Building a Lexicon Database for Arabic Dialects

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Overview

- Goals:
  - Desired properties of a lexicon and transcripts
- Common hurdles
- Hurdles particular to Arabic
- Some methods of approach:
  - Transcripts as plain-text or structured data files
  - Lexicon as plain-text or “tool-based” flat table
  - Lexicon as relational database (RDB)
- The next step -- now in progress:
  - Putting transcripts into the same RDB with the lexicon

What makes a good lexicon

- Full coverage for an adequately-sized corpus
  - List and describe all “word” tokens that are valid
  - Possibly add some common words not in the corpus
  - Token-count coverage of related corpora should be ⇨ 95%
- Consistent application of annotation conventions
  - Maximize the use of closed-set categorizations
  - Minimize the use of variant forms that “mean the same thing”
  - Centralize quality control activities among a small group of experts, working together closely
- Tight coupling between lexicon QC and transcripts
  - Error correction in the lexicon should propagate back to the transcripts

Common obstacles

- Axioms of manual transcription and annotation:
  - When a given task is done by N different people, there will be N different interpretations and techniques for the task.
  - The more often something must be done manually, the more mistakes will be made. (Typical minimum error rate is 5%)
  - For annotations involving unconstrained keyboard input, each person will create variant forms of a given annotation, and no two people will create the same form for it.
  - Most closed-set categorizations require a “miscellaneous” category. (Exception (?): “Is/Has X” vs. “Isn’t/Lacks X”)
  - For any particular annotation, a measurable percentage of instances within a corpus are indeterminate or ambiguous.
    - (“this guy” / ”the sky”) 

Common obstacles (cont.)

- Dependencies across layers of annotation
  - First layer: time segmentation of audio signal
  - Second layer: transcription of audio segments
    - Might catch segmentation errors
  - Third layer: building a lexicon from transcripts
    - Catches inconsistent spellings in transcription
  - Fourth layer: disfluency annotation
    - Catches segmentation and transcription errors
  - Fifth layer: treebanking
    - Potentially revises all previous layers
- **Worst case:** “Independent” layers create divergent versions of the same corpus.

Some Basic Problems with Arabic…

- The Arabic script-based writing system poses significant challenges for computational treatment.
  - Bidirectionality -- hard to render, harder to navigate and edit
  - Complex font with context-dependent rules for ligatures, glyph shape and character width
- Standard orthographic conventions represent an archaic form of the language.
  - Not “native” to any speaker of a current colloquial dialect
  - Colloquial (native) dialects have no standard orthography
- The absence of short vowels increases the difficulty.
  - Syntactic knowledge needed for correct word identification
  - Multiple meanings/pronunciations for a single written form

… and Special Problems with Colloquials

- Native speakers receive no formal instruction about their language -- no externalized grammar/analysis.
- Inherent phonological variability is unconstrained by - does not compete with - orthographic conventions or “correct speech”, so variants can have equal footing.
- Selection of consistent, appropriate spellings and morphological analyses for words entails deliberate and speculative choices.
- A systematic assessment of similarities and differences among colloquial dialects has yet to be done.

A Brief History of Implementation Details

Transcripts:

- Plain-text files and plain-text editors (bad old days)
  - Diverse information types are stored together “in-line”
  - Machine interpretation of content is difficult and brittle
  - Every corpus builder creates a new format
  - All data is manually editable -- nothing is safe
- Structured data files (XML) and specialized editors
  - Language content is always distinguishable from annotation
  - Many tools available for easy, reliable processing of data
  - Scope of format variation is constrained but not limiting
  - Scope of annotator effort is focused on appropriate tasks, and unrelated data is protected

Implementation Details (cont.)

Lexicons:

- Tab-delimited files and common (unix) shell tools
  - Tasks that are programmatic are fast, efficient, reliable; but:
  - Manual tasks are painful, and can break programmatic steps
  - Multi-stage manual work is especially risky, even with specialized tools for annotators/lexicographers
- Flat-table data and simple table-structured tools
  - Spreadsheets: easy to use and very capable, if entries are divided into reasonable sub-groups for handling/storage
  - Shoebox: has special attributes for linguists/lexicographers, but imposes its own set of limitations on what is possible
  - Data transfer across researchers/tools is simple and safe

Implementation Details: Lexicons (cont.)

- Relational Database (RDB)
  - Freely available servers are stable, easy to install, well documented, and can readily be made network-accessible.
  - Scalable to any size of lexical inventory with little or no effect on performance (speed)
  - Supports any appropriate conceptual model for lexicon creation, with configurable access permissions for users
  - Supports a wide rage of “sanity constraints” on input data (uniqueness, data type, string length, numeric min/max, …)
  - Provides lots of flexibility at the initial design stage and at any time thereafter (tables/fields can be added, modified)
  - Structured Query Language (SQL) provides a standardized, stable user interface for inserting, updating, retrieving data.

RDB Caveats

- Building a lexicon is always a complex process. RDB and SQL ***do not*** make it simpler (just more stable), and ***do*** require more technical expertise.

- Validating 50 K lexical entries is an inescapably long process. RDB will eliminate some delays and setbacks, but cannot reduce the basic effort required.

- Errors and failures are still possible -- on any scale.

Examples of Earlier Lexicons

- Callhome: tab-delimited, from transcripts & dictionaries

```
$aGGAlaB $@GG%l@//$@GG%lit 010 $aGGAlaB:noun+fem-sg//$aGGAlaB:adj+fem-sg
```

- Nahuatl (Jon Amith): based on Shoebox and fieldwork
  - Includes multiple dialects in a single DB, with indexed audio
  - Web enabled for maintenance, expansion and pedagogy
- CELEX: relational tables for lemmas vs. word forms, covering frequency, morphology, pronunciation, syntax
  - Distributed as a set of cross-referenced flat tables
  - Includes comprehensive documentation (~150 pages)

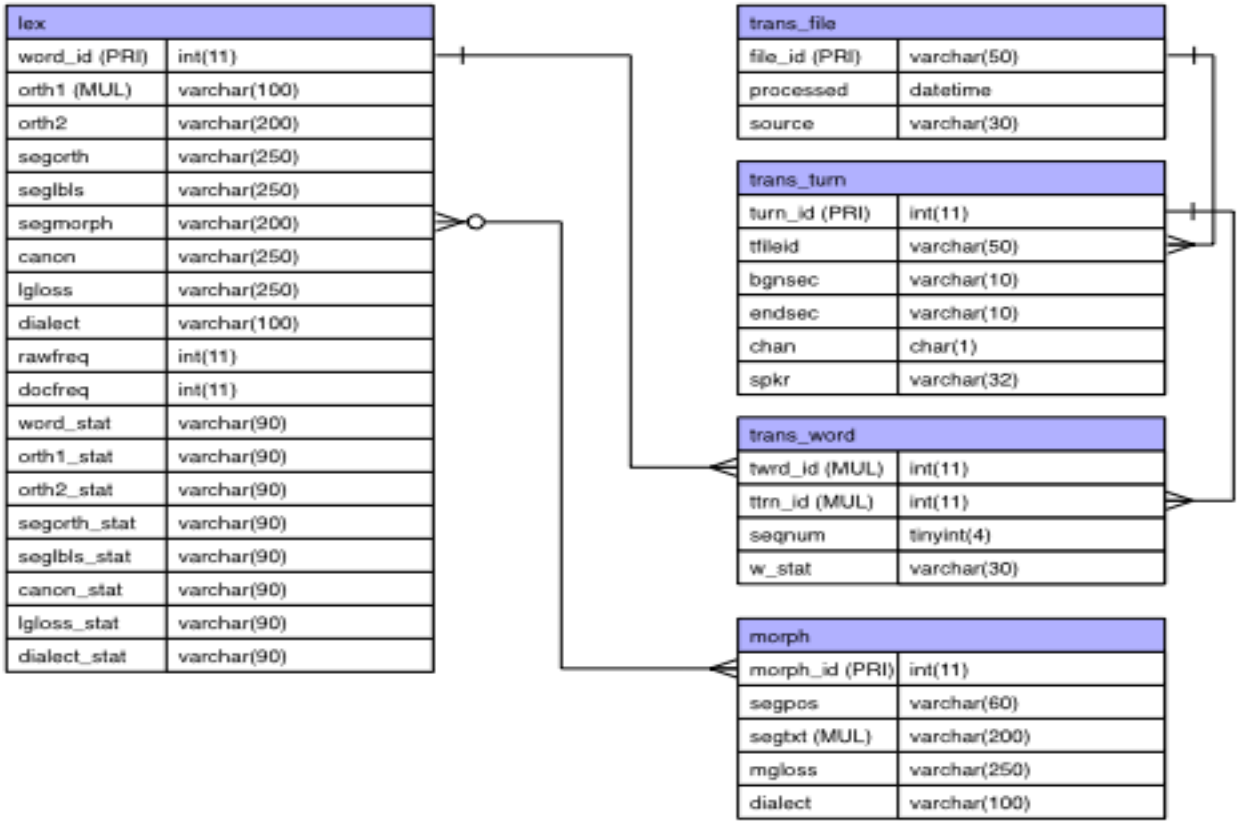
The Next Step (where we are now)

- Take one colloquial Arabic dialect at a time
- Create or acquire conversational transcripts
  - Time-stamped “turns” that index the associated audio
  - “Skeletal” orthography (no short vowels)
  - Can also include pronunciations (short vowels) as a separate layer, but this is not essential
- Load the transcripts into database tables
- Add morphology/POS/gloss annotations
- Review, revise and refine, then dump tables into the publishable lexicon and transcripts

Database Table Structure

lex_revision	
rwrd_id	int(11)
rgroup	varchar(250)
rgroupsz	int(11)
rdate	datetime
rby	varchar(30)
rorth1	varchar(100)
rorth2	varchar(200)
rsegorth	varchar(250)
rseglbls	varchar(250)
rcanon	varchar(250)
rlgloss	varchar(250)
rdialect	varchar(100)
rword_stat	varchar(90)
rorth1_stat	varchar(90)
rorth2_stat	varchar(90)
rsegorth_stat	varchar(90)
rseglbls_stat	varchar(90)
rcanon_stat	varchar(90)
rlgloss_stat	varchar(90)
rdialect_stat	varchar(90)

(usage undefined)



LDC / DOE-IRSG	David Graff & Shawn Medero	Nov.11.2005
trans-lex mysql data model		

Loading the tables

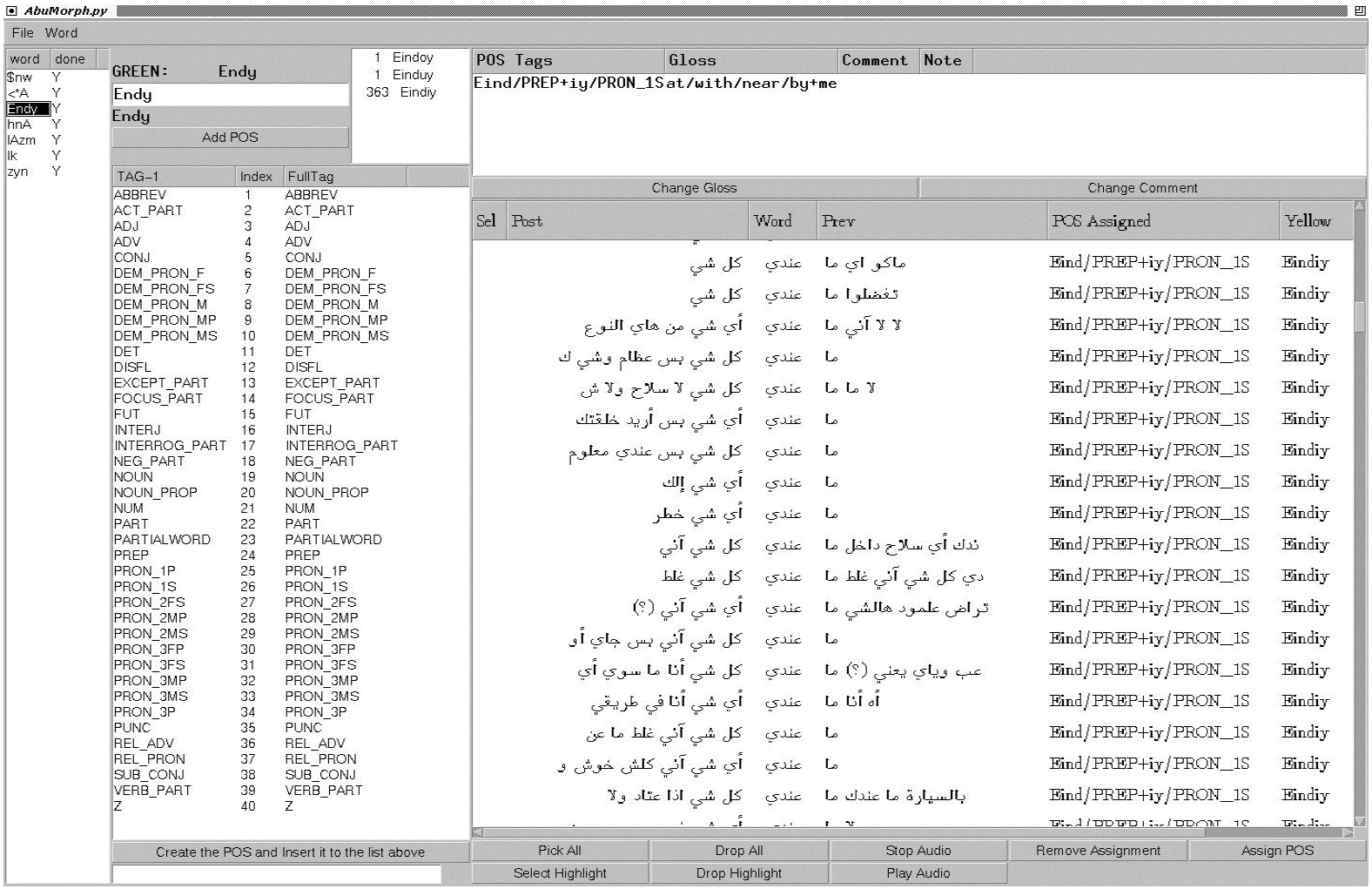
- For each transcript file:
  - Check for entry in trans_file, insert or update as needed
  - For each turn:
    - Check for entry in trans_turn, insert or update as needed
    - Delete entries (if any) from trans_word for this turn
    - For each word token:
      - Check for entry in lex, insert if needed
      - Add new entry to trans_word, citing turn-id, word-id, seq.number
      - Set “special feature” field in trans_word if token was uncertain “((this)) ((guy))“ or mispronounced “*nuclear”

Adding Morphology/POS/Gloss (MPG) Annotations

- Pull distinct words (skeletal “green” orthography) from lex table, sorted by frequency of occurrence in trans_word table (highest frequency first).
- Present one word at a time to an annotator, showing:
  - Skeletal (“green”) orthography
  - All associated vocalized (“yellow”) forms
  - Concordance drawn from token occurrences in turns
- Annotator provides:
  - “Canonical” vowelization
  - Segmentation into morphemes
  - Association of POS label to each morpheme
  - English gloss for each morpheme (and for word as a whole)

ABUMORPH Annotation Interface

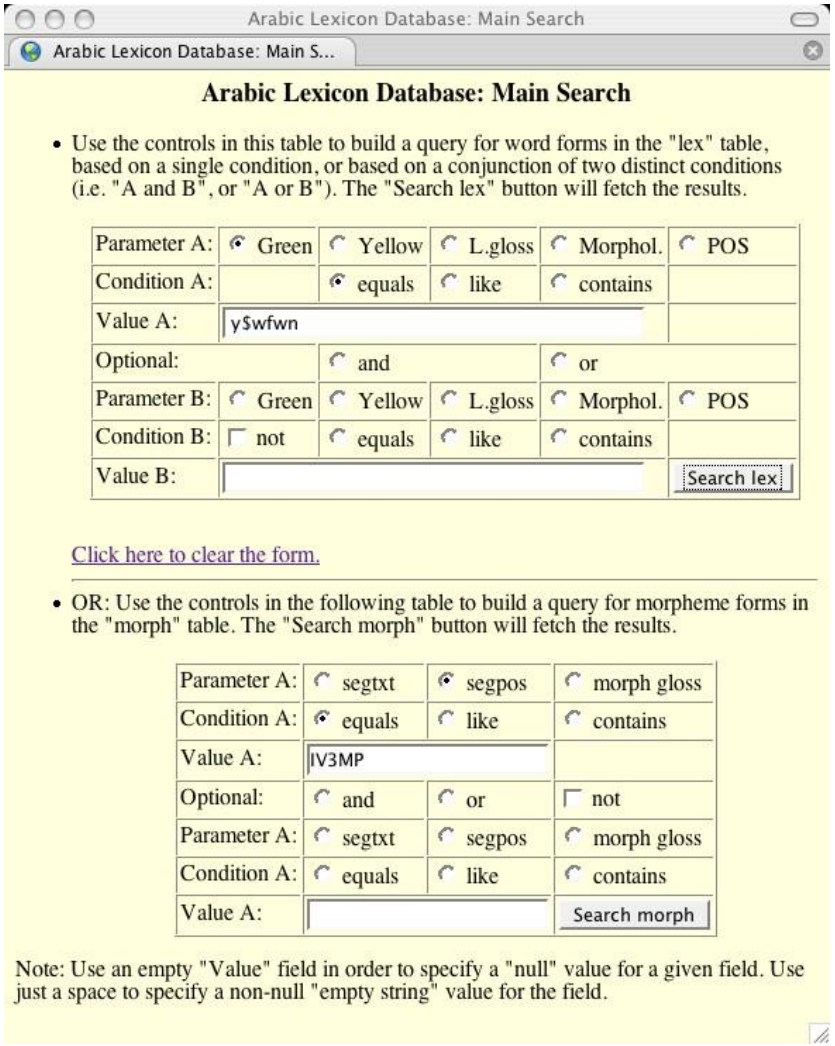
created by Hubert Jin



Vetting / Validating MPG Annotations

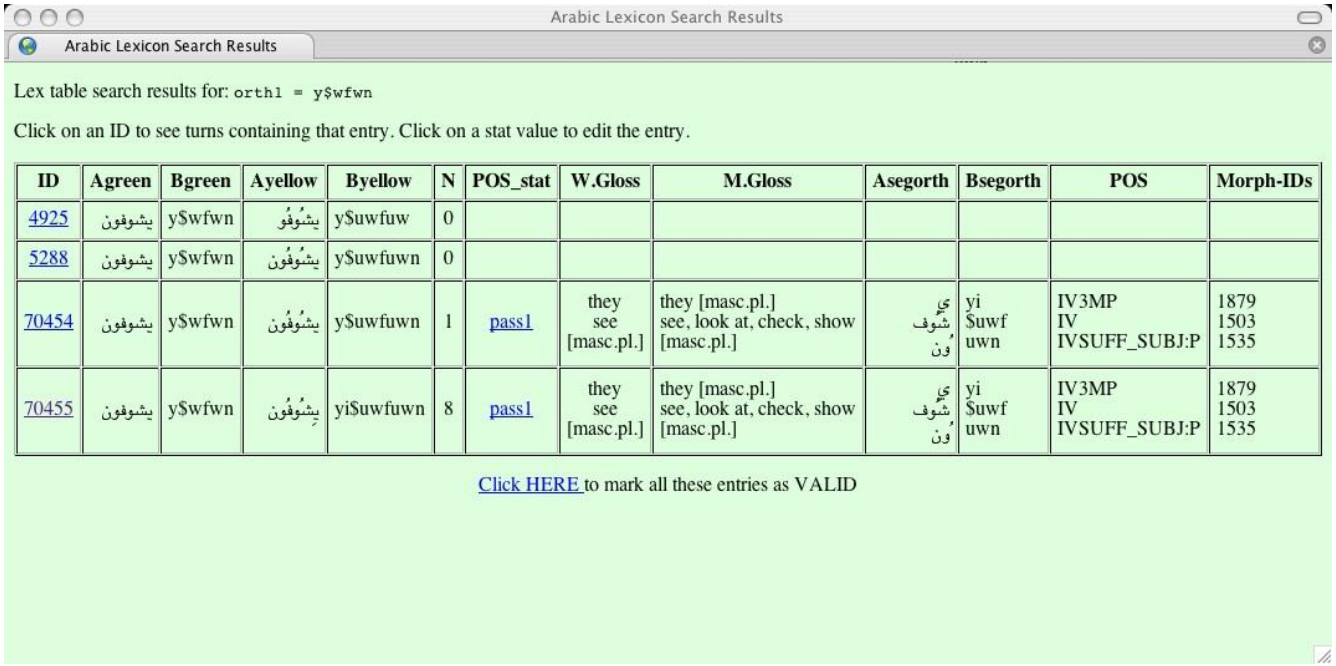
- Summary reports of morph and lex entries:
  - Alternate sortings by POS labels and orthography
  - Including frequency of occurrence
- Web-based query tool with login access limited to lexicographers:
  - Generic query-generator for finding items and sets in either the lex table or the morph table
  - Listing of lex or morph table entries with links to listings of element occurrences, and links to “Entry Editor” form
  - Entry Editor supports modification in place, creation of new entry based on modified current entry, and merging of current entry into some other entry

Main Lexicon Search Page



- Search either the lex table or the morph table
- Use exact match, SQL “like” or regular-expression match
- Use single search criterion or two conjoined criteria::
  - “A and B”
  - “A and not B”
  - “A or B”
- Each “Search” button brings a separate pop-up window of “Search Results”
- Each pop-up is re-used on subsequent searches

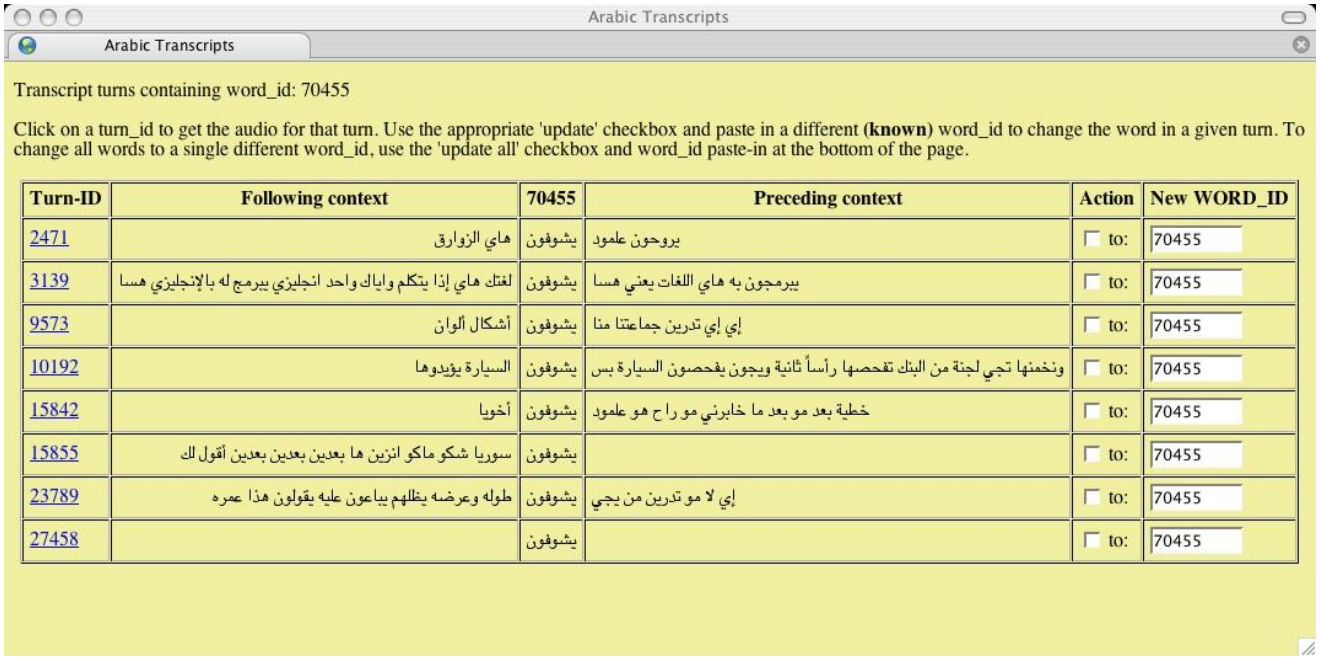
Lexicon Search Results Page



ID	Agreen	Bgreen	Ayellow	Byellow	N	POS_stat	W.Gloss	M.Gloss	Asegorth	Bsegorth	POS	Morph-IDs
4925	يشوفون	y$wfwn	يشُوفُو	y$uwfuw	0							
5288	يشوفون	y$wfwn	يشُوفُون	y$uwfuwn	0							
70454	يشوفون	y$wfwn	يشُوفُون	y$uwfuwn	1	pass1	they see [masc.pl.]	they [masc.pl.] see, look at, check, show [masc.pl.]	يِ شُوف ُون	yi $uwf uwn	IV3MP IV IVSUFF_SUBJ:P	1879 1503 1535
70455	يشوفون	y$wfwn	يِشُوفُون	yi$uwfuwn	8	pass1	they see [masc.pl.]	they [masc.pl.] see, look at, check, show [masc.pl.]	يِ شُوف ُون	yi $uwf uwn	IV3MP IV IVSUFF_SUBJ:P	1879 1503 1535

- “ID” links produce pop-up of transcript concordance page
- “POS_stat” links produce pop-up of lex-entry editor page
- “N” shows current frequency of word occurrence in transcripts

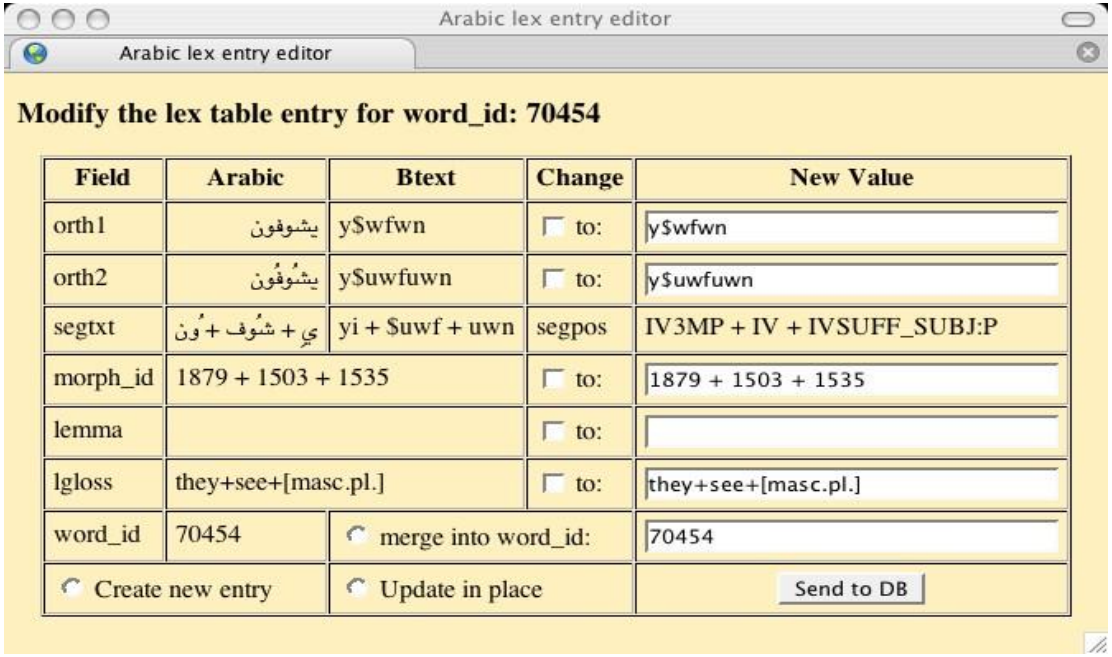
Transcript Concordance Display Page



Turn-ID	Following context	70455	Preceding context	Action	New WORD_ID
2471	هاي الزوارق	يشوفون	يروحون علمود	to:	70455
3139	لغتك هاي إذا يتكلم واياك واحد انجليزي بيرمج له بالإنجليزي هسا	يشوفون	بيرمجون به هاي اللغات يعني هسا	to:	70455
9573	أشكال ألوان	يشوفون	إي إي تدرين جماعتنا منا	to:	70455
10192	السيارة يؤيدوها	يشوفون	ونخمنها تجي لجنة من البنك تفحصها رأساً ثانية ويجون يفحصون السيارة بس	to:	70455
15842	أخويا	يشوفون	خطية بعد مو بعد ما خابرني مو راح هو علمود	to:	70455
15855	سوريا شكو ماكو انزين ها بعدين بعدين بعدين أقول لك	يشوفون		to:	70455
23789	طوله وعرضه يظلهم يباعون عليه يقولون هذا عمره	يشوفون	إي لا مو تدرين من يجي	to:	70455
27458		يشوفون		to:	70455

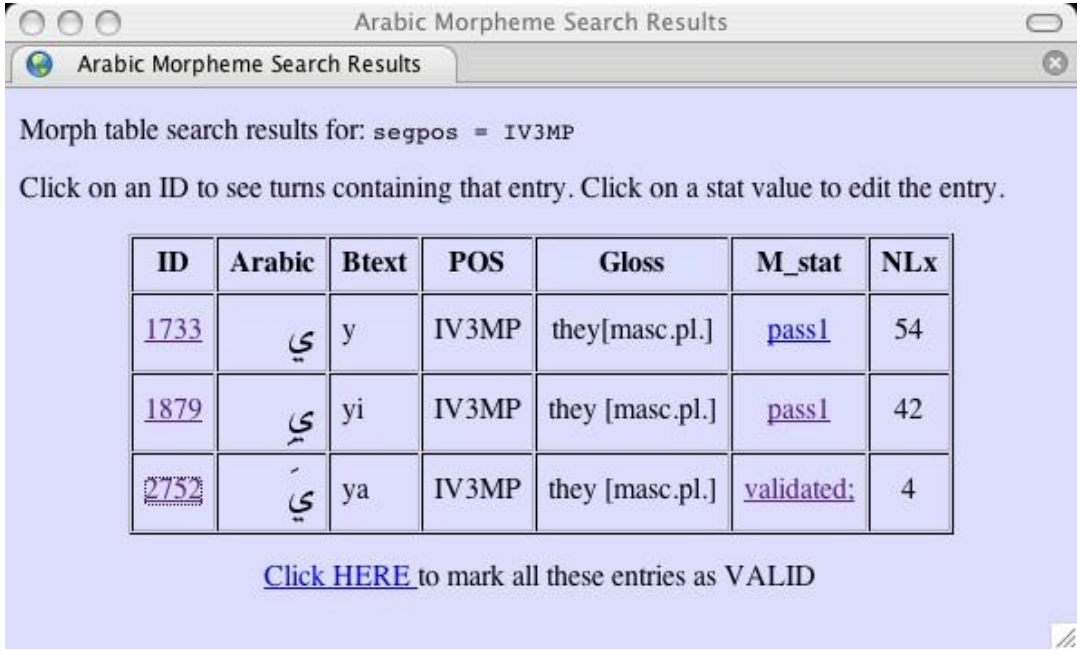
- “Turn-ID” link fetches audio segment for the turn
- Transcription errors involving the target word can be corrected (so far, only word replacement is supported)
- Separate interface will be needed for word deletion/insertion

Lexicon Entry Editor Page



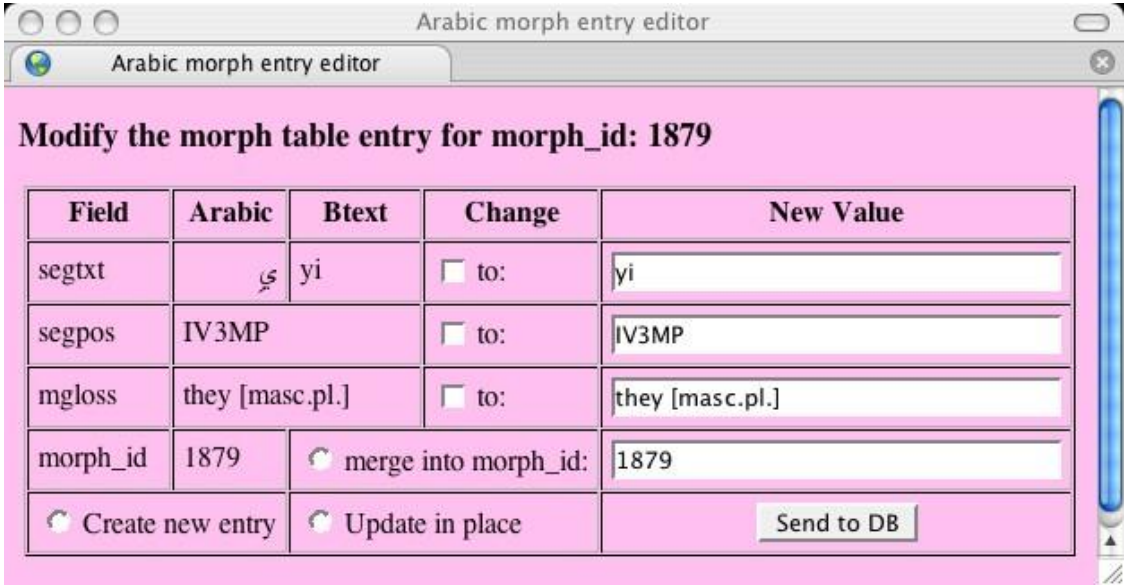
- Change Skeletal (“green”) or Pronunciation (“yellow”) spelling
- Change morphological composition and/or word gloss
- Update in place, or add as a new lex entry, or merge into some other existing lex entry (that is, render this entry obsolete)

Morph Search Results Page



- “ID” links to Lex Search Results to show all lex entries containing this morph entry
- “M_stat” links to a pop-up morph entry editor page
- “NLx” = number of lex entries currently using this morpheme

Morpheme Entry Editor Page



- Change the orthography, POS label and/or gloss
- Update in place, or create as a new entry, or merge all lex references to this entry so that they refer to some other morph entry instead (that is, render this entry obsolete)