

1. Calculate the partial derivatives for the function f , when $f(x, y)$ is

a) $xy^2 + 3x$, b) $\ln \frac{x}{y}$, c) $\frac{\sin x}{\cos y}$.

2. Calculate the gradient ∇f for the functions

a) $f(x, y, z) = x^2z + \ln(yz)$, b) $f(x, y) = \sqrt{x^2 + y^2}$.

3. Let

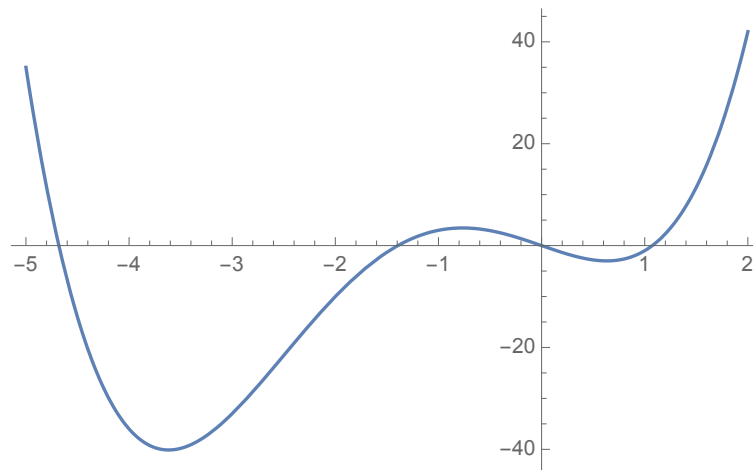
$$f(x) = x^4 + 5x^3 - 7x$$

Use the gradient descent method to find a (local) minimum x_{\min} for the function f . Calculate the derivative $f'(x)$ by hand, and find x_{\min} iteratively using the formula

$$x_{i+1} = x_i - \alpha f'(x_i).$$

You can do this by hand using a calculator, or write a program to do calculations using a computer.

If using a computer you can try different starting points x_0 and different learning rates α to find both of the minima.



(Answer: $x = -3.61617$ or $x = 0.631954$.)

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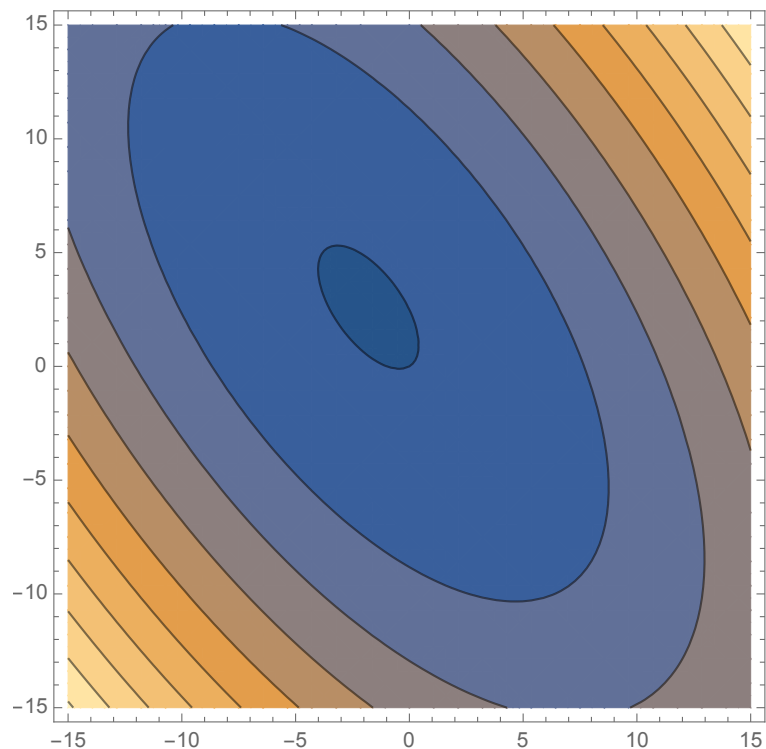
4. Let

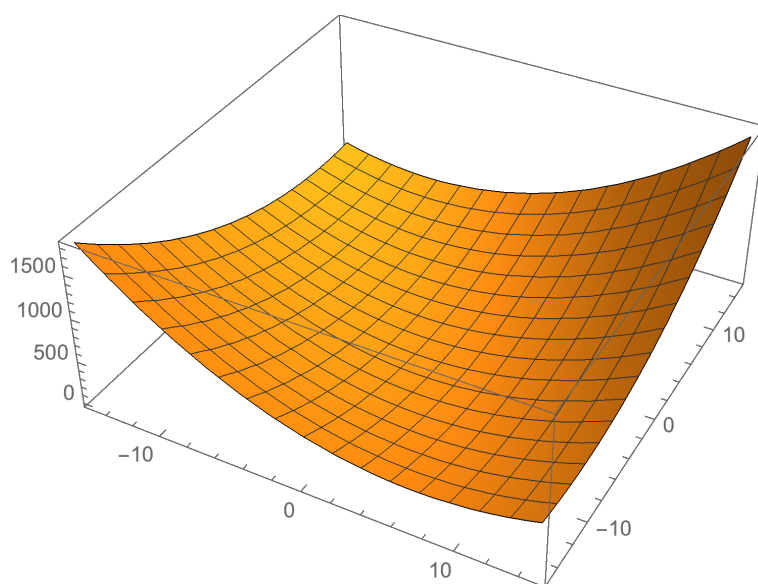
$$f(x, y) = 3x^2 + 3xy + 2y^2 + 3x - 5y$$

Use the gradient descent method to find the local minimum (x_{\min}, y_{\min}) for the function f . Calculate the partial derivatives of f by hand, and find (x_{\min}, y_{\min}) iteratively using the formulae

$$x_{i+1} = x_i - \alpha \frac{\partial f}{\partial x}(x_i, y_i)$$
$$y_{i+1} = y_i - \alpha \frac{\partial f}{\partial y}(x_i, y_i).$$

You can do this by hand using a calculator, or write a program to do calculations using a computer.





(Answer: $x_{\min} = -1.8$ and $y_{\min} = 2.6$.)