Check-In 01/14. *(True/False)* The vector $\mathbf{u} = \langle 2, -1, 0 \rangle$ is a unit vector.

Solution. The statement is *false*. We know a unit vector has length 1. We know if $\mathbf{v} = \langle x_1, x_2, \ldots, x_n \rangle$, then $\|\mathbf{v}\| = \sqrt{x_1^2 + x_2^2 + \cdots + x_n^2}$. But then $\|\mathbf{u}\| = \|\langle 2, -1, 0 \rangle = \sqrt{2^2 + (-1)^2 + 0^2} = \sqrt{4 + 1 + 0} = \sqrt{5} \neq 1$. Therefore, $\mathbf{u}$ is not a unit vector.

Check-In 01/16. *(True/False)* Suppose that $\mathbf{u}, \mathbf{v} \in \mathbb{R}^n$. If $\mathbf{u} \cdot \mathbf{v} = 0$, then either $\mathbf{u} = 0$ or $\mathbf{v} = 0$. Furthermore, $\mathbf{u} \perp \mathbf{v}$.

Solution. The statement is *false*. If $\mathbf{u} \cdot \mathbf{v} = 0$, it is true that $\mathbf{u}$ and $\mathbf{v}$ are perpendicular (so long as neither of them are nonzero). Furthermore, if $\mathbf{u}$ and $\mathbf{v}$ are perpendicular, then $\mathbf{u} \cdot \mathbf{v} = 0$. However, if $\mathbf{u} \cdot \mathbf{v} = 0$, it need not be the case that $\mathbf{u}$ and $\mathbf{v}$ are zero. For instance, if $\mathbf{u} = \langle 1, 0, \ldots, 0 \rangle$ and $\mathbf{v} = \langle 0, 1, 0, \ldots, 0 \rangle$, then $\mathbf{u} \cdot \mathbf{v} = 1(0) + 0(1) + 0(0) + \cdots + 0(0) = 0$ but neither $\mathbf{u}$ nor $\mathbf{v}$ are zero. Furthermore, it is impossible that $\mathbf{u} = 0$ or $\mathbf{v} = 0$. Both $\mathbf{u}, \mathbf{v}$ are *vectors* while 0 is a scalar.