

# TP1

## Image File Manipulation

The objective of this practical work is to implement basic image manipulation tools, e.g. read, write and convert. To this aim, and without loss of generality, the simple image file formats PBM (Portable Map) will be considered.

### "Portable Map" image file formats

The netpbm file formats PBM, PGM and PPM are respectively: portable bitmap, portable grayscalemap and portable pixmap (also called PNM for portable anymap). They were originally designed in the early 80's to ease image exchange between platforms. They offer a simple and pedagogical solution to develop image manipulation tools. In these formats, an image is a matrix of pixels where values represent the illumination in each pixel: white and black (PBM), grayscale (PGM) or 3 values RGB (PPM).

### Definition

The PNM file content is as follows:

1. A 'magic number' that identifies the file type. A pbm image's magic number is the two characters 'P1' (ASCII) or 'P4' (binary).
2. Whitespace (blanks, TABs, CRs, LFs).
3. The width and height (separated with a whitespace) in pixels of the image, formatted as ASCII characters in decimal.
4. Only for PGM and PPM: The maximum intensity value between 0 and 255, again in ASCII decimal, followed by a whitespace.
5. Width  $\times$  Height numbers. Those numbers are either decimal values coded in ASCII et separated by a whitespace for the formats P1, P2, P3, or directly binary values (usually 1 byte) in the case of P4, P5, P6. In the latter case, there is no whitespace between values.

Remarks:

- Lines beginning with "#" are ignored.
- In principle lines should not be longer than 70 characters.

## Examples



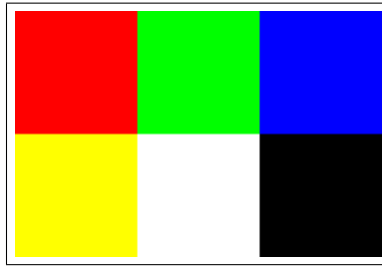
```
P1
# feep.pbm
24 7
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 1 1 1 1 0 0 1 1 1 1 0 0 1 1 1 1 0 0 1 1 1 1 0
0 1 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 0 1 0 0 1 0
0 1 1 1 0 0 0 1 1 1 0 0 0 1 1 1 0 0 0 1 1 1 1 0
0 1 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0
0 1 0 0 0 0 0 1 1 1 1 0 0 1 1 1 1 0 0 1 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
```

*PBM file of a  $24 \times 7$  image for which values are coded in ASCII decimal*



```
P2
# feep.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 1 0 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
```

*PGM file of a  $24 \times 7$  image . Intensity values are coded in ASCII decimal with 15 levels between black and white.*



```
P3
# 6 colors RGB
3 2
255
255 0 0 0 255 0 0 0 255
255 255 0 255 255 255 0 0 0
```

*PPM file of a  $3 \times 2$  image. Intensity values are coded in ASCII decimal*

## Exercise 1

Download the archive that contains a conversion program `pgmtopgm` between the PGM formats. Compile the program using the Makefile.

1. Test `pgmtopgm` on `mandrill.pgm`. What kind of conversion is performed (check the contents of `mandrill.pgm`) ?
2. How is the image stored within the program ?
3. What is the purpose of the functions `pm_getint` and `pm_getrawbyte` in the file `Util.c` ?
4. What data types are involved when manipulating intensities ? in the case of ASCII decimals (P1, P2, P3) ? in the case of binary values (P4, P5, P6) ?
5. Which color is associated to the maximal value ?
6. Comment on the sizes of files in the two formats.

## Exercise 2

The PPM format allows to store images in RGB format.

1. Write a program that converts a PPM image into three images with respect to the RGB components.
2. Propose an algorithm that converts PPM into PGM. Write the corresponding c program `ppmtopgm`.

3. Modify the program so that it makes the image brighter or darker.

**Note:** Use the Makefile in the directory, as well as the functions in Util.c, in order to complete these programs.

## Exercise 3

An extension of the netpbm format to transparent images exist, i.e. images for which there is an additional alpha channel encoding transparency. It is called PAM (extension .pam for files) for Portable Arbitrary Map. Look over the web and give the main principles of this extension, e.g. file header and pixel format.