

# A REPORT ON IMPLEMENTATION OF DATA SCIENCE SOLUTION FOR FAMILY OR DOMESTIC **VIOLENCE**



Data Science Postgraduate Project (COSC 2667)

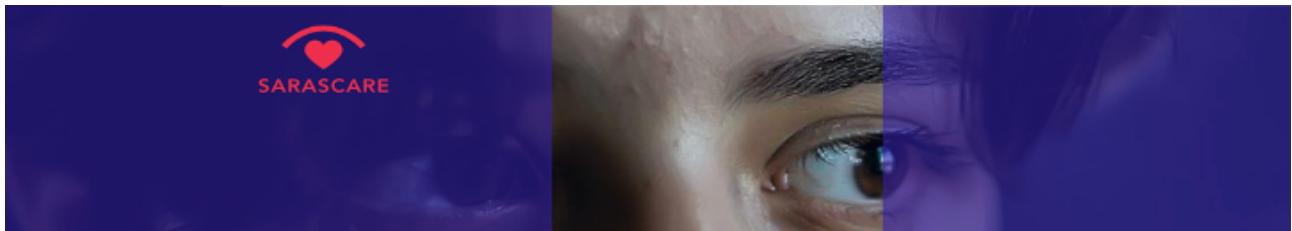


# Contents

About SarasCare	Page 3
Introduction	Page 3
Market Study	Page 4
Aim	Page 5
Ethical Consideration	Page 5
Problem Statement Study	Page 7
Relative Study WIth Criminology Department of RMIT	Page 8
Methodology	Page 10
- Timeline	Page 10
- Data Source	Page 11
- Solution Modelling	Page 12
- Developing the Hypothesis	Page 14
- Data PreProcessing	Page 14
Data Modelling	Page 16
-NLP Crude classifier	Page 17
- SimCSE: Simple Contrastive Learning of Sentence Embeddings	Page 19
- BERT base model (uncased)	Page 20
- OpenAI GPT 3	Page 24
Model Comparison	Page 25
Web Development	Page 26
Challenges	Page 28
Experiments	Page 29
UAT (User Acceptance Testing) Phase	Page 34
External Contributions	Page 35
Roles and Responsibilities	Page 36
Self Reflection	Page 37
Future Scope	Page 39
Conclusion	Page 40

---

## About SarasCare



SarasCare is a non-advantage affiliate situated in Melbourne, Australia. An endeavor to guarantee females who are subject to embryo evacuation only ward on their sex.

SarasCare as an organisation aims to use development to secure, reestablish and move in peril youngsters subject to violence. The company provides an extent of advancement driven courses of action that can help individuals fight social disgraceful demonstrations impacting women everywhere.

SarasCare has a WebApp that enables spectators of female feticide to report discreetly. The report is taken care by the company and the reasonable experts are sought and associated with for immediate action

### Our Supporters

---



With the intercession of the company , the goal is to diminish the demonstration of sexual orientation choice and female feticide. SarasCare has \ a remarkable relationship with corporate Australia where the company has had the option to use private area excesses and private area IT items to take care of social issues and help the neediest in the public arena. Just as making elective online data, assets and frameworks to help those encountering segregation or provocation and to make consciousness of cultural issues ,the company have likewise begun making elective spring up supply chains to disperse surplus labor and products from the Australian corporate area.

---

## Introduction

In the past few years, domestic violence has been recognized as a major public health issue. It affects many irrespective of economic, social, geographic or racial background

and ends up in significant injuries and death(Hegarty, Hindmarsh and Gilles, 2021).

In Victoria, even during lockdown measures, latest crime statistics reveal a significant increase of domestic violence based on the data over the past five years. Victoria Police's recorded crime data tells the monthly count of family violence incidents rising higher every upcoming month this year than previous years which is alarming.

There was an increase of 6.7% from June 2019 to June 2020, with 88,214 family violence incidents reported to police, compared to 82,651 and 76,093 during the same time in the previous years. In July 2020, when the second and more restrictive Melbourne lockdown began, there were 6810 incidents, increasing to 6930 in August. In comparison, July and August 2019 had 6186 and 6755 incidents, respectively.

Among women who went through Emotional abuse, and controlling behaviour over the last three months, the most common forms of abuse reported were constant verbal abuse and insults (47.2%), jealousy or suspicion about the respondent's friends (46.2%) and monitoring their time and whereabouts (41.3%). More than 66% of women reported that they had experienced multiple forms of emotional abusive, harassment or controlling behaviour in the three months prior to the survey, with victims reporting an average of nearly four (3.9) different types of emotional abuse, harassing or controlling behaviours. In an Australian research survey, women are three times more likely to experience an episode of domestic violence by their partners than their male counterparts. This is just based on reported cases of domestic violence, which tells that the actual number is even higher. Most women choose to stay silent over these issues due to lack of awareness regarding the domestic violence services available to them. Those that are knowledgeable tend to shy away from them as they require the victim to come forward to report a domestic violence case whereby a case officer sits with the victim noting down all the necessary information while the victim again has to rethink and tell the dreaded incident.

The point is to realize that women who have experienced Domestic violence want to be asked and are more likely to disclose if asked. The requirement is anonymity and lesser human emotions.

---

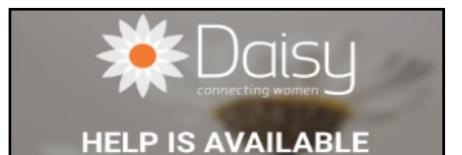
## Market Study

In the current situation, there are two applications both provided by 1800RESPECT services to provide support for people experiencing sexual assault, domestic or family violence. This service is part of Australian Government's Department of Social Services.

**Sunny app** - Sunny is an app developed by 1800RESPECT which focuses on women with disability and is a victim of domestic violence. They also help to understand what abuse is and acts as a middle person to redirect the victim. However, this app gives generic information to the user and not specific as most victims need. Also, there is a significant lag to give out information which some victims might not have.



**Daisy app** - Daisy is another app developed by 1800RESPECT to connect people experiencing violence or abuse to services in their local area. It provides clear information of the local support services near the victim. This app works by assigning a human councillor to the victim thus comes the space for human error.



## What is Missing ?

There is no current system to provide immediate help to victims of domestic violence, other than in terms of directing them to someone else. The case procedures and responses depend on multiple factors which makes it difficult for victims to decide what, where, when, how and whom to contact. Thus there is a requirement for an application model which can aid the case managers and help the victim to receive help asap, in case of domestic violence. A real time user interactive system to help victim to

get an immediate risk assessment discreetly, and contact the police on imminent risk situations.

---

## Aim

The aim of our project is to create an AI powered platform for both victims and case officers that can analyze and respond to queries to Domestic violence victims. The catch is that there is a definite need for handling human cases with a human touch, and human sensitivity while interacting with victims to gather case information. This very same sensitivity could be misjudged under the storm of emotions and lead to misclassification of the issue and the person experiencing the trauma be misdirected. The aim is to provide a risk categorization leading to the right recommendation which is data driven and unaffected by the cloud of uncertainty.

From a case officer point of view the aim is to provide a tool to help the officer in mitigating the risk classification error and a report available at disposal. From a user point of view the aim is to provide a platform that classifies risk on bases of model trained on data case files and a one stop platform to get optimum recommendation and a report that helps the victim to use it to his/her disposal.

The staggered aim was to create a Tool which is trained to analyse the case and then classify the case severity and possibly redirect the manager to the possible next best step that can be done.

The staggered aim was well achieved, and more features were added to the Minimum viable product and also there was a web platform created for interaction with the tool and process mapped with questions which leads to further analysis and report generation

---

## Ethical Consideration

As this project involved dealing with sensitive information and creating a safe solution for people suffering from domestic violence, multiple ethical considerations needed to be seen before beginning development on a solution to tackle this problem.

One of the major ethical points taken into consideration throughout the duration of the project was to maintain data privacy of the user as well of the participants whose data was used to develop the project. This was considered to be crucial as, if the information entered by the user was shared elsewhere then it would harm their already fragile mental health leading to them taking drastic measures. It was also taken into consideration the privacy of the data as the data contained domestic violence victims sharing their entire stories which contained highly delicate and sensitive information.

A second ethical issue we had catered to was the emotional wellbeing of the individuals utilizing our chatbot. Part of the process of referring these individuals to correct services involves asking a series of personal and slightly invasive questions in order to understand the user better. To address this issue, we had to develop a minimal number of questions to identify their risk level and subsequently refer them to the services available. In this way, we collect only the necessary information and minimize the chance of an emotional breakdown of the participant that might occur by rehashing traumatic memories when asking our questions.

Another point for ethical consideration is the fact that we must ensure that the output given by our model is fair and not prejudiced against any groups or types of people. Domestic violence is a serious issue that is experienced by people from a multiple

ethnicities backgrounds and cultures and hence the model needs to treat these participants equally.

Another ethical consideration that must be considered is the accountability of the project given that the output will recommend vulnerable people to their company will take the full responsibility for the recommendations suggested by the project in terms of services or next steps to take for the victim.

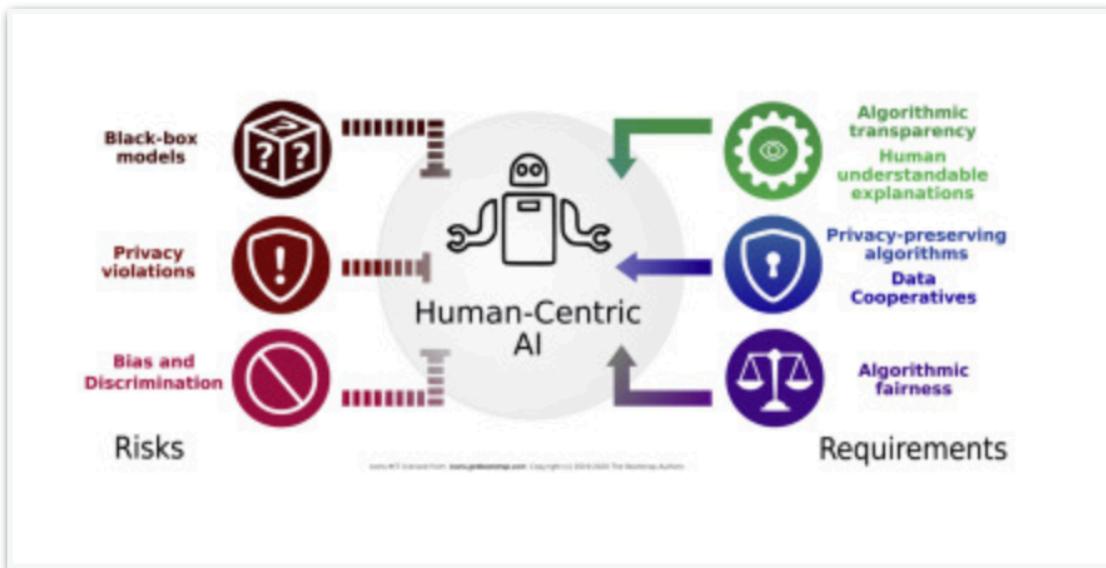


Fig :1

## Problem Statement Study

The first task was to understand the problem statement. For this we had to understand the reason for developing the solution which can really help to support the community in Australia. We have collaborated with fellow RMIT students from the department of family and domestic violence, who were responsible for supporting the requirement classification of the victim. We have been in constant discussion with a team of 5 students who helped us understand the sensitivity of the topic. The Team has explained the journey of victims of family and domestic violence and their support system process and loopholes. This session was conducted within the wireframe of SARASCare and the idea was to share the scope of work for the data science or AI which should also incorporate the human centric touch to handle the sensitive issue of the victim and provide a bias free and transparent solution.

Building a chatbot was an unprecedented task for us. Therefore, thorough research was required for the development of chat-bot. It includes reading multiple research papers, an article and number of blogs related to chat-bot.

Considering an chatbot, it is an automated system which performs interaction with humans .The bot interacts with the user, analyses the query and generates appropriate responses .Bot has the self-learning capabilities which help to learn every time a query is submitted to an agent. Currently majority of companies are emerging to make use of chatbot in order to minimise the expense of customer service and provide atomise client services.(irj,2021)

Based on that, two ways had been figured out. Rule based and self learning approach for the development of models

**1)Rule based :** The functioning of the bot is purely based on a predefined set of rules stated by the user. Chat-Bot performance varies from simple to complex query execution as per the complexity of defined rules. It's concept mainly works on if-else conditions. (Building a Simple Chatbot from Scratch in Python (using NLTK), 2021)

**2)Self learning :** This approach overcomes the limitation of Rule based bot. The functionality of bot is backed up by machine learning algorithms. Therefore, it is capable of handling complex query and interpreting natural language processing. (Building a Simple Chatbot from Scratch in Python (using NLTK), 2021)

**a)Retrieval based model:** A predefined set of intent and answers allow chatbot to use messages and context of the conversation for selecting a best response.

**b)Generative bot model :** This approach is more advanced in comparison to all other approaches. As the outcome of query is not based on set of rules or from the predefined responses but it takes word by word from the query and generates the response

The chatbot which could interact on various levels of complexities was a proposed model. Considering complexity, we determined that our chat-bot could be implemented in two ways. Rule based and Generative model.

- Reason for selection of both models : Our initial scope of project was based on a combination of a set of rules and generative model. As a result, a need arises to create a model which can perform both the functionalities together.

In reference to that, development on both the models were started in parallel. The main focus of implementation was interaction between human language and computers which derive meaning from human language in a smart way. NLP is a collection of slightly advanced techniques which can understand a broad range of questions. (How to Build a Chatbot—A Lesson in NLP, 2021)

---

## Relative Study WIth Criminology Department of RMIT

**MARAM Framework** - The MARAM Framework aims to establish a system-wide shared understanding of family violence. The MARAM Framework provides policy guidance to organisations that have responsibilities in assessing and managing family violence risk, including those that have been prescribed under regulation as Framework organisations. (Family Violence Multi-Agency Risk Assessment and Management Framework | Victorian Government, 2021)

The aim of MARAM is to increase the safety and wellbeing of Victorians. This is done by ensuring relevant services can effectively identify, assess and manage family violence risk. The Framework has been established in law under a new Part 11 of the Family Violence Protection Act 2008.

The MARAM framework is described stepwise in the image below. In our modelling we have replicated the same sequence to bring this more closer to the human version of risk classification.

After multiple discussions with the client and the case management students , the number of risk classification, how they can be labelled and what questions should be asked, where , when and how were also finalised .

We also took conference calls with multiple leaders in the domain, through the help of the client to validate our process and know more about the problem domain.

The MARAM framework is outlined below, which was kindly monitored and detailed by the criminology students after internal discussions.

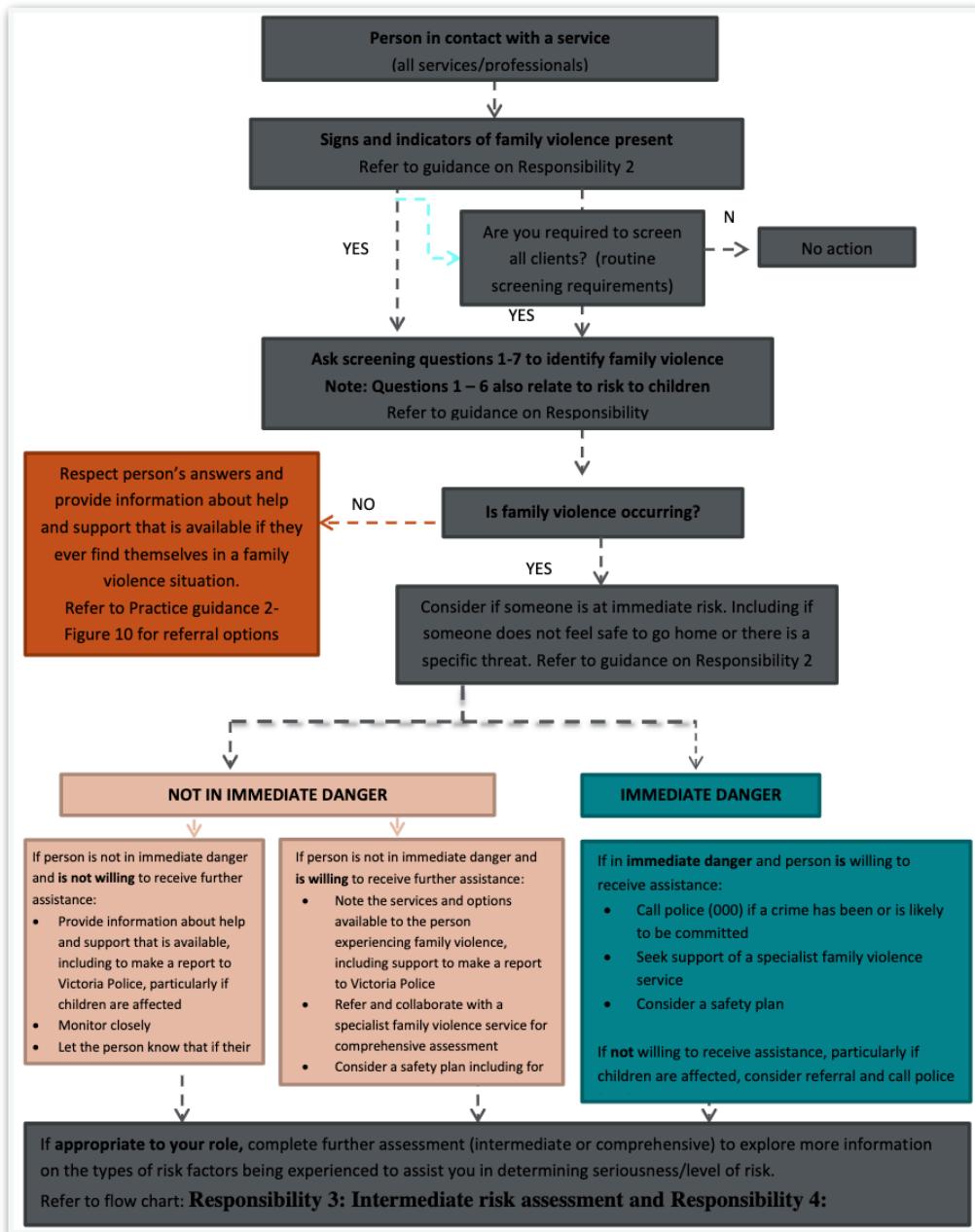


Fig : 2

## Support and Contributions

Initially after obtaining the case files online, they had to be assessed for their risks. That is whether the risk present in a case file is low, medium or high. Initially there were 5 categories, but it was reduced to three after expert opinion, and considering the usage of the case.

The labelled files was our training data and the risks assigned was the target column. As this subject matter is unknown to us thereby the task of assessing these risks were assigned to the criminology students. Twenty-eight Australian case files and four UK case files which were found by us were then given to them. The four UK case files contained mostly court proceedings against the perpetrator by the victim and so were not considered relevant data and thus were not assessed and shelved. Then out of the twenty-eight case files fifteen were assessed by the criminology students. The remaining thirteen were to be assessed and given to us later by them but were never given. Out of the fifteen assessed six were high, six were imminent, two were low and one was moderate. This data was then used for our model to classify risks whenever a victim enters their experience.

Another way in which the criminology students helped us was by giving recommendations that our chatbot will finally give out to the victims once risk assessment has been done and important questions have been asked. Recommendations have been made to important referral services like 1800 RESPECT, Safe Steps, Victorian Sexual Assault Crisis line, Domestic Violence Victoria, victims of crime helpline, No to violence, Beyond Blue etc. These recommendation were then further detailed aligning to the kind of Risk associated and the ordering was also seen.

Also, throughout the course of this project they helped us into the right directions by solving our doubts and helped us wherever they could regarding the subject matter.

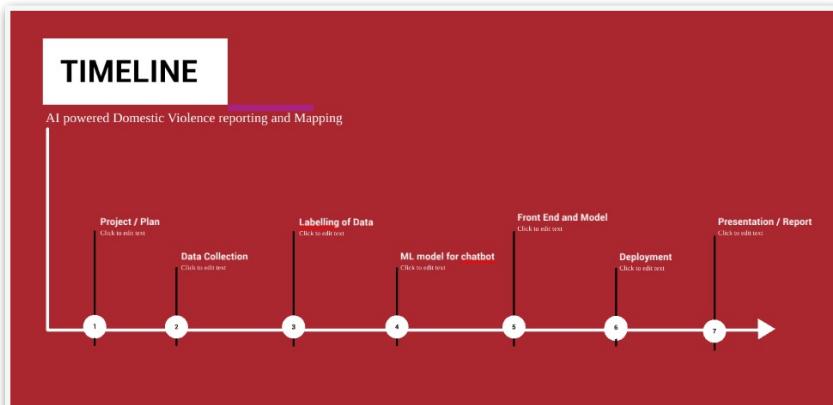
## **Recommendation List**

One of the critical deliverables was to share the recommendations list of support services. Criminology students help to share a list of support centre details categorised into three types: physical abuse, financial abuse and emotional abuse. The important task was also to provide the recommendation based on risk evaluation immediately , so that the victim gets quick relief and support. This will definitely save a lot of time which goes into the process of manual reading , filing and consulting again to provide judgement of service like (house, clothes, food or money). We have mapped the services in same nature to keep the sanity.

## **Methodology**

### **Timeline**

Through the support by client, The case management students and the fellow members of out time, we were able to maintain the time line and finish our minimum viable product.



## Data Source

This section details how the data for this project was gathered and the difficulties that the team was presented with while gathering this data.

### Social media gathering idea analysis

Another plan in consideration in terms of finding data online was to gather twitter and Facebook data. Twitter and Facebook posts would be collected which were related to domestic violence or had the keywords domestic violence, depression, sexual violence etc. However, this idea was dropped as these posts were not reliable enough and that these posts could not be labeled as low, medium and high. For example, there were some posts which contained words like depression and violence but were actually posts related to something else thereby the data would be deceiving.

One of the bigger disadvantages of the Search API is that the Tweets written in the past-week can only be accessed. This created an issue. Also due to time limitations, the criminology students couldn't label the data, hence we couldn't use this in our model.

Code snippet and the output file structured to csv is below.

This can be used later, as a next step to improve the model as a future scope of the project. If the 7 day limitation can be seen over, and access is received for legally pulling more data, it can be used for further fine-tuning of the model.

```
        ---- exception(response.status_code, response.url,
return response.json()

def main():
    bearer_token = auth()
    url = create_url()
    headers = create_headers(bearer_token)
    json_response = connect_to_endpoint(url, headers)
    print(json.dumps(json_response, indent=4, sort_keys=True))

    df = pd.DataFrame(json_response['data'])
    df.to_csv('C://Users/amrut/data science masters/saras/response_python.csv')

if __name__ == "__main__":
    main()
```

Fig : 4

The outfile file , which was structured.

author_id	id	text
0	1.19E+18	1.41E+18 RT @MehwishZulafqar: #EndSexualViolenceInIOJK Kashmir valley has only one women police station, and male police officers aren't trained to deal with cases of domestic violence.... don't forget to report this abusive Handel Ø™, Ø™,
1	1.2E+18	1.41E+18 RT @IrumWarrach4: Kashmir valley has only one women police station, and male police officers aren't trained to deal with cases of domestic violence.... don't forget to report this abusive Handel Ø™, Ø™,
2	46432070	1.41E+18 2021/06/19 02:00: U.S. reopens asylum access for victims of domestic violence, gang violence <a href="https://t.co/NDvXSDXBtY">https://t.co/NDvXSDXBtY</a>
3	1.2E+18	1.41E+18 RT @ArizShawana: Kashmir valley has only one women police station, and male police officers aren't trained to deal with cases of domestic violence.... don't forget to report this abusive Handel Ø™, Ø™,
4	1.4E+18	1.41E+18 RT
5	1.33E+18	1.41E+18 RT @MSignorile: Stop calling it a ´riots and calling them ´riots. There was nothing random or spontaneous about it. It was not a ´cebration.
6	1.38E+09	1.41E+18 RT @DrEmmaKatz: Just discovered that my article 'When Coercive Control Continues to Harm Children: Post-Separation Fathering, Stalking and Abuse' has been removed from the internet. I am shocked and angry. This is unacceptable.
7	1.25E+18	1.41E+18 RT @_myselfjolly: He's encouraging domestic violence.... don't forget to report this abusive Handel Ø™, Ø™,
8	1.2E+18	1.41E+18 RT @IrumWarrach4: Kashmir valley has only one women police station, and male police officers aren't trained to deal with cases of domestic violence.... don't forget to report this abusive Handel Ø™, Ø™,
9	1.83E+08	1.41E+18 RT @jennymcallister: Kim O'Reilly has bravely decided to share her story of domestic violence to help educate communities and better protect women.

Fig : 5

## UK/Australia case files

Some UK and Australian case files were gathered by the team where the case file contained the entire story of the victim as to how they met their partner, the good moments of their lives and then the descent into chaos of their partner and the subsequent crime. These case files were then given to the criminology team and they had to assess the risk of the domestic violence i.e. the level of domestic violence was low, moderate, high or imminent. 28 Case files were found in Australia while 5 case files were found in the United Kingdom.

## External Sources

Another plan in terms of gathering data was to create an account on a law website in the UK which gives out case files related to our subject. However, after creating an account they asked us why we wanted this data and where we were working. When we had provided the response, the access was not provided. They asked us for information as the users would need to be vetted in terms of if they are reliable or not for receiving this data. After adding all this information, the site never got back to us and hence any hope of finding data from them too was scrapped.

## Solution Modelling

### Developing the Process Flow.

This was an extra step the team did to Understand and evaluate the problem space as the problem required a lot more subject matter expertise and expert guidance due to the sensitive nature

After data gathering, we needed to build a flow to reach the final product. The decisions had to be in line with the client, the Subject Matter Experts in the field, and the Case management team students who were helping as partners to research and form ideas in the business side of the project.

We then were able to form a Decision flow which was finalised by the case management students ,and the client after discussions with multiple Subject Matter Experts famous in the field.

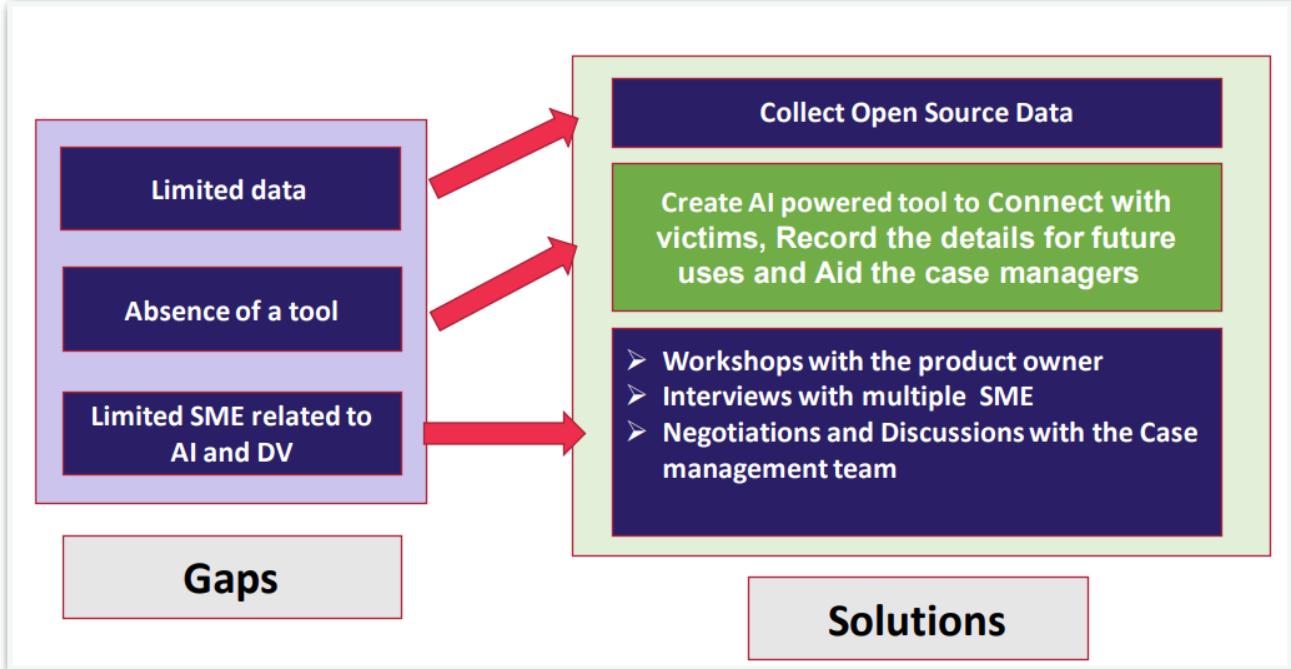


Fig : 6

After seeing the present and the future state of what the client wanted to achieve, we identified the three major gaps that prevented us from reaching the ideal future state.

Out of this, the second gap was considered as the important one, after discussions with the client, and was further explored to reach the final hypothesis through a top down approach.

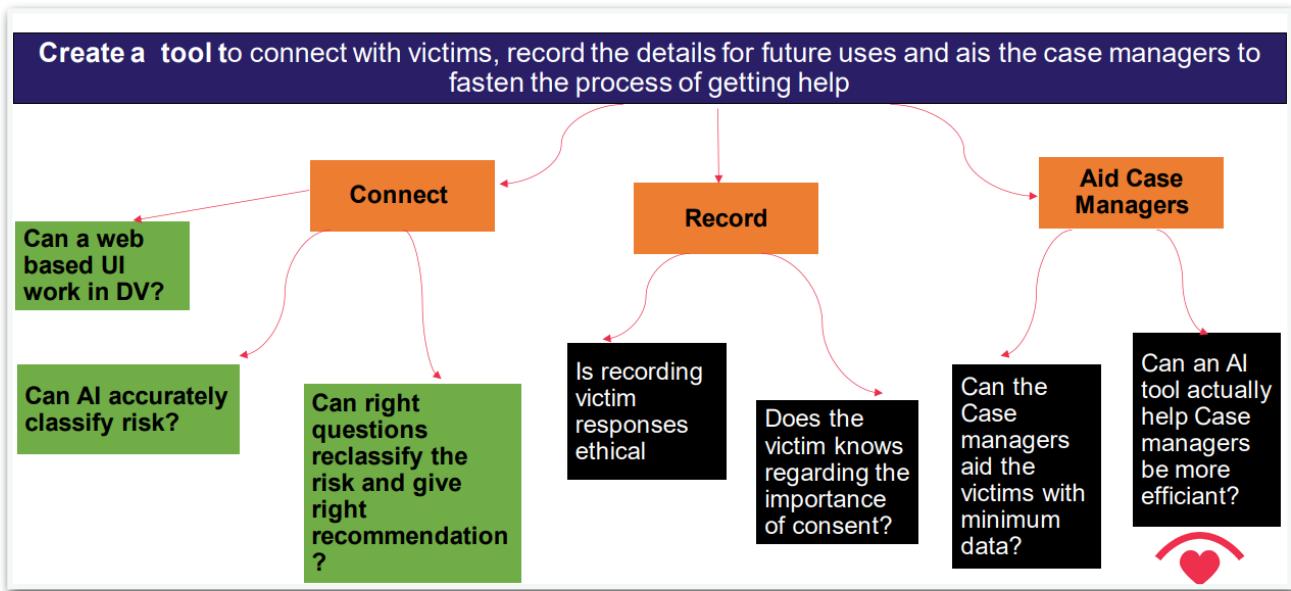


Fig : 7

This was then further discussed and analysed with the case management team and multiple subject matter experts on the field. The case management team were then able to come up with the flowchart below , to make the process flow of the project.

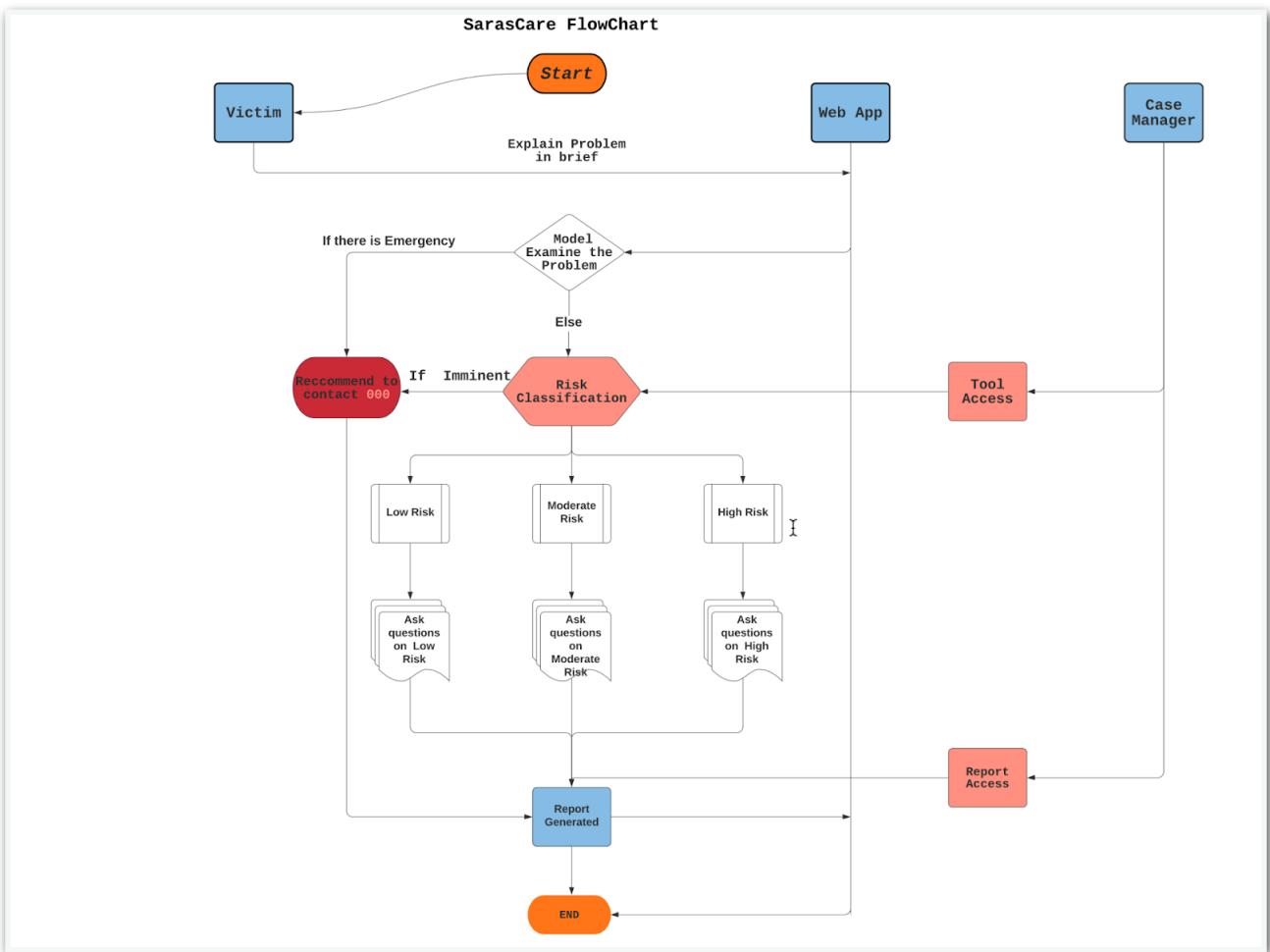


Fig : 8

## Developing the Hypothesis

3 Hypotheses were formulated , which if proved accurate would be able provide the right recommendations to the victim

1. Can a web based UI work in DV?
2. Can AI accurately classify risk?
3. Can right questions reclassify the risk?

## Assumptions

The Risk Category , the Violence category and the recommendation list are independent and complete

## Hypothesis tests

- Testing multiple state of art NLP tools and methodologies for Risk classification
- Testing whether the responses of further questioning can impact the initial classification and thus impact the recommendation
- Testing whether the Web Based tool is used by woman who experienced Domestic Violence(Long term Test)

## Data preparation

The case file data from open source was cleaned and preprocessed before inputting it into the NLP models for Risk Classification. Case Files were trained in a NLP Model which classified the risk using multiple Cosine Similarity based models. The questionnaire derived from the industry standard MARAM risk assessment for domestic violence is given to the recommendation Model model to recommend next Best Action.

The following steps to be involved in the completion of the project.

### **Data PreProcessing :**

1. **Setting up NLTK :** A natural language processing toolkit to work with human language data.(How to Build a Chatbot—A Lesson in NLP, 2021)
2. **Tokenization :** It will convert the textual data into the list of tokens i.e Words or the sentence which we want to segregate.(How to Build a Chatbot—A Lesson in NLP, 2021)



3. **Removing Noise :** From all the text, it will eliminate unwanted characters i.e Except numbers and letters it will remove all other characters.
4. **Removing stop words :** Words which are used more commonly in sentences and which carry little value in helping the user's needs are being removed.

Sample text with Stop Words	Without Stop Words
GeeksforGeeks – A Computer Science Portal for Geeks	GeeksforGeeks , Computer Science, Portal ,Geeks
Can listening be exhausting?	Listening, Exhausting
I like reading, so I read	Like, Reading, read

5. **Stemming :** It is the process of reducing derived words to their original or root word.i.e The following words “Consulting”, “consultant”, “consultant” will result in the original word “consult”.
6. **Lemmatisation :** It is the process of grouping together the different inflected forms of **word**, so they can be analysed as a single item.

example..

# Lemmatization

Mapping from text-word to lemma  
*help (verb)*

text-word	to	lemma
help		help (v)
helps		help (v)
helping		help (v)
helped		help (v)

Madrid 2010

Kilgarriff: Corpus Processing and NLP

11

## Normalisation

It rectifies the common spelling mistakes, slang, or typos in the text and converts these to its “normal” version that might alter the intended meaning of the sentence and convert these to its normal version. I.e (How to Build a Chatbot—A Lesson in NLP, 2021)

**Original:** @user3419 nay lol y u say dat?&wat u doing 2day?

**Post-normalization:** No, why did you say that? What you doing today?

## Recognising Entities

This step helps chatbot identify which thing is being talked about “For example, it would identify North America as a *location*, 67% as a *percentage*, and Google as an *organisation*. This step is also known as entity recognition”.  
example.(How NLP Text-Based Chatbots Work, 2021)

To further elaborate on the geographical trends, North America LOC has procured more than 50% PERCENT of the global share in 2017 DATE and has been leading the regional landscape of AI GPE in the retail market. The U.S. GPE has a significant credit in the regional trends with over 65% PERCENT of investments (including M&As, private equity, and venture capital) in artificial intelligence technology. Additionally, the region is a huge hub for startups in tandem with the presence of tech titans, such as Google ORG, IBM ORG, and Microsoft ORG.

## Dependency parsing

Dependency parsing will split the sentences into nouns, verbs, objects, punctuation and common phrases.(How to Build a Chatbot—A Lesson in NLP, 2021)It will help the machine to interpret the user query.  
example..

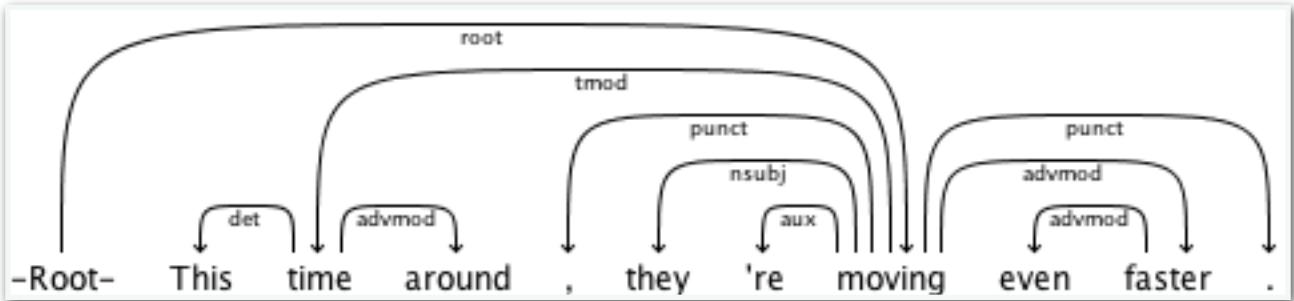


Fig : 9

## 5) Generation

This step itself depicts the outcome of all processes. The chatbot generates a number of responses using the information determined in all the other steps and selects the most appropriate response to send to the user.(How NLP Text-Based Chatbots Work, 2021)

## Data Modelling

### Data pipeline

Labelled risk data for the case data was used to train the NLP Model

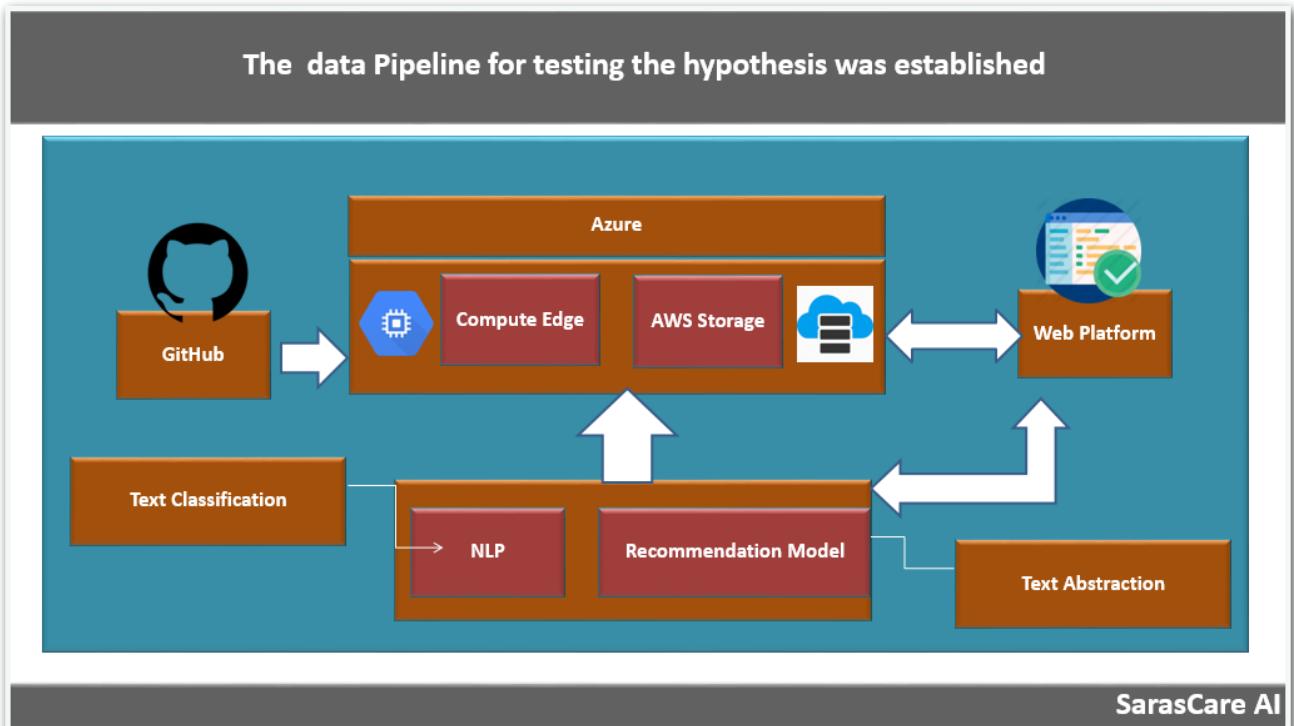


Fig : 10

Current solutions tested for the modelling Tasks

## NLP Crude classifier

This is the model we had finalised on in the limited time frame. The steps in the crude classifier is as mentioned below.

### Data Loading and Pre processing

- The files of unstructured textual data and the baseline files for classification are stored in the local system. These files are in .txt format to be read without any errors to the Doc2Vec model.
- All the text required to analyse in order of files in target directory are stored in a variable, and we created a list, data, that stores the content of all text files in order of their names for the testing purpose in the end.
- The Large English model was loaded from spaCy with the appropriate name. The code uses the alias 'en' for the model. This name may change depending on how one has installed spaCy in your environment.
- The data loaded is taken as input and outputs the preprocessed data in the same order. Then we defined a function to preprocess the data in each text file using spaCy.
- For the documents in the loaded data we defined an iterator that outputs data in the LabeledSentence format needed by Doc2Vec model. Final cleaned data is obtained after this step. The preprocessing parent function is then called on the data loaded.

### Document2Vector Approach

- This approach is the backbone of the SarasCare Minimum viable product. We collected domestic violence data in Australia from open sources and extracted information from them. This information is stored in separate files for each case, in the .txt format as specified in the earlier section. These files are cleaned in the earlier section of this code.
- The Document2Vector Approach takes these preprocessed files and trains a Doc2Vec model over the files. The same is done for our Baselines collected. We then project these document vectors for our Reports onto the Baseline vectors trained. This approach can be seen as a **crude classifier** based on distance measures between the two vectors in question.
- We decide to label each document vector with the risk Labels label, depending on which baseline vector was closer to the Report vector at hand. We generate an output data-frame with this approach which is used to test the accuracy.

### Training the Doc2Vec Model

- We called the class defined to return iterator over documents in the LabeledSentence format for input to Doc2Vec.

- This model is the final Doc2Vec model for the SarasCare MVP. It takes the cleaned data as an input along with the iterator on the labels to build the model vocabulary. This model is later saved to memory to be loaded later on.
- Then we defined and trained the model over 100 epochs for creating 300 dimension document vectors:

## Loading the Models

### Projecting the case files on Baselines

This is the core strategy of the project.

- The Doc2Vec model trained on data, along with Baseline vectors is taken as input and data-frame created to save the results of the approach. It outputs the data-frame created with the classification results.
- We calculated cosine similarities of case files with Baseline vectors: These vectors will be passed on as an input to the function to calculate projections.
- Resultant data-frame stores the results of all projections from the compiled data onto the Baseline vectors. This data-frame generated is used for seeing the accuracy of the model.

	<b>CaseFile</b>	<b>Low</b>	<b>High</b>	<b>Imminent</b>	<b>Maximum</b>
<b>0</b>	casefile1.txt	0.780743	0.755645	0.757018	Low
<b>1</b>	casefile2.txt	0.775064	0.750329	0.751014	Low
<b>2</b>	casefile3.txt	0.784609	0.740951	0.741844	Low
<b>3</b>	cf1.txt	0.770317	0.729343	0.724339	Low
<b>4</b>	cf10.txt	0.777257	0.735798	0.733438	Low
<b>5</b>	cf11.txt	0.693832	0.695329	0.693769	High
<b>6</b>	cf12.txt	0.750959	0.701517	0.699100	Low
<b>7</b>	cf13.txt	0.774784	0.735594	0.734090	Low
<b>8</b>	cf14.txt	0.719969	0.686481	0.684424	Low
<b>9</b>	cf15.txt	0.811048	0.743260	0.742062	Low
<b>10</b>	cf16.txt	0.777982	0.733548	0.733203	Low

## SimCSE: Simple Contrastive Learning of Sentence Embeddings

SimCSE is a simple contrastive learning framework that greatly advances the state-of-the-art sentence embeddings. The unsupervised approach, takes an input sentence and predicts itself in a contrastive objective, with only standard dropout used as noise. No supervision of the SIMCSE predicts itself, only use Dropout as noise In other words, we put the same input sentences in the pre-training ENCODER twice, including two embedding as a correct case, these two Encoder separate Dropout (without affecting each other, different Dropout forms different Embedding)

Contrast learning, close neighbour, pull far non-neighbour

$$\ell_i = \log \frac{e^{\text{sim}(\mathbf{h}_i, \mathbf{h}_i^+)/\tau}}{\sum_{j=1}^N e^{\text{sim}(\mathbf{h}_i, \mathbf{h}_j^+)/\tau}}, \quad (1)$$

SIM uses Cosine Similarity, pre-training uses BERT or ROBERT, then use comparison learning

We used Python package **SimCSE** which allows you to easily encode sentences into dense representations, build index for large corpora, and search semantically-similar sentences from the index.

Train SimCSE

We use the following hyper parameters for training SimCSE. For our implementation we tried the Bert model available.

### BERT base model (uncased)

#### Model description

BERT was [released](#) to the public, as a new era in NLP. Its lovingly called as MVP of NLP. Its open-sourced model code broke several records for tasks. The pre-trained model on massive datasets enables anyone building natural language processing to use this powerhouse. Bert allows to embed the meaning of words into densely packed vectors

Bert was pertained on the raw texts ,with no humans labelling them in any way with an automatic process to generate inputs and labels from those texts.

Bert was pertained with two goals .It used masking in the modelling process .Its different ones that see the words one after the other, or from autoregressive models like GPT which internally the future tokens.

BERT' main improvement was applying the bidirectional training of Transformer to language modelling unlike previous models which saw a text sequence either from left to right or combined left-to-right and right-to-left training

## Bert based network example

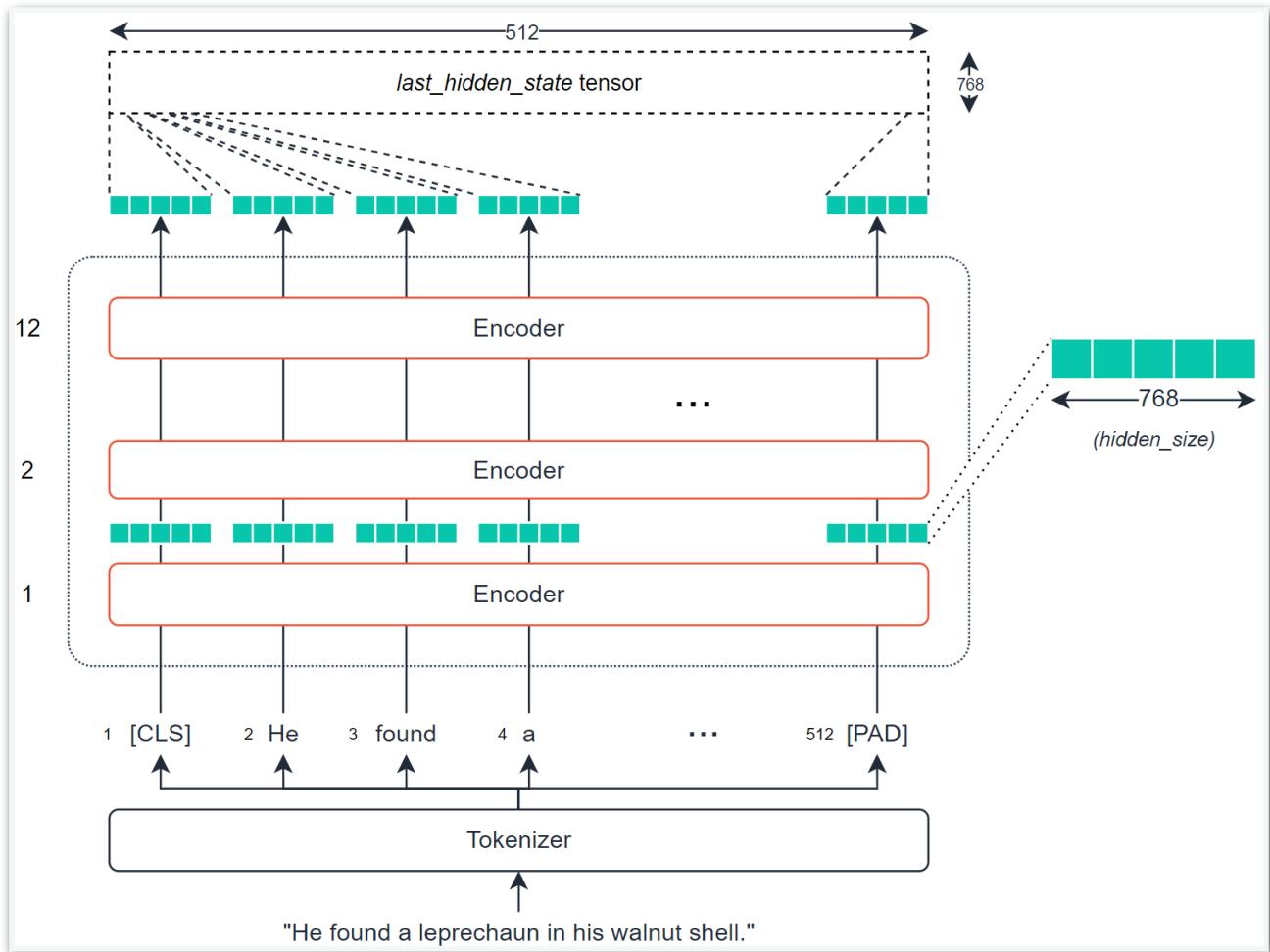


Fig : 11

## Bert Implementation

Bert can be used as a sentence comparison tool , by using Cosine similarity which we tried implementing in our model

We loaded the princeton-nlp's sim uncased best model.

```
In [2]: from simcse import SimCSE  
model = SimCSE("princeton-nlp/sup-simcse-bert-base-uncased")
```

```
06/19/2021 12:46:53 - INFO - filelock - Lock 2141673118856 acquired on C:\Users\Administrator/.cache\huggingface\transformers\886dba277a27c6ab50ab3d0bfd8839d354cfed717289623026415c62b687338.1b14bcddba43d86a607eedb4b638b87d30aa00c839358953dbd36f2cd3317c83.lock
```

We used the labelled data for pertaining

```
with open('C:/Users/amrutha/data science masters/saras/high.txt') as f:  
    high = f.read()  
    # print(contents)  
f.close()
```

```
with open('C:/Users/amrutha/data science masters/saras/low.txt') as f:  
    low = f.read()  
    # print(contents)  
f.close()
```

```
with open('C:/Users/amrutha/data science masters/saras/imminent.txt') as f:  
    imminent = f.read()  
    # print(contents)  
f.close()
```

The unlabelled data was used for test purpose. The case management students had overviewed them to be mostly High and Imminent risk classifications. So we are running by those assumptions

```
from os import listdir  
docLabelsCombined = []  
docLabelsCombined = [f for f in listdir("C://Users/amrutha/data science mast  
docLabelsCombined  
docLabelsCombined = []  
docLabelsCombined = [f for f in listdir("C://Users/amrutha/data science mast  
docLabelsCombined
```

After preprocessing and embeddings, we tried to calculate the similarity of the test data with the labelled data, which we combined together into the three risk categories.

The cosine similarity for each train document was seen with the three labelled risk documents, and the highest similarity score was considered

```

from pandas import DataFrame
dfObj = pd.DataFrame(columns=['CaseFile', 'Low', 'Hi

for d in dataCombined:
    sim_cosHigh = model.similarity(d, high)
    sim_cosLow = model.similarity(d, low)
    sim_cosImminent = model.similarity(d, imminent)
    if sim_cosHigh>sim_cosLow:
        if sim_cosHigh>sim_cosImminent:
            maxm="High"
        else:
            maxm="Imminent"
    else:
        if sim_cosLow>sim_cosImminent:
            maxm="Low"
        else:
            maxm="Imminent"

```

The results were as below

	CaseFile	Low	High	Imminent	Final
0	b'97 Cal.Rptr.2d 727 (2000)\n\n81 Cal.App.4th ...	0.137023	0.213526	0.210193	High
1	b'128 S.Ct. 2678 (2008)\n\n554 U.S. 353\n\nDwa...	0.203150	0.300361	0.240483	High
2	b'547 U.S. 813 (2006)\n\nDAVIS\nv.\nWASHINGTON...	0.170061	0.237552	0.202035	High
3	b'47 U.S. 103 (2006)\n\nGEORGIA\nv.\nRANDOLPH...	0.234857	0.260362	0.221336	High
4	b'131 S.Ct. 1143 (2011)\n\n562 U.S. 344\n\nMIC...	0.204075	0.288626	0.201635	High
5	INTRODUCTION\n1.\tThe Respondent to this appeal...	0.482674	0.527505	0.404143	High
6	IN THE COURT OF APPEAL (CIVIL DIVISION)\nON AP...	0.213829	0.234889	0.170420	High
7	b'91 Cal.Rptr.2d 596 (2000)\n\n77 Cal.App.4th ...	0.193391	0.230116	0.225062	High
8	b'661 F.3d 433 (2011)\n\nTroy MATTOS; Jayzel M...	0.276875	0.316248	0.328004	Imminent
9	b'67 Cal.Rptr.3d 317 (2007)\n\n156 Cal.App.4th...	0.230573	0.310262	0.289416	High
10	b'44 Cal.4th 1241 (2008)\n\n82 Cal.Rptr.3d 213...	0.252525	0.306063	0.273184	High
1b78de67023c6a874a39943f53ad4afeb0473d9	94 (2010)\n\n108 Cal.Rptr.3...	0.255033	0.299326	0.303567	Imminent

Even though we were aware most of these case files were of Imminent and High category, there were a few case files labelled as low.  
The risk of misclassification is very high in our case, and the model is misclassifying a higher risk as lower, which is even more worrisome.  
Hence we tried to see other models.

### Why we didn't choose BERT

- We had to use the labelled data available, as the input data was very less. We couldn't achieve the supervised classification in BERT.
- BERT is better in fine-tuned on tasks that use the whole masked sentence like in sequence classification or question answering
- BERT can have biased predictions.

### OpenAI GPT 3

OpenAI recently started GPT-3, Generative Pre-trained Transformer 3 (GPT-3) is the largest language model ever seen. [GPT-3](#) is a neural network trained by the OpenAI organisation with more parameters than earlier generation models. The main difference between GPT-3 and GPT-2, is its size which is 175 billion parameters. .

We received access for API to [OpenAI beta](#) by the client, so we tried on it-for our risk classification.

GPT-3 has 175 billion parameters and would require 355 years and \$4,600,000 to train - even with the [lowest priced GPU cloud on the market](#).

All GPT-3 models use the [same attention-based architecture as their GPT-2 predecessor](#).  
The smallest GPT-3 model (125M) has 12 attention layers, each with 12x 64-dimension heads. The largest GPT-3 model (175B) uses 96 attention layers, each with 96x 128-dimension heads

GPT-3 is capable of generating longer sentences and paragraphs than earlier models such as Google's BERT and Stanford NLP's Transformer.

OpenAI is used in this project via Python bindings, which can be installed using open ai library in pyPI. This in conjunction with the open ai API key can then be used in the model for the risk classification.

There are 4 different engines - Ada, Babbage, Curie and Davinci, which can be fine tuned for the NLP tasks.

[“https://lambdalabs.com/blog/demystifying-gpt-3/”](https://lambdalabs.com/blog/demystifying-gpt-3/)

[“https://beta.openai.com/docs/guides”](https://beta.openai.com/docs/guides)

### Content Filter

The filter is a great advantage of OpenAI to other NLP tools to see the sensitivity of the user inputs. As of now, it uses three ways of classifying text- as safe, sensitive, or unsafe.

## Label Descriptions

- **0** - The text is safe.
- **1** - This text is sensitive. The text could be talking about a sensitive data , either political, religious or topics such as race or nationality.
- **2** - This text is unsafe. The text contains profane language, prejudiced or hateful language, something that could be NSFW, or text that portrays certain groups/people in a harmful manner.

The above data is directly taken from the OpenAI documentation

## The Classifications endpoint

This again, is one of the newest features of OpenAI. It avoids fine-tuning. Hence there is no need for hyper-parameter tuning. Up to 200 labeled examples or a pre-uploaded file can be provided at query time.

Currently, files up-to 150 MB in size can be tried , and organisations are limited to storing a total of 1 GB of files at any given time. Each JSON entry has a single training example with "text" and "label" fields along with an optional "metadata" field.

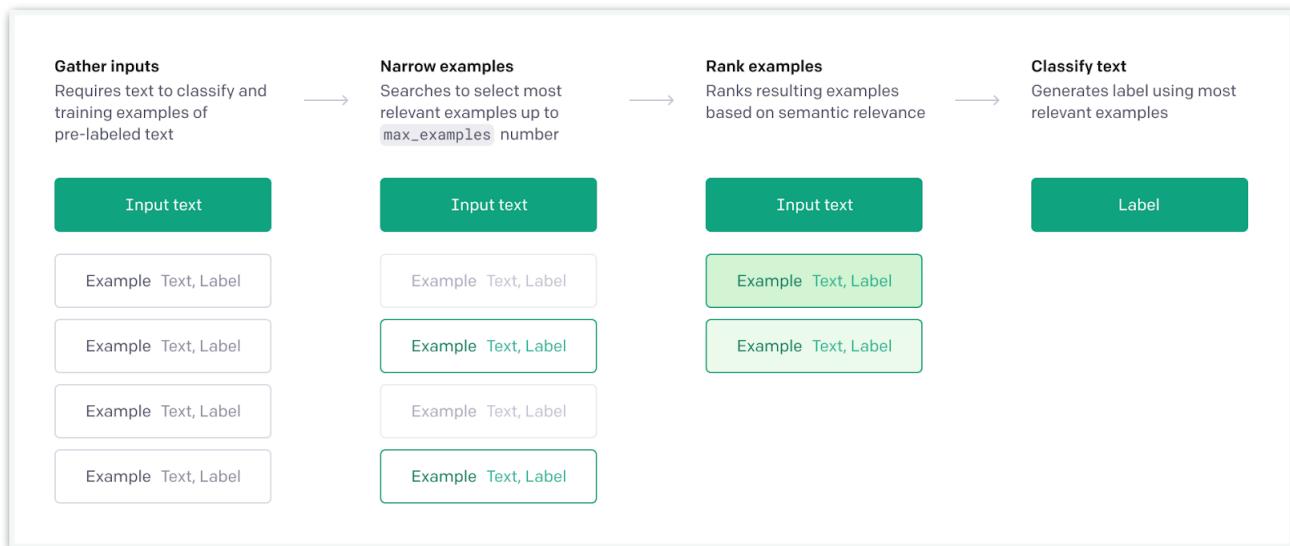


Fig : 11

Labeled data can be uploaded and saved by the endpoint similar to uploading documents for file-based [Search](#).

## **Why we didn't use OpenAI though it was working through the endpoints API**

The content filter gave us errors on multiple occasions due to the sensitivity of the content. Without passing the filter accessing OpenAI is not possible. The nature of our data is sensitive, and changing it wouldn't help in the later classification tasks.

- The OpenAI and a lot of the current implementations in GPT 3 is in Beta stage and experimental, especially the in-strict series. We do not know which problems have good efficiency and which does not. It's already known that for **Semantic search**

**and Long-form text continuation**, the instruct series performs poor than the core , as told in the OpenAI documentation,

- The content filter is known to make mistakes. This will cost the Risk not be classified which is the initial step of our project. It's known to give more higher false positives. Our data is clearly very sensitive and there is a high chance it would be blocked in the initial stages. The GPT is still not in the final stages, and proceeding in the side of caution, we chose to use it as the future step of the project.
- OpenAI isn't free, and it will charge later.

## Model Comparison

- The BERT and OpenAI models are the state of art technology used in classification and are better for the task than the crude classifier. We chose the crude classifier because of its alignment with our cause in the current timeline.
- The cost of misclassification is very high in a case like ours. Though all the models were fully accurate, BERT and OpenAI misclassified the higher risks as lower, and the crude classifier misclassified the lower risks to Higher. The costs for each misclassification are different. Hence even though the misclassification percentage was higher for the crude classifier, the cost was low. Hence we adopted the crude classifier.

## Web Development

The product development was done in python flask environment which is a python web framework. First the Flask class was imported and an instance of this class was initiated. Mainly the classes used were "Flask, request, render\_template, g, redirect, session, url\_for". To create the flow the first and foremost import action was to create a route to connect the model to the environment, typically the GET request is used for the same but here since the size was large we used POST and route() decorator was used to handle the different methods in HTTP. The major issue was generating a HTML from the python environment to showcase the interaction of the application and to act as the front end, the automatic configuration of Jinja2 template by flask helped to create this and template was taken from render\_template() method and each of the html page created like index, low, imminent were rendered using this method. Due to the presence of multiple pages present like navigating from experience to questionnaire page, the url\_for() function was used by prefixing the URL endpoint with the name of blueprint and a symbol dot. For example "return redirect(url\_for('home'))". The model.py is where the data model is implemented and output of that is connected to app.py which is the central link via pickle file. This architecture gave the independent development freedom where model could be altered for better accuracy but connecting modules did not get affected. Database was implemented using Flask-SQLAlchemy which helped in using SQLAlchemy with flask. The major reason for using this was we are dealing with just one application here, this method stands to be false if multiple applications were to be used. Therefore the python classes were converted to tables and every time a function is called for database sql-alchemy took care of it by converting the function call to sql statements. We use the create\_engine function in SQLAlchemy to interact with the database.

ChatBot

Username: user

Password: \*\*\*\*

**Login**

Fig : 12.1

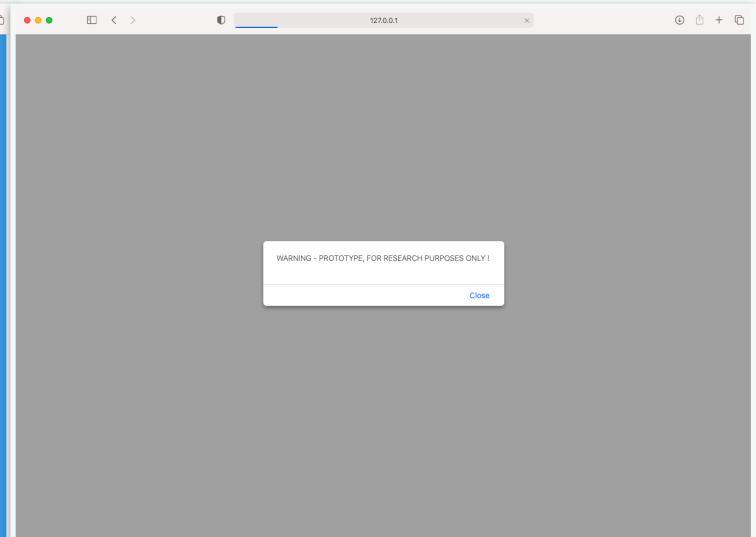


Fig : 12.2

SARASCARE

ChatBot

I was attacked by my husband and he took away the kids.

**Predict**

Fig : 12.3

**Imminent**

yes  
 yes  
 no

Has your partner ever made you feel guilty for spending time with your family or friends?

Is your partner weary of you being around individuals of the opposite sex?

Is your partner prone to jealousy?

**submit**

Fig : 12.4

**Severity of the case is: Imminent**

Are you intimidated by your partner?	<input checked="" type="checkbox"/> yes
Are you being isolated from your family and friends?	<input type="checkbox"/> no
Do you feel humiliated?	<input type="checkbox"/> None
Has your partner ever made you feel guilty for spending time with your family or friends?	<input type="checkbox"/> no
Is your partner weary of you being around individuals of the opposite sex?	<input checked="" type="checkbox"/> yes
Is your partner prone to jealousy?	<input checked="" type="checkbox"/> yes

Reccomendation : Women's Legal Service Phone: 8622 0600 Women's Legal Service Victoria is a state-wide specialist providing assistance and referrals for women experiencing disadvantage.

**Print**

Fig : 12.5

**Severity of the case is: Imminent**

Are you intimidated by your partner?	<input checked="" type="checkbox"/> yes
Are you being isolated from your family and friends?	<input type="checkbox"/> no
Do you feel humiliated?	<input type="checkbox"/> None
Has your partner ever made you feel guilty for spending time with your family or friends?	<input type="checkbox"/> no
Is your partner weary of you being around individuals of the opposite sex?	<input checked="" type="checkbox"/> yes
Is your partner prone to jealousy?	<input checked="" type="checkbox"/> yes

Reccomendation : Women's Legal Service Phone: 8622 0600 Women's Legal Service Victoria is a state-wide specialist providing assistance and referrals for women experiencing disadvantage.

**Print**

ML API.pdf Page 1 of 2

http://127.0.0.1:5000/high\_results

Page 1 of 2

Fig : 12.6

**User Login** - Figure 12.1 shows the login page where the user or admin logins are available. When logged in using the user login, a pop up is shown which showcases that the project is for research purpose only as shown in Fig 12.2, this is essential because the application is not production ready and there is a high chance of it being misused and formulation of diagnostic may not be optimum for a highly sensitive case like domestic violence. Once logged in the page showcase a platform to share the experience as shown in Fig 12.3, this text is parsed in GPT3 platform so that even if user enters incomplete sentences it can still read it as a whole and then the SVM algorithm works to determine the severity of the case through the case files. Once the severity is determined the questions are formulated and showcased for user to answer as in Fig 12.4, where the user answers them according to what they feel is right for them. These answers are collated and stored in database and is made to pass through an algorithm to formulate the recommendation as shown in Fig 12.5. There is a print/save feature incorporated in the page which lets the user to download or print the interaction with the application as shown in Fig 12.6 which can be used by user if consulting any other service so that user does not have to repeat the dreaded incident again and again.

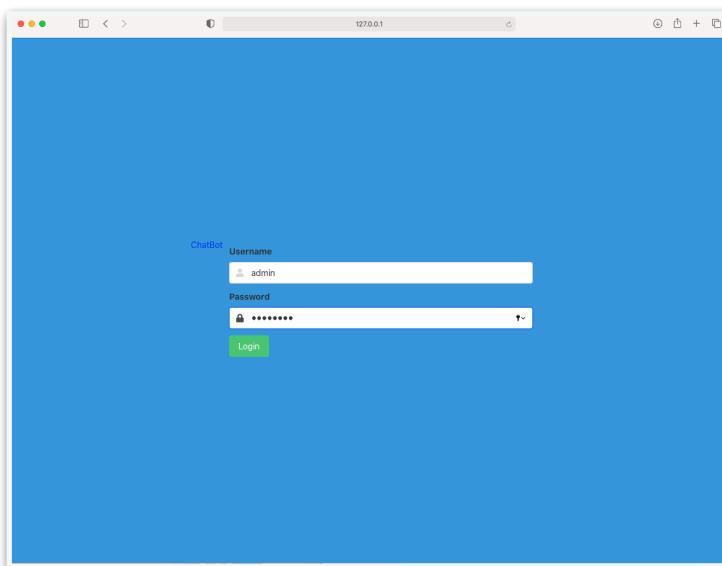


Fig : 13.1

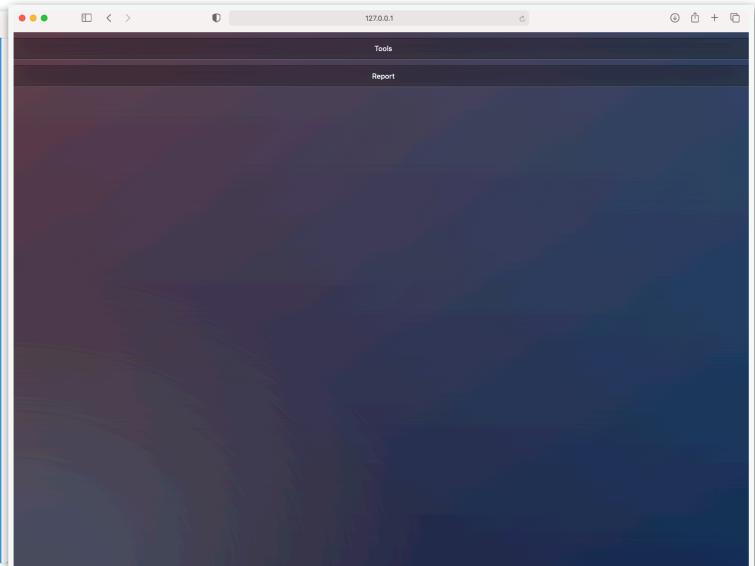


Fig : 13.2

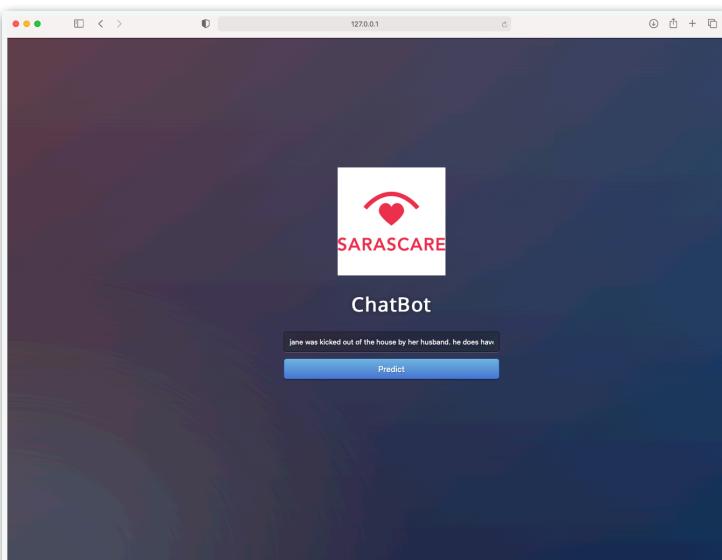


Fig : 13.3

Victim Reponse						
User	Priority Level	Q1	Q2	Q3	Q4	Q5
USER-1	IMMINENT	NO	YES	YES	NO	YES
USER-2	LOW	NO	NO	YES	NO	NO
USER-3	LOW	YES	NO	YES	NO	NO
USER-4	HIGH	YES	YES	YES	YES	YES
USER-5	HIGH	YES	NO	YES	NO	YES

Fig : 13.4  
Page 27 of 42

**Admin Login** - The admin login is provided for the case officers who handle the cases of domestic violence as shown in Fig 2.1 the admin is provided with two facilities as shown in Fig 2.2 as these two options will benefit case officers at large. The first option is where the case officer gets to use the risk classification tool as shown in Fig 2.3, this is in large helpful when case officer after consulting with the victim is not able to determine the severity of the situation and thus enters the experience of user and is in return provided by a risk categorisation which is data driven. The second option as shown in Fig 2.4 is where the case officer is provided with the database access where all the questions and answers by users who interacted with the systems are present, for privacy reasons the user is tagged as user1, user2 etc.

---

## Challenges

As wisely said ‘Challenges are the mark of progress’ which truly implies that our Sarascare application was full of challenges which were very complex and time consuming. The challenges were accepted , researched , tried out with different methodology and fit into our solution. Please find below major challenges faced though sarascare journey:

### Data Gathering

In Data gathering , as already discussed in previous section (XX) was the first task after requirement breakdown and mapping. The Data should consist of incidents shared by the victim, to evaluate the degree of violence/abuse or type of it.

The only available dataset initially was not usable in terms of modelling capabilities, as it did not align with the problem statement.But we started on I and concurrently searched for more data.The available data was more regarding COVID relief data within the organisation. The non availability of the data, took a lot of time due to the scarcity of the data being personal and sensitive.

The public data platform does not have data sources to detail the report of issue, it only consists of stats and count which was of no use in evaluating the severity of incident. Major data files are high risk , so there were minimum data files for Low/medium incident reporting.

This part of finding useful data took the most time of our internship (approximately two months). The main reason behind this delayed start was due to the fact that no such data existed online. The topic of domestic violence is quite delicate and the victims who reveal their side of story often do it with a lot of courage and strength. Therefore, gaining insightful data online is very tough as it is highly guarded. When the team thought of finding data, everyone believed that one could find it easily from Kaggle, data.gov, google public datasets or from any websites like the ones mentioned. However there was no data available from these sites which made it even more difficult to find the relevant data.

### Dependency of External Teams

The business flow of the application is closed synced with MARAM based assessment so that process will take all necessary measures to classify the risk. Also , we have to consult and discuss every possible risk flow from the Criminology team which took an extra piece of time eg. Risk assessment and Questionnaire etc.. For Risk assessment we have to get data labelled from criminology to train our test data and help classify the risk

level initially. For the recommendation list, and the questionnaire list was also highly dependant on them

### Learning to be the initial Data Scientists in an organisation

We were the initial data scientists who had the opportunity to do a data science project from scratch, for SarasCare. A technology supervisor who would have guided us in all of the hurdles that we faced while working on this project would have helped a lot, as it was the case in almost every other project. The university provided technical support in the later end, which helped us mitigate the issue.

### Change in Requirements

The initial draft of plan was to consider the chatbot from a victim perspective, but later while accessing the business requirement. We concluded to build the tool to accommodate the role of Case manager and Victim together. This has changed the layout of project plan and we have to start a couple of flows from scratch which consumed 1-2 weeks extra than planned.

### Hurdles in making AI acceptable to the teams who were working alongside

The criminology team and the data science team were collaborating in this project. We being the technical experts and the criminology team were the subject matter experts. There always was the fear on how the AI would be used, and it wasn't easy to make the whole team come to the conclusion that AI would be aiding the case managers in the future, not overtake them, in order to function together as one team for this project.

We had solely gathered all the case files used in this project. We did succeed in gaining the support of the criminology team, by the later ends of the project where they actively helped in labelling one third of the gathered case files, and in developing the solution flow. We learnt a lot of negotiating and dealing with teams with non technical back ground, and that communication gave us all a new perspective to our later journey where we would undoubtedly be having the same concerns.

We were able to understand multiple view points and how AI was seen with caution, as a part of this project, and we were happy to be able to convince the team who worked alongside with us that AI was used for the purpose of aiding the case managers.

- Experiments with Chatbot/ML models:** In the course of the project we have tried and implemented multiple experiments to ensure the product is reflecting the actual use with quality output. We have tried NLP, BOW methods, also Tidio and Dialog Flow application to try to model the tool as chatbot which is discussed in the previous section as well.

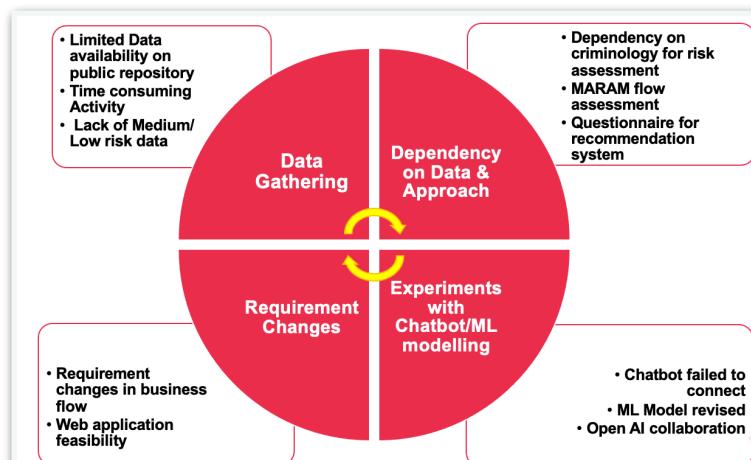


Fig : 14

# Key Lessons Learnt

## Data Strategies

The key challenging area was data , and with help of rigorous efforts we were able to find the exact match from below sources. The data did help to evaluate the incident and also judicial trials and Australian cases. This also help to share the data set ( after masking details) to public repositories to help develop more understanding for other people/ institutes.

## Team work

Team work is recognised as the backbone of any projects, even considering teams working on different subject areas being eager to help and support to work mutually. The support was constant throughout and helped to make decisions smoothly. We also kept 2 meetings (MON/THU) of the week to connect and share progress.

## External Support

We learnt to ask for help quickly to all sources available, and learnt that help is available. The support we received from RMIT,SarasCare , and external speakers was overwhelming and very constant. We are constantly receiving feedback which helped to produce greater outputs.

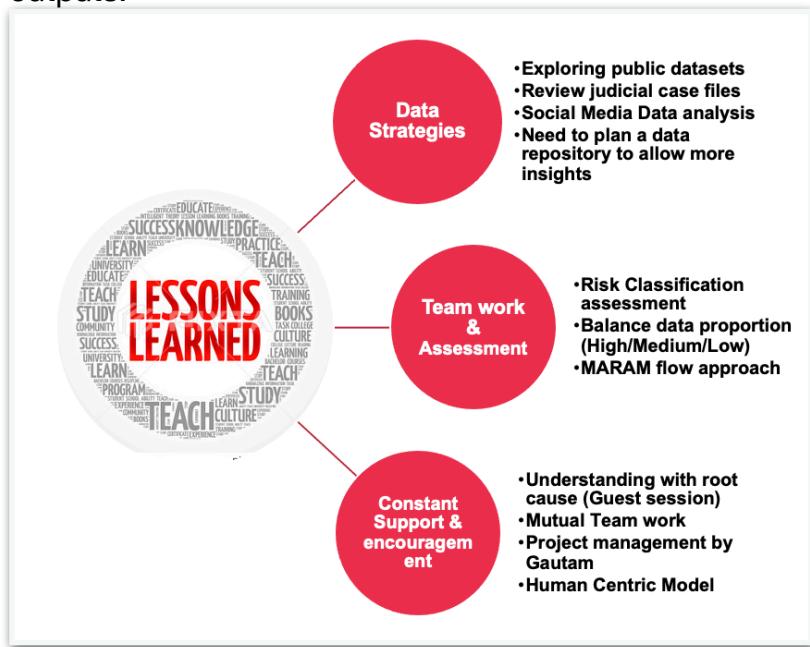


Fig : 15

# Experiments

Since the beginning of the project, many experiments were carried out for continuous improvement and enhancement of chatbot.

Experiments were carried out to integrate and enhance the existing system, while other experiments were developed in parallel to the current methodology in order to replace them if they performed better.

## Experiment with Rule based model

One of the experiments was done by creating a rule based chatbot on a platform called Tidio. Starting from greeting towards the end of chat, each and every process is executed according to the decision tree mentioned in figure 10.1. Here, the entire flow of conversation is controlled by the chatbot.

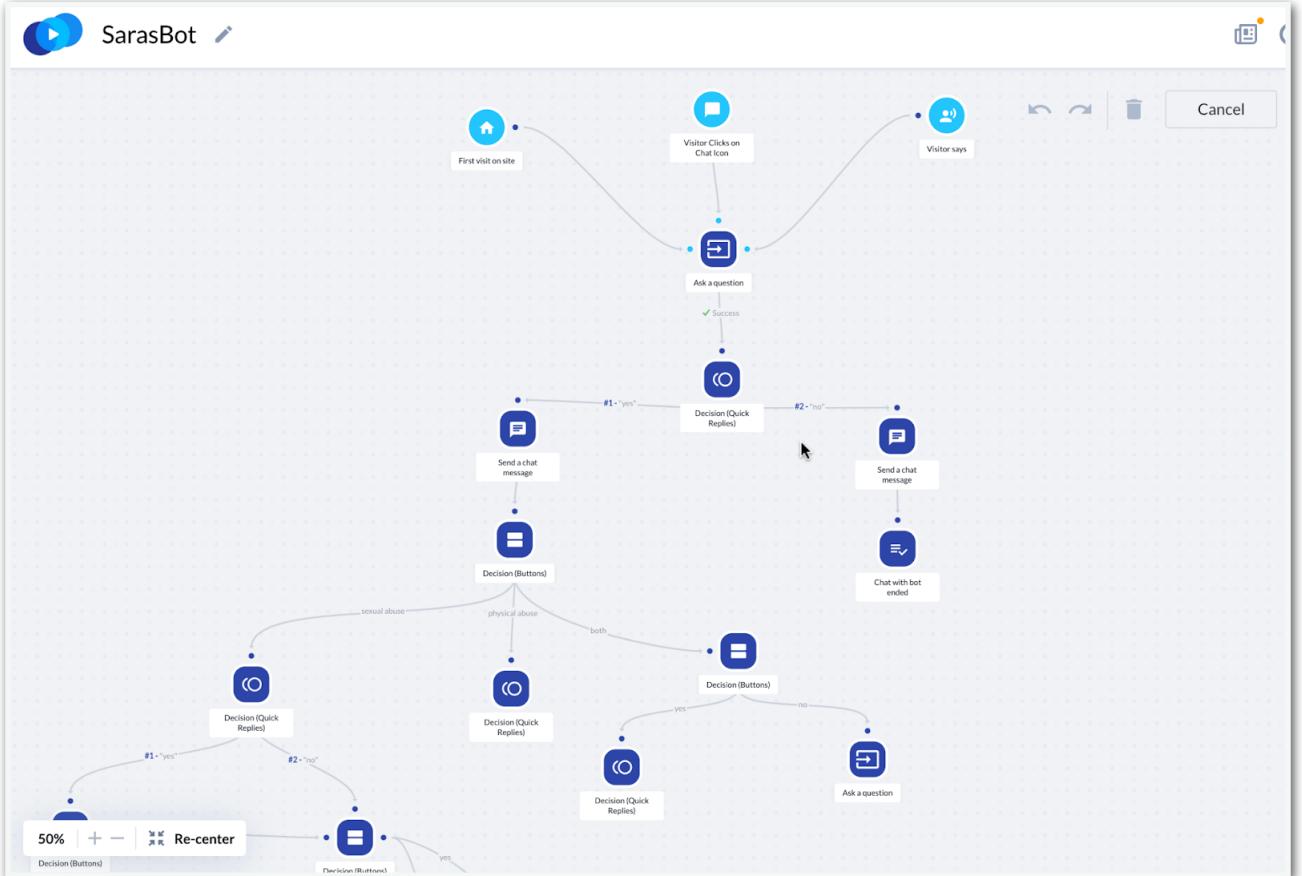


Fig : 16

### Experiment with Retrieval based model

Dialog Flow is a natural language understanding platform that makes it easy to design and integrate a conversational user interface into any of your devices. Using Dialog Flow, you can provide new and engaging ways for users to interact with your product.

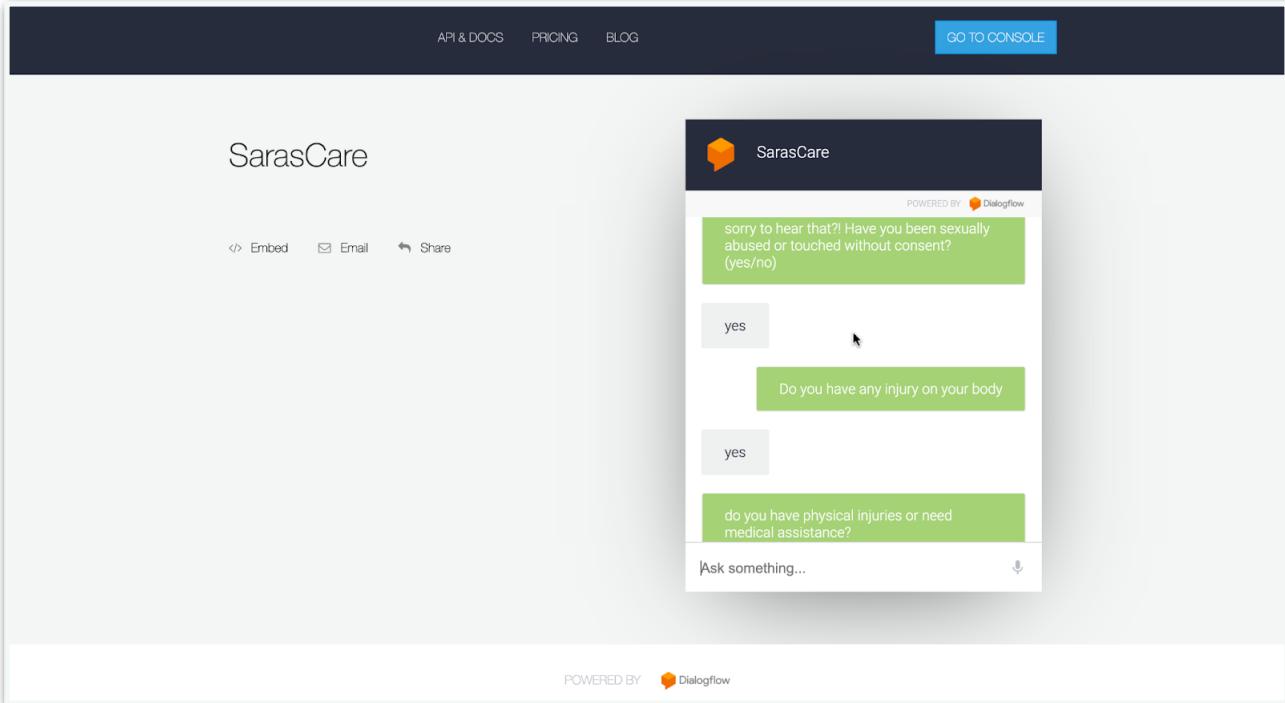


Fig : 17

### **Advantages**

#### **Capabilities of Rule based model**

- Background working on if-else conditions
- Automatic activation as per the condition of the administrator.
- Easy integration with platforms such as websites, and messenger and has webhooks built in.

### **Limitations:**

- Unable to deal with NLP modelling
- Work only on if-else condition
- Scalability comes with lots of dollars

### **Capabilities of Retrieval based model**

#### **Advantages :**

- Developer time is reduced by providing interactive visualisation that helps to quickly see, understand and edit the work.
- Can be swiftly integrated to websites as well as with platforms like messenger, telegram etc.
- FAQs in text documents could be easily trained into models.
- Reuse intents, data conditions, and handle supplemental questions

#### **Limitations:**

As per requirement, model need to ask multiple questions to users and in response users reply with yes or no. Here, dialogue Flow model get confused in directing to appropriate

intent. Which could be examined from the figures below. Because of this our model stuck into the loop instead of directing to relevant intents.

The screenshot shows the Dialogflow Essentials interface. On the left, there's a sidebar with various navigation options: Entities, Knowledge [beta], Fulfilment, Integrations, Training, Validation, History, Analytics, Prebuilt Agents, Small Talk, and Docs. Below that are Trial Free and Upgrade buttons. The main area is titled 'Intents' and has a 'CREATE INTENT' button at the top right. It features a search bar and a list of intents. The list includes 'Default Fallback Intent', 'Default Welcome Intent', and several follow-up intents under 'help' and 'problem.sexual'. There are also buttons for 'Add follow-up intent' and 'Edit' or 'Delete'.

Fig : 18

- For benefits of scalability it requires integration with google cloud.
- Flexibility, scalability and mobility of projects come with an expensive price tag.
- It works on specific intent, entity and response type but we were not having proper labelled data which we could use for intent and entity specification.
- It provides the functionality to train a set of questions so if we could have an appropriate set of FAQs, we could have trained it well.

---

## UAT (User Acceptance Testing) Phase

The User acceptance testing is conducted to ensure the business requirements are incorporated in the product developed. User Acceptance Testing (UAT) is the final stage of the software development process.

The users are in charge of user acceptability testing (UAT). Those stakeholders who will utilise the system to support their tasks in the day-to-day running of the business are referred to as 'users.' Hopefully, at least some of these users were involved in the elicitation of user requirements.

UAT Total User : 08

- Criminology student: 03
- Peer Student / RMIT: 05

User acceptance checklist was customised, please find below the results :

Task name	Crim stu1	Crim stu2	Crim S3	user1	user2	user3	user4	user5	Comments
Login Function	Good	Good	Good	Good	Good	Good	Good	Good	
register user	Good	Good	Good	Need Improvement	Good	Good	Good	Good	want to see auto login
admin/Victim login	Good	Need Improvement	Good	Need Improvement	Need Improvement	Good	Need Improvement	Good	
User Interface	Need Improvement	Need Improvement	Need Improvement	Good	Need Improvement	Good	Good	Good	want to see some more information in background
Risk assesment function	Good	Good	Good	Good	Good	Good	Good	Need Improvement	
Extra Questionnaire	Good	Good	Need Improvement	Good	Good	Good	Good	Good	
Recommendation system	Good	Good	Good	Good	Good	Good	Good	Good	
Report Config	Need Improvement	Good	Poor	Good	Good	Good	Poor	Good	they need email system and more structure
Do you want to recommend this app ?	Yes	Yes	after some improvement	yes	yes	yes	yes	yes	they are positive about this app

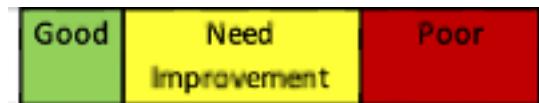


Fig : 19

The testing was conducted using a random selection of people and any major feedback was covered and mentioned in Comments.

- **Good** – The majority of people were interested to see this kind of web application to support the victim. They find the process flow is same as real time and also felt human centric decision making. They want to see this application to be working in real time victims.
- **Need improvement** – The people liked to see a few more features to be more interactive and engaging. They wanted to see the user interface to be more chatbot faced or have a dynamic background.
- **Poor** - They felt we can really improve the features so that other institutes like medical , or support can see proper case details and support systems to be mapped

## External Contributions

The aim of the project was also to understand and find solutions to infuse the AI & Data Science practices in reducing Family & domestic violence . The data shows that in COVID-19 situation , Australia has seen a rise of 6.7 % in incidents reported by victims. The victims of family & domestic violence are hesitant to openly discuss the problems , solutions , and reasons behind this act of abusiveness.

As a Team , we are very thankful and feel privileged to work on such a sensitive issue which clearly needs a quick attention and instant support service, we would not be able to progress and anticipate the true parameters behind the logic and implementation.

**Criminology Team:** The contribution of the criminology team ( 5 members) was the baseline skeleton, as they expertise in subject matter and supported us as reference models. We have conducted regular meetings weekly via MS teams and also created peer groups to stay connected and follow smooth transactions on the activities planned together.

- Data Gathering & validation
- MARAM risk assessment framework
- Recommendation system details

- Understanding the role & responsibilities of Case manager

**External Speaker & guest session:** Apart from the GUS team, we also got a chance to familiarise with some supreme personalities across Melbourne. We have conducted sessions to take feedback on the implementation planned and future scope of work.

- **Dr. Manjula** - we had sessions regarding the process understanding, relative study or projects in the pipeline. She has focused more towards keeping the identity and details of victims safe and secure.
- **RMIT Technical support** - we have received a lot of support in terms of applying new ML models or chatbot integration from Estrid. This has really provided fresh technologies and research papers to deal with data challenges.
- 

**SarasCare support & Motivation:** The key success of this project was also a constant push, support and encouragement shown by Gautam throughout the project was commendable. He in addition had acted as the program manager, helping us steer the project. He has shown us all possible outcomes and his tremendous knowledge from previous projects helped us to stick to the work. Gautam played the role of project manager where he used to act as a bridge between the technical aspirations & associated work from the GUS(RMIT criminology) team.

---

## Roles and Responsibilities

Name : Jewel James (s3763905)

Responsibilities :

- Formulated the problems statement such that it should add value to the business.
- Developed and deployed python-flask based web application(chatbot) from scratch
- Figured out the advantages and limitations of examined models and made decision on which model to implement in production.
- Explored and analysed dataset before inputting it in the model.
- Applied NLP model to the dataset for predicting the severity of the cases.
- Developed and deployed python-flask based web application(chatbot).
- Shared the results with stakeholders.
- Deployed application in Microsoft azure as per client requirement.
- Responsible for multiple parts of the presentation, and report writing.
- Worked 20-25 hours per week for the project.
- Regular 1 meetings every week for first 2 months and then twice a week as project progressed

Name : Amrutha Sreevalsan (s3765847)

Responsibilities :

- Data Collection -The UK case files, and pulling data from Twitter API
- Research on various modelling methodology and Subject Matter
- Implementation of Open AI GPT 3 ,SimCSE Bert and the Crude Classifier model.
- Figuring out the future scope, advantages and limitations of examined models.
- Worked on the Questionnaire provided by the criminology students to make it adaptable to the Web App, and designing methodology to ask the right questions to reach the right recommendations
- Screening of initial dataset (COVID relief) shared by SarasCare
- Liaised with the case management students and was a POC for the client with the team
- Responsible for multiple parts of the report, editing and Finalising it

- Worked 20-25 hours per week for the project.
- Regular 1 meetings every week for first 2 months and then twice a week as project progressed

Name : Ishan Patel (S3796723)

Responsibilities :

- Worked on the data collection part.
- Research on various chatbot methodology.
- Implementation of Chat-bot with PyTorch - NLP and Deep Learning.
- Creating a GUI for chat-bot using Tkinter.
- Exploring different technologies to enhance the model.
- Practical implementation of Rule based model on Tidio platform.
- Integration of model API on Facebook messenger and wordpress website.
- Research on Generative approach using Dialogue flow CX and Dialogue Flow ES
- Practical Implementation of Generative model using Dialogue Flow CX.
- Discovering a way to integrate current implemented model with experimented technologies.
- Figuring out future scope, advantages and limitations of examined models.
- Worked 20-25 hours per week for the project.
- Regular 1 meetings every week for first 2 months and then twice a week as project progressed

Name : Kushagra Malik

Responsibilities :

- Did exhaustive work for Data collection.
- Created two NLP classification models to classify the risk assessment of the user.
- Created a rule based chatbot for domestic violence and their services without the machine learning models for a start.
- In depth research on types of domestic violence.
- Created many questions to ask the user about the type of abuse that they are facing
- Searched for various ways to enhance the model.
- Explored through various services provided to domestic violence victims to create a set recommendation list for the chatbot.
- Worked 20-25 hours per week for the project.

Name : Gaurav Sinha

Responsibilities :

- Screening of initial dataset (COVID relief) shared by SarasCare
- Involved in Data gathering from various public repositories
- POC for the Data assessment from the Criminology Team.
- Scheduling meetings, Making MOM or chasing the cross team for status and action owners.
- Contributed in framing Questionnaire format based on risk and impact assessment.
- Researched about various techniques & implementations on github, data science projects
- Performed UAT task to evaluate the test business solutions and concluded the results.

- Was responsible for creating the layout final report and plan data arrangement and formatting.
- Worked 20-25 hours per week for the project.
- Regular 1 meetings every week for first 2 months and then twice a week as project progressed

## **Self Reflection**

### **Jewel James**

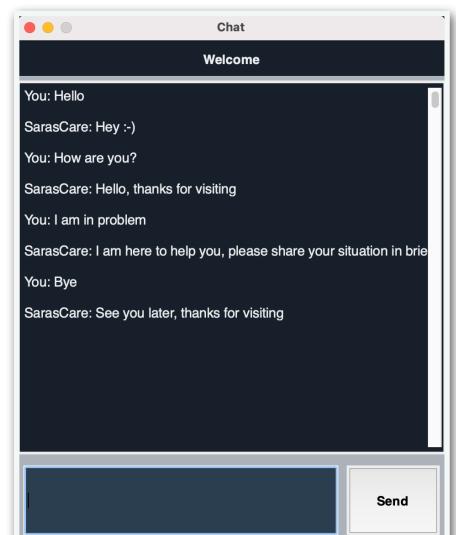
- The project was an amazing experience to understand the scope of data science in industry. As a technical person, I gained insights on how to better communicate with a non-technical individual i.e. our client to better understand his requirements. The requirements always came as a story, and I took up to engineer those requirements into sprints.
- Bringing client to same page as the team was a great challenge as the client initial requirements were quite advanced for the time and resources were limited.
- The next challenge came in the form of data collection in the domain of domestic violence. As of now, the domestic violence is a very niche and sensitive topic. I used a prior written script for scrapping data from twitter. With those small amount of case files, I collected from online, I attempted to use k-anonymity and l-diversity techniques to make the individual related anonymous before using it our machine learning models.
- The client specified, a change in requirement after 2 months which lead to scrapping off of work done till then and focusing on a different aspect of domestic violence i.e case officers
- We needed dialogue flow based data in order to create a chatbot using Generative models. But the data team retrieved was in the form of Case Files. Additionally, these case files were in the format of essay, so the only option was to Retrieval based models. The retrieved data only had content and user messages. The responses in the field of domestic violence are limited which made Retrieval based models the ideal choice.
- Since the data was in the form of an essay, the only option for me was to perform multi-label classification to predict the threat level of these domestic violence victims. While preprocessing these data files, I soon realised that these data contained partial sentences. To solve the issue, I used Open-AI's GPT-3 to predict the full sentences and fill the data accordingly. Since the data was so small, there were no cost for using Open AI's GPT-3.
- After carefully researching multiple online papers, I realised that Support Vector Machines (SVM) with linear kernel could solve the problem by using Cosine Similarity as metric. The advantage of SVM was that it was really powerful for small amount of data and had similar structure as shallow neural networks. Finally, I attempted to use Open AI's GPT-3 for sentence completion in user response. In summary, I learned a lot of soft-skills like negotiation ,team work and directing project flow. In terms of technical skills, I gained how to create Chatbots from scratch using OPEN-AI's GPT-3 and deep learning machine learning models. In future, I would like to try out RoBERTa to benchmark my SVM model which performed the best out of all my solutions.

### **Amrutha Sreevalsan**

- One of the best parts of working in this project was the satisfaction of working in a field that is so much socially relevant, and would help people who actually need it
- Working with a non technical team gave me a lot of insights on how to present something technical to people of a different background. It gave me a lot of lessons of how to gain acceptability to a project that feels foreign to the audience and gain their trust. Communication goes a long way, and it's always worth it in the end, when things can be connected, and we can create things that are of help to the society
- The project was challenging from the start, and I along with the team, had to work a lot on developing a proper flow of the problem statement itself, and there were a lot of moments when the team was demotivated. The criminology students had once stated that this project was impossible, and the way we dealt with the situation with the immense amount of support from Goutham was an eye opener for me. We had been pushing forward every moment of the project, with a lot of uncertainties and are grateful to a lot of people who helped and guided us to make this work.
- Opportunity to experiment with the state of the art tools like OpenAI GPT 3, and BERT was a great experience, which the client had provided the access to.
- The technical support from the college by Prof Estrid was extremely helpful to drive our project. Having the client support us more on the non technical side, we really appreciated her guidance and learnt a lot with Prof Estrid.
- Working as a team with fellow students was a learning experience, as we learnt about each other, and how to communicate and present the ideas in a way that is acceptable to everyone was again a lot to learn, and it was a lot of fun as well!!
- The OpenAI model though being far superior, gave errors due to content filter for sensitive content. Exploring this further is something that can be done as a next step
- The BERT model, though again was a superior one than the selected model, gave misclassification errors, with higher risk category miss classified as lower. The cost of this risk was too high, and we ended up choosing the crude classifier which misclassified lower risks to higher, which was a cheaper risk

### Ishan Patel

- Developing a chatbot was an unprecedented task for me. Therefore research on
- Chatbot methodologies and related approaches i.e rules based, retrieval based and
- generative based the model was an absolutely new concept that I learned as a part of a project.
- Working on group assignment along with student from Criminology department
- as a subject matter expert was a completely new experience.
- As fresher, understanding the client requirement and maintaining a satisfactory relation
- With them taught me another way of communication.
- In future projects I would like to enhance my communication with clients.
- As a role of explorer and mentioned responsibilities, I am attaching the screenshot of
- Chat-bot with PyTorch - NLP and Deep Learning. This showcase the implementation of other models.
- In terms of data, we were not having the intents and responses related to scope of the Project was a limitation for the mentioned chatbot to provide relevant outcomes.
- In addition, I had developed the rule based and retrieval based model, which are listed



- and explained along with their limitation Under experiment section part of the report.
- The unexecuted work will help me in future to make better chatbots and save plenty of my time in research.
- Golden Nugget : I learned various approaches and their methodologies for implementing chat bots and integrating them on social media and websites.

### **Kushagra Malik**

- One of the best parts of working in this project was experiencing the teamwork skills and knowledge that required everybody to be in constant communication with each other and get to know how much everyone has done.
- This was a challenging project as it was required to have communication with another department as well. This was something new and an enhancing experience for me.
- Learning Natural language processing as well as chatbots and creating machine learning models all on my own was an unparalleled challenge for me.
- Communicating with the client and learning about his needs and trying to work around with current knowledge and technologies was a beautiful experience.
- This internship required a lot of continuous self-learning from my side. This was a fun and rewarding experience.
- Things I would improve is communication with clients and my fellow teammates.
- I will continue to gain more knowledge on NLP and chatbots for my career.

### **Gaurav Sinha**

- The Best part of the project was its domain , the nature of work processes in social welfare domain. I got to learn and research about the family violence domain , the type of abuse and what steps are to be taken in this subject area.
- I have learned that current research is implemented in this area , and what parameters or factors are responsible to create and sustain any solution .
- The Knowledge gained to understand the world of NLP, BOW and RNN machine learning models. I have worked on the implementation and advise various steps taken to improved the efficiency of model
- Working as Team Player , which consists of Criminology , SarasCare team and various guest sessions which enrich the domain knowledge. It also helps to refine the process.

## **Future Scope**

- Collecting more casefiles can reduce the imbalance which is currently present in the dataset as most case files have been either assigned high or imminent. Thereby having more data can balance out the risk assessment between the assessments of low, medium, high and imminent. This balanced data will also improve the accuracy of our model.
- A second change that can be made to the project is by having a more complex model such as a deep learning or a neural network to assess the risk classification of the victim. The model currently predicting does not provide an accuracy as good as a neural network can.
- Another key improvement that can be done to the project is to provide data security to the victims. As the data right now is unprotected, any form of unwanted actions by unauthorized users can cause significant problems to both the victims and the

company. Therefore, having the data encrypted across the entire platform can be a good measure to improve data security.

- Another possibility is that in the future, the chatbot solution can be implemented on a world wide scale which potentially helps victims all throughout the world rather than just Australia.
- One more possibility is that the chatbot can be modified to cater for the various abuse crimes present within society. Thus , it will have the ability to help victims suffering from other types of abuse rather than just domestic violence.

---

## Conclusion

The web app is designed with a strong touch to reciprocate the experience of the victim after initial screening with case officer or case manager. The intent is to aid the case manager to reassure his/her decision based on whether the individual who experienced Domestic Violence receives the required support as soon as possible. In many cases , the victims are in need for a quick accomodation or financial aid. They don't want to go back to same partner, or home where the incident is likely to be repeated.This category of the cases are initially screened and flagged by our app and are prompted to seek assistance from Police as the case severity in imminent

This is possible by asking the right questionnaire.

The idea behind this repeated set of questions even after the victim provides an initial textual input is to double ensure the risk assessment of the victim and spontaneously trigger the relevant list of support services catered as a recommendation.

**Phase I:** The phase 1 of the project begins with initial breakdown of the requirements into tasks ( details below). We have also mutually worked with the criminology team , who were our reference as subject matter experts.

After initial understanding of requirements by following a process outlined clearly in the initial parts of the report, we moved forward to start with the next set of tasks.

Data Gathering activity focused to find the data which details about the incident summary was very time consuming and tedious. All the public resources and we started with UK case files and later on collected australia local case files. More details about Data gathering is mentioned in section of Chatbot in this report -

The AI powered Chatbot concept was the most interesting concept work of the project. As the requirement was to create a chatbot to support the victims 24\*7. We had tried to implement the chatbot using Tidio and Dialog flow platform which follows the if-else sequence of interaction.Due to non adaptability of the bot with the NLP models, we proceeded to creating a Web page which did the same requirements after receiving a nod from the client.

The details of the applications is mentioned in experiment section

**Phase 2 :** After receiving the data classified by GUS team from RMIT who worked alongside with us , after analysing all the details of the incident helped us label the cases file as High,Medium or low. This helped us think in the direction of a supervised model. The initial plan was to implement the logic of keyword analysis which will help us to mark the risk. After lot of literature review on BERT, Open AI and other state of art NLP models we tested a few based on the technology availability on the labeled files. We have implemented 3 models to keep checking and improving the accuracy.

We have also tried to scale this application to connect to Open AI GPT3 to connect our model and chatbot. The Preparation for questionnaire used in the Web app is in lines with

the MARAM assessment flow , which is an industry standard in handling Domestic Violence cases .The categorised questionnaire is then attempted by the victim via the Web App which further maps the support service should be advised to the victim. This helps to trigger the recommendation support service list in our implementation We further have created a survey form which probe the victim to post the response which in the background is run on the ML model. This model evaluate the weightage of the response against associated scenario and thus help to create a recommendation service.

---

## References

- Australian Institute of Health and Welfare. 2021. *Reports & data - Australian Institute of Health and Welfare*. [online] Available at: <<https://www.aihw.gov.au/reports-data>> [Accessed 18 June 2021].
- Domestic Violence Resource Centre Victoria. 2021. *Domestic Violence Resource Centre Victoria*. [online] Available at: <<https://www.dvrcv.org.au/>> [Accessed 18 June 2021].
- Hegarty, K., Hindmarsh, E. and Gilles, M., 2021. *Domestic violence in Australia: definition, prevalence and nature of presentation in clinical practice*. [online] MJA. Available at: <<https://www.mja.com.au/journal/2000/173/7/domestic-violence-australia-definition-prevalence-and-nature-presentation>> [Accessed 18 June 2021].
- Irjet.net. 2021. [online] Available at: <<https://www.irjet.net/archives/V7/i12/IRJET-V7I12102.pdf>> [Accessed 18 June 2021].
- Medium. 2021. *Building a Simple Chatbot from Scratch in Python (using NLTK)*. [online] Available at: <<https://medium.com/analytic-vidhya/building-a-simple-chatbot-in-python-using-nltk-7c8c8215ac6e>> [Accessed 18 June 2021].
- Medium. 2021. *How to Build a Chatbot—A Lesson in NLP*. [online] Available at: <<https://towardsdatascience.com/how-to-build-a-chatbot-a-lesson-in-nlp-d0df588afa4b>> [Accessed 18 June 2021].
- ultimate.ai. 2021. *How NLP Text-Based Chatbots Work*. [online] Available at: <<https://www.ultimate.ai/blog/ai-automation/how-nlp-text-based-chatbots-work>> [Accessed 18 June 2021].
- ultimate.ai. 2021. *How NLP Text-Based Chatbots Work*. [online] Available at: <<https://www.ultimate.ai/blog/ai-automation/how-nlp-text-based-chatbots-work>> [Accessed 18 June 2021].
- Vic.gov.au. 2021. *Family Violence Multi-Agency Risk Assessment and Management Framework | Victorian Government*. [online] Available at: <<https://www.vic.gov.au/family-violence-multi-agency-risk-assessment-and-management>> [Accessed 18 June 2021].
- <https://ai.googleblog.com/2018/11/open-sourcing-bert-state-of-art-pre.html>
- <https://beta.openai.com/>
- <https://lambdalabs.com/service/gpu-cloud>
- <https://lambdalabs.com/blog/demystifying-gpt-3/#3>

