SIGTYP 2020 Shared Task

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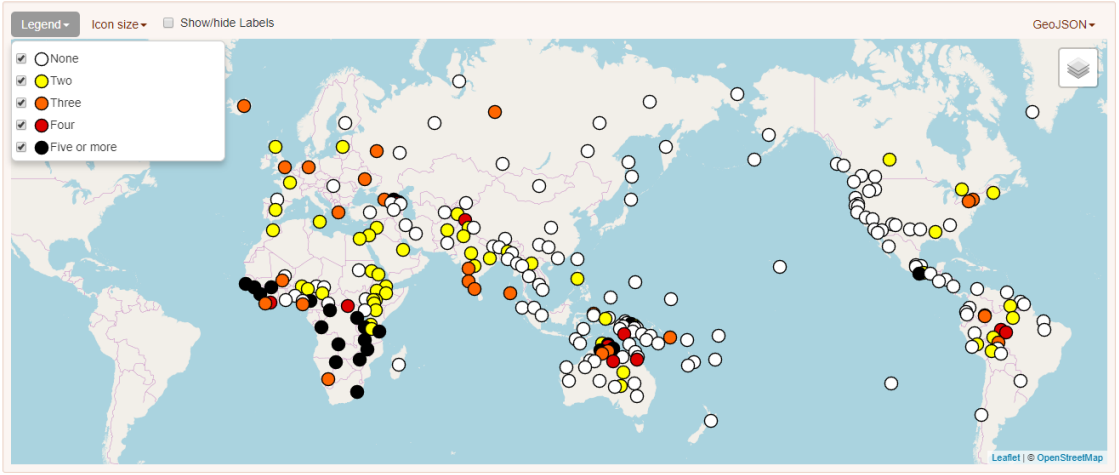
ACL Special Interest Group on Typology

https://sigtyp.github.io/

(founded 2020)

WALS: World Atlas of Language Structures

Number of Genders



192 WALS Features

- 1A Consonant Inventories
- 2A Vowel Quality Inventories
- ...
- 20A Fusion of Selected Inflectional Formatives
- 26A Prefixing vs. Suffixing in Inflectional Morphology
- 27A Reduplication
- 28A Case Syncretism
- ...
- 81A Order of Subject Object and Verb
- 85A Order of Adposition and Noun Phrase
- 107A Passive Constructions
- 120A Zero Copula for Predicate Nominals
- ...
- 129A Hand and Arm
- 131A Numeral Bases
- 138A Tea

7 General (Non-linguistic) Features

- WALS language code: *cze*
- Language name: *Czech*
- Family: *Indo-European*
- Genus: *Slavic*
- Latitude: *50.0*
- Longitude: *15.0* ... somewhere east of Kouřim :-)
- Country codes: *CZ*

Gender in WALS

- Lexical category of nouns
- Agreement or cross-reference elsewhere:
  - Pronouns
  - Adjectives, determiners (inflection)
  - Verbs (inflection)
  - … or a subset thereof

- Data:
  - Ukrainian and Russian: 3 genders (not 4, with animacy)
  - Czech and Slovak not shown at all
  - English: 3 genders; although only in pronouns!

Sparse Data

- 2662 languages in WALS (only 1357 used in the shared task)
- 7 general features
- 192 linguistic features (only 185 in the shared task)

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  - median: 28 linguistic features
  - minimum (2 languages): 4 linguistic features

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- **Languages per feature**
  - maximum (87A Order of Object and Verb): 785 languages
  - median: 168 languages
  - minimum (2 features): 8 languages

The Shared Task

- How well could the missing feature values be guessed?

- 1125 training languages
- 83 development languages
- 149 test languages

- Some features (about 50% randomly picked) are masked: the value is **?**

- Task: based on the remaining features in this or other languages, predict the values of the masked features

The ÚFAL Submission

- Probabilistic System
- Neural System
- Combined System

- $+$ a number of other dead-end attempts

Greenberg Universals

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  - 81A Order of Subject, Object and Verb
    - = 3 VSO
  - 87A Order of Adjective and Noun
    - = 2 Noun-Adjective

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  - 81A Order of Subject, Object and Verb
    - = 3 VSO
  - 87A Order of Adjective and Noun
    - = 2 Noun-Adjective
  - In training data (given that 81A = 3 VSO):
    - 54 languages have both features filled
    - 28 languages (52%) = 2 Noun-Adjective
    - 19 languages (35%) = 1 Adjective-Noun
    - 7 languages (13%) = 3 No dominant order

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- WALS features:
  - 81A Order of Subject, Object and Verb
    - = 3 VSO
  - 87A Order of Adjective and Noun
    - = 2 Noun-Adjective
  - In training data (regardless of 81A):
    - 713 languages have 87A filled
    - 455 languages (64%) = 2 Noun-Adjective
    - 200 languages (28%) = 1 Adjective-Noun
    - 53 languages (7%) = 3 No dominant order
    - 5 languages (1%) = 4 Only internally-headed relative clauses

Probabilistic System

$$
\begin{aligned}
score(s_i = x, t_j = y) \\
&= P(t_j = y | s_i = x) \\
&\times \log c(s_i = x, t_j = y) \\
&\times I(s_i, t_j)
\end{aligned} \tag{1}
$$

- Single best signal (no voting among source features)
- Country codes: ignore *US*
- Latitude and longitude: group into zones

Neural System

- Language embeddings based on their feature values
- Latitude and longitude: cluster the points via k-Means, use cluster id as feature
- Training neural network:
  - Pick language
  - Pick feature value (50% probability that it belongs to the language)
  - Goal of the network: predict that a feature value belongs to the language
- Prediction
  - For a language and a masked feature:
  - Pass all possible values to the network
  - Pick the value with the highest output probability

Combined System

- Development data:
  - Neural system is slightly better (74.49% $>$ 73.81%)
  - The systems make different errors (oracle $\rightarrow$ 81%)

- System-internal confidence scores:
  - Probabilistic system $\rightarrow$ cond. prob. $\times$ log count $\times$ mutual info
  - Neural system $\rightarrow$ output feature prob. from the network

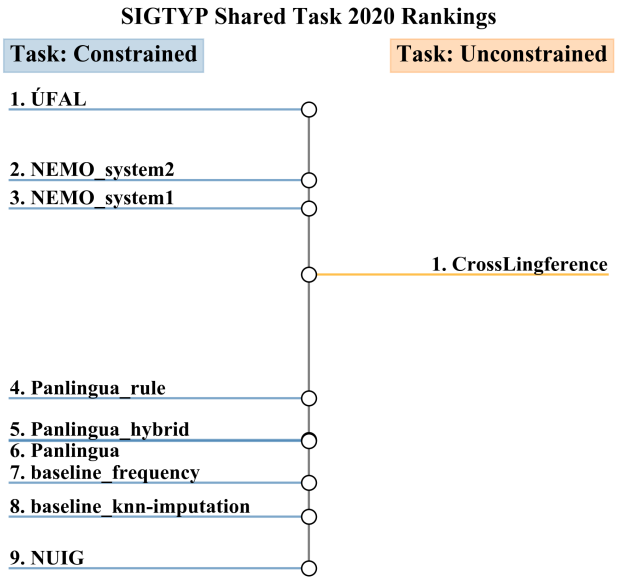
- Empirically found thresholds T_N and T_P
  - If neural confidence $> T_N$, use neural system
  - Else: if probabilistic confidence $> T_P$, use probabilistic system
  - Else use again neural system

Results

System	Dev	Test
Baseline	53.45	51.39
Probabilistic	73.81	71.08
Neural	74.49	69.80
Combined	75.50	**70.75**
Feed-forward	56.45	
kNN-Hamming	62.28	
kNN-LangEmbed	68.10	

Table 1: Accuracy of various models on the development and test data.

Ranking


SIGTYP Shared Task 2020 Rankings
Task: Constrained
Task: Unconstrained
1. ÚFAL
2. NEMO_system2
3. NEMO_system1
1. CrossLingference
4. Panlingua_rule
5. Panlingua_hybrid
6. Panlingua
7. baseline_frequency
8. baseline_knn-imputation
9. NUIG

Thanks!
Díky!