Find a function $w = f(z)$ that maps the domain $D = \{|z| < 1 \text{ and } |z - 1 - i| > 1\}$ onto the upper half plane $D^* = \{w, \Im(w) > 0\}$. Map the points $A(1), B(i), C(-1),$ and $D(1 + 2i)$ from the $z$ plane to $A(0), B(1), C(\infty)$ in the $w$ plane.