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**Assignment 03**

**Project Proposal**

**CS250: Data Structures and Algorithm (3+1)**

**BS (Mathematics) : Fall 2023**

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| **Course Learning Outcomes (CLOs)**  **CLO-1:** Understand the fundamentals of data structures and algorithms  **CLO-2: Apply Data Structures and Algorithms to solve complex engineering problems.**  **CLO-3: Use appropriate Data Structures and Algorithms to design solutions**  **CLO-4:** Investigate and evaluate various algorithms based on accuracy, time complexity, and memory requirements. |

**Hasan Amin (374866)**

**Ehtasham Khattak (366150)**

**In this assignment, you need to provide your project proposal along with group member details with task distribution. Use the template given to provide all information. Provide a 1 - page proposal of your selected project, explaining the overall aims and achievable targets. You should concisely explain the complex engineering problem you are trying to solve.**

Output:

# Task 1

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| Implementing Fast Fourier Transform (FFT) Algorithm and Image ProcessingIntroduction: The Fast Fourier Transform (FFT) is a pivotal algorithm in image processing, enabling the swift transformation of images from the spatial to frequency domain. By dissecting images into their frequency components efficiently, FFT empowers tasks like filtering for noise reduction, edge detection, and various enhancements. Its ability to unveil the underlying frequency information within images makes FFT indispensable for precise analysis and manipulation in diverse image processing applications.  This project will utilize Python to implement FFT and utilize the corresponding algorithm in processing images. Objectives:  * To Develop a deep understanding of the FFT algorithm and its applications. * To Implement the FFT algorithm in Python. * To Apply the FFT algorithm to process and manipulate images.  Proposed Methodology:  * Research and Understanding   + Comprehensive study of the FFT algorithm and its mathematical principles.   + Understanding the mathematical basis of how FFT operates on images.   + Exploring existing libraries or implementations for reference (NumPy, SciPy, etc.). * FFT Algorithm Implementation   + Step-by-step breakdown of the FFT algorithm:     - Transforming 1D arrays and understanding the iterative steps.     - Extending the algorithm to 2D arrays for image processing.   + Writing Python functions/classes for the FFT algorithm. * Image Processing with FFT   + Preprocessing images for FFT analysis (grayscale conversion, resizing, etc.).   + Applying the implemented FFT algorithm to images:     - Transforming images to the frequency domain.     - Performing operations like filtering, noise reduction, etc., in the frequency domain.     - Reconstructing images from the modified frequency domain.  Expected Outcome: Successfully implementing the FFT algorithm in Python for image processing.  Demonstrating the effectiveness of FFT in various image manipulation tasks.  A clear understanding of the trade-offs and limitations of the self-implemented FFT. |

# Task 2

Provide group member details along with task distribution, i.e. consider your group as a team undertaking this project for timely delivery to a client. You should clearly allocate primary roles to each group member.

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| Group Member Name | Role / Tasks Allocated |
| Hasan Amin | * Understand the Mathematical insights of the algorithm * Find the applications of various data structures in the algorithm to improve its efficiency and time complexity. * Write python functions for algorithm implementation. * Exploring Python libraries to deal with image datasets * Study the array (1D and 2D) transformations for FFT * Examine multiple options of image processing such as compressing, sharpening,blurring etc. |
| Ehtasham Khattak | * Investigate the possible implementation(s) of the algorithm in Numpy and elsewhere. * Write python functions for algorithm implementation. * Explore image datasets as our test data. * Study the array (1D and 2D) transformations for FFT |

# Task 3

In this section, you need to elaborate your project idea by mapping the below mentioned concepts to your project. Please mention briefly how a particular concept will be applied in your project. This mapping may change in next few weeks as you build and expand your project, but at this stage it should be elaborate enough to quantitatively monitor your project progress on weekly basis.

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| Topic | Application in your project |
| Data structures and algorithms |  |
| Array / linked lists | Will be used in pixel data storing |
| Singly / Doubly / Circular linked list | Scope will be explored further during the project |
| Running time complexity, function growth | Enhancing already implemented algorithms of FFT |
| Stacks and queues | Scope will be explored further during the project |
| Algorithm Analysis | Already implemented algorithms will be analysed to look for improvements |
| Sorting algorithms & Recursion | Scope will be explored further during the project |
| Trees & Binary search tree operations | Scope will be explored further during the project |
| AVL trees, priority queues | Scope will be explored further during the project |
| Binary heaps, hash tables | Scope will be explored further during the project |
| Graphs and search operations | Scope will be explored further during the project |
| Topological sort, spanning trees | Scope will be explored further during the project |
| Shortest paths, Greedy algorithms | Scope will be explored further during the project |