

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 |
|------------------------------|--------|-------|-------|---------|--------|
| <code>Full_Adder_c.qc</code> | 4 | 20 | 19 | 7 | [2] |
| <code>Full_Adder_d.qc</code> | 4 | 22 | 15 | 2 | [2] |
| <code>Full_Adder_e.qc</code> | 4 | 21 | 12 | 2 | [2] |
| <code>Toffoli_c.qc</code> | 3 | 17 | 16 | 6 | [2] |
| <code>Toffoli_d.qc</code> | 3 | 17 | 12 | 3 | [2] |
| <code>Toffoli_e.qc</code> | 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.