1. (a) Plot of \( f(x) = x^2 + x - 2 \)

(b) \( f'(x) = 2x + 1 \), so the equation for the tangent line to \( f(x) \) at \( x = 2 \) is \( T(x) = f(2) + f'(2)(x - 2) = 4 + 5(x - 2) = 5x - 6 \).

(c) A vector in the direction of the tangent line has a slope of 5, so the vector \( \langle 1, 5 \rangle \) is a good choice. It is shown on the graph above based at \( (2, 4) \).

2. (a) Plot of \( \begin{align*} x &= t \\ y &= t^2 + t - 2 \end{align*} \) for \( 0 \leq t < 4 \). This is different from the graph above because the domain is restricted.

(b) The vectors based at \( (0, 0) \) and ending at \( (x(t), y(t)) \) for \( t = 0, 1, 2, 3 \) are shown on the graph above.

(c) \( \langle x'(2), y'(2) \rangle = \langle 1, 5 \rangle \). This represents velocity - this vector is shown on the curve in the graph below 1.a.

(d) The speed of the particle is the magnitude of the velocity, or \( \sqrt{1^2 + 5^2} = \sqrt{26} \).
3. (a)-(d) shown below. The red arrows (from left to right) are the vectors \((-8,3), (-5,2),(-2,-1),\) and \((1,0)\). The black arrows show how these are obtained by adding the multiples \(-v,0,v,\) and \(2v\) of the vector \(v = (3,-1)\) to the vector \((-5,2)\).

\(\text{\arrayimage[3.1in]{3.1in}}\)

- (e) If we allow the scalar \(t\) to vary in the parametric equation \((-5,2) + t (3,-1)\) we get a line through the point \((-5,2)\) in the direction of the vector \((3,-1)\).

4. (a) \(l(t) = (-5 + 2t,2+3t,1-t) = (-5,2,1) + t (2,3,-1)\), so \(p = (-5,2,1)\) and \(v = (2,3,-1)\).

(b) Plot of the line from part (a)

(c) \(v\) is called the direction vector because it points in the direction of the line.

5. Let \(a = \langle -\sqrt{3},0,-1,0 \rangle\) and \(b = \langle 1,1,0,1 \rangle\) be vectors in \(\mathbb{R}^4\).

(a) The distance between \((-\sqrt{3},0,-1,0)\) and \((1,1,0,1)\) is \(\sqrt{(1 + \sqrt{3})^2 + 1^2 + 1^2 + 1^2} = \sqrt{7 + 2\sqrt{3}}\).

(b) The angle between \(a\) and \(b\) is found by:

\[
\arccos \left( \frac{a \cdot b}{|a||b|} \right) = \arccos \left( \frac{-\sqrt{3}}{2\sqrt{3}} \right) = \arccos(-1/2) = 2\pi/3
\]