4 Introduction to Graphics (rkm38)

You are asked to implement a Java class for storing images with arbitrary pixel order and an arbitrary number of colour channels. The skeleton of such a class is provided below. If `row_major` is set to `true` in the constructor, the class stores pixels in the row-major order and in the column-major order otherwise. If `interleaved` is set to `true` in the constructor, the class stores colour values in the interleaved order and in the planar order otherwise.

```
public class ExImage {
    final protected byte[] data;
    final protected int width, height, colour_channels, sx, sy, sc, first_pixel;

    public ExImage(int width, int height, int colour_channels,
                   boolean row_major, boolean interleaved)
    {
        data = new byte[width*height*colour_channels];
        this.colour_channels = colour_channels;
        this.width = width;  this.height = height; this.first_pixel = 0;
        ...
    }
    protected int get_index( int x, int y, int cc )
    ...
    public void set_pixel( int x, int y, byte[] value )
    ...
    public byte[] get_pixel( int x, int y )
    ...
}
```

(*a*) Write the missing piece of code in the constructor for setting the strides `sx`, `sy` and `sc` of the `ExImage` object. [4 marks]

(*b*) Implement `get_index`, `get_pixel`, and `set_pixel` methods. [3 marks]

(*c*) You want to add a region-of-interest functionality to the class. Write the code for a constructor with the signature

```
public ExImage( ExImage src_img, int ox, int oy, int width, int height)
```

that creates an object that operates on the region `(ox, oy, ox+width, oy+height)` of the image `src_img` without creating a copy of the data. [3 marks]

(*d*) Would you recommend storing linear or display-encoded pixel values in this class? Justify. [3 marks]

(*e*) The object of the `ExImage` class stores RGB values that are shown on a display with non-standard primaries $r(\lambda)$, $g(\lambda)$, $b(\lambda)$, where λ is the wavelength. Derive a formula for converting those RGB values to the display-encoded BT.709 RGB colour space. You are given CIE 1931 colour matching functions $x(\lambda)$, $y(\lambda)$, $z(\lambda)$ and a matrix $M_{XYZ\rightarrow 709}$ for converting from CIE 1931 XYZ to BT.709. Both the display and the target colour use a gamma of 2.2. Write equations rather than code. [7 marks]