DimonGen: Diversified Generative Commonsense Reasoning for Explaining Concept Relationships

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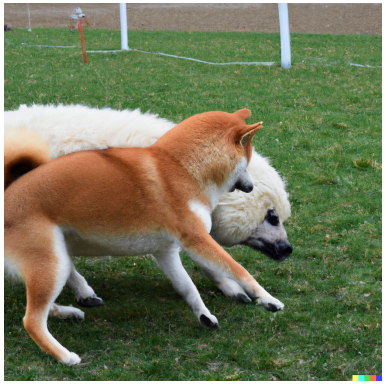
COMPUTER SCIENCE

Concept Relationships

Concept Relationships

dog <=?=> sheep



A **dog** attacks a **sheep?**

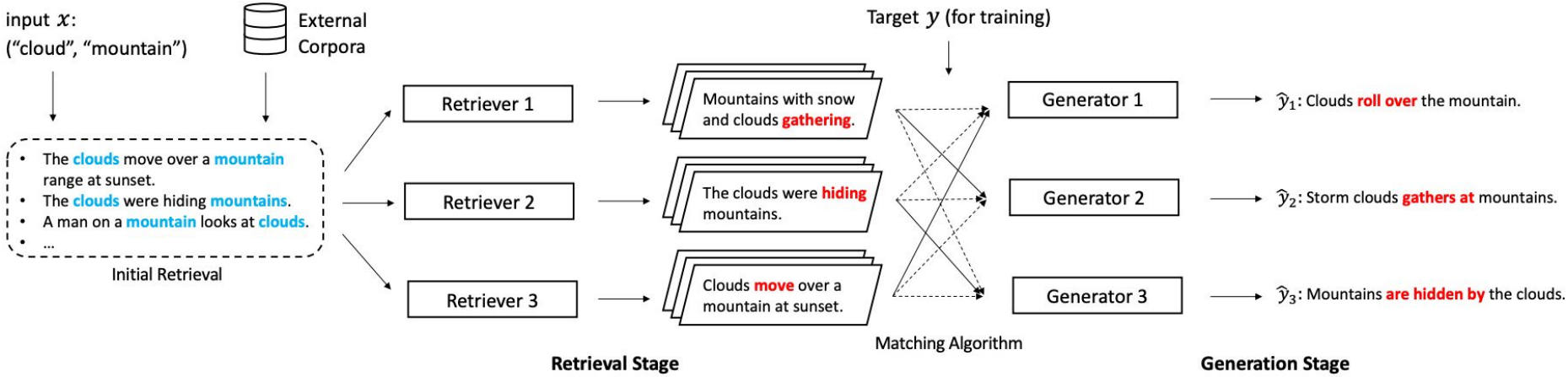
A **dog** herds a flock of **sheep?**

DimonGen: Diversified Generative Commonsense Reasoning

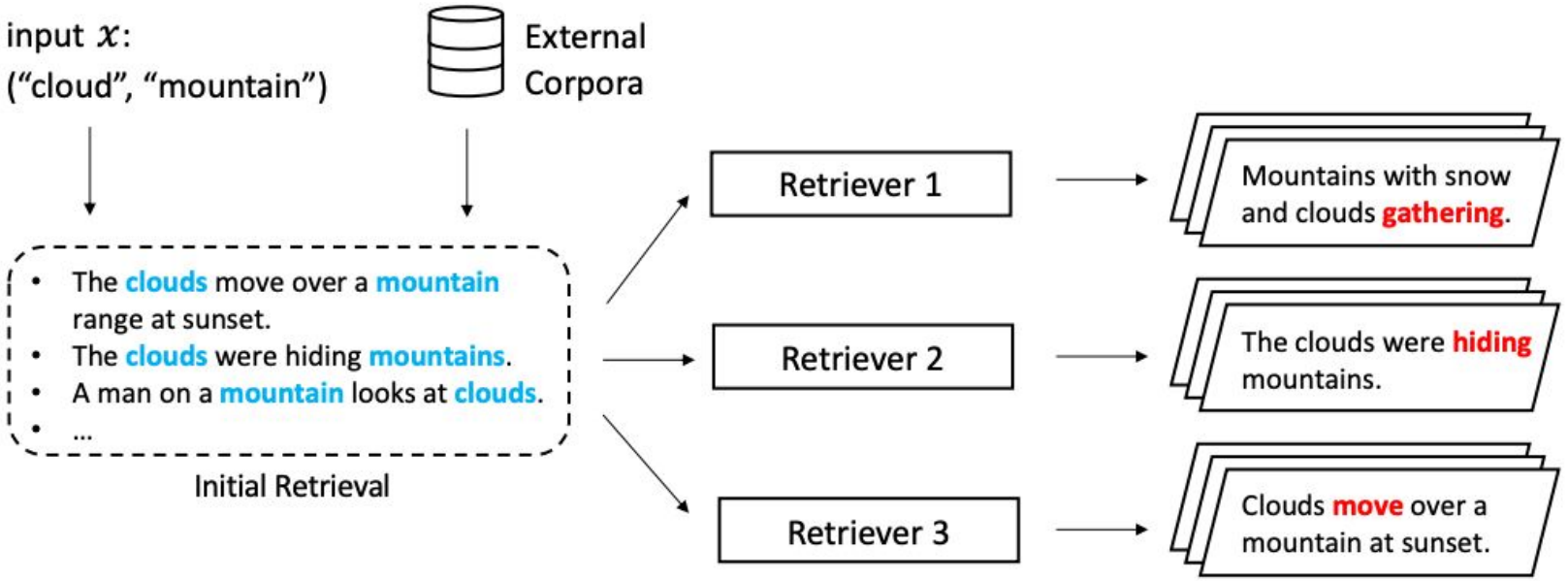
Input: two concepts
Output: sentences describing concept relationships in various everyday scenarios

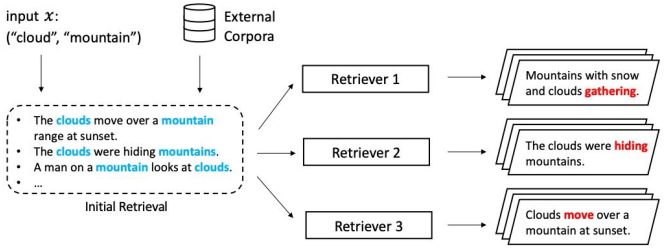
Methods

MoREE: Mixture of Retrieval-Enhanced Experts



Retrieval Stage





Retrieval Stage

identifier concept pair sentence

$$\boldsymbol{x}_{ji}^{\text{re}} = \boldsymbol{z}_i \; [\text{CLS}] \; \boldsymbol{x} \; [\text{SEP}] \; \boldsymbol{s}_j \; [\text{SEP}]$$

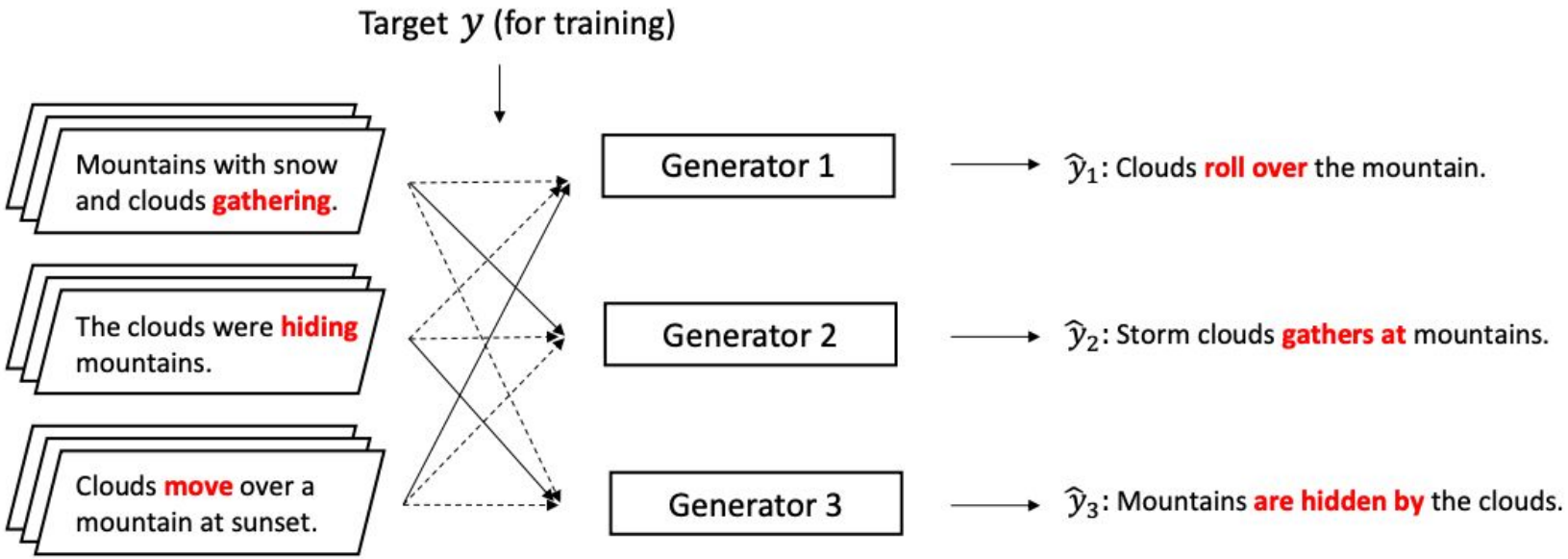
$$\mathcal{L}_c = \mathbb{E}_{(\boldsymbol{x}_j^{\text{re}}, y_c)} [\min_i - \log p(y_c | \boldsymbol{x}_{ji}^{\text{re}}; \theta)]$$

regularization term
(Jenson Shannon divergence)

$$\mathcal{L}_r = \frac{1}{n} \sum_{i=1}^{n} D_{\text{KL}}(P_i || \frac{1}{n} \sum_j P_j)$$

$$\mathcal{L} = \mathcal{L}_c + \alpha \mathcal{L}_r$$

Generation Stage



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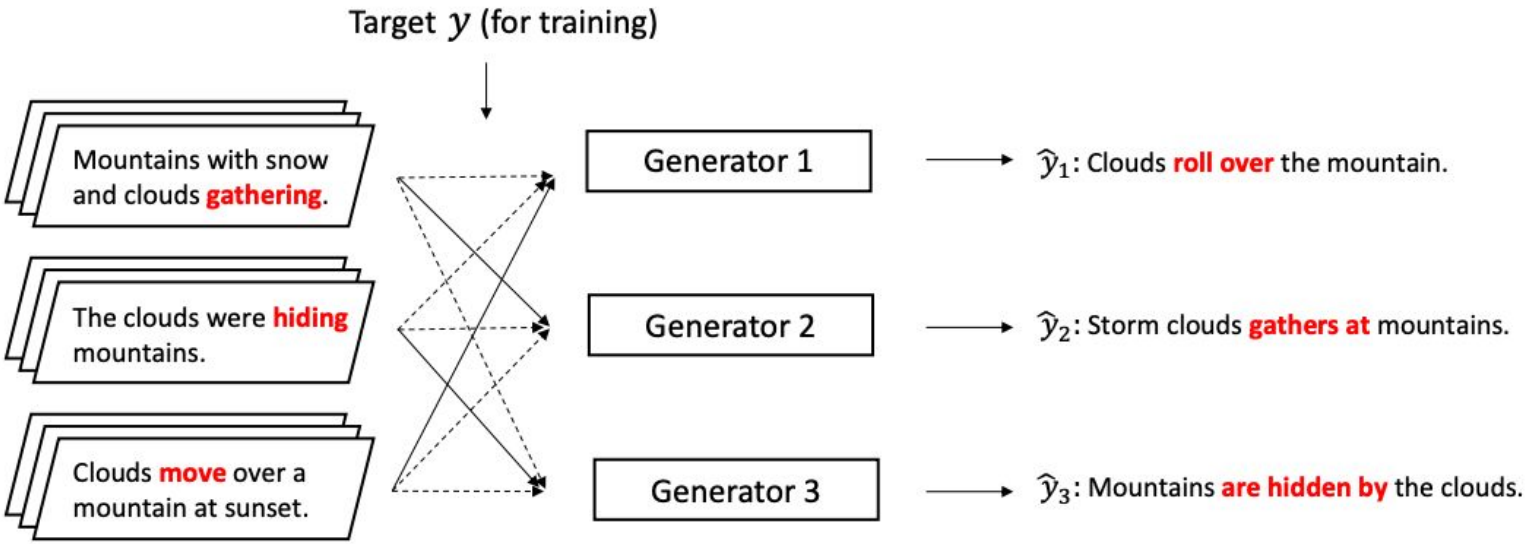
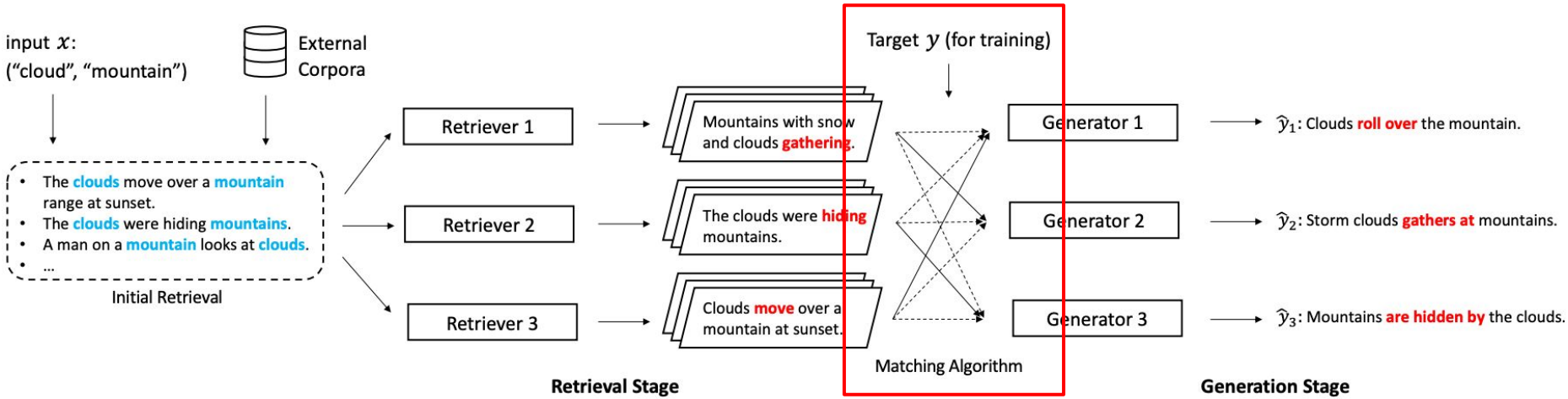


$$\boldsymbol{x}_i^{\text{gen}} = \boldsymbol{z}_i \; [\text{CLS}] \; \boldsymbol{x} \; [\text{SEP}] \; \boldsymbol{s}_1^i \; [\text{SEP}] \; \ldots \boldsymbol{s}_k^i$$

Matching Algorithm



$$\boldsymbol{y}_i^{\text{target}} = \arg\max_{\boldsymbol{y}_j \in \mathcal{Y}} \quad p(\boldsymbol{y}_j | \boldsymbol{x}_i^{\text{gen}}; \theta)$$

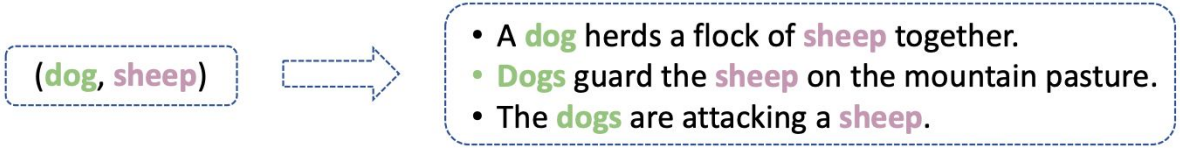
Experiments

Dataset

	train	dev	test
Number	15,263	665	1,181
Unseen ratio (%)	-	91.73	98.31
Avg. ref. number	4.13	3.71	3.38

	3-targets	4-targets	5-targets
ratio (%)	34.76	24.16	41.07

Based on CommonGen (Lin et al., 2020) and ConceptNet (Speer et al., 2017)



Automatic Evaluation

Method		Quality (top-k) ↑			Pairwise diversity ↓		Corpus diversity ↑	
		BLEU-4	ROUGE-l	S. R.	self-B.-4	self-R.-l	Entropy-4	Distinct-4
Sampling methods	**Top_k sampling**	14.97	40.29	87.75	38.54	61.27	9.50	74.53
	Top_p sampling	15.35	40.17	87.30	33.58	56.57	9.60	78.22
	Typical sampling	15.26	40.42	87.60	35.05	57.99	9.58	77.36
MoE methods	**MoE**	16.70	40.88	87.84	30.86	51.16	9.49	75.87
	MoKGE	16.60	41.34	88.37	29.73	50.02	9.58	79.12
	MoREE (ours)	**19.06**	**43.17**	**91.69**	**24.85**	**46.85**	**9.70**	**83.62**

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Human Evaluation

Method	Quality	Diversity	Gra & Flu
DimonGen	**4.70**	**4.25**	**4.67**
Typical	3.65	3.12	4.35
MoKGE	3.77	3.65	**4.63**
MoREE (ours)	**4.21**	**3.94**	4.61

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Results

Method		Quality (top-k) ↑			Pairwise diversity ↓		Corpus diversity ↑	
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Ablation Study

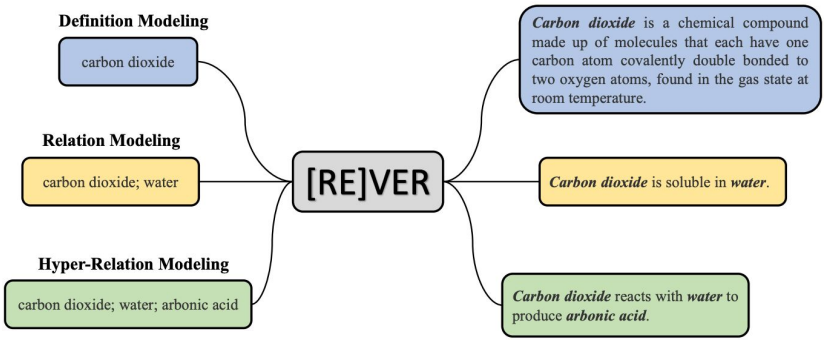
Method	Quality (top-k) ↑			Pairwise diversity ↓		Corpus diversity ↑	
	BLEU-4	ROUGE-l	S. R.	self-B.-4	self-R.-l	Entropy-4	Distinct-4
MoREE	**19.06**	**43.17**	91.69	**24.85**	**46.85**	**9.70**	**83.62**
w/o mixture of retrievers	16.91	41.84	91.04	27.77	50.43	9.54	80.69
w/o regularization term	18.57	42.88	**91.87**	29.40	51.45	9.55	79.31
w/o matching algorithm	16.64	41.78	91.27	28.98	50.96	9.48	77.47

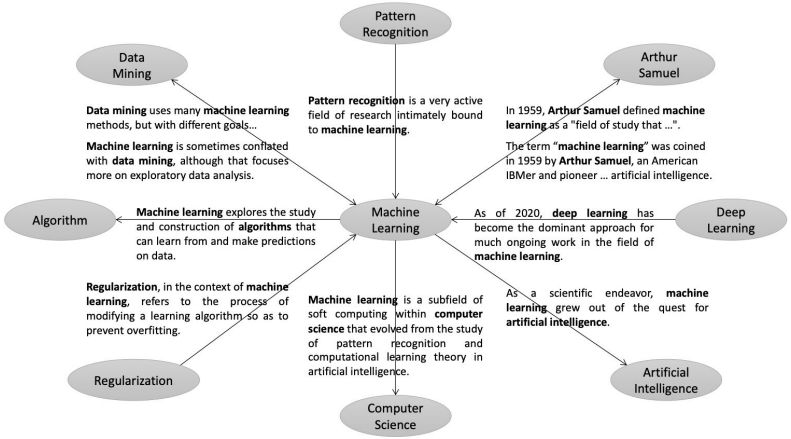
Generation Examples

Method \ Input	("dog", "sheep")	("airport", "way")
Typical sampling	• A man is walking along a road with a dog and two sheep. • A group of sheep and a dog are grazing on the grass. • A man and a dog are standing in a field with sheep.	• A plane is on its way to an airport. • An airplane is making its way down the runway at an airport. • A motorcade makes its way down the runway at an airport.
MoKGE	• a dog is eating a sheep. • Sheep and dogs are grazing in a meadow. • A dog is walking around a field with sheep.	• a woman makes her way through the airport. • passengers make their way through the airport. • A woman is making her way through an airport.
MoREE (ours)	• The dog is herding sheep with a farmer nearby. • A dog is chasing a flock of sheep. • The dog follows the sheep through the gate.	• passengers at an airport are carrying their luggage to and from the terminal as they make their way to their destinations. • A plane is on its way to the airport. • A plane is making its way down the runway at an airport.
DimonGen (Gold)	• A dog herds a flock of sheep together. • dogs guard the sheep on the mountain pasture. • The dogs are attacking a sheep.	• People make their way off a plane toward the airport. • There is a gray and red plane on the run way at the airport. • US Airways plane moves on a taxi way near its gate at an airport.

Related Works on Describing Entity/Concept Relationships

- DEER: Descriptive Knowledge Graph for Explaining Entity Relationships. EMNLP 2022.
- Open Relation Modeling: Learning to Define Relations between Entities. Findings of ACL 2022.
- [RE]VER: Learning Natural Language Representations for Verbalizing Entities and Relations. 2023.





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Thanks!