Textual Entailment Recognition Based on Dependency Analysis and *WordNet*

Jesús Herrera
Anselmo Peñas
Felisa Verdejo

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Dpto. de Lenguajes
y Sistemas Informáticos
E.T.S.I. Informática, UNED

C/ Juan del Rosal, 16
Ciudad Universitaria
28040 Madrid

(+34) 91 398 7983
(+34) 91 398 6535

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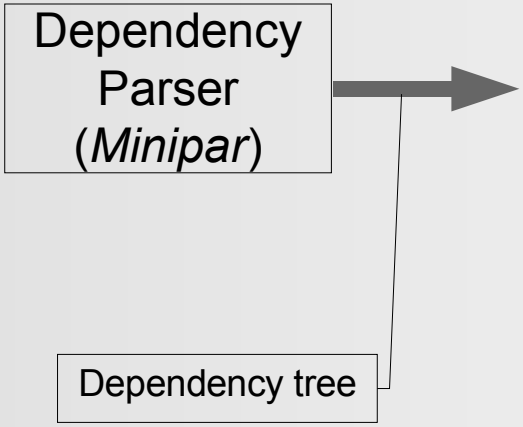
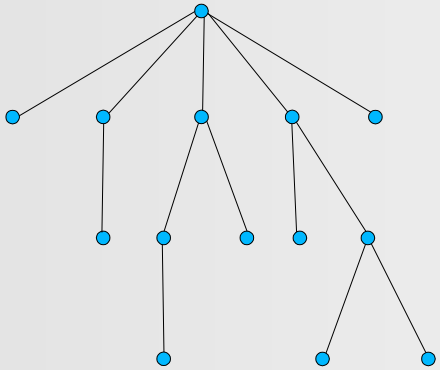
Objectives and Approach

- Objectives
  - Focusing on lexical analysis
  - Semantic relations at the lexical level (*WordNet*)
  - Analysis directed by dependency tree (*Minipar*)
  - How can lexical analysis help to resolve RTE?
- Approach
  - Matching between dependency trees

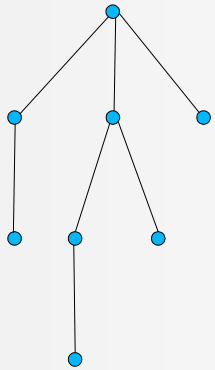
Architecture

Architecture





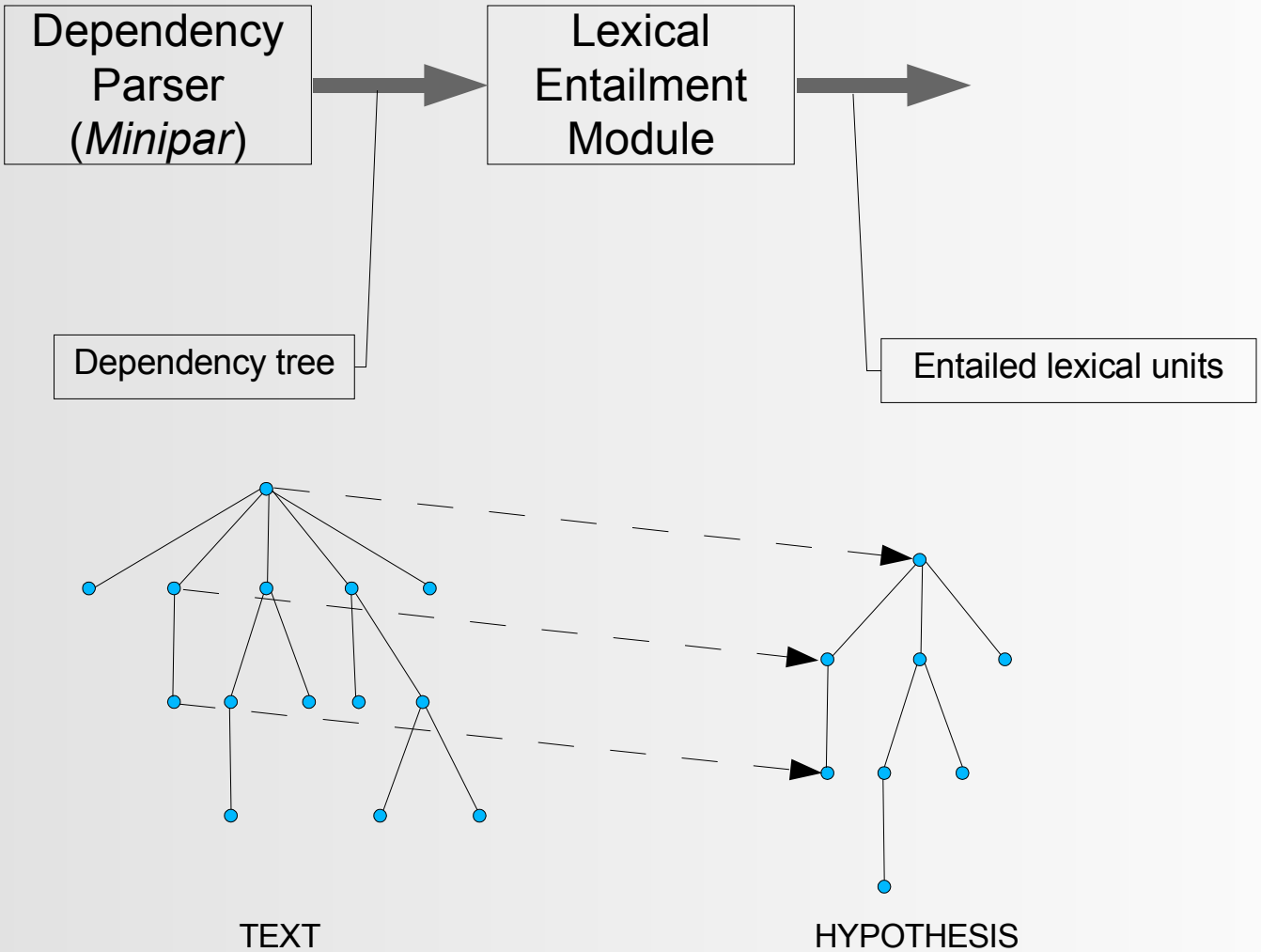
TEXT



HYPOTHESIS

Architecture

Architecture



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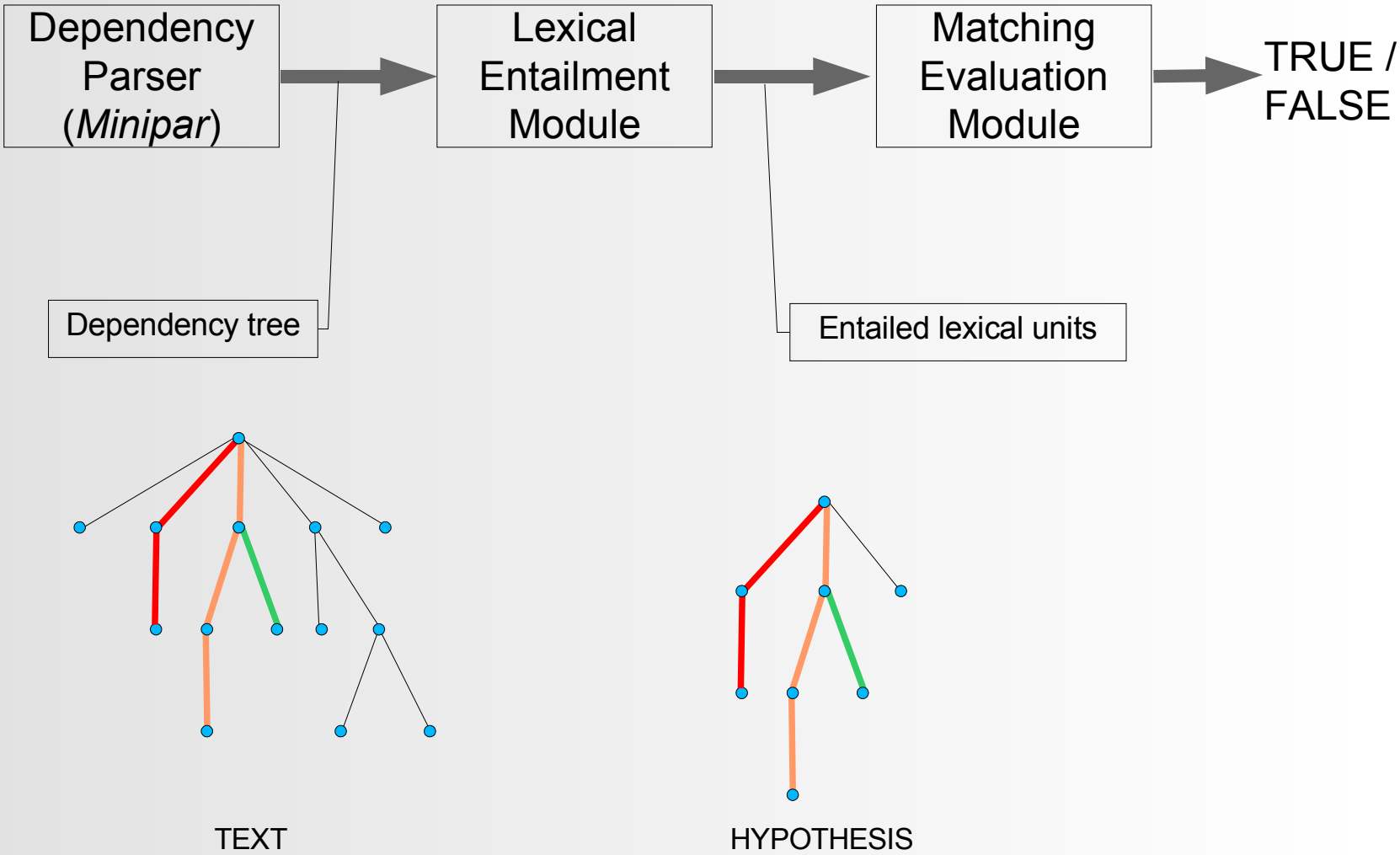
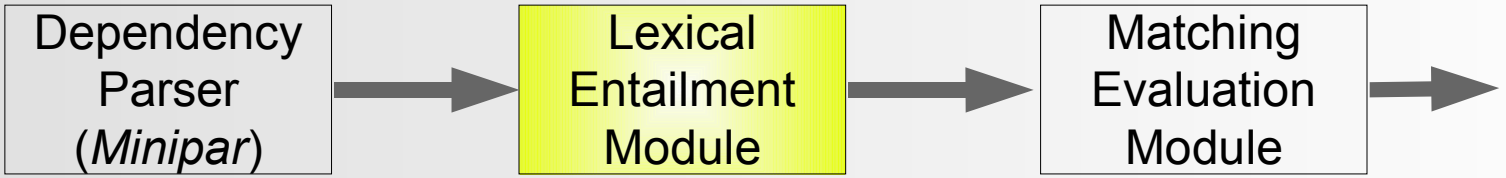


Lexical Entailment



When does exist an eltailment between lexical units?

Based on *WordNet* relations:

- Synonymy and "*WordNet* Similarity"
- Hyponymy and "*WordNet* Entailment"
- Multiwords
- Negation and Antonymy

Lexical Entailment

- Synonymy and "*WordNet* Similarity"

entails(T, H) **IF** synonymy(T, H) **OR** WN_similarity(T, H)

Examples:

synonymy(allow, grant) ≡ TRUE → entails(allow, grant)

WN_similarity(discover, reveal) ≡ TRUE → entails(discover, reveal)

Lexical Entailment

- Hyponymy and "*WordNet* Entailment"

Relations between *WordNet synsets* having a transitive property.

entails(T, H)
IF exists a path from a *synset* of T to a *synset* of H
conformed by hyponymy and/or WN_entailment relations

Examples:

hyponymy(glucose, sugar) ≡ TRUE → entails(glucose, sugar)

WN_entailment(death, kill) ≡ TRUE → entails(death, kill)

Lexical Entailment

- Multiwords

  Why recognize multiwords?

Word / Multiword 1	Relation between words / multiwords	Word / Multiword 2
Hamas	synonymy	Islamic_Resistance_Movement
melanoma	hyponymy	skin_cancer

Recognition of *WordNet* multiwords:

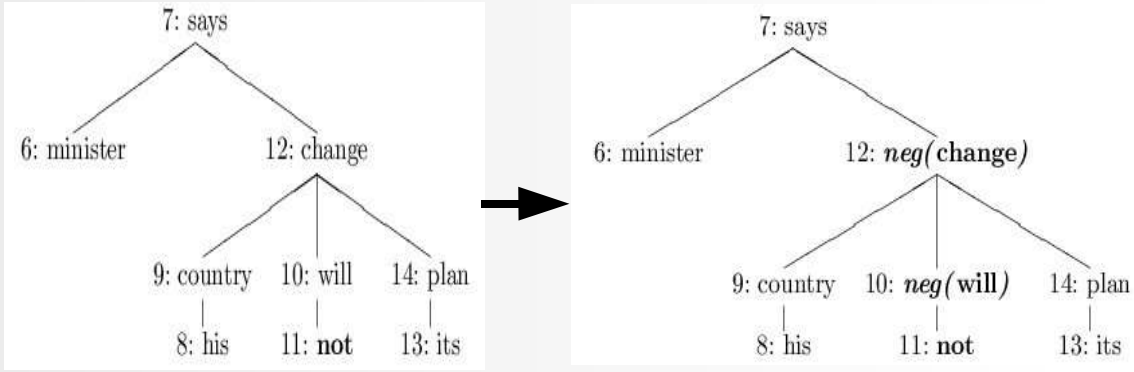
- Lemmatization of components
- Fuzzy matching between candidates and *WN* multiwords

Candidate Multiword	Processing Action	WordNet Multiword
Japanise_capital	Levenshtein's Distance < 10%	Japanese_capital

Lexical Entailment

- Negation and Antonymy

  Negation relations from a leave are propagated to the head



Entailment is implemented considering *WordNet*'s antonymy relation

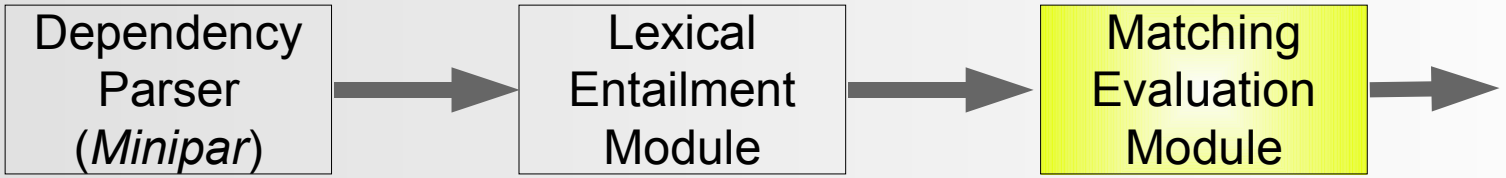
Example:

Text's node: neg(change) → antonymy(change, stay) = TRUE

entails(neg(change), continue)

Hypothesis' node: continue ← synonymy(stay, continue) = TRUE

Matching Between Dependency Trees



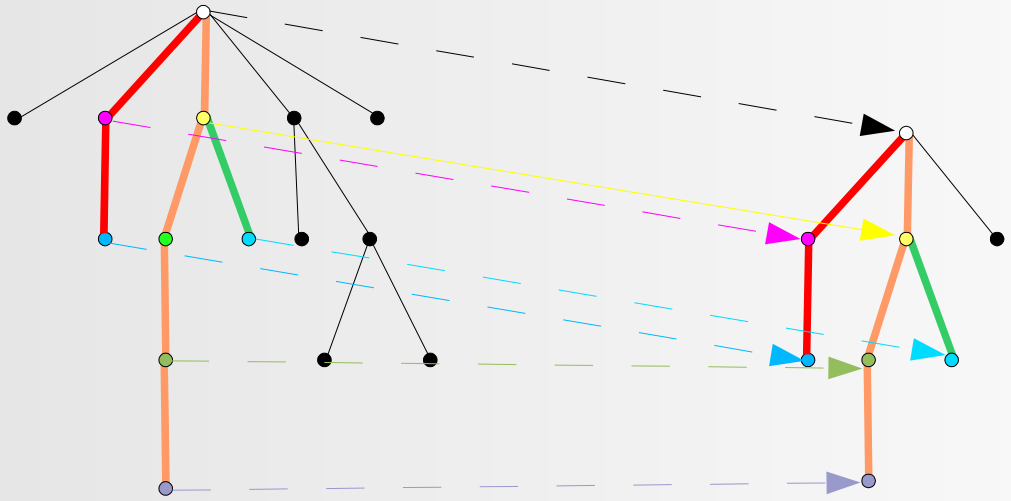
- Matching branches

- Similarity Text - Hypothesis

Matching Between Dependency Trees

- Matching branches

Branches from H tree whose all nodes are involved in a lexical entailment



Text's dependency tree

Hypothesis' dependency tree

Matching Between Dependency Trees

- Similarity T - H

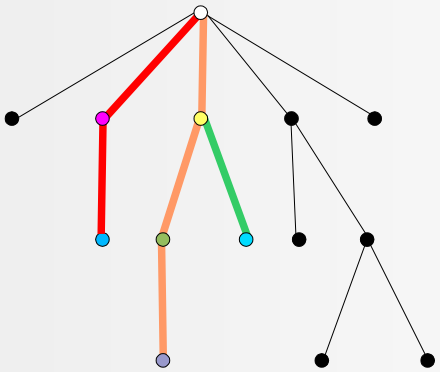
  Ratio of nodes from H pertaining to matching branches

  Example:

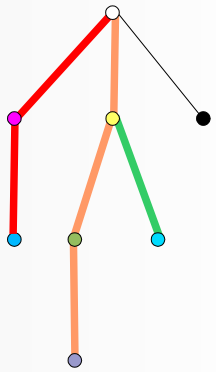
  # H nodes = 8

  # H matching nodes = 7

  Similarity(T, H) = 7/8



Text's dependency tree



Hypothesis' dependency tree

- When does a Text entail a Hypothesis?

  Best accuracy was obtained when Similarity(T, H) ≥ 50%

Experiments Design

Comparing the proposed system to...

- Training corpus

  Baseline System I

    Search for coincident words between T and H

  Baseline System II

    Search for coincident lemmas between T and H

- Test corpus

  Baseline System III

    Proposed System without *WordNet* based lexical entailment

Results

- Training corpus

	Baseline System I	Baseline System II	Proposed System
CD	76.29%	71.13%	80.41%
IE	47.14%	50.00%	47.14%
IR	51.43%	52.86%	51.43%
MT	53.70%	53.70%	55.56%
PP	52.44%	52.44%	54.88%
QA	51.11%	54.44%	46.67%
RC	48.54%	50.49%	53.40%
Overall Accuracy	**54.95%**	**55.48%**	**56.36%**

- Test corpus

	Baseline System III	Proposed System
CD	79.33%	78.67%
IE	52.50%	55.00%
IR	51.77%	51.77%
MT	55.83%	54.17%
PP	48.94%	42.55%
QA	48.46%	45.38%
RC	47.86%	47.14%
Overall Accuracy	**55.75%**	**54.75%**

Analysis and Conclusions

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- Lexical analysis, as proposed, is not enough
- Better results for tasks involving high lexical and syntactic coincidence
- High lexical matching  Semantic entailment
- In-depth treatment of syntactic relations needed
- RTE  Tackling a wide set of linguistic phenomena

Textual Entailment Recognition Based on Dependency Analysis and *WordNet*

THANK YOU