Image Processing - Basics

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Systems Modelling (LTTI.00.010)

17 November 2023

Reading, Writing and showing images

- Imread
- Imwrite (rename, change format)
- Imshow
- Subplot (display more than one image)

Image Properties

- Filename
- Filemoddate
- Filesize
- Width
- Height
- BitDepth
- ColorType
- NumberOfSamples
- CodingMethod
- CodingProcess

H x W x C

Image Rotation

J = imrotate(I,angle,method,bbox)

`method` — Interpolation method
`"nearest"` (default) | `"bilinear"` | `"bicubic"`

Interpolation method, specified as one of the following values:

Value	Description
`"nearest"`	Nearest-neighbor interpolation. The output pixel is assigned the value of the pixel that the point falls within. No other pixels are considered. Nearest-neighbor interpolation is the only method supported for categorical images.
`"bilinear"`	Bilinear interpolation. The output pixel value is a weighted average of pixels in the nearest 2-by-2 neighborhood.
`"bicubic"`	Bicubic interpolation. The output pixel value is a weighted average of pixels in the nearest 4-by-4 neighborhood.

bbox — Bounding box defining size of output image
`"loose"` (default) | `"crop"`

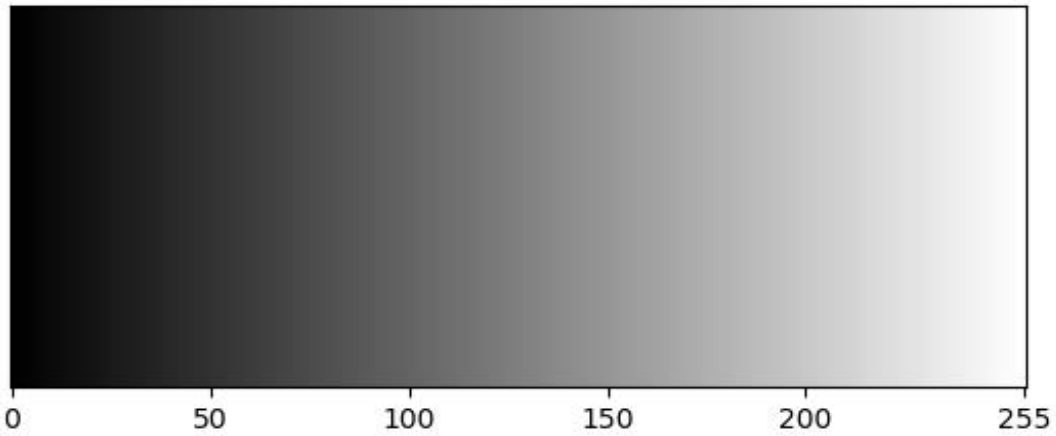
Bounding box that defines the size of output image, specified as either of the following values:

Value	Description
`"crop"`	Make output image `J` the same size as the input image `I`, cropping the rotated image to fit.
`"loose"`	Make output image `J` large enough to contain the entire rotated image. `J` is larger than `I`.

Data Types: `char` | `string`

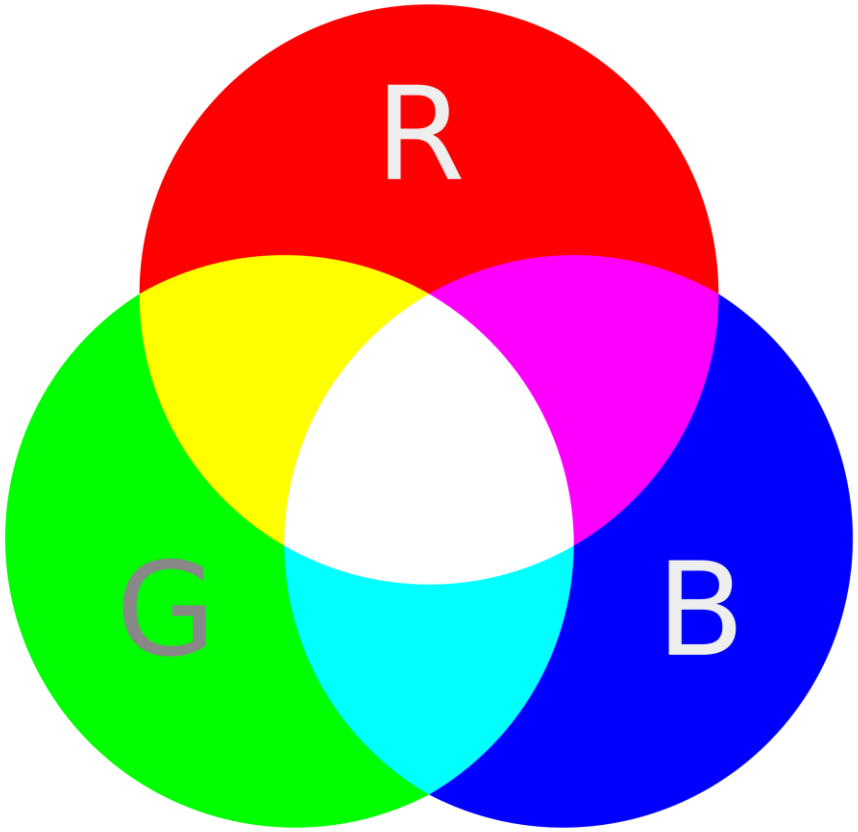
Grayscale

- Single-channeled images in which each pixel carries only information about the intensity of light.
- Exclusively made up of shades of gray.
- Should not be confused with black and white images (binary images) which contain only black and white pixels.
  - In binary images, either a pixel is black or it is white. They have no colours in between.
  - But Greyscale images have a wide range of shades of grey in their pixels.



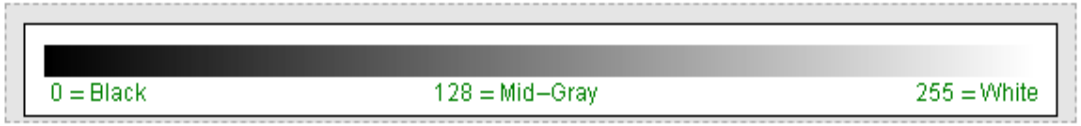
RGB Channels

- Every image is made up of pixels
- Each pixel is made up of combinations of colours, to be more precise, primary colours.
- A channel is the grayscale image of a coloured image, which is made up of only one of the primary colours that form the coloured image.
- Unlike grayscale images, RGB images are three channeled.
- Each pixel is made up of three channels, with each channel representing a colour.



Pixel Value - Grayscale

- Pixel (short for picture element) is a small block that represents the amount of gray intensity to be displayed for that particular portion of the image.
- For most images, pixel values are integers that range from 0 (black) to 255 (white).
- The 256 possible gray intensity values are shown below.



The range of intensity values from 0 (black) to 255 (white).

Why 256?

- The fundamental unit on a computer is a bit. A bit (binary unit) takes either the value 0 or 1.
- The byte (the fundamental unit of storage on a PC) is composed of 8 bits.
- Since each bit takes on one of two values and 8 bits make a byte, we can use the multiplication principle to realize that there are $2^8 = 256$ possible bytes.

Pixel Value - RGB

- Color images require more storage space than grayscale images.
- Pixels in grayscale images need just one byte to indicate the intensity of gray needed to render the pixel on screen.
- It turns out that any color can be built using the correct combination of red, green, and blue.
- Thus, pixels in color images are represented by three values (r,g,b). The values indicate the intensity of red, green, and blue, respectively, needed to render the pixel on screen.
- The range of intensities is exactly the same as grayscale images - 0 means none of the color appears in the pixel and 255 indicates the highest level of the color is evident in the pixel.
- For example, the triple (128, 0, 128) would represent a medium purple while (255, 215, 0) represents gold.

Masking

- Edit your images in a non-destructive way
- “conceal and reveal”
- non-destructive process of image editing
  - We can make changes later or fine-tune to our masks whenever we need to.
  - But if we erase the unwanted areas it is difficult for bringing those if we need those areas later in the process of image editing.
- Binary Masking:
- A binary mask defines a region of interest (ROI) of an image.
  - Mask pixel values of 1 indicate image pixels that belong to the ROI.
  - Mask pixel values of 0 indicate image pixels that are part of the background.

Denoising / Image Restoration

- Denoising is a task in image processing and computer vision that aims to remove or reduce noise from an image.
- Noise can be introduced into an image due to various reasons, such as camera sensor limitations, lighting conditions, and compression artifacts.
- The goal of denoising is to recover the original image, which is considered to be noise-free, from a noisy observation.

Thank You!