

Homework 4  
CMSC 691R  
Quantum Computation  
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## 1 Entanglement swapping problems

Let

$$\left\{ |\psi_{b_1 b_0}\rangle = \frac{1}{\sqrt{2}} [(-1)^{b_1} |b_1 b_0\rangle + |\bar{b}_1 \bar{b}_0\rangle] : b_1, b_0 \in \{0, 1\} \right\}$$

and

$$\left\{ |\psi_{b_2 b_1 b_0}\rangle = \frac{1}{\sqrt{2}} [(-1)^{b_2} |b_2 b_1 b_0\rangle + |\bar{b}_2 \bar{b}_1 \bar{b}_0\rangle] : b_2, b_1, b_0 \in \{0, 1\} \right\}$$

denote respectively the Bell bases for 2 qubit and 3 qubit Hilbert space, where  $\bar{b}_j$  denotes the complement of  $b_j$ .

Let all qubits be labeled from right to left with 0, 1, 2, ... Then what is the resulting state if a Bell measurement is made on:

1. Qubits 1,2 of

$$|\psi_{000}\rangle$$

2. Qubits 2, 5 of

$$|\psi_{000}\rangle \otimes |\psi_{000}\rangle$$

3. Qubits 2,5,8 of

$$|\psi_{000}\rangle \otimes |\psi_{000}\rangle \otimes |\psi_{000}\rangle$$

4. Qubits 1,2 of

$$\rho_{00} \otimes \rho_{00}$$

where

$$\rho_{00} = \frac{1}{2} |\psi_{00}\rangle \langle \psi_{00}| + \frac{1}{2} |\psi_{11}\rangle \langle \psi_{11}|$$