

# From Shallow to Deep Tense and Aspect Processing

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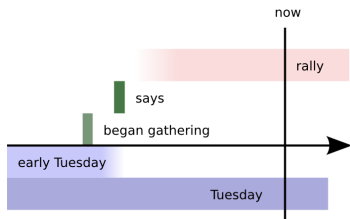
July 3, 2010

## Context

### Temporal Processing

- Identify temporal relations between the events (situations) described in a text
- and between events and temporal entities (e.g. dates)

“Nigeria state radio says thousands of people began gathering in the capital Abuja early Tuesday for the two day rally supporting General Sani Abacha’s candidacy.”



# Temporal Processing

## State-of-the-art

- TempEval-2007, TempEval-2010
- Data mostly from the Wall Street Journal
- 20%–40% error rates depending on the specific task
- Symbolic systems with access to syntactic analysis do not perform much better than machine learning methods using only shallow features

Our Goal: Temporal Processing for Portuguese

## Results So Far

### Data

- Portuguese translation of the TempEval-2007 (English) data
- Data annotations adapted from the English data

```
<s>Nigeria state radio <EVENT eid="e8" class="REPORTING" stem="say"
aspect="NONE" tense="PRESENT" polarity="POS"
pos="VERB">says</EVENT> thousands of people <EVENT eid="e9"
class="ASPECTUAL" stem="begin" aspect="NONE" tense="PAST"
polarity="POS" pos="VERB">began</EVENT> <EVENT eid="e10"
class="OCCURRENCE" stem="gather" aspect="NONE" tense="PRESPART"
polarity="POS" pos="VERB">gathering</EVENT> in the capital Abuja
<TIMEX3 tid="t2221" type="DATE" value="1998-03-03" mod="START"
temporalFunction="true" functionInDocument="NONE"
anchorTimeID="t2078">early Tuesday</TIMEX3>
<TLINK lid="l7" relType="OVERLAP-OR-AFTER" eventID="e8"
relatedToTime="t2221" />
<TLINK lid="l5" relType="OVERLAP" eventID="e9" relatedToTime="t2221" />
```

## Results So Far

Approach similar to that of [Hepple et al., 2007] for TempEval-2007

- Several machine learning algorithms, Weka's implementation (SVM, Naive Bayes, k-NN, etc..)
- Features for the classifiers: attributes of the TempEval annotations, surface strings, whether the corresponding surface forms occur adjacently

Applied to the 3 subtasks of TempEval-2007

- A: order events and temporal entities in the same sentence
- B: order events wrt the document's creation time
- C: order the main events of two consecutive sentences

## Results So Far

### Results

- Very similar to the results for English, and very close to the best results in TempEval-2007
- Grammatical tense seems to be the most important feature

	Task A	Task B	Task C
baseline (majority class)	57	56	47
English ([Hepple et al., 2007])	59	73	54
TempEval-2007 best	62	80	55
Portuguese	59	76	61

# Comments on the Results

- Limited information available to the classifiers

```
<s>Nigeria state radio <EVENT eid="e8" class="REPORTING" stem="say" aspect="NONE"
tense="PRESENT" polarity="POS" pos="VERB">says</EVENT> thousands of people began gathering in the
capital Abuja <TIMEX3 tid="t2221" type="DATE" value="1998-03-03" mod="START"
temporalFunction="true" functionInDocument="NONE" anchorTimeID="t2078">early Tuesday</TIMEX3>
<TLINK lid="l7" relType="OVERLAP-OR-AFTER" eventID="e8" relatedToTime="t2221"/>
```

says REPORTING say NONE PRESENT POS VERB NON-ADJACENT DATE START    **OVERLAP-OR-AFTER**

- More attributes needed
- Ultimately, syntactic information (at the least) is needed

# Why should deep processing perform better?

- Some NLP is needed, to get the attributes that are assumed
  - Disambiguating inflectional morphology is not trivial for all languages
- Syntax matters
- Mismatches between grammatical tense and semantic tense
  - “The train leaves tomorrow.”
  - “1884 – Dow Jones and Company publishes its first stock average.”



# Why should deep processing perform better?

## Limitations

- Grammar coverage
- The disambiguation model not picking up the preferred readings
- Some ambiguity may be difficult to underspecify (in some languages, a single grammatical tense can have readings of simple past and present perfect)
- Pragmatics and world knowledge seem to play a role, too
- Not all relevant information is in the same sentence

# Some HPSG Analyses of Tense and Aspect

- Focus on aspect
- Many are inspired by Reichenbach and DRT
- No consensus on the representation
- Some topics not discussed (e.g. backshifting, temporal anaphora)

# Some HPSG Analyses of Tense and Aspect

## ■ [Van Eynde, 2000]

- Utterance time, situation (=eventuality) time and location time
- Situation time and location time overlap
- For non-states the situation time is a subinterval of the location time
- In past tenses, location time precedes the utterance time, ...

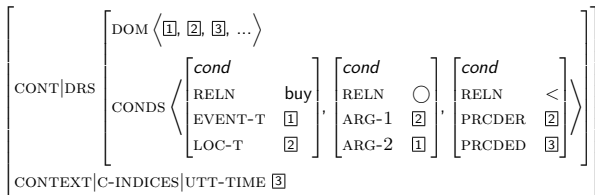
$$\left[ \text{CONTEXT} \left[ \text{C-INDS} \left[ \begin{array}{ll} \text{SIT-TIME} & \boxed{5} \\ \text{LOC-TIME} & \boxed{6} \\ \text{UTT-TIME} & \boxed{u} \end{array} \right] \right] \left[ \text{BACKGROUND} \left\{ \boxed{5} \subseteq \boxed{6}, \boxed{6} < \boxed{u} \right\} \right] \right]$$

- Multiple analyses for Dutch *hebben/zijn* + past participle (ambiguous between simple past and present perfect)

# HPSG Analyses of Tense and Aspect

- [Yoshimoto and Mori, 2002]

- Similar to Van Eynde's



- Relationship between the tenses of main clauses and adverbial clauses in Japanese

# HPSG Analyses of Tense and Aspect

## ■ [Bonami, 2002]

- Semantic scope of tense operators
- MRS representations with EPs for tense and aspectual operators

$\left[ \begin{array}{ll} \textit{tense-rel} & \\ \text{HANDLE} & \textit{handle} \\ \text{SCOPE} & \textit{handle} \\ \text{BEV} & \textit{evy-ind} \\ \text{TIME} & \textit{t-ind} \end{array} \right]$	$\left[ \begin{array}{ll} \textit{asp(ectual)-op(erator)-rel} & \\ \text{HANDLE} & \textit{handle} \\ \text{SCOPE} & \textit{handle} \\ \text{BEV} & \textit{evy-ind} \\ \text{EVY} & \textit{evy-ind} \end{array} \right]$
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- Focus on how to get different aspectual readings for imperfective vs perfective past forms with verbs of different aspectual classes
- Tense operators can licence up to 1 implicit aspectual operator directly under their scope

# HPSG Analyses of Tense and Aspect

## ■ [Flouraki, 2006]

- Aspect relations in MRSs, but no tense relations
- Adapts the event structure proposed by [Pustejovsky, 1991]  
Achievements and accomplishments are decomposed into a (preparatory) process and a resulting state:

$$\left[ \begin{array}{l} \textit{transition\_rel} \\ \text{LBL } \textit{handle} \\ \\ \text{EVENT\_STR} \end{array} \left[ \begin{array}{l} \text{EVENT1} \quad \boxed{1} \textit{ process} \\ \text{EVENT2} \quad \boxed{2} \textit{ state} \\ \text{RESTR} \quad \{ \boxed{1} < \boxed{2} \} \end{array} \right] \right]$$

- Focus on how to get different aspectual readings for imperfective vs perfective past forms with verbs of different aspectual classes
- The aspectual operators for imperfective and perfective past morphology constrain this structure (e.g. the imperfect removes the resulting state)

# Final Remarks

## Summary

- The current state-of-the-art for temporal information processing is largely guesswork
- Nevertheless, some shallow features are highly informative (grammatical tense)
- Grammatical information should improve the results

## Current and Future Work

- More attributes
- Implementation of tense and aspect semantics in LXGram
- Integration with LXGram

# References



Bonami, O. 2002. A syntax-semantics interface for tense and aspect in French. In Eynde, F. V., Hellan, L., and Beermann, D., editors, *The Proceedings of the 8th International Conference on Head-Driven Phrase Structure Grammar*, pages 31–50, Stanford. CSLI Publications.



Flouraki, M. 2006. Constraining aspectual composition. In Müller, S., editor, *The Proceedings of the 13th International Conference on Head-Driven Phrase Structure Grammar*, pages 140–157, Stanford. CSLI Publications.



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