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
`1.qc`	3	17	11	6	[3]
`3_17_b.qc`	3	33	23	5	[2]
`3_17_c.qc`	3	35	26	6	[2]
`3_17_d.qc`	3	35	24	4	[2]
`3_17_e.qc`	3	33	21	4	[2]
`17.qc`	4	43	30	4	[3]
`a2x_c.qc`	4	31	22	5	[2]
`a2x_e.qc`	4	30	20	4	[2]
`a3x_c.qc`	5	48	37	9	[2]
`a3x_c.qc`	5	44	33	8	[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
1_01234.qc	5	29		
1_02134.qc	5	**25**		
3_17_b_01234.qc	5	49		
3_17_b_02134.qc	5	**43**		
3_17_c_01234.qc	5	49		
3_17_c_02134.qc	5	**43**		
3_17_d_01234.qc	5	51		
3_17_d_02134.qc	5	47		
3_17_e_01234.qc	5	49		
3_17_e_02134.qc	5	**43**		
17_01234.qc	5	141		
17_03421.qc	5	**119**		
a2x_c_01234.qc	5	87		
a2x_c_02341.qc	5	59		
a2x_e_01234.qc	5	70		
a2x_e_02341.qc	5	**52**		
a3x_c_01234.qc	5	176		
a3x_c_10324.qc	5	86		
a3x_d_01234.qc	5	156		
a3x_d_01324.qc	5	**66**		
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		

The same circuits are available (in IBM format) in the folder labelled `qasm`.

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.

[3] Martin Roetteler, Mathias Soeken, and Nathan Wiebe. Reversible Logic Synthesis and Quantum Computing Benchmarks. `http://quantumfpl.stationq.com/`. Accessed: 2017-09-19.