CS 519: Interactive Computer Graphics Fall 2015
In-class Worksheet 2

Dual Contouring

Dual Contouring in 2D (Surface Net) Algorithm

Choose an isovalue σ

Let s_p be the scalar value at a grid point *p*
A grid edge *e* = [*p*,*q*] is bipolar if $s_p \geq \sigma$ and $s_q < \sigma$ or the reverse

Estimate the point of intersection on *e* as:
$w = (1-\alpha)p + \alpha q$ with $\alpha = (\sigma - s_p)/(s_q - s_p)$

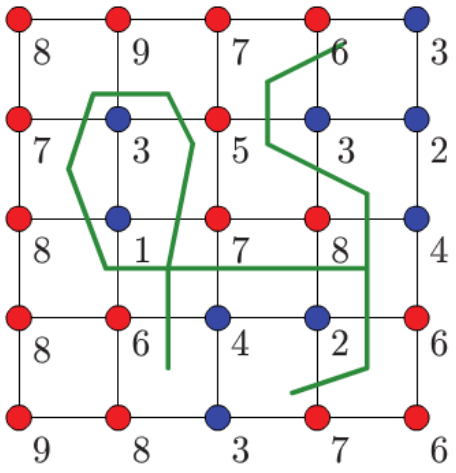
Let w_i be the *k* intersection points around a grid face.
Compute the contour vertex as:

$$w_c = \frac{1}{k}\sum_{i=1}^{k} w_i$$

Generate lines connecting contour vertices across bipolar grid edges.

1. **Dual Contouring**
   Suppose we chose an isovalue of 5. Generate the dual contour for the grid below. Simply estimate the vertex positions.

8	9	7	6	3
7	3	5	3	2
8	1	7	8	4
8	6	4	2	6
9	8	3	7	6



2. Vertex Placement

What are the coordinates of the contour vertex generated for the cell using an isovalue of 5

s(0,0) = 8 s(1,0) = 9

s(0,1) = 7 s(1,1) = 3

$$\alpha_1 = \frac{5-3}{9-3} = \frac{1}{3}$$

$$w_1 = \frac{1}{3}(1,0) + \frac{2}{3}(1,1) = \left(1, \frac{2}{3}\right)$$

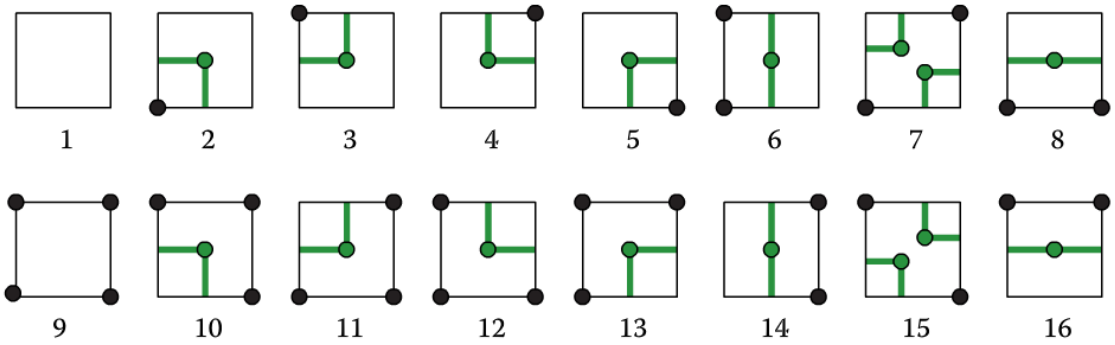
$$\alpha_2 = \frac{5-3}{7-3} = \frac{1}{2}$$

$$w_2 = \frac{1}{2}(0,1) + \frac{1}{2}(1,1) = \left(\frac{1}{2}, 1\right)$$

$$w = \frac{1}{2}\left(1, \frac{2}{3}\right) + \frac{1}{2}\left(\frac{1}{2}, 1\right) = \left(\frac{3}{4}, \frac{5}{6}\right)$$

3. Dual Marching Squares

Dual Marching Squares places contour vertices in cells but uses a lookup the following lookup table to generate the contour:



What cells from question would be different and in what way?

The 1-6-64-7 cell and 8-2-6-4 cell would have two contour vertices inside them.

What problem with Dual Contouring is Dual Marching Squares attempting to solve?

Dual Marching Squares attempts to reduce the frequency with which non-manifold contours are generated.