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USE OF AI IN THE FIELD OF COMPUTER SCIENCE TEACHING AND RESEARCH

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ABSTRACT

We humans have evolved into a machine-based civilisation. All facets of human existence rely on mechanical aids. We are surrounded with AI implementations at every turn. The term "smart" has come to describe the technology used in almost every modern appliance, from air conditioners to cameras to video games to medical equipment to traffic lights to refrigerators and beyond. The goal of Artificial Intelligence research is to develop computer systems with human-like cognitive and emotional capabilities. That is, to create robots with the same level of environmental awareness, conversational fluency, and decision-making capacity as humans. The computing capacity of computers has surpassed that of the human brain. Fifty years ago, computers were millions of times slower than they are now. For many activities, it seems that humans' brains are much more efficient than computers. This article explores how Artificial Intelligence (AI) is being used in Computer Science (CS) classrooms and labs now and where it is headed in the future. In the first part of the article, the authors examine the current state of AI in introductory and advanced computer science courses at a number of different institutions. Computer science education may also benefit from the incorporation of AI. The study of how to best educate future AI professionals lies at the crossroads of the two fields. This is discussed in general terms. South African institutions' artificial intelligence master's and doctoral programmes emphasise research above coursework. Current and future directions in Artificial Intelligence research are discussed.

Keywords: Artificial intelligence teaching, computer science, human brain, future trends, artificial intelligence research.

1. INTRODUCTION

The area of computer science devoted to artificial intelligence is expanding rapidly. In 1956, during a meeting where the goal was to have computers mimic human intellect, the phrase "artificial intelligence" was created. Early efforts at programming computers with intelligence included teaching them to play games and prove theorems. The first AIs were built on the foundations of search and logic. Expert systems, neural networks, evolutionary algorithms, swarm intelligence, and agent-based technologies are just a few of the fields that have benefited from the realisation of the methodologies' shortcomings and subsequent refinement.[1] The study makes an original contribution by providing an overview of the present state of artificial intelligence and future developments in this area. This document is a valuable resource for future and existing academics and practitioners in the subject of education.

This article provides a historical perspective on the evolution of artificial intelligence within the realm of computer science education and research, as well as suggestions for its future growth. The article elaborates on how AI is included into CS courses. Artificial intelligence (AI) is also discussed in the context of its application to the teaching of computer science. The field of artificial intelligence has expanded fast since its start. Applying AI methods, refining and expanding upon existing methods, and creating brand-new methods are the three primary foci of study. Following is a brief outline of where AI stands now and where it's headed in computer science education and research.

2. USE OF ARTIFICIAL INTELLIGENCE IN THE EDUCATION OF COMPUTER SCIENCE

a. The Use of AI in Computer Science Education

In a joint paper, the Association for Computing Machinery (ACM) and the Institute of Electrical and Electronics Engineers (IEEE) lay out which courses in artificial intelligence (AI) are mandatory and which are electives. [1]). See Table 1 for a complete rundown. The primary motivation for include AI in a CS undergraduate programme is to introduce students to the many subfields of AI. For most programmes, AI coursework occurs in the final year (the fourth year of a four-year degree or the third year of a three-year degree). This not just gives a springboard to understudies interested in pursuing graduate degrees in computer science and artificial intelligence, but also equips those headed straight into the workforce with a toolbox of approaches they can use to tackle challenges in a wide range of industries. Courses in artificial intelligence at this level used to focus on the fundamentals, but now include more advanced subjects as well. Uniform search, informed search, game playing, logic and resolution, expert systems, inference, uncertainty, fuzzy logic, planning, neural networks, genetic algorithms, agents, and natural language processing are some of the topics typically covered in an undergraduate course [2]. At the undergraduate level, several schools offer specialised courses in areas like expert systems in addition to more broad AI courses. Students who complete a course at this level will have a firm grasp of the fundamentals of artificial intelligence, an awareness of the benefits and drawbacks of various approaches, and the skills to put those approaches into practise in a variety of contexts.

Table 1. Intelligent Systems Topics[1]

Topic	
Fundamental Issues, e.g. history of artificial intelligence, ethical issues in AI.	Core
Basic Search Strategies, e.g. problem spaces, brute force search, two player games.	Core
Knowledge Based Reasoning, e.g. propositional and predicate calculus.	Core
Advanced Search, e.g. hill climbing, genetic	Elective

algorithms, simulated annealing.	
Advanced reasoning, e.g. reasoning on action and change, uncertainty.	Elective
Agents, e.g. agent architectures, agent theory, believable agents.	Elective
Natural Language Processing, e.g. parsing algorithms, language translation.	Elective
Machine Learning, e.g. inductive learning, learning neural networks.	Elective
Planning Systems, e.g. planning as search, planning and robotics.	Elective
Robotics, e.g. sensing, robot programming, world models.	Elective
Perception, e.g. image formation, image and object detection.	Elective

These more advanced subjects are often covered in a postgraduate degree programme, such as an Honours degree. Most of these programmes specialise on one area of artificial intelligence [3]; for example, neural networks, expert systems, or genetic programming. The issue is examined in great detail. It is crucial, says Congdon [3], to expose students to the process of designing frameworks for the particular space. Understudies ought to likewise be presented to proper exploration methods in this course [4]. It is expected that students will be able to formulate a research topic, carry out the necessary experiments, and write up their results [3]. Included in the curriculum [3] should be the approach used to evaluate the statistical significance of the result and compare the performance of the specific method to that of other AI methods. This lays the groundwork for graduate students who are interested in doing research in this area.

Ten institutions in South Africa were chosen to participate in an online survey of AI programmes. Two of the schools offer no courses in Man-made reasoning, either at the introductory or advanced levels. Three further schools include AI courses in their Honours programmes but do not incorporate AI instruction in their undergraduate degrees. There are currently just two schools where AI is a part of the required curriculum for graduating seniors. The remaining three schools all have a senior-year AI course that touches on both fundamentals and advanced subjects in AI. In eight of these schools, students may take AI courses at the Distinctions level. A top to bottom examination of contemporary issues in man-made brainpower, including brain organizations, developmental calculations, molecule swarm enhancement, and savvy frameworks plan, is provided here.

b. The Role of AI in Computer Science Education

The education of students in Computer Science is greatly aided by the use of artificial intelligence. Taking an AI course may help students learn more complex programming techniques, as stated by Kumar [5]. Learning how to optimise memory use while minimising processing time is a key skill for students building AI systems, and it requires them to rely on how they might interpret programming and information structures from their initial two years of college.

To keep students interested, AI has also been included into the teaching of other areas of computer science. In his computer security course, Vaughn [6] suggests using expert systems or neural networks, two forms of artificial intelligence, to determine whether a system is under assault. In a computer networking course, a multi-agent system (MAS), as described by Soh [7], may be used to evaluate the causes and effects of network congestion. When teaching the distinction between the template and strategy design patterns, Wick et al. [8] utilize a hereditary calculation for instance. In an early on programming course, the creators have additionally utilized hereditary calculations to show the qualification among legacy and appointment.

Online systems that act as a tutor or instructor, such as intelligent teaching agents [9] or intelligent tutoring systems (ITSs) [10] [citation needed].

Models of the understudy's information in the branch of knowledge, including weak spots and normal errors, are kept in these frameworks. The wise coaching framework puts together its choices with respect to the understudy model, which informs its choices for what to teach next and how to teach it. Each component of an ITS is often handled by a separate intelligent agent in agent-based architectures.

Each section is based on a different artificial intelligence approach. The modules are able to talk to one another thanks to an agent communication language. Figure 1 depicts one such architecture, a general one for AI-assisted programming tutorials [11].

Quite a bit of study has gone into the creation of smart tutoring systems for use in CS classrooms. The majority of the earlier work has been on creating coaching devices for instructing new programmers. Programming education has spawned a variety of intelligent tutoring systems (ITSs), such as PROUST [12] and INTELLITUTOR [13]. Anderson et al. [14] built a trainer to help people learn Lisp programming. Intelligent teaching tools, such as MoleHill and SIPLeSII, have been created by Alpert et al. [15] and Xu et al. [16] to aid students in learning to programme in Smalltalk. Pillay ([11], [17]) bases his proposal for a general architecture for intelligent programming teachers on this research. In order to help students learn about the theory of formal languages, Devezdic et al. [18] developed an ITS called FLUTE. The link between grammars and automata, as well as finite and pushdown automata, regular and context-free grammars, and more, are discussed.

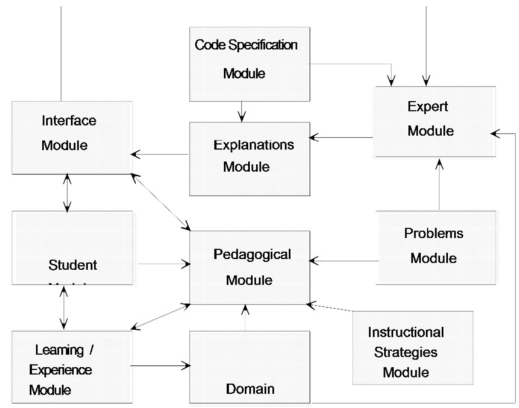

Figure 1. Intelligent programming teachers with a generic framework [11]

Most of these ITSs have only been tried out in the lab and have yet to get it into the classroom setting for actual instruction. The gap between ITSs' usage in research and in classrooms is one area that might require improvement.

3. RESEARCH INTO TEACHING ARTIFICIAL INTELLIGENCE

Research towards better methods of teaching AI sits at the crossroads of these two fields. It is difficult to teach courses in AI, as stated by Russell et al. [19]. There is a good collection of writing on the subject of educating AI classes.

Agent-based modelling is used by Hill et al. [20]. In this scenario, agents are tasked with completing missions in Wumpus World utilising fundamental Artificial intelligence techniques including state space portrayal, search, game playing, and first request thinking.

Understudies are so engaged in fostering the specialist territory that they neglect to see that they are simultaneously mastering a variety of AI principles.

In [21], Imberman implements the backpropagation learning method into a neural network and teaches it using LEGO robots. Students have been able to make a clear distinction between training and testing a neural network via the usage of LEGO robots to visualise the process. In addition, Kumar [22] suggests employing LEGO robots to educate students on artificial intelligence tenets including search, expert systems, game playing, and neural networks.

According to research by Pillay [23], using animation in lectures to clarify complex topics helps students better understand them, which is especially helpful in a first course on genetic programming. A detailed explanation of how to use a genetic operator like crossover, for instance.

Choosing programming assignments that would motivate students has been the subject of a lot of AI education research. To illustrate Markov processes, Popyack [24] offers a Blackjack project as an example. Othello has also been used to teach genetic programming by Eskin et al. [25] and elementary artificial intelligence ideas by Kolas et al. [26].

Research in this field has a lot of room to grow, providing opportunities to better understand how students learn and how to teach a variety of AI subjects.

4. DIRECTIONS IN ARTIFICIAL INTELLIGENCE RESEARCH

Initial artificial intelligence research focused on solving specific problems, such as those posed by game playing and theorem proving. Limitations of the strategies were discovered when they were employed, leading to refinements of the process; for instance, informed search was created as an upgrade of ignorant hunt. Some advances in AI have emerged from the discovery of these sorts of constraints; for instance, the discovery of machine learning may be traced back to the shortcomings of expert systems. Uses of artificial intelligence to specific issue spaces, refinement of flow draws near, and the creation of novel strategies are, hence, the three essential subjects in man-made brainpower research.

Various sorts of utilizations have made progress with the utilization of man-made consciousness to tackle issues, for example, recreated pilots, a specialist warning framework to assist understudies with distinguishing drug treatments for Helps patients, web indexes, computer games, versatile UIs, customized colleagues, and regular language cognizance ([3], [27], [28]).The use of artificial intelligence (AI) is expanding as new areas of computer science, medicine, etc., are found.

This is shown by the fact that most of the papers presented at the most recent World Congress on Nature and Biologically Inspired computing [29] dealt with practical applications of AI rather than theoretical considerations. Understanding the rationale for the success of an AI methodology, as well as its limits and how to work around them, is essential for the advancement of current methods. For instance, this article [30] explains how hereditary administrators in a hereditary programming framework capability and how they may be enhanced. Premature convergence is a problem that plagues genetic programming.

As a result, several studies have looked at ways to avoid this kind of early convergence ([31], [32]). To find solutions, most AI methods mimic either human intellect or biological/natural processes. Because conventional approaches fall short, new approaches are always being developed to

resolve issues in a new context; address shortcomings in current methods. Recent developments in artificial intelligence include the optimisation of bee colonies [33] and a developmental approach that models cellular processes [34].

Use of parallel processing to shorten AI system execution times and closing the hole between simulated intelligence labs and this present reality application climate are two extra review foci in the field of man-made reasoning. It takes a lot of processing power to implement most forms of artificial intelligence. Parallel processing, made possible by the advent of multi-core CPUs, may be utilised to speed up the execution of such methods. There is a lot of artificial intelligence (AI) research happening across many different application fields, but often the systems generated are just prototypes that are good enough for study but not reasonable enough to use in reality.There is a need to close the knowledge gap between AI research and practical applications.

5. CONCLUSION

In this work, we show that AI already plays a crucial role in CS education and research, and that this trend will only increase in the years to come. Students who are interested in pursuing research at the Master's level in the field of artificial intelligence will find that artificial intelligence is an essential part of both the undergraduate and graduate Computer Science curricula. There is a large amount of room for improvement in the teaching of AI, and studies that seek to pinpoint the causes of student struggles in this area would be very welcome. Application of AI, refinement of current AI methods, and the invention of new AI approaches are three main areas of focus in the field of AI research. Research on the potential of multi-core technology to lessen the processing burden of certain AI methods is warranted. Also, we need to figure out how to go from AI research prototypes to actual, practical systems.

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