Translation-based Lexicalization Generation and Lexical Gap Detection: Application to Kinship Terms

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Task Definition: LexGen and LexGap

Lexicalization **Gen**eration (**LexGen**):

Given a language *L* and a concept *s*, LexGen(*L*, *s*) returns a word in *L* which lexicalizes *s*, or a special GAP token indicating that no such word exists.

Lexical **Gap** Detection (**LexGap**):

Given a language *L* and a concept *s*, LexGap(*L*, *s*) returns TRUE if *L* has no word that lexicalizes *s*, or FALSE otherwise.

LexGap returns TRUE if and only if LexGen returns a GAP.

ChatGPT

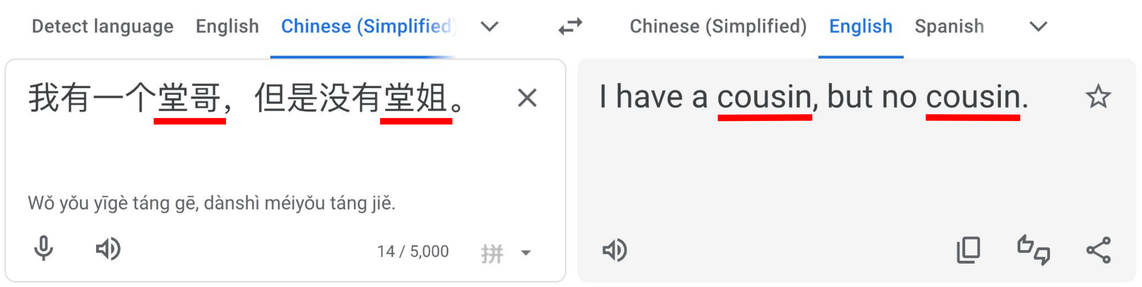
You

Given a word that means [father's younger brother] in Chinese is [叔叔], and a word that means [mother's brother] in Chinese is [舅舅]. Is there a word that means [elder brother] in [English]? If yes, give me that word. If no, say no.

ChatGPT

Yes, the word in English that means "elder brother" is "brother."

Google Translate



Concepts, Lexicalizations and Lexical Gaps

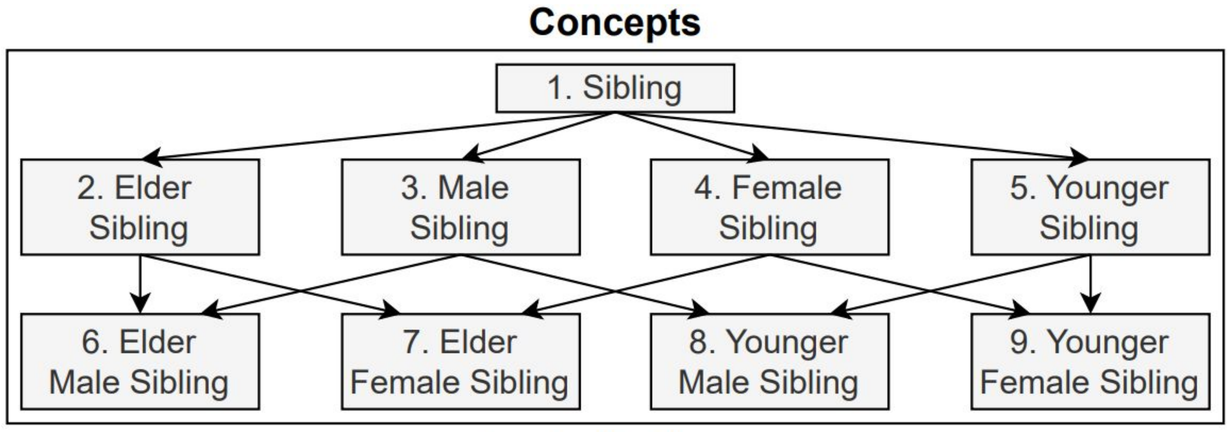
Concept: discrete word meaning

Kinship concepts have clear definitions and hierarchical structure

Lexicalization: a single word that can express (i.e. lexicalize) a concept.

Lexical Gap: a concept that has no lexicalization in a given language.

Concepts



Lexicalizations

Concepts	En	Es	Fr	Ja	Fa	Zh	Pl
1	Sibling	ø	fratrie	ø	ø	同胞	ø
2	ø	ø	ø	ø	ø	ø	ø
3	Brother	hermano	frère	ø	برادر	兄弟	brat
4	Sister	hermana	sœur	ø	خواهر	姐妹	siostra
5	ø	ø	ø	ø	ø	ø	ø
6	ø	ø	ø	兄さん	ø	哥哥	ø
7	ø	ø	ø	姉ちゃん	ø	姐姐	ø
8	ø	tato	ø	おとうと	ø	弟弟	ø
9	ø	ø	ø	いもうと	ø	妹妹	ø

*Using Linguistic Typology to Enrich Multilingual Lexicons: the Case of Lexical Gaps in Kinship (Khishigsuren, 2022)

Method

for each concept *s* **do**
  $L_0(s) \leftarrow$ Translate(seed(*s*), gloss(*s*))
for each concept *s* **do** ▷ **Multi-Word Filter #1**
  $L_1(s) \leftarrow$ GAP if $L_0(s)$ is not a word
for each triple (s_0, s_1, s_2) **do** ▷ **Horizontal Filter #2**
  $L_2(s_1) \leftarrow$ GAP; $L_2(s_2) \leftarrow$ GAP if $L_1(s_1) = L_1(s_2)$
for each concept s **do** ▷ **Back-Translation Filter #3**
  $L_3(s) \leftarrow$ GAP **if** BackTrans($L_2(s)$, gloss(*s*)) ≠ seed(*s*)
for each triple (s_0, s_1, s_2) **do** ▷ **Vertical Filter #4**
  if $L_3(s_0) = L_3(s_1)$ **then**
    if $L_3(s_2)$ = GAP **then** $L_4(s_1) \leftarrow$ GAP **else** $L_4(s_0) \leftarrow$ GAP

Propositions and Corollary

Proposition 1

If a concept P is an exclusive disjunction of its hyponym concepts C1 and C2, expressing P and C1 with the same word w can result in a colloquial contradiction.

Proof: C2 could be expressed by a phrase "w but not w", This phrase intuitively corresponds to a logical contradiction: $w(x) \wedge \neg w(x)$.

Example:

Robin is my parent but not my father => Robin es mi padre pero no mi padre

Excluded triples: 7, 8, 10 (See figure below.)

Proposition 2

If a concept P is an exclusive disjunction of its hyponym concepts C1 and C2, expressing C1 and C2 with the same word w can result in a colloquial contradiction.

Proof: P could be expressed by a phrase "either w or w", this phrase intuitively corresponds to a logical contradiction: $w(x) \oplus w(x)$.

Example:

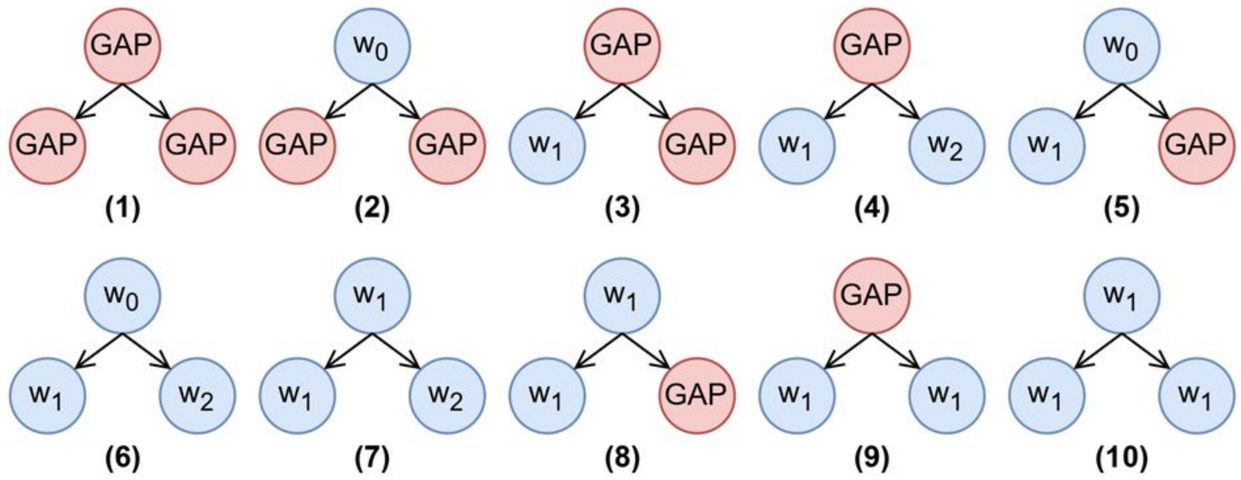
Tengo una prima pero no tengo ningún primo => I have a cousin but I have no cousin

Excluded triples: 9, 10

Corollary

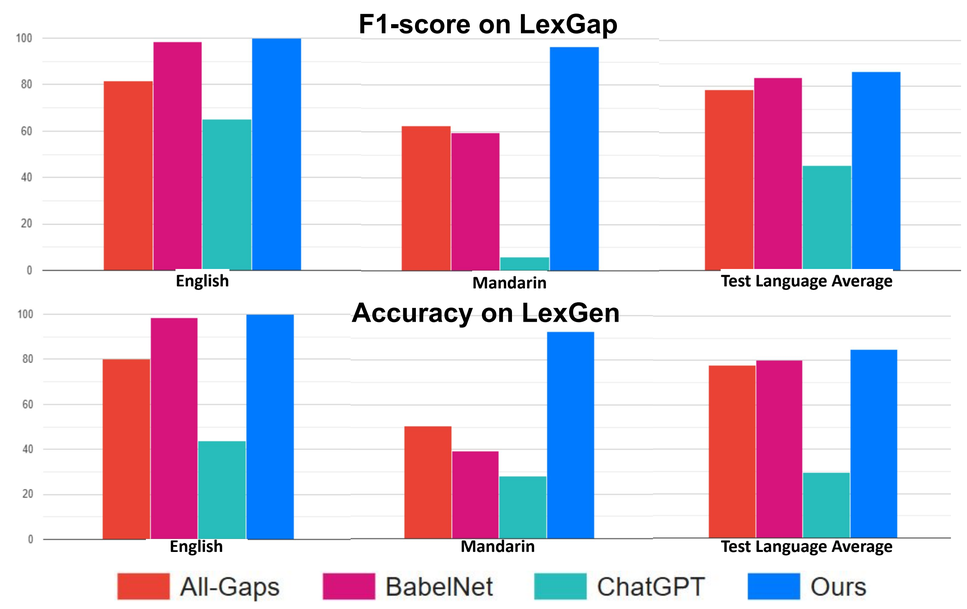
If a concept P is an exclusive disjunction of its hyponyms C1 and C2 then all their lexicalizations should be different.

Remaining triples: 1, 2, 3, 4, 5, 6



Experiment Setup and Results

Data: Database of Lexical Diversity in Kinship by Khishigsuren et al. (2022).
Translator: Google Translate, accessed February 15, 2024.
Metrics: Accuracy for LexGen and F1 score for LexGap.
Comparison: All-Gaps, BabelNet (v. 5.1), and ChatGPT (GPT-3.5 Turbo).
Development languages: English, Mandarin, and Persian.
Test languages: Spanish, Russian, French, German, Polish, Arabic, Italian, Mongolian, Hungarian, and Hindi.



Conclusion

- A novel translation-based method that generates concept lexicalizations and detects lexical gaps.
- Our method is grounded in formal definitions and propositions, and leverages translation and hypernym/hyponym taxonomy relations.
- Future work:
  - Apply our method to other domains
  - Employ large language models

github.com/UAlberta-NLP/KinshipAutoLex

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