

**CmpE 226 --- Database Systems****Spring 2003**

Your Name: \_\_\_\_\_ Your Phone: \_\_\_\_\_

1. (5 points) T/F – Which of the following statement is False and which is True:

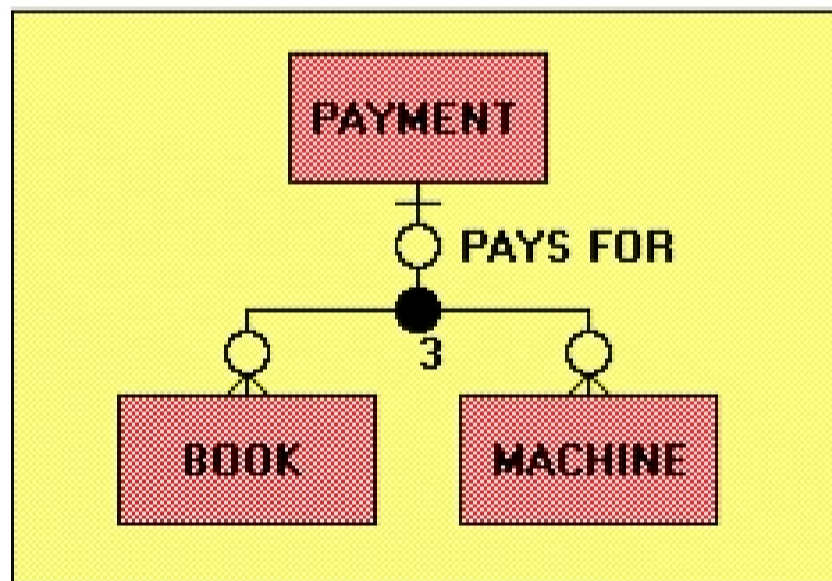
\_\_\_T\_\_\_ a) A "projection" of a table is a choice of some or all of its columns.

\_\_\_F\_\_\_ b) Product operands have to be the same set and order of attributes.

\_\_\_F\_\_\_ c) ALL, BY, AS, CURRENT are SQL commands.

\_\_\_F\_\_\_ d) ERD supports generalization.

\_\_\_F\_\_\_ e) The following ERD is showing an inclusive relationship that indicates "a Payment is either for Books or Machines."



2. Define

(a) (5 points) data abstraction. Name the four levels of data abstraction.

**Data abstraction allows us to hide some details of the representation of the data.  
The four levels of data abstraction are:**

**View level, logical level, constraint level, and physical level.**

(b) (5 points) Define aggregate functions in SQL. Name five aggregation functions.

**Max, Min, Avg, Count, and Sum, are aggregate operators.**

3. Consider the map of California shown in the Figure on the last page of the exam.

(a) (5 points) Represent using a constraint relation *California(region, x, y)* the five regions of the state of California. Use as few constraint tuples as possible.

- (b) (5 points) Assume that there are two water reservoirs located at (25, 20) and at (30, 15). Represent using a constraint relation *Closer\_to\_First(x; y)* those areas anywhere inside or outside of California that are closer to the first than to the second water reservoir. Use as simple type of constraints as possible.

The line through points (25,20) and (30,15) is  $y = -x + 45$ . The midpoint of these is (55/2, 35/2). The line perpendicular to  $y = -x + 45$  and going through the midpoint is  $y = x - 10$ . Being closer to the first point means being above this line.

```

CLOSER_TO_FIRST
-----
X   Y
-----
x   y       y > x - 10
-----

```

- (c) (5 points) Represent using a constraint relation *Distance\_to\_First(x; y; d)* the Euclidean distance  $d$  between any point  $(x, y)$  and the first reservoir.

```

DISTANCE_TO_FIRST
-----
X   Y   D
-----
x   y   d       d^2 = (x-25)^2 + (y-20)^2
-----

```

- (d) (5 points) Write a relational algebra query that finds those areas that are either less than 8 units distance from the first reservoir or in region  $B$  but not both. Use the relations that you defined above.

using  $\pi$  for project and  $\sigma$  for select, we define:

```

Within8 <-  $\pi_{X,Y} (\sigma_{d \leq 8} \text{DISTANCE\_TO\_FIRST})$ 

```

```

InB <-  $\pi_{X,Y} (\sigma_{\text{region}="B"} \text{CALIFORNIA})$ 

```

Then we have:

```

(Within8  $\setminus$  InB)  $\setminus$  (Within8  $\cap$  InB)

```

- (e) (5 points) Write a SQL query that finds the areas that are less than 3 units distance from the first reservoir and are also closer to the first reservoir than to the second reservoir. Use the relations that you defined above.

```

(SELECT X, Y
 FROM DISTANCE_TO_FIRST
 WHERE d < 3)
 INTERSECT
(SELECT X, Y
 FROM CLOSER_TO_FIRST)

```

4. (5 points) Suppose a manufacturer produces three types of soft drinks. Each bottle of the first type needs 6 units of sugar, 4 units of coloring, and 3 units of flavoring. Each bottle of the second type needs 5 units of sugar, 3 units of coloring, and 4 units of flavoring. Finally, each bottle of the third type needs 10 units of sugar, 7 units of coloring, and 2 units of flavoring. The manufacturer can use each day at most only 1000 units of sugar, 800 units of coloring, and 500 units of flavoring. Represent as a constraint relation with scheme *Produce*(*x*, *y*, *z*) all production possibilities where *x*, *y*, and *z* are, respectively, the amount of type one, two, and three soft drinks produced.

PRODUCE						
x	y	z				
x	y	z	$6x + 5y + 10z \leq 1000,$			
			$4x + 3y + 7z \leq 800,$			
			$3x + 4y + 2z \leq 500$			

5. (5 points) Prepare an entity-relationship diagram for any of the following problems. Have at least 7 1:1 and 1:M relationships. M:M relationships are not allowed. Use at least one parallel relationship type. Use fully and partly optional, inclusive, and exclusive relationships and conditions wherever applicable. Name at least 2 to 5 attributes per entity. As you prepare the diagrams, you may add additional entities. [Important: You must satisfy all the requirements in your model.]
- (a) All the rental properties in your neighborhood. Include the occupied and the vacant properties. Also show how occupancy changes over time.
  - (b) A map of how to get to your home or any other home in your neighborhood from different directions.
  - (c) A campus map. Include the area of the buildings. Also show how the buildings changed over time, i.e., when they were built or expanded in space.
  - (d) A parking lot. Show the parking lot and how cars are entering and leaving the parking lot.
  - (e) A passenger airplane flight scheduler. Include reservations, capacity check for the airplanes.