CSCI 1130A&B Introduction to Computing Using Java 2022-2023 First Term

Department of Computer Science and Engineering
The Chinese University of Hong Kong

Due date: 24 November 2022 (Thu)

Assignment 5

Full mark: 100
Expected normal time spent: 6 hours

Photo Touch

Aim:
1. using a given JAR as a library and working with packages
2. interoperating a few classes: PhotoTouch.main() to ImageFileIO.main(); and PPM to PGM
3. using 3D array of int

Task: Create a PPM (color image) app for photo touching.

Portable PixMap (PPM) – ASCII is a simple image file format. It can be created and edited using plain text editors. In this assignment, you are going to complete ONE Java class, PPM.

- Class PPM is an abstraction of an image object that supports PPM file reading, writing, screen display, conversion to gray color PGM, blurring a color image, etc.
- Main class PhotoTouch makes use of PPM and PGM to perform simple file reads and writes, as well as image processing.

Background:

1. Here is an example of a standard PPM file format, *free from additional features* for comment:

```
P3
4 2
255
255 0 0     0 255 0.      0   0 255     255 255 255
0 255 255   255 0 255    255 255 0       63  63  63
```

[1] Portable PixMap (PPM) is a simple image file which supports color (RGB) images in ASCII text format. Reference: https://en.wikipedia.org/wiki/Netpbm_format - PPM_example

- The first two characters on the first line (*header*) must be "**P3**".
- Then 3 numbers follow: *width* and *height* define the size of the image (4x2 above); *maxValue* is usually 255 which indicates maximum possible value of a pixel component value.
- Subsequent values defining an image in color (RGB). All pixel color channel values shall fall within 0 and *maxValue*, i.e., usually within 0 – 255, from none to intermediate to full.
- There are *height* pixel lines run from top to bottom row-by-row. Each pixel line contains *width* number of pixels.
- In the input PPM files, all numbers are delimited by white-spaces (including space, TAB and newline.) We assume NO **#comments** in PPM source files. In the output PPM and PGM files, use TAB and newlines as delimiters.
- Java `Scanner` class is well suited for reading the PPM file in plain text ASCII format.

2. The *origin (0, 0)* of the image and display coordinates system is always at the *top-left corner*.

3. You are provided **`Asg5Resources.zip`** to begin with. After unzipping and copying the contents to your PhotoTouch folder, try double clicking on the given **`ImageFileIO.jar`** to run it as a Java Executable. It is also a Library for incorporation into your NetBeans PhotoTouch project.
There is a src\ folder that provides you two skeleton Java source files. All necessary input files and output files are given, and you shall keep them in your project folder PhotoTouch/.

4. You are recommended to use this online tool: https://kylepaulsen.com/stuff/NetpbmViewer/

Key Steps and Points to Note:

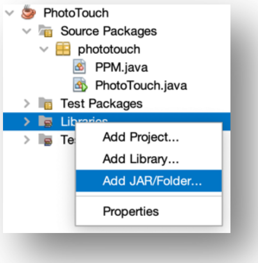
1. Close ALL your previous NetBeans projects. Do NOT open your own ImageFileIO project.

2. Create a new class **PhotoTouch** in a new NetBeans project **PhotoTouch** with package **phototouch**.

   a) Close your newly created, opened file PhotoTouch.java under NetBeans.

   b) Copy ALL files in **Asg5Resources.zip** to add/ replace files in your PhotoTouch folder under Windows Explorer/ mac Finder.

   c) Library → Add JAR… → Browse and Open **ImageFileIO.jar** (the one under your NetBeans project folder PhotoTouch\)



   d) There are given classes provided in the given JAR under package **imagefileio**. PhotoTouch shall make use of those given classes like ImageFileIO and PGM.

3. The initial given program can be compiled/ run but it lacks many features.

   a) Finish the class PPM according to the given guidelines in the comment blocks.

   b) Expect to see errors and warnings **BEFORE** PPM.java is **COMPLETED** properly.

   c) Run the main class PhotoTouch to test, compare and debug your work. Inspect input and output PPM and PGM files using the online PPM/ PGM tool, text editor and/or Excel. Check also screen outputs carefully.

4. All pixels in a PPM image is stored in a 3D array of int. It is in row-major order:

   pixels[row][column][rgb] where row is in [0, height-1], column is in [0, width-1], rgb is in [0-2]

5. In the given class ImageFileIO.PGM, all pixels are stored in a single String field in a PGM object, delimited by white spaces (mostly TABs and some newlines). For example:

   "123	37	0	255**\n**180	255	9	16**\n**"

   In your class PPM, **convertToPGM()** shall use StringBuilder to construct a new PGM pixels String. Color pixel to grayscale pixel conversion is using a simple formula: floor((R+G+B) / 3)

6. Method **blur()** shall construct a new blurred PPM color image. We employ a 5x5 linear filter. Each color component of a new pixel at [row R] [column C] is calculated as the average of the corresponding color component in a 5x5 neighborhood in the original color image. E.g.,

   Average the RED channel of the 25 pixels in [rows from R-2 to R+2] [columns from C-2 to C+2] and store the quotient (floored) value in the RED channel of the new image pixel at [R][C]. Do similarly for the GREEN and BLUE channels. Do so for ALL pixels in the image.

   For the two rows and two columns of pixels along the image boundaries and corners, take the original pixel values. Because they do not have a well-defined 5x5 neighborhood.

7. Shall you prepare your own PPM image file for testing and experiments, mind you that Excel accepts only TAB as delimiter. Make sure the last pixel line has a newline at the end of the file.

8. Do NOT modify those given code indicated in the skeleton source files. Finish your work incrementally, method by method. Practise divide-and-conquer.

9. Remember that an incomplete class may trigger dozens of error messages. You may declare your own methods in class PPM. You may inject debugging code BUT please remove them before packaging and submission.

Submission:

1. Prepare the header comment block properly in all your Java source files to include academic honesty declaration and your personal particulars.

2. **Locate** your NetBeans project folder, e.g., `H:\JAVA_ASG4\PhotoTouch`.

3. ZIP the project folder `PhotoTouch`. Upload and Submit `PhotoTouch.zip` via Online Assignment Collection Box on Blackboard <`https://blackboard.cuhk.edu.hk`>

Marking Scheme and Notes:

1. The submitted program should be free of any typing mistakes and compilation errors. Comment/remark, indentation, style are under assessment in every programming assignments unless specified otherwise. Variable naming, proper indentation for code blocks and adequate comments are important.

2. Remember to do your submission before 6:00 p.m. of the due date. No late submission would be accepted.

3. If you submit multiple times, **ONLY** the content and time-stamp of the **latest** one would be counted. You may delete (i.e. take back) your attached file and re-submit. We ONLY take into account the last submission.

University Guideline for Plagiarism

Attention is drawn to University policy and regulations on honesty in academic work, and to the disciplinary guidelines and procedures applicable to breaches of such policy and regulations. Details may be found at http://www.cuhk.edu.hk/policy/academichonesty/. With each assignment, students are required to submit a statement that they are aware of these policies, regulations, guidelines and procedures.