Exercises 2

1. Describe how to estimate the equation of a line that minimizes the sum of squared orthogonal distances for a set of points. Apply it on a following set of points:

$$p_1 = (-6, -2), p_2 = (-3, -1), p_3 = (0, 0), p_4 = (1, 1), p_5 = (3, 2)$$

2. Instead of minimizing the sum orthogonal errors, fit the points in previous exercise to a line $y = kx + L$ by minimizing the sum of squared errors in y.

3. An image has been smoothed with the following kernel:

$$h = k \cdot [1, 5, 10, 10, 5, 1]$$

   Can repeated convolutions of an image with the kernel

$$g = \frac{1}{2}[1, 1]$$

   be used to obtain the same result as with the first kernel? If yes, how many convolutions are needed? If no, explain the reasons why.

   What should the constant k be so that the filter gain is equal to 1?

4. (a) Show that the differential kernel $d_x^1 = \frac{1}{2}[1, 0, -1]$ is preferable from $d_x^2 = [1, -1]$ as an approximation of the first order derivative.

5. A ball is moving with constant velocity straight towards a camera along the optical axis. At time $t_0 = 0$ it covers 500 pixels, and at time $t_1 = 3$ it covers 750 pixels. At what time does it cover 1000 pixels? (The camera is assumed to be of pinhole type.)

6. You are given the following binary image:

1	1	1	1	1	0
1	1	1	1	0	0
1	0	0	0	0	0
0	0	0	0	0	1
0	0	0	1	1	1
0	1	1	0	0	1

   Assuming that $x = 1$ for the first column, compute the following:

   - Moments: $m_{00},\ m_{10},\ m_{01}$ and m_{20}
   - Centers of gravity: x_0 and y_0
   - Central moments: $\mu_{00},\ \mu_{01}$ and μ_{02}