CoNLL-SIGMORPHON
Shared Task 2018

Ryan Cotterell, Christo Kirov, John Sylak-Glassman, Géraldine Walther, Ekaterina Vylomova, Arya D. McCarthy, Katharina Kann, Sebastian Mielke, Garrett Nicolai, Miikka Silfverberg, David Yarowsky, Jason Eisner, Mans Hulden
Poster session 11.30-12.30

• In Grand Hall (level -2)

• All system papers presented
Get Involved with UniMorph!

• SIGMORPHON’s shared tasks over the last three years are part of a larger community effort

• Visit https://unimorph.github.io/ and sign up!

I WANT YOU!

To Work on Morphology!

UniMorph

The Universal Morphology (UniMorph) project is a collaborative effort to improve how NLP handles complex morphology in the world’s languages. The goal of UniMorph is to annotate morphological data in a universal schema that allows an inflected word from any language to be defined by its lexical meaning, typically carried by the lemma, and by a rendering of its inflectional form in terms of a bundle of morphological features from our schema. The specification of the schema is described here and in Sytok–Glassman (2016).

UniMorph Events

• SIGMORPHON 2016 Shared Task
• CoNLL-SIGMORPHON 2017 Shared Task

Annotated Languages

The following 51 languages have been annotated according to the UniMorph schema. Missing parts of speech will be filled in soon.

<table>
<thead>
<tr>
<th>Language</th>
<th>ISO-639-3</th>
<th>Forms</th>
<th>Paradigms</th>
<th>Nouns</th>
<th>Verbs</th>
<th>Adjectives</th>
<th>Source</th>
<th>License</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albanian</td>
<td>sqi</td>
<td>33483</td>
<td>589</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>W</td>
<td>◀ ◀ ◀</td>
</tr>
<tr>
<td>Arabic</td>
<td>ara</td>
<td>140003</td>
<td>4134</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>W</td>
<td>◀ ◀ ◀</td>
</tr>
<tr>
<td>Armenian</td>
<td>hye</td>
<td>338461</td>
<td>7033</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>W</td>
<td>◀ ◀ ◀</td>
</tr>
<tr>
<td>Basque</td>
<td>eus</td>
<td>11889</td>
<td>26</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>W</td>
<td>◀ ◀ ◀</td>
</tr>
<tr>
<td>Bengali</td>
<td>ben</td>
<td>4443</td>
<td>136</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>W</td>
<td>◀ ◀ ◀</td>
</tr>
</tbody>
</table>
Shared task
Shared task

• Second CoNLL shared task on supervised learning of (inflectional) morphology
Shared task

• Second CoNLL shared task on supervised learning of (inflectional) morphology

• featuring …
Shared task

- Second CoNLL shared task on supervised learning of (inflectional) morphology

- featuring ...

  - 2 tasks
Shared task

- Second CoNLL shared task on supervised learning of (inflectional) morphology

- featuring …

  - 2 tasks
  
  - 103 languages (task 1); 7 languages (task 2)
Shared task

- Second CoNLL shared task on supervised learning of (inflectional) morphology
- featuring …
  - 2 tasks
  - 103 languages (task 1); 7 languages (task 2)
  - 33 systems submitted, 15 teams, 17 institutions
Shared task

• Second CoNLL shared task on supervised learning of (inflectional) morphology

• featuring …

• 2 tasks

• 103 languages (task 1); 7 languages (task 2)

• 33 systems submitted, 15 teams, 17 institutions
Shared task

Outline

• Overview [MH]

• Task 1 Description [MH]

• Task 1 Language Data & Results [CK]

• Task 2 Description, Data & Results [MS]
Shared tasks
Shared tasks

• 1 Inflection (generation)
Shared tasks

• 1 *Inflection* (generation)

**inflect this lemma**

\[ \text{hate; V;V.PTCP;PRS} \rightarrow \text{hating} \]
Shared tasks

1. **Inflection** (generation)
   
   inflect this lemma

   ![Inflection Example]

   hate; V;V.PTCP;PRS → hating

2. **Cloze Task** (new!) - inflect word in context
Shared tasks

1. **Inflection** (generation)

   inflect this lemma

   hate; V;V.PTCP;PRS → hating

2. **Cloze Task** (new!) - inflect word in context

   inflect this lemma in context

   The __ are barking

   the/DT dog be/AUX+PRES+3PL bark/V+V.PTCP
Task 1: Inflection
Sub-task 1 (inflection)

- Train
  - Lemma
  - MSD (features)
  - Word form

- Test

CoNLL 2018 CoNLL-SIGMORPHON Shared Task
Sub-task 1 (inflection)

Train

lemma

run

MSD (features)

test

word form
Sub-task 1 (inflection)

Lemma: run

MSD (features): train

Word form: test

CoNLL 2018
Sub-task 1 (inflection)

<table>
<thead>
<tr>
<th>Lemma</th>
<th>MSD (features)</th>
<th>Word Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>run V;PST</td>
<td></td>
<td>ran</td>
</tr>
</tbody>
</table>

Train

Test
Sub-task 1 (inflection)

<table>
<thead>
<tr>
<th>Lemma</th>
<th>MSD (features)</th>
<th>Word Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>run</td>
<td>V;PST</td>
<td>ran</td>
</tr>
<tr>
<td>love</td>
<td>V;V.PTCP;PRS</td>
<td>loving</td>
</tr>
<tr>
<td>eat</td>
<td>V;PST</td>
<td>ate</td>
</tr>
</tbody>
</table>

...
Sub-task 1 (inflection)

<table>
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<tr>
<th>lemma</th>
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<tbody>
<tr>
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<td>loving</td>
</tr>
<tr>
<td>eat</td>
<td>V;PST</td>
<td>ate</td>
</tr>
<tr>
<td>hate</td>
<td>V;V.PTCP;PRS</td>
<td></td>
</tr>
</tbody>
</table>
### Sub-task 1 (inflection)

<table>
<thead>
<tr>
<th>Lemma</th>
<th>MSD (Features)</th>
<th>Word Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>run</td>
<td>V;PST</td>
<td>ran</td>
</tr>
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<td>love</td>
<td>V;V.PTCP;PRS</td>
<td>loving</td>
</tr>
<tr>
<td>eat</td>
<td>V;PST</td>
<td>ate</td>
</tr>
<tr>
<td>hate</td>
<td>V;V.PTCP;PRS</td>
<td></td>
</tr>
<tr>
<td>read</td>
<td>V;PST</td>
<td></td>
</tr>
</tbody>
</table>

---

**CoNLL 2018**

**CoNLL-SIGMORPHON Shared Task**
Sub-task 1 (inflection)

<table>
<thead>
<tr>
<th>lemma</th>
<th>word form</th>
</tr>
</thead>
<tbody>
<tr>
<td>run</td>
<td>ran</td>
</tr>
<tr>
<td>love</td>
<td>loving</td>
</tr>
<tr>
<td>eat</td>
<td>ate</td>
</tr>
<tr>
<td>hate</td>
<td>hating</td>
</tr>
<tr>
<td>read</td>
<td>read</td>
</tr>
</tbody>
</table>
### Conjugation

<table>
<thead>
<tr>
<th>Conjugation of schreiben</th>
<th>Indicative</th>
<th>Subjunctive</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infinitive</strong></td>
<td>schreiben</td>
<td></td>
</tr>
<tr>
<td><strong>Present Participle</strong></td>
<td>schreibend</td>
<td></td>
</tr>
<tr>
<td><strong>Past Participle</strong></td>
<td>geschrieben</td>
<td></td>
</tr>
<tr>
<td><strong>Auxiliary</strong></td>
<td>haben</td>
<td></td>
</tr>
<tr>
<td><strong>Present</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ich schreibe</td>
<td>wir schreiben</td>
<td>ich schreibe</td>
</tr>
<tr>
<td>du schreibst</td>
<td>ihr schreibt</td>
<td>du schreibst</td>
</tr>
<tr>
<td>er schreibt</td>
<td>sie schreiben</td>
<td>er schreibe</td>
</tr>
<tr>
<td><strong>Preterite</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ich schrieb</td>
<td>wir schrieben</td>
<td>ich schriebe</td>
</tr>
<tr>
<td>du schriebst</td>
<td>ihr schrieb</td>
<td>du schriebest</td>
</tr>
<tr>
<td>er schrieb</td>
<td>sie schrieben</td>
<td>er schriebe</td>
</tr>
<tr>
<td><strong>Imperative</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>schreib (du)</td>
<td>schreibt (ihr)</td>
<td></td>
</tr>
</tbody>
</table>

**Composed forms of schreiben**

- schreib (du)
- schreibe (du)

**Languages**

- [en](https://en.wiktionary.org/wiki/schreiben)
- [de](https://de.wiktionary.org/wiki/schreiben)
- [fr](https://fr.wiktionary.org/wiki/schreiben)
- [it](https://it.wiktionary.org/wiki/schreiben)

**Usage**

- *Ich schreibe* (I write)
- *Wir schreiben* (We write)
- *Du schreibst* (You write)
- *Erf schreibt* (He/She/It writes)
- *Ihr schreibt* (You write)
- *Sie schreiben* (They write)
Training data
Training data

<table>
<thead>
<tr>
<th>Conjugation</th>
<th>[edit]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>conjugation of schreiben</strong></td>
<td></td>
</tr>
<tr>
<td><strong>infinitive</strong></td>
<td></td>
</tr>
<tr>
<td>present participle</td>
<td></td>
</tr>
<tr>
<td>past participle</td>
<td></td>
</tr>
<tr>
<td>auxiliary</td>
<td></td>
</tr>
<tr>
<td><strong>indicative</strong></td>
<td></td>
</tr>
<tr>
<td>present</td>
<td></td>
</tr>
<tr>
<td>ich schreibe</td>
<td>wir schreiben</td>
</tr>
<tr>
<td>preterite</td>
<td></td>
</tr>
<tr>
<td>wir schrieben</td>
<td>ii</td>
</tr>
<tr>
<td>imperative</td>
<td></td>
</tr>
<tr>
<td>schreib (du)</td>
<td></td>
</tr>
<tr>
<td><strong>subjunctive</strong></td>
<td></td>
</tr>
<tr>
<td>wir schreiben</td>
<td></td>
</tr>
<tr>
<td>composed forms of schreiben</td>
<td></td>
</tr>
</tbody>
</table>

- schreiben V;SBJV;PRS;1:PL
Rule-based baseline (Task 1)

- Simple prefix/suffix transformation based method
- Designed to run fast and be (somewhat) linguistically informed
- By design hard to beat in low data condition (top in 5 languages)
### Baseline example

<table>
<thead>
<tr>
<th>train</th>
<th>lemma</th>
<th>infl. form</th>
<th>features</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>schielen</td>
<td>geschielt</td>
<td>V.PTCP;PST</td>
</tr>
</tbody>
</table>
Baseline example

<table>
<thead>
<tr>
<th>train</th>
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<td>geschielt</td>
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<td></td>
</tr>
</tbody>
</table>

align (MED)

<table>
<thead>
<tr>
<th>schielen</th>
<th>geschielt</th>
</tr>
</thead>
</table>
Baseline example

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<th>lemma</th>
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<tbody>
<tr>
<td></td>
<td>schielen</td>
<td>geschielt</td>
<td>V.PTCP;PST</td>
</tr>
</tbody>
</table>

align (MED)

schielen

geschielt
### Baseline example

<table>
<thead>
<tr>
<th></th>
<th>lemma</th>
<th>infl. form</th>
<th>features</th>
</tr>
</thead>
<tbody>
<tr>
<td>train</td>
<td>schielen</td>
<td>geschielt</td>
<td>V.PTCP;PST</td>
</tr>
</tbody>
</table>

**align (MED)**

<table>
<thead>
<tr>
<th></th>
<th>Pr</th>
<th>Stem</th>
<th>Suffix</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>schie</td>
<td>schiel</td>
<td>en</td>
</tr>
</tbody>
</table>

**suffix-transformation rules V.PTCP;PST**
Baseline example

<table>
<thead>
<tr>
<th>lemma</th>
<th>infl. form</th>
<th>features</th>
</tr>
</thead>
<tbody>
<tr>
<td>train</td>
<td>schielen</td>
<td>geschielet V.PTCP;PST</td>
</tr>
</tbody>
</table>

align (MED)

**Suffix**

- **Pr:**
  - schiel
- **Stem:**
  - en
- **Suffix:**
  - t

**Suffix-transformation rules V.PTCP;PST**

- n$ \rightarrow $
- len$ \rightarrow $lt$
- ielen$ \rightarrow $iel$t$
- chielen$ \rightarrow $chielt$
- en$ \rightarrow $t$
- elen$ \rightarrow $elt$
- hielen$ \rightarrow $hielt$
- schielen$ \rightarrow $schielt$

*CoNLL 2018*
Baseline example

<table>
<thead>
<tr>
<th>train</th>
<th>lemma</th>
<th>infl. form</th>
<th>features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schielen</td>
<td>Geschielt</td>
<td>V.PTCP;PST</td>
<td></td>
</tr>
</tbody>
</table>

align (MED)

Pr  Stem  Suffix
ge  Schiel  en t

prefix-transformation rules V.PTCP;PST

$ \rightarrow $ge
### Baseline example

<table>
<thead>
<tr>
<th>test</th>
<th>lemma</th>
<th>infl. form</th>
<th>features</th>
</tr>
</thead>
<tbody>
<tr>
<td>kaufen</td>
<td>???</td>
<td>V.PTCP;PST</td>
<td></td>
</tr>
</tbody>
</table>
### Baseline example

<table>
<thead>
<tr>
<th>test</th>
<th>lemma</th>
<th>infl. form</th>
<th>features</th>
</tr>
</thead>
<tbody>
<tr>
<td>kaufen</td>
<td>???</td>
<td></td>
<td>V.PTCP;PST</td>
</tr>
</tbody>
</table>

#### suffix-transformation rules V.PTCP;PST

- n$ → $  
- len$ → lt$  
- ielen$ → ielt$  
- chielen$ → chielt$  
- en$ → t$  
- elen$ → elt$  
- hielen$ → hielt$  
- schielen$ → schielt$
Baseline example

<table>
<thead>
<tr>
<th>lemma</th>
<th>infl. form</th>
<th>features</th>
</tr>
</thead>
<tbody>
<tr>
<td>test</td>
<td>kaufen</td>
<td>???</td>
</tr>
<tr>
<td></td>
<td>kauft</td>
<td>V.PTCP;PST</td>
</tr>
</tbody>
</table>

longest match to lemma

suffix-transformation rules V.PTCP;PST

- n$ → $
- len$ → lt$
- ielen$ → ielt$
- chielen$ → chiel$t$
- en$ → t$
- elen$ → elt$
- hielen$ → hielt$
- schielen$ → schiel$t$

CoNLL 2018 CoNLL-SIGMORPHON Shared Task
Baseline example

<table>
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<th>test</th>
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</table>

prefix-transformation rules V.PTCP;PST

$ \rightarrow \$ge
Baseline example

<table>
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<td>???</td>
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</table>

prefix-transformation rules V.PTCP;PST

most frequent for V.PTCP;PST

$ \rightarrow \$ge
Baseline example

**Test**

lemma: kaufen

infl. form: gekauft

features: V.PTCP;PST

prefix-transformation rules V.PTCP;PST

$ \rightarrow $ $ge$
Task 1 Data
## Task 1 Data Overview

- Inflectional (N, V, ADJ) paradigms from **103** languages
- **93** Development Languages, **10** Surprise Languages
- **~20** linguistic stocks represented

<table>
<thead>
<tr>
<th>Athabaskan</th>
<th>Isolate</th>
<th>Kartvelian</th>
<th>Quechuan</th>
<th>Semitic</th>
<th>Sino-Tibetan</th>
<th>Turkic</th>
<th>Uralic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Navajo</td>
<td>Basque</td>
<td>Georgian</td>
<td>Quechua</td>
<td>Arabic</td>
<td>Khaling</td>
<td>Turkish</td>
<td>Estonian</td>
</tr>
<tr>
<td>Haida</td>
<td></td>
<td></td>
<td></td>
<td>Hebrew</td>
<td></td>
<td></td>
<td>Finnish</td>
</tr>
</tbody>
</table>

- Hungarian
- Northern Sami
Morphological Processes

- Differing affixation patterns:
  - **Prefixing**: Navajo
  - **Suffixing**: Quechua, Turkish
  - **Circumfixing, Stem-changing**: Georgian, Spanish

- Non-Local Patterns:
  - **Templatic**: Arabic, Hebrew
  - **Vowel Harmony**: Turkish, Finnish, Hungarian
  - **Consonant Harmony**: Navajo
Data Sources

- Wiktionary ([www.wiktionary.org](http://www.wiktionary.org)): 98 languages
- Alexina Project: 3 languages (Khaling, Kurmanji and Sorani Kurdish)
- Alegria et al. 2009: Basque
- Prof. Jordan Lachler (Univ. of Alberta): Haida
Annotation

- All data sources normalized into triples (lemma, inflection, features):

<table>
<thead>
<tr>
<th>Lemma</th>
<th>Inflection</th>
<th>Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>achi’</td>
<td>iich’</td>
<td>V;REAL;1;DU,PROG</td>
</tr>
<tr>
<td>achi’</td>
<td>da’iich’</td>
<td>V;REAL;1;PL,PROG</td>
</tr>
<tr>
<td>achi’</td>
<td>ashch’</td>
<td>V;REAL;1;SG,PROG</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

- Simple UTF-8 tab-delimited text format

- All data presented using native orthography

- Tags follow the UniMorph Schema
UniMorph Schema

- UniMorph Schema provides tags for minimal units of meaning for inflectional morphology

- Developed at Johns Hopkins University based on linguistic typology research that takes into account even extremely low resource languages

- 25 dimensions of meaning (aka morphological categories) with over 300 feature values

- Feature values (e.g. PRS = present tense) are string-unique, i.e. do not need type to be specified; both PRS and tense=PRS are equally valid.

- User guide and machine-readable JSON specification available at unimorph.github.io

- Actively maintained with process for making modifications according to community feedback
Wiktionary Collection
Wiktionary Collection

- Each language only has ~2-3 relevant table types per POS, shared across thousands of unique lemmas.

- In practice, humans can manually annotate a few sample tables, and extrapolate the rest (e.g. hablo → 1;SG;PRS).

- Tagging accuracy verified by experts familiar with each language family.
Annotation Process

- Manually edited html paradigm templates using UniMorph Schema
  - ~300 inflection tags, designed for high typological coverage
Wiktionary Collection

- Parses available at unimorph.github.io
Data Sampling

• Constructed MLE probability distributions for over data triples (lemma, infl_form, infl_fts) by counting tokens of inflected forms in Feb. 2017 Wikipedia dump for each language.

• Estimated a smooth unigram distribution over triples using this method: Cotterell et al. 2018. Unsupervised disambiguation of syncretism in inflected lexicons. NAACL.

• Sampled 12000 triples without replacement from this distribution.

• From those triples, sampled all train, dev, and test data.

• Train, dev, test split data available at: https://github.com/sigmorphon/conll2018
Data Quantities

• *Task 1 training*: 10,000 (high), 1,000 (medium), 100 (low) forms

• *Test & Dev*: 1,000 forms each in Task 1

• 40 languages had fewer forms in one or more condition due to data constraints. E.g.: Haida, Bengali, Scottish Gaelic, Basque, Middle High German, Middle Low German, Mapudungun, …

• Detailed explanation of data contents available in paper
Participation Results Task 1
General Participation Statistics

- **15** individual teams competed
- **17** universities and institutes
- **33** individual systems
- **40** authors in total
- (A whole lot of morphology)
## Team Overview

<table>
<thead>
<tr>
<th>Team</th>
<th>Institute(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AXSEMANTICS$^1$</td>
<td>AX Semantics</td>
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Task 1 Results: High

[Graph showing results for UZH, WASEDA, BME, AXSEM, HAMBURG, IITBHU, MSU, TUEB.-OSLO, IIT-VARANASI, BASELINE]
Task 1 Results: Low

- UZH
- BME
- IITBHU
- MSU
- IIT-VARANASI
- WASEDA
- AXSEM
- HAMBURG
- TUEB.-OSLO
- UA
- BASELINE

CoNLL 2018 CoNLL-SIGMORPHON Shared Task
Innovations for Task 1

- **41** languages (out of **52** in 2017) improved in low-resource setting vs. 2017

- Best results, especially in the low/medium data, conditions were achieved using the following strategies:
  
  - Generating sequences of edit operations instead of standard str2str transduction (**AX SEMANTICS, UZH, HAMBURG, MSU, RACAI**)
  
  - Augmenting the available training data with artificial data (**TUEBINGEN-OSLO, WASEDA**)
  
- Detailed description papers in CoNLL proceedings!
Task 2: Inflection in Context
Task 2: Inflection in Context

“The cloze test”
Task 2 Description

TRACK 1:

The ___ are barking
the/DT dog be/AUX+PRES+3PL bark/V+V.PTCP

Figure 1: Test examples for tracks 1 and 2 in the cloze task.
Task 2 Description

TRACK 1:

The **dogs** are barking

the/DT dog be/AUX+PRES+3PL bark/V+V.PTCP
Task 2 Description

TRACK 1:

The **dogs** are **barking**
the/DT dog be/AUX+PRES+3PL bark/V+V.PTCP

TRACK 2:

The **dogs** are barking.
dog
Track 1 Data

train:

Tropical species have moved up to Florida.
Track 1 Data

train:
Tropical species have moved up to Florida.

Tropical/ADJ species/N;PL have/IND;PRS;FIN moved V;PST;V;PTCP up ADP to ADP Florida/PROP;SG ./PUNCT

test:
Many people want to use diplomacy.

Many/ADJ people want/IND;PRS;FIN to/PART use V;NFIN diplomacy/ADJ ./PUNCT
Track 1 Data

train:

Tropical species have moved up to Florida.

tropical/ADJ species/N;PL have/aux;ind;prs;fin moved/move/v;pst;v;ptcp up/up/adp to/to/adp Florida/propn;sg .

test:

Many people want to use diplomacy.

many/adj people/adj want/want/v;ind;prs;fin to/to/part use/use/v;nfin diplomacy/diplomacy/adj . /punct
Track 2 Data

train:

Tropical species have moved up to Florida.
Track 2 Data

train:
Tropical species have moved up to Florida.

move

test:
Many people want to use diplomacy.
Data Sources

Starting point: Universal Dependencies v2 Treebanks for seven European languages: English, Finnish, French, German, Russian, Spanish and Swedish

Der der ART Case=Nom|Definite=Def|Gender=Masc|Number=Sing|PronType=Art
Firma Firma NN Case=Nom|Gender=Masc|Number=Sing
liegt liegen VVFIN Number=Sing|Person=3|VerbForm=Fin
genau genau ADJD _
am _ _
an an APPR _
dem der ART Case=Dat|Definite=Def|Gender=Masc,Neut|Number=Sing|PronType=Art
Ortseingang Ortseingang NN Case=Dat|Gender=Masc,Neut|Number=Sing
. . _
### Data Sources

**Starting point:** Universal Dependencies v2 Treebanks for seven European languages: English, Finnish, French, German, Russian, Spanish and Swedish

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<th>Annotation</th>
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Data Sources

**Starting point:** Universal Dependencies v2 Treebanks for seven European languages: English, Finnish, French, German, Russian, Spanish and Swedish

```
Der Firma liegt genau am an dem Ortseingang.
```

**word form**

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**lemma**

.$.
Starting point: Universal Dependencies v2 Treebanks for seven European languages: English, Finnish, French, German, Russian, Spanish and Swedish
Data Conversion

UD morphosyntactic annotation was converted to the UniMorph schema using deterministic rules.

Der der DET;NOM;DEF;MASC;SG
Firma Firma N;NOM;MASC;SG
liegt liegen V;SG;3;FIN
genauf genau ADV
an an ADP
dem der DET;DAT;DEF;MASC;NEUT;SG
Ortseingang Ortseingang N;DAT;MASC;NEUT;SG
. . PUNCT
Data Conversion

UD morphosyntactic annotation was converted to the UniMorph schema using deterministic rules.

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<td>.</td>
<td>.</td>
<td>PUNCT</td>
</tr>
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</table>

Because there are few languages in task 2, this was doable.
Manual Annotation

Contextually plausible forms were annotated into the test data.

Das ragt der PRO;NOM;NEUT;SG
mal ragen ADV
angenhem angenehm ADV
heraus heraus ADV
aus aus ADP
dem der DET;DAT;DEF;NEUT;SG
Einheitssbrei Einheitssbrei N;DAT;NEUT;SG
. . PUNCT

Manual Annotation

Contextually plausible forms were annotated into the test data.

Plausible forms in context

Das ragt/rage/ragte mal
angenhem heraus aus dem Einheitssbrei

PRO;NOM;NEUT;SG

ADV

ADV

ADP

DET;DAT;DEF;NEUT;SG

N;DAT;NEUT;SG

PUNCT

CoNLL 2018 CoNLL-SIGMORPHON Shared Task
Manual Annotation

Contextually plausible forms were annotated into the test data.

Plausible forms in context

Annotators chose among forms in UniMorph tables

CoNLL 2018
Data Splits

- We preserve the original UD train, dev test splits
Data Splits

- We preserve the original UD train, dev test splits
- For the train set, we sampled 1k, 10k and 100k tokens into the low, medium and high sets, respectively.
Data Splits

- We preserve the original UD train, dev test splits
- For the train set, we sampled 1k, 10k and 100k tokens into the low, medium and high sets, respectively.
- For the dev set, we used all available sentences.
Data Splits

• We preserve the original UD train, dev test splits

• For the train set, we sampled 1k, 10k and 100k tokens into the low, medium and high sets, respectively.

• For the dev set, we used all available sentences.

• For test sets, we selected 1k examples for each language.
Data Splits

- We preserve the original UD train, dev test splits
- For the train set, we sampled 1k, 10k and 100k tokens into the low, medium and high sets, respectively.
- For the dev set, we used all available sentences.
- For test sets, we selected 1k examples for each language.

We saw two ___ and one ___.

dog

cat
Neural Baseline Model for Task 2

- **Basis**: Bidirectional LSTM Encoder-Decoder with attention

- **Encoder conditioned on**: lemmata, forms and MSDs of the left and right context token in track 1.

- **Encoder conditioned on**: the left and right context word form in track 2.
System Features

All systems were neural.

<table>
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<tr>
<th></th>
<th>predict MSD</th>
<th>subword context</th>
<th>context RNN</th>
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- First **predict MSD** of the target lemma, then inflect.
## System Features

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- First **predict MSD** of the target lemma, then inflect.
- Use character-based or other **subword context** model.
System Features

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- Use character-based or other **subword context** model.
- Encode the sentence context using a **context RNN**.
System Features

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- First **predict MSD** of the target lemma, then inflect.
- Use character-based or other **subword context** model.
- Encode the sentence context using a **context RNN**.
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- Combine training sets for different languages into **multilingual** training sets.
System Features

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- First **predict MSD** of the target lemma, then inflect.
- Use character-based or other **subword context** model.
- Encode the sentence context using a **context RNN**.
- Use a **context attention** mechanism.
- Combine training sets for different languages into **multilingual** training sets.
- Use **beam search** when decoding.
Evaluation

**Accuracy** for original forms

**Relaxed accuracy** for plausible forms: Correct if the output matches any of the plausible forms
Task 2: Track 1 Results

- BME-HAS
- CPH
- CU-1
- CU-2
- NYU
- UZH
- BL

High
Medium
Low
Task 2: Track 1 Results

- High
- Medium
- Low

Bar chart showing the results for different institutions:
- BME-HAS
- CPH
- CU-1
- CU-2
- NYU
- UZH
- BL

The chart compares the performance of various institutions in Track 1 of the Task 2 of the CoNLL-SIGMORPHON Shared Task.

For more information, please visit:

- Graduate School in Mathematics
- Life Science Zurich Graduate School
- Zurich-Basel Plant Science Center
- Competence Center for Systems Physiology
- Center of Competence Finance in Zurich
- Neuroscience Center Zurich
- Joint Projects at UZH and ETH Zurich

Published by:
International Relations Office: www.int.uzh.ch

For more information, please see the course catalogue:

- Excellence not only within Europe and worldwide exchange programs. The excellent reputation and the top infrastructure at UZH allow UZH's international strategy is supporting the mobility of students, teaching staff, and researchers through European and worldwide exchange programs. The excellent sports program Extra-curricular activities such as international networks, and has agreements with international exchange and full-time universities and the many cultural institutions, diverse leisure activities, high-quality research results. Research Activities

At a Glance

The University of Zurich –

1.2 who we are: America's first research university. It sounds simple because it is. It's who our connection to our community.

When we spoke with faculty, sta

Those are the words we heard most often Research. World. Excellence. Community.

Johns Hopkins University logo symbolizing our worldwide reach, book representing knowledge and discovery, logo looks the way it does—with the system. That's why the Johns Hopkins University.

University of Zurich:

• Degree programs in German
• Degree programs in French
• Degree programs in English

Modern infrastructure and state-of-the-art laboratories

• Excellent research institution with
• Former University Research Priority Programs
• Results

The University of Zurich engages in research collaboration with strategically selected, internationally renowned researchers from around the world. The university encourages students, teaching staff, and researchers through European and worldwide exchange programs. The excellent reputation and the top infrastructure at the University of Zurich allows researchers to engage in research collaboration with internationally renowned researchers from around the world. The University of Zurich engages in research collaboration with strategically selected, internationally renowned researchers from around the world. The University of Zurich engages in research collaboration with internationally renowned researchers from around the world.

CoNLL 2018
Task 2: Track 1 Results
Task 2: Track 2 Results

CoNLL 2018
CoNLL-SIGMORPHON Shared Task
Task 2: Track 2 Results

- **High**
- **Medium**
- **Low**

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**BME-HAS**

**CPH**

**CU-1**

**CU-2**

**NYU**

**UZH**

**BL**

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**CoNLL 2018**

**CoNLL-SIGMORPHON Shared Task**
Task 2: Track 2 Results
Task 2 Conclusions

- Neural transition-based transducer by Zurich works the best in the low and medium setting.
- Multilinguality incorporated by Copenhagen also clearly pays off.
- It is difficult to improve upon the baseline in the high setting in track 2. This might change given more training data or in a semisupervised scenario.
- The best track 1 system outperforms the best track 2 system for all languages. Context MSDs and lemmata clearly help!
SIGMORPHON 2019 Shared Task?

• There may be a fourth shared task next year (under SIGMORPHON)!

• Consider participating or helping organize and providing task suggestions!

• If arranged, it will feature new tasks, new languages
Thank you!

CoNLL–SIGMORPHON 2018 Shared Task: Universal Morphological Reinflection

- Task 1: Type-level inflection
- Task 2: Inflection in context
- Data and Baselines
- Registration
- Google Group
- Organizers
- Dates

Questions? Suggestions? Comments?

• Training/Dev/Test data available at:

• https://sigmorphon.github.io/sharedtasks/2018/