Multimedia Assignment 1
Due February 5, 2021

Submission Instructions:

1. Please submit your work directly in CANVAS (using the Canvas editor) or as a text/MS-word/PDF attachment by the due date/time. Please use only zip for compression.
2. It must be your own work – a penalty of at least one grade in your final grade and a report to the Dean of Students will result from sharing work or using other people work.
3. Please submit your assignment by the deadline – late submission will not be accepted and will result in a grade of 0. A grade of 1 denotes an issue with your assignment, which you have to resolve with the instructor.
4. As a part of the required deliverables, please submit only the source code of your program in C/C++/Java/Python or MATLAB, R. If I have doubts or concerns about your program. I might request that you submit the entire files required to produce a working program under Linux so that I can test your submission.
5. The code should include remarks that explain any non-trivial part of the program.
6. Please write your name in the assignment header and as a part of the file name of the attachment.
7. **Please do not submit your assignment via email. If you have a justified documented reason for being late then please submit the assignment to your Canvas drop-box and notify me by email.**
8. A question or two related to this assignment are very likely to be in the midterm and / or final examination

Assignment Instructions:

Enclosed is a PGM (or PGMA for PGM ASCII) image – baboon.pgma as well as the Wikipedia description of the format. You can use GIMP or ImageMagick to display pgma images. Additionally, you can use Photoshop / Linux. Additional information can be found in: http://people.sc.fsu.edu/~jburkardt/data/pgma/pgma.html

Your tasks are:

1. Develop a program to create a quad tree based image of an input pgma image with up to 256-gray levels. The program should have a parameter "variance threshold" that can get values between 0 and 1024.
    a. First, the program treats the entire image as a quad
    b. Next, for each quad
        i. If the quad contains only one pixel the program stops
        ii. If the variance of the quad is equal to or below the threshold, the program replaces the entire pixels of the quad with the arithmetic mean value of the pixels in the quad and stops.
        iii. If the variance of the quad is above the threshold the program divides the quad into four even quads and works on each of these quad recursively.
2. Test your program with the original baboon image using variance thresholds of 0, 16, 64, and 256.
3. You can use other images from Canvas for further testing.
4. Run an LZ-based compression program such as WinZip, **7zip**, zip, pkzip, rar, and UNIX-compress on the original image and on the quad based generated image and report the sizes before and after compression. Analyze the result of these values.
5. Deliverables: a) the code, b) the original and the Quad-tree based images, and c) the table generated in (4) and its analysis.

Notes:

1) **You do not have to generate the tree only the resultant image.**
2) **The above definition is recursive. Yet, recursive implementation is very inefficient and can result in a very slow execution or stack overflow. Nevertheless, it is easier to develop the recursive version of the program. So, you are allowed to use recursion.**
3) **You should actually create a new pgma image and when you write the new value of a quad you should write it into the new pgma image.**
4) **You do not have to write the LZ based program. Use any available program.**
5) **To estimate $\overline{p}$ the arithmetic mean of pixels in a quadrant use: $\overline{p} = \frac{1}{N}\sum_{i=1}^{N} P_i$ where P_i is a pixel in the quadrant.**
6) **To estimate the quadrant arithmetic variance (σ^2) use $\sigma^2 = \frac{1}{N-1}\sum_{i=1}^{N}(P_i - \overline{P_i})^2$**

Multimedia Assignment 1
Due February 5, 2021

PGMA Files Portable Gray Map (ASCII)

PGMA is the ASCII portable gray map format. It is a simple grayscale image description. The definition is as follows:

- The typical file extension is ".pgm", but an extension of ".pnm" is also occasionally used.
- A "magic number" for identifying the file type. An ASCII PGM file's magic number is the two characters "P2".
- Whitespace (blanks, TABs, CRs, LFs).
- A width, formatted as ASCII characters in decimal.
- Whitespace.
- A height, again in ASCII decimal.
- Whitespace (or NL).
- The maximum gray value, again in ASCII decimal.
- Whitespace.
- Width * height gray values, each in ASCII decimal, between 0 and the specified maximum value, separated by whitespace, starting at the top-left corner of the gray map, proceeding in normal English reading order. A value of 0 denotes black and the maximum value denotes white.
- **Characters from the "#" to the next end-of-line are ignored (comments). No line should be longer than 70 characters.**

Programs like GIMP are trying to maximize the contrast. You can generate an image with max contrast on your own.

PGMA example

The PGM and PPM formats (both ASCII and binary versions) have an additional parameter for the maximum value in a line between the X and Y dimensions and the actual pixel data.

```
P2
# Shows the word "FEEP" (example from Netpbm man page on PGM)
24 7
15
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 3 3 3 3 0 0 7 7 7 7 0 0 11 11 11 11 0 0 15 15 15 15 0
0 3 0 0 0 0 0 7 0 0 0 0 0 11 0 0 0 0 0 15 0 0 15 0
0 3 3 3 0 0 0 7 7 7 0 0 0 11 11 11 0 0 0 15 15 15 15 0
0 3 0 0 0 0 0 7 0 0 0 0 0 11 0 0 0 0 0 15 0 0 0 0
0 3 0 0 0 0 0 7 7 7 7 0 0 11 11 11 11 0 0 15 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

Example: