



THE PREDICATE MATRIX AND THE EVENT AND IMPLIED SITUATION ONTOLOGY: MAKING MORE OF EVENTS

Roxane Segers, Piek Vossen (Vrije Universiteit Amsterdam)

Marco Rospocher, Anne-Lyse Minard (Fondazione Bruno Kessler)

Egoitz Laparra, German Rigau (Universidad del Pais Vasco)

ESO in short!



- The **E**vent and Implied **S**ituation **O**ntology (ESO)
- Models the implications before, after and during an event and the roles of the entities involved in the event.
- Manually built event ontology with manual mappings to SUMO, FrameNet frames and Frame elements
- Manual mappings to WordNet synsets
- Written in OWL
- Freely available (CC BY SA license)

Background:



- NewsReader project: technology to process millions of documents in four languages. (*newsreader-project.eu*)
- Extraction of events: who did what, where and when.
- Event centric approach: changes in reality and over time.

The problem we had



- Millions of events in all kinds of lexicalizations, and with a variety of e.g. Frames and semantic roles.
- We know something has happened, but not what the *implications* or the pre and post situations of an event are.

Current application of ESO



- Used for Text Mining in a 2.1 million document collection:
 - Typing of events, e.g. eso:Transportation
 - Models and defines a) the implications of events and b) the roles of the participants affected by the event.
 - Runs on Semantic Role Labeled (SRL) text
 - Relies on Semantic Web techniques

Event implications?



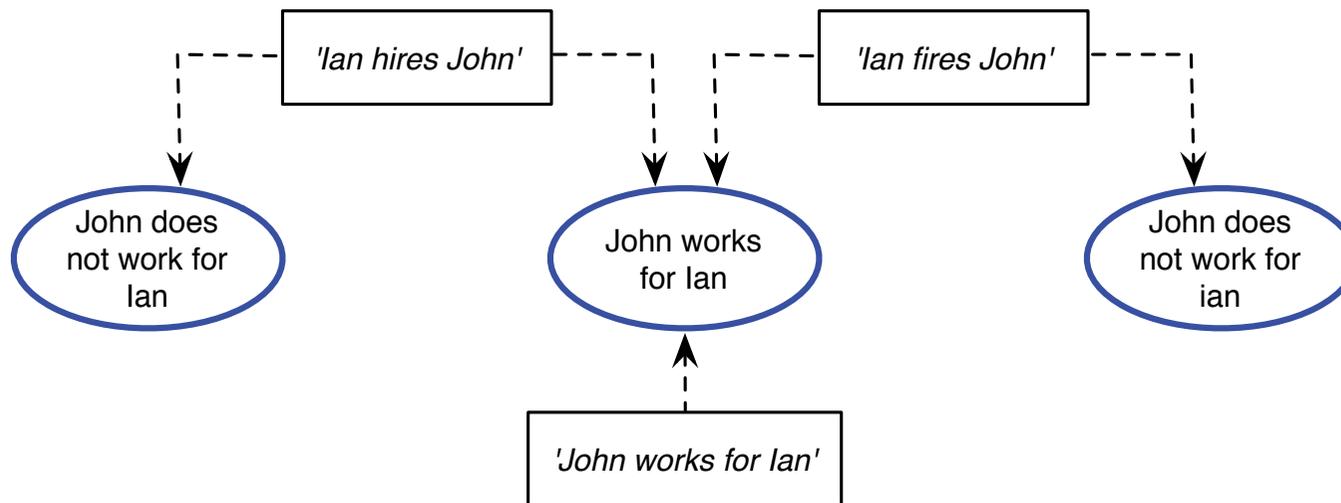
- “Apple hired Steve as their new CEO to save the company.”

Property change

- “Apple hired Steve as their new CEO to save the company.”
 - Before: Steve *notEmployedAt* Apple
 - After: Steve *employedAt* Apple
 - Steve *hasFunction* CEO
 - Steve *hasTask* save the company
 - Steve *isEmployed* true

Implications of Static and Dynamic Events

- Derive sequences of states and changes over time, regardless if the information is explicitly mentioned in text, or inferred by a reasoner:



Simple Semantics!

You (X) might be fired, quit your job, leave, resign or retire, but in the end, you no longer work for some employer.

eso: LeavingAnOrganization (skos:closematch fn: Quitting, fn: Firing)

X notEmployedAt Y

You might be a fn:Donor, a fn:Victim or a fn:Seller, but first you owned something and now you don't.

eso: ChangeOfPossession

X notHasInPossession Y

You may travel to Bucharest while smiling and with a certain speed, but in the end, you're in Bucharest and not where you were before.

eso: Translocation

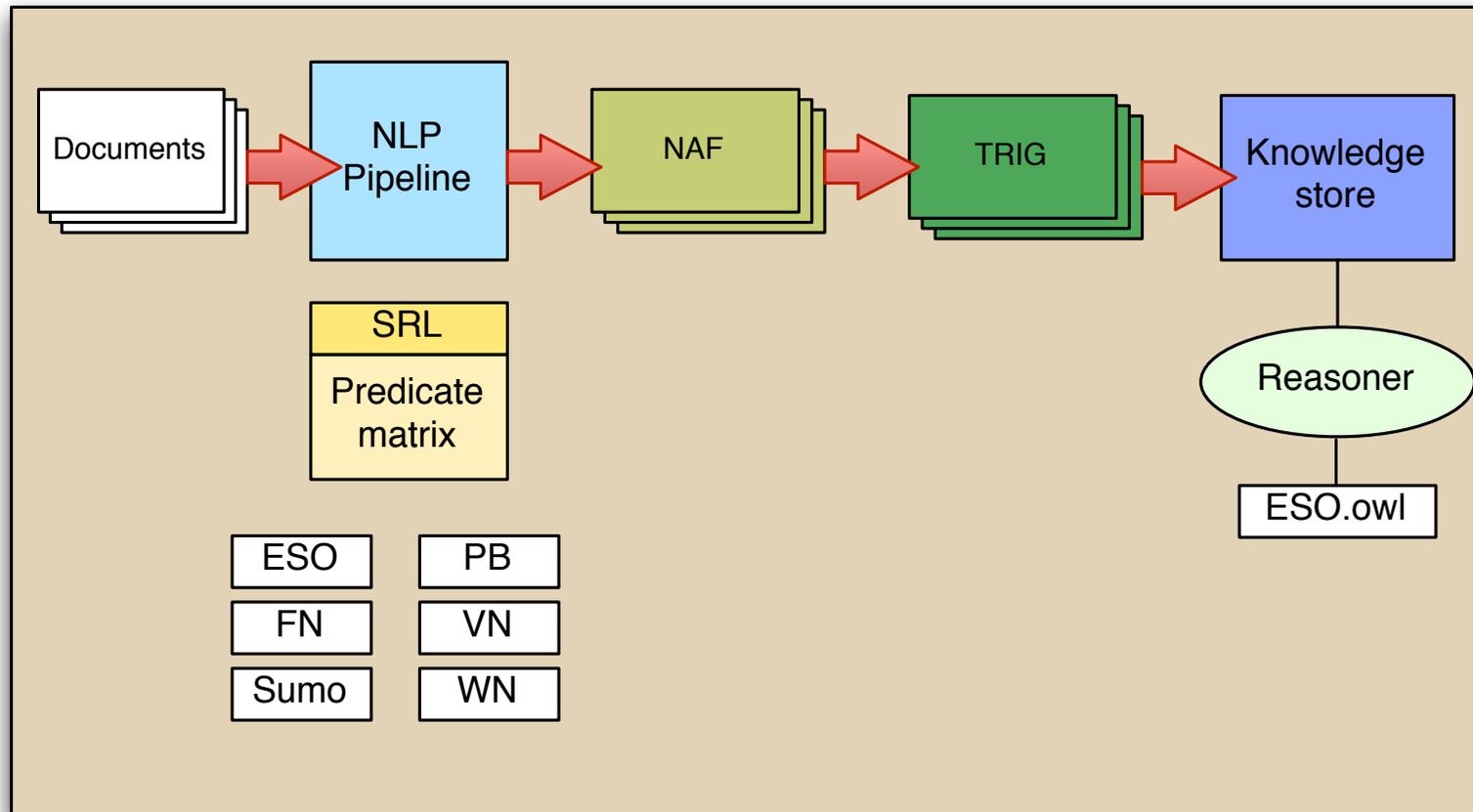
X atPlace Y

ESO approach to event modeling



- In ESO, we focus on modeling the implications of events, not on the semantics of the events themselves.
- And we don't define all possible implications of an event.
(Though the model is open to extensions)

How do we do it: ESO in our NLP and Knowledge Suite

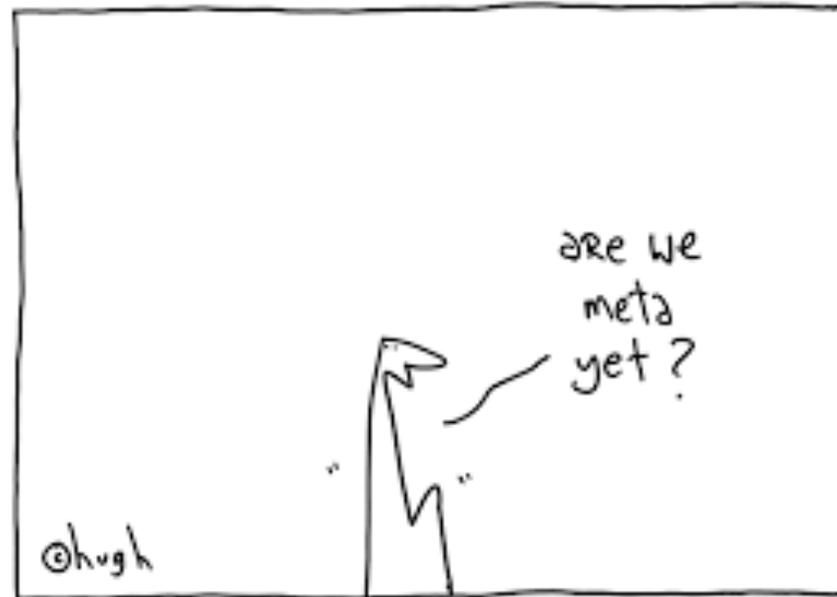


Predicate Matrix Version 2



- 8,495 Propbank and NomBank predicates, connected to:
 - 4,704 synsets
 - 554 Frames
 - 55 ESO Classes
- 23,386 Propbank and NomBank roles, connected to
 - 2,343 frame elements
 - 53 ESO roles

Instantiating ESO



Text to RDF

“John generously gave the book to Ian.”

John (**fn:donor**/**eso:possession-owner_1**) generously (**fn:manner**) gave
(**fn:Giving**/**eso:ChangeOfPossession**) the book (**fn:theme**/
eso:possession-theme) to Ian (**fn:Recipient**/**nwr:possession-owner_2**)

obj-graph-eventX

:eventX

a eso:ChangeOfPossession;

eso:ChangeOfPossession_possession-owner_1 :John;

eso:ChangeOfPossession_possession-owner_2 :Ian;

eso:ChangeOfPossession_possession-theme :book;

sem:hasTime :time_eventX.

Instantiating the pre and post situations

Situation rules:

eso:pre_ChangeOfPossession

eso:hasSituationRuleAssertion pre_ChangeOfPossessionAssertion1;

eso:hasSituationRuleAssertion pre_ChangeOfPossessionAssertion2.

eso:pre_ChangeOfPossessionAssertion1

eso:hasSituationAssertionSubject eso:possession-owner_1;

eso:hasSituationAssertionProperty eso:hasInPossession;

eso:hasSituationAssertionObject eso:possession-theme.

eso:pre_ChangeOfPossessionAssertion2

eso:hasSituationAssertionSubject eso:possession-owner_2;

eso:hasSituationAssertionProperty eso:notHasInPossession;

eso:hasSituationAssertionObject eso:possession-theme.

:eventX_pre (*John gave the book to Ian*)

:instanceX(John) eso:hasInPossession :instanceZ(book)

:instanceY(Ian) eso:notHasPossession :instanceZ(book)

-Decreasing subclassOf: QuantityChange

"The subclass of QuantityChange where some physical quantity or value is decreased."

Class mappings:

broadMatch: fn:Change_of_quantity_of_possession
broadMatch: fn:Cause_change_of_position_on_a_scale
broadMatch: fn:Change_position_on_a_scale
broadMatch: fn:Proliferating_in_number
broadMatch: fn: Expansion
broadMatch: fn: Cause_expansion
closeMatch: sumo:Decreasing

Role mappings:

quantity-item: fn:Item, fn:Possession, fn:Set
quantity-attribute: fn:Attribute, fn:Dimension
quantity-ratio: fn:Size_change, fn:Difference
quantity-value_1: fn:Initial_value, fn:Initial_number, fn:Initial_size, fn:Value_1
quantity-value_2: fn:Final_value, fn:Final_number, fn:Value_2, fn:Result_size

Assertions:

pre situation	quantity-item	hasAttribute	quantity-attribute
	quantity-attribute	hasRelativeValue	+
	quantity-attribute	hasValue	quantity-value_1
post situation	quantity-item	hasAttribute	quantity-attribute
	quantity-attribute	hasRelativeValue	-
	quantity-attribute	hasValue	quantity-value_2
	quantity-item	hasRelativeDecrease	quantity-ratio

Note that quantity-attribute is modeled with an existential restriction that allows to create a blank node in the named graph.

"Ford decreased the production with 2%."

pre situation	production	hasAttribute	:qwe123
	:qwe123	hasRelativeValue	+
post situation	production	hasAttribute	:qwe123
	:qwe123	hasRelativeValue	-
	production	hasRelativeDecrease	2%

"Apple lowered the price of the Iphone from 600 to 500 dollar."

pre situation	Iphone	hasAttribute	price
	price	hasRelativeValue	+
	price	hasValue	600
post situation	Iphone	hasAttribute	price
	price	hasRelativeValue	-
	price	hasValue	500

Contents of ESO

Component	Number
Event classes	63
Dynamic event classes	50
Static event classes	13
SUMO class mappings	46
FrameNet Frame mappings	103
Situation rule assertions	123
Properties	58
ESO roles	65
Mappings of roles to FrameNet FEs	131

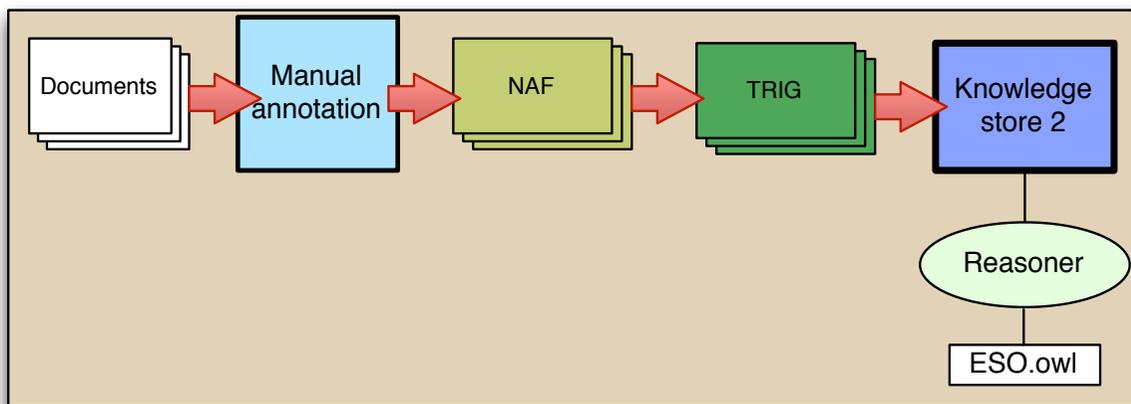
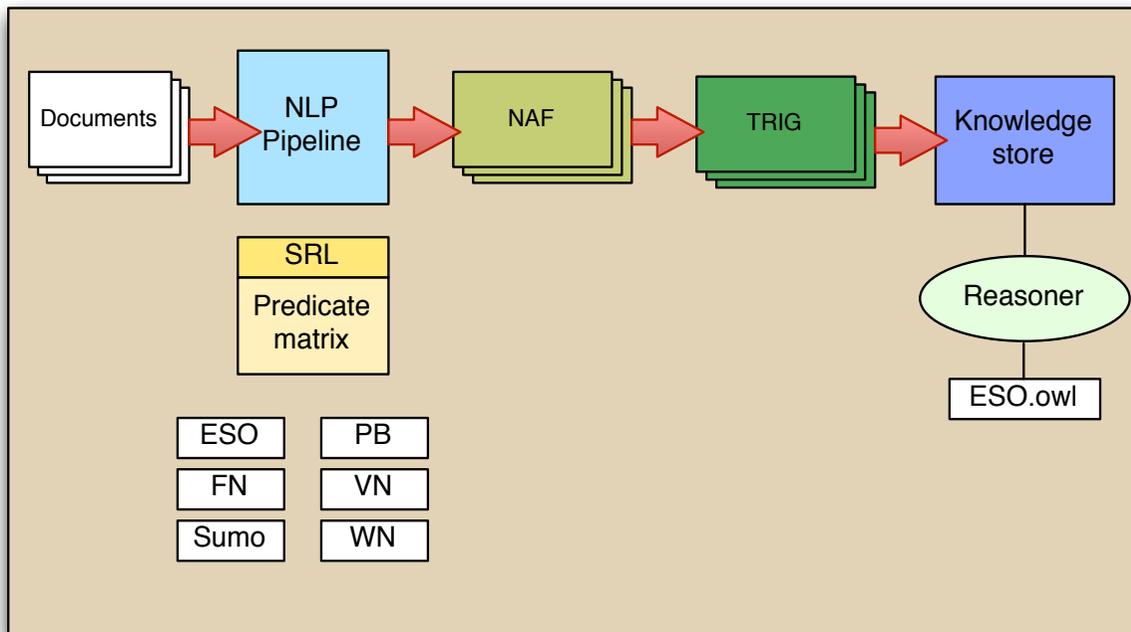
Evaluation



Evaluation on the MeanTime Corpus



- 120 articles, annotated manually with ESO classes and ESO roles for a Gold Standard.
- Same 120 articles, processed automatically with the Newsreader pipeline, including ESO and Predicate Matrix.
- Both loaded into a KnowledgeStore for inspection and comparison of the ESO events and inferred situations.



Manual annotation of MeanTime



- 600 sentences in total (712 predicates and 1033 roles).
- Precision and recall predicates: 28.1% and 20%
- Precision and recall roles: 11.21% and 10.24%

MeanTime processed automatically and the Gold Standard.

Component	KS automatic	KS Gold Standard
All events	5443	1120
ESO events	2508	441
ESO events with ESO roles	736	406
ESO events with at least one inferred situation	498	320
ESO events with pre and post situations	495	268
ESO events with a during situation	52	47

KS automatic: ESO event inspection

ESO events with pre/post or during situation	495
Number of events inspected	52 (10.5%)
Events with pre/post situation	43
Events with during situation	9
Correct class label	37 (71.1%)
Correct pre and post situation(s)	18 (41.8%)
Correct during situation(s)	6 (66%)
Correct ESO events (class + roles + situations)	21 (50%)

Error analysis

Error in interpretation sentence (multiple causes)	3
Error in interpretation predicate	9
Multiple conflicting ESO classes assigned	8
Wrong role instance (entities)	10
Wrong role instance (non-entity)	5
Role instance duplication	6
Conflicting assertions	1

Future work



- Evaluation:
 - ▣ Evaluation against baseline system (SemLink)
 - ▣ Quality checks on samples of the data
 - ▣ Show the *added value* and *relevance* of this ontology for e.g. a certain task: timeline creation (automatic vs manual)

Thank you for your attention!



ESO.owl, an extensive documentation and the manual
FrameNet LU to PWN 3.0 mappings:

<https://github.com/newsreader/eso>

Contact:

r.h.segers@vu.nl

rospocher@fbk.eu