Exercise 1

In the lecture you performed the derivation for a formula for the discrete first derivative of an image. Similarly to this derivation you can derivate a formula for the second derivative given below.

\[ L(f(x, y)) := \frac{\delta^2 f(x, y)}{\delta^2 x} + \frac{\delta^2 f(x, y)}{\delta^2 y} \]  

(5P) Subtask 1.1
Perform the derivation for the second derivative and rewrite it in form of a 3x3 matrix. For what could a matrix of this form be used when applied as a filter kernel?

Exercise 2

(1P) Subtask 2.1
Define the autocorrelation function.

(3P) Subtask 2.2
Calculate by hand the autocorrelation of the one dimensional Gaussian function with parameters \( \mu \) and \( \sigma \) for mean and standard deviation.

(3P) Subtask 2.3
Implement the autocorrelation of an image to determine its texture. If you are uncertain, first implement a one dimensional autocorrelation function and verify that it is working for a Gaussian. Does it give the same result as in the previous subtask? Now generalize your code to two dimensions and apply it to the images that you used in Tutorial Nr. 2. Plot the autocorrelation function as a gray scale image.

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