

Reading: For next week, read Chapter 14 up through section 14.7 and also section 18.1 of Chapter 18. We’ve actually used some of the earliest material in chapter 14, but we will focus on the Bloch Sphere, pure and mixed states as operators, and the relation between unitary and Hermitian matrices. Note that the Spectral Theorem is split between Theorem 14.1 on page 149 and Theorem 18.1 on page 206.

The **Second Prelim Exam**, which again is set for **Thursday, Nov. 20** *in class period*, will be “cumulative”—meaning concepts from all of the course may be drawn on—but will focus on Chapters 8–13 and Chapter 14 up through section 14.6.1, plus section 18.1. It will not have questions on the CHSH game (section 14.7) or the partial trace (aka. “traceout”) operation in section 14.6.2.

—————Assignment 6, due Thu. 11/13 “midnight stretchy” on CSE Autolab—————

(1) Lipton-Regan text, exercises 13.1 plus the first question in exercise 13.2: Using the orthonormal basis formed by the (unknown!) hit vector $\mathbf{h}$ and miss vector $\mathbf{m}$ as coordinates, calculate the 2×2 unitary matrix that represents reflection about $\mathbf{m}$ followed by reflection around the all-1s vector $\mathbf{j}$ —within the (unknown!) 2-dimensional subspace that they generate. Also write $\mathbf{j}$ as a length-2 vector (a, b) in this basis—i.e., such that $\mathbf{j} = a\mathbf{h} + b\mathbf{m}$. (You may suppose that the exact number k of solutions is known in advance. 12 pts. total)

(2) Show that the 4×4 matrix $\mathbf{E}$ from Assignment 4 has the states $|++\rangle$, $|+-\rangle$, $| - + \rangle$, and $|--\rangle$ as four orthonormal eigenvectors. For each one, what is its associated eigenvalue? What 4×4 diagonal matrix does $\mathbf{E}$ become when expressed in this eigenbasis (in the given order)? (18 pts. total)

(3) Lipton-Regan text, problem 14.7 in chapter 14: Use the spectral method in section 14.6 (to come in Tuesday’s lecture) to calculate a 2×2 matrix A such that $A^2 = \mathbf{W}$, where $\mathbf{W} = \frac{1}{\sqrt{2}}(\mathbf{X} + \mathbf{Y}) = \frac{1}{\sqrt{2}} \begin{bmatrix} 0 & 1 - i \\ 1 + i & 0 \end{bmatrix}$. (Begin by finding the eigenvectors and eigenvalues of $\mathbf{W}$. The fact that $\mathbf{W}$ is “anti-diagonal” may help save work or at least enable you to check your answers intuitively. 18 pts., for 48 total on the set)