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Computer Science Approaches

Amir Ali Khan

Ms Scholar Department of Computer Science the Iqra National University Peshawar

Muhammad Saeed Khattak

Ms Scholar Department of Computer Science the Iqra National University Peshawar

Abstract

An examination of the scientific components of computer science is presented in this paper. A comprehensive explanation of the scientific process and a comprehensive definition of science are presented here as a starting point. It is necessary to perform an investigation of the interrelationships that exist between science, technology, research, and development. Scholars such as Popper, Carnap, Kuhn, and Chalmers have proposed that physics is the pinnacle or climax of contemporary scientific thinking. This view is supported by the theory that physics is the highest point or culmination. Only a few subfields within the scientific community are even capable of approaching such a level of perfection. The examination of computer science in light of the current state of philosophy of science or theory of science is not a particularly fruitful endeavour. In the burgeoning field of computer science, the computer, which is a device that is continually expanding and embodies ideas aimed at organising knowledge and information about the world, including computers themselves, is the focal point of research. The concepts of logic and mathematics form the foundation of computer science, and its research methods, both experimental and theoretical, adhere to the traditions of established scientific disciplines. Despite the fact that it is a vast field, computer science is based on these principles. The approach of computer modelling and simulation is one of a kind within the field, and it is anticipated that it will continue to advance in the future, not just for usage on computers but also in a variety of scientific, commercial, and artistic fields.

Keywords. Computer Science, Theory of science, scientific methodology.

Introduction

There is a possibility that the name may give the impression that computer science does not immediately qualify as "science." As a relatively young subject of study, computer science (CS) must be seen as essentially distinct from other "classic" fields that have their roots in Greek philosophy. These fields include physics, mathematics, and others. It is acceptable to believe that computer science (CS) has undergone contemporaneous development with other subjects that have been around for a long time. This is because the first electronic digital computer was introduced in the 940s. The field of computer science is constructed on the foundations of a great number of other fields of study. As a consequence of this, educators in the subject of computer science are required to include ideas from other disciplines. Computer science encompasses a wide range of fields, including specific design and broad abstraction, as well as theoretical and practical components. The passage of time has resulted in the development of a growing number of scientific disciplines that can facilitate communication. This can be attributed, at least in part, to the development of communication means that are both efficient and easy, as well as the growing demand for a more comprehensive understanding of our reality, which is now typified by a preponderance of reductionism. It is possible to draw parallels between the arrangement depicted in Figure 1 and the process of examining an object through the lens of a microscope. By employing the highest possible resolution level, it is possible to gain access to the most centre region.

Within the primary domain, logic is utilised for objectives that are not related to the process of drawing conclusions. Moreover, it is the primary focus of the investigation that is being conducted. Despite the fact that certain branches of mathematics, such as those created by Frege, Russell, and Whitehead, are capable of being deduced logically, the entirety of mathematics cannot be reduced to logic in its entirety. At each level of the zoom out process, the interior areas are offered as requirements for the regions that are located outside. Without calling into question the fundamental structure of the subject, physics is the application of mathematics and logic as practical disciplines. By using this method, the particular nuances of fundamental mathematics and logic are obscured. The scientific discipline of physics, much like the scientific discipline of chemistry, is an essential part of the scientific discipline of biology. The primary objective of Figure 1 is to provide a graphical representation of the connections that exist between the three primary scientific subfields (natural sciences, social sciences, and logic and mathematics) and the philosophical systems that are included in the humanities. Simply put, the cultural environment is the primary factor that influences and moulds all aspects of human knowledge, including scientific and theoretical ways of thinking. On the other hand, the internal sciences, which include logic and mathematics, are extremely fundamental and certain They are provided with the most fundamental and general kinds of research topics.

When they speak, they use the most formal inflection possible. Deduction is the fundamental mode of operation that they employ. It is of the utmost importance to keep in mind that the fundamental concepts of mathematics and logic were produced through a method that was mostly inductive. This method transformed normal language into a collection of precise formulas and symbolic symbols. On the other hand, in contrast to the zone that came before it, the Natural Sciences region does not have a formalised theory that is founded on axioms. According to a number of well-known scientific philosophers, including Popper, Carnap, Kuhn, Chalmers, and others (4–7), the field of physics is regarded as the most advanced type of scientific study. Abbreviations that indicate truths that have been discovered by empirical research are included in the framework, which incorporates both theoretical and empirical components. On the other hand, the internal sciences, which include logic and mathematics, are extremely fundamental and certain. They are provided with the most fundamental and general kinds of research topics.

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WHAT IS SCIENCE

The whole is more than the sum of its parts. Aristotle,

Metaphysica

Sciences Belonging to Several Fields

As human civilization has advanced, it has closely followed the development of human thought, which has resulted in the establishment of other fields of study that, despite not being specifically classified under the primary divisions mentioned earlier, do exhibit significant similarities to some of those divisions. The field of modern sciences encompasses a wide range of issues that are not only diverse but also cross-disciplinary. In order to find answers to their questions and come up with new methods, emerging scientific disciplines are always broadening the scope of their research. This phenomenon can be attributed to the fact that the modern level of communication in a variety of scientific fields is characterised by increased intensity and simplicity. The field of computer science comprises the study of artificial intelligence, which employs mathematical logic and arithmetic as its foundation. In addition, computer science incorporates concepts from the fields of physics, chemistry, biology, psychology, and medicine. The way that science is arranged may undergo significant and often unexpected shifts as a result of the fact that information processing is becoming more intertwined with research and technology. This development is currently taking place.

When we have a better understanding of the complex information processes that are engaged in scientific study, the scientific community will specifically adopt a more metaphysical point of view. Consequently, in order to carry out scientific activities such as observation, experimentation, theory development, testing, and archiving, it is required to have an understanding of these information processes and to construct systems that are capable of carrying out scientific operations at the object level in an efficient manner. As a consequence of this, the distinction between artificial intelligence (AI) and the more general subject of science, which is concerned with the accumulation and organisation of information from all over the world, will eventually become less distinct. An essay that was written by Allen Newell and titled "Artificial Intelligence 25:3 (1985)" was published in 1985. The forthcoming synthetic (holistic) worldview is hinted at in this essay, which serves as an earlier indicator.

The Scientific Method

A logical framework that is utilised by scientists in order to address and solve problems and concerns that are associated with the scientific area is known as the scientific method. The scientific method is the source from which our scientific theories are derived. These theories include not just meta-theories, which are theories about ideas, but also the theories that drive the production of tools such as algorithms and instruments that are employed in the construction of those theories. Please refer to Figure 2 for a visual representation of the basic version, which is as follows:

1. Place the inquiry within the context of the existing body of knowledge, which should account for both theoretical frameworks and empirical evidence simultaneously. One may choose to

research a novel question that can be addressed using existing theories or one that requires the formation of an entirely new theory. Both options are available to the individual.

2. Instead of presenting a conclusive response to the question, you should address it by putting out a hypothesis that is hypothetical.

3. Construct hypotheses and construct inferences from the data.

4. Conduct an analysis of the theory by fitting it into the context of a specific experiment or area of research.

In Kuhn's opinion, a new theory must be consistent with the conventional scientific viewpoint, which is referred to as "normal science." In situations where the hypothesis generates inconsistencies that necessitate a substantial alteration of the existing theoretical framework, it is important to do more research. The new hypothesis needs to demonstrate productivity and give considerable benefits in order to challenge the mainstream scientific paradigm that is now in place. Although Kuhn calls this phenomenon the "scientific revolution," it is a phenomenon that occurs very infrequently. Under normal circumstances, iterations 2-3-4 of the loops are carried out in order to update the hypothesis until a consensus is established, which ultimately results in the value of 5. Following the attainment of consistency, the hypothesis develops into a theory, which is comprised of a coherent collection of statements that represent a new category of occurrences or a novel theoretical concept. Because of the significant inconsistencies, it is necessary to begin the process all over again from the very beginning.

It is required that the results be made available to the general public. Next, a procedure that is referred to as "natural selection" (6) is applied to hypotheses that are in competition with one another. After that, a theory needs to develop into a framework that not only clarifies facts and theoretical principles but also formulates predictions within that framework. In spite of the fact that the process can begin at any time, state 1 has been altered in order to incorporate the recently proposed theory or to improve upon an existing theory., the overarching conceptual framework of the scientific approach that is utilised in the process of developing new hypotheses is depicted. The flowchart illustrates how the scientific community is continuously expanding and adapting to new developments. The intrinsic provisionality of science, which always allows for the possibility of revision and self-correction, is one of the most important characteristics of the scientific scientific method. Repeat the experiment (in theory) to ascertain the validity of certain findings. The investigator's mental state, religious beliefs, or level of consciousness will not affect the validity of the findings. The essential characteristics of science—universality and openness— have a direct bearing on the issue of impartiality. First and foremost, a theory is adopted based on the outcomes of logical reasoning, observations, and/or experiments. The outcomes produced by the scientific process must be repeatable. The reasons behind these disparities are further investigated if the initial assertions are not confirmed. Every scientific truth is subject to change. However, a hypothesis must gain the trust of the scientific community in order to become a theory. The body of scientific knowledge can be made up of a variety of different hypotheses in domains where there are no widely accepted theories (such as the explanation of the universe's birth, while the "big bang" theory is the most widely accepted).

Modern Science contra Technology

However, in the context of contemporary science, the conventional dichotomous distinctions between science and technology appear to be inadequate due to the obsolescence of scientific principles. Present-day science is considerably more complex and diverse than that of Aristotle's time (present relations are illustrated in Figure 3); this is a fact that many contemporary philosophers find difficult to accept. Because of this, philosophy of science requires a more comprehensive and well-grounded understanding of contemporary sciences. The time has come for a paradigm transformation in the philosophy of science. According to this theory, computer science ought to be regarded as an enlargement of information theory, which encompasses not only the transmission of information but also its modification and interpretation. From a sociological point of view, it is possible to draw parallels between the computer revolution and the industrial revolution. Both revolutions were distinguished by an emphasis on the utilization of information and energy, respectively. The fourth word encapsulates the extremely complicated engineering problems that arise when directing the development of large software-hardware systems. These problems can be quite difficult to comprehend. According to [9], paradigms for empirical research were the most prevalent in the field of computer science during the 1950s, followed by paradigms for mathematical research during the 1960s, and then engineering-oriented paradigms started to emerge during the 1970s. There is a wide variety of research paradigms that are utilized within the field of computer science, which may be the cause of variations in understanding regarding the fundamental nature of computer science research. This fundamental question, "What can be (efficiently) automated?" is the driving force behind all computing. [3]: Computer science is the study of theoretical and practical disciplines that pertain to the creation and deployment of computers for the purpose of information processing and storage. Computer science comprises both theoretical and applied sciences. It comprises a wide range of disciplines, in addition to science, logic, and mathematics, among others. The field of study was established in the 1940s as a result of the convergence of factors including algorithm theory, mathematical logic, and electronic computers. Logic is of great significance not only because it plays a foundational role in all programming languages and because it investigates the limits of automated computation, but also because it recognizes that sequences of symbols, including numerical representations, can be interpreted as both programs and data. This is one of the reasons why logic is so important

. According to the following are subdomains inside computing:

1. Structures That Are One of a Kind

2. The Foundational Concepts Found in Programming

3. Complexity and the Use of Algorithms

4. Programming Languages That Are Most Commonly Employed

Architecture and Organization number five, and operating system frameworks number six

5. Focusing Constantly on the Objective Machine-human interaction is the eighth topic, followed by visual graphics and computing.

6) Systems that are Intelligent The field of software engineering The Administration of Data Considerations Regarding Social and Professional Activities

.7) Methods of Numerical Analysis and their Applications in Computational Science According to Dijkstra, the designation of the field as "Computer Science" is comparable to the designation of surgery as "Knife Science." As far as he is concerned, there is persistent pressure on departments of computer science to prioritize "Computer" over "Science."

Scientific Methods Of Cs

Any and all parts of conventional scientific methodology are included in the field of computer science. In the same vein, our technique shown in Figure 2 can be utilized in this scenario. The focus of computer science is on the study of an artificial object, specifically a computer, which advances concurrently with the development of theories that explain it and the accumulation of practical application experience. This is what makes computer science distinguished from other fields of study. A computer from the 1940s, one from the 1970s, and one from 2002 are all very different from one another, and this discrepancy is only growing. Attempting to define the year 2002 using computing words is a difficult endeavor.

Theoretical Computer Science

In the field of theoretical computer science, theories are developed by employing logical systems that incorporate precise definitions of objects (axioms) and operations (rules). These theories are developed in accordance with the principles of mathematics and logic. Both the systematic derivation and proving of theorems are made possible as a result of this. The process in question is extremely conventional. Concepts that are constantly being revisited in the field of computers include [10]: Models that is both abstract and organized Effectiveness is linked to the levels of abstraction. In the field of mathematics, the formation of several concepts is made possible by data models [10]. The conceivable values that data objects can have and the actions that can be performed on the data are the two components that make up a data model in the field of computer science. The tree data model, which is defined as a conceptual representation of hierarchical data structures, is one of the data models that is frequently utilized. Another type of data structure that can be seen as a specific instance of trees is the stack data structure, which includes push and pop operations. There is a substantial group of collections that consists of character strings. In mathematics, the data model that is considered to be the most fundamental is the set data model. It is possible to categorize any single mathematical concept, including trees and real numbers, as a different kind of set. Through the utilization of the relational data paradigm, the data is arranged into collections of two-dimensional tables. In order to extend the capabilities of the tree data model, the directed, undirected, and labeled graph data model is brought into existence. Patterns, automata, and regular expressions are all examples. The term "pattern" refers to a collection of items that share a particular characteristic. Patterns can be defined by the use of a graphical tool known as an automaton. The algebra that is utilized in the construction of patterns that automata may also define is referred to as "regular expression."

Experimental Computer Science

Experimental computer science is especially useful for overcoming complex software challenges, such as the creation of software development environments, the management of non-tabular data, and the construction of tools for the resolution of particular optimization issues. The strategy entails coming up with ideas for solving problems, and then determining whether or not those ideas are feasible by constructing prototypes of the systems. In the field of computer science, experimentation is utilised extensively in a variety of domains, including as natural language processing, computer vision, game development, neural networks/connectionism, machine learning, and planning. This investigation was carried out using the methods that are depicted. **Computer Simulation**

Computation, which includes computer-based modelling and simulation, has emerged as a third research tool to supplement theory and experimentation in recent years. Computing environments and techniques have advanced to the point that they can solve extremely complicated problems. It is now expected of university graduates, not just Computer Science majors, to be proficient in Computational Science tools such as 3D visualisation and computer simulation, efficient handling of large data sets, ability to access a variety of distributed resources, and ability to collaborate with other experts over the Internet. Scientific culture is beginning to include those abilities.

Conclusions

Recent years have seen the emergence of computing as an extra research tool to augment theory and experimentation. This includes the use of computer-based modelling and simulation. They have been able to efficiently address extremely complex problems as a result of the advancements that have been made in computer environments and approaches. Students who graduate from universities in the modern day are expected to have a comprehensive understanding of the tools used in computational science, in addition to having majored in computer science. Visualisation in three dimensions and computer simulation are two of the technologies that are included in this category. Other technologies include the effective management of large data sets, the utilisation of a variety of remote resources, and the capacity to communicate with other specialists over the Internet. These skills are being adopted by an increasing number of scientific communities presently.

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