Tools for cross-corpus linguistic analysis

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Introduction

- Linguistic corpora consist of annotated speech data
  - usually timing information
  - transcription (how something is said, transcribed in an alphabet representing sounds)
- Vast number of corpora
- Used mainly for phonetics (study of speech sounds) and phonology (study of systems of sounds, relationships of sounds)
- Speech Corpus Tools developed by Montreal Language Modeling Lab (MLML) to make searching these corpora user-friendly and fast
  - relies on PolyglotDB software (also developed by MLML)
  - translates different corpora into database format

Motivation

- Problem: huge amount of data, all in different formats
  - commonly in varying file types
  - often programming knowledge required to reduce data to desired subset
  - even if researcher has programming knowledge, searching can be very slow/tedious (1,000's of files)
- Searching for needle in a haystack, need some sort of unified method
- Better corpus querying saves time, money
- Can help to protect privacy of speakers in corpora by abstracting away from original recordings/only allowing user to view snippets of information.

Methodology

- SCT is the highest level software being used
  - written by MLML in Python
  - most abstracted away from data
  - most user-friendly, requires least programming knowledge
- It is built on the PolgyglotDB software
  - also written in Python by MLML
  - designed to be incorporated into Python scripts by researchers
  - requires general programming ability
- PolyglotDB software loads data into databases
  - uses both graphical and relational databases
  - graphical DBs represent data as nodes and edges
  - relational DBs represent data in tables of relatioships
  - both dramatically reduce time to complete query

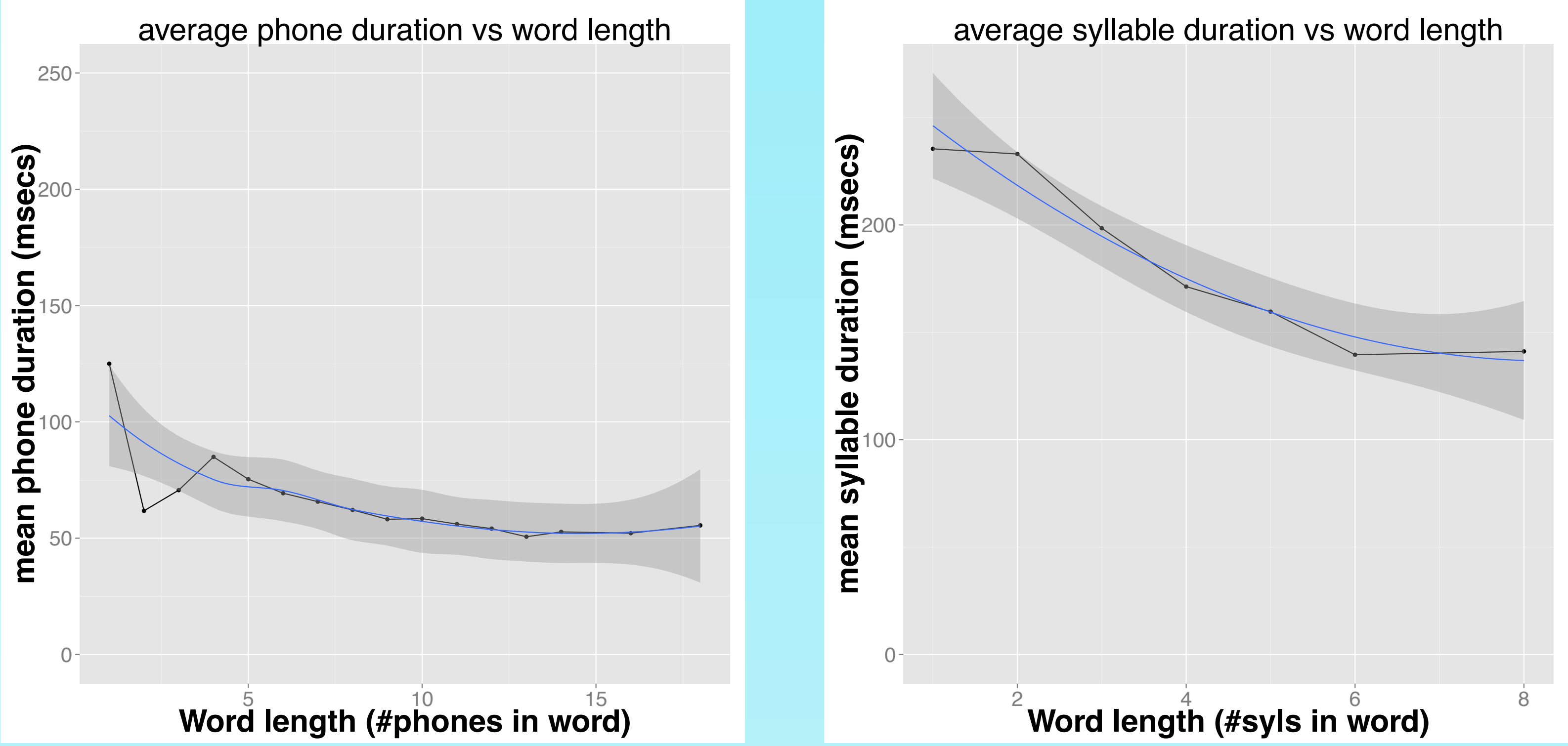
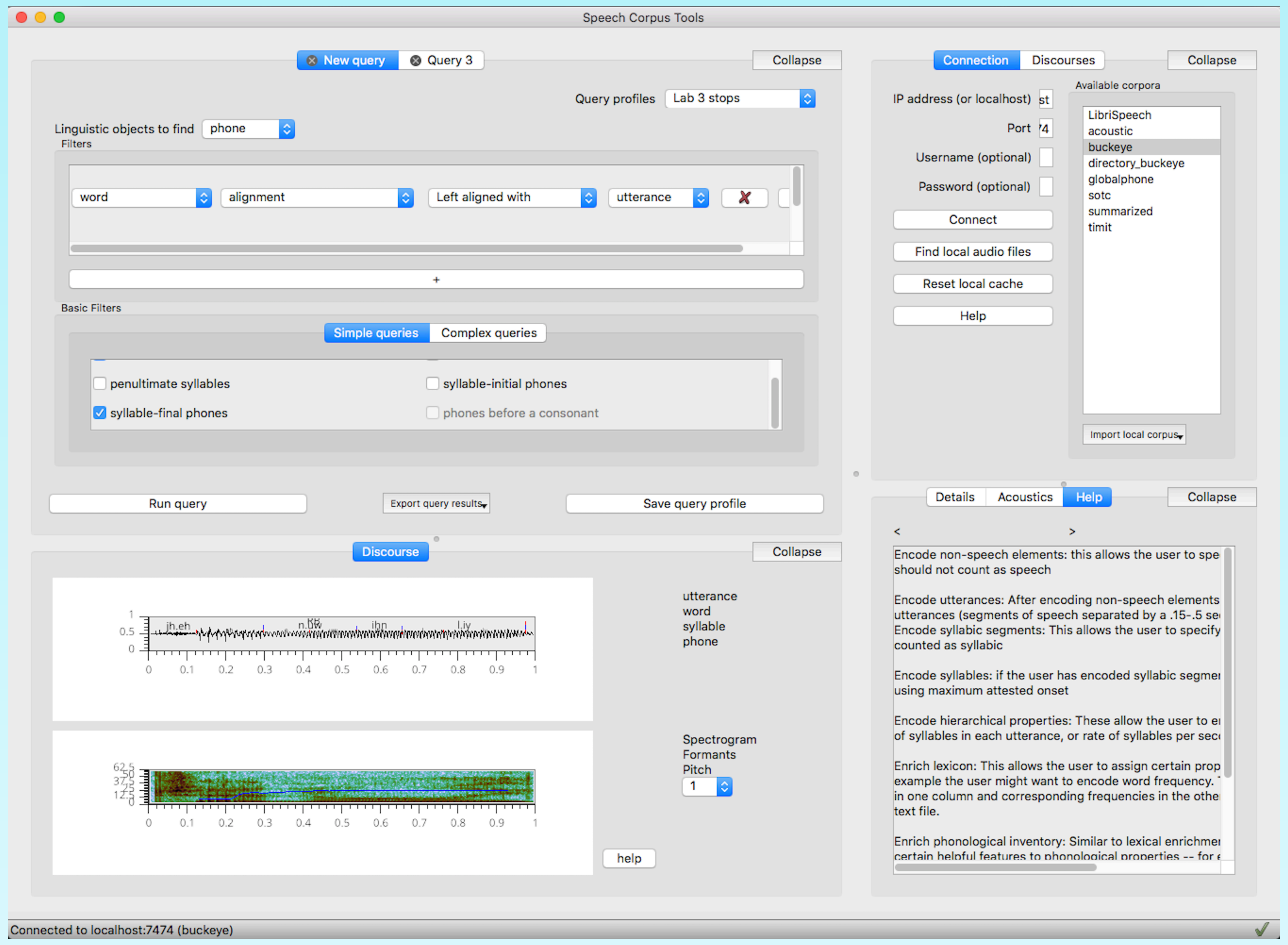


Fig. 1: Plots of results showing downward trend



□ penultimate syllables

☑ syllable-final phones

□ syllable-initial phones

□ phones before a consonant

Encode non-speech elements: this allows the user to spe
should not count as speech

Encode utterances: After encoding non-speech elements
utterances (segments of speech separated by a .15-.5 se
Encode syllabic segments: This allows the user to specify
counted as syllabic

Encode syllables: if the user has encoded syllabic segme
using maximum attested onset

Encode hierarchical properties: These allow the user to e
of syllables in each utterance, or rate of syllables per sec

Enrich lexicon: This allows the user to assign certain prop
example the user might want to encode word frequency.
in one column and corresponding frequencies in the othe
text file.

Enrich phonological inventory: Similar to lexical enrichme
certain helpful features to phonological properties -- for

Fig. 2: The SCT application

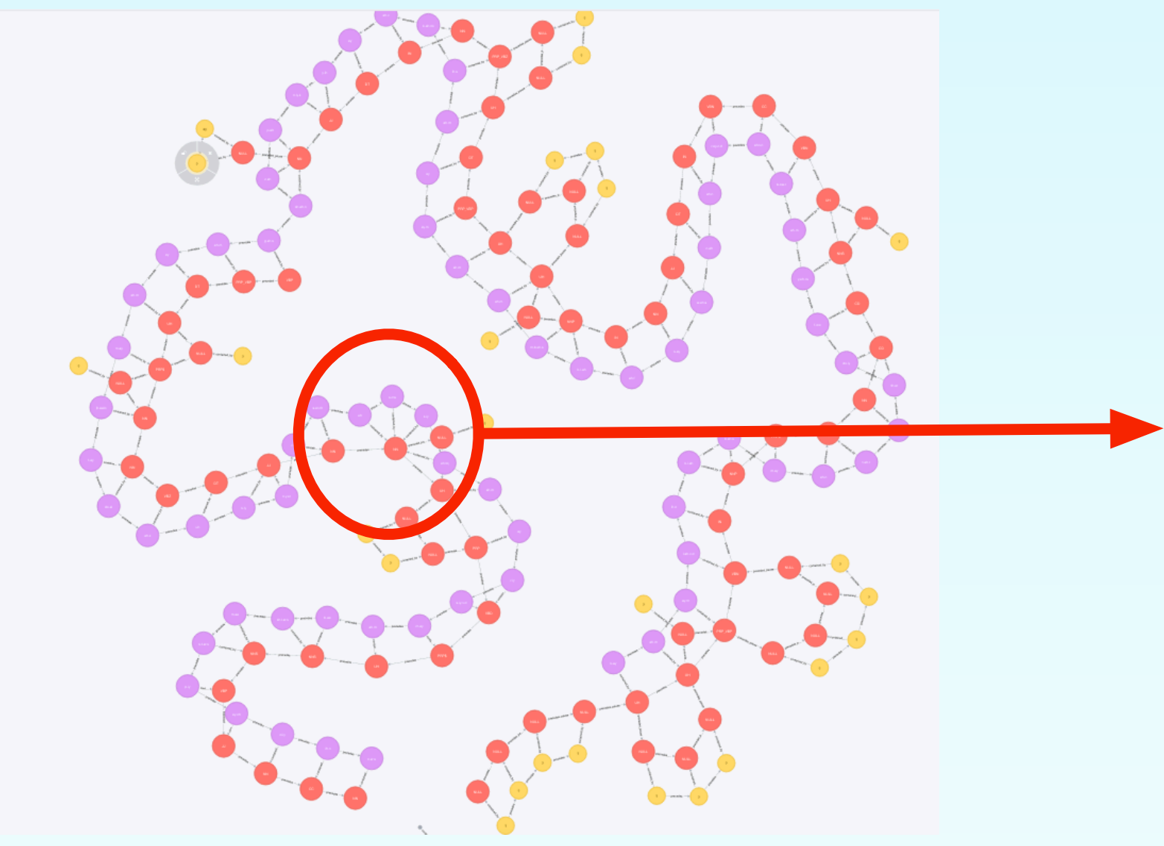


Fig. 3: Neo4j graph representation of a sentence

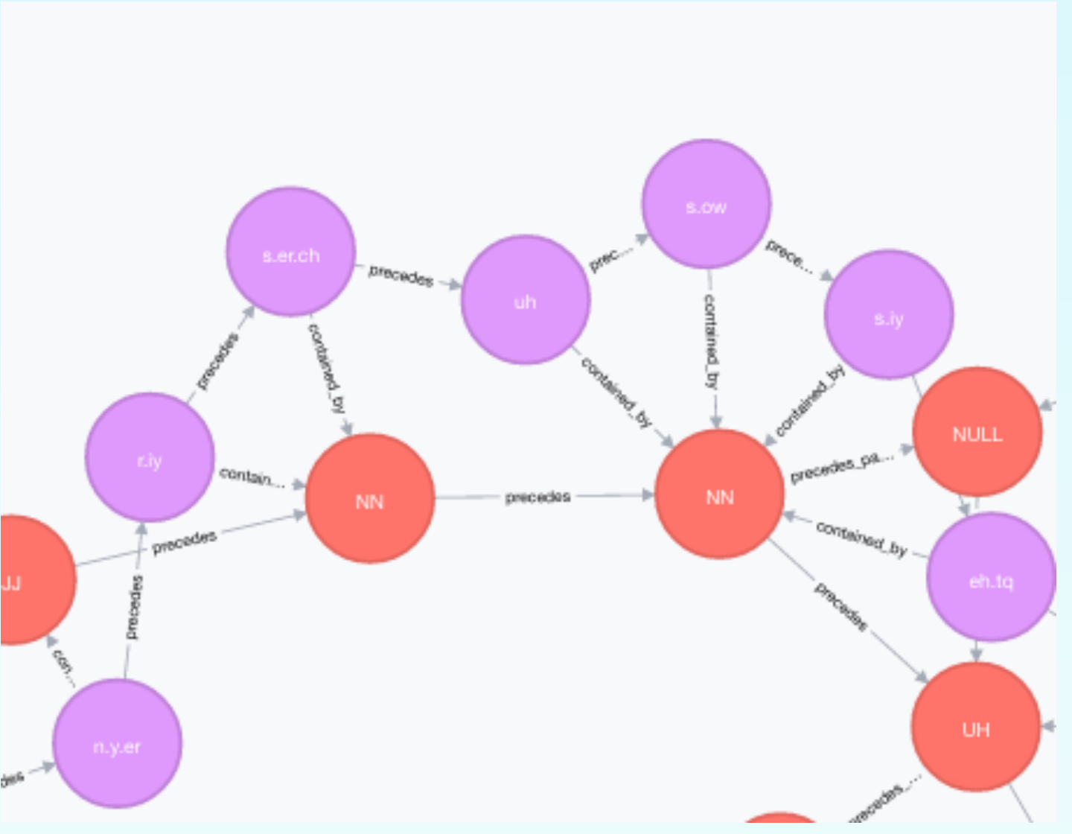
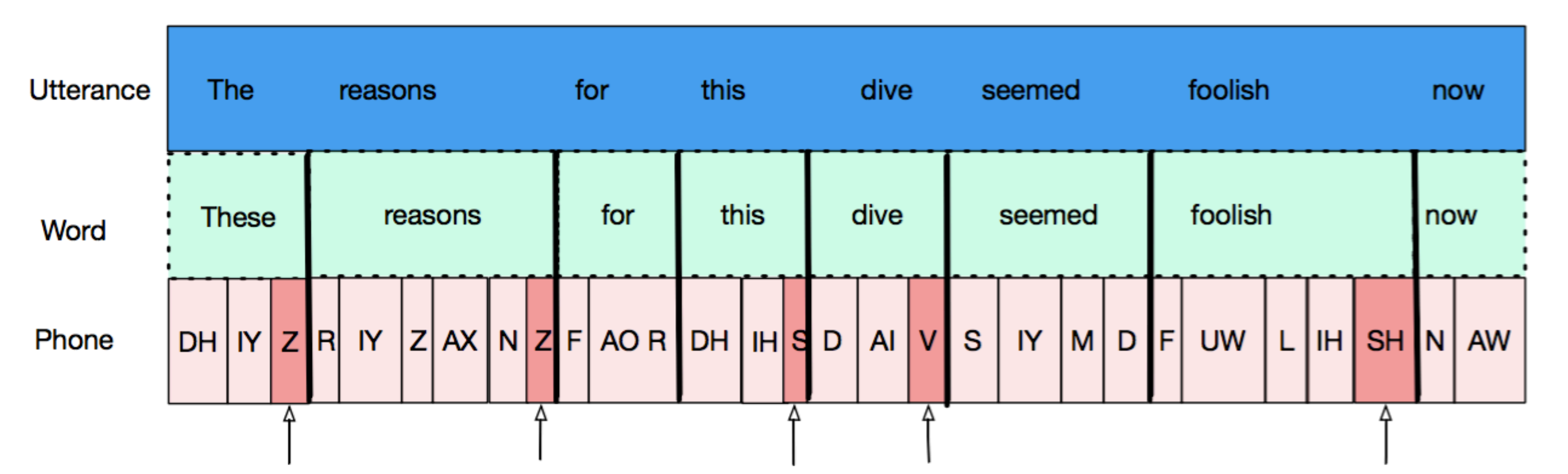


Fig. 4: A subset of that sentence



Utterance: The | reasons | for | this | dive | seemed | foolish | now

Word: These | reasons | for | this | dive | seemed | foolish | now

Phone: DH | IY | Z | R | IY | Z | AX | N | Z | F | AO | R | DH | IH | S | D | AI | V | S | IY | M | D | F | UW | L | IH | SH | N | AW

Fig. 5: The hierarchical nature of language shown. Thick black lines represent alignment — sharing a start or end time. The example query was word-final fricatives.

Example: Menzerath's Law

- Menzerath's law states that as syllables in word increase
  - duration of syllables decreases
  - duration of segments in syllables decreases
  - number of segments in syllables decreases
- Normally finding data to support this would be extremely tedious and time-consuming
- With SCT, can be done in minutes
- Querying the LibriSpeech corpus
  - 1,000 hours of read English
- Using filters to limit the data (see fig. 5)
  - Filters are used to select linguistic objects (utterances, words, phones, or syllables) and specify properties about them
  - Enriching data (building extra relationships) necessary to get properties like number of segments in syllable

Results

- Clear downward trend for syllables and segments
  - the more syllables/segments, the shorter the average length
- Normally getting data for these results would have taken much longer
  - 200,000+ phones, 70,000+ syllables from 50,000+ words
  - might have taken days (if not weeks) to gather data by hand/write individualized scripts for the corpus
  - once imported into SCT, data exported in matter of seconds
  - gave exact subsets of data that were useful for research question

My Jobs

- Working with both SCT and PolyglotDB
- Testing
- Writing documentation/tutorials
- Adding additional features to SCT/PolyglotDB
  - Help panel
  - Relativized/summary statistics
    - ~ average, median, standard deviation, baseline
  - Enrichment (speaker info, stress, tone)

References

- Michael McAuliffe, Morgan Sonderegger, Michael Wagner. 2016. A system for unified corpus analysis applied to duration compression effects across 12 languages [PowerPoint slides].
- Esposti, M. D., Altmann, E. G., & Pachet, F. (2016). *Creativity and Universality in Language*. Springer Verlag.

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