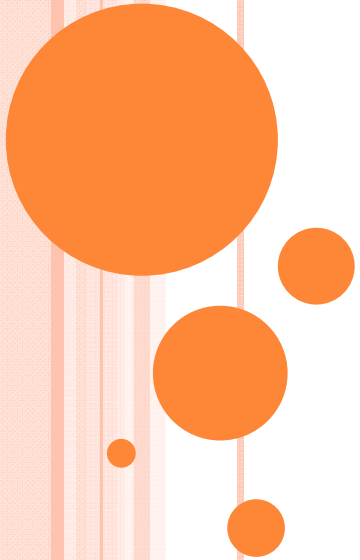


Summer Session II 2013
EECS 10 Week5 Discussion

Che-Wei Chang

OUTLINE

- Something about the discussion session
- Assignment 5
  - Digital Image Processing [80 pts + 20 bonus pts]

SOMETHING ABOUT THE DISCUSSION SESSION

- Last discussion for this course

- On this Thursday, please go to computer lab at 1:00 PM directly (2 hours lab hours)

Assignment Discussion

- Assignment 5
  - For this assignment, you will need to use selection structure, repetition structure, function and array data structure.
  - Read the assignment handout carefully

- Digital Image Processing
  - What is the input? What is the output?
  - What algorithm to solve this problem?
  - What is the control flow for this program?
  - How to implement this program?

ASSIGNMENT 5

- A manual driven digital image processing program
- Using function calls for image input/output, processing, and testing.
  - Function declaration, function definition, function call
  - Function parameter, argument.
  - Scope of the variables
- One-week assignment. Plan the schedule of your work.
  - Lab 1: setup the working environment
design the menu
building up the frame of the operation function
try 1~2 operations on the image
  - Lab 2: Complete the operation, and test your program
- Use the web browser to view your image

Menu Driven Digital Image Processing

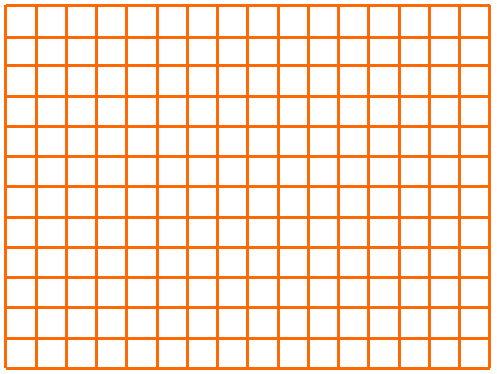
```
eecs10@zuma.eecs.uci.edu:106 > ./PhotoLab
--------------------------------
 1:  Load a PPM image
 2:  Save an image in PPM and JPEG format
 3:  Change a color image to black and white
 4:  Make a negative of an image
 5:  Flip an image horizontally
 6:  Flip an image vertically
 7:  Blur an image
 8:  Add noise to an image
 9:  Zoom in (Bonus)
 10: Mirror an image vertically (Bonus)
 11: Test all functions
 12: Exit
```

What is the input / output

- Input: original image (in ppm format)
- Output: processed image (in ppm and jpeg format)

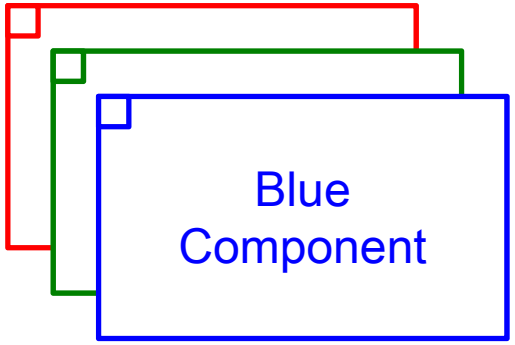
What is the input / output

- How to represent a picture in computer?
  - A picture is composed of pixels
  - One color for each pixel
  - Example: 16x12



WHAT IS THE INPUT / OUTPUT

- RGB color model
  - Three component for one color

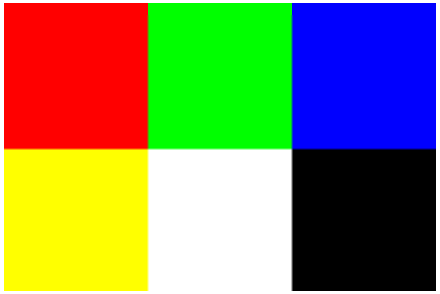


  - 3-tuple (R, G, B)
    - R: intensity of Red
    - G: intensity of Green
    - B: intensity of Blue
    - For image in ppm format, the range of the intensity is [0,255], using **unsigned char** for each intensity
  - Color examples:
    - Red (255, 0, 0), Green (0, 255, 0), Blue (0, 0, 255)
    - Yellow (255, 255, 0), Cyan (0, 255, 255), Magenta(255, 0, 255)
    - White (255, 255, 255), black(0, 0, 0)

WHAT IS THE INPUT / OUTPUT

- Input: original image (in ppm format)
- Output: processed image (in ppm and jpeg format)

- Any color = combination of 3 primary colors
- PPM example
  - ```
    P3   (colors)
    3 2  (3 columns, 2 rows)
    255  (255 for max color)
    255   0 0       0 255   0      0 0 255
    255 255 0     255 255 255      0 0   0
    ```

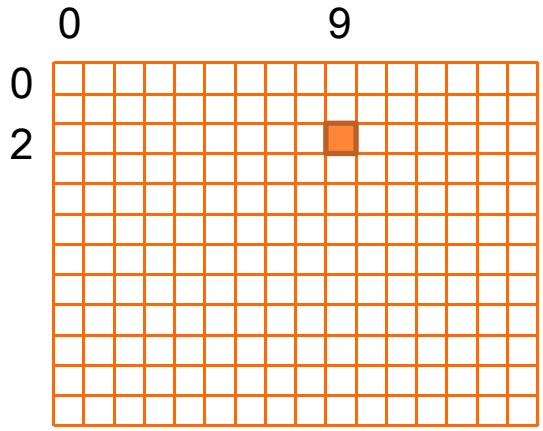

    ```

What is the input / output

- The data structure to represent a picture in computer
  - Two-dimensional arrays for the intensities of each pixel
    - an image of size 16x12

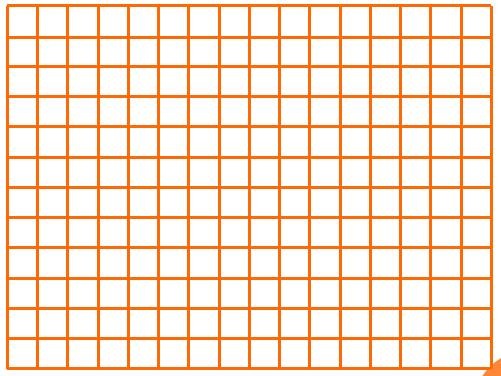
```
unsigned char R[16][12];
unsigned char G[16][12];
unsigned char B[16][12];
```

    - How to access every pixel ?
      - Coordinate of a pixel (x, y)
      - x = number of the column
      - y = number of the row
      - The color of the pixel (x, y) = (R[x][y], G[x][y], B[x][y])



WHAT IS THE INPUT / OUTPUT

- The data structure to represent a picture in computer
  - Two-dimensional arrays for the intensities of each pixel
    - How to access every pixel ?
      - List all possible coordinates of the pixel
      - Two for-loops to scan all the pixels
      - Inner loop : fix the number of the column, iterate the pixel in the same column with different row numbers
      - Outer loop : iterate all the columns
      - ```
        int x, y ;
        for (x=0; x < 16; x++){
         for (y=0; y < 12; y++){
          processing on pixel(x, y);
         }
        }
        ```


        ```

What is the input / output

- Input: original image (in ppm format)
- Output: processed image (in ppm and jpeg format)
- Use `scanf("%s", fname)` to input file name
  - Lecture 7 slides 33 for a complete example
- Provided Functions
  - ```
    int ReadImage (char fname[SLEN],
                   unsigned char R[WIDTH][HEIGHT],
                   unsigned char G[WIDTH][HEIGHT],
                   unsigned char B[WIDTH][HEIGHT]) ;
    ```
  - ```
    int SaveImage (char fname[SLEN],
                   unsigned char R[WIDTH][HEIGHT],
                   unsigned char G[WIDTH][HEIGHT],
                   unsigned char B[WIDTH][HEIGHT]) ;
    ```
  - Arguments are passed to the function by reference.
  - Please refer to lecture slide 28-29 in lecture 7 for “pass by reference”

What Algorithm

```
eecs10@zuma.eecs.uci.edu:106 > ./PhotoLab
--------------------------------
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 7:  Blur an image
 8:  Add noise to an image
 9:  Zoom in (Bonus)
 10: Mirror an image vertically (Bonus)
 11: Test all functions
 12: Exit
```
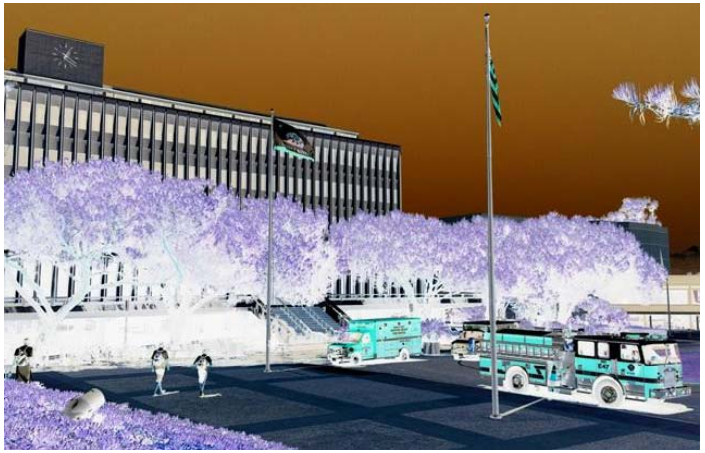

Black & White

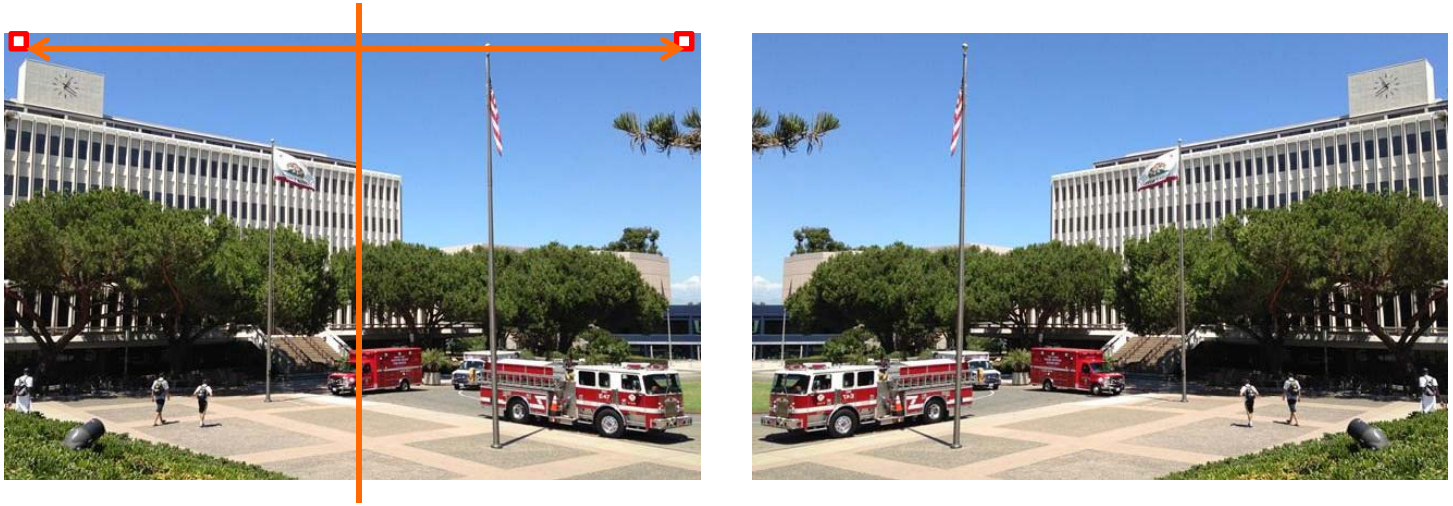
- Get the average value of the three color channels for each pixel (x,y).
- Set R[x][y], B[x][y] and G[x][y] to be the average value.

NEGATIVE



- Subtract R[x][y], B[x][y] and G[x][y] from 255 and set the new value back.

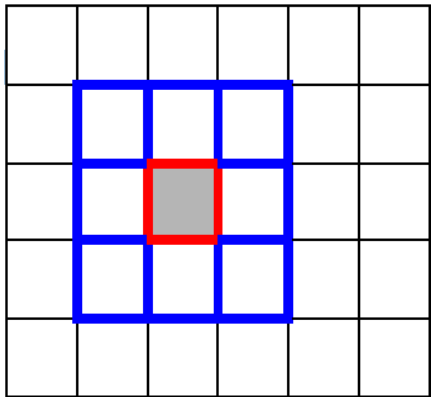
FLIP THE IMAGE



- Swap pixel (x,y) and pixel (width-1-x, y)
- Scan half of the picture

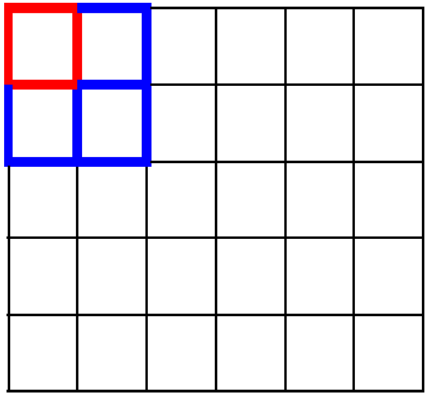
Blur

- Get the average values of the three channels of the current pixel and its 8 neighbors
- Set the pixel‘s color components to the average values respectively
- In order not to comtaminate the original value, use temporary array to keep the original image.



Blur

- Pixels on the corners and the edges have fewer neighbors.
- Should be handle separately.



Add Noise

- Set the percentage of the pixels which should be replace by noise, and calculate the number of noise pixels N
- Randomly choose coordinate and replace the pixel with noise
- Repeat for N times
- Noise: Black (0, 0, 0) or White (255, 255, 255)
- Example: 1000 pixels in total and percentage = 20
  200 pixels will be replace by noise

ZoomIn

- Enlarge the left-bottom quarter of the picture
- Example :

X	X	X	X	X	X		1	1	2	2	3	3
X	X	X	X	X	X		1	1	2	2	3	3
X	X	X	1	2	3		4	4	5	5	6	6
X	X	X	4	5	6		4	4	5	5	6	6

- Generate pixel_new(x, y) with pixel ((x+width)/2, (y+height)/2)

Mirror Vertically

- Replace pixel (x, height -1 - y) with pixel (x, y)
- Scan half of the picture

Provided Function

```
#define WIDTH  640      /* Image width */
#define HEIGHT 410      /* image height */
#define SLEN    80      /* maximum length of file names */

int main()
{
 /*
   * Two dimensional arrays to hold the current image data
   * One array for each color component
   */
     unsigned char   R[WIDTH][HEIGHT];
     unsigned char   G[WIDTH][HEIGHT];
     unsigned char   B[WIDTH][HEIGHT];
/*  Please replace the following code with proper menu  */
/*  with function calls for DIP operations              */
    AutoTest(R, G, B);
/*  end of replacing*/

    return 0;
}
```

```
void Aging(unsigned char R[WIDTH][HEIGHT],
           unsigned char G[WIDTH][HEIGHT],
           unsigned char B[WIDTH][HEIGHT])
{
  int x, y;
  for( y = 0; y < HEIGHT; y++ )
    for( x = 0; x < WIDTH; x++ ) {
     B[x][y] = ( R[x][y]+G[x][y]+B[x][y] )/5;
     R[x][y] = (unsigned char) (B[x][y]*1.6);
     G[x][y] = (unsigned char) (B[x][y]*1.6);
  }
}
Void AutoTest(unsigned char R[WIDTH][HEIGHT],
              unsigned char G[WIDTH][HEIGHT],
              unsigned char B[WIDTH][HEIGHT])
{
    char            fname[SLEN] = "UCI_Firetrucks";
    char            sname[SLEN];
    ReadImage(fname, R, G, B);
    Aging(R, G, B);
    strcpy(sname, "aging");
    SaveImage(sname, R, G, B);
    printf("Aging tested!\n\n");
}
```

ASSIGNMENT 5

- Test All
  - Call all the image processing in the program
  - Default input name UCI_Firetrucks
  - Read the UCI_Firetrucks.ppm
  - Save the processed image (ppm and jpg)
- View your result
  - eog
  - http://newport.eecs.uci.edu/~youruserid
- Submission
  - Run ‘test all’ option in the script
  - Name your files PhotoLab.c, PhotoLab.txt, PhotoLab.script