LA EXTRACCIÓN ABIERTA DE INFORMACIÓN PARA EL ESPAÑOL

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OUTLINE

Introduction

- Open Information Extraction (Open IE)
- Applications of Open IE
- Approaches to Open IE
- Problem

Open IE for Spanish

Experiments & Results

Error Analysis

Conclusions and Future Work

TRADITIONAL IE

- **Find all, say, acquisitions: *quien compró que***
- **Target relations are predefined:**
  - Relations: *acquisition(arg1, arg2, …, argN)*
  - args: *personas*, *empresas, moneda…*
- **Hand-labeled lexicalized training examples**
- **Lots of training data**
- **Tuned linguistic technologies (NER, parsing, …)**
- **Extensive human involvement**

Used in: Domain-specific information exrtaction from relatively small homogeneous corpora

WHAT IS OPEN IE? 1/2

Introduced by Banko *et al.* in 2007

Arbitrary relations, not predefined:

Born in, comes from, makes a deal with, …

Extracted tuples are called "*assertions*":

<Argument1, Relation, Argument2>

McCain fought hard against Obama, but finally lost the election

- *<McCain, fought against, Obama>*
- *<McCain, lost, the election>*

WHAT IS OPEN IE? 2/2

Unlexicalized, domain-independent:

looks only at POS/syntactic structure

No need in extensive hand-labeled training dataset:

uses heuristics or distant supervision

Fast and scalable to the Web:

appropriate for a large heterogeneous corpus

Can serve even undefined user needs:

users can interactively refine their need

APPLICATIONS OF OPEN IE

Different from traditional IE!

- **Common-sense knowledge collection**
- **New perspectives in QA systems**
- **New approach to IR** [Etzoni, 2011]
- **Machine Reading: automatic, unsupervised understanding of text** [Etzioni et al., 2006]
- **Web text quality automatic assessment** [Horn & Zhila et al., 2013 @ NoDaLiDa]

APPROACHES TO OPEN IE

1. **ML-based**

TextRunner (Banko,2007), WOE^{pos} & WOE^{parse} (Wu & Weld, 2010)

Shortcomings: Extracts incoherent relations

"The Mark 14 was central to the torpedo scandal of the fleet."

~~*<was central torpedo>*~~

2. **Syntactic and context analysis**

OLLIE (Mausam, 2012), FES (Aguilar, 2012)

Shortcomings: slow, computational resource demanding

3. **POS analysis and syntactic constraints**

ReVerb (Fader et al., 2011)

Shortcomings: only verb–based relations

Advantages: fast, easy to implement, accurate, efficient

PROBLEM

- **Requires language-specific information**
  e.g. Typical POS sequence in a relation
- **Was implemented for English only**
  "simple canonical ways in which verbs express relationships in English" [Etzoni et al., 2011]

3. POS analysis and syntactic constraints

ReVerb (Fader et al., 2011)

What are peculiarities of application of this method to another language?

WHY IS IT IMPORTANT?

- **Different morphology** (different POS-tagging)
- **Different grammar** (i.e. word order)
- **In general:**
  - **Languages are different**
  - **No work on languages other than English**
  - **We cannot expect the same behavior**

OUTLINE

Introduction

Open IE for Spanish

- Architecture of ExtrHech system

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ARCHITECTURE OF EXTRHECH OPEN IE SYSTEM FOR SPANISH 1/2

EAGLES POS-tag set for Spanish from Freeling-2.2

Syntactic constraints as regular expressions

1. "Relation phrase"-first approach: looks for **verb phrase**

$$VREL \rightarrow (V\ W^*P)|(V)$$

2. Looks for **noun phrases** to the left and right

$$NP \rightarrow N\ (PREP\ N)?$$

3. Rules for
   - Coordinating conjunctions
   - Relative clauses
   - Participles

ARCHITECTURE OF EXTRHECH OPEN IE SYSTEM FOR SPANISH 2/2: LIMITATIONS

- **Does not resolve zero subject (anaphora issues)**

“Cerró la entrada.”

(“[He] closed the entrance.”)

OUTLINE

Introduction

Open IE for Spanish

Experiments & Results

- For different Spanish datasets
- For parallel English-Spanish dataset
- Performance comparison

Error Analysis

Conclusions

EXPERIMENT OVER TWO SPANISH DATASETS 1/2

FACT-SPA-CIC

- **68 sentences in Spanish**
- **Manually selected from school textbooks**
- **Grammatically and orthographically correct**

RAW WEB TEXT

- **159 sentences**
- **randomly extracted from Web** (with language detection filter)
- **36 sentences (22%) either grammatically incorrect or incoherent**

  “cronista cumple del diego video diego el 10”

  (“journalist accomplishes of the [D]iego video [D]iego 10 [points]”)

PERFORMANCE FOR SPANISH DATASETS 2/2

Dataset	Precision	Recall
FactSpaCIC (grammatically correct)	87%	70%
Raw Web text (noisy)	55%	49%

$$\textbf{Precision} = \frac{correct\ assertions}{all\ extracted\ assertions} \qquad \textbf{Recall} = \frac{correct\ assertions}{all\ possible\ assertions}$$

- **correct assertions** as evaluated by two human annotators
- **all possible (correct) assertions** = all expected extractions + assertions returned by the system that both annotators considered correct

EXPERIMENT OVER PARALLEL ENGLISH-SPANISH DATASET

Gramatically correct dataset FactSpaCIC of 68 sentences was translated into English

System	Precision	Recall	correct extractions	found extractions	expected extractions
ExtrHech (Spanish)	87%	70%	99.5	115	137
ReVerb (English)	76%	50%	71	93	139

- ReVerb turned out to be less robust:
  More unattempted sentences

COMPARISON OF PERFORMANCE FOR VARIOUS OPEN IE SYSTEMS

System	Approach	Dataset (# of sent.)	Precision	Recall	Running Time
ExtrHech (Spanish)	syntactic constr. over POS-tagged text	FactSpaCIC (68)	0.87	0.73	< 5 min
		raw Web text (159)	0.55	0.49	
ReVerb (English)	syntactic constr. over POS-tagged text	FactSpaCIC (68), translated	0.76	0.50	< 5 min
		Yahoo (500)	0.87 0.60	at 0.20 at 0.50	
TextRunner (English)	self-learning on POS-tagged text	Yahoo (500)	< 0.64	at >0	< 5 min
WOE^{parse} (English)	self-learning on parsed text	Yahoo (500)	0.87	at 0.15	hours
OLLIE (English)	context analysis of parsed text	news, Wikipedia, biology textbooks (300)	0.66–0.85	N/A (various yield levels from [11])	N/A, probably hours

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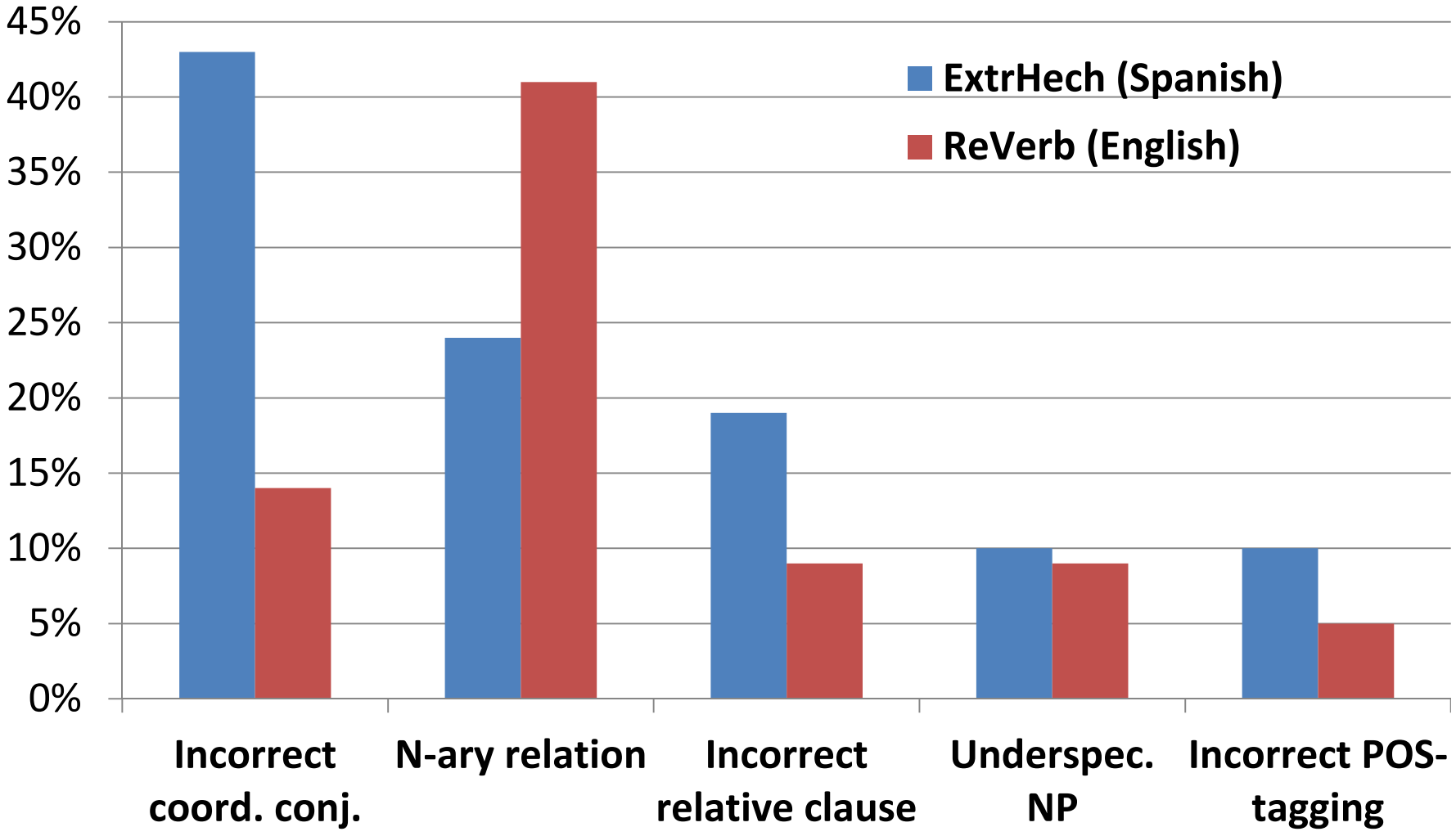
ERROR ANALYSIS

Performed:

- **For Spanish language system ExtrHech:**
  over FactSpaCIC (68 sent., grammatically correct) and Raw Web (159 sent.) datasets
- **For English language system ReVerb:**
  over the English translation of FactSpaCIC (68 sent., gram. correct)

CAUSES OF ERRORS FOR BOTH SYSTEMS 1/3



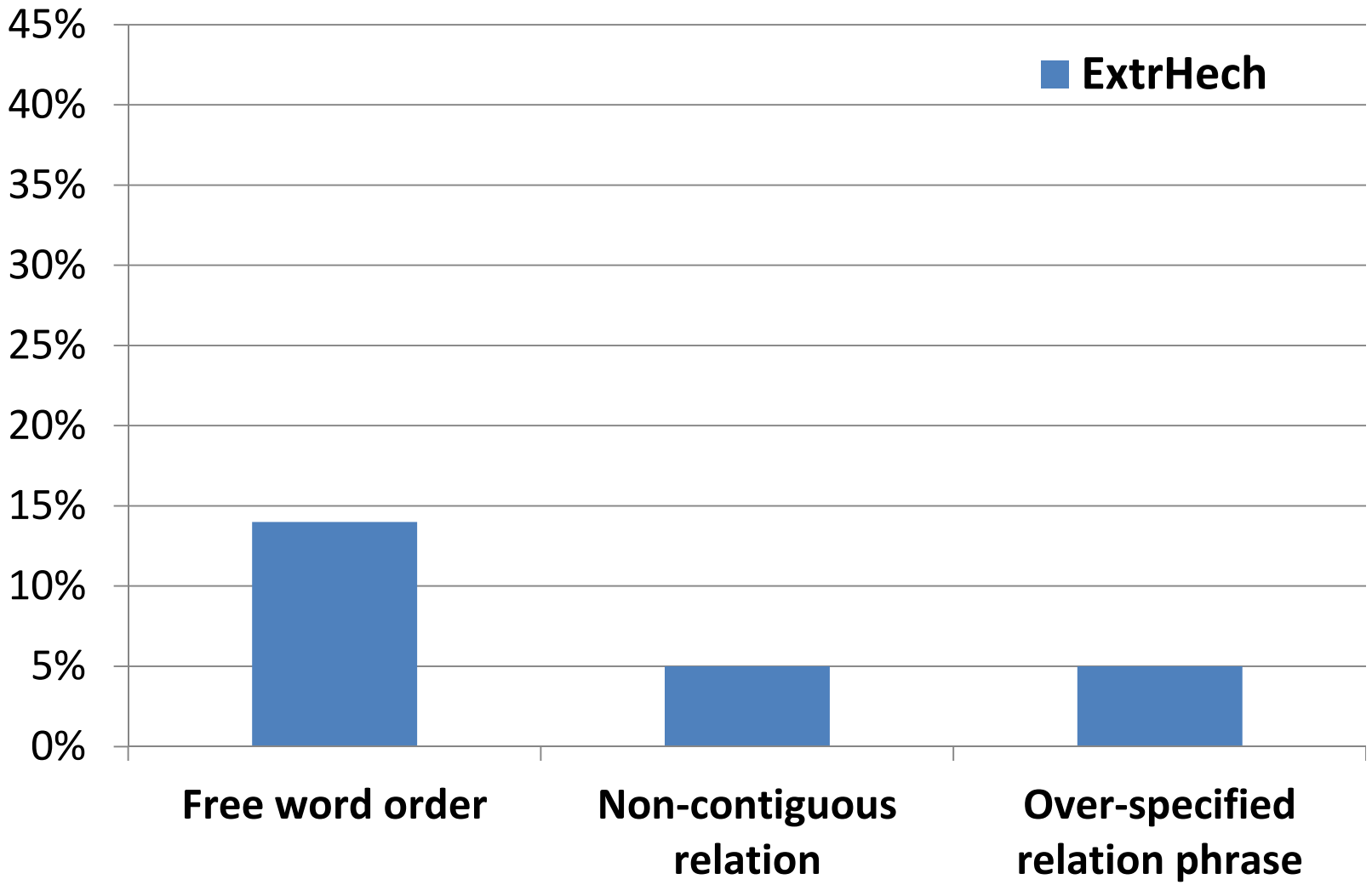
CAUSES OF ERRORS FOR BOTH SYSTEMS 2/3

Cause	ExtrHech	ReVerb	Example
Incorrect coordinative conjunction resulution	**43%**	**14%**	The hypothalamus is responsible for certain body functions such as temperature control and receives the signal of sleep, hunger and thirst <certain body functions; receives the signal of; sleep , hunger and thirst>
N-ary relation	**24%**	**41%**	...crevices and folds that give it the appearance of a peeled walnut <crevices and folds; give; it>

CAUSES OF ERRORS FOR BOTH SYSTEMS 3/3

Cause	ExtrHech	ReVerb	Example
Incorrect relative clause resolution	**19%**	**9%**	El lugar en el que florecieron las culturas <El lugar; florecieron; las culturas>
Under-specified noun phrase	**10%**	**9%**	The data from the consulted sources must be registered in index cards. <Arg1=the consulted sources>
Incorrect POS-tagging	**10%**	**5%**	Archaeology uses new techniques to … study the material remains and tracks and signs that man made in the past <the material; signs^**V**; that^**PN** man>

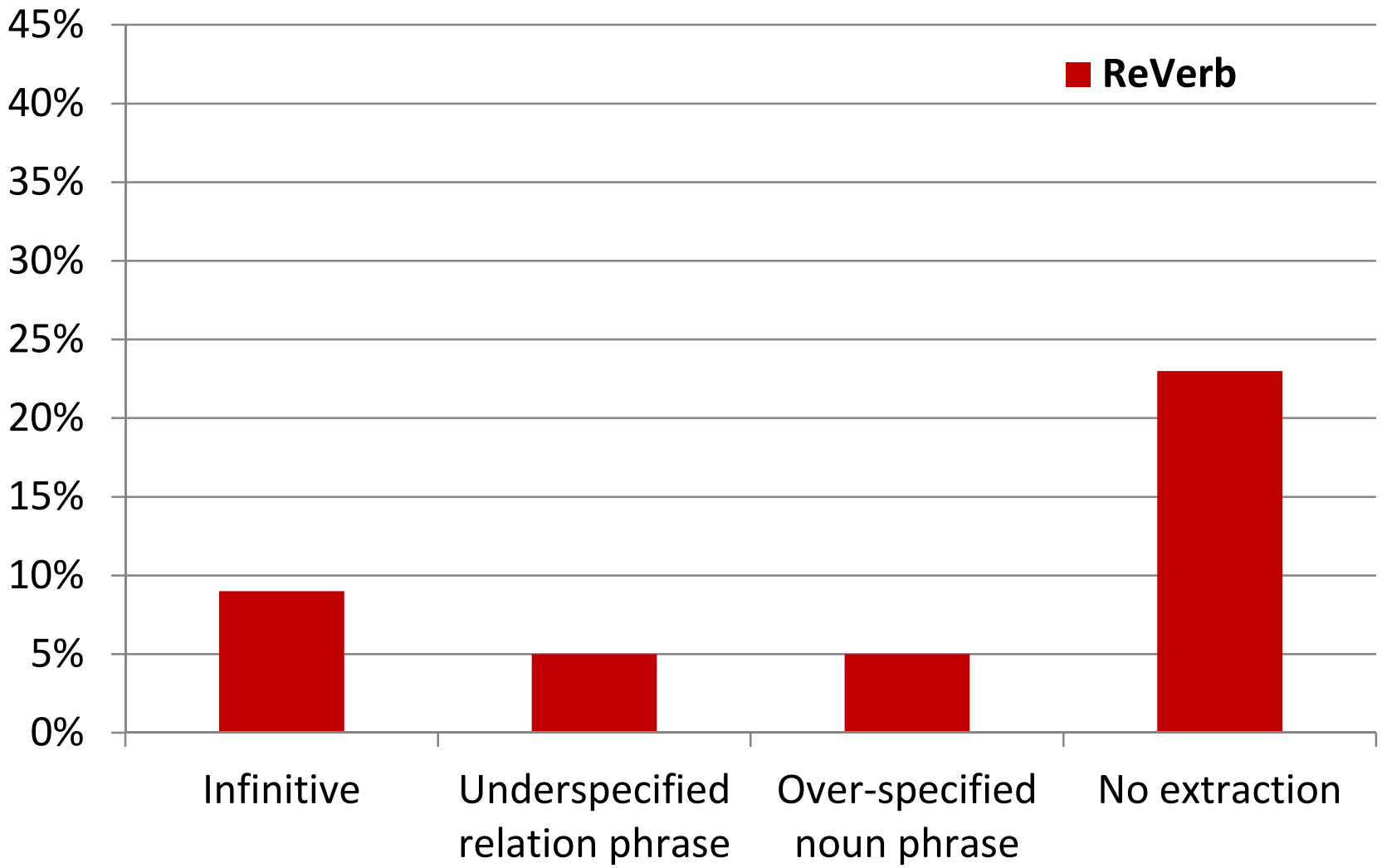
CAUSES OF ERRORS FOR **SPANISH** SYSTEM 1/2



CAUSES OF ERRORS FOR **SPANISH** SYSTEM 2/2

Cause	Extr Hech	ReVerb	Example	Intuition
Free word order	**14%**	–	De la médula espinal nacen los nervios periféricos. <la médula espinal; nacen; los nervios periféricos>	Sp
Non-contiguous relation	**5%**	–	bajo cuyo nombre pueden entrar los sextantes <nombre; pueden entrar; los sextantes>	Sp
Over-specified relation phrase	**5%**	–	La Botánica ha logrado analizar las características de la vegetación <Rel = ha logrado analizar las características de>	sys

CAUSES OF ERRORS FOR **ENGLISH** SYSTEM 1/2



CAUSES OF ERRORS FOR **ENGLISH** SYSTEM 2/2

Cause	Extr Hech	ReVerb	Example	Intuition
Infinitive	–	**9%**	such as to interpret what the eyes see, think, and control many of the body's movements <the eyes; control many of; the body 's movements>	Eng
Under-specified relation phrase	–	**5%**	a peaceful nation of navigators who was in contact with Egypt <a peaceful nation of navigators; was in; contact>	sys
Over-specified noun phrase	–	**5%**	The mammoths migrated from Africa 3.5 million years ago <Arg2 = Africa 3.5 million years>	sys/Eng
No extraction	–	**23%**	—	sys

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CONCLUSIONS

- **Open IE based on POS-tagged input & syntactic constraints adapted to Spanish**
- **First cross-lingual comparative study of Open IE**
- **Performance for Spanish is comparable to English**
  - for system based on the same approach
- **Detailed analysis of errors:**
  - POS-tagging accuracy of 95+% is sufficient for this task
  - Inverse word order is not the biggest problem
- **Good news for Russian (and other European languages): the approach should work as well**

FUTURE WORK

- **Run the system over a large corpus**
- **Most frequent assertions will be considered “facts”**
- **Cluster relation phrases and arguments**
- **Map relations to some ontology**

THANK YOU! QUESTIONS?

APPENDIX

DIFFERENCES IN IMPLEMENTATION

- **Different POS-tag set :**

  EAGLES vs Penn Tree

- **Different verb phrase treatment:**
  - Reflexive verbs in Spanish: *Juan se lava la cara.*
- **Based on regular expressions**
- **Differences in implementation of coordinative conjunction resolution,**

Purely engineering details

REGEX EXAMPLES

Verb phrase:

VREL → (V W*P)|(V)

W can be a noun, an adjective, an adverb, a pronoun, or an article

W =
r'(?:(?:\s+\w+\^\w+\^N.....)|(?:\s+\w+\^\w+\^A.....)|(?:\s+\w+\^\w+\^
R.)|(?:\s+\w+\^\w+\^P.....)|(?:\s+\w+\^\w+\^D.....)|(?:\s+\w+\^\w+\^
VMN....(?:\s+\w+\^\w+\^PP...000)?))'

PROBLEM

3. POS analysis and syntactic constraints

ReVerb (Fader et al., 2011)

- **Requires language-specific information**
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APPROACHES TO OPEN IE 1/3

Learning based systems:

TextRunner (Banko,2007), WOE^{pos} & WOE^{parse} (Wu & Weld, 2010)

- Automatically labeled sentences (using heuristics or distant-supervision)
- Learn relation phrase extractor
- Argument-first:
  Detect arguments (Arg1, Arg2) and then identificates a relation

Shortcomings:

- Noisy training corpus
- Doesn't work well for long sentences
- Detects incoherent relations:

(Faust; made; a deal) instead of (Fauts; made a deal with; the devil)

APPROACHES TO OPEN IE 2/3

Syntactic-analysis based systems:

OLLIE(Mausam, 2012), FES(Aguilar, 2012)

- Deeper syntactic and context analysis
- Detects relations that are not expressed via a verb

Shortcomings:

- High computational capacity
- Slow

APPROACHES TO OPEN IE 3/3

POS analysis and syntactic constraints based systems:

ReVerb (Fader et al., 2011)

- Does not need labeled corpus
- POS-tagging and rules
- “Relation phrase”- first
- Fast in implementation and execution

Shortcomings:

- Detects only verb-based relations
- Works on a sentence-level

DRAFTS

- **Does not resolve inverse word order**

Object/Indirect Object – Verb – Subject

“De la médula espinal nacen los nervios periféricos”

(“Out of the spinal cord come peripheral nerves”)

el^el^DA0MS0 mucho^mucho^RG hacer^hacer^VMN0000 y^y^CC el^el^DA0MS0 mucho^mucho^RG decir^decir^VMN0000 se^se^P0000000 convierten^convertir^VMIP3P0 en^en^SPS00 humo^humo^NCMS000 que^que^PR0CN000 oculta^ocultar^VMIP3S0 lo^el^DA0NS0 que^que^PR0CN000 realmente^realmente^RG podrÃ-a^podrÃa^VMIP3S0 estar^estar^VAN0000 ocurriendo^ocurrir^VMG0000 en^en^SPS00 lo^el^DA0NS0 mÃ^mÃ^NCFS000 ¡^¡^Faa s^s^NCFS000 profundo^profundo^AQ0MS0 de^de^SPS00 el^el^DA0MS0 ser^ser^NCMS000 .^.^Fp

76 utilizando conexión es de definición estándar.