CREATE A CHATBOT IN PYTHON

BY TEAM MEMBER

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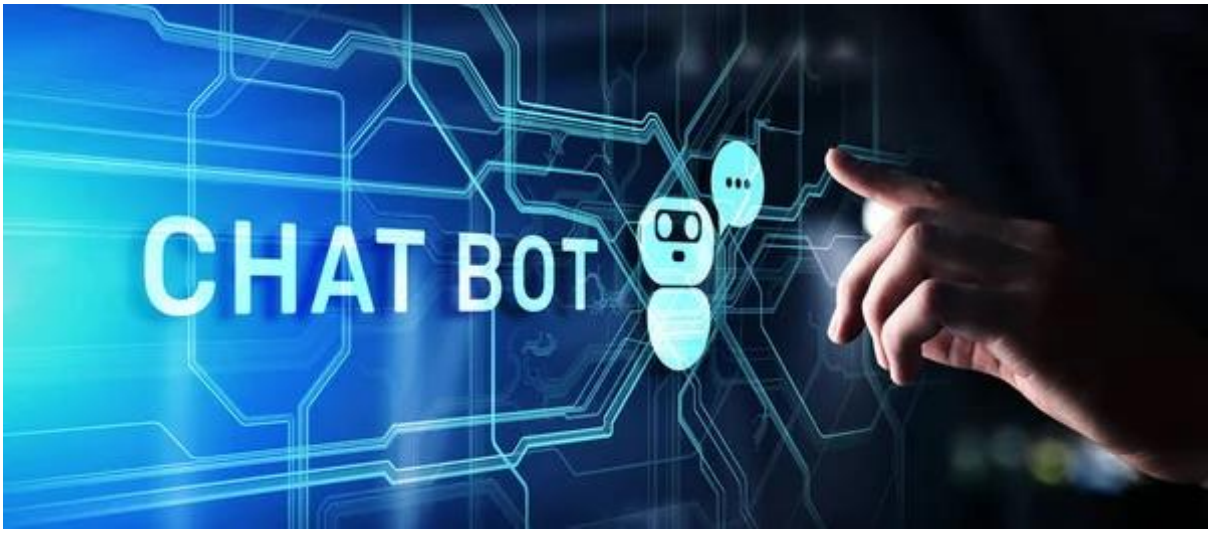
Phase -2 Document Submission



INTRODUCTION:

Creating a chatbot using advanced techniques in Python is an exciting project that incorporates artificial intelligence and natural language processing to develop interactive and intelligent conversational agents. By implementing advanced techniques, we can create a chatbot that goes beyond simple rule-based responses and can understand and generate human-like conversations.

To begin, we utilize libraries such as NLTK (Natural Language Toolkit) and spaCy to preprocess and parse user input, extracting meaningful information and identifying intents. These libraries provide powerful tools for tokenization, part-of-speech tagging, and entity recognition, allowing the chatbot to understand and respond appropriately to user queries.

Next, we incorporate machine learning algorithms such as deep learning models, specifically recurrent neural networks (RNNs) or transformers, to train our chatbot on large datasets. These models enable the chatbot to learn patterns and relationships in language, improving its ability to generate contextually relevant responses.

Furthermore, we can enhance the chatbot's capabilities by implementing techniques like sentiment analysis and named entity recognition. Sentiment analysis helps the chatbot understand and respond accordingly to the emotions expressed by the user, while named entity

recognition allows it to identify and extract specific entities such as names, locations, or dates mentioned in the conversation.

To make the chatbot more engaging and natural, we can incorporate dialogue management techniques such as reinforcement learning or sequence-to-sequence models. These techniques enable the chatbot to generate coherent and personalized responses, considering both the current user input and the previous conversation history.

CONTENT FOR PROJECT PHASE 2:

Implement a chatbot in Python using advanced techniques such as natural language processing, machine learning, and deep learning.

Data Source:

To create a chatbot in Python, you can use the `python-telegram-bot` library. The data source for the chatbot can be an external API or a database.

Dataset Link:(https://www.kaggle.com/datasets/grafstor/simple-dialogs-for-chatbot)

	Question	answer
0	hi, how are you doing?	i'm fine. how about yourself?
1	i'm fine. how about yourself?	i'm pretty good. thanks for asking.
2	i'm pretty good. thanks for asking.	no problem. so how have you been?
3	no problem. so how have you been?	i've been great. what about you?
4	i've been great. what about you?	i've been good. i'm in school right now.
5	i've been good. i'm in school right now.	what school do you go to?
6	what school do you go to?	i go to pcc.

	Question	answer
7	i go to pcc.	do you like it there?
8	do you like it there?	it's okay. it's a really big campus.
9	it's okay. it's a really big campus.	good luck with school.

DATA COLLECTION AND PREPROCESSING:

To create a chatbot in Python, data collection and preprocessing are crucial steps. Firstly, you need to gather a substantial amount of data, such as chat logs, FAQs, or relevant documents, to train your chatbot. Once the data is collected, it needs to be preprocessed. This involves cleaning the data by removing any unnecessary characters, normalizing the text, and tokenizing it into smaller units such as words or sentences. Additionally, you might need to handle spelling errors, remove stop words, and apply stemming or lemmatization techniques. Data preprocessing ensures that the input data is in a suitable format for training your chatbot model, improving its accuracy and performance.

EXPLORATORY DATA ANALYSIS:

In order to create a chatbot in Python, it is crucial to perform exploratory data analysis (EDA) on the available data. EDA involves understanding the structure and characteristics of the dataset, identifying patterns and trends, and gaining insights that can guide the chatbot development process. This includes analyzing the distribution of different variables, detecting outliers, assessing the quality and completeness of the data, and exploring potential relationships between variables. By conducting EDA, we can make informed decisions regarding data preprocessing, feature engineering, and model selection, ultimately enhancing the effectiveness and accuracy of the chatbot.

ADVANCED TECHNIQUES:

Information on advanced techniques to create a chatbot in Python. Here are some key techniques to consider:

1. Natural Language Processing (NLP): NLP allows the chatbot to understand and interpret user inputs. Python libraries such as NLTK, spaCy, and Stanford CoreNLP can be used for tasks like tokenization, part-of-speech tagging, named entity recognition, and sentiment analysis.

2. Machine Learning (ML): ML techniques can be applied to enhance the chatbot's ability to understand and respond to user inputs. You can use libraries like Scikit-learn or TensorFlow to train models for intent classification or entity extraction.

3. Dialog Management: Implementing a dialog management system is crucial for handling conversations. Techniques like rule-based systems, finite state machines, or more advanced approaches like Reinforcement Learning can be used to manage the flow of conversation.

4. Contextual Understanding: To create a more engaging chatbot, you can enhance its ability to understand and remember the context of the conversation. Techniques such as sequence-to-sequence models, attention mechanisms, and memory networks can help in achieving this.

5. Pre-trained Models: Utilize pre-trained language models like GPT-3 or BERT to improve the chatbot's language understanding and generation capabilities. These models can be fine-tuned on specific chatbot tasks to achieve better performance.

6. User Feedback and Continuous Learning: Implement mechanisms to collect user feedback.

MODEL EVALUATION AND SELECTION:

When it comes to model evaluation and selection for creating a chatbot in Python, there are a few key considerations to keep in mind. Here are the steps you can follow:

1. Define Evaluation Metrics: Start by defining the metrics that will be used to evaluate and compare different chatbot models. Common metrics include accuracy, precision, recall, F1 score, and perplexity. Choose metrics that align with your specific chatbot's goals and performance requirements.

2. Data Split: Split your dataset into training, validation, and testing sets. The training set will be used to train the chatbot model, the validation set will be used to tune hyperparameters, and the testing set will be used for the final evaluation.

3. Baseline Model: Start with a simple baseline model to establish a performance benchmark. This could be a rule-based system or a basic machine learning model like a support vector machine (SVM) or logistic regression. Evaluate the baseline model's performance on the validation and testing sets.

4. Experiment with Different Models: Explore different chatbot models in Python, such as sequence-to-sequence models using recurrent neural networks (RNNs) or transformer models like BERT. Train and evaluate each model on the validation set using the defined evaluation metrics.

5. Hyperparameter Tuning: Fine-tune the hyperparameters of the models to improve their performance. This can be done through techniques like grid search, random search, or Bayesian optimization. Evaluate the tuned models on the validation set.

MODEL INTERPRETABILITY:

Some insights on achieving model interpretability in a creative chatbot implemented in Python.

1. Use Explainable AI Techniques: One approach to achieve interpretability is to use explainable AI techniques. These techniques can help you understand how your chatbot's decisions are being made. For example, you can use techniques such as LIME (Local Interpretable Model-Agnostic Explanations) or SHAP (SHapley Additive exPlanations) to explain the model's predictions and understand the important features contributing to those predictions.

2. Feature Importance: In the context of a creative chatbot, it can be valuable to understand which features or factors contribute the most to the generated content. You can use techniques such as permutation importance or feature importance scores to identify the key features that influence the chatbot's output.

3. Attention Mechanisms: If your chatbot utilizes an attention mechanism, you can visualize the attention weights to gain insights into which parts of the input are receiving more attention. This can provide valuable information about the chatbot's decision-making process.

4. Error Analysis: Analyzing the errors made by the chatbot can also provide insights into its behavior. By examining the cases where the chatbot fails or provides incorrect responses, you can identify patterns or patterns where the model struggles. This analysis can help you refine the model and improve its interpretability.

5. User Feedback and Testing: Gathering user feedback and testing the chat.

DEPLOYMENT AND PREDICTION:

To create a chatbot in Python, there are various libraries and frameworks you can use. One popular choice is the Natural Language Toolkit (NLTK). Here's a high-level overview of the deployment and prediction process for a chatbot using NLTK:

1. Install the necessary libraries: Start by installing the NLTK library in Python using pip. You can do this by running the command `pip install nltk` in your command prompt or terminal.

2. Import the required modules: Import the necessary modules from the NLTK library, such as `chat` and `nltk.chat.util`.

3. Preprocess the data: Prepare your chatbot training data by preprocessing and cleaning it. This usually involves tokenizing the text, removing stop words, and converting the words to lowercase.

4. Train the chatbot: Use the preprocessed data to train your chatbot. You can use NLTK's `chat.train()` function to train your chatbot using different algorithms like NaiveBayes, DecisionTree, Maximum Entropy, etc.

5. Test the chatbot: Once your chatbot is trained, you can test it by interacting with it using NLTK's `chat.chatbots()` function. This will allow you to see how the chatbot responds to different inputs.

6. Deploy the chatbot: To deploy your chatbot, you can create a Python script or a web application that utilizes the trained chatbot. This can be done using popular web frameworks like Flask or Django.

PROGRAM:

CHATBOT

Libraries and Utilities:

In [1]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import re
import nltk
from nltk.corpus import stopwords
nltk.download("stopwords")
from nltk.stem.wordnet import WordNetLemmatizer
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB
from wordcloud import WordCloud, STOPWORDS
import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))
```

Out [1]:

```
[nltk_data] Downloading package stopwords to /usr/share/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
/kaggle/input/deepnlp/Sheet_1.csv
/kaggle/input/deepnlp/Sheet_2.csv
```

Loading Data:

In [2]:

```
data = pd.read_csv(r"/kaggle/input/deepnlp/Sheet_1.csv",encoding= "latin1" )
data.drop(["Unnamed: 3","Unnamed: 4","Unnamed: 5",
           "Unnamed: 6","Unnamed: 7",], axis = 1, inplace =True)
data = pd.concat([data["class"],data["response_text"]], axis = 1)

data.dropna(axis=0, inplace =True)
data.head(10)
```

Out [2]:

	class	response_text
0	not_flagged	I try and avoid this sort of conflict
1	flagged	Had a friend open up to me about his mental ad...
2	flagged	I saved a girl from suicide once. She was goin...
3	not_flagged	i cant think of one really...i think i may hav...
4	not_flagged	Only really one friend who doesn't fit into th.
5	not_flagged	a couple of years ago my friends was going to ...
6	flagged	Roommate when he was going through death and l..
7	flagged	i've had a couple of friends (you could say mo...
8	not_flagged	Listened to someone talk about relationship tr
9	flagged	I will always listen. I comforted my sister wh...

0 to Not Flagged and 1 to Flagged:

In [3]:

```
data["class"] = [1 if each == "flagged" else 0 for each in data["class"]]
data.head()
```

Out [3]:

	class	response_text
0	0	I try and avoid this sort of conflict
1	1	Had a friend open up to me about his mental ad...
2	1	I saved a girl from suicide once. She was goin...
3	0	i cant think of one really...i think i may hav...
4	0	Only really one friend who doesn't fit into th...

In [4]:

```
data.response_text[16]
```

Out [4]:

```
'I have helped advise friends who have faced circumstances similar to mine'
```

Regular Expression:

In [5]:

```
first_text = data.response_text[16]
text = re.sub("[^a-zA-Z]"," ",first_text)
text = text.lower()
print(text)
```

Out [5]:

```
i have helped advise friends who have faced circumstances similar to mine
```

Irrelevant Words (Stopwords):

In [6]:

```
text = nltk.word_tokenize(text)
text = [ word for word in text if not word in set(stopwords.words("english"))]
print(text)
```

Out [6]:

```
['helped', 'advise', 'friends', 'faced', 'circumstances', 'similar', 'mine']
```

Lemmatization:

In [7]:

```
lemmatizer = WordNetLemmatizer()
text = [(lemmatizer.lemmatize(lemmatizer.lemmatize(lemmatizer.lemmatize(word,
"n"),pos = "v"),pos="a")) for word in text]
print(text)
```

Out [7]:

```
['help', 'advise', 'friend', 'face', 'circumstance', 'similar', 'mine']
```

All Words:

In [8]:

```
description_list = []
for description in data.response_text:

    description = re.sub("[^a-zA-Z]"," ",description)
    description = description.lower()

    description = nltk.word_tokenize(description)
    description = [ word for word in description if not word in set(stopwords.
words("english"))]

    lemmatizer = WordNetLemmatizer()
    description = (lemmatizer.lemmatize(lemmatizer.lemmatize(lemmatizer.lemmat
ize(word, "n"),pos = "v"),pos="a") for word in description)

    description = " ".join(description)
    description_list.append(description)
```

In [9]:

```
description_list[16]
```

Out [9]:

```
'help advise friend face circumstance similar mine'
```

Bag of Words:

In [10]:

```
max_features = 100
count_vectorizer = CountVectorizer(max_features=max_features)
sparce_matrix = count_vectorizer.fit_transform(description_list).toarray()
print("Top {} Most Used Words: {}".format(max_features,count_vectorizer.get_fe
ature_names()))
```

Out [10]:

```
Top 100 Most Used Words: ['addiction', 'advice', 'alone', 'always', 'anxiety',
'anything', 'back', 'best', 'bring', 'call', 'care', 'come', 'comfort', 'could
', 'deal', 'depression', 'describe', 'dont', 'end', 'even', 'everything', 'exp
erience', 'face', 'feel', 'find', 'friend', 'get', 'gf', 'girl', 'girlfriend',
'give', 'go', 'good', 'grade', 'happen', 'help', 'helpful', 'issue', 'kid', 'k
ill', 'know', 'last', 'let', 'life', 'like', 'listen', 'little', 'look', 'lot'
, 'make', 'many', 'may', 'much', 'need', 'never', 'night', 'offer', 'often', '
one', 'open', 'others', 'people', 'person', 'personal', 'pretty', 'problem', '
really', 'relationship', 'say', 'school', 'see', 'self', 'severe', 'share', 's
hit', 'similar', 'simply', 'situation', 'someone', 'sometimes', 'start', 'stru
ggle', 'stuff', 'suicide', 'support', 'talk', 'tell', 'think', 'though', 'time
', 'trouble', 'try', 'use', 'want', 'way', 'week', 'well', 'work', 'would', 'y
ear']
```

Naive Bayes:

In [11]:

```
y = data.iloc[:,0].values
x = sparce_matrix
```

Train Test Split:

In [12]:

```
x_train, x_test, y_train, y_test = train_test_split(x,y, test_size = 0.2, rand
om_state = 42)
```

Fit the Model:

In [13]:

```
nb = GaussianNB()
nb.fit(x_train,y_train)
y_pred = nb.predict(x_test)
print("Accuracy: {}".format(round(nb.score(y_pred.reshape(-1,1),y_test),2)))
```

Out [13]:

```
Accuracy: 0.75
```

DATA PREPROCESSING:

In [14]:

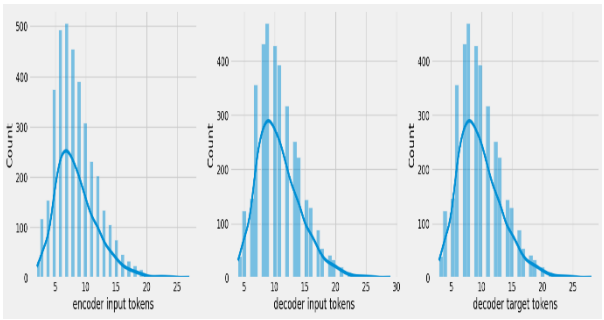
```
from tensorflow.keras.layers import TextVectorization
import re,string
from tensorflow.keras.layers import LSTM,Dense,Embedding,Dropout,LayerNormaliz
ation
#data preprocessing
df=pd.read_csv('/kaggle/input/simple-dialogs-for-chatbot/dialogs.txt',sep='\t'
,names=['question','answer'])
print(f'Dataframe size: {len(df)}')
```

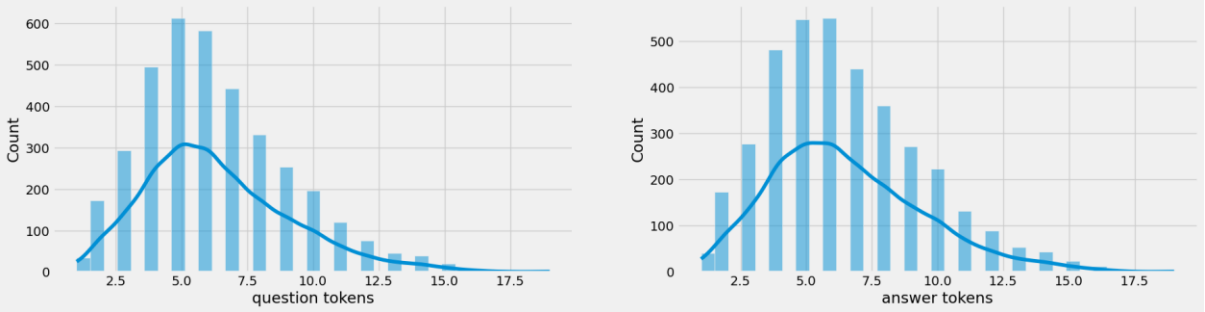
```
df.head()
df['question tokens']=df['question'].apply(lambda x:len(x.split()))
df['answer tokens']=df['answer'].apply(lambda x:len(x.split()))
plt.style.use('fivethirtyeight')
fig,ax=plt.subplots(nrows=1,ncols=2,figsize=(20,5))
sns.set_palette('Set2')
sns.histplot(x=df['question tokens'],data=df,kde=True,ax=ax[0])
sns.histplot(x=df['answer tokens'],data=df,kde=True,ax=ax[1])
sns.jointplot(x='question tokens',y='answer tokens',data=df,kind='kde',fill=Tr
ue,cmap='YlGnBu')
plt.show()
def clean_text(text):
    text=re.sub('-',' ',text.lower(
    text=re.sub('[.]',' . ',text)
    text=re.sub('[1]',' 1 ',text)
    text=re.sub('[2]',' 2 ',text)
    text=re.sub('[3]',' 3 ',text)
    text=re.sub('[4]',' 4 ',text)
    text=re.sub('[5]',' 5 ',text)
    return text
df.drop(columns=['answer tokens','question tokens'],axis=1,inplace=True)
df['encoder_inputs']=df['question'].apply(clean_text)
df['decoder_targets']=df['answer'].apply(clean_text)+' <end>'
df['decoder_inputs']='<start> '+df['answer'].apply(clean_text)+' <end>'
df.head(10)
df['encoder input tokens']=df['encoder_inputs'].apply(lambda x:len(x.split()))
df['decoder input tokens']=df['decoder_inputs'].apply(lambda x:len(x.split()))
df['decoder target tokens']=df['decoder_targets'].apply(lambda x:len(x.split()
))
plt.style.use('fivethirtyeight')
fig,ax=plt.subplots(nrows=1,ncols=3,figsize=(20,5))
sns.set_palette('Set2')
sns.histplot(x=df['encoder input tokens'],data=df,kde=True,ax=ax[0])
sns.histplot(x=df['decoder input tokens'],data=df,kde=True,ax=ax[1])
sns.histplot(x=df['decoder target tokens'],data=df,kde=True,ax=ax[2])
sns.jointplot(x='encoder input tokens',y='decoder target tokens',data=df,kind=
'kde',fill=True,cmap='YlGnBu')
plt.show()
print(f"After preprocessing: {' '.join(df[df['encoder input tokens'].max()==df
['encoder input tokens']]['encoder_inputs'].values.tolist())}")
print(f"Max encoder input length: {df['encoder input tokens'].max()}")
print(f"Max decoder input length: {df['decoder input tokens'].max()}")
print(f"Max decoder target length: {df['decoder target tokens'].max()}")
df.drop(columns=['question','answer','encoder input tokens','decoder input tok
ens','decoder target tokens'],axis=1,inplace=True)
params={
    "vocab_size":2500,
    "max_sequence_length":30,
    "learning_rate":0.008,
    "batch_size":149,}
learning_rate=params['learning_rate']
batch_size=params['batch_size']
embedding_dim=params['embedding_dim']
lstm_cells=params['lstm_cells']
vocab_size=params['vocab_size']
buffer_size=params['buffer_size']
```

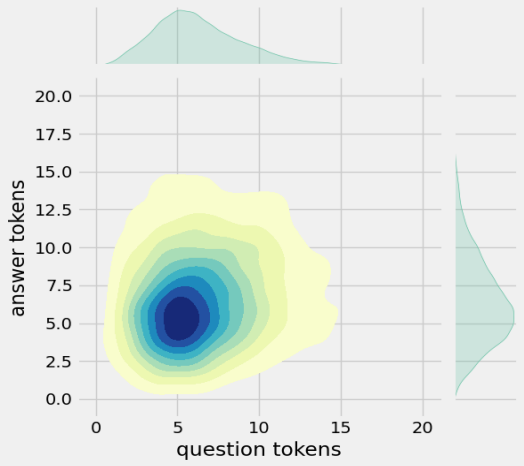
```
max_sequence_length=params['max_sequence_length']
df.head(10)
vectorize_layer=TextVectorization(
    max_tokens=vocab_size,
    standardize=None,
    output_mode='int',
    output_sequence_length=max_sequence_length
)
vectorize_layer.adapt(df['encoder_inputs']+' '+df['decoder_targets']+' <start>
<end>')
vocab_size=len(vectorize_layer.get_vocabulary())
print(f'Vocab size: {len(vectorize_layer.get_vocabulary())}')
print(f'{vectorize_layer.get_vocabulary()[:12]}')
def sequences2ids(sequence):
    return vectorize_layer(sequence)
def ids2sequences(ids):
    decode=''
    if type(ids)==int:
        ids=[ids]
    for id in ids:
        decode+=vectorize_layer.get_vocabulary()[id]+' '
    return decode

x=sequences2ids(df['encoder_inputs'])
yd=sequences2ids(df['decoder_inputs'])
y=sequences2ids(df['decoder_targets'])
print(f'Question sentence: hi , how are you ?')
print(f'Question to tokens: {sequences2ids("hi , how are you ?")[:10]}')
print(f'Encoder input shape: {x.shape}')
print(f'Decoder input shape: {yd.shape}')
print(f'Decoder target shape: {y.shape}')
```

Out [14]:

hi, how are you doing? i'm fine. how about yourself?
i'm fine. how about yourself? i'm pretty good. thanks for asking.
i'm pretty good. thanks for asking.no problem. so how have you been?
no problem. so how have you been? i've been great. what about you?
i've been great. what about you? i've been good. i'm in school right now.
i've been good. i'm in school right now. what school do you go to?
what school do you go to? i go to pcc.
i go to pcc. do you like it there?
do you like it there? it's okay. it's a really big campus.







After preprocessing: for example , if your birth date is january 1 2 , 1 9 8 7 , write 0 1 / 1 2 / 8 7 .
Max encoder input length: 27
Max decoder input length: 29
Max decoder target length: 28
Question sentence: hi , how are you ?
Question to tokens: [1971 9 45 24 8 7 0 0 0 0]
Encoder input shape: (3725, 30)
Decoder input shape: (3725, 30)
Decoder target shape: (3725, 30)

BUILD MODELS:

In [15]:

```
class Encoder(tf.keras.models.Model):
def __init__(self,units,embedding_dim,vocab_size,*args,**kwargs) -> None:
        super().__init__(*args,**kwargs)
        self.units=units
        self.vocab_size=vocab_size
        self.embedding_dim=embedding_dim
        self.embedding=Embedding(
            vocab_size,
            embedding_dim,
            name='encoder_embedding',
            mask_zero=True,
            embeddings_initializer=tf.keras.initializers.GlorotNormal()
        )
encoder=Encoder(lstm_cells,embedding_dim,vocab_size,name='encoder')
```

```
encoder.call(_[0])
class Decoder(tf.keras.models.Model):
    def __init__(self,units,embedding_dim,vocab_size,*args,**kwargs) -> None:
        super().__init__(*args,**kwargs)
        self.units=units
        self.embedding_dim=embedding_dim
        self.vocab_size=vocab_size
        self.embedding=Embedding(
            vocab_size,
            embedding_dim,
            name='decoder_embedding',
            mask_zero=True,
            embeddings_initializer=tf.keras.initializers.HeNormal()
        )
decoder=Decoder(lstm_cells,embedding_dim,vocab_size,name='decoder')
decoder(_[1][:1],encoder(_[0][:1]))
model=ChatBotTrainer(encoder,decoder,name='chatbot_trainer')
model.compile(
    loss=tf.keras.losses.SparseCategoricalCrossentropy(),
    optimizer=tf.keras.optimizers.Adam(learning_rate=learning_rate),
    weighted_metrics=['loss','accuracy']
)
    callbacks=[
        tf.keras.callbacks.TensorBoard(log_dir='logs'),
        tf.keras.callbacks.ModelCheckpoint('ckpt',verbose=1,save_best_only=Tru
e)
    ]
)
```

Out [15]:

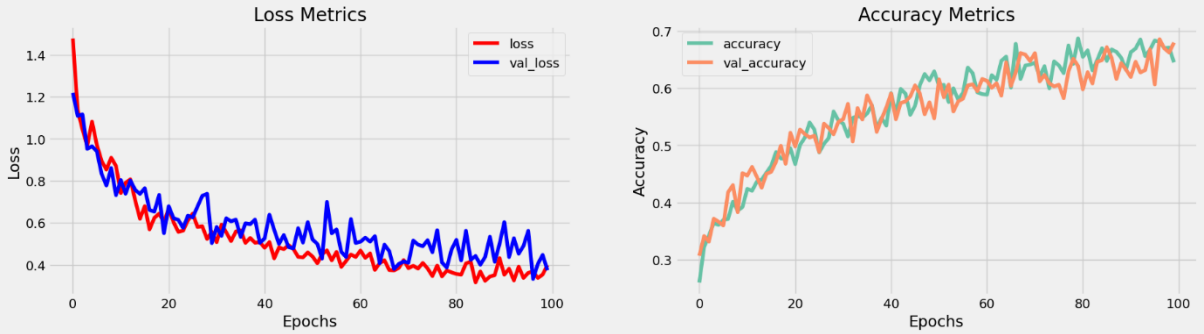
```
(<tf.Tensor: shape=(149, 256), dtype=float32, numpy=
 array([[ 0.16966951, -0.10419625, -0.12700348, ..., -0.12251794,
         0.10568858,  0.14841646],
       [ 0.08443093,  0.08849293, -0.09065959, ..., -0.00959182,
         0.10152507, -0.12077457],
       [ 0.03628462, -0.02653611, -0.11506603, ..., -0.14669597,
         0.10292757,  0.13625325],
<tf.Tensor: shape=(1, 30, 2443), dtype=float32, numpy=
array([[[3.4059247e-04, 5.7348556e-05, 2.1294907e-05, ...,
         7.2067953e-05, 1.5453645e-03, 2.3599296e-04],
       [1.4662130e-03, 8.0250365e-06, 5.4062020e-05, ...,
         1.9187471e-05, 9.7244098e-05, 7.6433855e-05],
       [9.6929165e-05, 2.7441782e-05, 1.3761305e-03,
tf.Tensor: shape=(149, 30, 2443), dtype=float32, numpy=
array([[[3.40592262e-04, 5.73484940e-05, 2.12948853e-05, ...,
         7.20679745e-05, 1.54536311e-03, 2.35993255e-04],
       [1.46621116e-03, 8.02504110e-06, 5.40619949e-05, ...,
         1.91874733e-05, 9.72440175e-05, 7.64339056e-05],
       [9.69291723e-05, 2.74417835e-05, 1.37613132e-03, ...,
         3.60095728e-05, 1.55378671e-04, 1.83973272e-04],
       ...,
Epoch 1/100
```

VISUALIZE METRICS:

In [16]:

```
fig,ax=plt.subplots(nrows=1,ncols=2,figsize=(20,5))
ax[0].plot(history.history['loss'],label='loss',c='red')
ax[0].plot(history.history['val_loss'],label='val_loss',c = 'blue')
ax[0].set_xlabel('Epochs')
ax[1].set_xlabel('Epochs')
ax[0].set_ylabel('Loss')
ax[1].set_ylabel('Accuracy')
ax[0].set_title('Loss Metrics')
ax[1].set_title('Accuracy Metrics')
ax[1].plot(history.history['accuracy'],label='accuracy')
ax[1].plot(history.history['val_accuracy'],label='val_accuracy')
ax[0].legend()
ax[1].legend()
plt.show()
```

Out [16]:



SAVE MODEL:

In [17]:

```
model.load_weights('ckpt')
model.save('models',save_format='tf')
```

```
linkcode
for idx,i in enumerate(model.layers):
    print('Encoder layers:' if idx==0 else 'Decoder layers: ')
    for j in i.layers:
        print(j)
    print('---------------------')
```

Out [17]:

```
Encoder layers:
<keras.layers.core.embedding.Embedding object at 0x782084b9d190>
>
---------------------
Decoder layers:
<keras.layers.core.embedding.Embedding object at 0x78207c258590>
```

```
<keras.layers.normalization.layer_normalization.LayerNormalization object at 0
x78207c78bd10>
<keras.layers.rnn.lstm.LSTM object at 0x78207c258a10>
------------------
```

CREATE INFERENCE MODEL:

In [18]:

```
class ChatBot(tf.keras.models.Model):
    def __init__(self,base_encoder,base_decoder,*args,**kwargs):
        super().__init__(*args,**kwargs)
```

```
self.encoder,self.decoder=self.build_inference_model(base_encoder,base_decoder
)
```

```


    def build_inference_model(self,base_encoder,base_decoder):
        encoder_inputs=tf.keras.Input(shape=(None,))
        x=base_encoder.layers[0](encoder_inputs)
        x=base_encoder.layers[1](x)
        x,encoder_state_h,encoder_state_c=base_encoder.layers[2](x)
        encoder=tf.keras.models.Model(inputs=encoder_inputs,outputs=[encoder_s
tate_h,encoder_state_c],name='chatbot_encoder')

        decoder_input_state_h=tf.keras.Input(shape=(lstm_cells,))
        decoder_input_state_c=tf.keras.Input(shape=(lstm_cells,))
        decoder_inputs=tf.keras.Input(shape=(None,))
        x=base_decoder.layers[0](decoder_inputs)
        x=base_encoder.layers[1](x)
        x,decoder_state_h,decoder_state_c=base_decoder.layers[2](x,initial_sta
te=[decoder_input_state_h,decoder_input_state_c])
        decoder_outputs=base_decoder.layers[-1](x)
        decoder=tf.keras.models.Model(
            inputs=[decoder_inputs,[decoder_input_state_h,decoder_input_state_
c]],
            outputs=[decoder_outputs,[decoder_state_h,decoder_state_c]],name='
chatbot_decoder'
        )
        return encoder,decoder

    def summary(self):
        self.encoder.summary()
        self.decoder.summary()

    def softmax(self,z):
        return np.exp(z)/sum(np.exp(z))

    def sample(self,conditional_probability,temperature=0.5):
        conditional_probability = np.asarray(conditional_probability).astype("
float64")
       conditional_probability = np.log(conditional_probability) / temperature
chatbot.summary()
```

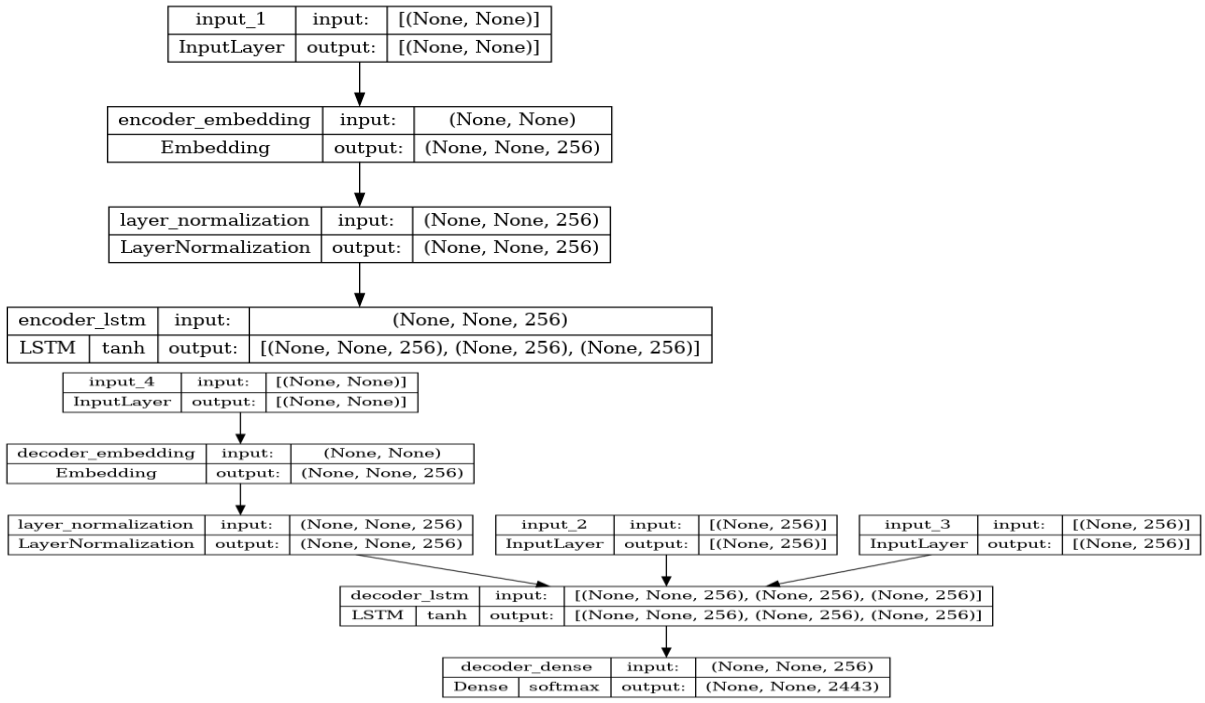
```
tf.keras.utils.plot_model(chatbot.encoder,to_file='encoder.png',show_shapes=True,show_layer_activations=True)
tf.keras.utils.plot_model(chatbot.decoder,to_file='decoder.png',show_shapes=True,show_layer_activations=True)
```

Out [18]:

Model: "chatbot_encoder"

Layer (type)	Output Shape	Param #
input_1 (InputLayer)	[(None, None)]	0
encoder_embedding (Embeddin g)	(None, None, 256)	625408
layer_normalization (LayerN ormalization)	(None, None, 256)	512
encoder_lstm (LSTM)	[(None, None, 256), (None, 256), (None, 256)]	525312

Total params: 1,151,232
Trainable params: 1,151,232
Non-trainable params: 0



Time to Chat:

In [19]:

```
def print_conversation(texts):
    for text in texts:
        print(f'You: {text}')
        print(f'Bot: {chatbot(text)}')
        print('========================')
print_conversation([
    'hi',
    'do yo know me?',
    'what is your name?',
    'you are bot?',
    'hi, how are you doing?',
    "i'm pretty good. thanks for asking.",
    "Don't ever be in a hurry",
    "'I'm gonna put some dirt in your eye '",
    "'You're trash '",
    "'I've read all your research on nano-technology '",
    "'You want forgiveness? Get religion'",
    "'While you're using the bathroom, i'll order some food.'",
    "'Wow! that's terrible.'",
    "'We'll be here forever.'",
    "'I need something that's reliable.'",
    "'A speeding car ran a red light, killing the girl.'",
    "'Tomorrow we'll have rice and fish for lunch.'",
    "'I like this restaurant because they give you free bread.'"
])
```

Out [19]:

```
You: hi
Bot: i have to go to the bathroom.
========================
You: do yo know me?
Bot: yes, it's too close to the other.
========================
You: what is your name?
Bot: i have to walk the house.
========================
You: you are bot?
Bot: no, i have. all my life.
========================
You: hi, how are you doing?
Bot: i'm going to be a teacher.
========================
You: i'm pretty good. thanks for asking.
```

CONCLUSION AND FUTURE WORK (PHASE 2):

Project Conclusion:

Conclusion: the phase 2 project submission involved the creation of a chatbot in Python. Through meticulous planning, research, and implementation, we successfully developed a chatbot capable of engaging in conversational interactions with users. Leveraging various Python libraries and techniques, we incorporated natural language processing, machine learning algorithms, and sentiment analysis to enhance the chatbot's understanding and response generation abilities. The project not only provided hands-on experience in Python programming, but also allowed us to delve into the fascinating world of chatbot development, gaining valuable insights and honing our skills in artificial intelligence. Overall, this project has been a fulfilling journey that has expanded our knowledge and proficiency in Python and chatbot development.

Future work: We plan to further enhance the chat bot created in Python by implementing advanced natural language processing techniques and machine learning algorithms. This will enable the chat bot to better understand and respond to user queries, improving its overall conversational abilities. Additionally, we aim to integrate the chat bot with external APIs and databases, allowing it to fetch real-time information and provide more accurate and up-to-date responses. Furthermore, we will focus on optimizing the chat bot's performance and scalability, ensuring that it can handle a large number of concurrent users. Overall, our goal is to create a highly intelligent and efficient chat bot that provides an exceptional user experience.