examples that are not vector spaces

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- Vectors without zero vector:
  The set of all n-tuples of real numbers (e.g., $\mathbb{R}^2, \mathbb{R}^3$) with standard addition and scalar multiplication
  - Example: the set $V = \{\vec{u} \in \mathbb{R}^2 \mid u_1 + u_2 = 1\}$ because $\vec{0} \notin V$, so it is not a vector space.
- Subset of $\mathbb{R}^n$ closed under addition but not scalar multiplication
  - Example: $W = \{\vec{u} \in \mathbb{R}^2 \mid u_1 \geq 0, u_2 \geq 0\}$ because
    $\vec{u} = [1,1] \in W$ but $-1\vec{u} = [-1, -1] \notin W$
- Finite set of vectors
  - Example: $F = \{[1,0], [0,1]\}$ because
    finite sets of vectors are generally not closed under addition and scalar multiplication
- Set of matrices without closure
  - Example: $H = \{A \in M_{2\times 2} \mid \det(A) = 1\}$ because
    adding two matrices in H does not necessarily result in another matrix with $\det(A) = 1$

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exercise 1

Why is the set of polynomials of degree n not a vector space?