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PPM Crossplatform Images

maXbox Starter 78 – The Portable Pixmap Format

Today I want to introduce a system independent image format for any images, machine learning data like feature maps in a CNN or just to exchange picture data on various platforms.

The Portable Pixmap format uses an uncompressed and inefficient format so that it is seldom used for storing large images but on the other side this is an advantage. We use this format for converting system-independent images to machine learning feature maps in a CNN (Convolutional Neural Network).

Besides PPM, other 2 popular Netpbm file formats include the portable bitmap format (.PBM) and the portable graymap format (.PGM). Sometimes, they are also collectively referred to the portable anymap format(*.PNM).

- PBM is for bitmaps (black and white, no grays).
- PGM is for grayscale (0-255 or 0-65535).
- PPM is for "pixmaps" which means full color.

Illust. 1: Conversion from BMP to PPM to JPG

One of image file formats that is developed by the Netpbm project.[1] For cross-platform purpose, the images are encoded using a text format as plain. PPM files specify the color of the pixel using a number from 0 to 65536 (or 0-255 for each channel), in addition to the image resolution height, width and so on.

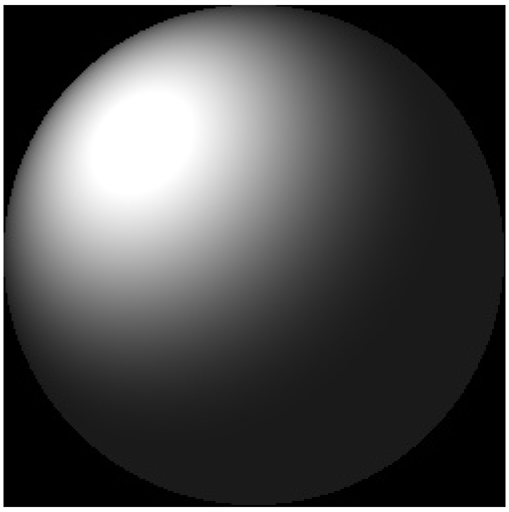
1 https://en.wikipedia.org/wiki/Netpbm#File_formats

So beside the plain format also a raw (binary) format exists. The ASCII ("plain") formats (P1-P3) allow for human readability and easy transfer to other platforms; the binary ("raw") formats (P4-P6) are more efficient in file size but may have native byte-order issues. This is how we define the header first:

```
Header:= Format('P6'#10'%d %d'#10'255'#10,[bmp.Width,bmp.Height]);
```

In my opinion the PPM format was devised to be an intermediate format for use in developing file format conversion systems. The PPM idea is that we have one format that any other format can be converted into.

As I said The PPM format is not intended to be an archival format, so it does not need to be too storage efficient. Thus, it is one of the simplest formats as a common denominator.


*Illust. 2: PPM to PNG with 251*251 Dimension*

Let's start with the code. Each file opens with a two-byte magic number (in ASCII) that identifies the type of file, the magic number is either an ASCII character string ″P1″, ″P2″,″P3″,″P4″, ″P5″ or “P6” depending upon the storage method used. “P1″ and “P4″ indicate that the image data is in a bitmap as black and white.

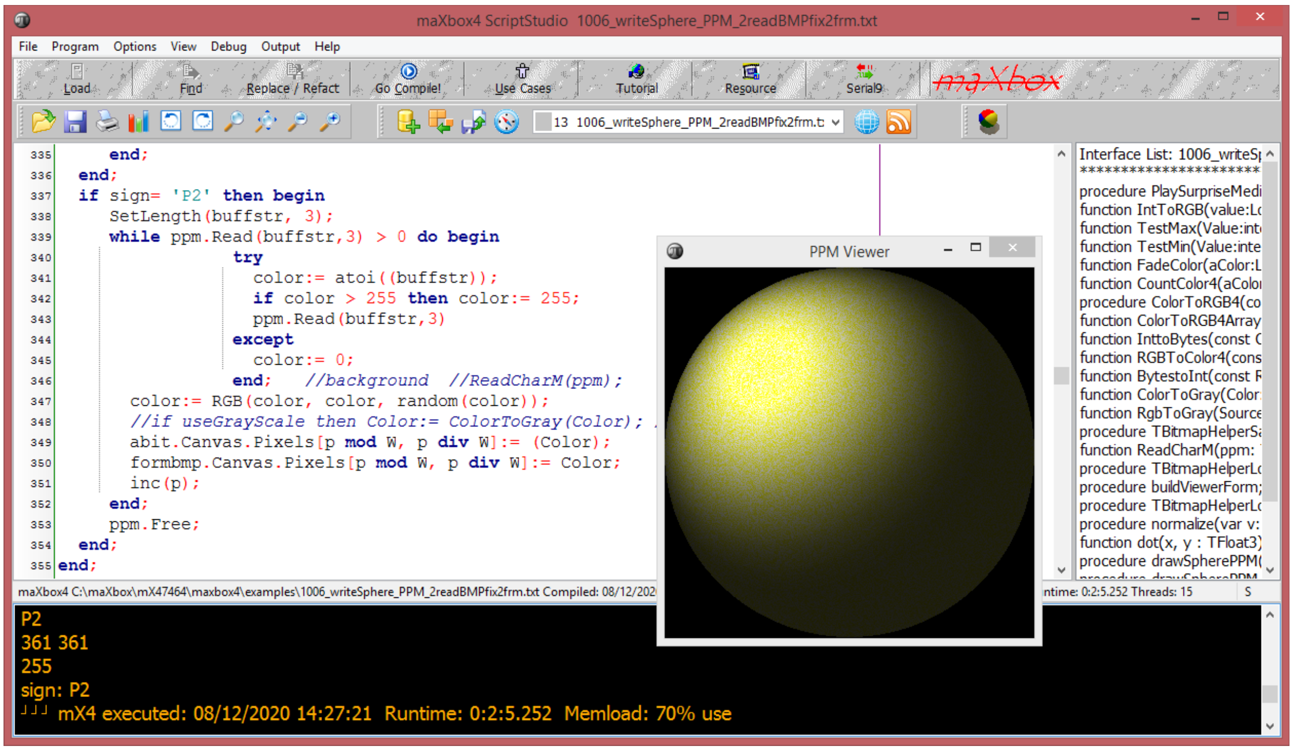
We use a pattern helper class as a procedure() to save the bitmap as a PPM file:

```
procedure TBitmapHelperSaveAsPPM_4(FileName: TFileName; bmp: TBitmap;
                                              useGrayScale: Boolean);
var
  i,j: Integer;
  Header: AnsiString;
  ppm: TMemoryStream;
  agb: TBytes;
```

We use a memory-stream and a byte-array for storage. Using a byte array can lead to some optimizations that can make accessing and changing information in the array faster than it would be with arrays of other types, in our case we define a 3 bytes array:

```
begin
  ppm:= TMemoryStream.Create;
  try
    Header:= Format('P6'#10'%d %d'#10'255'#10,[bmp.Width, bmp.Height]);
    writeln(Header);
    ppm.WriteBuffer((Header), Length(Header));
    setlength(agb,3)
    for i:= 0 to bmp.Width- 1 do
      for j:= 0 to bmp.Height- 1 do begin
         if useGrayScale then
           agb:= InttoBytes(ColorToGray(ColorToRGB(bmp.Canvas.Pixels[j,i])))
         else
           agb:= InttoBytes(ColorToRGB(bmp.Canvas.Pixels[j,i]));
         ppm.Write(stringOf(agb), 3);
         //ppm.Write(BytetoString(rgb),3);
      end;
    ppm.SaveToFile(FileName);
  finally
    ppm.Free;
  end;
end;
```

A PPM file consists of two parts, a header and the image data stored within *WriteBuffer()*. The header consists of at least three parts normally delineated by carriage returns and/or linefeeds but the PPM specification only requires white space.



```
    end;
  end;
  if sign= 'P2' then begin
    SetLength(buffstr, 3);
    while ppm.Read(buffstr,3) > 0 do begin
                try
                  color:= atoi((buffstr));
                  if color > 255 then color:= 255;
                  ppm.Read(buffstr,3)
                except
                  color:= 0;
                end;   //background  //ReadCharM(ppm);
      color:= RGB(color, color, random(color));
      //if useGrayScale then Color:= ColorToGray(Color);
      abit.Canvas.Pixels[p mod W, p div W]:= (Color);
      formbmp.Canvas.Pixels[p mod W, p div W]:= Color;
      inc(p);
    end;
    ppm.Free;
  end;
end;
```

```
Interface List: 1006_writeSp
**********************
procedure PlaySurpriseMedi
function IntToRGB(value:Lo
function TestMax(Value:int
function TestMin(Value:inte
function FadeColor(aColor:L
function CountColor4(aColor
procedure ColorToRGB4(co
function ColorToRGB4Array
function InttoBytes(const C
function RGBToColor4(cons
function BytestoInt(const R
function ColorToGray(Color
function RgbToGray(Source
procedure TBitmapHelperSa
function ReadCharM(ppm:
procedure TBitmapHelperLo
procedure buildViewerForm;
procedure TBitmapHelperLo
procedure normalize(var v:
function dot(x, y : TFloat3)
procedure drawSpherePPM(
```

```
maXbox4 C:\maXbox\mX47464\maxbox4\examples\1006_writeSphere_PPM_2readBMPfix2frm.txt Compiled: 08/12/202
ntime: 0:2:5.252 Threads: 15
```

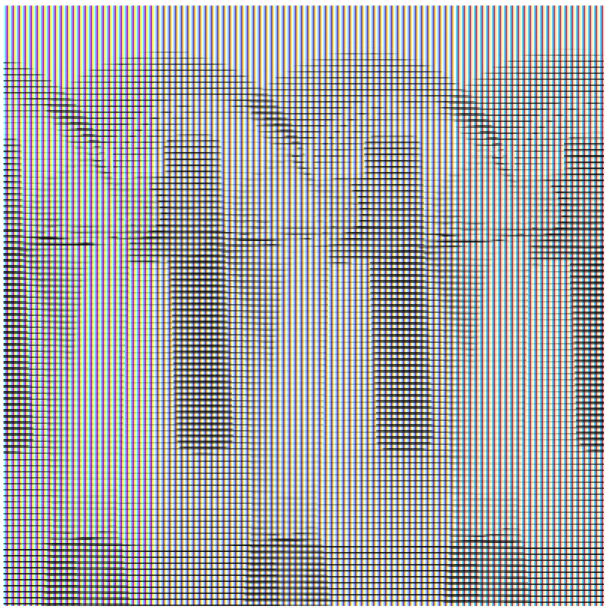
```
P2
361 361
255
sign: P2
 mX4 executed: 08/12/2020 14:27:21  Runtime: 0:2:5.252  Memload: 70% use
```

Illustration 3: maXbox viewer on a simple canvas

Interesting is a grayscale function as bool decision *useGrayScale:*

```
function ColorToGray(Color: TColor): TColor;
var L: Byte;
begin
  L:= round(0.2126*GetRValue(Color)+0.7152*GetGValue(Color)+0.0722*
                                                          GetBValue(Color));
  Result:= RGB(L, L, L);
end;
```

When converting from RGB to grayscale, it is said that specific weights to channels R,G, and B should be applied. These weights are: 0.2989, 0.5870, 0.1140., but I changed this weights as an optimized discriminator for feature maps.


Illustr. 4: Explain weights of grayscale

It is said that the reason for this is different human perception or sensibility towards these three colors, anyway it shows "tons" of different methods to generate grayscale images with different outcomes!

By the way you can test your PPM online:

http://paulcuth.me.uk/netpbm-viewer/

Just drag your PPM, PGM or PBM files onto the dashed area below the site to convert them to PNG images in a browser.

After convert bitmaps to PPM we step to the viewer to be independent of another app, for example with a P6 signature:

P6 - 361 * 361

# Example bitmap of resolution 361 with 255 colors on RGB channels

255

The last part of the header gives the maximum value of the colour components for the pixels, this allows the format to describe more than some single byte(0..255) colour values.

```
if sign = 'P6' then begin
     SetLength(buffstr, 3);
     while ppm.Read(buffstr, 3) > 0 do begin
       //color:= Bytestoint(bytesof(buffstr))
       color:= RGB(ord(buffstr[1]),ord(buffstr[2]),ord(buffstr[3]))
       if useGrayScale then
         Color := (ColorToGray(Color));
       abit.Canvas.Pixels[p mod W, p div W] := Color;
       inc(p);
     end;
  end;
```

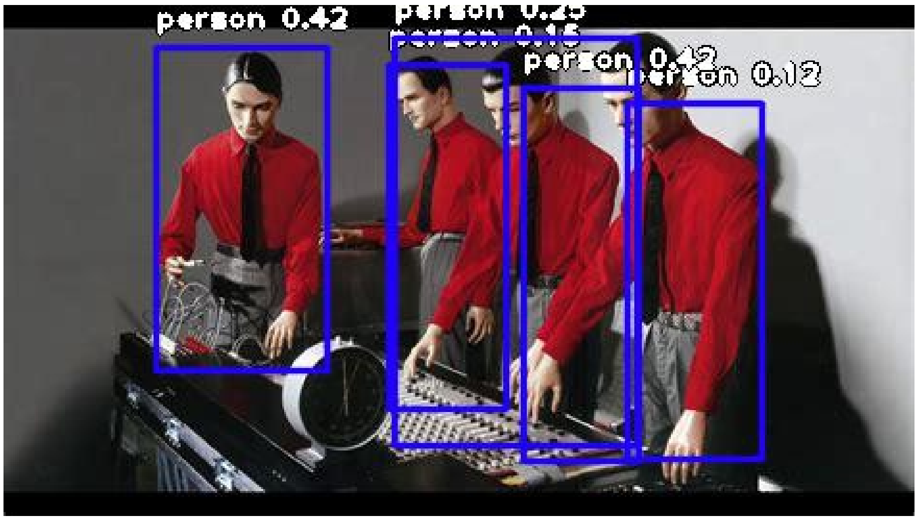
While not required by the format specification it is a standard convention to store the image in top to bottom, left to right order. Each pixel is stored as a byte, value 0 = black, value 255 = white. The components are stored in the usual order, Red - Green - Blue.

```
if sign = 'P2' then begin
     SetLength(buffstr, 3);
     while ppm.Read(buffstr,3) > 0 do begin
                 try
                   color:= atoi((buffstr));
                   if color > 255 then color:= 255;
                   ppm.Read(buffstr,3)
                 except
                   color:= 0;
                 end;   //background  //ReadCharM(ppm);
       color:= RGB(random(color), (color), (color));
       //if useGrayScale then Color:= ColorToGray(Color); //dark mode
       abit.Canvas.Pixels[p mod W, p div W]:= (Color);
       inc(p);
     end;
     ppm.Free;
  end;
```

You can find also in the script the *drawSpherePPM_Save* Procedure to generate a PPM from the Scratch. Now at last this is our process for object detection: an image to detect in the input folder, e.g.: manmachine.ppm then extract the feature map and mark the probability to convert back as a PNG.

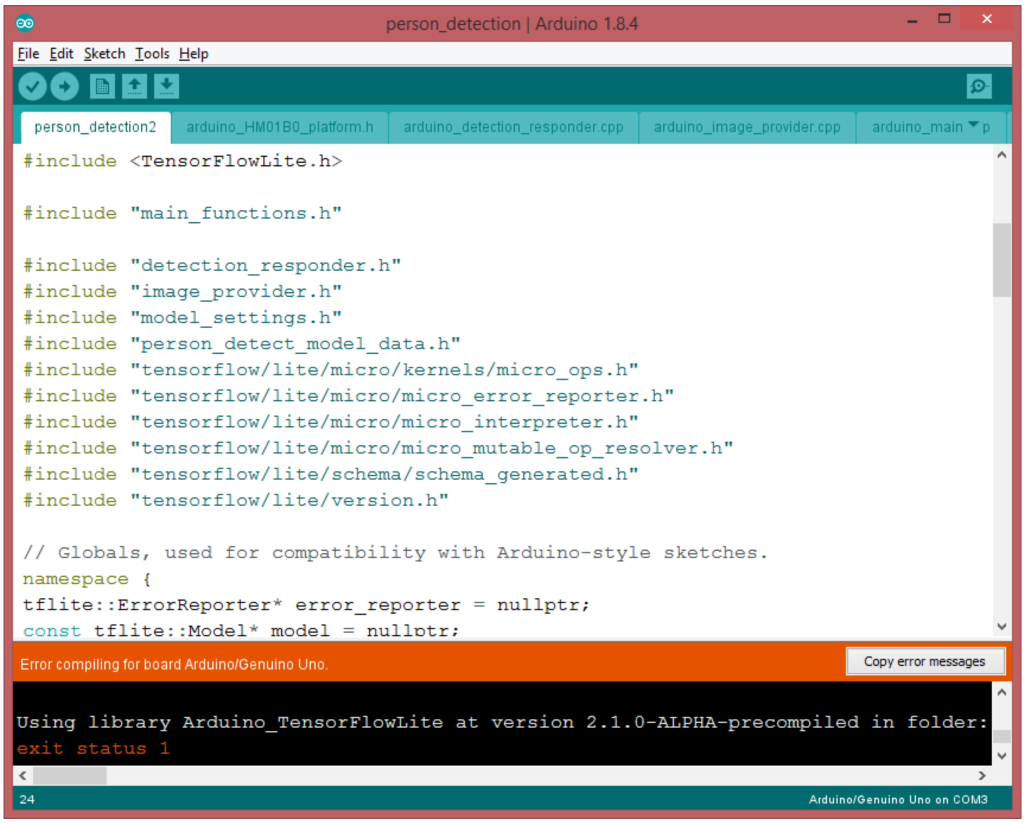
It goes on with the declaration of the created paths:

```
model_path = "./models/yolo-tiny.h5"
input_path = "./input/manmachine.ppm"
output_path = "./output/manmachineout.png"
```



Illustr. 5: Object Detection from PPM Intermediate

To detect only some of the objects above, I will need to call the *CustomObjects* method and set the name of the object(s) we want to detect to. Netpbm contains over 220 separate programs in the package, most of which have "pbm", "pgm", "ppm", "pam", or "pnm" in their names. The programs are designed to be minimal building blocks that can be used in various combinations to do other things like image detection on an Arduino with TensorFlowLite.


person_detection | Arduino 1.8.4
File Edit Sketch Tools Help
person_detection2
arduino_HM01B0_platform.h
arduino_detection_responder.cpp
arduino_image_provider.cpp
arduino_main
Copy error messages
24
Arduino/Genuino Uno on COM3

```
#include <TensorFlowLite.h>

#include "main_functions.h"

#include "detection_responder.h"
#include "image_provider.h"
#include "model_settings.h"
#include "person_detect_model_data.h"
#include "tensorflow/lite/micro/kernels/micro_ops.h"
#include "tensorflow/lite/micro/micro_error_reporter.h"
#include "tensorflow/lite/micro/micro_interpreter.h"
#include "tensorflow/lite/micro/micro_mutable_op_resolver.h"
#include "tensorflow/lite/schema/schema_generated.h"
#include "tensorflow/lite/version.h"

// Globals, used for compatibility with Arduino-style sketches.
namespace {
tflite::ErrorReporter* error_reporter = nullptr;
const tflite::Model* model = nullptr;
```

```
Error compiling for board Arduino/Genuino Uno.

Using library Arduino_TensorFlowLite at version 2.1.0-ALPHA-precompiled in folder:
exit status 1
```

Illustr. 6: PPM on an Arduino

Conclusion:

The portable pixmap format(PPM), the portable graymap format(PGM) and portable bitmap format(PBM) are image file formats designed to be easily exchanged between platforms. They are also sometimes referred collectively as the portable anymap format(PNM). These formats are a convenient (simple) method of saving image data.

And the format is not even limited to graphics, its definition allowing it to be used for arbitrary three-dimensional matrices or cubes of unsigned integers.

The script and data can be found:

http://www.softwareschule.ch/examples/sphere2.txt

http://www.softwareschule.ch/examples/sphere2.htm

http://www.softwareschule.ch/examples/detector2.htm

Author: Max Kleiner

Ref:

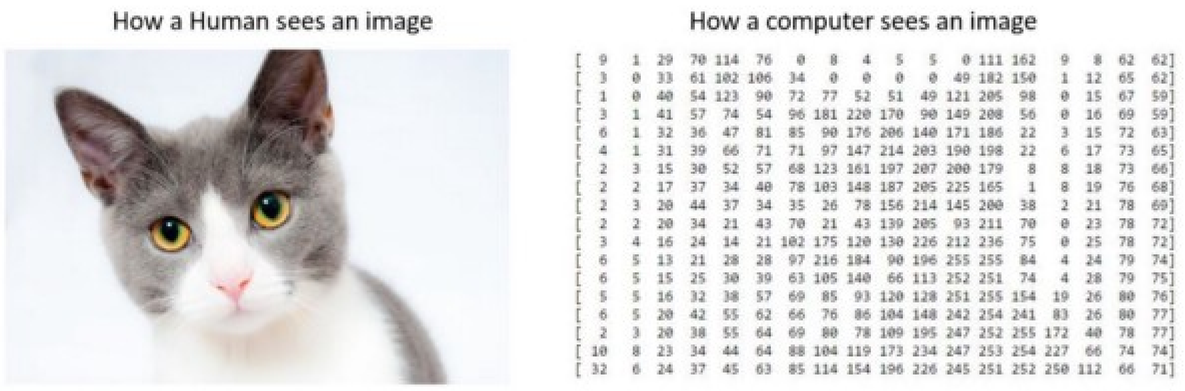
https://people.cs.clemson.edu/~dhouse/courses/405/notes/ppm-files.pdf

http://paulbourke.net/dataformats/ppm/

Blog:

https://maxbox4.wordpress.com

https://softwareschule.code.blog/2020/11/18/sphere-script/



```
[   9   1  29  70 114  76   0   8   4   5   5   0 111 162   9   8  62  62]
[   3   0  33  61 102 106  34   0   0   0   0  49 182 150   1  12  65  62]
[   1   0  40  54 123  90  72  77  52  51  49 121 205  98   0  15  67  59]
[   3   1  41  57  74  54  96 181 220 170  90 149 208  56   0  16  69  59]
[   6   1  32  36  47  81  85  90 176 206 140 171 186  22   3  15  72  63]
[   4   1  31  39  66  71  71  97 147 214 203 190 198  22   6  17  73  65]
[   2   3  15  30  52  57  68 123 161 197 207 200 179   8   8  18  73  66]
[   2   2  17  37  34  40  78 103 148 187 205 225 165   1   8  19  76  68]
[   2   3  20  44  37  34  35  26  78 156 214 145 200  38   2  21  78  69]
[   2   2  20  34  21  43  70  21  43 139 205  93 211  70   0  23  78  72]
[   3   4  16  24  14  21 102 175 120 130 226 212 236  75   0  25  78  72]
[   6   5  13  21  28  28  97 216 184  90 196 255 255  84   4  24  79  74]
[   6   5  15  25  30  39  63 105 140  66 113 252 251  74   4  28  79  75]
[   5   5  16  32  38  57  69  85  93 120 128 251 255 154  19  26  80  76]
[   6   5  20  42  55  62  66  76  86 104 148 242 254 241  83  26  80  77]
[   2   3  20  38  55  64  69  80  78 109 195 247 252 255 172  40  78  77]
[  10   8  23  34  44  64  88 104 119 173 234 247 253 254 227  66  74  74]
[  32   6  24  37  45  63  85 114 154 196 226 245 251 252 250 112  66  71]
```

Illustration 7: Bitmap and Pixmap