MINISTRY OF EDUCATION AND SCIENCE OF REPUBLIC OF KAZAKHSTAN
SULEYMAN DEMIREL UNIVERSITY
ENGINEERING FACULTY

Department of Computer Engineering

004.3

Alseytova Akerke Abylbekovna

Identification of human personality type using neural networks

6M070400– «Computing systems and software» speciality

Kaskelen, 2013

MINISTRY OF EDUCATION AND SCIENCE OF REPUBLIC OF KAZAKHSTAN
SULEYMAN DEMIREL UNIVERSITY
ENGINEERING FACULTY

SULEYMAN DEMIREL UNIVERSITY

Department of Computer Engineering

«Accepted for defense»
responsible director of department
d.t.s professor Amirgaliyev E. N.
«___» _____ 2013 year

Director of department
for postgraduate education
Ph.s.c. S. Aydogdu
«___» _____ 2013 year

Master dissertation

IDENTIFICATION OF HUMAN PERSONALITY TYPE USING NEURAL NETWORKS

6M070400– «Computing systems and software» speciality

Master student _____ Alseytova Akerke Abylbekovna

Supervisor _____ d.t.s professor Amirgaliyev E. N.

Kaskelen, 2013

ABSTRACT

Topicality of this work is based on conjunction of two knowledge psychology and information technology.

The structure of the thesis consists of Introduction, 3 Chapters, Conclusion and References.

First Chapter is about human character types, why it's so important to learn them and how the graphology knowledge will be useful in this investigation.

In the Second Chapter thesis explains the neural networks, advantages of using ANN, branches of knowledge where it is used and which algorithm will be used to solve our problem.

The Third Chapter can be also called as the main, because it shows as in details how we used neural networks to find out what is the character type of investigated person, why it is useful to use neural networks for this work and what we get as the result.

As a Conclusion part author thesis tells about what kind of work was aimed to do, how much percent of it was done and how it's planes to continue this work.

ТҮЙІН

Осы жұмыстың өзектілігі психология және ақпараттық технологиялар білімін ұштастыруында.

Диссертация: Кіріспе, 3 тарау, Корытынды және Пайдаланылған әдебиет бөлігінен құралады.

Бірінші тарау: адам мінезінің түрлері, оларды зерттеудің маңыздылығы және графологияның білімінің осы зерттеуге пайдасы туралы.

Тезистің екінші тарауы: нейронды желілер, нейронды желілерді қолданудың артықшылықтары, қай білім салаларында пайдаланылатыны және қай алгоритмді пайдалану керектігі жайлы баяндалады.

Тезистің үшінші тарауын негізгі деп санауға болады, себебі ол тарауда адам мінезін табу үшін нейронды желілерді қалай қолданғандығымыз, неге оны пайдалану пайдалы екендігі және нәтижеде не шыққандығы баяндалады.

Ал ақырғы бөлікте диссертацияға қойылған мақсаттар, неше пайызы орындалғандығы және алға қойылған мақсаттар туралы айтылады.

РЕЗЮМЕ

Актуальность этой работы основана на сочетании двух знаний психологии и информационных технологий.
Структура диссертации состоит из Введения, 3 глав, Заключения и Использованной литературы.

Первая глава о типах характера человека, почему так важно изучать их и как знание графологии будет полезным в этом исследовании.

Вторая глава тезиса о нейронных сетях, о преимущества использования ИНС (Исскуственных нейронных сетей), об отраслях знаний, где они используются, и какой алгоритм будет использоваться, чтобы решить поставленную нами цель.

Третья глава может считаться также в качестве основной, поскольку она в деталях показывает, как мы использовали нейронные сети, чтобы узнать каков характер типа исследуемого человека, почему это полезно использовать нейронные сети для этой работы и то, что мы получаем результата.

В заключительной части диссертации рассказывается о том, какова была поставленная цель данной работе, сколько процентов этого было сделано и как планируется продолжить эту работу.

CONTENT

INTRODUCTION

The main thing that differ us, humans from other beings is that we have intellect. And this kind of difference forces us to fill it with different sciences. One of the most interesting sciences is graphology.

Graphology is the pseudoscientific study and analysis of handwriting, especially in relation to human psychology. In the medical field, it can be used to refer to the study of handwriting as an aid in diagnosis and tracking of diseases of the brain and nervous system.

In this project we will take human signatures, take their attributes (12 attributes from 20-30 possible) and give them a number value from 0.1 to 0.9. These values become greater according to relation to two general types of human personality type: "extrovert" and "introvert".

All taken information is processes in the special application that is counting using neural networks.

This project can be useful in finding personality type for HR managers, school and university teachers, and just for those who is interested in it.

1. PSYCHOLOGY PART

1.1 RECOGNIZE THE HUMAN TYPE

The main thing that differ us, humans, from other beings is that we have intellect. And having intellect force us to fill it with knowledge. From ancient times people learned many types of knowledge. Starting from1870th one branch of philosophy becomes an independent scientific discipline in Germany and the United States. This was a *psychology.*

Psychology is an academic and applied discipline that involves the scientific study of mental functions and behaviors. Psychology has the immediate goal of understanding individuals and groups by both establishing general principles and researching specific cases, and by many accounts it ultimately aims to benefit society.

One of the most studied branches of psychology is *personality psychology. Personality psychology* is a branch of psychology that studies personality and individual differences. Its areas of focus include:

- Constructing a coherent picture of the individual and his or her major psychological processes
- Investigating individual differences—how people are unique
- Investigating human nature—how people are alike

"Personality" can be defined as a dynamic and organized set of characteristics possessed by a person who uniquely influences his or her cognitions, emotions, motivations, and behaviors in various situations. The word "personality" originates from the Latin *persona*, which means mask. Significantly, in the theatre of the ancient Latin-speaking world, the mask was not used as a plot device to *disguise* the identity of a character, but rather was a convention employed to represent or *typify* that character.

1.1.1. HUMAN CHARACTER TYPES

Human character types or personality type refers to the psychological classification of different types of individuals. Personality types are sometimes distinguished from personality traits, with the latter embodying a smaller grouping of behavioral tendencies. Types are sometimes said to involve *qualitative* differences between people, whereas traits might be construed as *quantitative* differences. According to type theories, for example, introverts and extraverts are two fundamentally different categories of people. According to trait theories, introversion and extraversion are part of a continuous dimension, with many people in the middle.

Types vs. traits

The term *type* has not been used consistently in psychology and has become the source of some confusion. Furthermore, because personality test scores usually fall on a bell curve rather than in distinct categories, personality type theories have received considerable criticism among psychometric researchers. One study that directly compared a "type" instrument (the MBTI) to a "trait" instrument (the NEO PI) found that the trait measure was a better predictor of personality disorders. Because of these problems, personality type theories have fallen out of favor in psychology. Most researchers now believe that it is impossible to explain the diversity of human personality with a small number of discrete types. They recommend trait models instead, such as the five factor model.

Type theories

An early form of personality type theory was the Four Temperaments system of Galen, based on the four humors model of Hippocrates; an extended Five Temperaments system based on the classical theory was published in 1958.

One example of personality types is Type A and Type B personality theory. According to this theory, impatient, achievement-oriented people are classified as Type A, whereas easy-going, relaxed individuals are designated as Type B. The theory originally suggested that Type A individuals were more at risk for coronary heart disease, but this claim has not been supported by empirical research.

There has been a study to prove that people with Type A personalities are more likely to develop personality disorders whereas Type B personalities are more likely to become alcoholics.

Developmental psychologist Jerome Kagan is a prominent advocate of type theory. He suggests that shy, withdrawn children are best viewed as having an inhibited temperament, which is qualitatively different from that of other children.

As a matter of convenience, trait theorists sometimes use the term *type* to describe someone who scores exceptionally high or low on a particular personality trait. Hans Eysenck refers to superordinate personality factors as *types*, and more specific associated traits as *traits*.

Several pop psychology theories (e.g., *Men Are from Mars, Women Are from Venus*, the enneagram) rely on the idea of distinctively different types of people.

Carl Jung

One of the more influential ideas originated in the theoretical work of Carl Jung as published in the book *Psychological Types*. The original German language edition, *Psychologische Typen*, was first published by Rascher Verlag, Zurich in 1921. Typologies such as Socionics, the MBTI assessment, and the Keirsey Temperament Sorter have roots in Jungian philosophy.

Jung's interest in typology grew from his desire to reconcile the theories of Sigmund Freud and Alfred Adler, and to define how his own perspective differed from theirs. Jung wrote, "In attempting to answer this question, I came across the problem of types; for it is one's psychological type which from the outset determines and limits a person's judgment." He concluded that Freud's theory was extraverted and Adler's introverted. Jung became convinced that acrimony between the Adlerian and Freudian camps was due to this unrecognized existence of different fundamental psychological attitudes, which led Jung "to conceive the two controversial theories of neurosis as manifestations of a type-antagonism."

Four functions of consciousness

In the book Jung categorized people into primary types of psychological function.

Jung proposed the existence of two dichotomous pairs of cognitive functions:

- The "rational" (judging) functions: *thinking* and *feeling*
- The "irrational" (perceiving) functions: *sensing* and *intuition*

Jung went on to suggest that these functions are expressed in either an introverted or extraverted form.

Jung proposed four main functions of consciousness:

- Two perceiving functions: Sensation and Intuition
- Two judging functions: Thinking and Feeling

According to Jung, the psyche is an apparatus for adaptation and orientation, and consists of a number of different psychic functions. Among these he distinguishes four basic functions:

- **sensation**—perception by means of the sense organs;
- **intuition**—perceiving in unconscious way or perception of unconscious contents.
- **thinking**—function of intellectual cognition; the forming of logical conclusions;
- **feeling**—function of subjective estimation;

Thinking and feeling functions are rational, while sensation and intuition are nonrational. According to Jung, rationality consists of figurative thoughts, feelings or actions with reason — a point of view based on objective value, which is set by practical experience. Nonrationality is not based in reason. Jung notes that elementary facts are also nonrational, not because they are illogical but because, as thoughts, they are not judgments.

Attitudes: Extraversion and Introversion

Analytical psychology distinguishes several psychological types or temperaments.

- **Extravert** (Jung's spelling, although some dictionaries prefer the variant *extrovert*)
- **Introvert**

Extraversion means "outward-turning" and introversion means "inward-turning". These specific definitions vary somewhat from the popular usage of the words.

The preferences for extraversion and introversion are often called as *attitudes*. Each of the cognitive functions can operate in the external world of behavior, action, people, and things (*extraverted attitude*) or the internal world of ideas and reflection (*introverted attitude*).

People who prefer extraversion draw energy from action: they tend to act, then reflect, then act further. If they are inactive, their motivation tends to decline. To rebuild their energy, extraverts need breaks from time spent in reflection. Conversely, those who prefer introversion *expend* energy through action: they prefer to reflect, then act, then reflect again. To rebuild their energy, introverts need quiet time alone, away from activity.

The extravert's flow is directed outward toward people and objects, and the introvert's is directed inward toward concepts and ideas. Contrasting characteristics between extraverts and introverts include the following:

- Extraverts are *action* oriented, while introverts are *thought* oriented.
- Extraverts seek *breadth* of knowledge and influence, while introverts seek *depth* of knowledge and influence.
- Extraverts often prefer more *frequent* interaction, while introverts prefer more *substantial* interaction.
- Extraverts recharge and get their energy from spending time with *people*, while introverts recharge and get their energy from spending time *alone*.

The attitude type could be thought of as the flow of libido (psychic energy). The functions are modified by two main attitude types: extraversion and

introversion. In any person, the degree of introversion or extraversion of one function can be quite different from that of another function.

1.1.2. WHY IT'S IMPORTANT TO LEARN THE HUMAN TYPE?

a. Understanding your personality type can help you choose a major and career path

Many people have difficulty defining the type of work they want to do, particularly when a tough job market might sway your decision towards a specific field over others. From your choice in subjects to study to deciding which major to sign on for, knowing your personality type can help you understand what works for you and why you're comfortable or uncomfortable in certain fields or industries. From there, you can look for a field of study that satisfies your preferences.

For instance, if you've chosen to go into law, knowing whether you have a preference for introversion or extraversion can help you narrow down the position you would be most comfortable working in (which helps you determine courses to take in order to prepare for the specific job). While a person who prefers extraversion might desire a position with more interaction with people (such as a legal clerk), one whose preference is introversion may be more comfortable in research.

b. Knowing your preferences can help you do well academically

Your personality type affects how you learn and determines what teaching styles are best for your natural preferences – and, as you might imagine, these learning preferences affect how you take in information. While college professors all have different ways of teaching, knowing how you learn best can help you determine why you're finding one class more difficult over another. Personality type is a great point of reference when approaching a professor. It helps them understand your learning style and preferences in order to determine how to help you understand the material better.

Personal preferences also play into study and work habits. If your preference is for intuition, you may be more apt to remember specifics when they relate to a pattern, whereas those whose preference is sensing may be more inclined to focus on and remember specifics.

c. Communicating your strengths is an essential part of the hiring process

If you know and understand your personality type, strengths and natural preferences, you'll be ahead of the crowd when applying for an internship or entry-level job. Clearly communicating your strengths to a potential employer is an important part of the hiring process, and it's also something that many people struggle with.

Determining your fit at a target company is also important during the job search, and depending on your personality type, you may fit in better at one company over another. For example, a person with a preference for judging might experience more stress in an environment that has little structure and prefers, instead, to have clear processes and responsibilities in place. This might become apparent during the hiring process, or you might discover the company is not the right fit during an internship. Either way, understanding your preferences helps you examine why a company might not be a good fit and will help guide you in finding one that is.

The way you communicate is vital to your leadership role. Whether you are a leader as a parent in your home, as a teacher in your classroom, in any business setting with peers, managers, staff or clients or as a young person learning leadership skills for the first time, you will be judged by the way you communicate.

We all know we are different, this is obvious. It is easier to communicate with people who are similar to us. However, if you can adapt your behavior to support, nurture, motivate and inspire people who are different to you then you set yourself apart as a great leader.

As a leader you have people's attention, to get respect you must communicate well. Understanding personality type can make the world of difference!

1.1.3 HOW CAN WE LEARN THE HUMAN TYPE?

An investigative personality type tends to be analytical, intellectual and scholarly. They enjoy research, mathematical or scientific activities. These individuals live in their mind and prefer to deal with the real world from a distance. They like to read, study, use books and other data instead of working hands-on. These individuals are unconventional and independent thinkers, who are curious and very insightful.

Investigative personality type enjoys solving problems

Using logic and solving highly complex, abstract problems are what these individuals enjoy most. An **investigative personality type** tends to focus on ideas when they are involved with people. Wherever they are, they collect information and analyze situations before making decisions. If they enjoy the

outdoors, it's because they are curious, not because they enjoy rugged, heavy, physical work.

Investigative personality type is intelligent but not a leader

An investigative personality type sees themselves as highly intelligent, but they may be introverted and lack leadership and persuasive skills. They use their mind /information to achieve, rather than their association with people and things. These individuals often avoid activities that seem mundane, commercial or enterprising. Take a free personality test to learn more about other work preferences and to **test personality**.

Possible occupations that fit an investigative personality type

An investigative personality type prefers working in an environment that encourages **scientific competencies,** allows independent work and focuses on solving abstract, complex problems in original ways. Some of the occupational areas that fit this personality are:

Figure 1. Occupational areas for investigative personality types.

A free personality test gives you more insight

One of the most popular models used for personality tests today is the Holland Codes developed by psychologist John L. Holland. The **investigative personality type** is one of six personality types in his theory.

1.2 GRAPHOLOGY

1.2.1 GRAPHOLOGY DEFİNİTİON

Graphology is the pseudoscientific study and analysis of handwriting, especially in relation to human psychology. In the medical field, it can be used to refer to the study of handwriting as an aid in diagnosis and tracking of diseases of the brain and nervous system. The term is sometimes incorrectly used to refer to forensic document examination.

Graphology has been controversial for more than a century. Although supporters point to the anecdotal evidence of thousands of positive testimonials as a reason to use it for personality evaluation, most empirical studies fail to show the validity claimed by its supporters.

1.2.2 GRAPHOANALYSİS

Graphoanalysis (a registered trademark of the International Graphoanalysis Society) is a system of Handwriting Analysis that falls within the approach of *Integrative Graphology*. The core tenet is that every stroke of handwriting has a meaning which can be understood only within the context of the other strokes present in the handwriting.

Basic Traits are the meanings that are ascribed to individual stroke structures. These scores are derived from the frequency and intensity of the stroke structure.

Evaluated Traits are the meanings ascribed to clusters of individual stroke structures. This indicates how the trait is made manifest in the personality.

A professional Graphoanalyst bases their report exclusively on the Evaluated Trait scores.

1.2.3 HİSTORY

The first specialized book dealing with the relationship between handwriting and the character of the writer was published in 1622 in Capri by Camillo Baldi (Baldo), an Italian, who was both Doctor of Medicine and Philosophy and Professor of Theoretical Medicine at the University of Bologna. Another Italian professor, this time of Anatomy, called Marcus Aurelius Severinus, wrote a book on the same subject about the same time; but he died

from the plague in 1656 before it was published. From the mid-seventeenth century onwards, the number of articles and treatises on this topic continued to increase. The most important of them are the studies of the Swiss physiognomist Lavater in the eighteenth century and a book by the French writer Hocquart which appeared in 1812, at first anonymously.

The real origins of modern graphology are to be found in France. A study circle formed amongst the members of the higher French clergy systematically examined the relationship between human qualities and their graphic expression in handwriting. Cardinal Regnier, Archbishop of Cambrai, Bishop Boudinet of Amiens and the Abbe Flandrin belonged to this study group. Flandrin later became the teacher of the man who is the acknowledged founder of modern graphology as a science, Jean Hippolyte Michon (1806-81); Michon also established the name Graphology which is composed of the Greek words grapho, meaning I write, and logos, which means theory or doctrine. The Abbe Michon, like most of the great graphological research workers before and after him, was a man of wide knowledge with many spheres of interest. In the course of his long life he published not only novels but also books on many topics; but the sphere in which he won the greatest success and everlasting fame was graphology, where he formulated almost all the signs and rules on which it is still based. Michon, who himself called graphology an art, worked only by experience and observation.

In the course of years of study, he compared the handwriting of thousands of people whose character was familiar to him. With his intuitive genius and great faculties of observation, he found the graphic signs which writers with similar qualities and deficiencies have in common. With the help of his collaborators, Delestre and Debarolle, he collected the signs of almost every human quality and published them from 1872 onwards. By his life work Michon produced an invaluable catalogue, so far unsurpassed, of graphological signs and rules based on his own experience. He did not attempt, however, to explain the probable reasons for the production of these signs, or to connect the psychology of handwriting with other branches of physiology or psychology, or to form a theoretical system.

The French school which followed him, led by his eminent pupil, Jules Crepieu-Jamin, continued to emphasize experience and empirical comparison in their graphological research. However, Crepieu-Jamin abandoned Michon's doctrine of definite signs, which point to only one meaning, and elaborated a more subtle system of co-ordination of dominant signs. A society for the study of graphology was founded by Depoin, who also edited a periodical. Thus a centre of research and discussion was created, which attracted many illustrious

Frenchmen including Dr. Binet, Director of the Sorbonne, Arsene Aruss and G. Tarde the sociologist. This tradition is upheld by the modern French school.

The theoretical system of graphology, based on physiology and psychology and its connection with the other branches of characterology, was the work of the German school. In Germany a contemporary of Michon, Adolf Hentze, worked as a graphological practitioner for a Leipzig periodical and by a series of correct handwriting analyses not only thrilled the readers of the paper but also drew attention to the subject. The books and articles, however, which this writer published did not help the development of research, the impetus for which came from Austria. Here E. Schwiedland, later a Professor of Economics, published articles and a book based on the discoveries of the French school.

Later, Schwiedland's interest was fully absorbed by economics, but his pupils, for instance, the gifted Austrian woman Rudolphine Poppee and the German Wilhelm Langenbruch, worked on so that the new science should be recognized. Langenbruch, a very able expert, founded in 1895 a periodical entirely devoted to graphology. He introduced two medical doctors to assist his researches and these later became his chief collaborators. One of them, Dr. William Preyer, a University Professor of Medical Physiology, was born in England. He went as a child to Germany and became the founder of the new theory which took into account the physiology, psychology and pathology of handwriting and so connected graphology with the other achievements of modern science.

In 1897, a second graphological periodical was founded in Germany, also a society for graphological research. The founder of both was Hans Busse, a gifted practitioner and an able organizer who edited a critical German edition of Crepieu-Jamin's main works. The chief contributors to Busse's periodical were Dr. Georg Meyer and Busse's assistant editor, Dr. Ludwig Klages. Dr. Georg Meyer was psychiatrist to a German mental home. He wrote a book in which he systematically analysed the scientific and theoretical basis of handwriting psychology, in particular the spontaneity of writing impulses.

The great importance of Meyer was overshadowed only by the eminence of Dr. Ludwig Klages, the most important research worker and the acknowledged high-priest of the German theoretical school. His achievements and those of Michon together form the real basis of graphology.

Klages, who later moved to Switzerland, wrote many books on problems of philosophy and the psychology of expression. He was the first to create a complete and systematic theory of graphology. It was he who first saw in it the expression of human personality as a whole, and fitted it into its place with the

other doctrines of human expression and characterology. He brought the basic elements of handwriting, into a system clearly defining the various meanings of every single handwriting trend, according to a general law of polarity (that is, the same trend can denote one quality in one handwriting and the converse of the same quality in another). Klages based his researches on a conception of writing as a conflict between natural impulses and rhythms on the one hand, and mental discipline on the other. He worked out a new system of analysis determined by a general standard of handwriting. For him the standard of writing is high when the writer succeeds in reconciling his genuine personal rhythm with the requirements of disciplined writing; the standard is lower by the degree to which he fails to achieve this reconciliation. By analysing the changeable and unchangeable elements in handwriting, he found a way to reveal both intentional and unintentional disguise. But in spite of his great merits, Klages' system also had deficiences. In the first place, he overemphasized his personality conception; his somewhat rigid system of compressing human nature into standards of value based on his ideals of personality does not allow for the relativity of all tendencies in human character. He is opposed to the idea that potential faculties of the same human being can develop in opposite directions and that the positive and negative aspects of the same writing tendency can consist in the same person.

Secondly, Klages' intellectualism, and his tendency to supercilious condescension in appreciating the achievements of the French empirical school, prevented graphology from developing discoveries by experience and practical achievement, and inclined it to a more sterile study of characterological theory. Thirdly, his slight knowledge of the peculiarities of national characters and handwritings confined his practical achievements to the zone of specifically German text-book writings and to a specific German conception of character. Fourthly, his somewhat Carlylean conception of personality resulted in his ignoring the Freudian and other schools of thought, and so he missed the connection between graphology and the modern psychology of the unconscious.

These last two points—the peculiarities of national handwriting and the connection between graphology and the psychology of the unconscious—were developed by two other men who, basing their ideas on those of Klages, filled the gap to a certain extent.

The first was Robert Saudek, who came from Czechoslovakia and finished his main works in England. He was a polyglot who wrote some of his books in English and some in German. He was especially concerned with the differences between national characters and national copy-book writing. He made a special study of English handwriting, in particular the criterion of speed which is a most

important factor. Thus he created a basis for the application of continental research to English handwriting.

The second was Max Pulver, the Swiss, one of the most ingenious of the present generation of graphologists. He partially abandoned Klages' abstract and idealistic conception of personality, and linked graphology with the discoveries of the psychology of the unconscious. He emphasized the strong symbolic element in handwriting, and especially illuminated the problem of what the writing space symbolizes in the writer's mind.

Apart from these general fields of research, many specialized fields have been investigated by different authors. Here are just a few of them.

- The identification of handwriting in law-cases has been dealt with by Michon himself, by Dr. Meyer, Busse, the German Schneickert, Weingart and the Austrian Dr. Gross.
- The writing of criminals has been extensively studied by Crepieu-Jamin, Langenbruch, Pulver, the Italian psychiatrist, Professor Lombroso, the Austrian Dr. Wieser and many others.
- There are excellent studies of children's handwriting by the Frenchman Couilliaux, and a German lady Mina Becker. The German Bahnsen wrote a book to show how graphology can be used for educational purposes.
- The expression of the sexual character in handwriting has been investigated, and thrilling discoveries have been made by Georg and Anja Mendelssohn.
- Monographs have been written by the Swiss Keller and by the Frenchman Duparchy on the writing of addresses and signatures.
- The graphological characteristics of illnesses have been dealt with in many books. A general diagnosis of all illnesses has been attempted, as for instance in the book by Duparchy, but these attempts have so far proved unsatisfactory. There are, however, many valuable studies of the writing of patients suffering from mental and nervous diseases also of degenerates, made by Lombroso, the German Koster, the Austrian psychiatrist Pick, the Frenchman Dr. Rogues de Fursac and many others.
- Handwriting and professional choice have been dealt with by the French collaborating under the direction of Pierre Foix.

Finally a few words on the development of graphology in England. As already mentioned, many great English writers and artists have been attracted by handwriting. A lot of clever remarks on the subject have been made by Scott, Poe, the Brownings, Byron, the painter Gainsborough, Disraeli and others. The first Englishman to deal extensively with the relation between character and

handwriting was Stephen Collett, alias Thomas Beverley, who published his book in 1823.

Continental graphology was introduced to England and made popular by Shooling, who translated the main work of Crepieu-Jamin. An English lady Rosa Vaughan also wrote a very useful text-book. The work of the" German heoretical school, was brought to England by Robert Saudek, the handwriting expert, novel-writer and polyglot from Prague. Saudek had many pupils of whom one, C. H. Brooks, wrote a textbook based on Saudek's system which was translated into German. In the last years before the 1939-45 war another fairly prominent continental graphologist, H. J. Jacoby, came to England and published some books here, in which he used photographic illustrations in a very clever way to explain the connection between features of handwriting and their pictorial parallels in nature and in human movements.

1.2.4. HANDWRİTİNG ANALYSİS TOOLS

A person's handwriting - the script - and its placing on the page express the unique impulses of the individual: logically, the brain sends signals along the muscles to the writing implement they control. By examining a handwriting sample, an expert graphologist is able to identify relevant features of the handwritten script, and the way the features interact. The features, and interaction between them, provide the information for the analysis. (No single handwriting sample will exhibit all 300 different features of course - a typical analysis will involve far less).

No single handwriting feature proves anything specific or absolute by itself; a single feature alone can only identify a trend. It is the combination of features, and the interaction between them that enable a full and clear interpretation.

Professional graphologists operate to a strict code of ethics, and these experts are constantly in demand; those who use it recognise its value in the workplace as an additional method of understanding character. It is therefore an extremely useful tool in identifying the quality and capacity of an individual's talents and potential, particularly in career guidance and improving relationships. Like other powerful behavioural or intuitive models, it is not easy to explain how and why graphology works, nevertheless it continues to be used, respected and appreciated by many because it achieves a high level of results.

As previously stated there are around 300 features - this introductory article attempts to explain some of the basic ones that can be readily understood and which give interesting information.

Slant

Right slant indicates a response to communication, but not how it takes place. For example, the writer may wish to be friendly, manipulative, responsive, intrusive, to sell, to control, to be loving, supportive, just to name some possibilities.

If the handwriting is generally upright, this indicates independence. A left slant tendency shows emotion and reserve. This writer needs to be true to self first and foremost and can be resentful if others try to push for more commitment from them.

Size

Handwriting is made up of three zones - or cases - middle, upper and lower. A basic average measure - or benchmark - by which size can be judged is 3mm per zone. This gives a benchmark for a non-remarkable full height of 9mm. More than this is large; less than this is small.

Large size handwriting can mean extravert and outgoing, or it can mean that the writer puts on an act of confidence, although this behaviour might not be exhibited to strangers.

Small size can, logically, mean the opposite. Small size handwriting can also indicate a thinker and an academic, depending upon other features in the script.

If the writing is small and delicate, the writer is unlikely to be a good communicator with anyone other than those on their own particular wavelength. These people do not generally find it easy to break new ground socially.

Pressure

Heavy pressure indicates commitment and taking things seriously, but if the pressure is excessively heavy, that writer gets very uptight at times and can react quickly to what they might see as criticism, even though none may have been intended. These writers react first and ask questions afterwards.

Light pressure shows sensitivity to atmosphere and empathy to people, but can also, if the pressure is uneven, show lack of vitality.

Upper zone or case (as in l, t, h, etc)

Tall upper strokes are reaching towards goals and ambitions or, if they are very extended, there may be unrealistic expectations of what the person feels they must achieve.

If there are reasonably proportioned upper zone loops, this indicates someone who likes to think things through and use their imagination in a sensible way. Wider upper zone loops indicate more of a tendency to dream up ideas and mull them over.

If the up-stroke goes up and then returns on top of itself, the writer may be squeezing out imagination and keeping to the basic requirement of getting down to the job in hand.

Lower zone (as in g, y, p, etc)

Lower loops are also varied and have different meanings.

For example a straight stroke shows impatience to get the job done.

A 'cradle' lower stroke suggests an avoidance of aggression and confrontation.

A full loop with heavy pressure indicates energy/money-making/sensuality possibilities, subject to correlation with other features.

A full lower loop with light pressure indicates a need or wish for security.

If there are many and varied shapes in the lower zone, the writer may feel unsettled and unfocused emotionally. Again the handwriting analyst would look for this to be indicated by other features in the script.

Word spacing

The benchmark by which to judge wide or narrow spacing between words is the width of one letter of the person's handwriting.

Wide spaces between words are saying - 'give me breathing space'.

Narrow spaces between words indicate a wish to be with others, but such writers may also crowd people and be intrusive, notably if the writing lacks finesse.

Line spacing

Handwriting samples are always best on unlined paper, and particularly for exhibiting line-spacing features.

Wide-spaced lines of handwriting show a wish to stand back and take a long view.

Closely spaced lines indicates that that the writer operates close to the action. For writers who do this and who have writing that is rather loose in structure, the discipline of having to keep cool under pressure brings out the best in them.

Page margins

The sides of the page each have a meaning. The left side margin shows the roots and beginnings/family. The right side shows other people and the future. The top is goals and ambitions. The foot of the page shows energy, instincts and practicality. Therefore margins are very informative.

If the writer has a wide left margin, the interest is in moving on. If it is narrow, caution and wanting to avoid being pushed before they are ready is indicated.

Narrow right margin shows impatience and eagerness to get out there and on with things.

Wide right margin shows that there may be some fear of the unknown.

Middle zone or case (as in a, c, e, etc)

These middle zone shapes can give some particularly interesting information.

The middle zone in the script represents the ego - from it we get a lot of information as to how the writer feels and acts in public settings - what makes them tick socially and at work.

Some people's handwriting consists of only one single style, but many people will have a mixture of two handwriting styles or more.

Again this provides useful information.

All of these features have potentially positive and negative connotations; the analyst uses the flow and facility (ease, smoothness) of the script to infer a positive or negative interpretation.

Arcade

This means that the middle zone of the writing is humped and rounded at the top like a series of arches. It is in the basic style of copy-book, though it is not taught in all schools. Writers who use this can be loyal, protective, independent, trustworthy and methodical, but negatively they can be secretive, stubborn and hypocritical when they choose. The most important characteristic is group solidarity against outsiders.

Garland

Garland is like an inverted 'arcade' and is a people-orientated script. These writers make their m's, n's and h's in the opposite way to the arcade writer, like

cups, or troughs, into which people can pour their troubles or just give information. The Garland writer enjoys being helpful and likes to be involved.

Angle

Angled middle zone is the analytical style, the sharp points, rather than curves, give the impression of probing. The angle writer, is better employing talents at work and for business or project purposes, rather than nurturing, which is the strength of the garland writer.

As with any indicators of personality style, the interpretation doesn't mean that each writer needs to be categorised and prevented or dissuaded from spreading their talents and interests, but the analysis can helpfully show where the person's strengths can be best employed.

Thread

Thread handwriting is like unravelled wool, waiting to be made up into something fresh. These writers are mentally alert and adaptable, but can also be elusive and lack patience. They are responders, rather than initiators. They can be very clever at drawing together strands of information and making something of them. Therefore they observe and bide their time, so that decisions are made at the most appropriate moment.

Wavyline

Wavyline handwriting is often an amalgam of all or most of the other forms and is usually written by people who are mentally mature and skilful. It shows that they can call on a variety of responses, to suit the occasion and indicates good coping mechanisms. They are adaptable and resourceful.

These features and interpretations provide a small but useful guide as to the way people behave, and particularly how they handle their social requirements. Check your own handwriting against these pointers to see what you can learn or confirm about yourself, and see also how effective even just a few simple graphology techniques can be in revealing personality style.

Understanding the personality through handwriting is a valuable way of making the best of both personal awareness and interpersonal situations for the benefit of all concerned.

The aim in using graphology to analyse a person's handwriting must always be positive. The interpretation should enable people analysed to use the understanding gained, to help them live their lives to the highest level of satisfaction that they choose. In a professional or organizational context, graphology can play an important part in enabling working relationships to be forged that will enhance the quality of the group or team performance.

As a child you were taught to write, but it's not likely that you still write in the way you were taught. The fact that you don't helps to explain the reason graphology exists and why graphology can be used to interpret personality.

1.2.5. SIGNATURE ANALYSIS

Your signature is unique. It is also your public face.. It represents you on important documents, on messages to friends: it is your mark of promise, your bond. And it says more about you than any other set of letters.

The signature is a multi-purpose sign. It commits you to, say, repay a debt, that what you state on your tax form is correct, that you support the views expressed in a letter — it is used to help enforce the law. Yet it is also used in personal communication to friends, wishing someone a happy birthday, and much more.

So it is not surprising that people use variations of their signatures depending on what it is being used for. A signature on a legal document might be signed with your full name, including initial letters of middle names. A letter to a friend might simply be signed with a pet name.

Your signature is central to your identity, yet you sign your name thousands of times in your life, so often that writing it becomes a completely automatic, mechanical act. The signature is a stylized form of writing: it shows how you want the world to percieve you.

As always in graphology, the rules of common-sense apply. Ask the writer to produce their typical signature that they would use to sign a cheque. Use that for your analysis.

The first thing to consider with the signature is how it compares with the rest of the person's handwriting. Although signatures tend to be slightly stylized, they echo traits in the script. Any differences between the two show a discrepancy between the writer's view of their own character and how they expect to be regarded — there is something false here. The meaning of the differences is explained on this webpage.

Size

The larger the signature, the greater the writer's self esteem, and expectation that this should be recognised.

Large signature: this shows a sense of high status -which may in real life be the case, but in terms of the signature that is not the point — of having value.

If the signature is larger than the handwriting, the writer carries a pretence of higher self esteem — and confidence — than is the case. It is a 'front'.

Medium size signature (same as handwriting): shows a balance of sense of value and modesty. If it is the same size as the script it shows someone with a knowledge of, and acceptance of, how he or she is perceived. When this person is in public, they do not put on an act.

Small signature: the writer expects little esteem from other people. This may imply a high degree of self-motivation and disregard for what people think, but is more likely to be a sign of low self-confidence. If the signature is smaller than the script, the writer does not expect recognition of their worth. It may be this is a deliberate holding back, a defensive posture.

Content

For typical use, the majority of people nowadays use their full first name and surname. Those who choose not to and opt for use of initials instead of their christian name(s) will have one of two reasons:

a) They prefer the formality and reserve of the more 'businesslike' initials, in which case they are likely to have conventional, perhaps even old fashioned, values, or

b) they deeply dislike their first name.

Writing your full name in your signature reveals a more informal, relaxed approach to life – the writer likes to get on first name terms quickly.

Legibility

Legibility bears little relation to speed: the fast writer can still be perfectly readable, and the slow writer can have an impossibly messy script. In handwriting, legibility is, subconsciously, a matter of choice. The same applies in the signature.

If the illegible signature closes a business letter, it shows that the writer does not consider their name to be of great importance to the matter in hand: they are a mere functionary. The personal signature may be very different.

A consistently illegible signature implies that 'you really ought to know who I am, and if you don't, it is your loss!'. A certain arrogance and self importance is apparent.

If the surname is more legible than the first name the writer shows reserve on first contact with people – a holding back of familiarity until they get to know a person better.

A first name more legible than the surname reveals a more approachable, direct person who will make a great effort to be friendly.

Complete legibility shows open and straightforward social attitudes. The writer is happy to be accepted as they are.

Comparisons on legibility with script

Legible script, illegible signature: the writer feels what is said is of more importance than his or her true identity, and is hiding his or her true self.

Illegible script, illegible signature: a deliberate attempt to create an aura of mystery and enigma around the writer, who enjoys the idea of being difficult to know. They do not want you to know what they are really thinking!

Illegible script, legible signature: greater importance placed on the writer's name than on what they actually say. Draw the obvious conclusion!

Placement

Like the margins and layout of the page, placement of signature is quite revealing. Business letters should not be used for analysis as they have a standard format.

Signature on left: writer seems in public to be withdrawing from the future, clinging to the past. May be a pose.

Signature in the middle: a show of importance, a need for attention.

Signature on right: forward looking, natural.

Direction and slant

The same interpretations on line direction and slant are made as for the script, but watch out for differences between the signature and the handwriting.

Signature rising more than handwriting: the writer is showing their optimism and energy to the outside world, but some of this is just show. The reality, revealed in the less image-conscious handwriting, is a more balanced, level headed approach.

Signature falls more than handwriting: the same principle reveals an appearance of pessimism and lack of vitality that may not be an accurate reflection of the writer's true feelings.

Right slant signature: an outgoing, bubbly, outer persona.

Left slant signature: does not push self forward.

Embellishments

The signature stands in its own right. Any additional strokes are a deliberate attempt to draw more attention to it.

Lines through signature: self-critical, unhappy.

Underlining: need for responsibility and importance. Betrays a lack of self-confidence and a need for recognition and status.

Circles: wants to be protected. May be very defensive and needs reasssurance.

Full stop: a sign of self-centredness – 'the world stops with me'!

Vertical line at end: a block on the outside world, this person has a private world to retreat into.

Larger letters or names: irregularities in letter or name size within the signature draw attention to certain parts of it, stressing their importance to the writer. Typically, formal people increase the size of the surname, for example.

Examples

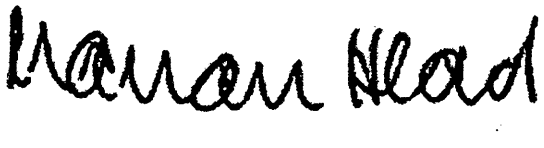

Figure 2. Signature of Example 1.

The initial capitals are the same size as the rest of the letters, indicating an informal, easy-going social image. The diminished upper zone shows self-sufficiency. The letters have angled tops and curving bases, revealing a gentle nature and a sharp mind. The double loops inside the 'a' s indicate great secrecy: this person is very capable socially, but highly self-reliant and does not let people know her inner thoughts very frequently.

Figure 3. Signature of Example 2.

This is a straightforward, unembellished signature, in the garland style. The impression is one of openness, (reinforced by the open top to the 'g'), softness, and the deep lower loop suggests a strong pull to family.

Figure 4. Signature of Example 3.

An interesting point about this signature is that only part of it – the surname – is underlined. This emphasizes the importance of the surname, yet the letters of the first name are disproportionately large. This person has two images: a formal, businesslike, professional manner, and a more chatty and extrovert private nature.

Figure 5. Signature of Example 4.

This signature starts with a flamboyant gesture and ends with a series of decreasing letter sizes and a long, looped underline embellishment. This person likes to make a big, stylish entrance to make his presence felt, but after this he retreats from this showy manner. The underline stresses his importance and status (see how it accentuates his first name again — the manner is informal). The crucifix like Y suggests an interest in religion.

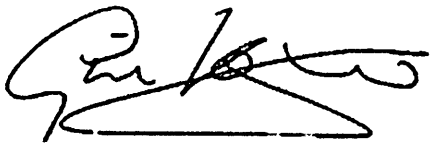

Figure 6. Signature of Example 5.

The sweeping, drooping line through the surname is a sign of great self-criticism in professional life. The large curve of the initial 'g' letter is protecting the rest of the first name, and the large underlining stroke steers clear of the christian name. It all adds up to someone who regards their private and professional lives as entirely separate existences.

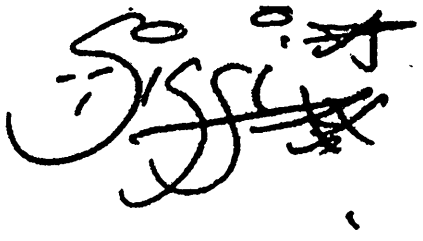

Figure 7. Signature of Example 6.

A highly embellished signature which only comprises the christian name. The circle 'i' dots show a strong desire to be seen as sophisticated. The heavy rising underline shows a high view of self worth, and the stylized 'kiss' crosses indicate an extravagantly showy image. The dots before and after the name imply that this image has been carefully planned and executed. This person wants to be seen as a 'star', and is prepared to work hard at it!

You are now equipped to gain some very deep understandings of what a person is really like from their handwriting, and, from their signature, how they would like to be seen. It is rare for there to be no discrepancy at all between script and signature style, and the differences are usually very revealing. Study them carefully, and always bear in mind the essential differences between the role of handwriting — to communicate information – and the signature — to say who you are.

2. TECHNOLOGY PART

2.1 NEURAL NETWORKS

Artificial Neural Networks are relatively crude electronic models based on the neural structure of the brain. The brain basically learns from experience. It is natural proof that some problems that are beyond the scope of current computers are indeed solvable by small energy efficient packages. This brain modeling also promises a less technical way to develop machine solutions. This new approach to computing also provides a more graceful degradation during system overload than its more traditional counterparts.

These biologically inspired methods of computing are thought to be the next major advancement in the computing industry. Even simple animal brains are capable of functions that are currently impossible for computers. Computers do rote things well, like keeping ledgers or performing complex math. But computers have trouble recognizing even simple patterns much less generalizing those patterns of the past into actions of the future.

Now, advances in biological research promise an initial understanding of the natural thinking mechanism. This research shows that brains store information as patterns. Some of these patterns are very complicated and allow us the ability to recognize individual faces from many different angles. This process of storing information as patterns, utilizing those patterns, and then solving problems encompasses a new field in computing. This field, as mentioned before, does not utilize traditional programming but involves the creation of massively parallel networks and the training of those networks to solve specific problems. This field also utilizes words very different from traditional computing, words like behave, react, self-organize, learn, generalize, and forget.

Analogy to the Brain

The exact workings of the human brain are still a mystery. Yet, some aspects of this amazing processor are known. In particular, the most basic element of the human brain is a specific type of cell which, unlike the rest of the body, doesn't appear to regenerate. Because this type of cell is the only part of the body that isn't slowly replaced, it is assumed that these cells are what provides us with our abilities to remember, think, and apply previous experiences to our every action. These cells, all 100 billion of them, are known as neurons. Each of these neurons can connect with up to 200,000 other neurons, although 1,000 to 10,000 is typical.

The power of the human mind comes from the sheer numbers of these basic components and the multiple connections between them. It also comes from genetic programming and learning.

The individual neurons are complicated. They have a myriad of parts, sub-systems, and control mechanisms. They convey information via a host of

electrochemical pathways. There are over one hundred different classes of neurons, depending on the classification method used. Together these neurons and their connections form a process which is not binary, not stable, and not synchronous. In short, it is nothing like the currently available electronic computers, or even artificial neural networks.

These artificial neural networks try to replicate only the most basic elements of this complicated, versatile, and powerful organism. They do it in a primitive way. But for the software engineer who is trying to solve problems, neural computing was never about replicating human brains. It is about machines and a new way to solve problems.

Artificial Neurons and How They Work

The fundamental processing element of a neural network is a neuron. This building block of human awareness encompasses a few general capabilities. Basically, a biological neuron receives inputs from other sources, combines them in some way, performs a generally nonlinear operation on the result, and then outputs the final result. Figure 8 shows the relationship of these four parts.

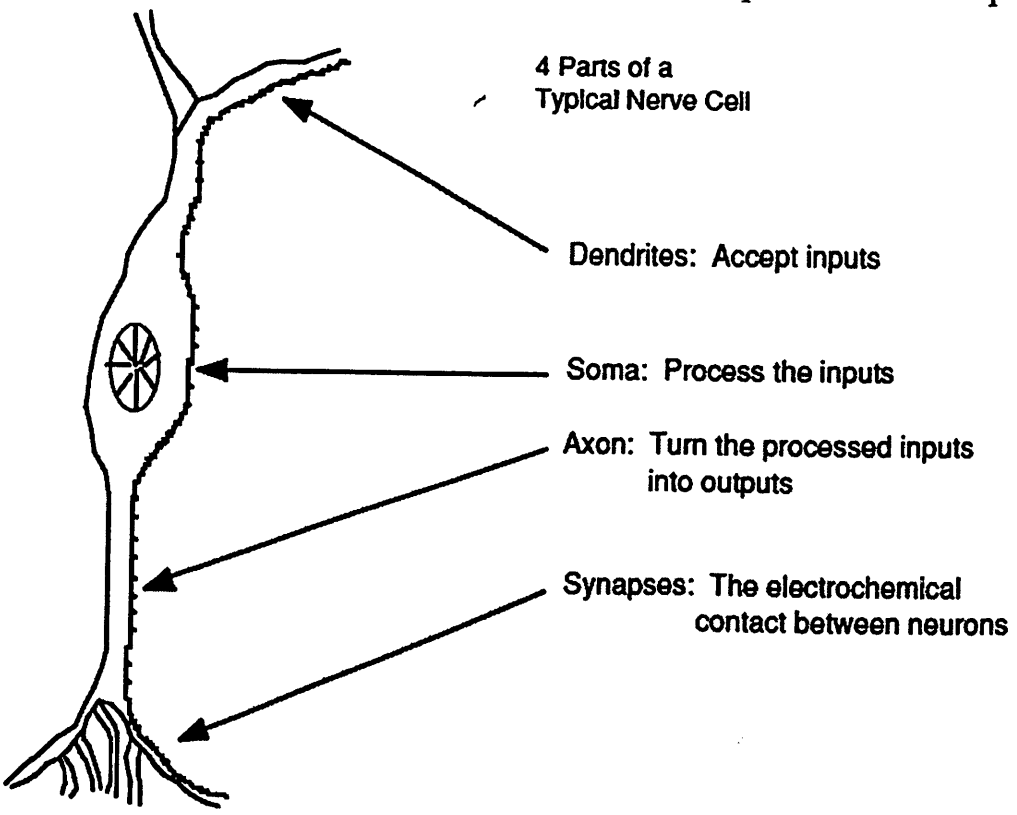

Figure 8. Relationship of dendrites, soma, axon and synapse.

Within humans there are many variations on this basic type of neuron, further complicating man's attempts at electrically replicating the process of thinking. Yet, all natural neurons have the same four basic components. These components are known by their biological names -dendrites, soma, axon, and synapses. Dendrites are hair-like extensions of the soma which act like input channels. These input channels receive their input through the synapses of other neurons. The soma then processes these incoming signals over time. The soma

then turns that processed value into an output which is sent out to other neurons through the axon and the synapses.

Recent experimental data has provided further evidence that biological neurons are structurally more complex than the simplistic explanation above. They are significantly more complex than the existing artificial neurons that are built into today's artificial neural networks. As biology provides a better understanding of neurons, and as technology advances, network designers can continue to improve their systems by building upon man's understanding of the biological brain.

But currently, the goal of artificial neural networks is not the grandiose recreation of the brain. On the contrary, neural network researchers are seeking an understanding of nature's capabilities for which people can engineer solutions to problems that have not been solved by traditional computing.

To do this, the basic unit of neural networks, the artificial neurons, simulate the four basic functions of natural neurons. Figure 9 shows a fundamental representation of an artificial neuron.

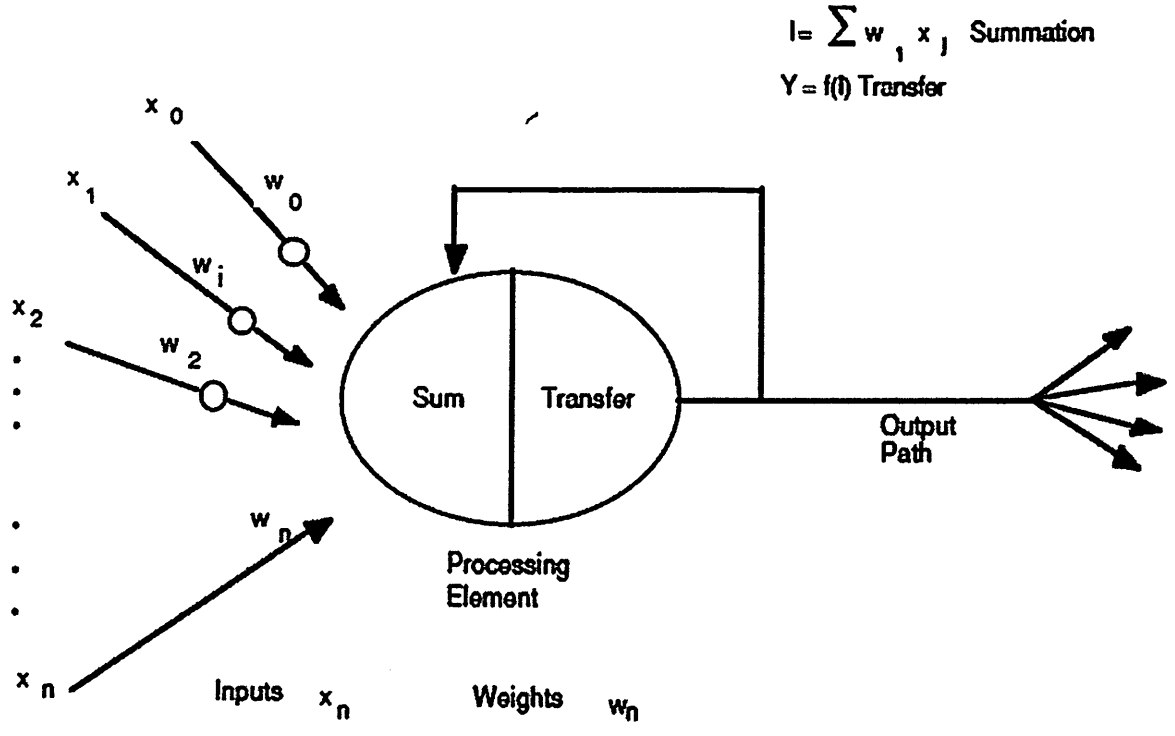

Figure 9. Fundamental representation of ANN

In Figure 9, various inputs to the network are represented by the mathematical symbol, x(n). Each of these inputs are multiplied by a connection weight. These weights are represented by w(n). In the simplest case, these products are simply summed, fed through a transfer function to generate a result, and then output. This process lends itself to physical implementation on a large scale in a small package. This electronic implementation is still possible with other network structures which utilize different summing functions as well as different transfer functions.

Some applications require "black and white," or binary, answers. These applications include the recognition of text, the identification of speech, and the image deciphering of scenes. These applications are required to turn real world inputs into discrete values. These potential values are limited to some known set, like the ASCII characters or the most common 50,000 English words. Because of this limitation of output options, these applications don't always utilize networks composed of neurons that simply sum up, and thereby smooth, inputs. These networks may utilize the binary properties of ORing and ANDing of inputs. These functions, and many others, can be built into the summation and transfer functions of a network.

Other networks work on problems where the resolutions are not just one of several known values. These networks need to be capable of an infinite number of responses. Applications of this type include the "intelligence" behind robotic movements. This "intelligence" processes inputs and then creates outputs which actually cause some device to move. That movement can span an infinite number of very precise motions. These networks do indeed want to smooth their inputs which, due to limitations of sensors, comes in non-continuous bursts, say thirty times a second. To do that, they might accept these inputs, sum that data, and then produce a n output by, for example, applying a hyperbolic tangent as a transfer function. In this manner, output values from the network are continuous and satisfy more real world interfaces.

Other applications might simply sum and compare to a threshold, thereby producing one of two possible outputs, a zero or a one. Other functions scale the outputs to match the application, such as the values minus one and one. Some functions even integrate the input data over time, creating time-dependent networks.

Electronic Implementation of Artificial Neurons

In currently available software packages these artificial neurons are called "processing elements" and have many more capabilities than the simple artificial neuron described above. Those capabilities will be discussed later in this report. Figure 10 is a more detailed schematic of this still simplistic artificial neuron.

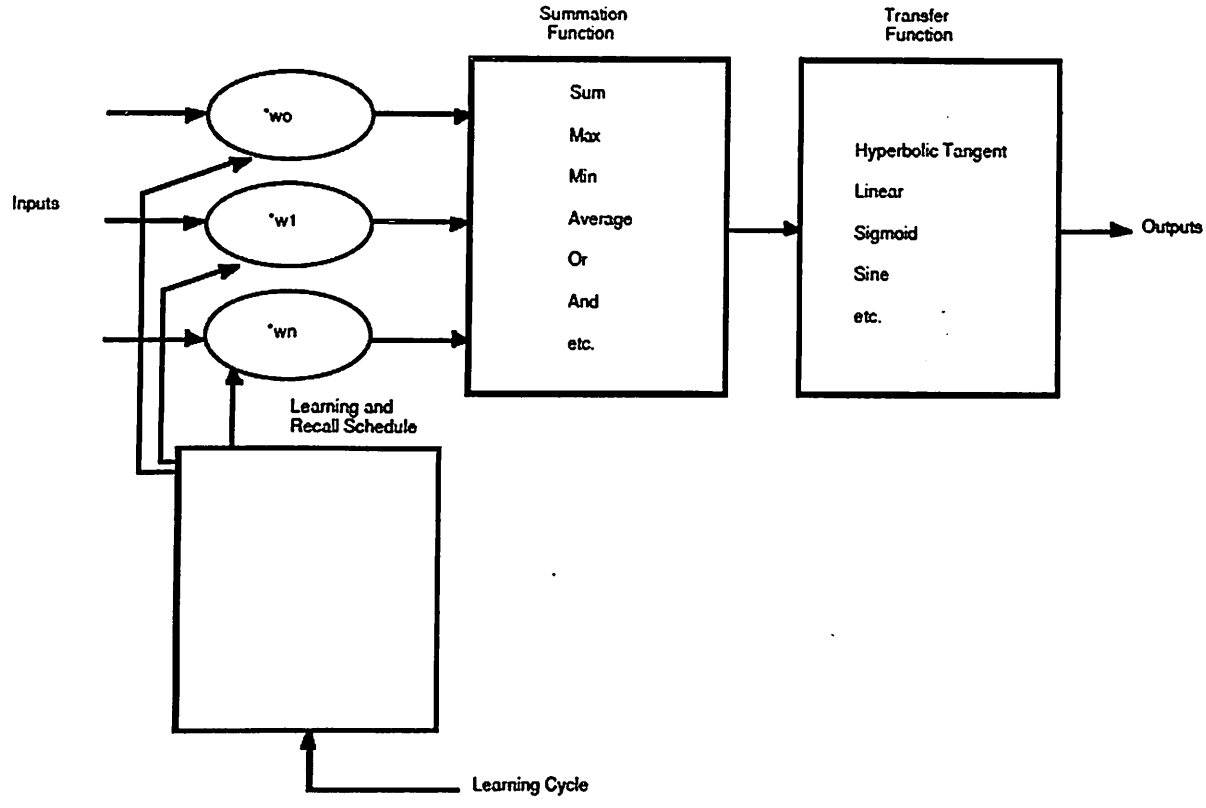

Figure10. Schematic of ANN

In Figure 10, inputs enter into the processing element from the upper left. The first step is for each of these inputs to be multiplied by their respective weighting factor (w(n)). Then these modified inputs are fed into the summing function, which usually just sums these products. Yet, many different types of operations can be selected. These operations could produce a number of different values which are then propagated forward; values such as the average, the largest, the smallest, the ORed values, the ANDed values, etc. Furthermore, most commercial development products allow software engineers to create their own summing functions via routines coded in a higher level language (C is commonly supported). Sometimes the summing function is further complicated by the addition of an activation function which enables the summing function to operate in a time sensitive way.

Either way, the output of the summing function is then sent into a transfer function. This function then turns this number into a real output via some algorithm. It is this algorithm that takes the input and turns it into a zero or a one, a minus one or a one, or some other number. The transfer functions that are commonly supported are sigmoid, sine, hyperbolic tangent, etc. This transfer function also can scale the output or control its value via thresholds. The result of the transfer function is usually the direct output of the processing element. An example of how a transfer function works is shown in Figure 11.

This sigmoid transfer function takes the value from the summation function, called sum in the Figure 11, and turns it into a value between zero and one.

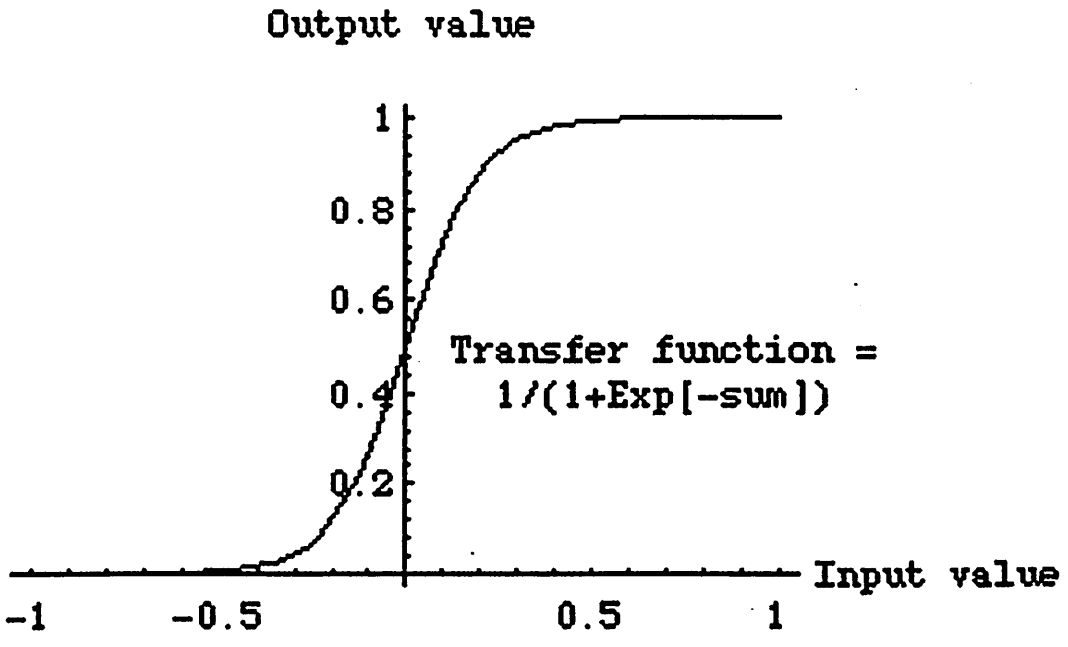

Figure 11. Transfer function

Finally, the processing element is ready to output the result of its transfer function. This output is then input into other processing elements, or to an outside connection, as dictated by the structure of the network.

All artificial neural networks are constructed from this basic building block - the processing element or the artificial neuron. It is variety and the fundamental differences in these building blocks which partially cause the implementing of neural networks to be an "art."

Artificial Network Operations

The other part of the "art" of using neural networks revolve around the myriad of ways these individual neurons can be clustered together. This clustering occurs in the human mind in such a way that information can be processed in a dynamic, interactive, and self-organizing way. Biologically, neural networks are constructed in a three-dimensional world from microscopic components. These neurons seem capable of nearly unrestricted interconnections. That is not true of any proposed, or existing, man-made network. Integrated circuits, using current technology, are two-dimensional devices with a limited number of layers for interconnection. This physical reality restrains the types, and scope, of artificial neural networks that can be implemented in silicon.

Currently, neural networks are the simple clustering of the primitive artificial neurons. This clustering occurs by creating layers which are then connected to one another. How these layers connect is the other part of the "art" of engineering networks to resolve real world problems.

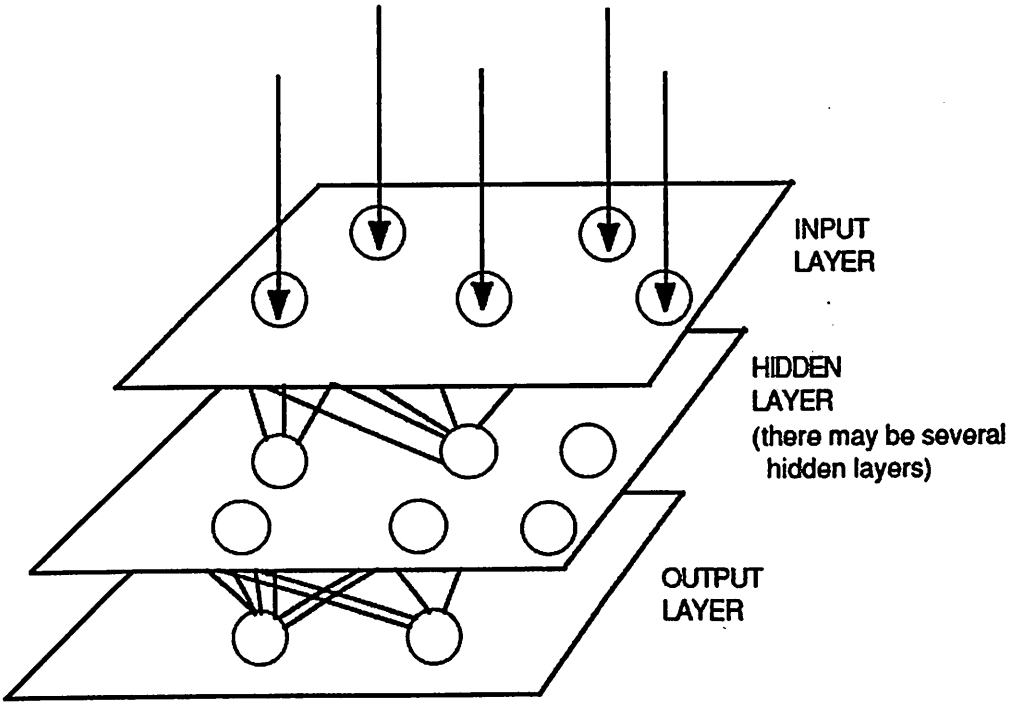

Figure 12. Neurons interface.

Basically, all artificial neural networks have a similar structure or topology as shown in Figure 12. In that structure some of the neurons interfaces to the real world to receive its inputs. Other neurons provide the real world with the network's outputs. This output might be the particular character that the network thinks that it has scanned or the particular image it thinks is being viewed. All the rest of the neurons are hidden from view.

But a neural network is more than a bunch of neurons. Some early researchers tried to simply connect neurons in a random manner, without much success. Now, it is known that even the brains of snails are structured devices. One of the easiest ways to design a structure is to create layers of elements. It is the grouping of these neurons into layers, the connections between these layers, and the summation and transfer functions that comprises a functioning neural network. The general terms used to describe these characteristics are common to all networks.

Although there are useful networks which contain only one layer, or even one element, most applications require networks that contain at least the three normal types of layers -input, hidden, and output. The layer of input neurons receive the data either from input files or directly from electronic sensors in real-time applications. The output layer sends information directly to the outside world, to a secondary computer process, or to other devices such as a mechanical control system. Between these two layers can be many hidden layers. These internal layers contain many of the neurons in various interconnected structures. The inputs and outputs of each of these hidden neurons simply go to other neurons.

In most networks each neuron in a hidden layer receives the signals from all of the neurons in a layer above it, typically an input layer. After a neuron

performs its function it passes its output to all of the neurons in the layer below it, providing a feedforward path to the output. (Note: in section 5 the drawings are reversed, inputs come into the bottom and outputs come out the top.)

These lines of communication from one neuron to another are important aspects of neural networks. They are the glue to the system. They are the connections which provide a variable strength to an input. There are two types of these connections. One causes the summing mechanism of the next neuron to add while the other causes it to subtract. In more human terms one excites while the other inhibits.

Some networks want a neuron to inhibit the other neurons in the same layer. This is called lateral inhibition. The most common use of this is in the output layer. For example in text recognition if the probability of a character being a "P" is .85 and the probability of the character being an "F" is .65, the network wants to choose the highest probability and inhibit all the others. It can do that with lateral inhibition. This concept is also called competition.

Another type of connection is feedback. This is where the output of one layer routes back to a previous layer. An example of this is shown in Figure 13.

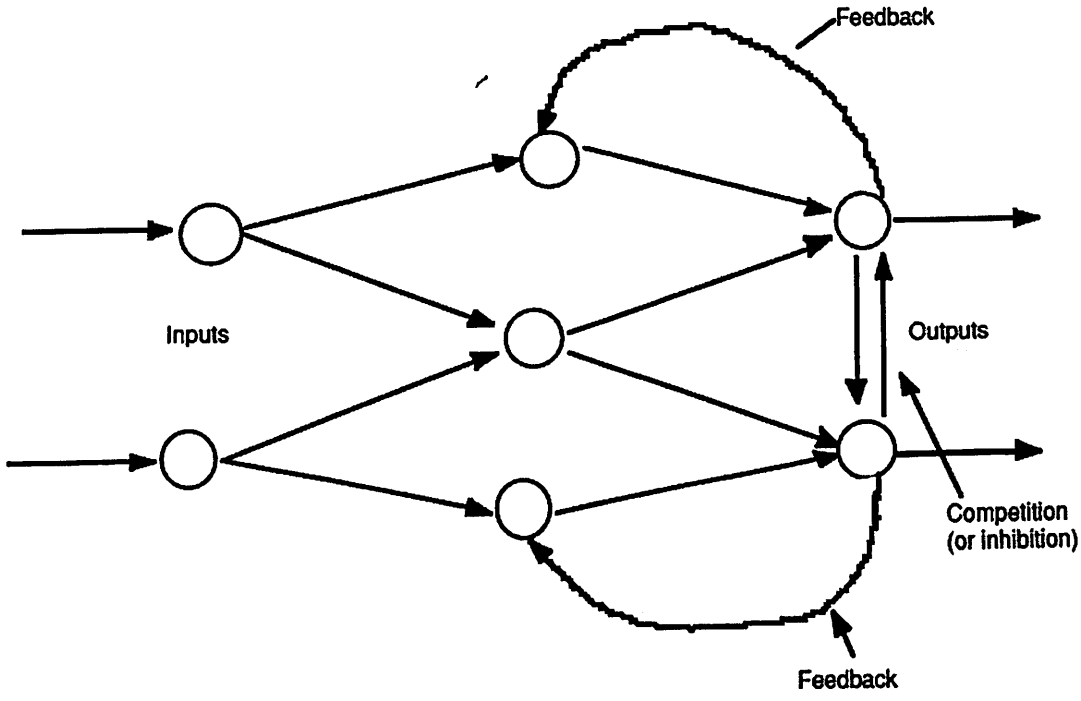

Figure 13. Feedback connection.

The way that the neurons are connected to each other has a significant impact on the operation of the network. In the larger, more professional software development packages the user is allowed to add, delete, and control these connections at will. By "tweaking" parameters these connections can be made to either excite or inhibit.

Training an Artificial Neural Network

Once a network has been structured for a particular application, that network is ready to be trained. To start this process the initial weights are chosen randomly. Then, the training, or learning, begins.

There are two approaches to training -supervised and unsupervised. Supervised training involves a mechanism of providing the network with the desired output either by manually "grading" the network's performance or by providing the desired outputs with the inputs. Unsupervised training is where the network has to make sense of the inputs without outside help.

The vast bulk of networks utilize supervised training. Unsupervised training is used to perform some initial characterization on inputs. However, in the full blown sense of being truly self learning, it is still just a shining promise that is not fully understood, does not completely work, and thus is relegated to the lab.

Supervised Training.

In supervised training, both the inputs and the outputs are provided. The network then processes the inputs and compares its resulting outputs against the desired outputs. Errors are then propagated back through the system, causing the system to adjust the weights which control the network. This process occurs over and over as the weights are continually tweaked. The set of data which enables the training is called the "training set." During the training of a network the same set of data is processed many times as the connection weights are ever refined.

The current commercial network development packages provide tools to monitor how well an artificial neural network is converging on the ability to predict the right answer. These tools allow the training process to go on for days, stopping only when the system reaches some statistically desired point, or accuracy. However, some networks never learn. This could be because the input data does not contain the specific information from which the desired output is derived. Networks also don't converge if there is not enough data to enable complete learning. Ideally, there should be enough data so that part of the data can be held back as a test. Many layered networks with multiple nodes are capable of memorizing data. To monitor the network to determine if the system is simply memorizing its data in some nonsignificant way, supervised training needs to hold back a set of data to be used to test the system after it has undergone its training. (Note: memorization is avoided by not having too many processing elements.)

If a network simply can't solve the problem, the designer then has to review the input and outputs, the number of layers, the number of elements per layer, the connections between the layers, the summation, transfer, and training functions, and even the initial weights themselves. Those changes required to create a successful network constitute a process wherein the "art" of neural networking occurs.

Another part of the designer's creativity governs the rules of training. There are many laws (algorithms) used to implement the adaptive feedback required to

adjust the weights during training. The most common technique is backward-error propagation, more commonly known as back-propagation. These various learning techniques are explored in greater depth later in this report.

Yet, training is not just a technique. It involves a "feel," and conscious analysis, to insure that the network is not overtrained. Initially, an artificial neural network configures itself with the general statistical trends of the data. Later, it continues to "learn" about other aspects of the data which may be spurious from a general viewpoint.

When finally the system has been correctly trained, and no further learning is needed, the weights can, if desired, be "frozen." In some systems this finalized network is then turned into hardware so that it can be fast. Other systems don't lock themselves in but continue to learn while in production use.

Unsupervised, or Adaptive Training.

The other type of training is called unsupervised training. In unsupervised training, the network is provided with inputs but not with desired outputs. The system itself must then decide what features it will use to group the input data. This is often referred to as self-organization or adaption.

At the present time, unsupervised learning is not well understood. This adaption to the environment is the promise which would enable science fiction types of robots to continually learn on their own as they encounter new situations and new environments. Life is filled with situations where exact training sets do not exist. Some of these situations involve military action where new combat techniques and new weapons might be encountered. Because of this unexpected aspect to life and the human desire to be prepared, there continues to be research into, and hope for, this field. Yet, at the present time, the vast bulk of neural network work is in systems with supervised learning. Supervised learning is achieving results.

One of the leading researchers into unsupervised learning is Tuevo Kohonen, an electrical engineer at the Helsinki University of Technology. He has developed a self-organizing network, sometimes called an autoassociator, that learns without the benefit of knowing the right answer. It is an unusual looking network in that it contains one single layer with many connections. The weights for those connections have to be initialized and the inputs have to be normalized. The neurons are set up to compete in a winner-take-all fashion.

Kohonen continues his research into networks that are structured differently than standard, feedforward, back-propagation approaches. Kohonen's work deals with the grouping of neurons into fields. Neurons within a field are "topologically ordered." Topology is a branch of mathematics that studies how to map from one space to another without changing the geometric configuration. The three-dimensional groupings often found in mammalian brains are an example of topological ordering.

Kohonen has pointed out that the lack of topology in neural network models make today's neural networks just simple abstractions of the real neural

networks within the brain. As this research continues, more powerful self learning networks may become possible. But currently, this field remains one that is still in the laboratory.

How Neural Networks Differ from Traditional Computing and Expert Systems

Neural networks offer a different way to analyze data, and to recognize patterns within that data, than traditional computing methods. However, they are not a solution for all computing problems. Traditional computing methods work well for problems that can be well characterized. Balancing checkbooks, keeping ledgers, and keeping tabs of inventory are well defined and do not require the special characteristics of neural networks. Table 2.6.1 identifies the basic differences between the two computing approaches.

Traditional computers are ideal for many applications. They can process data, track inventories, network results, and protect equipment. These applications do not need the special characteristics of neural networks.

Expert systems are an extension of traditional computing and are sometimes called the fifth generation of computing. (First generation computing used switches and wires. The second generation occurred because of the development of the transistor. The third generation involved solid state technology, the use of integrated circuits, and higher level languages like COBOL, Fortran, and "C". End user tools, "code generators," are known as the fourth generation.) The fifth generation involves artificial intelligence.

CHARACTERISTICS	TRADITIONAL COMPUTING (including Expert Systems)	ARTIFICIAL NEURAL NETWORKS
Processing style	Sequential	Parallel
Functions	Logically (left brained) via Rules Concepts Calculations	Gestault (right brained) via Images Pictures Controls
Learning Method	by rules (didactically)	by example (Socratically)
Applications	Accounting, word processing, math, inventory, digital communications	Sensor processing, speech recognition, pattern recognition, text recognition

Table 1. Comparing the traditional computing with artificial neural networks.

Typically, an expert system consists of two parts, an inference engine and a knowledge base. The inference engine is generic. It handles the user interface, external files, program access, and scheduling. The knowledge base contains the information that is specific to a particular problem. This knowledge base allows

an expert to define the rules which govern a process. This expert does not have to understand traditional programming. That person simply has to understand both what he wants a computer to do and how the mechanism of the expert system shell works. It is this shell, part of the inference engine, that actually tells the computer how to implement the expert's desires. This implementation occurs by the expert system generating the computer's programming itself, it does that through "programming" of its own. This programming is needed to establish the rules for a particular application. This method of establishing rules is also complex and does require a detail oriented person.

Efforts to make expert systems general have run into a number of problems. As the complexity of the system increases, the system simply demands too much computing resources and becomes too slow. Expert systems have been found to be feasible only when narrowly confined.

Artificial neural networks offer a completely different approach to problem solving and they are sometimes called the sixth generation of computing. They try to provide a tool that both programs itself and learns on its own. Neural networks are structured to provide the capability to solve problems without the benefits of an expert and without the need of programming. They can seek patterns in data that no one knows are there.

Characteristics	Von Neumann Architecture Used for Expert Systems	Artificial Neural Networks
Processors	VLSI (traditional processors)	Artificial Neural Networks; variety of technologies; hardware development is on going
Memory	Separate	The same
Processing Approach	Processes problem one rule at a time; sequential	Multiple, simultaneously
Connections	Externally programmable	Dynamically self programming
Self learning	Only algorithmic parameters modified	Continuously adaptable
Fault tolerance	None without special processors	Significant in the very nature of the interconnected neurons
Use of Neurobiology in design	None	Moderate
Programming	Through a rule based shell; complicated	Self-programming; but network must be properly set up
Ability to be fast	Requires big processors	Requires multiple custom-built chips

Table 2. Comparison of artificial intelligence's expert systems and neural networks.

Expert systems have enjoyed significant successes. However, artificial intelligence has encountered problems in areas such as vision, continuous speech recognition and synthesis, and machine learning. Artificial intelligence also is hostage to the speed of the processor that it runs on. Ultimately, it is restricted to the theoretical limit of a single processor. Artificial intelligence is also burdened by the fact that experts don't always speak in rules.

Yet, despite the advantages of neural networks over both expert systems and more traditional computing in these specific areas, neural nets are not complete solutions. They offer a capability that is not ironclad, such as a debugged accounting system. They learn, and as such, they do continue to make "mistakes." Furthermore, even when a network has been developed, there is no way to ensure that the network is the optimal network.

Neural systems do exact their own demands. They do require their implementor to meet a number of conditions. These conditions include:

-a data set which includes the information which can characterize the problem.

-an adequately sized data set to both train and test the network.

- an understanding of the basic nature of the problem to be solved so that basic first-cut decision on creating the network can be made. These decisions include the activization and transfer functions, and the learning methods.

-an understanding of the development tools.

- adequate processing power (some applications demand real-time .processing that exceeds what is available in the standard, sequential processing hardware. The development of hardware is the key to the future of neural networks).

Once these conditions are met, neural networks offer the opportunity of solving problems in an arena where traditional processors lack both the processing power and a step-by-step methodology.

A number of very complicated problems cannot be solved in the traditional computing environments. For example, speech is something that all people can easily parse and understand. A person can understand a southern drawl, a Bronx accent, and the slurred words of a baby. Without the massively paralleled processing power of a neural network, this process is virtually impossible for a computer. Image recognition is another task that a human can easily do but which stymies even the biggest of computers. A person can recognize a plane as it turns, flies overhead, and disappears into a dot. A traditional computer might try to compare the changing images to a number of very different stored patterns.

This new way of computing requires skills beyond traditional computing. It is a natural evolution. Initially, computing was only hardware and engineers made it work. Then, there were software specialists programmers, systems

engineers, data base specialists, and designers. Now, there are also neural architects. This new professional needs to be skilled different than his predecessors of the past. For instance, he will need to know statistics in order to choose and evaluate training and testing situations. This skill of making neural networks work is one that will stress the logical thinking of current software engineers.

In summary, neural networks offer a unique way to solve some problems while making their own demands. The biggest demand is that the process is not simply logic. It involves an empirical skill, an intuitive feel as to how a network might be created.

History of Neural Networks

The study of the human brain is thousands of years old. With the advent of modern electronics, it was only natural to try to harness this thinking process. The first step toward artificial neural networks came in 1943 when Warren McCulloch, a neurophysiologist, and a young mathematician, Walter Pitts, wrote a paper on how neurons might work. They modeled a simple neural network with electrical circuits.

Reinforcing this concept of neurons and how they work was a book written by Donald Hebb. The Organization of Behavior was written in 1949. It pointed out that neural pathways are strengthened each time that they are used.

As computers advanced into their infancy of the 1950s, it became possible to begin to model the rudiments of these theories concerning human thought. Nathanial Rochester from the IBM research laboratories led the first effort to simulate a neural network. That first attempt failed. But later attempts were successful. It was during this time that traditional computing began to flower and, as it did, the emphasis in computing left the neural research in the background.

Yet, throughout this time, advocates of "thinking machines" continued to argue their cases. In 1956 the Dartmouth Summer Research Project on Artificial intelligence provided a boost to both artificial intelligence and neural networks. One of the outcomes of this process was to stimulate research in both the intelligent side, AI, as it is known throughout the industry, and in the much lower level neural processing part of the brain.

In the years following the Dartmouth Project, John von Neumann suggested imitating simple neuron functions by using telegraph relays or vacuum tubes. Also, Frank Rosenblatt, a neuro-biologist of Cornell, began work on the Perceptron. He was intrigued with the operation of the eye of a fly. Much of the processing which tells a fly to flee is done in its eye. The Perceptron, which resulted from this research, was built in hardware and is the oldest neural network still in use today. A single-layer perceptron was found to be useful in classifying a continuous-valued set of inputs into one of two classes. The perceptron computes a weighted sum of the inputs, subtracts a threshold, and passes one of two possible values out as the result. Unfortunately, the perceptron

is limited and was proven as such during the "disillusioned years" in Marvin Minsky and Seymour Papert's 1969 book Perceptrons.

In 1959, Bernard Widrow and Marcian Hoff of Stanford developed models they called ADALINE and MADALINE. These models were named for their use of Multiple ADAptive LINear Elements. MADALINE was the first neural network to be applied to a real world problem. It is an adaptive filter which eliminates echoes on phone lines. This neural network is still in commercial use.

Unfortunately, these earlier successes caused people to exaggerate the potential of neural networks, particularly in light of the limitation in the electronics then available. This excessive hype, which flowed out of the academic and technical worlds, infected the general literature of the time. Disappointment set in as promises were unfilled. Also, a fear set in as writers began to ponder what effect "thinking machines" would have on man. Asimov's series on robots revealed the effects on man's morals and values when machines where capable of doing all of mankind's work. Other writers created more sinister computers, such as HAL from the movie 2001.

These fears, combined with unfulfilled, outrageous claims, caused respected voices to critique the neural network research. The result was to halt much of the funding. This period of stunted growth lasted through 1981.

In 1982 several events caused a renewed interest. John Hopfield of Caltech presented a paper to the national Academy of Sciences. Hopfield's approach was not to simply model brains but to create useful devices. With clarity and mathematical analysis, he showed how such networks could work and what they could do. Yet, Hopfield's biggest asset was his charisma. He was articulate, likeable, and a champion of a dormant technology.

At the same time, another event occurred. A conference was held in Kyoto, Japan. This conference was the US-Japan Joint Conference on Cooperative/Competitive Neural Networks. Japan subsequently announced their Fifth Generation effort. US periodicals picked up that story, generating a worry that the US could be left behind. Soon funding was flowing once again.

By 1985 the American Institute of Physics began what has become an annual meeting -Neural Networks for Computing. By 1987, the Institute of Electrical and Electronic Engineer's (IEEE) first International Conference on Neural Networks drew more than 1,800 attendees.

By 1989 at the Neural Networks for Defense meeting Bernard Widrow told his audience that they were engaged in World War IV, "World War III never happened," where the battlefields are world trade and manufacturing. The 1990 US Department of Defense Small Business Innovation Research Program named 16 topics which specifically targeted neural networks with an additional 13 mentioning the possible use of neural networks.

Today, neural networks discussions are occurring everywhere. Their promise seems very bright as nature itself is the proof that this kind of thing works. Yet, its future, indeed the very key to the whole technology, lies in hardware development. Currently most neural network development is simply proving that

the principal works. This research is developing neural networks that, due to processing limitations, take weeks to learn. To take these prototypes out of the lab and put them into use requires specialized chips. Companies are working on three types of neuro chips - digital, analog, and optical. Some companies are working on creating a "silicon compiler" to generate a neural network Application Specific Integrated Circuit (ASIC). These ASICs and neuron-like digital chips appear to be the wave of the near future. Ultimately, optical chips look very promising. Yet, it may be years before optical chips see the light of day in commercial applications.

2.1 .1 BACKPROPOGATİON NEURAL NETWORK

Backpropagation was created by generalizing the Widrow-Hoff learning rule to multiple-layer networks and nonlinear differentiable transfer functions. Input vectors and the corresponding target vectors are used to train a network until it can approximate a function, associate input vectors with specific output vectors, or classify input vectors in an appropriate way as defined by you. Networks with biases, a sigmoid layer, and a linear output layer are capable of approximating any function with a finite number of discontinuities.

Standard backpropagation is á gradient descent algorithm, as is the Widrow-Hoff learning rule, in which the network weights are moved along the negative of the gradient of the performance function. The term backpropagation refers to the manner in which the gradient is computed for nonlinear multilayer networks. There are a number of variations on the basic algorithm that are based on other standard optimization techniques, such as conjugate gradient and Newton methods. The Neural Network Toolbox implements a number of these variations. This chapter explains how to use each of these routines and discusses the advantages and disadvantages of each.

Properly trained backpropagation networks tend to give reasonable answers when presented with inputs that they have never seen. Typically, a new input leads to an output similar to the correct output for input vectors used in training that are similar to the new input being presented. This generalization property makes it possible to train a network on a representative set of input/ target pairs and get good results without training the network on all possible input/output pairs. There are two features of the Neural Network Toolbox that are designed to improve network generalization -regularization and early stopping. These features and their use are discussed later in this chapter.

This chapter also discusses preprocessing and postprocessing techniques, which can improve the efficiency of network training.

Before beginning this chapter you may want to read a basic reference on backpropagation, such as D.E Rumelhart, G.E. Hinton, R.J. Williams, "Learning internal representations by error propagation," D. Rumelhart and J. McClelland, editors. Parallel Data Processing, Vol.1, Chapter 8, the M.I.T. Press, Cambridge, MA 1986 pp. 318-362. This subject is also covered in detail in Chapters 11 and

12 of M.T. Hagan, H.B. Demuth, M.H. Beale, Neural Network Design, PWS Publishing Company, Boston, MA 1996.

The primary objective of this chapter is to explain how to use the backpropagation training functions in the toolbox to train feedforward neural networks to solve specific problems. There are generally four steps in the training process:

1. Assemble the training data
2. Create the network object
3. Train the network
4. Simulate the network response to new inputs.

The field of neural networks can be thought of as being related to artificial intelligence, machine learning, parallel processing, statistics, and other fields. The attraction of neural networks is that they are best suited to solving the problems that are the most difficult to solve by traditional computational methods.

Consider an image processing task such as recognizing an everyday object projected against a background of other objects. This is a task that even a small child's brain can solve in a few tenths of a second. But building a conventional serial machine to perform as well is incredibly complex. However, that same child might NOT be capable of calculating 2+2=4, while the serial machine solves it in a few nanoseconds.

A fundamental difference between the image recognition problem and the addition problem is that the former is best solved in a parallel fashion, while simple mathematics is best done serially. Neurobiologists believe that the brain is similar to a massively parallel analog computer, containing about 10^10 simple processors which each require a few milliseconds to respond to input. With neural network technology, we can use parallel processing methods to solve some real-world problems where it is very difficult to define a conventional algorithm.

2.1.2 THE FEED-FORWARD NEURAL NETWORK MODEL

If we consider the human brain to be the 'ultimate' neural network, then ideally we would like to build a device which imitates the brain's functions. However, because of limits in our technology, we must settle for a much simpler design. The obvious approach is to design a small electronic device which has a transfer function similar to a biological neuron, and then connect each neuron to many other neurons, using RLC networks to imitate the dendrites, axons, and synapses. This type of electronic model is still rather complex to implement, and we may have difficulty 'teaching' the network to do anything useful. Further

constraints are needed to make the design more manageable. First, we change the connectivity between the neurons so that they are in distinct layers, such that each neuron in one layer is connected to every neuron in the next layer. Further, we define that signals flow only in one direction across the network, and we simplify the neuron and synapse design to behave as analog comparators being driven by the other neurons through simple resistors. We now have a feed-forward neural network model that may actually be practical to build and use.

Referring to Figures 14 and 15, the network functions as follows: Each neuron receives a signal from the neurons in the previous layer, and each of those signals is multiplied by a separate weight value. The weighted inputs are summed, and passed through a limiting function which scales the output to a fixed range of values. The output of the limiter is then broadcast to all of the neurons in the next layer. So, to use the network to solve a problem, we apply the input values to the inputs of the first layer, allow the signals to propagate through the network, and read the output values.

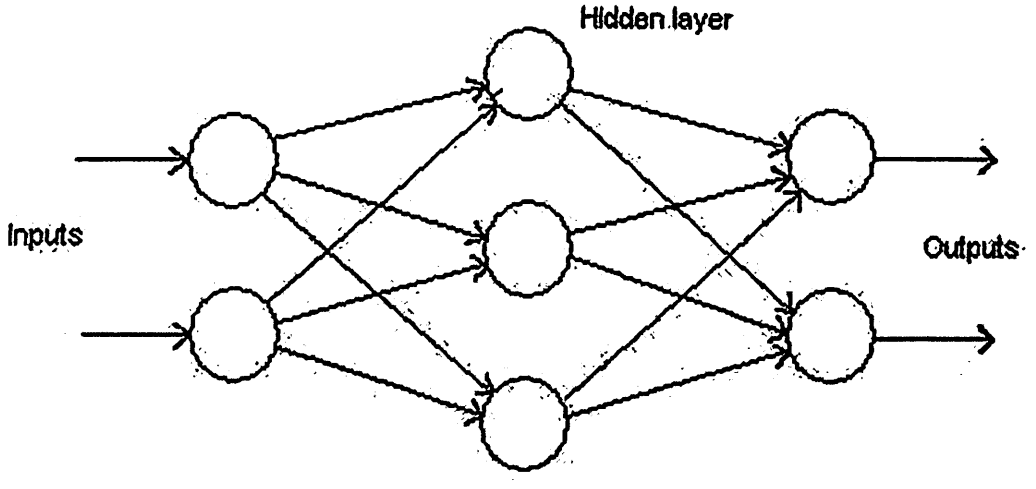

Figure 14. A Generalized Network.

Stimulation is applied to the inputs of the first layer, and signals propagate through the middle (hidden) layer(s) to the output layer. Each link between neurons has a unique weighting value.

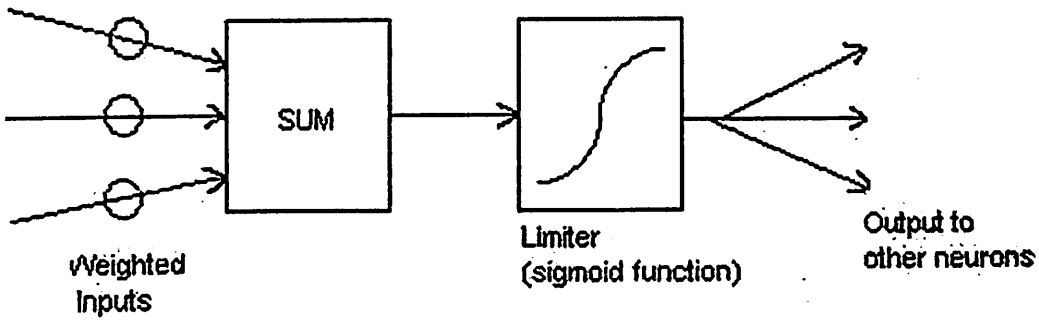

Figure 15. The Structure of a Neuron.

Inputs from one or more previous neurons are individually weighted, then summed. The result is non-linearly scaled between 0 and +1, and the output value is passed on to the neurons in the next layer.

Since the real uniqueness or 'intelligence' of the network exists in the values of the weights between neurons, we need a method of adjusting the weights to solve a particular problem. For this type of network, the most common learning algorithm is called Back Propagation (BP). A BP network learns by example, that is, we must provide a learning set that consists of some input examples and the known-correct output for each case. So, we use these input-output examples to show the network what type of behavior is expected, and the BP algorithm allows the network to adapt.

The BP learning process works in small iterative steps: one of the example cases is applied to the network, and the network produces some output based on the current state of its synaptic weights (initially, the output will be random). This output is compared to the known-good output, and a mean-squared error signal is calculated. The error value is then propagated backwards through the network, and small changes are made to the weights in each layer. The weight changes are calculated to reduce the error signal for the case in question. The whole process is repeated for each of the example cases, then back to the first case again, and so on. The cycle is repeated until the overall error value drops below some pre-determined threshold. At this point we say that the network has learned the problem "well enough" - the network will never exactly learn the ideal function, but rather it will asymptotically approach the ideal function.

2.2 DELPHI

2.2.1. WHAT IS DELPHI?

Delphi programming language is an integrated development platform for desktop graphical, mobile applications and web.

It was first developed by Borland as an application tool for windows in 1995 to 2008 and later adopted by Embarcadero Technologies from 2009 to present.

Some of the advantages of Delphi include: its readable code because of the clarity of its syntax, its initial versions had very great documentation, it supports the whole Windows API, among others.

2.2.2 ADVANTAGES OF USING DELPHI

The advantages of the Delphi programming language include, it is a very clear syntax, leading to readable code.

Additionally, it has great documentation especially in the initial versions; it has mechanism that allowed for simple creation of components which could be integrated in the IDE and many others.

Delphi programming language originated from an extension of the Pascal programming language that was designed for use in the object-oriented programming arena, called Object Pascal. Currently Embarcadero Delphi, known formerly as CodeGear Delphi and Borland Delphi, is an IDE for Microsoft Windows based application development.

3. PROJECT PART

3.1. CLASSIFICATION PROGRAM

İn this thesis our aim is to use a program for neural networks and find the human personality type. For this we will use a ready program done on the programming language Delphi.

That program is called Prothesis.

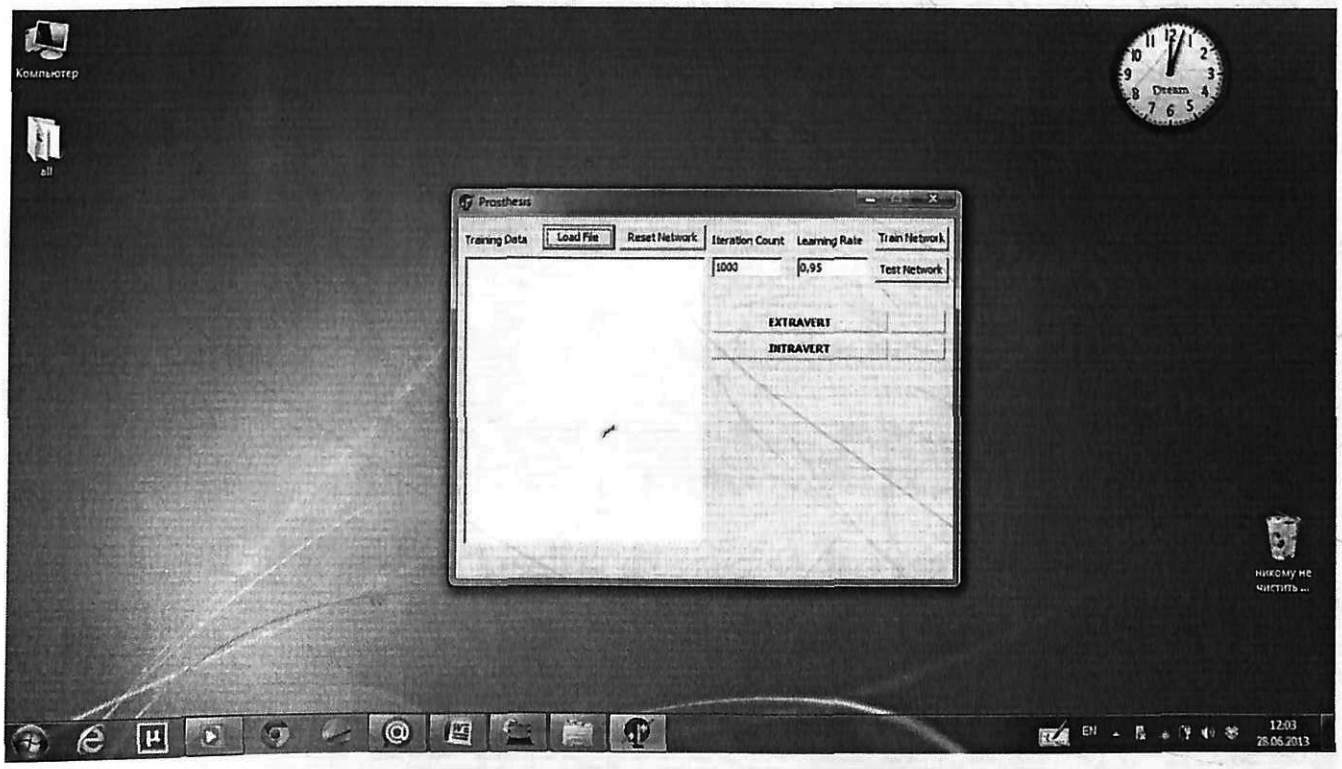

Figure 15. View of Prothesis program.

It is used for solving problems of supervised learning. As we remember from the previous chapters supervised learnig is when, both the inputs and the outputs are provided.

The network then processes the inputs and compares its resulting outputs against the desired outputs. Errors are then propagated back through the system, causing the system to adjust the weights which control the network. This process occurs over and over as the weights are continually tweaked. The set of data which enables the training is called the "training set." During the training of a network the same set of data is processed many times as the connection weights are ever refined.

For this program we give data in txt files. There are two types of txt files: First for training (in our example train.txt) and second for testing (in out example test.txt and test2.txt).

Also we must give Iteration count and Learning rate. By default Iteration count is 1000 and Learning rate is 0.95. For our problem we don't need any extra options, that's why we will them as it was given.

Every supervised learning needs inputs and outputs. To take inputs we must just load the needed file.

First of all, to train we load the train.txt.

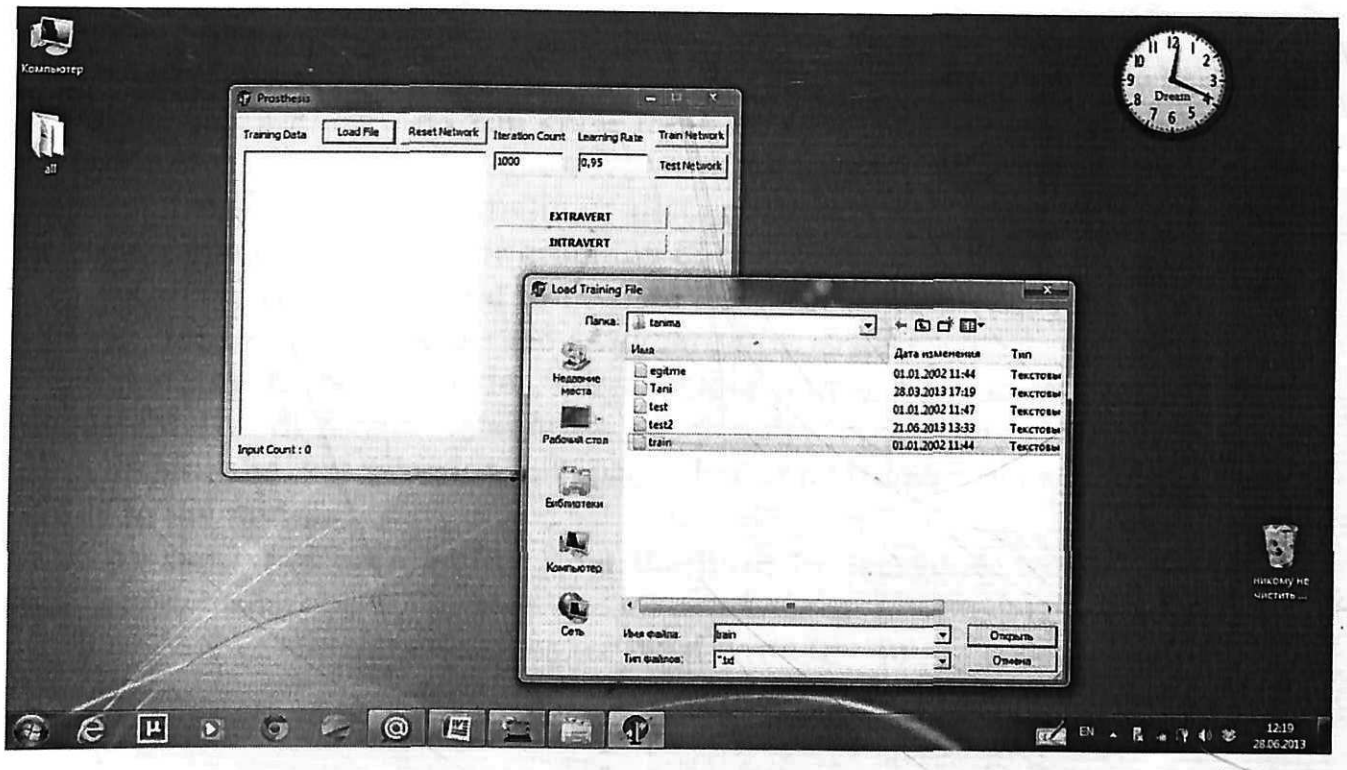

Figure 16. Loading the training data for input.

And second, load the testing data. It may be test.txt or test2.txt.

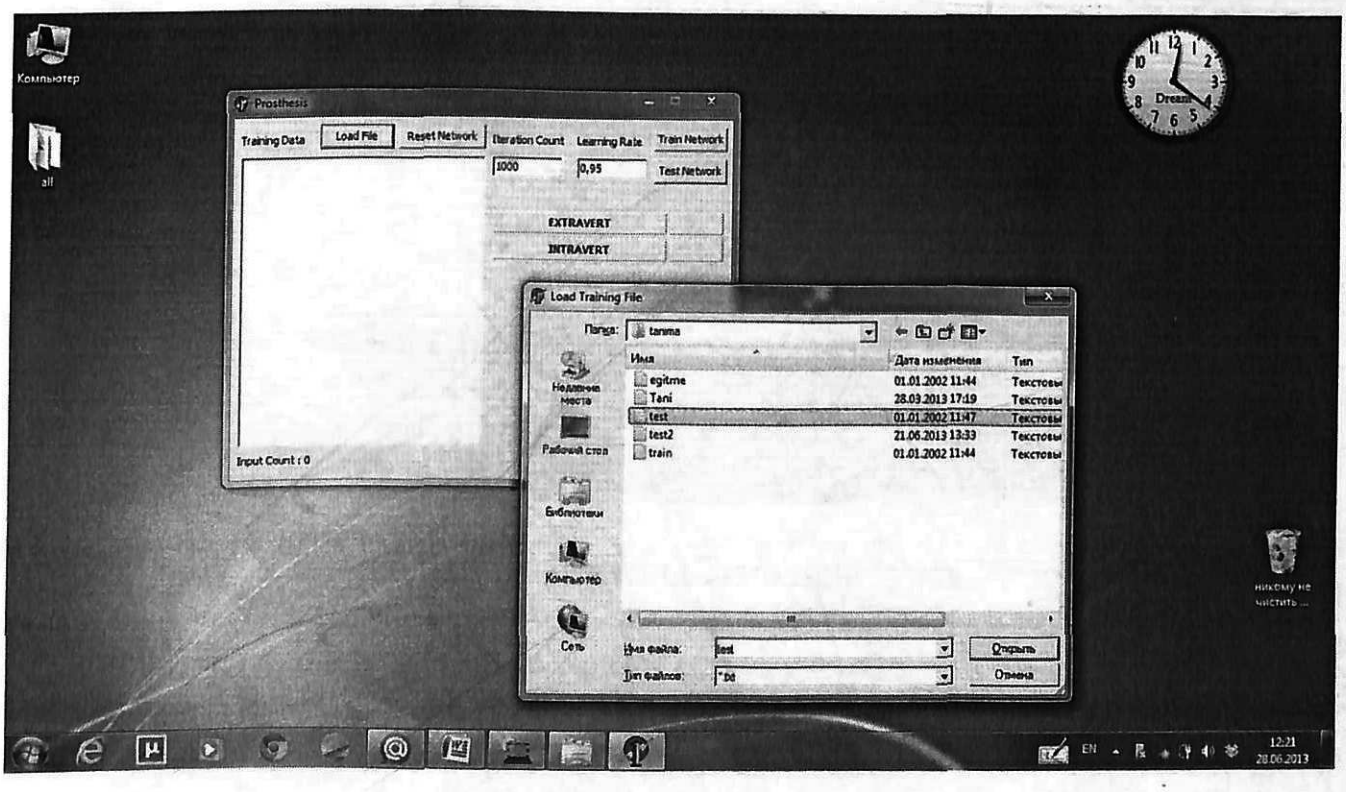

Figure 17. Loading the testing file as input.

In our input files we have a line of numbers less than 1 and greater than 0. (<1 and >0). They are attributes of taken signatures. There are 12 attributes. In the next part we will explain it wider.

Also, our program needs outputs. To get the answers we must know what kind of type divisions we need. As you know there are many ways to classify pepople by types. But we have two basic ones. As we remember from previous chapters:

Personality types are sometimes distinguished from personality traits, with the latter embodying a smaller grouping of behavioral tendencies.

Types are sometimes said to involve *qualitative* differences between people, whereas traits might be construed as *quantitative* differences.

According to type theories, for example, introverts and extraverts are two fundamentally different categories of people. According to trait theories, introversion and extraversion are part of a continuous dimension, with many people in the middle.

As the types are coming from the birth to everyone, we desided to take them as the basis.

To change the output names we must write the output types to Tani.txt file.

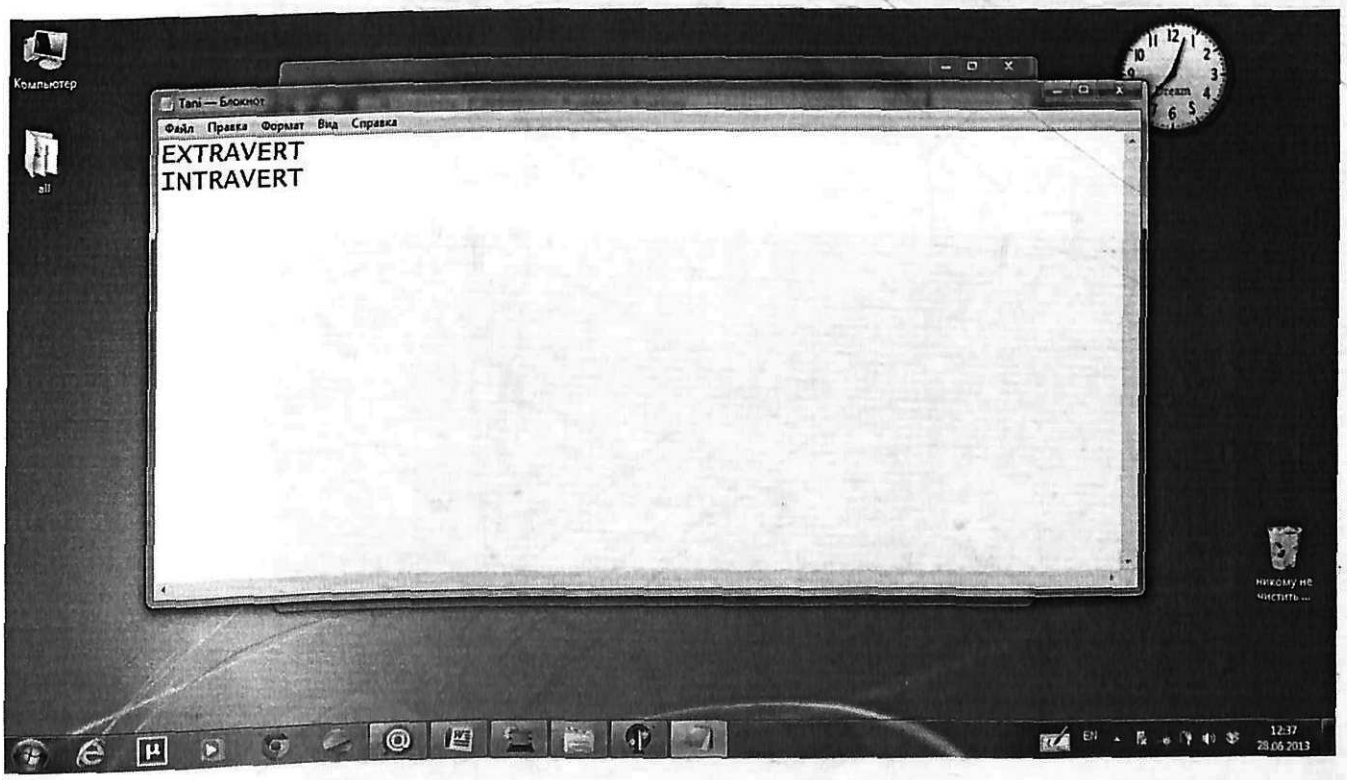

Figure 18. Inserting the output types.

Now, we can say that our program is ready to use.

3.1.1 PROJECT DEFİNİTİON

The aim of this project is to take ready signatures. Look through special attributes. With the help of that attributes fill the parameters txt file. This operation must be done to two groups of people.

First group will give us their signatures and also pass the psychological test to investigate if they are introverts or extraverts. This data will be used to train the network. The correctness of this information will affect all other data that will be tested.

Second group will give as their signatures. And this data will be tested to find if they are introverts or extroverts.

As our work is used only to show that this works, we must also test the second group's signatures. To be sure that test works right.

In this program we use 12 attributes of 30-40 possible. And we have 20 examples, 15 of them for trainig, and 5 for testing. The program will take 12 attributes as inputs and 2 types of employee types as outputs: Intravert and Extravert.

As the highest value we take 0.9. and as minimum 0.1. The program gives higher values to Extravert and then to Intravert in desending order.

This part of the project must be automatisized with the help of some program that will read the signature and give the attributes automatically. But it was for now impossible to do it because of some reasons, that's why for now we will write that attributes by ourselves.

As an example let's take this signature.

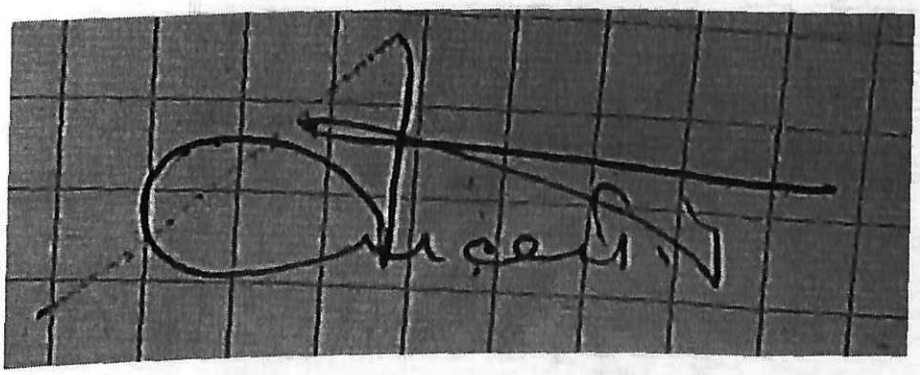

Figure 19. Example of sigature to show how to take the attributes.

Our attirbutes are accordings:

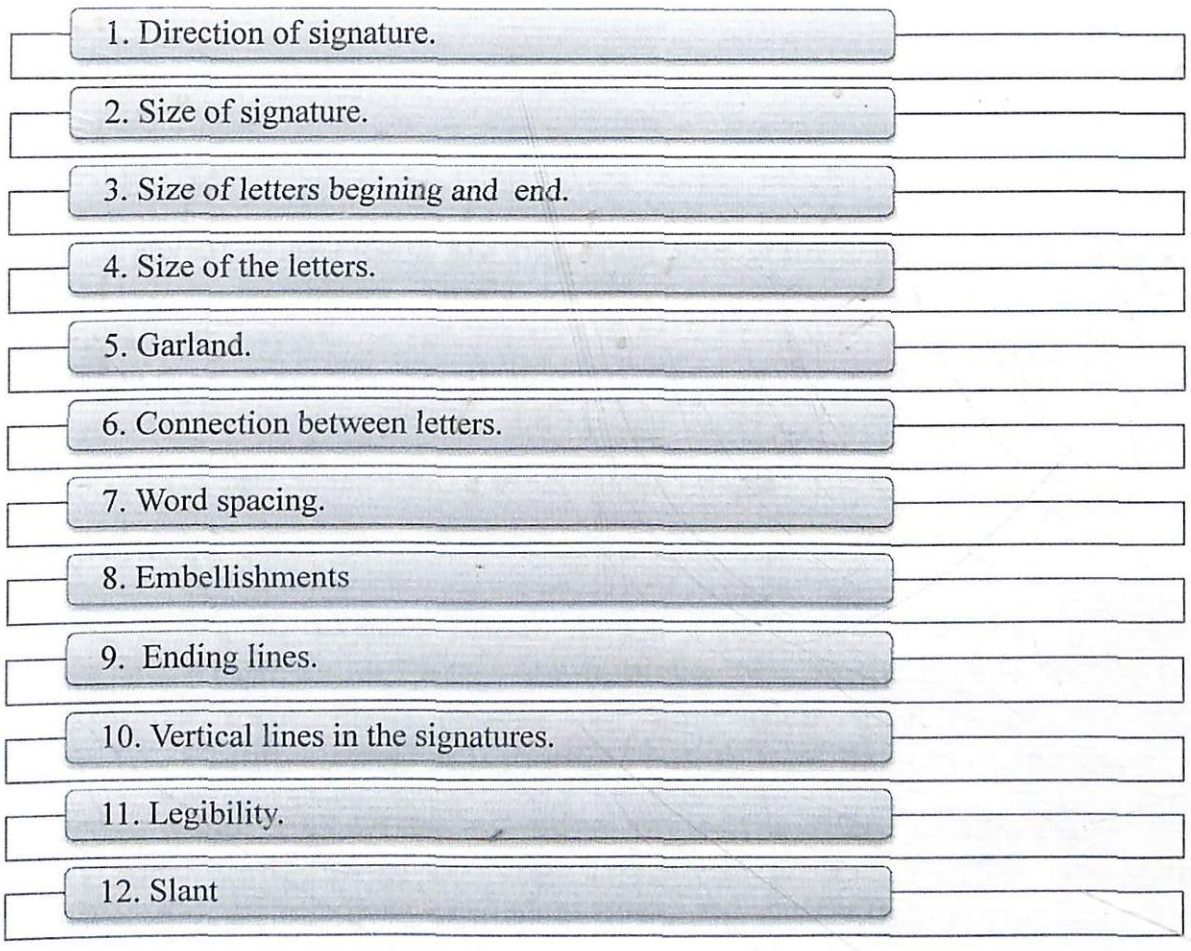

Figure 20. 12 needed attributes of the signature.

And for our signature let's give numbers.

1. Directions of signatures.

If your signatures end goes up then you are said to be optimistic. If goes to down you are tend to be pessimistic one. Optimism is more closly to evtraverts that's why higher it goes, the higher we must put mark to the signature. According to our signature it is straight. That's why we give 0.5.

2. Size of signature.

If the signature is long then it means that you are not hurrying, and think before acting. And if your signature is short, it means that you are reacting very fast, and not patient. İn this attribute you will put higher mark if your signature is short. Because long signatures are more closly to introverts. That's why we give 0.3 points.

3. Size of letters at the beginning and the end.

According to this attribute we must look through the sizes of letters at the beginning and at the end. If you have capital letters more at the beginning of

your signature. Then you tend to have leadership skills, and more extravert than extravert.

Looking to this attribute we will give 0.5 points to our signature.

4. Size of letters.

If the sizes of your letters are big, then you want a lot from the life, and want to achieve many things. This kind of characteristics are more closely to extraverts than to introverts.

And if your letters are small then you are more economic, rational and sometimes jealous.

According to this attribute we give 0.4 to our signature.

5. Garland.

Garland is like an inverted 'arcade' and is a people-orientated script. These writers make their m's, n's and h's in the opposite way to the arcade writer, like cups, or troughs, into which people can pour their troubles or just give information. The Garland writer enjoys being helpful and likes to be involved.

Angled middle zone is the analytical style, the sharp points, rather than curves, give the impression of probing. The angle writer, is better employing talents at work and for business or project purposes, rather than nurturing, which is the strength of the garland writer.

As with any indicators of personality style, the interpretation doesn't mean that each writer needs to be categorized and prevented or dissuaded from spreading their talents and interests, but the analysis can helpfully show where the person's strengths can be best employed.

Thread handwriting is like unraveled wool, waiting to be made up into something fresh. These writers are mentally alert and adaptable, but can also be elusive and lack patience. They are responders, rather than initiators. They can be very clever at drawing together strands of information and making something of them. Therefore they observe and bide their time, so that decisions are made at the most appropriate moment.

Looking to this we give 0.5 points to this attribute.

6. Connection between letters.

If your letters are connected to each other, it shows us about consecutive and logic thinking.

Owner of that signature is sometimes can be said as conservative and hard to take new things.

And if your letters are not fully connected, then your character type is more closely to extraversion.

According to our signature we will give 0.7 points to this attribute.

7. Word spacing.

This characteristic show us how do you spend your recourses. If letters are close to each other it shows that you are economic, and if the spaceing is very long, then you are spending them without thinking. According to this attribute we give 0.6 points to our signature.

8. Embellishment.

The signature stands in its own right. Any additional strokes are a deliberate attempt to draw more attention to it.

Lines through signature: self-critical, unhappy.

Underlining: need for responsibility and importance. Betrays a lack of self-confidence and a need for recognition and status.

Circles: wants to be protected. May be very defensive and needs reasssurance.

Full stop: a sign of self-centredness – 'the world stops with me'!

Vertical line at end: a block on the outside world, this person has a private world to retreat into.

Looking through this characteristics we can give 0.8 to our signature.

9. Ending lines.

If signature has ending lines, it shows us how the owner looks to the critics.

Longer the line, that's more it doesn't like critics. According to this attribute we give 0.8 points.

10. Vertical line in the signature.

If the owner has vertical lines in the signature, it shows in which stage the work becomes hard for the author.

If at the beginning, then owner doesn't have enough imagination at the beginning of the work.

If vertical lines are at the middle, or closer to middle, then the author has problems on passing from theoretical part to practical.

According to our signature we will give 0.5 points. To this attribute.

11. Legibility.

Legibility bears little relation to speed: the fast writer can still be perfectly readable, and the slow writer can have an impossibly messy script. In handwriting, legibility is, subconsciously, a matter of choice. The same applies in the signature.

If the illegible signature closes a business letter, it shows that the writer does not consider their name to be of great importance to the matter in hand: they are a mere functionary. The personal signature may be very different.

A consistently illegible signature implies that 'you really ought to know who I am, and if you don't, it is your loss!'. A certain arrogance and self importance is apparent.

If the surname is more legible than the first name the writer shows reserve on first contact with people – a holding back of familiarity until they get to know a person better.

A first name more legible than the surname reveals a more approachable, direct person who will make a great effort to be friendly.

Complete legibility shows open and straightforward social attitudes. The writer is happy to be accepted as they are.

According to this attribute we give 0.4 points.

12. Slant.

The same interpretations on line direction and slant are made as for the script, but watch out for differences between the signature and the handwriting.

Right slant signature: an outgoing, bubbly, outer persona.

Left slant signature: does not push self forward.

In this attribute we give 0.5 points.

And as the collection of all this attributes we take the human character type.

1. Direction of signature.	0.5
2. Size of signature.	0.3
3. Size of letters begining and end.	0.5
4. Size of the letters.	0.4
5. Garland.	0.5
6. Connection between letters.	0.7
7. Word spacing.	0.6
8. Embellishments	0.8
9. Ending lines.	0.8
10. Vertical lines in the signatures.	0.5
11. Legibility.	0.4
12. Slant	0.5

Figure 21. Points according to attributes.

Giving points in this way we will fill out table of attributes. Then we must write the same data in txt files, for training and testing.

This part is said to be the hardest one, because it takes a lot of time.

But making a program for pattern recognition that will take this attributes automatically will make solution of our program very easy.

And you can solve it in few seconds.

	Направление	Длина	Начало и конец	Величина букв	Закругленность	Связанность букв	Расстояние между	Подчеркивание	Длина хвостиков	Вертикальные линии	Ясность	Наклон	Тип
1	0.9	0.6	0.6	0.8	0.6	0.3	0.9	0.5	0.4	0.4	0.5	0.9	
2	0.6	0.5	0.5	0.6	0.4	0.3	0.7	0.6	0.4	0.8	0.5	0.7	
3	0.6	0.8	0.8	0.7	0.5	0.3	0.8	0.7	0.6	0.6	0.4	0.4	
4	0.6	0.9	0.9	0.8	0.5	0.9	0.8	0.7	0.6	0.6	0.7	0.6	
5	0.6	0.4	0.8	0.8	0.8	0.6	0.5	0.8	0.6	0.8	0.3	0.7	
6	0.6	0.3	0.6	0.4	0.6	0.9	0.6	0.3	0.7	0.3	0.9	0.5	
7	0.6	0.5	0.6	0.7	0.6	0.6	0.6	0.6	0.8	0.8	0.5	0.5	
8	0.7	0.6	0.5	0.5	0.3	0.4	0.5	0.8	0.3	0.6	0.9	0.4	
9	0.9	0.4	0.3	0.4	0.4	0.3	0.7	0.65	0.2	0.4	0.3	0.6	
10	0.7	0.5	0.4	0.7	0.5	0.2	0.4	0.3	0.5	0.3	0.2	0.7	
11	0.6	0.4	0.5	0.5	0.5	0.8	0.6	0.8	0.4	0.3	0.9	0.6	
12	0.6	0.6	0.6	0.5	0.6	0.3	0.6	0.8	0.9	0.3	0.8	0.6	
13	0.8	0.6	0.8	0.9	0.7	0.4	0.6	0.7	0.8	0.9	0.4	0.4	
14	0.7	0.7	0.8	0.8	0.7	0.4	0.7	0.6	0.9	0.6	0.4	0.6	
15	0.6	0.7	0.7	0.6	0.7	0.4	0.5	0.7	0.8	0.9	0.4	0.4	
16	0.6	0.3	0.4	0.7	0.8	0.3	0.5	0.5	0.7	0.7	0.3	0.4	
17	0.6	0.7	0.6	0.8	0.8	0.8	0.7	0.8	0.8	0.7	0.9	0.4	
18	0.6	0.7	0.7	0.8	0.6	0.3	0.7	0.8	0.8	0.4	0.4	0.4	
19	0.6	0.6	0.7	0.8	0.5	0.8	0.8	0.7	0.4	0.6	0.5	0.5	
20	0.6	0.5	0.6	0.4	0.5	0.4	0.6	0.65	0.4	0.5	0.4	0.5	

Figure 22. Table of attributes used for training and testing.

In the training file we take 15 signatures of students of master second years. First 8 of them are extraverts and other 7 are introverts.

3.1.2. PROJECT TRAİNİNG AND TESTİNG FİGURES

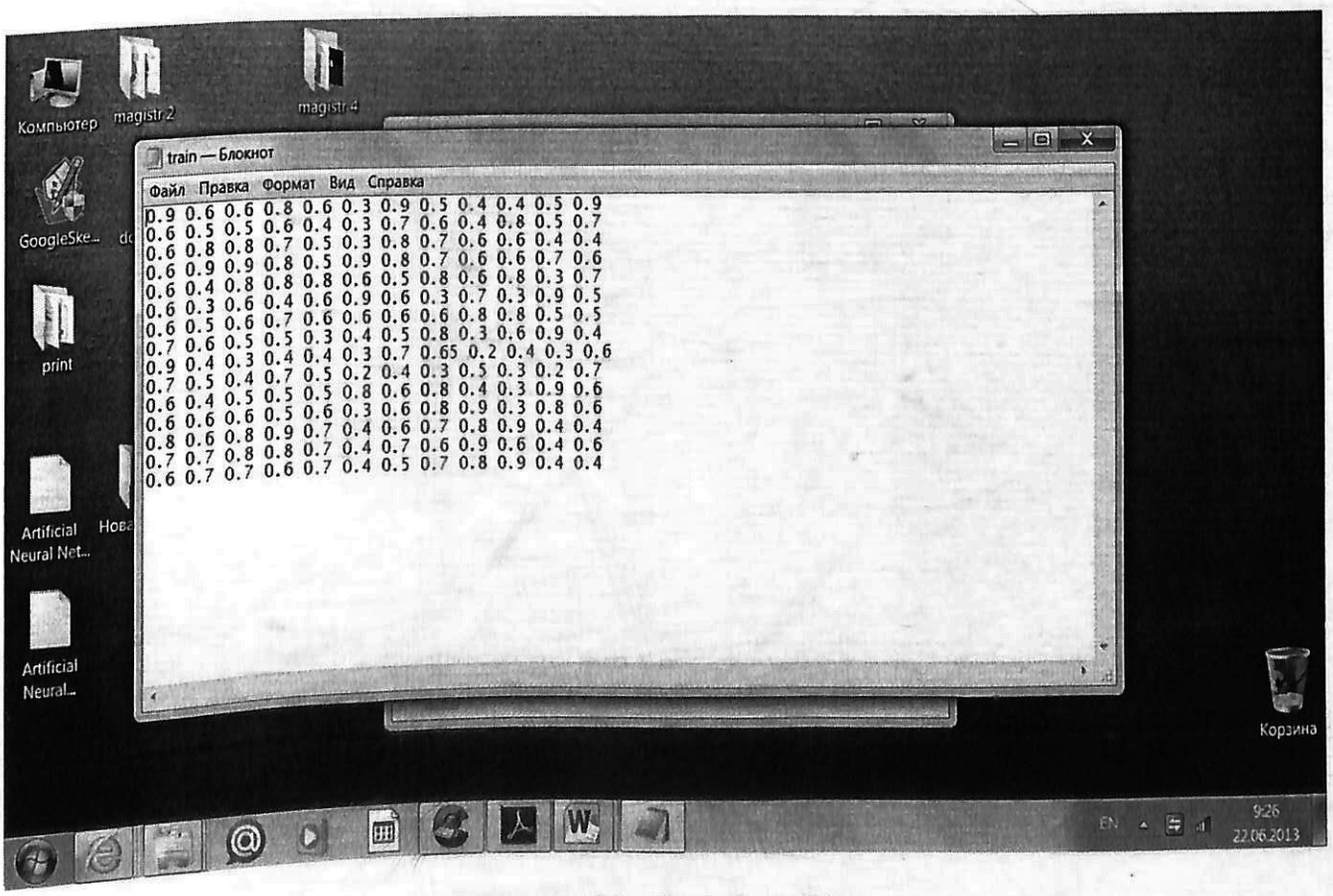

Figure 23. Training file.

Now, let's load it

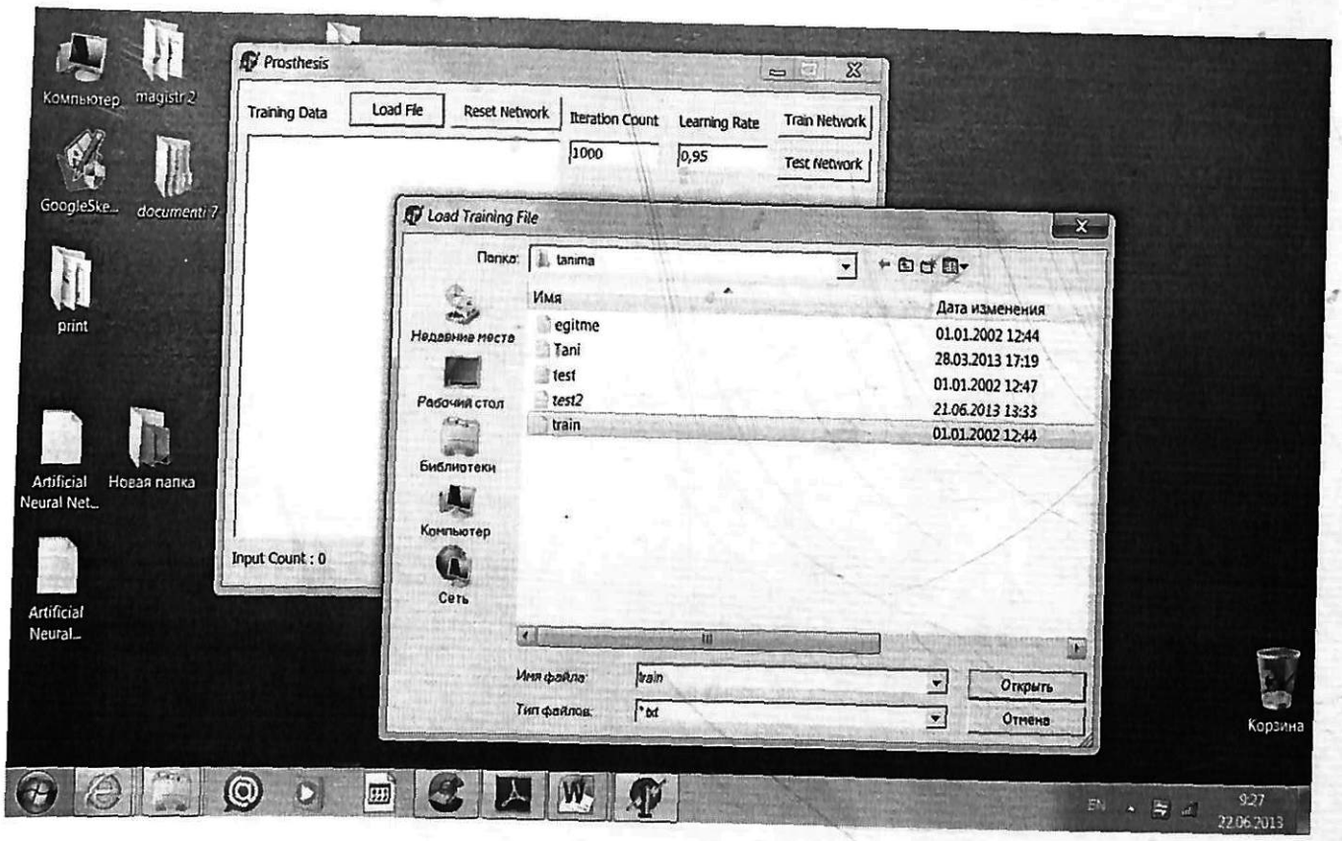

Figure 24. Loading training file.

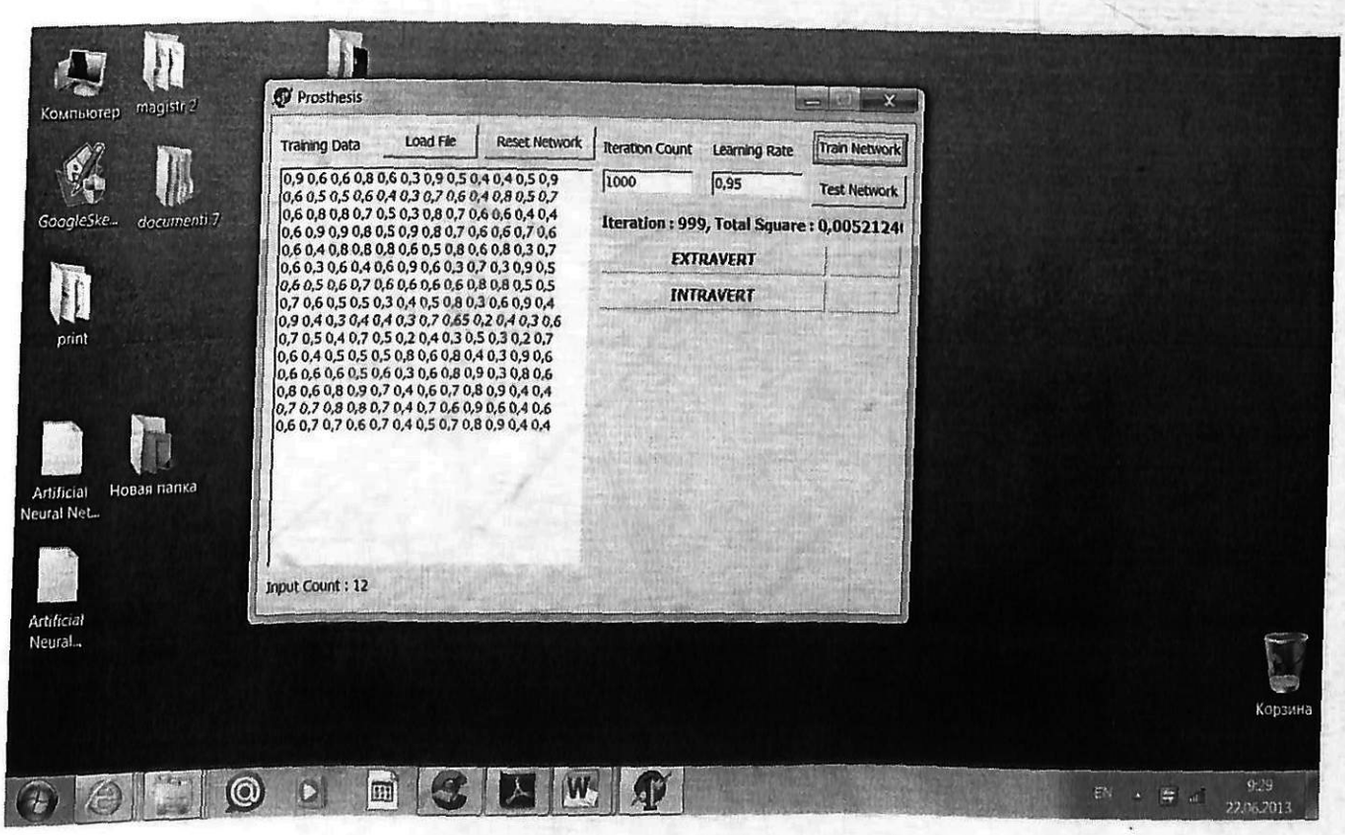

Figure 25. Train the network.

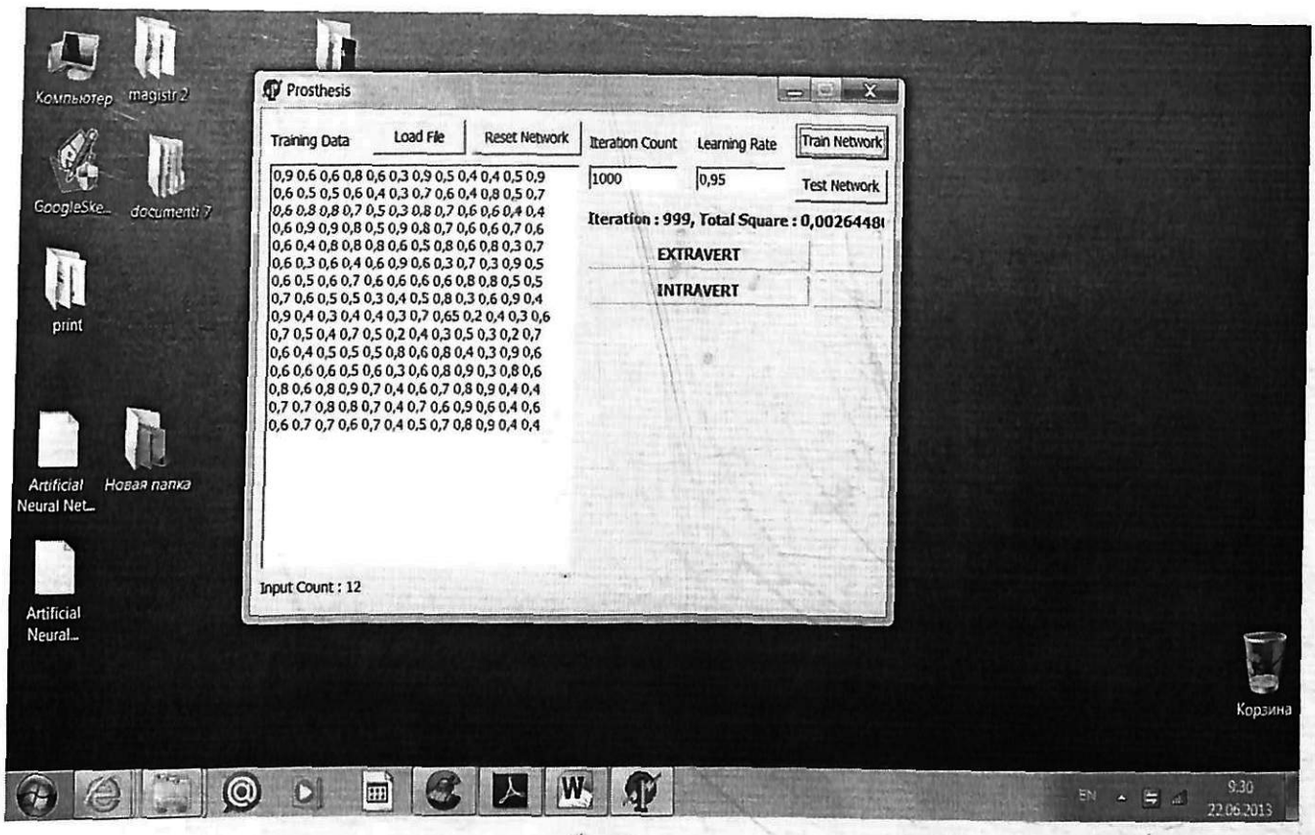

Figure 26. Train network until our total square's changes will not be so high.

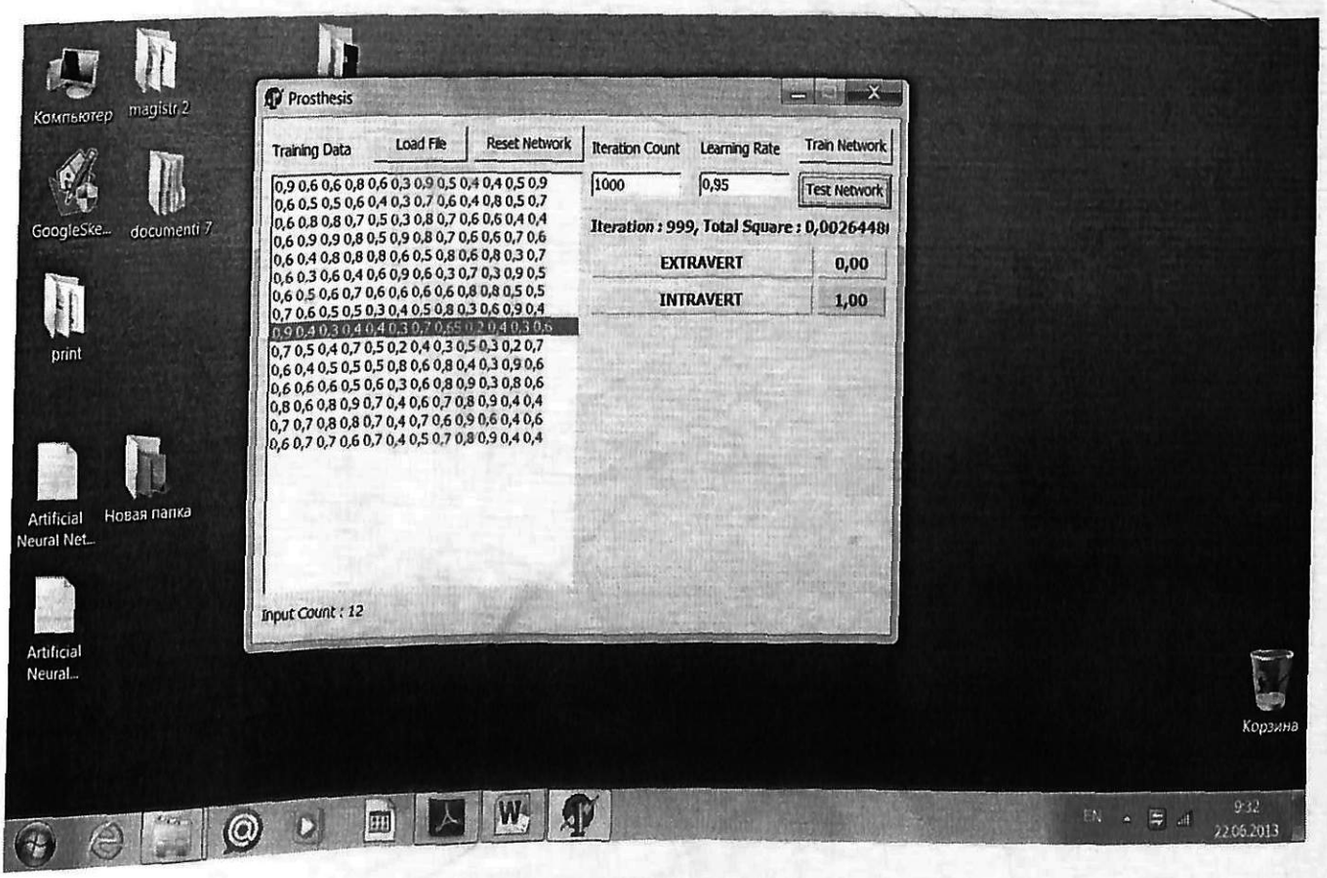

Figure 27. And we see that program takes last 7 data as introverts.

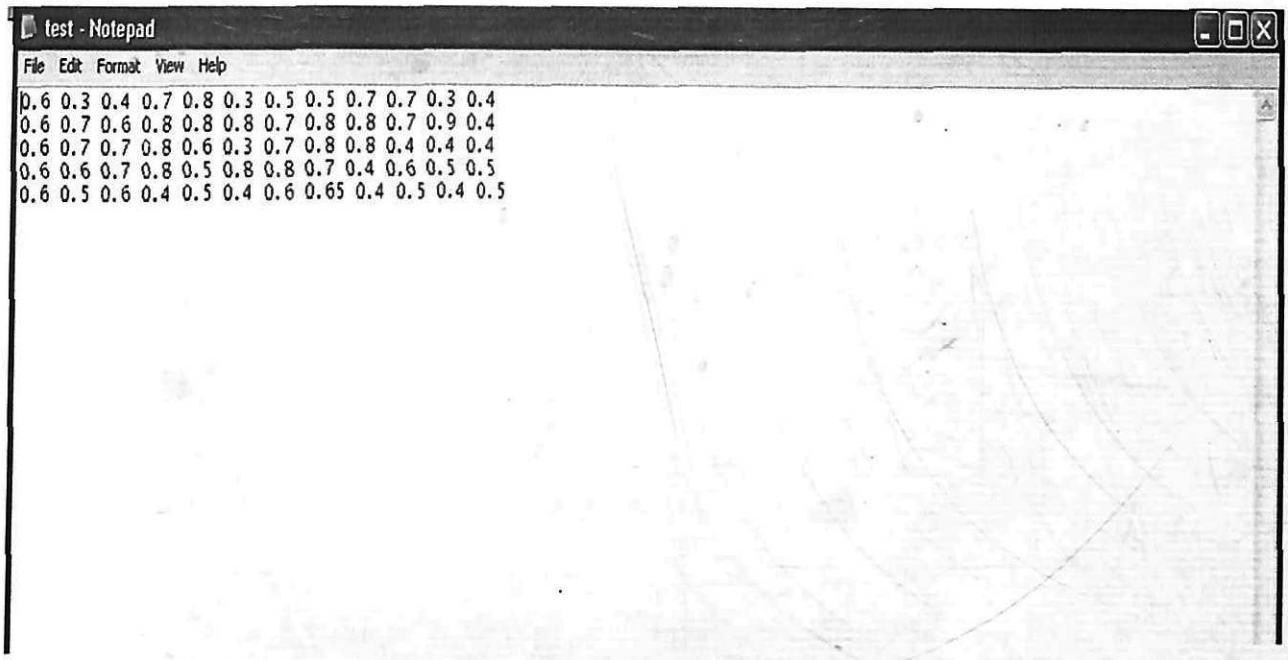

Figure 28. Testing Data

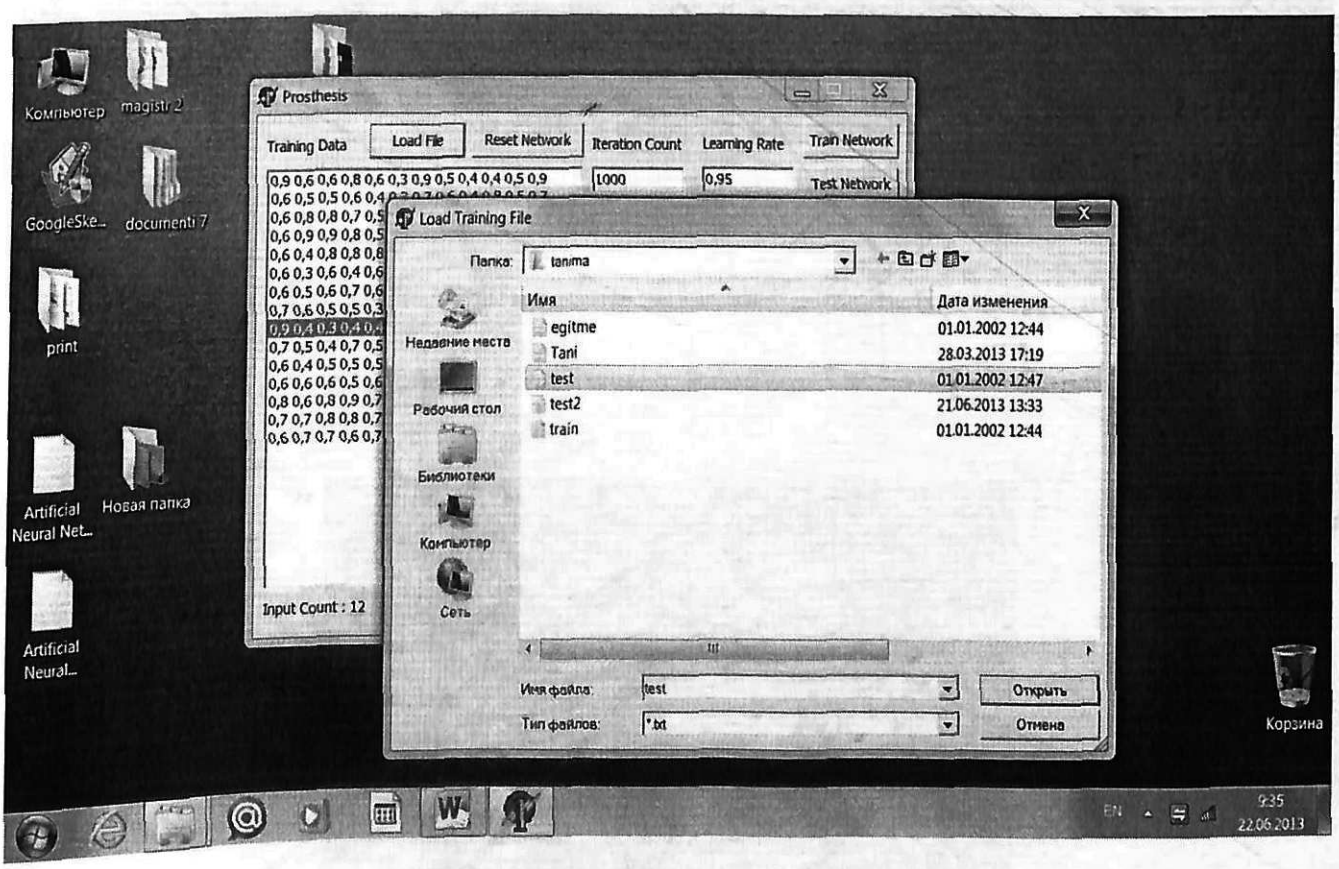

Figure 29. Load the testing file.

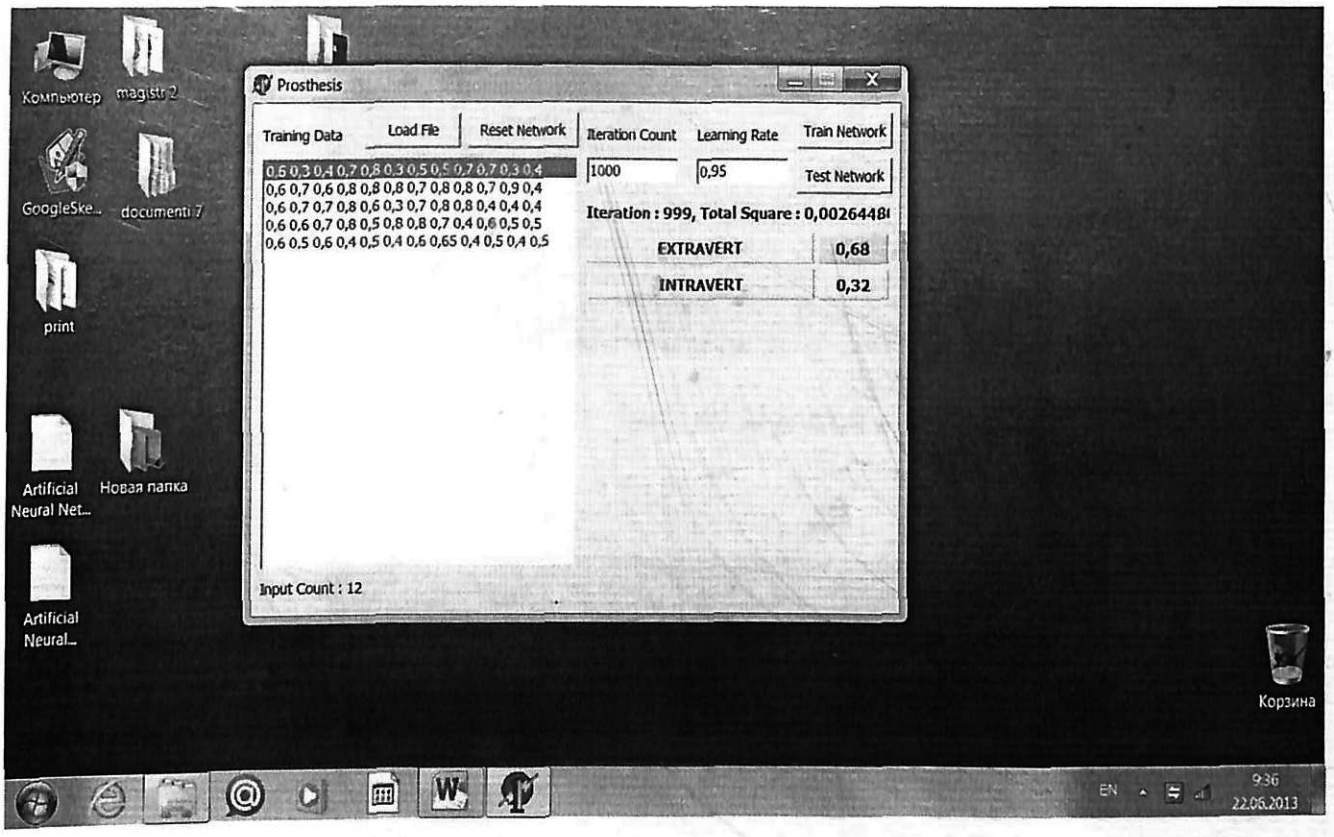

Figure 30. Test data one by one.

Also, we have second testing file with four students, 3 of them are extraverts and 1 introvert.

Figure 31. First signature.

Figure 32. Second signature.

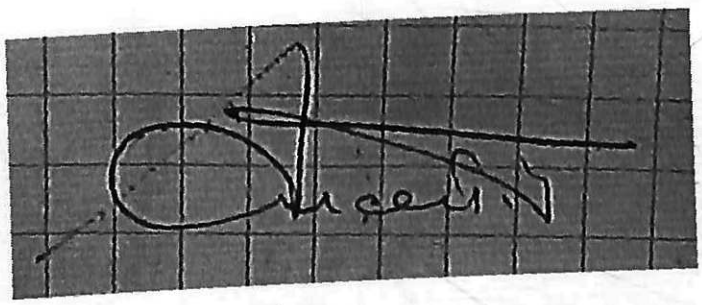

Figure 33. Third signature.

Figure 34. Fourth signature.

Let's check our program for correctness.

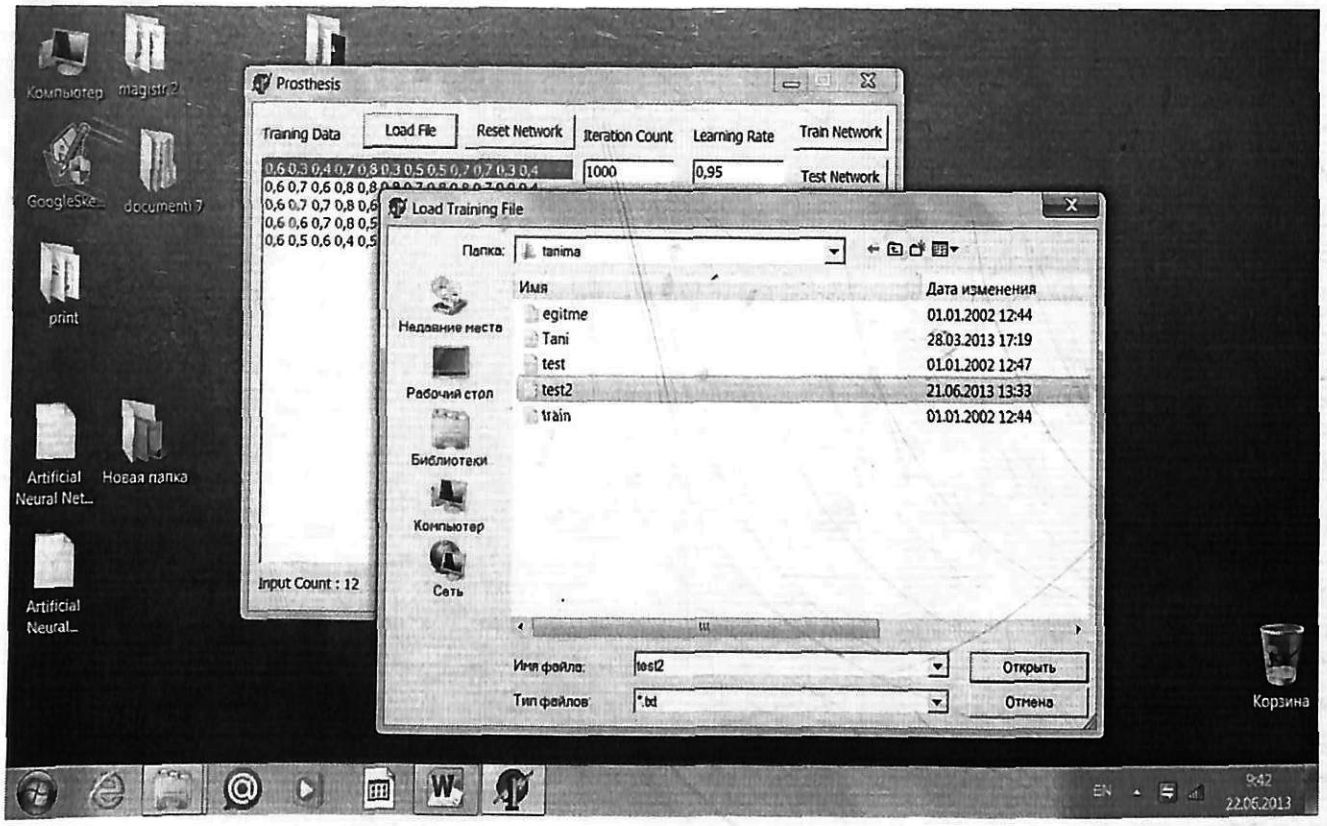

Figure 35. Loading test 2 file.

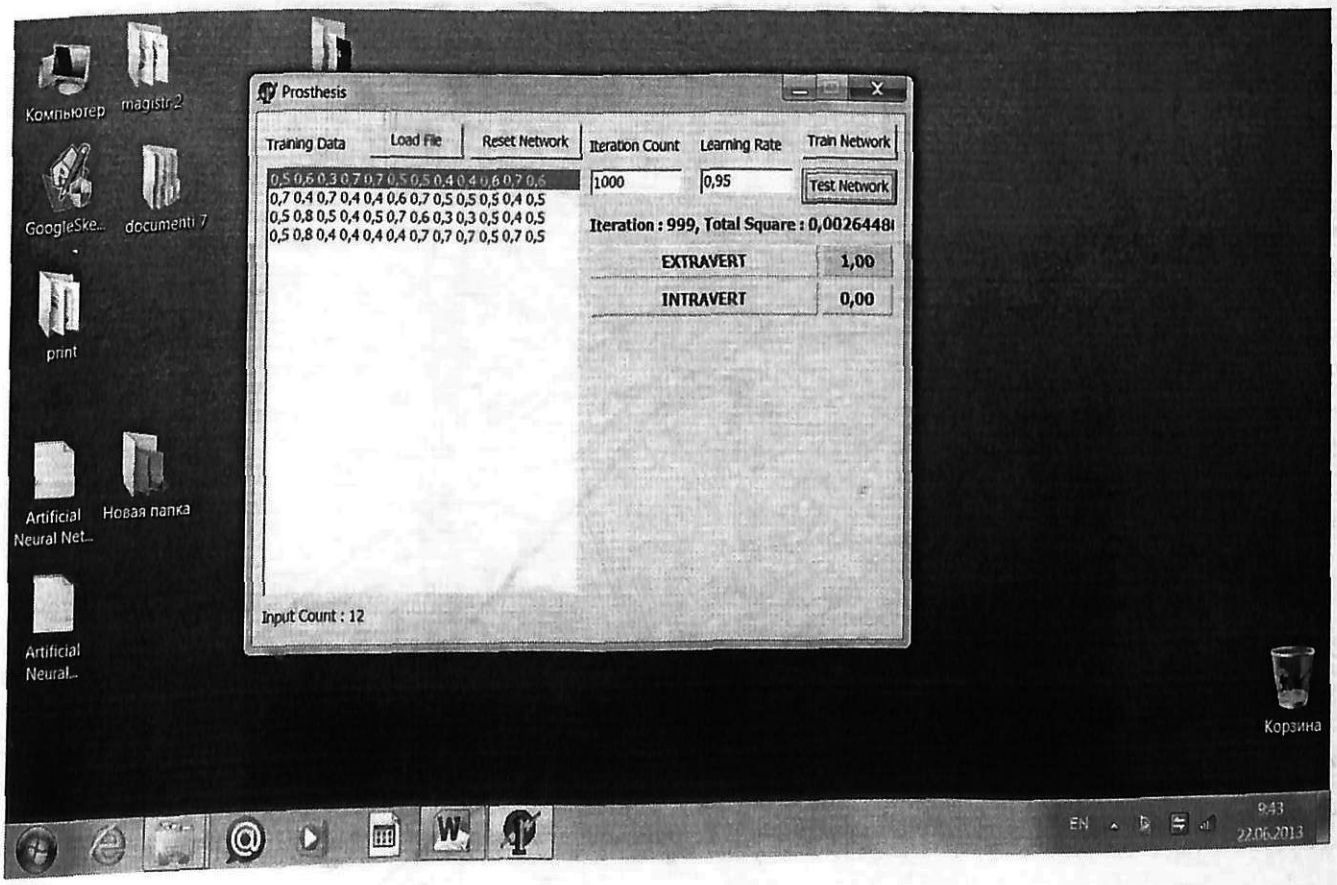

Figure 36. Testing first signature.

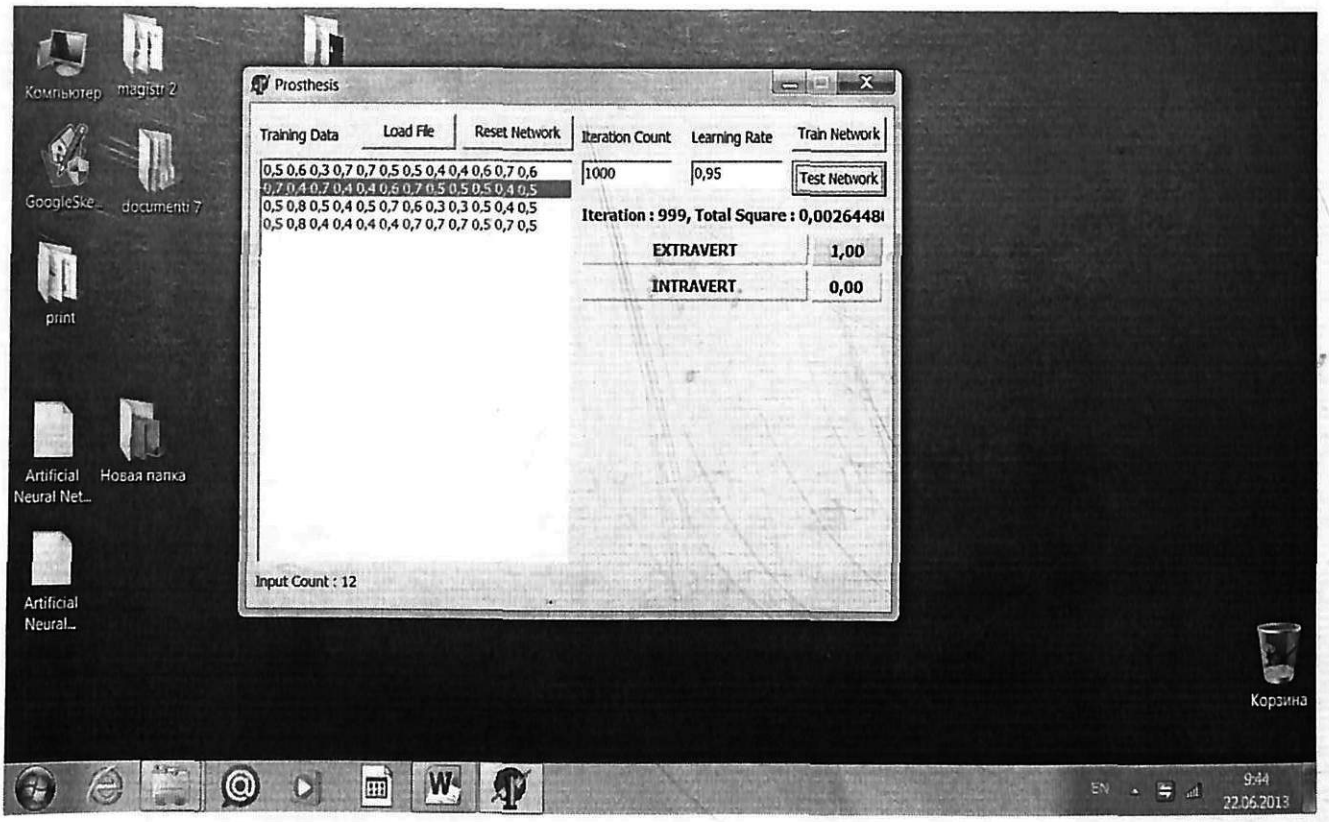

Figure 37. Testing second signature.

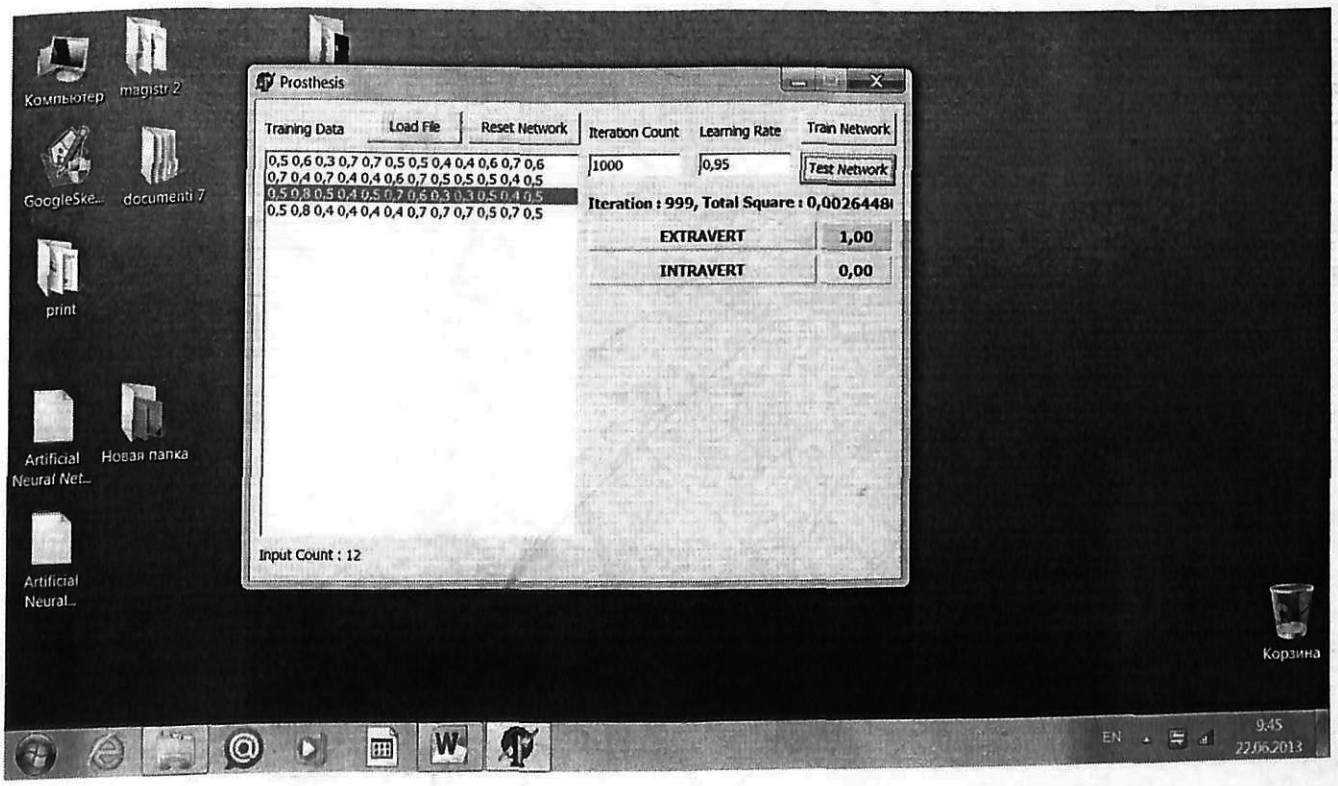

Figure 38. Testing third signature.

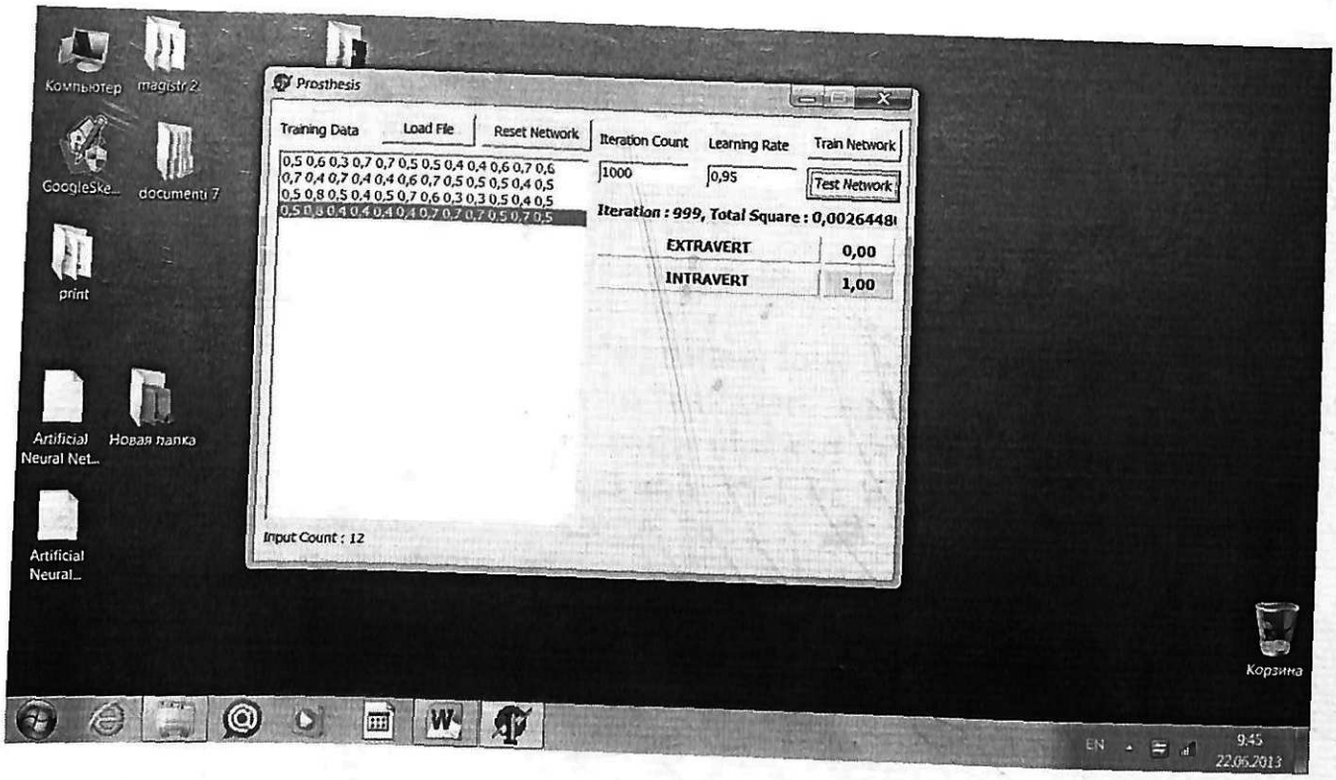

Figure 39. Testing the last signature.

All signatures show the correct character type. That's why we can say that our program works correctly.

CONCLUSION

In this project we took human signatures, take their attributes (12 attributes from 20-30 possible) and give them a number value from 0.1 to 0.9.
These values become greater according to relation to two general types of human personality type: "extrovert" and "introvert".

All taken information is processes in the special application that is counting using neural networks.

As the result we can take any signature, look through attributes and find to which of personal types it responds: to "extravert" and "introvert".

In the future we plan to automatize the part of taking attributes by using pattern recognition. And think that this will be useful to everyone who is interested in graphology.

REFERENCE

[1] http://en.wikipedia.org/wiki/History_of_psychology

[2] http://en.wikipedia.org/wiki/Psychology

[3] http://en.wikipedia.org/wiki/Personality_psychology

[4] Bernstein, Penner, Clarke-Stewart, & Roy (2008). Psychology, 8th edition. Boston, MA: Houghton Mifflin Company.

[5] Bess, T.L. & Harvey, R.J. (2001). Bimodal score distributions and the MBTI: Fact or artifact? Paper presented at the 2001 Annual Conference of the Society for Industrial and Organizational Psychology, San Diego, USA.

[6] Furnham, A., & Crump, J. (2005). Personality Traits, Types, and Disorders: An Examination of the Relationship Between Three Self-Report Measures. European Journal of Personality, 19, 167-184.

[7] Asendorpf, J. B. (2003). Head-to-head comparison of the predictive validity of personality types and dimensions. European Journal of Personality, 17, 327–346.

[8] http://www.usatodayeducate.com/staging/index.php/career/three-reasons-every-college-student-should-take-a-personality-test

[9] Article Source: http://EzineArticles.com/7016000

[10] http://general-psychology.knoji.com/signature-analysis-what-does-your-signature-say-about-your-personality/

[11] http://en.wikipedia.org/wiki/Backpropagation

[12] http://www.seattlerobotics.org/encoder/nov98/neural.html

[13] http://personalitytest.hubpages.com/hub/Signature-Analysis

[14] Айк Надж "Узнать характер человека по его подписи или практическая графология"

[15] http://www.graphocentric.co.uk/graphology-resources/a-brief-history-of-graphology/

[16] http://atozhandwriting.com/signature-analysis/

[17] Dave Anderson and George McNelli Artificial Neural Networks Technology, New York – 1992.-87p.

[18] Howard Demuth and Mark Beale Neural Network Toolbox For Use with MATLAB, The MathWorks, Inc.- 1997.-846 p.