**Mental Health Conversational AI (Pandora)**

**Overview**:

Pandora is a conversational AI designed to provide support and general information on mental health. The system utilizes a combination of machine learning (ML) and natural language processing (NLP) techniques to understand and respond to user inputs in a conversational manner. It's tailored to handle a variety of topics within mental health, offering empathetic responses and informative guidance.

**Machine Learning and Natural Language Processing Techniques:**

1. Tokenization and Text Preprocessing: We utilize the **Tokenizer** class from Keras to convert text input into sequences of integers where each integer represents a unique word in a dictionary. This is essential for preparing the data for the neural network, which cannot process raw text.

2. Sequence Padding: The **pad\_sequences** method from Keras is used to ensure that all sequences in a batch are of the same length by padding shorter sequences with zeros. This uniformity is necessary for batch processing by neural network layers.

3. Word Embedding: An **embedding layer** is used to transform the integer-encoded vocabulary into dense vectors of fixed size. This layer learns to map semantic meaning into a geometric space, which is crucial for the model to understand word relationships based on the training data.

4. Bidirectional LSTM (Long Short-Term Memory): We employ a **bidirectional LSTM** to capture context from both the past and the future within a sentence or a sequence. This is particularly useful in understanding the nuanced emotional content in users’ messages, which is crucial for mental health discussions.

5.Dense Layers and Softmax Activation: Following the LSTM, **dense layers with ReLU** activation are used for interpretation and decision-making, culminating in a **softmax layer** that classifies the user's input into one of several categories based on the detected intent.

**Dataset Description and Preprocessing:**

Dataset: The dataset consists of **predefined intents** and patterns representing different types of mental health-related conversations, such as greetings, personal introductions, expressions of emotions (e.g., sadness, stress, happiness), and requests for advice. Each intent is associated with a variety of possible user inputs (patterns) and appropriate responses.

Data Cleaning: Given the structured nature of our JSON dataset, minimal cleaning was required. We ensured that there were no duplicates in the patterns and that the text was standardized in terms of casing and punctuation for consistent processing by the tokenizer.

**Model Training and Response Generation**

Training: The model is trained on pairs of patterns and their corresponding intent tags using sparse categorical cross-entropy as the loss function and Adam optimizer. This setup helps the model learn to predict the intent of an input sentence accurately.

Response Handling: Depending on the predicted intent and the sentiment detected (using NLTK’s Sentiment Intensity Analyzer), the system selects an appropriate response from a pre-defined list. Sentiment analysis allows the chatbot to adjust its responses based on the emotional tone of the user input, providing a more personalized interaction.

Logic tree:

A diagram of a company

Description automatically generated

Sample dialogue Interactions:

Please enter your user ID to start: chaitanya

Hello chaitanya, I'm Pandora, your Personal Therapeutic AI Assistant. How can I assist you today?

You: i am feeling sad

1/1 [==============================] - 0s 18ms/step

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

You: someone i know has dies

1/1 [==============================] - 0s 26ms/step

Pandora: I'm trying my best to help you. So please talk to me

You: my friend died

1/1 [==============================] - 0s 19ms/step

Pandora: I'm sorry to hear that. If you want to talk about it. I'm here.

You: i want to kill myself

1/1 [==============================] - 0s 20ms/step

Pandora: It seems you're feeling quite down. I'm very sorry to hear that but you have so much to look forward to. Please seek help by contacting: 9152987821

User Models that were created:

A group of black and white text boxes

Description automatically generated

User appendix:

It stores the context of conversations or topics that have been engaged with by a user. It stores various terms like "sad," "death," "suicide," and "happy," a broad range of emotional discussions. This context is used to tailor interactions or to maintain a continuous, relevant dialogue with the user, reflecting their previous interactions or emotional states.

A screenshot of a computer

Description automatically generated

Strengths:

1. Natural Language Understanding (NLU): The chatbot demonstrates strong NLU capabilities by tokenizing and processing user input to understand the intent behind each message.

2. Sequential Model Architecture:Utilizes a sequential model architecture in TensorFlow/Keras, allowing for easy construction and training of deep learning models.

3. Bidirectional LSTM: Utilizes a bidirectional Long Short-Term Memory (LSTM) layer, which captures contextual information from both past and future inputs, enhancing the model's understanding of sentence structure and semantics

4. Dynamic Response Generation:Generates responses dynamically based on predicted intents and sentiment analysis, providing personalized and contextually relevant interactions with users.

**Weaknesses:**

1. Limited Dataset: Relies on a limited dataset of training sentences and intents. A larger and more diverse dataset may be needed to improve the chatbot's understanding and responsiveness to a wider range of user queries.

2. Overfitting Risk: Training the model for a large number of epochs (150 epochs in this case) without proper validation and regularization techniques may lead to overfitting, where the model performs well on the training data but poorly on unseen data.

3. Sentiment Analysis Complexity: The sentiment analysis component relies solely on the compound score provided by the SentimentIntensityAnalyzer, which may not capture the full complexity of user sentiment and emotions in natural language.

4. Context Management: The context management system saves user interactions in a JSON file, which may not scale well for a large number of users or conversational contexts. A more robust solution for context management may be required for scalability.

Analysis based on the responses from 10 users:

A graph showing different colored squares

Description automatically generated

**Conclusion:**

Pandora aims to mimic the empathy and responsiveness of a human therapist, within the constraints of a text-based AI system. While it is not a replacement for professional mental health services, it offers immediate, 24/7 support and information, potentially serving as a valuable tool for those seeking help or information about mental health issues.