Classical and Quantum Computations with Restricted Memory

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Abstract. Automata and branching programs are known models of computation with restricted memory. These models of computation were in focus of a large number of researchers during the last decades. Streaming algorithms are a modern model of computation with restricted memory. In this paper, we present recent results on the comparative computational power of quantum and classical models of branching programs and streaming algorithms.

In addition to comparative complexity results, we present a quantum branching program for computing a practically important quantum function (quantum hash function) and prove optimality of this algorithm.

Keywords: Complexity · Quantum computing
Branching programs · OBDDs · Hierarchy · Hashing

1 Introduction

The class of problems solvable with restricted memory and efficient algorithms (classical and quantum) for such problems are of great interest nowadays. There are many different models that process data streams and use few memory resources: automata, branching programs (BPs), or streaming algorithms. Streaming algorithms are a new model in computer science, while branching programs and automata were in the focus of a great number of computer science researchers during the last decades.

Our research group is focused on the study of automata, branching programs with the OBDD type restrictions, and models of streaming algorithms. These research interests largely coincide with the research interests of Juraj Hromkovič and his research group.

In this paper, we present an overview of our results on classical and quantum restricted computational models, especially on the comparison of the computational power of classical and quantum models.

Branching programs are a well-known model of computation that has proven useful in a variety of domains such as hardware verification, model checking, and

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