NumPy and Image Basics

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Computer Vision with Python

- Section Goals
  - Understand how to work with the basics of NumPy
  - Understand how to create arrays
  - Slice and index elements from arrays
  - Open and display images with NumPy

Let’s get started!

What is an image?

Computer Vision with Python

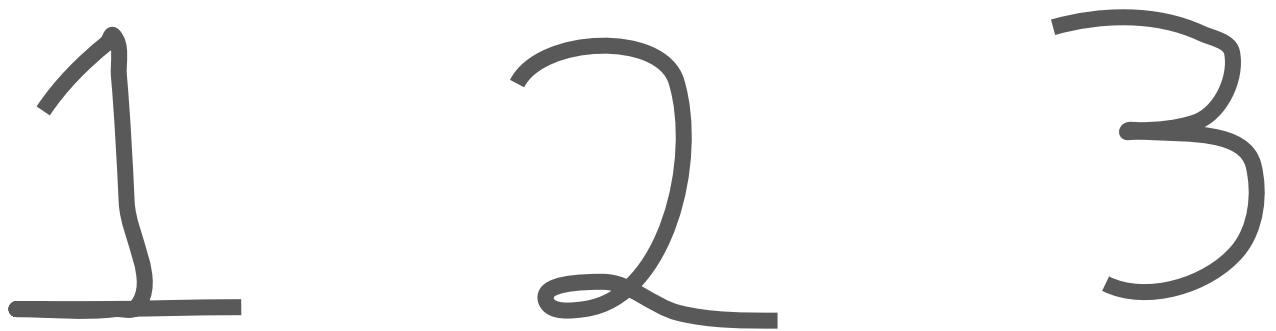
- Before we talk about how to use numpy with image files, let’s first discuss how computers handle images.
- Let’s imagine we wanted to build software that could sort out mail based on the zip code of the address.

Computer Vision with Python

- Often mail is handwritten, which means we would need to begin to understand how to use computer vision to actual read in image data of these handwritten numbers.
- How does a computer represent image data?

Computer Vision with Python

- Let’s imagine we have a simple image of a handwritten number:



Computer Vision with Python

- Each single digit image can be represented as an array

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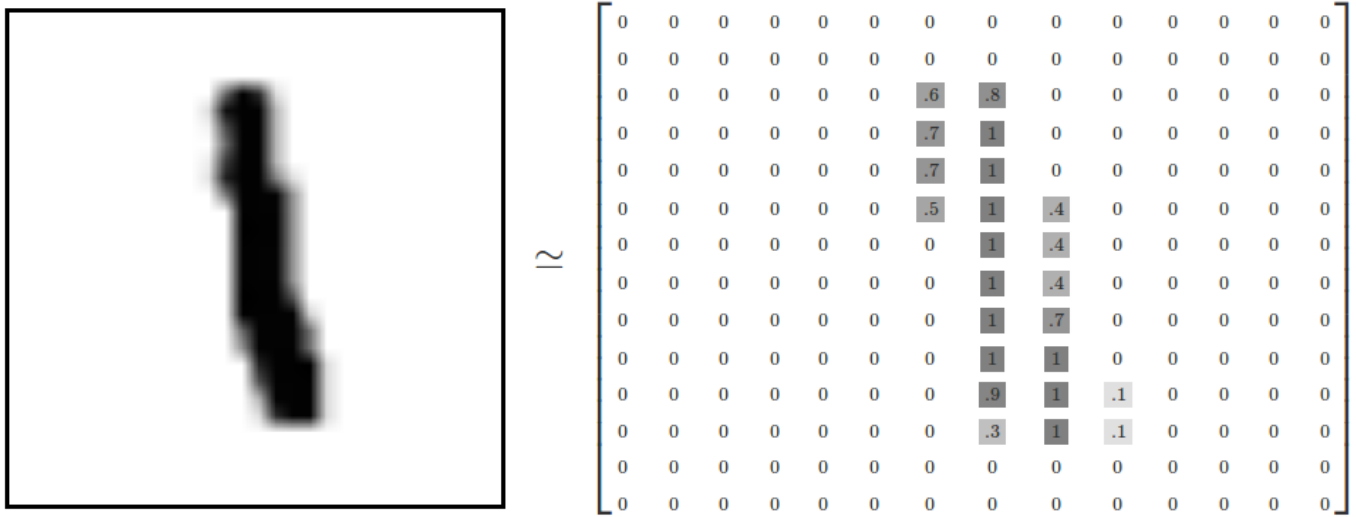
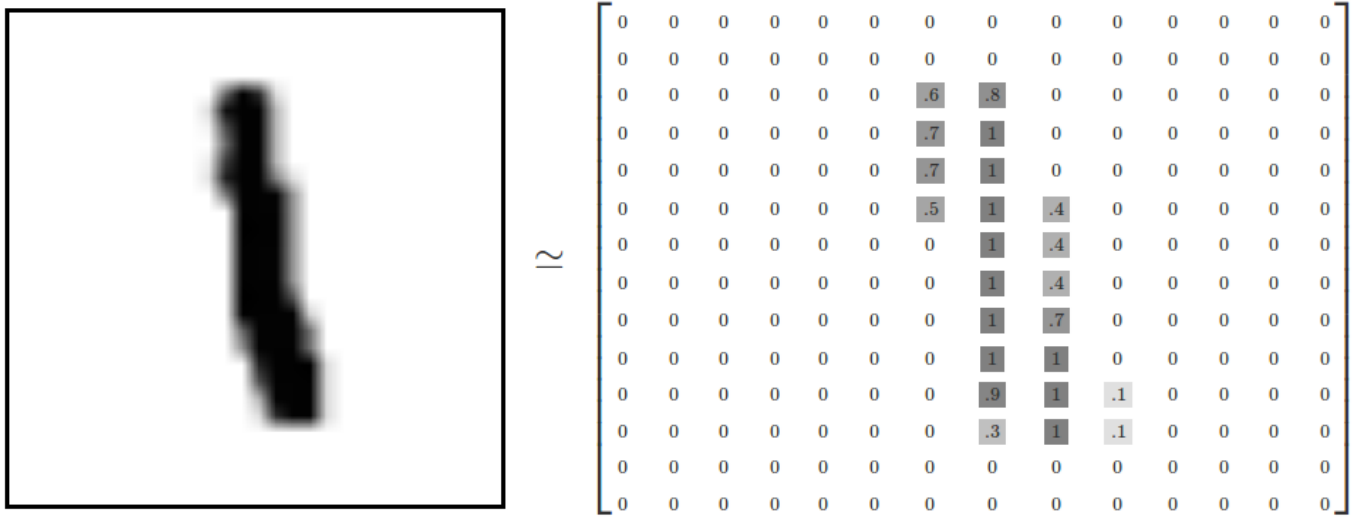
Computer Vision with Python

- For example, here a number is 28 by 28 pixels



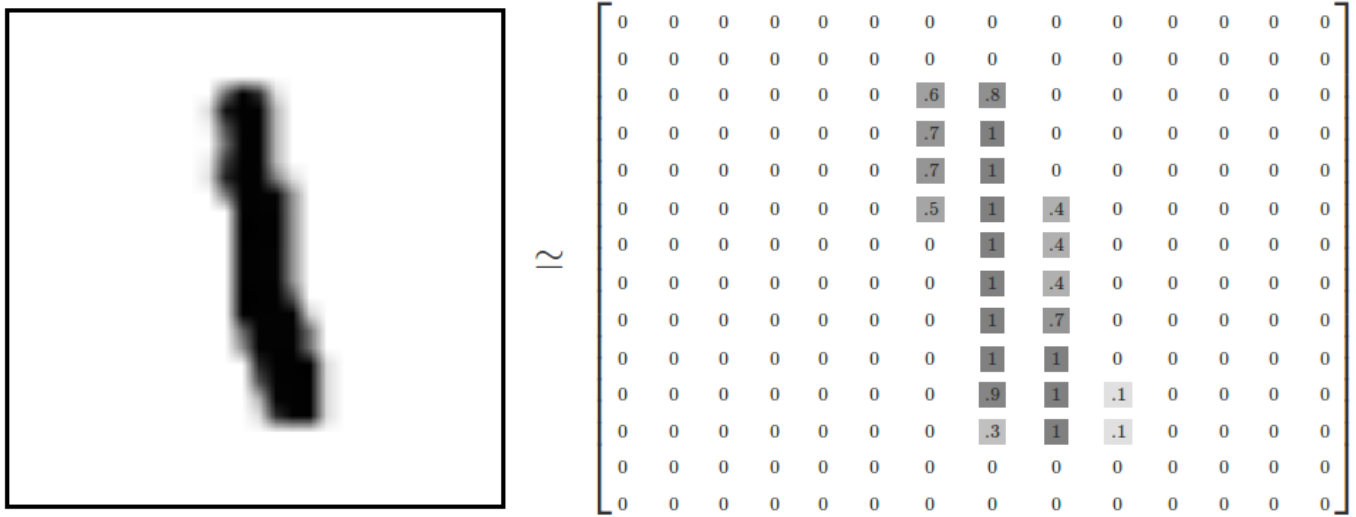
Computer Vision with Python

- Then how dark a pixel should be can be represented as a value between 0 and 1.



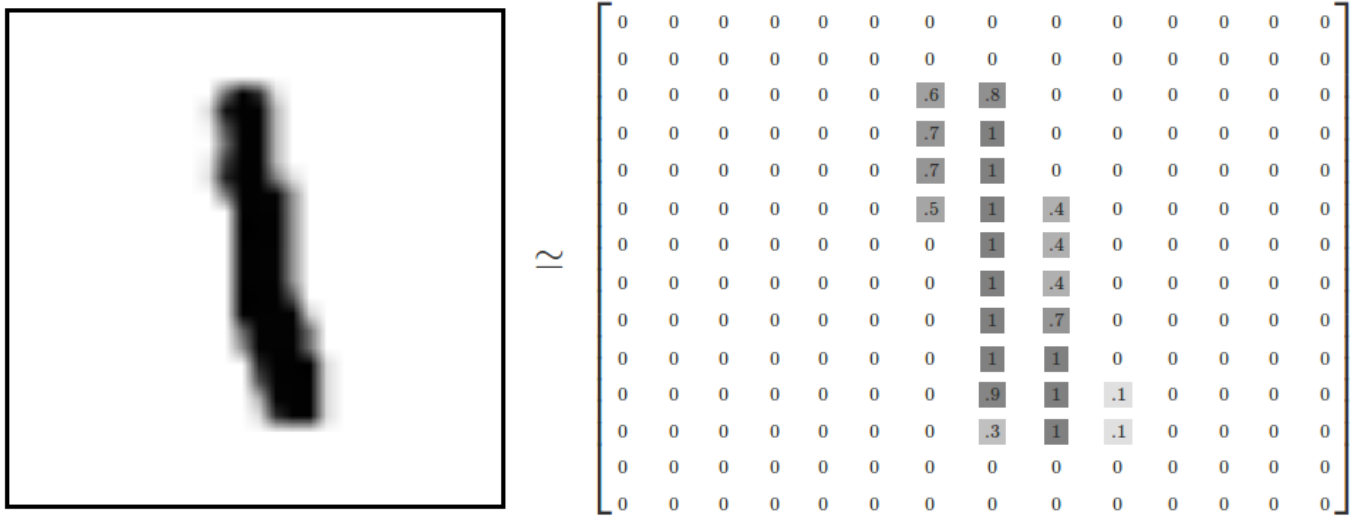
Computer Vision with Python

- Often the default images have values between 0 and 255



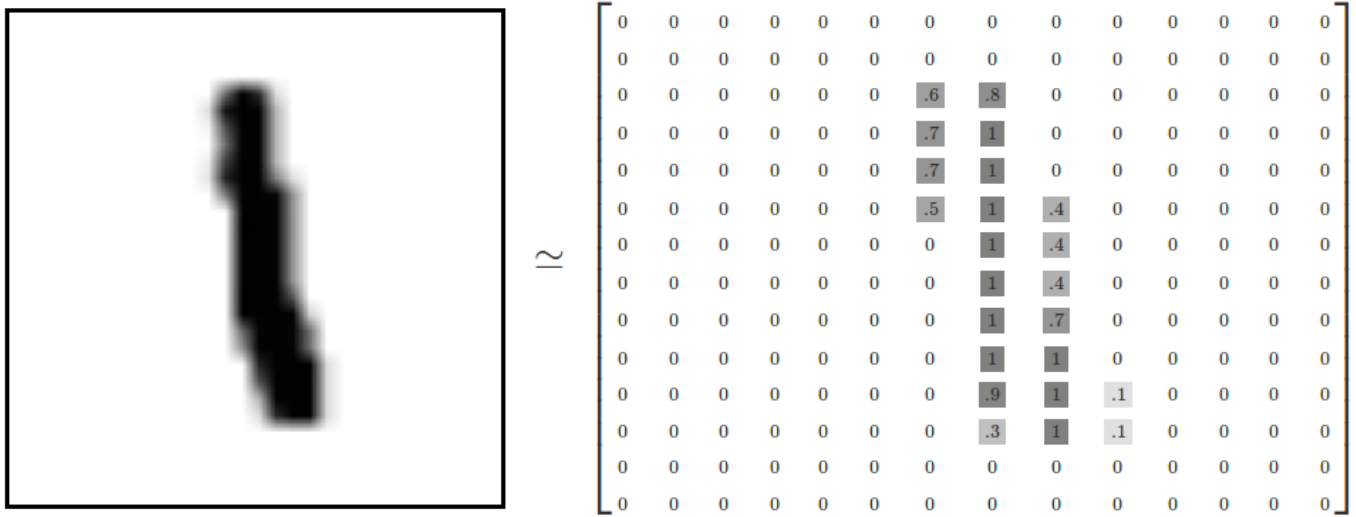
Computer Vision with Python

- The range 0 to 255 has to do with how computers store 8-bit numbers.



Computer Vision with Python

- But you can always divide all the values by 255 to normalize to between 0 and 1

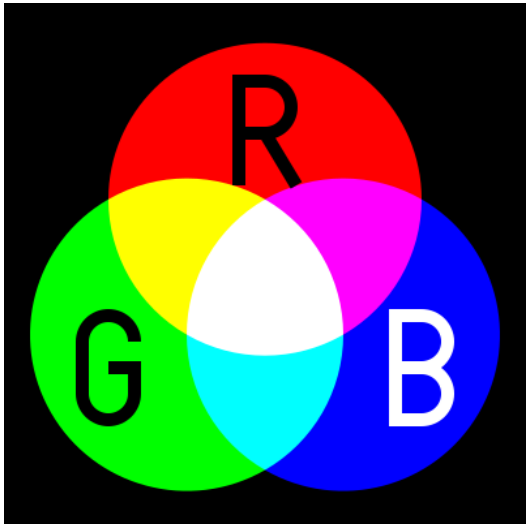


Computer Vision with Python

- Now that we've understood how grayscale images can be represented as arrays, what about color images?
- Color images can be represented as a combination of Red, Green, and Blue.

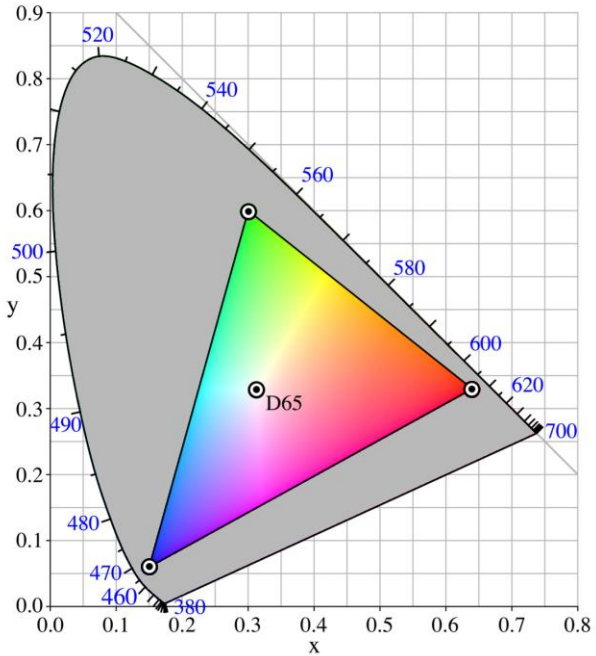
Computer Vision with Python

- Additive color mixing allows us to represent a wide variety of colors by simply combining different amounts or R, G, B.



Computer Vision with Python

- RGB allows to produce a range of colors



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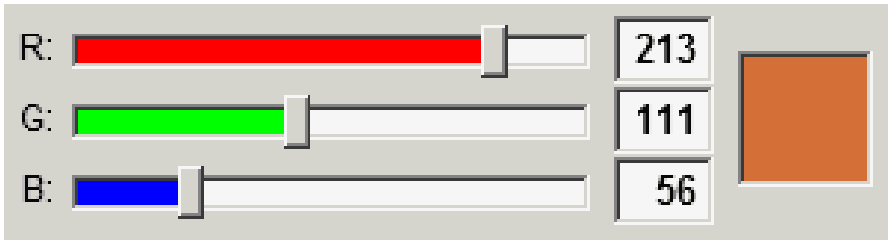
Computer Vision with Python

- Later on in the course we will learn about alternative color mappings that can be applied to images.

Computer Vision with Python

- Each color channel will have intensity values.
- You may have already seen this sort of representation in other software with RGB sliders.



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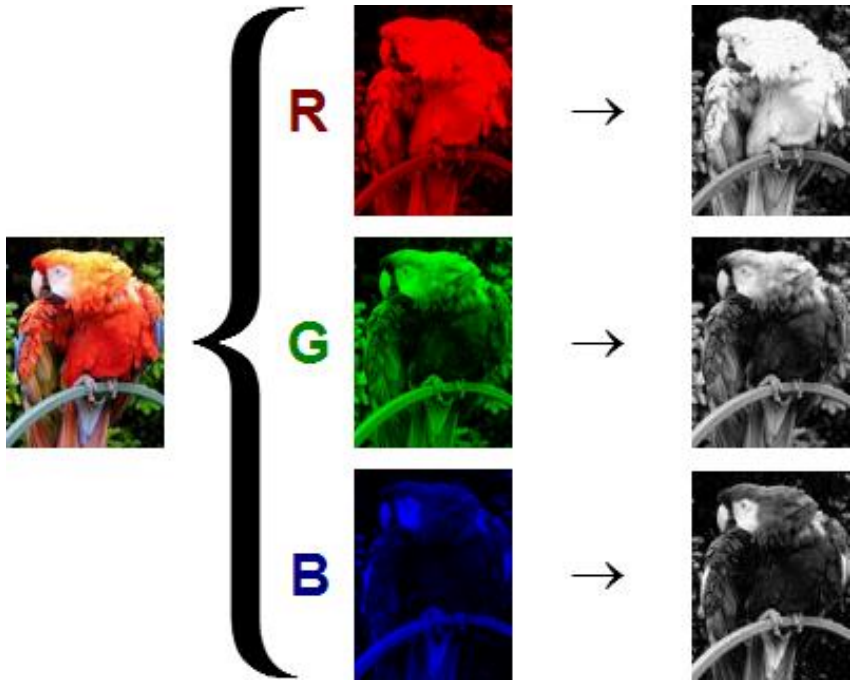


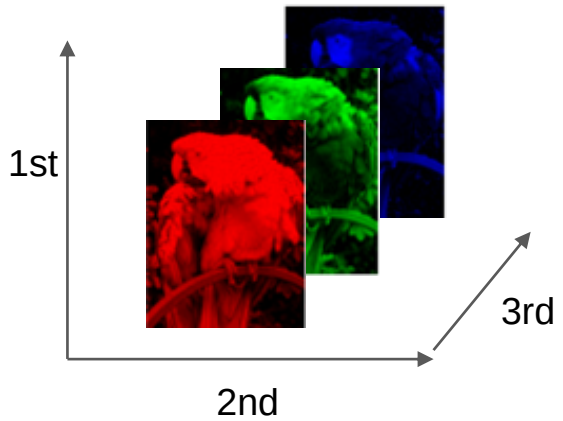
- The shape of the color array then has 3 dimensions.
- Height
- Width
- Color Channels

Computer Vision with Python

- This means when you read in an image and check its shape, it will look something like:
  - **(1280,720,3)**
  - **1280** pixel width
  - **720** pixel height
  - **3** color channels

Computer Vision with Python

- This means when you read in an image and check its shape, it will look something like:
  - **(720,1280,3)**
    - **720** pixel height
    - **1280** pixel width
    - **3** color channels



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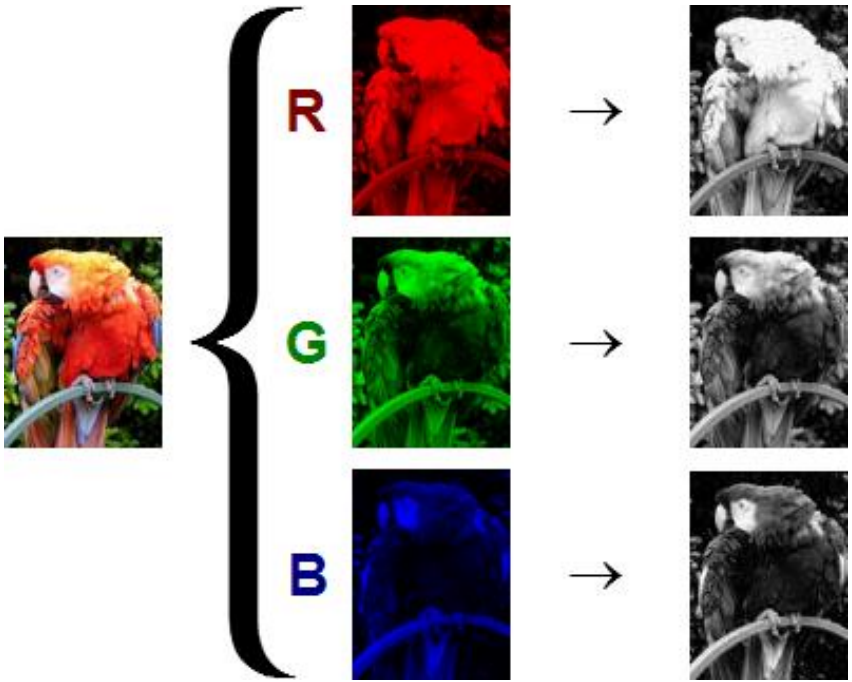
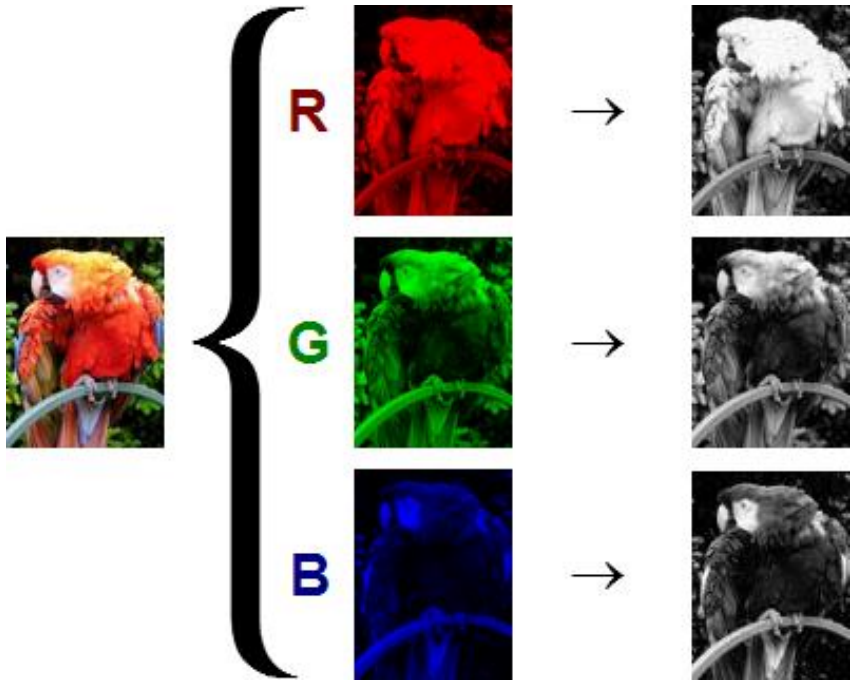


- Keep in mind the computer won't "know" a channel is Red, it just knows that there are now 3 intensity channels.



Computer Vision with Python

- The user needs to dictate which channel is for which color.
- Each channel alone is essentially the same as a grayscale image.

Computer Vision with Python

- Let’s explore this further with Numpy and Python!
- I encourage you to also check out the Wikipedia article on RGB color channeling for more interesting details!

NumPy Arrays

Images and NumPy

Numpy and Images Assessment Overview

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Numpy and Images Assessment Solutions

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