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Seminar Report

Sentiment Analysis Of Student Feedback

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Abstract

In recent years text analysis, which is also known as natural language processing(NLP) or computational linguistics is increasingly becoming one of the most important fields of computing in both research and the industry. Recent advancement in the field of natural language processing has shown us that not only it is an important field to explore, but also demonstrated to us that this field has a lot of potential to have further advances that can be beneficial for us in this field and in other fields that can benefit from those advances; This resulted into that this field has gained, and is still gaining a lot of recognition and understanding that it is relevant not only in research but also in usage and utilization. Natural language processing can be utilized in a wide range of ways. Many techniques and methodologies allow us to use natural language processing to understand large amounts of texts better, digest them, conclude better insights, and patterns, and extract important information from them. With the vast increment of digital information being text or other formats, we can no longer digest and analyze all those vast amounts of data just manually as humans; On the other hand, we need to have some computational methodologies that can support us in those scientific exploits of data; In order to do so, we should aim to better understand text analysis as a part of natural language processing, how to utilize it, when to utilize it, and be able to compare its usage and the need of its use in contrast to manual methods. Therefore, we will introduce text analysis in this report, the ideas behind it, and attempt to try to understand it better and its usage with a practical project that can demonstrate its use.

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List of Abbreviations

NLTK Natural Language Toolkit

DL Deep Learning

BERT Bidirectional Encoder Representations from Transformers

MLP Multi-Layer Perceptrons

1 Introduction

In this report, we will be introducing some usage of natural language processing, especially sentiment analysis, We will go over the idea of natural language processing and its use in sentiment analysis, the latest advancements in the field, and then we will demonstrate a small portion of its use over texts collected from students feedback from a teaching seminar over the course of 7 chapters. In order to understand what we are looking at, and what we are looking for, we would like to start by introducing the topic of sentiment analysis itself and go over some of the most important scientific papers that deal with it. In 2004 sentiment analysis was defined as "Sentiment analysis seeks to identify the viewpoint (s) underlying a text span; an example application is classifying a movie review as thumbs up or thumbs down"[PL04]by Pang et al; they further complimented their work by proposing a novel machine-learning method to deal with sentiment analysis back then.

Since then, a lot of advancements have been made in the field of sentiment analysis specifically, and natural language processing generally; But one major leap in the field was the introduction of BERT(Bidirectional Encoder Representations from Transformers.), This paper was groundbreaking in NLP and its model BERT was very good in NLP tasks including sentiment analysis through using a pre-training approach[Dev+19]; Fig. 1 demonstrates how BERT leveraged pre-training and fine-tuning.

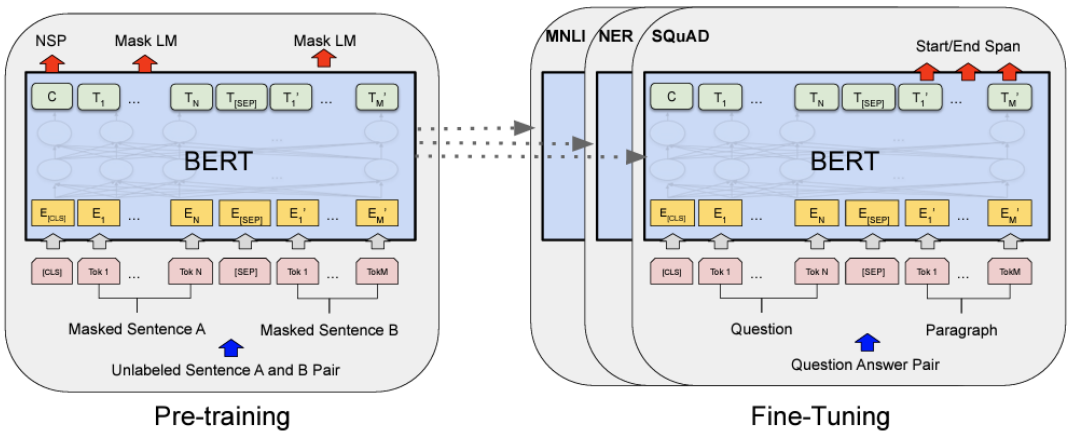

Figure 1: Pre-training and fine-tuning in BERT[Dev+19]

BERT[Dev+19] main additions to NLP that made it truly groundbreaking were the addition of five main points:

- **Bidirectional Context:** BERT used MLP (Multi-Layer Perceptrons), but in contrast to previous works, BERT introduced a bidirectional approach that understands words in context from both right and left, which made it perform very well in NLP tasks, including sentiment analysis.
- **Pre-training:** BERT is already pre-training on a massive textual dataset, making it better in understanding the relationships between words, which results in much better performance.

- **Transformer Architecture:** BERT is transformer-based, which uses self-attention mechanisms to capture dependencies between words in a sentence, This allows it to be highly effective in capturing the context in the information of the NLP tasks.
- **Fine-Tuning:** BERT is able to be fine-tuned into different NLP tasks in order to perform better specifically to the task at hand, including sentiment analysis.
- **Contextual Embeddings:** BERT's has the ability to generate contextual word embeddings, not only fixed embeddings like before makes it very suitable for sentiment analysis.

In summary, we can clearly see that BERT demonstrated very important additions to NLP advancements, that are also able to be utilized in sentiment analysis; On the other hand, sentiment analysis and NLP as a whole always have new advancements that we can keep aspiring for and to utilize, but the focus of this report is to use NLTK in order to do a simple sentiment analysis over the texts of students feedback, but we saw that it is fitting to introduce the field and some of its advancements before we dive in the implementation of our own usage of sentiment analysis models.

2 Methodology

When it comes to the methodology that we used to approach solving the problem we intended it to be a way of understanding more about sentiment analysis, then attempting to use the chosen sentiment analysis library on the students' feedback texts to gain more practical knowledge about it; in this case, we are using NLTK (Natural Language Toolkit) library to use its text analysis capabilities in order to do the sentiment analysis work. Our methodology is summarized by the following steps:

- **Gaining NLP familiarity:** In order to be able to utilize NLP correctly and especially sentiment analysis, we started by researching both, introducing both, and gaining the knowledge needed for the "know-how" in order to utilize sentiment analysis, alongside researching what is the suitable library or libraries to use.
- **Problem Definition and Scope:** The main goal of the work is to understand sentiment analysis better, gain some practical knowledge on how to utilize it, and then use the students' feedback texts in order to determine whether it is positive, negative, or neutral to extract insights from the textual data.
- **Data collection:** Luckily, the data collection phase was very easy since the course has a feedback module for the students to submit their feedback in an open manner, which provided us with the corresponding textual data; The only major downside is that the course is limited in number, hence the data is small.
- **Implementation and Performance Analysis:** The report demonstrates all the phases of the implementation that we went through; On the other hand, we also provide a performance analysis for the weekly feedback that we received from the students.

- **Challenges, Discussion, and Conclusion:** Lastly, we discuss the challenges that were faced in the project, provide brief recommendations on when to use computational sentiment analysis as opposed to just manually exploring the text, and then provide the conclusion of our work.

3 Setup

There are multiple ways to set NLTK and use it for sentiment analysis, some of which we are using here, but not limited to.

3.1 Using Google Colab

When it comes to small projects that do not have a huge amount of data, using an integrated cloud-based Jupyter Notebook implementation such as Google Colab[Col] would be the easiest and fastest way due to how easy and fast to start with it without any additional setup overheads.

3.2 Using a local Jupyter Notebook setup

On the other hand, the larger the dataset and the project, the more suitable a dedicated local workstation is for the project, This would require a local Jupyter notebook setup, since Google Colab is already based on it, but on our local machine, we need to have it set beforehand.

3.3 Setup Choice

In our scenario, both cloud-based or local Jupyter Notebook setups are viable since we do not have much data, but for code and text organizational purposes we opt for using a dedicated local machine.

4 Implementation

Our implementation consists of three main parts; The first step is the choice of a text analysis library and importing it in order to use it and utilize the sentiment analyzer in that respective library; In this case, we are going to use the library Natural Language Toolkit(NLTK), the second step is to use a lexicon that is used as a tool to test the sentiment in the target text; Lastly, is to use the sentiment analyzer on the text that we need to test the sentiment in.

4.1 NLTK and Vader lexicon

We used the NLTK[NLT] library in our project with the Vader lexicon in order to utilize them for the text analysis; We imported both.

```
import nltk
nltk.download('vader_lexicon')
from nltk.sentiment import SentimentIntensityAnalyzer
```

Listing 1: NLTK

4.2 Analyzer and sample text

```

#The analyzer that we will use, is imported from NLTK as seen earlier.
analyzer = SentimentIntensityAnalyzer()

# This is a sample text to test for the text analyzer
text = "I love this product, it's amazing!"

#In here we save the scores for the corresponding text.
scores = analyzer.polarity_scores(text)
```

Listing 2: Test

```
print(scores)
# Output: {'neg': 0.0, 'neu': 0.286, 'pos': 0.714, 'compound': 0.802}
```

Listing 3: ScoresExample

In NLTK's SentimentIntensityAnalyzer, the polarity_scores() method returns a dictionary with four sentiment scores: neg, neu, pos, and compound.

- neg: represents the negative sentiment score, ranging from 0 to 1, where 0 means no negative sentiment and 1 means very negative sentiment.
- neu: represents the neutral sentiment score, ranging from 0 to 1, where 0 means no neutral sentiment and 1 means completely neutral sentiment.
- pos: represents the positive sentiment score, ranging from 0 to 1, where 0 means no positive sentiment and 1 means very positive sentiment.
- compound: represents an overall sentiment score, ranging from -1 to 1, where -1 means very negative sentiment, 0 means neutral sentiment, and 1 means very positive sentiment.
- The compound score is calculated by normalizing the scores of neg, neu, and pos using the following formula: compound = (pos - neg) / (pos + neu + neg) The compound score is often used as a single metric to represent the overall sentiment of a text.

4.3 Testing Students Feedback

In this section, we will demonstrate our experiment that we used over students feedback for a course material, Of course, in order to protect the students' identity, we replaced their names as st1, st2, and so on, up to st16. But please note the following:

- Those are the texts and the results for week one only.
- There are 7 weeks total in text feedback.

- We will include all 7 weeks' texts, implementation, and results in the code section.

We will start with the first student text and its corresponding sentiment analysis results, then go on from there.

```
st1txt = "In a disciplined society, ethical values, norms and principles are very important because these things create basic unwritten laws of a society. If there are no ethical values in society, it will be like a Jungle where people don't know how should they behave etc. A society becomes more beautiful where norms like respecting elders, loving kids, helping others are followed. If there are no norms, people who have power will be doing many immoral things that would be making a problem for others. People will be interfering each others life and making it difficult to live for everyone. There can be a lot of similar scenarios that can be stated to support the fact that ethical values, norms and principles are very important and should be taken seriously." \
     "This chapter was informative and interesting. Although there was not much difficult stuff but still I got a lot to learn from it."


scores1 = analyzer.polarity_scores(st1txt)

print(scores1)
{'neg': 0.065, 'neu': 0.736, 'pos': 0.2, 'compound': 0.9436}
```

Listing 4: st1

```
st2txt = "In my opinion, ethical values, norms and principles are incredibly important and make us humans. I see them as significant because not only they keep the society balanced and well functioning, but they also give every human being a sense of individuality and teach us the importance of being empathetic. They help us to co-exist together in harmony and intelligent and capable beings, we humans, have the moral responsibility to take care of the life around us, and by us, I don't just mean humans, I also mean, animals, plants, every living thing." \
     "In my opinion, ethical values, norms and principles are incredibly important and make us humans. I see them as significant because not only they keep the society balanced and well functioning, but they also give every human being a sense of individuality and teach us the importance of being empathetic. They help us to co-exist together in harmony and intelligent and capable beings, we humans, have the moral responsibility to take care of the life around us, and by us, I don't just mean humans, I also mean, animals, plants, every living thing."

scores2 =analyzer.polarity_scores(st2txt)

print(scores2)
{'neg': 0.089, 'neu': 0.628, 'pos': 0.283, 'compound': 0.9837}
```

Listing 5: st2

```
st3txt = "It is through ethics & values that an individual is made aware that their choices have consequences, both for themselves and for others. Therefore, ethics and values build credibility, leadership
```

```
   skills, improve decision-making, and provide long-term benefits.
   Basic human needs can be satisfied through ethics and values.<br />
   In research, it is important to adhere to ethical norms for several
   reasons. First, norms promote the aims of research, such as knowledge
   , truth, and avoidance of error. For example, prohibitions against
   fabricating, falsifying, or misrepresenting research data promote the
    truth and minimize error."

scores3 = analyzer.polarity_scores(st3txt)

print(scores3)
{'neg': 0.071, 'neu': 0.677, 'pos': 0.252, 'compound': 0.9552}
```

Listing 6: st3

```
st4txt = "A set of principles that guide the development and application
    of AI is known as artificial intelligence ethics. Humans have a
   cognitive bias in nature and we can find it in our behaviors. Since
   data is a basement of AI the bias inside of the data causes biased AI
    models and results. Considering the evolution speed of AI it is
   relatively easy to predict how biased algorithms can contribute to
   human bias in a negative way. Ethics and guidelines are essential
   tools to keep control of such systems. Many of those aspects can be
   mentioned to have ethical AI.<br /> 1. Respect for individuals. This
   principle covers protecting human privacy, and security. The
   collected and used data, and information should not be used to cause
   privacy and security issues for individuals. <br /> 2. Beneficence.
   The purpose should only be beneficial to society. AI should not be
   used to create new types of weapons or damage the environment. <br />
    3. Justice. It is very important to have unbiased, fair decisions
   regardless of gender, race, nationality, or other similar factors
   which mostly come from biased training data."

scores4 = analyzer.polarity_scores(st4txt)

print(scores4)
{'neg': 0.099, 'neu': 0.745, 'pos': 0.156, 'compound': 0.9371}
```

Listing 7: st4

```
st5txt = "I think that ethical values, norms and principles are
   incredibly important and indispensable in our society. Only through
   them can society exist. It is not important that everyone follows the
    same ethical values, norms and principles. I think it is important
   that a similar direction is taken. Only through discourse can
   existing ethical values, norms and principles develop further and
   thus also society."  \
         "I found the tasks understandable and feasible. I had no
   difficulty in completing the tasks."

scores5 = analyzer.polarity_scores(st5txt)

print(scores5)
{'neg': 0.051, 'neu': 0.682, 'pos': 0.267, 'compound': 0.9564}
```

Listing 8: st5

```
st6txt ="I am afraid the question is not clear. Do I view them as
   significant? Towards what end is the importance of these topics is
   supposed to be evaluated? In the following I will assume that the end
    is of shaping the future direction of AI research.<br /> <br /> <br
   /> Depending on what route we take to achieve AI, incorporating
   ethics in AI would have different levels of importance and different
   manners of incorporation. In the classical, black-box approach, we
   are trying to build AI without necessarily developing a conceptual
   understanding of intelligence. This route leads to the risk of
   accidentally creating a machine that behaves in unpredictably
   undesirable ways, therefore the need to discuss the ethical
   implications becomes necessary sooner. The issue with discussing
   ethics this soon, is that there is no formal way to talk about ethics
    and therefore there is no clear way to incorporate these concerns
   justifiably.<br /> <br /> The second route is to take a more
   axiomatic route to AGI. This approach, while in the short run doesn't
    talk to you like chat-GPT does, but provides a conceptual
   understanding of intelligence. The formal route then allows for
   humans to develop a framework where ethical concerns can be properly
   incorporated when need be. <br /> <br /> I personally prefer the
   latter approach and therefore dislike the current trend of talking
   about informal concepts such as ethics and pretending that we
   actually mean something when we say those words." \
        "Usefulness: Not much in its current content.<br /> <br />
   Clarity: Apart from the last question, it was quite clear.<br /> <br
   /> Difficulty: None."

scores6 = analyzer.polarity_scores(st6txt)

print(scores6)
{'neg': 0.064, 'neu': 0.843, 'pos': 0.093, 'compound': 0.8582}
```

Listing 9: st6

```
st7txt = "From which I understood, when we discussed the ethical issues,
    we cannot only focus on the specific values or norms or principles.
   We have to include all three into consideration so that the result or
    decision will be better. If we only focus on the Intrinsic and
   extrinsic values, we cannot come to the perfect conclusion as there
   is no consideration on the situation or environment which is
   happening there. Similarly, using norms we can only discussion about
   the not to discriminate problems. Also facts are the truth all people
    believes and happens in real life. But we human always think
   accordantly based on situations. So I think for the AI too we should
   make all into consideration when deciding the ethical issues of AI."
   \
         "Usefulness: I learned about the terms clearly. (5)<br /> <br
   /> Clarity: Very clear explanation on terms.(5)<br /> <br />
   Difficulty: Not that difficult. (2)"

scores7 = analyzer.polarity_scores(st7txt)

print(scores7)
{'neg': 0.028, 'neu': 0.785, 'pos': 0.187, 'compound': 0.9744}
```

Listing 10: st7

```
st8txt = "Ethical values, norms, and principles are of great importance when it comes to the development and use of AI. They provide a framework for ensuring that AI systems are developed and used in a way that is consistent with human values and that promotes the common good.<br /> <br /> One of the most important reasons for the significance of these topics is that AI has the potential to have a significant impact on society, including on issues such as privacy, autonomy, and equality. Without a clear set of ethical values, norms, and principles to guide its development and use, AI systems could be developed and used in ways that are detrimental to society and to individuals.<br /> <br /> Furthermore, AI systems are becoming more autonomous and able to make decisions that have significant consequences. Without ethical values, norms, and principles to guide their decision-making, these systems could take actions that are harmful to individuals or to society as a whole.<br /> <br /> In addition, ethical values, norms, and principles also play a role in ensuring that the development and use of AI are inclusive, which is especially important in a world where AI is likely to have a significant impact on the economy and labor market. Ensuring that AI systems are developed and used in a way that is inclusive will help to mitigate the potential negative effects of AI on society and to ensure that the benefits of AI are shared widely.<br /> <br /> In conclusion, ethical values, norms and principles are of vital importance to ensure that AI is developed and used in a way that is consistent with human values and promotes the common good. They provide a framework for guiding the development and use of AI in a responsible manner, and for mitigating the potential negative effects of AI on society. They should be taken into account by all stakeholders involved in the development and use of AI." \
      "I found it useful and clear, it took some time to review the reading. I would have preferred it would have been shorter, since some of this concepts we saw in the first session."

scores8 = analyzer.polarity_scores(st8txt)

print(scores8)
{'neg': 0.029, 'neu': 0.745, 'pos': 0.226, 'compound': 0.9969}
```

Listing 11: st8

```
st9txt = "Even so I support the idea of ethical values, norms and principles, I convinced that the issue is that the AI has to learn that from somewhere...<br /> With other words any Learning Algorithm is based on experience in the form of input data and with this the simplest law of learning applies: if you put shit in shit comes out. <br /> And while Humans have, based on emotions feelings and creativity, the ability to overcome the shit they learn an AI can not really do that. Therefore the idea of training an AI with ethical values is nice but I believe we don't own a single dataset that's free from discrimination..."

scores9 = analyzer.polarity_scores(st9txt)

print(scores9)
{'neg': 0.055, 'neu': 0.771, 'pos': 0.174, 'compound': 0.8944}
```

Listing 12: st9

```
st10txt = "Yes they are significant for developing an ideal AI system. Ethical values can help in putting a weightage on various norms and principles that can help in developing a fairer and transparent AI with reduced biases." \
       "The chapter was good for basic theoretical understanding but definitions seem a bit vague, could be better explained with more concrete examples. The chapter was quite easy to follow."

scores10 = analyzer.polarity_scores(st10txt)

print(scores10)
{'neg': 0.021, 'neu': 0.668, 'pos': 0.311, 'compound': 0.9561}
```

Listing 13: st10

```
st11txt = "Values, norms & principles are very important. If AI did not adhere to any form of guidelines of this kind, it would eventually be disastrous. Even if the rules to construct AI-models are strict and scientific, their use and even their behaviour is not as strict. Both the results put out by the models and the environment are dynamic, ever-changing, almost volatile. Often enough, models built for recognizing/classification are not perfectly aligned with the real world, and depending on usage, this could be a major danger for people. <br /> Here norms, values and ethics come into play. Even though there exists the danger of people, governments or corporations putting values into AI that only benefit themselves, it is also a chance for giving values like equality, progress, respect for life etc. into AI, potentially making it a powerful tool in changingg the world for the better for everyone ." \
       "It was nice and short, even though a little bit hidden, it was not clear that there were excercises after the reading of the chapters"


scores11 = analyzer.polarity_scores(st11txt)

print(scores11)
{'neg': 0.078, 'neu': 0.702, 'pos': 0.221, 'compound': 0.9775}
```

Listing 14: st11

```
st12txt = "Values, Norms, and Principal all are fundamental elements of ethics. Value means giving significant emphasis on a particular thing or an action. Values offer ideals and benchmarks by which to judge things, options, deeds, and events. Moral principles are the main emphasis of ethics, while other principles such as economic, artistic, and epistemic values are also discussed. Values can be divided into two parts extrinsic and intrinsic values. For instance, Money has extrinsic values. The reason is anyone can achieve something in exchange for money. For example, anyone can get better medical treatment for good health or better quality of life at cost of money. On the other hand, Intrinsic values have big moral values such as freedom, happiness, and wellbeing.Norms are the set of Artificial Intelligence guidelines such as value based principles, commands, and imperatives. It implies what one should do or expectations of
```

```
    someone. Norms are classified by prescriptive encouraging and
    proscriptive discouraging behavior. There are a couple of norms for
    example, Statistical Regularities IT guys tend to wear headphones
    during coding, Social Norms, Moral Norms behavioral, and most
    importantly legal norms. Given the below five principles for AI
    ethics that focus on different values. The principle of beneficence
    or nonmaleficence Use AI for good that doesnt make any harm The
    principle of accountability  Who is the responsible person to take
    care of when AI causes harm The principle of Transparency  Need to
    understand what, and why AI does something The principle of fairness
    AI should be non discriminative. The principle of respecting basic
    human rights AI should respect and promote Human Rights."\
2           "The chapter is based on Ethical AI which is fundamental to
    Humans in the Age of Artificial Intelligence. It describes a couple
    of rules which is required to maintain during the development of an
    AI system. The Values, Norms, and Principles play vital roles to
    maintain security, privacy, freedom, and indiscrimination which are
    useful for developing smart systems."
3
4 scores12 = analyzer.polarity_scores(st12txt)
5
6 print(scores12)
7 {'neg': 0.0, 'neu': 0.737, 'pos': 0.263, 'compound': 0.9983}
```

Listing 15: st12

```
1 st13txt = "Ethical values are essential, for example in the case of Self
    -Driving vehicles. <br /> 1. What will happen to driving professions
    after the introduction of self-driving vehicles?<br /> 2. What will
    happen if dark-skinned pedestrians are not that effectively detected
    by the camera or visual perception of car due to less dark-skinned
    data during the training of the model?<br /> 3. what would happen, if
     richer people get priorities to drive through in an autonomous road
    management system?<br /> <br /> these are some of the many ethical
    issues, which are still to be answered." \
2           "This gave a nice overview of <br /> 1. Ethicals issues<br />
    2. Terms used in AI <br /> 3. Approaches in AI <br /> 4. And gave the
     idea about the further course of this paper."
3
4 scores13 = analyzer.polarity_scores(st13txt)
5
6 print(scores13)
7 {'neg': 0.017, 'neu': 0.871, 'pos': 0.113, 'compound': 0.9278}
```

Listing 16: st13

```
1 st14txt = "I would argue that ethical values, norms and principles are
    significant.<br /> We live together in a society, and I would say
    that most people want to live together in peace with each other.
    Probably no two persons have the same distribution of values, but as
    a society, we have some convergent values a lot of people have in
    common. If we had a lot of people with very different distributions
    of value, in the sense of contradicting values, we could not live as
    peacefully as do now. But the norms aligned to those values may be
    very different, that's at least how I would explain a lot of the
    conflict in the World. <br /> In short, Norms are guided by values,
    we can have the same values but have different ways to achieve them.
```

```
    <br /> Principles are one step further than values and norms, they
    are a collection of values and norms of a group of people, intended
    to be a guide. They reflect the norms and values of a large group of
    people and not anymore of a single individuum." \
2           "The essay part could be more clear, in what direction it
    should go. Not sure if we should go into AI ethic already or not (for
     example)."
3
4 scores14 = analyzer.polarity_scores(st14txt)
5
6 print(scores14)
7 {'neg': 0.065, 'neu': 0.746, 'pos': 0.189, 'compound': 0.9825}
```

Listing 17: st14

```
1 st15txt = "Ethical values, norms and principles are fundamental to
    society to prevent chaos. Without these, there would be no guide and
    control over society. This will lead to many malicious activities
    since there is no rule or principle. <br /> Ethical norms ensure a
    standard way of behaviour which is acceptable. This is important
    because humans have been known to be very irrational and without
    these norms, there would be absolute chaos.<br /> Our values help us
    in our decision-making process. This is very important since a lot of
     times these decisions may not just affect the maker but also other
    individuals in society.<br /> Principles help us draw lines we try
    not to cross. This will make us accountable to ourselves in upholding
     our values." \
2           "This chapter helps to appreciate the difficulty in setting
    priorities for the different norms of society especially having to
    select just five of them. This is also interesting to think about,
    especially in the field of AI where virtually every part of our lives
     will be affected and how would this be controlled"
3
4 scores15 = analyzer.polarity_scores(st15txt)
5
6 print(scores15)
7 {'neg': 0.062, 'neu': 0.78, 'pos': 0.157, 'compound': 0.9413}
```

Listing 18: st15

```
1 st16txt = "I think ethical values, norms and principles are extremely
    important for living together as humanity. Nobody should be
    discriminated by others based on their style of living or simply
    based on attributes like gender, color of their skin, etc. I am
    convinced, if we would care more about others and less about
    ourselves, we would live in a much more peaceful and fair world." \
2           "Overall easy and fast to read, ILIAS just shows me an error
    message which worries me a bit"
3
4 scores16 = analyzer.polarity_scores(st16txt)
5
6 print(scores16)
7 {'neg': 0.057, 'neu': 0.681, 'pos': 0.263, 'compound': 0.9581}
```

Listing 19: st16

5 Performance analysis

In this section, we will demonstrate the sentiment average for all the students for all of the seven weeks or chapters. Each week, we made a list of dictionaries that had the score of each student and used the compound result as the key, This dictionary list is called values_list and we used all those values to get the average for all the students' scores in each week or chapter.

5.1 Weekly Scores

Starting with chapter one average:

```
# create a list of dictionaries to add
scores_list = [scores1, scores2, scores3, scores4, scores5, scores6, scores7, scores8,
               scores9, scores10, scores11, scores12, scores13, scores14, scores15, scores16]

# specify the key i need, in this case, compound
key = 'compound'

# create a list to store the values of each key that i will extract from each dict
values_list = []

# loop over the list of dictionaries and extract the values for the specific key
for d in scores_list:
    if key in d:
        values_list.append(d[key])

# calculate the average of the values:
average = np.mean(values_list)

print(average)
0.95343125
```

Listing 20: All students sentiment score Chapter 1

The average score for week one sentiment analysis is 0.95 (1 being the most positive, 0 neutral, and -1 being negative), meaning that the sentiment analysis for the students' feedback in the first week or chapter of the course material was overwhelmingly positive.

```

# create a list of dictionaries to add
scores_list = [scores1, scores2, scores3, scores4, scores5, scores6, scores7, scores8,
               scores9, scores10, scores11, scores12, scores13, scores14, scores15, scores16]

# specify the key i need, in this case, compound
key = 'compound'

# create a list to store the values of each key that i will extract from each dict
values_list = []

```

```
# loop over the list of dictionaries and extract the values for the specific key
for d in scores_list:
    if key in d:
        values_list.append(d[key])

# calculate the average of the values:
average = np.mean(values_list)

print(average)
0.29841249999999997
```

Listing 21: All students sentiment score Chapter 2

Chapter 2 score is 0.29841249999999997 (Slightly positive)

```

# create a list of dictionaries to add
scores_list = [scores1, scores2, scores3, scores4, scores5, scores6, scores7, scores8,
               scores9, scores10, scores11, scores12, scores13, scores14, scores15, scores16]

# specify the key i need, in this case, compound
key = 'compound'

# create a list to store the values of each key that i will extract from each dict
values_list = []

# loop over the list of dictionaries and extract the values for the specific key
for d in scores_list:
    if key in d:
        values_list.append(d[key])

# calculate the average of the values:
average = np.mean(values_list)

print(average)
0.37424999999999997
```

Listing 22: All students sentiment score Chapter 3

Chapter 3 score is 0.37424999999999997 (Positive)

```

# create a list of dictionaries to add
scores_list = [scores1, scores2, scores3, scores4, scores5, scores6, scores7, scores8,
               scores9, scores10, scores11, scores12, scores13, scores14, scores15, scores16]

# specify the key i need, in this case, compound
key = 'compound'

# create a list to store the values of each key that i will extract from each dict
values_list = []

```

```
# loop over the list of dictionaries and extract the values for the specific key
for d in scores_list:
    if key in d:
        values_list.append(d[key])

# calculate the average of the values:
average = np.mean(values_list)

print(average)
0.48164375
```

Listing 23: All students sentiment score Chapter 4

Chapter 4 score is 0.48164375 (Positive)

```

# create a list of dictionaries to add
scores_list = [scores1, scores2, scores3, scores4, scores5, scores6, scores7, scores8,
               scores9, scores10, scores11, scores12, scores13, scores14, scores15, scores16]

# specify the key i need, in this case, compound
key = 'compound'

# create a list to store the values of each key that i will extract from each dict
values_list = []

# loop over the list of dictionaries and extract the values for the specific key
for d in scores_list:
    if key in d:
        values_list.append(d[key])

# calculate the average of the values:
average = np.mean(values_list)

print(average)
0.28245624999999996
```

Listing 24: All students sentiment score Chapter 5

Chapter 5 score is 0.28245624999999996 (Slightly positive)

```

# create a list of dictionaries to add
scores_list = [scores1, scores2, scores3, scores4, scores5, scores6, scores7, scores8,
               scores9, scores10, scores11, scores12, scores13, scores14, scores15, scores16]

# specify the key i need, in this case, compound
key = 'compound'

# create a list to store the values of each key that i will extract from each dict
values_list = []

```

```
# loop over the list of dictionaries and extract the values for the specific key
for d in scores_list:
    if key in d:
        values_list.append(d[key])

# calculate the average of the values:
average = np.mean(values_list)

print(average)
0.40803125
```

Listing 25: All students sentiment score Chapter 6

Chapter 6 score is 0.40803125 (Positive)

```

# create a list of dictionaries to add
scores_list = [scores1, scores2, scores3, scores4, scores5, scores6, scores7, scores8,
               scores9, scores10, scores11, scores12, scores13, scores14, scores15, scores16]

# specify the key i need, in this case, compound
key = 'compound'

# create a list to store the values of each key that i will extract from each dict
values_list = []

# loop over the list of dictionaries and extract the values for the specific key
for d in scores_list:
    if key in d:
        values_list.append(d[key])

# calculate the average of the values:
average = np.mean(values_list)

print(average)
0.38788125
```

Listing 26: All students sentiment score Chapter 7

Chapter 7 score is 0.38788125 (Positive)

5.2 All Weeks Average Scores

In this sub section, we would like to calculate the average scores for all the weeks or chapters.

```

# Import numpy for the calculations.
import numpy as np

# We save all 7 chapters vars and their values.
week1score = 0.95343125
week2score = 0.29841249999999997
week3score = 0.37424999999999997
week4score = 0.48164375
```

```
week5score = 0.28245624999999996
week6score = 0.40803125
week7score = 0.38788125

# We make a list so we can use np average
week_scores_list = [week1score, week2score, week3score, week4score,
    week5score,week6score, week7score]

#We calculate the average using numpy
average = np.mean(week_scores_list)
print("The average of the scores for the 7 weeks or chapters is:",
    average)

The average of the scores for the 7 weeks or chapters is:
    0.4551580357142857
```

Listing 27: All students sentiment score Chapter 7

We can see that the average score for all the chapters for all the students is 0.455, which is positive. To summarize the change over time in each week for its corresponding, we used Matplotlib Pyplot to illustrate that with a figure, Fig. 2 demonstrates the scores over the 7 chapters, the graph demonstrates that all 7 chapters were positive, starting with extremely positive in the first chapter, then a drop in chapter 2 to slightly positive, then again gaining momentum in chapter 3 and remaining positive in sentiment scores. Fig. 2 also clearly demonstrates that trend.

```
#Importing pyplot for plotting.
import matplotlib.pyplot as plt

# Sample list of scores over time
scores = [week1score, week2score, week3score, week4score, week5score,
    week6score, week7score]

# Create a line plot to visualize the changes in scores
plt.figure(figsize=(10, 6))
plt.plot(scores, marker='o', linestyle='-', color='b')
plt.title('Change in Scores Each Week')
plt.xlabel('Chapters')
plt.ylabel('Sentiment Scores')
plt.grid(True)

# Display the plot
plt.tight_layout()
plt.show()
```

Listing 28: Fig. 2 code

```
#Importing pyplot for plotting.
import matplotlib.pyplot as plt

# Sample list of scores over time
scores = [week1score, week2score, week3score, week4score, week5score,
    week6score, week7score]

# Corresponding time periods
time_periods = ['Week1', 'Week2', 'Week3', 'Week4', 'Week5', 'Week6', '
    Week7']

# Create a bar plot to visualize the changes in scores
```

```
plt.figure(figsize=(12, 8))
bars = plt.bar(time_periods, scores, color='skyblue')
plt.title('Change in Scores Over Time')
plt.xlabel('Time Period')
plt.ylabel('Score')

# Add scores inside the upper side of the bars with 2 decimal places
for bar, score in zip(bars, scores):
    plt.text(bar.get_x() + bar.get_width() / 2 - 0.15, bar.get_height()
    - 0.02, f'{score:.3f}', fontsize=12, ha='center')

# Rotate x-axis labels for better readability (optional)
plt.xticks(rotation=45)

# Display the plot
plt.tight_layout()
plt.show()
```

Listing 29: Fig. 3 code

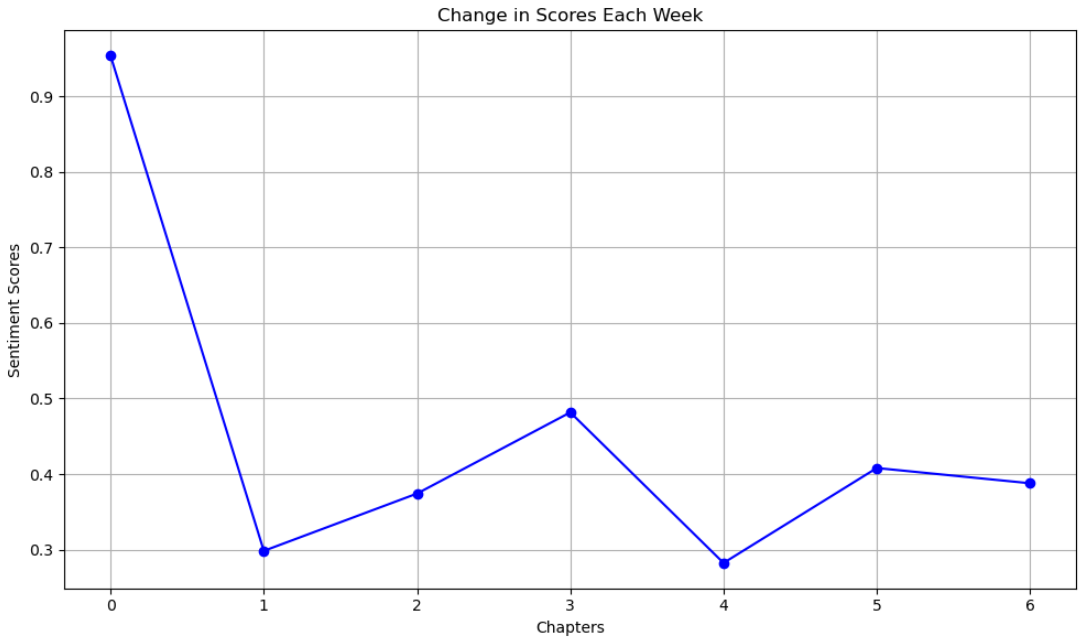

Figure 2: Lineplot for Weekly chapters sentiment scores of students feedback

Fig. 3 Demonstrates the same data for the weekly scores but in a bar blot in order to show the exact scores for each corresponding chapter or week, instead of the trend in the score.

Figures parameters:

- Scores from 0 to 1, 0 being neutral, 1 being most positive, no scores were negative, so nothing under 0.
- The X-axis demonstrates the score values.
- The Y-axis demonstrates the weeks or chapters.

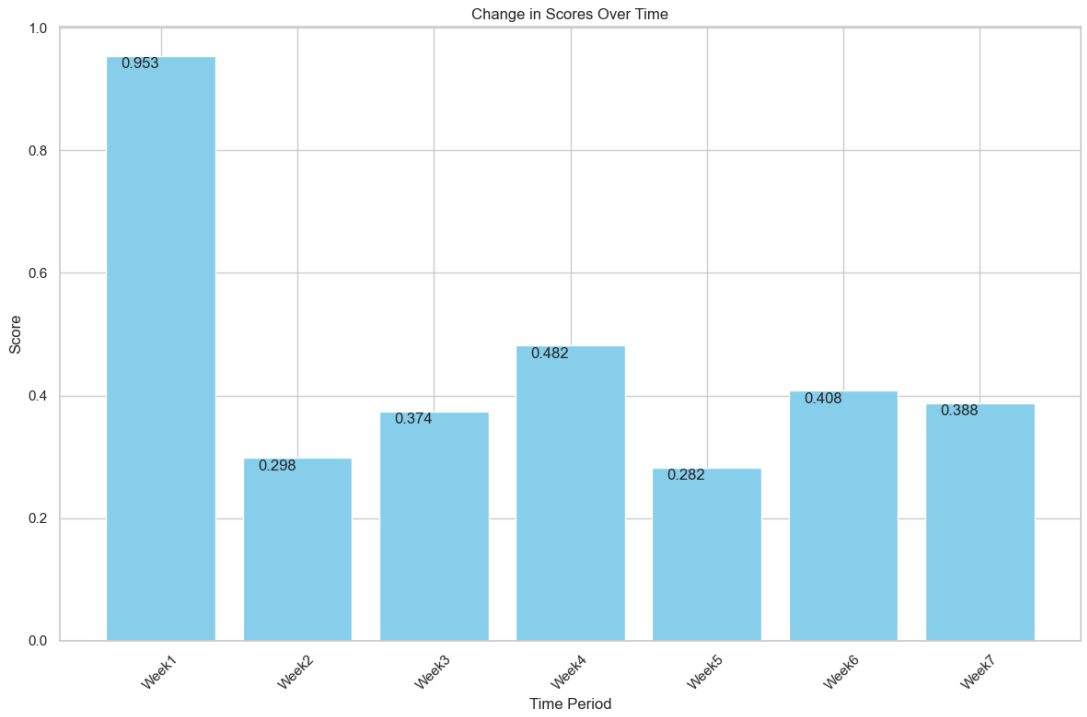

Figure 3: Barplot for Weekly chapters sentiment scores of students feedback

6 Challenges

A couple of challenges were faced in our project, mainly in the initiation of the practical phase where choosing a good Python library as a candidate to use for sentiment text analysis wasn't an easy task.

6.1 Choosing a library for use

There are many text analysis libraries to choose from, which makes it more challenging to choose the suitable one, but in our case, it's a simple scenario that would make any of the major text analysis libraries suitable for it; some of the most known text analysis libraries are:

- **NLTK (Natural Language Toolkit):** NLTK is a popular library for NLP and text analysis in Python. It offers various tools and resources for text processing, tokenization, stemming, and more. NLTK is known for its educational resources and comprehensive NLP capabilities.
- **spaCy:** spaCy is another widely used NLP library for Python. It's known for its speed and efficiency in performing various NLP tasks, including tokenization, part-of-speech tagging, entity recognition, and dependency parsing.
- **TextBlob:** TextBlob is a simple NLP library that provides an easy-to-use interface for common text analysis tasks such as sentiment analysis, part-of-speech tagging, and noun phrase extraction. It's built on top of NLTK and Pattern.

We chose NLTK library not only because it may be the most commonly used, but also because it is easy to use and does the required job.

6.2 Evaluating the lexicon and validity of the results

In order to use the text analysis library to do some sentiment analysis work, we need to use a lexicon that can identify the words used in order to give us a sentiment score, it can be challenging sometimes to choose a good lexicon that matches the library we want to use, in this case, we choose the Vader-lexicon to use in our work. On the other hand, if an underperforming lexicon were chosen, results may be incorrect, or they even may not make sense, such as being chaotic and not having an actual pattern that reflects the expected output.

7 Discussion

In this section, we would like to discuss the use of text analysis tools in order to evaluate if it is valid, when to use it, and when not to use it on the other hand. In general, we believe that the smaller the dataset that we have, the less likely is that we need to use a text analysis tool and just manually read the feedback; On the other hand, the larger the dataset is the more likely is that it is better to use a tool to do sentiment analysis over the larger texts. But we have to note that in this case, we insisted on using NLTK for sentiment analysis in order to gain a better understanding, test it, and have a better overview to use it later on with more textual data when we have additional student feedback from other sessions and additional courses.

8 Conclusion

In our course of studying natural language processing, and especially sentiment text analysis, we found that the use of sentiment analysis can be very useful in some cases, but on the other hand, can be underwhelming in others. In summary, our methodology constituted a well-structured approach, aiming not only to delve into the concept of sentiment analysis but also to put it into practical use for the examination of students' feedback. Leveraging the NLTK library allowed us to harness advanced text analysis techniques, ultimately yielding valuable insights that we can further elaborate on in order to have recommendations on how to improve the course material for educational improvements and to address any issues that we detect through the analysis.

References

[Col] Colab. *https://colab.research.google.com/*.

[Dev+19] Jacob Devlin et al. "BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding". In: 2019. arXiv: 1810.04805 [cs.CL].

[NLT] NLTK. *https://www.nltk.org/*.

[PL04] Bo Pang and Lillian Lee. "A Sentimental Education: Sentiment Analysis Using Subjectivity Summarization Based on Minimum Cuts". In: 2004. arXiv: cs/0409058 [cs.CL].

A Code & other material

For all the code for all weeks, calculating averages, graphs, and more, please refer to:
https://github.com/amawi/Sentiment.Analysis

For trying sentiment analysis tool that you can upload any text file to and get the sentiment analysis scores results, please refer to:
https://github.com/amawi/Sentiment.Analysis/blob/main/NLTK_With_File_Upload.ipynb