July 5

Problem 1.

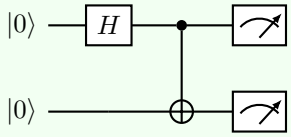
Using H and NOT gates, write a 1-qubit quantum circuit which maps inputs to outputs as follows

$$|0\rangle \mapsto |0\rangle$$
$$|1\rangle \mapsto -|1\rangle .$$

The gate which has this behavior is called the Z gate.

Problem 2.

What are the possible outputs of the following program, with probabilities? (Recall that the measurement at the end represents the question "Which one of $|00\rangle, |01\rangle, |10\rangle, |11\rangle$ spans the current state?")



Problem 3.

Using H, NOT, and CNOT gates, write a 2-qubit quantum circuit which does the following.

$$|00\rangle \mapsto |00\rangle$$
$$|01\rangle \mapsto |01\rangle$$
$$|10\rangle \mapsto |10\rangle$$
$$|11\rangle \mapsto -|11\rangle .$$

The gate which has this behavior is called a CZ gate.