6COSC023W – Project Specifications Design and Prototype

Person's Behaviour Analysis with text messages via NLP - BAWT

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1. Aim and Objectives

1.1 Problem Statement

Texting for communication has grown significantly in recent years, particularly with the widespread use of WhatsApp. WhatsApp is the most popular chat application with over 2 billion active users (Ruby, 2022). It is widely used by both businesses and young people.

People check the tone of conversations for a variety of reasons, such as parents wanting to monitor their children's chats or people with conditions like Alexithymia / Autism, which affects their ability to recognise and express emotions (Cherney, 2021).

Because people are not under the pressure of face-to-face social interactions, text messages tend to reveal more honesty in communication. As a result, it is critical to have a system in place to help people with Alexithymia or Autism better understand their communication patterns (Lister-Landman, Domoff, and Dubow, 2017).

1.2 Project Aim

Individuals with Alexithymia or Autism Spectrum Disorder struggle to understand and express their emotions, as well as recognise and respond to the emotions of others. Having a system that can analyse a person's behaviour would be extremely beneficial to these individuals in their daily lives. Furthermore, it may provide law enforcement with a more in-depth understanding of an individual's behavioural patterns, which is becoming increasingly important in today's world where crimes are committed via text messages.

1.3 Project Objectives

The aim of this paper is twofold:

First, using Sentiment Analysis, conduct a thorough analysis of a person's behaviour. According to recent studies, people frequently use emojis/gifs to express their emotions, but this method can sometimes lead to misunderstandings. Sentiment Analysis can accurately determine a person's level of positivity, allowing people with Alexithymia or Autism Spectrum Disorder to better understand others without causing distress. It can also help law enforcement manage inappropriate behaviour via text messages. Second, an NLP based system to prevent the user from sending inappropriate messages is proposed. Many people in today's world make mistakes when communicating with others via text. By automatically checking the tone of the message before it is sent, the proposed system aims to avoid such errors.

2. Requirements

2.1 Stakeholders

Individuals with Alexithymia and Autism Spectrum Disorder, as well as law enforcement personnel, will be the primary administrators, users, and beneficiaries of the project.

Individuals suffering from Alexithymia and Autism Spectrum Disorder will benefit from the research project because it will help them understand the emotions behind a text message, enhancing their ability to communicate and form relationships.

The application will be used by law enforcement personnel to judge a person's behaviour, potentially improving the accuracy of their assessments and decision-making processes.

Academic institutions, research organisations and law enforcement agencies may be among the organisations involved in the research's development and implementation. The research project will have an impact on these organisations as well, as it may improve their ability to support individuals with Alexithymia and Autism Spectrum Disorder, as well as make more informed decisions based on behaviour analysis.

Individuals with Alexithymia and Autism Spectrum Disorder, as well as law enforcement personnel and organisations involved in the application's development and implementation are among the project's stakeholders. The application will have an impact on these stakeholders because it will improve their ability to understand and communicate emotions, resulting in better relationships and overall quality of life for people with the mentioned disorders.

2.2 Gathering requirements

In this case, a library called SoAn was used to gather requirements (Social Analysis). Data from WhatsApp messages was extracted using SoAn, which included word frequency, word clouds, TF-IDF, and Sentiment Analysis.

SoAn was used to collect data from the researcher's and a few colleagues' WhatsApp messages who volunteered to share their chats with specific individuals. The messages were then analysed and aggregated to create a thorough examination of the chats.

The data analysis results were summarised using various word frequency and word cloud visualisations, as well as sentiment analysis results. The findings revealed insights into the types of words and emotions commonly expressed in WhatsApp chats, which can be useful in understanding individuals' communication patterns and preferences.

Because the data collected and analysed was limited to the researcher's own chats and a few voluntarily shared chats, the results may not be representative of all WhatsApp users or conversations. To confirm the findings and ensure generalizability, more research with a larger and more diverse sample size is required of which will be collected in due time to the final representation of the project.

2.3 List of project requirements

	Functional Requirements
Essential	- Compatibility with OS - Python and Libraries like Tensorflow, Pandas, Numpy, etc. are supported - VSCode - Google Colab/Jupyter - Ability to create figures, architectures, documentations - Google Docs/Canva/Draw.io - Data Backup - Google Drive/Github - Ability to develop ML/DL/NLP models - Research Writing Skills
Desirable	- Support for Linux and Windows - High Performance Hardware - intel i7/M1 or above

	● Massive RAM and Disk Space to manage datasets and development environments
Luxury	● Advanced Data Visualization tools ● UI friendly interface

Table 1: Functional Requirements

	Non-Functional Requirements
Essential	● Performance: the application should be able to efficiently process large datasets and perform intensive resource tasks. ● Security: the research project should safeguard user privacy and confidential data. ● Reliability: the research project should be stable and should not crash when used normally. ● Scalability refers to the research project's ability to handle increasing amounts of data and users.
Desirable	● User Experience: the research project should be simple and easy to use. ● Flexibility: the research project should be adaptable and integrate with other tools. ● Maintenance: the research project should be simple to update and maintain.
Luxury	● Personalization: based on the user's preferences, the research project should make tailored recommendations.

Table 2: Non-Functional Requirements

2.4 Analysis and modelling of requirement

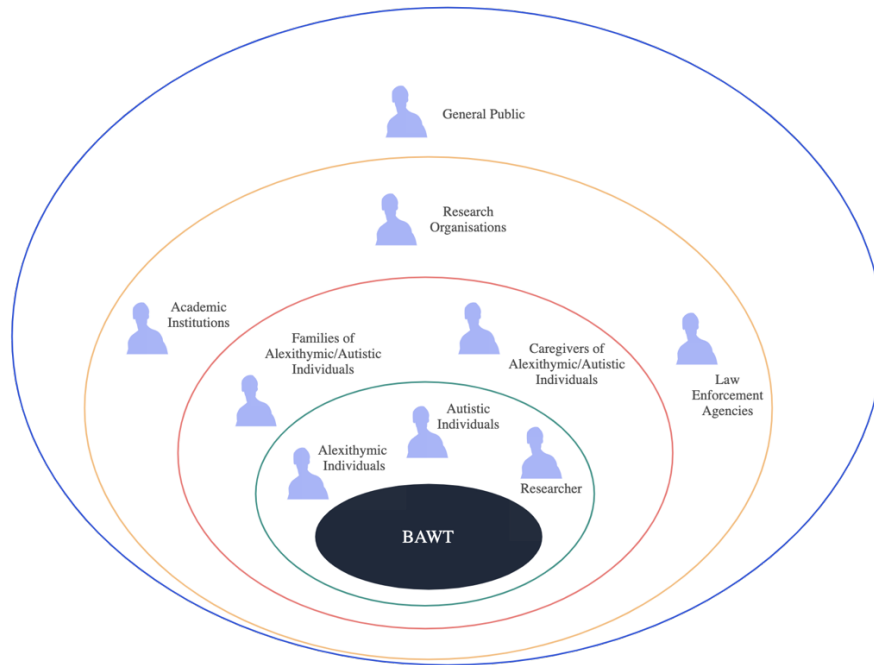### 2.4.1 Stakeholder Analysis Diagram

Figure 1: Stakeholder Analysis Onion Model Diagram

As illustrated in the Stakeholder Analysis Model, the project stakeholders include individuals with Alexithymia and Autism Spectrum Disorder, as well as law enforcement personnel and organizations involved in the development and implementation of the application.
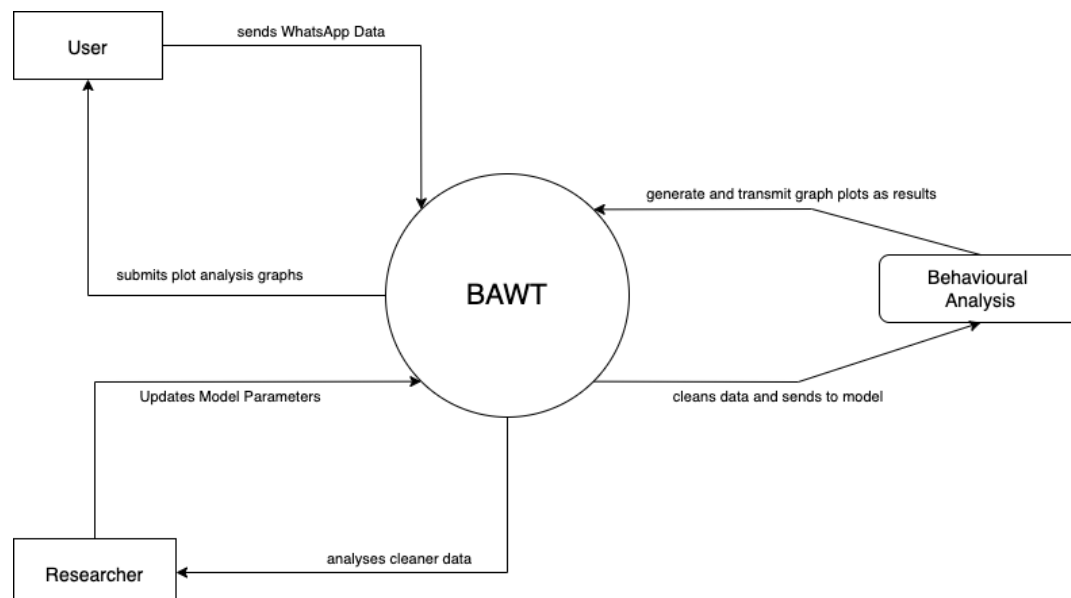
2.4.2 Context Diagram

Figure 2: Context Diagram

The diagram illustrated above outlines the boundaries of the system and its interactions. By defining these elements prior to the development phase, the researcher will gain an understanding of the intended flow of information.
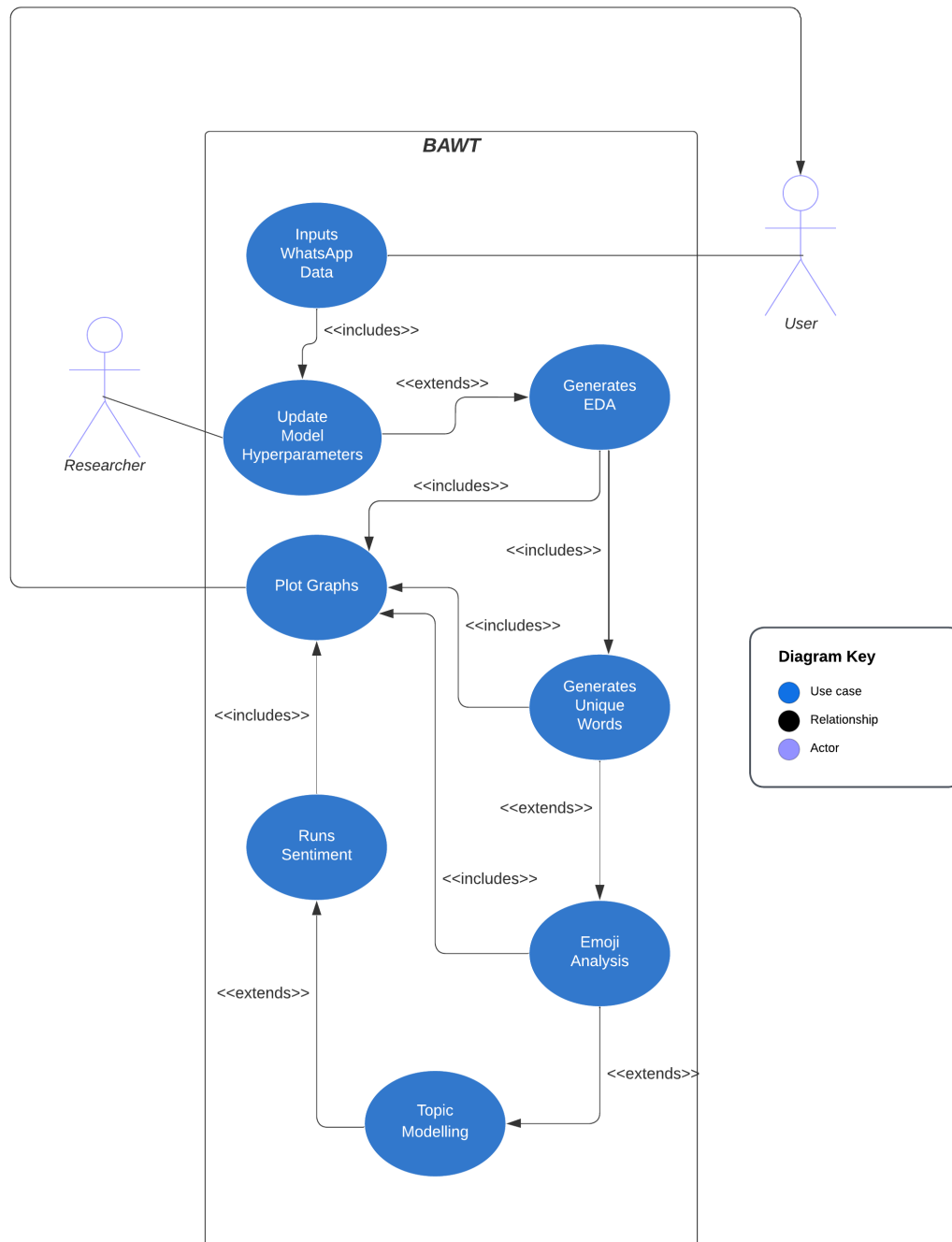
2.4.3 Use Case Diagram

Figure 3: Use Case Diagram

As depicted in the diagram above, the user provides the system with WhatsApp Chat data in the form of .txt files. The Researcher then updates the model hyperparameters to align the variables before running the model.

The data then undergoes a cleaning process and moves on to the Explanatory Data Analysis (EDA) section. This section provides basic analysis charts to provide an overview of the data.

The data then moves on to the Unique Words section, which utilizes the TF-IDF Algorithm to determine the most common and unique words used by the two users and provides charts to illustrate these findings.

The data then proceeds to the Emoji Analyzer, which also utilizes the TF-IDF Algorithm to identify the most commonly used emojis and provides charts to display these results.

Next, using Natural Language Processing (NLP) techniques such as Latent Dirichlet Allocation (LDA) and Non-Negative Matrix Factorization (NMF), the system performs Topic Modelling to uncover the most frequently discussed topics between the two users.

Finally, Sentiment Analysis is used to calculate the polarity score of the two users and determine the positivity level (either positive, neutral or negative) in the given period of the given chat.

3. Prototype

Criteria
Prototyping was solely carried out to explore the feasibility of creating the primary research component.
Discussion of Findings
The researcher encountered some difficulties while prototyping the research model. Text exports from iOS devices were discovered to be less compatible with the algorithm, which was designed to support text formats from Android devices primarily. Another challenge was language support, as the Sentiment Analysis Algorithm currently only works with popular languages such as English, Dutch, German, French, etc. but despite the fact that people use different languages they articulate them in English which makes it difficult for the algorithm to identify words. Furthermore, the emoji library used was out of date, making it difficult for the model to recognize newly created emojis.

Table 3: Prototype Findings

Here is the video demonstrating the prototype the researcher has made:

https://youtu.be/m7RXepHpOe4

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Appendix

2.2 Gathering Requirements

Figure 4: Consent Emails

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3. Prototyping

Here is the video once again:

https://youtu.be/m7RXepHpOe4

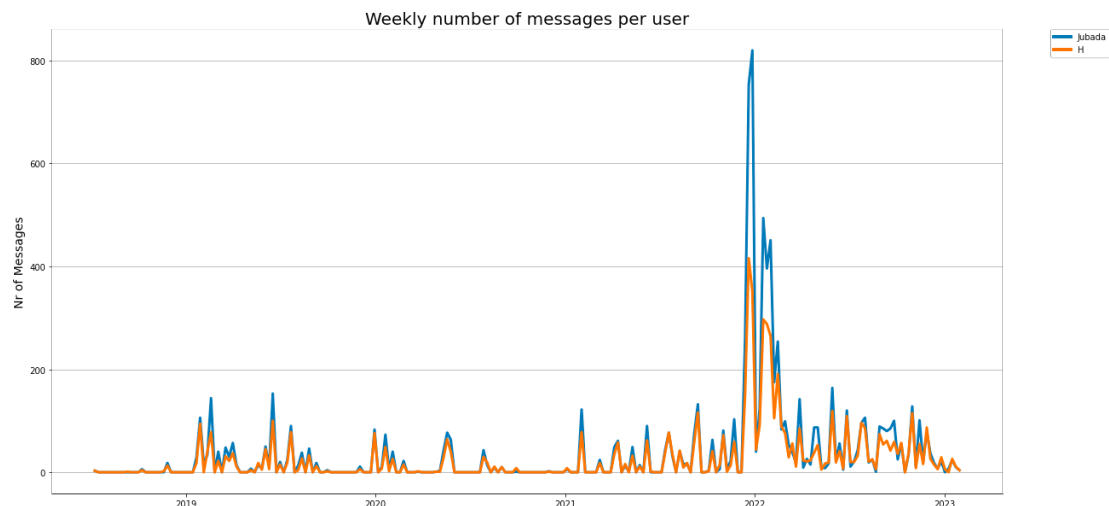The example portrayed below was between 2 of the researcher's colleagues:

Figure 5: weekly no. of messages

As you can see above with the sample chat used between 2 colleagues of the researcher, it was spiking during the beginning of 2022, which states that something must have been undergone. And as a result, the researcher questioned the user (refer to the image below) in regards to the spike and she mentioned that the other colleague was going through some relationship issues along with her mother getting affected with Covid.

Figure 6: chat as to why spike occurred

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Some other findings of the chat were as follows:
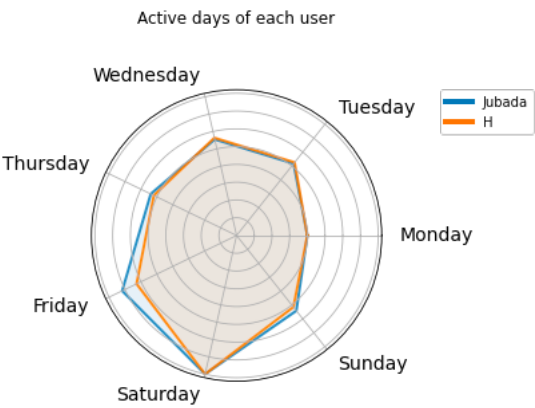
Figure 7: active days of users
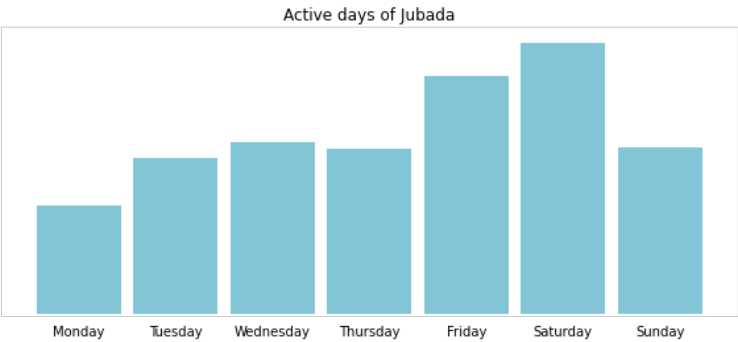
Figure 8: active days of user 1

Figure 9: active days of user 2
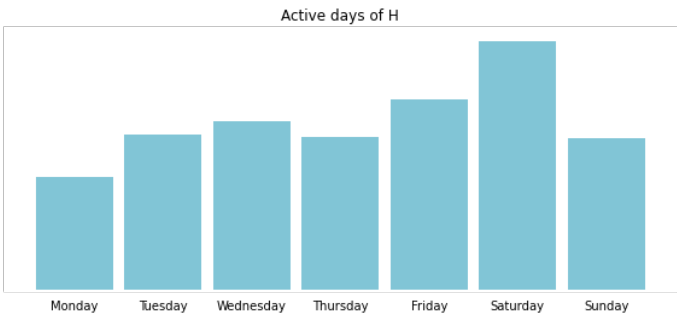

Figure 10: active hours

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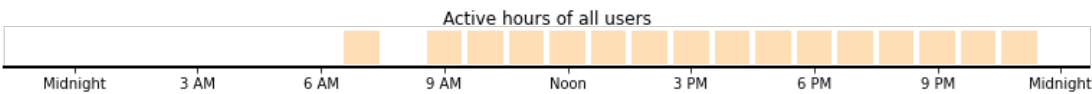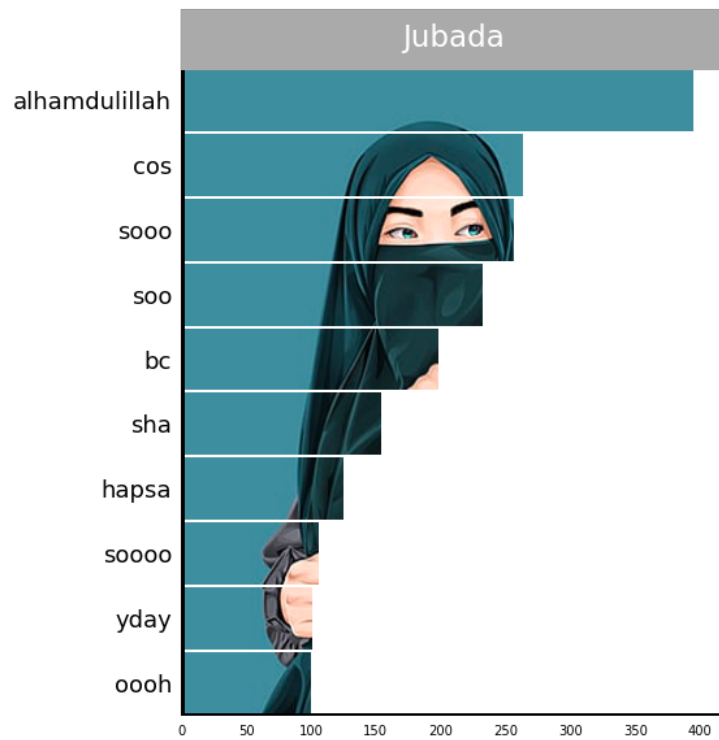
Figure 11: most common words used by user 1
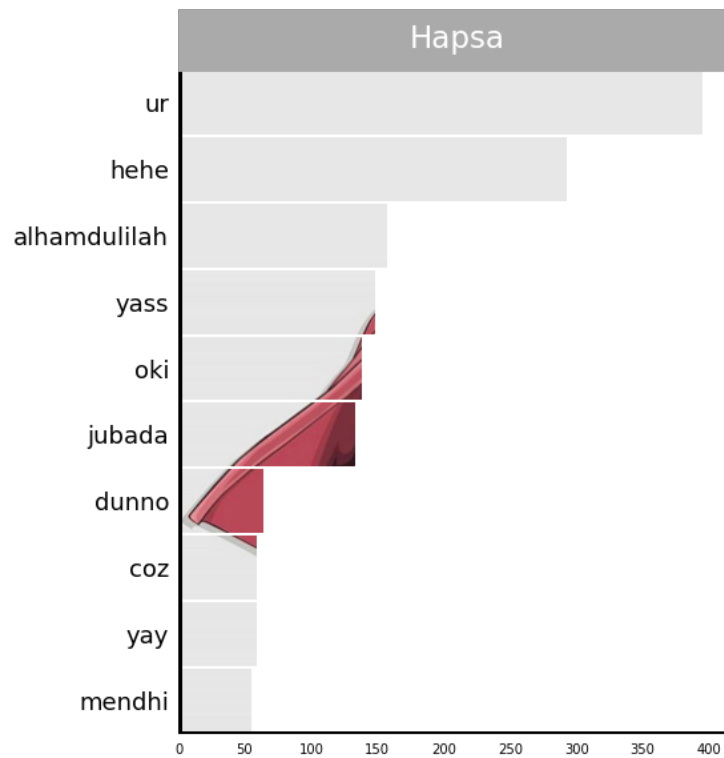
Figure 12: most common words used by user 2

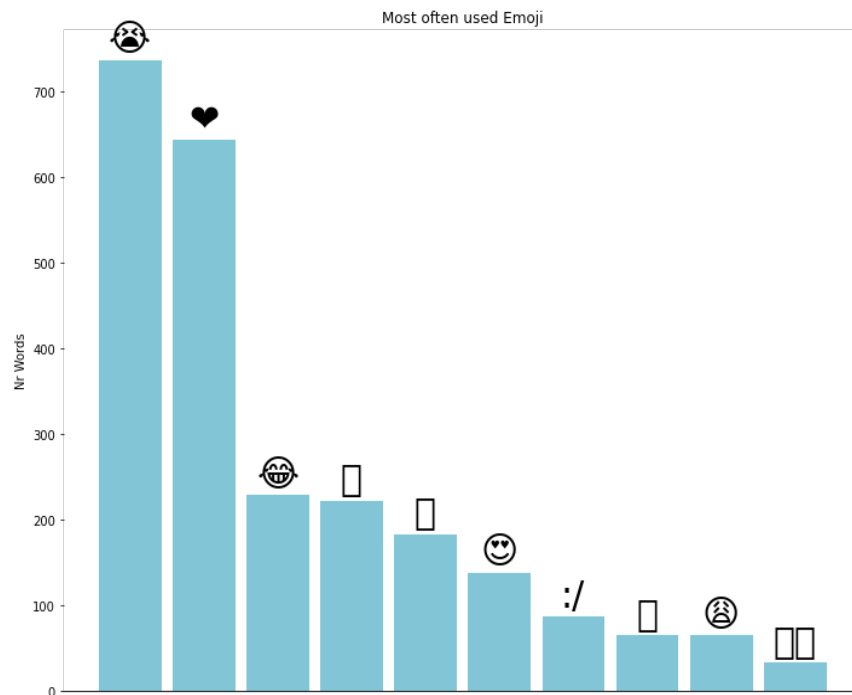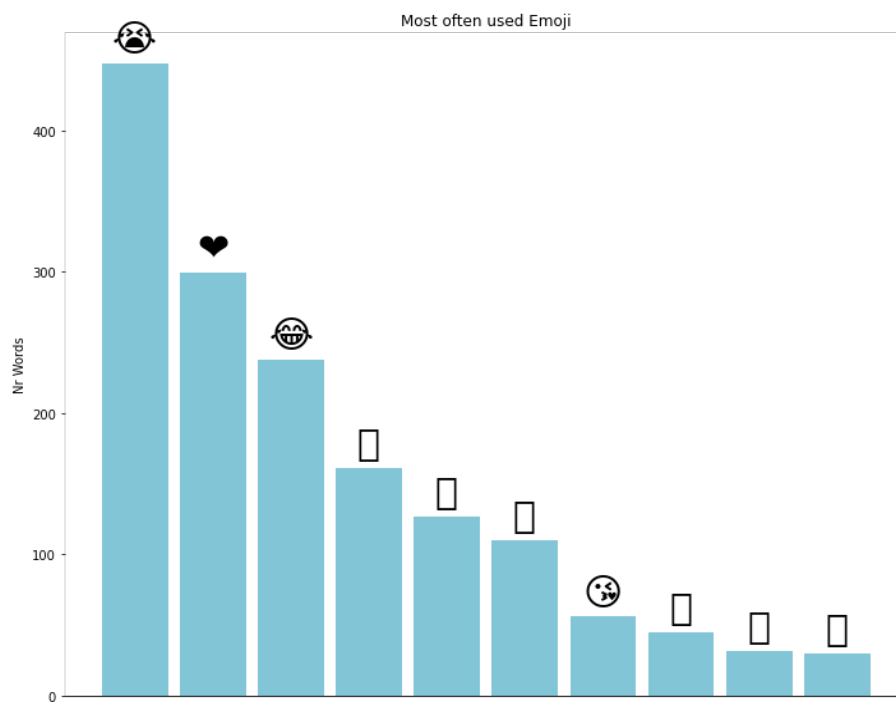6COSC023W – Final Project PSDP – BSc CS & BEng SE

Figure 13: most used emoji by user 1

Figure 14: most used emoji by user 2

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