TOPIC 4
INTRODUCTION TO MEDIA COMPUTATION:
DIGITAL PICTURES

Notes adapted from Introduction to Computing and Programming with
Java: A Multimedia Approach by M. Guzdial and B. Ericson, and
instructor materials prepared by B. Ericson.

Outline

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- ☐ Digital media
- ☐ Vision and colours
- ☐ Colour chooser
- ☐ Digital cameras, monitors
- ☐ Pixel
- ☐ Black and white
- ☐ Digital picture storage
- ☐ Picture objects

Computing with media

- **Media computation** is the processing of some collection of
  - Picture elements
  - Sound fragments
  - Movie frames
 - Text files
  - Web (HTML) pages

Digital media

- **Digital data** refers to the encoding of information in bits (0's and 1's)
- **Digital media** are electronic media that record a numeric encoding (as opposed to recording continuous (analog) signals)
  - Example: a digital camera captures and stores photos as digital data on a memory card rather than on film
  - Example: CDs and DVDs sample sound waves and record numbers that represent the sound at the time of that sample

Human vision

- Our eyes contain
  - **Rods** that allow us to see black, white, and shades of gray
  - **Cones** that allow us to see in color
    - Cones are sensitive to red, green, and blue light
    - All other colors are combinations of these
- Our eyes and brain work together to make sense of what we see
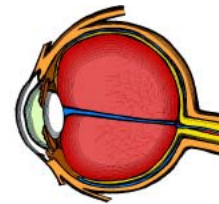
The RGB model

- On a computer, we can produce **white** light as a combination of the full intensities of red, green, and blue combined
- **Black** is the absence of all light
  - No red, green or blue light
- All other colors are combinations
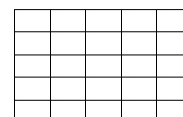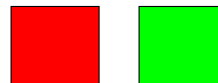 - of red, green, and blue
  - of different intensities
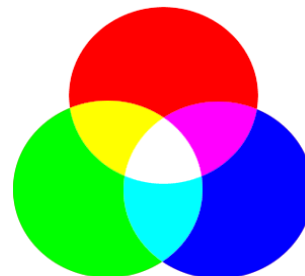
In Dr Java

- In DrJava's Interactions pane type
  ColorChooser.pickAColor();
- Click on the RGB tab and move the sliders to change the intensity of red, green, and blue
  - Note that each **intensity** is represented by a number between 0 and 255
  - **Why** is it between 0 and 255?
- Make white, black, red, blue, green, yellow, violet, and orange
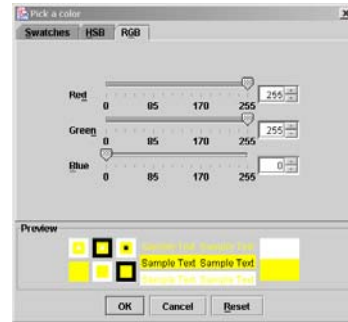
Digital cameras

- There are red, green, and blue filters that capture the amount of each color at each of many **positions** in a grid
- These positions are called **picture elements** or **pixels**
  - A grid of 640 x 480 pixels is **low resolution**
  - A grid of 1600 x 1200 is **high resolution**
- The more pixels, the better the picture (in theory); it can be enlarged without it looking grainy

Computer displays

- A display has **pixels** (picture elements)
- Each pixel has a red, green, and blue component
- Combinations of red, green, and blue of different intensities give the resulting color
  - Black is 0 red, 0 green and 0 blue
  - White is 255 red, 255 green, and 255 blue

Pictures are made up of pixels

- Digital cameras record light as pixels
- Monitors display pictures using pixels
- Our limited vision actually helps us to see the discrete pixels as a smooth picture
  - If we blow up the picture, however, we can see the pixels
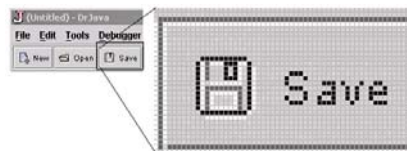
Storing pictures

- The **intensity** of the red, green, and blue colors at each pixel is stored as a set of three numbers, typically
  - 1 byte (8 bits) for red
  - 1 byte for green
  - 1 byte for blue
- What numbers can be stored in 1 byte?
  - 8 bits can hold 256 bit patterns
  - These can represent the numbers 0 to 255

From black to white

- Black is stored as 0, 0, 0
- White is stored as 255, 255, 255
- What about red?
  - Pure red is 255, 0, 0
  - But 100,0,0 is also red (a darker red)
- The gray at the right is stored as 200, 200, 200
  - How would a darker gray be stored?

	0	1	2	3
0	255,30,30	30,30,255	30,255,30	0,0,0
1	255,150,150	150,150,255	150,255,150	200,200,200

Storing digital pictures

- To store a 640 x 480 picture, we need nearly 1 million bytes!
- To store an image from a 1 megapixel (million pixel) camera, we need 3 million bytes!
- Most commonly stored in **.jpg (JPEG) files**
  - A **lossy compression** format
    - **lossy** means not all data is stored (but what is lost isn't that important)
    - **compression** makes the images use less space
- Other formats for storing digital pictures are GIF and BMP

Digital pictures in Java

- Java supports the use of digital pictures
- The textbook provides a Picture class
  - To use pictures, we create **picture objects** (objects of the Picture class)
  - The Picture class contains methods we can use to show and manipulate our pictures

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Creating Picture objects

□ We can create a picture object, for example:

Picture picture1 = new Picture();
System.out.println(picture1);

■ This creates a picture object, and prints information about it, but doesn't actually show any picture yet

□ To **show the picture**, do the following:

picture1.show();

Better picture objects

□ We **pick a file name** and save a reference to it in a variable called fileName (a file name is a string):

String fileName = FileChooser.pickAFile();

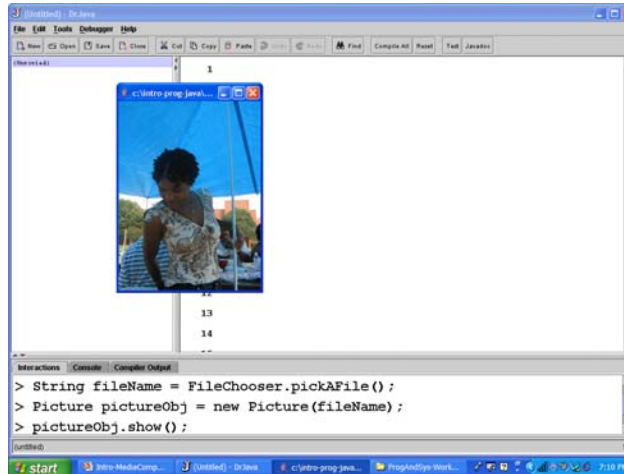□ Next, we create a Picture object from the file, and save a reference to it in a variable called pictureObj:

Picture pictureObj = new Picture(fileName);

□ Now we call the show() method on the picture object:

pictureObj.show();

Result

Summary

- Pictures are made up of a collection of pixels
- Pixels are made up of intensity values for red,   green and blue that range from 0 to 255
- All of these at maximum intensity is white
- All of these at zero is black
- Changing the intensity values changes the colour
- To make a picture object:

  String fileName = FileChooser.pickAFile();
  Picture pictureObj = new Picture(fileName);
  pictureObj.show();

  Don't forget that fileName and pictureObj are variables → you can pick any name you want! You do not have to use those exact names