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SHERLOCK HOLMES

ChatGPT-based chatbot with a personality

Practicum I

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Intro

Sherlock Holmes is a fictional detective of the late 19th and early 20th centuries, who first appeared in publication in 1887. He was devised by British author and physician Sir Arthur Conan Doyle. A brilliant London-based detective, Holmes is famous for his prowess at using logic and astute observation to solve cases. He is perhaps the most famous fictional detective, and indeed one of the best-known and most universally recognizable literary characters.

Wiki

Sherlock Holmes

Sherlock Holmes character

Sherlock Holmes in a 1904 illustration by Sidney Paget

First appearance	*A Study in Scarlet* (1887)
Last appearance	"The Adventure of Shoscombe Old Place" (1927, canon)
Created by	Sir Arthur Conan Doyle
In-universe information	
Occupation	Consulting private detective
Family	Mycroft Holmes (brother)
Nationality	British
Born	1854

Caption: Illustration of Sherlock Holmes and Dr. Watson Sherlock Holmes (right) explaining to Dr. Watson what he has deduced from a pipe left behind by a visitor; illustration by Sidney Paget for Sir Arthur Conan Doyle's "The Adventure of the Yellow Face," *The Strand Magazine*, 1893

About Holmes

Holmes approaches each problem with a strict scientific approach. In addition to his intellectual gifts, he also possesses an remarkable ability to disguise himself, a proficiency in playing the violin, and an intense enthusiasm for complex mental puzzles, leaning towards laziness or being erratic in his behavior when he is not mesmerized by a challenging issue. Holmes is emotionally detached, demonstrates iron-like focus, and exhibits selective learning, refusing to acknowledge facts that he finds unimportant. In spite of his apparent emotional aloofness, he is strongly devoted to his partner Dr. Watson and holds in high regard the very observant Princess Irene Adler. With his rational mind and enigmatic personality, Sherlock Holmes remains an enduring symbol of inquisitiveness and mental sharpness.

Why choose Sherlock?

We chose Sherlock Holmes as the character for our chatbot because we have adored him since our childhood days. We were always interested in detective fiction during our childhood, and the fact that Sherlock's astute mind, sharp observation, and zeal to solve mysteries won our hearts. We, like most children, were drawn to his personality and inspired by him. His sharp perception to notice the slightest clues, rational thinking, and capacity to keep calm even in pressure makes him ideally a fit as a proper chatbot that can think and respond like a detective. A chatbot based on the theme of Sherlock doesn't just offer intelligent responses, it's a light-hearted, engaging experience where every chat is like solving a mystery case.

Literature Details

The total collection has 4 novels:

- A Study in Scarlet (1887)
- The Sign of the Four (1890)
- The Hound of the Baskervilles (1901–1902)
- The Valley of Fear (1914–1915)
- Another 56 short stories

Important Characters

Other characters from the franchise:

- Dr. John H. Watson
- Mycroft Holmes
- Inspector Lestrade

Important Character Traits

Holmes is:

- Shrewd
- Logical
- Socially awkward
- Observant

EXPERIMENT

Data Generation

In this project, we first downloaded all the Sherlock Holmes stories (4 novels and 56 short stories) from Kaggle. We combined them into one large text file. Then, we used regular expressions to find and extract the lines spoken by Sherlock Holmes. These patterns helped us catch different ways Holmes's dialogue appears in the text. For example, in "I have no data yet," said Holmes, the sentence comes before, “said Holmes.” In another case like Holmes said, "It is a capital mistake to theorize before one has data," the quote comes after “Holmes said.” Sometimes it appears in a more descriptive way, like Sherlock replied, "You see, but you do not observe."

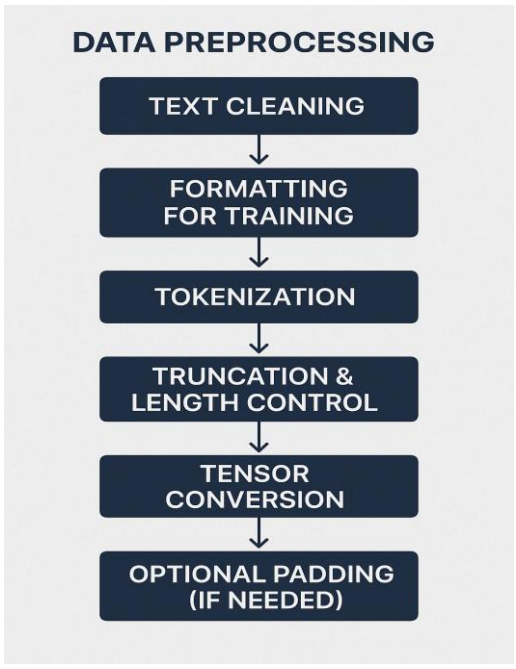
We also looked for patterns where Holmes might be speaking but it’s written in a different form, such as "It’s elementary," I said, which may come from Holmes through Watson's narration. We removed short sentences with less than 20 characters to keep only useful dialogue. After collecting these sentences, we used GPT-2 to generate Question-Answer pairs for each. All these Q&A pairs were saved in a text file to train our model.

Data Preprocessing

The data preprocessing for fine-tuning the Sherlock Holmes chatbot follows six main steps.

- First, we clean the text by removing extra spaces, fixing punctuation, and keeping the format consistent.
- Then, we add special tokens like <|startoftext|> and <|endoftext|> around each Question-Answer pair to show where each input and output starts and ends.
- After that, we use GPT-2’s tokenizer to turn the text into tokens that the model can understand.
- We make sure the total length of each sequence is not more than 1024 tokens by using truncation.
- These tokenized sequences are then changed into PyTorch tensors so they can be used for training.
- Padding is added if needed to make all sequences in a batch the same size.

These steps help prepare clean and structured data for training the chatbot.

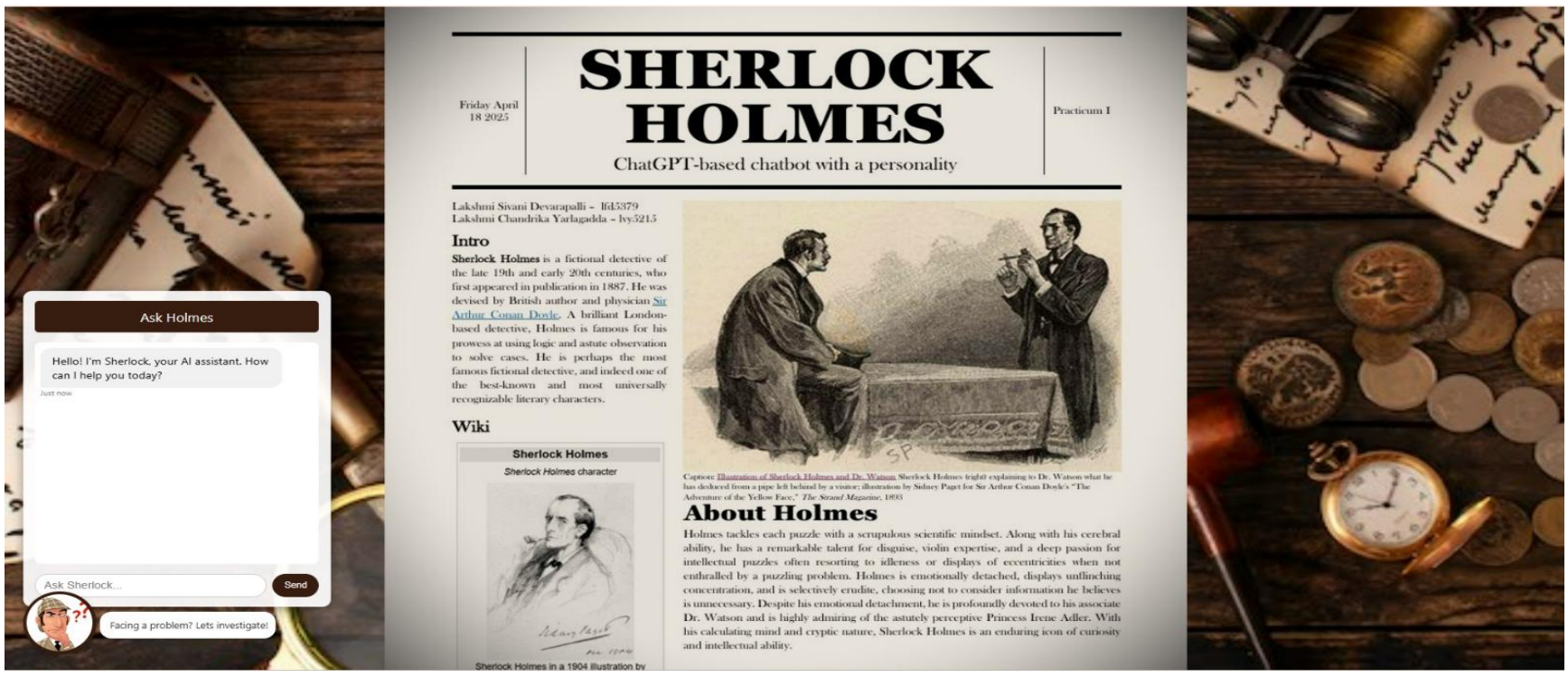


Model and training

The load_dataset function loads the QA text file and breaks it into manageable chunks with the help of the GPT-2 tokenizer. A data collator is used while training to format the tokenized text into a suitable format for GPT-2's causal language modeling. The train function initializes GPT-2 with pretrain weights and then trains it on the conversational data of Sherlock. The training was conducted with a low learning rate and epoch to ensure Sherlock's personality is retained while having contextual and coherent responses.

UI design

We also designed a web page for Sherlock Holmes to use the bot. This webpage displays a Sherlock-themed chatbot UI with a toggleable chat popup that allows users to send messages and receive responses from a backend API.



Caption: User Interface for the chatbot we have developed

RESULTS

Prompts and responses

Without training:

```
url = baseurl + "/chatbot"

# send a query to the chatbot
query = 'How do you spend your free time?'
response = requests.post(url, json={'text': query})

# print the response
print(response.json())
```

```
{'cleaned_response': "Well, I don't know if I could do this for you. I just wanted to make it clear to you that I love entertaining and I love my job."
```

```
url = baseurl + "/chatbot"

# send a query to the chatbot
query = 'Sherlock Holmes, where do you live?'
response = requests.post(url, json={'text': query})

# print the response
print(response.json())
```

```
{'cleaned_response': 'Yes, I live in Chicago. But I live in Westwood, Illinois. I live in Santa Fe, New Mexico. I live in Myrtle Beach, South Carolina. Elementary
```

```
url = baseurl + "/chatbot"

# send a query to the chatbot
query = 'Sherlock Holmes, how do you develop your exceptional skills?'
response = requests.post(url, json={'text': query})

# print the response
print(response.json())
```

```
{'cleaned_response': 'How do you create a strong and authentic way of interacting with people and being more connected to the world around you?
```

With training (Client responses);

```
url = baseurl + "/chatbot"

# send a query to the chatbot
query = 'Sherlock Holmes, where do you live?'
response = requests.post(url, json={'text': query})

# print the response
print(response.json())
```

```
{'cleaned_response': 'My house is situated at the northernmost end of the city, between the hills and the city. I am a hard worker and dependable individual who often has to face obstacles in my pursuit of justice.
```

```
url = baseurl + "/chatbot"

# send a query to the chatbot
query = 'How do you spend your free time?'
response = requests.post(url, json={'text': query})

# print the response
print(response.json())
```

```
{'cleaned_response': 'I spend my free time trying to figure out the best way to solve crimes and solve complex cases. It is important to me to stay focused on solving cases and keeping my focus on solving the cases I solve.'
```

```
url = baseurl + "/chatbot"

# send a query to the chatbot
#query = 'Sherlock Holmes, where do you live?'
query = 'Sherlock Holmes, how do you develop your exceptional skills?'
response = requests.post(url, json={'text': query})

# print the response
print(response.json())
```

```
{'cleaned_response': 'I use my skills to help me solve cases and solve cases that others may not think I can solve.
```

With training (UI):