

Project 2 Chatbot Report

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System Description:

Introduction:

My chatbot is a mental health chatbot designed to provide support and assistance to users experiencing emotional distress or seeking guidance on mental health-related topics. It leverages specific Machine Learning (ML) and Natural Language Processing (NLP) techniques to understand user input, generate appropriate responses, and maintain engaging conversations in a supportive manner.

ML and NLP Techniques Used:

1. Intent Recognition:

- I employed intent recognition to understand the user's intention or purpose behind their input.
- Technique Used: Supervised learning approach using a neural network model to classify user input into predefined intents or categories.

2. Data Augmentation:

- Data augmentation techniques were applied to increase the diversity of training data and improve the model's robustness.
- Technique Used: Synonym replacement augmentation to generate new training examples by replacing words with their synonyms.

3. Neural Network Architecture:

- I developed a neural network model to process and understand user input and generate appropriate responses.
- Technique Used: Multi-layer perceptron (MLP) architecture with fully connected layers, ReLU activation functions, and batch normalization.

4. User Modeling:

- User modeling techniques were used to personalize interactions and tailor responses based on individual user preferences.
- Technique Used: Maintained user profiles containing information such as user preferences, past interactions, and conversation history.

How They Were Used:

• Training Phase:

- Data augmentation techniques such as synonym replacement were applied to generate additional training examples, increasing the diversity of the dataset.
- The neural network model was trained using supervised learning techniques, where input-output pairs were used to learn the mapping between user input and corresponding intents or responses.

• Inference Phase:

- During the inference phase, the trained model was used to process user input, classify intents, and generate appropriate responses.
- User profiles were updated and maintained during interactions, allowing the chatbot to adapt its responses and recommendations to individual users.

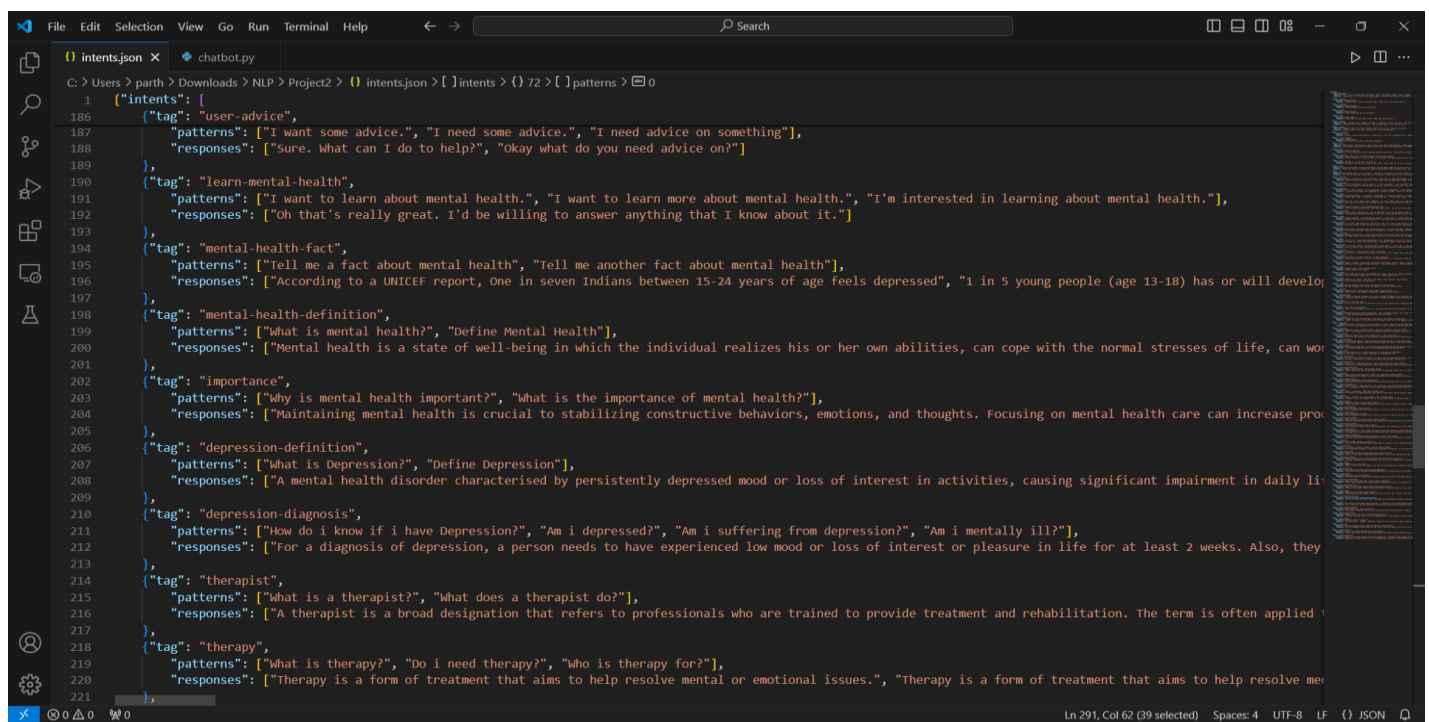
In conclusion, my chatbot system combines specific ML and NLP techniques, including intent recognition, data augmentation, neural network architecture, and user modeling, to create a conversational agent capable of understanding user input, generating contextually relevant responses, and maintaining engaging conversations. By leveraging these techniques, my system aims to provide users with a personalized and interactive experience, enhancing user satisfaction and engagement.

Dataset Description:

Overview:

The dataset used is a comprehensive collection of conversations related to mental health. It encompasses various conversation types, including basic exchanges, frequently asked questions about mental health, classical therapy discussions, and general advice given to individuals facing anxiety and depression. The primary objective of this dataset is to facilitate the training of a chatbot model that emulates a therapist, capable of providing empathetic and supportive responses to those seeking emotional solace.

The dataset consists of a collection of intents, each representing a specific category or topic of conversation. Each intent contains patterns, which are example phrases or sentences that users might input to express that intent, and corresponding responses, which are the chatbot's predefined replies for each intent. Here is a small snippet of the dataset:

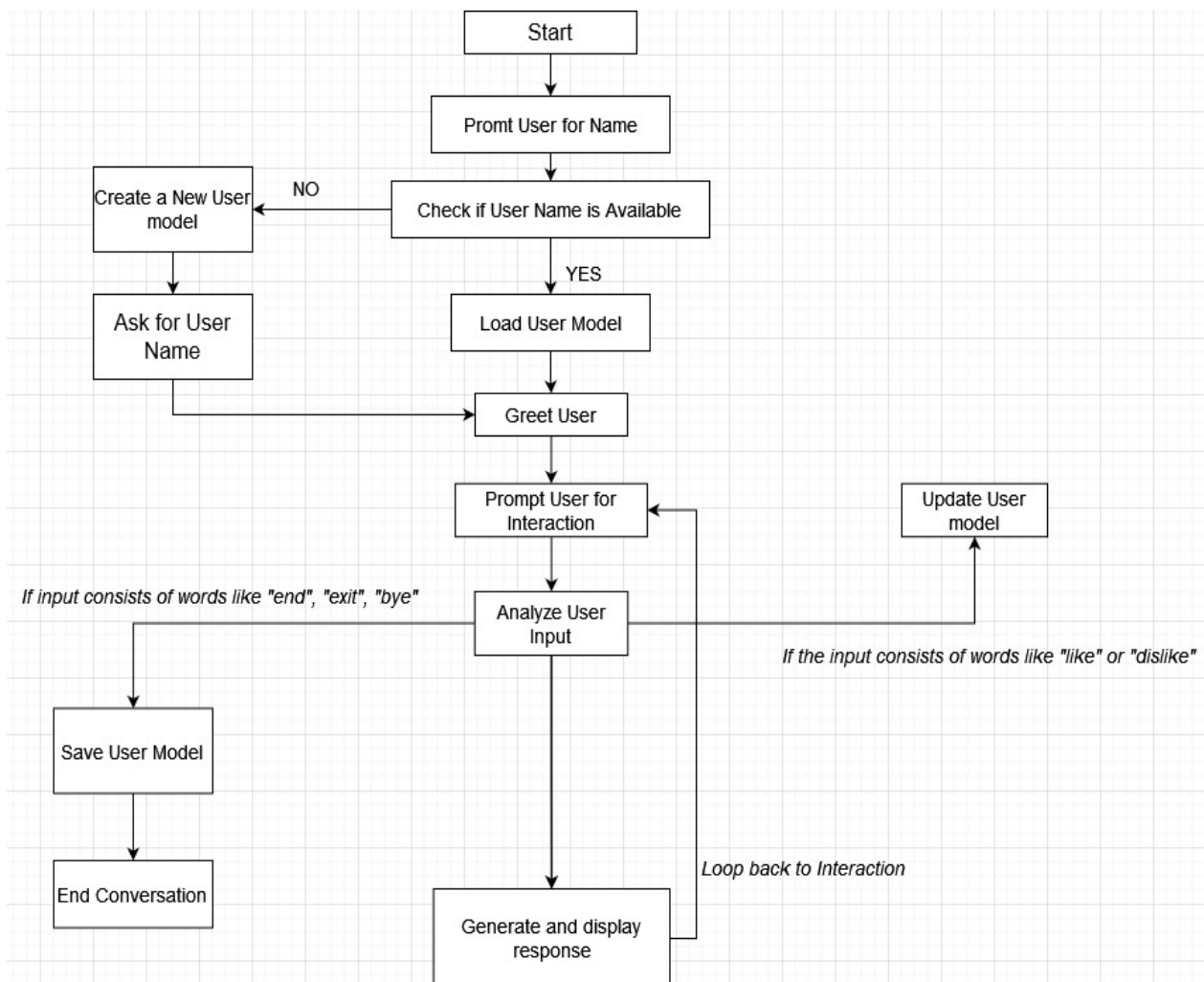


```
1  {"intents": [
186    {"tag": "user-advice",
187      "patterns": ["I want some advice.", "I need some advice.", "I need advice on something"],
188      "responses": ["Sure. What can I do to help?", "Okay what do you need advice on?"]
189    },
190    {"tag": "learn-mental-health",
191      "patterns": ["I want to learn about mental health.", "I want to learn more about mental health.", "I'm interested in learning about mental health."],
192      "responses": ["Oh that's really great. I'd be willing to answer anything that I know about it."]
193    },
194    {"tag": "mental-health-fact",
195      "patterns": ["Tell me a fact about mental health", "Tell me another fact about mental health"],
196      "responses": ["According to a UNICEF report, One in seven Indians between 15-24 years of age feels depressed", "1 in 5 young people (age 13-18) has or will develop a mental health disorder"]
197    },
198    {"tag": "mental-health-definition",
199      "patterns": ["What is mental health?", "Define Mental Health"],
200      "responses": ["Mental health is a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to realize his or her potential"]
201    },
202    {"tag": "importance",
203      "patterns": ["Why is mental health important?", "What is the importance of mental health?"],
204      "responses": ["Maintaining mental health is crucial to stabilizing constructive behaviors, emotions, and thoughts. Focusing on mental health care can increase productivity and improve overall well-being"]
205    },
206    {"tag": "depression-definition",
207      "patterns": ["What is Depression?", "Define Depression"],
208      "responses": ["A mental health disorder characterised by persistently depressed mood or loss of interest in activities, causing significant impairment in daily life"]
209    },
210    {"tag": "depression-diagnosis",
211      "patterns": ["How do i know if i have Depression?", "Am i depressed?", "Am i suffering from depression?", "Am i mentally ill?"],
212      "responses": ["For a diagnosis of depression, a person needs to have experienced low mood or loss of interest or pleasure in life for at least 2 weeks. Also, they must have experienced these symptoms for most of the day, nearly every day"]
213    },
214    {"tag": "therapist",
215      "patterns": ["What is a therapist?", "What does a therapist do?"],
216      "responses": ["A therapist is a broad designation that refers to professionals who are trained to provide treatment and rehabilitation. The term is often applied to psychologists, social workers, and counselors"]
217    },
218    {"tag": "therapy",
219      "patterns": ["What is therapy?", "Do i need therapy?", "Who is therapy for?"],
220      "responses": ["Therapy is a form of treatment that aims to help resolve mental or emotional issues.", "Therapy is a form of treatment that aims to help resolve mental or emotional issues"]
221    },
222  ]}
```

Cleaning:

- **Normalization:** Ensure consistency in text by converting all text to lowercase.
- **Tokenization:** Split sentences into individual words or tokens to facilitate processing.
- **Removal of Special Characters:** Remove punctuation marks or special characters that may not contribute to the understanding of text.
- **Stopword Removal:** Eliminate common words (e.g., "is", "are", "the") that do not carry significant meaning.

A diagram of logic



Sample dialog interactions:

```
Hello! I am a chatbot. Before we start, tell me your name. Type "quit" to exit.
> Shriniketan
User Name not found. Creating a new User.
Nice to meet you, Shriniketan. What should I call you?
> Shri
Tell me some of the things you like.
> Esports, soccer
Tell me some of the things you don't like.
> Cold, Rain
Thankyou for sharing that with me, Shri! How can I help you today?
> I am sad
How long have you been feeling this way?
> A long time
I see. What else?
> I am depressed
For a diagnosis of depression, a person needs to have experienced low mood
or loss of interest or pleasure in life for at least 2 weeks. Also, they
will have experienced the following symptoms: feelings of sadness,
hopelessness, or irritability nearly every day.
> My friend just died
I am really sorry to hear that. I am here to help you with grief, anxiety
and anything else you may feel at this time.
> What is mental health
```

Mental health includes our emotional, psychological, and social well-being. It affects how we think, feel, and act. It also helps determine how we handle stress, relate to others, and make choices.

> thanks

Happy to help!

> okay byee

Let's discuss further why you're feeling this way.

> Quit

Hello! I am a chatbot. Before we start, tell me your name. Type "quit" to exit.

> Parth

Greetings Parth! How can I help you today?

> I am stressed

I am sorry to hear that. What is the reason behind this?

> I need therapy

Therapy is a form of treatment that aims to help resolve mental or emotional issues.

> What is the difference between sadness and depression

Sadness is a normal reaction to a loss, disappointment, problems, or other difficult situations. Feeling sad from time to time is just another part of being human. In these cases, feelings of sadness go away quickly and you can go about your daily life. Other ways to talk about sadness might be feeling low, feeling down, or feeling blue. A person may say they are feeling depressed, but if it goes away on its own and doesn't impact life in a big way, it probably isn't the illness of depression. Depression is a mental illness that affects your mood, the way you understand yourself, and the way you understand and relate to things around you. It can also go by different names, such as clinical depression, major depressive disorder, or major depression. Depression can come up for no reason, and it lasts for a long time. It's much more than sadness or low mood. People who experience depression may feel worthless or hopeless. They may feel unreasonable guilty. Some people may experience depression as anger or irritability. It may be hard to concentrate or make decisions. Most people lose interest in things that they used to enjoy and may isolate themselves from others. There are also physical signs of depression, such as problems with sleep, appetite and energy and unexplainable aches or pains. Some may experience difficult thoughts about death or ending their life (suicide). Depression lasts longer than two weeks, doesn't usually go away on its own, and impacts your life. It's a real illness, and it is very treatable. It's important to seek help if you're concerned about depression.

> I am feeling lonely

How long have you been feeling this way?

> sometime

I'm sorry, but I don't understand. Can you please rephrase or provide more information?

> I dont want to talk about it.

Is there something else that you want to talk about?

> I guess not

That's no problem. I can see why you'd be stressed out about that. I can suggest you some tips to alleviate this issue. Would you like to learn more about that?

> Why is mental health important?

Maintaining mental health is crucial to stabilizing constructive behaviors, emotions, and thoughts. Focusing on mental health care can increase productivity, enhance our self-image, and improve relationships.

> What does it mean to have a mental illness?

Mental illnesses are health conditions that disrupt a person's thoughts, emotions, relationships, and daily functioning. They are associated with distress and diminished capacity to engage in the ordinary activities of daily life. Mental illnesses fall along a continuum of severity: some are fairly mild and only interfere with some aspects of life, such as certain

phobias. On the other end of the spectrum lie serious mental illnesses, which result in major functional impairment and interference with daily life. These include such disorders as major depression, schizophrenia, and bipolar disorder, and may require that the person receives care in a hospital. It is important to know that mental illnesses are medical conditions that have nothing to do with a person's character, intelligence, or willpower. Just as diabetes is a disorder of the pancreas, mental illness is a medical condition due to the brain's biology. Similarly to how one would treat diabetes with medication and insulin, mental illness is treatable with a combination of medication and social support. These treatments are highly effective, with 70-90 percent of individuals receiving treatment experiencing a reduction in symptoms and an improved quality of life. With the proper treatment, it is very possible for a person with mental illness to be independent and successful.

> What are some of the warning signs of mental illness?

Symptoms of mental health disorders vary depending on the type and severity of the condition. The following is a list of general symptoms that may suggest a mental health disorder, particularly when multiple symptoms are expressed at once.

In adults:

Confused thinking

Long-lasting sadness or irritability

Extreme highs and lows in mood

Excessive fear, worrying, or anxiety

Social withdrawal

Dramatic changes in eating or sleeping habits

Strong feelings of anger

Delusions or hallucinations (seeing or hearing things that are not really there)

Increasing inability to cope with daily problems and activities

Thoughts of suicide

Denial of obvious problems

Many unexplained physical problems

Abuse of drugs and/or alcohol

In older children and pre-teens:

Abuse of drugs and/or alcohol

Inability to cope with daily problems and activities

Changes in sleeping and/or eating habits

Excessive complaints of physical problems

Defying authority, skipping school, stealing, or damaging property

Intense fear of gaining weight

Long-lasting negative mood, often along with poor appetite and thoughts of death

Frequent outbursts of anger

In younger children:

Changes in school performance

Poor grades despite strong efforts

Excessive worrying or anxiety

Hyperactivity

Persistent nightmares

Persistent disobedience and/or aggressive behavior

Frequent temper tantrums

> What treatment options are available?

I'm sorry, but I'm not sure how to respond to that.

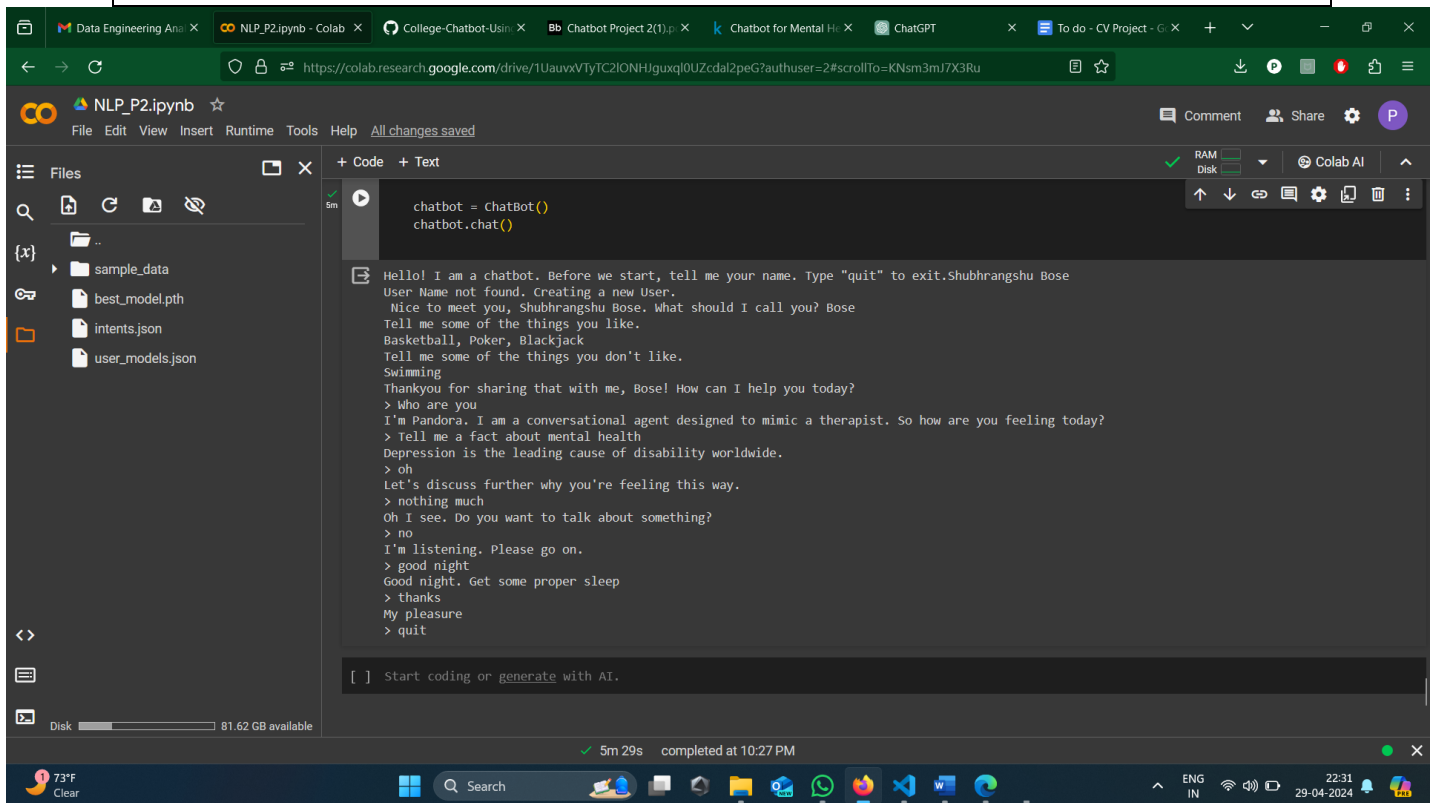
> Can you prevent mental health problems?

We can all suffer from mental health challenges, but developing our wellbeing, resilience, and seeking help early can help prevent challenges becoming serious.

> Thnaks

I'm sorry, but I don't understand. Can you please rephrase or provide more information?

```
> Thanks
My pleasure
> Goodbye
Have a nice day.
> quit
```



The screenshot shows a Google Colab notebook titled 'NLP_P2.ipynb'. The left sidebar displays a file explorer with 'sample_data', 'best_model.pth', 'intents.json', and 'user_models.json'. The main code cell contains the following Python code:

```
chatbot = ChatBot()
chatbot.chat()
```

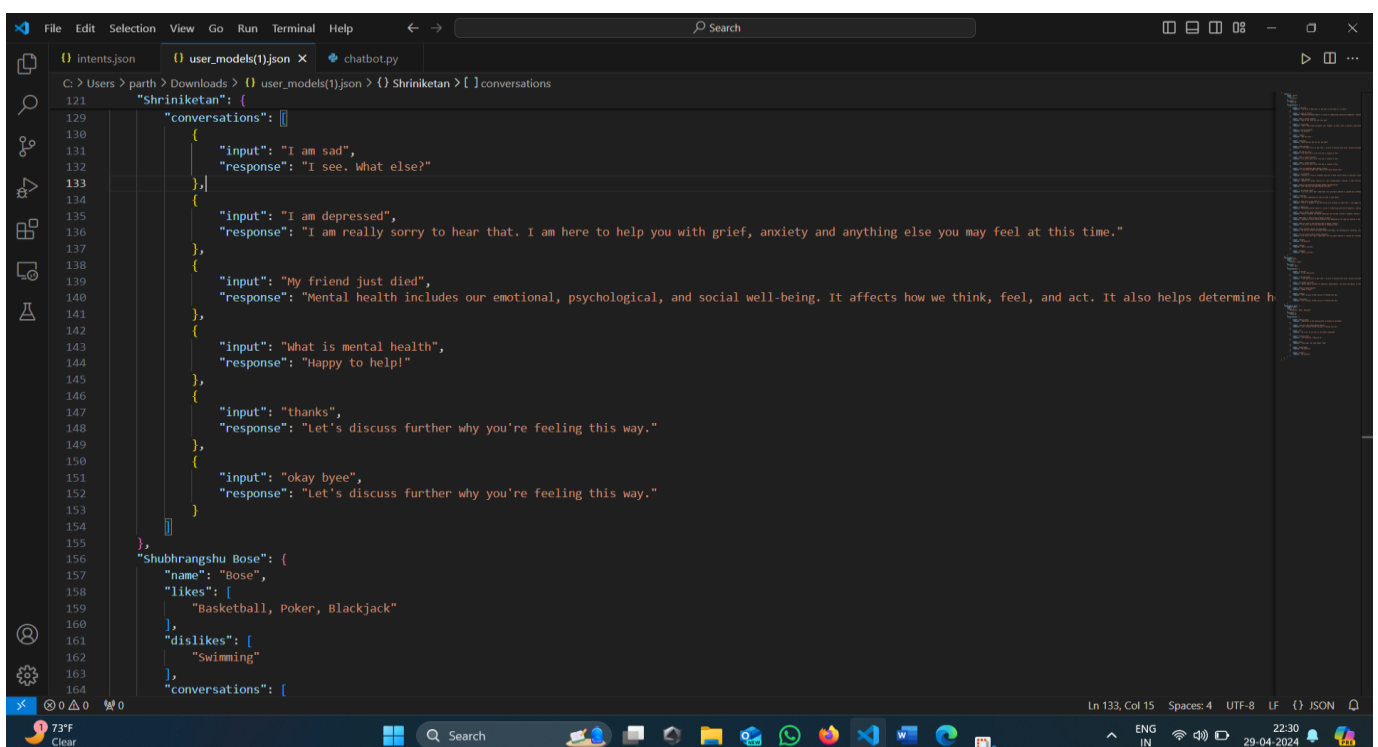
The output of the code cell shows a chatbot conversation:

```
Hello! I am a chatbot. Before we start, tell me your name. Type "quit" to exit.
Shubhrangshu Bose
User Name not found. Creating a new User.
Nice to meet you, Shubhrangshu Bose. What should I call you? Bose
Tell me some of the things you like.
Basketball, Poker, Blackjack
Tell me some of the things you don't like.
Swimming
Thankyou for sharing that with me, Bose! How can I help you today?
> Who are you
I'm Pandora. I am a conversational agent designed to mimic a therapist. So how are you feeling today?
> Tell me a fact about mental health
Depression is the leading cause of disability worldwide.
> oh
Let's discuss further why you're feeling this way.
> nothing much
Oh I see. Do you want to talk about something?
> no
I'm listening. Please go on.
> good night
Good night. Get some proper sleep
> thanks
My pleasure
> quit
```

The bottom status bar indicates the notebook is 'completed at 10:27 PM'.

An appendix for sample user models that were created:

Here is a snippet of the user model json file.



The screenshot shows a VS Code editor with the 'user_model.json' file open. The file contains a JSON object with a 'conversations' array and a 'Shubhrangshu Bose' user model. The snippet shown is as follows:

```
{
  "conversations": [
    {
      "input": "I am sad",
      "response": "I see. What else?"
    },
    {
      "input": "I am depressed",
      "response": "I am really sorry to hear that. I am here to help you with grief, anxiety and anything else you may feel at this time."
    },
    {
      "input": "My friend just died",
      "response": "Mental health includes our emotional, psychological, and social well-being. It affects how we think, feel, and act. It also helps determine h"
    },
    {
      "input": "What is mental health",
      "response": "Happy to help!"
    },
    {
      "input": "thanks",
      "response": "Let's discuss further why you're feeling this way."
    },
    {
      "input": "okay bye",
      "response": "Let's discuss further why you're feeling this way."
    }
  ],
  "Shubhrangshu Bose": {
    "name": "Bose",
    "likes": [
      "Basketball, Poker, Blackjack"
    ],
    "dislikes": [
      "Swimming"
    ],
    "conversations": [
```

Evaluation of the Chatbot:

Strengths:

1. **Understanding User Intents:**
 - The chatbot demonstrates proficiency in understanding user intents related to mental health concerns, thanks to the robust intent recognition model.
2. **Empathetic Responses:**
 - The chatbot provides empathetic and supportive responses tailored to users' emotional needs, enhancing the user experience and fostering a sense of understanding and trust.
3. **Personalization:**
 - User modeling techniques enable the chatbot to personalize interactions based on individual user preferences, emotional state, and past interactions, enhancing engagement and relevance.
4. **Diverse Training Data:**
 - Data augmentation techniques, such as synonym replacement, enrich the training data, improving the model's ability to handle a wide range of user inputs and scenarios.

Weaknesses:

1. **Limited Domain Coverage:**
 - The chatbot's effectiveness may be limited to mental health-related topics, and it may struggle to handle queries outside its predefined domain.
2. **Overreliance on Predefined Responses:**
 - The chatbot's responses are based on predefined templates, which may lead to repetitive or generic replies, potentially reducing engagement and user satisfaction.
3. **Difficulty Handling Ambiguity:**
 - The chatbot may struggle to handle ambiguous or unclear user inputs, leading to misinterpretation of user intent and potentially inappropriate responses.
4. **Lack of Contextual Understanding:**
 - The chatbot may lack the ability to understand nuanced contextual cues in user input, leading to limitations in providing contextually relevant responses.
5. **Risk of Bias or Misinformation:**
 - If not carefully monitored and updated, the chatbot may perpetuate biases or provide inaccurate information, potentially leading to negative user experiences or misinformation dissemination.

Likert-Style Feedback:

1. On a scale of 1 to 5, how satisfied are you with the responsiveness of the chatbot?

1 - Very Dissatisfied | 2 – Dissatisfied | 3 - Neutral | 4 – Satisfied | 5 - Very Satisfied

2. How helpful did you find the chatbot's responses?

1 - Not Helpful at All | 2 - Slightly Helpful | 3 - Moderately Helpful | 4 – Helpful | 5 - Extremely Helpful

3. To what extent did the chatbot understand your queries?

1 - Didn't Understand at All | 2 - Partially Understood | 3 - Understood Somewhat | 4 - Mostly Understood | 5 - Completely Understood

4. How satisfied are you with the accuracy of the information provided by the chatbot?

1 - Very Inaccurate | 2 - Somewhat Inaccurate | 3 – Neutral | 4 - Somewhat Accurate | 5 - Very Accurate

Responses:

Shubrangshu Bose, my classmate (not in NLP)

- 5
- 4
- 4
- 5

Siddhant (my roommate)

- 4
- 4
- 3
- 4

Shriniketan Kulkarni (my other roommate)

- 5
- 4
- 4
- 4

References:

- <https://thecleverprogrammer.com/2023/03/27/end-to-end-chatbot-using-python/>
- <https://www.kaggle.com/code/jocelyndumlao/chatbot-for-mental-health-conversations/notebook#Pattern-and-Response-Analysis>