Some automatic analyses of morphological structures

Nicolas Ballier USPC Paris Diderot CLILLAC-ARP (EA3967)

16/8/2017

OUTLINE AND ROADMAP

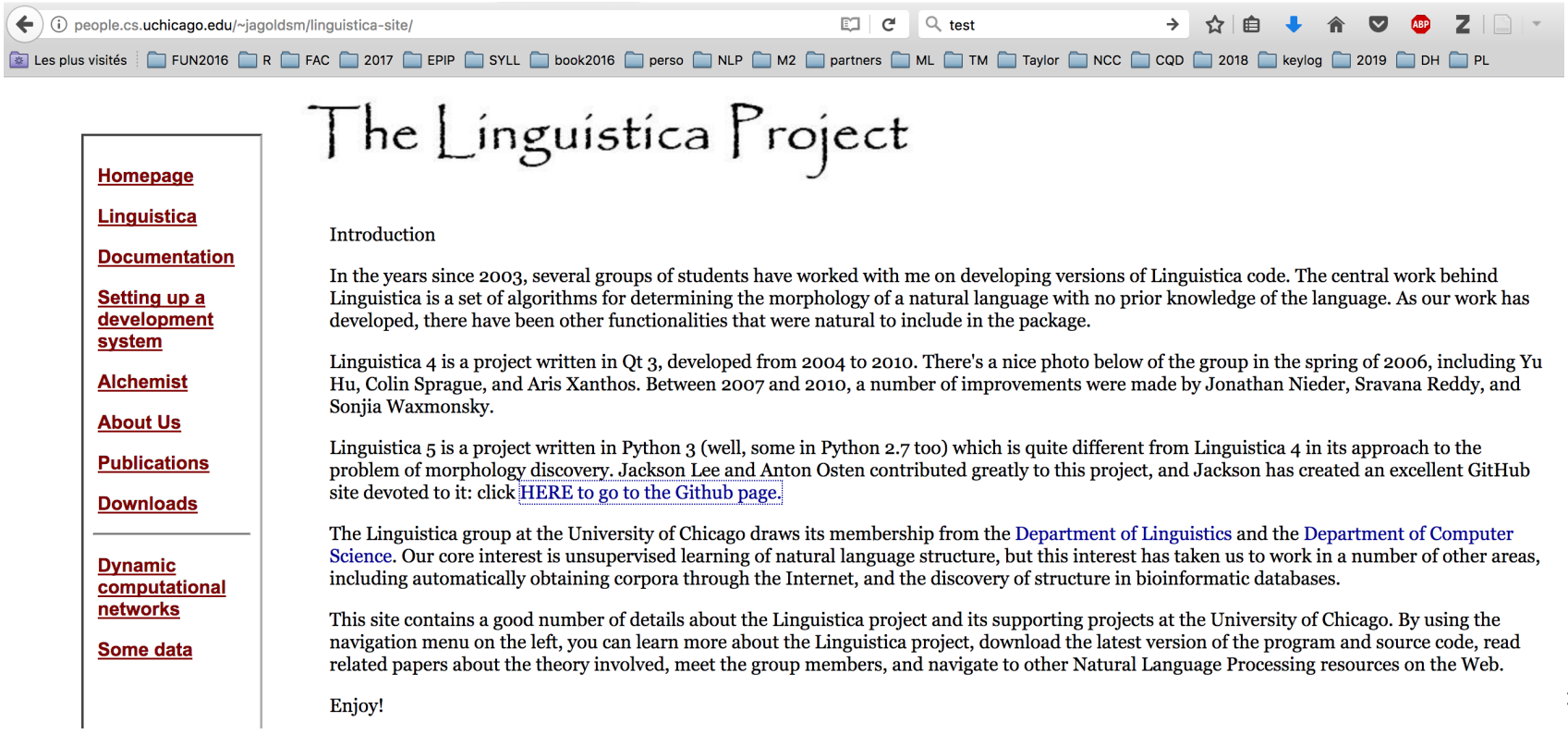
- 1: Linguistica (Python 3.5): the tool, its history and some uses
- 2: some uses of the program (data modelling and the learnabibility paradigm)
- 3. Morfessor (Python 2.7)
- 4. CHIPMUNK (Java)

SOME NOTIONS IN THE FIELD

- supervised versus unsupervised
- unsupervised morphology “discovery and morpheme segmentation”
- “learning algorithm”
- learnability
- Naive discriminant learning (Baayen 2011)

SECTION 1 : Linguistica 5 (python3)

https://github.com/linguistica-uchicago/lxa5



***

DataViz and unsupervised learning: Lee & Goldsmith 2016

- unsupervised word category induction (Christodoulopoulos et al. 2010)
- tools for data visualization
- model syntactic neighborhood
- reconstructing paradigms
- Signatures with the most stems in the Brown corpus
- Automatic outputs from character data

LEARNABILITY OF THE STRUCTURES

- morphological stems
- syntactic neighbours
- homophones
- “signatures”

Automatic output from the Brown corpus (Linguistica 2016)

affixes_to_signatures.txt
biphones.txt
phones.txt
predecessors.txt
signatures_to_stems.txt
signatures_to_stems_truncated.txt
signatures_to_words.txt
signatures_to_words_truncated.txt
stems_to_signatures.txt
stems_to_words.txt
successors.txt
triphones.txt
wordlist.txt, wordlist_by_avg_bigram_plog.txt ,
wordlist_by_avg_unigram_plog.txt
words_as_tries.txt
words_to_signatures.txt
words_to_sigtransforms.txt

DATA CLUSTERING : LEXICAL-FUNCTIONAL NETWORKS

Figure 1:

LINGUISTICA : DETECTING MORPHOLOGICAL STRUCTURES (signatures)

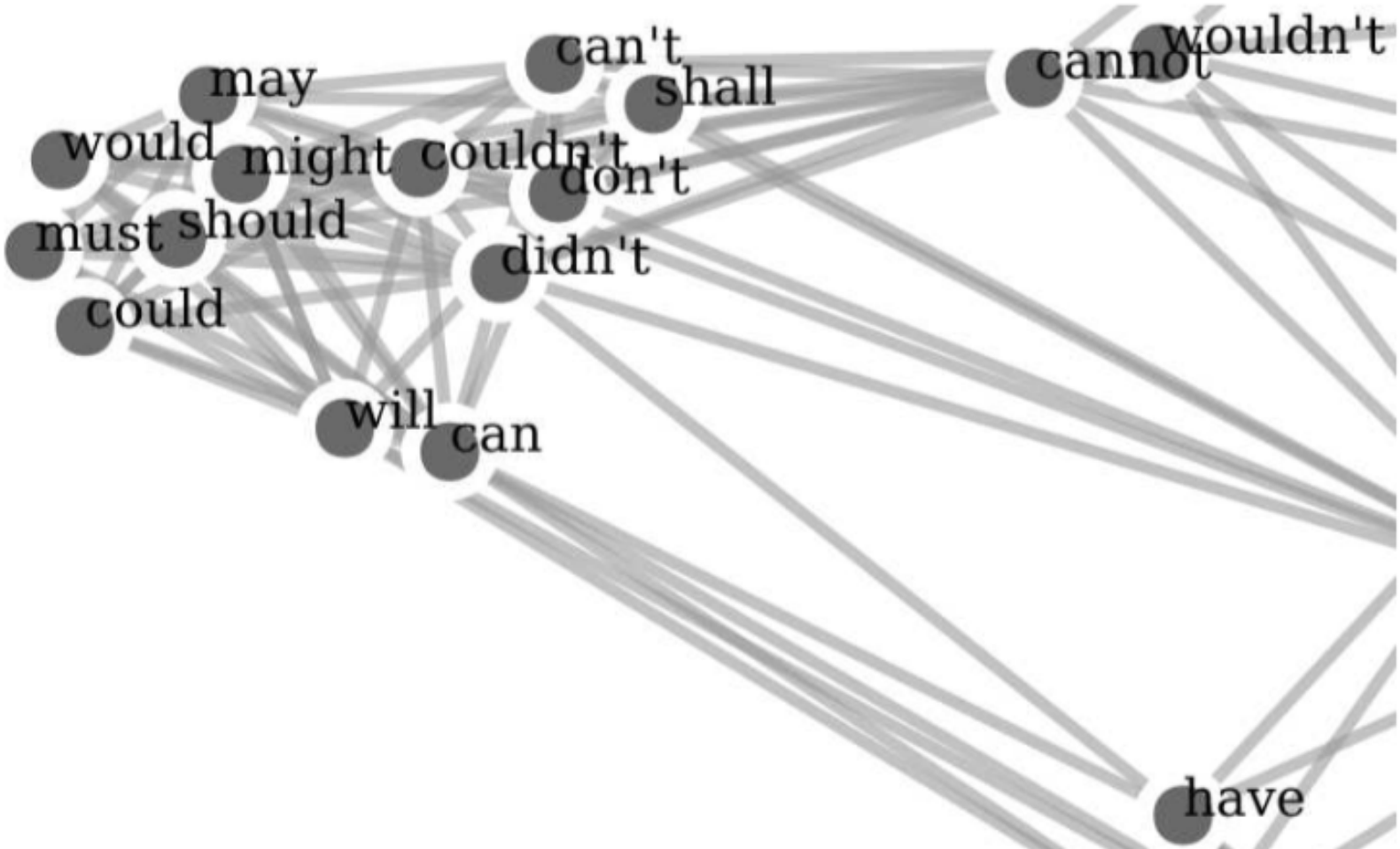
	Signature	Stem count
1	NULL/s	2327
2	's/NULL	813
3	NULL/ly	587
4	NULL/d/s	346
5	NULL/d	314
6	ed/ing	197
7	'/NULL	190
8	's/NULL/s	181
9	d/s	175
10	ies/y	173
11	NULL/ed/ing/s	151
12	NULL/ed	134

NULL/ed/ing/s (number of stems: 151)

abound	administer	affirm	aff
appeal	arrest	assault	att
awaken	award	beckon	be
bloom	bolt	broaden	bu
claw	click	climb	clu
coil	compound	concern	co
confront	contact	contrast	cra
crown	decay	deck	dia
display	drill	drown	du
eschew	escort	exceed	ex
extend	filter	flounder	fro
haunt	hoot	hover	ho

LINGUISTICA : DETECTING SYNTACTIC STRUCTURES

NETWORK OF MODAL NEIGHBOURS IN THE BROWN CORPUS (Lee & Goldsmith 2016)



LINGUISTICA : DETECTING STRUCTURES

SYNTACTIC NEIGHBOURS IN THE BROWN CORPUS (Lee & Goldsmith 2016)

Word	Syntactic neighbors
the	a his their an its this my our that
would	could must will can should may might
after	before like during since without through

Table 1: Syntactic neighbors

Figure 4:

FIRST STEPS WITH LINGUISTICA

http://linguistica-uchicago.github.io/lxa5/download.html

for the command line interface

Library/Python/3.5/anaconda/lib/python3.5/site-packages/linguistica

go to /Library/Python/3.5/anaconda/lib/python3.5/site-packages/linguistica

python -m linguistica cli *** ####follow the steps described here: http://linguistica-uchicago.github.io/lxa5/cli.html

LINGUISTICA (ref): http://www.aclweb.org/anthology/N16-3005
John A. Goldsmith. 2001. Unsupervised learning of the morphology of a natural language. Computational Linguistics, 27(2):153–198.

John A. Goldsmith. 2006. An algorithm for the unsupervised

Morfessor

training sets : corpora / lexical inventories

Mathias Creutz & Krista Lagus (Helsinki) Creutz, M., & Lagus, K. (2005). Unsupervised morpheme segmentation and morphology induction from text corpora using Morfessor 1.0. Helsinki University of Technology.

Sami Virpioja Peter Smit Stig-Arne Grönroos Mikko Kurimo Aalto University.

The output can be directed to a file using the following syntax: morfessor1.0.pl -data inputfilename > outputfilename

If additionally some optional parameters are defined, Morfessor can be invoked, e.g., like this: morfessor1.0.pl -savememory -gammalendistr 10 -trace 19 -data inputfilename > outputfilename

"Morfessor is a family of probabilistic machine learning methods that find morphological segmentations for words of a natural language, based solely on raw text data." (Morfessor report)

MORFESSOR: FIRST STEPS

Install setuptools for python curl
https://bootstrap.pypa.io/ez_setup.py -o - | python ez_setup.py
####copy morfessor.master.zip from github:
####https://github.com/aalto-speech/morfessor ####read
report + doc from
http://morfessor.readthedocs.io/en/latest/cmdtools.html ###run
the script morfessor-train –encoding=ISO_8859-15 –traindata-list
–logfile=log.log -s model.bin -d ones traindata.txt

EXAMPLE of OUTPUT

INFO:morfessor.io:Reading corpus from list 'traindata.txt'...
INFO:morfessor.io:Done. INFO:morfessor.baseline:Compounds in training data: 34148 types / 34148 tokens
INFO:morfessor.baseline:Starting batch training
INFO:morfessor.baseline:Epochs: 0 Cost: 1047578.61975
..... INFO:morfessor.baseline:Epochs: 1 Cost: 790234.810818 .....INFO:morfessor.baseline:Epochs: 2 Cost: 747577.177172
.....INFO:morfessor.baseline:Epochs: 3 Cost: 743192.072777
.....INFO:morfessor.baseline:Epochs: 4 Cost: 742134.191572
.....
INFO:morfess ..... INFO:morfessor.baseline:Epochs: 6 Cost: 741768.998685 INFO:morfessor.baseline:Done. Epochs: 6 Final cost: 741768.998685 Training time: 206.947s
INFO:morfessor.io:Saving model to 'model.bin'...
INFO:morfessor.io:Done. openroam-prg-og-1-158-87:Morfessor

CHIPMUNK (Java-based)

SUPERVISED LEARNING trained on English data

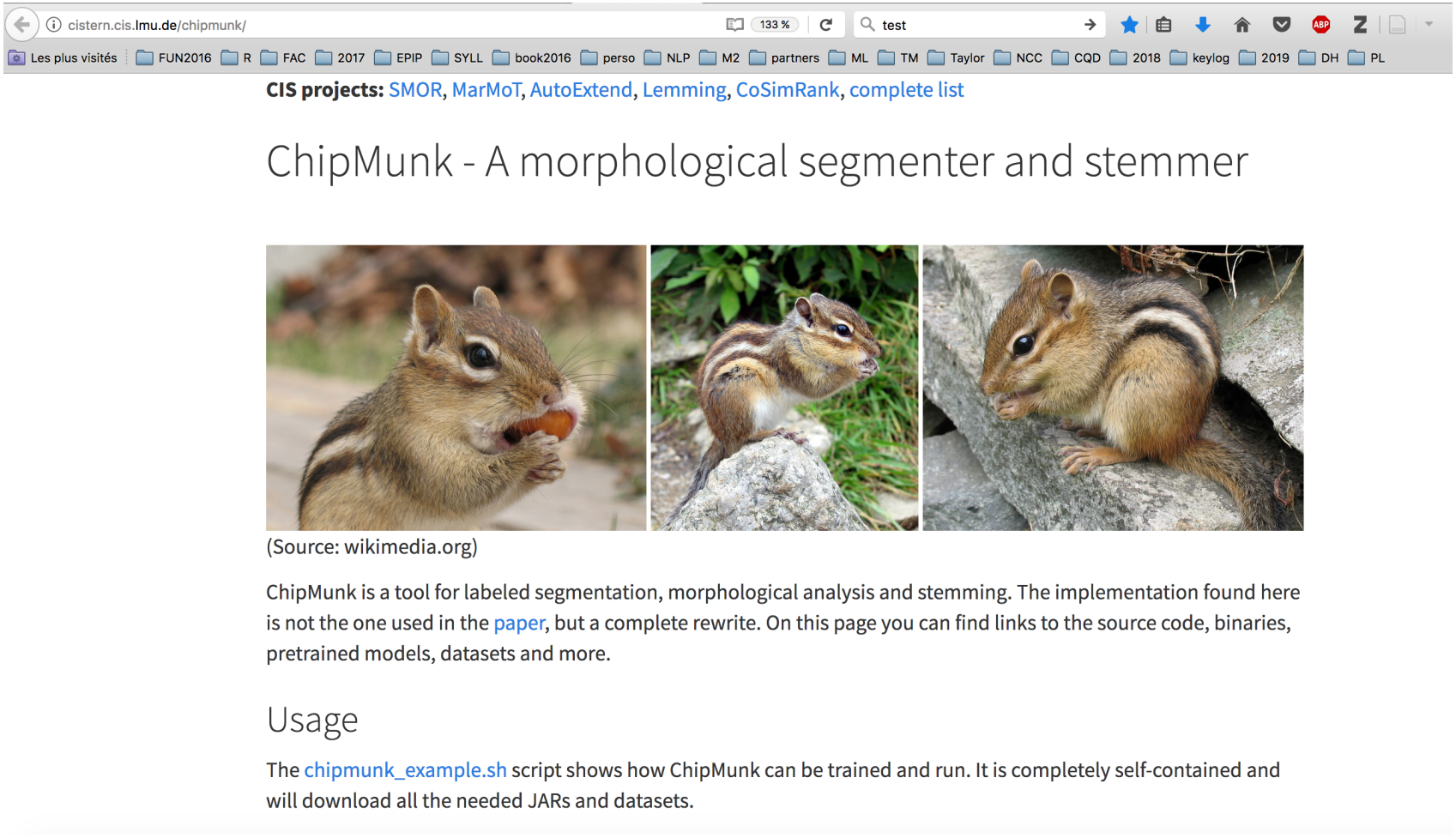


Figure 5:

CHIPMUNK : FIRST STEPS

sh chipmunk_example.sh ### runs the input.txt file

Creutz, M., & Lagus, K. (2005). Unsupervised morpheme segmentation and morphology induction from text corpora using Morfessor 1.0. Helsinki University of Technology.

http://nlp.cs.swarthmore.edu/~richardw/papers/creutz2005-unsupervised.pdf

CHIPMUNK: sample outputs

```
wonderful wonder:SEGMENT ful:SEGMENT
wonderland wonder:SEGMENT land:SEGMENT
wonderland wonder:SEGMENT land:SEGMENT
wonderland wonder:SEGMENT land:SEGMENT
wonderment wonder:SEGMENT ment:SEGMENT
wonderment wonder:SEGMENT ment:SEGMENT
wonderment wonder:SEGMENT ment:SEGMENT
wondrous  wondrous:SEGMENT
wondrous  wondrous:SEGMENT
wondrous  wondrous:SEGMENT
wonga-wonga  wonga:SEGMENT -:SPECIAL wonga:SEGMENT
wonga-wonga  wonga:SEGMENT -:SPECIAL wonga:SEGMENT
wonkywonky:SEGMENT
wonkywonky:SEGMENT
wonted  wont:SEGMENT ed:SEGMENT
wonted  wont:SEGMENT ed:SEGMENT
woodbine  woodbine:SEGMENT
woodbine  woodbine:SEGMENT
woodblock wood:SEGMENT block:SEGMENT
woodblock wood:SEGMENT block:SEGMENT
woodblock wood:SEGMENT block:SEGMENT
woodchuck wood:SEGMENT chuck:SEGMENT
```

Figure 6:

SAMPLE OUTPUT (Slovak)

big bytoví hudobníci big:SEGMENT :SPECIAL bytoví:SEGMENT :SPECIAL hudobníci:SEGMENT čižmáky č:SEGMENT ižmáky:SEGMENT :SPECIAL Dekapitulácia Dekapitulácia:SEGMENT demokratúra demokratúra:SEGMENT dePrimátor dePrimát:SEGMENT or:SEGMENT diskutéka diskutéka:SEGMENT

REFERENCES

Main papers describing the programs plus

Baayen, R. H. (2011). Corpus linguistics and naive discriminative learning. Revista Brasileira de Linguística Aplicada, 11(2), 295-328. http://www.sfs.uni-tuebingen.de/~hbaayen/publications/BaayenBJAL2011.pdf

Goldsmith, J. A. (2010). Segmentation and morphology. The Handbook of Computational Linguistics and Natural Language Processing, Blackwell Wiley, 364-393. Goldsmith, J. 2001. Unsupervised learning of the morphology of a natural language.Computational Linguistics, 27(2):153–198. Goldsmith. J. 2006. An algorithm for the unsupervised learning of morphology.Natural Language Engineering, 12(4):353–371) Goldsmith et al. 2017 Linguistica https://linguistica-uchicago.github.io/lxa5/demo.html

CONCLUSION

THANK YOU !

nballier@free.fr