|  |
| --- |
| **Introduction to AI COM526 Software Prototype and Report (AE2)** |
|  |
|  |
| |  |  | | --- | --- | | Your student number + Name: | Boldizsar Banfia  15363236 | | Choice of prototype:  (Chatbot/Email Categorisation/ Sudoku) | Chatbot | |
|  |

#### 

# **Introduction**

# Like many things AI is a tool, whether the underlying reason for usage is nefarious or benevolent is up to the user. Since the creation takes up substantial time and effort it is mostly done by wealthy corporations to solve an issue, and despite being inherently controversial (Duggal 2021), often the benefit outweighs the drawbacks (Marr 2020). Since there is no program sentient just yet, they are prone to be biased and discriminative which poses a legal issue (Rodrigues 2020). This is most often derived from the method of training the AI (Marr 2021), AE2 chatbot eliminates this headache due to the pre-devised and developed persona, serving one specific scenario, instead of using an unsupervised learning method. Chatbots are not exempted from ethical concerns either. According to a recent worldwide survey the most concerns are about privacy and security (Statista 2022). Users worry about non-consensual sensitive data collection and monetization (Code Academy 2022). AE2 chatbot is relieved of this responsibility since there is no general chatbot library or any third-party API had been imported or incorporated into the program. A custom-built neural network is fed with the training data that even though learns and adapts, solely reacts to inputs after choosing the most suitable scenario. Ergo there is no massage download or upload to a database or functionality to store anything making it a non-personalized contextual chatbot (Santanu Pattanayak 2019, pp. 238–240). On the professional level, there are multiple barriers including the absence of interpreting human emotions and intents or limited responses present in the AE2 chatbot too. However, the prototype is prominent at aligning with the brand, or the use case it was created for as well as addressing personalized issues within the provided scenario! Chatbots in the right place and used appropriately are not only good companions but serve as an impeccable information source yet merely a trivial multitude of them are currently used in health care compared to other technologies in the UK (Statista 2022b).

## *Statement of the problem*

In this new era of technology, people becoming more dependent on smart technology by the year, and beginning to be mindful of accessibility, apart from huge corporations, the majority of implementations of websites are shallow. Despite the UK being the strictest in accessibility governance (Collins 2021), the interaction capability of people with impaired vision is low. In fact, apart from the conventional colour tuning and occasionally available text reading, there is not much else that exists at all (W3CV 2016).

## *Aims and Objectives*

It was reported, eight years ago worldwide there were nearly 100 million men (Statista 2015) (Statista 2015b) until the age of 49, that had impaired vision one way or another. Last year 25% of the whole population suffered from the same fate (Statista 2022c). The primary objective is to facilitate access to, and interaction with websites for those people. Moreover, this method does not deplete the possibility of usage on commercial sites as well as on healthcare websites.

***Literature Review/ State of the Art***

***Proposed Solution***

Each major mobile maker has its assistant. Those AIs are capable of a lot of things on different levels, but one thing they all have in common is voice control. Having one sense barely or not functioning at all, one must rely on the others. Because mind control is still a work in progress, the most practical approach is voice interaction.

***Prototype Design***

The aim was the conventional AI-based (Holmes *et al.* 2021, pp. 13–15) chatbot that even though processes the in and output, has set responses that are being selected by a system in place.



(DatatScienceDojo 2020).

The original format of the code was a smart assistant. Source code:

<https://github.com/NeuralNine/neuralintents/blob/master/neuralintents/main.py>

After stripping it down to pieces to understand, it was built back up and split into two files plus the training (JSON) file. The reason for the two files is that it was not wrapped around functions so they could not be called, hence the whole program would have run simultaneously. That kept resulting in errors, so it was separated to enable the train.py to build and feed the neural network first and then take input and call the responses.

***Prototype Development and AI Algorithms used***

Let us go briefly step by step. Firstly, importing all the libraries as follows:

Starting with the hearth of it: train.py

Text

Description automatically generated

Some of the TensorFlow libraries had to be changed to work. After loading the training file, the program loops through the document, splitting, and tokenizing the data into words and populating a list with them to make it reusable (Grimmer et al. 2022, pp. 50–52). Example of word tokenization  

Then eliminating duplicates checks against a list of keys that are to be ignored and erases them. Essentially cleaning the data as shown below.

Text

Description automatically generated

After getting the data ready, the words are converted to binary representation, since the neural network only takes numerical values. It uses the “pickle” module to serialize.



The following part is the machine learning, and data preparation to be fed into the model for training. The program iterates through the words, turning all letters into the lower case to eliminate errors, and checking each word if it occurs in the pattern. The code then tokenizes and lemmatizes the patterns in the document. This is done to simplify the words and make them simpler to work with (Patel and Ajay Uppili Arasanipalai 2021, p. 15) and boost the interpretation and output accuracy of the chatbot. Each word will be given a value of 1 or zero, based their occurrence.

Text

Description automatically generated

When the document has been processed, it is randomized  This helps to prevent the model from learning any patterns that might be introduced by the order of the training data. In the lasts phase to gain the final from, the list must be converted to a numpy array and splits into two separate lists training\_x for input data and training\_y as the output data to train the model. Text

Description automatically generated

The initial error was that the array had an inhomogeneous shape after 2 dimensions. Presumably, the original code handled it differently, but it had to be turned into 1 dimension to work. To correct this mistake, ensured that all entries in the train list have the same shape. The method used was to pad the shorter elements with zeros as needed to ensure that they are all the same length.

Graphical user interface, text, application

Description automatically generated

After tackling and preparing the data the building of the neural network began that encompasses a sequential model of 4 linear stacks where the output of one layer is fed as input to the next layer.

First layer  the dense, specifies that all the 128 nodes, also called neurons are fully connected in the previous layer. Also specifies the one-dimensional input shape that has the same length as the number of elements in the training\_x.

The model then has two more dense layers, with 64 and the same number of neurons as the number of elements in the first element of training\_y, respectively.  , 

In between these dense layers, there are two dropout layers, each with a rate of 0.5. These layers randomly drop out 50% of the units in the previous layer during training to avoid overfitting.  . This forces the model to learn multiple independent representations of the same data, which can improve generalization to new data (Patterson and Gibson 2017, pp. 277–279).

Since there are multi-class classification model due to two or more out put the loss function was used  (Bonaccorso 2018, pp. 330–331), and specifies the metrics to use for evaluating the model. In this case, the metric is accuracy.

Finally, the model is trained using the fit method, which takes in the training data training\_x and training\_y as well as the number of epochs (iterations over the entire dataset) The model is then saved using the save method.



And the training begins: Text

Description automatically generated

Chatbot. Py.:

Same libraries, apart from one, , that will provide the very voice of the program! The file is comprised of 4 functions and the one that calls them. The first function takes a sentence as input and tokenizes it, then lemmatizes each word.

The second function is turning the words into a numerical value. It does this by checking each word in the sentence against the list of words used for training the model and assigning a value of 1 or 0 based on occurrence.

Text

Description automatically generated

The third Function takes a sentence as input and uses the trained model to predict the intent of the message. It does this by first processing the sentence using the words\_box function and then using the model to predict the likelihood of each possible class (intent). It returns a list of the classes with the highest likelihoods, sorted by the probability that are greater than 25% .

The fourth function takes the list of predicted classes and the training data (in JSON format) as input and selects a response from the set of pre-defined responses for the most likely class.

Finally, the assembly begins with greeting the user out loud by A screenshot of a computer

Description automatically generated with medium confidence , to indicate to the person that the interaction has started. Simultaneously the voice recognition is initiated. Once it was transcribed to text, it goes through the above-described processes and gives an output deemed the best, and then the voice recognition restarts. This goes as long as the exit word was spoken, which closes the program.

Training.JSON:

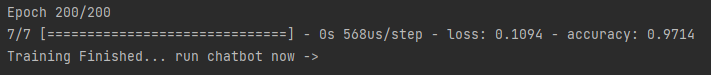
The key to entirely tailor the subject of AE2 chatbot. Has a simple structure:Shape

Description automatically generated with medium confidence

Tags stands for categories. Patterns provide examples to the neural network per category, that will be later matched with an input from the user. Responses are the outputs, and even though they are predefined they get randomized to avoid conversation loop.

Attempted project Named Entity Recognition (NER) that involves identifying and extracting specific named entities from text (Spacy 2022). Would have been used to store data such as the name of the user to give a tailored much human-like conversation. Or could have been used to identify users against a database or many more things. Unfortunately, A screenshot of a computer

Description automatically generated with low confidence this very downloadable file did not work after multiple attempts, nonetheless the file called NER.py is left within the program.

How to run AE2 chatbot. Carefully install all the libraries. Note, TensorFlow might be going to give a little trouble, intentionally left the original imports in the file, which had to be tweaked to work. Once it is done, run train.py, and wait for this massage in the terminal 

Then run chatbot.py and enjoy! Final note, since PyCharm accessing your mic, it also prone to give you trouble that must be solved within the settings.

***Evaluation***

Mainly chatbots are being distinguished into two categories, rule-based or scripted ones, which can only follow a predefined set of rules, and AI-based which are built on complicated machine-learning algorithms that allow them to self-learn (Luce 2019, pp. 23–25). The widespread rule-based chatbots are common due to their simplicity but have substantially more disadvantages than AI-based (Wijaya 2021). Contrary to most chatbots in python (Python 2022), where the chatbot itself is imported as a library (Mannelly 2021) and all the input-output processing happens in the cloud, or the exact input being queried in a database, AE2 chatbot is solely using local resources governed and trained by itself with the given data, ergo it falls into the AI-based branch. In its current state as a raw console application, can be incorporated into any website, and easily be turned into a client-side version.

***Limitation***

In this specific scenario, chatbots in general within health care are rare and hard to implement due concerns about health regulations and the inability to replace a human (Amos 2022). Hence the data was almost impossible to get, and even though the prototype works, the specific scenario we came up with is fiction!

Due to its structure, being trained locally by a dataset, it can be just as much of a drawback as an advantage. It very much depends on the use case of the application.

One of the limitations includes uncolorful answers that can be a little boring after a while (Raval 2020) due to the “limited” training data and lacking the human intricacy and responses despite the machine learning algorithm.

# **Conclusion**

Creating a rule-based chatbot is a time-consuming procedure. Depending on the duties it is expected to perform, a chatbot in a commercial setting may be needed to have a lot more intent. In such a case, rule-based chatbots become unfeasible since maintaining a rule basis becomes incredibly difficult. Furthermore, the conversational capabilities of the chatbot would be severely constrained because it is very difficult to predict how a user will engage with the bot. They became a relic of the past, giving space to AI-based chatbots (Wörndl *et al.* 2021, pp. 12–15).

Due to insufficient time, the code was left in its current state, however, there were ample ideas about how to further utilize it or make it perfectly suitable for personal or business use. Starting with placing it on a website. Only if had another two more days.

**(Total word count): 2209**

# **Reference List (Harvard Style)**

AMOS, Z., 2022. *Chatbots in Healthcare: How Hospitals Are Navigating the Pros and Cons - Unite.AI* [online] [viewed 10 Jan 2023]. Available from: https://www.unite.ai/chatbots-in-healthcare-how-hospitals-are-navigating-the-pros-and-cons/

BONACCORSO, G., 2018. *MASTERING MACHINE LEARNING ALGORITHMS : Expert Techniques to Implement Popular Machine Learning Algorithms and Fine-Tune Your Models;Expert.* Packt Publishing

CODE ACADEMY, 2022. *Ethics of Chatbots* [online] Available from: https://www.codecademy.com/article/ethics-of-chatbots

COLLINS, P., 2021. *What Is the Law on Accessibility?* [online] Available from: https://info.webusability.co.uk/blog/what-is-the-law-on-accessibility

DATATSCIENCEDOJO, 2020. *Building a Rule-Based Chatbot in Python | Data Science Dojo* [online] Available from: https://datasciencedojo.com/blog/rule-based-chatbot-in-python/

DUGGAL, N., 2021. *Advantages and Disadvantages of Artificial Intelligence* [online] Available from: https://www.simplilearn.com/advantages-and-disadvantages-of-artificial-intelligence-article

GRIMMER, J., M.E. ROBERTS and B.M. STEWART, 2022. *Text as Data*. Princeton University Press

HOLMES, W. *et al.*, 2021. *AI and Education*. UNESCO Publishing

LUCE, L., 2019. *Artificial Intelligence for Fashion : How AI Is Revolutionizing the Fashion Industry*. New York: Apress Media

MANNELLY, J., 2021. *How to Build a GPT-3 Chatbot with Python* [online] [viewed 9 Jan 2023]. Available from: https://jman4190.medium.com/how-to-build-a-gpt-3-chatbot-with-python-7b83e55805e6

MARR, B., 2020. *10 Wonderful Examples of Using Artificial Intelligence (AI) for Good* [online] Available from: https://www.forbes.com/sites/bernardmarr/2020/06/22/10-wonderful-examples-of-using-artificial-intelligence-ai-for-good/

MARR, B., 2021. *The 7 Biggest Ethical Challenges of Artificial Intelligence* [online] Available from: https://bernardmarr.com/the-7-biggest-ethical-challenges-of-artificial-intelligence/

PATEL, A.A. and AJAY UPPILI ARASANIPALAI, 2021. *Applied Natural Language Processing in the Enterprise*. ‘O’Reilly Media, Inc.’

PATTERSON, J. and A. GIBSON, 2017. *Deep Learning*. ‘O’Reilly Media, Inc.’

PYTHON, R., 2022. *ChatterBot: Build a Chatbot with Python – Real Python* [online] Available from: https://realpython.com/build-a-chatbot-python-chatterbot/

RAVAL, H., 2020. Limitations of Existing Chatbot with Analytical Survey to Enhance the Functionality Using Emerging Technology. *International Journal of Research and Analytical Reviews (IJRAR)*, **7**

RODRIGUES, R., 2020. Legal and human rights issues of AI: gaps, challenges and vulnerabilities. *Journal of Responsible Technology* [online], **4**(100005), 100005 Available from: https://www.sciencedirect.com/science/article/pii/S2666659620300056

SANTANU PATTANAYAK, 2019. *Intelligent Projects Using Python : 9 Real-World AI Projects Leveraging Machine Learning and Deep Learning with TensorFlow and Keras*. Packt Uuuu-Uuuu

SPACY, 2022. *Models & Languages · SpaCy Usage Documentation* [online] Available from: https://spacy.io/usage/models

STATISTA, 2015a. *Number of Vision Impaired Men Worldwide by Age 2015* [online] [viewed 8 Jan 2023]. Available from: https://www.statista.com/statistics/740490/global-male-blindness-numbers-by-age/

STATISTA, 2015b. *Number of Vision Impaired Women Worldwide by Age 2015* [online] [viewed 8 Jan 2023]. Available from: https://www.statista.com/statistics/740473/global-female-blindness-numbers-by-age/

STATISTA, 2022a. *AI Ethical Concerns in Financial Services 2021* [online] [viewed 8 Jan 2023]. Available from: https://www.statista.com/statistics/1254019/ai-ethical-concerns-in-financial-services/

STATISTA, 2022b. *Digital Health Use in the UK in 2021* [online] Available from: https://www.statista.com/statistics/1306523/digital-health-use-in-the-uk/

STATISTA, 2022c. *Disability Prevalence by Impairment 2018/19* [online] Available from: https://www.statista.com/statistics/860984/disability-prevalence-impairment-united-kingdom-uk-by-age-group/

W3CV, 2016. *Accessibility Requirements for People with Low Vision* [online] Available from: https://www.w3.org/TR/low-vision-needs/

WIJAYA, C.Y., 2021. *Creating a Simple Rule-Based Chatbot with Python* [online] Available from: https://medium.com/geekculture/creating-a-simple-rule-based-chatbot-with-python-e7928d0573af

WÖRNDLW., C. KOO and J.L. STIENMETZ, 2021. *Information and Communication Technologies in Tourism 2021 : Proceedings of the ENTER 2021 ETourism Conference, January 19-22, 2021*. Cham, Switzerland: Springer

# **Bibliography (Harvard Style)**

Amditis, Joe. “What Are Some Ethical Considerations That Chatbots Raise, and How Should They Be Addressed?” *Medium*, NJ Mobile News Lab, 22 Mar. 2017, medium.com/mobilenewslab/what-are-some-ethical-considerations-that-chatbots-raise-and-how-can-those-be-best-be-addressed-7f7fed23557.

Bafna, Sachi. “7 Reasons Chatbots Fail and How We Can Fix It – Customer Service Blog from HappyFox.” *Customer Service Blog from HappyFox - Improve Customer Service & Experience*, 3 Dec. 2021, blog.happyfox.com/7-reasons-chatbots-fail-and-how-we-can-fix-it/.

BBC News. “How Did an AI Chatbot Go Viral? - BBC News.” *Www.youtube.com*, 24 Dec. 2022, www.youtube.com/watch?v=AtY6auzszDU. Accessed 7 Jan. 2023.

Channel 4 News. “New AI Chatbot “ChatGPT” Interviewed on TV.” *Www.youtube.com*, 8 Dec. 2022, www.youtube.com/watch?v=GYeJC31JcM0. Accessed 7 Jan. 2023.

clearbridge. “Clearbridge Mobile.” *Clearbridge Mobile*, 18 July 2019, clearbridgemobile.com/7-key-predictions-for-the-future-of-voice-assistants-and-ai/.

Hern, Ian, and ez. “How to Design an Accessible Website (a Complete Guide).” *Website Guides, Tips & Knowledge*, 21 June 2022, www.dreamhost.com/blog/make-your-website-accessible/#:~:text=One%20of%20the%20cornerstones%20of. Accessed 8 Jan. 2023.

---. “How to Design an Accessible Website (a Complete Guide).” *Website Guides, Tips & Knowledge*, 21 June 2022, www.dreamhost.com/blog/make-your-website-accessible/#:~:text=One%20of%20the%20cornerstones%20of.

ideta. “Why Chatbots Fail? 7 Common Limitations of Chatbots.” *Ideta.io*, 2021, www.ideta.io/blog-posts-english/why-chatbots-fail-chatbot-seven-limitations.

Jeffrey Van Camp, and Parker Hall. “8 Best Smart Speakers (2020): Alexa, Google Assistant, Siri.” *Wired*, WIRED, 3 Feb. 2020, www.wired.com/story/best-smart-speakers/.

SAS. “3 Steps for AI Ethics.” *Www.sas.com*, 5 Mar. 2021, www.sas.com/en\_in/insights/articles/analytics/artificial-intelligence-ethics.html. Accessed 8 Jan. 2023.

Verstegen, Chelsea. “The Pros and Cons of Chatbots.” *Www.chatdesk.com*, 2021, www.chatdesk.com/blog/pros-and-cons-of-chatbots.