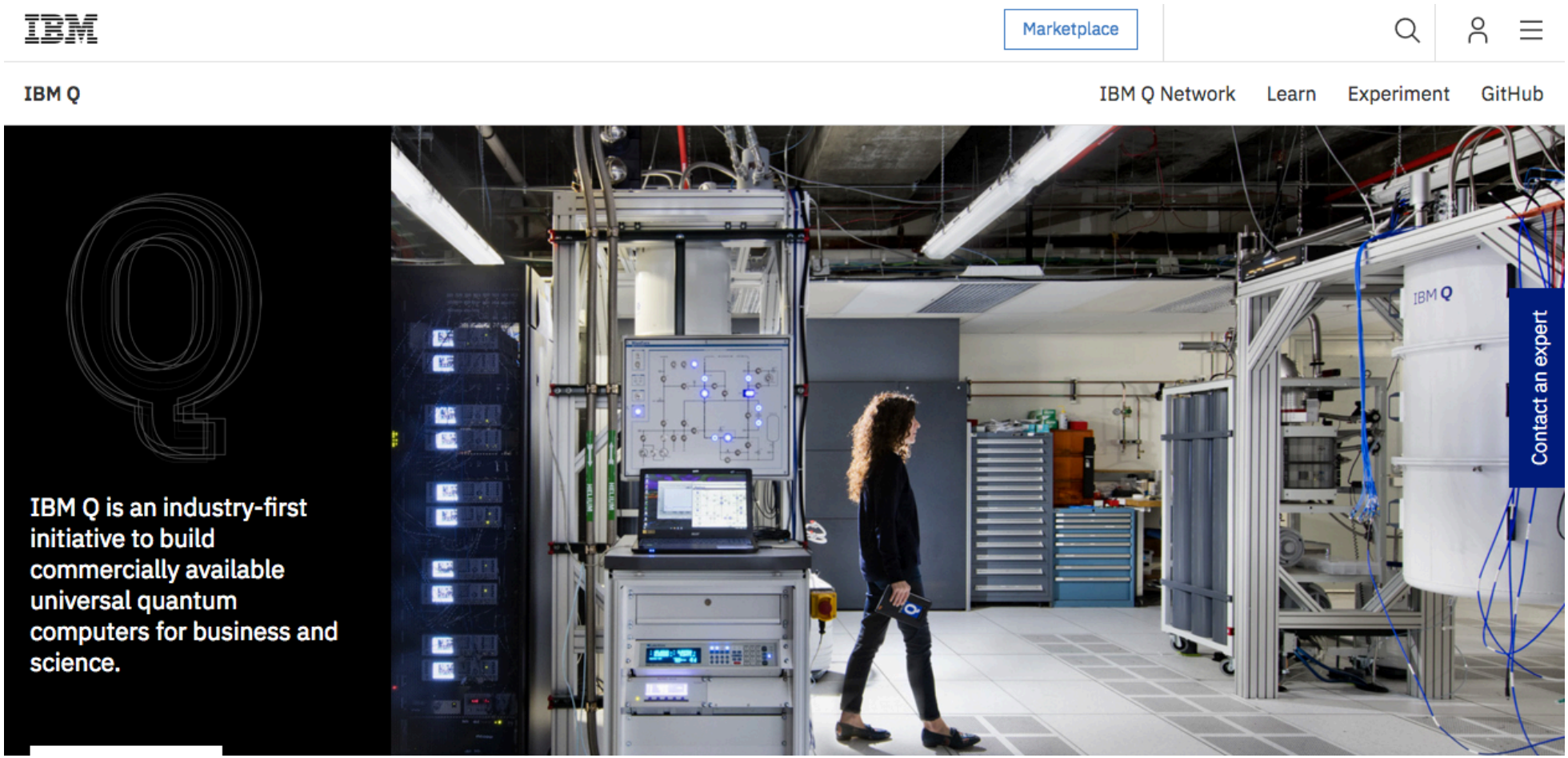
Quantum Computing Project

2019 fall

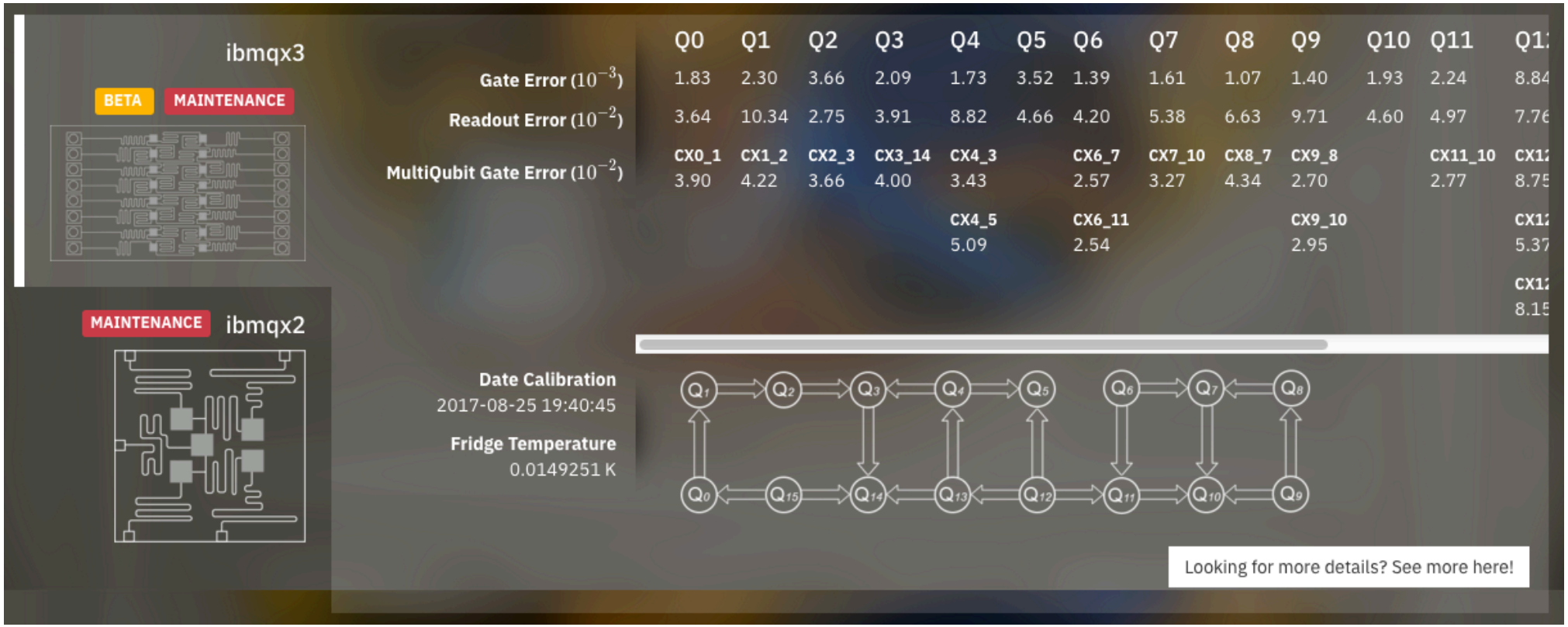
Project research

- Individual project
- Study and perform quantum computing on line.
- mid-term report on Nov 6
- Poster presentation on Dec 27
- Term paper before Jan 10

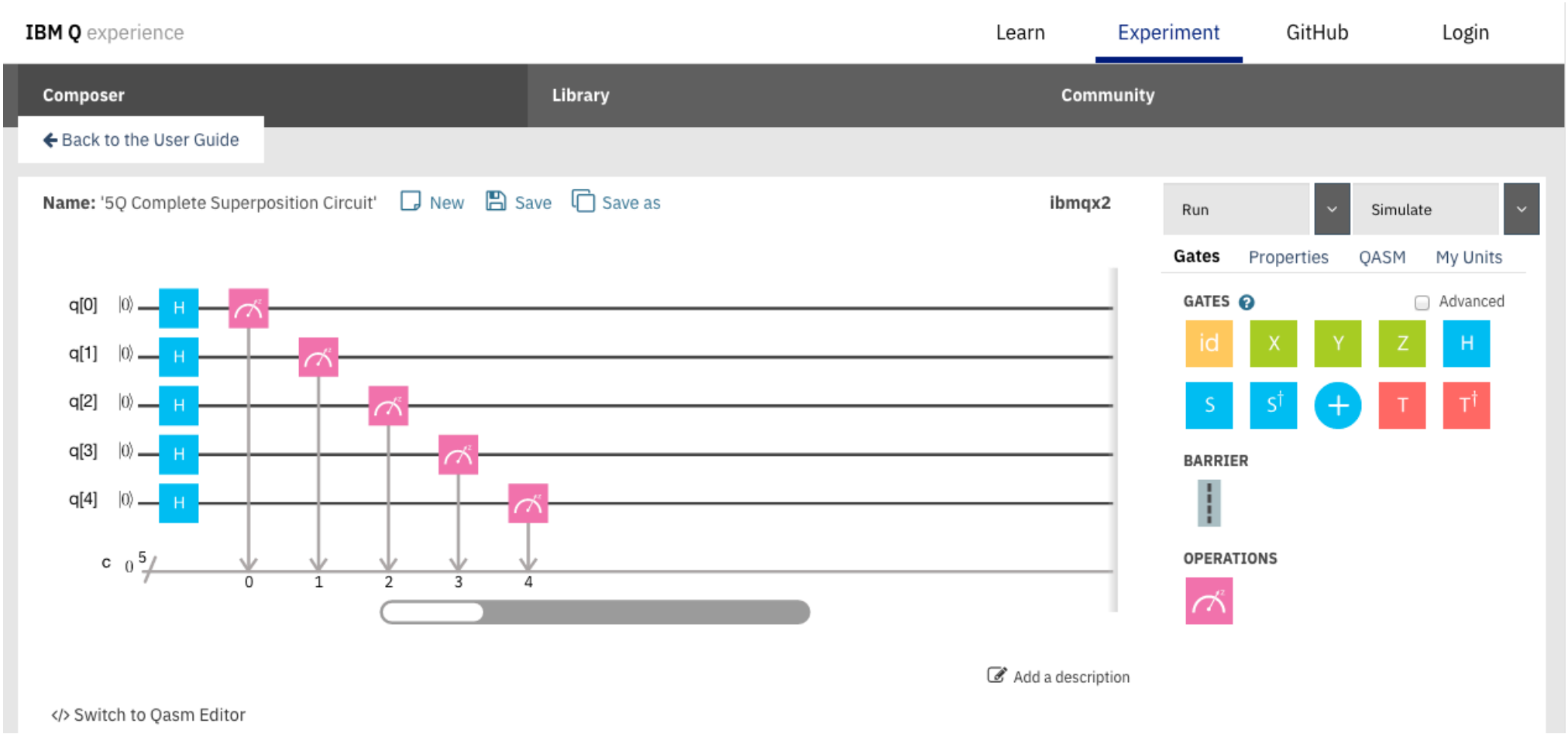
IBM Q


IBM
Marketplace
IBM Q
IBM Q Network
Learn
Experiment
GitHub
IBM Q is an industry-first initiative to build commercially available universal quantum computers for business and science.
IBM Q
Contact an expert

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

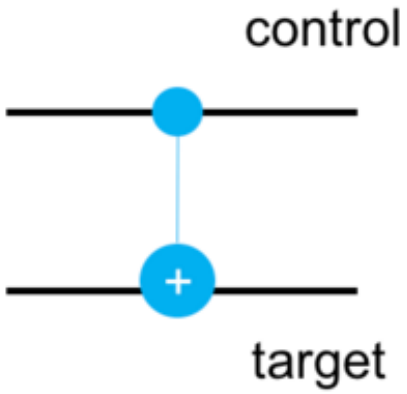
Table of Quantum Gates and what they do				
State	Gate sequence to prepare the state	Transformation on Bloch sphere	Gates to measure in the respective basis	Name of measurement basis
|0>	(none, ground state)	None		Z, "standard"
|1>	X	π rotation around X		Z, "standard"
|+>	H	π rotation around X + Z	H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

ibm q: beginer's guide

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. (π/2 rotation around Z axis).
$S^\dagger$	inverse of S. maps X→−Y. (-π/2 rotation around Z axis).
T	π/4 rotation around Z axis.
$T^\dagger$	-π/4 rotation around Z axis.

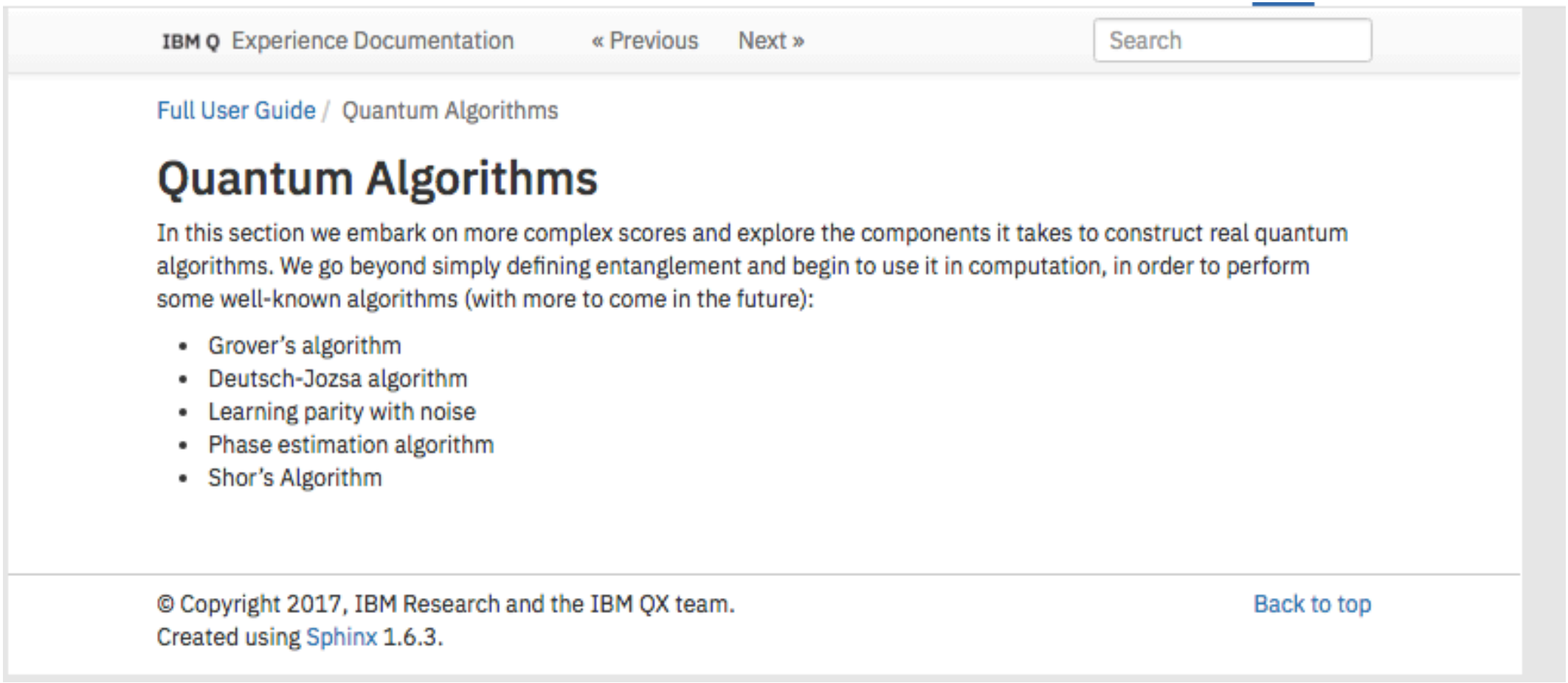
ibm q: beginer's guide

2-bit gate



Starting state		Ending State
|00>	→	|00>
|10>	→	|10>
|01>	→	|11>
|11>	→	|01>

ibm q: beginer's guide



ibm q: full user guide

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.