

## Problem 22

In each of Problems 21 through 24, determine the order of the given partial differential equation; also state whether the equation is linear or nonlinear. Partial derivatives are denoted by subscripts.

$$u_{xx} + u_{yy} + uu_x + uu_y + u = 0$$

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### Solution

The second derivative of  $u$  is the highest derivative, so the order of the PDE is 2. The PDE is nonlinear because there are nonlinear functions of  $u$ , namely  $uu_x$  and  $uu_y$ .

$$uu_x = \frac{1}{2} \frac{\partial}{\partial x}(u^2)$$

$$uu_y = \frac{1}{2} \frac{\partial}{\partial y}(u^2)$$