Computational Thinking And Its Role In Discrete Mathematics

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Abstract
This paper aims to emphasize the need of Computational Thinking and its role in discrete mathematics teaching. Firstly, importance of Computational Thinking is discussed and then the relationship between Computational Thinking and the teaching of discrete mathematics is analyzed. Secondly, some content of discrete mathematics, which have close relationship with Computational Thinking, are described by corresponding application based examples.

Keywords: *Computational thinking; discrete mathematics teaching; abstraction.*

Introduction

Computational Thinking should be one of the basic abilities of compound innovation talents like mathematical thinking and engineering thinking. Some globally leading colleges and universities have been trying to reform their curriculum by introducing computational Thinking. Computational thinking is a basic concept in spotlight, which concerns the fundamentals and the future direction of computer and computer science education. This phrase was brought to the forefront by an article on this subject by Jeannette Wing of Carnegie Mellon University. Ms.Wing defined computational thinking as "taking an approach to solve problems, design systems and understand human behavior that draws on concepts fundamental to computing [2]

Computational Thinking is not necessarily a alleyway to producing software hardware artifacts, but to solve problems in diverse contexts of everyday life – even in the absence of computational devices. Some aspects of Computational Thinking have been used even before the existence of modern computers. The original computing method was counting by human fingers centuries ago. In this sense, Computational Thinking may be a blend of thinking elements previously related to other thinking Paradigms, such as logical, math, analytical or engineering oriented thinking Ancient schooling was all about real life instances in the form of stories. At present we teach students the concepts but fail to implant their applications, later students also don't relate to it. They will identify the concept but fail to apply them. A simple example: formula to calculate the area and perimeter of a square/rectangle is known to a child age 10 and above. But fail to calculate the cost to fence the garden or carpet the room. Concepts are known-but it is not of any use if they fail to apply them when required [3].

Importance of Computational Thinking

Computers are indisputably the best Invention of millennium. Computers have inundated the world where in any field or subject culminates into functioning in front of a computer. Through Computational thinking one can excel in life as they are better equipped to solve glitches. People with Computational Thinking skills can think algorithmically, visualize stuff with abstraction, compare and contrast situations to arrive at a solution by decomposition [3].

A constant shift from face-to-face to online learning is an unavoidable force of change as students are digital native sand need immediate data, so is the work force. To stay ahead of the tide all students, institutions and instructors should shift towards online teaching. Self-study, problem solving, abstraction, decomposition and generalization are the key elements to succeed in an online environment, and these skills are in turn computational thinking's core elements. The learning environment in a typical classroom can be characterized as active interactions between learners and instructors or between learners and other learners. Teacher control model blended learning environment is our solution to extend the school learning time and space to anytime.

Access to the Internet through personal and mobile devices has made a global knowledge network widely accessible. Nowadays humans are so dependent on gadgets that they are surrendering to computers rather than bettering it. Depending extensively on gadgets, Computational Thinking is declining in students. Children take devices for granted and ponder only how to use it and discourse about its applications, conversely do not think what drives into making them i.e. Computational Thinking skills. Computational Thinking has become an ultimate skill, ranking alongside reading, writing and arithmetic, it can be found in all the subjects Computational thinking is used in each subject but to teach computational thinking, computer science is the subject with utmost applicability. Mathematics to some an extent with concepts like set theory, abstract algebra, graphs and trees.

There is always imbalance between students learning and the industry requirements. As the problems they face are new which cannot be built with logic rather requires abstraction, critical thinking and problem solving. Which are the important aspect of Computational Thinking and very few acquire it. Computational Thinking is different from computer science, it is not word processor, spreadsheet etc. and not even programming- it is a skill used by computer scientists which can be acquired by learning computers. As Computational Technique does not need a computer and just goes on in the head. It is a mental tool.

Content Of Discrete Mathematics

Discrete mathematics has applications to all fields of computer science. In Discrete Mathematics, we are concerned with objects such as integers, pro positions, sets, relations and functions which are all discrete. We learn concepts associated with them, properties and relationships' among them. Discrete Mathematics includes sets, functions and relations, matrix algebra, combinatory and finite probability, graph theory, finite differences and recurrence relations, logic, mathematical induction, and algorithmic thinking. Because of this diversity of topics, it is perhaps preferable to study all these content of discrete mathematics, but, discrete mathematics has a minimal set which is a necessary condition to grasp computational thinking [1]. Here we will discuss some of the topics such as Mathematical Logic, Set Theory with application.

Mathematical Logic

Logic is a language for analyzing some statement. It is a set of rules which can be used when doing logical reasoning. Human reasoning has been observed over centuries from at least the times of Greeks, and patterns appearing in reasoning have been extracted and abstracted. The foundation of the logic was laid down by a British mathematician Boole in the middle of the 19th century. Mathematical logic is interested in true or false of statements, and how the truth/falsehood of a statement can be determined from other statements. We use symbols to represent arbitrary statements so that the results can be used in many similar but different situations, so logic can promote the clarity of thought and eliminate ambiguity and mistakes. There are various types of logic such as logic of sentences (propositional logic), logic of objects (predicate logic), uncertainties logic etc. But in Discrete Mathematics course, we are only concern with propositional logic and predicate logic which are fundamental to other logic [1].

Example 1 (logical as Boolean searching): In propositional logic, there are many connectives ($\neg,\wedge,\vee$) which are used extensively in searching of information of webpage on internet. Considering Google search engines, it supports Boolean searching technique, which usually can help find web pages about particular subject. In Google, "+" or bank stands for logical connectives "", "-" stands for logical connectives. "OR" stands or logical Connectives . If we input sentence "computational thinking " in Google, then all the Webpage about computational thinking are searched; If we input sentence "computational - thinking " in Google, then all the webpage which conclude "computational" but no "thinking" are searched, so searching result becomes little.

Set Theory:

The concept of set is fundamental to computer science. For example, relationships between two objects are represented as a set of ordered pairs of objects, the concept of ordered pair is defined using sets; natural numbers, which are the basis of other numbers, are also defined using sets; the concept of function, being a special type of relation, is based on sets, and graphs and digraphs consisting of lines and points are described as an ordered pair of sets. The relation is a special set which consist of two-tuples, it is an abstraction of relations we see in our everyday life such as those between parent and child, address and telephone number, Main calling function and sub called function etc. In set theory, we focus our attention on properties of those relations, such as reflexivity, irreflexivity, symmetry, antisymmetry and transitivity. A function is something that associates each element of a set with an element of another set. It appears quite often even in no technical contexts. For example, a social security number uniquely identifies the person; the income tax rate varies depending on the income, and so on. As you might have noticed, a function is quite like a relation, but one element in Function doesn't map onto many elements.

Example 2 (relation closure application in mobile telephone): Mobile telephone network has data centers in cities say A, B, C, D and E. There are direct, one-way optical cables from A to B, from A to C, from B to D and from C to E. We can model this situation by relation. Let R be the relation, aRb if there is an optical cables from the data center *a* to that in *b*, How can we guarantee there is some link composed of one or more optical cables from one city to another? Although R cannot be used directly to answer this, however, we can find all pairs of data center that have a link by constructing transitive closure of R.

Conclusion

Computational Thinking is a brain-based activity that enables us to solve problems in better and systematic way. There is an immediate need to teach Computational Thinking as early as elementary level. Once students embrace to think computationally, students do perform well as they can relate, understand concepts better. So Computational Thinking is a skill for a better life. We want our students to understand and play an active role in the digital world that surrounds them, not to be passive consumers of an opaque and baffling technology. A sound understanding of computing concepts will help them see how to get the best from the systems they use, and how to solve problems when things go wrong. Also Companies across all fields are starving for computational thinkers, so there is need to reform curriculum considering Computational thinking skills.

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