Exercise 3

Advanced Methods in Medial Image Analysis, Julia Wolleb

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Exercise 3: Gradient-based Optimization in 2D

Implement the vanilla gradient-descent algorithm to optimize the *Peaks* function

$$f(x,y) = 3*(1-x)^2 e^{-x^2-(y+1)^2} - 10*(\frac{x}{5} - x^3 - y^5)e^{-x^2-y^2} - \frac{1}{3}e^{-(x+1)^2-y^2} \quad (1)$$

- Calculate analytic gradients $\frac{\partial f}{\partial x}, \frac{\partial f}{\partial y}$ in your update procedure. You may use *Wolfram Alpha* or similar.
- Run your implemented optimizer serveral times with different step-sizes $\gamma_0 = 0.1$, $\gamma_1 = 0.01$, $\gamma_2 = 0.001$ and $\gamma_3 = 0.0001$ at the initial position: $x = 1, y = 0.5$.
- Report the performance of your optimizer in form of convergence plots (e.g. using matplotlib.pyplot.plot). The x-axis shows the number of steps, the y-axis shows the value of the *Peaks* function $f(x,y)$ at the current step.
- Hand in your code, which does not throw exceptions.

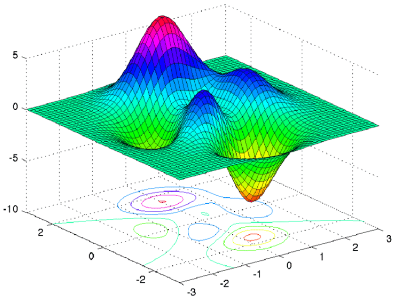

Figure 1: The Matlab *Peaks* function