Investigating the accuracy of extract personality traits using linguistic analysis

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Declaration

I hereby declare that this dissertation entitled ‘Investigating the accuracy of extract personality traits using linguistic analysis’ is entirely my own work, and it has never been submitted nor is it currently being submitted for any other degree.

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Abstract

Recently, personality variations have inspired a surge of theoretical accounts on the theories of personality and the accuracy of the cognitive tool, personality insights. This research explores the investigation of accuracy the personality traits being extracted including the evolution of personality and the cognitive technology along with impact it has in everyday lives.

As the cognitive technology is increasing over the years, the tools of the technology are becoming more powerful than ever. The personality insight tool is being used by many individuals, organisation and companies. It is being used in my aspect of life from hiring the suitable candidate for the role to understanding a patients’ personality through healthcare. Personality insights tries to provide insights into someone’s personality. This is done by looking at something written through blog posts, tweets or any data that consists of the person’s hobbies, the kind of person they are and what they do in their everyday life. As the use of this tool is rapidly increasing, its is putting a more impact on how people make decisions. Accuracy has been put on the line to rely on this tool to decide whether an applicant is successful at a job applied for or if a patient is more of a stressful person.

Many theories have been introduced on how personality can be interpreted but a comparison, analysis and conclusion on the accuracy on extracting personality traits is yet to be discovered through using different sources to extract the same data inputted. This study investigates and critically evaluates with linguistic analysis on how accurate the method of extracting personality traits can actually be. The study also included the development of a custom application that helped aid to extract personality traits to linguistically analyse the accuracy. The application is used as a source to compare with another source to carefully evaluate the significant difference or similarity of both results received.
Acknowledgment

I would like to take this opportunity to thank all the people who have helped me throughout this dissertation. Firstly, to Mohammed Mostafa, thank you for supervising me throughout this project especially when I was struggling at some points and giving me the guidance with a strategic plan on what to do. Also like to thank all the other lecturers for their guidance throughout the year. Lastly, I would like to thank my family and friends for encouraging me at all times.
Aims & Objectives

Aims

To investigate the accuracy of extract personality insights using linguistic analysis along with developing a personality insight system to extract data in a calculation of the big 5 for accuracy analysis. Using hypothesis testing methods to find the significant difference or similarity of two sources of extracting personality traits.

Objectives

1. Create relevant literature review of the research topic
2. Develop low and high fidelity designs of the application
3. Conduct primary research through surveys and interviews.
4. Hypothesis testing through the t-test method and linguistically analyse and conclude the accuracy of extract personality traits through the t-test results.

1.0 Literature Review

1.1 Theories of Personality

(Anon 2017, p.1) states that personality refers to individuals’ characteristics patterns of thought, emotion, and behaviour, together with the psychological mechanisms. Some fundamental characteristics of personality include consistency, psychological, multiple expression, and impact behaviours and actions. Consistency is defined as a fundamental characteristic as it is acted by an individual in same or similar ways in a variety of situations (Anon 2017, p.2). According to (Pompian, 2012), personality is constructed psychologically but research argues that biological processes also influence it. The fundamentals include having impact on behaviour and actions in which personality although is influenced by the way we move and respond but it also enables
us to act in certain ways. The multiple expression explained by (Makrani, p.20) describes personality to be displayed in more than just behaviour. Thoughts, feelings close relationships, and other social interactions are all influent by personality overall.

(Psychology.jrank.org, 2017) further explains how there are 5 theories the develop personality. These theories include, *type personality, psychoanalytic personality, behaviourist personality, social cognitive personality, and humanistic personality.*

### 1.2 Type Theory

(Garima Roy, 2014) publishes an article defining the type theory and the founder behind it. The article explains how the type theory of personality was founded by “Carl Jung” in his ideas on what attitude means. In Carl Jung’s perspective, attitude is a person’s predisposition to act in a certain manner. Carl Jung refers the two contrasting attitudes - extroversion and introversion as the yin-yang symbol.

(Mae Sincero, 2016) states that introversion in a person is more conscious of his inner world and his environment. It is someone who focuses more on their own fantasies, ambitions, feelings, and actions. The “shy” personality typically refers to the introvert type of attitude.

However, (Helgoe, 2010) states that for people who have a more extroversion attitude, they are more known as people who give more attention of what’s happening outside their inner world. This means their inner cognitive processes are often set aside as they get influenced by their environment.
The four functions of personality also play a big role in Carl Jungs important concepts. These four functions are: *Feeling, Thinking, Sensation and Intuition* (*Frager & Fadiman, 2005*).

1.2 Humanistic Theory

(McLeod, 2007) describes The humanistic theory as individuals having free will and that an individual can actively develop themselves to their highest potential and reach self-actualisation. Carl Rogers is a psychologist who came up with this humanism personality theory. Rogers called his theory the self theory. Rogers believed that an individual had three selves. The first was the ideal self, this is the person that a person is trying to be as humanist believe that an individual is always trying to become the best person, the ideal self is who we are trying to be. Self-image is who an individual thinks they are and an individuals true self is who they actually are. It is possible to have ideas about yourself that are pretty much entirely wrong, this occasionally happens all the time as a person thinks they are this way, that way when an outside observer would say that actually no they’re not.

“AllPsych” article explain that humanist hold their beliefs through showing that the present is the most important aspect of a person and they do not try to predict the future nor looking at the best, instead they look and the here and now. Humasit believe that the theory of humanistic is reality based and to be psychologically healthy people must take responsibility for themselves, whether the person’s actions are positive or negative.

1.3 Social Cognitive Theory

Social cognitive theory provides a framework for understanding, predicating, and changing of human behaviour (Ormond, 2012). Social cognitive theory is learning by observation and modelling and is a way to acquire social skills and many non-social behaviours. Originally social learning theory – learning by observation and imitation until Albert Bandura recognised that cognitive learning separates humans from other species of animals that learn through imitation.

**General Principles**
1. People can learn by observing others’ behaviours

2. Learning can occur with observation alone (no immediate change in behaviour)

3. Cognition plays an important role in learning (knowing results, consequences, etc. from learned behaviour)

4. People have control over their actions

**Modelling**

The meat of social cognitive theory – modelling teaches new behaviours, positive or negative. Models can be people (peers, parents, actors, sports figures) or characters (books, movies, videogames). Effective models are competent, have prestige or power, are relevant, and behave in gender appropriate ways.

Social Cognitive theory dates to the 1970s when a paradigm shift took place from a focus on behaviour to a focus on cognition. Conner and Norman state that Bandura’s first book in 1959 was on adolescent aggression which was followed in 1973 by Aggression: A Social Learning Analysis, still based on behavioural analysis and examining role models. (2007, p.127)

1.4 Introduction to IBM Watson

IBM Watson is a cognitive technology which are products of the field of AI (Artificial Intelligence). IBM Watson perform a task that only humans are used to able to do. They are technology that can think like a human. IBM Watson enables us to analyse and interpret all our data which includes unstructured text, images, audio, and video. With this cognitive technology, we are provided with personalised recommendation by understanding a user’s personality, tone, and emotion. (IBM Watson, 2017)

(Sánchez, 2016) states that Watson is broken down into a set of cognitive capabilities which is split into 4 key areas, vision, speech, data, and language. An example is Watson’s personality insights tool. This tool helps companies understand the individual. Everyone likes be interacted differently. Personality insights can understand what each
of us is looking to do, how we expect to be treated in the interaction, communication, and engagement that we prefer.

There are many situations in people not understanding what the difference between traditional and cognitive technology is. There are 3 main things in cognitive technology which differentiate from traditional technology.

1. They interact naturally with humans using vision, language, and speech. Which means they can read and ingest data in ways that a human wouldn’t be able to do in as much complexity as it can. Which then helps us humans understand it.

2. They also got machine and deep learning which means they can learn at high scales and gain all the knowledge about a subject whether that be oil and gas, medical, vehicle dismantling or retail etc. It’s whatever the subject, the technology is learning and taking all the data, and turning it into suggestions, aiming to help people have a higher confidence level when making decisions.

3. Unlike tradition systems where they are put into a data centre and they lose value straights, cognitive systems get smarter which become more valuable, the more data you put in them, the more you interact with them and the more they learn.

1.4 Understanding of language

(IBM Software Group, 2012 p.5) states how effective navigation through the flood of unstructured information requires a new era of computing that we call cognitive systems. It defines how Watson does not really understand the individual words in the language. Rather it understands the features of language that are used by people. From those features, it can determine whether one text passage (which we call a question) infers another text passage (which we call an answer), with a high level of accuracy under changing circumstances.

1.5 Watson response to questions

(IBM Software Group, 2012 p.4) explain how Watson goes through the following process to derive its responses to a question. This process is when Watson is
presented with a question, Watson parses the question to extract the major features of the question. It therefore generates a set of hypotheses by looking across the corpus for passages that have some potential for containing a valuable response. Watson continues on and uses various reasoning algorithms that aid to perform a deep comparison of the language of the question and the language of each potential response. Different comparisons can make it difficult at certain situations as there a hundred of reasoning algorithms and each reasoning algorithm produces multiple scores that show the extent to which the potential response is inferred by the question based on the specific area of focus of that algorithm. After these steps, each resulting score is then weighted against a statistical model that captures how well that algorithm did at establishing the inferences between two similar passages for that domain during the “training period” for Watson. That statistical model can then be used to summarize a level of confidence that Watson has about the evidence that the question infers the candidate answer. Watson repeats this process for each of the candidate answers until it can find responses that surface as being stronger candidates than the others.

![Figure 2 - How Watson derives a response to a question](http://www.redbooks.ibm.com/redpapers/pdfs/redp4955.pdf)

**Figure 2 - How Watson derives a response to a question**

1.6 Cognitive systems

Cognitive systems are similar to applying human-like characteristics to conveying ideas. They help solve problems with higher accuracy, more resilience, and on a massive
scale over large bodies of information when combined with inherent strength of digital computing.

Cognitive systems can be divided into 4 key elements (Figure 3)

![Diagram of Cognitive Systems](http://www.redbooks.ibm.com/redpapers/pdfs/redp4955.pdf)

*Figure 3 - Elements of a cognitive system*

The medium shaded boxes indicate the current capabilities of cognitive systems. The lighter shaded boxes indicate the future capabilities of cognitive systems. (figure 3)

(IBM Software Group, 2012) explains more in depth how cognitive systems are similar to humans, gathering, memorising and recalling information, which is the equivalent of human memories. Cognitive systems also have a basic ability to communicate and act. These abilities are organized by certain behavioural constructs such as the following examples: *The ability to create and test hypotheses*, *The ability to tease apart and create inferences about language*, *The ability to extract and evaluate useful information* (such as dates, places, and values)
These skills are foundational, without which neither computers nor humans can determine the correct correlation between questions and answers. (IBM Software Group, 2012 p.7)

1.7 Use of Watson in Health Institutions

Watson is working with many other healthcare institutions and hospitals and there’s an increasing awareness within medicine, that whatever illness you have as an individual, it might be labelled the same, however because we all are individual, it really is not. This is especially relevant within paediatric health care. In years gone by, it was thought that if an adult and a child had the similar strain of cancer, you would just treat the child with smaller dose of the same treatment. This is quickly becoming clear that children are so very different in their makeup to adults and as such their care and treatment should be very different and if possible personalised. To help with this, IBM is working with organisations such as the New York genome centre, to look at how genomics can help in the quest for personalised medicine. Watson is working with them by ingesting cancer patients’ DNA information and searches the vast medical literature to identify the most likely DNA mutations or other issues driving the cancer. It pinpoints relevant drugs that can target those specific DNA issues and prevents the information to doctors with the supporting evidence in a matter of minutes instead of in a matter of weeks or months. (IBM & NYGC, 2017)

IBM Watson are also in partner with the likes of the Boston children’s hospital. The hospital is pioneering precision paediatric medicine. IDM Watson are helping these partners in bringing the first cognitive patient experience to a hospital. This will all start from when a patient/ parent receives a letter through the post saying that they’re got an appointment with a doctor, they’ll be an opportunity for them to download an app and interact with that app and ask questions about the experience they are about to have in the hospital. When they reach that hospital, they will then be able to navigate around the hospital. During the treatment part, they can ask questions but also the doctor can get feedback and understand that patient or the child much better, understanding what they like and what they don’t like.
In the Memo article “5 amazing ways IBM Watson is transforming healthcare”, it states that in the future a patient could interact with IBM Watson’s cognitive technology before they speak to anyone at the hospital according to (Balkizas, 2016) This means people can soon contact the NHS digitally, and be welcomed by a digital concierge. The other 4 ways IBM Watson is transforming healthcare are that doctors will be informed as (Balkizas, 2016) describes how vast amount of information is one of the key challenges in healthcare. “A clinical team cannot know all the information that has been published between 2015-2016, but Watson can”. If a person is looking at a disease that is rare, they need to be subscribing to a number of publications and scouring the internet to find what’s essentially a needle in a haystack. With the cognitive technology improving, Watson is able to search all the information, so doctors don’t have to spend thousands of hours reading and investigating. (Memorial Sloan Kettering Cancer Center, 2017) states that their treatment centre in New York is training IBM Watson to be able to quickly provide evidence based recommendations to time poor clinicians. It takes all those unstructured notes and restructures it in a way that the doctor can check easily, with treatment recommendations of which drug to give, which radiation or dosage,” says (Balkizas, 2016) “It also advise what treatments are not suitable because of the persons demographic, their patient history, and so on. (The Memo, 2016) explain how the cognitive technology enables you to follow a treatment plan and also makes sure it’s the best yet accurate plan for a person at any given time. “Watson can customise plans to ensure patients actually follow the advice,” explains (Balkizas, 2016) “An adult might want formal instructions, but a 13-year-old might not want to be instructed in this way.”

1.8 Five-factor model in a workplace

"The Five-Factor Model of Personality in the Workplace" by Sean P. Neubert clearly showed a large correlation between elements of the five-factor model and job performance. But what is not entirely clear is what types of jobs show increased performance, and more importantly which types show little or no correlation. As stated by the author, most if not all studies on this topic were performed on sales jobs or other jobs highly dependent on interaction with others. With a wider variety of research, an equally wide array of results might occur. Much of the research also seems to look at traits as either on or off, in that certain traits that seem to have negative effects on a
certain aspect of job performance could be positive in lower amounts. (Hurtz & Donovan, 2000)

The author rightly stated that the five-factor model's relation to job performance is most likely due to the social aspects of the workplace rather than an individual's ability. Cognitive ability is the major factor in job performance, and outside of jobs that are based on social interaction, the model's effect is merely a product of background environment in the workplace. The social aspects of most jobs are unnecessary to the actual work one is required to do. Granted this social aspect can almost never be removed--and is a must for many people due to personal needs for interaction--the model will have its affect in a large number of cases.

"The Five-Factor Model of Personality in the Workplace" by Sean P. Neubert clearly showed a large correlation between elements of the five-factor model and job performance. It doesn't clear the fact on what jobs show increased performance and which show little or no correlation. The author, Sean P. Neubert states how studies on this topic were performed on sales jobs or other jobs that involved high interactive with other people. Much of the research also seems to look at traits as either on or off, in that certain traits that seem to have negative effects on a certain aspect of job performance could be positive in lower amounts.

The five-factor model is less impacted on larger companies as large companies comes an impersonal relation between employee and employer. This shows that if the individual employee has met all the required cognitive abilities and the role of the job does not involve teamwork or customer interaction, they will perform just as well as those who have a favourable personality. Compared to a large company, smaller companies often much more personal between and employee and employer. In this case a non-favourable personality could have a very large effect on a person's job performance. Cognitive ability seems to be a concrete factor in all cases, but the effects of personality on job performance seem to vary greatly depending on the importance or prevalence of social situations in the workplace.
1.9 Big 5 Personality Traits

The psychometric success article explains how each of these 5 personality traits describes, relative to other people, the frequency or intensity of a person’s feelings, thought, or behaviours. As everyone possess all 5 of these traits to a greater or lesser degree, two individuals could be described as Extraversion, Agreeableness, Conscientiousness, Neuroticism and ‘agreeable’ (agreeable people value getting along with others). But there could be significant variation in the degree to which they are both agreeable. In other words, all 5 personality traits exist on a continuum rather than as attributes that a person does or does not have. (Dr. John A. Johnson, 2016)

1.10 Costa & McCraes Personality model

One of the most well researched and respected personality models in the field is Costa & McCraes big 5. This model evaluates how strong a person is on 5 different axes.

Trait 1 – Openness to experience

(Crowe-associates.co.uk, 2017) states how this trait describes how open or closed a person thinking is. Highly open people are intellectually curious, an interest in Art and science, open people appreciate emotion, unusual ideas, imaginations, adventures and having new experiences. People with low scored tend to have more traditional interest, as they prefer familiarity over doing something new and they don’t often like change.

Trait 2 – Conscientiousness

Highly conscious people are that are over achievers, who are always on top of it, they’re disciplined, responsible and good at planning ahead. A high score on conscientiousness suggest strong abilities to regulate and control your behaviour. Low
scored of the trait tend to be more impulsive and unorganised. *(Crowe-associates.co.uk, 2017)*

**Trait 3 – Extroversion**

This is how a person gets their energy as people with high extroversion trait scores fell recharged and energised by going out and being around people, they like parties and generally talking to other people. People with low extraversion trait scores feel rejuvenated and energised by spending time alone, they tend to be quieter and more deliberate. They go to a party and they have to recover the next day.

**Trait 4 – Agreeableness**

Highly aggregable people are considerate, friendly, and helpful. These are people who make sacrifices for others and they assume others are good people. People with low agreeableness trait scores are usually suspicious, distant, and uncooperative. These are often people who done care about other people’s well-being and are less likely to help other people out.

**Trait 5 – Neuroticism**

This trait measures emotional stability. Highly neurotic people are more prone to negative emotions like anxiety, anger, depression. They’re easily stressed out, they are reactive and more likely to be frustrated in a day-to-day like. People that have low neuroticism scores are calmer, and collected. These are people who are emotionally stable and balanced.

### 1.11 Big 5 Model – Strength & Weakness

*(Help and Sciences, 2017)* explains that the big 5 test model is set to be accurate in predicting patterns of behaviour over a period of time. Although it states the model cannot accurately predict any single specific behaviour as the model is limited as the human behaviour is based on multiple factors and not just personality alone. *(Help and
Sciences, 2017) does state the U.S Air force psychologist using the model to identify strong correlation between agreeableness, dependability, and emotional stability.

1.12 Personality recognition through Conversations

(Mairesse, F. & Walker, M. a., 2006) The big 5 personality can be defined through conversations from the actions an individual makes. As explained in figure 4 – an individual who shows constant happiness or cheerfulness, including being more talkative and loud are extraverts whilst people who use negative emotion words through a conversation are more likely to be neurotics. (Scherer, 1979; Furnham, 1990; Heylighen and Dewaele, 2002; Gill and Oberlander, 2002; Pennebaker and King, 1999).

1.13 LIWC and its history

Linguistic Inquiry and Word Count (LIWC) was developed in early-to-mid 1990s by Martha E. Francis and James W. Pennebaker (1993) to study possible therapeutic use of language. The 2nd version was released in 2001 as known as the second LIWC (SLIWC), which evolved with an expansion of the dictionary that was part of the LWIC, including processing component as the second part. SLWC also expanded with a more modern software processing capabilities. The version of LWIC got better and better with LWIC2015 being its current version.

To provide an efficient and effective method which studies emotions, cognitive and structural present in individuals’ verbal and written speech samples, LIWC was developed for this purpose. According to (Francis, 1993), it was developed as part of an exploratory study of language and disclosure. Various versions were released up until the LIWC2015. This new version has defined a new evolution to LIWC as it significantly altered the dictionary. This new version was designed to analyse more than one language files efficiently. (Shalin Hai-Jew, 2016) states that the LWIC2015 version was built on LWIC2007 through the expansion of the dictionary. LWIC2015 captures “on average, over 86 percent of the words people use in writing and speech” (Pennebaker, Boyd, Jordan & Blackburn, 2016, p. 10). (Pennebaker, J.W., Francis, M.E. & Booth, R.J., 2001) explains the LIWC2015 being able to run in 3 versions, Macintosh, Windows
PC (64-bit) and Windows PC (32-bit). LIWC2015 enables 3 ways to analyse text, one being to allow the user to multiple text files for analysis, choose entire directories and subdirectories containing text files for analysis and Choose text columns within an Excel file (or another delimited spreadsheet file, such as CSV). (James W. Pennebaker, Roger J. Booth, Ryan L. Boyd, and Martha E. Francis, 2016). When it comes to analysing the text using LIWC2015, the compatibility is quite limited as LIWC only allows to analyse file types of: .docx, .doc, .txt, .rtf, .pdf, .xlsx, .xls, .csv. Dictionaries of the latest version LIWC2015 can now accommodate numbers, punctuations, and even short phrases (Pennebaker, J. & Chung, C., 2007).

1.14 Linguistic Analysis

David Crystal tells us that linguistics is the science of language and linguists are people who try to understand why human language is the way it is. Linguists study the history and acquisition of language and its structure use. (ALL, 2015) states that there are multiple different areas in the structure area of linguistic analysis. Structural linguistics is interested in the form properties of language which includes things like word structure, which we find studied in morphology. There are phonological and phonetic areas of linguistic which leads to the study of sounds and how sound is used to make meaning. Phonetics is the study of how we can differentiate between sounds while phonology is the set of sounds used by a particular language. The human voice can produce many different phonetic distinctions but in any one language, we only have a limited set of phonological ones. Syntax is another area in the field on linguistic analysis as it’s the examination of how meaningful structures are put together out of different words. (Rickford, 2002) explains how there are also multiple areas of the area use in linguistic analysis. Psycholinguistics is how we develop an acquire language, historical linguistic is how languages change and develop over time. Sociolinguistics is looking at how social conventions norms values the rules governing our behaviour.
2.0 Project Methodology

2.1 Research Philosophy

(Studylib, 2016 p1-14) states that research or inquiry is guided by a set of beliefs. This set of beliefs or worldview is known as paradigms. A paradigm is essentially a way of thinking about the world. Guban and Lincoln (1994) defined paradigms as “basic belief systems based on ontological, epistemological and methodological assumptions” (p. 107). They assert that there is no way to prove that one paradigm is superior to the others, which is why they are debated. According to Guban and Loncoln (1994), these ontological, epistemological and methodological assumptions are so interrelated within inquiry paradigms that answering one question limits how the others can be answered. Beliefs or views of the world around us have been debated through history in the field of philosophy, dating back at least as far as early Greece.

Ontology refers to beliefs about the nature of reality (Guba & Lincoln, 1994). In philosophical terms, it refers to the study of our existence and the fundamental nature of reality or being. Beliefs about the nature of reality therefore determine what we know about it. The kind of study on accuracy of the big 5 is what “exists” is what can be presented.

Epistemology is more philosophical in nature than methodology. It examines the relationship between knowledge and the researcher during discovery. It refers to how we come to know what we know. One’s ontological beliefs will dictate how objective the relationship between the researcher and what can we known should be. (Wheeler and Pereira, 2004) states how this philosophy shows what we learn from senses when knowledge becomes difficult to understand. Therefore, personality can only be examined through the big 5 when it is given information that contains data about a person’s personality. (Killam, 2013 p18)

Methodology is the way we go about discovering knowledge in a systematic way. Methodology is known to be more specific and practice based than epistemology. The appropriate methodology is driven by ones ontological and epistemological beliefs since
methods like experiments or interviews have varying degrees of objectivity. Accuracy can only be judged when it is compared to one or more ways of methodology. (Studylib, 2016 p1-14)

2.2 Data Collection Methods

A sufficient amount of data will need to be attained to achieve the aims and objectives set in this research. Primary research will involve using quantitative data gathering methods of questionnaires that will be divided into 2 sections. Participants for the data collections will be given a survey. The survey will help support the research to analyse, evaluate and conclude the result. The survey will be given through email or face-to-face for the participant to complete. The competition of this will be moved forward into allowing the participant to complete the online questionnaire given from an accurate well-known personality insight test online. Sufficient amount of data is required which is why the application developed will be given to the few participants who do not wish to share the data and to the ones who are happy with it, they will be required to give the researcher a few lines about themselves or given authority to take their bio on social media or their personal statements for research purposes. Qualitative data will equally be conducted as part of the research which an interview will be held as part of the data collection from a participant who constantly interviews candidates for job roles judging by their personality for whether they are suitable for the role. Interview questions will be asked relevant to the research which will aid to get results on how personality is tested visually and methods used to understands a person’s personality.

Secondary data methods are also required. Methods that will be included are: published data which most published records can be obtained from libraries and archives. Libraries carry a vast variety of books, journals, and periodicals. The information can be used as a reference in the research. Periodicals and journals provide up to date information and they are also available in libraries. Newspaper are an excellent source of data collection historical research. Some record cannot be obtained from any other source except newspaper as it does not exist in books and journals. Old newspapers record can be obtained from the archives (matterym, 2017). In published data books are easier to use as data are arranged in order in books while newspapers are difficult to
use because in newspapers there is no list of contents or bibliography. Electronic data can be another method which includes data like movies, documentaries and television programs can also be sued for recording data in secondary research. In the social sciences and humanities, it can be a good source of information. The research of investigating the accuracy of the big 5 will use internet as a secondary resource as most of the books are available on the internet in e-book format. Information of gathered while staying at home. The information can be obtained faster than any other source. On the internet e-books, e-journals, e-periodicals and e-magazines are available to help support the research required for the investigation of the accuracy in extract personality traits. The internet is a multiple source of information as all the above-mentioned sources can be obtained from the internet. Most recent and most up to date information can be obtained from the internet as it won’t be available in books and other forms. An advantage on including this is getting information from the internet can be inexpensive as compared to other sources such as articles, books, and journals etc. (Reading Craze, 2014)

2.3 Research Approach

An interpretative research philosophy will be adopted involving an inductive research strategy for gathering qualitative data. This involves interviewing two business owners. The interview will be held in one-on-one questions and answers sessions. These participants will be my co-workers and the employer of the vehicle dismantling company I work for. Interview sample will range from 3-15 people. Using this research method will result in a lot of data being conducted from a small number of people which will be useful for the research project I am excelling in.

The first stage of the interview will be to identify the unit of the analysis. This will be done by breaking up the interview to useful chunks of data. This could be done by working with individual words, groups of words or phrases, or could use sentences and paragraphs.
Stage 2 will be to go through the interview and give a one or two-word summary to each line of data. The summary will accurately describe the meaning of the segment of the text. This is called open coding. It will be helpful to use a word from the sentence the interviewer is coding to help create the open code. After open coding the entire interview, the interviewer will make a list of all the codes, then look for similar codes and redundant codes. The objective for this purpose is to reduce the long listing codes, down to a smaller, more manageable number, which can be a scale from 20-25. This process is called an iterative process, which means the interviewer will go back to the original data and check if the new codes match as known as constant comparison.

(Creswell, 2013) states that quantitative methods involve the process of statistically collecting, analysing, interpreting, and writing the research study. This method includes survey and experimental research. This type of research method is conducted through closed questions with defined answers to choose from which allows you to make your own analysis and conclusion about. Quantitative research aims to explain, predict and control phenomena. This method contains hypothesis which are specific, testable and started prior to particular study. As quantitative research is based on numbers and mathematical calculations, qualitative research is based on written or spoken narratives. (Goertz & Mahoney, 2012) states that qualitative research method primarily focuses on human thoughts and emotions rather than statistics.

According to (Keith F Punch, p119), qualitative research is conducted through a prolonged contact which gives the researcher the role of gaining a overview of the context under study. The methods aim to explain and gain insights including understanding of phenomena while. While Qualitative is considered subjective, holistic and process oriented, quantitative research is objective, focused and outcome oriented. (Mugenda, Olive M.) defines qualitative research which has hypothesis that are tentative, evolving, based on particular study.

Qualitative research has sampling which is purposive and is small. The research method is non-standardized, narrative and on-going. However, quantitative research has sampling which is random and is representative sample. It is standardised and numerical that includes measurements and numbers.
2.4 Project Plan

The following table shows the expected schedule for the completion of the project broken down into stages as described. (*see objective 1-5*).

Note: *The table plan below is only estimated.*

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Duration</th>
<th>Start date</th>
<th>Finish date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Research objective 2</td>
<td>3 days</td>
<td>21/10/2016</td>
<td>23/10/2016</td>
</tr>
<tr>
<td>2</td>
<td>Lit Review</td>
<td>130 days</td>
<td>22/10/2016</td>
<td>01/03/2017</td>
</tr>
<tr>
<td>3</td>
<td>Create low fidelity prototypes of application</td>
<td>5 days</td>
<td>12/11/2016</td>
<td>17/11/2016</td>
</tr>
<tr>
<td>4</td>
<td>Create Hi fidelity prototypes of application</td>
<td>8 days</td>
<td>25/11/2016</td>
<td>04/12/2016</td>
</tr>
<tr>
<td>5</td>
<td>Set up IBM Bluemix account to use the Watson tool</td>
<td>2 days</td>
<td>02/01/2017</td>
<td>04/01/2017</td>
</tr>
<tr>
<td>6</td>
<td>Develop and design the application</td>
<td>80 days</td>
<td>06/01/2017</td>
<td>27/03/2017</td>
</tr>
<tr>
<td>7</td>
<td>Interview with the agreed participant/s</td>
<td>2 days</td>
<td>01/04/2017</td>
<td>03/04/2017</td>
</tr>
<tr>
<td>8</td>
<td>Paper based questionnaire handed out to the 40 participants and results retrieved</td>
<td>8 days</td>
<td>20/03/2017</td>
<td>28/03/2017</td>
</tr>
<tr>
<td>9</td>
<td>User testing</td>
<td>5 days</td>
<td>26/03/2017</td>
<td>31/03/2017</td>
</tr>
</tbody>
</table>
Enter data from participants into the application | 4 days | 01/04/2017 | 05/04/2017
---|---|---|---
Linguistically analyse results through the t-test method | 4 days | 05/04/2017 | 09/04/2017
Enter data from participants into the application | 4 days | 06/04/2017 | 10/04/2017

(Table 1.1 – Project schedule)

IT should be noted that stage 8 will need to acquire sufficient information from the participant to maximise accuracy of the result extracted. Stage 6 is dependent on Stage 3 & 4. The Gantt chart below is a graphical representation of the table above.

2.5 Application Process

To design and develop an application for the primary research that will be undertaken. This involves functionality of enabling the participant to enter a few lines of data about themselves that will extract the participant’s personality of the Big 5 (See objective 3).

The application should be constructed in such a way that the main application can be used by a user who isn’t willing to share any data on themselves and would like to see the results only.

The developments of this application should be broken down into 4 steps. This includes: Low fidelity prototype; High Fidelity prototype; Development of the application; Testing methods

Design of the application is important as if the participant does not agree to share their data and would like to participate privately then design methods will need to be informed by research. Low fidelity prototypes will need to be included to decrease time taken into developing the application as instead of later modifying the application when in development, low fidelity designs will give a fix design layout to go with.
To get an understanding on the functions needed to be included in the application, high fidelity prototypes need to be taken place to get a visual idea on what functions would be included to support the research undertaken.

Evaluation on what programs to use to develop the application will be required including a discussion on what programming language will support best for the application in both usability and visual terms. Design pattern research is also required to develop the system with ease and minimise time taken as possible to use the time for primary research purposes.

To assess the application, it is intended that it undergoes a series of testing methods informed by the research undertaken. The testing methods defined should be used to assess the functionality of the application and the overall usability of the application.

2.6 Use Case Diagram

There are many benefits to create a visual diagram to show how the actual program will be developed and the functions involved. Use case is a methodology used in system analysis to identify, clarify, and organise system requirements.
Use Case Diagram Description

The user is enables to run the program by opening the GUI and viewing the GUI. User then input text which holds a validation point of inputting more than 100 words into the text area. User then executes the paragraph by clicking on the submit button and converting the json. In the process of executing, IBM Watson checks credentials and any validation error the parsing the text to three different sections, raw personality insights, personality percentage box and graphs. The buttons are then enabled, allowing users to click the “show personality insight” button for access to the raw insight and button for the graph. The graphs buttons consist of many buttons that show different graphs for different objects in the json for easy readability. (WhatIs, 2015; Choudhary 2017)
2.7 Case Diagram

(Figure 6 – Application Case Diagram)
Case Diagram Description

Class diagram involved using suitable references to the variables set. Private variables are set for limited access to the variables and public variables were set for global access. Private variables were set with getters and setters to access the class in which the variables were set to use them as part of a function the GUI class. Children class were passed on in an array from each layer to reach to the main root class to access them from the GUI class. Using getters like, getTree(); enabled the GUI class to get access from the class even when they were set as private. (Choudhary, 2017)

2.8 Sequence Diagram

The sequence diagram is used primarily to show the interactions between objects in the sequential order that those interactions occur. A sequence diagram is a good way to visualise and validate various runtime scenarios. These can help to predict how personality insight system will behave and to discover responsibilities a class may need to have in the process of modelling a new system. (Choudhary, 2017)
Sequence Diagram Description

The GUI Class connects to the IBM Personality Insights class by using the username and password, Watson service. The GUI Class then gets the “toString” which is generated from the MainRoot class. The GUI Class gets access to the MainRoot class to access its variables set. The MainRoots assigns variables to the json objects and accesses the Tree class by creating tree variable and retrieving the attributes in the Tree class. The Tree class returns back the string by using the “toString” method and gets the ArrayList from the ChildLayer1 class. The ChildLayer1 class then returns back toString and declares a variable to access the ChildLayer2 class variables by creating an ArrayList. The same process then happens up to ChildLayer3. The CreateChart Class uses a method and constructor to get access of the variables set in the GUI Class. This is then used to set values to each graph created. The CreateChart class sends the parameters to the GUI class and the GUI class returns the method. (Choudhary, 2017)

2.9 User Interface

Development factors, visibility factors and acceptance factors are three important factors that should be considered when designing a user interface (Martin, 2017 p.1). These factors will allow participants to easily navigate through the application. A well-designed screen must reflect the needs and capabilities of its users, be developed within the physical constraints imposed by the hardware on which it is displayed, and effectively utilise the capabilities of its controlling software. Graphics, including icons and images, are an integral part of design. Design guidelines for various type of graphical are presented. Icons are described, including a discussion of what kinds of icons exist, what influences their usability, and how they should be designed so they are meaningful and recognisable. (Galitz, 2002)
The GUI Layout was designed to enable users to easily read the personality insight. There are three design layouts, before executing, after executing and the graph frame.

The input text was changed a few times and finally to the one shown above. The input text contains “opening of moby dick”. This was inserted for testing purposes, to allow the user to test the system before using it. The font was changed from Arial to Raleway. This was refactored for user interface purposes. This makes the program look much bolder and appealing to use. The textarea size was [104, 22]. This allows the user to put as much detail they want about themselves or about other people.

User testing is an important aspect when developing the application. The input text shown in figure 1 contains the “opening of moby dick” which was default set for testing purposes although any user were enabled to alter the text as part of the survey. Due to many prototypes of the application, factoring took place where the font style was changed from Arial to Raleway. “When you compose any text, the selection of font style is a fundamental factor. It reflects the content’s tone and the best readable font becomes a wise choice for body text.” (Smith, 2017). User functionality was also considered when designing and developing the application. As shown in figure 1, they
graph buttons are disabled as this can only be enabled once the input text is extracted which gives out the results for the big 5, values and needs.

2.10 Use of Json

Json which stands for JavaScript object notation is a lightweight data interchange format. Json is used as an easier-to-use alternative to XML. It gives us a human-readable collection of data that we can access in a logical manner. (Lengstorf, 2017)

Json creates an object that can be accessed using variables. By enclosing the variable’s value in curly braces, indicating that the value is an object. Json are also stored in an array. This is slightly more complicated example involves storing two people in one variable. To do this, we enclose multiple objects in square brackets, which signifies an array.

Below is a step-by-step on how the IBM Watson Json is presented and how it is linked:

(Figure 9 –Json code screenshot #1)

Above is the first layer of the json root. Inside the first layer of tree, there is one object that contain an array and two attributes. The Array is then expanded to the following:
This is then expanded to the big 5 and the first layer of needs and values as such:

```
{
  "id": "UNKNOWN",
  "processed_lang": "en",
  "source": "UNKNOWN",
  "tree": {
    "children": [
      {
        "id": "personality",
        "name": "Big 5"
      }
    ]
  }
}
```

(Figure 10 – Json code screenshot #2)

As needs and values only have two layers, personality big 5 is then expanded to other objects and shown above

(Figure 11 – Json code screenshot #3)

2.11 Design patterns

Design patterns can speed up the development process by providing tested, proven development paradigms. Effective software design requires considering issues that may not become visible until later in the implementation. Reusing design patterns helps to prevent subtle issues that can cause major problems and improves code readability for coders and architects familiar with the patterns. *(SourceMaking, 2007)*
The use of multiple classes allows easy modification to specific code and separating the json objects into classes allows easy access to variables needs. The idea a design pattern as an attempt to standardize what are already accepted best practices. In principle, this might appear to be beneficial, but in practice it often results in the unnecessary duplication of code.

2.12 User Testing

<table>
<thead>
<tr>
<th>Step</th>
<th>Test</th>
<th>Expected Outcome</th>
<th>Actual Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Submitting without any input to the text area.</td>
<td>Validation error and message stating that the system cannot be executed with anything inputted to the text area</td>
<td>As Expected Validation and Error message as such:</td>
</tr>
<tr>
<td>2</td>
<td>Executing with less than 100 words.</td>
<td>Validation error and message stating that the system cannot be executed less than 100 words.</td>
<td>As Expected Validation and Error message as such:</td>
</tr>
<tr>
<td>3</td>
<td>Printing Personality insight percentages in an easy readable box.</td>
<td>Print objects in the right location in the GUI</td>
<td>As Expected Prints in right location with displaying the percentage only.</td>
</tr>
</tbody>
</table>
4 Executing without internet access | Validation error and message if user is executing without internet access which disables connectivity to IBM Watson. | *Not as expected.* Crashes the program giving error.

“Exception in thread "AWT-EventQueue-0"
java.lang.RuntimeException: java.net.UnknownHostException: gateway.watsonplatform.net”

5 Enabling buttons after executing. | Enables the buttons after executing the inputted text. Allowing users to click these buttons functions for different purposes. | *As Expected* Disables buttons when starting the program and enabling the buttons once executed after validating.

(Table 1.2 – User Testing)

2.13 T-Test method

The t-test was developed by William Sealy Gosset. He worked at the Guinness brewery over a hundred years ago and he developed this test to determine things like the difference between barley yield. William Sealy Gosset wanted to publish this statistical test to share with other statisticians but the brewer was nervous and they didn’t want him to publish and give away any secrets. After convincing the brewer, he had to publish under the pseudonym student. This is why the t-test is known as the students t-test instead of the Gosset’s t-test. The t-test is a hypothesis testing method that will allow to compare whether the average difference between two quantitative results, personality insight application and the big 5 survey is significant or not. This will
determine how similar they are in results and judged by accuracy due to this. *(University of St Andrews, 2003)*

T-value is a ratio of signal to noise. Signal is going to be numbers that tell the difference between two samples and noise is numbers that kind of get in the way. To find out the signal you will need to find the difference between two mean:  $\bar{X}_1 - \bar{X}_2$

Calculating sample one (X1) and sample two (X2), the absolute value or the difference between the two is going to tell how much signal there is or how much difference there is. The noise will be the variability of the groups themselves and so the factor will look something like:

(Figure 12 – T-test formula)
“S1” is the standard deviation which is how far data is spread from the mean. In the t-test method the standard deviation is squared by itself which gives the variance. Increasing the variance will lower the t-value which is like giving no more noise. The other factor in the t-value formula (figure 5) is the number of samples that is taken as an increase number of samples will increase the signal up to a point. The difference between the means will give more signal, higher t-value and increasing that variability will decrease it.

To calculate the t-value, you will need to figure out the mean, standard deviation, variance and how much data is conducted. Once this value is obtained, they can be plugged into the t-value formula shown in figure. Once the equation is calculated, if the result is higher than 1 then it will mean there’s more signal, there is more noise. (Statistics How To, 2015)

### 2.14 T-Score

T-Score is a form of a standardized test statistics. This method allows to help compare scores as it enables to take an individual score and transform it into a standardized form. T Score is the calculations of ratio between the difference between two groups and the difference within the groups. The t-score result will determine if both groups, the survey results, and application results have a significant difference or similarity. The smaller the t-score, the more similarity there is between both result groups and if the larger t-score tells you that groups are different.
2.15 T-Score Formula

T-Score only fits well with a small sample of 30 and under and also if the popular standard deviation is not known. The t-score formula is:

\[ t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} \]

This is where:

\( \bar{x} \) = sample mean
\( \mu_0 \) = population mean
\( s \) = sample standard deviation
\( n \) = sample size

If the sample contains only one item then the formula becomes:

\[ t = \frac{\bar{x} - \mu_0}{s} \]

The square root in the denominator becomes \( \sqrt{1} \)

2.16 Testing t-value through t-test

t-test is testing our null hypothesis which says there’s no statistically significant difference between the samples. This means if any difference we would find is be simply due to chance. This is followed by identifying a critical value, a number and if the t-value is lower than the critical value then we don’t reject that our null hypothesis but if we get a t-value that’s higher than the critical value, then we reject our null hypothesis as there must be an alternate hypothesis as there could be something going on between these two fields. To find the critical value we use a t-table (*table 2.2*).
2.17 One-tailed vs Two-tailed t-test

One-tailed test determines if two sets of groups of the results mean is greater or less than the other. It helps direct the decision of determining the effect of a change. As the two sets of data groups are from different sources, one from the survey and the other from the application – one-tailed test should be only used if there is not worry about missing an effect in the untested direction whilst a two-tailed test should only be used when one mean being greater, lower, or similar is accepted as part of the findings for the research.

![One-tailed vs Two-tailed t-test](https://blogs.oracle.com/marketingcloud/the-difference-between-one-tailed-two-tailed-testing)

3.0 Findings & Discussion

3.1 Introduction

The data through primary and secondary research has been used for this study with linguistic analyses and evaluation to answer the research topic. Both quantitative and qualitative research has been conducted which will aid to present a breakdown of the findings in this section.

3.2 Analysis & Results 1

“A sufficiently large sample size is necessary to produce results among variables that are significantly different.” (DePaulo, 2000).
30 people participated in the big 5 survey to provide strong analysis with evaluation to the study. The survey was used against the personality application to define the accuracy of personality traits. The data collected from this survey addressed different type of question relevant to the big 5 (see figure). This survey was most suitable to compare with the actual personality traits extracted from the application since both detect data from the big 5.

The T-test method was successfully used to compare both the results from the data entered in the survey and the personality insight application. The two-tailed test was used since it was most suitable to find the significant difference or similarity of both groups, survey and application results. Since the research hypothesis either had two ways to go, whether the traits are accurate or not by using two different styles of getting participants personality insights. Gathering both sets of data and calculating the means was the first thing to the direction of getting the critical two-tail test result. Using the formula stated in figure 12 the results came back with a significant difference in variance at first from both groups of data. “299.629” and “850.047” showed how significantly difference both variances were. This resulted in the “t critical two-tail” value consisting of “1.975” which meant the t-stat would determine whether both groups were significantly different or similar.

Formula used for t-statistics:

\[ \text{Subtracting both mean: } x-bar - \mu \text{ then dividing standard deviation (s) by the square root of n: } \frac{s}{\sqrt{n}}. \text{ then taking the value obtained from subtracting } \mu \text{ from } x-bar \text{ and divide it by the value given from dividing } s \text{ by the square root of } n: \frac{(x-bar - \mu)}{(s/\sqrt{n})}. \]

This resulted with the t-stat consisting the value of “12.276”. This showed that if the “t critical two-tail” value consists of “1.975”, then the t-stat value being below this will determine the both sets of groups as accurate since it similar. In this case, after calculating the t-stat from the formula stated above, the results define how both groups
are significantly different which means the accuracy is very low since both results show a significant gap.

3.4 Analysis & Results 3

To support the hypothesis result, the same process was repeated but this time on a spreadsheet, Excel. (Cameron.econ.ucdavis.edu, 2010) shows a step-by-step guide on how to add the “data analysis toolpack” since excel does not include this function on its default settings. Installing the function gave the access to enter data details for both groups giving the results as shown in figure.

The results figure on the right shows the results of both groups, defined as “variable 1" and “variable 2". The mean and variance results for both groups are identically the same as calculated with the formula. The results for the t-stat states how its significantly different as compared

<table>
<thead>
<tr>
<th></th>
<th>Variable 1</th>
<th>Variable 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>60.85483871</td>
<td>28.56</td>
</tr>
<tr>
<td>Variance</td>
<td>299.6297654</td>
<td>850.047</td>
</tr>
<tr>
<td>Observations</td>
<td>155</td>
<td>155</td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>0.111030146</td>
<td></td>
</tr>
<tr>
<td>Hypothesized Mean Difference</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>df</td>
<td>154</td>
<td></td>
</tr>
<tr>
<td>t Stat</td>
<td>12.48194703</td>
<td></td>
</tr>
<tr>
<td>P(</td>
<td>t</td>
<td>&gt;</td>
</tr>
<tr>
<td>t Critical one-tail</td>
<td>1.654808385</td>
<td></td>
</tr>
<tr>
<td>P(</td>
<td>t</td>
<td>&gt;</td>
</tr>
<tr>
<td>t Critical two-tail</td>
<td>1.975488058</td>
<td></td>
</tr>
</tbody>
</table>

(Table 3.1 – Excel t-test data analysis)

(Figure 15 – Line Graphs results)
to the “t critical two-tail” value. Giving the results, “12.481” The data analysis function in excel also produces the one-trail critical value including the hypothesized mean difference.

Figure 15 shows how both groups have a different result in the line chart. The line chart presents both groups results and in comparison, the application result groups seem to have higher results compared to the survey result. This means that there is no similarity in both groups.

3.4 Scatter results

3.5 Histogram

Histogram is a graphical way to represent data. Specifically, a histogram is basically a bar chart that represents of a frequency distribution. As the width represents the interval and the height represents the corresponding frequency. Interval results were created once using the “data analysis” function to create the following:

(Figure 16 – Scatter Graph results)
The data included in the application results had to be changed from a range to fit well for a histogram. As the number had to be a single value at first, to make it compatible for a bar graph which will enable to create a histogram from it, a range had to be set starting for “0”.

### 3.6 Boxplot results

A boxplot is a quick visual way to see how data is distributed. Its shows where the lowest values lie or the highest values lie and where most of the values lie. The boxplot is used to represent both results from the survey and application to see the difference in both.

Table 3.3 shows a representation of the result in its minimum value, quartile value, medium value, maximum value, mean value and range value. Using the excel formula to calculate the results (=QUARTILE.INC (B3:B157,0) – The results conducted for the boxplot are as shown in table 3.3.

(Table 3.2 – Histogram data results)

(Figure 17 – Histogram results)

<table>
<thead>
<tr>
<th>Application Results</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-0.1</td>
<td>1</td>
</tr>
<tr>
<td>0.1-0.2</td>
<td>2</td>
</tr>
<tr>
<td>0.25-0.4</td>
<td>5</td>
</tr>
<tr>
<td>0.4-0.4</td>
<td>3</td>
</tr>
<tr>
<td>0.65-0.6</td>
<td>15</td>
</tr>
<tr>
<td>0.65-0.7</td>
<td>7</td>
</tr>
<tr>
<td>0.75-1</td>
<td>8</td>
</tr>
<tr>
<td>1.0-1.0</td>
<td>1</td>
</tr>
<tr>
<td>1.05-1.1</td>
<td>9</td>
</tr>
<tr>
<td>1.05-1.1</td>
<td>10</td>
</tr>
<tr>
<td>1.15-1.2</td>
<td>1</td>
</tr>
<tr>
<td>1.15-1.2</td>
<td>13</td>
</tr>
<tr>
<td>1.25-1.5</td>
<td>0</td>
</tr>
<tr>
<td>More</td>
<td>5</td>
</tr>
</tbody>
</table>

(Table 3.3 – Boxplot representation results)
Figure 20 shows the boxplot statistics for both results. As the results are majorly different, representing on the boxplot – it shows there is a significant difference in both groups. The dots denotes the median, the top and bottom of the boxes the 3\textsuperscript{rd} and 1\textsuperscript{st} quartiles respectively, and the whiskers extend the median quartile distance.

3.7 Summary of findings

The results from both the survey and application were significantly different from using the relevant graphs to represent this and the t-test method both by formula and the spreadsheet. The comparison shows that when the same participants fill in fields for both the survey and the application, both extract different results for the personality traits. From the findings and results conducted it clearly shows that the accuracy is very low since there are significant difference in both methods in extracting data which mean if a person/company extracts personality traits from different sources, they are more likely not to get an accurate result in their personality traits.
(The Memo, 2015) states in an article published by themselves how the “IBM Watsons’ personality reader is creepily accurate.” Although this may be true in one point of view, they don’t have enough sources and justifications to support this. It states how the personality insight service can “read your mind” by just measuring personality traits by processing a 100-word piece of tex. The application created had a minimum word count validation of 100 words also which meant participants had to enter 100 words+ information about themselves. Once the information was inputted in the application, it extracted the insight of personality through the big 5. Although this gave out percentages whilst the survey results using the formula extracted decimal results, comparison would only be compatible if both values had the same number format.

3.8 Limitations

As the participants conducted were 30, a much larger scale would have been suitable to determine the accuracy. Since the results extracted had many similar comparison, the majority were significantly different which means the results were fluctuating in comparison. From an insight of the findings this shows that the personality trait extracts may differ depending on what source is used to get the traits. The quantitative research that was supposed to be conducted was interviewing an employer regarding the traits and how the company extracts candidates and employee’s personality traits. This was not progressed further since the findings conducted from the comparisons of both the survey and the application shows that the results may fluctuate depending on what is chosen to extract the traits, the survey, or the application.

3.8 Review of Aims & Objectives

The overall aim of this study was to critically analyse and conclude the accurate of extract personality traits. The aim was achieved through accomplishing the objectives set stated below:

1. Create relevant literature review of the research topic – This was achieved through reviewing the theories of personality and how many theories stated shows how there was different interpretations on extracting personality. This literature review
explained how the IBM Watsons personality tool works and how big 5 is used in everyday lives including workplaces and the health care organisations.

2. **Develop low and high fidelity designs of the application** – This was achieved by creating the designs both on low fidelity and high fidelity with drafts, coming with a final draft that had the relevant and suitable functions to support the research through using the application to extract information inputted by the participants.

3. **Conduct primary research through surveys and interviews.** – As interviews were discounted due to it no longer helping to support the research, the surveys were conducted by random people including the company that was supposedly due for an interview. The survey consisted of different questions related to the big 5, with a formula to calculate the survey inputs to compare with the application.

4. **Hypothesis testing through the t-test method and linguistically analyse and conclude the accuracy of extract personality traits through the t-test results.** – This objective was achieved by using the t-test method to compare both results and conclude whether the traits extracted were significantly different or similar to show if it was accurate or not. Using the formula states in figure 12 and the excel formula of “=TTest”, the results enable to analyse and conclude the accuracy through both the statistical figure and graph results.

### 3.9 Reflection & Future work

As more organization/companies and individuals are using the personality insight service to extract their personality traits, it’s becoming more crucial to understand the accuracy of this service. This means publishing a survey that would extract the big 5 needs to be at same formula as extracted the big 5 from the personality insight tool using a custom application or a default application provided online. Although in a first person point of view some statements of the personality extracted may be true but the question is if it’s the same from other people’s point of view. The IBM Research team states that personality insight technology is cognitive because it’s not just guessing at
the personality of the individual, it uses the personality tool to extract keyword to define the personality through the big 5.

Knowing an employee’s personality in a company is important since an employee represents a company through their role. As there has been an increasingly number of companies using the personality insight tool, the service needs to hold a strong accuracy to extract. When using such a powerful tool to determine a candidates’ personality it is important to understand people can lie on personality tests. Although it has been estimated that only about one out of seven applicants tend to fake their responses during an actual employment section according to (John A. Johnson Ph.D, 2011). To be more cautious of this not happening, employers would be recommended to use the application service rather than a survey since the more information entered, the more the tool can analyse a more accurate result.
4.0 References


5.0 Bibliography


6.0 Appendix A – Ethics Approval

DEVOLVED ETHICS APPROVAL APPLICATION SUMMARY

Student Name: Zergham Choudhary  
Student Number: 200664805

Module Name: Software Engineering Dissertation Project  
Module Number: BCO6010

Programme Name: Software Engineering  
Supervisor Name: Mostafa Mohamed

<table>
<thead>
<tr>
<th>To be completed by student and supervisor before submission to Ethics Approval Panel</th>
<th>Student Signature;</th>
<th>Supervisor Signature;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>N/A</td>
</tr>
<tr>
<td>Application for ethics approval</td>
<td>[ Yes ]</td>
<td>-</td>
</tr>
<tr>
<td>Participant information sheet</td>
<td>[Yes ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Participant consent form</td>
<td>[Yes ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Pilot interview/s</td>
<td>[Yes ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Pilot questionnaire/s</td>
<td>[Yes ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Letter/s to participating organisation/s</td>
<td>[Yes ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Confirmation of interviewee participation</td>
<td>[Yes ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

First Submission [ ]  
Resubmission [ ]
Date: 06/12/2016

For use by the devolved ethics approval panel:

Panel Members Name Signature

Module leader, Chair:

Supervisor: CSM Ethics Committee Representative:

Date: Date of Reassessment:

Outcome:

Project Approved Chair’s Action
Reference number issued: Application not Approved

When undertaking a research or enterprise project, Cardiff Met staff and students are obliged to complete this form in order that the ethics implications of that project may be considered.

If the project requires ethics approval from an external agency (e.g., NHS), you will not need to seek additional ethics approval from Cardiff Met. You should however complete Part One of this form and attach a copy of your ethics letter(s) of approval in order that your School has a record of the project.

The document *Ethics application guidance notes* will help you complete this form. It is available from the Cardiff Met website. The School or Unit in which you are based may also have produced some guidance documents, please consult your supervisor or School Ethics Coordinator.

Once you have completed the form, sign the declaration and forward to the appropriate person(s) in your School or Unit.

**PLEASE NOTE:**
Participant recruitment or data collection MUST NOT commence until ethics approval has been obtained.

**PART ONE**

<table>
<thead>
<tr>
<th>Name of applicant:</th>
<th>Zergham Choudhary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisor (if student project):</td>
<td>Mohamed Mostafa</td>
</tr>
<tr>
<td>School / Unit:</td>
<td>Cardiff Metropolitan University</td>
</tr>
<tr>
<td>Student number (if applicable):</td>
<td>St20064805</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Programme enrolled on (if applicable):</td>
<td>BA Hons Software Engineering</td>
</tr>
<tr>
<td>Project Title:</td>
<td>Investigate the accuracy of extract personality traits using linguistic analysis</td>
</tr>
<tr>
<td>Expected start date of data collection:</td>
<td>12/12/2016</td>
</tr>
<tr>
<td>Approximate duration of data collection:</td>
<td>4-6 weeks</td>
</tr>
<tr>
<td>Funding Body (if applicable):</td>
<td>N/A</td>
</tr>
<tr>
<td>Other researcher(s) working on the project:</td>
<td>N/A</td>
</tr>
<tr>
<td>Will the study involve NHS patients or staff?</td>
<td>No</td>
</tr>
<tr>
<td>Will the study involve human samples and/or human cell lines?</td>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Does your project fall entirely within one of the following categories:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper based, involving only documents in the public domain</td>
</tr>
<tr>
<td>Laboratory based, not involving human participants or human samples</td>
</tr>
</tbody>
</table>

| Practice based not involving human participants (eg curatorial, practice audit) | No |
| Compulsory projects in professional practice (eg Initial Teacher Education) | No |
| A project for which external approval has been obtained (e.g., NHS) | No |

If you have answered YES to any of these questions, expand on your answer in the non-technical summary. No further information regarding your project is required. If you have answered NO to all of these questions, you must complete Part 2 of this form.

In no more than 150 words, give a non-technical summary of the project
Investigating how accurate the cognitive technology is. Using various research methods to linguistically analyse how accurate the IBM Watson personality traits are. As traditional systems are dying out and cognitive systems are becoming more popular, investigating the accuracy of this system will give a better understanding on how well the Watson tool is. Using primary research will give a better analysis on how well the system performs and whether its trustworthy for places such as medication, education, business etc. The project will also involve in creating the personality traits system which will enable users to enter a
DECLARATION:
I confirm that this project conforms with the Cardiff Met Research Governance Framework

I confirm that I will abide by the Cardiff Met requirements regarding confidentiality and anonymity when conducting this project.

STUDENTS: I confirm that I will not disclose any information about this project without the prior approval of my supervisor.

Signature of the applicant: Zergham Choudhary
Date: 21/11/2016

FOR STUDENT PROJECTS ONLY
Name of supervisor: Mohamad Mostafa
momostafa@cardiffmet.ac.uk

Signature of supervisor:

Research Ethics Committee use only
Decision reached: Project approved
Project approved in principle
Decision deferred
Project not approved
Project rejected

Project reference number: Click here to enter text.
Name: Click here to enter text. Date: Click here to enter a date.

Signature:

Details of any conditions upon which approval is dependant:
## PART TWO

### A RESEARCH DESIGN

<table>
<thead>
<tr>
<th>A1 Will you be using an approved protocol in your project?</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2 If yes, please state the name and code of the approved protocol to be used¹</td>
<td>N/A</td>
</tr>
<tr>
<td>A3 Describe the research design to be used in your project</td>
<td>An interpretative research philosophy will be adopted involving an inductive research strategy for gathering qualitative data. This involves interviewing two business owners. The interview will be held in one-on-one questions and answers sessions. These participants will be my co-workers and the employer of the vehicle dismantling company I work for. Interview sample will range from 3-15 people. Using this research method will result in a lot of data being conducted from a small number of people which will be useful for the research project I am excelling in. The first stage of the interview will be to identify the unit of the analysis. This will be done by breaking up the interview to useful chunks of data. This could be done by working with individual words, groups of words or phrases, or could use sentences and paragraphs. Stage 2 will be to go through the interview and give a one or two-word summary to each line of data. The summary will accurately describe the meaning of the segment of the text. The is called open coding. It will be helpful to use a word from the sentence the interviewer is coding to help create the open code. After open coding the entire interview, the interviewer will make a list of all the codes, then look for similar codes and redundant codes. The objective for this purpose is to reduce the long listing codes, down to a smaller, more manageable number, which can be a scale from 20-25. This process is called an iterative process, which means the interviewer will go back to the original data and check if the new codes match as known as constant comparison. The final theme will reflect the purpose of the research, being exhaustive and place all the data in a category and should be sensitising. The qualitative research should be sensitive to what’s in the data. Questionnaires are also vital for this project as it will bring a more rigid approach which will involve larger number of people. Although Questionnaires will be limited compared to interviews, it is still a key method to go with to test the accuracy of extracting personality traits. Another research method that will be undertaken is secondary research. This will be theoretical work in the past, secondary analysis by reports etc.</td>
</tr>
</tbody>
</table>

¹ An Approved Protocol is one which has been approved by Cardiff Met to be used under supervision of designated members of staff; a list of approved protocols can be found on the Cardiff Met website here
Questionnaire

- The researcher aims to gather the completion of 20+ questions to ensure validity of the study and gain a large amount of data.
- The researcher will need to write a letter to the business to attain permission to hand out questionnaires to the customers and employees.
- Participants will take 5-10 minutes to complete the questionnaire.

Sample:

- 2 days will be covered to get a sample of available participants in the business hours.

Volunteering and convenience sampling will be involved for this type of research. Volunteering sampling will involve placing the questionnaire on the counter for volunteers to fill in if they want to. This will result in a more accurate result as they are keen to fill in the questionnaire for a purpose of perhaps finding out their personality levels etc.

Convenience sampling will involve making sure the questionnaire is handed to the customer if they have a few minutes to spare. For employees, this will involve after they finish work or during their break time.

Semi-structured interview

- Freedom of response will allow the researcher to gain opinions and thoughts of the participant.
- Intended to have interviews with 3-15 people in the business.
- Contact with the business will begin in November and the interview is forecasted to take place in December.
- Recording will take place to each interview and will last from 10-15 minutes.
- Open-ended questions to collect qualitative information.

Sample

- Sample range will be from 5-15 people within the business.

Two sampling techniques I will use are purposive and convenience sampling. For convenience sampling, the interviewer will need to make sure the manager or business owner is available at their convenient time. Making sure to fix a time and day where it suits the interviewee is vital for a successful interview.

Purposive sampling will also be undertaken and picking the suitable interviewee is important for the research. Personality insights involve finding a candidate's personality and interviewing the manager, supervisor, or business owner will be more relevant and will be more purposeful for the research that is being undertaken.
Use of thematic analysis will be undertaken as the interviewer will identify, analyse and report patterns or themes within the data.

The use of inductive analysis will be taken as the interviewer will right down everything that is happening in the interview process.

The interviewer will familiarise the data by reading it repeatedly and generate initial code which will include making important notes on what the interviewee has said. Doing this method will result in large amount of data into a manageable summary which is designed to not lose validity along the way.

Participants
- All participants will be 18+
- The recorder will only record if permission is received from the interviewee
- There would be no discrimination against age, gender, race disability etc.
- Each participant will receive a letter of permission
- Participants may withdraw their data at any point.

Analysis
- Data gathered from quantitative research will extracted from the Watson tool, personality traits
- Qualitative data will be collected to help support the aims and objectives set.

Consent
- Consent from participants is required from the interviewees by the completion of the consent form before they can take part in the study.

All data gathered from both types of research will remain confidential and will be stored securely in a password protected computer system. Also, all participants will remain anonymous; any data provided will not be traceable back to specific people.

| A4 Will the project involve deceptive or covert research? | No |
| A5 If yes, give a rationale for the use of deceptive or covert research | N/A |
| A6 Will the project have security sensitive implications? | No |
| A7 If yes, please explain what they are and the measures that are proposed to address them | N/A |
### B PREVIOUS EXPERIENCE

**B1 What previous experience of research involving human participants relevant to this project do you have?**

Previously conducted research on 2013 Young Enterprise scheme. The teams’ goals were to develop a unique chocolate brand and product. This involved various research methods that included surveys, interviews with michton chocolate factory and secondary research on case studies, internet, and book resources to understand the target audience and how the product will be produced to meet customer needs.

**B2 Student project only**

What previous experience of research involving human participants relevant to this project does your supervisor have?

Mohamed Mostafa has 4 years of previous human participant experience as part of his doctorate research and previously supervised undergraduate dissertation/projects to success.

### C POTENTIAL RISKS

**C1 What potential risks do you foresee?**

**Questionnaire**
- Questionnaire being too data sensitive to the participants.
- Not being able to answer some questions in the questionnaire

**Interview**
- The interviewee may not want to answer questions if the information is confidential or personal.
- Cause of participant mistakenly saying something they want to change. This may result in the participant becoming more nervous and anxious.
- The participant may suddenly cancel the interview set.

**C2 How will you deal with the potential risks?**

**Questionnaire**
- Questionnaire will be sent to the business for approval before handing them out to customers and employees. A consent form and project description will be attached to the questionnaires for participants to read to ensure they are fully aware of their participation. The researcher will ensure all questions are suitable and appropriate to ask participants.
- Participants will be allowed to withdraw their data at any time and will be notified regarding this beforehand. They will be notified that they have the right to skip any questions they cannot full understand.

**Interview**
- Participation information sheet and consent form will be sent to the interviewee to ensure they are aware of the topics up for discussion.
- Participant and researcher will arrange a suitable time and date.
• Right of withdraw will be allowed and will be notified to the participant beforehand.

When submitting your application you **MUST** attach a copy of the following:

- All information sheets
- Consent/assent form(s)

An exemplar information sheet and participant consent form are available from the Research section of the Cardiff Met website.

---

**SEMI STRUCTURED INTERVIEWS**

<table>
<thead>
<tr>
<th>Order of semi structured Interview</th>
<th>Discussed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Ask respondent approval to use recording systems</td>
<td></td>
</tr>
<tr>
<td>Ask respondent to sign and acknowledge consent form</td>
<td></td>
</tr>
<tr>
<td>2) Ask Background questions</td>
<td></td>
</tr>
<tr>
<td>• name of the person</td>
<td></td>
</tr>
<tr>
<td>• Similar job role to the questionnaire participant?</td>
<td></td>
</tr>
</tbody>
</table>
3) **Recruitment process and methods**

**Probes**

- What is your professional status?

- In your work environment, how well do you get along with people? Have you ever been in an argument with any of your co-workers? Explain any argument situation and explain how this was resolved. *(only ask if they are employed)*

- What are your favourite hobbies?

- How often do you go out with friends and family?

- Are you involved in any sport? If yes, what are they and how often do you play them?

- What do you enjoy learning?

- Do you consider yourself to be a team worker? Explain a situation where you put your teamwork skills to work.

- What are your biggest achievements in life?

- What would you like to do in the future?
## SEMI STRUCTURED INTERVIEWS - EMPLOYERS

<table>
<thead>
<tr>
<th>Order of semi structured Interview</th>
<th>Discusses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Ask respondent approval to use recording systems</td>
<td></td>
</tr>
<tr>
<td>Ask respondent to sign and acknowledge consent form</td>
<td></td>
</tr>
<tr>
<td>2) Ask Background questions</td>
<td></td>
</tr>
<tr>
<td>• name of the person</td>
<td></td>
</tr>
<tr>
<td>• Number of years owning the business</td>
<td></td>
</tr>
<tr>
<td>• Different type of job roles in the business.</td>
<td></td>
</tr>
</tbody>
</table>
### 3) Recruitment process and methods

Probes:

- What is your recruitment process?
- What are the main things you look at in a candidate’s CV?
- What do you look in a candidate to find the most suitable person for the job?
- What type of questions do you ask your candidates to know more about them?

### 4) Discuss personality traits

Probes:

- What type of personality do you seek to find in a candidate?
- How do you seek to find what sort of personality a candidate has?
- Do you sometimes struggle finding out what sort of personality a candidate has?
- Have you ever used a system where you can straight away find a person’s personality traits?

### 5) Discuss the tool available to find personality traits

Probes:

- If you were given a system where you can easily find a candidates personality traits, would that be useful? Please explain how it can help you.
SURVEY

Introduction This is a personality test, it will help you understand why you act the way that you do and how your personality is structured.

Please follow the instructions below, scoring and results are on the next page.
Instructions In the table below, for each statement 1-50 mark how much you agree with on the scale 1-5, where:

1=disagree,

2=slightly disagree,

3=neutral,

4=slightly agree

5=agree
• Extroversion (E) is the personality trait of seeking fulfillment from sources outside the self or in community. High scorers tend to be very social while low scorers prefer to work on their projects alone.

• Agreeableness (A) reflects much individuals adjust their behavior to suit others. High scorers are typically polite and like people. Low scorers tend to 'tell it like it is'.

• Conscientiousness (C) is the personality trait of being honest and hardworking. High scorers tend to follow rules and prefer clean homes. Low scorers may be messy and cheat others.
• Neuroticism (N) is the personality trait of being emotional.

• Openness to Experience (O) is the personality trait of seeking new experience and intellectual pursuits. High scorers may dream a lot. Low scorers may be very down to earth.
PARTICIPANT INFORMATION SHEET

The Possible Challenges of developing a Vehicle Managing System

Project summary

The purpose of this research project is to investigate the accuracy of extracting personality traits. Your participation will enable the collection of data which will form part of a study being undertaken at Cardiff Metropolitan University.

Why have you been asked to participate?

You have been asked to participate because you fit the profile of the population being studied; that is you at the age of 18+.

Your participation is entirely voluntary and you may withdraw at any time.

Project risks

The research involves the completion of a questionnaire and participation in an interview and will be recorded for later analysis. We are not seeking to collect any sensitive data on you; this study is only concerned with possible challenges of developing a vehicle management system and will not discuss any irrelevant questions. We do not think that there are any significant risks associated with this study. However, if you do feel that any of the questions are inappropriate then you can stop at any time. Furthermore, you can change your mind and withdraw from the study at any time – we will completely respect your decision.

How we protect your privacy

All the information you provide will be held in confidence. We have taken careful steps to make sure that you cannot be directly identified from the information given by you. Your personal details (e.g. signature on the consent form) will be kept in a secure location by the research team. When we have finished the study, and analysed all the information, the documentation used to gather the raw data will be destroyed except your signed consent form which will be held securely for 5 years. The recordings of the interview will also be held in a secure and confidential environment during the study and destroyed after 5 years.
YOU WILL BE OFFERED A COPY OF THIS INFORMATION SHEET TO KEEP

If you require any further information about this project then please contact:

Zergham Choudhary, Cardiff Metropolitan University

Cardiff Metropolitan University email: st20064805@cardiffmet.ac.uk
PARTICIPANT CONSENT FORM

Cardiff Metropolitan University Ethics Reference Number:

Participant name or Study ID Number: GMH Vehicle Recyclers

Title of Project: The Possible Challenges of developing a Vehicle Managing System

Name of Researcher: Zergham Choudhary

<table>
<thead>
<tr>
<th>Participant to complete this section:</th>
<th>Please initial each box.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.</td>
<td></td>
</tr>
<tr>
<td>2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason.</td>
<td></td>
</tr>
<tr>
<td>3. I agree to take part in the above study.</td>
<td></td>
</tr>
<tr>
<td>4. I agree to the interview being recorded</td>
<td></td>
</tr>
<tr>
<td>5. I agree to the use of anonymised quotes in publications</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>
6. I would like my organisation’s name to be anonymised in all publications

Signature of Participant ___________________________ Date ______

Name of person taking consent ___________________________ Date ______

Signature of person taking consent ___________________________
LETTER TO AN ORGANISATION

Dear GMH Vehicle Recyclers,

I am an undergraduate student at Cardiff Metropolitan University. The title of my research is Investigating the accuracy of Extract personality traits using Linguistic analysis. Its aim is to find out how accurate this system is. As part of my research I would like to undertake research with employer and discussing the recruitment methods and process he/she uses and discuss the available system. I am writing to you because my research topic fits your profile. Before any primary data is collected this project will have been approved by Cardiff Metropolitan University and all data collection will be in accordance with the university’s ethics code of practice.

My purpose in writing is to ask if you would permit me to issue a questionnaire to your employees. Their participation would be entirely voluntary, neither they nor the company would be identified in the research and it would only take 10 to 15 minutes for each employee to complete a questionnaire. I would hope to gain 20+ responses from your employees and customers

The areas which would be covered by the questionnaire include:

- Hobbies
- Work
- Skills
- Activities

I shall be very happy to make the results of my research available to you as a participant in the research when it is complete. If you would like to participate in this project and or are interested in discussing it further, please contact me.

Thank you in anticipation.

Yours sincerely,

Zergham Choudhary
St20064805@outlook.cardiffmet.ac.uk

Cardiff School of Management
Cardiff Metropolitan University
Llandaff Campus, Western Avenue,
Cardiff, CF5 2YB
Hi,

I confirm that Zergham Choudhry from Cardiff Metropolitan University is able to take his research upon my organisation allowing to interview the employees and myself. I have read the information sheet and understand what this research involves. Many Thanks,

Best regards,

Rhys Parry (Manager)
GMH Recyclers
Tel: 029 2036 2229
Fax: 029 2036 2820
email: rhp@gmhrecyclers.co.uk

Old Army Camp, Mardy Road
Rumney, Cardiff, CF3 2EH

---

Hi Zergham,

In response to your email, I can confirm that Zergham Choudhary a student from Cardiff Metropolitan University has my permission to take his research upon my company allowing to interview myself and my employees. I have acknowledged and read the information sheet and fully understand what the research involves. I believe students as yourself are the future and backbone of our country and I am willing to help you in any way that you need.

Kind Regards,

Amir Choudhary
Proprietor of Premier Store Abertillery
19-21 Victoria Street
Abertillery
NP13 1PQ
Email amc2k10@gmail.com
Mobile number 07870688551.
package personalityinsights;

import com.google.gson.Gson;
import java.awt.event.ActionEvent;
import javax.swing.JButton;
import javax.swing.JFrame;
import javax.swing.JLabel;
import javax.swing.JPanel;
import javax.swing.JScrollPane;
import javax.swing.JTextArea;
import com.ibm.watson.developer_cloud.personality_insights.v2.PersonalityInsights;
import com.ibm.watson.developer_cloud.personality_insights.v2.model.Profile;
import java.text.DecimalFormat;
import java.util.ArrayList;
import javax.swing.JOptionPane;
import org.jfree.chart.ChartFactory;
import org.jfree.chart.ChartFrame;
import org.jfree.data.general.DefaultPieDataset;

/**
 * @author zac68
 */
public class GUIFrame extends javax.swing.JFrame {

    public String str;
    public double openAverage;
    public double conAverage;
    public double extAverage;
    public double agrAverage;
    public double neuAverage;
    public double open1;
    public double open2;
    public double open3;
    public double open4;
    public double open5;
    public double open6;
    public double Con1;
    public double Con2;
    public double Con3;
    public double Con4;
    public double Con5;
    public double Con6;
    public double Ext1;
    public double Ext2;
    public double Ext3;
    public double Ext4;
public double Ext5;
public double Ext6;
public double Agr1;
public double Agr2;
public double Agr3;
public double Agr4;
public double Agr5;
public double Agr6;
public double Neu1;
public double Neu2;
public double Neu3;
public double Neu4;
public double Neu5;
public double Neu6;
public double Needs1;
public double Needs2;
public double Needs3;
public double Needs4;
public double Needs5;
public double Needs6;
public double Needs7;
public double Needs8;
public double Needs9;
public double Needs10;
public double Needs11;
public double Needs12;

/**
 * Creates new form GUIFrame
 */
public GUIFrame() {
    initComponents();
    btnOpen.setEnabled(false);
    btnExt.setEnabled(false);
    btnNeu.setEnabled(false);
    btnjsondisplay.setEnabled(false);
    btnNeeds.setEnabled(false);
    btnCon.setEnabled(false);
    btnAg.setEnabled(false);
    btnBig5Aver1.setEnabled(false);
}

/**
 * This method is called from within the constructor to initialize the form.
 * WARNING: Do NOT modify this code. The content of this method is always
 * regenerated by the Form Editor.
 */
@SuppressWarnings("unchecked")
// <editor-fold defaultstate="collapsed" desc="Generated Code">
private void initComponents() {
    jScrollPane1 = new javax.swing.JScrollPane();
    inputfield = new javax.swing.JTextArea();
    jPanel1 = new javax.swing.JPanel();
}
Call me Ishmael. Some years ago—never mind how long precisely—having little or no money in my purse, and nothing particular to interest me on shore, I thought I would sail about a little and see the watery part of the world. It is a way I have of driving off the spleen, and regulating the circulation. Whenever I find myself growing grim about the mouth; whenever it is a damp, drizzly November in my soul; whenever I find myself involuntarily pausing before coffin warehouses, and bringing up the rear of every funeral I meet; and especially whenever my hypos get such an upper hand of me, that it requires a strong moral principle to prevent me from deliberately stepping into the street, and methodically knocking people's hats off—then, I account it high time to get to sea as soon as I can.
lblNeur.setForeground(new java.awt.Color(255, 0, 0));
lblNeur.setText("0.0");

jLabel4.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel4.setText("Openness");

jLabel5.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel5.setText("Agreeableness");

jLabel6.setFont(new java.awt.Font("Raleway Medium", 0, 18)); // NOI18N
jLabel6.setText("Openness");

jLabel7.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel7.setText("Conscientiousness");

jLabel8.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel8.setText("Extraversion");

jLabel9.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel9.setText("Neuroticism");

javax.swing.GroupLayout jPanel1Layout = new javax.swing.GroupLayout(jPanel1);
jPanel1.setLayout(jPanel1Layout);

jPanel1Layout.setHorizontalGroup(jPanel1Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING)
    .addGroup(jPanel1Layout.createSequentialGroup().addGap(31, 31, 31)
        .addGroup(jPanel1Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING)
            .addComponent(jLabel4)
            .addComponent(jLabel7)
            .addComponent(jLabel8)
            .addComponent(jLabel5)
            .addComponent(jLabel9))
    .addGroup(jPanel1Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING)
        .addComponent(lblNeur)
        .addComponent(lblAg)
        .addComponent(lblCon)
        .addComponent(lblOpen)
        .addComponent(lblExt))
    .addGap(30, 30, 30))
    .addGroup(jPanel1Layout.createSequentialGroup()
        .addGap(47, 47, 47)
    .addContainerGap(109, Short.MAX_VALUE))
    .addGroup(jPanel1Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING)
        .addComponent(jLabel2)
        .addGap(98, 98, 98))
    .addGroup(jPanel1Layout.createSequentialGroup()
        .addGap(109, 109, 109)
    .addContainerGap(297, Short.MAX_VALUE))
```
.addComponent(jLabel6)
.addContainerGap(212, Short.MAX_VALUE))
);
jPanel1Layout.setVerticalGroup(
    jPanel1Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING)
    .addGroup(jPanel1Layout.createSequentialGroup()
        .addGap(36, 36, 36)
        .addComponent(jLabel2)
        .addGap(32, 32, 32)
        .addGroup(jPanel1Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.BASELINE)
            .addComponent(lblOpen)
            .addComponent(jLabel4)
        .addGroup(jPanel1Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.BASELINE)
            .addComponent(jLabel7)
            .addComponent(lblCon)
        ).addGap(18, 18, 18)
        .addGroup(jPanel1Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.BASELINE)
            .addComponent(jLabel8)
            .addComponent(lblExt)
        .addGroup(jPanel1Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.BASELINE)
            .addComponent(lblAg)
        .addGroup(jPanel1Layout.createSequentialGroup()
            .addGap(180, 180, 180)
            .addComponent(jLabel6, javax.swing.GroupLayout.PREFERRED_SIZE, 0, javax.swing.GroupLayout.PREFERRED_SIZE)
        ).addContainerGap(100, Short.MAX_VALUE))
    ));
btnjsondisplay.setText("Show Personality Traits");
btnjsondisplay.addActionListener(new java.awt.event.ActionListener() {
    public void actionPerformed(java.awt.event.ActionEvent evt) {
        btnjsondisplayActionPerformed(evt);
    }
});
```
btnNeeds.setText("Needs");
btnNeeds.addActionListener(new java.awt.event.ActionListener() {
    public void actionPerformed(java.awt.event.ActionEvent evt) {
        btnNeedsActionPerformed(evt);
    }
});

btnOpen.setText("Openness");
btnOpen.addActionListener(new java.awt.event.ActionListener() {
    public void actionPerformed(java.awt.event.ActionEvent evt) {
        btnOpenActionPerformed(evt);
    }
});

btnExt.setText("Extraversion");
btnExt.addActionListener(new java.awt.event.ActionListener() {
    public void actionPerformed(java.awt.event.ActionEvent evt) {
        btnExtActionPerformed(evt);
    }
});

btnAg.setText("Agreeableness");
btnAg.addActionListener(new java.awt.event.ActionListener() {
    public void actionPerformed(java.awt.event.ActionEvent evt) {
        btnAgActionPerformed(evt);
    }
});

btnNe.setText("Neuroticism");
btnNe.addActionListener(new java.awt.event.ActionListener() {
    public void actionPerformed(java.awt.event.ActionEvent evt) {
        btnNeActionPerformed(evt);
    }
});

btnCon.setText("Conscientiousness");
btnCon.addActionListener(new java.awt.event.ActionListener() {
    public void actionPerformed(java.awt.event.ActionEvent evt) {
        btnConActionPerformed(evt);
    }
});

btnSubmit.setBackground(new java.awt.Color(102, 204, 0));
btnSubmit.setFont(new java.awt.Font("Yu Gothic UI Semibold", 1, 24));
btnSubmit.setText("SUBMIT");
btnSubmit.setActionCommand(""l");
btnSubmit.setAutoscrolls(true);
btnSubmit.addActionListener(new java.awt.event.ActionListener() {
    public void actionPerformed(java.awt.event.ActionEvent evt) {
        btnSubmitActionPerformed(evt);
    }
});

jPanel4.setBackground(new java.awt.Color(255, 255, 255));
jLabel10.setFont(new java.awt.Font("Raleway SemiBold", 1, 24)); // NOI18N
jLabel10.setText("Needs");

lblChallenge.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblChallenge.setForeground(new java.awt.Color(255, 0, 0));
lblChallenge.setText("0.0");

lblCloseness.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblCloseness.setForeground(new java.awt.Color(255, 0, 0));
lblCloseness.setText("0.0");

lblCuriosity.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblCuriosity.setForeground(new java.awt.Color(255, 0, 0));
lblCuriosity.setText("0.0");

lblExcitement.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblExcitement.setForeground(new java.awt.Color(255, 0, 0));
lblExcitement.setText("0.0");

lblHarmony.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblHarmony.setForeground(new java.awt.Color(255, 0, 0));
lblHarmony.setText("0.0");

jLabel11.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel11.setText("Challenge");

jLabel12.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel12.setText("Excitement");

jLabel13.setFont(new java.awt.Font("Raleway Medium", 0, 18)); // NOI18N
jLabel13.setText("Openness");

jLabel14.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel14.setText("Closeness");

jLabel15.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel15.setText("Curiosity");

jLabel16.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel16.setText("Harmony");

lblIdeal.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblIdeal.setForeground(new java.awt.Color(255, 0, 0));
lblIdeal.setText("0.0");

lblLiberty.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblLiberty.setForeground(new java.awt.Color(255, 0, 0));
lblLiberty.setText("0.0");

lblLove.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblLove.setForeground(new java.awt.Color(255, 0, 0));
lblLove.setText("0.0");

lblPracticality.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblPracticality.setForeground(new java.awt.Color(255, 0, 0));
lblPracticality.setText("0.0");

lblSelfexpression.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblSelfexpression.setForeground(new java.awt.Color(255, 0, 0));
lblSelfexpression.setText("0.0");

lblStability.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblStability.setForeground(new java.awt.Color(255, 0, 0));
lblStability.setText("0.0");

lblStructure.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblStructure.setForeground(new java.awt.Color(255, 0, 0));
lblStructure.setText("0.0");

jLabel17.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel17.setText("Self-expression");

jLabel18.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel18.setText("Ideal");

jLabel19.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel19.setText("Liberty");

jLabel20.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel20.setText("Love");

jLabel21.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel21.setText("Practicality");

jLabel22.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel22.setText("Stability");

jLabel23.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel23.setText("Structure");

javax.swing.GroupLayout jPanel4Layout = new javax.swing.GroupLayout(jPanel4);
jPanel4.setLayout(jPanel4Layout);
.addComponent(jLabel20)
.addComponent(jLabel21)
.addComponent(jLabel22)
.addComponent(jLabel23)
.addComponent(jLabel17)
.addPreferredGap(javax.swing.LayoutStyle.ComponentPlacement.RELATED,
javax.swing.GroupLayout.DEFAULT_SIZE, Short.MAX_VALUE)
.addGroup(jPanel14Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING)
.addComponent(lblCloseness)
.addComponent(lblChallenge)
.addComponent(lblCuriosity)
.addComponent(lblExcitement)
.addComponent(lblHarmony)
.addComponent(lblIdeal)
.addComponent(lblLiberty)
.addComponent(lblLove)
.addComponent(lblPracticality)
.addComponent(lblSelfexpression)
.addComponent(lblStability)
.addComponent(lblStructure)
.addGap(30, 30, 30)
.addGroup(javax.swing.GroupLayout.Alignment.TRAILING, jPanel14Layout.createSequentialGroup()
.addContainerGap(163, Short.MAX_VALUE)
.addComponent(jLabel10)
.addGap(157, 157, 157)
.addGroup(jPanel14Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING)
.addGroup(jPanel14Layout.createSequentialGroup()
.addGap(47, 47, 47)
.addComponent(jLabel13)
.addContainerGap(265, Short.MAX_VALUE)));
.addGroup(jPanel14Layout.createSequentialGroup()
.addGap(33, 33, 33)
.addComponent(jLabel10)
.addGap(35, 35, 35)
.addGroup(jPanel14Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.BASELINE)
.addComponent(lblChallenge)
.addComponent(jLabel11)
.addPreferredGap(javax.swing.LayoutStyle.ComponentPlacement.UNRELATED)
.addGroup(jPanel14Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.BASELINE)
.addComponent(lblCloseness)
.addPreferredGap(javax.swing.LayoutStyle.ComponentPlacement.UNRELATED)
addGroup(jPanel4Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.BASELINE)
    .addComponent(jLabel23)
    .addComponent(lblStructure))
.addGroupGap(94, Short.MAX_VALUE)
.addGroup(jPanel4Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING)
.addGroup(jPanel4Layout.createSequentialGroup()
    .addGroupGap(180, 180, 180)
    .addComponent(jLabel13), javax.swing.GroupLayout.PREFERRED_SIZE, 0, javax.swing.GroupLayout.PREFERRED_SIZE)
    .addPreferredGap(391, Short.MAX_VALUE)))

jPanel2.setBackground(new java.awt.Color(255, 255, 255));

jLabel3.setFont(new java.awt.Font("Raleway SemiBold", 1, 24)); // NOI18N
jLabel3.setText("Values");

lblConservation.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblConservation.setForeground(new java.awt.Color(255, 0, 0));
lblConservation.setText("0.0");

lblOpennesstochange.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblOpennesstochange.setForeground(new java.awt.Color(255, 0, 0));
lblOpennesstochange.setText("0.0");

lblHedonism.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblHedonism.setForeground(new java.awt.Color(255, 0, 0));
lblHedonism.setText("0.0");

lblSelfenhancement.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblSelfenhancement.setForeground(new java.awt.Color(255, 0, 0));
lblSelfenhancement.setText("0.0");

lblSelftranscendence.setFont(new java.awt.Font("Roboto Medium", 0, 16)); // NOI18N
lblSelftranscendence.setForeground(new java.awt.Color(255, 0, 0));
lblSelftranscendence.setText("0.0");

jLabel24.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel24.setText("Conservation");

jLabel25.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel25.setText("Self-enhancement");

jLabel26.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel26.setText("Openness");

jLabel27.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel27.setText("Openness to change");

jLabel28.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N

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jLabel28.setText("Hedonism");

jLabel29.setFont(new java.awt.Font("Raleway Medium", 0, 16)); // NOI18N
jLabel29.setText("Self-transcendence");

javax.swing.GroupLayout jPanel2Layout = new javax.swing.GroupLayout(jPanel2);
jPanel2.setLayout(jPanel2Layout);
jPanel2Layout.setHorizontalGroup(
    jPanel2Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING)
    .addGroup(jPanel2Layout.createSequentialGroup()
        .addGap(31, 31, 31)
        .addGroup(jPanel2Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING)
            .addComponent(jLabel24)
            .addComponent(jLabel27)
            .addComponent(jLabel28)
            .addComponent(jLabel25)
            .addComponent(jLabel29)
        )
    )
    .addGroup(jPanel2Layout.createSequentialGroup()
        .addGap(128, 128, 128)
        .addComponent(jLabel3)
    ).addContainerGap(javax.swing.GroupLayout.DEFAULT_SIZE, Short.MAX_VALUE)
    .addGroup(jPanel2Layout.createSequentialGroup()
        .addGap(47, 47, 47)
        .addComponent(jLabel26)
    ).addContainerGap(212, Short.MAX_VALUE)
);

jPanel2Layout.setVerticalGroup(
    jPanel2Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING)
    .addGroup(jPanel2Layout.createSequentialGroup()
        .addGap(35, 35, 35)
        .addComponent(jLabel13)
        .addGap(33, 33, 33)
        .addGroup(jPanel2Layout.createParallelGroup(javax.swing.GroupLayout.Alignment.BASELINE)
            .addComponent(lblConservation)
            .addComponent(jLabel24)
        )
    ));

jPanel2Layout.setPreferredGap(java.awt.LayoutStyle.ComponentPlacement.RELATED, javax.swing.GroupLayout.DEFAULT_SIZE, Short.MAX_VALUE);

addComponent(lblConservation)
addComponent(lblSelftranscendence)
addComponent(lblSelfenhancement)
addComponent(lblOpennessstochange)
addComponent(lblConservation)
addComponent(lblHedonism)
jLabel30.setFont(new java.awt.Font("Raleway", 3, 13)); // NOI18N
jLabel30.setForeground(new java.awt.Color(255, 0, 51));
jLabel30.setText("Zergham Choudhary (ST20064805)");

btnBig5Aver1.setText("Big 5 Average");
btnBig5Aver1.addActionListener(new java.awt.event.ActionListener() {
    public void actionPerformed(java.awt.event.ActionEvent evt) {
        btnBig5Aver1ActionPerformed(evt);
    }
});

javax.swing.GroupLayout layout = new javax.swing.GroupLayout(getContentPane());
getContentPane().setLayout(layout);
layout.setHorizontalGroup(
    layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING)
    .addGroup(layout.createSequentialGroup()
        .addGap(19, 19, 19)
        .addGroup(layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING)
            .addGroup(layout.createSequentialGroup()
                .addComponent(jScrollPane2, javax.swing.GroupLayout.DEFAULT_SIZE, 507, Short.MAX_VALUE)
                .addPreferredGap(javax.swing.LayoutStyle.ComponentPlacement.RELATED, 207, Short.MAX_VALUE))
            .addGroup(layout.createSequentialGroup()
                .addGap(140, 140, 140)
        .addGap(19, 19, 19))
    .addGroup(layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING)
        .addComponent(jPanel1, javax.swing.GroupLayout.DEFAULT_SIZE, javax.swing.GroupLayout.DEFAULT_SIZE, Short.MAX_VALUE))
    .addGroup(layout.createSequentialGroup()
        .addGap(140, 140, 140)
        .addComponent(btnNe, javax.swing.GroupLayout.DEFAULT_SIZE, 139, Short.MAX_VALUE)
        .addComponent(btnExt, javax.swing.GroupLayout.DEFAULT_SIZE, 139, Short.MAX_VALUE))
    .addGroup(layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING)
        .addComponent(jPanel2, javax.swing.GroupLayout.DEFAULT_SIZE, javax.swing.GroupLayout.DEFAULT_SIZE, Short.MAX_VALUE))
    .addGroup(layout.createSequentialGroup()
        .addPreferredGap(javax.swing.LayoutStyle.ComponentPlacement.RELATED, 207, Short.MAX_VALUE))
    .addGroup(layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING)
)}
.addContainerGap(javax.swing.GroupLayout.DEFAULT_SIZE, Short.MAX_VALUE)
   .addGap(29, 29, 29))
   .addGroup(layout.createParallelGroup(javax.swing.GroupLayout.Alignment.LEADING, false)
   .addGroup(layout.createSequentialGroup()
   .addGroup(layout.createSequentialGroup()
   .addGroup(layout.createSequentialGroup()  
   .addComponent(btnNe, javax.swing.GroupLayout.PREFERRED_SIZE, 48, javax.swing.GroupLayout.PREFERRED_SIZE)
   .addComponent(btnAg, javax.swing.GroupLayout.PREFERRED_SIZE, 48, javax.swing.GroupLayout.PREFERRED_SIZE)
   .addComponent(btnBig5Aver1, javax.swing.GroupLayout.PREFERRED_SIZE, 48, javax.swing.GroupLayout.PREFERRED_SIZE)
   .addGroup(layout.createSequentialGroup()  
   .addComponent(jScrollPane2))
   .addGap(39, 39, 39)
   .addGroup(layout.createParallelGroup(javax.swing.GroupLayout.Alignment.BASELINE)
   .addComponent(jLabel1)
   .addComponent(jLabel30))
```java
private void btnSubmitActionPerformed(java.awt.event.ActionEvent evt) {
    // TODO add your handling code here:
    PersonalityInsights service = new PersonalityInsights();
    service.setUsernameAndPassword("f94f378a-099d-4a80-b541-1cc104a2fef6", "BkhZXR7zUNGW");
    String str = inputfield.getText();
    if (str == null || str.isEmpty()) {
        JOptionPane.showMessageDialog(null, "Please Enter text in the input field", "Error", JOptionPane.ERROR_MESSAGE);
        return;
    }
    String trimmed = str.trim();
    int words = trimmed.isEmpty() ? 0 : trimmed.split("\s+").length;
    if (100 > words) {
        JOptionPane.showMessageDialog(null, "Please enter 100+ words", "Error", JOptionPane.ERROR_MESSAGE);
        return;
    }
    System.out.println(words);
    Profile profile = service.getProfile(str).execute();
    btnOpen.setEnabled(true);
    btnExt.setEnabled(true);
    btnNe.setEnabled(true);
    btnjsondisplay.setEnabled(true);
    btnNeeds.setEnabled(true);
    btnCon.setEnabled(true);
    btnAg.setEnabled(true);
    btnBig5Aver1.setEnabled(true);
    // 1. New Gson processing instance
    Gson gson = new Gson();
    // 2. Create class hierarchy from the planets.json file. To level class structure is the SolarSystem class.
    gson.fromJson(new FileReader("C:\Users\zac68\Desktop\test.json"), Personality.class);
    MainRoot S = gson.fromJson(profile.toString(), MainRoot.class);
    Tree t = S.getTree(); // accessing the tree
```
ArrayList<main_child> jc = t.getChildren(); // Accessing the root/main Child
layer of tree which contains Personality, Needs and Values
main_child child = jc.get(0); //Getting the 1st object - NOTE: there is only
one object which inside contains Personality, Needs and Values

ArrayList<ChildLayer1> pjc1 = child.getChildren(); //Accessing 1st childer
layer
ChildLayer1 child1 = pjc1.get(0); //Getting the first set of objects = PERSONALITY

ArrayList<ChildLayer2> pjc2 = child1.getChildren(); //Accessing 1st
//Getting the Big 5 objects
ChildLayer2 big5one = pjc2.get(0); // = openness
ChildLayer2 big5two = pjc2.get(1); // = conscienctiousness
ChildLayer2 big5three = pjc2.get(2); // = extraversion
ChildLayer2 big5four = pjc2.get(3); // = agreeableness
ChildLayer2 big5five = pjc2.get(4); // = neuroticism

ArrayList<ChildLayer3> neuroticism = big5five.getChildren(); //Accessing the
5th objects child
ChildLayer3 neu1 = neuroticism.get(0);
ChildLayer3 neu2 = neuroticism.get(1);
ChildLayer3 neu3 = neuroticism.get(2);
ChildLayer3 neu4 = neuroticism.get(3);
ChildLayer3 neu5 = neuroticism.get(4);
ChildLayer3 neu6 = neuroticism.get(5);

Neu1 = neu1.percentage;
Neu2 = neu2.percentage;
Neu3 = neu3.percentage;
Neu4 = neu4.percentage;
Neu5 = neu5.percentage;
Neu6 = neu6.percentage;
double neuTotal = 0;
for (int i = 0; i < neuroticism.size(); i++) {
    neuTotal = neuTotal + neuroticism.get(i).percentage;
}
neuAverage = neuTotal / 6; // Getting the average of the percentages
System.out.println("Neuroticism Average: " + neuAverage); //Console print

ArrayList<ChildLayer3> agreeableness = big5four.getChildren();
ChildLayer3 agr1 = agreeableness.get(0);
ChildLayer3 agr2 = agreeableness.get(1);
ChildLayer3 agr3 = agreeableness.get(2);
ChildLayer3 agr4 = agreeableness.get(3);
ChildLayer3 agr5 = agreeableness.get(4);
ChildLayer3 agr6 = agreeableness.get(5);

Agr1 = agr1.percentage;
Agr2 = agr2.percentage;
Agr3 = agr3.percentage;
Agr4 = agr4.percentage;
Agr5 = agr5.percentage;
Agr6 = agr6.percentage;
double agrTotal = 0;
for (int i = 0; i < agreeableness.size(); i++) {
    agrTotal = agrTotal + agreeableness.get(i).percentage;
}
agrAverage = agrTotal / 6;
System.out.println("Agreeableness Average:   " + agrAverage);

ArrayList<ChildLayer3> extraversion = big5three.getChildren();
ChildLayer3 ext1 = extraversion.get(0);
ChildLayer3 ext2 = extraversion.get(1);
ChildLayer3 ext3 = extraversion.get(2);
ChildLayer3 ext4 = extraversion.get(3);
ChildLayer3 ext5 = extraversion.get(4);
ChildLayer3 ext6 = extraversion.get(5);

Ext1 = ext1.percentage;
Ext2 = ext2.percentage;
Ext3 = ext3.percentage;
Ext4 = ext4.percentage;
Ext5 = ext5.percentage;
Ext6 = ext6.percentage;
double extTotal = 0;
for (int i = 0; i < extraversion.size(); i++) {
    extTotal = extTotal + extraversion.get(i).percentage;
}
extAverage = extTotal / 6;
System.out.println("Extraversion Average:   " + extAverage);

//Getting big 5 object twos total and average.
ArrayList<ChildLayer3> conscientiousness = big5two.getChildren();
ChildLayer3 con1 = conscientiousness.get(0);
ChildLayer3 con2 = conscientiousness.get(1);
ChildLayer3 con3 = conscientiousness.get(2);
ChildLayer3 con4 = conscientiousness.get(3);
ChildLayer3 con5 = conscientiousness.get(4);
ChildLayer3 con6 = conscientiousness.get(5);

Con1 = con1.percentage;
Con2 = con2.percentage;
Con3 = con3.percentage;
Con4 = con4.percentage;
Con5 = con5.percentage;
Con6 = con6.percentage;
double conTotal = 0;
for (int i = 0; i < conscientiousness.size(); i++) {
    conTotal = conTotal + conscientiousness.get(i).percentage;
}
conAverage = conTotal / 6;
System.out.println("Conscientiousness Average:   " + conAverage);

ArrayList<ChildLayer3> openness = big5one.getChildren();
ChildLayer3 op1 = openness.get(0);
ChildLayer3 op2 = openness.get(1);
ChildLayer3 op3 = openness.get(2);
ChildLayer3 op4 = openness.get(3);
ChildLayer3 op5 = openness.get(4);
ChildLayer3 op6 = openness.get(5);

open1 = op1.percentage;
open2 = op2.percentage;
open3 = op3.percentage;
open4 = op4.percentage;
open5 = op5.percentage;
open6 = op6.percentage;

//using for loop to get everything inside openness and divide by how many there are to get average
double opennessTotal = 0;
for (int i = 0; i < openness.size(); i++) {
    //adding all the objects percentage in "myList"
    opennessTotal = opennessTotal + openness.get(i).percentage;
}
openAverage = opennessTotal / openness.size();

DecimalFormat decimalFormat = new DecimalFormat("#,##0.0");
lblOpen.setText(decimalFormat.format(big5one.getPercentage() * 100) + ("%"));
lblCon.setText(decimalFormat.format(big5two.getPercentage() * 100) + ("%"));
lblExt.setText(decimalFormat.format(big5three.getPercentage() * 100) + ("%"));
lblAg.setText(decimalFormat.format(big5four.getPercentage() * 100) + ("%"));
lblNeur.setText(decimalFormat.format(big5five.getPercentage() * 100) + ("%"));

//--------Need
main child chld = jc.get(1); //Getting the 1st object - NOTE: there is only one object which inside contains Personality, Needs and Values
ArrayList<ChildLayer1> njc1 = chld.getChildren(); //Accessing 1st childer layer

ChildLayer1 child2 = njc1.get(0); //Getting the first set of objects = PERSONALITY

ArrayList<ChildLayer2> njc2 = child2.getChildren(); //Accessing 1st childer layer

ArrayList<Double> needspr = new ArrayList();
for (int i = 0; i < njc2.size(); i++) {
    needspr.add(njc2.get(i).getPercentage());
}

Needs1 = njc2.get(0).getPercentage();
Needs2 = njc2.get(1).getPercentage();
Needs3 = njc2.get(2).getPercentage();
Needs4 = njc2.get(3).getPercentage();
Needs5 = njc2.get(4).getPercentage();
Needs6 = njc2.get(5).getPercentage();
Needs7 = njc2.get(6).getPercentage();
Needs8 = njc2.get(7).getPercentage();
Needs9 = njc2.get(8).getPercentage();
Needs10 = njc2.get(9).getPercentage();
Needs11 = njc2.get(10).getPercentage();
Needs12 = njc2.get(11).getPercentage();

lblChallenge.setText(decimalFormat.format(needspr.get(0) * 100) + ("%"));
lblCloseness.setText(decimalFormat.format(needspr.get(1) * 100) + ("%"));
lblCuriosity.setText(decimalFormat.format(needspr.get(2) * 100) + ("%"));
lblExcitement.setText(decimalFormat.format(needspr.get(3) * 100) + ("%"));
lblHarmony.setText(decimalFormat.format(needspr.get(4) * 100) + ("%"));
lblIdeal.setText(decimalFormat.format(needspr.get(5) * 100) + ("%"));
lblLiberty.setText(decimalFormat.format(needspr.get(6) * 100) + ("%"));
lblPracticality.setText(decimalFormat.format(needspr.get(7) * 100) + ("%"));
lblSelfexpression.setText(decimalFormat.format(needspr.get(8) * 100) + ("%"));
lblStability.setText(decimalFormat.format(needspr.get(9) * 100) + ("%"));
lblStructure.setText(decimalFormat.format(needspr.get(10) * 100) + ("%"));
lblConservation.setText(decimalFormat.format(valuespr.get(0)) + ("%"));
lblOpennesstochange.setText(decimalFormat.format(valuespr.get(1)) + ("%"));
lblHedonism.setText(decimalFormat.format(valuespr.get(2)) + ("%"));
lblSelfenhancement.setText(decimalFormat.format(valuespr.get(3)) + ("%"));
lblSelftranscendence.setText(decimalFormat.format(valuespr.get(4)) + ("%"));

private void btnOpenActionPerformed(java.awt.event.ActionEvent evt) {
    // TODO add your handling code here:
    new CreateChart().createOpennessBarChart(open1, open2, open3, open4, open5, open6);
}

private void btnNeedsActionPerformed(java.awt.event.ActionEvent evt) {
    // TODO add your handling code here:
}
// Prints a certain value from the List
new CreateChart().createNeedsBarChart(Needs1, Needs2, Needs3, Needs4, Needs5,
Needs6, Needs7, Needs8, Needs9, Needs10, Needs11, Needs12);

private void btnConActionPerformed(java.awt.event.ActionEvent evt) {
    // TODO add your handling code here:
    new CreateChart().createConBarChart(Con1, Con2, Con3, Con4, Con5, Con6);
}

private void btnNeActionPerformed(java.awt.event.ActionEvent evt) {
    // TODO add your handling code here:
    new CreateChart().createNeuBarChart(Neu1, Neu2, Neu3, Neu4, Neu5, Neu6);
}

private void btnAgActionPerformed(java.awt.event.ActionEvent evt) {
    // TODO add your handling code here:
    new CreateChart().createAgrBarGraph(Agr1, Agr2, Agr3, Agr4, Agr5, Agr6);
}

private void btnExtActionPerformed(java.awt.event.ActionEvent evt) {
    // TODO add your handling code here:
    new CreateChart().createExtBarGraph(Ext1, Ext2, Ext3, Ext4, Ext5, Ext6);
}

private void btnjsondisplayActionPerformed(java.awt.event.ActionEvent evt) {
    // TODO add your handling code here:
    PersonalityInsights service = new PersonalityInsights();
    service.setUsernameAndPassword("18f94f9f-5dd1-4052-91c6-778ae15951f1",
    "x6TngRtXCsX");
    Profile profile = service.getProfile(str).execute();
    Gson gson = new Gson();
    MainRoot S = gson.fromJson(profile.toString(), MainRoot.class);
    txtoutput.setText(S.toString());
}

private void btnClearActionPerformed(java.awt.event.ActionEvent evt) {
    // TODO add your handling code here:
    txtoutput.setText(""澄);
    inputfield.setText(""澄);
    lblChallenge.setText("0.0%"澄);
    lblCloseness.setText("0.0%"澄);
    lblCuriosity.setText("0.0%"澄);
    lblExcitement.setText("0.0%"澄);
    lblHarmony.setText("0.0%"澄);
    lblIdeal.setText("0.0%"澄);
    lblLiberty.setText("0.0%"澄);
    lblLove.setText("0.0%"澄);
    lblPracticality.setText("0.0%"澄);
    lblSelfexpression.setText("0.0%"澄);
    lblStability.setText("0.0%"澄);
    lblStructure.setText("0.0%"澄);
    lblConservation.setText("0.0%"澄);
    lblOpennesstochange.setText("0.0%"澄);
lblHedonism.setText("0.0");
lblSelfenhancement.setText("0.0");
lblSelftranscendence.setText("0.0");
lblOpen.setText("0.0");
lblCon.setText("0.0");
lblExt.setText("0.0");
lblAg.setText("0.0");
lblNeur.setText("0.0");
btnOpen.setEnabled(false);
btnExt.setEnabled(false);
btnCon.setEnabled(false);
btnAg.setEnabled(false);
btnNeur.setEnabled(false);
btnjsondisplay.setEnabled(false);
btnNeeds.setEnabled(false);
btnAg.setEnabled(false);
btnBig5Aver1.setEnabled(false);

private void btnBig5Aver1ActionPerformed(java.awt.event.ActionEvent evt) {
    // TODO add your handling code here:
    new CreateChart().createPieChart(openAverage, conAverage, extAverage, agrAverage, neuAverage);
}
} catch (javax.swing.UnsupportedLookAndFeelException ex) {
    java.util.logging.Logger.getLogger(GUIFrame.class.getName()).log(java.util.logging.Level.SEVERE, null, ex);
}

//</editor-fold>

/* Create and display the form */
java.awt.EventQueue.invokeLater(new Runnable() {
    public void run() {
        new GUIFrame().setVisible(true);
    }
});

// Variables declaration - do not modify
private javax.swing.JButton btnAg;
private javax.swing.JButton btnBig5Aver1;
private javax.swing.JButton btnClear;
private javax.swing.JButton btnCon;
private javax.swing.JButton btnExt;
private javax.swing.JButton btnNe;
private javax.swing.JButton btnNeeds;
private javax.swing.JButton btnOpen;
private javax.swing.JButton btnSubmit;
private javax.swing.JTextArea inputfield;
private javax.swing.JLabel jLabel1;
private javax.swing.JLabel jLabel10;
private javax.swing.JLabel jLabel11;
private javax.swing.JLabel jLabel12;
private javax.swing.JLabel jLabel13;
private javax.swing.JLabel jLabel14;
private javax.swing.JLabel jLabel15;
private javax.swing.JLabel jLabel16;
private javax.swing.JLabel jLabel17;
private javax.swing.JLabel jLabel18;
private javax.swing.JLabel jLabel19;
private javax.swing.JLabel jLabel2;
private javax.swing.JLabel jLabel20;
private javax.swing.JLabel jLabel21;
private javax.swing.JLabel jLabel22;
private javax.swing.JLabel jLabel23;
private javax.swing.JLabel jLabel24;
private javax.swing.JLabel jLabel25;
private javax.swing.JLabel jLabel26;
private javax.swing.JLabel jLabel27;
private javax.swing.JLabel jLabel28;
private javax.swing.JLabel jLabel29;
private javax.swing.JLabel jLabel3;
private javax.swing.JLabel jLabel30;
private javax.swing.JLabel jLabel4;
private javax.swing.JLabel jLabel5;
private javax.swing.JLabel jLabel6;
private javax.swing.JLabel jLabel7;
private javax.swing.JLabel jLabel8;
private javax.swing.JLabel jLabel9;
private javax.swing.JPanel jPanel1;
private javax.swing.JPanel jPanel2;
private javax.swing.JPanel jPanel4;
private javax.swing.JScrollPane jScrollPane1;
private javax.swing.JScrollPane jScrollPane2;
private javax.swing.JLabel lblAg;
private javax.swing.JLabel lblChallenge;
private javax.swing.JLabel lblCloseness;
private javax.swing.JLabel lblCon;
private javax.swing.JLabel lblConservation;
private javax.swing.JLabel lblCuriosity;
private javax.swing.JLabel lblExcitement;
private javax.swing.JLabel lblExt;
private javax.swing.JLabel lblHarmony;
private javax.swing.JLabel lblHedonism;
private javax.swing.JLabel lblIdeal;
private javax.swing.JLabel lblLiberty;
private javax.swing.JLabel lblLove;
private javax.swing.JLabel lblNeur;
private javax.swing.JLabel lblOpen;
private javax.swing.JLabel lblOpennessstochange;
private javax.swing.JLabel lblPracticality;
private javax.swing.JLabel lblSelfenhancement;
private javax.swing.JLabel lblSelfexpression;
private javax.swing.JLabel lblSelftranscendence;
private javax.swing.JLabel lblStability;
private javax.swing.JLabel lblStructure;
private javax.swing.JTextArea txtoutput;

// End of variables declaration
}
package personalityInsights;

/**
 * @author zac68
 */

public class MainRoot {
    // declaring as private then using getters and setters
    private String id;
    private String processed_lang;
    private String source;
    private Tree tree;

    private Integer word_count;
    private String word_count_message;

    @Override
    public String toString() {
        return "ID: " + id + "\n" + "Processed Lang: " + processed_lang + "\n" + "Source: " + source + "\n" + "Word Count: " + word_count + "\n" + "WD Message: " + word_count_message + "\n" + "TREE: " + tree + "\n";
    }

    public String getId() {
        return id;
    }

    public void setId(String id) {
        this.id = id;
    }

    public String getProcessed_lang() {
        return processed_lang;
    }

    public void setProcessed_lang(String processed_lang) {
        this.processed_lang = processed_lang;
    }

    public String getSource() {
        return source;
    }

    public void setSource(String source) {
this. source = source;

public Tree getTree() {
    return tree;
}

public void setTree(Tree tree) {
    this.tree = tree;
}

public Integer getWord_count() {
    return word_count;
}

public void setWord_count(Integer word_count) {
    this.word_count = word_count;
}

public String getWord_count_message() {
    return word_count_message;
}

public void setWord_count_message(String word_count_message) {
    this.word_count_message = word_count_message;
}
package personalityinsights;

import java.util.ArrayList;

/**
 * @author zac68
 */
public class Tree {

    private String id;
    private String name;
    private ArrayList<main_child> children;

    @Override
    public String toString() {
        return  
                ID: " + id + "Name: " + name + "\n";
    }

    public String getId() {
        return id;
    }

    public void setId(String id) {
        this.id = id;
    }

    public String getName() {
        return name;
    }

    public void setName(String name) {
        this.name = name;
    }

    public ArrayList<main_child> getChildren() {
        return children;
    }

    public void setChildren(ArrayList<main_child> children) {
        this.children = children;
    }

}
package personalityinsights;

import java.util.ArrayList;

public class main_child {
    private String id;
    private String name;
    private ArrayList<ChildLayer1> children;

    @Override
    public String toString() {
        return
                "ID: " + id + 
                "NAME: " + name + 
                children + "\n";
    }

    public String getId() {
        return id;
    }

    public void setId(String id) {
        this.id = id;
    }

    public String getName() {
        return name;
    }

    public void setName(String name) {
        this.name = name;
    }

    public ArrayList<ChildLayer1> getChildren() {
        return children;
    }

    public void setChildren(ArrayList<ChildLayer1> children) {
        this.children = children;
    }
}
11.0 Appendix E – CHILDLAYER1.JAVA CODE

/*
 * To change this license header, choose License Headers in Project Properties.
 * To change this template file, choose Tools | Templates
 * and open the template in the editor.
 */
package personalityinsights;

import java.util.ArrayList;

/**
 * @author zac68
 */
public class ChildLayer1 {
    private String category;
    private String id;
    private String name;
    private double percentage;
    private ArrayList<ChildLayer2> children;

    @Override
    public String toString() {
        return "\n" + "CATEGORY: " + category + "\n" + "ID: " + id + "\n" + "NAME: " + name + "\n" + "PERCENTAGE: " + percentage + "\n" + children + "\n";
    }

    public String getCategory() {
        return category;
    }

    public String getId() {
        return id;
    }

    public void setId(String id) {
        this.id = id;
    }

    public String getName() {
        return name;
    }
}
public void setName(String name) {
    this.name = name;
}

public double getPercentage() {
    return percentage;
}

public void setPercentage(double percentage) {
    this.percentage = percentage;
}

public ArrayList<ChildLayer2> getChildren() {
    return children;
}

public void setChildren(ArrayList<ChildLayer2> children) {
    this.children = children;
}

package personalityinsights;

import java.util.ArrayList;

public class ChildLayer2 {
    private String category;
    private String id;
    private String name;
    private double percentage;
    private double sampling_error;
    private ArrayList<ChildLayer3> children;

    @Override
    public String toString() {
        return "\n" + "\n" + "CATEGORY: " + category + "\n" + "ID: " + id + "\n" + "NAME: " + name + "\n" + "PERCENTAGE: " + percentage + "\n" + "SAMPLING ERROR: " + sampling_error + "\n" + children;
    }

    public String getCategory() {
        return category;
    }

    public void setCategory(String category) {
        this.category = category;
    }

    public String getId() {
        return id;
    }

    public void setId(String id) {
        this.id = id;
    }

    public String getName() {
        return name;
    }

    public void setName(String name) {
        this.name = name;
    }
}


```java
public void setName(String name) {
    this.name = name;
}

public double getPercentage() {
    return percentage;
}

public void setPercentage(double percentage) {
    this.percentage = percentage;
}

public double getSampling_error() {
    return sampling_error;
}

public void setSampling_error(double sampling_error) {
    this.sampling_error = sampling_error;
}

public ArrayList<ChildLayer3> getChildren() {
    return children;
}

public void setChildren(ArrayList<ChildLayer3> children) {
    this.children = children;
}
```
13.0 Appendix G – CHILD Layer3.JAVA CODE

/*
 * To change this license header, choose License Headers in Project Properties.
 * To change this template file, choose Tools | Templates
 * and open the template in the editor.
 */
package personailityinsights;

/**
 * @author zac68
 */
public class ChildLayer3 {
    private String category;
    private String id;
    private String name;
    double percentage;
    private double sampling_error;

    // Constructor
    public ChildLayer3(String category, String id, String name, double percentage, double sampling_error) {
        this.category = category;
        this.id = id;
        this.name = name;
        this.name = name;
        this.percentage = percentage;
        this.sampling_error = sampling_error;
    }

    // toString override - not related to JSON processing, just included for debugging purposes
    @Override
    public String toString() {
        return "category: " + category + 
                "\n" + "ID: " + id + 
                "\n" + "Name: " + name + 
                "\n" + "Percentage: " + percentage + 
                "\n" + "Sampling Error: " + sampling_error 
                + "\n" + "\n";
    }

    public void setCategory(String category) {
        this.category = category;
    }

    public void setId(String id) {

this.id = id;
}

public void setName(String name) {
    this.name = name;
}

public void setPercentage(double percentage) {
    this.percentage = percentage;
}

public void setSampling_error(double sampling_error) {
    this.sampling_error = sampling_error;
}
14.0 Appendix H – CREATECHART.JAVA CODE

```java
package personalityinsights;

import java.awt.Color;
import java.util.ArrayList;
import javax.swing.JFrame;
import org.jfree.chart.ChartFactory;
import org.jfree.chart.ChartFrame;
import org.jfree.chart.ChartPanel;
import org.jfree.chart.JFreeChart;
import org.jfree.chart.plot.CategoryPlot;
import org.jfree.chart.plot.PiePlot;
import org.jfree.chart.plot.PiePlot3D;
import org.jfree.chart.plot.PlotOrientation;
import org.jfree.data.category.DefaultCategoryDataset;
import org.jfree.data.general.DefaultPieDataset;
import org.jfree.data.general.PieDataset;
import org.jfree.util.Rotation;
import personalityinsights.ChildLayer3;
import personalityinsights.MainRoot;

public class CreateChart extends JFrame{

    //creating a constructor
    public void createPieChart(double openAverage, double conAverage, double extAverage, double agrAverage, double neuAverage ){

        DefaultPieDataset pieDataset = new DefaultPieDataset();
        pieDataset.setValue("Openness", openAverage);
        pieDataset.setValue("Conscientiousness", conAverage);
        pieDataset.setValue("Extraversion", extAverage);
        pieDataset.setValue("Agreeableness", agrAverage);
        pieDataset.setValue("Neuroticism", neuAverage);

        //using the jfreechart library
        JFreeChart chart = ChartFactory.createPieChart("Average of Big 5", pieDataset, true, true, true);
        PiePlot P = (PiePlot) chart.getPlot();

        //creating the frame for the chart
        ChartFrame frame = new ChartFrame("Big 5 Average", chart);
        frame.setVisible(true);
        frame.setSize(800, 800);
        frame.setLocationRelativeTo(null);

    }

    public void createOpennessBarChart(double open1, double open2, double open3, double open4, double open5, double open6 ){

        DefaultCategoryDataset openbardataset = new DefaultCategoryDataset();
        openbardataset.setValue(open1, "Percentage", "Adventurousness");

    }

}
```
openbardataset.setValue(open2, "Percentage", "Artistic interests");
openbardataset.setValue(open3, "Percentage", "Emotionality");
openbardataset.setValue(open4, "Percentage", "Imagination");
openbardataset.setValue(open5, "Percentage", "Intellect");
openbardataset.setValue(open6, "Percentage", "Liberalism");
JFreeChart OpenBarChart = ChartFactory.createBarChart(
    "Openness", //Title
    "Name", // X-axis Label
    "Percentage", // Y-axis Label
    openbardataset, // Dataset
    PlotOrientation.VERTICAL, //Plot orientation
    false, // Show legend
    true, // Use tooltips
    false // Generate URLs
);
OpenBarChart.getTitle().setPaint(Color.BLACK); // Set the colour of the title
OpenBarChart.setBackgroundPaint(Color.WHITE); // Set the background colour of the chart
CategoryPlot OpenCatPlot = OpenBarChart.getCategoryPlot(); // Get the Plot object for a bar graph
OpenCatPlot.setBackgroundPaint(Color.WHITE); // Set the plot background colour
OpenCatPlot.setRangeGridlinePaint(Color.GRAY); // Set the colour of the plot gridlines

ChartFrame barframe = new ChartFrame("Openness", OpenBarChart);
barframe.setVisible(true);
barframe.setSize(800, 800);
barframe.setLocationRelativeTo(null);

}  

public void createConBarChart(double Con1, double Con2, double Con3, double Con4, double Con5, double Con6){
    //------------------------ Conscientiousness Bar Graph ------------------------
    DefaultCategoryDataset ConBarDataset = new DefaultCategoryDataset();
    ConBarDataset.setValue(Con1, "Percentage", "Achievement striving");
    ConBarDataset.setValue(Con2, "Percentage", "Cautiousness");
    ConBarDataset.setValue(Con3, "Percentage", "Dutifulness");
    ConBarDataset.setValue(Con4, "Percentage", "Orderliness");
    ConBarDataset.setValue(Con5, "Percentage", "Self-discipline");
    ConBarDataset.setValue(Con6, "Percentage", "Self-efficacy");
    JFreeChart ConBarChart = ChartFactory.createBarChart(
        "Conscientiousness", //Title
        "Name", // X-axis Label
        "Percentage", // Y-axis Label
        ConBarDataset, // Dataset
        PlotOrientation.VERTICAL, //Plot orientation
        false, // Show legend
        true, // Use tooltips
        false // Generate URLs
    );
}
ConBarChart.getTitle().setPaint(Color.BLACK); // Set the colour of the title
ConBarChart.setBackgroundPaint(Color.WHITE); // Set the background colour of the chart
CategoryPlot ConCatPlot = ConBarChart.getCategoryPlot(); // Get the Plot object for a bar graph
ConCatPlot.setBackgroundPaint(Color.WHITE); // Set the plot background colour
ConCatPlot.setRangeGridlinePaint(Color.GRAY); // Set the colour of the plot gridlines

ChartFrame ConBarFrame = new ChartFrame("Conscientiousness", ConBarChart);
ConBarFrame.setVisible(true);
ConBarFrame.setSize(800, 800);
ConBarFrame.setLocationRelativeTo(null);

}  

public void createExtBarGraph(double Ext1, double Ext2, double Ext3, double Ext4, double Ext5, double Ext6){
  //------------------- Extraversion Bar Graph ------------------///
  DefaultCategoryDataset ExtBarDataset = new DefaultCategoryDataset();
  ExtBarDataset.setValue(Ext1, "Percentage", "Activity level");
  ExtBarDataset.setValue(Ext2, "Percentage", "Assertiveness");
  ExtBarDataset.setValue(Ext3, "Percentage", "Cheerfulness");
  ExtBarDataset.setValue(Ext4, "Percentage", "Excitement-seeking");
  ExtBarDataset.setValue(Ext5, "Percentage", "Friendliness");
  ExtBarDataset.setValue(Ext6, "Percentage", "Gregariousness");
  JFreeChart ExtBarChart = ChartFactory.createBarChart("Extraversion", //Title
    "Name", // X-axis Label
    "Percentage", // Y-axis Label
    ExtBarDataset, // Dataset
    PlotOrientation.VERTICAL, //Plot orientation
    false, // Show legend
    true, // Use tooltips
    false // Generate URLs
  );
  ExtBarChart.getTitle().setPaint(Color.BLACK); // Set the colour of the title
  ExtBarChart.setBackgroundPaint(Color.WHITE); // Set the background colour of the chart
  CategoryPlot ExtCatPlot = ExtBarChart.getCategoryPlot(); // Get the Plot object for a bar graph
  ExtCatPlot.setBackgroundPaint(Color.WHITE); // Set the plot background colour
  ExtCatPlot.setRangeGridlinePaint(Color.GRAY); // Set the colour of the plot gridlines
  ChartFrame ExtBarFrame = new ChartFrame("Extraversion", ExtBarChart);
  ExtBarFrame.setVisible(true);
  ExtBarFrame.setSize(800, 800);
public void createAgrBarGraph(double Agr1, double Agr2, double Agr3, double Agr4, double Agr5, double Agr6){
//---------------------- Extraversion Bar Graph ------------------------//
    DefaultCategoryDataset AgrBarDataset = new DefaultCategoryDataset();
    AgrBarDataset.setValue(Agr1, "Percentage", "Activity level");
    AgrBarDataset.setValue(Agr2, "Percentage", "Assertiveness");
    AgrBarDataset.setValue(Agr3, "Percentage", "Cheerfulness");
    AgrBarDataset.setValue(Agr4, "Percentage", "Excitement-seeking");
    AgrBarDataset.setValue(Agr5, "Percentage", "Friendliness");
    AgrBarDataset.setValue(Agr6, "Percentage", "Gregariousness");
    JFreeChart AgrBarChart = ChartFactory.createBarChart(
        "Agreeableness", //Title
        "Name", // X-axis Label
        "Percentage", // Y-axis Label
        AgrBarDataset, // Dataset
        PlotOrientation.VERTICAL, //Plot orientation
        false, // Show legend
        true, // Use tooltips
        false // Generate URLs
    );
    AgrBarChart.setTitle().setPaint(Color.BLACK); // Set the colour of the title
    AgrBarChart.setBackgroundPaint(Color.WHITE); // Set the background colour
    CategoryPlot ExtCatPlot = AgrBarChart.getCategoryPlot(); // Get the Plot object for a bar graph
    ExtCatPlot.setBackgroundPaint(Color.WHITE); // Set the plot background colour
    ExtCatPlot.setRangeGridlinePaint(Color.GRAY); // Set the colour of the plot gridlines
    ChartFrame ExtBarFrame = new ChartFrame("Extraversion", AgrBarChart);
    ExtBarFrame.setVisible(true);
    ExtBarFrame.setSize(800, 800);
    ExtBarFrame.setLocationRelativeTo(null);
}

public void createNeuBarChart(double Neu1, double Neu2, double Neu3, double Neu4, double Neu5, double Neu6){
    DefaultCategoryDataset NeuBarDataset = new DefaultCategoryDataset();
    NeuBarDataset.setValue(Neu1, "Percentage", "Activity level");
    NeuBarDataset.setValue(Neu2, "Percentage", "Assertiveness");
    NeuBarDataset.setValue(Neu3, "Percentage", "Cheerfulness");
    NeuBarDataset.setValue(Neu4, "Percentage", "Excitement-seeking");
    NeuBarDataset.setValue(Neu5, "Percentage", "Friendliness");
    NeuBarDataset.setValue(Neu6, "Percentage", "Gregariousness");
    JFreeChart NeuBarChart = ChartFactory.createBarChart(
        "Agreeableness", //Title
        "Name", // X-axis Label
"Percentage", // Y-axis Label
NeuBarDataset, // Dataset
PlotOrientation.VERTICAL, // Plot orientation
false, // Show legend
true, // Use tooltips
false // Generate URLs
);

NeuBarChart.setTitle().setPaint(Color.BLACK); // Set the colour of the title
NeuBarChart.setBackgroundPaint(Color.WHITE); // Set the background colour of the chart

CategoryPlot ExtCatPlot = NeuBarChart.getCategoryPlot(); // Get the Plot object for a bar graph
ExtCatPlot.setBackgroundPaint(Color.WHITE); // Set the plot background colour
ExtCatPlot.setRangeGridlinePaint(Color.GRAY); // Set the colour of the plot gridlines

ChartFrame ExtBarFrame = new ChartFrame("Extraversion", NeuBarChart);
ExtBarFrame.setVisible(true);
ExtBarFrame.setSize(800, 800);
ExtBarFrame.setLocationRelativeTo(null);


DefaultCategoryDataset NeuBarDataset = new DefaultCategoryDataset();
NeuBarDataset.setValue(Needs1, "Percentage", "Challenge");
NeuBarDataset.setValue(Needs2, "Percentage", "Closeness");
NeuBarDataset.setValue(Needs3, "Percentage", "Curiosity");
NeuBarDataset.setValue(Needs4, "Percentage", "Excitement");
NeuBarDataset.setValue(Needs5, "Percentage", "Harmony");
NeuBarDataset.setValue(Needs6, "Percentage", "Ideal");
NeuBarDataset.setValue(Needs7, "Percentage", "Liberty");
NeuBarDataset.setValue(Needs8, "Percentage", "Love");
NeuBarDataset.setValue(Needs9, "Percentage", "Practicality");
NeuBarDataset.setValue(Needs10, "Percentage", "Self-expression");
NeuBarDataset.setValue(Needs11, "Percentage", "Stability");
NeuBarDataset.setValue(Needs12, "Percentage", "Structure");

JFreeChart NeuBarChart = ChartFactory.createLineChart("Needs", // Title
"Name", // X-axis Label
"Percentage", // Y-axis Label
NeuBarDataset, // Dataset
PlotOrientation.VERTICAL, // Plot orientation
false, // Show legend
true, // Use tooltips
false // Generate URLs
);

NeuBarChart.getTitle().setPaint(Color.BLACK); // Set the colour of the title
NeuBarChart.setBackgroundPaint(Color.WHITE);  // Set the background colour of the chart
CategoryPlot ExtCatPlot = NeuBarChart.getCategoryPlot();  // Get the Plot object for a bar graph
ExtCatPlot.setBackgroundPaint(Color.WHITE);  // Set the plot background colour
ExtCatPlot.setRangeGridlinePaint(Color.GRAY);  // Set the colour of the plot gridlines

ChartFrame ExtBarFrame = new ChartFrame("Needs", NeuBarChart);
ExtBarFrame.setVisible(true);
ExtBarFrame.setSize(800, 800);
ExtBarFrame.setLocationRelativeTo(null);
### 15.0 Appendix J – BOTH GROUPS CALCULATION

<table>
<thead>
<tr>
<th>Big 5 survey</th>
<th>Application</th>
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<tbody>
<tr>
<td><strong>1</strong></td>
<td>$E = 20 + (1) \ 1 - (6) \ 4 + (11) \ 3 - (16) \ 4 + (21) \ 2 - (26) \ 4 + (31) \ 3 - (36) \ 4 + (41) \ 2 - (46) \ 4 = 11/40 = 27.5%$</td>
</tr>
<tr>
<td>$A = 14 - (2) \ 3 + (7) \ 3 - (12) \ 2 + (17) \ 4 - (22) \ 2 + (27) \ 3 - (32) \ 3 + (37) \ 4 + (42) \ 2 + (47) \ 3 = 22/40 = 55%$</td>
<td>$A = 28.9%$</td>
</tr>
<tr>
<td>$C = 14 + (3) \ 5 - (8) 2 + (13) \ 4 - (18) 1 + (23) \ 4 - (28) 4 + (33) \ 3 - (38) 5 + (43) 4 + (48) 3 = 11/40 = 27.5%$</td>
<td>$C = 0%$</td>
</tr>
<tr>
<td>$N = 38 - (4) \ 4 + (9) 2 - (14) \ 4 + (19) \ 2 - (24) \ 4 + (29) \ 4 - (34) \ 4 - (39) \ 4 - (44) \ 4 - (49) 2 = 12/40 = 55%$</td>
<td>$N = 0%$</td>
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<tr>
<td>$O = 8 + (5) \ 4 - (10) \ 4 + (15) \ 5 - (20) 2 + (25) \ 4 - (30) 3 + (35) 4 + (40) 4 + (45) 3 + (50) 5 = 28/40 = 70%$</td>
<td>$O = 92.3%$</td>
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</tbody>
</table>

| **2** | $E = 20 + (1) \ 3 - (6) \ 2 + (11) \ 5 - (16) 2 + (21) \ 5 - (26) \ 3 + (31) \ 4 - (36) \ 5 + (41) 2 - (46) 2 = 25/40 = 62.5\%$ | $E = 27.2\%$ |
| $A = 14 - (2) \ 2 + (7) \ 3 - (12) \ 2 + (17) \ 3 - (22) \ 2 + (27) \ 3 - (32) \ 2 + (37) \ 4 + (42) \ 2 + (47) \ 5 = 28/40 = 70\%$ | $A = 28\%$ |
| $C = 14 + (3) \ 3 - (8) 1 + (13) \ 4 - (18) 3 + (23) \ 5 - (28) 2 + (33) \ 5 - (38) 3 + (43) 4 + (48) 3 = 29/40 = 72.5\%$ | $C = 2.1\%$ |
| $N = 38 - (4) \ 4 + (9) \ 3 - (14) \ 5 + (19) \ 3 - (24) \ 2 - (29) \ 4 - (34) \ 5 - (39) \ 2 - (44) \ 3 - (49) 3 = 18/40 = 45\%$ | $N = 1.2\%$ |
| $O = 8 + (5) \ 2 - (10) \ 3 + (15) \ 3 - (20) 3 + (25) \ 3 - (30) 3 + (35) 4 + (40) 4 + (45) 5 + (50) 3 = 23/40 = 57.5\%$ | $O = 2.1\%$ |

| **3** | $E = 20 + (1) \ 5 - (6) \ 4 + (11) \ 3 - (16) 4 + (21) \ 2 - (26) \ 4 + (31) \ 3 - (36) \ 4 + (41) \ 2 - (46) 4 = 15/40 = 37.5\%$ | $E = 59.9\%$ |
| $A = 14 - (2) \ 3 + (7) \ 3 - (12) \ 2 + (17) \ 4 - (22) \ 4 + (27) \ 4 - (32) \ 3 + (37) \ 4 + (42) 2 + (47) \ 3 = 22/40 = 55\%$ | $A = 24.5\%$ |
| $C = 14 + (3) \ 5 - (8) 2 + (13) \ 4 - (18) 2 + (23) \ 4 - (28) 4 + (33) \ 3 - (38) 5 + (43) 4 + (48) 3 = 24/40 = 60\%$ | $C = 20.4\%$ |
| $N = 38 - (4) \ 5 + (9) \ 2 - (14) \ 4 + (19) \ 2 - (24) \ 4 - (29) \ 4 - (34) \ 4 - (39) \ 4 - (44) \ 4 - (49) 2 = 11/40 = 27.5\%$ | $N = 51.6\%$ |
| $O = 8 + (5) \ 4 - (10) \ 4 + (15) \ 5 - (20) 2 + (25) \ 4 - (30) 2 + (35) 4 + (40) 4 + (45) 3 + (50) 5 = 29/40 = 72.5\%$ | $O = 96.9\%$ |

| **4** | $E = 20 + (1) \ 5 - (6) \ 1 + (11) \ 5 - (16) 5 + (21) \ 5 - (26) \ 2 + (31) \ 3 - (36) \ 5 + (41) \ 5 - (46) 5 = 25/40 = 62.5\%$ | $E = 26.5\%$ |
| $A = 14 - (2) \ 5 + (7) \ 4 - (12) \ 1 + (17) \ 5 - (22) \ 2 + (27) \ 5 - (32) \ 1 + (37) \ 5 + (42) \ 2 + (47) \ 5 = 34/40 = 85\%$ | $A = 94.4\%$ |
| $C = 14 + (3) \ 4 - (8) 1 + (13) \ 5 - (18) 1 + (23) \ 5 - (28) 5 + (33) 3 - (38) 5 + (43) 3 + (48) 3 = 29/40 = 72.5\%$ | $C = 59.8\%$ |
| $N = 38 - (4) \ 5 + (9) \ 3 - (14) \ 5 + (19) \ 2 - (24) \ 3 - (29) \ 2 - (34) \ 5 - (39) \ 2 - (44) \ 4 - (49) 2 = 16/40 = 40\%$ | $N = 9.6\%$ |
| $O = 8 + (5) \ 5 - (10) \ 2 + (15) \ 5 - (20) 4 + (25) 3 - (30) 4 + (35) 5 + (40) 5 + (45) 5 + (50) 2 = 27/40 = 67.5\%$ | $O = 59.8\%$ |

<p>| <strong>5</strong> | $E = 20 + (1) \ 1 - (6) \ 1 + (11) \ 5 - (16) 2 + (21) \ 4 - (26) \ 2 + (31) \ 3 - (36) \ 5 + (41) \ 5 - (46) 3 = 25/40 = 62.5%$ | $E = 22.2%$ |
| $A = 14 - (2) \ 2 + (7) \ 3 - (12) \ 3 + (17) \ 2 - (22) \ 5 + (27) \ 2 - (32) \ 3 + (37) \ 3 + (42) \ 3 + (47) \ 5 = 19/40 = 47.5%$ | $A = 24.3%$ |
| $C = 14 + (3) \ 5 - (8) 3 + (13) \ 5 - (18) 2 + (23) \ 5 - (28) 2 + (33) 4 - (38) 3 + (43) 5 + (48) 5 = 33/40 = 82.5%$ | $C = 14%$ |
| $N = 38 - (4) \ 3 + (9) \ 3 - (14) \ 5 + (19) \ 2 - (24) \ 3 - (29) \ 2 - (34) \ 5 - (39) \ 3 - (44) \ 4 - (49) 3 = 15/40 = 37.5%$ | $N = 5.5%$ |
| $O = 8 + (5) \ 4 - (10) \ 2 + (15) \ 5 - (20) 2 + (25) 5 - (30) 3 + (35) 5 + (40) 4 + (45) 5 + (50) 5 = 29/40 = 72.5%$ | $O = 91.6%$ |</p>
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<td>E = 20 + (1) S - (6) 1+ (11) 3- (16) 1+ (21) 4 - (26) 2+ (31) 3- (36) 5 + (41) 5 - (46) 3 = 25/40 = 62.5%</td>
<td>E = 4.5%</td>
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<td>A = 14 - (2) S + (7) 5- (12) 1+ (17) 5 - (22) 5 + (27) 2 - (32) 3 + (37) 3 + (42) 3 + (47) 5 = 21/40 = 52.5%</td>
<td>A = 66.8%</td>
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<td>C = 14 + (3) 2 - (8) 3+ (13) 3- (18) 2+ (23) 5 - (28) 2 + (33) 4- (38) 3 + (43) 5 + (48) 5 = 28/40 = 70%</td>
<td>C = 1.8%</td>
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<td>N = 38 - (4) 5 + (9) 4- (14) 5+ (19) 2 - (24) 3 - (29) 2 - (34) 5 - (39) 3 - (44) 4 - (49) 3 = 14/40 = 35%</td>
<td>N = 0%</td>
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<td>O = 8 + (5) 1- (10) 3+ (5) 5- (20) 5 + (25) 5 - (30) 3 + (35) 5 + (40) 4 + (45) 5 + (50) 5 = 27/40 = 67.5%</td>
<td>O = 83.8%</td>
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<tr>
<td>E = 20 + (1) 1 - (6) 4+ (11) 2- (16) 5+ (21) 1 - (26) 4 + (31) 1- (36) 4 + (41) 1- (46) 5 = 4/40 = 10%</td>
<td>E = 17.4%</td>
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<tr>
<td>A = 14 - (2) 4 - (7) 2- (12) 3+ (17) 3 - (22) 2 + (27) 4 - (32) 4 + (37) 2 + (42) 2 + (47) 2 = 16/40 = 40%</td>
<td>A = 4.7%</td>
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<tr>
<td>C = 14 + (3) 3 - (8) 4+ (13) 4- (18) 5+ (23) 4 - (28) 4 + (33) 4- (38) 2 + (43) 4 + (48) 3 = 21/40 = 52.5%</td>
<td>C = 9.6%</td>
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<td>N = 38 - (4) 5 + (9) 2- (14) 5+ (19) 4 - (24) 4 - (29) 4 - (34) 5 - (39) 4 - (44) 5- (49) 4 = 8/40 = 20%</td>
<td>N = 3.1%</td>
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<td>O = 8 + (5) 5- (10) 2+ (15) 5- (20) 2+ (25) 3 - (30) 4 + (35) 3 + (40) 4 + (45) 5 + (50) 2 = 27/40 = 67.5%</td>
<td>O = 17.3%</td>
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<td>E = 20 + (1) 3 - (6) 3+ (11) 5- (16) 3+ (21) 5 - (26) 2 + (31) 3 - (36) 4 + (41) 2 - (46) 3 = 16/40 = 40%</td>
<td>E = 33.1%</td>
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<td>A = 14 - (2) 1 + (7) 3- (12) 1+ (17) 4 - (22) 4 + (27) 4 - (32) 2 + (37) 5 + (42) 4 + (47) 4 = 30/40 = 75%</td>
<td>A = 41.2%</td>
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<td>C = 14 + (3) 3 - (8) 1+ (13) 4- (18) 2+ (23) 3 - (28) 4 + (33) 3- (38) 2 + (43) 3 + (48) 3 = 24/40 = 60%</td>
<td>C = 63.8%</td>
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<td>N = 38 - (4) 3 + (9) 2- (14) 3+ (19) 2 - (24) 3 - (29) 3 - (34) 3 - (39) 2 - (44) 2- (49) 3 = 20/40 = 50%</td>
<td>N = 35.1%</td>
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<td>O = 8 + (5) 3- (10) 4+ (15) 4- (20) 3 + (25) 3 - (30) 2 + (35) 3 + (40) 4 + (45) 5 + (50) 3 = 19/40 = 47.5%</td>
<td>O = 33.9%</td>
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<td>E = 20 + (1) 2 - (6) 1+ (11) 5- (16) 4+ (21) 5 - (26) 1 + (31) 4- (36) 5 + (41) 3 - (46) 2 = 24/40 = 60%</td>
<td>E = 5.8%</td>
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<td>A = 14 - (2) 1 + (7) 5- (12) 4+ (17) 5 - (22) 1 + (27) 4 - (32) 1 + (37) 1 + (42) 5 + (47) 4 = 3/40 = 7.5%</td>
<td>A = 11.7%</td>
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<td>C = 14 + (3) 2 - (8) 5+ (13) 2- (18) 5+ (23) 1 - (28) 5 + (33) 2- (38) 3 + (43) 1 + (48) 3 = 7/40 = 17.5%</td>
<td>C = 0.5%</td>
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<td>N = 38 - (4) 3 + (9) 5- (14) 4+ (19) 3 - (24) 1 - (29) 1 - (34) 2 - (39) 3 + (44) 1- (49) 3 = 28/40 = 70%</td>
<td>N = 3.8%</td>
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<td>O = 8 + (5) 1- (10) 2+ (15) 5- (20) 1+ (25) 3 - (30) 1 + (35) 4 + (40) 4 + (45) 3 + (50) 4 = 26/40 = 65%</td>
<td>O = 60.3%</td>
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<td>E = 20 + (1) 3 - (6) 4+ (11) 5- (16) 3+ (21) 3 - (26) 3 + (31) 3 - (36) 4 + (41) 3 - (46) 5 = 17/40 = 42.5%</td>
<td>E = 9.9%</td>
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<td>A = 14 - (2) 4 - (7) 3- (12) 1+ (17) 4 - (22) 2 + (27) 3 - (32) 2 + (37) 4 + (42) 3 + (47) 4 = 26/40 = 65%</td>
<td>A = 7.9%</td>
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<td>C = 14 + (3) 4 - (8) 4+ (13) 5- (18) 1+ (23) 3 - (28) 2 + (33) 3- (38) 2 + (43) 3 + (48) 4 = 27/40 = 67.5%</td>
<td>C = 24.9%</td>
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<td>N = 38 - (4) 4 + (9) 5- (14) 4+ (19) 1 - (24) 4 - (29) 1 - (34) 3 - (39) 1 - (44) 1- (49) 1 = 27/40 = 67.5%</td>
<td>N = 24.7%</td>
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<td>O = 8 + (5) 3- (10) 2+ (15) 4- (20) 1+ (25) 4 - (30) 2 + (35) 4 + (40) 1 + (45) 5 + (50) 5 = 29/40 = 72.5%</td>
<td>O = 73.8%</td>
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<td>12</td>
<td>[E = 20 + (1) 3 - (6) 2 + (11) 5 - (16) 2 + (21) 5 - (26) 2 + (31) 5 - (36) 2 + (41) 5 - (46) 3 = 32/40 = 80%]</td>
<td>[E = 47.5%]</td>
<td>[A = 24.2%]</td>
<td>[C = 60.1%]</td>
<td>[N = 6.9%]</td>
<td>[O = 98.7%]</td>
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<td>13</td>
<td>[E = 20 + (1) 4 - (6) 2 + (11) 5 - (16) 2 + (21) 5 - (26) 2 + (31) 5 - (36) 4 + (41) 4 - (46) 2 = 31/40 = 77.5%]</td>
<td>[E = 66.2%]</td>
<td>[A = 5.3%]</td>
<td>[C = 14%]</td>
<td>[N = 27.9%]</td>
<td>[O = 94.7%]</td>
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<td>14</td>
<td>[E = 20 + (1) 5 - (6) 1 + (11) 3 - (16) 1 + (21) 5 - (26) 5 + (31) 5 - (36) 3 + (41) 5 - (46) 2 = 29/40 = 72.5%]</td>
<td>[E = 4.5%]</td>
<td>[A = 66.8%]</td>
<td>[C = 1.8%]</td>
<td>[N = 0%]</td>
<td>[O = 83.8%]</td>
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<td>15</td>
<td>[E = 20 + (1) 3 - (6) 2 + (11) 4 - (16) 1 + (21) 4 - (26) 2 + (31) 3 - (36) 2 + (41) 4 - (46) 1 = 32/40 = 80%]</td>
<td>[E = 18.2%]</td>
<td>[A = 62.8%]</td>
<td>[C = 30.3%]</td>
<td>[N = 0%]</td>
<td>[O = 83.8%]</td>
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<td>16</td>
<td>[E = 20 + (1) 3 - (6) 2 + (11) 4 - (16) 2 + (21) 5 - (26) 4 + (31) 5 - (36) 2 + (41) 5 - (46) 2 = 27/40 = 67.5%]</td>
<td>[E = 85.4%]</td>
<td>[A = 59.1%]</td>
<td>[C = 46%]</td>
<td>[N = 6.9%]</td>
<td>[O = 51.4%]</td>
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<td>17</td>
<td>[E = 20 + (1) 4 - (6) 2 + (11) 2 + (16) 5 + (21) 2 - (26) 2 + (31) 5 - (36) 5 + (41) 4 - (46) 5 = 7/40 = 17.5%]</td>
<td>[E = 8.3%]</td>
<td>[A = 11.2%]</td>
<td>[C = 1%]</td>
<td>[N = 0.7%]</td>
<td>[O = 51.2%]</td>
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<td>18</td>
<td>E = 20 + (1) 3 - (6) 2 + (11) 4 - (16) 1 + (21) 4 - (26) 2 + (31) 5 - (36) 2 + (41) 4 - (46) 1 = 32/40 = 80%</td>
<td>E = 18.2%</td>
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<td>A = 14 - (2) 4 - (7) 4 - (12) 4 - (17) 4 - (22) 4 - (27) 4 - (32) 4 - (37) 4 + (42) 4 + (47) 4 = 26/40 = 65%</td>
<td>A = 62.8%</td>
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<td>C = 14 + (3) 5 - (8) 4 + (13) 3 - (18) 4 + (23) 5 - (28) 3 + (33) 3 + (38) 4 + (43) 5 + (48) 4 = 25/40 = 62.5%</td>
<td>C = 30.3%</td>
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<td>N = 38 - (4) 2 + (9) 3 - (14) 2 + (19) 2 - (24) 2 - (29) 2 - (34) 3 - (39) 3 - (44) 2 - (49) 1 = 27/40 = 67.5%</td>
<td>N = 4.4%</td>
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<td>O = 8 + (5) 4 - (10) 3 + (15) 4 - (20) 2 + (25) 5 - (30) 4 + (35) 4 + (40) 4 + (45) 4 + (50) 5 = 24/40 = 60%</td>
<td>O = 69.3%</td>
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<td>19</td>
<td>E = 20 + (1) 5 - (6) 1 + (11) 5 - (16) 1 + (21) 5 - (26) 1 + (31) 5 - (36) 1 + (41) 5 - (46) 1 = 40/40 = 100%</td>
<td>E = 56.9%</td>
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<td>A = 14 - (2) 4 - (7) 5 - (12) 1 + (17) 4 - (22) 2 + (27) 4 - (32) 1 + (37) 4 + (42) 5 + (47) 4 = 32/40 = 80%</td>
<td>A = 73.9%</td>
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<td>C = 14 + (3) 5 - (8) 3 + (13) 2 - (18) 4 + (23) 4 - (28) 4 + (33) 3 + (38) 3 + (43) 5 + (48) 4 = 24/40 = 60%</td>
<td>C = 18.8%</td>
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<td>N = 38 - (4) 2 + (9) 3 - (14) 2 + (19) 2 - (24) 2 - (29) 2 - (34) 3 - (39) 3 - (44) 2 - (49) 1 = 26/40 = 65%</td>
<td>N = 0.4%</td>
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<td>O = 8 + (5) 4 - (10) 2 + (15) 4 - (20) 4 + (25) 4 - (30) 1 + (35) 5 + (40) 3 + (45) 2 + (50) 5 = 23/40 = 57.5%</td>
<td>O = 84.7%</td>
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<td>E = 20 + (1) 5 - (6) 1 + (11) 5 - (16) 1 + (21) 5 - (26) 1 + (31) 5 - (36) 1 + (41) 5 - (46) 1 = 40/40 = 100%</td>
<td>E = 2.4%</td>
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<td>A = 14 - (2) 4 - (7) 5 - (12) 1 + (17) 4 - (22) 2 + (27) 4 - (32) 1 + (37) 4 + (42) 5 + (47) 4 = 32/40 = 80%</td>
<td>A = 11%</td>
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<td>C = 14 + (3) 5 - (8) 3 + (13) 2 - (18) 4 + (23) 4 - (28) 4 + (33) 3 + (38) 3 + (43) 5 + (48) 4 = 24/40 = 60%</td>
<td>C = 0.7%</td>
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<td>N = 38 - (4) 2 + (9) 3 - (14) 2 + (19) 2 - (24) 2 - (29) 2 - (34) 3 - (39) 3 - (44) 2 - (49) 1 = 26/40 = 65%</td>
<td>N = 1.2%</td>
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<td>O = 8 + (5) 4 - (10) 2 + (15) 4 - (20) 4 + (25) 4 - (30) 1 + (35) 5 + (40) 3 + (45) 2 + (50) 5 = 23/40 = 57.5%</td>
<td>O = 83.8%</td>
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<td>E = 20 + (1) 5 - (6) 3 + (11) 5 - (16) 3 + (21) 5 - (26) 2 + (31) 5 - (36) 4 + (41) 2 - (46) 2 = 24/40 = 60%</td>
<td>E = 1.7%</td>
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<td>A = 14 - (2) 4 + (7) 5 - (12) 1 + (17) 4 - (22) 2 + (27) 4 - (32) 1 + (37) 4 + (42) 5 + (47) 4 = 31/40 = 77.5%</td>
<td>A = 10.5%</td>
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<td>C = 14 + (3) 5 - (8) 3 + (13) 2 - (18) 4 + (23) 4 - (28) 4 + (33) 3 + (38) 3 + (43) 5 + (48) 4 = 24/40 = 60%</td>
<td>C = 0.5%</td>
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<td>N = 38 - (4) 2 + (9) 3 - (14) 2 + (19) 2 - (24) 2 - (29) 2 - (34) 3 - (39) 3 - (44) 2 - (49) 1 = 28/40 = 70%</td>
<td>N = 1.7%</td>
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<td>O = 8 + (5) 4 - (10) 2 + (15) 4 - (20) 4 + (25) 4 - (30) 1 + (35) 5 + (40) 3 + (45) 2 + (50) 5 = 23/40 = 57.5%</td>
<td>O = 30.5%</td>
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<td>E = 20 + (1) 5 - (6) 4 + (11) 5 - (16) 5 + (21) 5 - (26) 2 + (31) 5 - (36) 5 + (41) 5 - (46) 5 = 25/40 = 62.5%</td>
<td>E = 9.6%</td>
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<td>A = 14 - (2) 5 + (7) 4 - (12) 1 + (17) 5 - (22) 2 + (27) 5 - (32) 1 + (37) 5 + (42) 5 + (47) 5 = 34/40 = 85%</td>
<td>A = 94.4%</td>
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<td>C = 14 + (3) 5 - (8) 1 + (13) 5 - (18) 5 + (23) 5 - (28) 5 + (33) 5 - (38) 5 + (43) 5 + (48) 2 = 28/40 = 70%</td>
<td>C = 99.8%</td>
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<td>N = 38 - (4) 5 + (9) 3 - (14) 5 - (19) 2 - (24) 3 - (29) 1 - (34) 5 - (39) 5 - (44) 1 - (49) 2 = 16/40 = 40%</td>
<td>N = 9.6%</td>
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<td>O = 8 + (5) 5 - (10) 2 + (15) 2 - (20) 2 + (25) 5 - (30) 4 + (35) 4 + (40) 5 + (45) 5 + (50) 2 = 24/40 = 62.5%</td>
<td>O = 91.8%</td>
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<td>E = 20 + (1) 5 - (6) 4 + (11) 5 - (16) 5 + (21) 5 - (26) 2 + (31) 5 - (36) 5 + (41) 5 - (46) 5 = 25/40 = 62.5%</td>
<td>E = 17.4%</td>
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<td>A = 14 - (2) 5 + (7) 4 - (12) 1 + (17) 5 - (22) 2 + (27) 5 - (32) 1 + (37) 5 + (42) 5 + (47) 5 = 34/40 = 85%</td>
<td>A = 4.7%</td>
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<td>C = 14 + (3) 4 - (8) 5 + (13) 5 - (18) 5 + (23) 5 - (28) 5 + (33) 5 - (38) 5 + (43) 5 + (48) 2 = 28/40 = 70%</td>
<td>C = 9.6%</td>
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<td>N = 38 - (4) 5 + (9) 3 - (14) 5 - (19) 2 - (24) 3 - (29) 1 - (34) 5 - (39) 5 - (44) 1 - (49) 2 = 16/40 = 40%</td>
<td>N = 3.1%</td>
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<td>O = 8 + (5) 5 - (10) 2 + (15) 2 - (20) 2 + (25) 5 - (30) 4 + (35) 4 + (40) 5 + (45) 5 + (50) 2 = 27/40 = 67.5%</td>
<td>O = 17.3%</td>
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