Multilingual Anchoring: Interactive Topic Modeling and Alignment Across Languages

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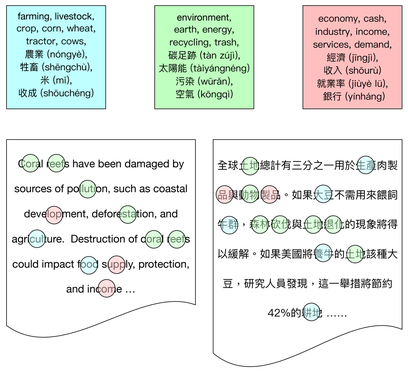
Motivation

- Large text collections often require topic triage quickly in low-resource settings (e.g. natural disaster, political instability)
- Analysts need to examine multilingual documents but are scarce in one or more languages

Modeling Multilingual Topics



Anchor-based Topic Models

- An **anchor word** is a word that appears with high probability in one topic and low probability in all other topics
- Conditional co-occurrence matrix $\bar{Q}$ has entries such that $\bar{Q}_{i,j} = p(\text{word } 2 = j \mid \text{word } 1 = i)$
- Given anchor words $s_1, \ldots, s_K$, the algorithm approximates $\bar{Q}_i$ as the convex combination of $\bar{Q}_{s_1}, \ldots \bar{Q}_{s_K}$ and finds coefficients $C_{i,k}$ that estimate $p(\text{topic} = k \mid \text{word} = i)$

$\bar{Q}$ matrix	carburetor	concealer	album	liner
carburetor	0.80	0.05	0.05	0.10
concealer	0.13	0.60	0.07	0.20
album	0.05	0.05	0.70	0.20
liner	0.25	0.20	0.15	0.45

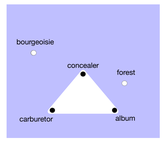
$$\bar{Q}_{\text{liner}} \approx C_1 \bar{Q}_{\text{carburetor}} + C_2 \bar{Q}_{\text{concealer}} + C_3 \bar{Q}_{\text{album}} \quad (1)$$

This decomposition (Eq. 1) resembles the topic distribution of ``liner'' over an automotive topic, a cosmetics topic, and a music topic.

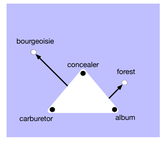
Bridging Languages: How Do You Say Anchor in Chinese?

Monolingual Anchoring

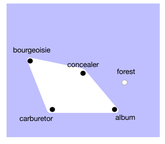
Rows in $\bar{Q}$ corresponding to the anchor words are the vertices of the convex hull formed by $\bar{Q}$.



To greedily find an anchor word, find a row in $\bar{Q}$ that is farthest away from the current span of anchor words.

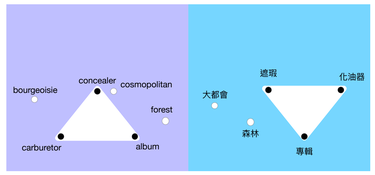


The goal is to maximize total span of anchor words so that each row in $\bar{Q}$ lies within this span and can be accurately approximated.

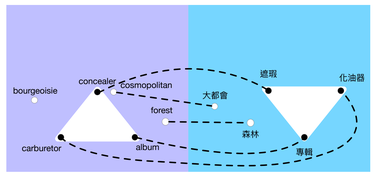


Multilingual Anchoring

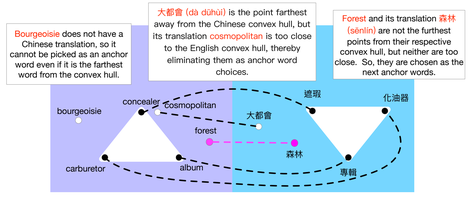
The challenge for multilingual topic modeling is to align topics cross-lingually even when words from different languages do not co-occur in the same documents.



Our algorithm first uses a dictionary to link words across languages.

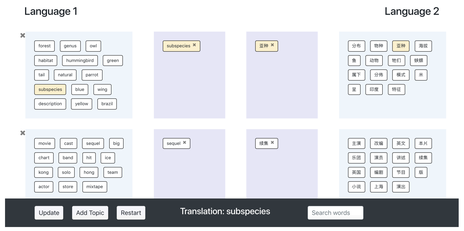


Then, it finds anchor words such that they are linked and can simultaneously expand the span of anchors words for both languages.

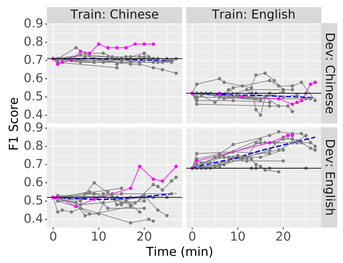


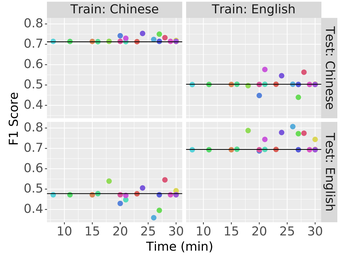
MTAnchor: Interactive Topic Modeling

User Interface



User Study



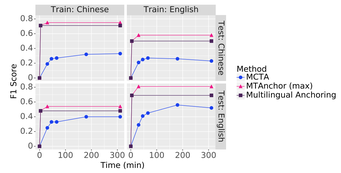


More Information

- Code: `https://github.com/forest-snow/mtanchor_demo/`
- Author: `http://www.cs.umd.edu/~myuan/`
- This work was supported in part by the JHU Human Language Technology Center of Excellence (HLTCOE) and Raytheon BBN Technologies, by DARPA award HR0011-15-C-0113.

Comparing Models

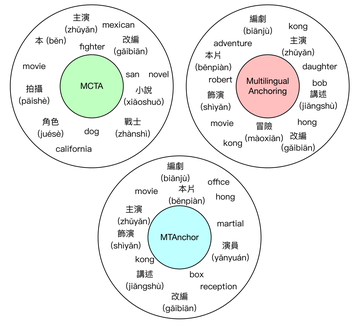
Speed and Classification Accuracy



Topic Coherence

Dataset	Method	Topic coherence EN-I	ZH-I SI-I	EN-E	ZH-E SI-E
Wikipedia	Multilingual anchoring	0.14	0.18	0.08	0.13
	MTAnchor (maximum)	**0.20**	**0.20**	**0.10**	**0.15**
	MTAnchor (median)	0.14	0.18	0.08	0.13
	MCTA	0.13	0.09	0.00	0.04
Amazon	Multilingual anchoring	**0.07**	**0.06**	**0.03**	**0.05**
	MCTA	-0.03	0.02	0.02	0.01
LORELEI	Multilingual anchoring	0.08	0.00	0.03	n/a
	MCTA	**0.13**	0.00	**0.04**	n/a

Sample Film Topic



Conclusions

- Anchoring algorithm can be applied multilingually
- People can provide helpful linguistic and cultural knowledge to improve topic models