

1 Models

I chose the following models for evaluation:

- a.) **Large LM:** GPT-4 (The 8K context version, from the OpenAI library)
- b.) **Small LM:** GPT-2 (from hugging face transformer library)

I used the following hyper-params:

	GPT-4	GPT-2
Temperature	0.3	0.3
Max-tokens	200	200

Table 1: Hyperparameters for the two models

2 Prompts

I chose the following three prompts. I considered these phenomenons more complex ones, and thus may tend to differentiate the two model more.

- a.) There are seven continents on earth because
- b.) Water is a polar molecule because
- c.) The earth is round because

Note that, although the token limit is set to a relatively large value, the token limit capped for some outputs from the model.

3 Answers

3.1 There are seven continents on earth because

GPT-4: **There are seven continents on earth because** the Earth's landmass is divided into large, continuous areas that are separated by natural boundaries such as oceans and mountain ranges. These large landmasses are known as continents, and there are seven of them:

1. Africa 2. Antarctica 3. Asia 4. Europe 5. North America 6. Australia (or Oceania, which includes Australia, New Zealand, and the Pacific Islands) 7. South America

The division of the Earth's landmass into continents is based on both geological and geographical factors. The continents have formed over millions of years due to the movement of tectonic plates, which has caused the landmasses to drift, collide, and break apart. In addition to these geological factors, continents are also defined by their distinct geographical features, such as climate, flora, fauna, and human populations.

GPT-2: **There are seven continents on earth because** the moon is a hot spot."

We all have a right to be comfortable, but the truth is we've all been there. There's no greater gift than to have our body to do that.

Discussion:

The GPT-4 model gave a comprehensive reasoning of the phenomenon, it gives a reasoning that is widely accepted by the science community. It provided relevant information to support its reasoning. The argument is reasonably convincing, although not extremely convincing.

The GPT-2 model provided irrelevant information given the question. The quality of the reasoning is very bad. The information provided seems to get even more irrelevant forward through the sequence. The model was gibbering, but the overall grammar looks correct.

Overall, the large GPT-4 model out-performed GPT-2 model by a significant amount.

3.2 Water is a polar molecule because

GPT-4: Water is a polar molecule because it has an uneven distribution of electron density, resulting in regions of partial positive and negative charges within the molecule. This occurs because water (H₂O) is composed of one oxygen atom and two hydrogen atoms, forming a bent molecular structure with an angle of approximately 104.5 degrees between the hydrogen-oxygen-hydrogen atoms.

Oxygen is more electronegative than hydrogen, meaning it has a stronger attraction for electrons. As a result, the shared electrons in the covalent bonds between oxygen and hydrogen are drawn more towards the oxygen atom. This uneven distribution of electron density creates a partial negative charge (δ^-) on the oxygen atom and partial positive charges (δ^+) on the hydrogen atoms.

The presence of these partial charges causes water molecules to exhibit an overall dipole moment, making it a polar molecule. The polarity of water contributes to its unique properties, such as its high boiling point, high specific heat capacity, and ability to dissolve a wide range of substances.

GPT-2: Water is a polar molecule because at high temperatures its polar molecules form a hydroxyl group that is called hydroxyl triphosphate, or triphosphate. The water is considered to be a non-magnetic stable material and can be understood to provide stability as a result of its physical properties: it can retain high temperature, maintain temperature stability and can penetrate air.

In a study published in Nature this week, the researchers at the University of East Anglia and the University of Cambridge, all from the University of Bristol, have found that when they examined surface temperature at high temperatures, the hydroxyl groups formed at supercooled periods - between 2°C and 14°C. This high frequency of formation could help explain the formation of new ice caps where higher ocean temperatures were seen by the Sun.

In a paper published today in the journal Nature Geoscience, scientists in the UK and the US believe they are able to prove in a liquid medium that

Discussion:

Again, the GPT-4 model gave a human-like reasoning of the phenomenon, it gives a reasoning that is widely accepted by the science community. It provided relevant information to support its reasoning. It provided a lot of relevant facts and information, and even expanded on the explanation. The argument is overall very convincing. It can even be used for high school chemistry courses.

The GPT-2 model provided some **seemingly correct mechanism**, although it is in fact, incorrect. The GPT-2 spitted out many professional slang and used a research

from **University of Cambridge and University of Bristol** to support its argument. However, the true underlying mechanism isn't in fact relevant with the information it provided.

Overall, the large GPT-4 model out-performed GPT-2 model by a significant amount. However, GPT-2 did a slightly better job comparing to the previous prompt.

3.3 The earth is round because

GPT-4: The earth is round because of the force of gravity and the way it acts on the planet's mass. When the Earth was forming approximately 4.5 billion years ago, it started as a collection of dust and gas particles in space. As these particles began to clump together due to gravitational attraction, they formed a larger and larger mass.

Gravity pulls objects towards the center of mass, and as the mass of the early Earth grew, the force of gravity increased. This force caused the material to compress and become more dense, eventually forming a solid body. Gravity acts uniformly in all directions towards the center of mass, which causes the Earth to take on a spherical shape, as this is the most energy-efficient configuration that minimizes gravitational potential energy.

While the Earth is not a perfect sphere (it is slightly flattened at the poles and bulging at the equator due to its rotation), it is generally considered to be an oblate spheroid. This round shape is a direct result of the force of gravity acting on

GPT-2: The earth is round because God's will." "And why? Why are we so certain about man?" "Because you are a good man." "All things are in Him whose justice we choose." So we believe. In some cases, the Bible has suggested that these are good examples or that a good person was chosen, which many have questioned. "And why are you so certain about me?" "Because I am not fit to be a man." "You have not found a god to be in you?" "Because you believe!" So one of the major reasons for choosing a god is not for any of these reasons. One may like to think that being a good person makes you a good god. However, most people do not like to think that this means "I am just an evil person by choice." In fact, the reason why such a person would love the world such a lot is because of God. People love God. God does not love them when they like. As

Discussion:

The GPT-4 model gave a comprehensive reasoning of the phenomenon, it gives a reasoning that is widely accepted by the science community. It provided relevant information to support its reasoning. It even indicated a small error in the phenomenon I described. It described the underlying physics mechanism in plain words that is preciable to almost all audiences, good job!

The GPT-2 model provided relevant information, which is an **indeed** alternative reasoning that aligns with other popular belief. However, the other parts of the reasoning is purely non-sense. It started gibbering irrelevant information. It is hard to judge the correctness of its argument. However, the quality of the reasoning is very bad, and the response is mostly irrelevant information.

Again, the large GPT-4 model out-performed GPT-2 model by a significant amount.

4 Code

The code is merged with this PDF file and enclosed below.

```

!pip install tokenizers
!pip install transformers
!pip install openai

import numpy as np
import pandas as pd
import torch
from torch.utils.data import DataLoader
from torch.utils.data import Dataset
import torch.nn as nn
from tqdm import tqdm
import matplotlib.pyplot as plt
import openai
from transformers import GPT2Tokenizer, GPT2LMHeadModel, pipeline

from google.colab import drive
drive.mount('/content/drive')
folder = '/content/drive/MyDrive/CSC401/'
with open(folder+'api.txt', 'r') as file:
    API_KEY = file.read()

📁 Mounted at /content/drive

openai.api_key = API_KEY
message_history = []

```

▼ Large model - GPT4 8K

```

def GPT4_predict(prompt, model='gpt-4', max_token=400):
    message_history.append({"role": "user", "content": f"{prompt}"})

    completion = openai.ChatCompletion.create(
        model=model,
        messages=message_history,
        temperature=0.3,
        max_tokens=max_token
    )

    reply_content = completion.choices[0].message.content

    message_history.append({"role": "assistant", "content": f"{reply_content}"})

    return reply_content

```

▼ Small model - GPT2

```

def GPT2_predict(generator, prompt, max_token=200):
    return generator(prompt, max_length=max_token, num_return_sequences=1)[0]['generated_text']

GPT2_tokenizer = GPT2Tokenizer.from_pretrained('gpt2')
GPT2_model = GPT2LMHeadModel.from_pretrained('gpt2')
generator = pipeline('text-generation', model='gpt2')

prompt1 = 'There are seven continents on earth because'
prompt2 = 'Water is a polar molecule because'
prompt3 = 'The earth is round because'
prompts = [prompt1, prompt2, prompt3]

```

▼ Response from for prompt 1

```

max_len = 200

print(f'{prompt1} \n {GPT4_predict(prompt1, max_token=max_len)}')

There are seven continents on earth because
the Earth's landmass is divided into large, continuous areas that are separated by natural boundaries such as oceans and mountain
1. Africa

```

2. Antarctica
3. Asia
4. Europe
5. North America
6. Australia (or Oceania, which includes Australia, New Zealand, and the Pacific Islands)
7. South America

The division of the Earth's landmass into continents is based on both geological and geographical factors. The continents have form

```
print(f'{prompt1} \n {GPT2_predict(generator, prompt1, max_token=max_len)}')
```

Setting `pad_token_id` to `eos_token_id`:50256 for open-end generation.
 There are seven continents on earth because
 There are seven continents on earth because the moon is a hot spot."

We all have a right to be comfortable, but the truth is we've all been there. There's no greater gift than to have our body to do t

▼ Response from for prompt 2

```
print(f'{prompt2} \n {GPT4_predict(prompt2, max_token=max_len)}')
```

Water is a polar molecule because
 it has an uneven distribution of electron density, resulting in regions of partial positive and negative charges within the molecu
 Oxygen is more electronegative than hydrogen, meaning it has a stronger attraction for electrons. As a result, the shared electrons
 The presence of these partial charges causes water molecules to exhibit an overall dipole moment, making it a polar molecule. The p

```
print(f'{prompt2} \n {GPT2_predict(generator, prompt2, max_token=max_len)}')
```

Setting `pad_token_id` to `eos_token_id`:50256 for open-end generation.
 Water is a polar molecule because
 Water is a polar molecule because at high temperatures its polar molecules form a hydroxyl group that is called hydroxyl triphosph
 In a study published in Nature this week, the researchers at the University of East Anglia and the University of Cambridge, all fro
 In a paper published today in the journal Nature Geoscience, scientists in the UK and the US believe they are able to prove in a li

▼ Response from for prompt 3

```
print(f'{prompt3} \n {GPT4_predict(prompt3, max_token=max_len)}')
```

The earth is round because
 of the force of gravity and the way it acts on the planet's mass. When the Earth was forming approximately 4.5 billion years ago,
 Gravity pulls objects towards the center of mass, and as the mass of the early Earth grew, the force of gravity increased. This for
 While the Earth is not a perfect sphere (it is slightly flattened at the poles and bulging at the equator due to its rotation), it

```
print(f'{prompt3} \n {GPT2_predict(generator, prompt3, max_token=max_len)}')
```

Setting `pad_token_id` to `eos_token_id`:50256 for open-end generation.
 The earth is round because
 The earth is round because of God's will." "And why? Why are we so certain about man?" "Because you are a good man." "All things a

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