

Variants of Mathematical Induction as Strong Proof Techniques in Theory of Computing

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Abstract : In the theory of computing, there are a wide variety of direct and indirect proof techniques. However, mathematical induction (MI) stands out to be one of the most powerful proof techniques for proving hypotheses, theorems, and new results. There are variations of mathematical induction-based proof techniques, which are broadly classified into three categories, such as structural induction (SI), weak induction (WI), and strong induction (SI). In this expository paper, several different variants of the mathematical induction techniques are explored, and the specific scenarios are discussed where a specific induction technique stands out to be more advantageous as compared to other induction strategies. Also, the essential difference among the variants of mathematical induction are explored. The points of separation among mathematical induction, recursion, and logical deduction are precisely analyzed, and the relationship among variations of recurrence relations, and mathematical induction are being explored. In this context, the application of recurrence relations, and mathematical inductions are considered together in a single framework for codewords over a given alphabet.

Keywords : alphabet, codeword, deduction, mathematical, induction, recurrence relation, strong induction, structural induction, weak induction

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