

1) Quantum measurement

$$|4\rangle = \frac{1}{\sqrt{3}} (|000\rangle + |010\rangle + |111\rangle)$$

Write down possible collapsed states with corresponding probabilities. Measurement is done with s.b.d. projectors $|0\rangle\langle 0|$ and $|1\rangle\langle 1|$. Qubits are numbered from left to right.

- Measure on the first qubit
- | — the first and second qubit
- | — all three qubits

2) Swap operation

- Make sure that the following circuit performs a swap operation



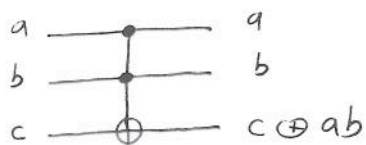
$$a, b \in \{0, 1\}$$

$$|a, b\rangle \rightarrow |a \oplus b, b\rangle \rightarrow \dots$$

- Perform the swap operation on the state

$$\frac{1}{\sqrt{2}} (|00\rangle + |01\rangle)$$

3) The Toffoli gate



$$a, b, c \in \{0, 1\}$$

Apply the gate on states

- $|000\rangle$
- $|110\rangle$
- $\frac{1}{\sqrt{2}} (|00\rangle + |01\rangle) \otimes |0\rangle$