Compiling and Annotating a Syriac Corpus

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Compiling and Annotating a Syriac Corpus

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David Taylor (Oxford)
March 15, 2008 – AAACL
Borgia 13

13th century manuscript, a Melkite Euchologion
Overview

- Project Objectives
- Corpus and Lexical Resources
- Morphological Tools and Markup
- Reduction of Annotation Costs
- Review Process
- Conclusions
Project Objectives (I)

- Create a digital and print concordance of all of the works of Ephrem the Syrian (d. 373 AD)
- 0.5 million word corpus
Project Objectives (2)

- Create an annotated digital corpus of all Syriac literature
  - From the 2nd Century
  - To the 20th Century
  - On the order of 50 million words

- Transform Syriac scholarship
  - Enable new insights
  - Discover new literary, theological, and historical connections
Near-term Objectives

- Develop infrastructure for Syriac corpus development
  - Digital text acquisition
  - Lexical resources
  - Linguistic annotations
  - Morphological analysis and disambiguation
  - User interface
- Provide motivation for cost-conscious active learning for annotation
Syriac in One Slide

- Northwest Semitic
- Dialect of Aramaic
- Three scripts
- Reads right to left
- Highly inflective
- Texts are largely unvocalized
- Primarily a literary and ecclesiastical language beginning in the 9th century
Corpus Transcription

- Digitization of Syriac-script texts is in progress
  - By human transcription
  - By Syriac OCR (Clocksin)
  - Post-editing also in progress
- Works of Ephrem the Syrian are complete
- 5 million total words transcribed to date
Lexical Resources

- Comprehensive digital dictionary in-progress
  - Based on the print dictionary of Payne-Smith
  - Augmented by other print dictionaries
  - Coverage will grow from traditional texts to newly acquired corpora
- Common resource both for computational tools and human consultation
- Encoded with XML markup (TEI)
- GUI for online access
Project Workflow

Define Morphological Tagset

Morphological Tagset

Morphology Rules

Define Morphology Rules

Corpus Transcription (incl. OCR)

Transcribed Corpus

Assemble Dictionary (incl. OCR)

Digital Dictionary

Define Lexicographic Tagset

Lexicographic Tagset

Define Tagging Features

Corpus + Morph. Analysis Hypotheses

Annotation Accelerator
*Active Learning Tagger
*Web UI

Web Annotators

Annotated Corpus

Annotation Reviewer
*Active Learning Tagger
*Web UI

Final Annotated Corpus

Reviewer

Issues

Editor

Review Issues
Morphological Analysis

- **Input:** Syriac text
  - Currently romanized
- **Output:** all possible morphological parse(s)

- **Method:** Finite-state morphology
Finite-State Morphology

- Word formation viewed as generative process
  - From morphemes to words
  - Produced by a finite-state transducer
- Auto-segmental approach
  - Root tier
  - Consonant-Vowel tier
  - Vocalization tier
- Knowledge-engineered
  - Lexicons for roots, morphemes
  - Rules for word formation, interdigitation
- Xerox XFST toolkit and techniques (Beesley & Karttunen, 2003)
- Prior work by Kiraz (1993)
  - Currently using the Kiraz categories and attributes
Parsing morphological structure

\texttt{xfst[1]: up mono}
[\texttt{PronQu+impers-4}]

\texttt{xfst[1]: up layleyn}
[\texttt{PronQu+wh+pl}]

\texttt{xfst[1]: up lawkelDDyenhy}
[\texttt{PronSubj+enc+3sg+f}]

\texttt{xfst[1]: up qTal}
[\texttt{qTl-P1a+Ethpeel+Perf+pl+3+f-2}]
[\texttt{qTl-P1a+Peal+Perf+sg+3+m}]
[\texttt{qTl-P1a+Peal+Perf+pl+3+f-2}]

\texttt{xfst[1]: up lekal}
[\texttt{1kl-P3+Peal+Perf+sg+3+m}]
[\texttt{1kl-P3+Peal+Perf+pl+3+f-1}]

\texttt{xfst[1]: up nelkuwl}
[\texttt{1kl-P3+Peal+Imperf+sg+3+m}]
[\texttt{1kl-P3+Peal+Imperf+pl+1}]
Current Status of Morphology

- About 1500 lexical items
- Several hundred rules (mostly verbal)
- Remaining issues:
  - Working directly with Unicode
  - Some derivational patterns
  - Verb object-suffixes and effects on vowels
  - Diacritics
  - Partial vocalization
Linguistic Annotation

- Linguistic information associated with each word (token):
  - Maximally disambiguated morphological analysis(es)
  - Including grammatical category
  - Vocalization (to varying degree)
    - Depends on metrical demands
- Not a trivial task, even for trained annotators
Accelerating Corpus Annotation

- Reduce the total cost of human annotation efforts without compromising accuracy
- Use probabilistic models for computer-aided tagging
  - In particular, for morphological disambiguation
- Use active learning
  - (Seung et al, 1992; Thrun et al., 1992)
- Still requires human expertise for selected examples
- More details in:
  - LAW 2007
  - LREC 2008
Our Tagging Approach

- Use a state-of-the art tagger:
  - Maximum Entropy tagger (Rathnaparkhi, 1995)
  - aka Maximum Entropy Markov Model (MEMM)
  - aka Conditional Markov Model (CMM) trained locally by Maximum Entropy learner

- Requirements: Syriac morphological tag set, annotated data, “feature” templates for classification, human oracles
Features for Tagging

- Combination of lexical, orthographic, contextual, morphological, and frequency-based information

- For each word:
  - The textual form of the word itself
  - Tags of the preceding two words
  - The textual form of the following word
  - Diacritics
  - Arbitrary variable-length word prefixes and suffixes

- Following Toutanova & Manning (2000)
## Syriac Labels

<table>
<thead>
<tr>
<th>Tags</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclitic</td>
<td>Vocalized word (vowels)</td>
</tr>
<tr>
<td>Suffix – gender, person, number, suffix/contraction</td>
<td>Word – seyame</td>
</tr>
<tr>
<td>Word – gender, person, number, state, tense, form</td>
<td>Word – lexeme flag</td>
</tr>
<tr>
<td>Lexeme – grammatical category</td>
<td>Lexeme – lexeme</td>
</tr>
<tr>
<td>Lexeme – first, second, third, fourth suffix</td>
<td>Lexeme – seyame</td>
</tr>
<tr>
<td>Lexeme – prefix</td>
<td>Word type</td>
</tr>
<tr>
<td>Lexeme – form</td>
<td>Lexeme – vowel pattern</td>
</tr>
<tr>
<td>Root – root type</td>
<td>Lexeme – number of vowels</td>
</tr>
<tr>
<td></td>
<td>Lexeme – radical type</td>
</tr>
<tr>
<td></td>
<td>Root</td>
</tr>
</tbody>
</table>

3403 distinct tags (not including features)
Active Learning

- **Goal:** produce annotated corpora with least possible time and annotator effort

- **Method**
  - Use probabilistic tagger to annotate new data
  - Find most informative sentences/words
  - Ask oracle (human annotator) for answer
  - Use the answer to retrain the tagger
  - Repeat the process until cost limit reached

- **Developed for English, now applying to Syriac**
  - Details and extensive results presented for the group earlier this afternoon by Peter McClanahan
Active Learning Results (Short Version!)

[Graphs showing cumulative cost and tag accuracy over time for different methods: Random, LS, QBU, and QBC.]
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Annotated Corpus

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Review Process

- Use active learning framework for editorial review of transcriptions and annotations
- Review issues raised during annotation for feedback to upstream components
Conclusions

- Now developing tools and resources for Syriac language processing
- Accelerating corpus annotation in novel ways
  - Therefore, minimizing cost
- Deliverables of interest to Syriac scholars:
  - Digital and print concordance of the works of Ephrem the Syrian
  - Large annotated Syriac corpus
- Interface specifics still undetermined
  - Seeking best practices and advice
Questions?