Assignment 4: Due in the beginning of class: 9 Feb 2012

1. Express a two qubit system, such that the likelihood to be $|0\rangle$ is 64% times for the first bit and 36% for the second bit [Hint: for $|xx>$; $|x\rangle = \frac{1}{\sqrt{2}}(|0\rangle + |1\rangle)$, each qubit has a likelihood of 50% to be $|0\rangle$]. How many different states are possible for such a system and what are the probabilities for each [Hint: for $|xx>$ above, there are four possible states, each with a probability of 25%].

2. Show that two consecutive operations of the Hadamard logic gate leaves a qubit unchanged (in its orginal form).

3. Consider a qubit as a vector in the Bloch sphere. Show that a Hadamard operation is equivalent to three rotational transformations.

4. In the teleportation problem discussed in the class, if Alice and Bob had shared the Bell state $|\beta_{01}\rangle$ initially, (instead of the $|\beta_{00}\rangle$), how will that change the circuit required for teleportation?

5. How will you generate a classical NAND gate using the quantum logic gates that you have learned so far.