

STAINED GLASS CHATBOT

ABSTRACT

When you are first learning a hobby, you have a lot of questions. Some go to classes, some go to books, and some go online to find answers. The problem arises when a student goes home from a class or reads a book or blog, they still have questions. This chatbot is aimed to help consolidate a lot of questions the user may have into a learning environment where the chatbot can help answer those questions.

Kimberly Cable

Bellevue University, DSC 680 – Applied Data Science
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Stained Glass Chatbot

Topic

When you are first starting in stained glass, you have a lot of questions. A stained glass chatbot will help to answer those questions.

Business Problem

When you are first learning a hobby, you have a lot of questions. Some go to classes, some go to books, and some go online to find answers. The problem arises when a student goes home from a class or reads a book or blog, they still have questions. This chatbot is aimed to help consolidate a lot of questions the user may have into a learning environment where the chatbot can help answer those questions.

Data Explanation

```
{
  "intents": [
    {
      "tag": "greeting",
      "patterns": [
        "Hi",
        "Hello",
        "Hey"
      ],
      "responses": [
        "Hello",
        "Hi",
        "How are you?"
      ]
    },
    {
      "tag": "goodbye",
      "patterns": [
```

```
    "Bye",  
    "See you later",  
    "Goodbye"  
  ],  
  "responses": [  
    "See you!",  
    "Have a nice day!",  
    "Bye"  
  ]  
},  
...
```

For the chatbot to learn, initial data needs to be created. For this, I used Facebook stained-glass sites and previous class notes I have taken over the years. Initial questions I had about stained glass were transformed into a JSON file broken down into tags, patterns, and responses. Tags are topics that a user may query about. For example, if the user asks what my name is, “name” would be the tag since it is the topic of the query. Patterns are the queries that a user may ask about the tag. For example, regarding the tag “name”, a user may ask “What is your name” or “Do you have a name?”. These questions are different ways of asking the chatbot what their name is. These known types of questions would then become patterns. These patterns then will be used for the models to learn from so the user doesn’t have to ask these specific questions to get the response they are looking for. Responses are static responses that will be used for answers to the queries about the tags.

Methods

To create the data we will use for training the model, I will use the tags, patterns, and responses I created in the intents JSON file. A vocabulary of all the words will be created from the patterns. Classes will be created from the tags. A list of all the pattern words will be created along with their associated tags. Once this is complete, we can take this data into the Keras model for training. We first convert all

the words into a numerical value using the bags of words technique. The numerical values then are used to look at all the features (words) to predict the tag (or subject) it is associated with. Once the highest probability is chosen, we can then randomly use the responses to present to the user. If no tag was found, a “help teach me” response is displayed so the user can use the “Train Me” tab to help create a better model to use.

Analysis

Model: "sequential"

Layer (type)	Output Shape	Param #
dense (Dense)	(None, 128)	12672
dropout (Dropout)	(None, 128)	0
dense_1 (Dense)	(None, 64)	8256
dropout_1 (Dropout)	(None, 64)	0
dense_2 (Dense)	(None, 22)	1430

Total params: 22,358

Trainable params: 22,358

Non-trainable params: 0

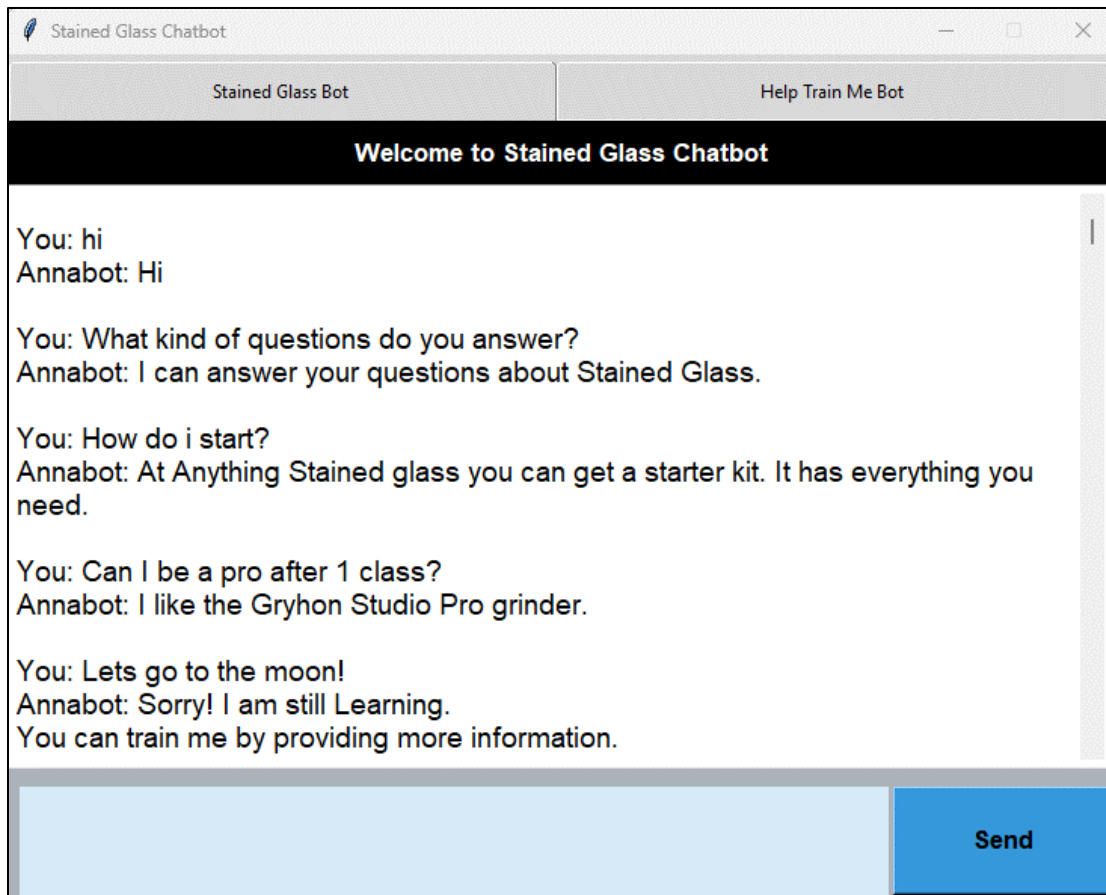
We used the Sequential class with three layers and used some dropout layers which help with overfitting the data between layers. The model was then compiled using the categorical cross-entropy for the loss function and the optimizer used was the Stochastic Gradient Descent (SGD). A loss function is used to calculate the quantity that the model should seek to minimize while training your data. Here we are using the categorical cross-entropy loss function as it is used for training categorical data, which we are with the chatbot, to predict the probability of whether the data is part of one class (tag) or another class (tag). The optimizer determines how the network will be updated based on the loss

function. With SGD, just a few samples are selected randomly by the model instead of using the whole training dataset for each iteration.

We trained 21,781 words of which none were non-trainable. After training the model, we received between 98 and 100% accuracy with 200 epochs (passes over the training dataset).

```
Epoch 195/200
14/14 [=====] - 0s 769us/step - loss: 0.0563 - accuracy: 0.9857
Epoch 196/200
14/14 [=====] - 0s 769us/step - loss: 0.0612 - accuracy: 0.9714
Epoch 197/200
14/14 [=====] - 0s 846us/step - loss: 0.0846 - accuracy: 0.9714
Epoch 198/200
14/14 [=====] - 0s 769us/step - loss: 0.0692 - accuracy: 0.9857
Epoch 199/200
14/14 [=====] - 0s 762us/step - loss: 0.0340 - accuracy: 0.9857
Epoch 200/200
14/14 [=====] - 0s 808us/step - loss: 0.0315 - accuracy: 1.0000
```

Now that the data has been properly trained, the chatbot will then use the model created from the user's queries (testing). A user types in a question and hits the "SEND" button. Once that is done, the query will be lemmatized and vectorized with the bag of words method as we did with our training data patterns. The model will then predict the tag (or class) of the user's query. The highest probability will be the response from that tag.



Here is an example of a user's query:

```
1/1 [=====] - 0s 54ms/step
```

```
hi [['greeting', '0.9994406']]
```

```
Query: hi
```

```
Bot: Hi
```

```
1/1 [=====] - 0s 14ms/step
```

```
What kind of questions do you answer? [['occupation', '0.9987835']]
```

```
Query: What kind of questions do you answer?
```

```
Bot: I can answer your questions about Stained Glass.
```

```
1/1 [=====] - 0s 14ms/step
```

```
How do i start? [['supply', '0.99996984']]
```

```
Query: How do i start?
```

```
Bot: At Anything Stained glass you can get a starter kit. It has everything you need.
```

```
1/1 [=====] - 0s 14ms/step
```

```
Can I be a pro after 1 class? [['grinder', '0.53233564']]
```

```
Query: Can I be a pro after 1 class?
```

Bot: I like the Gryhon Studio Pro grinder.

1/1 [=====] - 0s 14ms/step

Lets go to the moon! []

Going through the example:

Question 1: hi

Response: Hi

This correctly predicted the tag 'greeting' with a 99.9% probability.

Question 2: what kind of questions do you answer?

Response: I can answer your questions about Stained Glass.

This correctly predicted the tag "occupation" with a 98.9% probability

Question 3: how do I start?

Response: At Anything Stained glass you can get a starter kit. It has everything you need.

This correctly predicted the tag "supply" with a 99.9% probability

Question 5: Can I be a pro after 1 class?

Response: I like the Gryhon Studio Pro grinder.

This incorrectly predicted the tag "grinder" with a 53.2% probability, but we could change the threshold to higher than 50% so incorrect answers do not show up.

Question 6: lets go to the moon!

Response: none

This correctly determined that there was no correct tag that matched so the response from the model was an empty array

Conclusion

Although this is a very primitive version of what a chatbot should be, it answers questions to the best of its ability (as any normal human would). As users input more of their expertise into the training tab, the model will be able to have a broader and more decisive model to draw from so as time goes on the chatbot will be a good tool for any beginning-stained glass artist.

Assumptions

This chatbot only knows as much as I can input into its initial learning JSON data. It will give a lot of incorrect responses as it initially learns as not all questions or inquiries will have been considered.

Limitations

The chatbot can only answer questions from the initial data I provided. As more and more users use the chatbot and help it with its learning, this chatbot can only have the limitations of the technology it has been provided. With more upgrades and modifications, there is no limit to its usefulness.

Challenges

The biggest challenge faced was creating a dataset robust enough to answer the many questions a user may have without having to reply that it doesn't know the answer. I think with a good beta environment, stained glass experts can input their knowledge into the model, so it has a better knowledge pool to learn from.

Future Uses/Additional Applications

Once this chatbot is up and running, upgrades to the base learning dataset will need to be done.

Currently, the chatbot only allows additions to the learning dataset. In later upgrades, the chatbot should allow users to modify its current "tags" and their associated "patterns" and "responses" to allow the model to learn with patterns or responses that are not currently there.

Another great addition in future upgrades may be having the ability to display images to the user based on specific queries for visual guidance.

Recommendations

Learning more about Neural Networks and Deep Learning will help in enhancing this chatbot to become “smarter” and thus helping more beginning stained-glass artists. Also, having the ability to save a user’s chats to use to help the chatbot learn (for those who don’t enter their expertise in the training tab) will help.

Implementation Plan

To implement a chatbot, the application would first need to be beta tested with actual stained-glass artists to help build a good foundation for the model to be trained with. Once a few iterations of the beta test have been done, the application should be able to be uploaded to a host for public usage.

Ethical Assessment

As I will be taking questions and answer from users in Facebook groups, there are the ethical considerations of their privacy and not making responses personal of any sort. Also, since I will be creating the answers for this chatbot, it is my personal opinions and responses will be generated.

References

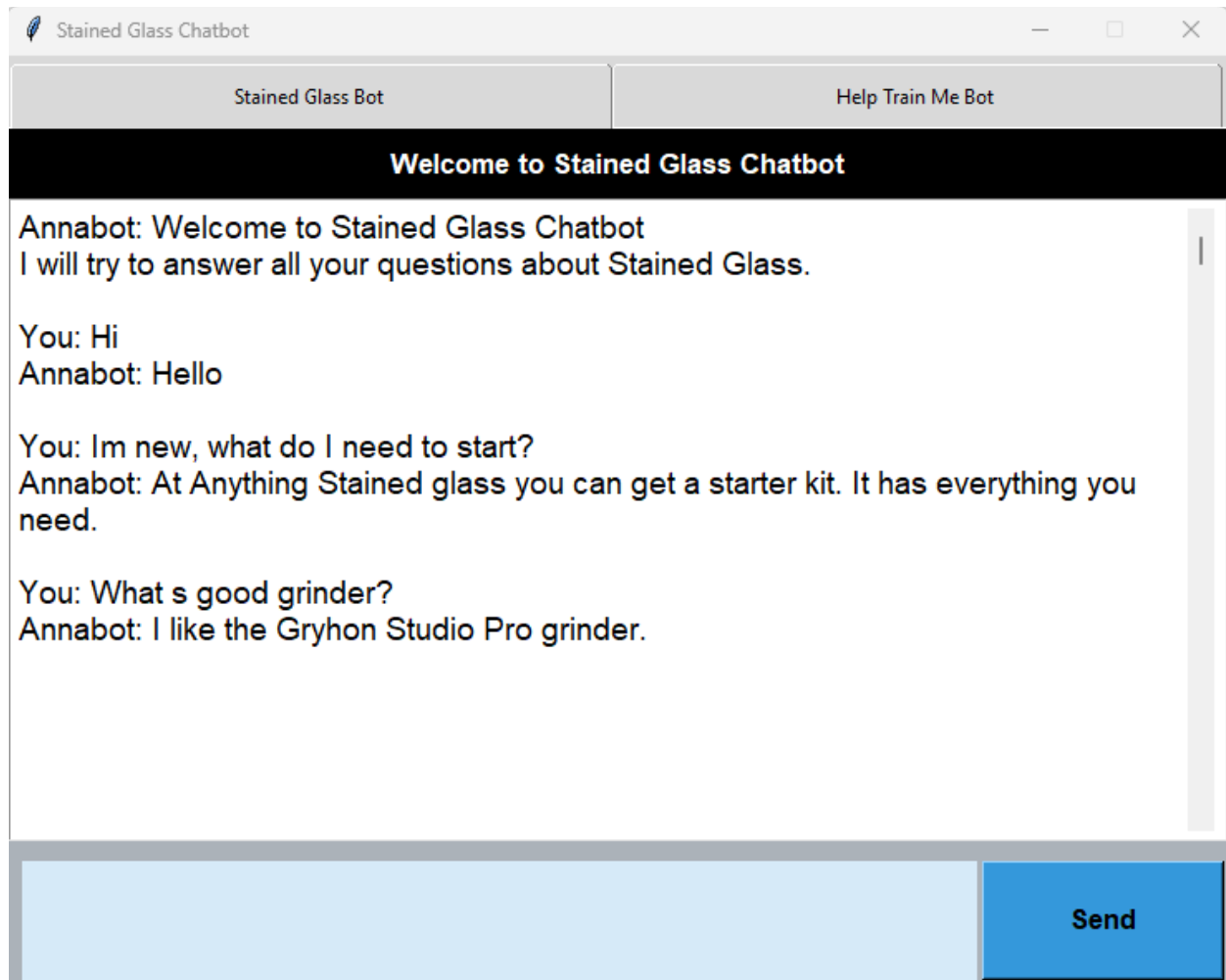
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Appendix

Chatbot User Interface



Chatbot Training Bot

The training chatbot takes a user's input (tag, patterns, and responses) and uses it to help train itself better.

Initial question: Let's go to the moon

Lets go to the moon! [['foilproblems', '0.7531287']]

Query: Lets go to the moon!

Bot: Warm the glass on a light box or plate warmer. This should help with sticking

As you can see the chatbot with a 75% probability, incorrectly predicted the "tag" "foilproblems" to the question and responded with an invalid response of "Warm the glass on a light box or plate warmer.

This should help with sticking"

After going into the "Help Me Train Bot" tab and entering the information about the moon:

The screenshot shows a web application window titled "Stained Glass Chatbot". It has two tabs: "Stained Glass Bot" and "Help Train Me Bot". The "Help Train Me Bot" tab is active, displaying a form titled "Help Train Me". The form contains several input fields: "Subject" with the value "moon", "Question1" with the value "How do we go to the moon", "Question2" (empty), "Answer1" with the value "We cant go to the moon but we can depict the moon in glass!", and "Answer2" (empty). At the bottom of the form is a blue button labeled "Train Me".

Subject: moon
Question1: How do we go to the moon
Answer1: We cant go to the moon but we can depict the moon in glass!

Subject translates to the "tag".

Question1 translates to the "pattern".

Answer1 translates to the "response".

Next, we re-trained the model with the new information inputted from the user.

Model: "sequential_1"

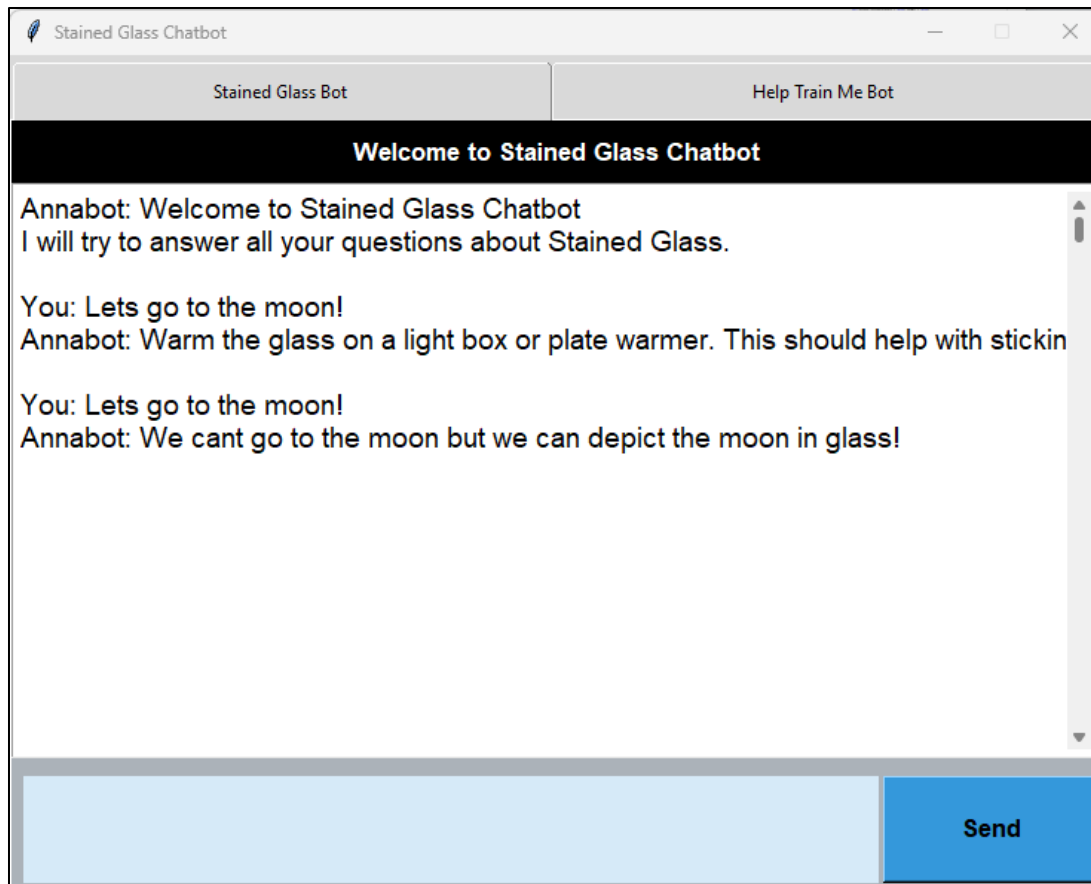
Layer (type)	Output Shape	Param #
dense_3 (Dense)	(None, 128)	13184
dropout_2 (Dropout)	(None, 128)	0
dense_4 (Dense)	(None, 64)	8256
dropout_3 (Dropout)	(None, 64)	0
dense_5 (Dense)	(None, 23)	1495

Total params: 22,935
Trainable params: 22,935
Non-trainable params: 0

...
Epoch 195/200
15/15 [=====] - 0s 858us/step - loss: 0.1220 - accuracy: 0.9718
Epoch 196/200
15/15 [=====] - 0s 790us/step - loss: 0.0345 - accuracy: 1.0000
Epoch 197/200
15/15 [=====] - 0s 786us/step - loss: 0.0399 - accuracy: 1.0000
Epoch 198/200
15/15 [=====] - 0s 786us/step - loss: 0.0559 - accuracy: 0.9859
Epoch 199/200
15/15 [=====] - 0s 857us/step - loss: 0.0508 - accuracy: 0.9859
Epoch 200/200
15/15 [=====] - 0s 857us/step - loss: 0.0555 - accuracy: 0.9859
Trained Successfully

Now when we ask the same question, the model correctly predicts the correct “tag” “moon” with a 99% probability thus giving the correct response.

1/1 [=====] - 0s 37ms/step
Lets go to the moon! [['moon', '0.9998412']]
Query: Lets go to the moon!
Bot: We cant go to the moon but we can depict the moon in glass!



The intents file is subsequently updated as well with the new information.

Intents file:

```
...  
  
  {  
    "tag": "moon",  
    "patterns": [  
      "How do we go to the moon"  
    ],  
    "responses": [  
      "We cant go to the moon but we can depict the moon in glass!"  
    ],  
    "context": ""  
  }  
...
```