
Assignment 6

Deadline: Tuesday, November 8, 2022 (end of day)

Objective

Realize a lossless image compression and compare your result with GIF compression for the sample image provided on Ilias (https://ilias.unibe.ch/goto_ilias3_unibe_fold_2572742.html).

Task: Image compression

Analyze the three images present on ILIAS to decide which compression strategy is the most promising one. Below, we suggest two such strategies, namely 2D run-length encoding and quadtree representation. Choose one of them, or yet another strategy of your own design. Regardless of the compression method you choose, write an algorithm to decompress the image back to the original image.

1. 2D run-length encoding

The idea is to represent the image as a sequence of horizontal *bands* that are composed of several identical rows of pixels. Within each band, the repeated row of pixels is represented by means of runs of pixels with the same color. Finally, entropic encoding is applied to reduce the number of bits needed to encode the different run lengths.

- (a) Determine the width w , height h , and number of distinct colors c of the input image.
- (b) Represent the image as a sequence of bands $(h_1, r_1), (h_2, r_2), \dots$, where $h_i \in [1, h]$ the height of the band, r_i the repeated row, and $\sum h_i = h$.
- (c) Represent each row r_i as a sequence of runs $(c_1, w_1), (c_2, w_2), \dots$, where $c_i \in [1, c]$ the color of the run, $w_i \in [1, w]$ the length of the run, and $\sum w_i = w$ (see lecture slides).
- (d) Instead of using a fixed number of bits to represent the run lengths w_i , use entropic coding to represent the most frequent lengths with only few bits and less frequent lengths with more bits, for example by means of Huffman codes (see lecture slides).

2. Quadtree representation

The idea is to subdivide the image into quadratic cells and then represent each cell by means of a quadtree.

- (a) Determine the width w , height h , and number of distinct colors c in the input image.

- (b) Cover the image with a grid of quadratic cells, for example cells of 64×64 pixels.
- (c) For each cell, build a quadtree, which contains non-terminal nodes for heterogeneous regions with different colors, and terminal nodes for homogeneous regions with the same color $c_i \in [1, c]$ (see lecture slides).
- (d) Represent each quadtree as a sequence of symbols for non-terminal and terminal nodes, for example using a depth-first traversal (see lecture slides).

3. Compression result

- (a) For the chosen compression strategy, calculate the number of bits needed to represent the sample image after compression.
- (b) Implement the decompression algorithm to recover the original image.

Hand-in

Submit on ILIAS one and only **one folder** containing:

- The response to question 3a).
- A text file, with your name, github link and a brief explanation of your algorithm

Please take these conditions into account, otherwise your exercise will not be evaluated. If you have any questions you can contact us via email.