**1.8: Linear transformations** MA322-001 Feb 7 Worksheet

Usually we thought of $\vec{b}$ as given, and tried to solve for $\vec{x}$. We've started to let $\vec{b}$ vary, and asked if we can even find a $\vec{x}$. That led us to just try an $\vec{x}$, to see which $\vec{b}$ we got. In other words, we can view a matrix like $A$ as a function that that takes $\vec{x}$ and gives us $\vec{b} = A\vec{x}$ as the answer.

This function $A(\vec{x}) = A\vec{x}$ is better than the ordinary function. It is **linear**. $A(\vec{x}+\vec{y}) = A(\vec{x}) + A(\vec{y})$ and $A(c\vec{x}) = cA(\vec{x})$.

Consider $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 1 & 1 \end{bmatrix}$. What does it do to a vector $\vec{x} = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$?

Does $A(\vec{x}) = \begin{bmatrix} 3 \\ 4 \\ 5 \end{bmatrix}$ have a solution?

**Takeaway:** $\vec{x} \xrightarrow{A} \vec{b}$

**Weird question:** If $\vec{x}$ is small, is $\vec{b}$ small?

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1.7.1 In each matrix decide if the columns are linearly independent. If they are not, cross out the **minimum** number of columns to make them linearly independent.

$$\begin{bmatrix} 1 & 2 \\ 4 & 5 \\ 6 & 7 \end{bmatrix} \qquad \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 9 \\ 6 & 7 & 13 \end{bmatrix} \qquad \begin{bmatrix} 0 & 1 & 2 \\ 0 & 3 & 4 \\ 0 & 5 & 6 \end{bmatrix} \qquad \begin{bmatrix} 1 & 2 \\ 1 & 1 \\ 0 & 0 \end{bmatrix} \qquad \begin{bmatrix} 1 & 1 \\ 1 & 1 \\ 0 & 0 \end{bmatrix}$$

1.8.1 Write down a matrix that sends $\vec{x} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$ to $\vec{b} = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$, but also sends $\vec{x} = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$ to $\vec{b} = \begin{bmatrix} 4 \\ 5 \end{bmatrix}$ and $\vec{x} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ to $\vec{b} = \begin{bmatrix} 6 \\ 7 \end{bmatrix}$.