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Designing Templates for Eliciting Commonsense Knowledge From Pretrained Sequence-To-Sequence Models

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Text-To-Text Pretrained Transformer (T5)

- Formulate most NLP tasks in a “text-to-text” format
- From encoder-only to encoder-decoder pretraining

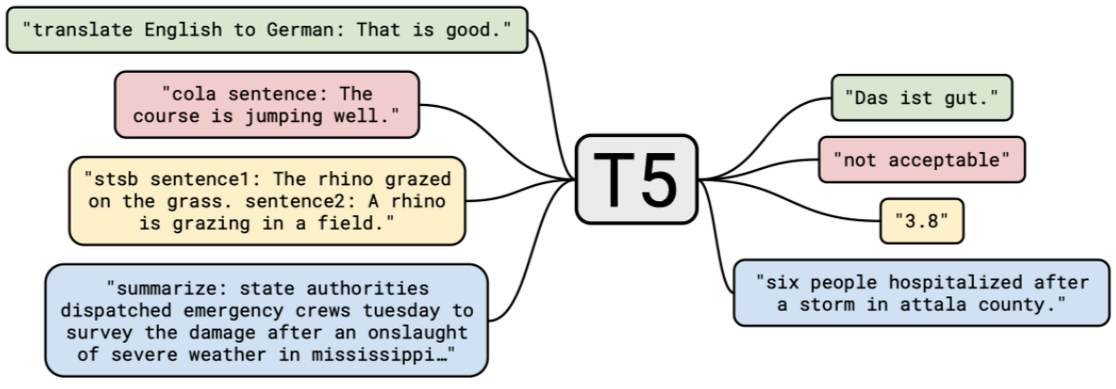

Figure 1: The text-to-text framework proposed by Raffel et al. [1].[1]

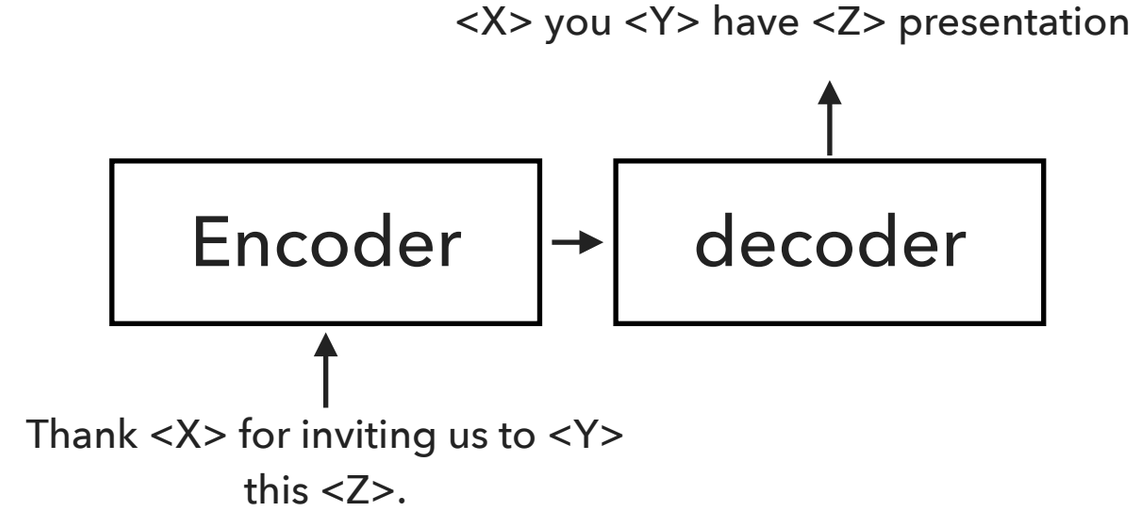

Figure 2: An encoder-decoder model that performs masked language model training.

1. Figure is taken from p.3 in [1].

Text-To-Text Pretrained Transformer (T5)

- Consider the MNLI task

Task: MNLI	Input	Output
Original	(Hypothesis) The St. Louis Cardinals have always won. (Premise) yeah well losing is i mean i'm i'm originally from Saint Louis and Saint Louis Cardinals when they were there were uh a mostly a losing team but	2
T5	**mnli hypothesis:** The St. Louis Cardinals have always won. **premise:** yeah well losing is i mean i'm i'm originally from Saint Louis and Saint Louis Cardinals when they were there were uh a mostly a losing team but	**contradiction**

Table. 1 An example of T5's text-to-text template for MNLI task; all inputs and outputs are texts for T5. The original inputs do not include the texts in the parentheses, but we put them explicitly in texts for T5.

* This example is taken from appendix D.3 in [1].

Commonsense Reasoning as Multiple-Choice Question Answering

- WinoGrande [2] setting

Task: WinoGrande	Input	Output
Original	He never comes to my home, but I always go to his house because the _ is smaller.	(Option1) home (Option2) house

Table. 2 An example from WinoGrande commonsense reasoning dataset. Models are expected to fill in the right option texts in "_"; in this example, the correct answer is (Option1) home.

Research Questions

- Is there commonsense embedded in the pretrained models?
- What are the “design factors” for text-to-text framework?

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Text-To-Text Template (Without Context)

Task: WinoGrande	Input	Output
Original	He never comes to my home, but I always go to his house because the _ is smaller.	(Option1) home (Option2) house
Option 1	hypothesis: ***home*** is smaller. premise: He never comes to my home, but I always go to his house because the	entailment
Option 2	hypothesis: ***house*** is smaller. premise: He never comes to my home, but I always go to his house because the	contradiction

Table 3: Given an example in WinoGrande, we decompose it as two instances.

- If the output pair is (entailment, contradiction) for (home, house), we know that "home" is the correct answer.
- But ...

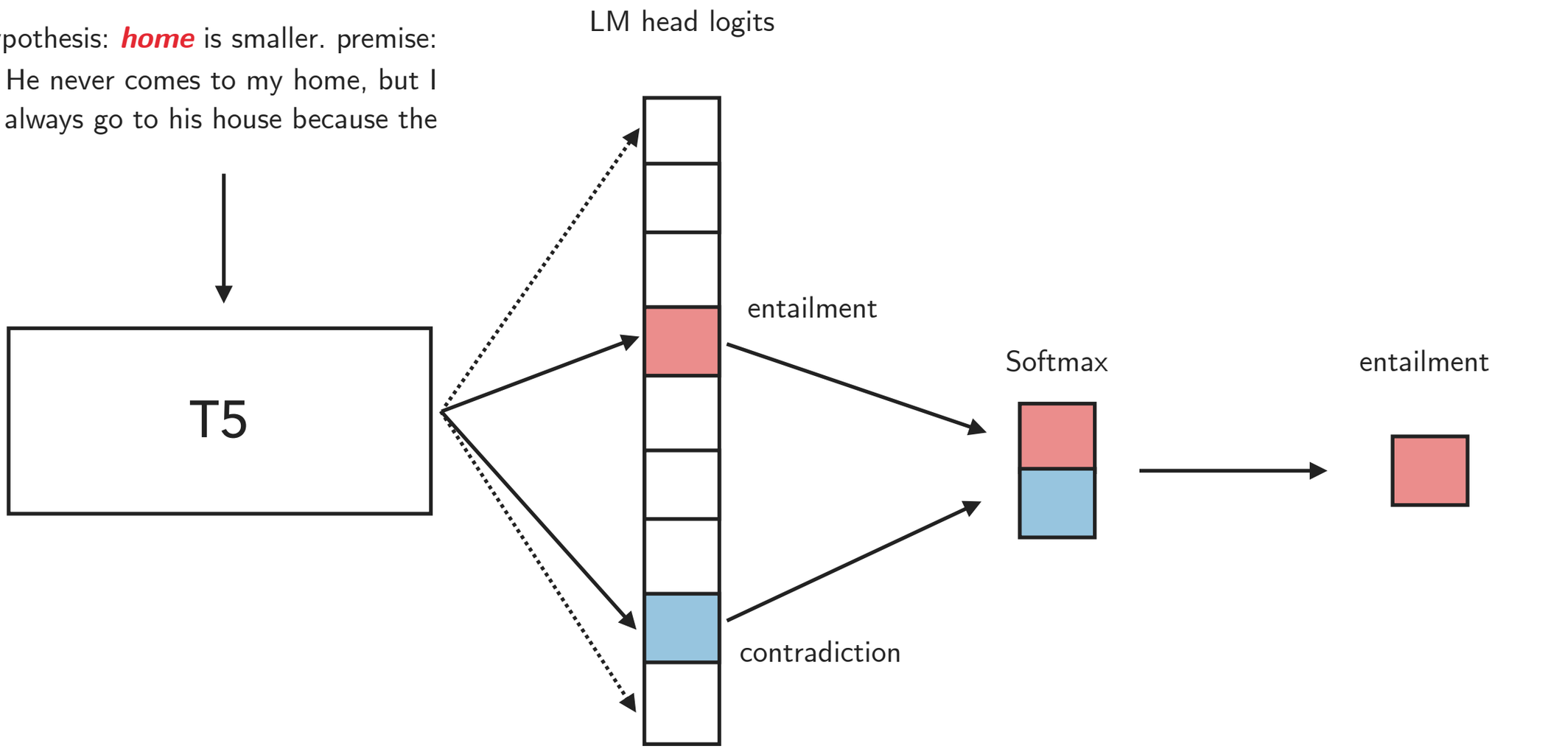
Text-To-Text Template (Without Context)

Output combinations	Option1	Option2
Option 1	entailment/entailment	entailment/ contradiction
Option 2	contradiction/entailment	contradiction/ contradiction

Table 4: When using text pairs, we cannot decide which option is the correct answer on the diagonal cases.

- We need a solution to deal with the cases that we cannot assign correct answers purely by texts.

Exploiting Pretrained Tokens With Logit Trick [3]



Text-To-Text Template (With Context)

Task: ARC-Easy	Input	Context	Output
Original	A green plant absorbs light. A frog eats flies. These are examples of how organisms	organism that obtains energy by eating both plants and animals.	(A) obtain energy (B) escape predators (C) produce offspring (D) excrete waste
(A)	hypothesis: A green plant absorbs light. A frog eats flies. These are examples of how organisms **obtain energy** premise: organism that obtains energy by eating both plants and animals.		true
(B)	hypothesis: A green plant absorbs light. A frog eats flies. These are examples of how organisms **escape predators** premise: organism that obtains energy by eating both plants and animals.		false
(C)	hypothesis: A green plant absorbs light. A frog eats flies. These are examples of how organisms **produce offspring** premise: organism that obtains energy by eating both plants and animals.		false
(D)	hypothesis: A green plant absorbs light. A frog eats flies. These are examples of how organisms **excrete waste** premise: organism that obtains energy by eating both plants and animals.		false

Table 5: For other commonsense reasoning tasks that provide context for reasoning or more than two options, we can easily extend our proposed template approach. Here we use an example in ARC-Easy [4] for demonstration.

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WinoGrande [2]

- Metric: accuracy

Condition	Target token	Logit	Training size					
			Zero-Shot	XS	S	M	L	XL
#1	entailment/contradiction		0.506	0.657	0.693	0.757	0.809	0.840
#2		✓	0.608	0.718	0.740	0.788	0.837	0.854
#3	true/false		0.477	0.676	0.697	0.760	0.823	0.852
#4		✓	0.566	0.723	0.752	0.800	0.843	0.865
Our leaderboard submission (test set)			-	0.683	0.705	0.776	0.824	0.846

Table 6: Results on WinoGrande, measured by the accuracy of models trained on different dataset sizes. Condition #2 is our leaderboard submission.

OpenbookQA [5] and ARC-Easy [4]

- Metric: accuracy

Condition	Dataset	
	OpenBookQA	ARC-Easy
w/o contexts	0.768	0.808
w/ contexts	0.834	0.872
Our submission (test set)	0.832	0.891

Table 7: Results on OpenbookQA and ARC-Easy, measured by accuracy. We conduct the experiments with true/false target tokens and logit trick, corresponding to condition #4 in Table 6.

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Take Home

- Using the template we proposed with the logit trick, pretrained T5 performs better than random without fine-tuning.
  - Does it mean that T5 captures some commonsense during pretraining?
- We explored a direction for designing templates for the text-to-text framework.
  - Is there a general rule for the template design?

[1] Raffel, Colin, et al. "Exploring the limits of transfer learning with a unified text-to-text transformer." *Journal of Machine Learning Research* 21.140 (2020): 1-67.

[2] Sakaguchi, Keisuke, et al. "Winogrande: An adversarial winograd schema challenge at scale." *arXiv preprint arXiv:1907.10641* (2019).

[3] Nogueira, Rodrigo, Zhiying Jiang, and Jimmy Lin. "Document ranking with a pretrained sequence-to-sequence model." *arXiv preprint arXiv:2003.06713* (2020).

[4] Clark, Peter, et al. "Think you have solved question answering? try arc, the ai2 reasoning challenge." *arXiv preprint arXiv:1803.05457* (2018).

[5] Mihaylov, Todor, et al. "Can a suit of armor conduct electricity? a new dataset for open book question answering." *arXiv preprint arXiv:1809.02789* (2018).

Thank You!

Have questions?

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