# ITEC 120

Lecture 23
Working with Photos

## Review

- 2D Arrays
  - Sum/Min/Max
  - Tombstone / Copy / Insert
- Higher dimensional arrays

Photo manipulation

## Objectives

- Real world application of 2D arrays
- Introduction to OO programming

Photo manipulation

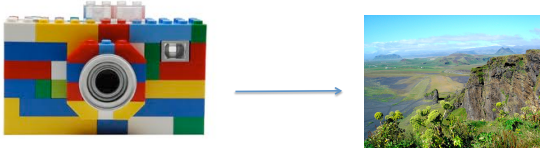## Photography

- Camera => Picture…How does it work?



Photo manipulation

## How

Ends up with:
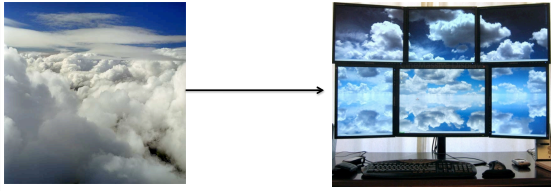2,073,600 pixels

0,0

1920,1080

Lots of little dots
make up the image

Photo manipulation
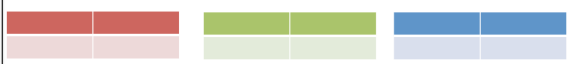
## Pixels



Real life

Virtual life

A pixel is one slot in the grid of a picture
It contains 3 pieces of information
The amount of red, green, and blue light at that point
It ranges from 0 to 255.

Photo manipulation

Why red, green, and blue?

## Storing pixels

- So far we would need three 2D arrays

- Clunky
- How to take .jpg and get 3 arrays out of it
- How to display 3 arrays worth of data

Photo manipulation

## Solution

Need 4 files:
*http://www.radford.edu/~aaray/*
Picture.java
DigitalPicture.java
PictureFrame.java
Pixel.java

- Picture.java
- Contains the ability to load / display pictures
- Gives access to 2D array of pixels
- Similar to Scanner, Robot, and Sound objects you have encountered

Photo manipulation

## Tools

Resolution: 1024x768

Load a picture from disk:
```
String file = "test3.jpg";
Picture p = new Picture();
p.load(file);
```
Get an array of pixels:
```
Pixel[][] array2D = p.get2DArray();
```
Show picture to user:
```
p.show();
```

Pixels:
 Red
 Green
 Blue
Range:
 0-255
 (Intensity of color at position)

Pictures are pixels are stored in an array:
[ P0, P1, P2, P3, P4...P786432]

Photo manipulation

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## Pixels

- Two methods, Six variants
  - getColor/setColor
  - getRed() or setRed(0)
  - What are the other variants?

Photo manipulation

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## Blank photo

- Create a blank picture of size 1024x768
- Fill it with black pixels
- Display it

```
Picture pic = new Picture(1024,768);
Pixel[][] pixels = pic.get2DArray();
for (int i=0; i<pixels.length; i++) {
        for (int j=0; j<pixels[i].length; j++) {
                pixels[i][j].setRed(0);
                pixels[i][j].setGreen(0);
                pixels[i][j].setBlue(0);
        }}
pic.show();
```

Photo manipulation

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## Color gradient

```
Picture pic = new Picture(510,510);
Pixel[][] pixels = pic.get2DArray();
for (int i=0; i<pixels.length; i++)
{
        for (int j=0; j<pixels[i].length; j++)
        {
                pixels[i][j].setRed((i+j)/4);
                pixels[i][j].setGreen((i+j)/4);
                pixels[i][j].setBlue((i+j)/4);
        }
}
pic.show();
```

Black and white because all light is the same intensity.
Purple is a mix of red and blue w/ lack of green.

Photo manipulation

## Effects

- Manipulating a 2D array
  - Basic effects today
  - More advanced on Wednesday
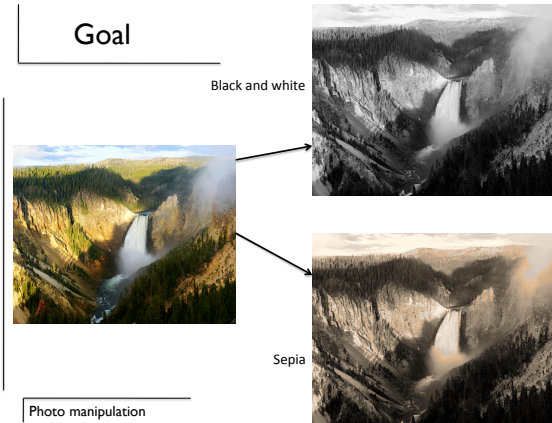- What photography effects are you familiar with?

Photo manipulation

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## Goal



Black and white

Sepia

Photo manipulation

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## Black and white

- Force all 3 types of light to have the same value (average of all 3)

```
for (int i=0; i<array.length; i++)
{
    for (int j=0; j<array[i].length; j++)
    {
        int r = pixels[i][j].getRed();
        int b = pixels[i][j].getBlue();
        int g = pixels[i][j].getGreen();
        int w = (r+g+b)/3;
        pixels[i][j].setRed(w);
        pixels[i][j].setBlue(w);
        pixels[i][j].setGreen(w); }}
    pic.show();
```

Photo manipulation

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## Sepia algorithm

- Make the picture black and white
- Manipulate colors based on the red value

```
if (r < 63){
    r=r*1.1;              Low red?  Add 10% and decrease blue by 9%
    b=b*.9;}
if (r > 62 and r < 192){
    r=r*1.15;             Medium red?  Add 15% and decrease blue by 15%
    b=b*.85;}
if (r  >191){
    r=r*1.08;             High red?  Add 8%
    if (r> 255){          Check to see if maxed
        r=255;                 Guarantee right range
        b*=.93;                Decrease blue by 8%
}}
```
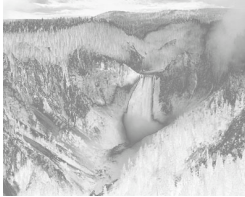
Photo manipulation

## Other effects





Negative:
255 – r
255 – g
255 – b

Sunset:
Lower green and red by 30%

Photo manipulation

## Other effects



Black and white
Make negative if intensity
is <128

Photo manipulation

What other types of effects can you create
with basic manipulations?

## Review

- Basic pixel manipulation
- Explanation of pixels
- Picture object
- Simple photo modifications

Photo manipulation