On Assessing the Political Biases of Multilingual Large Language Models

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Introduction

 100M+ people interact with LLMs everyday through ChatGPT et al.

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Benefits and Risks of LLMs for Democratic Deliberation

- 100M+ people interact with LLMs everyday through ChatGPT et al.
- · LLMs are used to foster democratic participation (make.org)

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Quelle est la conclusion de la Convention ?	Comment la Convention a-t-elle pris en compte les arguments religieux ?	Quelles règles d'encadrement de l'aide active à mourir souhaitées par la Convention ?
Poser une question à l'IA		2

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Ducel et al. (2024)

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 left-right scoring per question is arbitrary

Constraining the Setting

- · Assessing biases of LLMs for
 - · machine translation
 - · writing assistance
 - · summarization

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Embedding Politics

Word Embedding 101: the Distributional Hypothesis

is traditionally followed by cherry pie, a traditional dessert often mixed, such as strawberry computer peripherals and personal digital a computer. This includes information available on the internet



If two words appear in similar contexts, they are synonyms (Harris, 1954)

Word Embedding 101: Masked Language Modeling

is traditionally followed by **cherry** pie, a traditional dessert often mixed, such as **strawberry** computer peripherals and personal **digital** assistants. These devices usually a computer. This includes **information** available on the internet



Devlin et al. (2019)

Word Embedding 101: Masked Language Modeling

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• One vector per token \rightarrow What about higher-level embeddings?

Sentence Embedding 101: NLI/STS

Met my first girlfriend that way.



/

At 8:34, the Boston Center controller received a third transmission from American 11 The Boston Center controller got a third transmission from American 11.



Reimers and Gurevych (2019)

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- (5) The two sentences are completely equivalent, as they mean the same thing. The bird is bathing in the sink.
- i ne bira is bathing in the sink.
- Birdie is washing itself in the water basin.
- (4) The two sentences are mostly equivalent, but some unimportant details differ.
- In May 2010, the troops attempted to invade Kabul.
- The US army invaded Kabul on May 7th last year, 2010.
- (3) The two sentences are roughly equivalent, but some important information differs/missing.
- John said he is considered a witness but not a suspect.
- "He is not a suspect anymore." John said.
- (2) The two sentences are not equivalent, but share some details.
- They flew out of the nest in groups.
- They flew into the nest together.
- (1) The two sentences are not equivalent, but are on the same topic.
- The woman is playing the violin.
- The young lady enjoys listening to the guitar.
- (0) The two sentences are on different topics.
- John went horse back riding at dawn with a whole group of friends.

Sunrise at dawn is a magnificent view to take in if you wake up early enough for it.



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expensive annotation ⇒
 limited to English

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Sentence Embedding 101: query-document pairs



Karpukhin et al. (2020); Lee et al. (2019); Xiong et al. (2021)

Sentence Embedding 101: query-document pairs



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• expensive annotation \implies limited to English

Sentence Embedding 101: cross-lingual embeddings



Artetxe and Schwenk (2019); Feng et al. (2022)

Semantic similarity? What about politics?

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- · existing methods give "semantic" representation
- → "Liberty is an essential part of democracy"
 ≈ "Liberty is not an essential part of democracy"
- → "Liberty is an essential part of democracy" ≠ "Democracies should always guarantee the liberty of their citizen"

What the model should learn:

• topic-stance, e.g. Manifesto (Merz et al., 2016): 3,219 programs of 954 parties over 78 years and 60 countries in 40 languages

Britain is struggling to energe from a long and difficult recession/Families 30-5 5 are finding it hard to make and meet/Millions are unemployed, and millions are unemployed, and u

Britain needs a fresh start/We need hope for a different, better future./

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Topics/stances

- Traditional Morality: Negative
- Multiculturalism: Positive
- Multiculturalism: Negative
- Law and Order: Positive
- National Way of Life: Positive
- National Way of Life: Negative
- Civic Mindedness: Positive Party
- Reform Movement
- Francophone Socialist Party

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- party of the speaker, e.g. Parlamint (Erjavec et al., 2024): parliamentary debates of 29 countries in 31 languages over 28 years



Erjavec et al. (2024)



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 source of newspaper (e.g. custom dataset through scraping)





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 ⇒ train a multi-task classifier

Constraining a multilingual representation space

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 Evaluate: Precision@1 on multi-parallel EuroParl (21 languages × 23,647 sentences)
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- Evaluate: Precision@1 on multi-parallel EuroParl (21 languages × 23,647 sentences)
- Fine-tune from XLM-RoBERTa

Model	P@1
LaBSE	93.4
MEXMA	89.1
Bi-Encoder (ours)	90.9
Manifesto Classifier (unconstrained)	46.7
Classifier (constrained)	79.7

Meta-evaluation: probing source of newspaper article

- Linear probing to evaluate multiple embeddings
- Custom dataset of 12
 French newspapers
- Year 2024, temporal split: 4 months for train/dev/test (50K+ articles each)
- In addition to multilingual constraint: continual MLM training using CC-100

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Model	Accuracy
majority	17.6
LaBSE	53.1
MEXMA	57.1
Bi-Encoder (ours)	65.1
Manifesto Classifier (unconstrained)	57.9
Parlamint Classifier (unconstrained)	62.5
Classifier (unconstrained)	62.8
Classifier + MLM	67.4
Classifier (constrained)	70.1

Assessing Biases

document $D = (s_1, s_2, ..., s_N)$ sentence $s_n = (w_1, w_2, ..., w_L)$

word $w_l \in \{0,1\}^V$ (one-hot: $\sum_{l=1}^L w_l = 1$)

document $D = (s_1, s_2, ..., s_N)$ sentence $s_n = (w_1, w_2, ..., w_L)$ word $w_l \in \{0, 1\}^V$ (one-hot: $\sum_{l=1}^L w_l = 1$) word embeddings $\mathbf{h}_n = \text{encoder}(s_n)$, $\mathbf{h} \in \mathbb{R}^{L \times d}$ sentence embedding $\mathbf{s}_n = \text{pool}(\mathbf{h}_n) \in \mathbb{R}^d$

document $D = (s_1, s_2, ..., s_N)$ sentence $s_n = (w_1, w_2, ..., w_I)$ word $w_l \in \{0, 1\}^V$ (one-hot: $\sum_{l=1}^{L} w_l = 1$) word embeddings $\mathbf{h}_n = \operatorname{encoder}(s_n), \mathbf{h} \in \mathbb{R}^{L \times d}$ sentence embedding $\mathbf{s}_n = \text{pool}(\mathbf{h}_n) \in \mathbb{R}^d$ clusters $c = (c_1, c_2, ..., c_N), c_n = cluster(\mathbf{s}_n), c_n \in \{0, 1\}^K$ (one-hot) ideological distribution $p = (p_1, p_2, ..., p_K), p_k = \frac{\sum_{n=1}^N c_{nk}}{N},$ $p_k \in [0,1]^K, \sum_{k=1}^K p_k = 1$

document $D = (s_1, s_2, ..., s_N)$ sentence $s_n = (w_1, w_2, ..., w_I)$ word $w_l \in \{0, 1\}^V$ (one-hot: $\sum_{l=1}^{L} w_l = 1$) word embeddings $\mathbf{h}_n = \operatorname{encoder}(s_n), \mathbf{h} \in \mathbb{R}^{L \times d}$ sentence embedding $\mathbf{s}_n = \text{pool}(\mathbf{h}_n) \in \mathbb{R}^d$ clusters $c = (c_1, c_2, ..., c_N), c_n = cluster(\mathbf{s}_n), c_n \in \{0, 1\}^K$ (one-hot) ideological distribution $p = (p_1, p_2, ..., p_K), p_k = \frac{\sum_{n=1}^N c_{nk}}{\sum_{n \neq 1} r_{nk}}$. $p_k \in [0,1]^K, \sum_{k=1}^K p_k = 1$

summarization bias $b = KL(p,q) = \sum_{k=1}^{K} p_k \log \left(\frac{p_k}{q_k}\right)$, q = ideological distribution of summary, $b \ge 0$

- small b: the two distributions match well, small bias
- great b: the two distributions do not match well, great bias

Machine Translation biases: more formally

sentence $s_n = (w_1, w_2, ..., w_L)$ word $w_l \in \{0, 1\}^V$ (one-hot: $\sum_{l=1}^L w_l = 1$) word embeddings $\mathbf{h}_n = \operatorname{encoder}(s_n), \mathbf{h} \in \mathbb{R}^{L \times d}$ sentence embedding $\mathbf{s}_n = \operatorname{pool}(\mathbf{h}_n) \in \mathbb{R}^d$

Machine Translation biases: more formally

sentence
$$s_n = (w_1, w_2, ..., w_L)$$

word $w_l \in \{0, 1\}^V$ (one-hot: $\sum_{l=1}^L w_l = 1$)
word embeddings $\mathbf{h}_n = \operatorname{encoder}(s_n), \mathbf{h} \in \mathbb{R}^{L \times d}$
sentence embedding $\mathbf{s}_n = \operatorname{pool}(\mathbf{h}_n) \in \mathbb{R}^d$
clusters $c = (c_1, c_2, ..., c_N), c_n = \operatorname{cluster}(\mathbf{s}_n), c_n \in \{0, 1\}^K$
bias $b = 1 - \frac{\sum_{n=1}^N \sum_{k=1}^K c_{nk} c'_{nk}}{N}, b \in [0, 1], c'$ = clusters of the translation

Conclusion

- · Assessing the political biases of LLMs is a timely matter
- · Existing methods rely on questionnaires which is brittle
- · We propose a method for embedding political text

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- · Assessing the political biases of LLMs is a timely matter
- · Existing methods rely on questionnaires which is brittle
- · We propose a method for embedding political text
- Stay tuned for results

Thank you for your attention!

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Related Work



- Limited to English language/US politics
- Uses an LLM for stance detection: possible meta-bias?
- More constrained than questionnaires but still finds little coherence among LLMs outputs, needs to filter
- Pro-neutral-con stance framework rigid: what does it mean to be pro domestic violence? pro holocaust?