

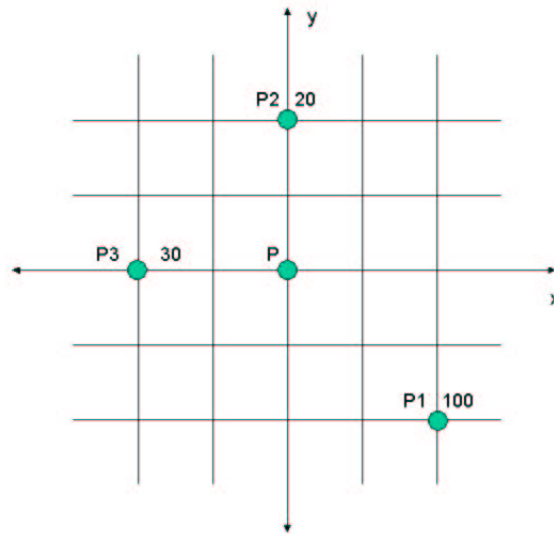
**READ ME FIRST**

- Don't spend too much time on any one problem. This exam will take approximately 60 minutes.
  - Amount of time spent on a problem is not necessarily proportional to the points.
  - Scan through the entire test and do the easy problems first.
  - If something is not clear, ASK.
  - BE NEAT. We cannot give you points for something that we can't read.
  - Write down your assumptions.
  - Don't just write your answer, show how you got them.
  - This is a CLOSED BOOK, CLOSED NOTES exam. You are allowed one 8.5x11 "cheat sheet".
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1	20 points	Shepard's	
2	20 points	Trilinear	
3	30 points	Flow Vis	
4	10 points	DVR	
5	20 points	Contour Lines	
	100 points	GRAND TOTAL	

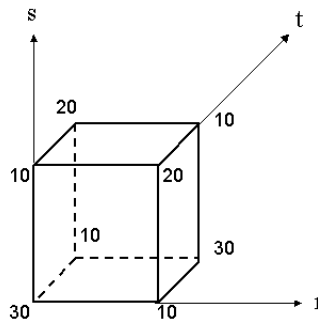
**1. Shepard's Interpolation (20 points)**

Given the three points:  $P_1(2,-2)$ ,  $P_2(0,2)$ ,  $P_3(-2,0)$  and their corresponding values 100, 20, 30 (see figure below). Find the value at  $P(0,0)$  using Shepard's Interpolation when  $u = 3$ , i.e. inverse distance cube.



**2. Trilinear Interpolation (20 points)**

The cube below has the corresponding values at each vertex. Assume that this is a unit cube with the origin at one of the vertices as shown in the figure. Find the value of an interior point where  $r = 0.2$ ,  $s = 0.5$ ,  $t = 0.1$ .



**3. Flow Visualization (30 points)**

A 2D flow field flows uniformly in one direction, but changes 45 degrees clockwise each time unit (see illustration below). Use the origin (0,0) as the seed location, an integration step of 1 unit, and Euler integration.

**(a) 10 points**

Starting at  $t = 0$ , draw the *streamline* after two integration steps. Show coordinates of points along the streamline. Yes, knowing which flow field(s) to use in the calculation is part of the problem.

**(b) 10 points**

Starting at  $t = 0$ , draw the *pathline* after two integration steps. Show coordinates of points along the pathline.

**(c) 10 points**

Starting at  $t = 0$ , draw the *streaklines* after two integration steps. Show coordinates of points along the streaklines.

**4. Direct Volume Rendering (10 points)**

What are the two major methods of doing direct volume rendering? Sketch an outline of each algorithm (not more than 5 lines each).

**5. Contour Lines (20 points)**

The values at each grid vertex can be obtained by evaluating the following function:  $g(x, y) = x + y^2$ . Evaluate this function for  $x = -2, -1, 0, 1, 2$  and  $y = -2, -1, 0, 1, 2$ . You should end up with a 5 x 5 grid. Now, draw the contour line(s) of this data set when the threshold value is set to 2.5.