

# Textual Entailment Recognition and its Applicability in NLP Tasks\*

## *Reconocimiento de Implicación Textual y su aplicabilidad en Tareas de PLN*

Óscar Ferrández

Dept. de Lenguajes y Sistemas Informáticos (Universidad de Alicante)  
Carretera San Vicente s/n 03690 Alicante España  
ofe@dlsi.ua.es

**Resumen:** Tesis doctoral en Informática realizada en la Universidad Alicante (UA) por Oscar Ferrández bajo la dirección del Dr. Rafael Muñoz Guillena. El acto de defensa de la tesis tuvo lugar en Alicante el 27 de Julio de 2009 ante el tribunal formado por los doctores Manuel Palomar (UA), Andrés Montoyo Guijarro (UA), Arantza Díaz de Ilarraza (EHU/UPV), Luis Alfonso Ureña (UJA) y Raquel Martínez Unanue (UNED). Calificación: Sobresaliente *Cum Laude* por unanimidad.

**Palabras clave:** Implicación Textual, Aplicaciones PLN, Semántica de textos

**Abstract:** Ph.D Thesis in Computer Science, specifically in the field of Computational Linguistics, written by Oscar Ferrández under the supervision of Dr. Rafael Muñoz Guillena. The author was examined on July 27<sup>th</sup>, 2009 by a panel formed by Dr. Manuel Palomar (UA), Dr. Andrés Montoyo Guijarro (UA), Dr. Arantza Díaz de Ilarraza (EHU/UPV), Dr. Luis Alfonso Ureña (UJA) and Dr. Raquel Martínez Unanue (UNED). The grade obtained was *Sobresaliente Cum Laude*.

**Keywords:** Textual Entailment, NLP Applications, Texts Semantics

### 1. Introduction

Human languages are extremely rich and ambiguous resulting in the fact that the same information can be expressed employing different words and linguistic structures. In other words, an ambiguous text might represent several distinct meanings and a concrete meaning might be expressed in different ways. However, controlling language variability is something which as yet has not been attained. In terms of reasoning, there are many inferences easily detected by humans but extremely difficult for computers to address.

While the problem of language variability is the context of this work, it has been concretely focused on textual entailment. Textual entailment has been defined as a generic framework for modelling semantic variability, which appears when a concrete meaning is described in different manners. Hence, language variability can be addressed by defining the concept of textual entailment as a

one-way meaning relation between two text snippets. Two coherent fragments of text are defined and according to the definition of textual entailment, the meaning of one of them must entail the meaning of the other, should this not occur the entailment does not hold.

Since a lot of applications in many Natural Language Processing (NLP) areas are highly influenced by the problem of language variability, solving textual entailment relations would help many NLP applications to increase their final performance by means of correct language variability disambiguation.

This thesis exposes the major topics in textual entailment by means of examples together with thorough discussions. As a result, an end-to-end textual entailment system was developed following the idea that textual entailment relations can be recognised from different linguistic levels. Specifically, lexical, syntactic and semantic, each performing a set of useful inferences to determine entailments.

The final entailment decision is taken by a machine learning classifier which uses as features the set of inferences. Extensive evaluations over the PASCAL Recognising Textual

\* This thesis has been partially funded by the EU Commission (project FP6-IST-033860) and by the Spanish Government (project TIN2006-15265-C06-01).

Entailment datasets have been carried out throughout this thesis. Furthermore, another motivation as well as a contribution of this thesis consisted of applying our system to other Natural Language Processing tasks such as Question Answering, Automatic Text Summarization and the particular semantic task of linking Wikipedia categories to WordNet glosses.

## 2. Thesis Overview

**Chapter 1** introduces the concept of textual entailment within the field of Artificial Intelligence and NLP.

**Chapter 2** is intended to provide the related work relevant to this thesis. Apart from detailing the most up-to-date textual entailment systems, this chapter also describes resources used within the system development and testing as well as the two main competitions and/or workshops in this field.

**Chapter 3** comprises the detailed description of our system. Carefully explaining each inference and how they assist in solving entailment relations.

**Chapter 4** discusses the framework in which the system is evaluated as well as analysing the results obtained.

**Chapter 5** presents the applicability of our system in other NLP tasks rather than puristic textual entailment recognitions. It permits us to make an extrinsic system evaluation, assessing the gain of applying our system to QA and SUM among others.

**Chapter 6** gives conclusions together with some thoughts for future work.

**Chapter 7** presents the software developments carried out in this thesis.

**Appendix A** illustrates the official results regarding each PASCAL Recognizing Textual Entailment challenge.

**Appendix B** shows the official results corresponding to the different Answer Validation Exercise competitions.

**Appendix C** presents the bar graphs for the information gain values of each feature.

**Appendix D** gives a brief bio-sketch of the author and a summary of the research projects relative to this thesis.

## 3. Thesis Contributions

With the ideas, reasoning and experiments exhibited in this thesis, we demonstrate that the combination of lexical, syntactic and semantic knowledge is the correct way to tackle

the entailment recognition. As our main contributions, we would like to highlight:

- We have measured the impact of trivial lexical and syntactic inferences within the task of detecting entailments. Concluding that these deductions play a crucial role in the final entailment decision.
- Dealing with complex analyses (i.e. the semantic perspective), we have evaluated the benefits of using linguistic resources in order to recognise entailments. For instance, WordNet, FrameNet, VerbNet and VerbOcean allowed: (i) the use of semantic inferences based on synonyms, antonyms, etc; (ii) more abstract semantic deductions using Frame Analysis; and (iii) to measure the importance of finding out correspondences between verbs and entities.
- Furthermore, we have implemented some new linguistic resources based on FrameNet: the *Frame-to-Frame similarity metric* and the *FrameNet-WordNet alignment measure*. Although in this thesis they have been used in order to discover entailments, they could also be useful in other NLP tasks and/or applications.
- Regarding the applicability of our textual entailment system in other NLP tasks. It was successfully applied to Summarization, Question Answering and the task of linking Wikipedia categories to WordNet glosses.

In a nutshell, the investigations posed throughout this thesis reveal the importance of combining linguistic features derived from distinct perspectives, analyses and/or resources. It results in the implementation of a textual entailment system capable of making use of these variety of features (Ferrández, Muñoz, and Palomar, 2008; Ferrández, Muñoz, and Palomar, 2009).

## References

- Ferrández, Óscar, Rafael Muñoz, and Manuel Palomar. 2008. Studying the influence of semantic constraints in ave. In *LNCS 5706, CLEF 2008*, pages 460–467.
- Ferrández, Óscar, Rafael Muñoz, and Manuel Palomar. 2009. Alicante University at TAC 2009: Experiments in RTE. In *TAC 2009 Workshop*.