0.1 SIMPLE QUESTIONS
1. Give me a set of $n$ vectors whose $1$-norm, $\infty$-norm, and $2$-norms are all the same.

**Solution** The $n$ columns of the identify matrix all have these norms equal to $1$.

**Solution** Well, I can give you the zero vectors $n$-times!

**Real-time followup** Do you think there are any others?

2. Does the Neumann series converge for the matrix

$$\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$$

**Solution** No.

$$A^k = \begin{bmatrix} 1 & k \\ 0 & 1 \end{bmatrix}$$

3. Is this a matrix?

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

Give a discussion about different possible answers.

**Solution** The matrix meets a syntactic definition of an element of $\mathbb{R}^{6 \times 6}$. As such, it is a valid input to many methods designed to work with matrices. However, it likely fails to represent a useful, meaningful, or interesting linear operator between vector spaces. Moreover, it’s unclear that any type of structure is preserved by linear combinations of rows or columns. Finally, it seems to look like a face, which is another clue.

**Followup** Which answer do you like best and why?

0.2 FUN QUESTIONS
4. What does this Julia code do? Describe as much detail or as many interpretations as possible.

```julia
function myf(n::Int)
    A = zeros(n, n)
    for i=1:n
        for j=max(1,i-1):2:min(i+1,n)
            A[i,j] = 1/2
        end
    end
    M = I - A
    b = ones(n)
    b[1] = 0
    b[end] = 0
    return maximum(M\b)
end
```
Solution This builds a matrix that looks like

\[
\begin{bmatrix}
0.5 & 0 & \cdots \\
0.5 & -1 & 0.5 & 0 & \cdots \\
0 & 0.5 & -1 & 0.5 & 0 & \cdots \\
\vdots & \vdots & \ddots & \ddots & \vdots & \\
\cdots & & & 0.5 & -1 & 0.5 & 0 & \cdots \\
\end{bmatrix}
\]

More detail here… was in a hurry to get your this info!

This function can be interpreted as the longest time it takes for a random walk to exit an \(n\)-integer region with

Real-time Followup

If only one end-point was valid, is that an easy change? Can you do it?