A finite-state morphological transducer for Kyrgyz

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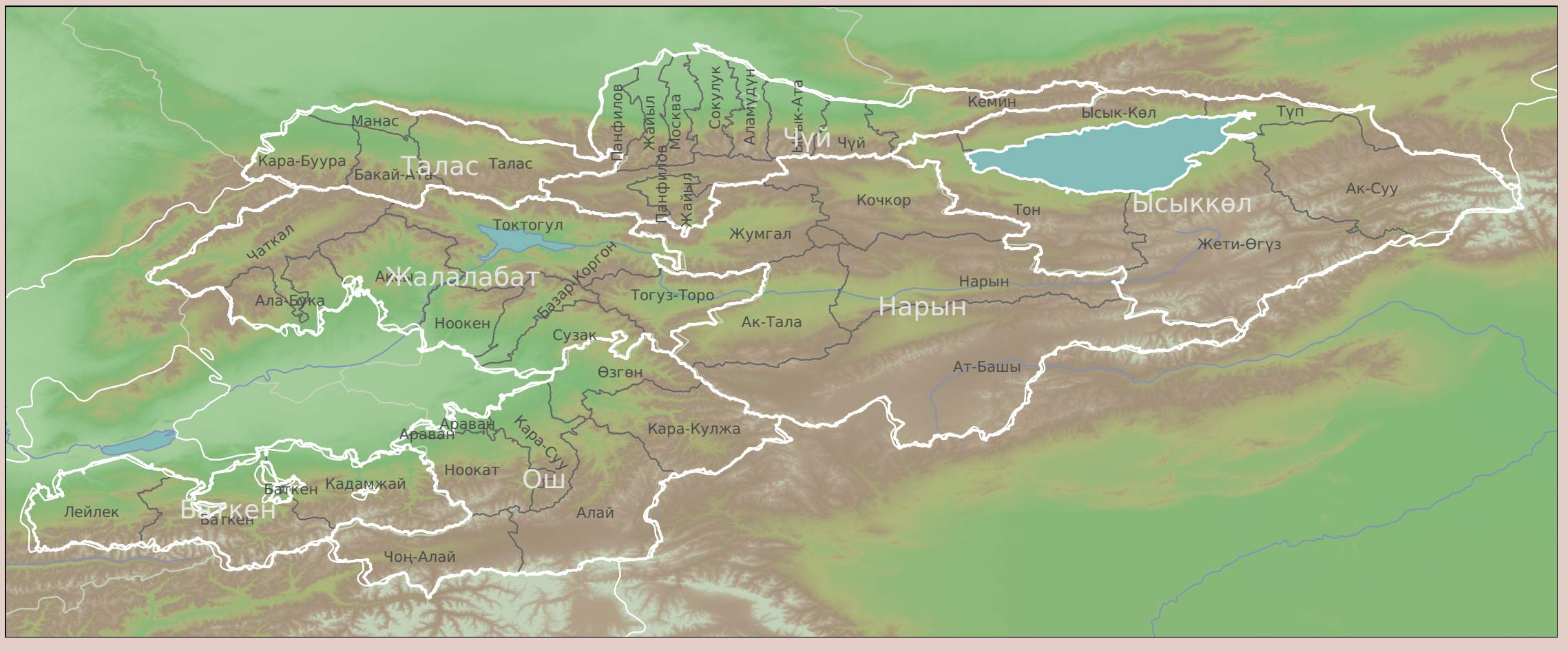
Kyrgyz

- Turkic language
  - Similar historically to Southern Altay
  - Similar by convergence to Kazakh, Uzbek
- Spoken in
  - Kyrgyzstan, as co-official language
    high levels of bilingualism with Russian
  - China, Tajikistan, Uzbekistan
- Over 3 million native speakers
  (estimate based on data from Ethnologue)
- Our transducer based on written Kyrgyz of the former Soviet Union (literary and colloquial standards)



Morphological transducers

Morphological transducers

- Take a surface form, and produce all valid lexical forms
  e.g. 'алдым'
- Take a lexical form, and produce one or more valid surface forms
  e.g., `ал<v><tv><ifi><p1><sg>`, `алд<n><px1sg><nom>`

Transducers for Turkic languages

- Turkish (Çöltekin, 2010; Öflazer, 1994)
- Crimean Tatar (Altıntaş, 2001)
- Turkmen (Tantuğ et al., 2006)
- …this is the first transducer for Kyrgyz
- and it's GPL (=free and open)!

Framework: HFST

- Reimplementation of Xerox FST formalisms (`lexc` and `twol`)
- Also provides a wrapper around popular FST free/open-source toolkits: SFST, OpenFST, and Foma

Morphotactics

Morphological & orthographical words

- өнүктүрөбүзбү ? '*will we develop [it]?*'
  `өнүк<v><tv><caus><aor><p1><pl>+бы<qst>`
- келатсаң '*if you come*'
  `кел<v><iv><prt_impf>+жат<vaux><gna_cnd><p2><sg>`

Irregular [noun + possessive + case] forms

- Some combinations of possessive and case morphemes are distinct (i.e., not formed simply by concatenation):

case	form	1SG	2SG	3SP
nom	—	-(I)м	-(I)ң	-(S)I
acc	-NI	-(I)мдI	-(I)ңдI	**-(S)Iн**
gen	-NIн	-(I)мдIн	-(I)ңдIн	-(S)IнIн
loc	-DA	-(I)мдА	-(I)ңдА	**-(S)IндА**
abl	-DAн	-(I)мдАн, **-(I)мАн**	-(I)ңдАн, **-(I)ңАн**	**-(S)IнАн**
dat	-GA	**-(I)мА**	**-(I)ңА**	**-(S)IнА**

- Trade-off:
  - morphophon. complicateder, morphotactics simpler
  - underlying form used: `{S}{I}{n}`
  - phonological rules delete `{n}`, `{S}` by context

Noun-noun compounds

- one type of N-N compunds: N2 has `<px3>` and related morphology

```
LEXICON N-INFL-3PX-COMPOUND
%<n%>:%>%{S%}%{I%}%{n%} GEN-POS ;

LEXICON Nouns
аба% ырайы:аба% ырай N-INFL-3PX-COMPOUND ;
                                        ! ”weather”
чакыруу% кагазы:чакыруу% кагаз N-INFL-3PX-
                         COMPOUND ; ! ”invitation”
```

Example output

Gloss

(1) Үстөл жана отургучтардын астын карап жатат, бирок Азамат аякта эмес.
table and chairs' underside looking is, but Azamat there not.
'*[She's] looking under the tables and chairs, but Azamat isn't there.*'

Output

```
^Үстөл/Үстөл<n><nom>$
^жана/жан<v><iv><prc_impf>/жана<adv>/жана<cnjcoo>$
^отургучтардын/отургуч<n><pl><gen>$
^астын/аст<n><px3pl><acc>/аст<n><px3sg><acc>$
^карап/кара<v><iv><gna_perf>/кара<v><iv><prc_real>/кара<v><tv><gna_perf>/кара<v><tv><prc_real>$
^жатат/жат<vaux><aor><p3><pl>/жат<vaux><aor><p3><sg>/жат<vaux><prc_irre>$ (intransitive verb forms removed)
^,/,<cm>$
^бирок/бирок<cnjadv>$
^Азамат/Азамат<np><ant><m><nom>$
^аякта/ал<det><dem>+жак<n><loc>/аяк<n><loc>/аякта<v><tv><imp><p2><sg>$
^эмес/э<cop><neg><p3><pl>/э<cop><neg><p3><sg>$
^./.<sent>$
```

Tagset

`<n>`	Noun	`<p2>`	Second person	`<px3sg>`	3rd person poss. (Singular)
`<np>`	Proper noun	`<p3>`	Third person	`<px3pl>`	3rd person poss. (Plural)
`<v>`	Verb	`<ant>`	Anthroponym	`<neg>`	Negative
`<det>`	Determiner	`<dem>`	Demonstrative	`<aor>`	Aorist
`<cnjcoo>`	Coord. conjunct.	`<m>`	Masculine	`<imp>`	Imperative
`<cnjadv>`	Adv. conjunct.	`<sg>`	Singular	`<gna_perf>`	Verbal adverb (Perfect)
`<adv>`	Adverb	`<pl>`	Plural	`<prc_impf>`	Participle (Imperfect)
`<vaux>`	Auxiliary verb	`<nom>`	'Nominative'	`<prc_irre>`	Participle (Irrealis)
`<cop>`	Copula	`<gen>`	Genitive	`<prc_real>`	Participle (Realis)
`<iv>`	Intransitive	`<acc>`	Accusative	`<cm>`	Comma
`<tv>`	Transitive	`<loc>`	Locative		

Morphophonology

Desonorisation

- {N} desonorises to д after a consonant
  алма-{N}{I} → алманы '*apple*–ACC'
  сыр-{N}{I} → сырды '*secret*–ACC'
- {L} desonorises to д after cons. of sonority ≤ /l/
  сыр-{L}{A}р → сырлар '*secret*–PL'
  кыз-{L}{A}р → кыздар '*girl*–PL'

```
”L Desonorisation”
%{L%}:д <=> :VoicedLowSonCns %>: __ ;

”N Desonorisation”
%{N%}:д <=> :VoicedCns %>: __ ;
```

Lenition

- Turn {y} into a harmonised high vowel when a vowel doesn't follow the following consonant
  мур{y}н → мурун '*nose*'
  мур{y}н+{I}м → мурдум '*my nose*'

```
%{y%}:Vy <=> [ :LastVowel :Cns* :Cns ]/[:0] __
        [ :Cns [ .#. | :Cns ] ]/[ :0 | %>:] ;
 where Vy in ( и ү и и ү ы ы у у ы у у )
LastVowel in ( и ү е э ө я а ё о ы ю у )
           matched ;
```

й+vowel letters

- [а о у] become [я ё ю] after й and й deletes
- й incorporated into the context of many rules
- + separate rules to change the characters
- + a rule to delete the original й

```
”Deletion of й before yoticised vowels”
й:0 <=> __ [ :YotVow ]/[ :0 | %>: ] ;
```

Further information

- The transducer is available from apertium's svn repo: more info at: http://wiki.apertium.org/
- Turkic RBMT mailing list (we speak your language!): apertium-turkic@lists.sourceforge.net (>25 subscribers)
- See our paper in the LREC 2012 proceedings
- And feel free to contact the authors any time!

Evaluation

8,466 total stems

Noun	4,972	Conjunction	58
Verb	1,231	Postposition	51
Adjective	944	Pronoun	29
Proper noun	796	Determiner	27
Adverb	295		
Numeral	63		

Test corpora

- **Kyrgyz Wikipedia** dump dated 2011-09-23
- All 2010 articles from **Radio Free Europe / Radio Liberty** (RFE/RL)'s Kyrgyz service (`azattyk.org`)
- both split into 10 equal parts; coverage calculated over each separately; standard deviation of mean calculated

Coverage measures

- **Naïve coverage** - percentage of surface forms in a given corpus receiving ≥ 1 analysis
  (surface forms may have missing analyses)
- **Mean ambiguity** - average number of analyses for each surface form found in analyed corpus

Coverage results (as of r36739)

corpus	tokens	known	cov.	amb.
Wikipedia	329,524	270,668	**82.1%**	**2.35**
RFE/RL	4,112,558	3,614,193	**87.9%**	**2.43**

Precision & recall

- **Precision** (of a form's analyses % correct): **97.32%**
- **Recall** (percentage of analyses provided by the transducer that are correct for a form, by comparing against a gold standard): **94.56%**

Future Work

- case changes for words with one root
  Финляндия '*Finland*', финляндиялык '*Finnish*'
- phonology (vowel harmony, desonorisation) with abbreviations
  АКШ [акышы] '*USA*', АКШнын / *АКШтын
- vowel harmony with numbers
  100 [жүз], 100дүн [жүздүн] / *100нын
- compound verbs (esp. ones with changeable parts)
- gerunds with mono-syllabic V-final verbs
  иште- '*work*' → иштеш / иштөө '*working*'
  же- '*eat*' → жеш / *жөө '*eating*'
- Disambiguation
- Machine translation between Turkic languages