

Polarity Information for RTE

based on Nairn et al. (2006)

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Hauptseminar „Linguistic Inference and Textual Entailment“
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Overview

- r Logical Textual Inference
- r Polarity
- r Verbal constructions
 - Factive constructions
 - Implicative constructions
- r Implication signatures
- r Textual Inference Approach
 - Polarity propagation algorithm
- r Examples in RTE-2 data

Logical textual inference

- r recognize whether given text can be strictly or plausibly inferred from, or is contradicted by, another piece of text
- r based on
 - linguistic knowledge
 - assumptions about language use
 - knowledge about the world
 - any combination thereof

Polarity

- r grammatical category that distinguishes affirmative and negative
- r Examples

positive	negative
Ed opened the door.	Ed didn't open the door.
Ed managed to open the door.	Ed forgot to open the door.

Different semantic behaviours

- r Verbal constructions of the same verb may have different semantic behaviours
- r factive constructions
 - *forget/remember/know/...that...*
 - presuppose rather than entail that complement sentence is true

Different semantic behaviours

- r implicative constructions
 - *forget/remember/know/...to...*
 - have entailments
 - some carry presuppositions
 - § difficult to pin down

Ed didn't manage/dare/bother/happen to open the door.		
Entailment:	Ed did not open the door.	
Presuppositions:	manage	ability
	dare	fear
	bother	...
	happen	...

Purpose of paper

- r build partial computational semantics for implicative constructions
 - ignoring presupposition
- r handling of simple factive constructions
- r interaction between implicative and factive verbs
- r in context of ACLAINTE project

ACL AINT

- r PASCAL-like experiment on local textual inference
- r more nuanced task
 - Entailment
 - § true
 - § false
 - § unknown
 - neither Hypothesis nor negated Hypothesis can be inferred

Types of implicative verbs

Entailment either positive or negative depending on polarity of environment.

r two-way implicatives

- yield entailment in both affirmative and negative environments
- *forget to*
 - § negative entailment in affirmative environment
 - § positive entailment in negative environment

r one-way implicatives

- yield entailment only in one of the environments
- *force to, attempt to*

Challenges

- r no database for this type of semantic information
 - compilation of table of „implication signatures“
- r embedded structures of factives and implicatives
 - polarity of environment of embedding predicates determined relatively to the chain of predicates
 - recursive computation of relative polarity

Ea didn't manage to remember to open the door.

Implication Signatures

- r identification of natural implications of verbs
 - decreasing frequency verbs in BNC
- r by hand
- r classification of 400 complement-taking verbs
 - infinitival complements
 - that-complements
 - 1/3 of them carried implication

Types of implication

r entailment

- positive
- negative

r presupposition

- factive
- counterfactive

implication signature table

	Word in subcat frame	Relative Polarity (+) positive (-) negative	
		Entailment	
Two-way implicatives	<i>manage to</i> <i>forget to</i>	(+) positive (-) negative	(-) negative (+) positive
One-way +implicatives	<i>force to</i> <i>refuse to</i>	(+) positive (-) negative	none none
One-way -implicatives	<i>attempt to</i> <i>hesitate to</i>	none none	(-) negative (+) positive
		Presupposition	
Factives Counterfactives	<i>forget that</i> <i>pretend that</i>	(+) positive (-) negative	(+) positive (-) negative
Neutral	<i>want to</i>	Entailment/Presupposition none none	

Textual inference approach

- r parsing of text
- r transformation into normalized representation (skolemization & canonicalization)
- r representation: verbal predication corresponds to constructed concept
 - mapping of verbal predicate to concept in background ontology
 - role restrictions: based on arguments and modifiers
 - concept named according to the normalized verbal predicate
- r => input to entailment and contradiction detection

Textual Inference Approach

r entailment and contradiction detection (ECD)

- structural matching
- inference-based techniques
- operation on packed representations
 - § ambiguities encoded
 - § no need for disambiguation

Implication Projection

- r solution to interaction of multiple embedded clauses
- r entailment of complement-taking construction
 - dependent on the polarity of its context
 - context polarity is not determined locally
 - § dependent on embedding structure of contexts
 - neutralization possible
 - Ea refusea not to attempt to leave.*
 - § negative entailment of not attempt is neutralized by the negative polarity of refuse
- r polarity of context depends on the sequence of potential polarity switches stretching back to the top context

Implication Projection

- r each complement-taking verb
 - performs operations on its parent context's polarity
 - § polarity switching
 - § polarity perserving
 - § polarity setting according to signature table entry of the verb
- r polarity = relative
 - if the polarity switching sequence starts below top level context, final polarity may be different
 - polarity of a context = polarity relative to ancestor context
- r polarity = recursive
 - top level polarity of most interest
 - polarities of lower levels needed to compute top level polarity

Implication Projection Algorithm

- r every context C
 - relative polarity towards set of ancestor contexts $p(C)$
 - § positive $(+)_C$
 - § negative $(-)_C$
 - positive towards itself
- r computation of polarity sets $(+)_C$ and $(-)_C$
 - parent's sets $(+)_{p(C)}$ and $(-)_{p(C)}$
 - with reference to the verb $V_{p(C),C}$
 - the verb's signature $\text{sig}^e(V_{p(C),C})$

Relative polarity computation

$$\oplus_C =_{def} \{C\} \cup \begin{cases} \oplus_{p(C)} & \text{if } sig^+(V_{p(C),C}) = + \\ \ominus_{p(C)} & \text{if } sig^-(V_{p(C),C}) = + \\ \emptyset & \text{otherwise} \end{cases}$$

$$\ominus_C =_{def} \begin{cases} \oplus_{p(C)} & \text{if } sig^+(V_{p(C),C}) = - \\ \ominus_{p(C)} & \text{if } sig^-(V_{p(C),C}) = - \\ \emptyset & \text{otherwise} \end{cases}$$

Polarity composition

Ed did not forget to force Dave to leave.

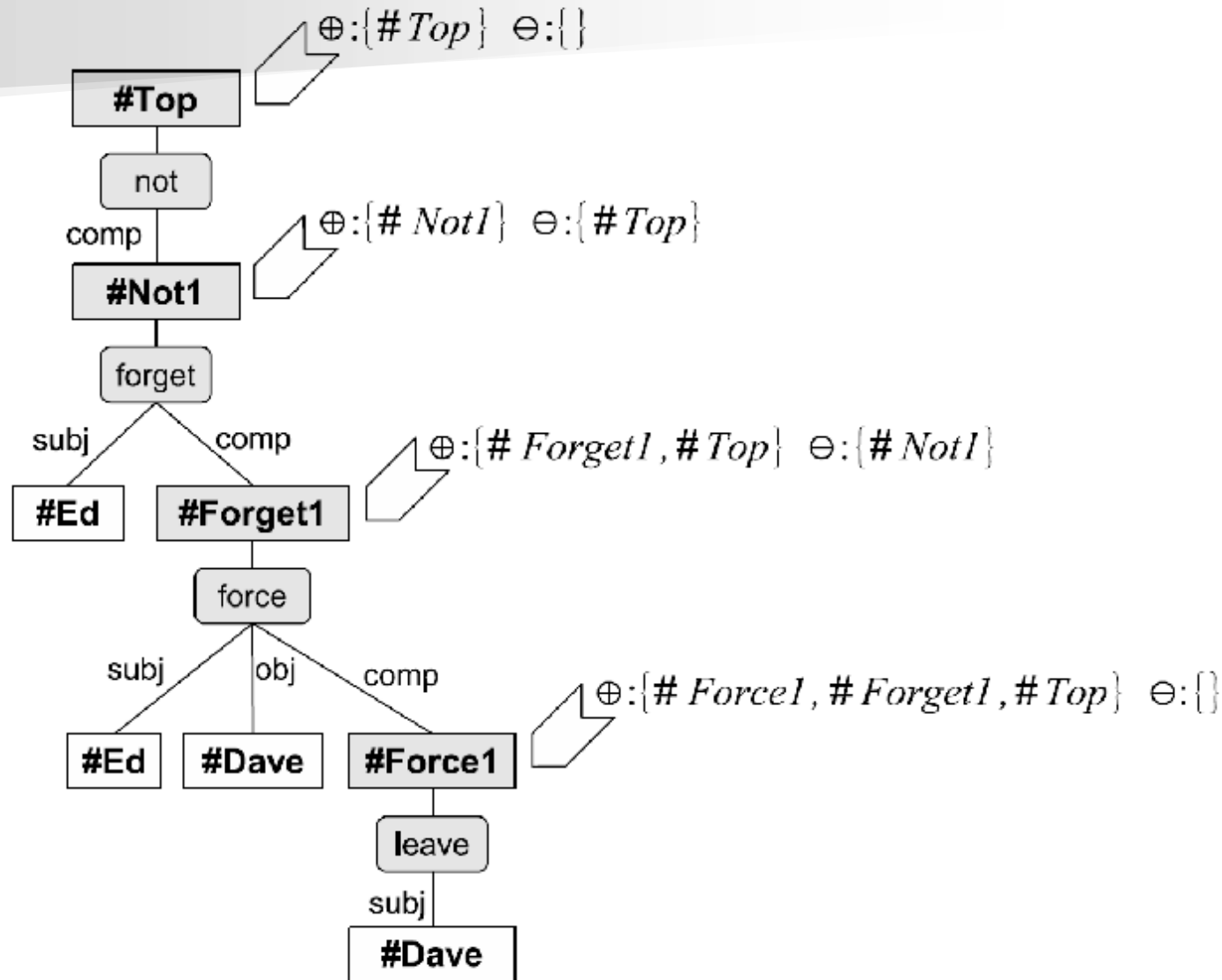
r Dave leave \hat{e} +

– force Dave to leave \hat{e} +

§ forget to force Dave to leave \hat{e} -

– not forget to force Dave to leave \hat{e} +

Propagation of Polarities



Instantiation of contexts

- r relative context polarities serve for
 - extraction of information about instantiability and uninstantiability of contexts
- r instantiables
 - head event skolem of a context + role fillers should be made instantiable
 - § in the context it arises
 - § in all contexts relative to which its originating context has positive polarity
- r uninstantiables
 - in all contexts relative to which its originating context has negative polarity
$$\textit{instantiables}(C) =_{def} \{ \textit{head}(C') \mid C \in \oplus_{C'} \}$$
$$\textit{uninstantiables}(C) =_{def} \{ \textit{head}(C') \mid C \in \ominus_{C'} \}$$

Author commitment

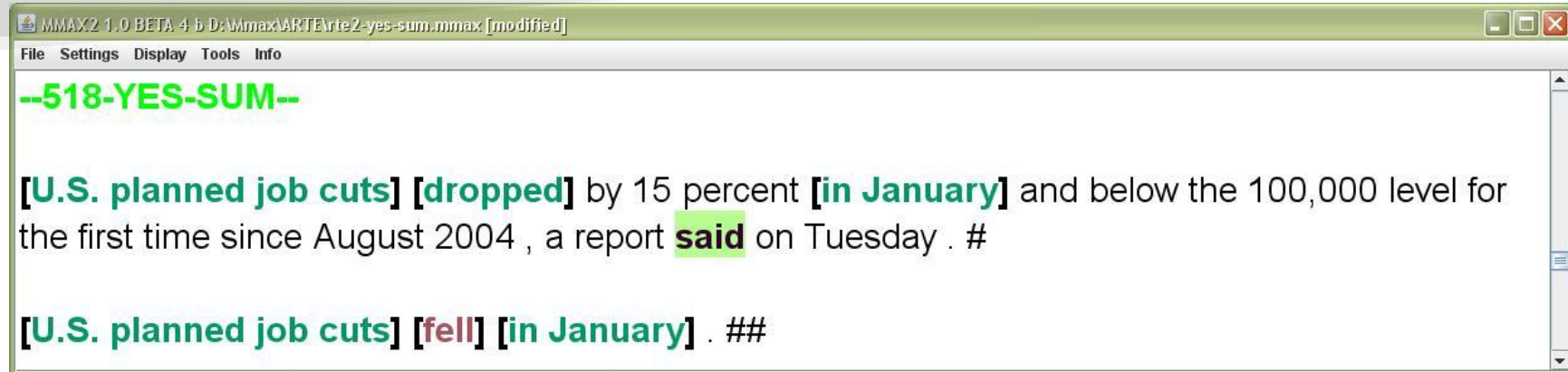
- r truth/falsity in top level context
 - reveals author commitment towards utterance
 - composition of
 - § truth of complement clause
 - instantiability of head predicate skolem + head predicate skolem denotes event description
 - è instantiation of event description
 - § falsity of complement clause
 - uninstantiability è non-instantiation
- r Author commitment ~ truth of utterance

Polartiy in RTE-2 data

	Neutral	Factive	Counterfactive	Implicative	Negation	Total
IE	10	2	0	2	1	15
IR	3	1	0	8	0	12
QA	1	1	0	3	1	6
SUM	14	3	0	1	0	18
Total	28	7	0	14	2	51

- r annotations in subcorpus of 400 positive entailment pairs
 - only expressions that are important for entailment value

Polarity in RTE-2 data



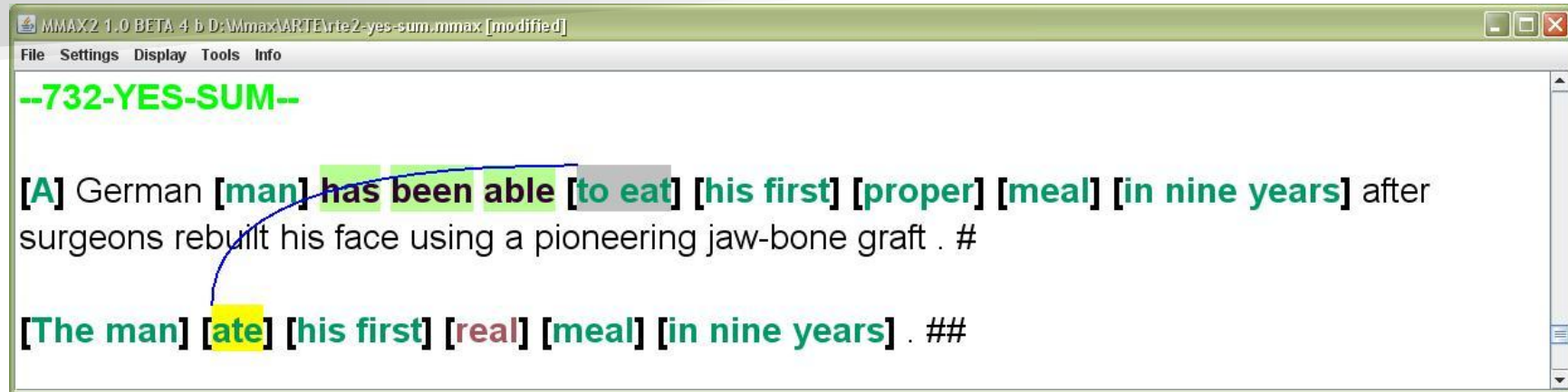
- r *said* – neutral
- r typical text-hypothesis combination in RTE
 - T – report/claim
 - H – content of report/claim presented as fact

Polarity in RTE-2 data



- r 2 predicates
 - *revealed* – factive
 - *told* – neutral
- z use of propagation algorithm to compute polarity

Polarity in RTE-2 data

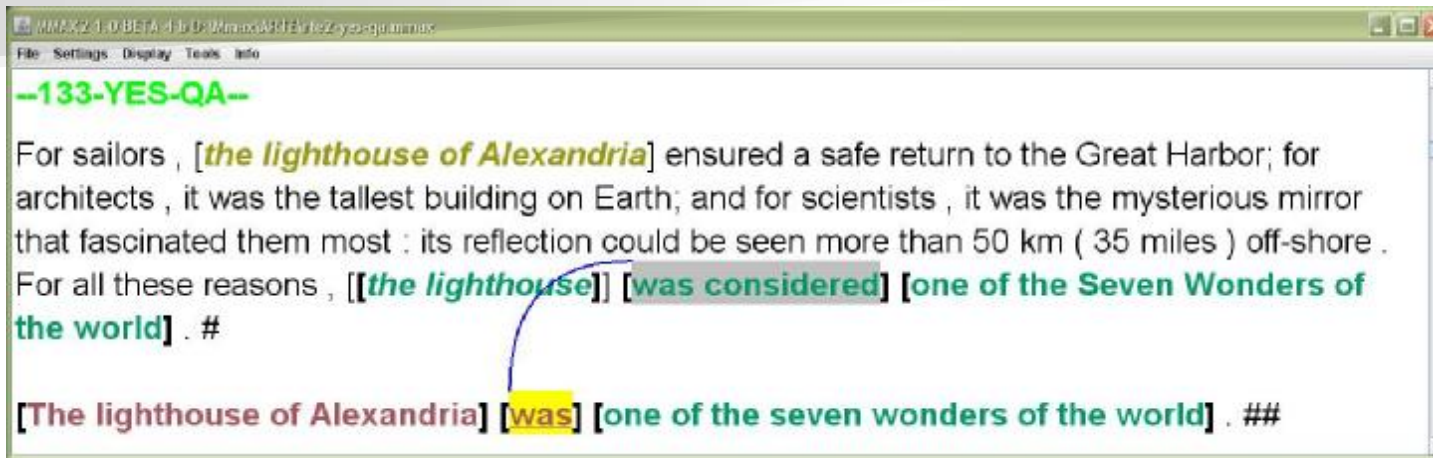


r *has been able* – implicative

r entailment based on

- conversational implicatures
- common-sense interpretation of *to be able to*

Polarity in RTE-2 data



r *was considered* – neutral

Polarity in RTE-2 data



- r same context: positive polarity
 - but: entailment does not hold
- r questions:
 - differences?
 - other factors involved?
 - error?

Conclusions

- r polarity actually occurs
 - in natural texts
 - in RTE data (yet infrequently)
- r method to compute polarity values for
 - simple structures
 - § factive
 - § implicational
 - embedded structures
- r first systematic implementation of textual inferences based on
 - polarity
 - interaction of implicative verbs and factive verbs
 - author commitment to truth or falsity of complement clause

References

- r R. Nairn, C. Condoravdi, L. Karttunen (2006): *Computing relative polarity for textual inference*. ICoS-5.
<http://www2.parc.com/istl/members/karttunen/publications/icos2006.pdf>
- r K. Garoufi (to be published): *Towards a better understanding of Textual Entailment*.