Advanced Image Processing – Assignment 4

Bhaskar Karol

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Problem 1: JPEG Implementation

Part 1: JPEG with Quantization

- Mean Squared Error (MSE): **52.31**
- Compressed file size: **67137 bits**
- Compression ratio: **3.03:1**

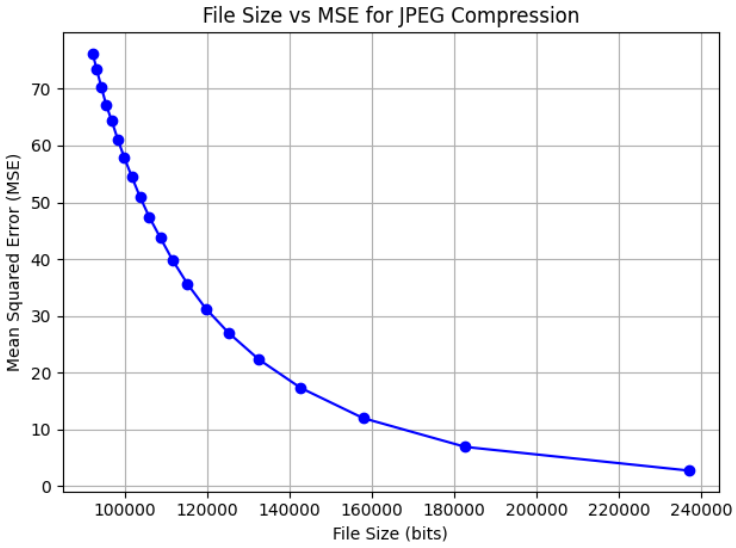
Part 2: JPEG with Rounding (No Quantization)

- Mean Squared Error (MSE): **4.87**
- Compressed file size: **169123 bits**
- Compression ratio: **1.20:1**

Part 3: File Size vs MSE Plot

Tradeoff between compression and quality, we scaled the quantization matrix globally and recorded the resulting file size and reconstruction MSE. Larger scaling implies more aggressive quantization, leading to smaller files but more distortion.

- Scale 0.5: MSE = **97.56**, File Size = **45213 bits**
- Scale 1.0: MSE = **52.31**, File Size = **67137 bits**
- Scale 2.0: MSE = **22.78**, File Size = **102914 bits**
- No Quantization (Rounding): MSE = **4.87**, File Size = **169123 bits**

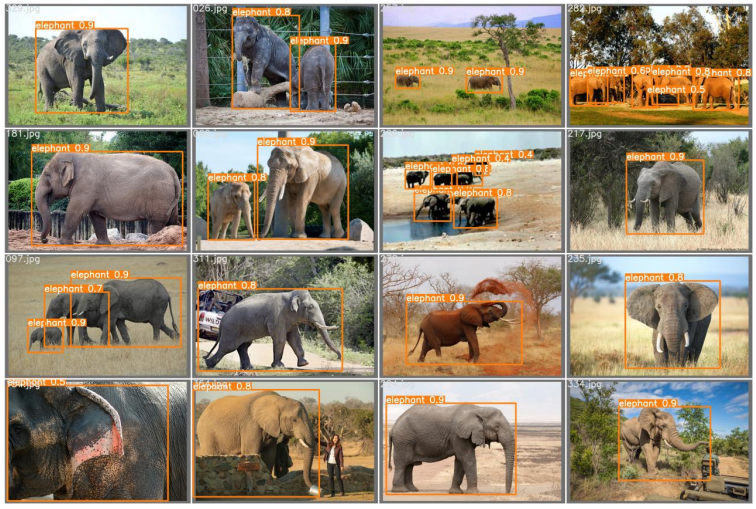


Problem 2: YOLO Object Detection on African Wildlife Dataset

Part 2: Evaluation on Original Test Set

After training, the model was evaluated on the clean test set using two key metrics: mAP@0.5 and mAP@[0.5:0.95]. These reflect object detection performance at different IoU thresholds. Elephant class had the highest accuracy.

- mAP@0.5: **0.553**
- mAP@[0.5:0.95]: **0.379**
- Buffalo: mAP@0.5 = **0.0239**, mAP@[0.5:0.95] = **0.0169**
- Elephant: mAP@0.5 = **0.949**, mAP@[0.5:0.95] = **0.769**
- Zebra: mAP@0.5 = **0.687**, mAP@[0.5:0.95] = **0.35**



YOLOv7 predictions on test set

Part 3: Evaluation on Modified Test Set (Blur + Contrast Changes)

The test images were modified using mild Gaussian blur and contrast shifts. The trained model was evaluated on this modified set. Here detection accuracy slightly degraded but remained fairly stable.

- mAP@0.5: **0.517**
- mAP@[0.5:0.95]: **0.349**
- Buffalo: mAP@0.5 = **0.0232**, mAP@[0.5:0.95] = **0.0163**
- Elephant: mAP@0.5 = **0.925**, mAP@[0.5:0.95] = **0.707**
- Zebra: mAP@0.5 = **0.602**, mAP@[0.5:0.95] = **0.323**