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1. For each matrix A and vector $\mathbf{b}$, decide whether $\mathbf{b}$ lies in the column space of A.
   (a) $A = \begin{bmatrix} 2 & 3 \\ -4 & -6 \end{bmatrix}, \quad \mathbf{b} = \begin{bmatrix} 1.5 \\ -3 \end{bmatrix}$
   (b) $A = \begin{bmatrix} 1 & -3 & -3 \\ 2 & 1 & -4 \\ 3 & -1 & -1 \end{bmatrix}, \quad \mathbf{b} = \begin{bmatrix} -2 \\ -7 \\ 2 \end{bmatrix}$
   (c) $A = \begin{bmatrix} -2 & 1 & 4 \\ 0 & -5 & -4 \\ 1 & -3 & -4 \end{bmatrix}, \quad \mathbf{b} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$
2. Construct a 3×3 matrix whose column space contains $(1,1,0)$ and $(1,0,1)$ but not $(1,1,1)$. Construct a 3×3 matrix whose column space is only a line.
3. Problem set §2.1, exercises 2, 3, 22, 25, 27

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4. For each of the following matrices, describe its null space as a linear combination of special solutions.
   (a) $A = \begin{bmatrix} 1 & 0 & 2 & -3 \\ 0 & 1 & 4 & 1 \end{bmatrix}$
   (b) $A = \begin{bmatrix} 1 & 2.5 & 0 & 2 \\ 0 & 0 & 1 & -2 \end{bmatrix}$
   (c) $A = \begin{bmatrix} 2 & 3 \\ 4 & 6 \\ -2 & -3 \end{bmatrix}$
   (d) $A = \begin{bmatrix} 2 & 3 \\ 4 & 6 \\ -2 & -6 \end{bmatrix}$
5. For each system, use elimination to decide whether it is consistent. If it is, find the particular solution and all special solutions, and then write the general solution.
   (a) $\begin{cases} 2x + 3y - z = 1 \\ x \qquad\quad + z = 1 \end{cases}$
   (b) $\begin{cases} x + 3y + 3z = 1 \\ 2x + 6y + 9z = 5 \\ -x - 3y + 3z = 5 \end{cases}$
6. The plane P defined by $x - 3y - z = 12$ is parallel to the plane P' defined by $x - 3y - z = 0$. One particular point on the plane P is $(12, 0, 0)$. Describe all points on the plane P in parametric form.
7. Problem set §2.2, exercises 3, 4, 7, 8, 12, 30, 39.