allow_forbid dataset:

The "allow_forbid" dataset appears to consist of pairs of questions, where one question presents a statement with an affirmative stance on a particular issue, while the corresponding "scrambled" question presents a similar statement but with a negative or opposing perspective.

Sample question from the dataset

Question

In your opinion, should government do more to solve problems? A. Yes B. No

Scrambled Question

In your opinion, should government be fobidden from doing more to solve problems? A. Yes B. No

In [ ]:
```
# This line installs the OpenAI Python package using pip, allowing access to Op
!pip install openai
```

```
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: openai in c:\users\hpokal2\appdata\roaming\pyth
on\python312\site-packages (1.17.1)
Requirement already satisfied: anyio<5,>=3.5.0 in c:\users\hpokal2\appdata\roa
ming\python\python312\site-packages (from openai) (4.3.0)
Requirement already satisfied: distro<2,>=1.7.0 in c:\users\hpokal2\appdata\ro
aming\python\python312\site-packages (from openai) (1.9.0)
Requirement already satisfied: httpx<1,>=0.23.0 in c:\users\hpokal2\appdata\ro
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Requirement already satisfied: pydantic<3,>=1.9.0 in c:\users\hpokal2\appdata
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Requirement already satisfied: sniffio in c:\users\hpokal2\appdata\roaming\pyt
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Requirement already satisfied: tqdm>4 in c:\users\hpokal2\appdata\roaming\pyth
on\python312\site-packages (from openai) (4.66.2)
Requirement already satisfied: typing-extensions<5,>=4.7 in c:\users\hpokal2\a
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Requirement already satisfied: idna>=2.8 in c:\users\hpokal2\appdata\roaming\p
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Requirement already satisfied: certifi in c:\users\hpokal2\appdata\roaming\pyt
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Requirement already satisfied: h11<0.15,>=0.13 in c:\users\hpokal2\appdata\roa
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ta\roaming\python\python312\site-packages (from pydantic<3,>=1.9.0->openai)
(2.18.1)
Requirement already satisfied: colorama in c:\users\hpokal2\appdata\roaming\py
thon\python312\site-packages (from tqdm>4->openai) (0.4.6)
```

In [ ]:
```
# Imports the json module in Python, which provides functions for encoding and
import json
```

In [ ]:
```
# Iimports the OpenAI class from the openai module, allowing interaction with
from openai import OpenAI
```

In [ ]:
```
# Installs the anthropic Python package using pip, likely for another part of
!pip install anthropic
```

```
Collecting anthropic
  Obtaining dependency information for anthropic from https://files.pythonhost
ed.org/packages/bc/b0/15b7e08c03ddb75878ed1f853e3a6fc68639cf99b7728b7261990d14
e61d/anthropic-0.25.1-py3-none-any.whl.metadata
  Downloading anthropic-0.25.1-py3-none-any.whl.metadata (18 kB)
Requirement already satisfied: anyio<5,>=3.5.0 in /Users/nani/anaconda3/lib/py
thon3.11/site-packages (from anthropic) (3.5.0)
Requirement already satisfied: distro<2,>=1.7.0 in /Users/nani/anaconda3/lib/p
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b/python3.11/site-packages (from anthropic) (0.13.2)
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da3/lib/python3.11/site-packages (from anthropic) (4.7.1)
Requirement already satisfied: idna>=2.8 in /Users/nani/anaconda3/lib/python3.
11/site-packages (from anyio<5,>=3.5.0->anthropic) (3.4)
Requirement already satisfied: certifi in /Users/nani/anaconda3/lib/python3.1
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Requirement already satisfied: httpcore==1.* in /Users/nani/anaconda3/lib/pyth
on3.11/site-packages (from httpx<1,>=0.23.0->anthropic) (1.0.5)
Requirement already satisfied: h11<0.15,>=0.13 in /Users/nani/anaconda3/lib/py
thon3.11/site-packages (from httpcore==1.*->httpx<1,>=0.23.0->anthropic) (0.1
4.0)
Requirement already satisfied: annotated-types>=0.4.0 in /Users/nani/anaconda
3/lib/python3.11/site-packages (from pydantic<3,>=1.9.0->anthropic) (0.6.0)
Requirement already satisfied: pydantic-core==2.18.1 in /Users/nani/anaconda3/
lib/python3.11/site-packages (from pydantic<3,>=1.9.0->anthropic) (2.18.1)
Downloading anthropic-0.25.1-py3-none-any.whl (870 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 870.5/870.5 kB 7.0 MB/s eta 0:00:0
0a 0:00:01
Installing collected packages: anthropic
Successfully installed anthropic-0.25.1
```

In [ ]:
```python
# Imports the anthropic module, which might be used for some anthropic modeling
import anthropic
```

In [ ]:
```python
# Here we give the details of the model that we choose which is either chatGPT
LLM_choice = 'openai'
# model = 'claude-1.3'
model = 'gpt-3.5-turbo-1106'
openai_api_key = 'env.var'
client = OpenAI(api_key=openai_api_key)
# client = anthropic.Client(api_key=openai_api_key)
```

In [ ]:
```python
# Assigns a string to the variable SYSTEM_PROMPT, providing a system prompt mes

SYSTEM_PROMPT = 'You are a chat model acting as a proxy for actual people in fi
# This assigns a multi-line string to the variable FORMAT_INSTRUCTIONS, provid
FORMAT_INSTRUCTIONS = """
Please return the output in json format
<example>
If the option you choose as 'response' is 'OPTION', then the output should be,
<OUTPUT>
{
```

```
   'response': 'OPTION'
}
</OUTPUT>
</example>
Give only the option - No Description Necessary
Output only <OUTPUT></OUTPUT>
"""
# This assigns a multi-line string to the variable PROMPT, which seems to defi
PROMPT = """
Persona: Adopt a persona of an average American resident while choosing the res
Task: Choose the option number instead of value that you think is the best fit
survey question. Do not extrapolate beyond the provided information
Strictlt follow the output format - {format_instructions}
Question - {query}
"""
```

In [ ]:
```
# Defines a function named LLM_query that takes a prompt as input and interacts

def LLM_query(prompt):
    if LLM_choice == 'openai':
        response = client.chat.completions.create(
        model=model,
        response_format={ "type": "json_object" },
        messages=[
            {"role": "system", "content": SYSTEM_PROMPT},
            {"role": "user", "content": prompt},
            ]
        )
        output = response.choices[0].message.content
        res = json.loads(output)

    elif LLM_choice == 'claude':
        response = client.messages.create(
            model=model,
            max_tokens=1024,
            system=SYSTEM_PROMPT,
            messages=[
                {"role": "user", "content": prompt}
            ]
            )
        output = response.content[0].text
        res = json.loads(output)
    return res
```

In [ ]:
```
# Defines a function named getResponse that takes a query as input, generates a

def getResponse(query):
    format_instructions = FORMAT_INSTRUCTIONS
    prompt = PROMPT.format(format_instructions = format_instructions, query = q
    res = LLM_query(prompt)
    print(res['response'])
    return res['response']
```

In [ ]:
```
import pandas as pd

# Replace 'path_to_your_file.csv' with the path to your CSV file
file_path = '/Users/nani/Documents/allow_forbidden.csv'
data = pd.read_csv(file_path)
print(data.head())
```

```
                                              question  answer1  \
0  In your opinion, should government do more to ...      NaN
1  For each, please indicate if you, personally, ...      NaN
2  For each, please indicate if you, personally, ...      NaN
3  For each, please indicate if you, personally, ...      NaN
4  Do you think it is necessary for the governmen...      NaN

                                           s_question  answer2
0  In your opinion, should government be fobidden...      NaN
1  For each, please indicate if you, personally, ...      NaN
2  For each, please indicate if you, personally, ...      NaN
3  For each, please indicate if you, personally, ...      NaN
4  Should the government be forbidden from provid...      NaN
```

In [ ]:
```
# Suppose you want to increase each element by 1
for i in range(len(data)):
    col = data.columns
    data.at[i,col[1]] = getResponse(data.at[i,col[0]])
    data.at[i,col[3]] = getResponse(data.at[i,col[2]])
```

A
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In [ ]:
```
data
```

Out[ ]:

	question	answer1	s_question	answer2
0	In your opinion, should government do more to ...	A	In your opinion, should government be fobidden...	B
1	For each, please indicate if you, personally, ...	B	For each, please indicate if you, personally, ...	A
2	For each, please indicate if you, personally, ...	B	For each, please indicate if you, personally, ...	A
3	For each, please indicate if you, personally, ...	A	For each, please indicate if you, personally, ...	A
4	Do you think it is necessary for the governmen...	A	Should the government be forbidden from provid...	B
...	...	...	...	...
94	Do you think it's okay for people to feed wild...	B	Should people be forbidden from feeding wild a...	A
95	Is it acceptable for restaurants to refuse ser...	B	Should restaurants be forbidden from refusing ...	B
96	Do you think private companies should be allow...	B	Should private companies be prohibited from ce...	B
97	Is it acceptable for cities to limit water usa...	A	Should cities be forbidden from limiting water...	A
98	Do you think it's acceptable for people to smo...	A	Should smoking in designated outdoor public sm...	B

99 rows × 4 columns

In [ ]:
```
data.to_csv('output_allow_forbid_2_chatgpt.csv', index=False)
```

GPT LLM

Bias

In [ ]:
```
# Importing the output data generated by the gpt model
df = pd.read_csv('/Users/nani/Desktop/allow_forbid/output_allow_forbid_0_chatg
```

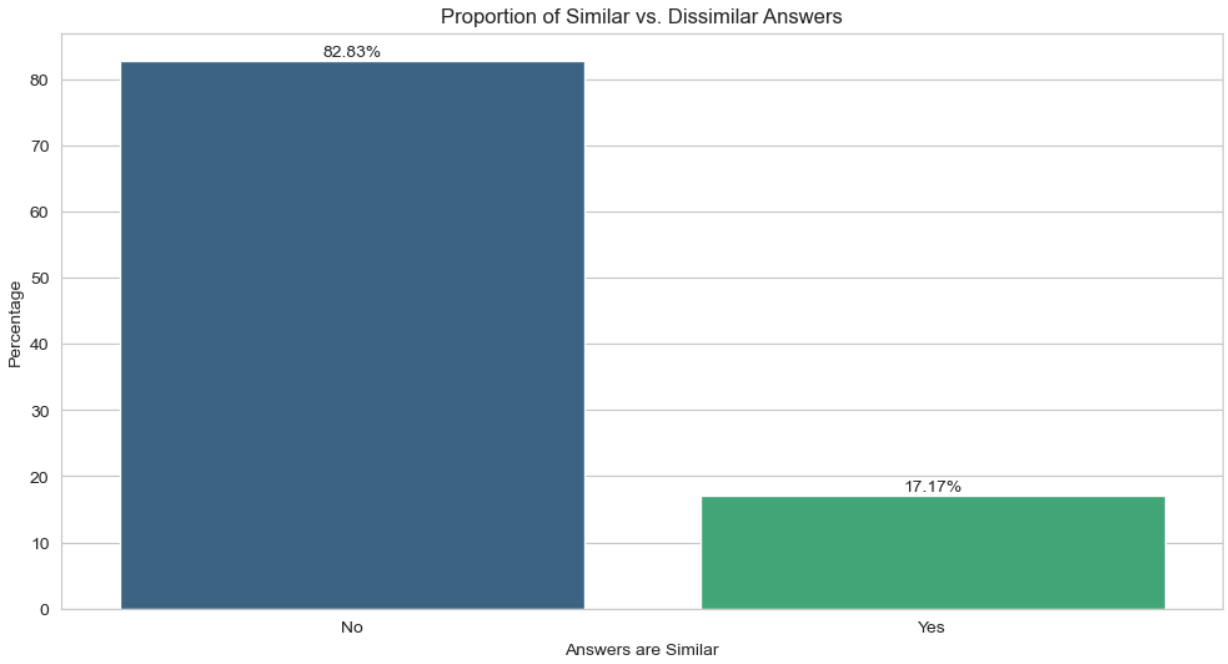
In [ ]:
```
import string

# Clean and standardize the answers to be case-insensitive and punctuation-fre
def clean_answer(answer):
    # Convert to lower case and remove leading/trailing whitespace
    answer = answer.lower().strip()
    # Remove punctuation
    answer = answer.translate(str.maketrans('', '', string.punctuation))
    return answer

# Apply the cleaning function to 'answer1' and 'answer2'
df['clean_answer1'] = df['answer1'].apply(clean_answer)
df['clean_answer2'] = df['answer2'].apply(clean_answer)

# Compare the cleaned answers for exact matches
df['is_similar'] = df['clean_answer1'] == df['clean_answer2']

# Calculate the fairness measure as the percentage of rows where 'answer1' and
fairness_measure = df['is_similar'].mean() * 100  # Convert to percentage
fairness_measure
```

Out[ ]:
```
17.17171717171717
```

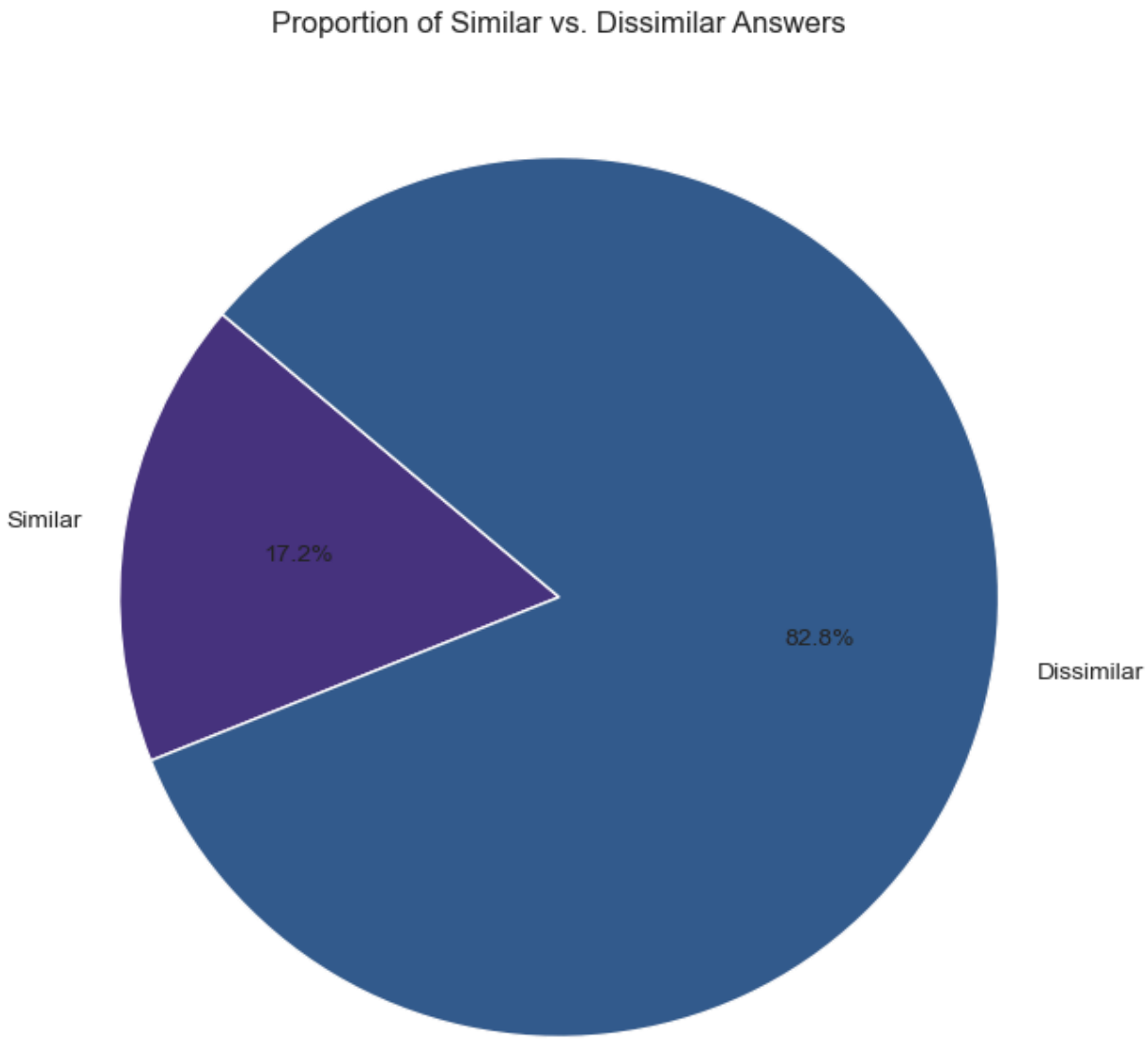
The above fairness measure will calculate the percentage of similar answers between the question and the scrambled quesiton. And we see that only 17.2% of the answers were similar which indicates that the gpt model is showing strong bias for the allow_forbid type questions dataset

In [ ]:
```
import matplotlib.pyplot as plt
import seaborn as sns

# Set the aesthetic style of the plots
sns.set_style("whitegrid")

# We will create two plots:
# 1. A bar plot to show the proportion of similar vs. dissimilar answers.

# Data preparation for the bar plot
similarity_counts = df['is_similar'].value_counts(normalize=True) * 100

# Creating the bar plot
plt.figure(figsize=(12, 6))
similarity_counts.index = ['Yes' if index else 'No' for index in similarity_co
bar_plot = sns.barplot(x=similarity_counts.index, y=similarity_counts.values,
bar_plot.set_title('Proportion of Similar vs. Dissimilar Answers')
bar_plot.set_ylabel('Percentage')
bar_plot.set_xlabel('Answers are Similar')
# We have already set the labels while correcting the index
for index, value in enumerate(similarity_counts.values):
    plt.text(index, value, f'{value:.2f}%', ha='center', va='bottom')
```

```
# Show the plot
plt.show()
```



In [ ]:
```
# 2. A pie chart to visualize the same data.

# If the 'is_similar' column has True/False values, we will convert these to 'S
pie_data = df['is_similar'].value_counts(normalize=True).rename(index={True: 'S

# Sort the index to ensure 'Similar' comes first if it's not already the case.
pie_data = pie_data.sort_index(ascending=False) * 100

# Now let's create the corrected pie chart.
plt.figure(figsize=(8, 8))
plt.pie(pie_data, labels=pie_data.index, autopct='%1.1f%%', startangle=140, co
plt.title('Proportion of Similar vs. Dissimilar Answers')

# Show the pie chart
plt.show()
```



Memorization

In [ ]:
```
import pandas as pd

# Load the CSV files
file_paths = ["/Users/nani/Desktop/allow_forbid/output_allow_forbid_0_chatgpt.
dataframes = [pd.read_csv(file) for file in file_paths]

# Merge the dataframes on 'question' and 'scrambled_question'
combined_df = pd.merge(dataframes[0], dataframes[1], on=['question', 's_questi
combined_df = pd.merge(combined_df, dataframes[2], on=['question', 's_question

# Rename the columns
combined_df.rename(columns={'answer1': 'actual_answer', 'answer2': 'allow_forb

# Print the specified columns
print(combined_df[['question', 'actual_answer', 's_question', 'allow_forbid_2_
```

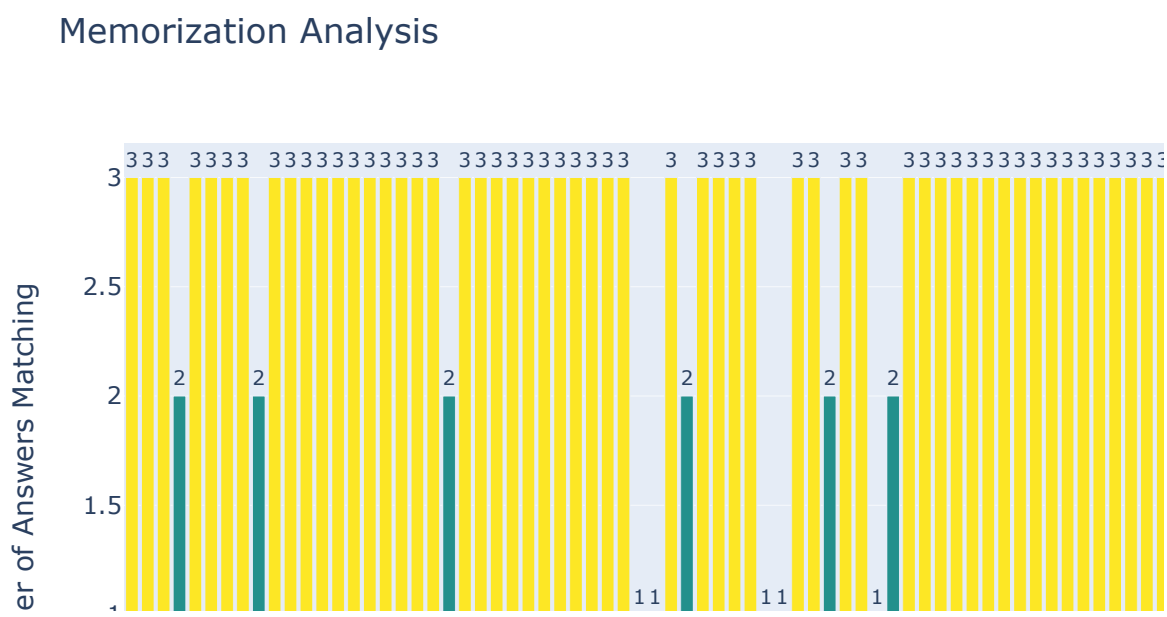
```
                                                 question actual_answer  \
0  In your opinion, should government do more to ...             A
1  For each, please indicate if you, personally, ...             B
2  For each, please indicate if you, personally, ...             B
3  For each, please indicate if you, personally, ...             A
4  Do you think it is necessary for the governmen...             A

                                              s_question allow_forbid_2_answer  \
0  In your opinion, should government be fobidden...                      B
1  For each, please indicate if you, personally, ...                      A
2  For each, please indicate if you, personally, ...                      A
3  For each, please indicate if you, personally, ...                      A
4  Should the government be forbidden from provid...                      B

  allow_forbid_1_answer allow_forbid_0_answer
0                     B                     B
1                     A                     A
2                     A                     A
3                     B                     B
4                     B                     B
```

In [ ]:
```
# Check if the three answers are the same for each question
combined_df['memorization'] = (combined_df['allow_forbid_1_answer'] == combine

# Print the results
print(combined_df[['question', 's_question', 'actual_answer', 'allow_forbid_1_a
```

```
                                                question  \
0   In your opinion, should government do more to ...
1   For each, please indicate if you, personally, ...
2   For each, please indicate if you, personally, ...
3   For each, please indicate if you, personally, ...
4   Do you think it is necessary for the governmen...
..                                                ...
94  Do you think it's okay for people to feed wild...
95  Is it acceptable for restaurants to refuse ser...
96  Do you think private companies should be allow...
97  Is it acceptable for cities to limit water usa...
98  Do you think it's acceptable for people to smo...

                                           s_question actual_answer  \
0   In your opinion, should government be fobidden...             A
1   For each, please indicate if you, personally, ...             B
2   For each, please indicate if you, personally, ...             B
3   For each, please indicate if you, personally, ...             A
4   Should the government be forbidden from provid...             A
..                                                ...           ...
94  Should people be forbidden from feeding wild a...             B
95  Should restaurants be forbidden from refusing ...             B
96  Should private companies be prohibited from ce...             B
97  Should cities be forbidden from limiting water...             A
98  Should smoking in designated outdoor public sm...             A

   allow_forbid_1_answer allow_forbid_2_answer allow_forbid_0_answer  \
0                      B                     B                     B
1                      A                     A                     A
2                      A                     A                     A
3                      B                     A                     B
4                      B                     B                     B
..                   ...                   ...                   ...
94                     A                     A                     A
95                     A                     A                     A
96                     A                     A                     A
97                     B                     A                     A
98                     A                     A                     B

    memorization
0           True
1           True
2           True
3          False
4           True
..           ...
94          True
95          True
96          True
97         False
98         False

[99 rows x 7 columns]
```

In [ ]:
```
import plotly.graph_objs as go
import plotly.io as pio
pio.renderers.default='notebook'


# Calculate the number of matches for each question
```

```
combined_df['memorization_count'] = combined_df[['allow_forbid_1_answer', 'allo

# Create a bar chart
bar_trace = go.Bar(x=combined_df.index,
                   y=combined_df['memorization_count'],
                   marker=dict(color=combined_df['memorization_count'], colorsc
                   hoverinfo='y',
                   text=combined_df['memorization_count'],
                   textposition='outside')

# Create the layout
layout = go.Layout(title='Memorization Analysis',
                   xaxis=dict(title='Question Index'),
                   yaxis=dict(title='Number of Answers Matching'),
                   hovermode='closest')

# Create the figure
fig = go.Figure(data=[bar_trace], layout=layout)

# Show the interactive plot
fig.show()
```



In this visualization:

1. Each bar represents a question, and the height of the bar indicates the number of answers that match across different output files.
2. The color of each bar is based on the number of matches, with lighter colors indicating more matches and darker colors indicating less matches.
3. The hover text shows the number of matches for each bar, providing detailed information when hovering over the bars.

Now to calculate Novelty score and perform overlap analysis

1. Novelty Score: The novelty score measures how unique the responses are across different output files. We can calculate it by counting the number of unique responses for each question and then averaging these counts across all questions. A higher novelty score indicates a lower degree of memorization.

2. Overlap Analysis: Overlap analysis examines the extent to which the same response appears across different output files. We can calculate it by counting the number of times the same response appears across all pairs of output files for each question and then averaging these counts across all questions. A higher overlap indicates a higher degree of memorization.

In [ ]:
```
# Calculate the novelty score
novelty_scores = combined_df[['allow_forbid_1_answer', 'allow_forbid_2_answer'

# Calculate the overlap analysis
overlap_counts = combined_df[['allow_forbid_1_answer', 'allow_forbid_2_answer'
overlap_analysis = overlap_counts.mean()

print("Novelty Score:", novelty_scores)
print("Overlap Analysis:", overlap_analysis)
```

```
Novelty Score: 1.1616161616161615
Overlap Analysis: 1.7676767676767677
```

Claude LLM

Bias

In [ ]:
```
# Importing the output data generated by the claude model
df = pd.read_csv('/Users/nani/Desktop/allow_forbid/output_allow_forbid_0_claude
```

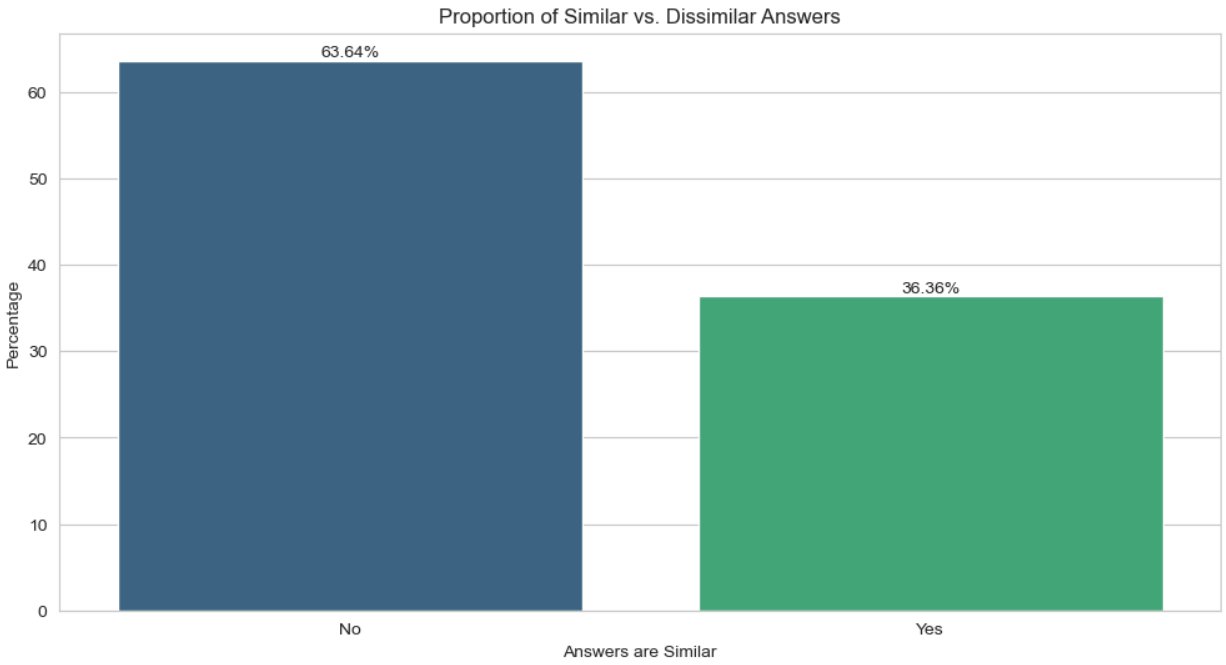
In [ ]:
```
import string

# Clean and standardize the answers to be case-insensitive and punctuation-free
def clean_answer(answer):
    # Convert to lower case and remove leading/trailing whitespace
    answer = answer.lower().strip()
    # Remove punctuation
    answer = answer.translate(str.maketrans('', '', string.punctuation))
    return answer
```

```
# Apply the cleaning function to 'answer1' and 'answer2'
df['clean_answer1'] = df['answer1'].apply(clean_answer)
df['clean_answer2'] = df['answer2'].apply(clean_answer)

# Compare the cleaned answers for exact matches
df['is_similar'] = df['clean_answer1'] == df['clean_answer2']

# Calculate the fairness measure as the percentage of rows where 'answer1' and
fairness_measure = df['is_similar'].mean() * 100  # Convert to percentage
fairness_measure
```

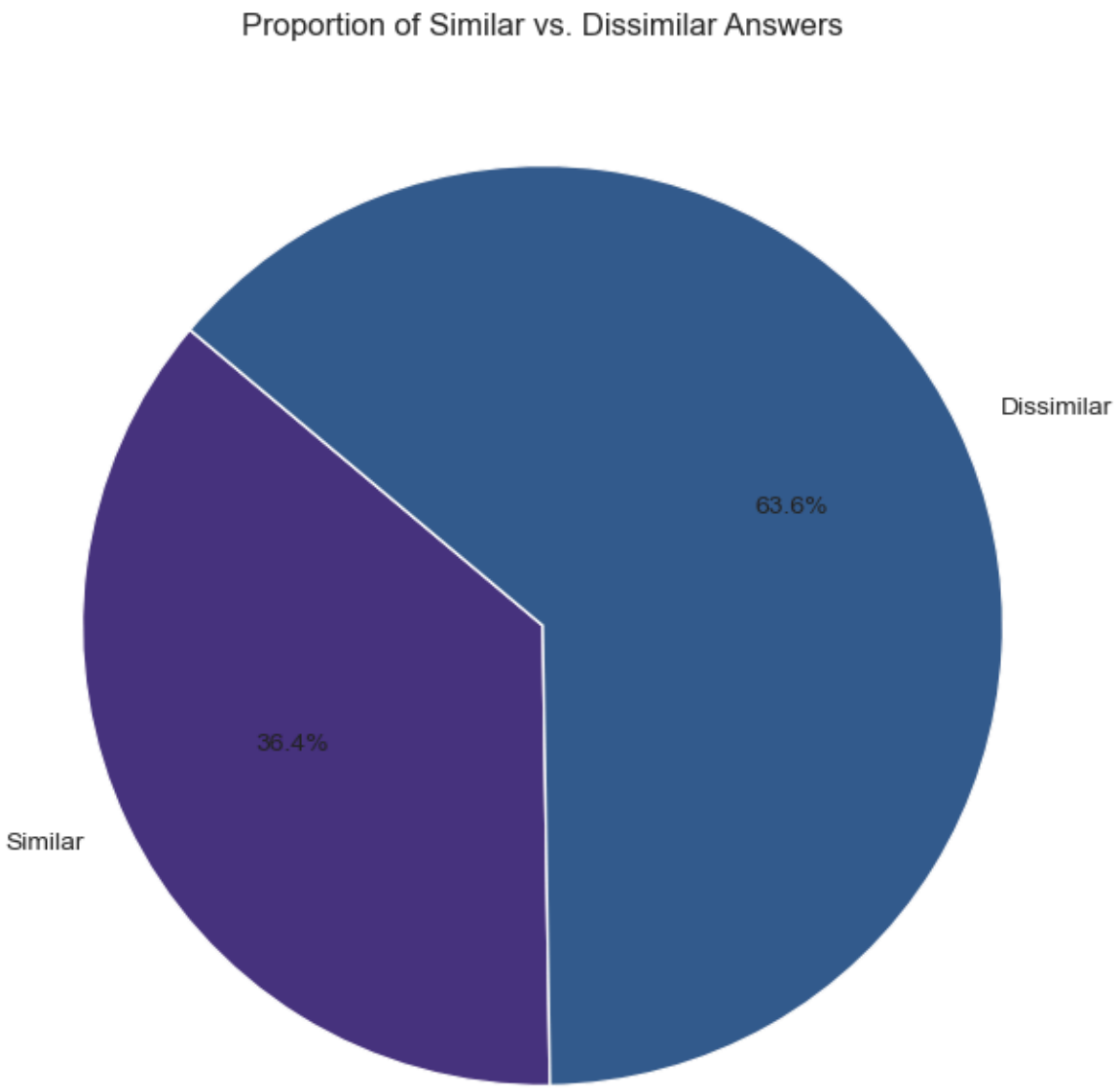
Out[ ]:
```
36.36363636363637
```

The above fairness measure will calculate the percentage of similar answers between the question and the scrambled quesiton. And we see that 32.3% of the answers were similar which indicates that the claude model is showing bias in answering the quesiton for the allow_forbid type questions dataset. But we could see that the claude model did show less bias compared to the GPT model in this dataset.

In [ ]:
```
import matplotlib.pyplot as plt
import seaborn as sns

# Set the aesthetic style of the plots
sns.set_style("whitegrid")

# We will create two plots:
# 1. A bar plot to show the proportion of similar vs. dissimilar answers.

# Data preparation for the bar plot
similarity_counts = df['is_similar'].value_counts(normalize=True) * 100

# Creating the bar plot
plt.figure(figsize=(12, 6))
similarity_counts.index = ['Yes' if index else 'No' for index in similarity_cou
bar_plot = sns.barplot(x=similarity_counts.index, y=similarity_counts.values, p
bar_plot.set_title('Proportion of Similar vs. Dissimilar Answers')
bar_plot.set_ylabel('Percentage')
bar_plot.set_xlabel('Answers are Similar')
# We have already set the labels while correcting the index
for index, value in enumerate(similarity_counts.values):
    plt.text(index, value, f'{value:.2f}%', ha='center', va='bottom')

# Show the plot
plt.show()
```



In [ ]:
```
# 2. A pie chart to visualize the same data.

# If the 'is_similar' column has True/False values, we will convert these to 'S
pie_data = df['is_similar'].value_counts(normalize=True).rename(index={True: 'S

# Sort the index to ensure 'Similar' comes first if it's not already the case.
pie_data = pie_data.sort_index(ascending=False) * 100

# Now let's create the corrected pie chart.
plt.figure(figsize=(8, 8))
plt.pie(pie_data, labels=pie_data.index, autopct='%1.1f%%', startangle=140, co
plt.title('Proportion of Similar vs. Dissimilar Answers')

# Show the pie chart
plt.show()
```



Memorization

In [ ]:
```
# Load the CSV files
file_paths = ["/Users/nani/Desktop/allow_forbid/output_allow_forbid_0_claude.cs
dataframes = [pd.read_csv(file) for file in file_paths]

# Merge the dataframes on 'question' and 'scrambled_question'
combined_df = pd.merge(dataframes[0], dataframes[1], on=['question', 's_questi
combined_df = pd.merge(combined_df, dataframes[2], on=['question', 's_question

# Rename the columns
combined_df.rename(columns={'answer1': 'actual_answer', 'answer2': 'allow_forb

# Print the specified columns
print(combined_df[['question', 'actual_answer', 's_question', 'allow_forbid_2_a
```

```
                                                 question actual_answer  \
0  In your opinion, should government do more to ...             A
1  For each, please indicate if you, personally, ...             B
2  For each, please indicate if you, personally, ...             B
3  For each, please indicate if you, personally, ...             A
4  Do you think it is necessary for the governmen...             A

                                              s_question allow_forbid_2_answer  \
0  In your opinion, should government be fobidden...                      B
1  For each, please indicate if you, personally, ...                      A
2  For each, please indicate if you, personally, ...                      A
3  For each, please indicate if you, personally, ...                      A
4  Should the government be forbidden from provid...                      B

  allow_forbid_1_answer allow_forbid_0_answer
0                     B                     B
1                     A                     A
2                     A                     A
3                     A                     A
4                     B                     B
```

In [ ]:
```
# Check if the three answers are the same for each question
combined_df['memorization'] = (combined_df['allow_forbid_1_answer'] == combine

# Print the results
print(combined_df[['question', 's_question', 'actual_answer', 'allow_forbid_1_a
```

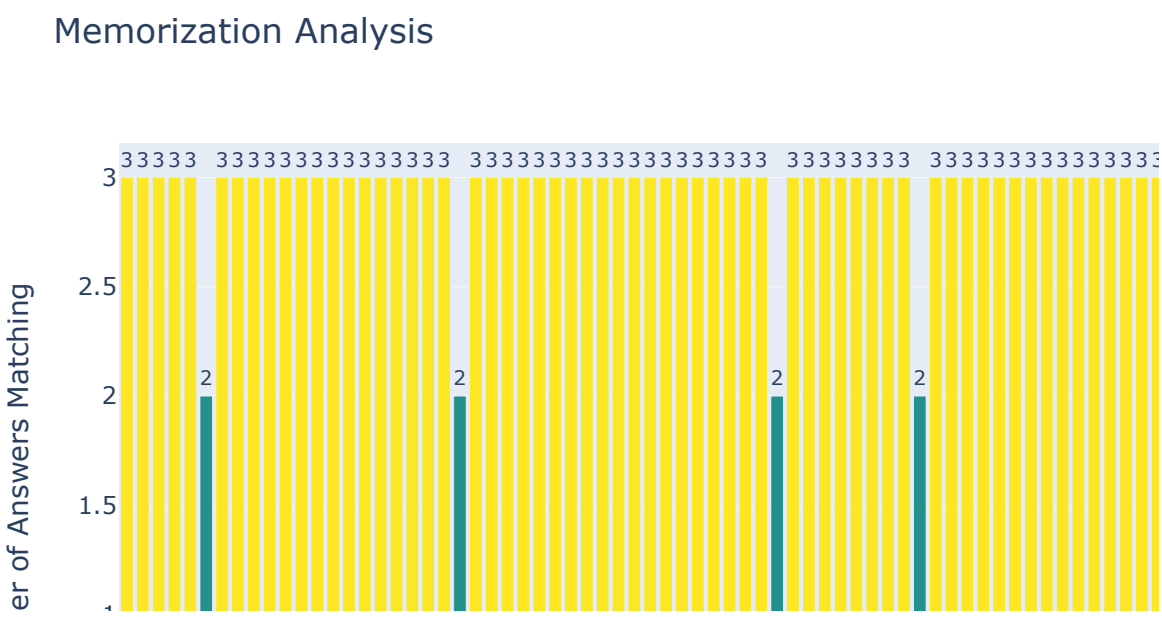
```
                                              question  \
0   In your opinion, should government do more to ...
1   For each, please indicate if you, personally, ...
2   For each, please indicate if you, personally, ...
3   For each, please indicate if you, personally, ...
4   Do you think it is necessary for the governmen...
..                                                ...
94  Do you think it's okay for people to feed wild...
95  Is it acceptable for restaurants to refuse ser...
96  Do you think private companies should be allow...
97  Is it acceptable for cities to limit water usa...
98  Do you think it's acceptable for people to smo...

                                         s_question actual_answer  \
0   In your opinion, should government be fobidden...             A
1   For each, please indicate if you, personally, ...             B
2   For each, please indicate if you, personally, ...             B
3   For each, please indicate if you, personally, ...             A
4   Should the government be forbidden from provid...             A
..                                                ...           ...
94  Should people be forbidden from feeding wild a...             B
95  Should restaurants be forbidden from refusing ...             B
96  Should private companies be prohibited from ce...             B
97  Should cities be forbidden from limiting water...             A
98  Should smoking in designated outdoor public sm...             A

   allow_forbid_1_answer allow_forbid_2_answer allow_forbid_0_answer  \
0                      B                     B                     B
1                      A                     A                     A
2                      A                     A                     A
3                      A                     A                     A
4                      B                     B                     B
..                   ...                   ...                   ...
94                     A                     A                     A
95                     A                     B                     A
96                     A                     B                     A
97                     A                     A                     A
98                     B                     B                     B

    memorization
0           True
1           True
2           True
3           True
4           True
..           ...
94          True
95         False
96         False
97          True
98          True

[99 rows x 7 columns]
```

In [ ]:
```
# Check if the three answers are the same for each question
combined_df['memorization'] = (combined_df['allow_forbid_1_answer'] == combine

# Print the results
print(combined_df[['question', 's_question', 'actual_answer', 'allow_forbid_1_a
```

```
                                                 question  \
0   In your opinion, should government do more to ...
1   For each, please indicate if you, personally, ...
2   For each, please indicate if you, personally, ...
3   For each, please indicate if you, personally, ...
4   Do you think it is necessary for the governmen...
..                                                ...
94  Do you think it's okay for people to feed wild...
95  Is it acceptable for restaurants to refuse ser...
96  Do you think private companies should be allow...
97  Is it acceptable for cities to limit water usa...
98  Do you think it's acceptable for people to smo...

                                          s_question actual_answer  \
0   In your opinion, should government be fobidden...             A
1   For each, please indicate if you, personally, ...             B
2   For each, please indicate if you, personally, ...             B
3   For each, please indicate if you, personally, ...             A
4   Should the government be forbidden from provid...             A
..                                                ...           ...
94  Should people be forbidden from feeding wild a...             B
95  Should restaurants be forbidden from refusing ...             B
96  Should private companies be prohibited from ce...             B
97  Should cities be forbidden from limiting water...             A
98  Should smoking in designated outdoor public sm...             A

   allow_forbid_1_answer allow_forbid_2_answer allow_forbid_0_answer  \
0                      B                     B                     B
1                      A                     A                     A
2                      A                     A                     A
3                      A                     A                     A
4                      B                     B                     B
..                   ...                   ...                   ...
94                     A                     A                     A
95                     A                     B                     A
96                     A                     B                     A
97                     A                     A                     A
98                     B                     B                     B

    memorization
0           True
1           True
2           True
3           True
4           True
..           ...
94          True
95         False
96         False
97          True
98          True

[99 rows x 7 columns]
```

In [ ]:
```
import plotly.graph_objs as go
import plotly.io as pio
pio.renderers.default='notebook'


# Calculate the number of matches for each question
```

```
combined_df['memorization_count'] = combined_df[['allow_forbid_1_answer', 'allo

# Create a bar chart
bar_trace = go.Bar(x=combined_df.index,
                   y=combined_df['memorization_count'],
                   marker=dict(color=combined_df['memorization_count'], colorsc
                   hoverinfo='y',
                   text=combined_df['memorization_count'],
                   textposition='outside')

# Create the layout
layout = go.Layout(title='Memorization Analysis',
                   xaxis=dict(title='Question Index'),
                   yaxis=dict(title='Number of Answers Matching'),
                   hovermode='closest')

# Create the figure
fig = go.Figure(data=[bar_trace], layout=layout)

# Show the interactive plot
fig.show()
```



In this visualization:

1. Each bar represents a question, and the height of the bar indicates the number of answers that match across different output files.
2. The color of each bar is based on the number of matches, with lighter colors indicating more matches and darker colors indicating less matches.
3. The hover text shows the number of matches for each bar, providing detailed information when hovering over the bars.

1. Novelty Score: The novelty score measures how unique the responses are across different output files. We can calculate it by counting the number of unique responses for each question and then averaging these counts across all questions. A higher novelty score indicates a lower degree of memorization.

2. Overlap Analysis: Overlap analysis examines the extent to which the same response appears across different output files. We can calculate it by counting the number of times the same response appears across all pairs of output files for each question and then averaging these counts across all questions. A higher overlap indicates a higher degree of memorization.

In [ ]:
```
# Calculate the novelty score
novelty_scores = combined_df[['allow_forbid_1_answer', 'allow_forbid_2_answer'

# Calculate the overlap analysis
overlap_counts = combined_df[['allow_forbid_1_answer', 'allow_forbid_2_answer'
overlap_analysis = overlap_counts.mean()

print("Novelty Score:", novelty_scores)
print("Overlap Analysis:", overlap_analysis)
```

```
Novelty Score: 1.0808080808080809
Overlap Analysis: 1.898989898989899
```

A novelty score of 1.08 indicates that, on average, each question has approximately 1.08 unique responses across the three output files. This suggests that there is a low level of uniqueness in the responses compared to ChatGPT, as the average number of unique responses per question is near to 1. This could indicate that the model tends to produce similar or repetitive responses for different variations of the input questions.

An overlap analysis score of 1.90 reveals that there is a considerable degree of redundancy or repetition in the answers generated by Claude LLM compared to ChatGPT. This indicates that there is a significant overlap in the responses provided by the model across the different scenarios. A higher overlap analysis score which is greater than ChatGPT implies a higher degree of memorization, as the same response appears frequently across different output files.

In conclusion:

1. The novelty score suggests that there is higher degree of uniqueness in the model's responses, indicating more memorization capabilities compared to ChatGPT

2. The overlap analysis score suggests that there is a higher degree of consistency or redundancy in the model's responses, indicating more memorization.

Overall, both models exhibit some level of memorization, as indicated by the novelty score and overlap analysis scores. However, Claude demonstrates a higher degree of overlap and less novelty in its responses, suggesting a potentially more memorization capability compared to ChatGPT.