Angel: Interactive Computer Graphics, Third Edition

Chapter 12 Solutions

12.5 Let case 0 be the case with no black or no white vertices, case 1 be the case with 1 black or one white vertex, case 2 be the case with two adjacent white vertices and and case 3 be the case with two diagonally opposite white vertices. Coloring consective vertices as 0 or 1, the 16 cases are

0000 0 all white
0001 1 one white
0010 1 one white
0011 2 two consecutive white
0100 1 one white
0101 3 diagonally opposite white
0110 2 two consecutive white
0111 1 one black
1000 1 one white
1001 2 two consecutive white
1010 3 diagonally opposite white
1011 1 one black
1100 2 two consecutive white
1101 1 one black
1110 1 one black
1111 0 all black

12.9 If the values of the function $f(x, y, z)$ are given at the corners of a unit cube with a vertex at the origin and lying in the positive octant, then trilinear interpolation approximates f inside the cube by the function

$$g(x,y,z) = (1-x)(1-y)(1-z)f(0,0,0) + x(1-y)(1-z)f(1,0,0)$$
$$+(1-x)y(1-z)f(0,1,0) + (1-x)(1-y)zf(0,0,1) + xy(1-z)f(1,1,0)$$
$$+x(1-y)zf(1,0,1) + (1-x)yzf(0,1,1) + xyzf(1,1,1).$$

Clearly where the cube is located is unimportant and the values of f can be replaced by samples at the vertices of any parallelepiped.

12.15 A possible approach is to consider volumes rather than surfaces. Thus, if we have a cube with one black vertex and the others white, the three points of intersection and the black vertex form a tetrahedron that "fills" part of the cube. We can use more tetrahedra for the other cases.