CENG 391 – Introduction to Image Understanding
Homework 3

December 7, 2020

Due Date: December 18, 2020

Download and extract the contents of
`ceng391_04T_feature_detection_and_matching.tar.gz`.

Exercise 1   Gaussian Image Pyramid

Write a new class `ImagePyr` in a file named as `image_pyr.cc` that represents
a Gaussian Pyramid with the following properties:

a. It should have the following private fields:

   - an integer `m_n_levels` storing number of pyramid levels (octaves).
   - an `Image` pointer `m_levels` storing pyramid levels in an array of
     `Image`s.

b. The constructor must take the desired number of levels, a pointer to
   the base image to create the pyramid levels for and the initial sigma,
   `sigma0`, for the base image.

c. The destructor must deallocate all memory allocated by the construc-
   tor.

d. A getter for the number of levels.

e. A getter for the ith level image.

f. Level 0 is a copy of the base image given in the constructor (do not
   just copy the pointer, create a new image that is a copy of the base
   image).

g. Level i is created by first Gaussian smoothing the image at level $i - 1$
   so that its scale (sigma value) is doubled. And then it is downsampled
   by two in x and y dimensions so that its width and height are the half
   of the width and height of the image at level $i - 1$ (Downsample by
   throwing out every other row and column of the smoothed image).

Exercise 2   Gaussian Image Pyramid Tester

Write the code for a new executable `image-pyr-test` in a file named as `image_pyr_test.cc` that reads an image from a file given as the first command line argument and creates an image pyramid with number of levels equal to the number given as the second command line argument. It should than save each pyramid level in files named as "`/tmp/pyr_level_i.png`" where i is the level number. The test program should display a usage message if there is a missing argument or it is given an argument with an invalid value. Modify `CMakeLists.txt` so that this test executable is compiled along with the existing executables in the project.