

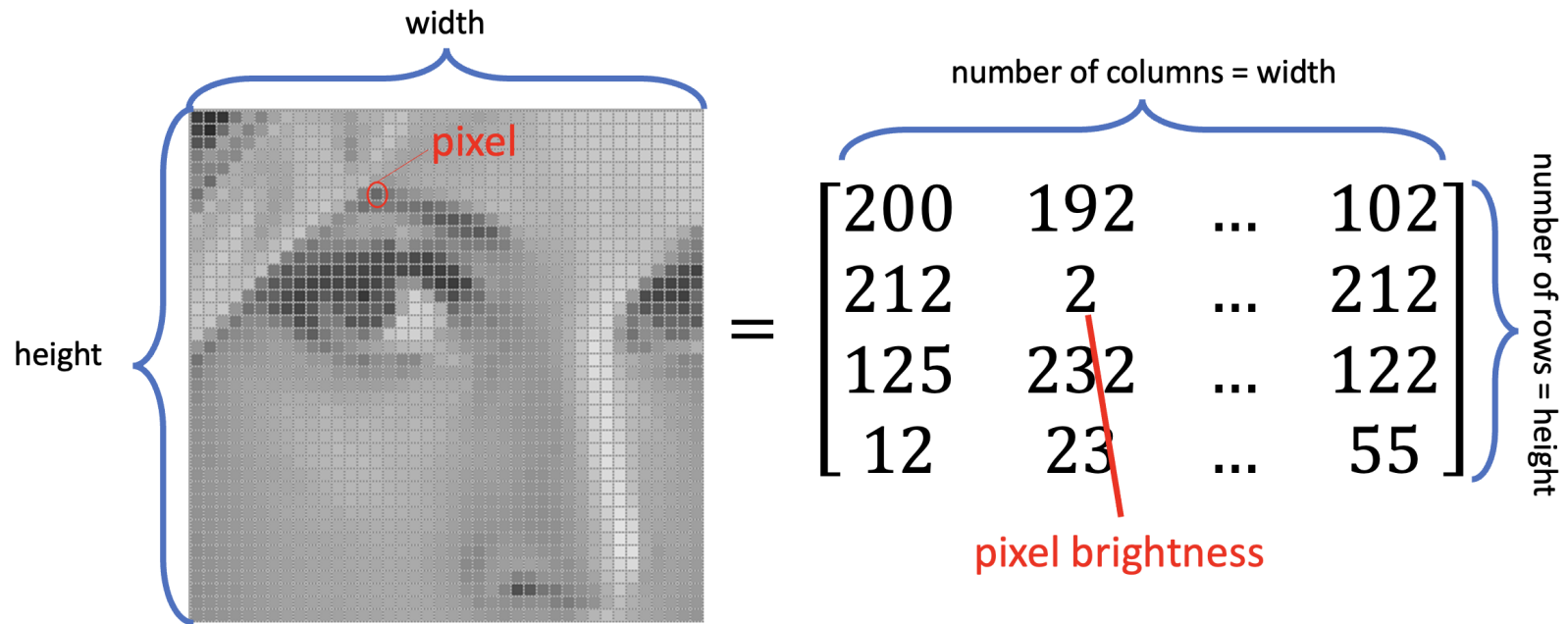
How Computer Stores/Displays Images?

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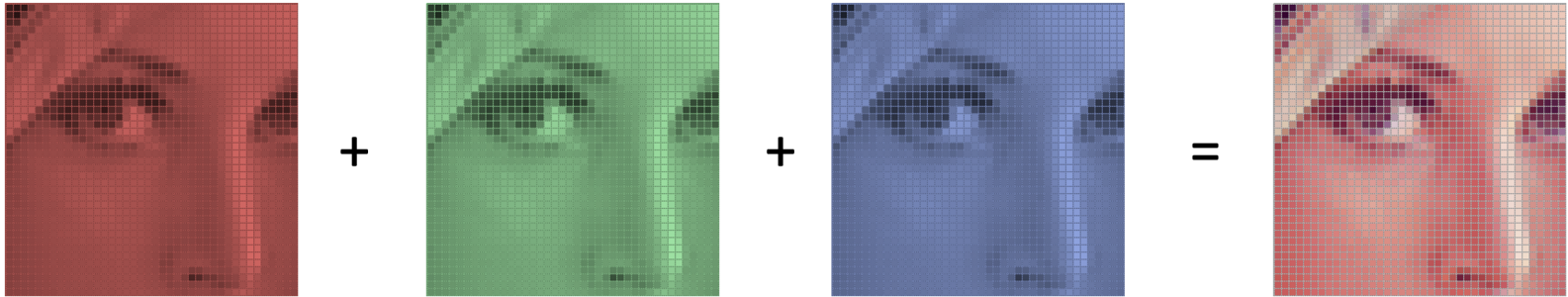
Microsoft Teams (search "song liu").

Images are Matrices



- Grayscale images are expressed as matrices in computer.
- A pixel in the image corresponds to an element in the matrix.
- Each element of the matrix indicate the brightness of a pixel. There are usually 256 levels of brightness, 0 is darkest while 255 is brightest.

Colored Images are Matrices too



- One colored image is expressed as **three** individual matrices:
 - Three matrices indicate brightness in Red, Green and Blue tones (RGB).
 - Computer can display a colored image by stacking three images together.

Images Files are Flattened Matrices

- **Image files** usually store images as flattened matrices.
 - Many file system (such as tape) can only support sequential read/write.
 - Recall, a row-major flattened matrix is

$$\begin{bmatrix} 1, & 2 \\ 3, & 4 \end{bmatrix} \implies [1, 2, 3, 4].$$

- Check Lab 4 homework for more details.
- Knowing these facts, we can build a "textual image viewer" using C programming language.

Building an Image Viewer

- Suppose you have obtained an `int` array `a` with length `M*N`.
 - It contains a flattened matrix `[12, 232, ..., 254]`
 - Let the "unflattend" matrix be $A \in \mathbb{N}^{m \times n}$.
 - Matrix A represents an image with width `N` and height `M`.
- To visualize your image, simply print out an M by N matrix replacing the integer value of $A_{i,j}$ according to the following rules.
 - if $A_{i,j} \leq 85$, print empty space .
 - if $85 < A_{i,j} \leq 170$, print character `I`.
 - if $170 < A_{i,j} \leq 255$, print character `M`.

Building an Image Viewer

Can you see the image?

If not, please zoom out by pressing ctrl + -