Using WordNet to Build Lexical Sets for Italian Verbs

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OUTLINE

- What is a lexical set?
- Building lexical sets: goal and motivation
- Methodology: Sentence annotation and lexical sets extraction
  - The Baseline algorithm
  - The LEA algorithm
- Results
- Final considerations and further work

WHAT IS A LEXICAL SET?

Lexical sets are paradigmatic sets of words which occupy the same argument position for a verb, as found in a corpus. (cf. Hanks, 1996 and Jezek and Hanks, 2015)[1]

to read

-> Subject *reads* Object

-> Object *{book, letter, newspaper, report, paper, word, article, story, papers, time, text, mind, page, novel, magazine, poem, passage, ..}* [2]

[1] Hanks P., 1996. Contextual dependencies and lexical sets. *The International Journal of Corpus Linguistics*, 1(1).
Jezek E. and Hanks P., 2010, "What lexical sets tell us about conceptual categories." Lexis 4.7: 22.

[2] Lemmas are extracted from the BNC Corpus, using SketchEngine (Kilgarriff, A. et al., 2004, "Itri-04-08 the sketch engine." Information Technology 105: 116.)

Lexical sets change from verb to verb

- to read – OBJ: *{book, letter, newspaper, report, paper, word, article, story, papers, time, text, mind, page, novel, magazine, poem, passage, bible, ..}*
- to publish – OBJ: *{report, book, article, paper, result, work, letter, study, document,..}*
- to write – OBJ: *{letter, book, article, poem, report, song, name, program, story, word, ..}*
- to send – OBJ: *{letter, message, copy, child, man, troops, money, ..report, .. food,..}*
- to devour – OBJ: *{book, meal, animal, plant, child, Mariana, buffalo, carcass, .. food,.. }*
- to eat – OBJ: *{food, meal meat, fish, breakfast, sandwich, lunch, dinner, bread, diet, ..}*

Lemmas are extracted from the BNC Corpus, using SketchEngine (Kilgarriff, A. et al.,2004, "Itri-04-08 the sketch engine." Information Technology 105: 116.)

Different senses of a verb have different lexical sets

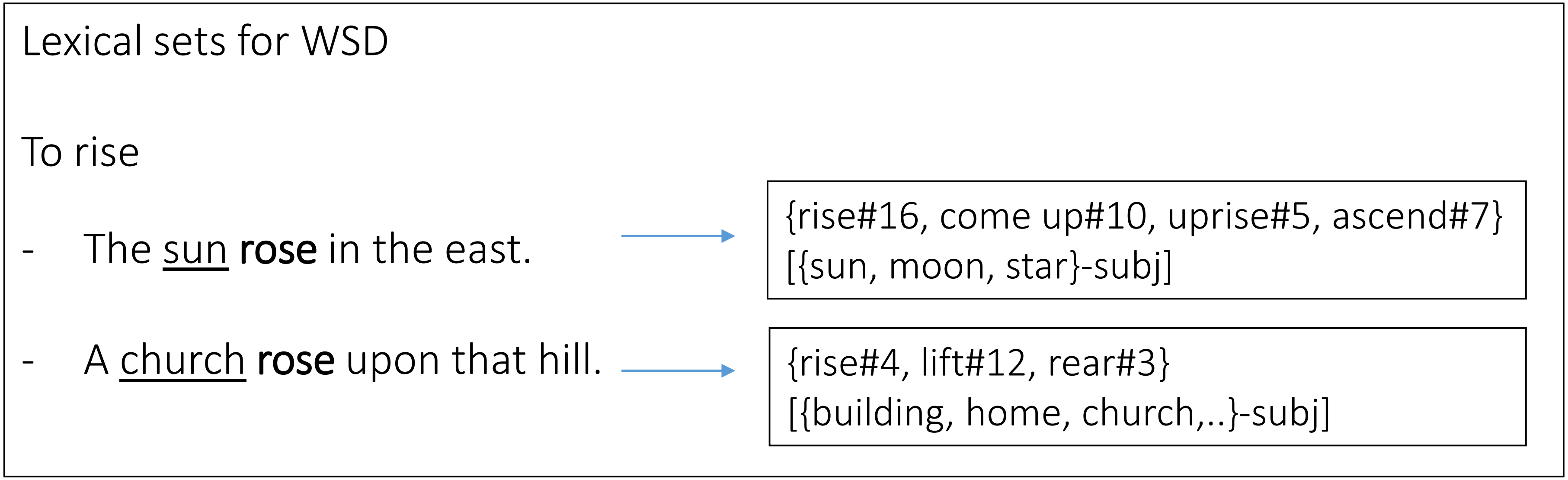
Subject of ‘to rise’ for different senses of the verb:

- to rise up, to rear: *{building, home, church,..}*
- to come up, to uprise: *{sun, moon}*
- to go up, to increase (in value): *{turnover, price, share, rate, unemployment, profit, income, figure, temperature, cost, level, ..}*
- to come up, to move up: *{smoke, ..}*

MOTIVATION

- Verbs' selectional preferences
- Word Sense Disambiguation

if lexical sets are associated to verb senses -> verb meaning can be induced



Lexical sets for WSD

To rise

- The sun **rose** in the east. → {rise#16, come up#10, uprise#5, ascend#7} [{sun, moon, star}-subj]
- A church **rose** upon that hill. → {rise#4, lift#12, rear#3} [{building, home, church,..}-subj]

MOTIVATION

- Verbs' selectional preferences
- Word Sense Disambiguation

  if lexical sets are associated to verb senses -> verb meaning can be induced
- Semantic Role Labeling -> to automatically annotate roles

Lexical sets for SRL

To rise

- The *land* was silent when the *sun* **rose** in the east.

Rise.01 :

Arg1: *Logical subject, patient, thing rising*

Candidate: "land" and "sun"

[{building, home, church, sun, moon, star}-subj]

no "land" -> Arg1: sun

OUR EXPERIMENT

GOAL: Building lexical sets for argument positions of Italian verbs at sense level

WE NEED:

- a repository of verbs with the specification of their argument structure for each sense
- a repository of sentences associated to each verb sense from which the members of the lexical sets can be extracted

METHODOLOGY

- We use the T-PAS resource [1] , a repository of verb frames for Italian in which :
  - the expected semantic type for each argument slot is specified (e.g. Human, Food, Event, Location, Artifact, …)
  - each frame is related to sentences in a corpus in which the verb is annotated

- In these sentences, we automatically annotate the sets of fillers for the argument slots of the selected verb -> the Baseline Algorithm and the Lea Algorithm

- Both algorithms use a mapping from Semantic types to MultiWordNet synsets [2]

T-PAS resource + MultiWordNet + Sentence Annotation -> Lexical Set

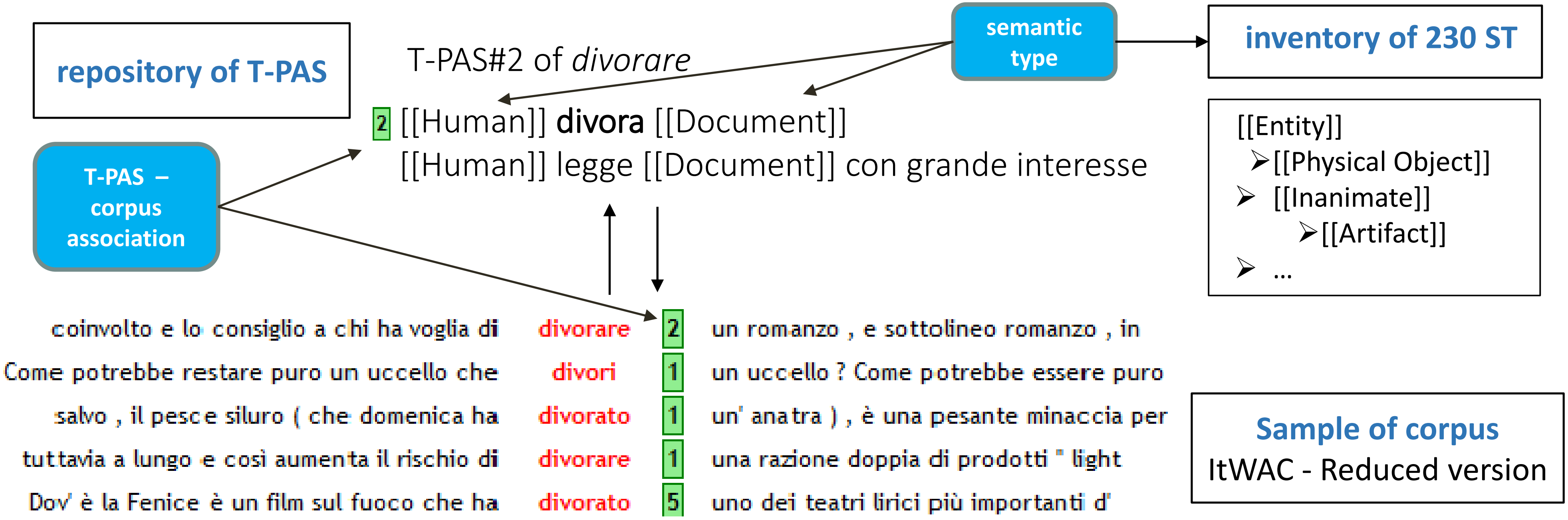
[1] Jezek E. et al., 2014, "T-PAS: a resource of corpus-derived Typed Predicate Argument Structures for linguistic analysis and semantic processing" In *Proceedings of the 9th International Conference on Language Resources and Evaluation (LREC'14),* Reykjavik, Iceland.

[2] Pianta E. et al., 2002. "MultiWordNet: developing an aligned multilingual database". In *Proceedings of the 1st international conference on global WordNet*, volume 152, pages 55–63.

T-PAS: Typed Predicate Argument Structures

T-PAS is a repository of corpus-derived verb patterns for Italian with specification of the expected semantic type for each argument slot.

T-PASs are acquired following Corpus Patten Analysis methodology (Hanks, 2004).



repository of T-PAS

T-PAS – corpus association

T-PAS#2 of *divorare*

2 [[Human]] **divora** [[Document]]

[[Human]] legge [[Document]] con grande interesse

semantic type

inventory of 230 ST

[[Entity]]
- [[Physical Object]]
- [[Inanimate]]
  - [[Artifact]]
- …

coinvolto e lo consiglio a chi ha voglia di	divorare	2	un romanzo , e sottolineo romanzo , in
Come potrebbe restare puro un uccello che	divori	1	un uccello ? Come potrebbe essere puro
salvo , il pesce siluro (che domenica ha	divorato	1	un' anatra) , è una pesante minaccia per
tuttavia a lungo e così aumenta il rischio di	divorare	1	una razione doppia di prodotti " light
Dov' è la Fenice è un film sul fuoco che ha	divorato	5	uno dei teatri lirici più importanti d'

Sample of corpus
ItWAC - Reduced version

Visit **tpas.fbk.eu** and download T-PAS

Hanks P., 2004. “Corpus pattern analysis”. In *Proceedings of the Eleventh EURALEX International Congress*, Lorient, France, Universite de Bretagne-Sud;

SENTENCE ANNOTATION AND LEXICAL SET BUILDING

Input data from T-PAS

repository of T-PASs

T-PAS#2 of *preparare*
[[Human]] **prepara** [[Food | Drug]]
Eng.: [[Human]] **prepare** [[Food | Drug]]

Sentences

"La nonna, prima di infornare le patate, **prepara** una torta"
Eng. "The grandmother, before baking the potatoes, **prepares** a cake"

Sentence annotation = annotate lexical items corresponding to Semantic type

[[Human]] – subj = ?   [[Food]] – obj = ?   [[Drug]] – obj = ?

For all the sentences
=
Lexical set

THE BASELINE ALGORITHM

to identify possible candidate members:

[[Human]] – subj = ? [[Food]] – obj = ? [[Drug]] – obj = ?

1) uses TextPro 2.0[1] for PoS-tagging and lemmatization
2) checks if each lemma is in MWN
3) uses the Semantic type – synsets mapping

Automatic Semantic Type-Synsets mapping
[[Human]] -> human#n
[[Food]] -> food#n
[[Drug]] -> drug#n

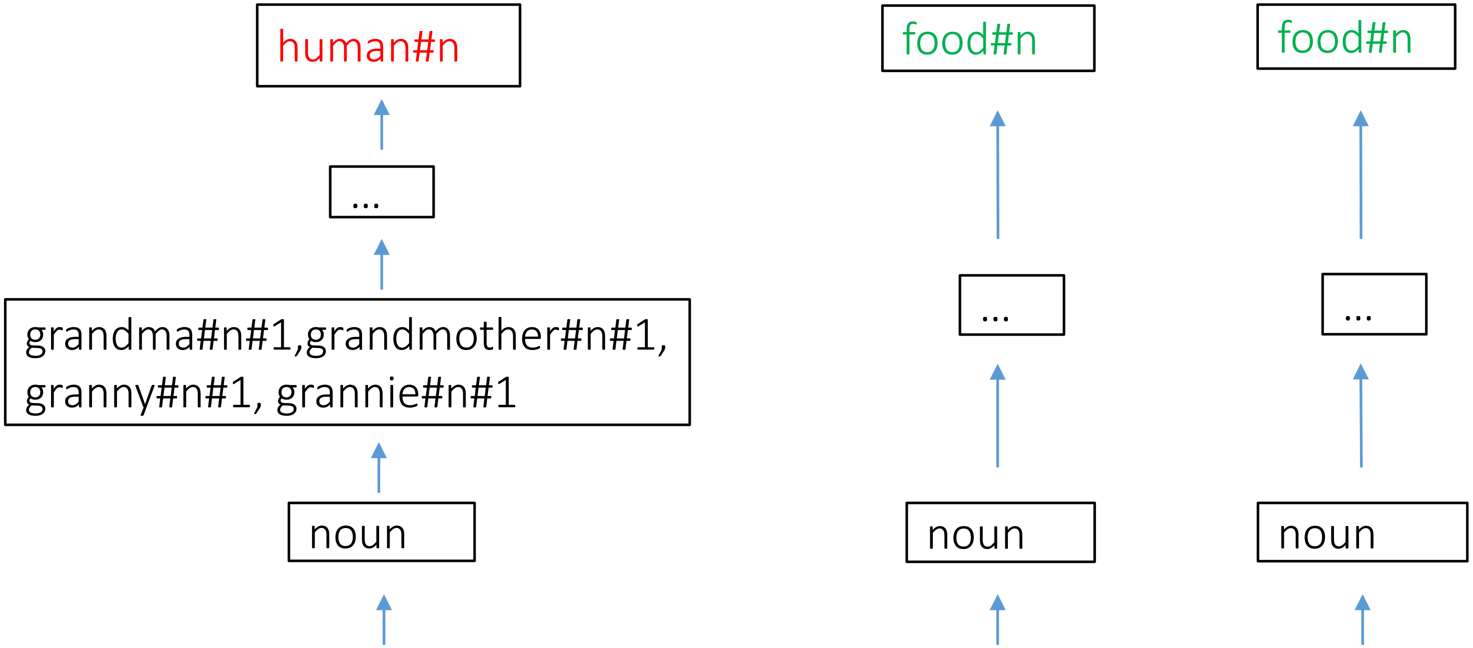
checking if the lemma belongs to a corresponding mapped synset or if it is an hyponym of one such synsets

[1] Pianta E. et al., 2008. The TextPro Tool Suite. In Proceedings of the 6th International Conference on Language Resources and Evaluation (LREC'08), Marrakech, Morocco.

BASELINE:

T-PAS#2 of *preparare*
[[Human]] **prepara** [[Food | Drug]]
Eng.: [[Human]] **prepare** [[Food | Drug]]

[[Human]] – subj = ? [[Food]] – obj = ? [[Drug]] – obj = ?



human#n

...

grandma#n#1,grandmother#n#1, granny#n#1, grannie#n#1

noun

food#n

...

noun

food#n

...

noun

"La nonna, prima di infornare le patate, **prepara** una torta"
Eng. "the grandmother, before baking the potatoes, **prepares** a cake"

LEA:
THE LEXICAL SET EXTRACTION ALGORITHM

to identify possible candidate members:

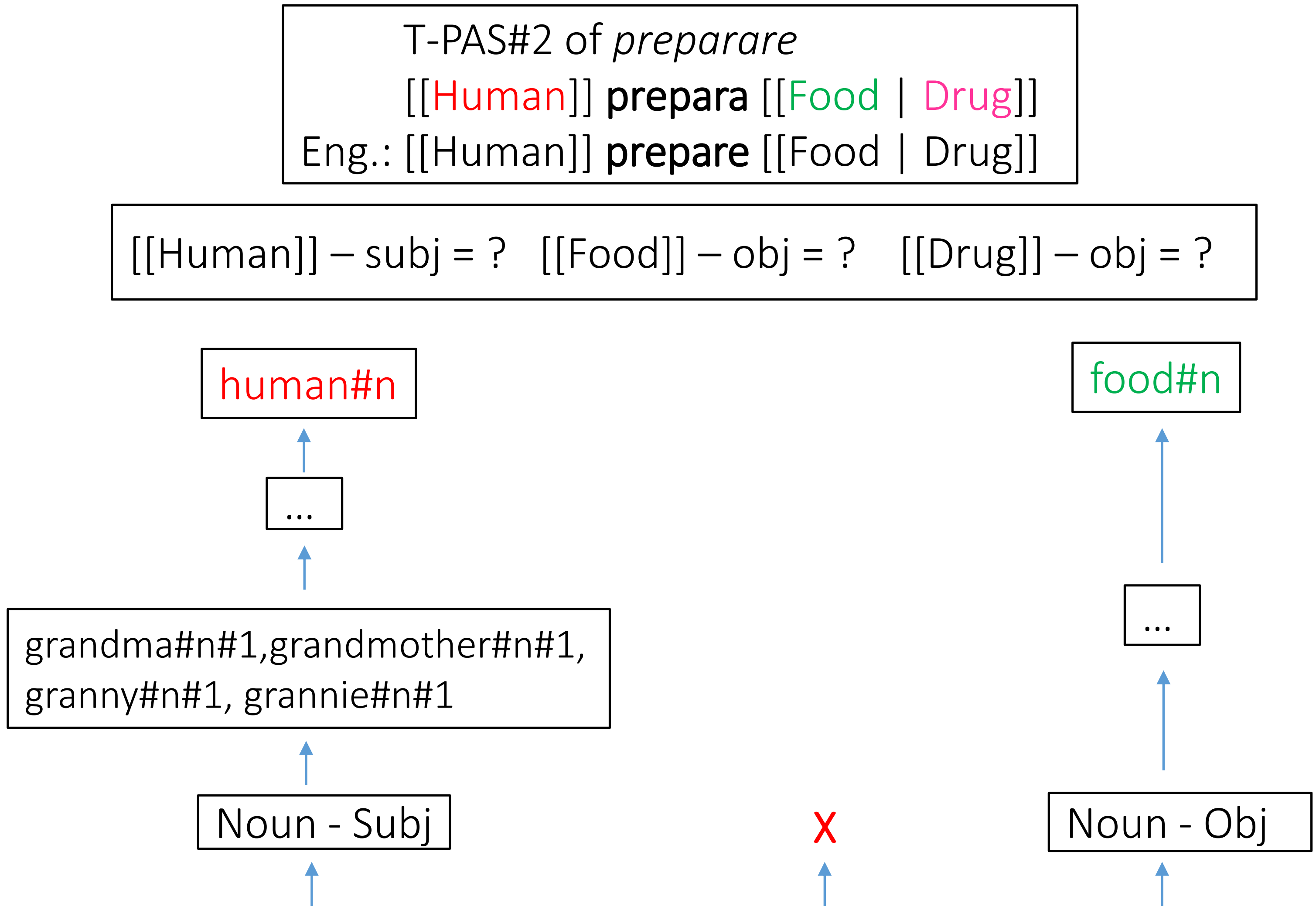
[[Human]] – subj = ?   [[Food]] – obj = ?   [[Drug]] – obj = ?

Baseline +

- uses dependency tree of the sentence
- recognizes named entities with TextPro 2.0
- checks for multiword expressions in MWN

-> we expect a higher Precision

LEA: syntactic information



T-PAS#2 of *preparare*
[[Human]] **prepara** [[Food | Drug]]
Eng.: [[Human]] **prepare** [[Food | Drug]]

[[Human]] – subj = ?   [[Food]] – obj = ?   [[Drug]] – obj = ?

human#n

...

grandma#n#1,grandmother#n#1,
granny#n#1, grannie#n#1

Noun - Subj

X

food#n

...

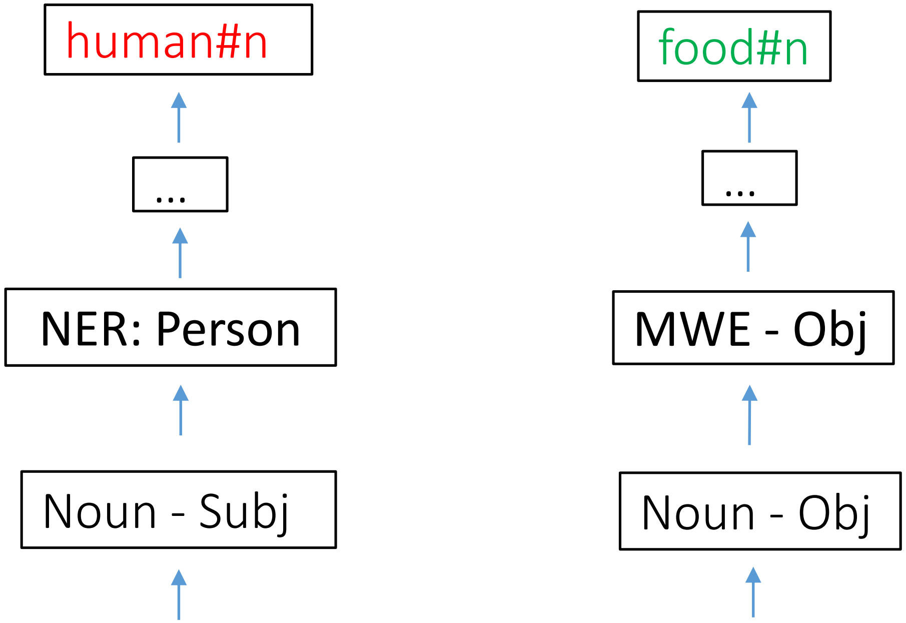
Noun - Obj

"La nonna, prima di infornare le patate, **prepara** una torta"
Eng. "the grandmother, before baking the potatoes, **prepares** a cake"

LEA: NER and MWE

T-PAS#2 of *preparare*
[[Human]] **prepara** [[Food | Drug]]
Eng.: [[Human]] **prepare** [[Food | Drug]]

[[Human]] – subj = ? [[Food]] – obj = ? [[Drug]] – obj = ?



human#n

...

NER: Person

Noun - Subj

food#n

...

MWE - Obj

Noun - Obj

"Maria Rossi **prepara** la conserva di frutta"
Eng.: "Maria Rossi **prepares** the fruit conserve"

GOLD STANDARD

- 3 annotators manually marked the lexical items or the multiword expressions that correspond to the STs (no pronouns, no relative clauses)

- 500 examples

(10 sentences x a selection of 10 different STs x 5 different T-PASs;
e.g. 10 sentences x [[Food]] x 5 T-PASs)

- 981 annotated tokens out of 15090

RESULTS: SENTENCE ANNOTATION

Results for sentence annotation for Baseline and LEA

Automatic mapping			
	Precision	Recall	F1
Baseline	0.28	0.42	0.34
LEA	0.70	0.25	0.37

Results after manual revision of the Semantic Type - synsets mapping

Mapping with manual revision of 11 ST			
Baseline	0.30	0.52	0.38
LEA	0.72	0.32	0.44

Evaluation.

Inaccuracies are due to:

- recognition of proper names (Baseline 10 /185 , Lea 26/185)
- PoS tagging step
- dependency parsing step

- automatic mapping of STs - synsets
- different structure of the two resources (e.g. in T-PAS [[Machine]] is a hypernym of [[Vehicle]], the same is not true for machine#n in MWN)

RESULTS: LEXICAL SET

Similarity between Gold Standard lexical set and lexical set annotated with Baseline and LEA (Dice's coefficient)

5 most populated lexical sets	Baseline	LEA
Cuocere#2-SBJ-[[Food]] *{pasta, pesce, sugo, carciofo,..}*	0.54	0.57
Crollare#1-SBJ-[[Building]]	0.71	0.60
Dirottare#1-OBJ-[[Vehicle]]	0.83	0.66
Prescrivere#2-OBJ-[[Drug]]	0.42	0.46
Togliere#4-OBJ-[[Garment]]	0.72	0.61

Baseline -> low precision causes major differences with the gold standard sets

LEA -> low recall penalizes the amount of detected items given few sentences to annotate

CONSIDERATIONS AND FURTHER WORK

Final considerations:

- on large scale acquisition, the higher precision for LEA is more promising than the Baseline
- first step on automatic acquisition of lexical sets

Further work:

- extension of the sentence annotation and lexical set population for all T-PAS
- comparison of lexical set in different T-PASs with the same Semantic type

Thank you for your attention