

Soft Computing in Human Sciences

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ABSTRACT

There are various problems that cannot be solved by conventional, hard techniques. Soft computing has emerged as a way of solving these problems, the way humans do. It is a new approach to computing. It is an effective technique for solving problems of classification, prediction, optimization, pattern recognition, image processing, etc. Soft computing techniques include fuzzy logic, genetic algorithms, evolution strategies, artificial neural network, expert systems, and machine learning. These techniques have been used in human-related sciences to solve practical problems related to humans: their activities, health, and social needs. This paper provides an introduction to various applications of soft computing techniques in the human sciences.

KEYWORDS: *soft computing, hard computing, computer science, human sciences, natural sciences*

How to cite this paper: Matthew N. O. Sadiku | Uwakwe C. Chukwu | Abayomi Ajayi-Majebi | Sarhan M. Musa "Soft Computing in Human Sciences" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-6 | Issue-2, February 2022, pp.870-875, URL: www.ijtsrd.com/papers/ijtsrd49305.pdf



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INTRODUCTION

Computing is the study of natural and artificial information processes. It has now become a natural science. Today, computing supports online communities, who work through people, who work through software that works through hardware. New ways to view computing affects how we design and build computing systems. As new principles are discovered, computing is evolving and thriving constantly. Figure 1 shows how computing evolved through the four stages of hardware, software, people, and community [1]. Every day more people use computers to do more things in different ways, so engineering, computer science, health, business, psychology, mathematics, and education compete for the computing crown. Academic institutions that compartmentalize computing research into isolated groups deny its multi-disciplinary future.

Computing includes computer science, computer engineering, software engineering, information technology, information science, and information systems. The main functions of computing systems

include design, computation, communication, and automation. Computation is the execution of algorithms on a computer. The computer is the tool, computation is the principle [2].

Computation is a process of converting the input of one form to some other desired output form using some actions. Computation was present long before computers were invented, but the remarkable shift to this realization occurred only in the last decade. In the 1940s, computation was seen as a tool for solving problems, cracking codes, analyzing data, managing business processes, and running simulation models.

Computation has established itself as a powerful tool that made formerly intractable analyses tractable. It has become a third pillar of science, joining theory and experiment. Computation has become utterly indispensable in many fields leading to computational biology, computational chemistry, computational physics, computational anatomy, computational electromagnetics, computational fluids, computation

social sciences, etc. [3]. Computation is everywhere and is evolving to higher levels.

There is a major paradigm shift in the methods of computing, which is the evolution from hard computing to soft computing. The term “soft computing” was coined by Lofti A. Zadeh in 1991. Since then, the area has experienced rapid development. Soft computing became a discipline within computer science in the early 1990s. The terms “machine intelligence” and “computational intelligence” have been used to have close meaning as soft computing. The principal premise of soft computing (SC) is that we live in a world that is imprecise and uncertain. Soft computing refers to the use of “inexact” solutions to computationally hard tasks [4]. Soft computing’s aim is to exploit tolerance for approximation, partial truth, uncertainty, and imprecision, achieving close resemblance with human like decision making. It can be used in human-related sciences to solve practical problems related to humans: their activities, health, and social needs.

OVERVIEW OF SOFT COMPUTING

There are two types of computing: hard computing and soft computing. Hard computing is traditional computing that requires precisely stated analytical model and very large computation time. It is a process of programming the computer to solve problems using existing mathematical algorithms. It is facing the problem of “living with” some aspects of vagueness. Unlike the conventional hard computing, soft computing is widely used for coping with the tolerant of imprecision, uncertainty, partial truth, and approximation.

It differs from the conventional hard computing as it can handle uncertainty, imprecision easily. While conventional hard computing is based on crisp values and binary numbers, SC uses soft values and fuzzy sets.

Soft computing is a consortium of techniques which work with real life problems and provides flexible information processing capabilities for handling real-life and complex situations. The techniques strive to provide approximate solutions at low cost, thereby speeding up the process [5]. Soft computing (SC) is a branch of computer science that resembles the processes of the human brain. It may also be regarded as a newly emerging multidisciplinary field. Its main objective is to develop intelligent machines in order to solve real- world problems.

Soft computing provides insights into real-world problems and is just not limited to theory. It is the process of solving real-life complex problems using approximate calculations just like the human brain

works. It has tolerance for uncertainty and is imprecise in nature due to which it has spread widely into various industries.

Soft computing refers to a collection of computational techniques in computer science, artificial intelligence, and machine learning. The techniques aim to exploit the tolerance of imprecision and uncertainty to achieve tractability, robustness, and low solution cost.

Its principle components include:

- Neural networks
- Expert systems
- Machine learning
- Probabilistic reasoning
- Evolutionary algorithms
- Artificial neural networks
- Fuzzy logic
- Swarm intelligence
- Interactive computational models

These computation methods or technologies provide information processing capabilities to solve complex practical problems. Some of these techniques are illustrated in Figure 2 [6]. Soft computing combines these technologies is to solve real-world problems, which cannot be solved by hard computing.

APPLICATIONS OF SC IN HUMAN SCIENCES

Soft computing is used for solving real-life problems and can be applied in different fields such as education, healthcare, business, industry, engineering, power systems, transportation, communication systems, wireless communications, data mining, home appliances, robotics, etc. [7]. Although a lot of applications of soft computing have been made in the natural sciences, few applications of soft computing have been made in the human sciences, such as the social and the behavioral sciences. Soft Computing seems to enjoy a wide range of applications in human sciences. Some common applications are presented as follows.

- **Biometrics:** Every human has unique physiological and behavioral characteristics. These characteristics are referred to as biometrics. There are generally two types of biometrics: static and dynamic. Static biometrics remain the same throughout the lifespan while dynamic characteristics may change gradually with time. Examples of static biometrics include fingerprints, iris patterns, face proportions, and DNA. Dynamic biometrics includes voice, lips movement, handwriting, and typing biometrics. One of the most important application areas of biometrics is in security. Computerized systems need a robust and accurate security measure to authenticate the identity of users. Typing biometrics and neural network have been used as

an additional security layer for conventional password-based or PIN-based protection for computer users [8].

- **Handwriting Analysis:** This is another form of biometric modality. It is a technique for modeling human activities and judging the human as a device. It is also used to determine the types of human mental state. The need of human personality recognition is important in the modern world. The handwritings reveal many things such as a mental problem, hidden talents, morality, health issue, past experience, etc. Handwriting work indicates personality and behavior of humans such as handwriting, speech, hand gestures, American Sign Language, interviewing, recruitment, selection, team-building, counseling, and career-planning. Handwriting tends to expose the true behavior, emotional outlay, fears, and many other traits. It is referring to intelligence or brain writing [9].
- **Human Activity Recognition (HAR):** This apprehends the regard of various computer science communities just because of its potency in real world applications. Human activity recognition is done over the sensor based system. There are two ways to recognize activity: online and offline activity recognition. HAR can be done into three main steps: data collection, features extraction, and classification training and testing. Various HAR tools are used in developing devices for real world process. HAR systems are used in military, healthcare, intelligent homes, security etc. Soft computing is the science of reasoning and deduction that uses the real world phenomena of grouping, memberships, and classification of various quantities. Human activity recognition uses classifier that is support vector machine (SVM), a soft computing approach, which is well known classifier [10].
- **Rainfall Forecasting:** Rain is one of the nature's indispensable gifts and the entire agriculture industry depends on rain in developing nations. Therefore, rainfall prediction is essential in countries thriving on agro-based economy. It is well known that rainfall and climate are highly non-linear and complex phenomena in nature. Due to the complex nature of the parameters involved, there is uncertainty in a rainfall prediction. Soft computing is an innovative approach to construct computationally intelligent systems that possess humanlike expertise. Unlike conventional hard computing techniques the guiding principle of soft computing is to exploit tolerance for imprecision, uncertainty, robustness,

partial truth to achieve tractability, and better rapport with reality [11,12].

- **Obesity Prediction:** Since obesity started capturing headlines on all forms of media, researches have spurred in all possible directions. There has been a global interest on combating obesity. Obesity is an abnormal accumulation of body fat. It is associated with an increased risk of illness, disability, and death. Although many researches have been conducted to find the cause of obesity by using statistical approaches, none of them has concluded in any substantial results. Real-world phenomena such as obesity are very complex in nature to model. Soft computing methods have addressed childhood obesity prediction problem [13].
- **Terrorism Analysis:** Terrorism is a globally prevalent crime against humanity in modern society. It is threat to humanity and stable governance in both developing nations and developed nations. Counter-terrorism efforts require precise and reliable techniques to analyze the patterns existing in data of previous terrorist activities. Terrorist event databases are generally fetched from newspaper articles, internet blogs, television broadcasts, memoirs, books, interviews, etc. With the evolution of technology, methods of generating event databases have also evolved. Forecasting terrorist attacks always remains a dominant question in terrorism analysis. Figure 3 shows major parameters of a terrorist attack event [14]. Most of the applications used for analyzing terrorism data are based on soft computing techniques, such as approximate reasoning, metaheuristic optimization, and machine learning.

Other applications of soft computing in human sciences include weather forecasting, malware detection, analysis of human knee joint, human behavior recognition, speech recognition, pattern recognition, facial expression recognition, communications, human-centered interfaces, image processing, and decision-support systems.

BENEFITS

Soft computing uses imprecise elucidations to computationally hard tasks for which there is no established algorithm. In contrast with hard computing, soft computing is liberal to imprecision, ambiguity, approximation as well as fractional truths. Soft computing is receptive to uncertainty, imprecision as well as partial truth and is applicable for the real world practical problems where the ideal model is unavailable [15]. Other benefits of soft computing include the following [16].

- Its applications are tolerant to imprecision, approximation and uncertainty.
- It incorporates stochastic.
- It can generate (evolve) its own programs.
- It can deal with ambiguous and noisy data.
- It allows parallel computations.
- Programs learn by own.
- It requires very less time for computation.
- Its role model is human brain or human reasoning.
- It is applicable in real-time.

CONCLUSION

Computing is already moving into all fiends, including education, where it is inspiring young men and women to consider computing careers. Children have been taught computing principles using ordinary materials such as cards, drawing paper, games, exercises, and magic tricks. This way they can understand computing concepts without a computer.

Soft computing is one of the most attractive fields today. Practically no area is left untouched by soft computing. In most of the applications, soft computing techniques show strong intelligence, robustness, and cost-effectiveness. Soft computing techniques will be indispensable tools for analysis in the new era. Soft computing techniques still await their golden age in human sciences. More information about soft computing in healthcare can be found in the books [17-26] and the following related journals:

- Soft Computing
- Applied Soft Computing
- Journal of Human Sciences and Extension
- Biomedical Soft Computing and Human Sciences

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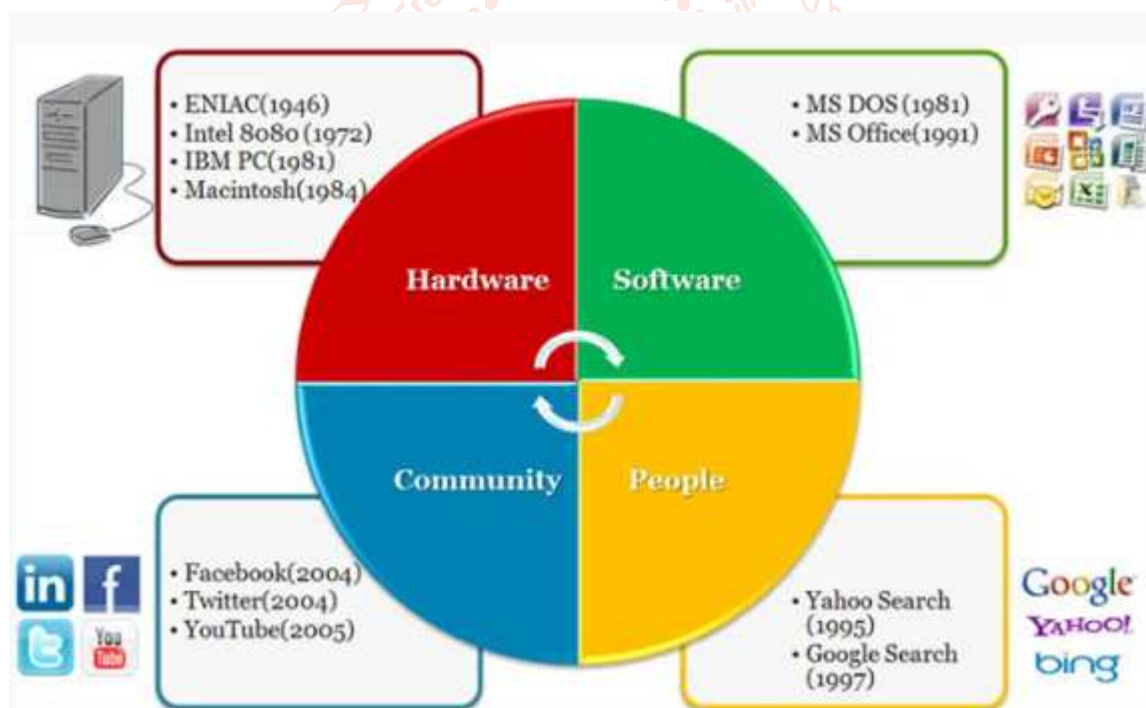


Figure 1 the four stages of computing [1].

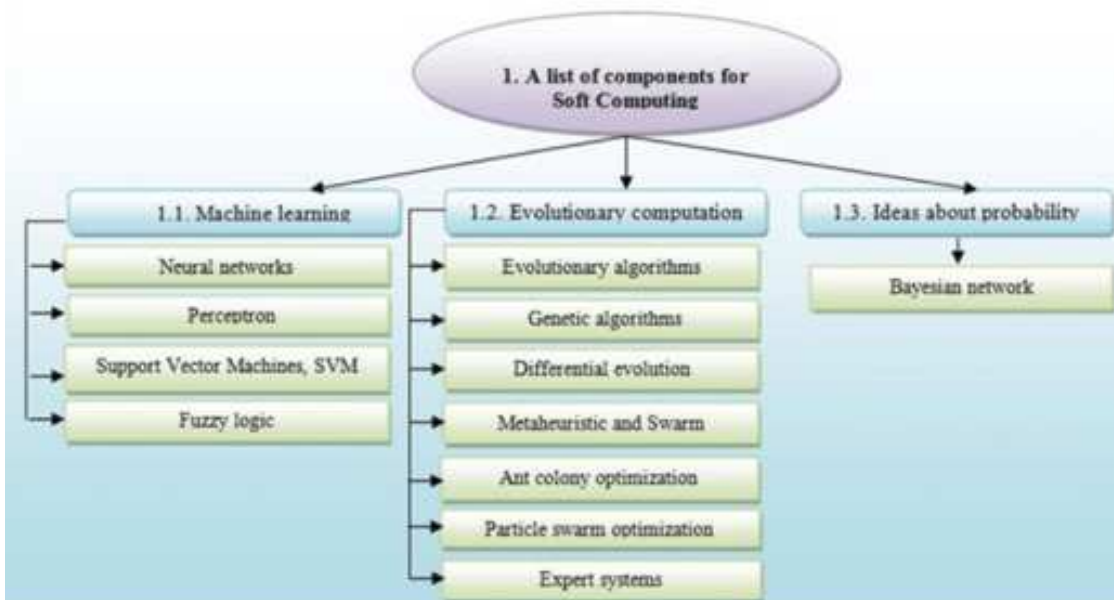


Figure 2 Soft computing approaches [6].

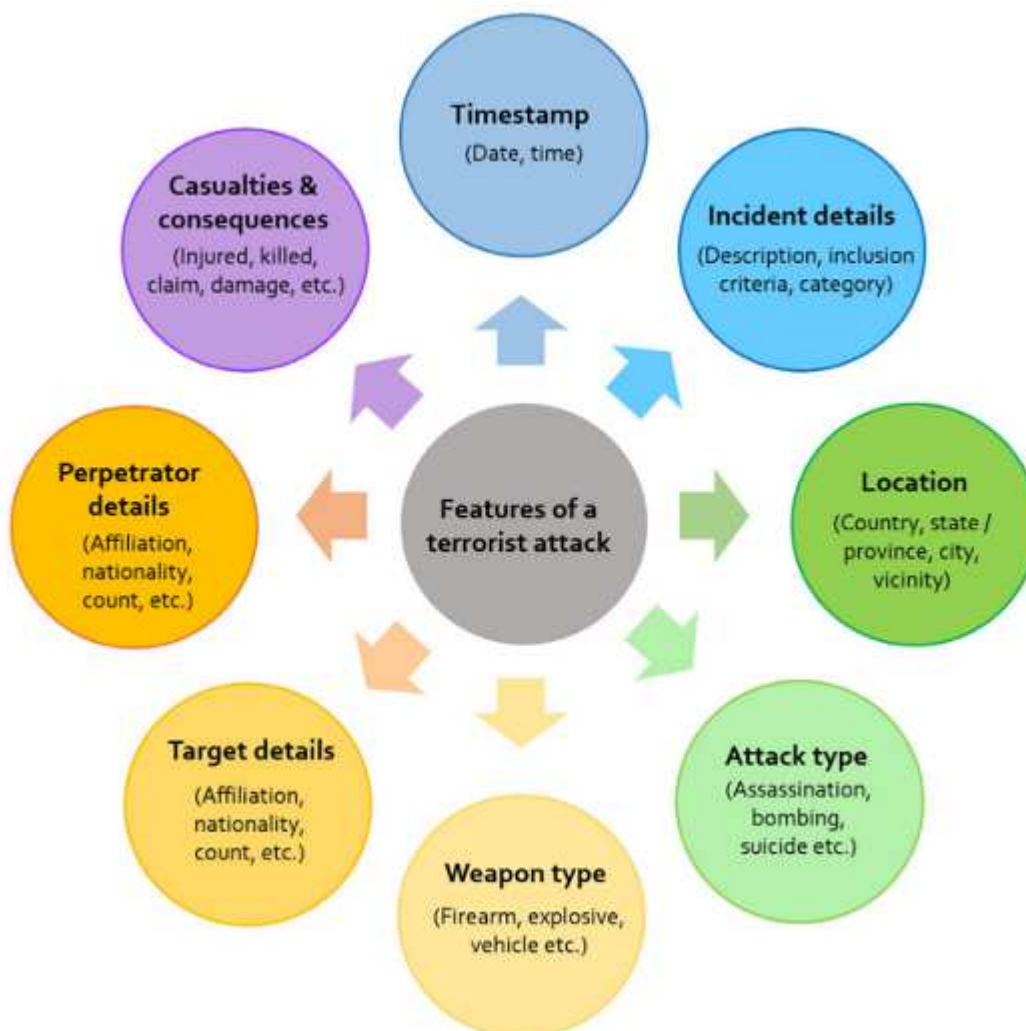


Figure 3 Major parameters of a terrorist attack event [15]