CS 470: Assignment 02

Programming Assignments (95%)

Your program MUST be written in **Python**. Your code file should be named **A02.py.**

The goal of this assignment is to write code to perform **convolution**.

You may NOT use OpenCV functionality for performing filtering/convolution! However, you may use the following OpenCV functionality:

- Loading/saving an image
- Window display
- Grayscale conversion
- convertScaleAbs
- flip
- copyMakeBorder

If you are not sure whether a library function is permitted, ASK ME!

A02.py should contain the following functions:

- **def read_kernel_file(filepath)**
    - Open a file for reading and grab the first line
    - The kernel files have the format:
        - (row count) (column count) (value 0,0) (value 0,1) … (value r,c)
    - For example:
        - 3 3 1 2 1 0 0 0 -1 -2 -1
    - …will ultimately become:
        - 1 2 1
0 0 0
-1 -2 -1
    - Split the line into tokens by spaces
        - Use the string split method
    - Grab the first and second tokens, convert them to ints, and store them as the row and column counts:
        - rowCnt = int(tokens[0])
    - Create a numpy array of zeros of shape (rowCnt, colCnt) to store your kernel values
    - Starting at index = 2, loop through each row and column of the kernel/filter and store the correct token (converted to a float)
    - Return your kernel

- **def apply_filter(image, kernel, alpha=1.0, beta=0.0, convert_uint8=True)**
    - Cast both the image and kernel to "float64"
    - Rotate the kernel 180 degrees so that you are performing convolution:
        - kernel = cv2.flip(kernel, -1)
    - Create a padded image:
        - Get the amount of padding as the height and width of the **kernel** integer-divided by 2
        - Use copyMakeBorder to create a padded image using borderType=cv2.BORDER_CONSTANT and value=0 (zero-padding)
    - Create a FLOATING-POINT (**float64**) numpy array to hold our output image
        - Note this output image should be the size of the original image, NOT the padded one!
    - For each possible center pixel (row,col) (you can use the dimensions of the original image or the output image, but NOT the padded image!!!!)
        - You can do correlation of the neighborhood using a neat numpy trick:
            - Grab the subimage from the PADDED image
              [row : (row + kernel.shape[0]), col : (col + kernel.shape[1])]
            - Multiply the subimage by the kernel:
                - filtervals = subImage * kernel
            - Get the sum of these values:
                - value = np.sum(filtervals)
            - Write this to your output image
                - output[row,col] = value
    - If convert_uint8 is True:
        - Use convertScaleAbs on the output image using the provided alpha and beta
    - Return output image

In addition to the functions, you will also copy and paste in the following to allow you to run your program with Gradio (be sure to "import gradio as gr" at the top):

```
def filtering_callback(input_img, filter_file, alpha_val, beta_val):
    input_img = cv2.cvtColor(input_img, cv2.COLOR_BGR2GRAY)
    kernel = read_kernel_file(filter_file.name)
    output_img = apply_filter(input_img, kernel, alpha_val, beta_val)
    return output_img


# Later, at the bottom
if __name__ == "__main__":
    main()
```

```
def main():
    demo = gr.Interface(fn=filtering_callback,
                        inputs=["image",
                                "file",
                                gr.Number(value=0.125),
                                gr.Number(value=127)],
                        outputs=["image"])
    demo.launch()

                            inputs=[image_data,
                                    filter_filename,
                                    alpha_number,
                                    beta_number],
                            outputs=image_output)

        edge_button.click(edge_callback,
                            inputs=[image_data,
                                    scale_number,
                                    thresh_number],
                            outputs=mh_output)

    demo.launch()
```

If you run your program, you should be able to open a web browser to http://127.0.0.1:7860 and see a nice GUI version.

Testing Screenshot (5%)

I have provided several new files for testing:

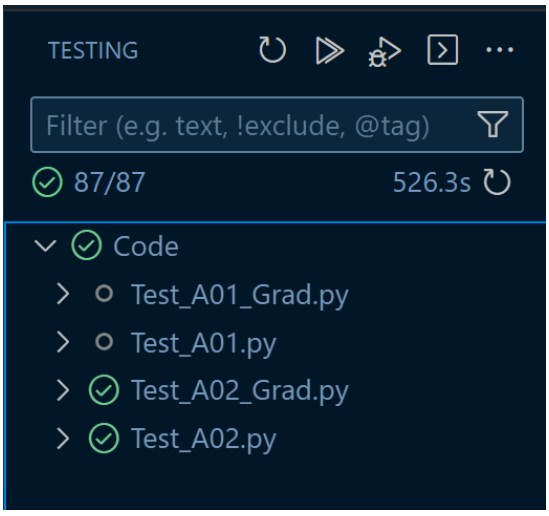
- Test_A02.py – the test program for CS 470
- assign02/
    - images/
        - Input images for testing
    - filters/
        - Filter files
    - ground/
        - Ground-truth images organized by filters and approach

Copy these files/folders into the MAIN project folder; your python program (A02.py) should also reside there.

You can either run the testing programs directly OR you can use the testing section of Visual Code.

You MUST run the tests and send a screenshot of the test results! Even if your program(s) do not pass all the tests, you MUST send this screenshot!

You may have to do “Command Palette” → “Python: Configure Tests” → unitttest → root directory → "test_*.py", and then modify .vscode/settings.json to use "Test_*.py



This screenshot should show clearly:

- The final result of the test run on the command line ("OK" for all passing, "FAILED (failures=N)" for some or all failing).
- OR
- The testing view in Visual Code (see image on right)

Because there are SIGNIFICANTLY more tests than before, I'm really looking for the checkboxes (or failed overall markers) for Test_A02. I don't need to see ALL of the tests.

Grading

Your OVERALL assignment grade is weighted as follows:

- 5% - Testing results screenshot
- 95% - Programming assignments

I reserve the right to take points off for not meeting the specifications in this assignment description.

In general, these are things that will be penalized:

- **Code that is not syntactically correct (up to 60 points off!)**
- Sloppy or poor coding style
- Bad coding design principles
- Code that crashes, does not run, or takes a VERY long time to complete
- Using code from ANY source other than the course materials
- Collaboration on code of ANY kind; this is an INDIVIDUAL PROJECT
- Sharing code with other people in this class or using code from this or any other related class
- Output that is incorrect
- Algorithms/implementations that are incorrect
- Submitting improper files
- Failing to submit ALL required files