

# Worksheet 2 - Quantum Circuit Simulator Level 2

Now that you are familiar with using quantum circuit simulators, let's try some challenges.

## Activity 1: Use the [Quantum Machine](#) in the 2-qubit system

- a. Follow the Q-bot's C-NOT tutorial to learn about the 2-qubit system.

## Activity 2: Apply a Hadamard gate to a qubit

- a. Open the [IBM Quantum Composer](#).
- b. Use the following OpenQASM 2.0 code<sup>1</sup>:

```
OPENQASM 2.0;
include "qelib1.inc";

qreg q[1];

h q[0];
```

- c. Describe the calculated probabilities that the Hadamard gate produces when applied to a qubit (try out both: a qubit in state  $|0\rangle$  and in state  $|1\rangle$ ).

### Activity 3: Apply a CNOT gate after having applied a Hadamard gate

- a. Open the [IBM Quantum Composer](#).
- b. Use the following OpenQASM 2.0 code:

```
OPENQASM 2.0;

include "qelib1.inc";

qreg q[2];

h q[0];

cx q[0], q[1];
```

- c. Describe step by step what the code does with a qubit in state  $|0\rangle$ , for example.

- d. Describe the difference between activity 2 (a Hadamard gate is applied to a qubit, only one qubit is required) and this activity (a Hadamard gate is applied to a qubit, and then a CNOT gate is applied to the resulting qubit; for this operation a second qubit, the control qubit, is needed).

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<sup>1</sup> OpenQASM stands for Open Quantum Assembly Language. It is a programming interface designed for communicating with a real quantum computer and giving it instructions. You may check the following tutorial: [Introduction to OpenQASM](#)