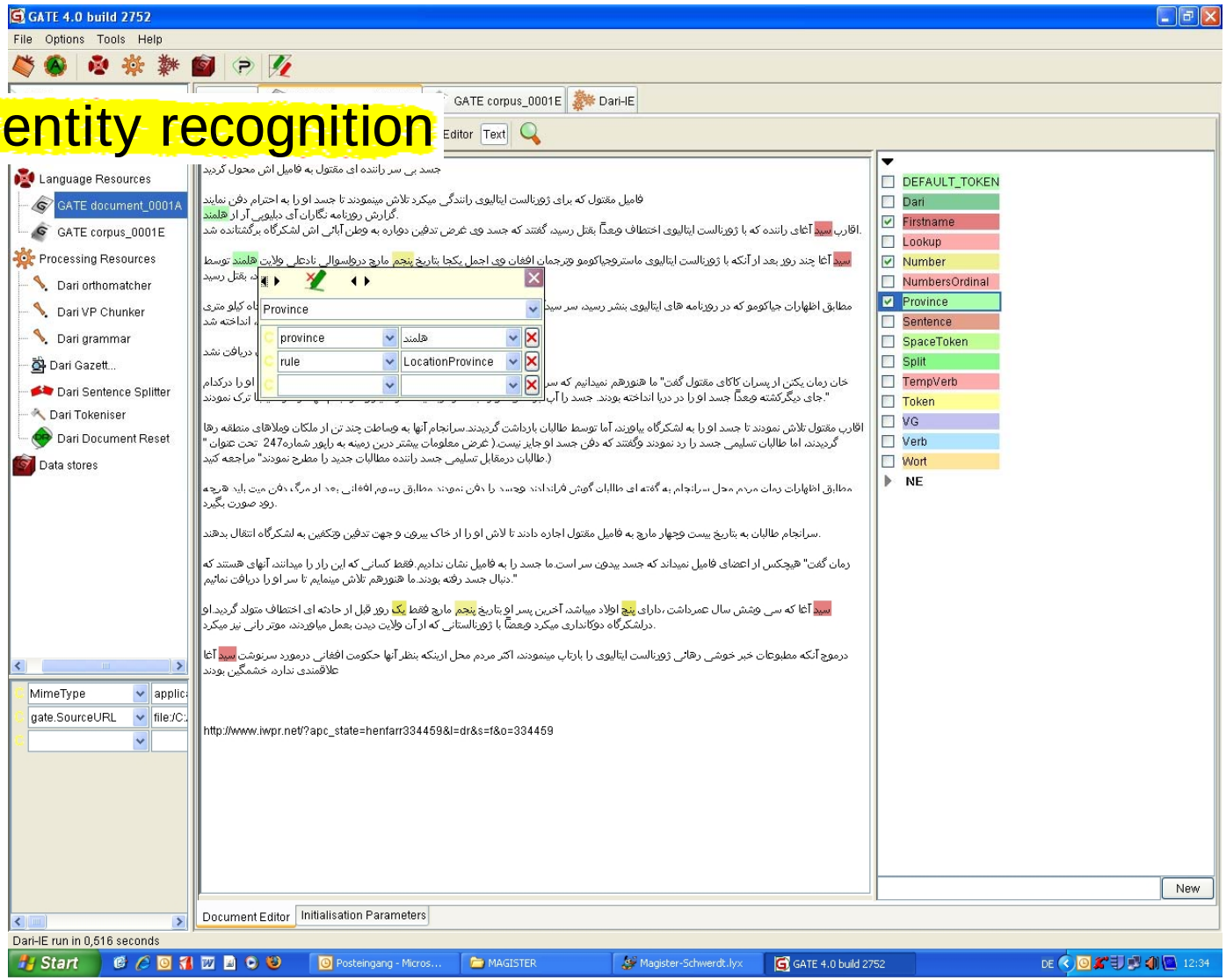
Named entity recognition



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- A Dari-German full-form dictionary with approximately 48,000 entries was integrated in the Gazetteer
- For each dictionary entry the following information is available: *ID, source of the entry, subject area, German translation, German part of speech, German grammatical gender, Number of words in German, Dari lemma/headword, Dari number, English translation, source of the Dari word, Dari part of speech, Number of words in Dari, Dari dialect, description, frequency*

Dictionary entries

ball

ID	60532	60544
Herkunft	Dr_De_xxx200611	DR_DE_xxx2006-12-34974
Sachgebiet	GV	GV
Dt. Übersetzung	Ball	Schnecke
Dt. Wortart	N	NoCo
Dt. Genus (+Wortart)	N,m	
Anzahl d. dt. Wörter		sw
Dt. Genus		fem
Dari-Lemma	گوی	گوک
Quelle		LTWB
Dari Wortart	N	NoCo
Dari Wortanzahl		sw
Dialekt		FD

snail

3 | Multilingual IE - Dari-German dictionary - III

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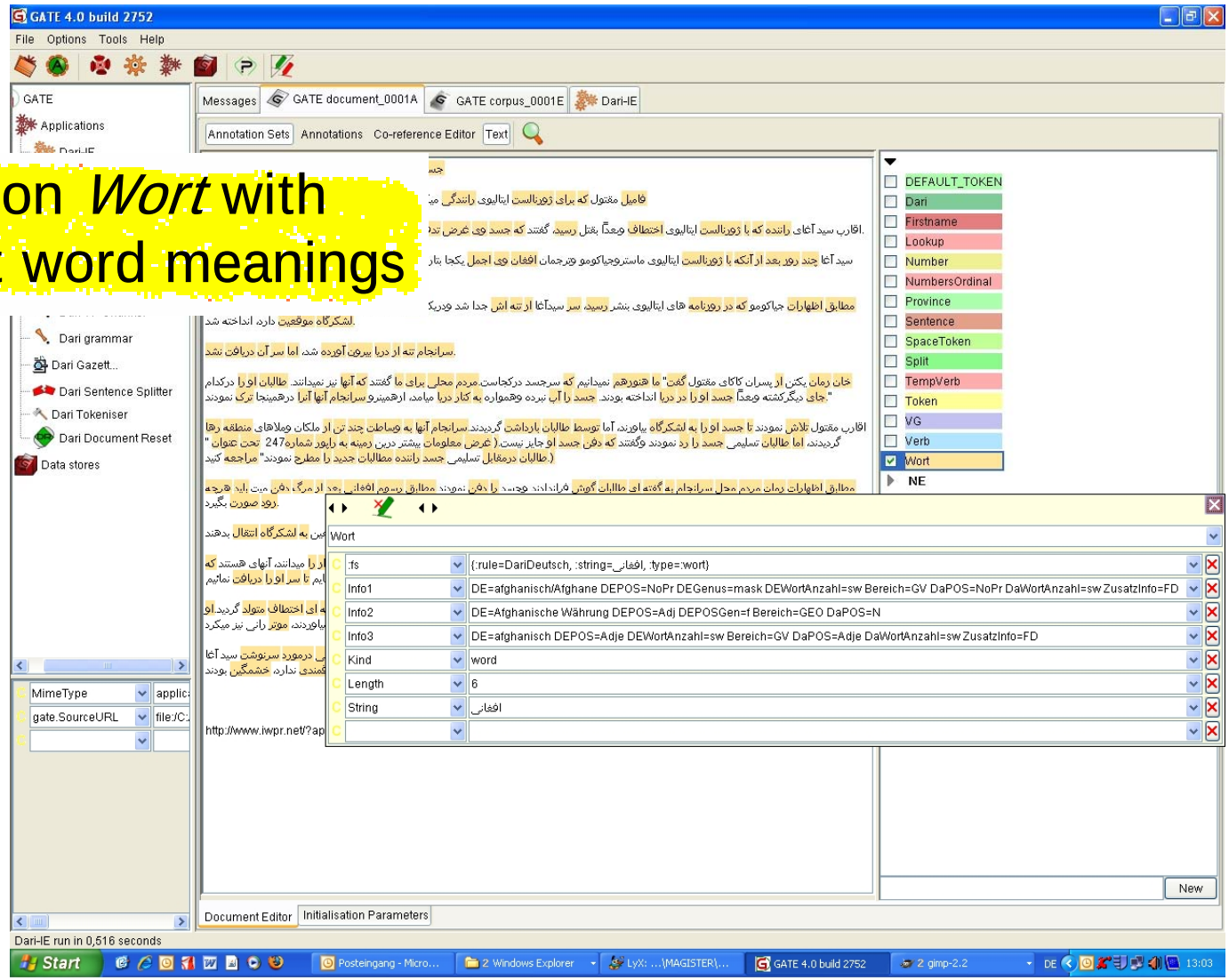
Annotation *Wort* with different word meanings



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- For the identification of the action types used in the Dari documents the verbal phrases must be analyzed.
- Morphological analysis for the most important verbs in Dari
- Two full-form lexica
  - 39,552 inflectional past tense forms of the 8,818 verbs from the Dari-German dictionary
  - 6,592 past-participle forms of the verbs

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- The forms of the present tense in Dari are irregular.
- The morphological analysis of the present tense is restricted (at the moment) to the 84 most often used verbs.
- Information provided by the morphological analysis: *stem*, *mood* (indicative, subjunctive, and imperative), *number*, *tense*, *negation*, *voice* and *translation of the infinitive*
- Compound tenses are also handled.

Past tense forms of *budan* ("to be")

			->	budam بودم
			->	bude بودی
budan بودن	->	bud بود	->	bud بود
			->	budem بودیم
			->	buded بودید
			->	budand بودند

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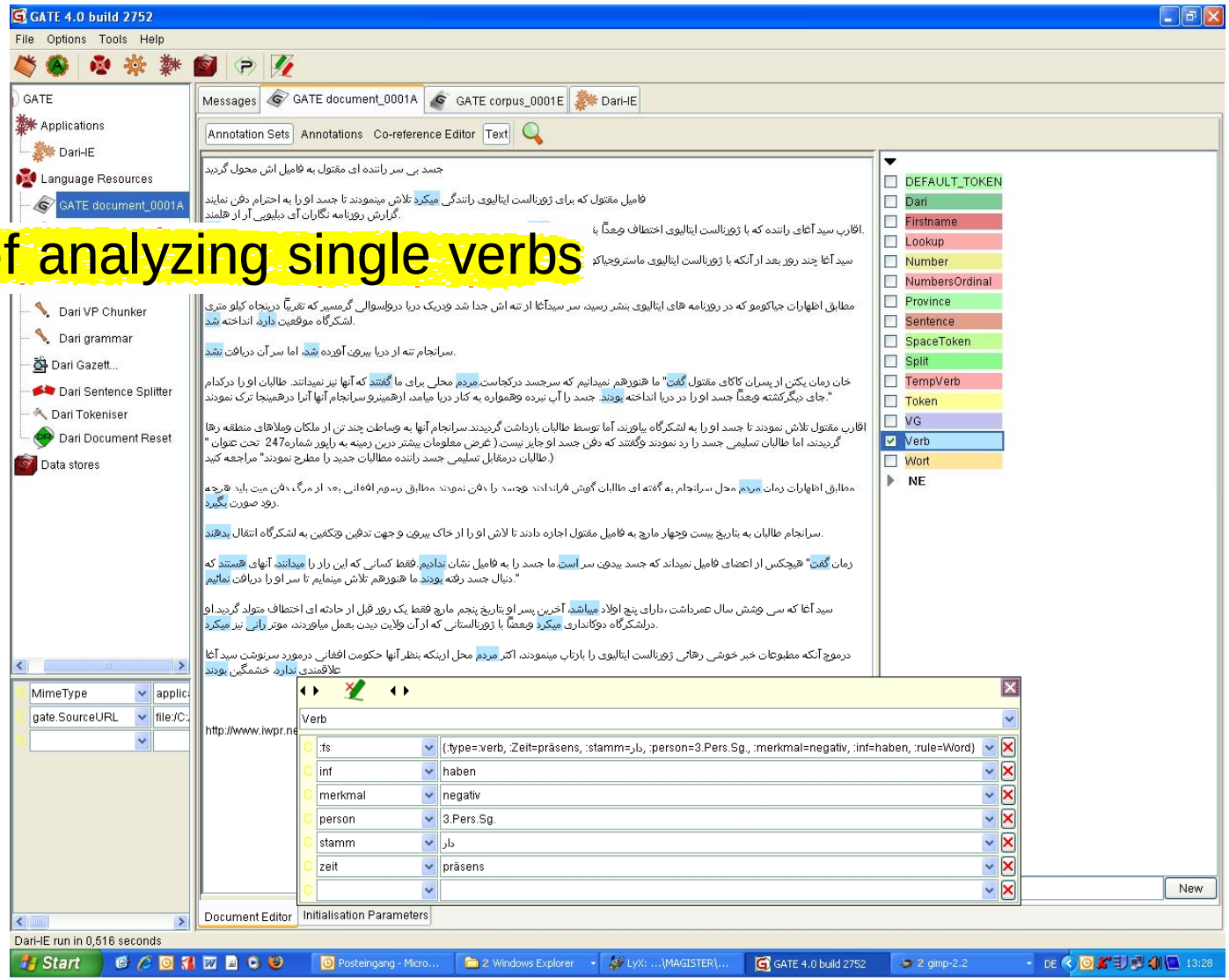
Result of analyzing single verbs



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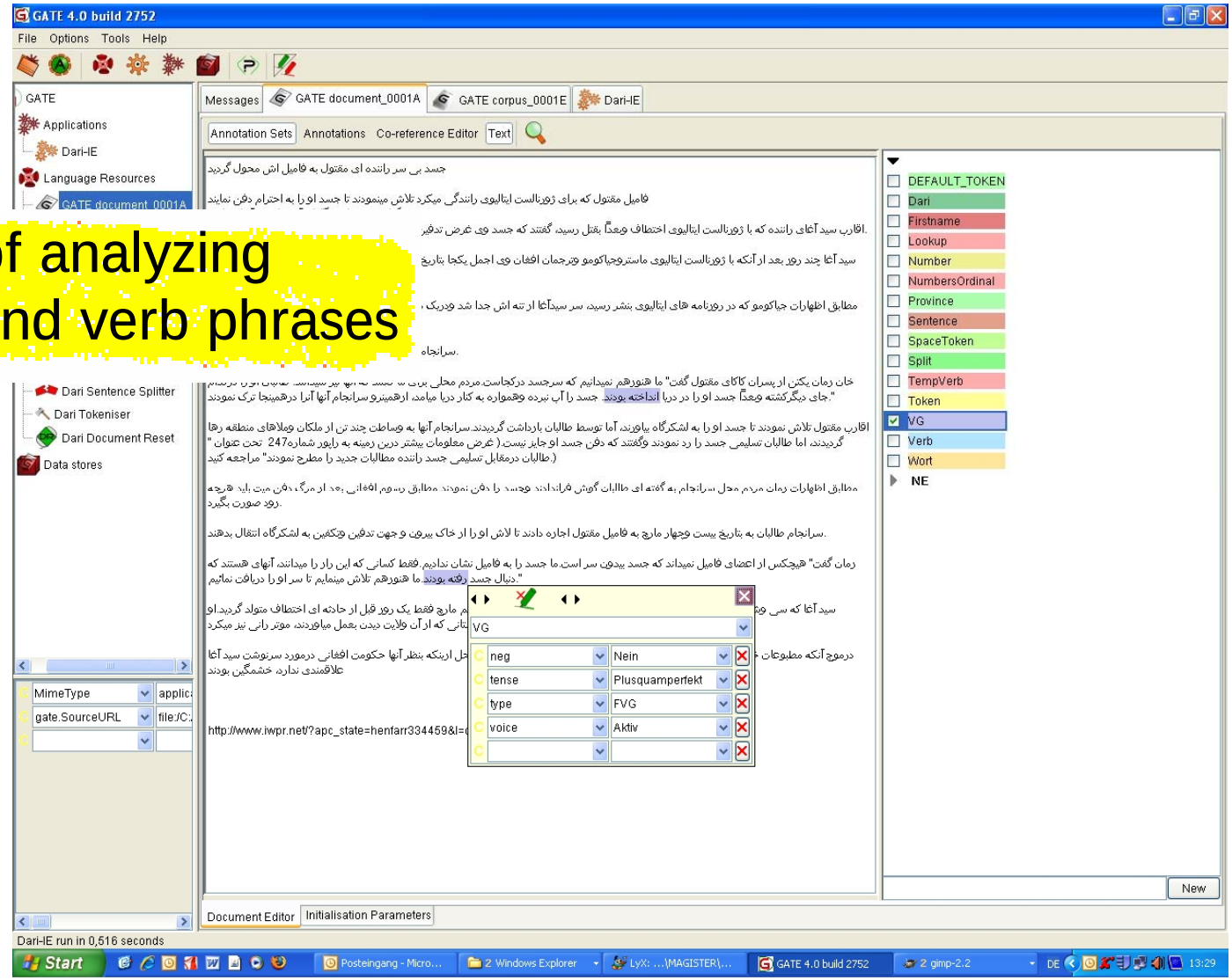

Result of analyzing compound verb phrases

- Transliteration of Dari names to those written in roman scripts.
- Spelling variants in both languages; at the moment only an ad hoc solution; more principal solution needed: for each name *one* canonical form and its spelling variants are defined
- Tight integration of the word-to-word translation with the information extraction result
- How to get the same coverage of linguistic data (dictionaries, grammars ...) and functionality (POS tagger, morphology ...) for less commonly spoken languages?

4 | Conclusion

- ZENON system version 1 explained
- Main idea of multilingual information extraction
- 2nd language: Dari
- Named entity recognition for Dari texts
- Integration of Dari-German dictionary
- Morphological analysis of Dari verb groups
- Open problems
- We are in the process of integrating the modules for the semantic analysis of English and Dari documents.