Consider the Laplace equation \( \Delta u = 0 \) in \( \Omega \), where the open set \( \Omega \) is the intersection of the unit disk with the first quadrant of the plane \( \mathbb{R}^2 \). Assume that the Dirichlet boundary condition \( u = 0 \) on the positive \( x \)-axis is given, and the Neumann boundary condition \( u_x = g(y) \in C^\infty([0,1]) \) on the positive \( y \)-axis. Assume that \( u \) is \( C^\infty \) on the unit arc. Show that

\[
u(r, \theta) = r(\ln r \sin \theta + \theta \cos \theta)\]

is a solution to this problem in polar coordinates. Show that the solution is not \( C^1 \) at the corner.