

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

Worksheet – Digital Imaging > Octree Algorithm¹

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

1. Given the following color component values, mark which three-bit child number belongs in each level of the octree:

R: 10010110

G: 01110100

B: 11011001

Level 1: _____

Level 5: _____

Level 2: _____

Level 6: _____

Level 3: _____

Level 7: _____

Level 4: _____

Level 8: _____

2. Say that the pixel above is the first one to be processed as you create an octree for an RGB image file. Draw the resulting octree.
3. Say that you're inserting a new color into the octree, and it entails inserting a 257th leaf node. You now have to decide which node will "absorb" its children, thereby reducing the number of nodes again to less than 256. Give a strategy for choosing this node, and justify your strategy.
4. Assume that the node you've chosen (in #3 above) is pictured below. What color should be used to represent all the children nodes that are deleted. Give a specific color (r,g,b), where r, g, and b are integers between 0 and 255. Explain how you got this color and why it makes sense to do it this way.
5. The octree algorithm described in the book never lets the number of leaf nodes go above 256. However, it's theoretically possible to keep generating leaf nodes until you've run all the pixels in the image through the octree, and

¹This material is based on work supported by the National Science Foundation under Grant No. DUE-0340969. This worksheet was written by Annie Lausier and Jennifer Burg.

at that point reduce the number of nodes to 256. Give one advantage and one disadvantage of waiting until the end.

6. Determine the file size in kilobytes of an RGB image file of dimensions 100 x 80 with no compression, disregarding the header.
7. Determine the file size in kilobytes of an uncompressed indexed color file of dimensions 100 x 80, including a color table of 256 RGB colors, disregarding the header.
8. Using the file sizes of the RGB image and indexed image above, determine the compression rate of indexed color.
9. Explain what makes the octree algorithm's color selection for indexed color efficient.