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

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# Introduction

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].

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

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

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.
# Introduction

**Research Questions**

- Is there commonsense embedded in the pretrained models?
- What are the “design factors” for text-to-text framework?
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   a. Text-to-text template
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# Proposed Solution

Text-To-Text Template (Without Context)

## Task: WinoGrande

| Input | Output |
|-------|--------|
| 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 ...
### Proposed Solution

**Text-To-Text Template (Without Context)**

| Output combinations | Option 1       | Option 2       |
|---------------------|----------------|----------------|
| 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.


hypothesis: home is smaller. premise: He never comes to my home, but I always go to his house because the
### 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 obtain energy by eating both plants and animals. | 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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# Evaluation

## WinoGrande [2]

- **Metric:** accuracy

| Condition | Target token          | Logit | 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.
### Evaluation

#### 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    |                  | 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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# Conclusion

**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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