DEPARTMENT OF
NETWORKED SYSTEMS
AND SERVICES

Simple quantum circuits in IBM Quantum Composer

2025. 03. 12.

2025 spring

Balázs Solymos

BME Department of Networked Systems and Services

solymosb@hit.bme.hu

MŰEGYETEM 1782

IBM COMPOSER

Interactive tool for building and simulating quantum circuits

(https://quantum-computing.ibm.com/composer/)

- Different state visualizations
  - State vector
  - Q-Sphere
  - Measurement probabilities
  - Phase disc
- Generates OpenQUASM code in the background
  - Circuits can be run on IBM physical hardware

Tasks in Composer

SIMPLE QUANTUM GATES

Use X, Y, Z, H gates in Composer!

Investigate the effects of the gates on the different state visualizations!

SIMPLE QUANTUM GATES

Use the phase gate!

+1: Combine the phase gate with the previous four gates (X,Y,Z,H) to create an arbitrary single qubit superposition!

MEASUREMENT

Construct a Quantum Random Number Generator!

Investigate the quantum state before and after measurement!

MEASUREMENT

Investigate the following quantum circuits (where “M” denotes a measurement):

- H – H – M
- H – M - M
- H – M – H – M
- H – H – M – H – H – M

ENTANGLEMENT

Examine the operation of the CNOT gate

- Create fully entangled Bell states!
- Create a circuit that can create general n-qubit entangled states!
- Examine the effects of X and Z gates on the bell states!
- What can this be used for?

ENTANGLEMENT

+1: Create and examine the circuit for quantum superdense coding!