# HW 9

Jeffrey Lansford

10.1 a) $|\psi\rangle = \frac{1}{\sqrt{2}}|00\rangle + \frac{1}{\sqrt{2}}|11\rangle$

$=$

$\alpha_0 \beta_0 |00\rangle + \alpha_0 \beta_1 |01\rangle + \alpha_1 \beta_0 |10\rangle + \alpha_1 \beta_1 |11\rangle$

For our two states to decompose into

$\alpha_0|0\rangle + \alpha_1|1\rangle$ and $\beta_0|0\rangle + \beta_1|1\rangle$

The multiplication of $\alpha_0$ and $\beta_0$ must equal to $1/\sqrt{2}$, and the same for $\alpha_1 \beta_1$

$\alpha_0 \beta_0 = \alpha_1 \beta_1 = \frac{1}{\sqrt{2}} \quad \alpha_0 \beta_1 = \alpha_1 \beta_0 = 0$

But then

$\alpha_0 \beta_1$ must equal to zero, then

$\alpha_0 \beta_0 = 0$ or $\alpha_1 \beta_1 = 0$ which is a contradiction

b) $\frac{1}{\sqrt{2}}|00\rangle + \frac{1}{\sqrt{2}}|11\rangle$

$$P(00) = |\alpha_{00}|^2 = \left|\frac{1}{\sqrt{2}}\right|^2 = 1/2$$

c) $P(11) = |\alpha_{11}|^2 = \left|\frac{1}{\sqrt{2}}\right|^2 = 1/2$

d) This is suprizing because that means that both qubits are either both in the position of 0 or 1. Both bits are the same with each other even if they are far apart.