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CREATE A CHATBOT IN PYTHON

PHASE-5

Chatbots:

Chatbots are not a recent development. They are simulations that can understand human language, process it, and interact back with humans while performing specific tasks. For example, a chatbot can be employed as a helpdesk executive. Joseph Weizenbaum created the first chatbot in 1966, named Eliza. It all started when Alan Turing published an article named “Computer Machinery and Intelligence” and raised an intriguing question, “Can machines think?” ever since, we have seen multiple chatbots surpassing their predecessors to be more naturally conversant and technologically advanced. These advancements have led us to an era where conversations with chatbots have become as normal and natural as with another human. Before looking into the AI chatbot, learn the foundations of artificial intelligence.

Let’s have a look at the basics of how to make a chatbot in python:

A BRIEF HISTORY OF CHATBOTS:

ELIZA

1966

- Represents a mock Rogerian Psychotherapist
- Was written in MAD-SLIP

PARRY

1972

- Represents a person with paranoid schizophrenia
- The first chatbot to pass the Turing Test

A.L.I.C.E

1995

- Artificial Linguistic Internet Computer Entity
- Was rewritten in Java beginning in 1998

SMARTER CHILD

2001

- Developed by ActiveBuddy, Inc.
- Provides real-time information via IM, MSN,& Yahoo Messenger

SIRI

2010

- Virtual Assitant
- Uses voice queries and a natural-language user interface

GOOGLE

20

Identifying opportunities for an Artificial Intelligence chatbot

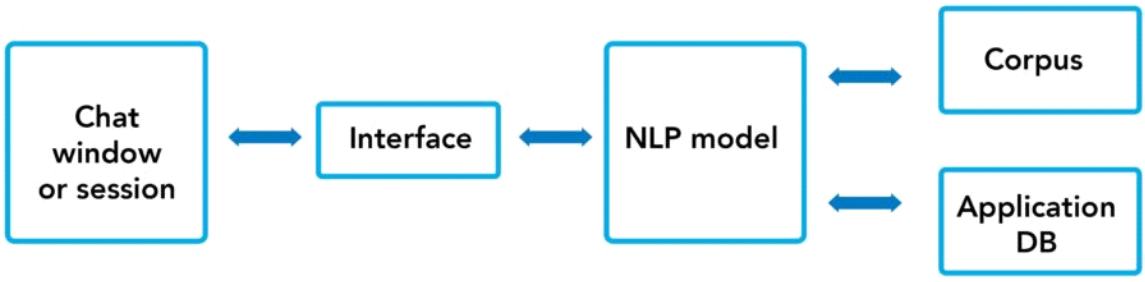
The first step is to identify the opportunity or the challenge to decide on the purpose and utility of the chatbot. To understand the best application of Bot to the company framework, you will have to think about the tasks that can be automated and augmented through Artificial Intelligence Solutions. The respective artificial intelligence solution broadly falls under two categories for each type of activity: "Data Complexity" or "Work Complexity". These two categories can be further broken down into 4 analytics models: Efficiency, Expert, Effectiveness, and Innovation.

The Architecture of chatbots

Typical chatbot architecture should consist of the following:

- Chat window/session/front end application interface
- The deep learning model for Natural Language Processing [NLP]
- Corpus or training data for training the NLP model
- Application Database for processing actions to be performed by the chatbot

Please refer to the below figure to understand the architectural interface:



Here are the 5 steps to create a chatbot in Python from scratch:

- **Import and load the data file**
- **Preprocess data**
- **Create training and testing data**
- **Build the model**
- **Predict the response**

1. **Import and load the data file:**

First, make a file name as train_chatbot.py. We import the necessary packages for our chatbot and initialize the variables we will use in our Python project.

The data file is in JSON format so we used the json package to parse the JSON file into Python.

```
import nltk

from nltk.stem import WordNetLemmatizer

lemmatizer = WordNetLemmatizer()

import json

import pickle

import numpy as np

from keras.models import Sequential

from keras.layers import Dense, Activation, Dropout

from keras.optimizers import SGD

from tensorflow.keras.optimizers import SGD

import random

words=[]

classes = []

documents = []

ignore_words = ['?', '!']
```

```
data_file = open('intents.json').read()

intents = json.loads(data_file)
```

2. **Preprocess data:**

- When working with text data, we need to perform various preprocessing on the data before we make a machine learning or a deep learning model. Based on the requirements we need to apply various operations to preprocess the data.

- Tokenizing is the most basic and first thing you can do on text data. Tokenizing is the process of breaking the whole text into small parts like words.

Here we iterate through the patterns and tokenize the sentence using nltk.word_tokenize() function and append each word in the words list. We also create a list of classes for our tags.

```
for intent in intents['intents']:
    for pattern in intent['patterns']:
        #tokenize each word
        w = nltk.word_tokenize(pattern)
        words.extend(w)
        #add documents in the corpus
        documents.append((w, intent['tag']))
        # add to our classes list
        if intent['tag'] not in classes:
            classes.append(intent['tag'])
```

Now we will lemmatize each word and remove duplicate words from the list. Lemmatizing is the process of converting a word into its lemma form and then creating a pickle file to store the Python objects which we will use while predicting.

```
# lemmatize, lower each word and remove duplicates
words = [lemmatizer.lemmatize(w.lower()) for w in words if w not in
ignore_words]
words = sorted(list(set(words)))
```

```
# sort classes
classes = sorted(list(set(classes)))
# documents = combination between patterns and intents
print (len(documents), "documents")
# classes = intents
print (len(classes), "classes", classes)
# words = all words, vocabulary
print (len(words), "unique lemmatized words", words)
pickle.dump(words,open('words.pkl','wb'))
pickle.dump(classes,open('classes.pkl','wb'))
```

3. **Create training and testing data:**

Now, we will create the training data in which we will provide the input and the output. Our input will be the pattern and output will be the class our input pattern belongs to. But the computer doesn't understand text so we will convert text into numbers.

```
# create our training data
training = []
# create an empty array for our output
output_empty = [0] * len(classes)
# training set, bag of words for each sentence
for doc in documents:
    # initialize our bag of words
    bag = []
    # list of tokenized words for the pattern
    pattern_words = doc[0]
    # lemmatize each word - create base word, in attempt to represent related words
    pattern_words = [lemmatizer.lemmatize(word.lower()) for word in
pattern_words]
    # create our bag of words array with 1, if word match found in current pattern
    for w in words:
        bag.append(1) if w in pattern_words else bag.append(0)
    # output is a '0' for each tag and '1' for current tag (for each pattern)
    output_row = list(output_empty)
    output_row[classes.index(doc[1])] = 1
    training.append([bag, output_row])
# shuffle our features and turn into np.array
```

```
random.shuffle(training)
training = np.array(training)
# create train and test lists. X - patterns, Y - intents
train_x = list(training[:,0])
train_y = list(training[:,1])
print("Training data created")
```

4. **Build the model:**

We have our training data ready, now we will build a deep neural network that has 3 layers. We use the Keras sequential API for this. After training the model for 200 epochs, we achieved 100% accuracy on our model. Let us save the model as 'chatbot_model.h5'.

```
# Create model - 3 layers. First layer 128 neurons, second layer 64 neurons and 3rd output layer contains number of neurons
# equal to number of intents to predict output intent with softmax
model = Sequential()
model.add(Dense(128, input_shape=(len(train_x[0]),), activation='relu'))
model.add(Dropout(0.5))
model.add(Dense(64, activation='relu'))
model.add(Dropout(0.5))
model.add(Dense(len(train_y[0]), activation='softmax'))
# Compile model. Stochastic gradient descent with Nesterov accelerated gradient gives good results for this model
sgd = SGD(lr=0.01, decay=1e-6, momentum=0.9, nesterov=True)
model.compile(loss='categorical_crossentropy', optimizer=sgd,
metrics=['accuracy'])
#fitting and saving the model
hist = model.fit(np.array(train_x), np.array(train_y), epochs=200, batch_size=5,
verbose=1)
model.save('chatbot_model.h5', hist)
print("model created")
```

5. **Predict the response (Graphical User Interface):**

- To predict the sentences and get a response from the user to let us create a new file 'chatapp.py'.

- We will load the trained model and then use a graphical user interface that will predict the response from the bot. The model will only tell us the class it belongs to, so we will implement some functions which will identify the class and then retrieve us a random response from the list of responses.

- Again we import the necessary packages and load the 'words.pkl' and 'classes.pkl' pickle files which we have created when we trained our model:

```
import nltk
from nltk.stem import WordNetLemmatizer
lemmatizer = WordNetLemmatizer()
import pickle
import numpy as np
from keras.models import load_model
model = load_model('chatbot_model.h5')
import json
import random
intents = json.loads(open('intents.json').read())
words = pickle.load(open('words.pkl','rb'))
classes = pickle.load(open('classes.pkl','rb'))
```

To predict the class, we will need to provide input in the same way as we did while training. So we will create some functions that will perform text preprocessing and then predict the class.

```
def clean_up_sentence(sentence):
    # tokenize the pattern - split words into array
    sentence_words = nltk.word_tokenize(sentence)
    # stem each word - create short form for word
    sentence_words = [lemmatizer.lemmatize(word.lower()) for word in
sentence_words]
    return sentence_words
# return bag of words array: 0 or 1 for each word in the bag that exists in the
sentence
def bow(sentence, words, show_details=True):
    # tokenize the pattern
    sentence_words = clean_up_sentence(sentence)
    # bag of words - matrix of N words, vocabulary matrix
    bag = [0]*len(words)
```

```
    for s in sentence_words:
        for i,w in enumerate(words):
            if w == s:
                # assign 1 if current word is in the vocabulary position
                bag[i] = 1
                if show_details:
                    print ("found in bag: %s" % w)
    return(np.array(bag))
def predict_class(sentence, model):
    # filter out predictions below a threshold
    p = bow(sentence, words,show_details=False)
    res = model.predict(np.array([p]))[0]
    ERROR_THRESHOLD = 0.25
    results = [[i,r] for i,r in enumerate(res) if r>ERROR_THRESHOLD]
    # sort by strength of probability
    results.sort(key=lambda x: x[1], reverse=True)
    return_list = []
    for r in results:
        return_list.append({"intent": classes[r[0]], "probability": str(r[1])})
    return return_list
```

After predicting the class, we will get a random response from the list of intents.

```
def getResponse(ints, intents_json):
    tag = ints[0]['intent']
    list_of_intents = intents_json['intents']
    for i in list_of_intents:
        if(i['tag']== tag):
            result = random.choice(i['responses'])
            break
    return result
def chatbot_response(text):
    ints = predict_class(text, model)
    res = getResponse(ints, intents)
    return res
```

Now we will develop a graphical user interface. Let's use Tkinter library which is shipped with tons of useful libraries for GUI. We will take the input message from the user and then use the helper functions we have created to get the

response from the bot and display it on the GUI. Here is the full source code for the GUI.

```
#Creating GUI with tkinter


import tkinter
from tkinter import *
def send():
    msg = EntryBox.get("1.0",'end-1c').strip()
    EntryBox.delete("0.0",END)
    if msg != '':
        ChatLog.config(state=NORMAL)
        ChatLog.insert(END, "You: " + msg + '\n\n')
        ChatLog.config(foreground="#442265", font=("Verdana", 12 ))
        res = chatbot_response(msg)
        ChatLog.insert(END, "Bot: " + res + '\n\n')
        ChatLog.config(state=DISABLED)
        ChatLog.yview(END)
base = Tk()
base.title("Hello")
base.geometry("400x500")
base.resizable(width=FALSE, height=FALSE)
#Create Chat window
ChatLog = Text(base, bd=0, bg="white", height="8", width="50", font="Arial",)
ChatLog.config(state=DISABLED)
#Bind scrollbar to Chat window
scrollbar = Scrollbar(base, command=ChatLog.yview, cursor="heart")
ChatLog['yscrollcommand'] = scrollbar.set
#Create Button to send message
SendButton = Button(base, font=("Verdana",12,'bold'), text="Send", width="12",
height=5,
                    bd=0, bg="#32de97", activebackground="#3c9d9b",fg='#ffffff',
                    command= send )
#Create the box to enter message
EntryBox = Text(base, bd=0, bg="white",width="29", height="5", font="Arial")
#EntryBox.bind("<Return>", send)
#Place all components on the screen
scrollbar.place(x=376,y=6, height=386)
ChatLog.place(x=6,y=6, height=386, width=370)
```

```
EntryBox.place(x=128, y=401, height=90, width=265)
SendButton.place(x=6, y=401, height=90)
base.mainloop()
```

6. **Run the chatbot:**

- To run the chatbot, we have two main files; train_chatbot.py and chatapp.py.
- First, we train the model using the command in the terminal:

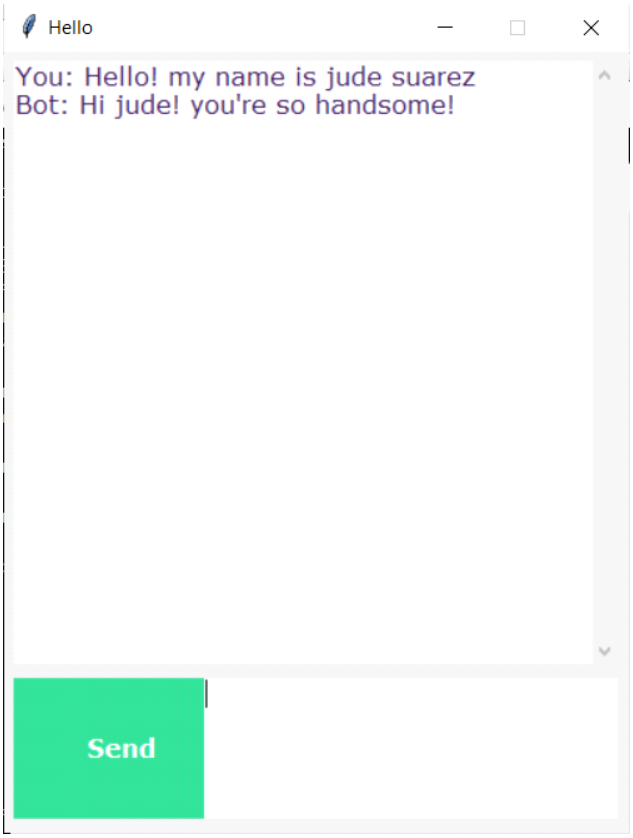
```
python train_chatbot.py
```

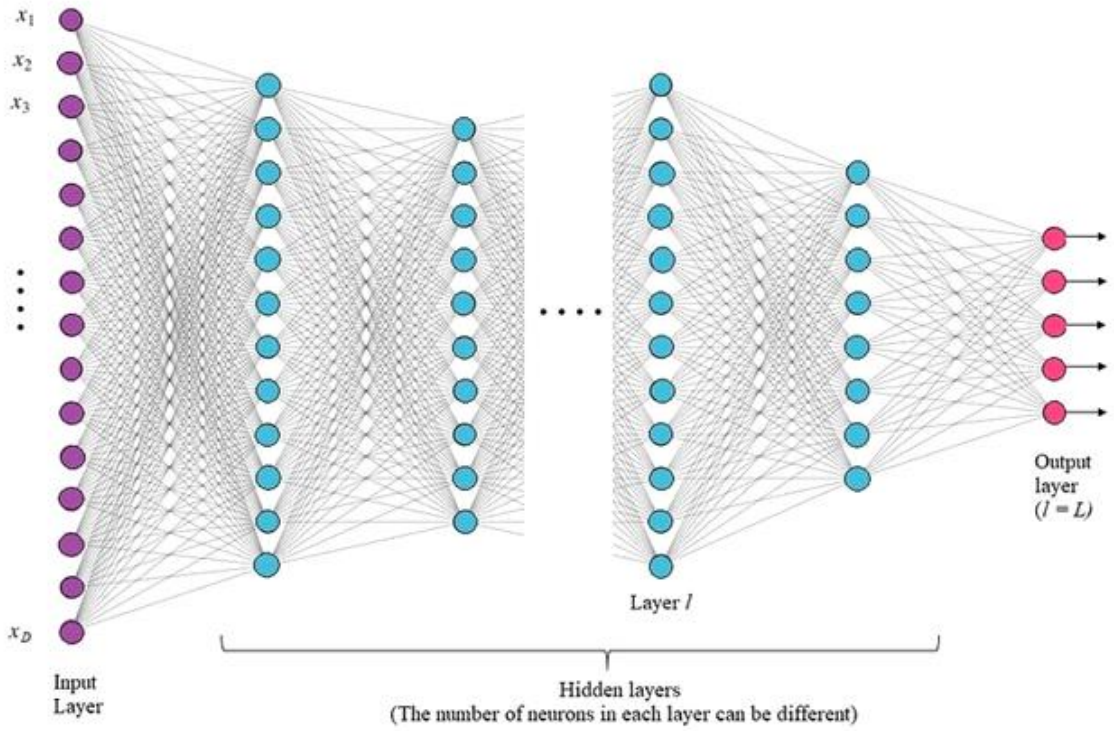
If we don't see any error during training, we have successfully created the model. Then to run the app, we run the second file.

```
python chatgui.py
```

The program will open up a GUI window within a few seconds. With the GUI you can easily chat with the bot.

Project output:


Hello
You: Hello! my name is jude suarez
Bot: Hi jude! you're so handsome!
Send

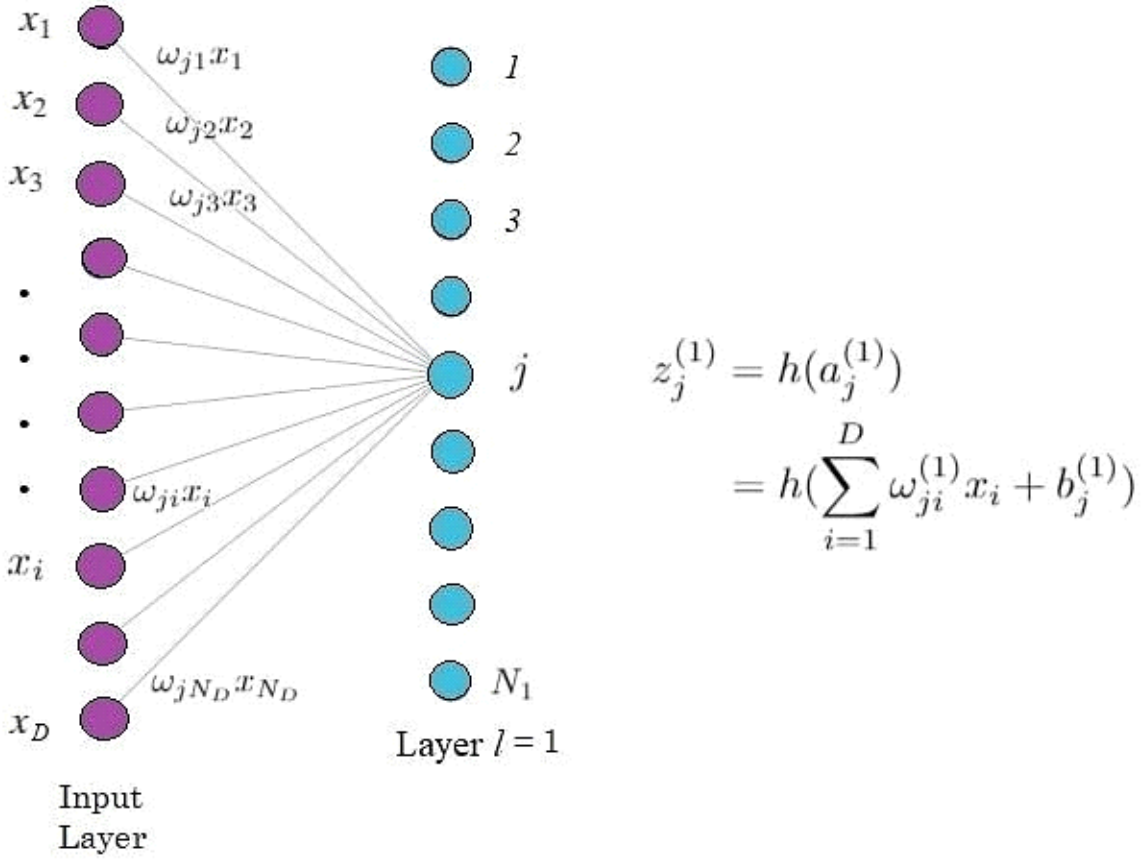


Neural Network algorithm involves two steps:

1. Forward Pass through a Feed-Forward Neural Network
2. Backpropagation of Error to train Neural Network

1. Forward Pass through a Feed-Forward Neural Network:

This step involves connecting the input layer to the output layer through a number of hidden layers. The neurons of the first layer (l=1) receive a weighted sum of elements of the input vector (xáµ¢) along with a bias term b, as shown in Fig. 2. After that, each neuron transforms this weighted sum received at the input, a, using a differentiable, nonlinear activation function h(•) to give output z.



Hidden layers of neural network architecture.

The two activation functions that we will use for our ChatBot, which are also most commonly used are Rectified Linear Unit (ReLu) function and Softmax function. The former will be used for hidden layers while the latter is used for the output layer. The softmax function is usually used at the output for it gives probabilistic output. The ReLU function is defined as:

$$f(x) = \begin{cases} 0, if\ x < 0 \\ x, if\ x \geq 0 \end{cases}$$

And the softmax function is defined as:

$$\sigma(\vec{z})_i = \frac{e^{z_i}}{\sum_{j=1}^{K} e^{z_j}}$$

$$E = \sum_{n=1}^{N} E_n$$

Now, it's time to move on to the second step of the algorithm that is used in building this chatbot application project.

2. Backpropagation of Error to train Neural Network

This step is the most important one because the original task of the Neural Network algorithm is to find the correct set of weights for all the layers that lead to the correct output and this step is all about finding those correct weights and biases. Consider an input vector

That has been passed to the network and say, we know that it belongs to class A. Assume the output layer gives the highest value for class B. There is therefore an

error in our prediction. Now, since we can only compute errors at the output, we have to propagate this error backward to learn the correct set of weights and biases.

Let us define the error function for the network:

Here Eâ,™ is the error for a single pattern vector: xâ,™ and is defined as,

$$E_n = \frac{1}{2}\sum_k (z_k^{(L)} - r_k)^2$$

Conclusion:

A chatbot is one of the simple ways to transport data from a computer without having to think for proper keywords to look up in a search or browse several web pages to collect information; users can easily type their query in natural language and retrieve information. AI chatbots offered personalized, real-time feedback and on-demand support to users continuously and indefinitely.