

ECE 592-100 – Signal Processing Tour of Quantum Computing

Quiz 1– Spring 2023

February 20, 2023

Please remember to justify your answers carefully.

Last name: _____ First name: _____

Question 1 (Linear dependence.)

Consider the row vectors $[1 \ 1 \ 1]$, $[2 \ 0 \ 3]$, and $[1 \ -1 \ 2]$. Explain why they are linearly dependent.

Solution. $(1)[1 \ 1 \ 1] + (-1)[2 \ 0 \ 3] + (1)[1 \ -1 \ 2] = [0 \ 0 \ 0]$.

Question 2 (Diagonalizable matrices.)

Consider the matrix

$$A = \begin{bmatrix} 1 & 1 \\ 2 & 0 \end{bmatrix}.$$

Show that A is not diagonalizable.

Solution. $AA^\dagger \neq A^\dagger A$, hence A is not normal, hence it is not diagonalizable.

Question 3 (Square of matrix.)

The matrix A has eigen values 1 and 2. What are the eigen values of its square, A^2 ?

Solution. The eigen values of A^2 are squares of the eigen values of A , hence $1^2 = 1$ and $2^2 = 4$. (To see why eigen values of A^2 are squared, consider $A|v\rangle = v|v\rangle$, then $A^2|v\rangle = A(A|v\rangle) = vA|v\rangle = v^2|v\rangle$, and v^2 is an eigen value of A^2 .)