Quantum Computing Project

2018 fall

Project research

- Individual project

- Study and perform quantum computing on line.

- mid-term report on Nov 13
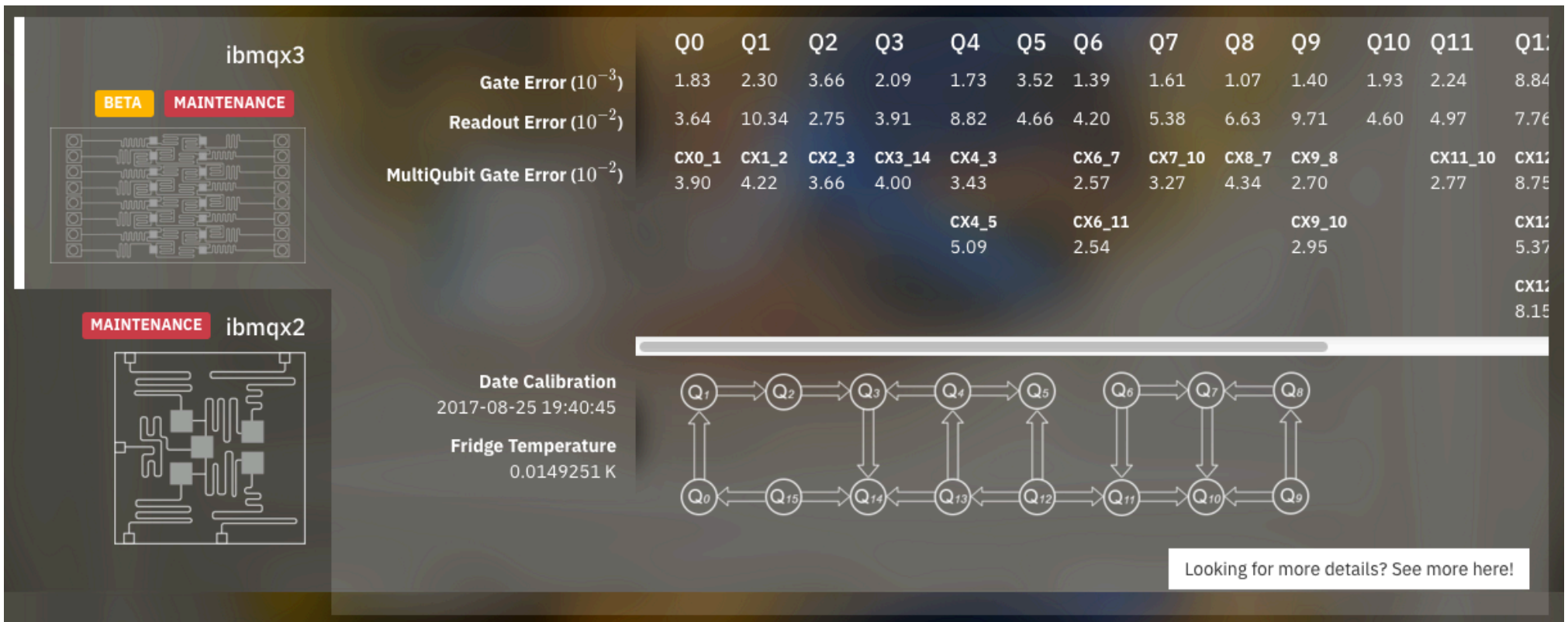
- Term paper before Jan 18

IBM Q

IBM quantum processors

QC composer
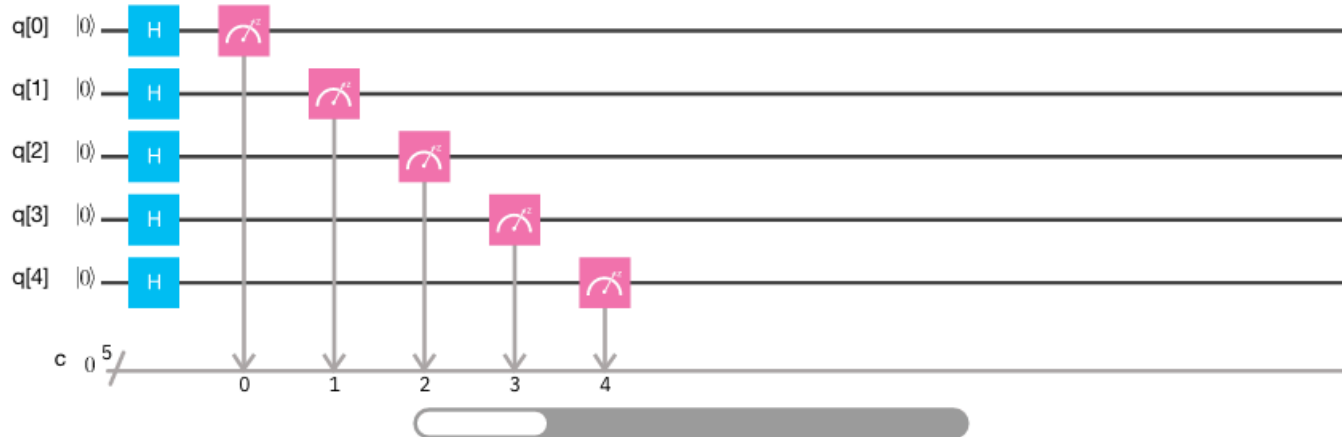
https://quantumexperience.ng.bluemix.net/qx/editor

Perform QC using IBM Q

- Do the following tasks：

- Understand quantum logic gates and algorithms

- Compose your code and run results

- Calculate the ideal result using python program

- Contains at least 3 qubits and 20 gates including 2-bit gates.

- Copy code is not allowed!

Summary of quantum gates

Table of Quantum Gates and what they do				
State	Gate sequence to prepare the state	Transformation on Bloch sphere	Gates to measure in the respective basis	Name of measurement basis
|0>	(none, ground state)	None		Z, "standard"
|1>	X	π rotation around X		Z, "standard"
|+>	H	π rotation around X + Z	H	X
|->	X H	π rotation around X + π rotation around X + Z	H	X

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Gate	Transformation on Bloch sphere (defined for single qubit)
X	π-rotation around the X axis, Z→−Z. Also referred to as a bit-flip.
Z	π-rotation around the Z axis, X→−X. Also referred to as a phase-flip.
H	maps X→Z, and Z→X. This gate is required to make superpositions.
S	maps X→Y. This gate extends H to make complex superpositions. ($\pi/2$ rotation around Z axis).
$S^\dagger$	inverse of S. maps X→−Y. ($-\pi/2$ rotation around Z axis).
T	$\pi/4$ rotation around Z axis.
$T^\dagger$	$-\pi/4$ rotation around Z axis.

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2-bit gate
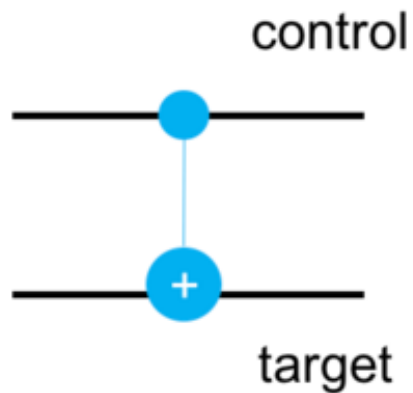
	Starting state		Ending State
control	|00>	→	|00>
	|10>	→	|10>
	|01>	→	|11>
target	|11>	→	|01>

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Quantum Algorithms

In this section we embark on more complex scores and explore the components it takes to construct real quantum algorithms. We go beyond simply defining entanglement and begin to use it in computation, in order to perform some well-known algorithms (with more to come in the future):

- Grover's algorithm
- Deutsch-Jozsa algorithm
- Learning parity with noise
- Phase estimation algorithm
- Shor's Algorithm

<u>ibm q: full user guide</u>

Why do this project

- A full controllable quantum system for one to manipulate and measure.

- Understand quantum superposition and quantum uncertainty with real experiment.

- Understand the matrix formalism of quantum physics.