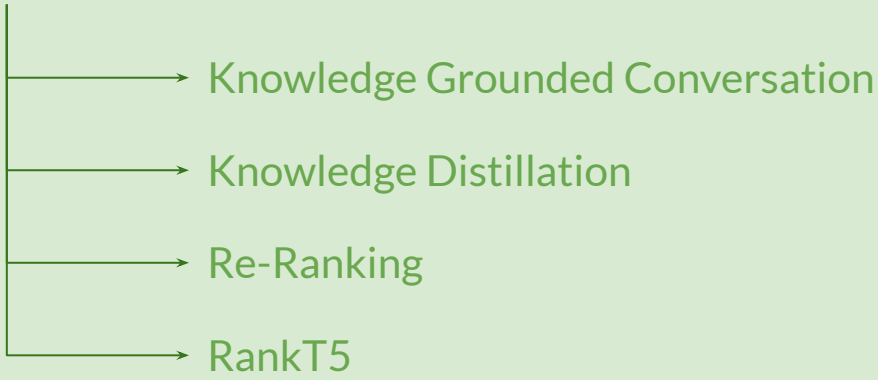
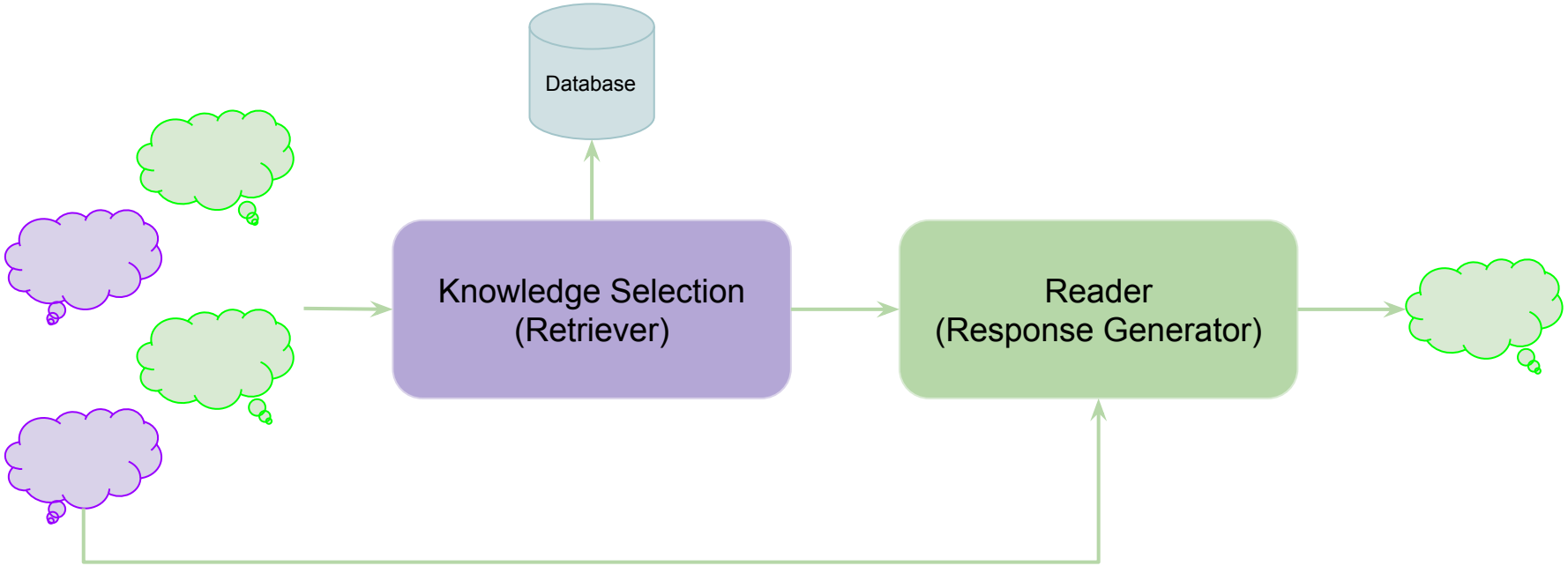
Foresight: Leveraging Masked Response as query for Knowledge Selection

Kavin R V (IISER Bhopal)
Mr. Suvodip Dey
Dr. Maunendra Sankar Desarkar

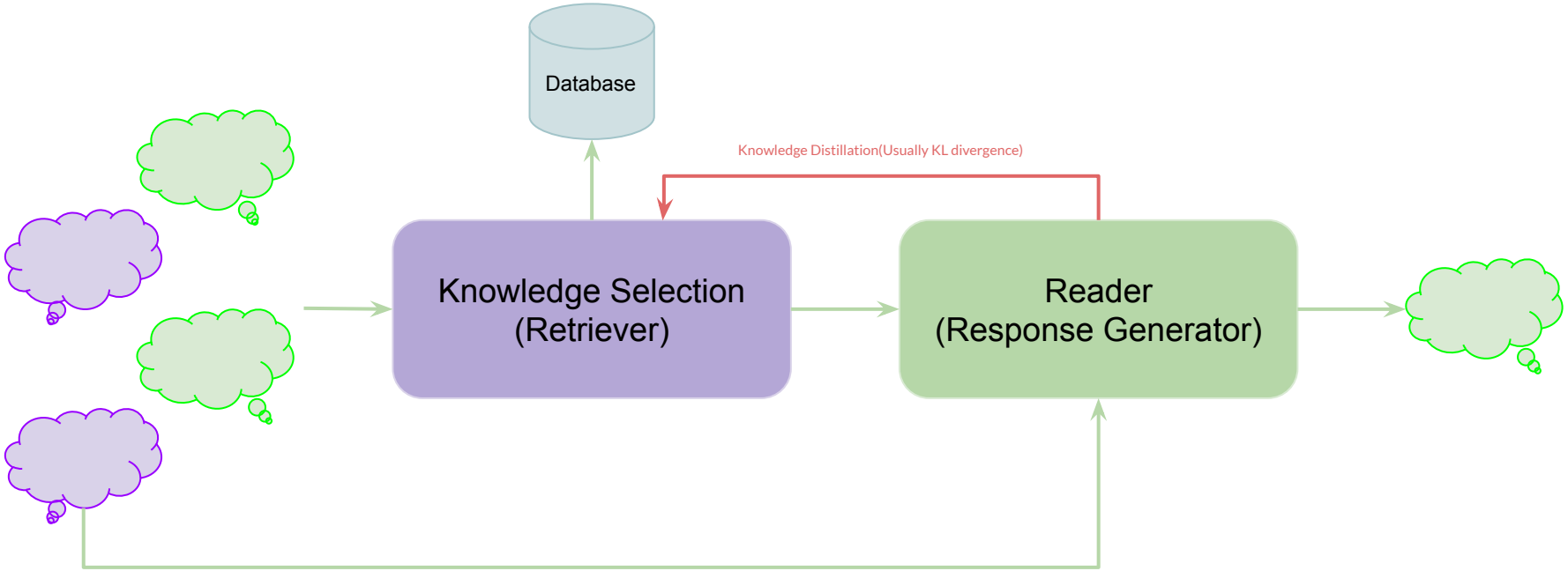
Background


Knowledge Grounded Conversation
Knowledge Distillation
Re-Ranking
RankT5

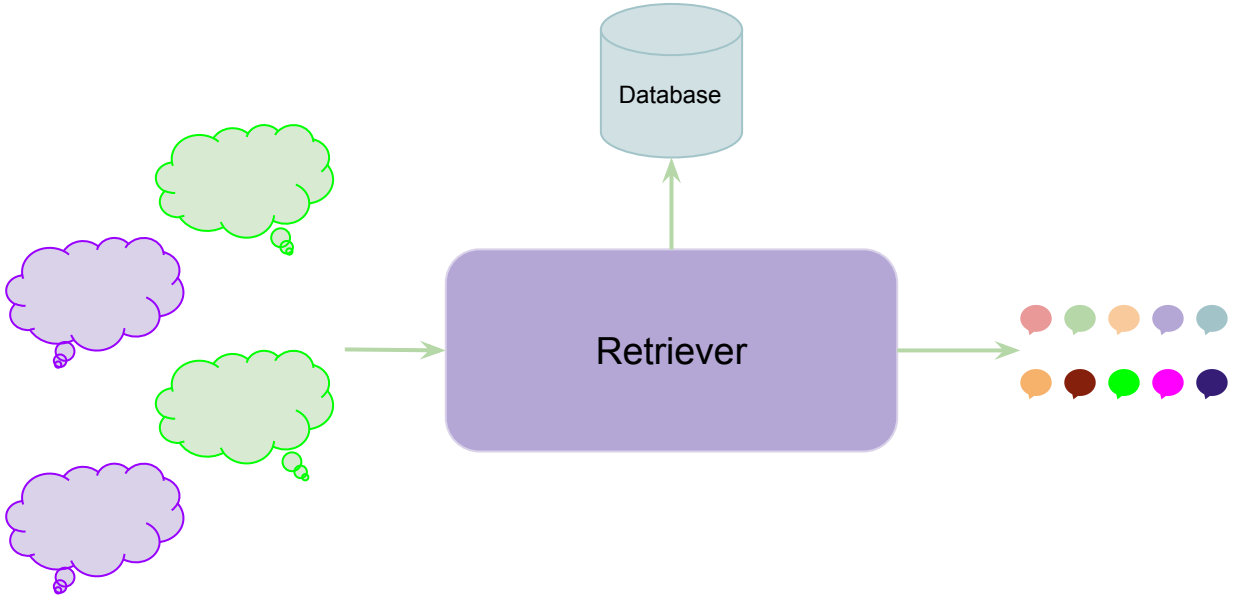
Knowledge Grounded Conversation



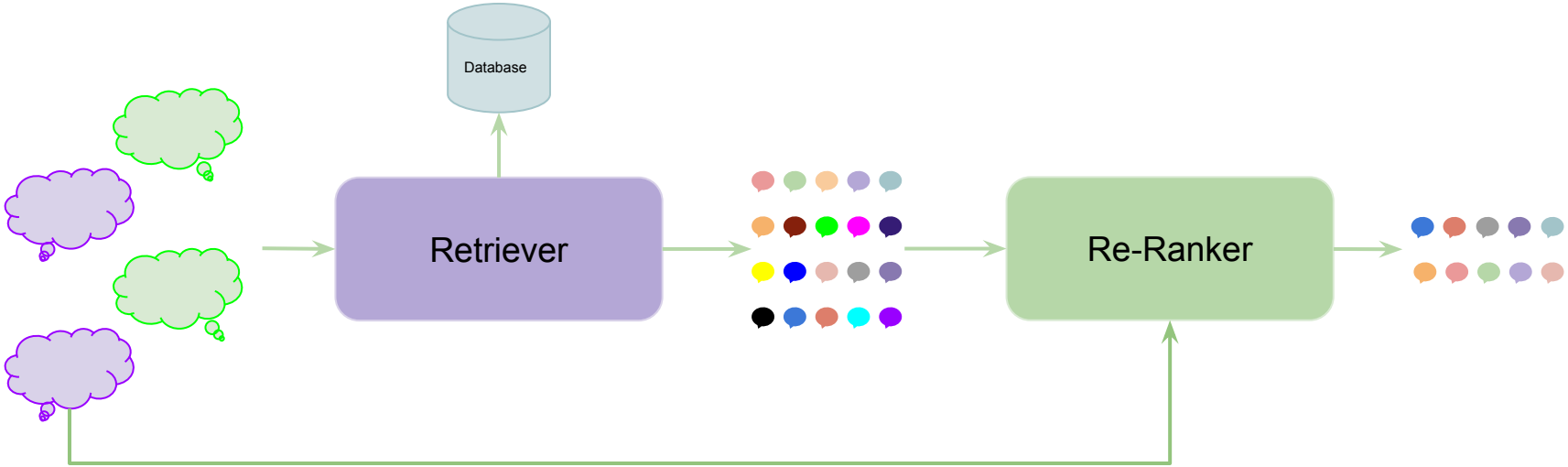
Knowledge Distillation



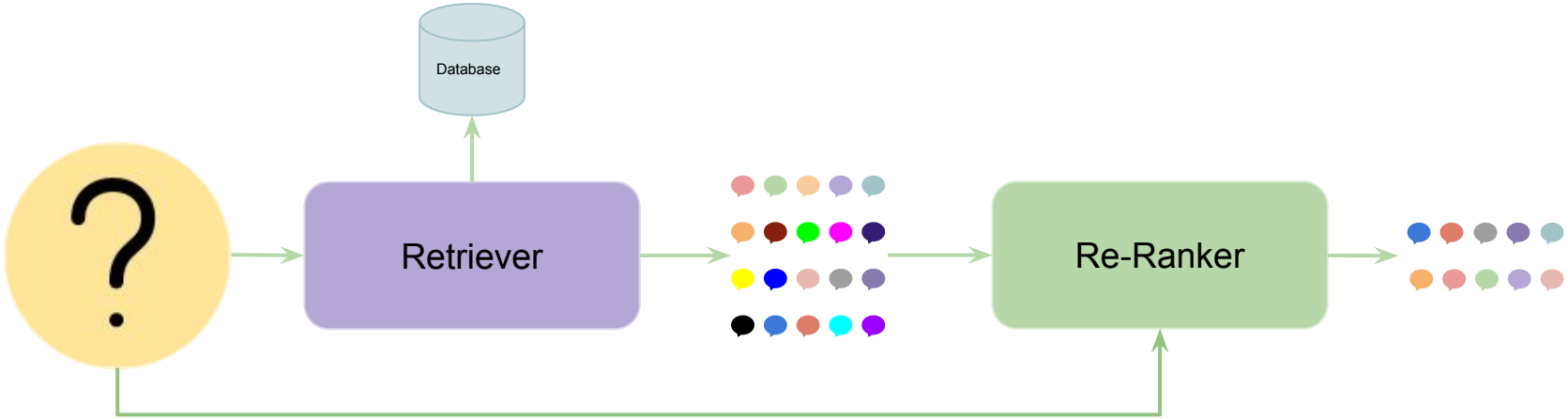
Re-Ranking



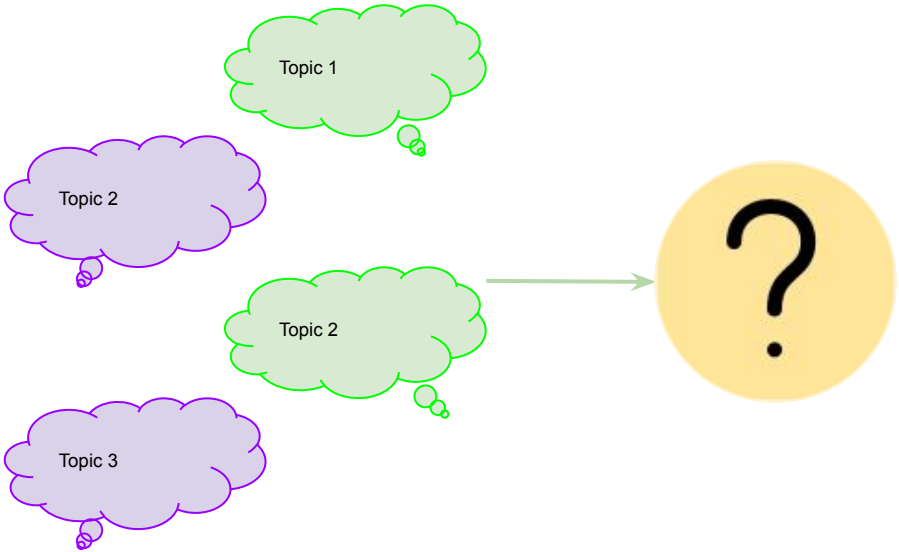
Re-Ranking



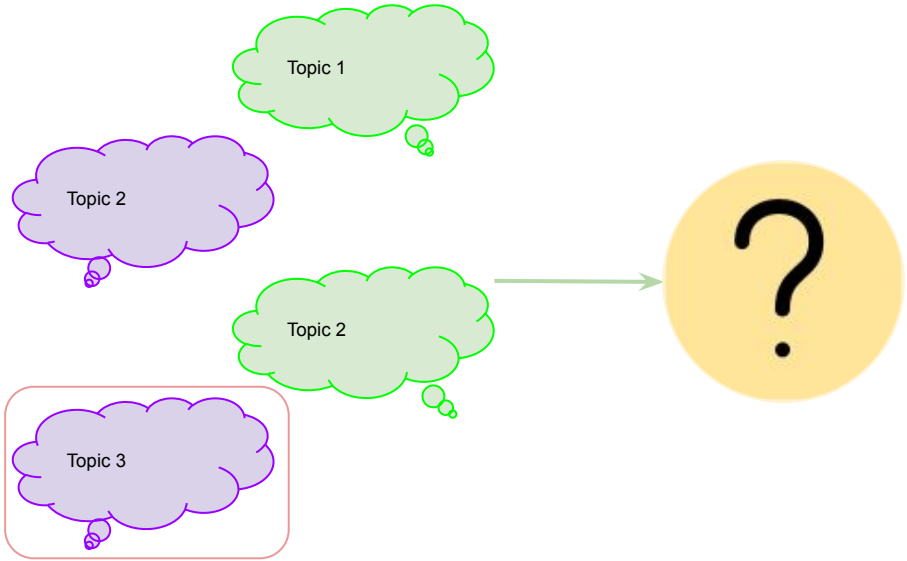
Query For Conversations



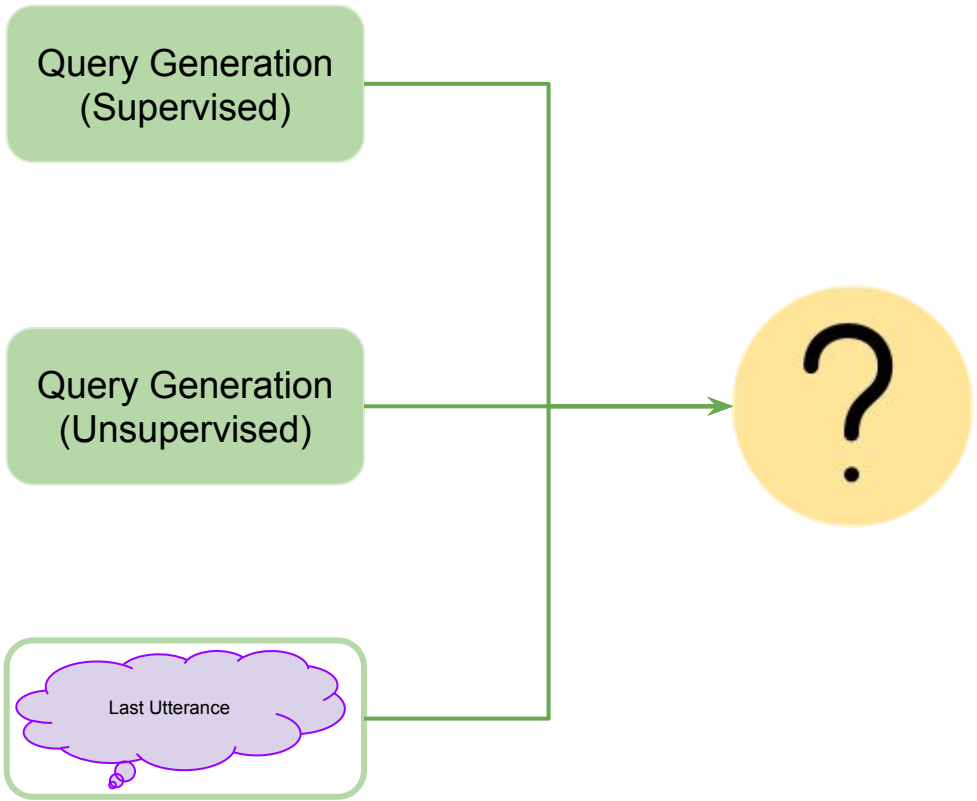
Query For Conversations



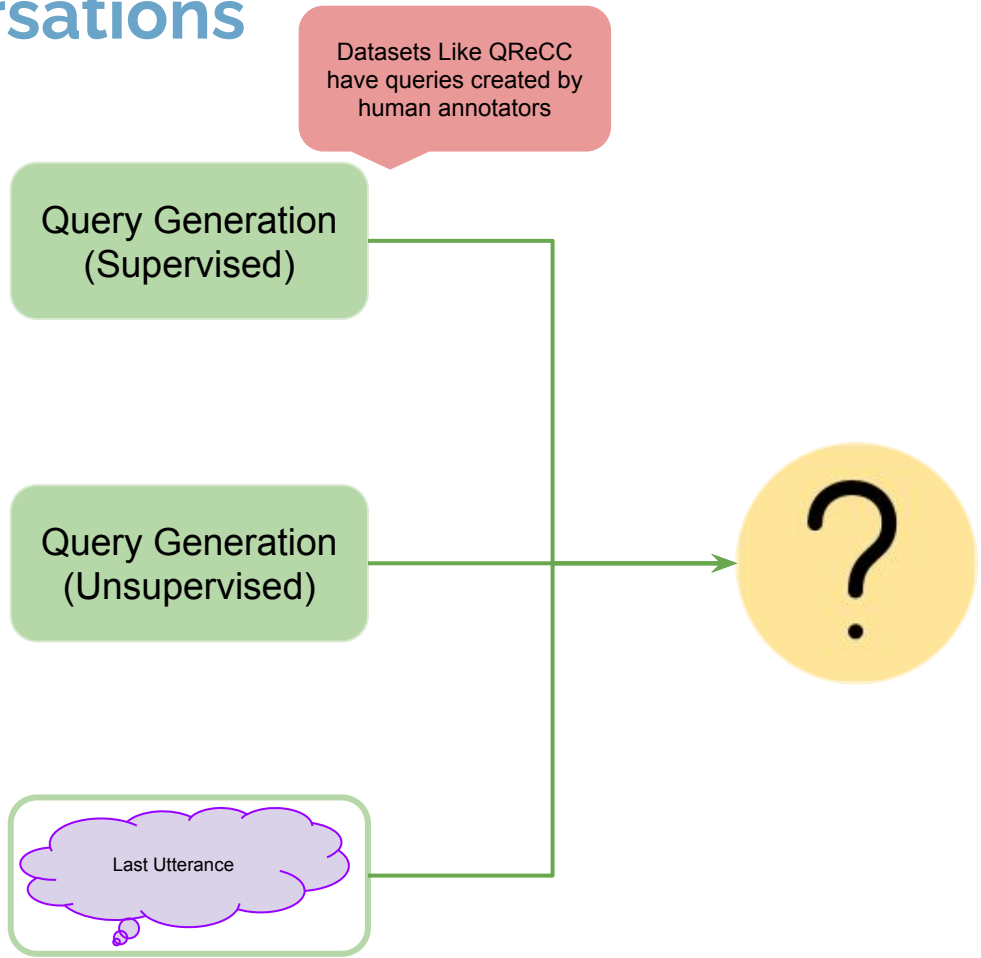
Query For Conversations



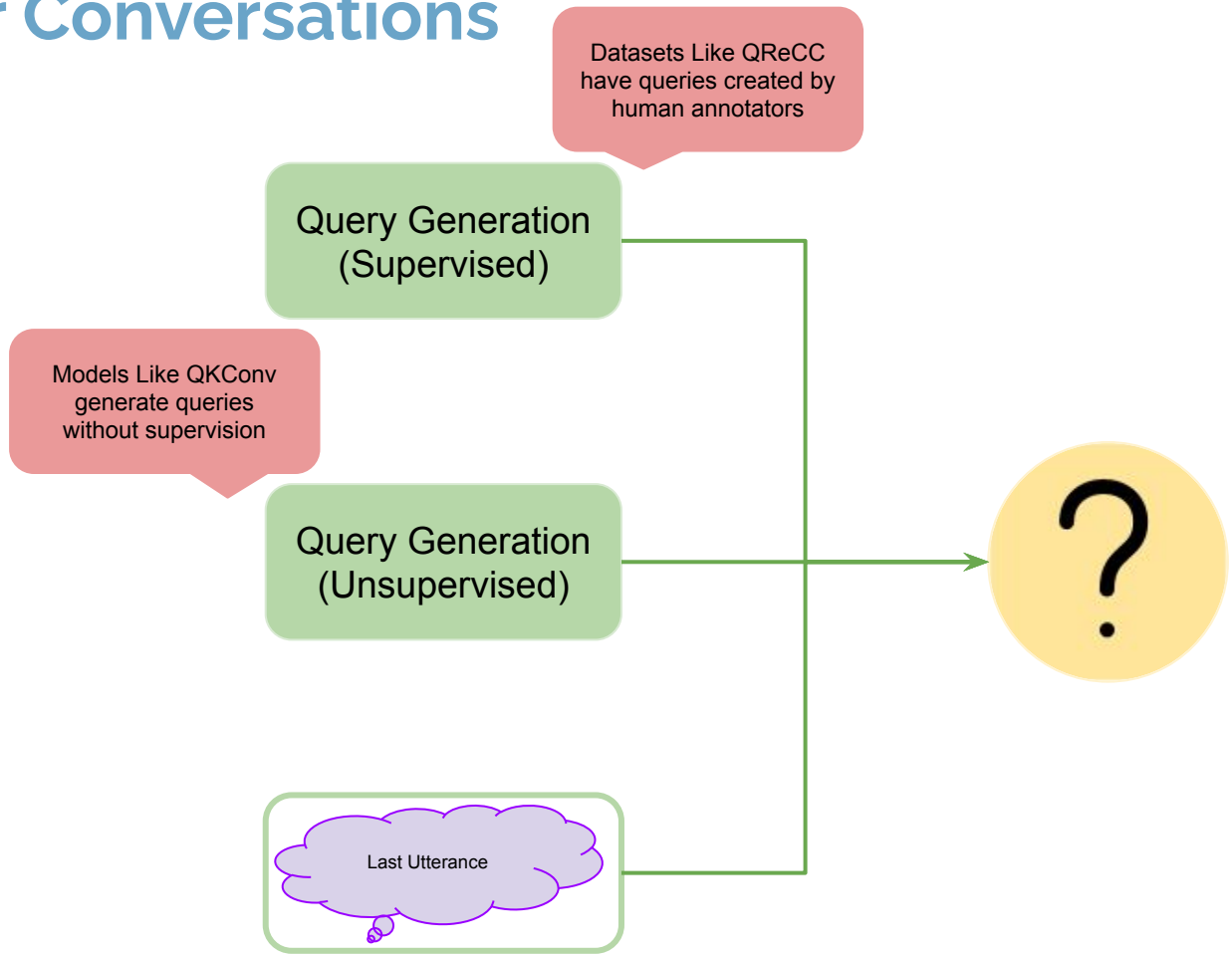
Query For Conversations



Query For Conversations



Query For Conversations



Methodology

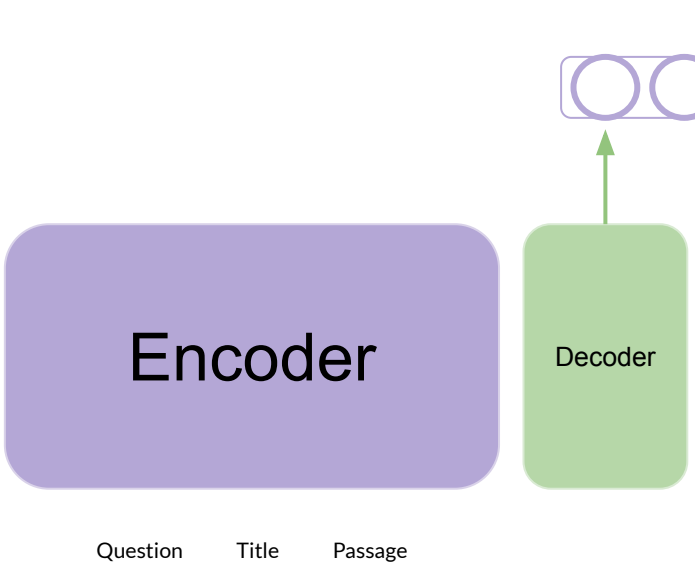
Wizard of Wikipedia

Conversation

Response

Knowledge

Rank-T5



$$l_{softmax}(y_i, \hat{y}_i) = -\sum_{j=1}^{m} y_{ij} log \left(\frac{e^{\hat{y}_{ij}}}{\sum_{j'} e^{\hat{y}_{ij'}}} \right)$$

$\hat{y}_{ij}$ = score of j-th passage for i-th query

y_{ij} = 1 if the passage j is a provenance to query i

Rank-T5

→ Good Performance Compared to other Re-Rankers

Encoder

Decoder

Question Title Passage

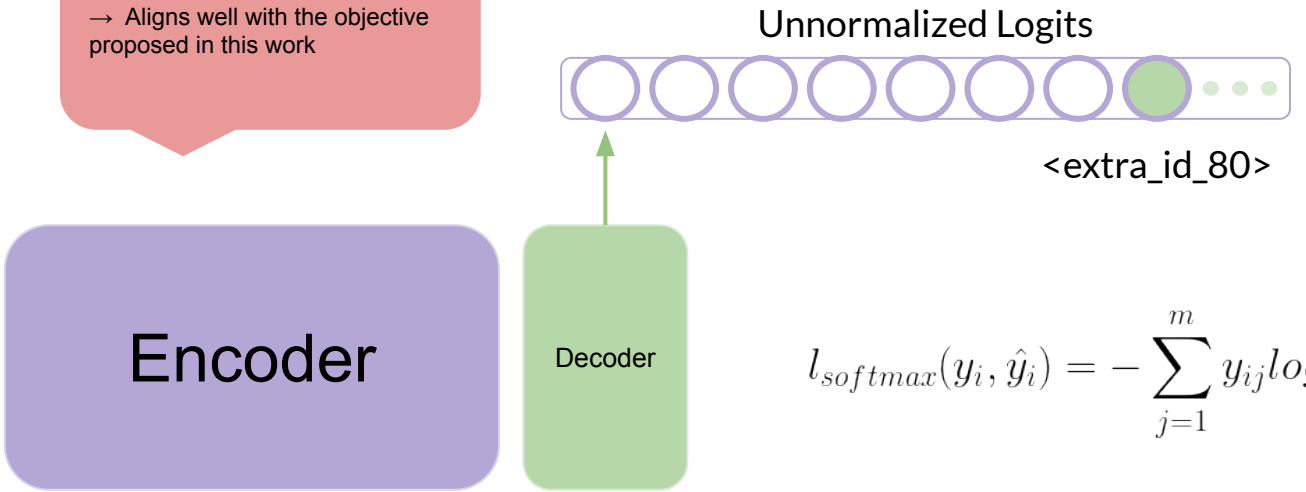
$$l_{softmax}(y_i, \hat{y}_i) = -\sum_{j=1}^{m} y_{ij} log\left(\frac{e^{\hat{y}_{ij}}}{\sum_{j'} e^{\hat{y}_{ij'}}}\right)$$

$\hat{y}_{ij}$ = score of j-th passage for i-th query

y_{ij} = 1 if the passage j is a provenance to query i

Rank-T5

→ Good Performance Compared to other Re-Rankers
→ Aligns well with the objective proposed in this work

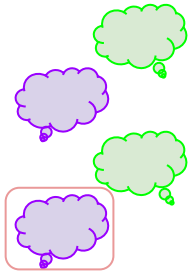


$$l_{softmax}(y_i, \hat{y}_i) = -\sum_{j=1}^{m} y_{ij} log\left(\frac{e^{\hat{y}_{ij}}}{\sum_{j'} e^{\hat{y}_{ij'}}}\right)$$

$\hat{y}_{ij}$ = score of j-th passage for i-th query

y_{ij} = 1 if the passage j is a provenance to query i

Rank-T5



Unnormalized Logits

<extra_id_80>

Encoder

Decoder

Question Title Passage

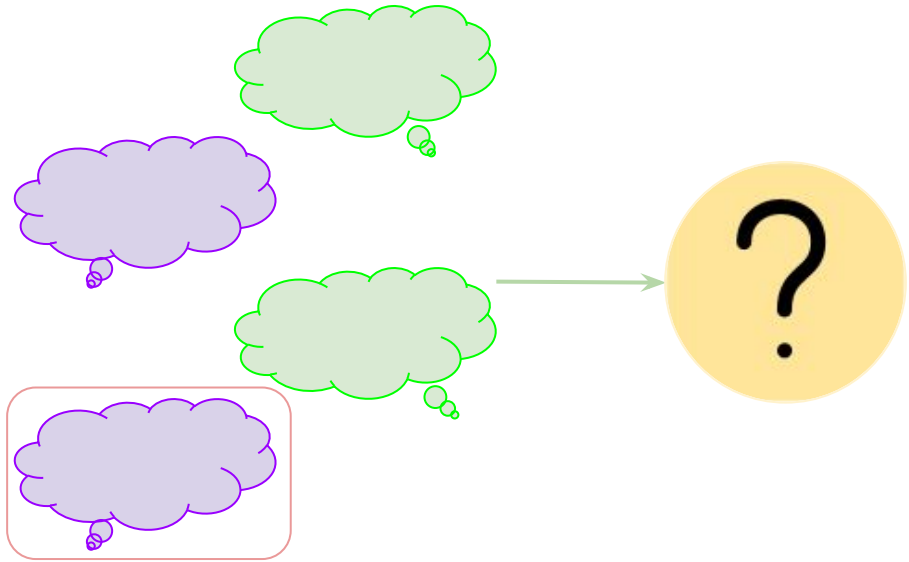
$$l_{softmax}(y_i, \hat{y}_i) = -\sum_{j=1}^{m} y_{ij} log\left(\frac{e^{\hat{y}_{ij}}}{\sum_{j'} e^{\hat{y}_{ij'}}}\right)$$

$\hat{y}_{ij}$ = score of j-th passage for i-th query

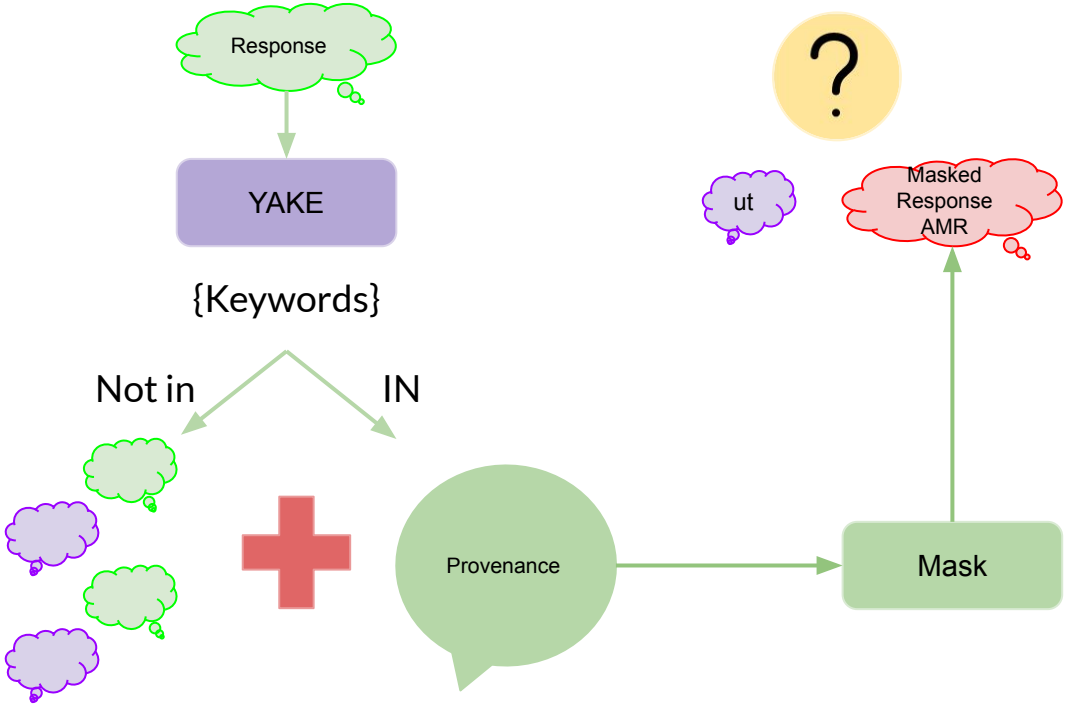
y_{ij} = 1 if the passage j is a provenance to query i

Rank-T5

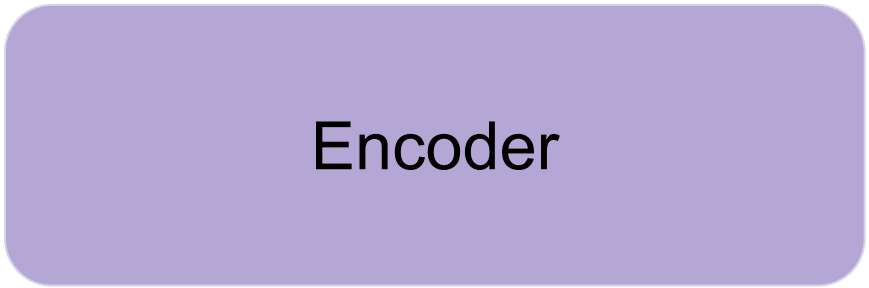
	MRR	R@1	R@2	R@3	R@4	R@5	nDCG@1	nDCG@2	nDCG@3	nDCG@4	nDCG@5
Rank-T5 query as last utterance	88.57	81.12	91.59	95.29	97.20	98.75	81.12	87.72	89.58	90.40	91.00

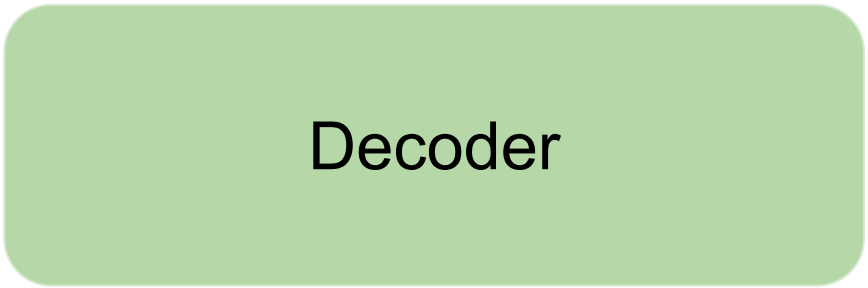


Masked Response



Masked Response





question: Masked Response title: Passage Title context: Passage

How does social interaction relate to transition as mentioned? <eou> Kids <extra_id_3> to interact with their peers.Record shows that the first kindergarten centers were opened late 18th <extra_id_2> in <extra_id_1> and <extra_id_0>

Kids **learn** to interact with their peers.Record shows that the first kindergarten centers were opened late 18th **century** in **Bavaria** and **Strasbourg**

Masked Response

question: How does social interaction relate to transition as mentioned? <eou> Kids***<extra_id_3>*** to interact with their peers.Record shows that the first kindergarten centers were opened late 18th***<extra_id_2>*** in***<extra_id_1>*** and***<extra_id_0>*** **title**: Kindergarten **passage**: Kindergarten (; from German, which literally means "garden for the children") is a preschool educational approach traditionally based on playing, singing, practical activities such as drawing, and social interaction as part of the transition from home to school. At first such institutions were created in the late 18th **century** in **Bavaria** and **Strasbourg** to serve children whose parents both worked out of the home. The term was coined by the German Friedrich Fröbel, whose approach globally influenced early-years education. Today, the term is used in many countries to describe a variety of educational institutions and **learn**ing spaces for children ranging from two to seven years of age, based on a variety of teaching methods. In 1779, Johann Friedrich Oberlin and Louise Scheppler founded in Strasbourg an early establishment for caring for and educating pre-school children whose parents were absent during the day. At about the same time, in 1780, similar infant establishments were established in Bavaria. In 1802, Princess Pauline zur Lippe established a preschool center in Detmold, the capital of the then principality of Lippe, Germany (now in the State of North Rhine-Westphalia). In 1816, Robert Owen, a philosopher and pedagogue, opened the first British and probably globally the first infants school in New Lanark, Scotland.</s>

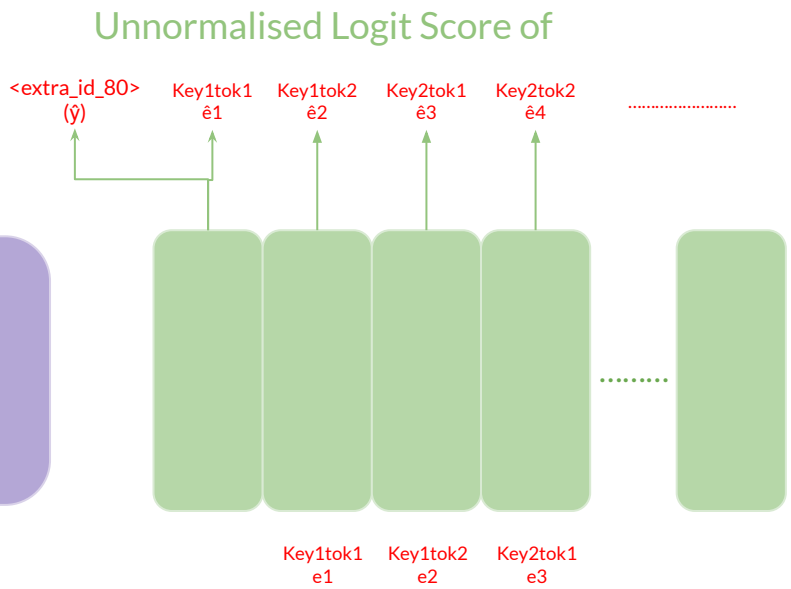
Keyword Estimation

$$\text{RankScore}(q_i, p_j) = \hat{y}_{ij}$$

$$\text{KEScore}(q_i, p_j) = \sum_k \hat{e}_{ik} = \hat{z}_{ij}$$

Encoder

question: Masked Response title: Passage Title context: Passage



Keyword Estimation

$$l_{softmax}(y_i, \hat{y}_i) = -\sum_{j=1}^{m} y_{ij} log\left(\frac{e^{\hat{y}_{ij}}}{\sum_{j'} e^{\hat{y}_{ij'}}}\right)$$

$$l_{softmax}(y_i, \hat{z}_i) = -\sum_{j=1}^{m} y_{ij} log\left(\frac{e^{\hat{z}_{ij}}}{\sum_{j'} e^{\hat{z}_{ij'}}}\right)$$

$$l_{kl}(\hat{Z}||\hat{Y}) = \sum_{j=1}^{m} \frac{e^{\hat{z}_{ij}/\tau}}{\sum_{j'} e^{\hat{z}_{ij'}/\tau}} log\left(\frac{\frac{e^{\hat{y}_{ij}}}{\sum_{j'} e^{\hat{y}_{ij'}}}}{\frac{e^{\hat{z}_{ij}/\tau}}{\sum_{j'} e^{\hat{z}_{ij'}/\tau}}}\right)$$

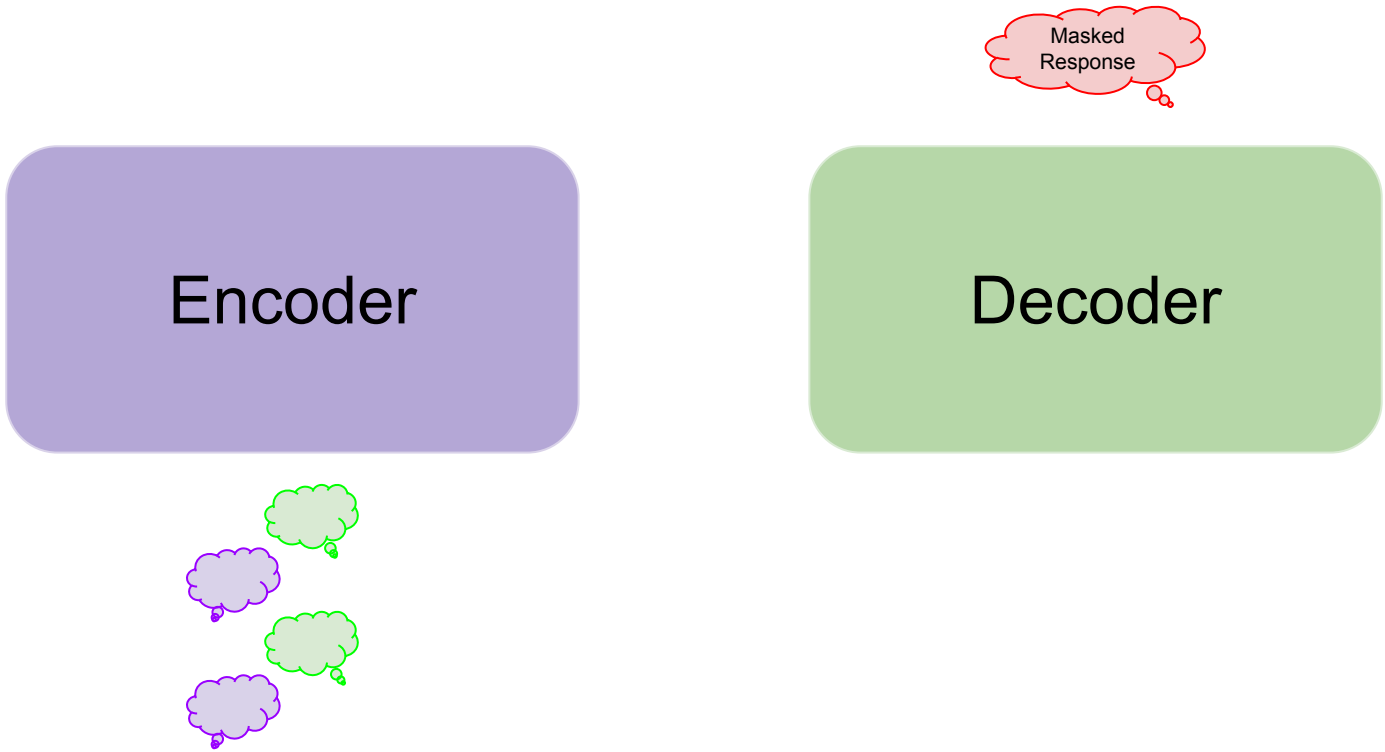
$$l_{SKL} = l_{KL}(\text{stopgrad}(\hat{Z})||\hat{Y}) + l_{KL}(\text{stopgrad}(\hat{Y})||\hat{Z})$$

$$l_1 = l_{softmax}(y_i, \hat{y}_i) + l_{softmax}(y_i, \hat{z}_i)$$

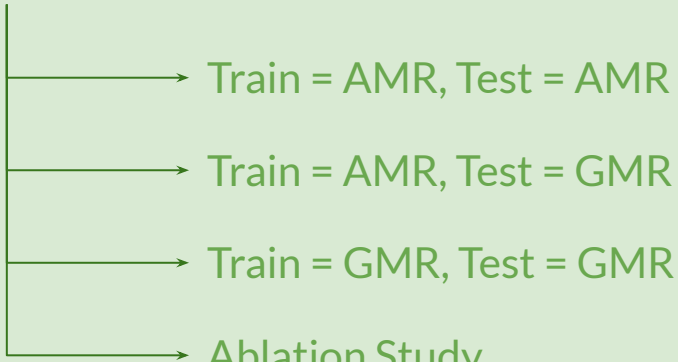
$$l_2 = l_{softmax}(y_i, \hat{y}_i) + l_{KL}(\hat{Z}||\hat{Y})$$

$$l_3 = l_{softmax}(y_i, \hat{y}_i) + \lambda \cdot l_{SKL}$$

Generated Masked Response



Experiments and Results



Results (test_q = ut+amr, train_q = ut+amr)

	MRR	R@1	R@2	R@3	R@4	R@5	nDCG@1	nDCG@2	nDCG@3	nDCG@4	nDCG@5
Rank-T5 query as last utterance	88.57	81.12	91.59	95.29	97.20	98.75	81.12	87.72	89.58	90.40	91.00
Rank-T5 w/o KE loss	94.79	90.94	97.09	98.39	99.18	99.59	90.94	94.82	95.47	95.81	95.97
Rank-T5 With L1 loss	94.79	91.00	96.93	98.39	98.99	99.59	90.99	94.74	95.47	95.73	95.96
Rank-T5 L2 loss (t=2)	94.65	90.72	96.90	98.42	99.10	99.56	90.72	94.62	95.38	95.67	95.85
Rank-T5 L2 loss (t=3)	94.96	91.29	96.98	98.56	99.16	99.83	91.29	94.88	95.67	95.93	96.18
Rank-T5 L2 loss (t=5)	94.40	90.34	96.69	98.23	99.08	99.37	90.34	94.34	95.12	95.48	95.60
Rank-T5 L3 loss (t=1)	**95.46**	**91.53**	**97.41**	**98.55**	**99.28**	**99.84**	**91.53**	**95.61**	**95.96**	**96.07**	**96.90**

Results (test_q = ut+gmr, train_q = ut+amr)

	MRR	R@1	R@2	R@3	R@4	R@5	nDCG@1	nDCG@2	nDCG@3	nDCG@4	nDCG@5
Rank-T5 query as last utterance	88.57	81.12	91.59	95.29	97.20	98.75	81.12	87.72	89.58	90.40	91.00
Rank-T5 w/o KE loss	85.29	76.14	88.08	93.33	96.60	98.23	76.14	83.68	86.30	87.71	88.34
Rank-T5 With L1 loss	85.65	76.41	89.04	93.99	96.76	98.39	76.41	84.38	86.85	88.05	88.68
Rank-T5 L2 loss (t=2)	86.93	78.45	90.21	94.50	97.03	98.45	78.45	85.87	88.01	89.11	89.66
Rank-T5 L2 loss (t=3)	87.02	78.62	90.32	94.53	96.98	98.45	78.62	86.00	88.11	89.16	89.73
Rank-T5 L2 loss (t=5)	86.74	78.12	90.04	94.56	97.03	98.56	78.12	85.64	87.90	88.97	89.56
Rank-T5 L3 loss (t=1)	87.23	78.94	90.42	94.70	97.17	98.56	78.94	86.19	88.32	89.39	89.92

Results (test_q = ut+gmr, train_q = ut+gmr)

	MRR	R@1	R@2	R@3	R@4	R@5	nDCG@1	nDCG@2	nDCG@3	nDCG@4	nDCG@5
Rank-T5 query as last utterance	88.57	81.12	91.59	95.29	97.20	98.75	81.12	87.72	89.58	90.40	91.00
Rank-T5 w/o KE loss	89.69	83.00	92.13	95.78	**97.88**	**99.05**	83.00	88.76	90.59	91.49	**91.94**
Rank-T5 With L1 loss	89.30	82.18	92.19	96.06	97.71	98.91	82.18	88.50	90.43	91.14	91.61
Rank-T5 L2 loss (t=2)	89.52	82.81	91.78	95.73	97.77	98.97	82.81	88.47	90.44	91.32	91.79
Rank-T5 L2 loss (t=3)	89.44	82.54	91.94	96.06	97.82	98.94	82.54	88.47	90.53	91.29	91.72
Rank-T5 L2 loss (t=5)	89.56	82.59	92.36	96.03	98.07	99.13	82.59	88.75	90.59	91.47	91.88
Rank-T5 L3 loss (t=1)	**89.82**	**83.92**	**92.38**	**96.19**	97.93	98.88	**83.92**	**88.89**	**90.79**	**91.54**	91.91

Results {Ablation Study} (q = gmr)

	MRR	R@1	R@2	R@3	R@4	R@5	nDCG@1	nDCG@2	nDCG@3	nDCG@4	nDCG@5
Rank-T5 query as last utterance	88.57	81.12	91.59	95.29	97.20	98.75	81.12	87.72	89.58	90.40	91.00
Rank-T5 w/o KE loss	82.86	72.58	85.58	91.78	95.13	97.50	72.58	80.78	83.88	85.33	86.24
Rank-T5 With L1 loss	83.22	73.04	86.32	91.78	95.24	97.61	73.04	81.42	84.15	85.63	86.55
Rank-T5 L2 loss (t=2)	82.46	71.98	85.34	91.54	94.86	97.14	71.98	80.40	83.51	84.94	85.82
Rank-T5 L2 loss (t=3)	81.67	70.51	85.12	90.94	94.86	97.61	70.51	79.73	82.64	84.33	85.39
Rank-T5 L2 loss (t=5)	83.70	73.67	86.86	92.41	95.59	97.82	73.67	81.99	84.77	86.14	87.00
Rank-T5 L3 loss (t=1)	85.29	76.06	88.47	93.30	96.25	98.34	76.06	83.89	86.31	87.57	88.38

Results {Ablation Study} % of GMR in Train

	MRR	R@1	R@2	R@3	R@4	R@5	nDCG@1	nDCG@2	nDCG@3	nDCG@4	nDCG@5
Rank-T5 L2 loss (t=3) 50% GMR	**89.44**	82.45	**92.25**	95.95	**97.85**	98.91	82.45	**88.63**	90.48	**91.30**	**91.72**
Rank-T5 L2 loss (t=3) 0-50% GMR	**89.44**	**82.54**	91.94	**96.06**	97.82	**98.94**	**82.54**	88.47	**90.53**	91.29	**91.72**
Rank-T5 L2 loss (t=3) 100% GMR	88.85	81.80	91.32	94.94	97.44	98.78	81.80	87.81	89.62	90.69	91.21

References

- KILT: a Benchmark for Knowledge Intensive Language Tasks
- Wizard of Wikipedia: Knowledge-Powered Conversational agents
- Leveraging Passage Retrieval with Generative Models for Open Domain Question Answering
- Distilling Knowledge from Reader to Retriever for Question Answering
- Query Enhanced Knowledge-Intensive Conversation via Unsupervised Joint Modeling
- Open-Domain Question Answering Goes Conversational via Question Rewriting
- RankT5: Fine-Tuning T5 for Text Ranking with Ranking Losses