Variational Methods for Computer Vision
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Winter Semester 17/18

Visual Scene Analysis
Institute for Computer Science
University of Siegen

Weekly Exercises 1

Room: H-C 6336/37
Friday, 20.10.2017, 14:15-15:45
Submission deadline: Tuesday, 17.10.2016, 14:15 in Room H-C 6336

Programming

Familiarize yourself with MATLAB.

Exercise 1 (2 points)**.** Find functions to read the example image *peppers.png* into MATLAB and convert its type to double with values in $[0, 1]$. Then show the image in a figure. Next, understand the 'colon' (:) operator and the 'reshape' function. Convert the image I into a vector and back into an image using these functions. *This basic operation will be called 'vectorizing' in the future.*

Exercise 2 (2 points)**.** Implement a "Laplace" filter Δ. This operation can be represented by a small filter matrix:

```
Δ = [0 1 0; 1 −4 1; 0 1 0];
```

Applying a filter like this to an image applies its localized effect. In our case the Laplace filter will magnify edges in the image.
Compute $\Delta * I$, the convolution of this filter with our test image, with the 'imfilter' function or the 'conv2' function. Read their documentation carefully to implement the correct operations.
You may assume that the image has a value of '0' outside its domain.

Exercise 3 (8 points)**.** Convolutions are linear operators. This means that we can also write the convolution as an equivalent matrix-vector multiplication. Write the image as a vector and devise an appropriate matrix A so that applying it to the vectorized image directly yields the vectorized convolution.
Check with your previous results to make sure that both are equal within machine precision.

Exercise 4 (4 points)**.** Test your Laplace filter on the task of image sharpening. Compute $I - \alpha(\Delta * I)$ for different values of $\alpha > 0$ and visualize the results.
Then add noise to the image I by computing

```
I = I + 0.1*rand(size(I));
```

and repeat the experiment. How does the presence of noise change the sharpening process?