Benchmark Circuits for IBM's Quantum Computer

1 Introduction

IBM's 5 qubit quantum computer [1] supports gates from the Clifford+T gate library. This repository contains some Clifford+T circuits that have been transformed to be executed on IBM's Q5.

2 Benchmark Circuits

The following circuits are available in the folder labeled `original`.

Name	Qubits	Gates	Depth	T-depth	Source
`a2x_c.qc`	4	31	22	5	[2]
`a2x_e.qc`	4	30	20	4	[2]
`Full_Adder_c.qc`	4	20	19	7	[2]
`Full_Adder_d.qc`	4	22	15	2	[2]
`Full_Adder_e.qc`	4	21	12	2	[2]
`Toffoli_c.qc`	3	17	16	6	[2]
`Toffoli_d.qc`	3	17	12	3	[2]
`Toffoli_e.qc`	3	17	12	3	[2]

The transformed circuits—to fit the Q5 architecture—are found in the folder labeled `IBM`. Different permutations, produce different results. Since the computer has 5 available qubits, circuits can be extended to 5 qubits at no cost. The names of the circuits are obtained by taken the original name and appending the permutation to it. A summary is given below.

Name	Qubits	Gates	Depth	T-depth
Full_Adder_c_01234.qc	5	60		
Full_Adder_c_01324.qc	5	28		
Full_Adder_d_01234.qc	5	74		
Full_Adder_d_01324.qc	5	42		
Full_Adder_e_01234.qc	5	55		
Full_Adder_e_01324.qc	5	37		
Toffoli_c_01234.qc	5	17		
Toffoli_d_01234.qc	5	25		
Toffoli_e_01234.qc	5	23		

References

[1] IBM Q. https://www.research.ibm.com/ibm-q/. Accessed: 2017-09-05.

[2] D. Michael Miller, Mathias Soeken, and Rolf Drechsler. Mapping NCV circuits to optimized Clifford+T circuits. In *Reversible Computation - 6th International Conference, RC 2014, Kyoto, Japan, July 10-11, 2014. Proceedings*, pages 163–175, 2014.