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Physics 84
Skills Diagnostic
1/26/17

1, 2, 3, 4

1 Eigenvalues and Eigenvectors

Find the eigenvalues and eigenvectors of the following matrix:

$$\begin{bmatrix} 2 & i \\ -i & 2 \end{bmatrix}.$$

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2 Digital Logic Circuits

Design and draw a simple logic circuit that takes two classical bits as input and is described by the following truth table:

A	B	Out
0	0	1
0	1	1
1	0	0
1	1	1

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3 Qubit States and Measurements

A qubit is prepared in the quantum state $\big|\psi\big\rangle = \frac{1}{\sqrt{3}}\big|0\big\rangle + i\sqrt{\frac{2}{3}}\big|1\big\rangle$.

1. What is the probability that an ideal projective measurement in the $\{\big|a\big\rangle, \big|a_\perp\big\rangle\}$ basis will find the qubit in the state $\big|a\big\rangle$ if $\big|a\big\rangle = \big|0\big\rangle$?
2. What if $\big|a\big\rangle = \frac{1}{\sqrt{2}}(\big|0\big\rangle + \big|1\big\rangle)$?

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4 Matrix Operations

Write down a matrix U_χ such that $U_\chi \begin{bmatrix} a \\ be^{i\varphi} \end{bmatrix} = \begin{bmatrix} a \\ be^{i(\varphi+\chi)} \end{bmatrix}$ for any real numbers a, b, and φ. Is U_χ a unitary matrix?

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