Supplement to Chapter 3 of *The Science of Digital Media* – Digital Image Processing

Worksheet – Digital Imaging > Huffman Encoding[1]

Before completing this worksheet, you should view the on-line interactive tutorial "Huffman Encoding." This tutorial can be accessed at the website for *The Science of Digital Media*.

c	a	a	b	g	g
c	d	f	b	b	f
d	d	h	d	e	b
f	g	g	a	a	a
h	g	a	g	g	c
d	a	c	i	g	c
j	k	d	c	c	a

Color	Frequency
a	8
b	4
c	7
d	6
e	1
f	3
g	8
h	2
i	1
j	1
k	1

1. Create a Huffman tree from the colors and frequencies above.

2. After placing 0s and 1s in your tree's branches, determine the new code to accompany each color.

Color	Code
a	
b	
c	
d	
e	
f	
g	
h	
i	
j	
k	

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3. How many bits were in the original image?

4. How many bits is this new image table?

5. Think about how decoding of a Huffman encoded file would work. Say that the first seven bits in the encoded image are 0111010. (This is an arbitrary example and may not match the codes you got above, but just think of the example in the abstract.) If you had the Huffman tree for decoding, how would you decode the string of bits?

6. Rather than save the whole Huffman tree in the encoded file, it's possible to save just the frequency table. Why is this sufficient?

7. Compute the compression rate for this example. Assume that the encoded file contains the compressed image file and also the frequency table. Then what is the compression rate of the image after the Huffman encoding? (You don't have to consider the size of the file header. There would be a header, but let's not worry about its format.)

8. Is Huffman encoding lossy or lossless? Explain what this means.