Linear Algebra Course (Fall 2023)
Mid-Semester Project
Due Date: 24th November

Image Manipulation with Linear Algebra

Introduction

The purpose of this project is to apply fundamental concepts of linear algebra to perform various image manipulation operations. Students will gain a better understanding of how matrices can be used to transform and manipulate images.

Prerequisites

Basic knowledge of linear algebra, including matrices, matrix multiplication, and transformations. Proficiency in a programming language (e.g., Python, MATLAB, or C++).

Project Overview

In this project, students will implement the following image manipulation operations using linear algebra techniques:

1. **Image Resizing**
   Implement resizing of images using matrix operations. This includes both upscaling and downscaling.

2. **Image Rotation**
   Perform image rotation by applying rotation matrices. Students will learn how to transform pixel coordinates to achieve rotation.

3. **Image Filtering**
   Apply convolution operations on the image using filter kernels. This includes operations like blurring, sharpening, and edge detection.

4. **Color Manipulation**
   Implement color transformations, such as grayscale conversion, color inversion, and color balance adjustments. Project Structure

Main Components

1. **Image Class:** Create a class or data structure to represent and manipulate images. This should include methods for loading images, performing operations, and saving results.

2. **Matrix Transformation:** Implement functions for matrix transformations needed for resizing and rotation. Students will need to apply scaling and rotation matrices.

3. **Convolution:** Develop functions for convolution operations with various filter kernels for image filtering.

4. **Color Transformations:** Implement methods to manipulate colors in the image, such as converting to grayscale or adjusting color balance.

Workflow

1. Load an image from a file or generate one programmatically

2. Implement the desired image manipulation operations (resizing, rotation, filtering, and color manipulation)

3. Display or save the manipulated image

4. Document and explain the linear algebra concepts applied in each operation

Evaluation Criteria

Students will be evaluated based on the following criteria:

- Correct implementation of image manipulation operations

- Efficiency of the implemented algorithms

- Clarity and documentation of the code, including explanations of the linear algebra concepts used in each operation

- The visual quality of the manipulated images

Good Luck, Have Fun, Code a Lot !