DSP2 SS2020 – Exercise 5.1: Segmentation - Template Matching

1. The new src folder includes the usual main.cpp file and two new files:
   - Segmentation.h: declaration of the class for the Template Matching
   - Segmentation.cpp: implementation of the class for the Template Matching
2. The new data folder includes the Lena image from the last exercise and two new images:
   - template_1.tiff: the template image you should use for the cross correlation
   - template_2.tiff: if you like, you can also test your cross correlation implementation with this template (this is optional)

3. Implement the function "void Segmentation::crossCorrelate(const cv::Mat &input, const cv::Mat &templ, cv::Mat &output)
   - "Input": float value input image
   - "templ": float value template image, which you have to find in the input image
   - "output": result image of the cross correlation
   a. At first, think about the number of rows and columns you need for the output image and create the output image accordingly
   b. Implement the cross correlation:
      - Think about the number of for-loops
      - Think about the image ranges (which values do you need for the "for-loops"?)
      - Use the formula given below
      - Write the result to the output image
4. The result image of the cross correlation has the largest value on the matching point between input image and template image. The main function already locates this value and draws a rectangle around your matching point in the original image. This is the contour of the template. This way you can see where you found the template in the input image.
   - To find the maximum, we use the function "cv::Point Segmentation::findMaximum(const cv::Mat &input)"
   - We use the function "void Segmentation::drawRect(const cv::Mat &input, cv::Point origin, cv::Size size, cv::Mat &output)" to draw the contour of the template
   - To experiment with custom templates, you can uncomment and modify line 33 in main.cpp. This will save the specified part from the input image as "template.tiff" in the data folder. To use this new template, put its filename in line 13 and rerun the program.

Appendix: Formula for normalized cross correlation

- Image $g(x, y)$
- Pattern (Template) $p(k, l)$ with $k \leq x, l \leq y$
- Normalized Cross Correlation Function:

$$c(x, y) = \frac{\sum_k \sum_l g(x + k, y + l) p(k, l)}{\sqrt{\sum_k \sum_l g(x + k, y + l)^2} \sqrt{\sum_k \sum_l p(k, l)^2}}$$