Semi Cognitive Approach to RTE-Using FrameNet for Semantic Clustering

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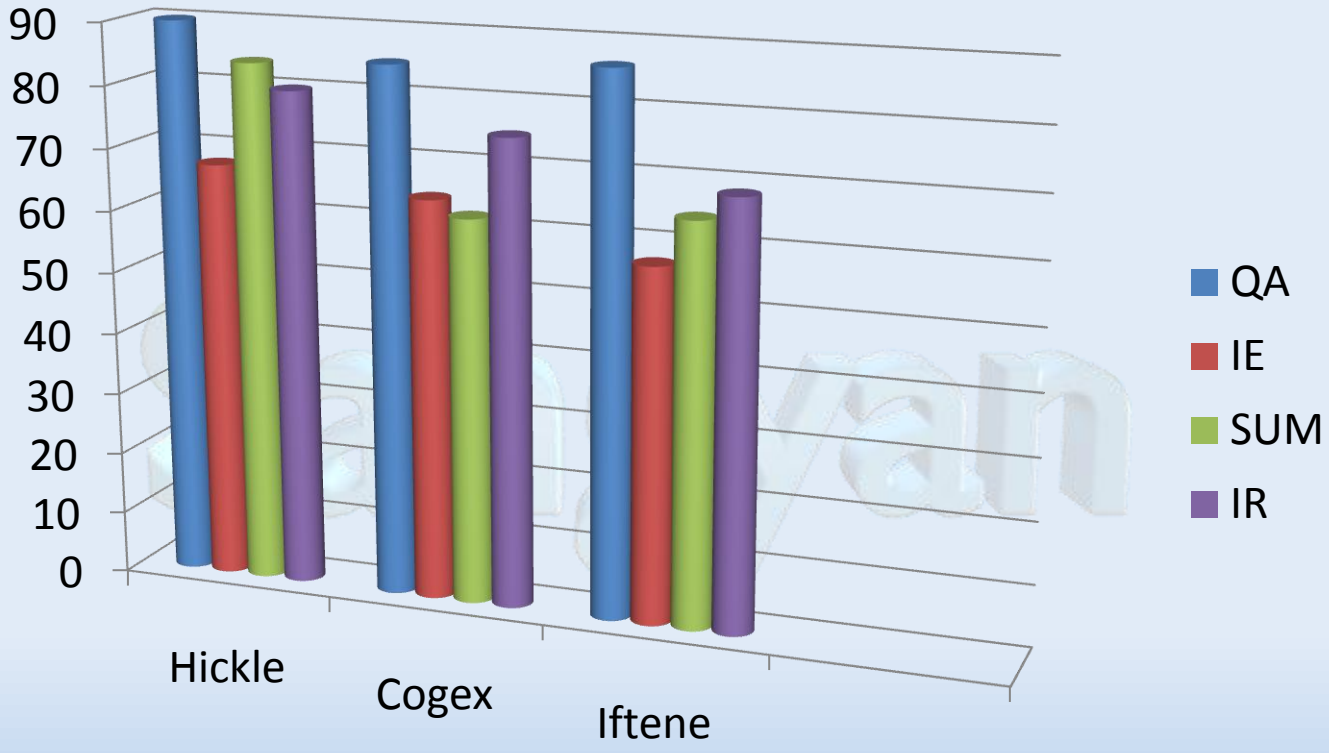
Outline

- Introduction
- System Architecture
  - Semantic Analysis Module
  - Syntactic Analysis Module
- Results & Evaluations
  - Error Analysis and Perspectives
- Conclusion

Where it got started…

- Two years ago…
- Research papers by *Iftene*, LCC etc.
- Analysis of approaches – interesting analysis

Interesting Analysis



Graph depicts the relative low scores in Information Extraction Subtask.

Graph Analysis

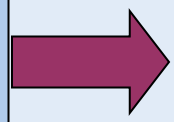
- The systems focus on the *face value* of the sentence and thus scores were low in IE subtask, which required *indirect inference*

- Conclusion: The context inference is important

Example

RTE-1 Development Set :
<pair id="58" value="TRUE" task="IR">
T : Iraqi militants said Sunday they would behead Kim Sun-Il, a 33-year-old translator, within 24 hours unless plans to dispatch thousands of South Korean troops to Iraq were abandoned.

H :Translator kidnapped in Iraq.



Entailment pair would not have been resolved by a system which can not view *kidnap*ping and *behead*ing under the same context of say *danger*

Various Techniques

- Various approaches we analyzed
  - N-gram
  - Edit Distance with Dependency Trees
- All above had the same problems:
  lack of semantics
  lack of determinism
- For example (RTE-3)

Text: Claude Chabrol divorced Agnes, his first wife, to marry the actress Staphane Audran. His third wife is Aurore Paquiss.

Hypothesis: Aurore Paquiss married Chabrol.

FrameNet & *Semantic Clustering*

- FrameNet corpus is not new to RTE Fraternity. *(RTE 2 – Burchardt et al 2006)*

- But, the usage highlighted the Frame Semantics: local roles, participants and also Frame Hierarchies.

Shalemanesar for Clustering

- A word (W) may have different senses $\{W_{s1}, W_{s2} \ldots W_{sn}\}$
- The word will *ideally* belong to n frames.
- Each different sense of the word will make it belong to a different frame depicting that sense.

Clustering Improves Mapping

- Although two words may not be synonyms or directly related, one of them (W1) might belong to a frame F1 due to sense $W1_{s1}$ in a particular context.
- Other word, W2 may have a sense $W2_{s2}$, so that $W1_{s1} <=> W2_{s2}$

Semantic Mapping Aids Entailment

- Both these words will be clustered under Frame F1, which will ease the semantic mapping.
- The improved semantic mapping can be a powerful measure to improve the entailment deduction.

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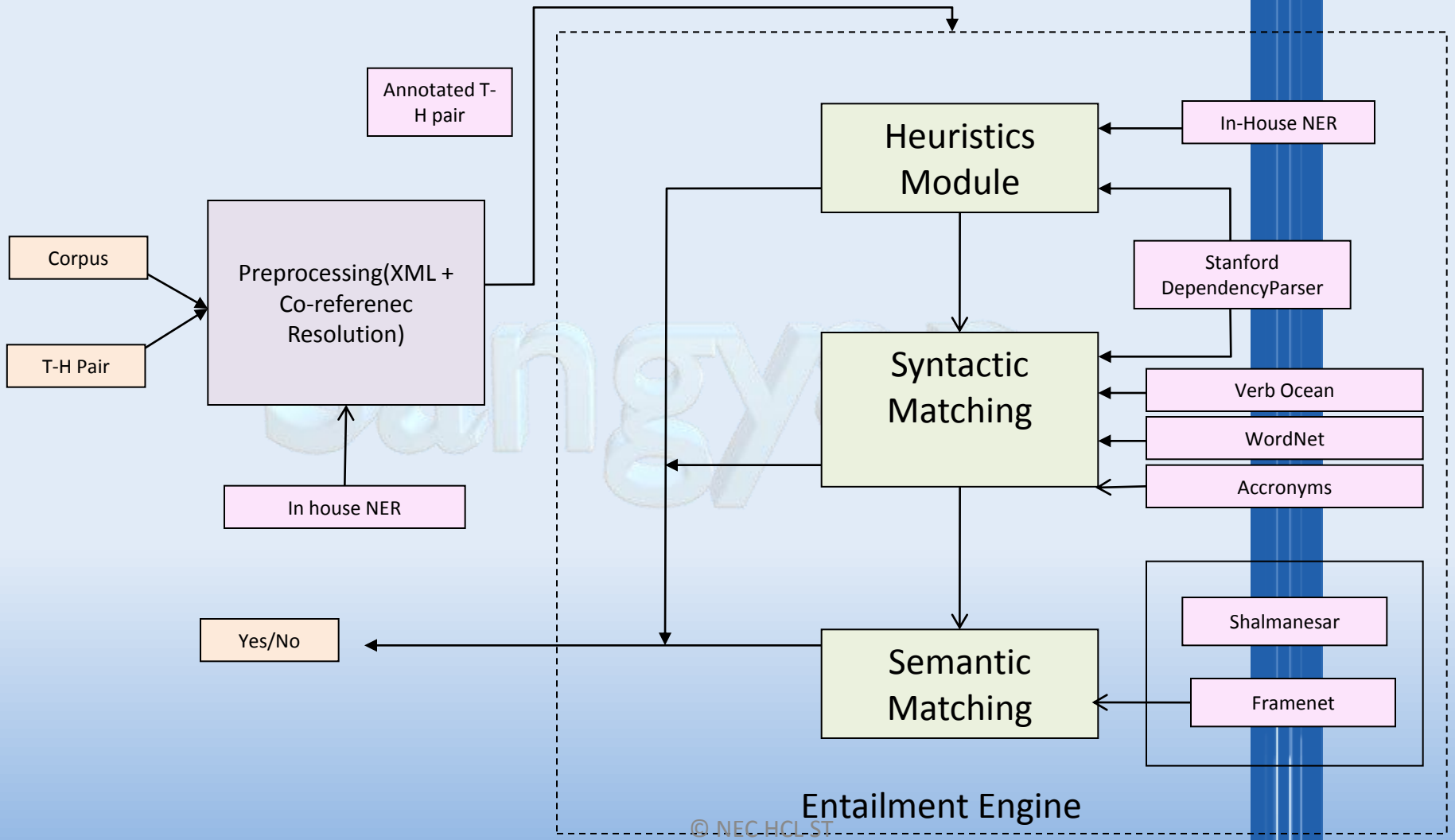
System Architecture



Dependency Tree Match Module

- We extract the ‘Syntactic Roles’ of entities from Stanford dependencies.
- The dependency tree overlap measures the syntactic similarity between the t-h pairs.
- This match gives equal importance to all the relations.

Dependencies not Dependable

- Example:
  - Hypothesis: **The Irish Republican Army is a Catholic paramilitary group**.
    Text I: Answering questions in parliament, Ahern told MPs that the meetings with Adams, whose party is the political wing of the **IRA, Northern Ireland's main Catholic paramilitary group**, had merely been to maintain dialogue.
- Many a times, the semantic equivalence is not reflected in the syntactic structure of two sentences.

GAH over Dependencies

- Instead of typical specific rules which feature in traditional rule based system, Sangyan uses GAH rules (Generically Applicable Heuristics derived from Dependencies).
- GAH are templates which can be applied to extract meaning from a wide range of constructs

GAH in Action>>>

T-H pairs (RTE-6 Development Set)	Meaning	Syntactic Role
Hypothesis: Gerry Adams is the **leader of Sinn Fein.**	Gerry Adams "is-a" leader of Sinn Fein	nsubj(leader, Adams)
Text I: London and Dublin are awaiting for an Irish Republican Army response to a call from **Gerry Adams, leader of the group's Sinn Fein political wing,** for an end to violence.	Gerry Adams "is-a" leader of the group's Sinn Fein political wing	appos(Adams, leader)
Text II: Irish Prime Minister Bertie Ahern admitted on Tuesday that he had held a series of private one-on-one meetings on the Northern Ireland peace process with **Sinn Fein leader Gerry Adams,** but denied they had been secret in any way.	Gerry Adams "is-a" leader of Sinn Fein	nn(Adams, leader)

GAH V/S Rules

- The biggest challenge for rules is their specific applicability.
  - Ex: **Gerry Adams is the leader of Sinn Fein.**
  - **…Gerry Adams, leader of the group's Sinn Fein political wing…**
- It takes one GAH to tackle both the cases, but, two rules to do the same.

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Semantic Module

- Semantic module handles semantic variability
  - Semantic module tries establish semantic relatedness between the TH pair
    For example:
    Text: **Satomi Mitarai died of blood loss**.
    Hypothesis: **Satomi Mitarai bled to death.**

- FrameNet frames provide an excellent way of representing the context and semantics.
  - Abstract over the various syntactical level problems like noun verb alternation etc
  - We use a combination of Frame Match and Lexical Overlap and not frame elements

- In this example, the frame of both “died” and “death” is “Death”

Semantic Module

- We use a combination of Frame Match and Lexical Overlap
- For example (RTE -6)

  Text : **The Patriot Act, passed by Congress a few weeks after the Sept. 11, 2001, terror attacks**, gave federal law enforcement officials broader powers of surveillance and prosecution against suspected terrorists, their financiers and their sympathizers.

  Hypothesis: **Congress passed the Patriot Act after September 11, 2001**.
- The frame "Giving" matches in both text and hypothesis and there is a high lexical overlap between the text and hypothesis.

Semantic Module

- Certain frames are equivalent in particular context .
- For example:

  Text: South Korea has **lifted** a five-year ban on beef imports from the US , despite growing public protests prompted by fears of mad cow disease .

  Hypothesis: South Korea **removes** a US beef ban.
- We get frames **Removing → remove**

  Body_movement → lifted

- We identified both manually and automatically some such frames and added the functionality to equate them during the match process.
- This helps in widening the match criterion of the frame match

Semantic Module

- Text : **Bahrain 's king has appointed a Jewish woman** as the country 's envoy to the United States . Bahrain 's king has appointed a Jewish woman as the country 's envoy to the United States .

  Hypothesis**: Bahrain names a Jewish ambassador** .

- Equivalent frame: Being_named → name Change_of_leadership --> appoint

Clusters and Dark Clouds

- FrameNet is a useful resource
- But, **Lack of Coverage** is a problem
  - Although FrameNet contains more than 6500 fully annotated lexical units and associated frames,
  - not sufficient for many real world scenarios such as RTE-6.
  - Also, it takes expert human supervision for the addition of new frames, which is a time consuming task.
  - For our system handling coverage become easy as we were not using frame elements
  - Added many frames both manually and automatically

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Report Card Time!!

RTE 6 – Main Task

Development Set			Test Set		
Precision	Recall	F-Measure	Precision	Recall	F-Measure
30.64	33.0	31.78	21.66	46.03	29.46

Introspect!! Failure Analysis

- Median Result
  - presents immense opportunities to improve
- Major working area :
  - FrameNet module
    - Requirement of more data for FrameNet equivalence
    - Coverage : Need more frames
  - Lexical Module
    - Intelligent match
  - Syntactic Module
    - Give weight age to more important relation
  - Training the system for setting appropriate Threshold

Problem Area: FrameNet

- More frames for frame equivalance required
- **Text**: Her interpreter, Allan Enwiyah, 32, was shot dead and his body abandoned nearby by the kidnappers, while her **driver got away**.
  Hypothesis: Jill Carroll's **driver escaped**

  * the frame of "escape" is "Departing" and that of "get away" is "Evading".

Problem Area: Lexical Module

- **Text**: Vice President Dick Cheney accidentally sprayed a companion with birdshot while hunting quail on a private Texas ranch, injuring the man in the face, neck and chest, the vice-president's office confirmed yesterday after a Texas newspaper reported the incident.
  Hypothesis: Harry M. Whittington is Vice President Dick Cheney"s hunting companion.
- Despite the low frame match, the true entailment is deduced due to the high lexical overlap.

Problem Area: Syntactic Module

- **Text**: The White House on Monday carefully distanced itself from Vice President Dick Cheney‟s delayed notification about his accidental shooting of a hunting companion.
  Hypothesis: Harry M. Whittington is Vice President Dick Cheney‟s hunting companion

- Probabilistic nature of the syntactic module of our system, which causes the system to give many false positives.

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Future looks *Meaningful*

- While syntactic analysis based systems start hitting the wall pretty soon, Adding semantic analysis module definitely provides a new dimension of growth and improvisation.
- Scope was adding new frames is immense
- Exploring semantic roles for matching
- Problem areas are very solvable

Thank You

- Questions/Answers
- Graphics by UVassociates
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