Hausübungen zur Vorlesung
Quantenalgorithmen
WS 2013/2014
Blatt 1 / 30 October, 2013

Exercise 1:
Measure the quantum states in the computational basis. What are the states after the measurement? Compute \( \langle z_1 | z_2 \rangle \).

1. \( |z_1 \rangle = (\frac{1}{2} + \frac{1}{2} i)|0\rangle - \frac{1}{\sqrt{2}}|1\rangle \)

2. 
\[
\begin{array}{c}
|1\rangle \\
|z_2\rangle
\end{array}
\]
\[
\theta = \frac{\pi}{3}
\]

Exercise 2:

1. Show that the product of two unitary matrices is unitary;
2. Show that the columns of a unitary matrix form an orthonormal set.

Exercise 3:
Let \( |z_0 \rangle = |1\rangle \), \( |z_1 \rangle = \frac{i}{\sqrt{2}}|0\rangle + \frac{1}{\sqrt{2}}|1\rangle \). Find a linear transformation \( U \), such that \( |z_0 \rangle = U |z_1 \rangle \).
How many such transformations can you find?

Exercise 4:
Show that the states \( |z_0 \rangle = -\frac{1}{\sqrt{2}}|0\rangle + \frac{\sqrt{3}}{2}|1\rangle \) and \( |z_1 \rangle = -\frac{i}{\sqrt{2}}|0\rangle - \frac{\sqrt{3}}{2}|1\rangle \) are equivalent.