$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ Give the matrix B for

which $AB = \begin{bmatrix} 2a+3b & b-a & a+2b \\ 2c+3d & -c+d & c+2d \end{bmatrix}$

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} 2 & -1 & 1 \\ 3 & 1 & 2 \end{bmatrix} = \begin{bmatrix} 2a+3b & -a+b & \\ & & \end{bmatrix}$$

Have a set $\mathcal{S}$ of vectors:

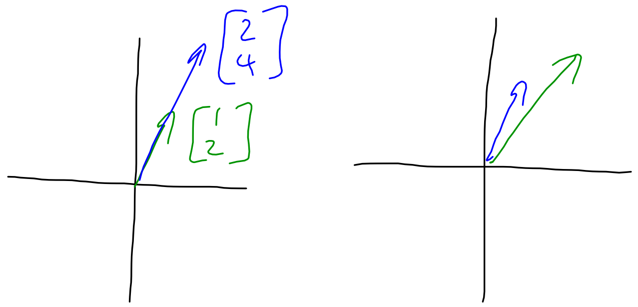
$\mathcal{S} = \{\vec{v}_1, \vec{v}_2, \ldots, \vec{v}_n\}$

The <u>span</u> of $\mathcal{S}$ is another set of vectors.

It is denoted span(S), and it is all linear combinations of the vectors in S.

$S = \left\{ \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} 3 \\ 4 \end{bmatrix} \right\}$ $\quad \begin{bmatrix} 1 \\ 2 \end{bmatrix} \in \text{span}(S)$ $\quad \pi \begin{bmatrix} 1 \\ 2 \end{bmatrix} + e \begin{bmatrix} 3 \\ 4 \end{bmatrix}$

$$S = \left\{ \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} 2 \\ 4 \end{bmatrix} \right\}$$



Is $\vec{u} = \begin{bmatrix} 1 \\ -8 \\ -9 \end{bmatrix}$ in $\text{span}\Bigg(\underbrace{\left\{ \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} \right\}}_{S_1}\Bigg)$?

$$\underline{c_1} \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix} + \underline{c_2} \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} + \underline{c_3} \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 1 \\ -8 \\ -9 \end{bmatrix}$$

$$c_1 + c_2 + c_3 = 1$$
$$2c_1 + c_2 \quad = -8$$
$$3c + c_2 + c_3 = -9$$

$$\bar{u} \in \text{span}(S_1) \text{ because } -5\begin{bmatrix}1\\2\\3\end{bmatrix} + 2\begin{bmatrix}1\\1\\1\end{bmatrix} + 4\begin{bmatrix}1\\0\\1\end{bmatrix} = \begin{bmatrix}1\\-8\\9\end{bmatrix}$$

$$\begin{array}{c} A \\ \begin{bmatrix} 1 & 1 & 1 \\ 2 & 1 & 0 \\ 3 & 1 & 1 \end{bmatrix} \end{array} \begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix} = \begin{bmatrix} 1 \\ -8 \\ -9 \end{bmatrix}$$

$$A^{-1}\left(\quad \right) = A^{-1}\left(\quad \right)$$

$$(A^{-1}[\quad])\begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix} = A^{-1}[\quad]$$

$$I\begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix} = A^{-1}\begin{bmatrix} 1 \\ -8 \\ -9 \end{bmatrix}$$

$$\begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix} = A^{-1}\begin{bmatrix} 1 \\ -8 \\ -9 \end{bmatrix}$$

$$A\bar{x} = \bar{b}$$

$$0x = 5$$

$\det(A) \neq 0 \iff A$ is invertible

if, and only if,

$A\vec{x} = \vec{b}$ A is square $\begin{bmatrix} 0 & 0 & 0 & 0 & 1 \end{bmatrix}$

$\det(A) = 0 \Longrightarrow A\vec{x} = \vec{b}$ has no sol or inf many.

$\det(A) = 0$ and $\vec{b} = \vec{0} \Longrightarrow$ inf many sols.