Workshop on Semantic Annotation and the Integration and Interoperability of Multimodal Resources and Tools

Treebanks of Logical Forms: they are Useful Only if Consistent

Rodolfo Delmonte, Agata Rotondi
Department of Linguistic Studies
Università Ca' Foscari
Email: delmont@unive.it
Website: http://project.cgm.unive.it

Overview

- Introduction
- XWN: General presentation
  - Scope and Architecture of LF
  - Some Example LFs
- XWN: Problems
  - Nominal Compounds
  - Tagging Errors
  - Negation - Scope
  - Free Variables
  - Three-Place Predicates
  - Inconsistent LFs
- Conclusions

Introduction: Available LF Resources

- XWNet (Moldovan and Rus, 2001)
- WN30-lfs (Clark et al., 2008)
- ILF (Agerri and Peñas, 2010)
- http://wordnet.princeton.edu/glosstag.shtml
- http://wordnetcode.princeton.edu/standoff-files/wn30-lfs.zip
- http://xwn.hlt.utdallas.edu
- http://www.isi.edu/~hobbs/LFToolkit/index.html
- Vasile Rus: Logic Form Identification* - Guidelines for Task 14 former 16) at SENSEVAL-3 by Ken Litkowski

Introduction: Systems that Produce LFs

- Percy Liang, Michael I. Jordan, Dan Klein, 2011. Learning dependency-based compositional semantics. *Association for Computational Linguistics (ACL).*
- Cahill, McCarthy, van Genabith, Way, 2003. Quasi-Logical Forms from F-Structures for the Penn Treebank.
- Luke S. Zettlemoyer and Michael Collins, 2009. Learning Context-dependent Mappings from Sentences to Logical Form. In *Proceedings of the Joint Conference of the Association for Computational Linguistics and International Joint Conference on Natural Language Processing* (ACL-IJCNLP), 2009.
- Maria Liakata, Stephen G. Pulman: From Trees to Predicate-argument Structures. COLING 2002. & Stephen G. Pulman, Maria Liakata: Learning domain theories. RANLP 2003: 29-4.
- Minimal Recursive Semantics in the Hinoki Treebank: Francis Bond et al. 2004, In Proceedings of the First International Joint Conference on Natural Language Processing IJCNLP-04.
- Discourse Representation Structures (DRSs) from CCG by Johan Bos, ccg2sem a post-processor, downloadable from http://groups.inf.ed.ac.uk/ccg/software.html
- Alshawi, H., Pi-Chuan Chang, M. Ringgaard. (2011). Deterministic Statistical Mapping of Sentences to Underspecified Semantics
- Jerry Hobbs, The Tacitus Project – Mini Tacitus, a JAVA implementation by Rutu Mulkar-Mehta

LF from WN – parsing glosses

- To improve the accuracy of the parsing, the glosses have been extended in the following way:
- the adverb glosses were extended with the adverb and "is" in front of the gloss and a period at the end of it, as in: /entirely is without any others being included or involved ./
- the adjective glosses were extended with the adjective and "is something" in front of the gloss and a period at the end of it, as in: /infinite is something total and all-embracing ./
- the verb glosses were extended with the "to" + verb + "is to" in front of the gloss and a period at the end of it, as in: /to hiccup is to breathe spasmodically , and make a sound ./
- the noun glosses were extended with the noun and "is" in front of the gloss and a period at the end of it, as in: /space is the unlimited 3-dimensional expanse in which everything is located./

LF from WN – parsing glosses

- The glosses have been tagged with an improved version of Brill's tagger, trained on WordNet. A voting scheme between two parsers has been used in order to parse the glosses with high accuracy. The two parsers are: Charniak's parser and an in-house parser (a Collins' type of parser). The parsed glosses provided in our first release of XWN fall into three categories: GOLD, SILVER and NORMAL. GOLD quality is attributed to those parsed glosses that have been manually checked. SILVER quality is attributed to those parsed glosses for which there has been agreement between the two parsers, but without human verification. NORMAL quality is attributed to the rest of the glosses, meaning that there has been no agreement between the two parsers and no human intervention has been employed to check them. The in-house parser was given precedence in this situation.

Types	Adverb.	Adjectiv.	Verbs	Nouns
Gold	3994	16059	14441	32844
Silver	0	4321	0	7228
Normal	0	0	0	54796
Total	3994	20380	14441	94868

Table 1.: Number of Gold/Silver/Normal LF entries in XWN

Nouns

- The LFT codifies the syntactic subjects, syntactic objects, prepositional attachments, complex nominals, and modifiers. The Logic Form of a gloss is represented in the following manner for each part-of-speech: * 'noun': For each synset, the first word representing the synset is taken and assigned the argument 'x1'.
- *plant:NN(x1) -> living:JJ(x1) organism:NN(x1) lack:VB (e1, x1, x2) power:NN(x2) of:IN(x2, x3) locomotion:NN (x3)*
- *Compound nn*
  - *jam_session:NN(x1) -> impromptu:JJ(x1) nn(x1, x2, x3) jazz:NN(x2) concert:NN(x3)*

Adjective and Adverbs

- For each synset, the first word representing the synset is taken and assigned the argument 'x1'. In the gloss of the synset on the RHS, the argument 'x1' refers to the same entity as the one described by the first word in the synset.
- *ascetic:JJ(x1) -> practice:VB(e1, x1, x2) great:JJ(x2) self-denial:NN(x2)*

- For each synset, the first word representing the synset is taken and assigned the argument 'e1'. In the gloss of the synset on the RHS, the argument 'e1' refers to the same action (or a modification of the same action).
- *grossly:RB(e1) -> in:IN(e1, x1) gross:JJ(x1) manner:NN (x1)*

Verbs

For each synset, the first word representing the synset is taken and assigned the argument 'e1', its subject is assigned the argument 'x1' and the object 'x2'. Please note that the object argument can be a dummy since the verb could be an intransitive one.

- *give:VB(e1, x1, x2, x3) -> allow:VB(e1, x1, x3) to:IN(e1, e4) have:VB(e2, x3, x2) or:CC(e4, e2, e3) take:VB(e3, x3, x2)*

- *recognize:VB(e1, x1, x2) -> show:VB(e1, x1, x5) approval:NN(x3) or:CC(x5, x3, x4) appreciation:NN(x4) of:IN(x5, x2)*

Other categories

- prepositions are treated as predicates with two arguments, the first being the head noun that is modified by the prepositional phrase, and the second being the modified head noun;
- possessive pronouns introduce a relation between the governing head and the referent of the possessive pronoun, the predicate POS is used to represent this relation.

CONJUNCTIONS deleted

<gloss pos="NOUN" synsetID="07164600">

<synonymSet>seedcake, seed_cake</synonymSet>

<text> a sweet cake flavored with sesame or caraway seeds and lemon </text>

<lft quality="NORMAL">

seedcake:NN(x1) -> sweet:JJ(x1) cake:NN(x1) flavor:VB(e1, x7, x1) with:IN(e1, x6) sesame:NN(x2) caraway:JJ(x5) seed:NN(x3) and:CC(x30, x31, x32) lemon:NN(x4) </lft>

</gloss>

PHRASAL & PREPOSITIONAL VERBS

<gloss pos="VERB" synsetID="00040699">
<synonymSet>powder</synonymSet>

<text> apply powder to; "She powdered her nose"; "The King wears a powdered wig" </text>

<lft quality="GOLD">

powder:VB(e1, x1, x2) -> apply:VB(e1, x1, x3) powder:NN(x3) to:IN(e1, x2) </lft>

</gloss>

PHRASAL & PREPOSITIONAL VERBS

<gloss pos="NOUN" synsetID="07918617">
<synonymSet>secondary</synonymSet>
<text>the defensive football players who line up behind the linemen </text>
<lft quality="NORMAL">
secondary:JJ(x4) -> defensive:JJ(x1) football:NN(x1) player:NN(x1) line:VB(e1, x1, x26) behind:IN(e1, x2) linemen:NN(x2) </lft>
</gloss>

Problems: Nominal Compounds

<lft quality="NORMAL">

bataan:NN(x1) -> peninsula:NN(x2) and:CC(x1, x2, x3) island:NN(x3) in:IN(x1, x4) philippines:NN(x4) japanese:JJ(x5) force:NN(x5) besiege:VB (e1, x9, x5) american:NN(x6) force:NN(x7) in:IN(x6, x8) *world_war_ii:NN (x8)* </lft>

<lft quality="NORMAL">

wac:NN(x1) -> member:NN(x1) of:IN(x1, x2) women's:NN(x2) army:NN (x3) corp:NN(x4) be:VB(e1, x2, e2) organize:VB (e2, x9, x2) during:IN(e2, x5) *world:NN(x5) war:NN(x6) ii:NN(x7)* but:CC(e4, e0, e3) be:VB(e3, x1, x8) no:RB(e3) longer:RB(e3) separate:JJ(x8) branch:NN(x8) </lft>

Problems: Nominal Compounds

<lft quality="SILVER">

battle_of_the_ardennes_bulge:NN(x1) -> battle:NN(x1) during:IN(x1, x2) *world:NN(x2) war:JJ(x2) ii:NN(x3)*

</lft>

<lft quality="NORMAL">

snafu:NN(x1) -> acronym:NN(x1) often:RB(e0) use:VB(e1, x2, x1) by:IN (e1, x2) soldier:NN(x2) in:IN(e1, x3) *world:NN (x3) war:NN(x4) ii:JJ(x3)* situation:NN(x5) normal:JJ(x6) all:JJ(x6) fucked:NN(x6) up:IN(e1, x6) </ lft>

Tagging Errors

<gloss pos="NOUN" synsetID="10317346">

<synonymSet>Hawking, Stephen_Hawking, Stephen_William_Hawking</synonymSet>

<text> English theoretical physicist (born in 1942)

</text>

<lft quality="NORMAL">

hawk:VB(e1, x3) -> english:NN(x1) theoretical:JJ(x1) physicist:NN(x2)</lft>

</gloss>

Negation

- 3107 cases of NOT overall
  - 2024 in Adjectives; 947 in Nouns; 79 in Adverbs; 57 in Verbs
- some 20% are wrongly scoped
- Other negation markers:
  - NO, NONE, NOTHING, NEVER, NOR
  - 676 occurrences, we come up to 3783 cases

Negation Scope

- Negation can receive different scope according to its semantic role: it can negate the main verb or modifiers of the verb like adverbials – and in this case it will receive wide scope over the proposition, verb and arguments - or it can negate some specific argument or adjunct and in this case it will receive narrow scope.

Negation Scope

<synonymSet>unenlivened</synonymSet>
<text> not made lively or brightened

(NP (NP (NN something))
(VP (RB not) (VBN made)
(ADJP (JJ lively) (CC or) (JJ brightened)))

unenlivened:JJ(x1) ->
not:RB(e1) make:VB(e1, x5, x3, x1) lively:JJ(x3) brightened:JJ(x3)

unenlivened:JJ(x1) ->
make:VB(e1, x5, x3, x1) not:RB(x3) lively:JJ(x3) brightened:JJ(x3)

Two/Three Place Predicates

- Transitive Verbs are regarded two-place predicates, while Intransitive Verbs are usually treated as one-place
- Transitive = LF: draw:VB(e2, x1, x3) air:NN(x3)
- ?? Intransitive = LF: breathe:VB(e1, x1, x2)
- ?? Weather = LF: snow:VB(e1, x1, x2)
  - drizzle:VB(e1, x1, x2) -> rain:VB(e1, x1, x3) lightly:RB(e1)
- Ditransitive = LF: put:VB(e1, x1, x3, x2)
  - Only 3 times over 408
- Problems with representation arise when considering the mapping from syntax to semantics

Two/Three Place Predicates

- Verbs with Secondary Predication Arguments, perceptive verbs, causative verbs may have a two/three-place structure in LF
- LF: cause(e1,x1,e2), event(e2,x2,x3)
- LF: name(e1,x3,x2,x1), someone(x2),property(x3)
- Theoretically, this is due to the need to interpret the Secondary Predication as belonging to the Object or second argument and not to the Subject or first argument
- Problems with representation arise when considering the mapping from syntax to semantics
- These structures are represented with small clauses in PT.

Two/Three Place Predicates

- **Verbs that can take this kind of Small Clause include all perception verbs, and a number of other verbs hold, keep, leave, call, pronounce; wish; believe, consider, render, regard, find, imagine, think; appoint, elect, make, vote; certify, christen, declare, name, among others.**
- **On the contrary Double Object constructions have 3-place structure**

(S (NP-SBJ His bel canto style)
(VP gave
(NP the performance)
(NP a special distinction)))

Two/Three Place Predicates

S (NP-SBJ The late
(NAC Secretary (PP of (NP State))) John Foster Dulles)
(VP considered
(S (NP-SBJ the 1954 Geneva agreement)
(NP-PRD (NP a specimen))))

However this is the Chomskyian proposal, which is not universally accepted. In particular, LFG makes use of Open or Predicative Complements. As a consequence, there is no need to use bracketing or constituency structure to support the interpretation that takes place in the f-structure from the lexicon, being thus a property of verb entries and not of syntax.

Problems: Free Variables

<lft quality="GOLD">
hibernate:VB(e1, x1, x2) -> sleep:VB(e1, x1, x9)
during:IN(e1, x3) winter:NN(x3) </lft>

<text> a man of such superior qualities that he seems like a deity to other people </text>

<lft quality="NORMAL">
god:NN(x1) -> man:NN(x1) of:IN(x1, x2) such:JJ(x2) superior:JJ(x2) quality:NN(x2) that:IN(e1, x5) seem:VB(e1, x2, x26) like:IN(e1, x3) deity:NN(x3) to:IN(x3, x4) other:JJ(x4) people:NN(x4) </lft>

Problems: Free Variables DIE

- Die – 78 occurrences in the Nouns file
- Always treated as a two place predicate: die(e1,x2,x1)

- One case of three-place predicate:
  - <gloss pos="NOUN" synsetID="01194260”> <synonymSet>last</ synonymSet>
  - last – a person’s dying act
  - last:JJ(x3) -> person:NN(x1) die:VB(e1, x1, x1, x1) act:NN(x1)

Problems: Free Variables DIE

- <synonymSet>cenotaph</synonymSet>

  <text> a monument built to honor soldiers who died in a war </text>

cenotaph:NN(x1) -> monument:NN(x1) ***build:VB(e1, x4, x1)*** to:IN(e1, e2) honor:VB(e2, x1, x2) soldier:NN(x2) ***die:VB(e3, x5, x2)*** in:IN(e3, x3) war:NN(x3)

```
(S (NP (NN cenotaph) )
      (VP (VBZ is)
         (NP (NP (DT a) (NN monument) )
            (VP (VBN built)
               (S (VP (TO to)
                     (VP (VB honor)
                        (NP (NP (NNS soldiers) )
                           (SBAR (WHNP (WP who) )
                              (S (VP (VBN died)
                                    (PP (IN in)
                                       (NP (DT a) (NN war) ) ) ) ) ) )
```

Two/Three Place Predicates

- XWN: predication are represented as small clauses:

```
(S (S (VP (TO to)
          (VP (VB cause_to_sleep) ) ) )
     (VP (VBZ is)
       (S (VP (TO to)
            (VP (VB make)
              (VP (VB fall)
                (ADVP (RP asleep) ) ) ) )
```

2-place - cause_to_sleep:VB(e1, x1, x2) ->

- make:VB(e1, x1, e2) fall:VB(e2, x2, x3) asleep(x3)

Two/Three Place Predicates

- XWN: predication are represented as small clauses
- only a few cases have a two-place predicate; the great majority of the cases has three-place LF
    - Consider 57 in Verbs + 25 in Adjectives
    - Make 1132 in Verbs + 340 in Adjectives
    - Cause 539 in Verbs + 259 in Adjectives etc.
- 3-place but not eventive
- Reverence = consider hallowed or exalted
- reverence:VB(e1, x1, x2) -> consider:VB(e2, x1, x3, x2) hallowed:JJ(x3) exalted:JJ(x3)

Two/Three Place Predicates

- ✓ **Only deep relations not surface ones: Past Participles??**

<synonymSet>enlivened, spirited</synonymSet>

<text> made lively or spirited

(NP (NP (NN something))

(VP (VBN made)

(ADJP (JJ lively) (CC or) (JJ spirited))))

- ➢ **enlivened:JJ(x1) ->**
  - ➢ **make:VB(e1, x3, x2, x1) lively:JJ(x2) spirited:JJ(x2)**

Two/Three Place Predicates

<synonymSet>unenlivened</synonymSet>

<text> not made lively or brightened

(NP (NP (NN something))

(VP (RB not) (VBN made)

(ADJP (JJ lively) (CC or) (JJ brightened)))

- **unenlivened:JJ(x1) ->**
  - **not:RB(e1) make:VB(e1, x5, x3, x1) lively:JJ(x3) brightened:JJ (x3)**
  - *make:VB(e1, x1,e2) event(e2,x2,x3) lively:JJ(x3) brightened:JJ(x3) not:RB(e2)*

Two/Three Place Predicates

<synonymSet>set_ablaze, set_aflame, set_on_fire</synonymSet>

<text> set fire to; cause to start burning

(VP (TO to)
(VP (VB cause)
(S (VP (TO to)
(VP (VB start)
(S (VP (VBG burning)))

- **set_ablaze:VB(e1, x1, x2) ->**
  - **cause:VB(e1, x1, x2) to:IN(e1, e2) start:VB(e2, x2, e3) burn:VB(e3, x2, x3)**

Inconsistent LFs

- We extracted all the records containing just the LF from every single file, we then sorted them and checked for their consistency: this was done in order to verify that no two Logical Form are identical to each other. Whenever this happens, the meaning associated to one synset would be interchangeable with the meaning associated to another synset, which is clearly a sign of inconsistency. We found the following situation, over 94868 entries for Nouns 43 are duplicate LFs
- over 20380 entries for Adjective, 47 are duplicate LFs
- over 3994 entries for Adverbs, 12 are duplicate LFs
- over 14441 entries for Verbs, 29 are duplicatre LFs

Inconsistent LFs

- alaska_peninsula:NN(x1) -> peninsula:NN(x1) in:IN(x1, x2) southwestern:JJ(x2) alaska:NN(x2)
- alpaca:NN(x1) -> wool:NN(x1) of:IN(x1, x2) alpaca:NN(x2)
- anagoge:NN(x1) -> mystical:JJ(x1) allegorical:JJ(x1) interpretation:NN(x1)
- approbation:NN(x1) -> official:JJ(x1) approval:NN(x1)
- bailey:NN(x1) -> outer:JJ(x1) courtyard:NN(x1) of:IN(x1, x2) castle:NN(x2)
- Bernoulli:NN(x1) -> swiss:JJ(x1) mathematician:NN(x1)

Inconsistent LFs

- blood_count:NN(x1) -> number:NN(x1) of:IN(x1, x2) red:JJ(x2) white:JJ (x2) corpuscle:NN(x2) in:IN(x2, x3) blood:NN(x3) sample:NN(x4)
- card_catalog:NN(x1) -> enumeration:NN(x1) of:IN(x1, x2) resource:NN (x2) of:IN(x2, x3) library:NN(x3)
- cassava:NN(x1) -> source:NN(x1) of:IN(x1, x2) tapioca:NN(x2)
- catapult:NN(x1) -> use:VB(e1, x2, x1) to:IN(e1, e2) propel:VB(e2, x1, x1) small:JJ(x1) stone:NN(x1)
- clash:NN(x1) -> state:NN(x1) of:IN(x1, x2) conflict:NN(x2) between:IN(x2, x3) person:NN(x3)

CONCLUSIONS

- Eventually we may comment that there are a number of resources available with Logical Forms representations of WordNet glosses, and a number of algorithms which can be used off-the-shelf to produce Logical Forms from PTB constituency based phrase structure representations: none of these resources is however usable as is, do to error rates which average 30%.

CONCLUSIONS

- Residual problems regard
  - the presence of a dummy variable in intransitive and weather verbs
  - the presence of empty free variables
  - how to encode secondary predication and how to render small clause constructions in a homogeneous manner

CONCLUSIONS

- Improvements can be achieved by manual correction of all the LFs contained in these resources. The research has focussed on the typing of the mistakes present in the resource itself. We classified mistakes by their syntactic or semantic type in order to facilitate a revision of the resource that we intend to do using regular expressions.