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Reordering method and hierarchies for quantum and classical ordered binary decision diagrams

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Abstract

© Springer International Publishing AG 2017.We consider Quantum OBDD model. It is restricted version of read-once Quantum Branching Programs, with respect to “width” complexity. It is known that maximal complexity gap between determin-istic and quantum model is exponential. But there are few examples of such functions. We present method (called “reordering”), which allows to build Boolean function g from Boolean Function f, such that if for f we have gap between quantum and deterministic OBDD complexity for natural order of variables, then we have almost the same gap for function g, but for any order. Using it we construct the total function REQ which deterministic OBDD complexity is 2Ω(n/logn) and present quantum OBDD of width O(n2). It is bigger gap for explicit function that was known before for OBDD of width more than linear. Using this result we prove the width hierarchy for complexity classes of Boolean functions for quantum OBDDs. Additionally, we prove the width hierarchy for complexity classes of Boolean functions for bounded error probabilistic OBDDs. And using “reordering” method we extend a hierarchy for k-OBDD of polynomial size, for k = o(n/log3n). Moreover, we proved a similar hierarchy for bounded error probabilistic k-OBDD. And for deterministic and proba-bilistic k-OBDDs of superpolynomial and subexponential size.

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Keywords

Branch-ing programs, Computational complexity, Hierarchy, OBDD, Probabilistic OBDD, Quantum computing, Quantum models, Quantum OBDD, Quantum vs classical

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