# ELEC 3035: Quiz on linear algebra

**(The quiz aims to evaluate the average level of the class and is anonymous.)**

1. *Matrix–vector and matrix–matrix products*

$$\begin{bmatrix}1 & 2\\ 2 & 1\end{bmatrix}\begin{bmatrix}1\\ 2\end{bmatrix} = ? \qquad\qquad \begin{bmatrix}1 & 2\\ 2 & 1\end{bmatrix}\begin{bmatrix}1 & 3\\ 2 & 4\end{bmatrix} = ?$$

2. *Linear system of equations* Solve the following systems of equations in $u_1$ and $u_2$. Give only the final answer. (Do not show your derivation.) If the system has a unique solution, write it down. If the solution is not unique, show the general solution with free parameter(s). If there is no solution, say so.

$$\begin{bmatrix}1 & 2\\ 2 & 1\end{bmatrix}\begin{bmatrix}u_1\\ u_2\end{bmatrix} = \begin{bmatrix}5\\ 4\end{bmatrix}, \qquad \begin{bmatrix}u_1\\ u_2\end{bmatrix} = ?$$

$$\begin{bmatrix}1 & 2\\ 2 & 4\end{bmatrix}\begin{bmatrix}u_1\\ u_2\end{bmatrix} = \begin{bmatrix}5\\ 4\end{bmatrix}, \qquad \begin{bmatrix}u_1\\ u_2\end{bmatrix} = ?$$

$$\begin{bmatrix}1 & 2\\ 2 & 4\end{bmatrix}\begin{bmatrix}u_1\\ u_2\end{bmatrix} = \begin{bmatrix}4\\ 8\end{bmatrix}, \qquad \begin{bmatrix}u_1\\ u_2\end{bmatrix} = ?$$

3. *Least squares solution* Find the least squares fit to the points $\begin{bmatrix}-1\\ -1\end{bmatrix}$, $\begin{bmatrix}0\\ 1\end{bmatrix}$, and $\begin{bmatrix}1\\ 1\end{bmatrix}$. Sketch the solution.

4. *Least norm solution* Find the solution $\begin{bmatrix}u_{\mathrm{ln},1}\\ u_{\mathrm{ln},2}\end{bmatrix}$ of the system $\begin{bmatrix}1 & 2\end{bmatrix}\begin{bmatrix}u_1\\ u_2\end{bmatrix} = 4$ that has minimal 2-norm, i.e., $u_{\mathrm{ln},1}^2 + u_{\mathrm{ln},2}^2$ is as small as possible.

5. *Eigenvalues and eigenvectors* What are the eigenvalues and eigenvectors of the matrix $\begin{bmatrix}1 & 0\\ 0 & 2\end{bmatrix}$?