

11-712: NLP Lab Report

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Abstract

1 Basic Information about Akkadian

Akkadian is the oldest attested member of the Semitic language family used primarily between the 3rd and 1st millennia BCE. It encompasses two central dialects: Assyrian, spoken largely in the Assyrian empire centered in northern Mesopotamia; and Babylonian, centered in the south.

Akkadian texts were written using a cuneiform script adopted from Sumerian. The cuneiform symbols largely represent syllables, though some denote logographic values (e.g., one symbol for the word “man”). The process by which a text is transcribed from a clay tablet includes the following:

1. Transliteration, in which the cuneiform signs are rendered into their syllabic values¹ (let S_n stand in for the signs):²

$$\begin{array}{cccccccccc} S_1 & S_2 & S_3 & S_4 & S_5 & S_6 & S_7 & S_8 & S_9 \\ \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} \\ q\acute{a} & ra & dum & na & ra & am & i & pu & u\acute{s} \end{array}$$

2. Normalization, in which the transliterated syllables are rendered into the lexical form of the word.

qarrādum narām īpuš

Vowel length (long vs. short) and whether or not a consonant is doubled are important for distinguishing different words. Note that the original scribes may choose to syllabalize a word in several different ways, so that, for example, the lexical word *išarum* may be written in cuneiform as *i-ša-rum* or *i-ša-ru-um* (Huehnergard, 2005, 71).

As we have them in digitized form, Akkadian texts are generally transliterated, but not normalized. A typical text looks like the following (Kt a/k 394):

um-ma wa-ak-lúm-ma
a-na kà-ri-im
Kà-ni-iš.ki
qí-bí-ma

¹Logograms are transliterated as capital letters, with homophones disambiguated with an index (e.g., KU₆)

²Example due to (Huehnergard, 2005, 72).

2 Past Work on the Morphology of Akkadian

The earliest computational work on Akkadian looks to be Kataja and Koskeniemi (1988), which outlines a two-level framework for Akkadian word formation, seeing regular verbs as possessing ordered slots to be filled by (in order): person, root (and flection/vocalization), gender and number, optional subjunctive indicators, and optional object markers; nouns, analogously, are defined as (in order) stem, case and number, and optional possessive markers. The authors provide about a dozen examples of useful phonological alternations, including the assimilation of *N* before consonants and the assimilation of dentals occurring after other dentals.

Macks (2002) describes work implementing an Akkadian morphological analyzer in Prolog (for the Babylonian dialect). The analyzer, available online,³ parses G, D, and N stem verbs in the preterite, perfect, imperfect, durative, precative and vetitive tenses, yielding the verb stem (but not lexical form with vocalization), tense, person, number and gender. The input verb token is required to be in normalized form, though the analyzer does retain some flexibility by enabling wildcards for vowel length.

Barthélemy (1998) also describes work developing a two-level morphological analyzer for Old Babylonian verb forms (but without suffixes like enclitic particles or pronouns). This work is very useful as a high-level overview of the problems involved in analyzing Akkadian verbs, and offers a useful description of Akkadian *stems* (verbal structural classes, applicable to any root, marked by changes to prefixes, infixes and radical reduplication that impact the semantics of the verb, such as whether a verb is habitual, factitive, causative, passive, etc.). In a manner similar to Kataja and Koskeniemi (1988), this work decomposes a verb into nine slots, each ranging over a fixed vocabulary: the personal prefix, stem prefix, infix, first radical, infix, second radical reduplication, second radical (plus vocalization), third radical, and gender/number suffix, and then transforms the lexical form into a surface form through phonological transformations. This work lists a few general trends (e.g., the dissimilation of *bb* → *mb*, *ij* → *i*) but no explicit rules. Barthélemy (2009) builds on this work by further decomposing the verb form into a tree-like structure, with the “core” (including the lexical class, voice and aspect) embedded within the personal (gender, number, etc.) affixes.

Two commonalities among all prior work is that 1.) all require normalized forms as input, not the transcribed text that we have in the form of corpora; and 2.) all focus on the more complex verbal morphology; the simpler morphology of nouns and adjectives may be good low-hanging fruit.

3 Available Resources

Akkadian lexicon with 3704 words (with somewhat regular categorization for part of speech, from which can extract 741 nouns, 305 verbs, 141 adjectives and 55 adverbs). More work may be necessary to convert these forms to their stems. (Note for future work: these entries also have English/Danish translations.)

A corpus of Old Assyrian texts is available in the form of 2,094 letters between merchants unearthed at the colony of *kārum Kaneš* near Kültepe, Turkey. Since the original text documents contain annotations and metadata (e.g., line numbers, notes in English and German about the text) and, as transcriptions of cuneiform tablets, also contain word fragments (where the original tablet is missing or illegible), I create development and test corpora by extracting only those tokens with a hyphen (which denotes cuneiform sign boundaries) and exclude all words with missing/reconstructed fragments. Appendix A presents an original source text transcription along with the tokens extracted from it using this method.

³<http://www.wiglaf.org/akkadian/>

From this set, I randomly created two development corpora of 5,000 tokens each (`dev1.corpus.txt` and `dev2.corpus.txt`), and one final test corpus of 10,000 tokens (`test.corpus.txt`). 59,649 remaining tokens from this corpus are saved as `unused.corpus.txt` if we need them, and the token counts of all 17,997 distinct types are saved in `vocab.counts.txt`. These counts can help prioritize work to maximize impact.

4 Survey of Phenomena in Akkadian

4.1 Nouns

4 cases (nominative, genitive, accusative, oblique), 2 genders (masculine, feminine), 3 numbers (singular, dual, plural). Inflections are all suffixes. In OB, the dual is restricted to body parts (eyes, feet, etc.). After OB, final m and n no longer appear.

Strong vs. weak verb forms.

5 Initial Design

6 System Analysis on Corpus A

7 Lessons Learned and Revised Design

8 System Analysis on Corpus B

9 Final Revisions

10 Future Work

A Data

Example Old Assyrian text transcription (for text CCT 1, 11b). Brackets (e.g., “[a-ší]” in line 8) denote text that is missing or illegible in the original cuneiform tablet but has been reconstructed by scholars in the process of transcription. Notes are scattered throughout (e.g., *obv.* denotes the text of the front side [obverse] of a tablet, *rev.* the text on the back [reverse]).

CCT 1, 11b

#3 BM 113574a

#6 EL 24;

15-16: Larsen, OACP 31

#10 - OIP XXVII 59, 22-30 ##

obv. ! (Siegelabrollung B)
1 KIŠIB DINGIR-ma-lá-ak DUMU Sú-en6-SIPA
 KIŠIB Bé-lá-nim DUMU Šu-Ku-bi-im
 KIŠIB E-ni-ba-áš DUMU A-šūr-DU10
 (Siegelabrollung C)
 [KIŠIB] Wa!-wa!-lá
lo.e. (Siegelabrollung C)
rev. ! (2 Stempel C)
5 [1/3 ma]-na KÙ.BABBAR ṣa-ru-pá-am

[i-ṣé-e]r DINGIR-ma-lá-ak
 [DUMU Sú-en6]-SIPA ù Wa-wa-lá
 [a-ší]-tí-šu d.En-líl-ba-ni i-šu
 [i]š-tù ha-muš-tim ša kà-ší-im
 (Siegelabrollung A)
 10 ša qá-tí E-na-nim <ITU>.KAM
 a-lá-na-tim li-mu-um
 u.e. (Siegelabrollung B)
 A-gu5-tum 1/2 GÍN.TA i-ITU.KAM
 ṣí-ib-tám ú-ṣú-bu KÛ.BABBAR
 i-qá-qá-ad šal-mì-šu-nu ra-ki-is
 le.e.
 15 qá-té d.En-líl-ba-[ni]
 (Siegelabrollung B)
 Wa-wa-lá [ú-kà-al]
 r.e. (Siegelabrollung A)
 @END_FILE

Tokens extracted from this text by the method described in section 3 are:

DINGIR-ma-lá-ak Sú-en6-SIPA
 Bé-lá-nim Šu-Ku-bi-im
 E-ni-ba-áš A-šùr-DU10
 Wa!-wa!-lá
 ṣa-ru-pá-am
 DINGIR-ma-lá-ak
 Wa-wa-lá
 d.En-líl-ba-ni i-šu
 ha-muš-tim kà-ší-im
 qá-tí E-na-nim
 a-lá-na-tim li-mu-um
 A-gu5-tum i-ITU.KAM
 ṣí-ib-tám ú-ṣú-bu
 i-qá-qá-ad šal-mì-šu-nu ra-ki-is
 qá-té
 Wa-wa-lá

References

- François Barthélemy. A morphological analyzer for akkadian verbal forms with a model of phonetic transformations. In *Proceedings of the Workshop on Computational Approaches to Semitic Languages*, Semitic '98, pages 73–81, Stroudsburg, PA, USA, 1998. Association for Computational Linguistics. URL <http://dl.acm.org/citation.cfm?id=1621753.1621766>.
 François Barthélemy. Une description morphologique structurée en arbre du verbe akkadien qui utilise des structures de traits et des transducteurs multirubans, 2009.
 Richard Caplice. *Introduction to Akkadian*. Editrice Pontificio Istituto Biblico, Roma, 2002.
 John Huehnergard. *A Grammar of Akkadian*. Eisenbrauns, Winona Lake, Indiana, 2005.

- Laura Kataja and Kimmo Koskeniemi. Finite-state description of semitic morphology: a case study of Ancient Akkadian. In *Proceedings of the 12th conference on Computational linguistics - Volume 1*, COLING '88, pages 313–315, Stroudsburg, PA, USA, 1988. Association for Computational Linguistics. ISBN 963 8431 56 3. doi: 10.3115/991635.991699. URL <http://dx.doi.org/10.3115/991635.991699>.
- Aaron Macks. Parsing Akkadian verbs with prolog. In *Proceedings of the ACL-02 workshop on Computational approaches to semitic languages*, SEMITIC '02, pages 1–6, Stroudsburg, PA, USA, 2002. Association for Computational Linguistics. doi: 10.3115/1118637.1118638. URL <http://dx.doi.org/10.3115/1118637.1118638>.