

Let  $f(x, y) = x^4 + y^4 - 4xy + 1$ .

1. Find the first order partial derivatives of  $f$  ( $f_x$  and  $f_y$ ).
2. Find all critical points of  $f$  (solutions to the system of equations  $f_x = f_y = 0$ ). There are three critical points.

3. Find all second order partial derivatives of  $f$  ( $f_{xx}, f_{yy}$ , and  $f_{xy} = f_{yx}$ ).
4. Determine whether  $f$  has a local maximum, local minimum, or saddle point at each of the critical points from part (c) using the discriminant,

$$D_f(x, y) = f_{xx}(x, y)f_{yy}(x, y) - (f_{xy}(x, y))^2.$$