Exercise Sheet Computer Vision 7

Submission: 30.06  
(30 Points)

Exercise 1 Convolution  (6 Points)

a) What is a convolution? What operations can be represented in this format?  
   (2 Points)

b) What is a kernel? Make an example of a squared one  
   (1 Points)

c) Can you think of operations that cannot be represented as a convolution?  
   Why?  
   (3 Points)

Exercise 2 Edge Detection  (14 Points)

a) Explain, considering the given code sample, each step of the Sobel-Algorithm.  
   What is it used for? What are the two mathematical concepts behind this algorithm? Individuate their implementation in the code.

```java
function sobel(Image image) {
    int[][] Sx = { {-1,0,1}, {-2,0,2}, {-1,0,1} };
    int[][] Sy = { {-1,-2,-1}, {0,0,0}, {1,2,1} };
    for (int x=1;x<image.getWidth()-1;x++) {
        for (int y=1;y<image.getHeight()-1;y++) {
            int intensity_sum_x=0, intensity_sum_y=0;
            for (int i=-1;i<=1;i++) {
                for (int j=-1;j<=1;j++) {
                    int intensity = image.getIntensity(x+i, y+j);
                    intensity_sum_x+=(intensity*Sx[1-j][1-i]);
                    intensity_sum_y+=(intensity*Sy[1-j][1-i]);
                }
            }
            int new_intensity = sqrt((intensity_sum_x)*(intensity_sum_x)
                    +(intensity_sum_y)*(intensity_sum_y));
            edges_image.setIntensityPixel(x, y, new_intensity);
        }
    }
    return edges_image;
}```
Exercise 3 Harris Corners and SIFT (10 Points)

a) What is a point of interest in an image? How is it defined? Which image properties can be used to find such points? (3 Points)

b) Explain the Harris-Corner pseudo code (4 Points)

c) What are the differences between Harris Corners and SWIFT features? (3 Points)

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