

# CS304 Database System Concepts

## Assignment 10

**Due: May 4, 2012**

**(Please submit hard copies to class or to Zheng on due date.)**

Name:

Matric No:

Q1. (2 points) Consider join processing using symmetric fragment and replicate with range partitioning. How can you optimize the evaluation if the join condition is of the form  $|r.A - s.B| \leq k$ , where  $k$  is a small constant? Here,  $|x|$  denotes the absolute value of  $x$ . A join with such a join condition is called a band join.

Q2. (2 points) Recall that histograms are used for constructing load-balanced range partitions.

a) Suppose you have a histogram where values are between 1 and 100, and are partitioned into 10 ranges, 1-10, 11-20, ..., 91-100, with frequencies 15, 5, 10, 10, 20, 5, 5, 20, 5, and 5, respectively. Give a load-balanced range partitioning function to divide the values into 5 partitions.

b) Write an algorithm(Pseudo-code) for computing a balanced range partition with  $p$  partitions, given a histogram of frequency distributions containing  $n$  ranges.

Q3. (2 points) Suppose you wish to handle a workload consisting of a large number of small transactions by using shared nothing parallelism.

a) Is intraquery parallelism required in such a situation? If not, why, and what form of parallelism if appropriate.

b) What form of skew would be of significance with such a workload?

c) Suppose most transactions accessed one *account* record, which includes an account type attribute, and an associated *account\_type\_master* record, which provides information about the account type. How would you partition and/or replicate data to speed up transactions? You may assume that the *account\_type\_master* relation is rarely updated.

Q4. (2 points) Consider a distributed system with two sites, A and B. Can site A distinguish among the following?

B goes down.

The link between A and B goes down.

B is extremely overloaded and response time is 100 times longer than normal

What implications does your answer have for recovery in distributed systems?

Q5. (2 points) Explain the difference between data replication in a distributed system and the maintenance of a remote backup site.

Q6. (2 points) To build a highly available distributed system, you must know what kinds of failures can occur.

- a) List possible types of failure in a distributed system.
- b) Which items in your list from part a) are also applicable to a centralized system?

Q7. (2 points) Consider a failure that occurs during 2PC for a transaction. For each possible failure that you listed in Q6 a), explain how 2PC ensures transaction atomicity despite the failure.

Q8. (2 points) Consider the relations

*employee*(name, address, salary, plant\_number)

*machine*(machine\_number, type, plant\_number)

Assume that the *employee* relation is fragmented horizontally by *plant\_number*, and that each fragment is stored locally at its corresponding plant site. Assume that the *machine* relation is stored entirely at the Armonk site. Describe a good strategy for processing each of the following queries.

- a) Find all employees at the plant that contains machine number 130
- b) Find all machines at the Almaden plant.
- c) Find  $\text{employ} \bowtie \text{machine}$