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: 7 November 2022 (Mon) **Assignment 4** Full mark: 100
Expected normal time spent: 6 hours

Image File I/O

Aim: 1. abstraction and encapsulation with constructor as well as instance fields and methods
2. declaring and invoking methods with object parameters and return values
3. file I/O and String operations

Task: Create a PGM app for image handling.

Portable GrayMap (PGM) – ASCII is a simple image file format. It can be created and edited using plain text editors as well as Excel! In this assignment, you are going to complete two Java classes, PGM and ImageFileIO.

- Class PGM is an abstraction of an image object that supports PGM file reading, writing, screen display, stacking, gray color inversion, etc.
- Main class ImageFileIO makes use of PGM to perform simple file reads and writes, as well as SID image construction.

Background:

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

```
P2
4 2
255
127 255 255 127
255   0   0 255
```

[1] Portable GrayMap (PGM) is a simple image file which supports grayscale images in ASCII text format. Reference: https://en.wikipedia.org/wiki/Netpbm_format#PGM_example

   - The first two characters on the first line (*header*) must be "**P2**".
   - 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 grayscale. All pixel values shall fall within 0 and *maxValue*, i.e., usually within 0 – 255, from black to gray to white.
   - There are *height* pixel lines run from top to bottom row-by-row. Each pixel line contains *width* number of pixels.
   - All numbers are delimited by white-spaces (including space, TAB and newline.) To facilitate ***Excel*** **Tab-delimited Text** file processing in this assignment, we use tab as pixel value separator on the same row AND newline as row separator AND a newline at end-of-file. We assume NO **`#comments`** in PGM source/ output files.
   - Java `Scanner` class is well suited for reading the PGM 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 **`Asg4Resources.zip`** to begin with. Try open **`digit0.tab`** with Excel. A sample output file is provided for your reference (generated using a sample SID 115599.) There is a src\ folder that provides you two skeleton Java source files. All necessary PGM input files and output files are given, and you shall keep them in your project folder ImageFileIO/.

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

Key Steps and Points to Note:

1. Create a new class **`ImageFileIO`** in a new NetBeans project **`ImageFileIO`** with package **`imagefileio`**.

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

   b) Copy the given file ImageFileIO.java to replace yours under Windows Explorer/ mac Finder.

   c) Open the file ImageFileIO.java again under NetBeans.

   d) Copy the given file PGM.java into your source package folder **`imagefileio`** too.

2. The initial given program CANNOT be compiled/ run because it lacks many features.

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

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

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

   d) When your work is almost in shape, customize and complete your own method **`prepareSID()`** in class ImageFileIO, that generates your own **`sid.pgm`**.

3. Restriction in this assignment: you must NOT use array or other data structures for pixel value handling.

4. All pixels in a PGM image is 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**"

   We can extract individual pixel values one-by-one using **`nextInt()`** method of a Scanner object over the pixels String.

5. Method **`invert()`** shall calculate new pixel value as (maxValue – original pixel value). It builds a new PGM of the same size by concatenating new pixels String with new pixel values, TAB and newlines.

6. Shall you prepare your own PGM 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.

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

8. Remember that an incomplete class may trigger dozens of error messages. You may declare all necessary methods by providing missing method signatures in class PGM with empty method bodies first. To silent more errors and warnings, preliminarily insert proper return statements with desired or dummy value of appropriate type in applicable methods.

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\ImageFileIO`**.

3. ZIP the project folder **`ImageFileIO`**. Upload and Submit **`ImageFileIO.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.