AI 361: Assignment 2

**Due: Saturday, November 30th, 11:59pm.**

**Submit via Moodle.**

**Weight: 5%**

**General guidelines:**

**What to Submit?**

You will submit the assignment on Moodle before the due date. Only submit the following:

* For the written exercises, you need to supply a written or typed answer in a (.TXT, .DOC, .DOCX, .PDF, or any readable format).

**Submission guidelines:**

* Make sure your Name, Student Number, and UPM Email are included in a the submission files.
* Make sure you have comments. Both inline and function headers.
* Use proper/effective variable names.

**Regarding the use of generative AI (aka ChatGPT)**

* + Not allowed for this assignment!
  + A zero mark will be assigned, without negotiation, for any cases suspected of involving generative AI misuse or obvious instances of copying and pasting activities. Clear cases of academic misconduct will be reported to the Department Head and the Dean’s office.

**Q1: Pseudocode for Noise Introduction and Image Reconstruction Using Convolution (Weight: 2.5%)**

**Purpose:**

Write pseudocode to introduce noise into an image and then apply convolution to reconstruct the original image by reducing or eliminating the noise.

**Requirements:**

1. **Part 1: Introduce Noise**
   1. **Write pseudocode to add random noise to a given image.** The noise can be "salt and pepper" noise, where random pixels are set to either the minimum or maximum intensity, or Gaussian noise, where random values from a normal distribution are added to pixel intensities.
   2. **Hint for Noise Introduction:**
      1. **Salt and Pepper Noise:** Loop through each pixel in the image. For each pixel, with a small probability, set its value to either the minimum or maximum intensity.
      2. **Gaussian Noise:** For each pixel, add a random value sampled from a Gaussian distribution (with a defined mean and standard deviation) to the pixel’s intensity.
2. **Part 2: Apply Convolution for Image Reconstruction**
   1. Write pseudocode to apply a convolution filter (such as a Gaussian blur or median filter) that will help reduce the noise and attempt to reconstruct the original image.
   2. **Hint for Convolution:**
      1. Define a convolution kernel (e.g., a Gaussian or median kernel).
      2. Slide the kernel across the image, computing the new pixel values based on neighboring pixels to smooth or average out the noise.
      3. **Set padding:** Decide on padding (e.g., zero-padding or edge-padding) to handle edges of the image. Padding ensures the kernel can cover all pixels, even those at the edges.
      4. **Set slide parameters:** Determine the stride or step size for sliding the kernel across the image. A stride of 1 means moving one pixel at a time, while a larger stride skips pixels for faster, but potentially less precise, convolution.
      5. **Slide the kernel across the image, compute new pixel values based on neighboring pixels to smooth or average out the noise.**

**Q2: Pseudocode for Contrast Enhancement in RGB Channels (Weight: 2.5%)**

**Purpose:**

Write pseudocode to enhance the contrast of an image by adjusting the RGB channels. This enhancement can emphasize the difference between light and dark areas, improving image visibility and detail.

**Requirements**:

1. **Part 1: Contrast Enhancement in RGB Space**
   1. Write pseudocode to adjust the contrast of each RGB channel independently, enhancing the difference between light and dark values.
   2. **Hint for RGB Adjustment**:
2. Normalize each RGB channel's pixel values to a common scale (e.g., 0 to 255).
3. Apply a contrast adjustment formula, such as linear stretching or histogram equalization, to each channel separately. iii. Scale the adjusted values back to the original range, if necessary.
4. **(BONUS) Part 2: Contrast Enhancement in HSL/HSV Space (Weight: +1%)**
   1. Write pseudocode to convert the image from RGB to HSL or HSV color space and adjust the "Lightness" or "Saturation" channels to enhance contrast, emphasizing shadows and highlights.
   2. **Hint for HSL/HSV Adjustment**:
5. Convert the RGB image to HSL or HSV color space.
6. Increase contrast by modifying the "Lightness" (L) channel to enhance light and dark regions or adjust the "Saturation" (S) channel to make colors more vivid.
7. Convert the adjusted image back from HSL/HSV to RGB.

**FAQs:**

* **Q:** What is a pseudocode?
  + Pseudocode is a way to describe algorithms in a structured but informal, human-readable form, bridging the gap between everyday language and programming code. It outlines the logic of an algorithm or program without being tied to a specific programming language syntax.
  + Pseudocode Writing Guide:
    - Use Plain English: Write instructions in simple language.
    - Indent for Structure: Use indentation to show hierarchy, such as loops or conditionals.
    - Use Standard Programming Terms: Terms like IF, ELSE, FOR, and WHILE are common.
    - Be Consistent: Stick to a consistent format to improve readability.
    - Avoid Specific Syntax: Pseudocode is not meant to follow any specific programming language syntax strictly.
  + Pseudocode for Calculating the Factorial of a Number:
    - Input: Integer 𝑛 (the number to calculate the factorial of)
    - Output: Integer factorial (the factorial of 𝑛)
    - Parameters: 𝑛: Integer input from the user
    - Pseudocode:

|  |
| --- |
| START  DEFINE INPUT: n (Integer)  DEFINE OUTPUT: factorial (Integer)  INPUT n  SET factorial = 1  IF n < 0 THEN  PRINT "Factorial is not defined for negative numbers"  ELSE  FOR i FROM 1 TO n DO  factorial = factorial \* i  END FOR  PRINT "The factorial of", n, "is", factorial  END IF  END |

* **Q:** I don’t know where to start.
  + **A:** Join the office hour or send me a message on MS Teams and I will do my best to address your questions.
* **Q:** There is a bug in my code!
  + **A:** Debugging is part of the challenges we as programmers need to be patient with. Spend some time with it and if not resolved, share your code, and provide details about the issue on the MS Teams channel. Your classmates may provide some hints and I can also share feedback.
* **Q:** I don’t know how to do X?
  + **A:** Approach me and I will try to guide how to do it. I may end up myself searching with you some of the questions.
* **Q:** My code isn’t working.
  + **A:** It is probably a matter of more testing and debugging. Do your best and if you still cannot make it work, let me know and I will join the debugging activity.
* **Q:** You’re asking us to do a bunch of things you haven’t taught us!
  + **A:** I know. This is because some real-life cases will require extensive search to find a solution for. Let me know if you feel that this is overwhelming.
* **Q:** Can I email the professor with questions?
  + **A:** Of course, anytime!
* **Q:** If I submit it at 12:00am, you’ll still mark it, right?
  + **A:** 11:59pm and earlier is on time. Anything after 11:59pm is late. Anything late will not be probably marked. If I find you have a legitimate cause, you will be graded according to the following rules (24 hours after deadline 🡪 assignment is marked out of 75% only, 48 hours after deadline 🡪 assignment is marked out of 50% only, 72 hours after deadline 🡪 assignment is marked out of 25% only).