

Homework 1 ECE 712

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Download the matlab files Q1.mat and Q2.mat on the course website.

- 1) Load file Q1.mat into matlab. In this file you will find a matrix \mathbf{A}_1 and vectors \mathbf{b}_1 and \mathbf{b}_2 . Use matlab to determine if there is a linear combination of the columns of \mathbf{A}_1 which is equal to \mathbf{b}_1 . How are the coefficients of this linear combination determined? Repeat for the vector \mathbf{b}_2 . What condition must apply on the vector \mathbf{b} for there to be an exact solution to the system of equations $\mathbf{A}\mathbf{x} = \mathbf{b}$, when \mathbf{A} is a tall matrix? *Hint:* The matlab command `orth(A)` supplies an orthonormal basis for $R(\mathbf{A})$. Are \mathbf{b}_1 and $\mathbf{b}_2 \in R(\mathbf{A})$?
- 2) Now load the file Q2.mat, which contains a matrix \mathbf{A}_2 and a vector \mathbf{b}_2 . Using matlab, find \mathbf{x} so that $\mathbf{A}_2\mathbf{x} = \mathbf{b}_2$. Is \mathbf{x} unique? *Hint:* The matlab command `null(A)` returns an orthonormal basis for the nullspace of \mathbf{A} . Let \mathbf{z} be any vector in $N(\mathbf{A})$. Using matlab, show that $\mathbf{x} + \mathbf{z}$ is also a solution.
- 3) Using matlab, find an orthonormal basis for $R(\mathbf{A}_1)^\perp$, where \mathbf{A}_1 is given in Q1 above. Show that a vector \mathbf{v} in this space does indeed satisfy the required property with respect to the columns of \mathbf{A}_1 . Also, demonstrate that any vector $\mathbf{y} \in N(\mathbf{A}_2)$ satisfies the required property with respect to the rows of \mathbf{A}_2 .