

COMP 9517

T3, 2019

## Assignment 1: Specification

**Maximum marks achievable: 10 marks**

This assignment is **worth 10% of the total course marks**.

The assignment files should be submitted online.

Instructions for submission will be posted closer to the deadline.

**Deadline for submission is week 4 Monday Oct 7<sup>th</sup>, 23:59:59**

***Deliverables:*** You will submit a report (maximum 5 pages) briefly explaining the approach you have taken in Tasks 1, 2 and 3 and include some sample input images and the intermediate and final images obtained. You must also submit the Python source code files.

***Submission:*** The assignment files should be submitted online via WebCMS. Instructions for submission will be posted closer to the deadline.

***Tip:*** You are advised to use Opencv3 with python 3+. Jupyter notebook files are preferred as source code files.

### ***Objectives:***

The objective of this assignment is to familiarise yourself with performing basic image processing operations using OpenCV in Python. This assignment also introduces you to basic image analysis, and helps you gain the following skills:

1. Opening and reading from image files
2. Displaying data as image files and writing image files
3. Performing simple mathematical operations on images
4. Applying image filters
5. Image manipulation and adjustment

### ***Description:***

Image processing techniques are used in digital art to represent digital images in more creative (and alternative!) ways. The goal of this assignment is to open a digital image, perform a sequence of image processing / manipulation operations (step-by-step as listed under ***Instructions***) and produce a creative effect, namely an oil painting-like output image.

Below is an original image, and the final 'oil painting' result obtained after applying a sequence of image manipulation operations.



### ***Instructions:***

#### ***Task 1 (3 marks)***

Two colour images (*dog.jpg*, *light\_rail.jpg*) have been provided to you as sample inputs. You may also test on other input images of your choice.

Starting with an input colour image (let us call this image  $A$ ), you should combine the three colour-bands into one band using the following equation:

$$I(x,y) = 0.299 * r(x,y) + 0.587 * g(x,y) + 0.114 * b(x,y)$$

Where  $r$ ,  $g$  and  $b$  are colour-bands of image  $I$ .

You will go through the image pixel by pixel and perform this operation on each pixel. The resulting image  $I$  will contain only one combined band, i.e. it is a grey-level image.

Retain a copy of the resultant image  $I$ .

Include  $I$  as an intermediate result in the report.

### Task 2 (4 marks)

Once you obtain the combined single band image  $I$ , the next task is to perform the following sequence of operations on  $I$ . The goal is to find the most frequent local pixel value in a neighbourhood (including the current pixel) to create another image  $J$ .

To create image  $J$ , first make a copy of image  $I$  called  $J$ .

, you will:

- first define an appropriate neighbourhood (window) around a pixel in  $I$
- compute the intensity histogram for pixels in the neighbourhood around each pixel-
  - pick the most frequent pixel value in the neighbourhood using the histogram, and replace the central pixel in the corresponding window in  $J$  with the most frequent local pixel value for that window
  - repeat the above for every pixel in  $I$

Try at least 3 different window sizes in Task 2.

The resulting image  $J$  for each window size is the output for Task 2, which should be included in the report.

Any additional and meaningful intermediate results may also be included in the report.

### Task 3 (3 marks)

Using  $J$  from Task 2, you will construct the final ‘oil painting effect’ image. To do this, you will

- make a copy of the original image  $A$  (and let us call it image  $B$ )
- for each pixel  $(x, y)$  in the image  $J$ , in the local neighbourhood of pixel  $(x, y)$  defined in Task 2
  - find all pixels in  $J$  which have the same value of  $J(x, y)$
  - get the corresponding colour intensities of those pixels in image  $B$
  - calculate the average intensities of those pixels in each band
  - then replace  $B(x, y)$  with the average intensities in each corresponding band

Try the same window sizes here as in Task 2, to experiment with the art effects produced. The resulting image  $B$  for different window sizes is the output for Task 3 and should be included in the report.

Compulsory output images to be included in the report (for each window size): intermediate outputs  $I$  and  $J$ , oil painting-like image  $B$ .