Write one representation of a vector. The class as a whole should try to generate as many representations as possible.

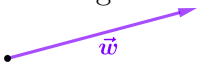
Solution Some representations just provide an algebraic name for the vector:

$$\mathbf{v},\ \vec{v},\ |v\rangle,\ \langle v|,\ \psi \tag{1}$$

Some representations list only the components of a vector and assume that you know what the basis is. The components are just a list of numbers (the list is as long as the dimension of the vector space), so there are many different ways of writing a list of numbers:

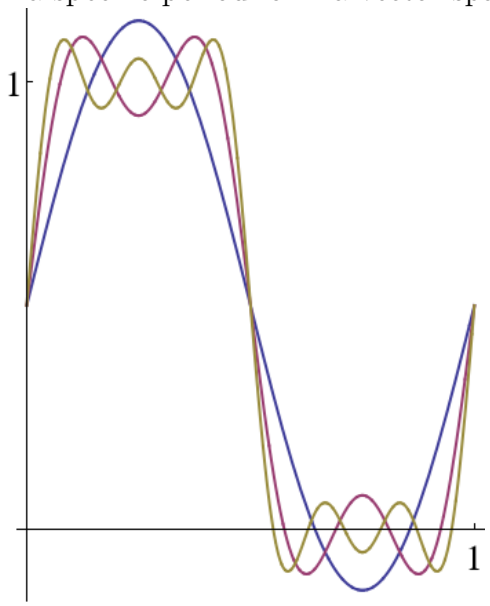
$$\langle 0,1\rangle,\ (0,1),\ \begin{pmatrix}0\\1\end{pmatrix} \tag{2}$$

When you first learn about vectors in a physics class, you are normally talking about vectors that have a magnitude and a direction. These can be represented by arrows:



But notice that the "magnitude" does not always have dimensions of [length]. For example, for a velocity vector, the magnitude will be a speed with dimensions [length/time]. In these cases, the length of the arrow on the page will be proportional to, but not equal to, the magnitude of the vector.

Many other types of mathematical objects obey the abstract rules for a vector space (see GMM). As you advance through your career, you will add such representations. For example, periodic functions with a specific period form a vector space. This concept underlies the technique of Fourier series:



Basis vectors are, of course, also examples of vectors. There are many different representations of basis vectors:

$$x\hat{x},\ x^2\hat{i},\ \begin{pmatrix}3\\4\end{pmatrix},\ \frac{1}{2}|+\rangle - \frac{\sqrt{3}}{2}|-\rangle,\ 3\sin(2\pi x) + 4\sin(5\pi x) \tag{3}$$