CS 89.15/189.5, Fall 2015

Computational Aspects of Digital Photography

Assignment 0: C++ Refresher

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First programming assignment

Programming assignment 0 available on class website

- just a warm up
- familiarize yourself with C++ and the basecode
- compile
- change brightness/contrast of an image

C++

Why C++?

More efficient than Java (compilation, memory)

- Ridiculously more efficient than Python

Standard language for many domains where performance matters (graphics, imaging)

Good experience

Modeled after a slide by Frédo Durand

Online resources

http://cs.brown.edu/courses/cs123/docs/java_to_cpp.shtml

http://www.cprogramming.com/java/c-and-c++-for-java-programmers.html

http://www.horstmann.com/ccj2/ccjapp3.html

and many more…

Images in C++

Digital images

Can be encoded as 3D arrays

- 2D (x,y) grid of pixels
- for each (x,y), have a number of channels (e.g. R, G, B)

Formally:

- Domain: 2D plane
- Range: RGB space

Other color spaces possible

Values often encoded as 8- or 16-bit integers ([0..255] or [0..65535])

- But we will use floats in [0..1] to make life simpler

Modeled after a slide by Frédo Durand

Arrays

C++ vector

- dynamically sized
- templatized by type, float in our case
- e.g.: data = std::vector<float>(size, initialValue);

Array3D (array3d.h)

- our templatized wrapper to access a C++ vector as a 3D array

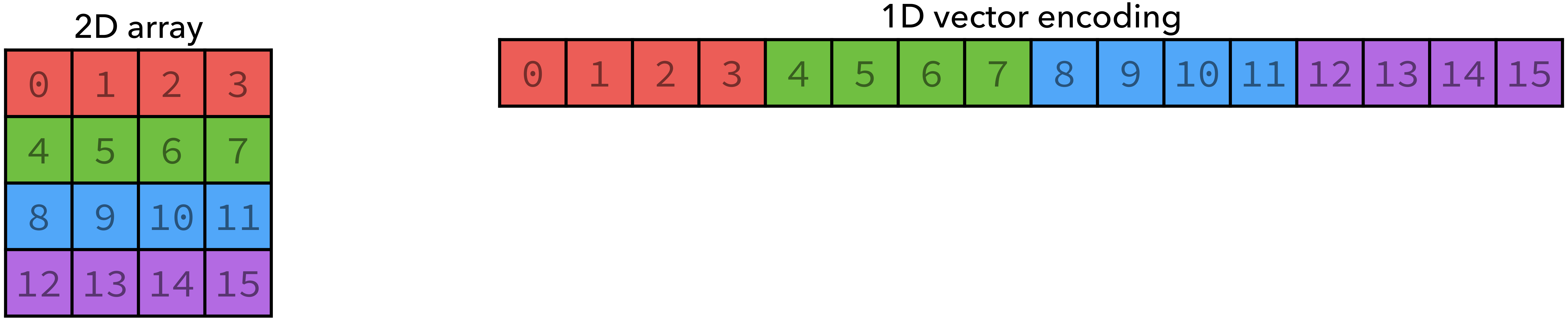
1D to 2D

vectors only have one 1D index

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

turn 2D index into 1D through strides

- pixel at x,y stored at y*width + x



2D array

0	1	2	3
4	5	6	7
8	9	10	11
12	13	14	15

1D vector encoding

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

1D to 3D

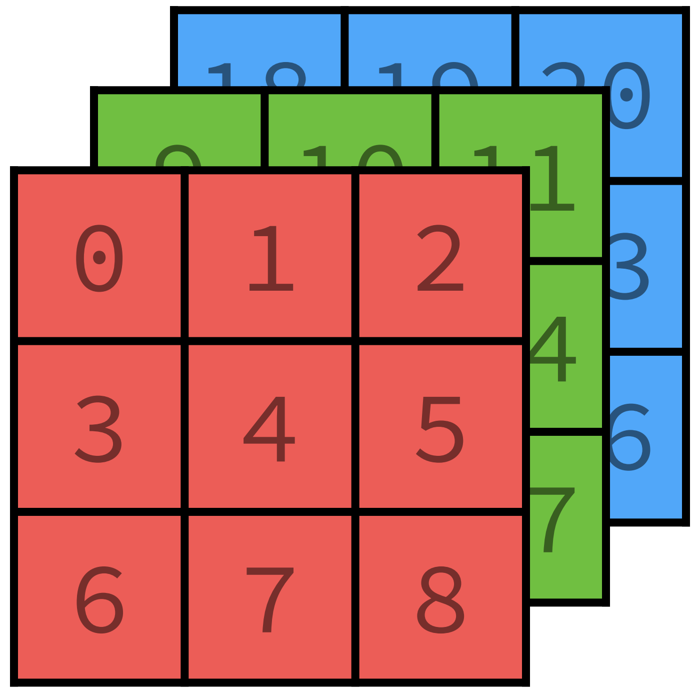
vectors only have one 1D index

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

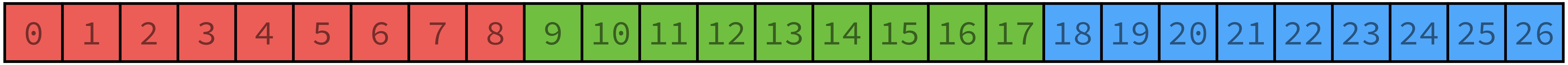
likewise for 3D where z is the color channel

- pixel at x,y,z stored at z*width*height + y*width + x

3D array



1D vector encoding



0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

- other choices possible, e.g. y*width*depth + x*depth + z
  - why favor one over the other?

Modeled after a slide by Frédo Durand

Our FloatImage class

Inherits from Array3D<float>

Stores a vector of pixel values

- size width*height*numChannels

size & number of dimensions

- could be used to represent 2D images with single channel, or even 1D arrays

access data using operator(…), e.g.: image(x,y,z)

File formats

We'll use PNG

- simple to read, no big library needed
- only lodepng.(h|cpp) in ext subdirectory
- easy to convert to/from other formats

We'll talk about how JPEG and other formats work later

Programming Assignment 0

Just a warm up

familiarize yourself with C++, the FloatImage class

compile

change brightness & contrast of an image

Next…

History of photographic technology

Slide credits

Frédo Durand