Database Systems

CSCE 413/813 — Test 2 — Fall 2003

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1. (3 points) List three common requirements of environmental modeling systems.

2. (3 points) Represent the map of Texas, shown on the next page, using the Worboys data model. (Hint: Texas became part of the U.S. in 1845.)

3. (6 points) Let $Ship(ID, X, Y, T)$ be a parametric rectangle relation that describes the movement of a set of ships. Find the ID numbers of the ships that are at time $t = 20$ within 500 miles of the ship with $ID = 1$. (Hint: Describe a sequence of steps to solve this problem in the PReSTO system.)

4. A computer screen projector is shining a rectangle on the wall of a classroom when it is turned on at time $t = 0$. As it is moved slowly backward the rectangle is enlarged until time $t = 10$. In particular, the lower-left corner moves with uniform speed from $(2, 1)$ to $(0, 0)$, and the upper-right corner moves with uniform speed from $(8, 4)$ to $(10, 5)$.

   (a) (4 points) Represent the rectangle between times $t = 0$ and $t = 10$ using a parametric rectangles relation.

   (b) (4 points) Represent the parametric rectangle as an input relation in the PReSTO system.

   (c) (6 points) Translate the above parametric rectangle relation into a geometric transformation relation. (Hint: Take $V = [0, 1] \times [0, 1]$, $I = [0, 10]$, and find the transformation function f.)

5. A triangular soap film whose corner vertices are three fingers is created at time $t = 0$. The three fingers move with uniform speed from time $t = 0$ minutes to time $t = 10$ minutes as follows. The first finger moves from $(10, 10)$ to $(0, 0)$, the second finger moves from $(30, 30)$ to $(40, 40)$, and the third finger moves from $(10, 50)$ to $(10, 100)$. At time $t = 10$ the soap film pops.

   (a) (4 points) Represent the soap film using a parametric 2-spaghetti relation.

   (b) (6 points) Translate the above parametric 2-spaghetti relation into a constraint database relation.

6. Consider the following two parametric rectangles:

   $R1 = \langle [t^2 + 40, t^2 + 45], [0, 20] \rangle$ and
   $R2 = \langle [t^2 + 33, 14t], [3, 10] \rangle$

   (a) (4 points) Are these parametric rectangles in *normal form*? Why or why not?

   (b) (4 points) Find the time interval when the two parametric rectangles intersect.

   (c) (6 points) Find the intersection of the two parametric rectangles.