EE 5600: Linear Systems Analysis - Assignment 1

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Question 1.

$$x_1 = \begin{bmatrix} 2 \\ -3 \\ -1 \end{bmatrix}, \quad x_2 = \begin{bmatrix} 1 \\ 1 \\ -1 \end{bmatrix}$$

a)
First norm:

$$\begin{aligned} ||x_1||_1 &= \sum_1^3 x_{1i} \\ &= 2 - 3 - 1 \\ &= \textbf{-2} \end{aligned}$$

and

$$\begin{aligned} ||x_2||_1 &= \sum_1^3 x_{2i} \\ &= 1 + 1 - 1 \\ &= \textbf{1} \end{aligned}$$

b)
Second norm:

$$\begin{aligned} ||x_1||_2 &= \sqrt{\sum_1^3 x_{1i}^2} \\ &= \sqrt{2^2 + (-3)^2 + (-1)^2} \\ &= \boldsymbol{\sqrt{14}} \end{aligned}$$

and

$$
\begin{aligned}
||x_2||_2 &= \sqrt{\sum_{1}^{3} x_{2i}^2} \\
&= \sqrt{1^2 + 1^2 + (-1)^2} \\
&= \mathbf{\sqrt{3}}
\end{aligned}
$$

c)
Infinite norm:

$$
\begin{aligned}
||x_1||_\infty &= max(x_1) \\
&= \mathbf{2}
\end{aligned}
$$

and

$$
\begin{aligned}
||x_2||_\infty &= max(x_2) \\
&= \mathbf{1}
\end{aligned}
$$

Question 2. Find two orthonormal vectors that span the same space as two vectors in problem 1.

Question 3.

$$A_1 = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -1 \end{bmatrix}, \quad A_2 = \begin{bmatrix} 4 & 1 & 1 \\ 3 & 2 & 0 \\ 1 & 1 & 0 \end{bmatrix}, \quad A_3 = \begin{bmatrix} 1 & 2 & -3 & 4 \\ 0 & -1 & 2 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$