

Colour Space - CMY

1. What is a Colour Space?

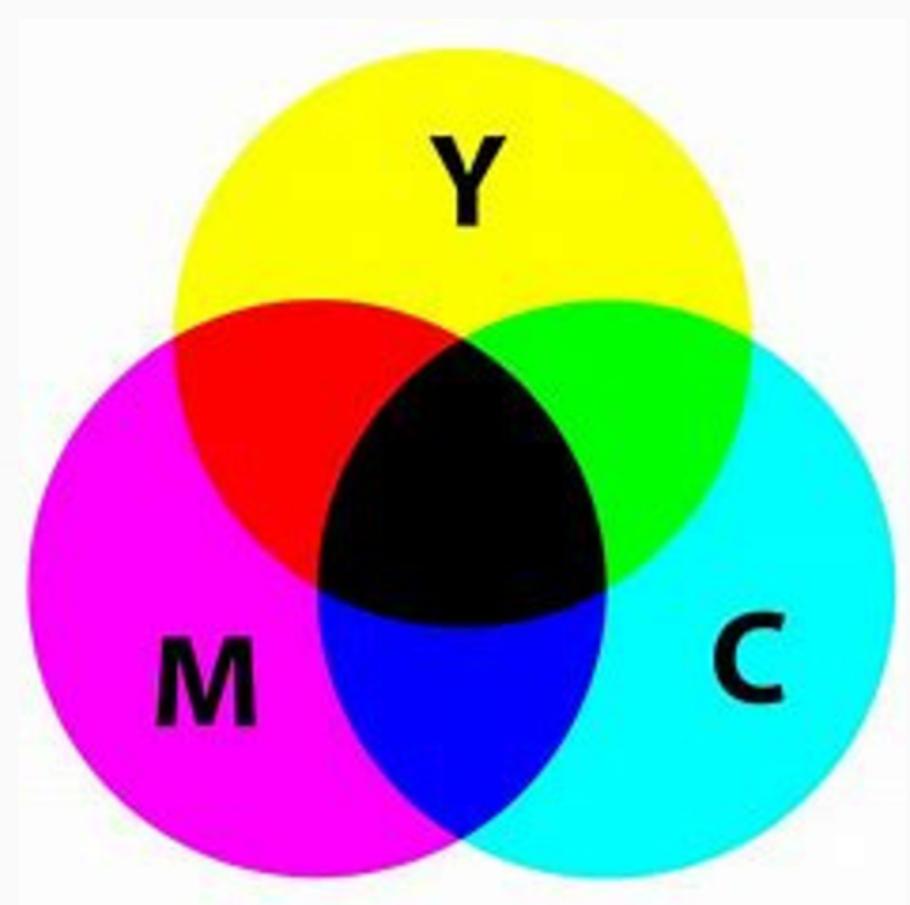
A colour space is a system for organizing colours to represent and reproduce visual information across devices like monitors, printers, and cameras. It defines the range of colours that can be used in a specific application or device.

Common colour spaces include:

- RGB (Red, Green, Blue)
- CMY / CMYK (Cyan, Magenta, Yellow, Black)
- HSV / HSL(Hue,Saturation,Value)

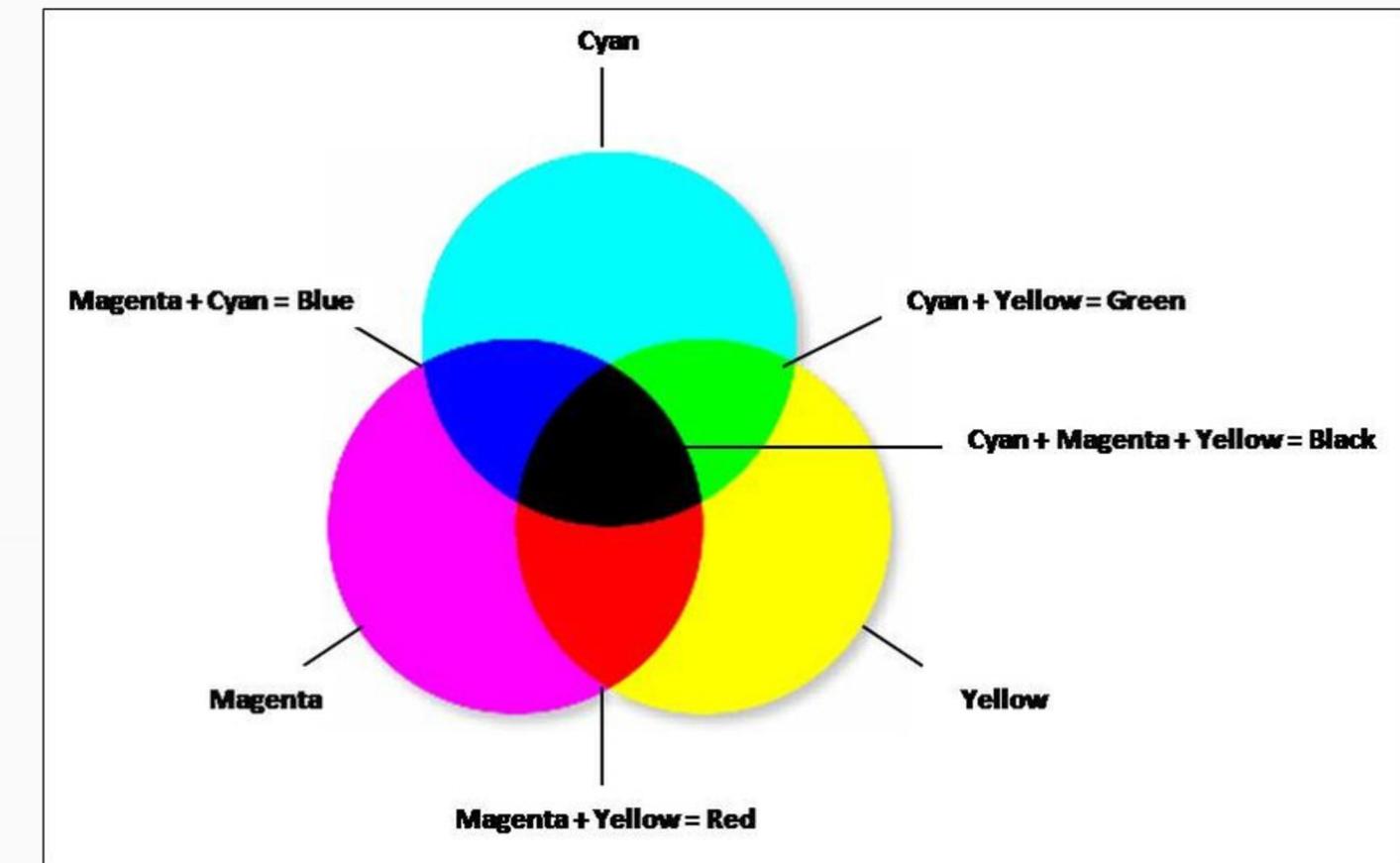
2. Introduction to CMY Colour Space

In the CMY color model, colors are created by subtracting different amounts of cyan, magenta, and yellow ink from a white background. When all three colors are combined at full strength, they create black. However, because the process of subtracting color can result in a loss of brightness and saturation, black ink is often added to improve the overall color quality.



Subtractive Colour Mixing

- Combining Cyan + Magenta → Blue
- Combining Cyan + Yellow → Green
- Combining Magenta + Yellow → Red
- Combining all three ideally produces black, but in practice it results in a muddy brown.





Relationship Between CMY and RGB

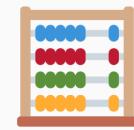
Each CMY colour is the inverse of its corresponding RGB component:



Conversion Formula

You can convert between them using the formula:

$$\begin{aligned} \text{CMY} &= 1 - \text{RGB} \\ \text{RGB} &= 1 - \text{CMY} \end{aligned}$$

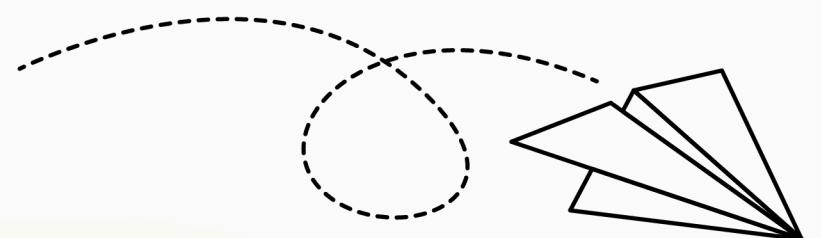


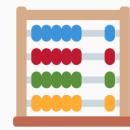
Example: RGB to CMY Conversion

- Convert the RGB color ($R=102$, $G=204$, $B=255$) to CMY.

- Step 1: Normalize the RGB values (0 to 1 range)

$$\begin{aligned} \bullet R &= 102 / 255 \approx 0.4 \\ \bullet G &= 204 / 255 \approx 0.8 \\ \bullet B &= 255 / 255 = 1.0 \end{aligned}$$





Example: RGB to CMY Conversion

- Step 2: Apply CMY conversion formulas

$$\bullet C = 1 - R = 1 - 0.4 = 0.6$$

$$\bullet M = 1 - G = 1 - 0.8 = 0.2$$

$$\bullet Y = 1 - B = 1 - 1.0 = 0.0$$

- Final Answer:

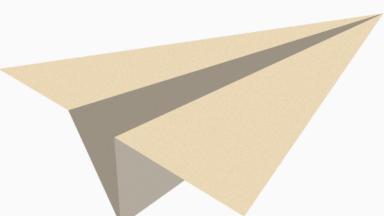
$$\bullet \text{CMY} = (0.6, 0.2, 0.0)$$

CMYK

The CMY model alone falls short when it comes to producing a deep, rich black. In real-world printing, this leads to faded or muddy results. That's why black (K) ink is added—to achieve true black, improve sharpness, and reduce ink usage. This also enhances contrast in photos and gradients. Because of these benefits, CMYK has become the standard in all professional printing systems.

$$K = \min(C, M, Y)$$

C, M, Y values are obtained by:



$$C = 1 - R$$

$$M = 1 - G,$$

$$Y = 1 - B$$



Advantages of CMY Model

- **Natural for Printing:** Works well in printing simulations and color separation.
- **Simpler for Some Tasks:** Useful for basic color processing and simulations.
- **Complementary to RGB:** Can be helpful for tasks like color correction and enhancement.

✗ Disadvantages of CMY Model

- **Not Common in CV:** RGB is more widely used for most computer vision tasks.
- **Conversion Issues:** Converting from RGB to CMY can cause color inaccuracies.
- **Smaller Color Range:** CMY has a limited gamut compared to RGB or other models.
- **Not Ideal for Displays:** Not suited for devices like monitors that use RGB.



Applications of CMY Model

- **Color-Based Segmentation:** Segments objects in real-time for object detection and tracking.
- **Color Correction for Printing:** Adjusts colors in real-time for print preview and quality control.
- **Background Subtraction:** Isolates objects in real-time for motion detection and surveillance.
- **Ink Simulation:** Simulates ink behavior in real-time for 3D printing and print systems.

Thank you.

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