Automatic Morphological Analysis of Learner Hungarian

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4 June, 2015

Introduction and Motivation

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Our focus: Hungarian morphological analysis for learner language

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- Hearkens back to the *parsing ill-formed input* literature (see Heift and Schulze, 2007, ch. 2)
- Illustrates that different linguistic properties need different kinds of systems (see Leacock et al., 2014, ch. 7)

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- Allows for flexbility & adaptability in, e.g., the positing of valid forms
  - Step towards different analyses for different kinds of learners

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The work is still in progress, and thus the evaluation also points to ways in which the system can be improved

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run -PST -2SG.INDEF
'you [2sg.] ran'

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(2) a. ház -ban
house -INESS
'in (a) house'

b. könyv -eim -ben
book -1SG.PL -INESS
'in my books'

Automatic morphological analysis for Hungarian

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Compared to Durst et al. (2014) & Vincze et al. (2014), we focus on descriptions of target and non-target-like forms

Corpus data

- Daily journals from students of Hungarian (n=14) at 3 levels of proficiency at IU (9391 sentences)
  - Topics self-selected, each entry 10–15 sentences in length
  - More descriptive language than typically found in exercises

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  - More descriptive language than typically found in exercises
- For all learners, data spans at least one semester
  - For 4 learners, texts are available from multiple semesters

Error annotation

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  - Morphemes (MOR, agreement & derivation)
  - Relations between morphemes (REL, selection)
  - Sentences (SNT, syntax)

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  - Sentences (SNT, syntax)
- Target (TGT) layer provided

Example annotation

(3) **Ajanl** **-om** bor -t , nem sör -t
recommend 1SG.DF wine ACC , not beer ACC
'I recommend wine, not beer.'

TXT	Ajanlom		bort		,	nem	sört		.
SEG	Ajanl	om	bor	t	,	nem	sör	t	.
CHA	CL								
MOR		MAD							
REL									
SNT									
TGT	Ajánl	ok	bor	t	,	nem	sör	t	.

Morphological analysis

Analyzer uses:

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- System posits possible stems implied by attested affixes

Knowledge base

Bulk of grammatical knowledge encoded here:

- Hand-wrote 205 affixes
  - Inflection (e.g. noun case, verb conjugation, possession)
  - Derivation (e.g. nominalizing suffixes, verbalizing suffixes)

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  - Inflection (e.g. noun case, verb conjugation, possession)
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- An affix corresponds to a set of possible categories, encoding combinatory possibilities
  - Affix categories also contain features describing relevant linguistic properties

(4) *-ot*: `KP[k:acc]\N[vh:bk]`

Building an analysis

(5) lát -hat -atlan -ság -od -at
see -"be able" -NEG -"ness" -2SG -ACC
'your [2sg] invisibility'

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- Allows for root morphemes that are nonstandard, misspelled, proper nouns, etc.

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Importance of grammar-writer: put relaxable constraints into features & non-relaxable constraints into main categories

Morphological analysis

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(7) a. lát -t -ál
see -PST -2SG.INDEF
'you saw'

b. V m i s 2 s - - - n
0 1 2 3 4 5 6 7 8 9

- Indicates: Main verb (m), indicative mood (i), past tense (s), second person (2), singular (s), indefinite (n)

Native language data

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  - **Accuracy** defined w.r.t. context-specific tags
- **Unknown POS**: system recognizes a word but no tag for it
  - Analyzer doesn't have access to POS data in its dictionary
- **Unknown word**: system cannot produce a derivation

Native language data

	Total	POS	+N	POS+N
Precision	0.308	—	0.307	—
Recall	0.262	—	0.315	—
Accuracy	0.467	0.568	0.505	0.592
Unk. POS	0.425	0.425	0.425	0.425
Unk. Word	0.067	0.067	0.067	0.067

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Limitation of dictionary (unknown POS) is a major problem

Corrected learner data

- Corrected forms for 1021 tokens from L2 Hungarian learners

	Total_{Strict}	Total_{Free}	ML
Accuracy	0.499	0.509	0.846
Unk. POS	0.499	0.499	—
Unk. Word	0.109	0.097	0.027

- *Strict*: no constraint relaxation; *Free*: constraint relaxation
- Compare to Magyarlanc (ML, Zsibrita et al., 2013)

Raw learner data

- Same 1021 tokens, now with no corrections

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Accuracy	0.464	0.478	0.753
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- *Magyarlanc*: accuracy falls by about 10%
- Large proportion of test cases involve monomorphemic words for which the analyzer recognizes no internal structure

Error detection

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Without hypothesis:

	Score
Precision	0.380
Recall	0.789
F_1	0.513
$F_{0.5}$	0.424

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With hypothesis:

	Score
Precision	0.400
Recall	0.043
F_1	0.078
$F_{0.5}$	0.152

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Some possible solutions:

- Spelling corrector as part of the pipeline (Durst et al., 2014)
- Short list of common Hungarian names
- Determine preference ordering of analyses

Grammar extraction

Exploratory analysis of approximating learner's interlanguage grammar

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Exploratory analysis of approximating learner's interlanguage grammar

- **Goal:** Extract as much information as possible from learner productions to infer features of the interlanguage
- Sort out features which are good at distinguishing learner level from those which characterize individual learner differences

Complexity

- Morphemes Per Word (MPW)
- Words Per Sentence (WPS)

	MPW	WPS
Beg01	1.38	5.79
Beg02	1.40	4.37
Beg03	1.52	3.84
Beg04	1.31	5.43
Beg06	1.52	5.75
Beg08	1.44	2.81
Beg09	1.58	3.28
Int01	1.51	6.40
Adv01	1.60	15.73
Adv02	1.66	10.90

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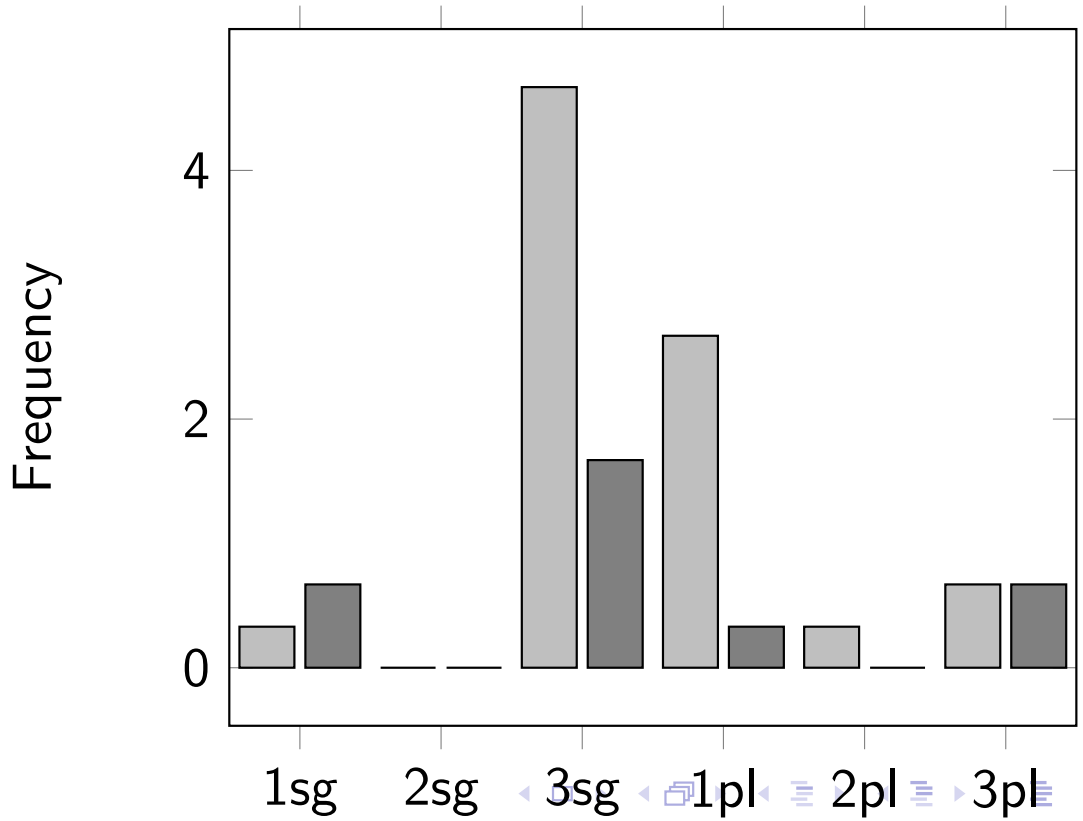
- WPS has individual variation, but seems to increase over course of acquisition: may indicate proficiency

Coverage

Verbal paradigm in the present tense indicative

- Beg. learner
- Favors 3rd person & 1st person plural, indefinite



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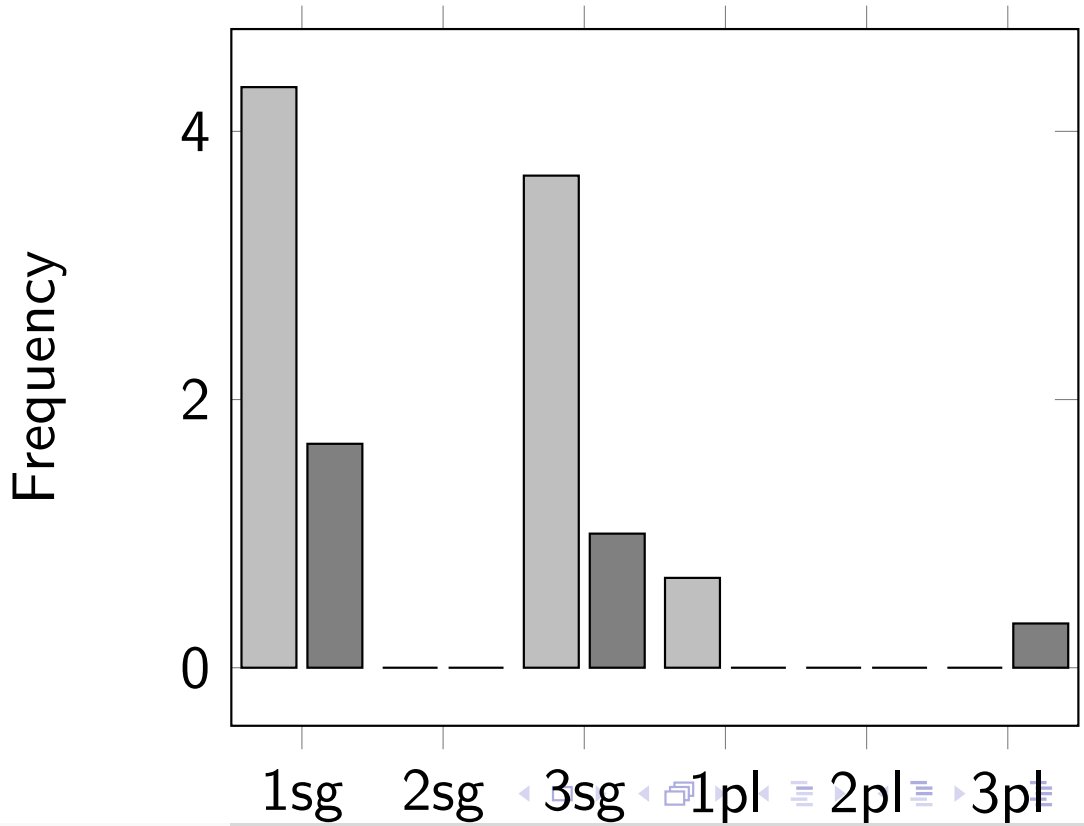
- Adv. learner
- Favors 1st & 3rd person singular, indefinite



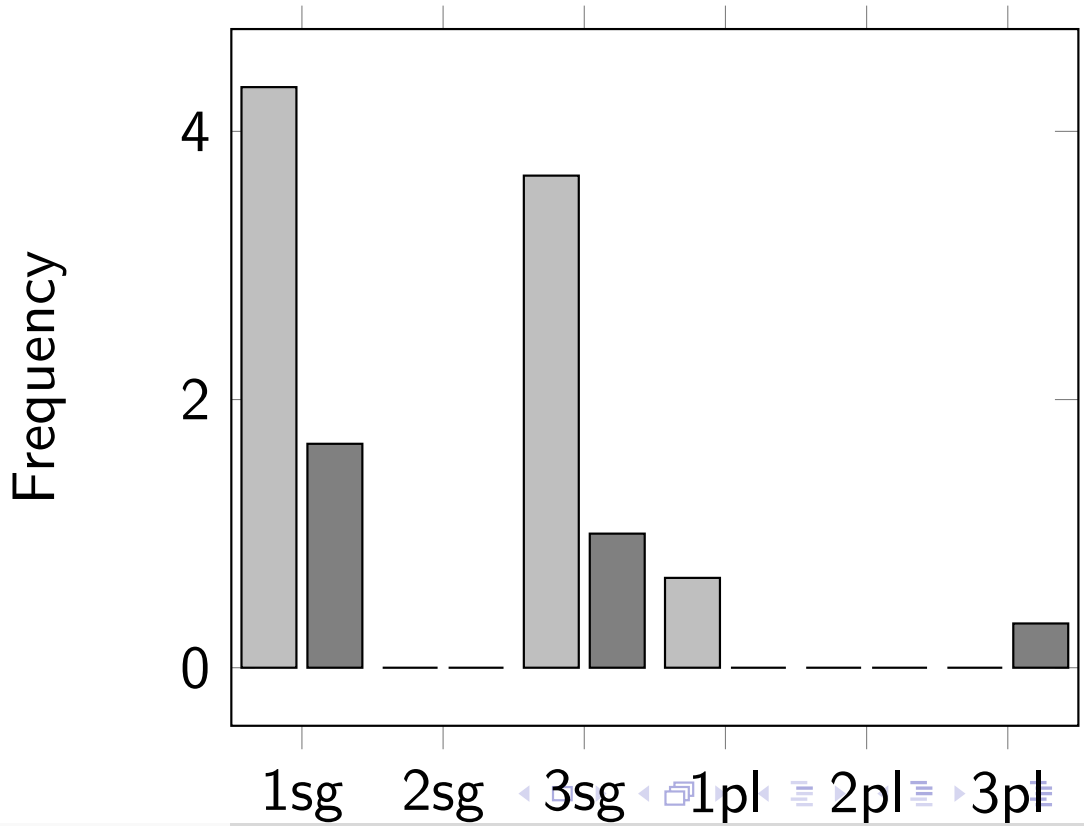
Coverage

Verbal paradigm in the present tense indicative

- Adv. learner
- Favors 1st & 3rd person singular, indefinite

⇒ Different usage patterns

- Investigation possible by auto. analysis



Summary

We have:

- Presented a rule-based morphological analysis system for learner Hungarian, employing constraint relaxation
  - We have used little in the way of hand-built resources
- Performed three different evaluations to illustrate its utility for linguistic analysis, error analysis, or downstream applications
  - Information captured by the analyzer shows promise for describing the interlanguage of learners of Hungarian

Outlook

Future directions:

- Handle named entities (Durst et al., 2014), e.g., lists of common names
- Extend methodology to syntax
- Explore record of language use to aid in disambiguation:
  - e.g., if ambiguous stem only ever occurred previously with verbal morphology, its current use may be verbal
- Investigate iterative bootstrapping methods to allow for reduction of initial knowledge base

Thank you!

Köszönöm!

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