

AgentG: A user friendly and engaging bot to chat for e-commerce lovers

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Abstract

Regular customer assistance chatbots are generally based on dialogues delivered by humans. It faces symbolic issues usually related to data scaling and the privacy of one's information. In this paper, we coeval AgentG, an intelligent chatbot used for customer assistance. It is built using deep neural network architecture. It clouts huge-scale and free publicly accessible e-commerce data. Different from existing counterparts, AgentG takes a great data advantage from in-pages that contain product descriptions along with user-generated data content from these online eCommerce websites. It results in more efficient from a practical point of view as well as cost-effective while answering questions that are repetitive. This helps in providing the freedom to people who work as customer service in order to answer questions with highly accurate answers. We have demonstrated how AgentG acts as an additional extension to the actual stream web browsers and how it is useful to users in having a better experience who are doing online shopping.

Keywords: E-commerce, NLTK, Chatbot, Keras, Deep Neural Network

Introduction

The service provided to customer by the customer service department plays a vital role in producing profits for an organization. A company with this division has to spend a lot over the resources may be billions in order to change the customer's perception that he holds. People in customer service department have to spend most of their time in answering the questions asked by customers through telephone or applications like messaging so that the questions posed by the customers are satisfied. This outdated technique that was earlier used for customer service mainly suffers from two issues: Firstly, many questions that are asked to the staff members usually are of repetitive nature, these questions can be economically responded by using machines. Secondly, to provide the round the clock facilities is a cumbersome task, generally for the businesses that are mostly non-global. Consequently, these virtual assistants will be of great importance and replace the customer service personnel. As they are more cost-effective and time saving, of late, virtual assistance provided as a substitute for the service provided to customers is rapidly getting popular with businesses that are customer oriented. The basic building blocks of these bots are the conversations among humans that occurred earlier in the past. These are upfront but involve the two problems namely data scalability and the privacy of those customers' conversations. Getting in touch with a support staff who work in the customer service division to answer their queries involves a lot of waiting time. This mechanism is not very effective and also it involves scalability issues (Raghuv eer & Tripathy, 2012, 2014a, 2014b, 2015, 2016). Another important aspect that needs to be considered is that the privacy of the customer's conversations are at stake. These discussions are not permissible to be used as data for training. The solution to the above problem of training is finding easily available and large amounts of data related to serving the customers. These data act as a basic block to build the bot that serves as the helping agent. In this paper, we create AgentG, an influential service provided to customers which is a chatbot that manages such extensive and freely accessible data on all the e-shopping websites. There exist large e-commerce websites that showcase a great variety of product descriptions and also content that are user-generated. Some of the shopping webpages are Amazon.com, Flipkart.com, and Snapdeal.com. The above existing data are extracted and provided as an input to the bot being constructed namely AgentG. This virtual assistant helps in providing better services to the customers while shopping online along with the human staff. The extracted data is stored in a json file that is processed using the Natural Language Toolkit (NLTK) package

available in Python. This processed data is used as training data to the deep learning model. The NLTK package is used for Natural Language Processing (NLP).

Literature Survey

In Baktha & Tripathy (2017), the proposed system is different Recurrent Neural Network (RNN) architectures that can be used in the sentiment analysis field. The models analyzed in this work are vanilla -RNN, Long-Short Term Memory (LSTM) and Gated Recurrent Unit (GRU). The training was on Google News dataset and for evaluation; the dataset was the Amazon health product reviews, sentiment analysis benchmark datasets SST-1 and SST-2.

Behera (2016) said that Chappie is being used as a routing agent wherein it can identify the needs of user on the basis of first few chats into one of the services provided by business and then send it to an agent who has a good knowledge in that service. It examines the chats and extracts important content of the user that is similar to likes of wit.ai website (WIT) with the help of (NLP). Then it uses this useful information and AIML to start talking to the user.

Cui et al (2017) demonstrates a chatbot name SuperAgent, it is a useful chatting assistant that helps in providing service to customers. It is extremely beneficial and available widely for data on e-shopping. It can easily pull crowdsourcing styles, which contain collection of hi-tech NLP and also merge into e-commerce websites as an additional feature extension.

Du Preez et al (2009) provides the detailed knowledge about the development and design of an intelligent and highly accurate chatbot system based on voice recognition. This paper presents a technology and a method to demonstrate and to verify a framework that has been proposed and require to provide support to such a bot (a Web service).

El Zini et al (2019) proposed system is a chatbot to interact with virtual patients so that the doctors can complete the clinical assessment of the patient with ease. This also led to significant logistical savings. A deep learning framework is developed to improve the virtual patient's conversational skills based on the domain specific embeddings, then a long-short term memory (LSTM) network is used to derive sentence embeddings before a convolutional neural network model selects an answer from script to a specific query. Accuracy of the system is around 81%.

In Gupta & Tripathy (2014, February), the proposed system is a combination of content-based model and memory-based collaborative filtering techniques that are used to build a recommendation system using a deep neural feed forward network. This model is analyzed using parameters such as number of users, ratings and system model. The recommendations are generated based on the cosine similarity values. The evaluation metric used is root mean square error (RMSE). The observations from the experiment got is the relationship between the test error and various factors.

Holotescu (2016) stated that with the advancement of Massive Open Online Courses (MOOC) providers, like "edX, Coursera, FutureLearn, or MOOC.ro", it is indeed problematic to find the best resources for learning. MOOCBuddy - is a recommendation system for MOOC which works as a chatbot for application named Facebook Messenger, generally based on social media profile of the user along with their interests, which can be provided as solution.

Hristidis (2018) have provided an overview on the technologies that are the driving force of chatbots such as information retrieval and deep learning. They also offer some insights on difference between conversational chatbots and transactional chatbots. Conversational bots are trained on general chat logs whereas the transactional bots are trained for specific purpose such as any ticket booking service.

Kowalski et al (2009) discuss the end result of two cases that have been studied in a large international corporation in order to test the utilization of chatbots for security in training the internal aspect of the customer data. However, it appears to be the data that is qualitative in nature which suggest that the attitude of the customers appear to be highly positive towards security while using chatbots rather than with the existing traditional e-learning courses for security training at the company.

Kumar et al (2018) proposed a method for chatbots to be built using deep learning technologies, which is a new area of machine learning. In deep learning every algorithm applies a non-linear approach on the input to learn statistical information from it. The statistical information is then used to obtain the output. For large datasets the data is split into training and testing set. This process of applying non-linear approach to the input is repeated until an acceptable accuracy, precision, recall or f1-measure is obtained.

Nuruzzaman & Hussain (2018) conducted a survey on various chatbots and their techniques. According to the paper, research suggested that 75% of the customers have had poor customer service experience as the chatbots have not been able to respond to all queries of the customers. It also gives a comparison among all the existing chatbots and the techniques used to build them. One of the major problems related to chatbots that result in poor performance is their inability to generate long, meaningful responses.

Orin (2017) proposed the first chatbot in Bengali that is named as Golpo totally based on a feature of being language-independent and uses the natural language processing library with a process of making the machine learn. The experiment performed in this project has shown that the chatbot can give responses to the customers in real time world. Based on the calculation of customers, Golpo can generate syntactically natural and correct Bengali responses.

Pilato et al (2005) proposed a chatbot system to help the user to communicate with a community that consists of chatbots, having specific properties in order to go through many concepts that are mechanically produced with the help of Latent Semantic Analysis (LSA) paradigm. The knowledge of chatbots are created in order to deal with the field of Cultural Heritage, which are then coded into semantic space that is further created with the help of LSA, making them useful to calculate their own accuracy formulated by the customer, which are later mapped into the same semantic space.

In Raghuvver & Tripathy (2016), authors say that the database is used to store the knowledge of the chatbot, which is accessing the core in deeper Relational Database Management System (RDBMS). The storage of knowledge here is the database and interpreter here work as a function stored program and produce sets of required pattern-matching. By using programming language of Pascal or Java the interface has been built.

Satu et al (2017) talk about a combination of artificial conversation systems along with an e-commerce site that will give unrestricted services for chatting. When user will get into the ecommerce website firstly, he can enquire about e-commerce to know the system particularly. Ecommerce system sends the query of the customer to the Artificial Intelligence Markup Language (AIML) Knowledge Base System in order to get answers just by applying the algorithm for pattern matching.

Background Study

This section provides descriptions about some necessary concepts.

a. Json File

The input file introduced here is a JSON file which stores objects and data structures that are simple in JavaScript Object Notation (JSON) format, which is a standard data interchange format. It is mostly used for data transmission between a server and a web application.

b. Natural Language Toolkit (NLTK)

NLTK is one of the most useable platforms for writing Python programs in order to work along with data that is generally human language. It provides us with easy-to-use interfaces for WordNet, along with a set of libraries for text processing like classification, stemming, tokenization etc.

c. Tokenization of Words

There exist a pre-trained Punkt tokenizer in the NLTK data package generally for English in order to perform reduction of words to their corresponding stem or root form—mostly a word's written form and lemmatization along with removal of Noise, stop words.

d. Bag of Words

As we have gone through and completed the phase of text pre-processing, now we have changed the given text into an array or a vector consisting of meaningful and logical numbers (Jena et al 2001; Jena et al 2002). One of the most common way of text based representation is bag of words that gives the deeper insight about the appearances of the words in the document. It generally includes the two of the things: A collection of words that are known. A count of known words that are present. Here we are only considering if the words that we know are present in the given document, and if they are there then what is their position of occurrence.

e. Deep Learning

Deep learning is a subset of the machine learning field. The main idea behind deep learning is using the "behavior of the neurons in human brain" that learn by getting trained to become better. The deep learning paradigm uses the concept of multiple layers of nodes in order to extract features from raw input at higher levels. This is done in a progressive manner by the neural network.

e. Feed Forward Neural Network

A Feedforward network is also known as Deep feedforward network, or multilayer perceptron (MLP). In general, the process of approximation of some function f^* can be said to be the aim of a feed forward network. For instance, consider the case of a classifier whose goal is to map the given input 'x' to the category or class label 'y' represented by the equation $y=f^*(x)$. In terms of a MLP, the mapping is defined using a parameter θ as $y=f(x, \theta)$ whose value is learnt by choosing the best method of approximation. An artificial neural network uses a method called backpropagation to update the weights of the hidden layers so as to get better accuracy in the end. Consider a neural network with an input layer of two neurons, two hidden layers with three neurons each and an output layer with one neuron. In a feed forward network every node is connected to every other layer's node as shown in Fig. 1.

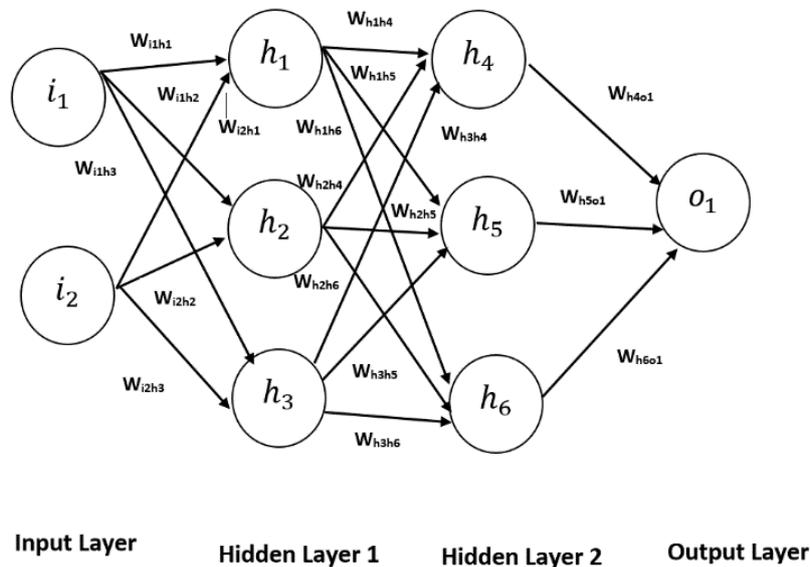


Figure 1. The Feed forward network with two hidden layers

The network can be represented with the following equation:

$$Output [O] = Input[X] \times Weight\ matrix[W] + Bias[B]$$

The weight matrix between input layer and hidden layer 1 in the network above is given by:

$$W_{IH} = \begin{bmatrix} w_{i_1h_1} & w_{i_1h_2} & w_{i_1h_3} \\ w_{i_2h_1} & w_{i_2h_2} & w_{i_2h_3} \end{bmatrix}$$

Using backpropagation, each of the weights in W_{IH} are updated to reduce the loss using the specified optimizers.

Methodology

According to the statistics on the usage of chatbots, more than 67% of the clients throughout the world use a chatbot for customer support. E- Commerce being one of the major customer based business also have started providing chatbots for customer service. In this work, an interactive chatting machine AgentG is created that intelligently answers the queries related to E-commerce websites or products.

In this section, more information about the dataset, the proposed model, pre-processing steps and the libraries that are used is provided.

a. Dataset

The project needs a corpus that is fed into a model for training purpose. The dataset described below is a json file named intents.json that contains these terms like tags, patterns and responses. These tags act like the class or target for the deep learning module. The model predicts the input to belong to any one of these categories. The Table 1 shows the data file.

Table 1: Description of the dataset

Tag	No. of patterns	No. of responses	Example
Greetings	5	3	Hi, Hello
Good bye	3	3	Bye, Goodbye
Thanks	3	3	Thank you, Thanks
Flipkart	3	3	Big Billion days, Flipkart fashion latest trend
Amazon	3	2	Great Indian festival, freedom sale
Mobiles	3	3	Price of oppo phone
Computers	4	3	Best Desktop or Notebook
Payments	3	2	Pay by cash only
Return Policy	2	2	Exchange policy on a product

b. Building the Bot -Proposed System

The proposed system (Fig. 2) is described as follows:

Step 1: Creating a corpus file. A json file consisting of tags, patterns and responses is created for numerous topics like greetings, thank you, mobiles, laptops, Flipkart, Amazon, payments, return policy and goodbye.

Step 2: The next step is to extract the words from patterns in the json file using the word tokenizer. The tags in the json file are stored into labels.

Step 3: A bag of words is created for each word in the pattern based on the vocabulary.

Step 4. The deep neural network is then trained on these pairs of patterns to responses.

Step 5: predicting the answers for any queries asked by the customer.

In this work we are using keras library and NLTK. NLP is the area that commonly emphasize on the common interactions amid computers and human language that is largely known as Natural Language Processing. It is an intersection of computer science, linguistics computation and artificial intelligence system. It is a kind of way for computers to go through and understand, then analyze and finally derive proper meaning from language

that can be useful. By using NLP, we can structure knowledge in order to perform automatic summarization, named entity recognition, relationship extraction etc.

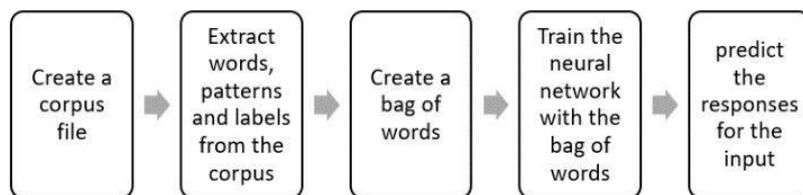


Figure 2. The sequence of steps of the proposed system

c. Corpus

In this work we have mostly used a json file that consists of tags, patterns and responses. This json file contains topics related to queries such as "hi", "hello", Flipkart related queries such as big billion days or Amazon's Great Indian festival days. Mobiles and Laptops are also added as topics in the corpus. The json file is called intents.json (Fig. 3). This file is read and words, patterns and labels are extracted. This pre-processing is done by word tokenizer and Lancaster Stemmer.

We make use of random function in order to get more favourable responses from the available responses under a particular label or tag as in the json file. Since our model is trained by taking data from the NLTK package, any query that does not match the words in the json file is also answered. This feature makes the chatbot more reliable.

```

{"intents": [
  {"tag": "greeting",
   "patterns": ["Hi", "How are you", "Is anyone there?", "Hello", "Good day"],
   "responses": ["Hello, thanks for visiting", "Good to see you again", "Hi there, how can I help?"],
   "context_set": ""
  },
  {"tag": "goodbye",
   "patterns": ["Bye", "See you later", "Goodbye"],
   "responses": ["See you later, thanks for visiting", "Have a nice day", "Bye! Come back again soon."]
  },
  {"tag": "thanks",
   "patterns": ["Thanks", "Thank you", "That's helpful"],
   "responses": ["Happy to help!", "Any time!", "My pleasure"]
  }
]
  
```

Figure 3. Screenshot of the corpus used for training and predicting the responses

d. Keras Library and Proposed Architecture

Keras is one of the libraries used in this work. It is a high-level neural networks API that is used to implement deep learning models. In this work a fully connected neural network with three hidden layers with 128 neurons in the first hidden layer with Rectified Linear Unit (ReLU) as the activation function, 64 neurons in the second hidden layer with ReLU as the activation function and the third hidden layer has number of neurons equal to the number of classes the query may belong to, in this work it is 9 whose activation layer is a Softmax. In between the first and second hidden layer, a drop out layer (0.25) is added. A dropout layer is also added between dense layer 2 and dense layer 3. The model is compiled using the stochastic gradient descent (SGD) optimizer with categorical cross-entropy loss. Accuracy is used as a measure of metric. Fig. 4 shows the architecture parameters used in this work.

The activation functions used are ReLU (Rectified Linear Unit) and Softmax. The equation of ReLU can be defined as follows:

$$f(x) = \max(0, x)$$

Layer (type)	Output Shape	Param #
dense_1 (Dense)	(None, 128)	10368
dropout_1 (Dropout)	(None, 128)	0
dense_2 (Dense)	(None, 64)	8256
dropout_2 (Dropout)	(None, 64)	0
dense_3 (Dense)	(None, 9)	585
Total params: 19,209		
Trainable params: 19,209		
Non-trainable params: 0		

Figure 4. Feed forward network architecture used in the work

The SoftMax is an activation function that normalizes an input vector of n real numbers into a probability distribution comprising of the n probabilities that are proportional to the exponents of the input numbers. The equation is given by:

$$S(y_i) = \frac{e^{y_i}}{\sum_j e^{y_j}}$$

e. Tkinter Library for creating the GUI

The chatbot is presented to the user in the form of a dialog box that has a chat screen along with a send button that is clicked after every typed by the user.

To create this GUI, a package named tkinter which is a standard python interface to the Tk GUI toolkit available with python is used. Some features that can be specified while creating the interface are the title, font color, background color, font style, width, height and so on. The GUI created in this work shown in Fig. 5.

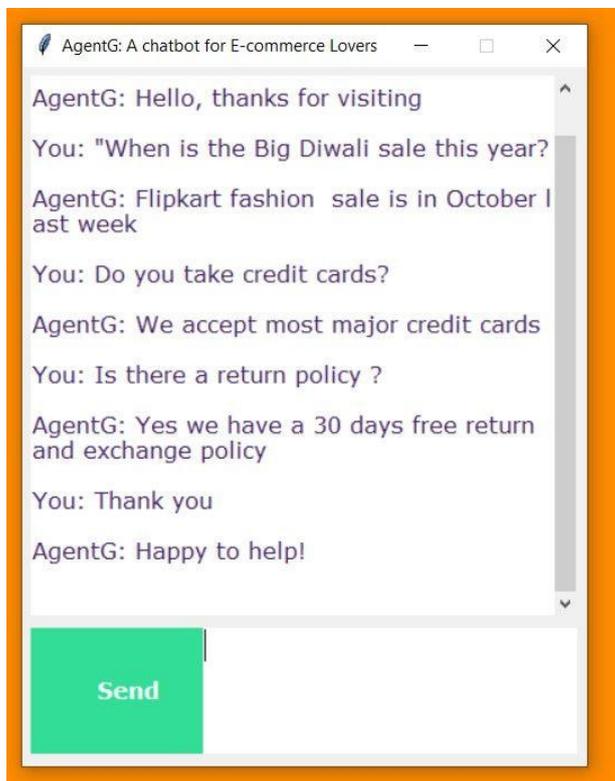


Figure 5. GUI for the chatbot created using Tkinter

These results (Fig. 8) is then filtered by an error threshold value of 0.25 such that all values from the predict function that are greater than 0.25 are valid predictions. The result is then sorted in the descending order so that the class with the maximum probability is at the first place. To the user the maximum probability tag and the value is displayed. Table 2 shows the probability matches to different queries of the user. The Fig. 8 shows the prediction and the most probable class for user's input.

```
Results: [[0, 0.99999964]]
Prediction of class: [{'intent': 'Amazon', 'probability': '0.99999964'}]
```

Figure 8. Prediction and most probable class for user's input

STEP 5: Pick a Response from that Class

The result of the class with maximum probability along with the input json file is used by the get_response method to get a random response from the set of responses associated with that tag and pattern. Fig. 9 shows the response for the user's input.

```
You: When is the Great indian festival?
AgentG: Next sale is After November 14
```

Figure 9. Response for the user's input

6. Results and Discussion

The figures below show the conversation with the virtual customer service agent 'AgentG'. A series of questions was asked to AgentG like; which is the best camera with cost being less than Rs. 10,000? The response in this case was "Samsung galaxy M30". If queries related to price or exchange policy were asked, the response was "no exchange or 30 day free return time". AgentG has a special feature that makes it capable to answer queries, which it had not faced but are based upon queries put at it in the past. The model has an accuracy of around 80%.

```
Hi there I am AgentG !! How may I help you? (type quit to stop)!

You: Hi
Tag: greeting
Hi there, how can I help?

You: Hello
Tag: greeting
Good to see you again

You: How are you?
Tag: greeting
Good to see you again

You: Is anyone there?
Tag: greeting
Good to see you again

You: Good day
Tag: greeting
Good to see you again
```

Figure 10. Greetings tag conversation with AgentG (existing queries)

Figure 10 shows the conversation with AgentG where the customer greets the chatbot in different ways. The chatbot's response was greeting the user back. These queries were existing in the corpus. Figure 11 deals with the unseen greeting queries and the chatbot's response to it.

```
You: hello there
Tag: greeting
Good to see you again

You: hi there
Tag: greeting
Hi there, how can I help?
```

Figure 11. Greetings tag conversation with AgentG (unseen queries)

```
Hi there I am AgentG !! How may I help you? (type quit to stop)!

You: Hello
Hello, thanks for visiting

You: whatsup?
Have a nice day

You: New fashion in Flipkart this week?
Aliya's Dresses and Ranbir's jackets are the latest flipkart fashion trends

You: Best gaming laptops?
DELL Xps 13, HP Envy 13

You: price of oppo reno 2
Yes we have a 30 days free return and exchange policy

You: How much does an oppo reno2 cost?
It would be around Rs. 37,000
```

Figure 12. General conversation about Flipkart and Amazon's sale

Figure 12 displays the response of the chatbot when a the user asks about Flipkart's fashion, Amazon's Great Indian festival , gaming laptops , price of a mobile phone and so on.

```
You: Is there a return policy for food?
No returns or Exchanges on food products

You: When is the Great indian festival?
Next sale is After November 14

You: Do the portal accept only cash?
We accept VISA, Mastercard and AMEX

You: Which desktop is best suited for home use?
Alienware Are 51M, ASUS TUF Gaming laptops

You: Thank you
My pleasure

You: Bye
Bye! Come back again soon.
```

Figure 13. Conversation about exchange policy or computers

Figure 13 displays the response of the chatbot when a user asks about payment mechanisms, return or exchange policy and desktops.

Conclusions

We have come up with AgentG, a customer service chatbot that can be used for websites that allows online shopping. As we compare the traditional way of servicing the customer we infer that AgentG has an advantage of being huge-scale, freely available, and collaboratively collected data about the customers. Also, AgentG uses the up-to-date NLP and machine learning techniques. Based on the analysis of its usage the outcome obtained was that AgentG was involved in helping the endwise user experience with respect to online shopping. An extremely convenient method to acquire information regarding the customers specifically if the content generated by the user involves the data from the product page.

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Author Biographies:



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