

Image Encoding User Guide

Huffman Encoding
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Compilation:

To compile the Huffman encoding executable file, huff, may be specifically created with the use of the top-level makefile by running the command `make huff`. Additionally, all executables in the project can be created by simply running the `make` command without any arguments.

If you wish to compile the source code without the use of the makefile, all the source files for the Huffman program can be found in `src/huffman`. To compile, use the following command:

```
g++ -std=c++11 -o huff huffman.cpp bitstream.cpp huffnode.cpp \ `pkg-config opencv --cflags --libs`
```

Usage:

```
./huff -[e|d] <infile> <outfile>
-[e|d]: either -e to encode the infile, or -d to decode the
        infile
<infile>: the file to be encoded or decoded
<outfile>: the file that the resulting encoding or decoding is
           saved to
```

Three Channel Color PPM Images Should Be Used For Input and Output Images

The Huffman encoding program is a command-line utility for encoding and decoding image files according to the Huffman encoding algorithm. When encoding, an image file is given as the input file and the encoding is saved to the given output file. When decoding, a file encoded with this application is given as the input file, and the decoded image is saved to the given output file. When encoding, several statistics are also printed to the console. The total entropy detected in the source image, the average number of encoded bits per source symbol (8 bits), and the total compression ratio are all printed as statistics.

This program uses OpenCV for image reading and writing, and only certain image formats will work properly. The program was designed to handle only 3-channel color images with channel intensities in the range of 0 to 255. A variety of image types are suitable for encoding, such as PNG, PPM, and JPEG. Only PPM images are the intended image type when using the program to decode, although other image types may also work.

Example:

A JPEG image of a hummingbird is encoded with the Huffman executable. Several statistics are printed to the console, and the compressed.bin file is created.

```
>>./huff -e Hummingbird.jpg compressed.bin
Entropy: 5.93722
Average Bits per Value: 5.9504
Compression Rate: 25.5962%
```

To decode the compressed.bin file and recreated the image, the Huffman executable is run using the -d flag.

```
>>./huff -d compressed.bin Bird.ppm
```

Note that the new image file, Bird.ppm, has the PPM file format, rather than the JPEG format of the original. The underlying image data in both Hummingbird.jpg and Bird.ppm will be identical, thanks to the lossless nature of the Huffman encoding algorithm.