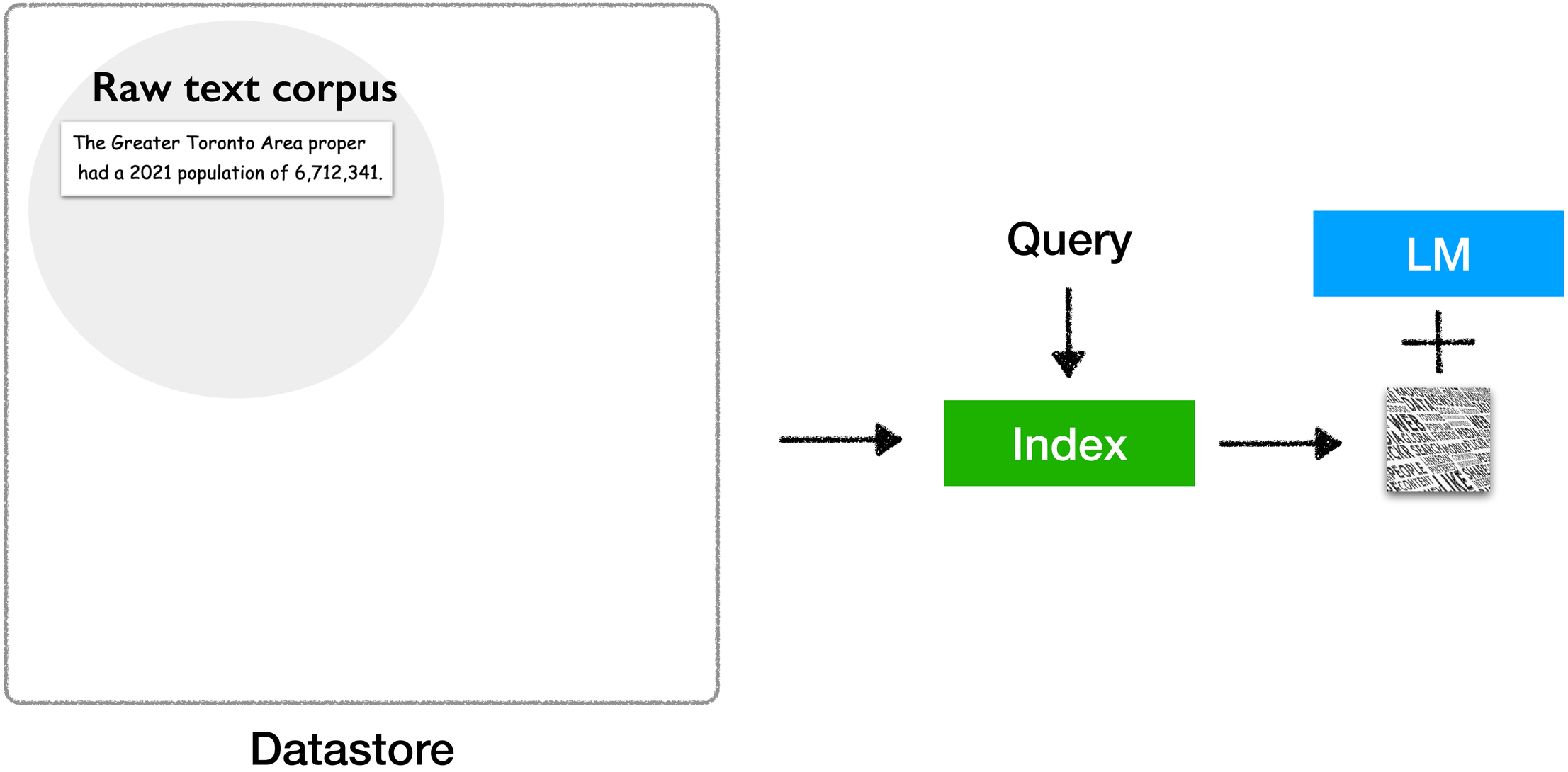
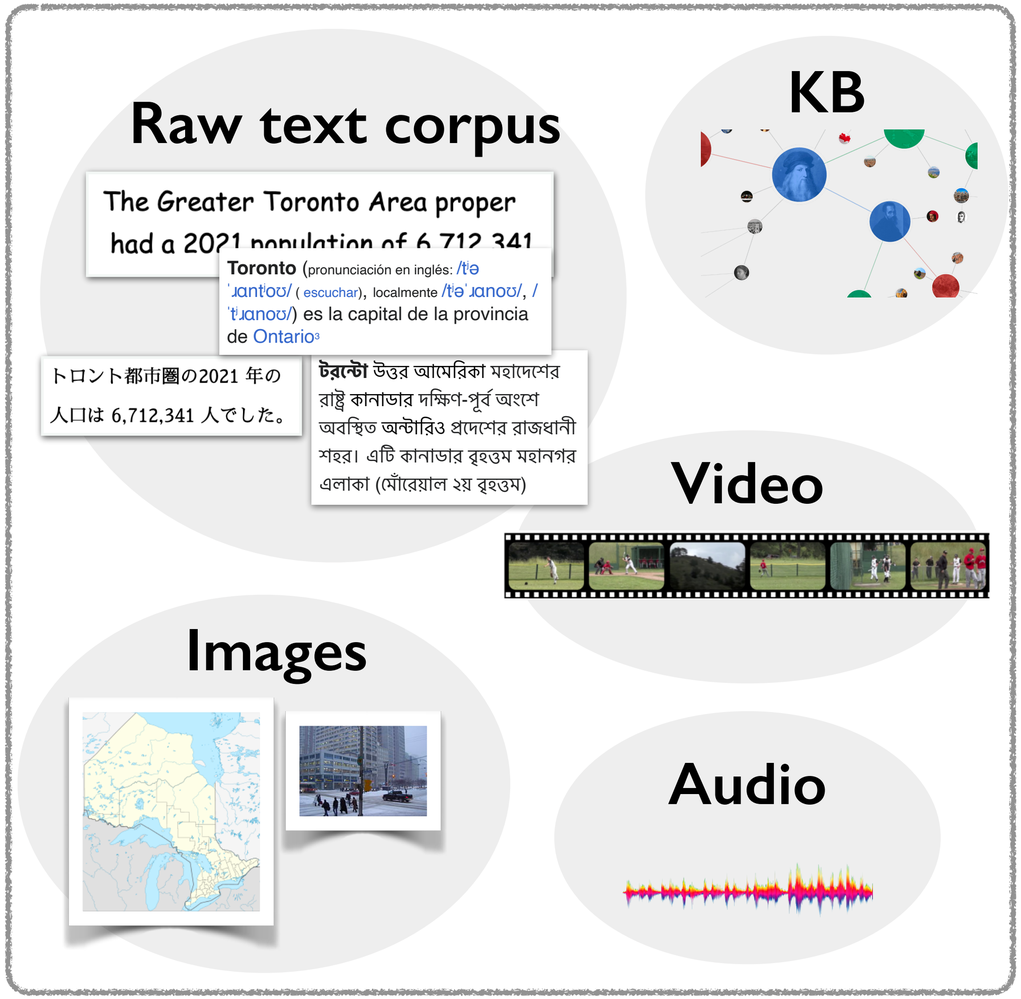
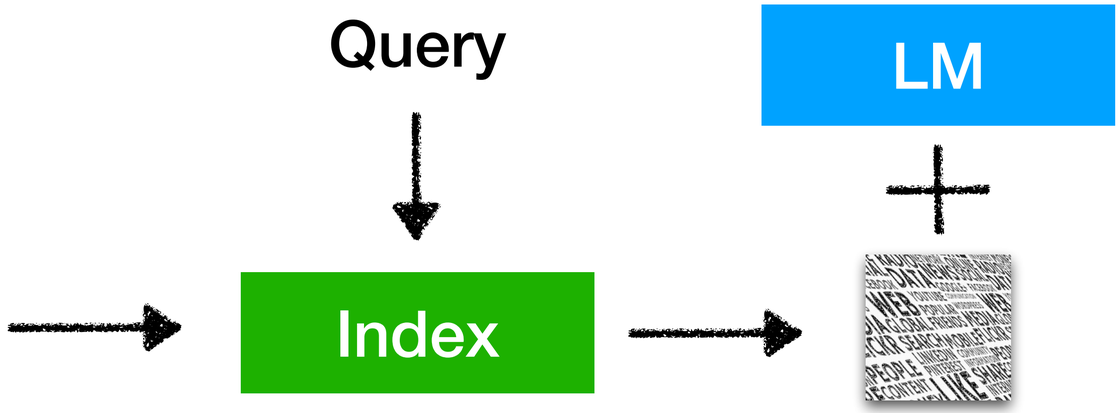
Section 7:
Multilingual & Multimodal

Retrieval-based LM for diverse knowledge sources

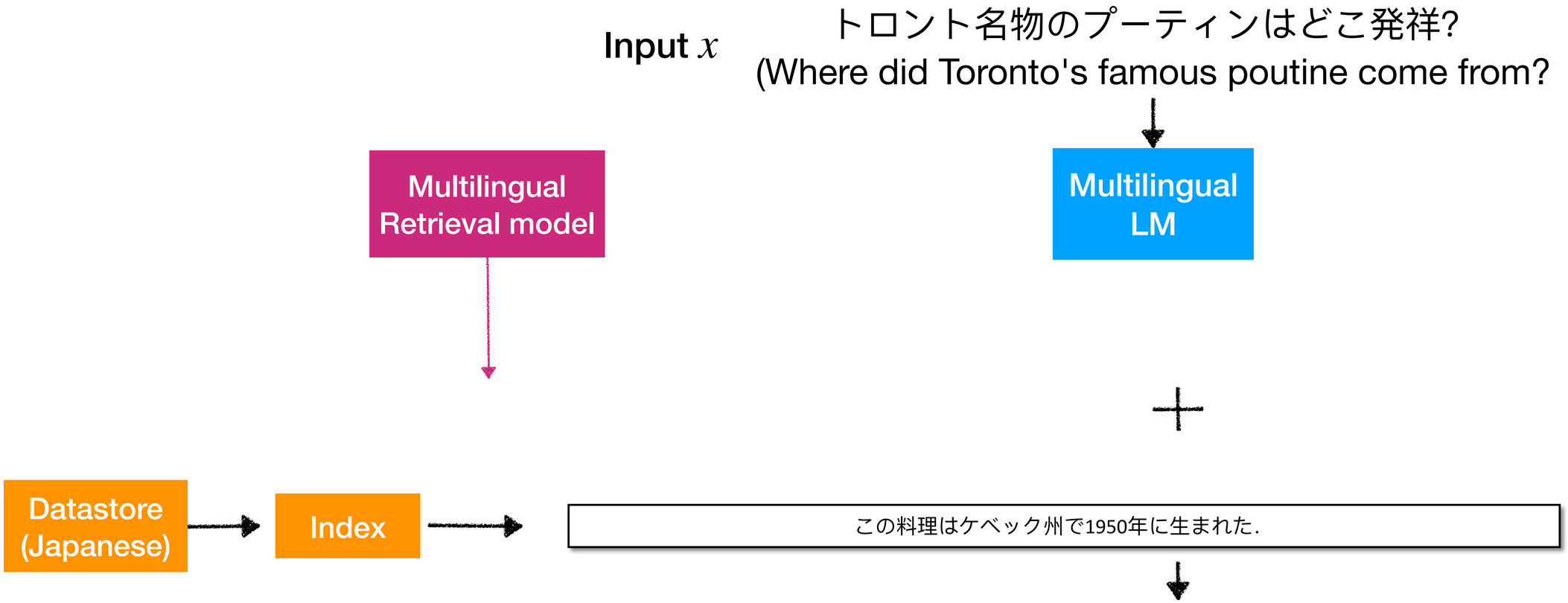


Retrieval-based LM for diverse knowledge sources





Multilingual Retrieval-based LM

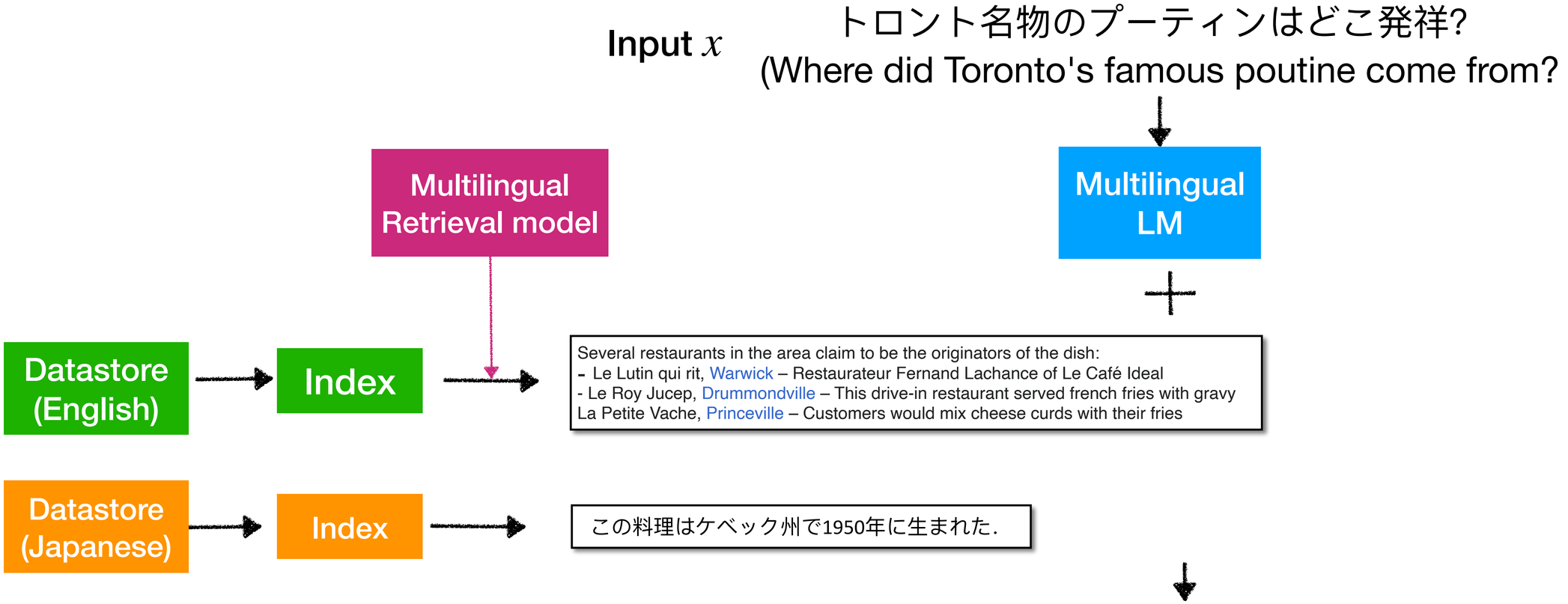


(Limited amount of data is available in Japanese datastore…)

Output y

プーティンはケベック州で1950年代に生まれた.

Multilingual Retrieval-based LM

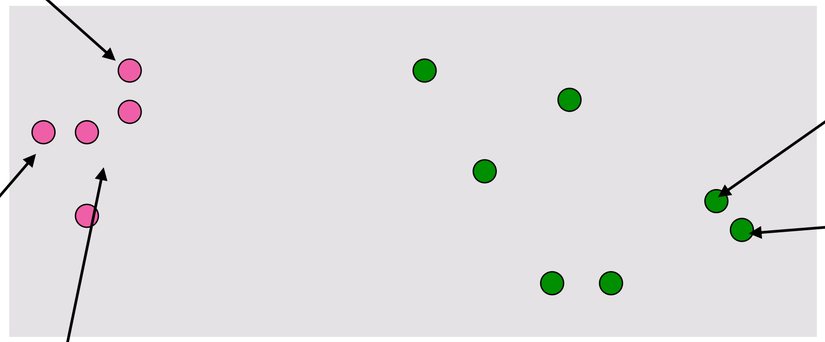


Language biases in representation spaces

この料理はケベック州で
1950年に生まれた.

Several restaurants in the area claim to be the originators of the dish:
- Le Lutin qui rit, Warwick – Restaurateur Fernand Lachance of Le Café Ideal
- Le Roy Jucep, Drummondville – This drive-in restaurant served french fries with gravy
La Petite Vache, Princeville – Customers would mix cheese curds with their fries

Datastore (Japanese)



The Greater Toronto Area proper had a 2021 population of 6,712,341.

トロント都市圏の2021 年の人口は 6,712,341 人でした。

Datastore (English)

最も有名なランドマークはCNタワーで、地上建築物としてはかつて世界最高であった553 mの高さを持つ。

Language biases in representation spaces

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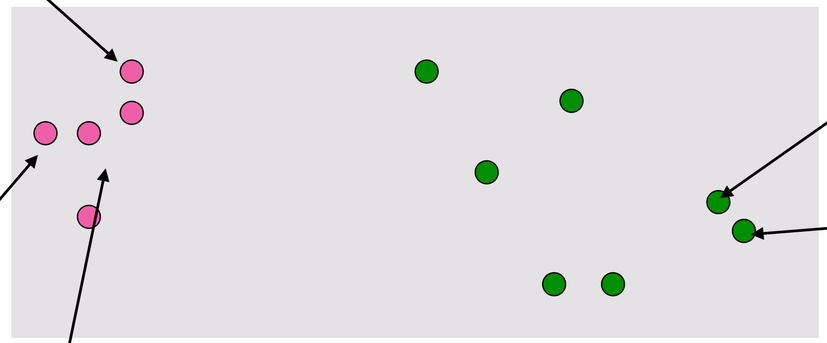

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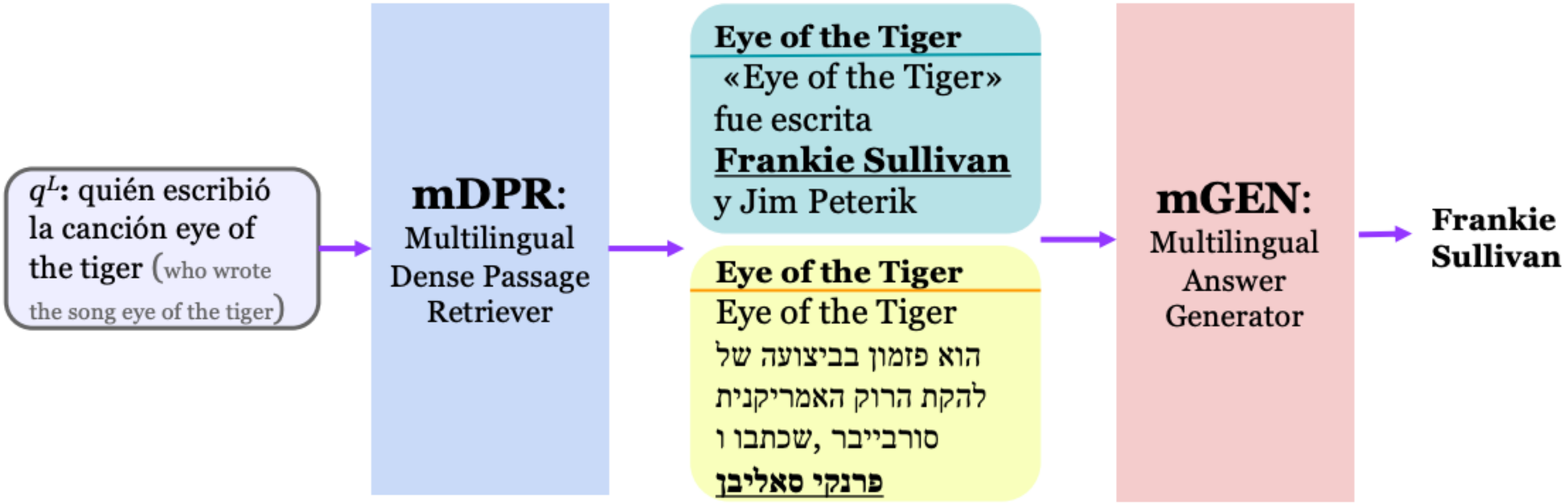
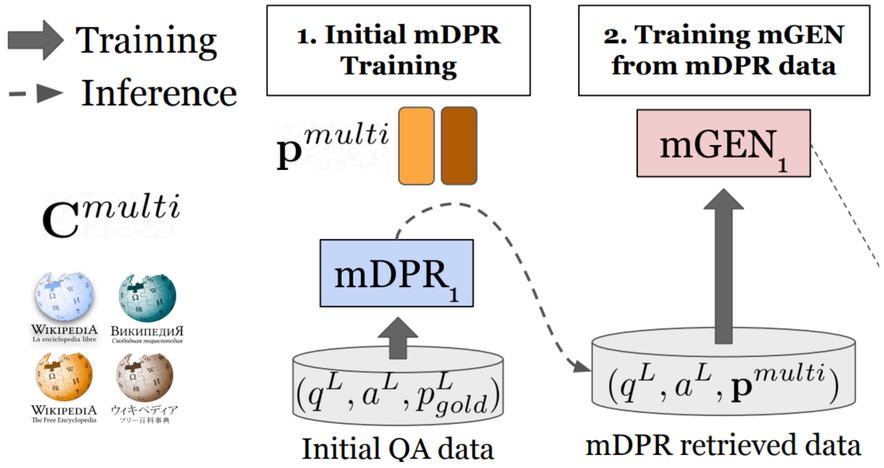
CORA (Asai et al., 2021)



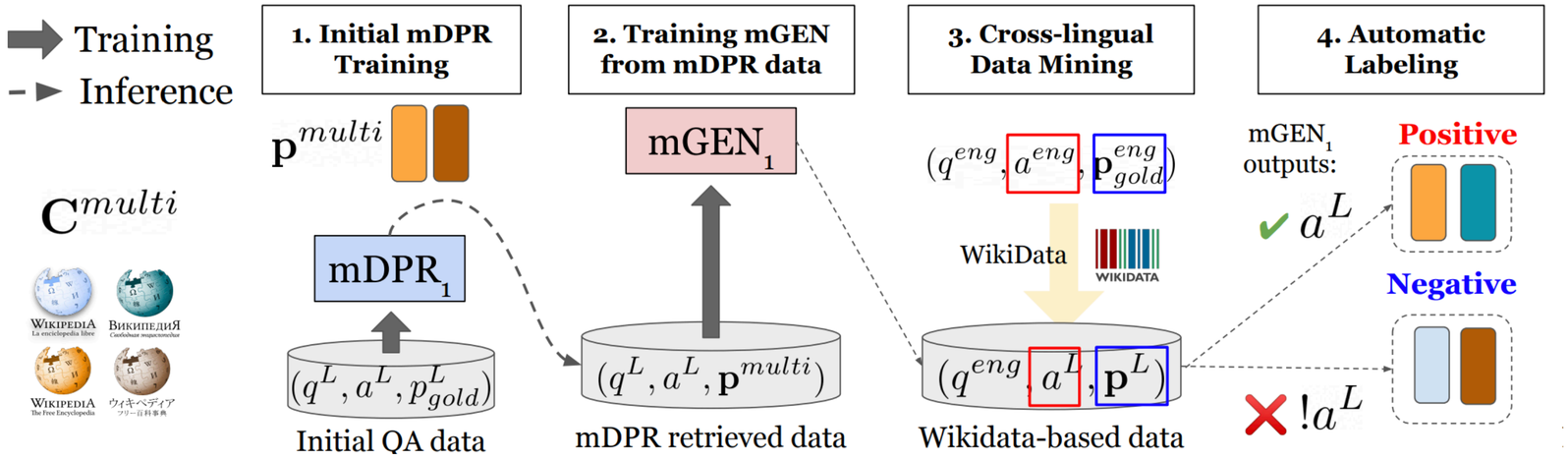
Asai et al. 2021. “One question answering model for many languages with cross-lingual dense passage retrieval”

CORA: iteratively training multilingual LM & retriever



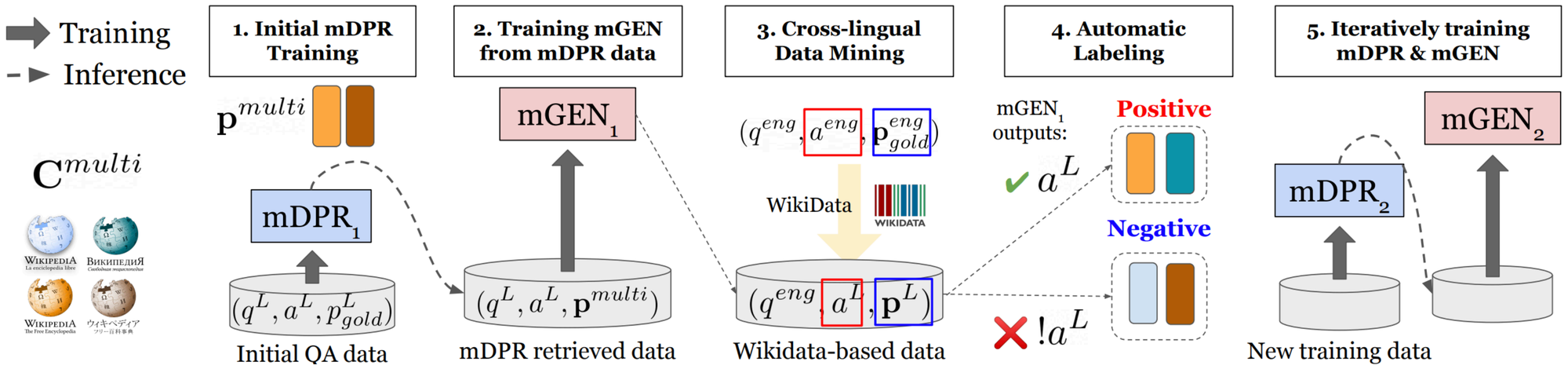
Initial training of retriever and LM

CORA: iteratively training multilingual LM & retriever



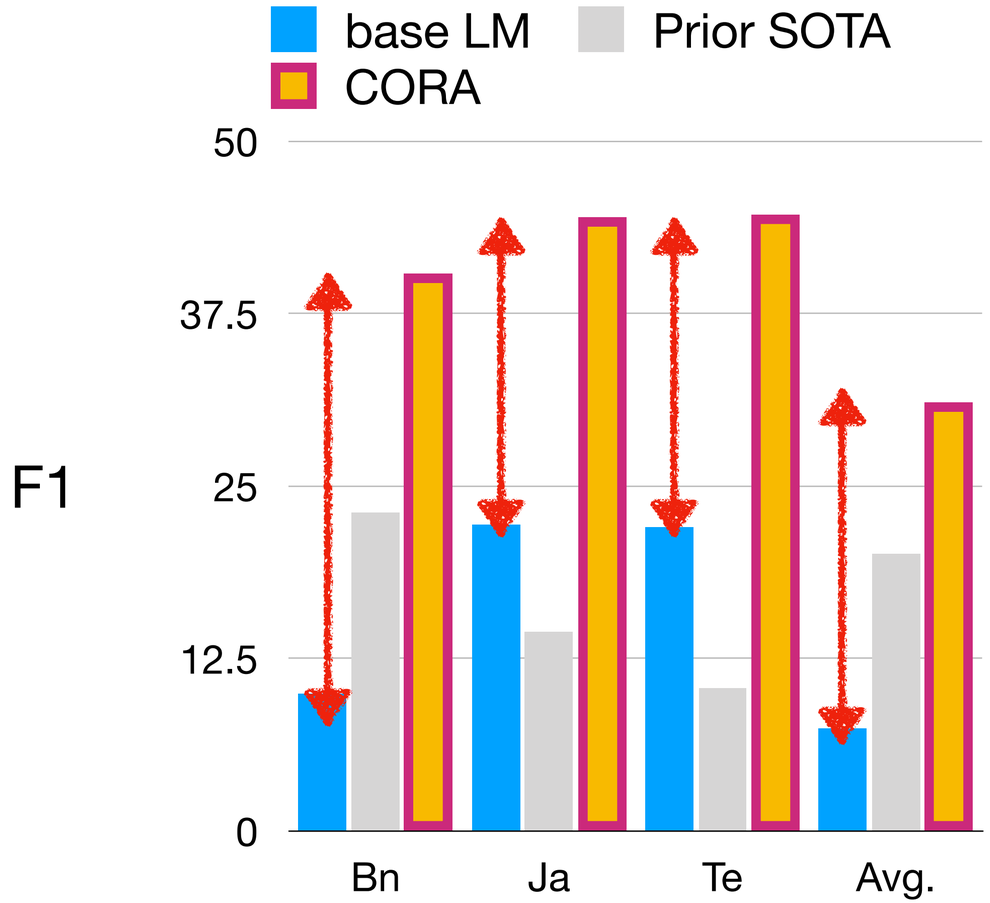
Expand training data using trained models as well as structured cross-lingual data.

CORA: iteratively training multilingual LM & retriever



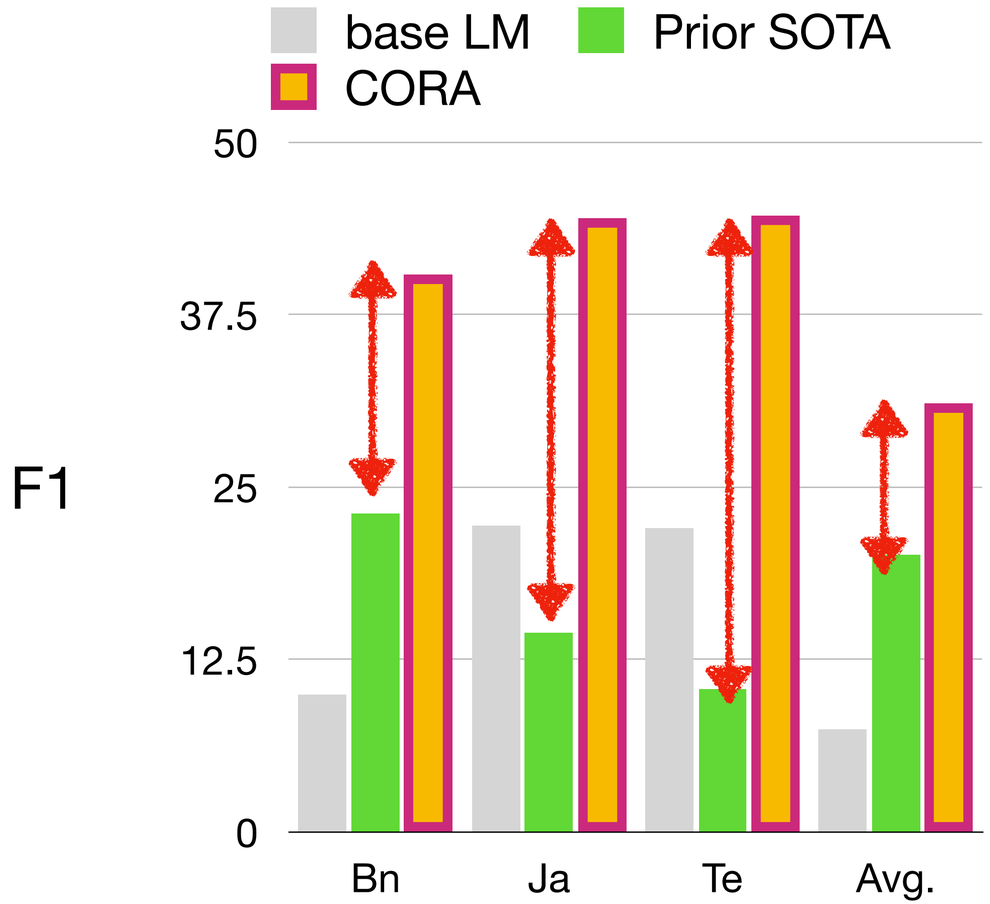
Repeat training

Results



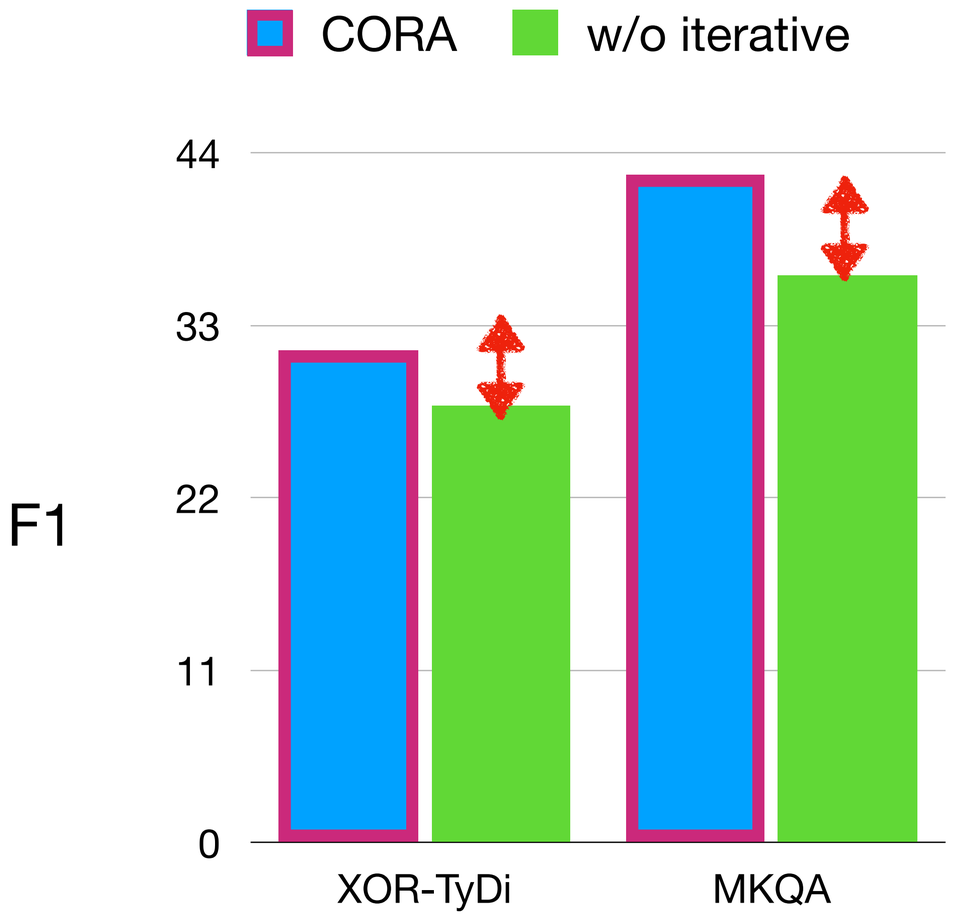
Large gains from fine-tuned LM without retrieval

Results



Significantly Outperforms prior SOTA

Results



Iterative training of retriever and LM gives large performance improvements

Multilingual retrieval-based LMs for diverse tasks

Question Answering

* CL-ReLKT (Limkonchotiwat et al., 2022): knowledge transfer for better cross-lingual retrieval training
* Gen-TyDi QA (Muller et al., 2023): generate full sentence answers for cross-lingual QA.

Fact Verification

* CONCRETE (Hung et al., 2022): Improving cross-lingual fact-checking with cross-lingual retrieval

Dialogue

* Cross-lingual Knowledge-grounded Dialogue (Kim et al 2021): a Korean knowledge-grounded dialogue system that learns to generate Korean response given English & Korean knowledge

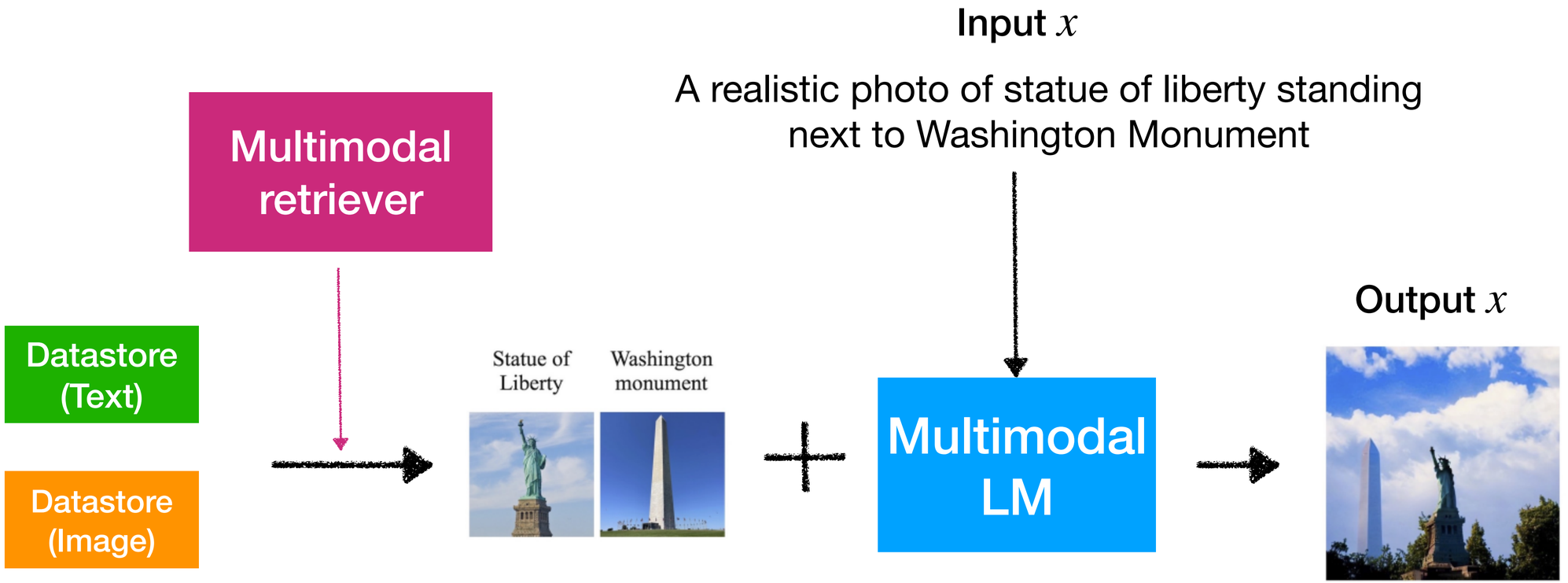
Event Extraction

* R-GQA (Du and Ji, 2022): retrieve similar QA pairs for event argument extraction.

Key-phrase generations

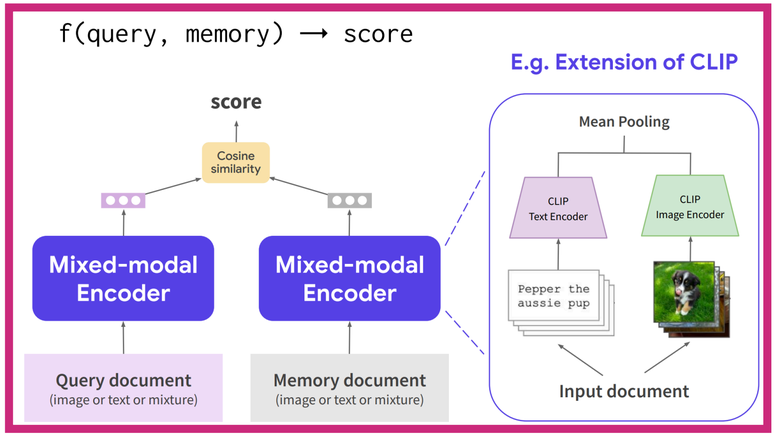
* Retrieval-augmented Multilingual Key phrase Generation (Gao et al 2022): Using iterative training to improve retrieval & LM for key phrase generations

Multi-modal retrieval-augmented generations



Yasunaga et al. 2023. “Retrieval-Augmented Multimodal Language Modeling”

RA-CM3 (Yasunaga et al., 2023)



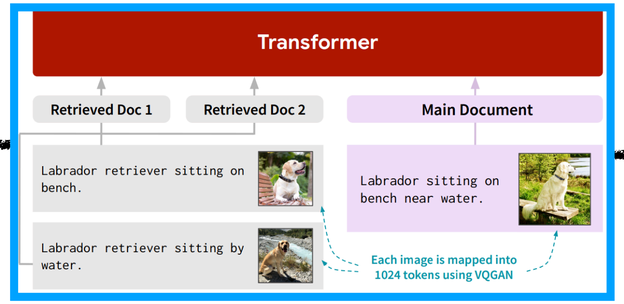
Input x

A realistic photo of statue of liberty standing next to Washington Monument

Output x

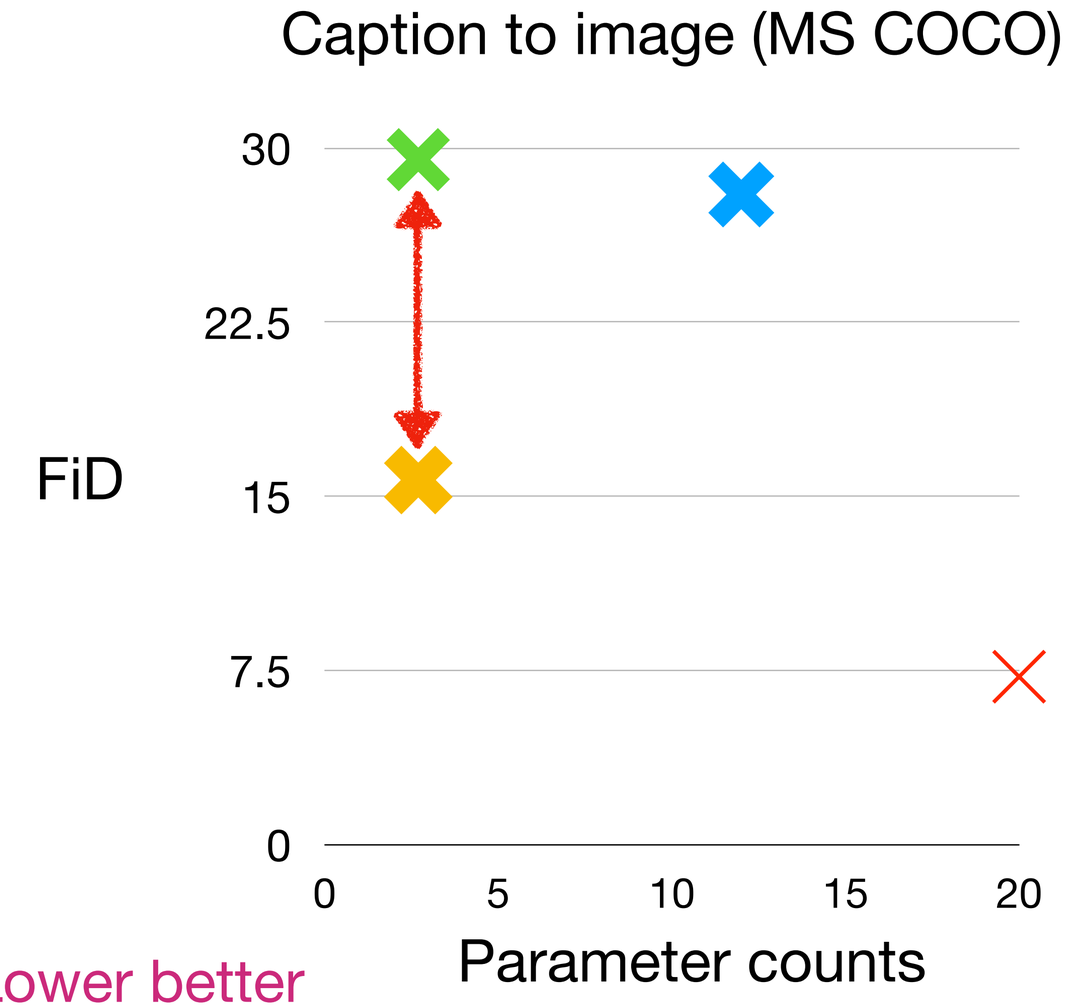
Datastore (Text)

Datastore (Image)



Yasunaga et al. 2023. “Retrieval-Augmented Multimodal Language Modeling”

Results



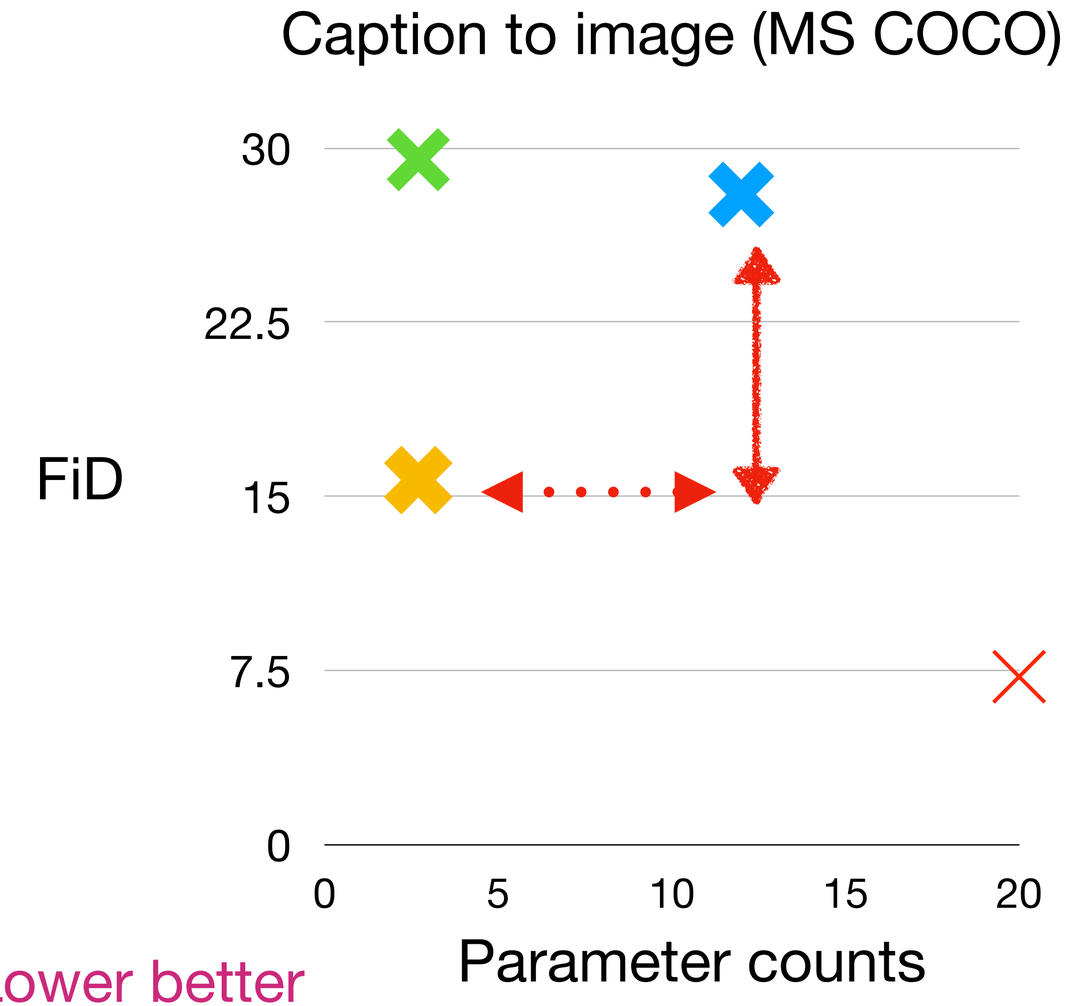
Lower better

Significantly outperforms base LM (CM3)

- DALL-E
- Vanilla CM3
- RA-CM3
- Parti

Yasunaga et al. 2023. “Retrieval-Augmented Multimodal Language Modeling”

Results



Lower better

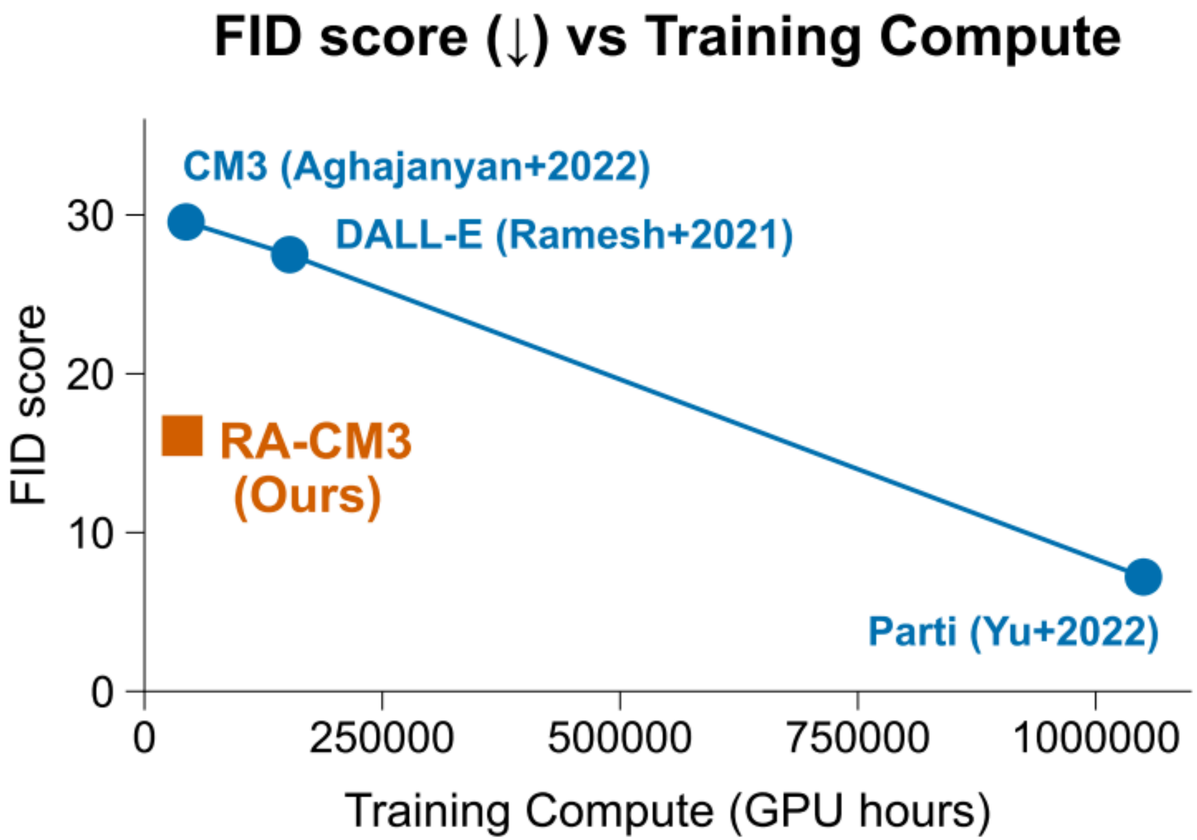
Outperforms DALE (12B) using much less params (2.7 B)

- DALL-E
- Vanilla CM3
- RA-CM3
- Parti

Yasunaga et al. 2023. “Retrieval-Augmented Multimodal Language Modeling”

Results

Caption to image (MS COCO)



Retrieval-augmented generation achieves significantly better training efficiency

Yasunaga et al. 2023. “Retrieval-Augmented Multimodal Language Modeling”

More applications beyond text

Multi-modal Retrieval-augmented Pre-training

* RAVEAL (Hu et al 2023): Pretraining visual-language model using knowledge memory

Multi-modal Question Answering

* MuRAG (Chen et al., 2022)

Multi-modal Classification

* ALIGN (Gur et al., 2021)

Multimodal using image and text have been actively studied

More applications beyond text

Multi-modal Retrieval-augmented Pre-training

* RAVEAL (Hu et al 2023): Pretraining visual-language model using knowledge memory

Multi-modal Question Answering

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Multi-modal Classification

* ALIGN (Gur et al., 2021)

Retrieval-augmented training for molecules

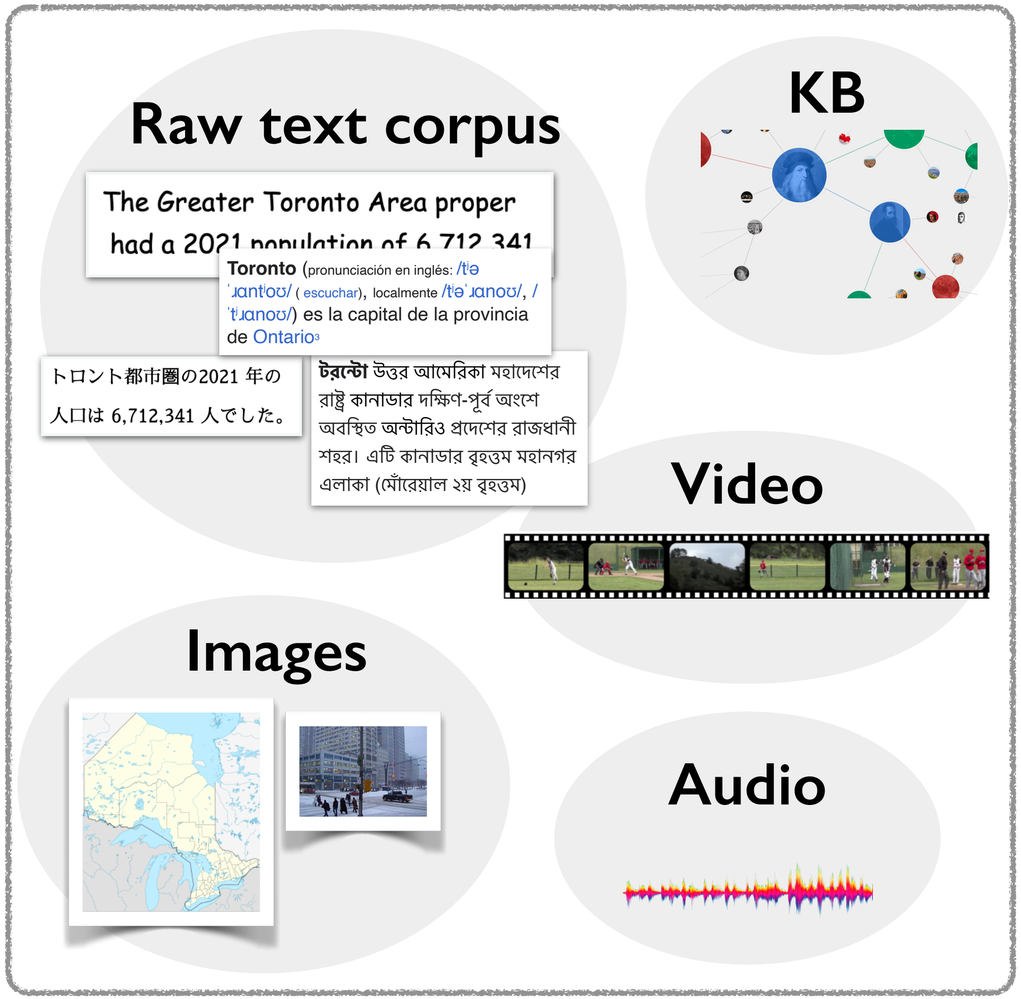
* Retrieval-based Molecule Generation (Wang et al., 2023)

Retrieval-augmented 3D motion generations

* ReMoDiffus (Zhang et al., 2023)

New extensions for new input / output modality!

Wrapping up …



Extension to multilingual

Cross-lingual retrieval and generation to overcome **datastore scarcity** in many world languages

Extension to multimodal

Key effectivenesses (Section 5; long-tail, efficiency) apply to diverse modality

References (1)

Akari Asai, Xinyan Yu, Jungo Kasai, Hannaneh Hajishirzi. One Question Answering Model for Many Languages with Cross-lingual Dense Passage Retrieval. *NeurIPS 2021*.

Peerat Limkonchotiwat, Wuttikorn Ponwitayarat, Can Udomcharoenchaikit, Ekapol Chuangsuwanich, Sarana Nutanong. CL-ReLKT: Cross-lingual Language Knowledge Transfer for Multilingual Retrieval Question Answering. *NAACL Findings 2022*.

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Ziniu Hu, Ahmet Iscen, Chen Sun, Zirui Wang, Kai-Wei Chang, Yizhou Sun, Cordelia Schmid, David A. Ross, Alireza Fathi. REVEAL: Retrieval-Augmented Visual-Language Pre-Training with Multi-Source Multimodal Knowledge Memory. *CVPR 2023*.

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