1.6.2 Sketch the range and orientation of the curve \( z(t) = t^2 + 2t + i(t + 1) \)

(a) for \(-1 \leq t \leq 0\).
(b) for \(1 \leq t \leq 2\).

[Hint: Use \( x = t^2 + 2t, \ y = t + 1 \) and eliminate the parameter \( t \).]

1.6.3 Find a curve (give a map and an appropriate domain) whose range is a portion of the parabola \( y = x^2 \) that

(a) joins the origin to the point \( 2 + 4i \).
(b) joins the point \((-1 + i)\) to the origin.
(c) joins the point \((1 + i)\) to the origin.

1.6.7 Find a curve (give the map and an appropriate domain) whose range is a portion of the circle \( C_1(0) \) that joins the point 1 to \( i \) if

(a) the curve moves counterclockwise along the quarter circle.
(b) the curve is oriented clockwise.

3.3.4 Let \( v(x, y) = \arctan \left( \frac{y}{x} \right) \), for \( x \neq 0 \). Compute the partial derivatives, and verify that \( v \) satisfies Laplace’s equation.

3.3.11 Let \( f(z) = f(re^{i\theta}) = u(r, \theta) + iv(r, \theta) \) be analytic on a domain \( D \) that does not contain the origin. Working with the polar form of the Cauchy-Riemann equations, differentiate them first with respect to \( \theta \) and then with respect to \( r \). Use the results to establish the polar form of Laplace’s equation:

\[ r^2 u_{rr}(r, \theta) + ru_r(r, \theta) + u_{\theta\theta}(r, \theta) = 0. \]

3.3.13 The function \( F(z) = z^{-1} \) is used to determine a vector field known as a dipole.

(a) Express \( F(z) \) in the form \( F(z) = \phi(x, y) + i\psi(x, y) \).
(b) Plot, in the same plane, the level curves \( \phi(x, y) = c \) for \( c = 1, 1/2, 1/4 \), and \( \psi(x, y) = d \) for \( d = 1, 1/2, 1/4 \). [You might do this by adapting the Sage notebook from several weeks back that we used to draw level sets for \( \text{Re } f(z) \) and \( \text{Im } f(z) \), when \( f(z) = z^3 \).]