18.435/2.111 Homework # 6
Due Thursday, October 26

1: Suppose you have been captured by aliens who own a quantum computer they let you use. They give you a challenge: they will give you one of two states, $|0\rangle$ and $-\frac{1}{2}|0\rangle + \frac{\sqrt{3}}{2}|1\rangle$, and you have to tell them which one they gave you. If you succeed, they will let you go back to Earth, but if you fail, they will put you in their zoo on Cor Leonis[1]. After talking with them for some time, you ascertain that there is a third option — you can tell them that you dropped the qubit, and they will give you a new qubit in one of the two states and let you try again. (You can do this as many times as you want.) What should you do?

Hint: Consider applying a POVM with three outcomes, $|e_1\rangle\langle e_1|$, $|e_2\rangle\langle e_2|$, $|e_3\rangle\langle e_3|$, where these three (non-normalized) vectors are carefully chosen.

2: Problem 5.2 in Nielsen and Chuang (Measured quantum Fourier transform).
This problem seems fairly hard to me, so if there's enough demand, I'll post a hint for this.

3: Problem 5.3 in Nielsen and Chuang (Kitaev's algorithm).

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[1]Saying "I've always wanted to see Cor Leonis" will not earn you any points on this homework question.