Zurich University
of Applied Sciences

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Digital Image Processing
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Lab 2 – Grayscale Transformations

This lab focuses on simple image enhancement by basic gray level transformations. In particular we will be dealing with brightness adjustment and contrast enhancement.

Learning Objectives

- You know how to obtain a gray level histogram of an image.
- You understand basic gray level transformations such as γ-correction or histogram equalization.
- You know how to apply these transformations.

1 Grayscale Histograms

The idea of this exercise is that you develop **your own code** to compute a gray level histogram of an arbitrary image.

1. In a first step think about an efficient way to determine the gray level histogram of an image.
2. Write your own code to compute the histogram for the three given images `bloodCells.tif`, `xRayChest.tif` and `ctSkull.tif`.
3. Now use a built-in function from your favorite python image processing library (scikit-image, Pillow, numpy, etc.) to compute the histogram of the above mentioned images.
4. For each case display the resulting histogram.

2 γ-Correction

In this exercise you are supposed to write your own γ-correction code to adjust the brightness of the images `xRayChest.tif` and `ctSkull.tif`. Recall that the mapping for γ-correction is defined as

$$s = r^{\gamma}, \text{ with } \; r \in [0,1], \; s \in [0,1].$$

1. Write your own code that applies γ-correction to the given images. Make sure you choose well-suited data types.
2. Try various values for γ and check which yields the best result.
3. Use your favorite python image processing library (e.g., scikit-image) to compute the gamma correction for an image. Compare the output (and if you want the source code as well) to your own implementation.

3 Contrast Stretching and Histogram Equalization

The gamma correction requires finding a well-suited set of parameters. By contrast, histogram-based methods such as histogram equalization do not require any parameter tuning and automatically adapt to the input image.

1. Plot the histogram and the cumulative density of the input image.
2. Implement an automatic histogram equalization algorithm and explain which impact it has on the given grayscale images.
3. Compare your handwritten implementation with an existing implementation from your favorite image processing library (e.g., Pillow or scikit-image).