CS 519: Scientific Visualization Fall 2017
In-class Worksheet

Volume Visualization

The Over Operator

Suppose we store colors with an alpha value that indicates the level of transparency with 0 being transparent and 1 being opaque. Compositing of two colors with alpha values can be accomplished using the over operator:

C_A over $C_B = \alpha_A C_A + (1-\alpha_A)\ \alpha_B C_B$

$\alpha_{AB} = \alpha_A + (1-\alpha_A)\ \alpha_B$

1. Blending

Suppose C_A=(0.5, 0.5, 0.75, 0.75) and C_B=(0.0, 0.25, 0.25, 0.5)

a. Compute C_A over C_B

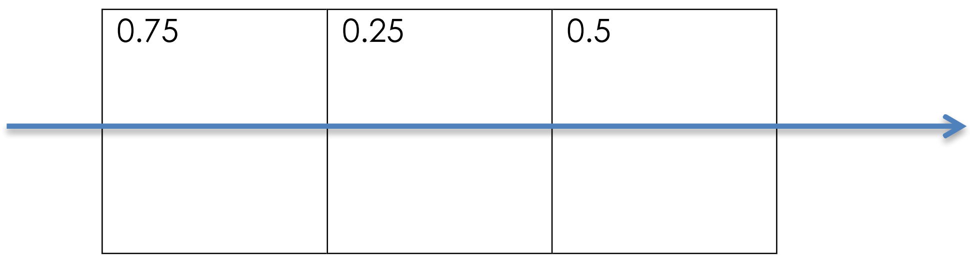
b. Compute α_{AoverB}

2. Algebra for the over operator

a. Prove that the Over operator is not commutative

b. Is it true that Over is associative
C_A over (C_B over C_C) = (C_A over C_B) over C_C ?

3. **Image-Order Volume Visualization**
Consider the following ray through a pixel into a volume in which the scalar data are all in [0,1]. One particular ray moves through the following 3 cells:



Suppose the transfer function we use is simply $I(s) = (1 - s, 0, s, s)$
Suppose the distance the ray traveled through each cell is 1

a. What is the color produced by a Maximum Intensity Projection?

b. What is the color produced by an Average Intensity Projection?

c. How would the color be produced by compositing with the Over operator? Just write out an expression, don't do the computation.

Pre-multiplied alpha
Suppose we use pre- multiplied alpha. A color (r,g,b) and an alpha value α is stored as (αr, αg, αb, α). Compositing of two colors with alpha values can be accomplished using the over operator: C_A over $C_B = C_A + (1-\alpha_A)C_B$

4. Derive a set of expressions using pre-multiplied alpha that allows front to back volume rendering. What advantage in terms of optimizations does this expression have? Can this be done with post-multiplied alpha?