Scientific Visualization I
Assignment 4
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Exercise 4. 1 [2 Points] Grid Types I

(a) This is a unstructured grid because it has no explicit topology. The connectivity fo each grid is varied. Some vertices are connected to only 3 vertices, while some is connected to more than 6. The connectivity has no relation with location. Must use dedicated non-uniform data structure to store the data.

(b) This is a structured grid because it has a explicit topology. The connection for vertex exist only to its neighboring vertices. Vertex connectivity can be easily categorize into 2 type: vertices on the outest and most inner rim of circle has connection to 3 neighbor vertex and vertices inside the circle has connection to 3 neighbor vertex. All data could be stored in a uniform data structure with dimension 4, indicating its top, down, left, right neighbors.

Exercise 4. 2 [2 Points] Grid Types II

(a) This is a simulation with multigrid presentation. The advantage is that it focus in specific areas which can avoid unnecessary detail in other areas. It reveals the grid with actual simulation with importance. However, multigrid would have issue when it comes to interpolation on boundary. Moreover, it would take more effort for human to comprehend grid sizes with physical size.

(b) This is a simulation with Cartesian grid presentation. Its uniform structure gives more visibility ordering of elements than multigrid. For human, the overall image gives a understandable result for simulation. However, its rigid structure prohibits it to focus on particular area.

Exercise 4. 3 [1 Points] Voronoi Diagram

A Voronoi diagram has the property that for each sample every point within a Voronoi region is closer to it than to every other sample. For each Voronoi cell, which is a Voronoi region, are determined by the intersection of all half spaces, which is separated by the perpendicular bisector between two neighboring points

Delaunay graph is the geometric dual (topologically equal) of the Voronoi diagram. In Delaunay graph, two nodes are connected if and only if the Voronoi two cells share an edge.

Exercise 4. 4 [1 Points] Bi-linear Interpolation

First interpolate in x-axis to get f(4,2) and f(4,6), then interpolate these points to get f(4, 3.5)

$$u = \frac{4-3}{7-3} = 0.25$$

$$f(4,2) = (1-u)f(3,2) + (u)f(7,2) = 0.75 \times 0.5 + 0.25 \times 0.1 = 0.4$$

$$f(4,6) = (1-u)f(3,6) + (u)f(7,6) = 0.75 \times 0.2 + 0.25 \times (-0.3) = 0.075$$

$$v = \frac{3.5-2}{6-2} = 0.375$$

$$f(4,3.5) = (1-v)f(4,2) + (v)f(4,6) = \frac{89}{320} = 0.278125$$

Exercise 4. 5 [5 Points] ParaView: Color Mapping