CMPEN/EE455: Digital Image Processing I
Fall 2019
Project #1

assigned: 27 August 2019
due: Friday 13 September 2019

reading assignment:
1. G&W Ch. 2.1-2.5
2. MATLAB documents under **Project Material** on CANVAS

Lab Introduction and Digital Image Quantization

This project counts **50%** of a regular project.

It introduces you to project requirements and to MATLAB's capabilities for digital image processing. Its main technical task is to consider the effects of spatial and gray-scale resolution changes on a digital image.

To acquaint you with MATLAB for our course, the following files appear under **Project Material** on CANVAS:

- Introductory MATLAB documents:
  `MATLABprimer.pdf`, `G-W-Matlab-Ch2.pdf`, and `MATLAB Introduction for CMPEN/EE455`
- Sample MATLAB *.m files `main.m`, `mean3x3.m`, and `zero.m` along with input image `lake.gif`
  These files follow the coding and image-processing conventions I want you to use for the projects.
- Our **Images** database in archive `Images.zip`
- The **Computer Project Protocol** and **Report Model** for doing projects and writing reports.

For the 512×512 digital image "walkbridge.tif" in our **Images** database, do the following:

1. Write a MATLAB program to change (downsample) the spatial resolution to 256×256, 128×128, and 32×32 pixels. Save these three images as 512×512 images. To do this, you will replicate pixels (upsample) to reach the desired size; i.e., perform nearest-neighbor interpolation. Do not change the gray-scale resolution.

   Note that you must write MATLAB code that explicitly scans through the 2D array of an image in the x and y directions, per the example `main.m` file. Also, to read in the tif-format "walkbridge" image, you will need the following commands:
   `f = imread('walkbridge.tif');` (Read the image into "f")
   `f = f(:,:,1);` (Get the first "layer" of the tif image)

   WARNING: It is forbidden to use MATLAB functions that perform complete 2D array processing in one command during our course!

2. Create an interpolated 512×512 image from your 32×32 image of part 1 (*before* you upsampled it to 512×512!) using either bilinear, bicubic, or inverse-distance interpolation, as discussed in G&W Sect. 2.4 and the **Project Material** document "Proj1-Interpolation.pdf."

3. Write a program to change the gray-level quantization of the original 512×512 image by reducing the number of bits per pixel from 8 to 7, 6, 5, 4, 3, 2 and 1 bits/pixel. Save these 7 new images. Be sure that the gray levels used in the new images span the 8-bit range! For example, for the new 6 bits/pixel image, the image pixels should use the 64 gray levels 0, 4, 8, 12, ... 252.

4. Make a 512×512 image that: (i) changes the spatial resolution to 256×256 pixels and (ii) has 6 bits/pixel gray-scale resolution. Does this image depict any artifacts relative to the original high-resolution image?

5. Write a project report using the given project report template.
   a. All methods should be described in addition to the structure of your code.
   b. All results should be presented and discussed.
   c. Per the Computer Project Protocol, upload all required files to CANVAS.