Image Representation

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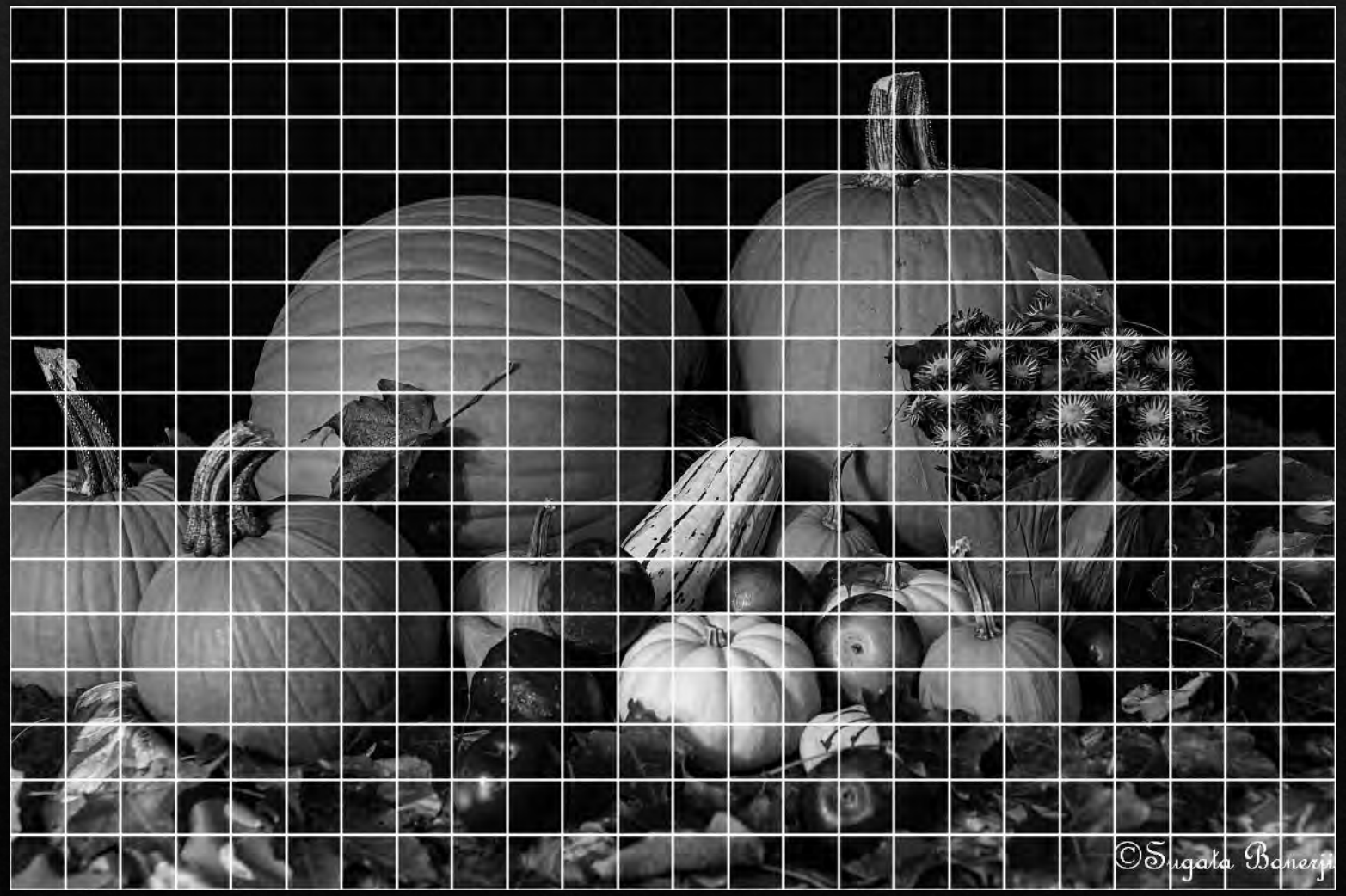
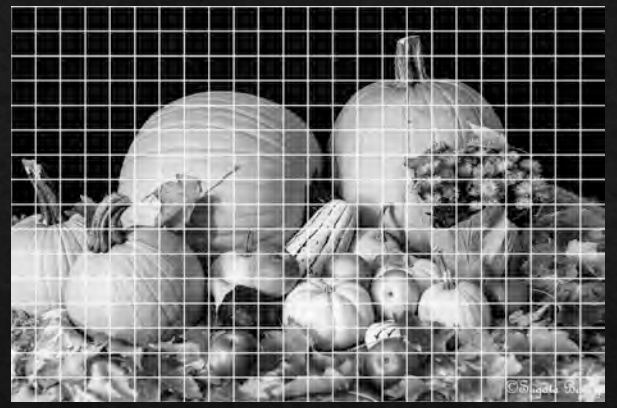
Image Formation

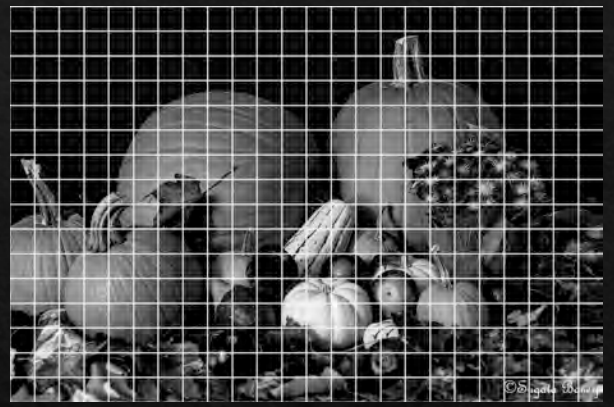


- A digital grayscale image is a 2-d matrix of intensity values
- The intensity **I** is a function of position
  - *I(x,y)*
- Each of the array elements (*enlarged here for clarity*) is called a pixel (picture element)
- Each pixel has one single intensity

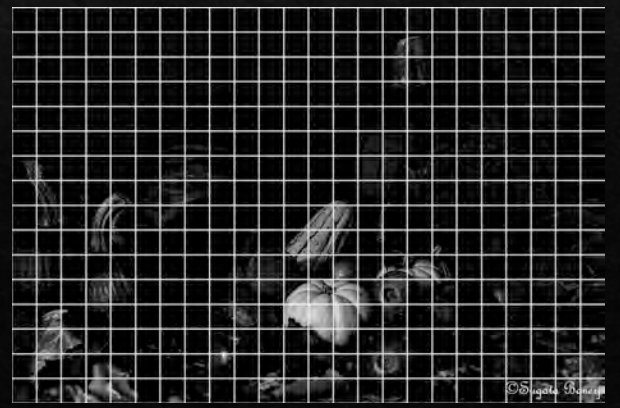
Image Formation (contd.)



Red



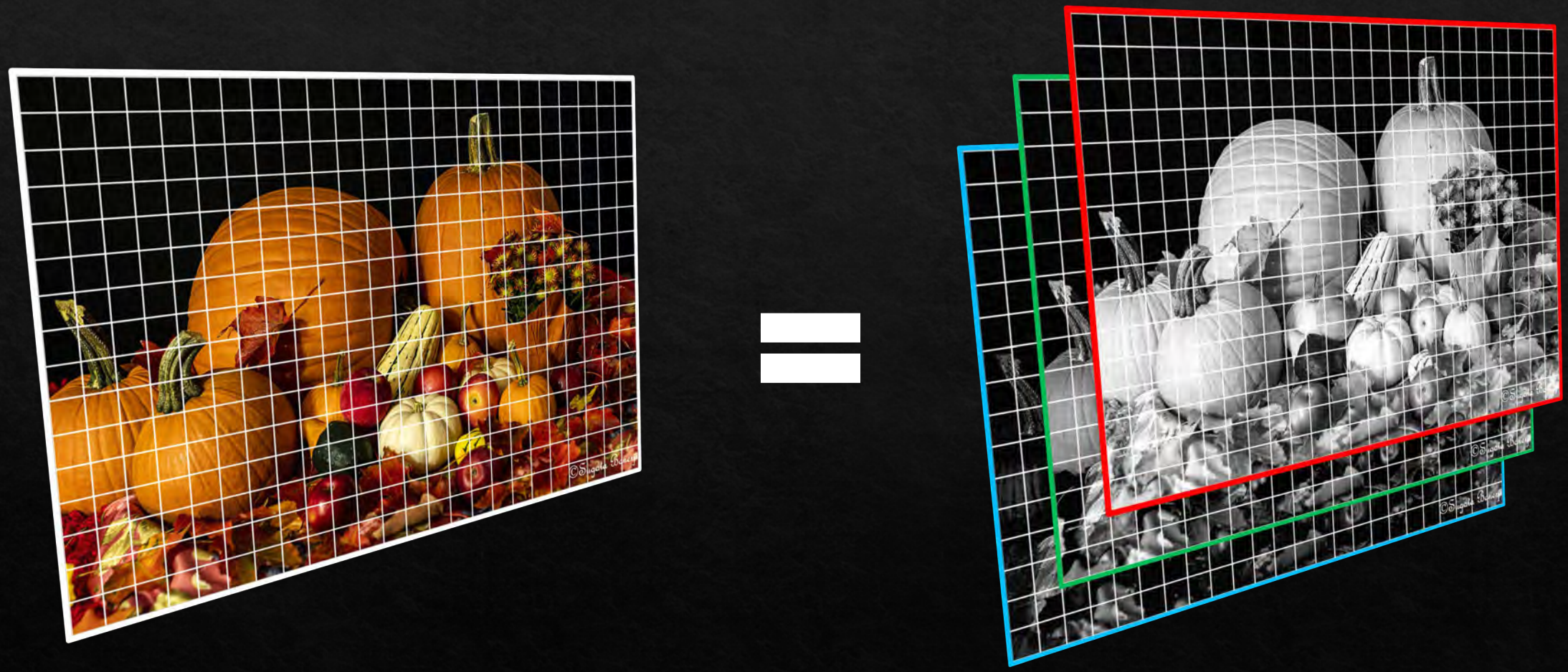
Green



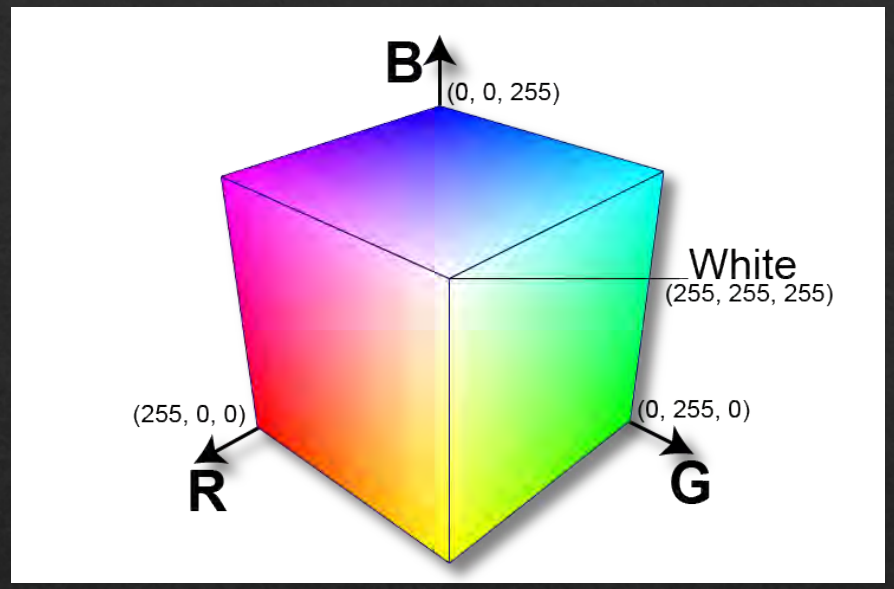
Blue

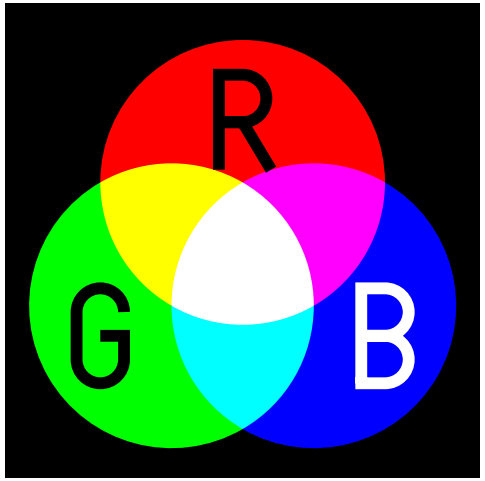
A color image is made up of three component images

Image Formation (contd.)



So an RGB color image is a 3-D array *I(x,y,c)* with each pixel being represented by three 8-bit integers





The RGB Color System

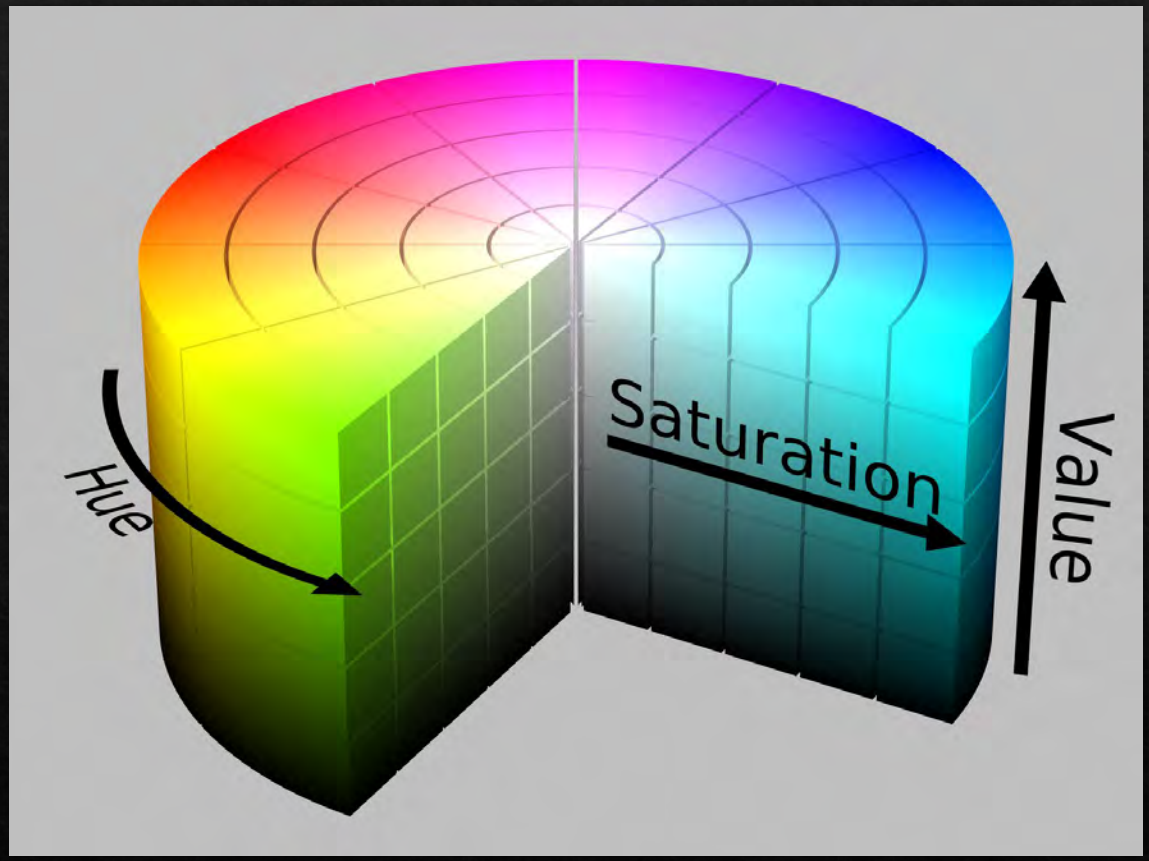
Try: http://math.lakeforest.edu/banerji/slider.html

Grayscale

- Only one intensity image to represent all colors
- Several systems used
  - *Y = 0.2126*R + 0.7152*G + 0.0722*B*
  - *Y = 0.299*R + 0.587*G + 0.114*B*
  - *Y = 0.2627*R + 0.6780*G + 0.0593*B*
- Weight for Green > Red > Blue
- The three weights add up to 1
- Further reading:
  - https://en.wikipedia.org/wiki/Grayscale

The HSV Color System

- Hue is represented by an angle – it indicates the color
- Saturation indicates the purity of the color
  - 0 means gray
- Value indicates the intensity value of the pixel
  - Similar to the grayscale image
- Related color spaces: HSL, HSV, HSB, HSI
- Further reading:
  - https://en.wikipedia.org/wiki/HSL_and_HSV



Other Color Systems

- CMY
- CMYK
- YCbCr
- $I_1I_2I_3$
- L*a*b* (CIELAB)
- XYZ
- oRGB
- Further Reading:
  - https://en.wikipedia.org/wiki/Color_model

The Big Question

- If all images are matrices of numbers, then how can we tell
  - What is in an image?
  - Whether two images are similar?
  - Whether two images are different?
  - Which parts of an image are important?
- For this, we need to convert the matrix into a feature vector.