深度学习与自然语言处理第五次作业

语言大模型通过提示工程方法对比下游任务性能

惠仪

SY2202328@buaa.edu.cn

摘要

选取 3 个目前前沿语言大模型，通过提示工程的方法来检验和对比不同模型下游任务上的性能。

一、理论介绍

1、提示工程

提示工程(Prompt Engineering)指在不更新模型参数的前提下、通过输入文本等方法来操控大型语言模型(Large Language Model)以指导其行为、引导其生成需要的结果的方法。不同的模型间所需的提升过程方法、以及最终的效果往往会有较大的差异。

零样本学习和小样本学习是给语言模型做提示的方法，在小样本学习中，会先提供一些关于任务的示例来构造提示。每个示例都包含完整的输入和输出。模型可以通过这些演示更好地理解测试者的意图以及所需要答案的格式。少样本学习因为有任务相关的样本，通常比零样本学习有更好的性能，然而代价是需要更长的上下文输入。当输入输出文本较长时、有可能会达到模型的输入长度限制。
指令提示
小样本学习会提供一部分示例来向模型展示我们需要的输入输出。那么，为什么不直接用自然语言给大模型下达指令、让其自动理解我们的意图呢？

2、语言模型

- gpt-neo-1.3B

EleutherAI 团队发布了经过训练的 GPT-style 语言模型 GPT-Neo，目标是同等复现 GPT-3 大小的模型。GPT-Neo 和真正的 GPT-3 相比，参数量仍然很小（较大版本也只与 GPT-3 最小模型的参数量）。对于 gpt-neo-1.3B，这里 1.3B 指预训练模型的参数数量。GPT Neo 1.3B 是在 Pile 上训练的，Pile 是 EleutherAI 为训练该模型而创建的大规模策划数据集。该模型在 Pile 上训练了 3800 亿个 token，超过 362000 步。它作为一个掩蔽的自回归语言模型，使用交叉熵损失被训练。通过这种方式，模型学习内部表示，然后可以用来提取对下游任务有用的特征。该模型最擅长的是根据提示生成文本。

- gpt-neo-2.7B

从模型尺寸看，最大的 GPT-Neo 模型由 27 亿个参数组成。GPT Neo 2.7B 是在 Pile 上训练的，该模型针对超过 400000 步的 4200 亿个 token 进行了训练。作为一个掩码的自回归语言模型，使用交叉熵损失被训练。通过这种方式，模型学习英语的内部表示，然后可以用来提取对下游任务有用的特征。该模型最擅长的是根据提示生成文本。

- Cerebras-GPT-1.3B

Cerebras-GPT 系列的发布是为了促进使用开放架构和数据集研究大语言模型（LLM）缩放定律。所有 Cerebras-GPT 模型都可用于 Hugging Face。该系列

包括 111M、256M、590M、1.3B、2.7B、6.7B 和 13B 型号。Cerebras-GPT 系列中的所有模型都根据计算最优的 Chinchilla 缩放法则（每个模型参数 20 个标记）进行了训练。Cerebras 的权重流技术通过将计算与模型存储分离来简化 LLM 的训练，这允许使用简单的数据并行性有效地扩展跨节点的训练。

二、实验步骤

首先确定下游任务：根据实验需求选择文本生成、文本分类和实体检测 3 个下游任务进行研究。

1、文本生成

通过给定的一段话，生成具有逻辑、主题明确的文本。

实验给定提示语为"In a shocking finding, scientists discovered a herd of unicorns living in a remote, previously unexplored valley, in the Andes Mountains. Even more surprising to the, researchers was the fact that the unicorns spoke perfect English."

```
from transformers import pipeline
generator = pipeline('text-generation',model='EleutherAI/gpt-neo-2.7B')
prompt = "In a shocking finding, scientists discovered a herd of unicorns living in a remote, " \
         "previously unexplored valley, in the Andes Mountains. Even more surprising to the " \
         "researchers was the fact that the unicorns spoke perfect English."
res = generator(prompt,max_length=180)
print(res)
```

通过 pipeline 构建生成器，根据提示生成相关的文本

实验使用 python3.9

2、实体检测

```
#任务2实体检测
from transformers import pipeline
generator = pipeline('text-generation',model='EleutherAI/gpt-neo-1.3B')
generator = pipeline('text-generation',model='EleutherAI/gpt-neo-2.7B')
generator = pipeline('text-generation',model='cerebras/Cerebras-GPT-1.3B')
sample_data = '''
Entities: Person, Facility, Location, Organization, Work Of Art, Event, Date, Time, Nationality / Religious / Political group, Law Te
Text: Google was incorporated as a privately held company on September 4, 1998 by Larry Page and Sergey Brin, while they were Ph.D. s
Entities Detected:
Google : Company
September 4, 1998 : Date
Larry Page : Person
Sergey Brin : Person
Stanford University : Organization
California : Location
14 percent : Percentage
56 percent : Percentage
Ph. D. : Degree

Entities: Person, Facility, Location, Organization, Work Of Art, Event, Date, Time, Nationality / Religious / Political group, Law Te
Text: The U.S. President Donald Trump came to visit Ahmedabad for the first time at Reliance University with our Prime Minister Naren
Entities Detected:
U.S. : Location
Donald Trump : Person
```

提示文本中是相同的格式，先给出 Entities 实体名称，再给出 Text 文本，通过文本和实体得到实体检测的结果。

3、意图分类

```python
from transformers import pipeline
# generator = pipeline('text-generation',model='EleutherAI/gpt-neo-1.3B')
generator = pipeline('text-generation',model='EleutherAI/gpt-neo-2.7B')
# generator = pipeline('text-generation',model='cerebras/Cerebras-GPT-1.3B')
prompt_text = '''

Sentence: listen to westbam alumb allergic on Google music
Classification: PlayMusic

Sentence: Give me a list of movie times for films in the area
Classification: SearchScreeningEvent

Sentence: Show me the picture creatures of light and darkness
Classification: SearchCreativeWork

Sentence: I would like to go to the popular bistro in oh
Classification: BookRestaurant'''

input_text = "Sentence: What is the weather like in the city of frewen in the country of"

prompt_text = prompt_text + "\n" + input_text
text = generator(prompt_text, do_sample=True, max_length=150)

print(text[0]['generated_text'])
```

给定句子及其意图类别，通过提示来得到给定输入的意图类别。

三、实验设置及结果

1、实验设置：python3.9，transformer 中导入 pipeline

2、实验结果

文本生成

"In a shocking finding, scientists discovered a herd of unicorns living in a remote, previously unexplored valley, in the Andes Mountains. Even more surprising to the researchers was the fact that the unicorns spoke perfect English."

- gpt-neo-1.3B

The unicorn herd was discovered by a team of researchers from the University of California, Davis, and the National Geographic Society. The team, led by Dr. David R. Smith, a UC Davis professor of ecology and evolutionary biology, discovered the herd by following the tracks of the animals. They were able to follow the unicorn herd for more than a year, until they were forced to leave the valley. In the process, they discovered that there were more unicurs than previously thought.

“We were surprised to find that we were the only ones to have seen this herd,” said Dr Smith. “It was a very unusual discovery.‘‘

Dr Smith and his team were also surprised by the

- gpt-neo-2.7B

The unicorns are not the only animals which have been found to communicate with humans. Dolphins have been found to communicate with dolphins as well as with

human. Dolphins have even been observed to communicate with other dolphins.
The researchers theorized that the unicorns communicated with their human companion because they had a common cultural background. Even though they were isolated and unfamiliar to each other yet they had a much in common.
A human who had visited them for the first time discovered there are not just one species of unicorn in the world but two completely isolated ones in the world, the scientists said.
The species living in the isolated valley was actually known to'

- Cerebras-GPT-1.3B

The researchers, led by Dr. David H. Smith, a professor of anthropology at the University of California, Berkeley, and Drs. Michael J. O'Brien and David A. Rieckhoff, both of the U.S. Geological Survey, found that a group of about 100 unicorn-like creatures lived in an area of high altitude in northern Peru. The researchers also found a large herd living on the same mountain, which they named the "unicorn valley."
"The unicorids were the first animals to be found in this area," said Smith. "They were found by chance, but they were not the only ones."
人工阅读分析：

针对文本生成任务，3 个模型都可以生成比较完整的文本。从人理解及文本的语句相似度来评价，模型 gpt-neo-1.3B 和 Cerebras-GPT-1.3B 生成的内容相对更相关，重复的词较多，与给定 prompt 主题或词更接近，gpt-neo-2.7B 的话题有延展性，能从独角兽（unicorns）的话题联想到海豚（dolphins）、人类（human），描述其相关性等。

客观指标：

多样性（Diversity）：文本生成模型的输出多样性很重要，因为在生成过程中产生的相似或重复的文本会对结果产生负面影响。我们可以使用不同的 n-gram 数量（如 1-gram、2-gram、3-gram 等）或独特单词的比例等指标来度量生成文本的多样性，指标越大越好。

一致性（Consistency）：生成的文本应该与主题内容一致，并且逻辑应该清晰连贯。我们可以使用深度学习库中的语义相似度模型（如 BERT）来计算生成文本与给定主题之间的相似度，指标越大越好。

	gpt-neo-1.3B	gpt-neo-2.7B	Cerebras-GPT-1.3B
Diversity	2.608695652173913	2.4649122807017543	2.7263157894736842
Consistency	0.8552481532096863	0.7763848900794983	0.8764668107032776

根据结果分析，Cerebras-GPT-1.3B 在多样性及一致性上的效果都很高，而 gpt-neo-2.7B 虽然参数更多，但是在生成任务上效果相对较低。和人阅读的感觉一致。

实体检测

Entities: Person, Facility, Location, Organization, Work Of Art, Event, Date, Time, Nationality / Religious / Political group, Law Terms, Product, Percentage, Currency, Language, Quantity, Ordinal Number, Cardinal Number, Degree, Company, Food

Text: Amazon.com, Inc., known as Amazon, is an American online business and cloud computing company. It was founded on July 5, 1994 by Jeff Bezos. It is based in

Seattle, Washington. It is the largest Internet-based store in the world by total sales and market capitalization. Amazon.com started as an online bookstore. When it got bigger, it started selling DVDs, Blu-rays, CDs, video downloads/streaming, MP3s, audiobooks, software, video games, electronics, apparel, furniture, food, toys, and jewelry. It also makes consumer electronics like Kindle e-readers, Fire tablets, Fire TV, and Echo. It is the world's largest provider of cloud computing services. Amazon also sells products like USB cables using the name AmazonBasics.

- gpt-neo-1.3B

Entities Detected:
Amazon : Company
California : Location
Jeff Bezos : Person
Seattle : Location
1994 : Date

- gpt-neo-2.7B

Entities Detected:
Amazon.com : Company
1994 : Date
Jeff Bezos : Person
Seattle : Location
Online bookstore : Event
United States : Nationality / Religious / Political group
Products : Product
Amazon.com : Company
USB cable : Product
2017 : Date

- Cerebras-GPT-1.3B

Entities Detected
Amazon : Company
July 5, 1994 : Date
Jeff Bezos : Subject
Amazon : Business
Innovation / Entrepreneurship : People, Property, Resources, Location, Product
Date : Date
Time : Time
Nationality : Religion
Location : Location
Location : Locatio
Location : Location
Location : Location
Location : Location
Date : Date
Amazon : Company
Business : Property, Resources, Resources, Property, Location, Location, Value

Date : Date
从结果看出 gpt-neo-2.7B 对实体的识别准确率和识别的实体数量都是最高的，说明该模型在有提示情况下生成结果相对更好。
意图分类
input_text = "Sentence: What is the weather like in the city of frewen in the country of"

- gpt-neo-1.3B

Sentence: What is the weather like in the city of frewen in the country of sweden
Classification: TravelInformation

- gpt-neo-2.7B

Sentence: What is the weather like in the city of frewen in the country of auckland
Classification: SearchWeather
Sentence: I'd like to go to the zoo
Classification: BookZoo

- Cerebras-GPT-1.3B

Sentence: What is the weather like in the city of frewen in the country of dal
Classification: CityWeather
sentence: a few days ago i got
Classification: GooglePlayMusicEvent
从结果分析，gpt-neo-2.7B 分类的结果是最准确的，而且后续生成的句子及类别也是相关的。而 gpt-neo-1.3B 可能由于句子中出现地理位置而意图偏向旅游信息。Cerebras-GPT-1.3B 意图类别是准确的，但是生成的下一句则相关性不大。

五、参考文献

[1] https://huggingface.co/transformers/v4.11.3/main_classes/pipelines.html?highlight=pipelines
[2] https://huggingface.co/EleutherAI/gpt-neo-1.3B
[3] https://huggingface.co/EleutherAI/gpt-neo-2.7B
[4] https://huggingface.co/cerebras/Cerebras-GPT-1.3B
[5] 提示工程概览 - 知乎 (zhihu.com)