Technische Universität Berlin

DIGITAL IMAGE PROCESSING

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Exercise 1:

Introduction

Group Z

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Contents

Part 1: Presentation of the Solution

In this exercise we add a filter to sharpen the image.

The function filter2D() is been used. To add the filter, we need a convolution with a kernel. The code is shown as followed:
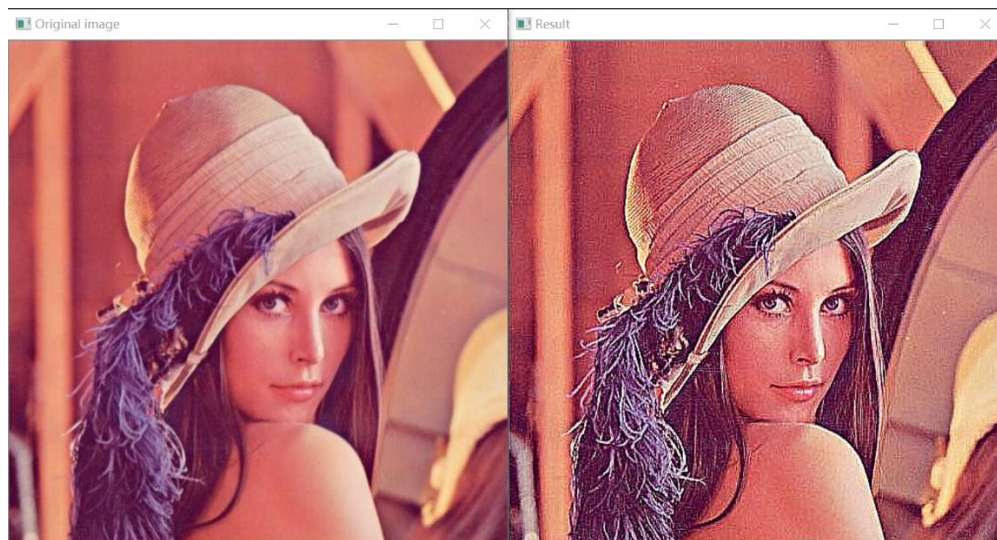
```cpp
Mat kernel(3, 3, CV_32F, Scalar(-1));
kernel.at<float>(1, 1) = 9;
```

We set a 3x3 matrix with a scalar of -1 and middle value of 9. Then we use the filter2D() function to obtain our output image:

```cpp
filter2D(img, newImg, img.depth(), kernel);
```

Here we set the depth of the output image the same as the original one.

The input and output are present as followed:

Part 2: Theoretical Questions

1. What is a digital image?

Definition:
   A digital image is a numeric representation, usually refers to raster images.
Procedures:
   From 3D world to image world, there are 3 stages, namely **image formation**, **digitizatio**n and **quantization**.
   Firstly, acquiring a photo with pinhole camera (image formation). Then by sampling to transfer the vector data into discrete coordinates according to the spatial resolution (digitization). Finally, determining the number of gray levels in the

digitized image (quantization).

Representations:

(1) (Set of) matrices (multi-channel, temporal)

(2) Chain code (e.g. for object boundaries)

(3) Topological data structures (Graphs)

(4) Hierarchical (e.g. pyramids and trees)

Here: Digital Image Function f
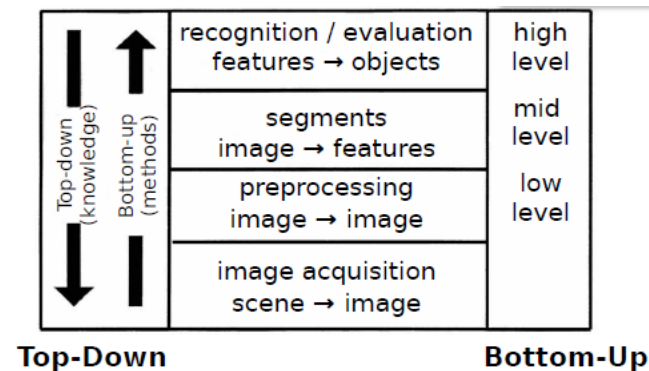
Most general: $f: IN^2 \rightarrow \mathbb{C}^C$

Mostly: $f: IN^2 \rightarrow IN^C$

c=1 $\rightarrow$ Gray-scale

c=3 $\rightarrow$ Color

More specific: $f: [1, N_x] \times [1, N_y] \rightarrow [0, 255]$

2. What does the paradigm "bottom-up processing" mean?

Bottom-Up processing: Perceive the individual parts and organize them into a whole, if possible. Information available in the stimulus itself. Bottom-Up processing relies on properties of the stimulus such as patterns of light and dark areas.

Bottom-Up processing is data driven, based on methods, which constructs object hypothesis by linking evidence in image.

3. State at least three fundamentally different image sources!

(1) Optical: film camera and microscope

(2) EM-Waves: radio wave and ultraviolet radiation

(3) Ultra sound

(4) Sonar

(5) Synthetic Aperture Radar