If you want to give in code, please send it to artemiy.burov@fhnw.ch
Please note that the exercises marked by (*) are considered to be extracurricular.

Assignment 1: Exercise on States of a Bipartite System

1. Given two states $|\psi\rangle = |+\rangle = \frac{1}{\sqrt{2}}(|0\rangle + |1\rangle)$ and $|\phi\rangle = |-\rangle = \frac{1}{\sqrt{2}}(|0\rangle - |1\rangle)$, find $|\psi\rangle \otimes |\phi\rangle$.

2. Given two the 2-qubits states $|00\rangle + |01\rangle$ and $|00\rangle + |11\rangle$, tell which one is entangled and which one is not. Describe entanglement in your own words - what is it?

Assignment 2: Exercise on Measurements

Consider the state $|\psi\rangle = \frac{1}{\sqrt{57}}|0\rangle + \sqrt{\frac{56}{57}}|1\rangle$. What are the probabilities of measuring the state in $|0\rangle$, and in $|1\rangle$?

Assignment 3: Exercise on Quantum Circuits

1. Design a quantum circuit to generate the 3-qubits GHZ state[1] $|\text{GHZ}\rangle = \frac{1}{\sqrt{2}}(|000\rangle + |111\rangle)$. Remember the entangling circuit shown in figure 1 (used in the lecture) and the state $|\psi\rangle = \frac{1}{\sqrt{2}}(|00\rangle + |11\rangle)$ it produces.

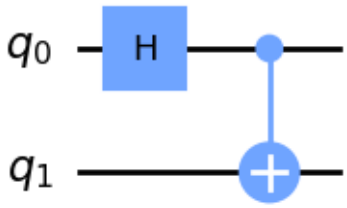

Figure 1: Entangling quantum circuit with a *CNOT gate*.

2. Implement the circuit using in the IBM Q web interface and give the corresponding Qiskit code (Python) to generate it.

3. Measure and give the probability of measuring the state in $|111\rangle$? Does it make sense to you given the expression of the state?

4. Is the state $|\text{GHZ}\rangle$ entangled? Why yes or why not (in your own words)?

[1] If you are curious about GHZ states or need a strong hint for the circuit, check the associated Wikipedia page.