


Word Sense Annotation, Disambiguation and Knowledge Transfer for Bulgarian


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Plan of the Talk

- Brief update on our work
- Sense annotation
- SRL
- WSD experiments
- Conclusions

IICT – VU Exchange Visit

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AComIn
Advanced Computing for Innovation
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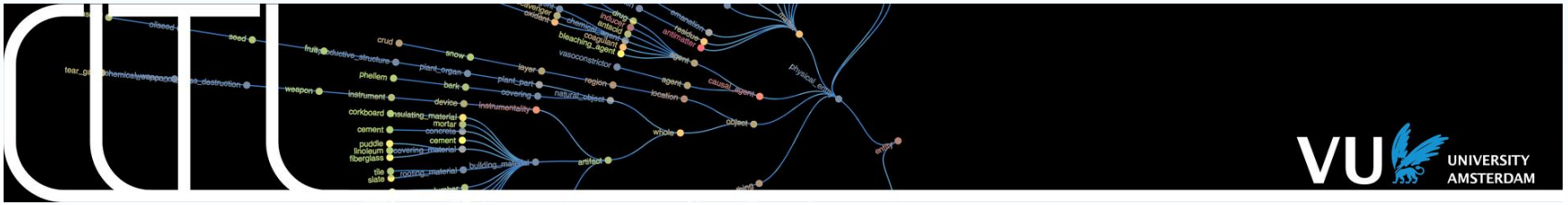
IICT
Institute of Information and Communication Technologies



AComIn: Advanced Computing in Innovation

- A 3,2 M€ grant in FP7 Capacity with a single beneficiary – IICT-BAS
- Objectives:
  - Strengthening Human Potential
  - Providing up-to-date Research Infrastructure
  - Focus on users
  - Networking with EU partners
  - Strengthening the IICT-BAS Innovation Capacity
  - Dissemination via various events/channels
  - Organising assessment of the IICT-BAS achievements

Last Year – July 2014 - Amsterdam

- The Core Wordnet for Bulgarian was released via Open Multilingual Wordnet site: http://compling.hss.ntu.edu.sg/omw/
- Our NLP pipe was tuned to produce NAF output. The pipe for Bulgarian was included into NewsReader website.
- Preliminary ideas on Semantic Role Labeling. However, we did not have the treebank semantic annotation finished yet

Meanwhile: from July 2014 to July 2015

- Sense annotation of the treebank and WSD experiments with the UKB tool
- Extending our Wordnet with senses from the treebank
- Catena approach to MWEs and valency
- Using DBPedia for transliterating/translating foreign names into Bulgarian
- Transferring BulTreeBank into Universal Dependencies format (first release was on 15 May 2015 with 125k, which is half of the resource): http://universaldependencies.github.io/docs/#language-bg

This year – July 2015 - Amsterdam

- Preparation for new WSD experiments with the UKB tool: extraction of relations from SemCor
- Transferring the predicate matrix information from the annotated English part of a news corpus (Setimes) to the Bulgarian part
- Cleaning the extended Wordnet
- Evaluation of the results for Bulgarian from Antoni's WN tool

Sense Annotation

Two stages:

- Stage 1 - DONE
  - Mapping the definitions of a Bulgarian explanatory dictionary to the intersected senses of Core and Base Concepts in Princeton WordNet
  - Mappings manually checked and curated wrt: selection of the correct sense; addition of a sense or update of a definition
- Stage 2
  - Mapping nouns, verbs, adjectives and adverbs from the treebank to WordNet – ALMOST DONE
  - Annotation of domain specific texts (IT) with WordNet – STARTED
  - Using Antoni's WN tool for extending the WordNet - STARTED

Sense Annotation: Process

Three layers:

- Verb valency frames [Osenova et. al. 2012]
- Senses of verbs, nouns, adjectives and adverbs
- DBPedia URIs over named entities.

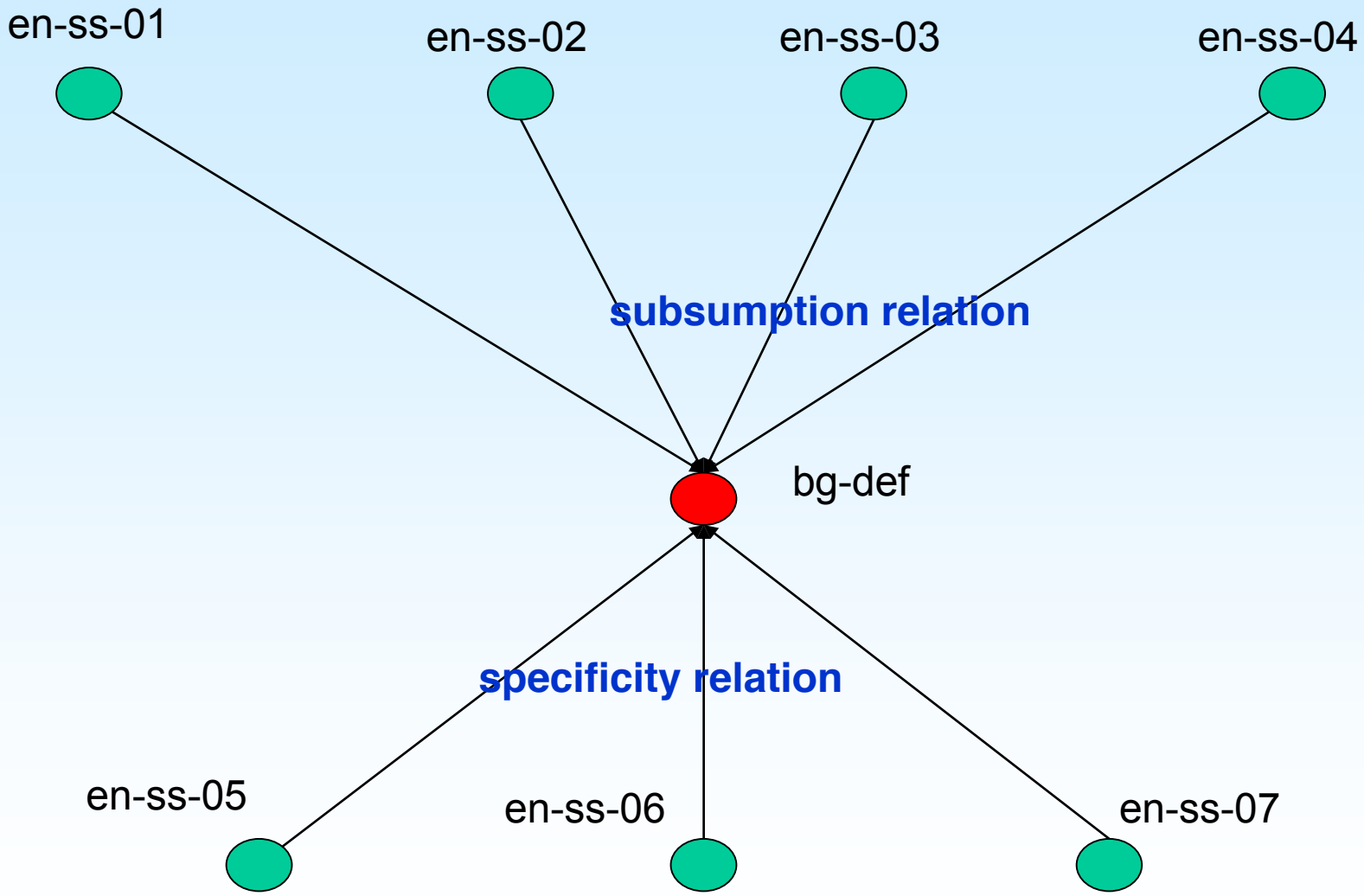
Mapping of Treebank Senses to Wordnet

Partial concept correspondence dominates - the concepts differ in terms of specificity;

The use attribute *rel(ation)* with three values – 0, 1, 2

- 0 – one-to-one correspondence (**equality**);
- 1 – a more specific definition in Bulgarian is mapped to a more general English definition;
- 2 – a more general definition in Bulgarian is mapped to a more specific English definition;

Synset Mapping



DBPedia Linking

- DBPedia URIs annotation was performed as a separate activity
- It covered 10 885 named entities
- Unfortunately, the coverage of the Bulgarian DBPedia is rather small
- For that reason, the Bulgarian Wikipedia was explored

Sense Annotation: MWEs

- During sense annotation all the idiomatic expressions (*idioms*, *light verb constructions*, etc.) have been specifically labeled as multiword expressions (in contrast to the previously pure syntactic approach, taken in the annotation of the treebank)
- Since many of these expressions have a rather narrow potential for combination with other units, the differences show in the ontological constraints.
- Example: PERSON/GROUP OF PERSONS remains/remain without **roof** (PERSON/GROUP OF PERSONS becomes/become homeless)

Some Statistics

- Sense coverage of the BulTreeBank with Wordnet mappings:
  - **79 703** tokens;
  - 37 330 nouns;
  - 14 341 verbs;
  - 17 304 adjectives;
  - 10 728 adverbs.

All tokens: **107 961**

- Verb valency frames:
  - 1755 verbs;
  - 3435 valency frames
- Extending WN with Antoni's tool: after manual evaluation the precision was improved from **66.84%** (only Core WN) to **76.53%** (plus evaluated additions).

Some Observations on the PM transfer on Setimes Data

- Reasons for non-transfer
  - Error is POS tagger or lemma in BG
  - BG lemma is not present in WN
- Transferred cases
  - The sense differs from PM, but still holds
  - Several senses matched, and the correct one there
  - One sense matched from BG WN, but the correct one
  - Wrong sense match due to the missing BG sense in WN

The Sense Differs from PM, but still Holds

- Prodi **sought** to confirm
- Проди **искаше (wanted)** да се убеди

In EN: seek, hunt, look for (verb.contact))

In BG: want=desire (verb.emotion)

Several Senses Matched, Including the Correct one

- Ministers will not **have** summer holidays
- Много министерства няма да **разрешават (allow)** отпуск

Since two different verbs have been used: have and allow, the transferred concept from PM of Permission is correct

One Sense Matched from BG WN, but the Correct One

- This **is expected** in November
- Това **се очаква** през ноември

In BG WN there is only one mapping:
verb.cognition: regard something as probable or likely

Wrong Sense Match due to Missing BG Sense

I am here **to share (communication)** the emotion

Аз съм тук, за да **споделя (possession)** вашите емоции

He must **make (verb.social=carry out)** a political decision

Той трябва **да вземе (take=verb.possession)** политическо решение

Knowledge-based WSD

- Our own toy implementation of Page Rank and Personalized Page Rank
- Small knowledge graph: ontology and relations
- Experiments with inheritance, structure of the graph, mappings from the text to the graph
- Easy to control and easy to observe the performance

UKB: Graph Based Word Sense Disambiguation and Similarity

- Knowledge-based approach to word sense classification; no supervision in the form of a manually annotated corpus needed
- Personalized PageRank algorithm
- http://ixa2.si.ehu.es/ukb

First Experiments

- We are using the knowledge graph developed by UKB team via mapping from Bulgarian WordNet to English WordNet

Graph	Accuracy	Recall
WN	0.517	0.940
WNG	0.538	0.940

- Not very optimistic
- A possible solution: adding more knowledge to the graph

Knowledge Graph

- We performed several extensions of the Knowledge Graph with additional arcs
  - Domain relations from WordNet
  - Inferred hypernymy relations
  - Syntactic relations from the gold corpus
  - Extended syntactic relations

Syntactic Relations

- From Universal Dependency Representation of BulTreeBank extraction of dependency relations denoting **event-participant** semantic relations:

  SynSet1 – DepRel – SynSet2

- 15,675 triples
- 8,772 relations: 1,844 nsubj, 3,875 nmod, 1,025 amod, 716 iobj and 1,312 dobj dependency relations

Extended Syntactic Relations

- If in the triple SynSet1 – DepRel – SynSet2, SynSet11 is hyponym of SynSet1 and SynSet1 is participant in the event then we add the triple SynSet11 – DepRel – SynSet2

  A doctor kisses a girl. → *A surgeon kisses a girl.*

- Result: 372,247 (nsubj), 1,125,823 (nmod), 377,577 (amod), 114,760 (iobj) and 292,202 (dobj) semantic relations

More Syntactic Relations

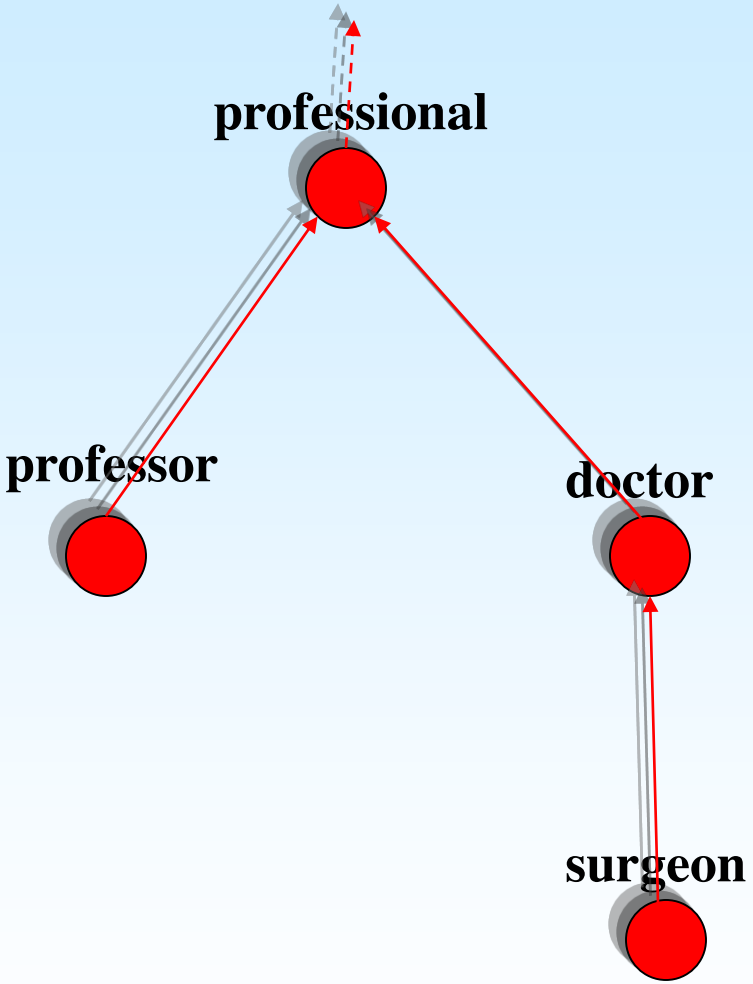
- The relations in the treebank are not the most general ones
- Our goal for each event to find the most general concept restricting each participant in the event. The same participants in more general event:

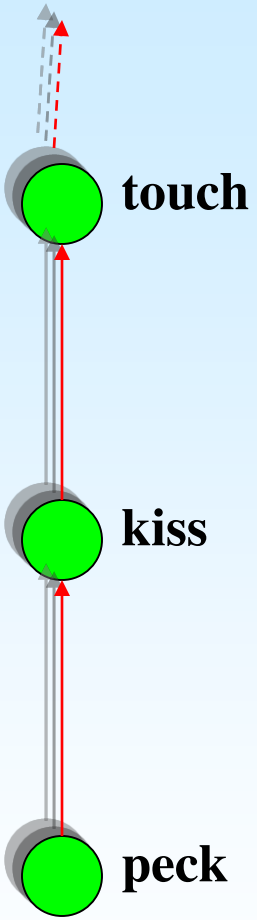
  A doctor kisses a girl. → *A professional kisses a woman.* → *A professor kisses a bar girl.*

  A doctor kisses a girl. → *A doctor touches a girl.*

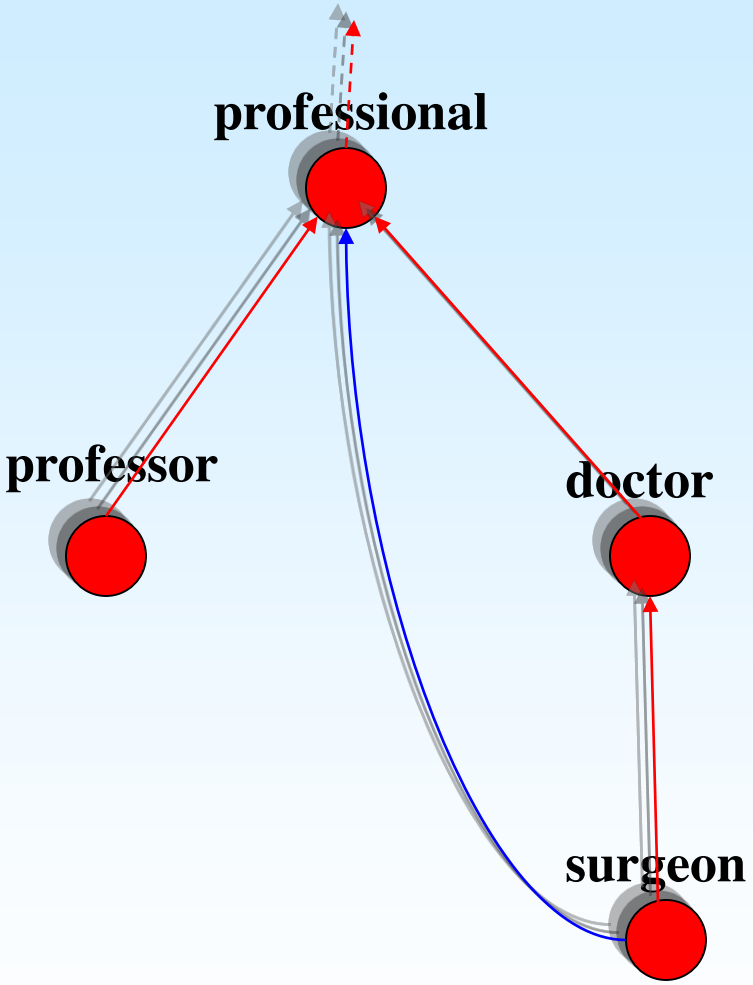
- In the experiments: move to the direct hyperonym and extend with all hyponyms

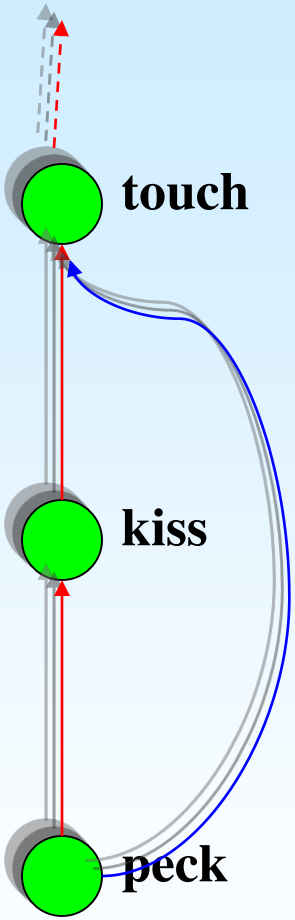
Knowledge Graph Extensions



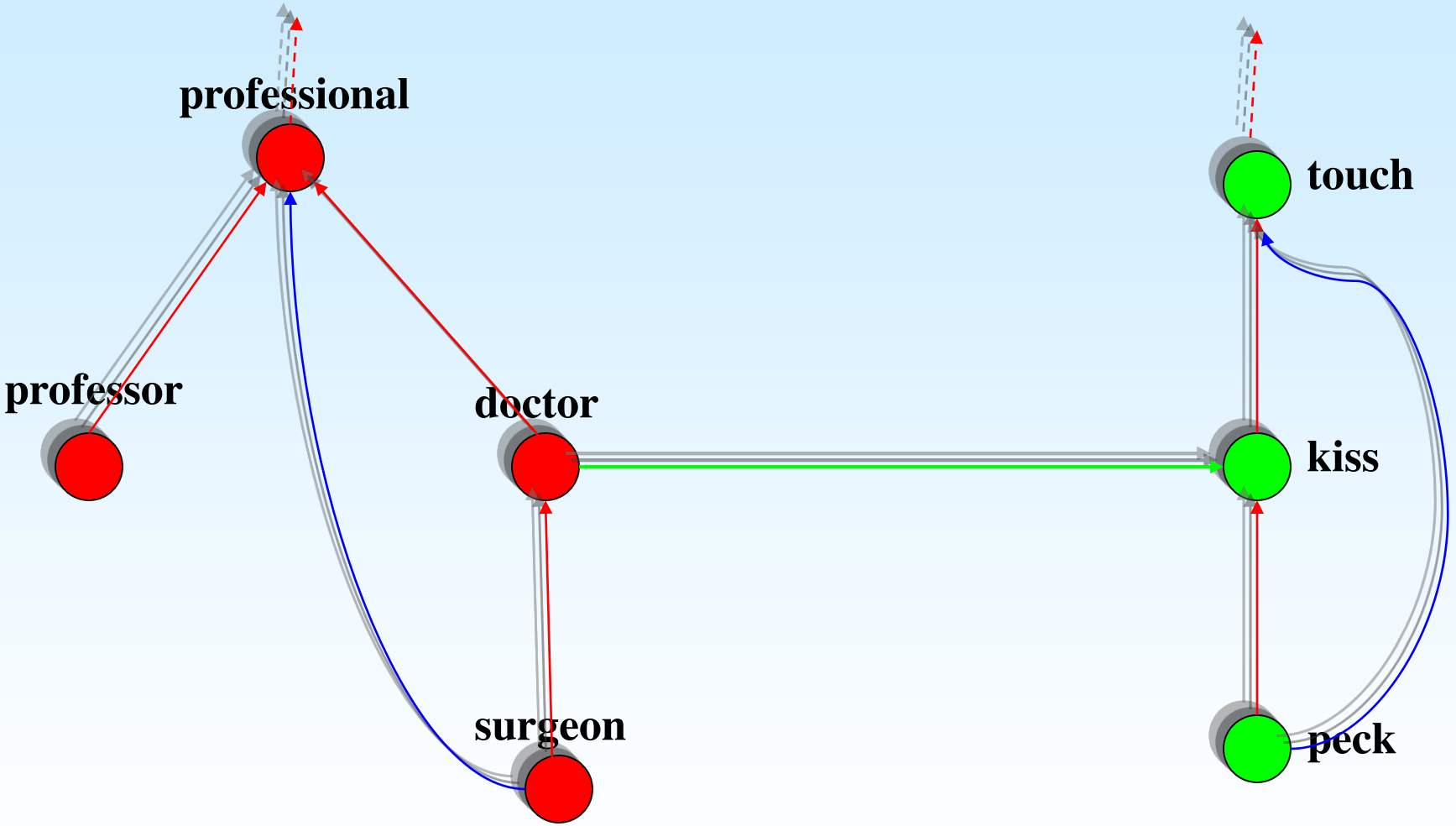


Knowledge Graph Extensions – Inheritance

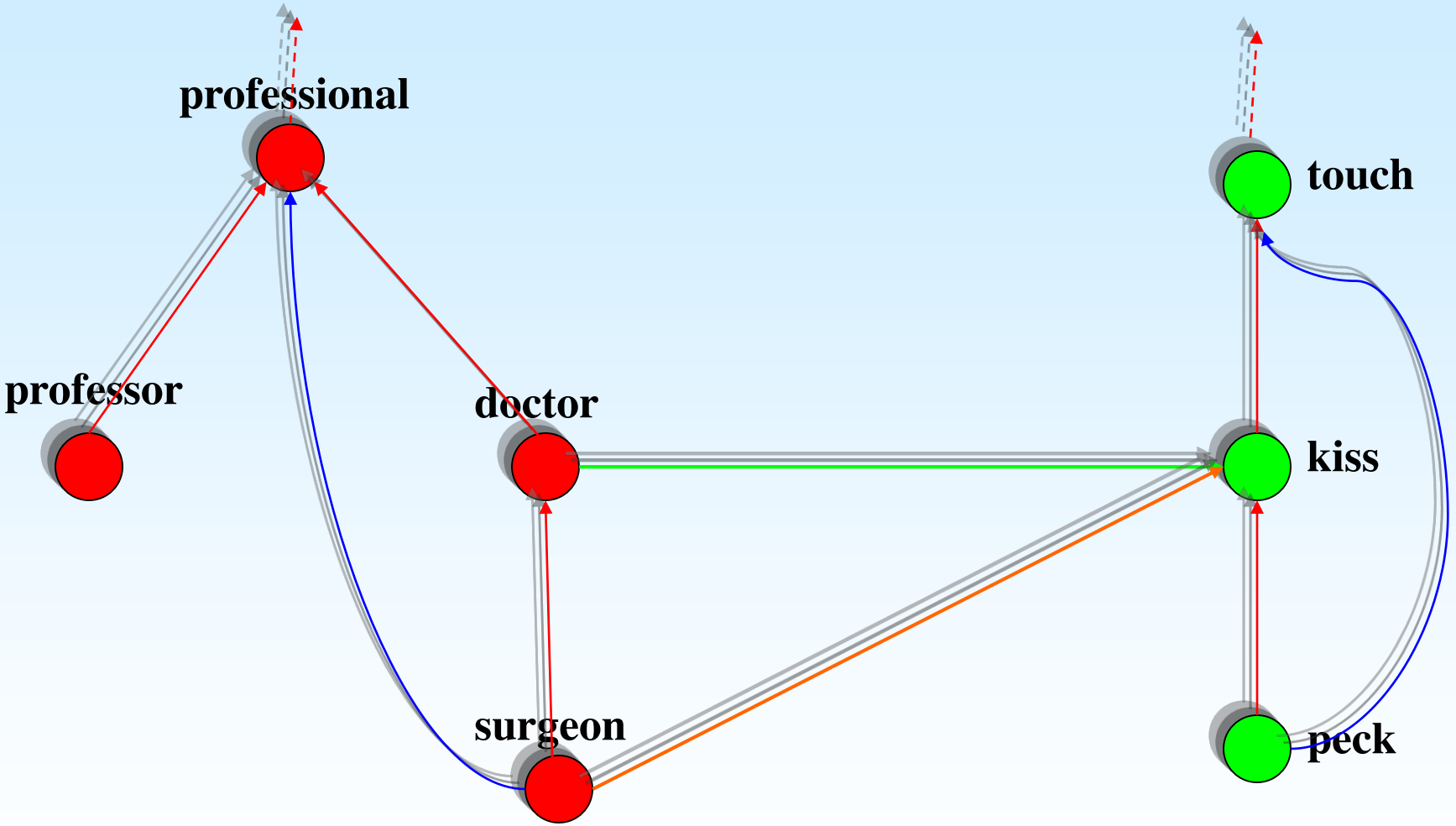




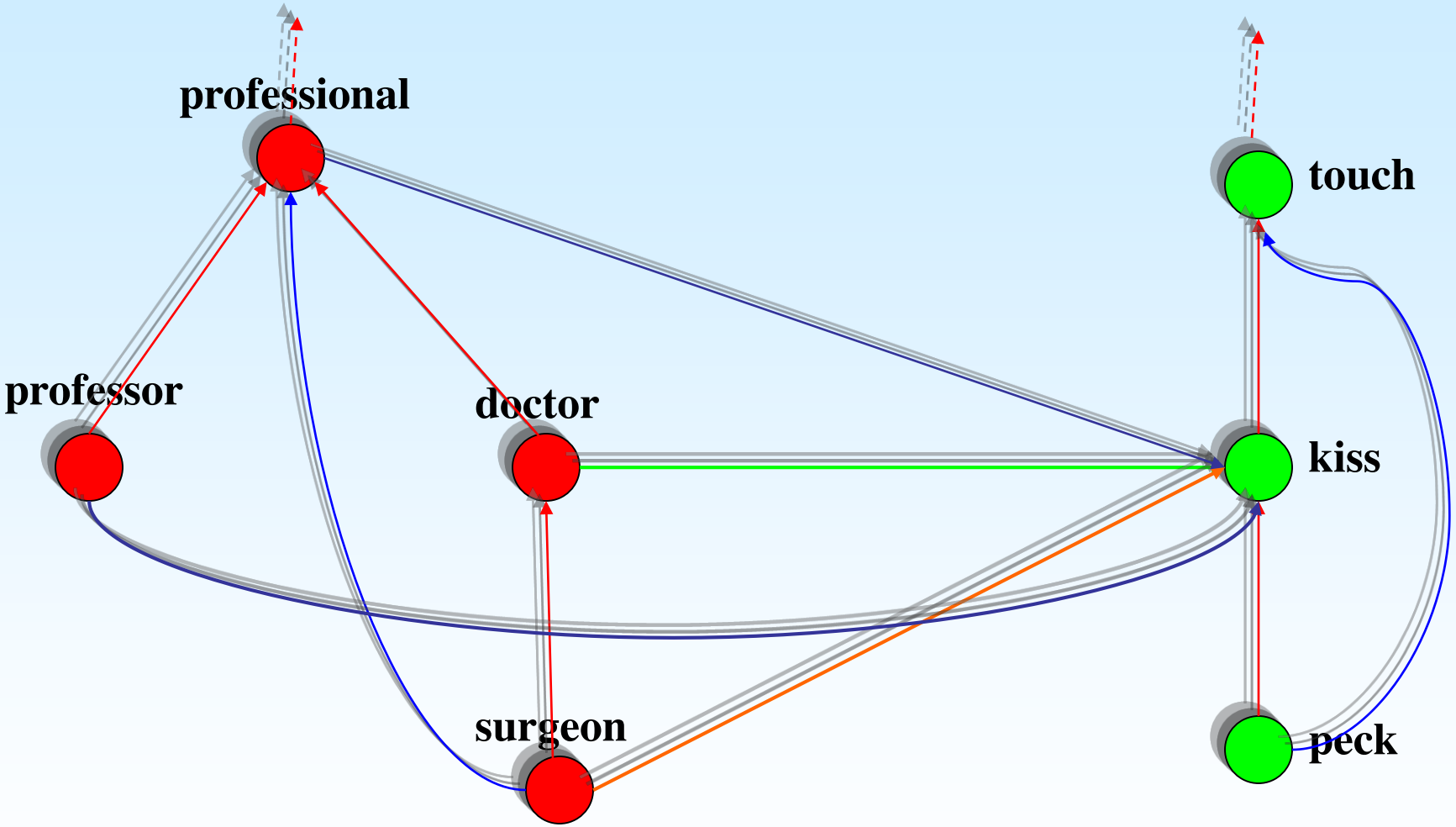
Knowledge Graph Extensions – Syntax



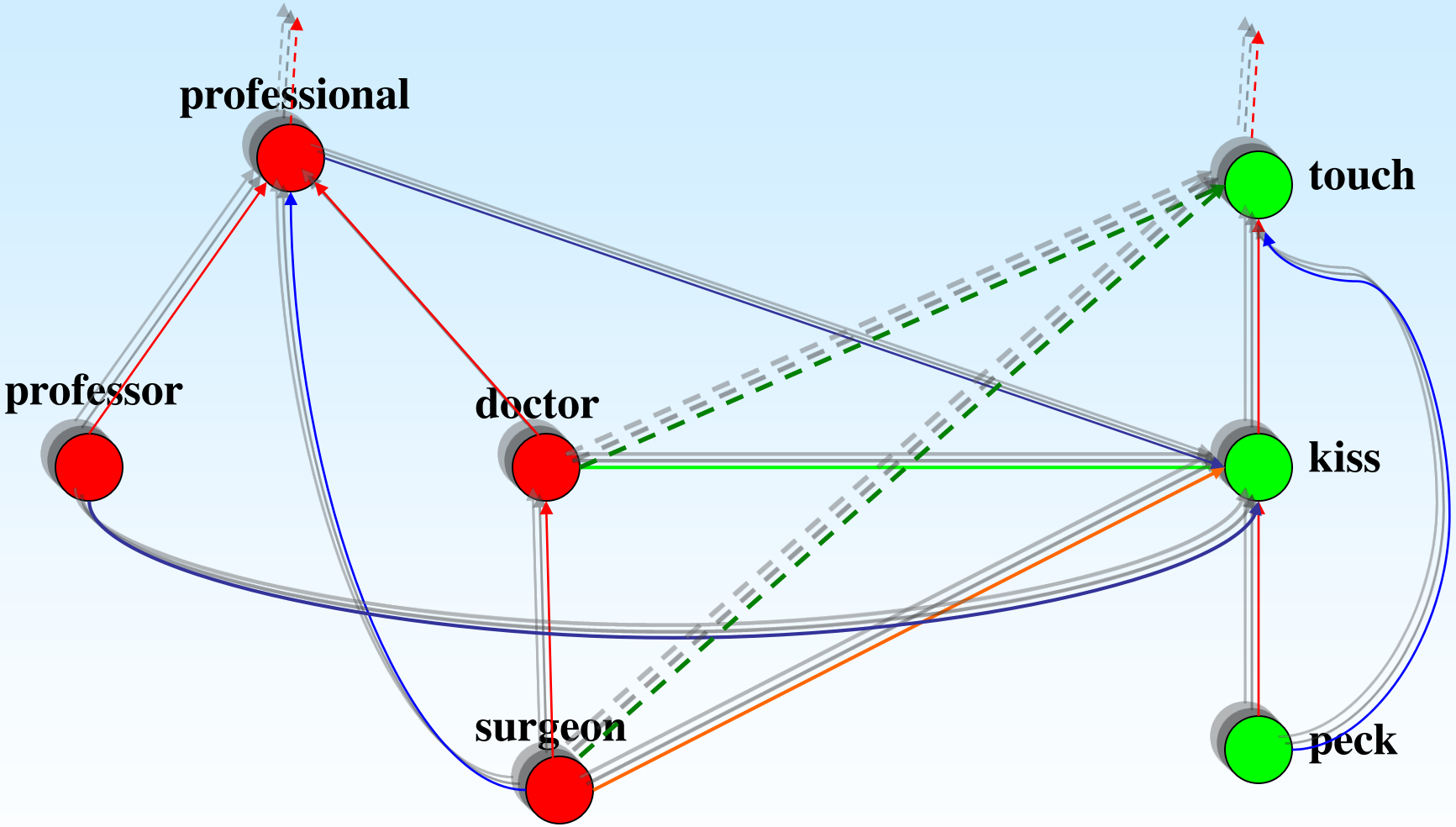
Knowledge Graph Extensions – Syntax ↓



Knowledge Graph Extensions – Syntax ↑↓



Knowledge Graph Extensions – Syntax V↑



Knowledge Graphs

- **WN**: WN relations
- **WNG**: WN relations + relations from the glosses
- **WNI**: WN relations + inferred hypernymy relations
- **WNGI**: WN + glosses + hypernymy
- **WNGID1**: WN + glosses + hypernymy + synset-to-domain
- **WNGID2**: WN + glosses + hypernymy + domain synset-to-synset
- **WNGIS**: WN + glosses + hypernymy + dependency relations
- **WNGISE**: WN + glosses + hypernymy + extended dependency
- **WNGISED1**: WN + glosses + hypernymy + extended dependency + synset-to-domain
- **WNGISED2**: WN + glosses + hypernymy + extended dependency + domain synset-to-synset
- **WNGISEUD2**: WN + glosses + hypernymy + extended dependency one level up + domain synset-to-synset

Results

Graph	Accuracy	Recall
WN	0.517	0.940
WNG	0.538	0.940
WNI	0.535	0.940
WNGI	0.537	0.940
WNGID1	0.538	0.940
WNGID2	0.550	0.940
WNGIS	0.565	0.941
WNGISE	0.616	0.941
WNGISED1	0.617	0.941
WNGISED2	0.624	0.941
WNGISEUD2	0.656	0.941

Experiments with SemCor

- We have tried the most successful BTB knowledge graph and SemCor as a dataset – non-encouraging result:

  WNG: **57.78**; WNGISD2: **57.66**; WNGISED2: **55.80**
- Syntactic Analysis of SemCor and new semantic relations are extracted: 95901 new relations – new experiments over SemCor itself
- Different domains:
  - The first most frequent synsets in BTB and SemCor do not have common elements
  - About 8000 common relations between BTB and SemCor

OntoNotes

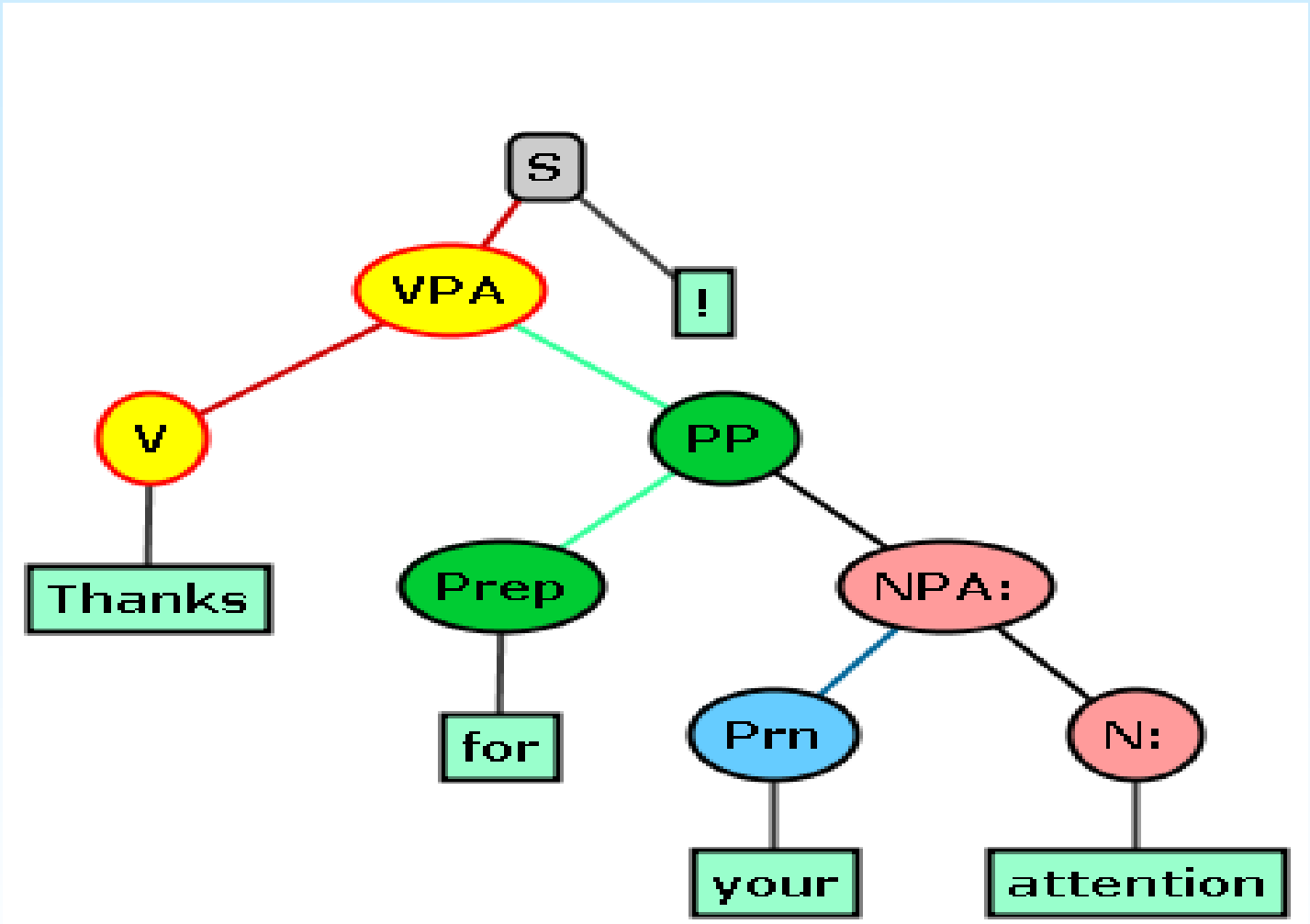
- A corpus with syntactic and semantic annotation
- We are studying the annotation in order to do the same experiments
- Constituent annotation
- Senses are not exactly the same as in WordNet

Knowledge-based WSD – to Sum Up

- Crucial role is played by the Knowledge Graph
- Adding new relations is meaningful and helps
- Searching for new relations – automatic from semistructural information source (efficiency problem)
- Knowledge transfer between languages
- Integration with other approaches
- Integration of annotated texts

Open Questions

- What is a good knowledge graph?
  Hypothesis: similar number of links and disambiguating links
- How to cope with the number of nodes and links?
  Hypothesis: only a small portion of nodes and links converge slowly. Number of iterations is small for many nodes and arcs
- How the nodes from the text are linked to knowledge graph?
  Hypothesis: directed links from KG to the text
- How to incorporate the annotated corpus in KG?
  No idea!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VPA
!
V
PP
Thanks
Prep
NPA:
for
Prn
N:
your
attention