Project | Image compression

Title	**Due date**
Image Compression Project	January 5, 2025

Objective

In this project, you will design and implement a unique image compression system, applying both lossy and lossless techniques. The project will demonstrate your understanding of multimedia concepts while giving you hands-on experience in implementing compression algorithms.

Project Description

Each student will:

1. Develop a unique image compression system combining specific lossy and lossless techniques assigned to you.
2. Test the system on a provided input image.
3. Generate a compressed file and decompress it back to verify the results.
4. Measure and report metrics such as compression ratio and PSNR.
5. Submit a report explaining your implementation, results, and challenges.

Project Components

1. Input Image

Each student is assigned a unique input image to ensure projects are distinct. Use only the image assigned to you.

2. Compression Techniques

Your compression system must include:

- **One lossless technique** (e.g., VLC, RLC, Arithmetic Coding).
- **One lossy technique** (e.g., Adaptive Quantization, Wavelet Transform).

Both techniques must be implemented in your system *as per the table provided*.

3. System Requirements

Your program should:

a. Accept the input image in the specified format (PNG).
b. Perform the assigned compression tasks.
c. Output a compressed file.
d. Decompress the file and generate an output image.

Tasks to Complete

A. Implementation

1. Design your compression system: Combine the assigned lossy and lossless techniques.
2. Write the code: Implement the compression and decompression processes using a programming language of your choice.
3. Optimize: Adjust your implementation for efficiency (compression ratio vs. quality trade-offs).

B. Testing

1. Use the provided input image to test your system.
2. Measure the following:
   - Compression Ratio: Size of the compressed file compared to the original.
   - PSNR (Peak Signal-to-Noise Ratio): Indicates the quality of the decompressed image.

C. Reporting

Prepare a report (PDF format) of a maximum of 6 pages that includes:

1. Introduction: A brief overview of image compression and the techniques assigned to you.
2. Implementation Details:
   - Explain the algorithms and techniques you implemented.
   - Highlight any unique optimizations or enhancements.
3. Results:
   - Show before-and-after metrics (compression ratio, PSNR, SSIM).
   - Include visual comparisons of the original and decompressed images.
4. Conclusion: Summarize your findings and lessons learned.

D. Submission

1. Code files (in a ZIP archive).
2. A sample compressed file generated by your system.
3. Your report (PDF format).
4. A Google Drive URL of a screen-recorded demonstration of your program running.
5. Submit your files to the following email address: elias.alzaghrini@ul.edu.lb

Rules and Guidelines

1. **Individual Work**: This project must be completed individually. Collaboration is not allowed.
2. **Assigned Techniques**: You must use the techniques specified in the project table.
3. **Late Submissions**: Late submissions will incur penalties unless prior approval is granted.

Grading Criteria

30% Correctness
20% Implementation of Techniques
20% Efficiency
20% Report Quality
10% Documentation

Tools and Resources

1. You may use libraries for basic image processing (e.g., OpenCV, PIL) but must implement the compression algorithms yourself.
2. Metrics like PSNR can be calculated using existing libraries.

Student ID	Input Image	Lossless Technique	Lossy Technique
Aad Nakhle	image_1.png	RLC with VLC	Adaptive Quantization
Aad Hanna	image_2.png	Entropy-based VLC	Region-specific Quantization
Achkouty Joe	image_3.png	Arithmetic Coding	Predictive Quantization (Red Channel)
Al Fhaily Christolio	image_4.png	Arithmetic Coding	Predictive Quantization (Green Channel)
Al Haber Emma Nour	image_5.png	Arithmetic Coding	Predictive Quantization (Blue Channel)
Aramouni Marissa	image_6.png	Custom VLC	Custom Quantization Matrices
Assaker Charbel	image_7.png	Run-length Encoding	Variable Block Sizes (4x4 to 16x16)
Azar Abdo	image_8.png	Optimized VLC	Frequency-domain Quantization
Beainy Theresa	image_9.png	Multi-pass Arithmetic Coding	Multi-level Quantization
Bou Malham Pierre	image_10.png	Adaptive VLC	Wavelet Transform (Haar)
Bou Merheb Kevin	image_1.png	Huffman Coding	Wavelet Transform (Daubechies)
Bou Naoum Elie	image_2.png	Huffman Coding	Wavelet Transform (Haar)
Chahine Georges	image_3.png	Adaptive VLC	Frequency-based Quantization
Chahoud Christia	image_4.png	Threshold Encoding	Threshold Quantization
Chebib Joanna	image_5.png	Color-based VLC	Color Space Compression
Daher Charbel	image_6.png	Spatial-temporal VLC	Blended Spatial-Temporal Compression
Daldalian Paolo	image_7.png	Layered VLC	Progressive Compression
Fakhoury Jad	image_8.png	Noise-aware VLC	Noise-adjusted Quantization
Hanna Johnny	image_9.png	Histogram-based VLC	Preprocessing for Quantization
Jabbour Charbel	image_10.png	Edge-aware VLC	Edge-aware Quantization
Kamal Anthony	image_1.png	Region-specific VLC	Detail-preserving Quantization
Kandalaft Yorgo	image_2.png	Dynamic Block Encoding	Adaptive Block Quantization
Kassis Pia	image_3.png	Entropy-optimized VLC	Entropy-optimized Quantization
Kdeissy Karen	image_4.png	Multi-level VLC	Frequency-domain Quantization
Kiwan Charbel	image_5.png	Frequency-aware VLC	Custom Quantization Scheme
Maalouf Pauline	image_6.png	Custom Arithmetic Coding	Dynamic Quantization Selection
Matta Marc Raphael	image_7.png	Dynamic VLC	Low-light Adjustment
Melki Georges	image_8.png	Low-light VLC	Speed-enhanced Quantization
Merhi Elissa	image_9.png	Speed-focused VLC	File Size Reduction Prioritization
Nachef Cyril	image_10.png	Size-prioritized VLC	PSNR-maximizing Quantization
Nasr Claude	image_1.png	Quality-prioritized VLC	Selective Channel Quantization
Nehme Elio	image_2.png	Selective VLC	Context-based Arithmetic Quantization
Nohra Ghayath	image_3.png	Context-based Arithmetic Coding	Custom Error Metrics
Said Hadi	image_4.png	Custom Error-aware VLC	Gradient-based Quantization
Salameh Mary	image_5.png	Gradient-specific VLC	Hybrid Quantization (Lossy & Lossless)
Sawaya John	image_6.png	Hybrid VLC	Region-specific Lossy Encoding
Teddy Elias	image_7.png	Region-priority VLC	Adaptive Lossy Compression
Touma Ralph	image_8.png	Adaptive VLC	Energy-efficient Lossy Encoding
Younes Jean Pierre	image_9.png	Energy-efficient VLC	High-resolution Lossy Optimization
Youssef Roy	image_10.png	Resolution-prioritized VLC	High-resolution Lossy Optimization