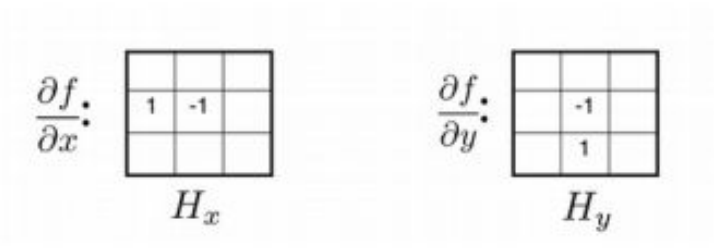
**Homework #3**

1) Take x-axis and y-axis derivatives of images in ‘sample images1’ directory. To do this, use linear filters given below. **Empty places are zero.** Put image results of convolving with Hx and Hy filters into report. Also, put the result of gradient magnitude of images (sum up two convolved images which belong to x and y directions).




The gradient of an image is a vector of its partials *[1]*;

$$\nabla f = \begin{bmatrix} g_x \\ g_y \end{bmatrix} = \begin{bmatrix} \frac{\partial f}{\partial x} \\ \frac{\partial f}{\partial y} \end{bmatrix}$$

where:

$\frac{\partial f}{\partial x}$ is the derivative with respect to x (gradient in the x direction)

$\frac{\partial f}{\partial y}$ is the derivative with respect to y (gradient in the y direction).

Formulation of gradient magnitude;

$$\sqrt{g_y^2 + g_x^2}$$

2) Repeat process in the #2 question with sobel filters (sobel x and sobel y).

| | | |
|---|---|---|
| -1 | 0 | +1 |
| -2 | 0 | +2 |
| -1 | 0 | +1 |

Gx

| | | |
|---|---|---|
| +1 | +2 | +1 |
| 0 | 0 | 0 |
| -1 | -2 | -1 |

Gy

3) Calculate histogram of the 'grayImage.jpg' in “sample images2” folder. Plot the histogram. And write a code to threshold the given image. Put thresholded images into your report.

4) Using given ground truth segmentation ('ground_truth.png'), plot an ROC curve for your thresholding algorithm. Which threshold is better according to ROC?

IMPORTANT :
Besides image reading and writing and exponential (exp) functions, do not use any image processing function from Python and OpenCV.

All the operations have to be coded from scratch, i.e. filtering, sliding window scheme, etc.

You should comment your code, so that it can be easily understood.

Use Python/Ipython. Your code has to be in script file with .py/.ipynb extension.

You must explain what you implement in the report. You must show your output images in the related parts of the report. Please zip and upload all your files.

Cheating and plagiarism on assignments will be punished according to ITU regulation.

*References:*

[1] *Gonzalez, Rafael; Richard Woods. Digital Image Processing (3rd ed.). Upper Saddle River, New Jersey: Pearson Education, Inc.*