2. \[ f(x,y) = 12x^2 - 4y^3 + 2xy + 20 \]
\[ f_x = 24x + 2y \]
\[ f_{xx} = 24 \]
\[ f_y = -12y^2 + 2xy = 12(x-y^2) \]
\[ f_{yy} = -24 \]
\[ f_{xy} = 2y \quad f_{yx} = 2y \]

\[ D(x,y) = f_{xx} \cdot f_{yy} - f_{xy} \cdot f_{yx} = 24(-24y) - (-24)(2y) = -24(2y)(y+1) \]

- Critical Points:

\[ f_x = 24(x+y) = 0 \implies y = -x \]
\[ f_y = 12(x-y^2) = 0 \]

\[ 2x - (-x)^2 = 0 \implies 2x - x^2 = 0 \implies x(2-x) = 0 \]

\[ x = 0 \quad \text{or} \quad x = 2 \]

Combine with \( y = -x \)

- Locations of two CPs

\( (x,y) = (0,0) \quad (x,y) = (2,-2) \)

2nd Derivative Test:

\( (x,y) = (0,0) \)

\[ D(0,0) = -(2y^2)(0+1) = (-) \implies (0,0) \text{ is a Saddle Point} \]

\( (x,y) = (2,-2) \)

\[ D(2,-2) = -(2y^2)(-2+1) = (-y)(-1) = (+) \]

Use either \( f_{xx} \) or \( f_{yy} \) at \( (2,-2) \) to determine if max/min.

\[ f_{xx}(2,-2) = 2y = (+) \implies \text{Relative minimum at } (2,-2) \]