

CS585
Database Systems
Spring 2014
Exam I

Name: _____

Student ID: _____

	Maximum	Received
Problem 1	20	
Problem 2	25	
Problem 3	20	
Problem 4	10	
Problem 5	10	
Problem 6	15	
Total	100	

2hr exam. One 8.5X11 cheat sheet allowed.

1) 20 pts

Indicate whether each of the following statements is true or false (T/F):

F _____ In SQL, CREATE and DELETE are used to create and delete a table, respectively.

F _____ Since the R-Tree is a balanced tree, the worst case cost of any of its operations is $O(\log n)$.

T _____ If K is a foreign key in relation R1, then K must be a primary key for some other relation.

F _____ Suppose 'Country' and 'City' are the two fields of the table 'Students' to record relevant information about all the current graduate students at USC, the following SQL query will return results with distinct values of 'Country'.

SELECT DISTINCT(Country), City FROM Students;

T _____ JDBC architecture requires that at least one JDBC driver be installed on the client side.

F _____ Point-Region Quadtree can be used for indexing of points and regions.

F _____ In web applications, since DB communication cost is usually high, to achieve the best performance one needs to always fetch the minimal amount of data needed to fill up the current screen.

F _____ NoSQL databases do not support any SQL-like query languages.

T _____ Conceptual schemas that include inheritance can be properly mapped to the relational model.

T _____ Views can be used to present necessary information, while hiding details in underlying relation(s).

2) 25 pts

Morgan Importing purchases antiques and home furnishings in Asia and ships those items to a warehouse facility in Los Angeles. Mr. Morgan uses a database to keep a list of items purchased, shipments and shipment items. This database include the following tables:

SHIPMENT(Shipment ID: NUMBER, ShipperName:VARCHAR, ShipperInvoiceNumer:NUMBER, DepartureDate: DATE, ArrivalDate: DATE, InsuredValue: NUMBER);

ShipmentID	ShipperName	ShipperInvoice Number	DepartureDate	ArrivalDate	InsuredValue
1	ABC Trans-Oceanic	2008651	10-Dec-08	15-Mar-09	\$15,000
2	ABC Trans-Oceanic	2009012	10-Jan-09	20-Mar-09	\$12,000
3	Worldwide	49100300	05-May-09	17-Jun-09	\$27,500
4	International	399400	02-Jun-09	17-Jul-09	\$7,500
5	Worldwide	84899440	10-Jul-09	28-Jul-09	\$25,000
6	International	488955	05-Aug-09	11-Sep-09	\$18,000

ITEM(ItemID: NUMBER, Description: VARCHAR, PurchaseDate: DATE, Store: VARCHAR, City: VARCHAR, Quantity: NUMBER, LocalCurrencyAmt: NUMBER, ExchangeRate: NUMBER);

ItemID	Description	PurchaseDate	Store	City	Quantity	LocalCurrencyAmt	ExchangeRate
1	QE Dining Set	07-Apr-09	Eastern Treasures	Manila	2	403405	0.01774
2	Willow Serving Dishes	15-Jul-09	Jade Antiques	Singapore	75	102	0.5903
3	Large Bureau	17-Jul-09	Eastern Sales	Singapore	8	2000	0.5903
4	Brass Lamps	20-Jul-09	Jade Antiques	Singapore	40	50	0.5903

SHIPMENT_ITEM(ShipmentID: NUMBER, ShipmentItemID: NUMBER, ItemID: NUMBER, Quantity: NUMBER, Value: Number);

ShipmentID	ShipmentItemID	ItemID	Quantity	Value
1	1	4	100	\$3000
2	1	1	2	\$14300
2	2	2	50	\$3000
2	3	4	60	\$1800
4	1	4	40	\$1200
4	2	3	8	\$9500
4	3	2	75	\$4500

(1) What is the result of the following query?
 SELECT ShipmentID, ShipperName, ShipperInvoiceNumber
 FROM SHIPMENT
 WHERE ShipperName LIKE 'AB%';

ShipmentID	ShipperName	ShipperInvoiceNumber
1	ABC Trans-Oceanic	2008651
2	ABC Trans-Oceanic	2009012

(2) What is the result of the following query?
 SELECT ItemID, MAX(Quantity)
 FROM SHIPMENT_ITEM
 WHERE ShipmentID IN (SELECT ShipmentID
 FROM SHIPMENT
 WHERE InsuredValue < 14000)
 GROUP BY ItemID
 HAVING Value < 5000;

ItemID	MAX(Quantity)
2	75
4	60

(3) Write the SQL query: List the ShipmentID, ShipperName, and ShipperInvoiceNumber for all shipments with an insured value greater than 10000.

```
SELECT ShipmentID, ShipperName, ShipperInvoiceNumber FROM SHIPMENT
where InsuredValue > 10000
```

(4) Write the SQL query: Determining the average InsuredValue.

```
SELECT avg(InsuredValue) FROM SHIPMENT
```

(5) Write the SQL query: Show the ShipperName and DepartureDate of all shipments that have an item with a value of \$1,000 or above. Use a subquery. Present results sorted by ShipperName in ascending order and then DepartureDate in descending order.

```
SELECT ShipperName, DepartureDate from SHIPMENT where ShipmentID in
(select ShipmentID from SHIPMENT_ITEM where Value/Quantity >= 1000) order by
ShipperName asc, DepartureDate desc
```

(6) Write the SQL query: Show the ShipperName, DepartureDate of shipment, and Value for items that were purchased in Singapore. You must use a combination of a join and a subquery.

```
SELECT S.ShipperName, S.DepartureDate, SI.Value FROM SHIPMENT S inner
join SHIPMENT_ITEM SI on (S.ShipmentID = SI.ShipmentID) inner join ITEM I on
(SI.ItemID = I.ItemID) where I.ItemID in (select ItemID from ITEM where
City='Singapore')
```

or

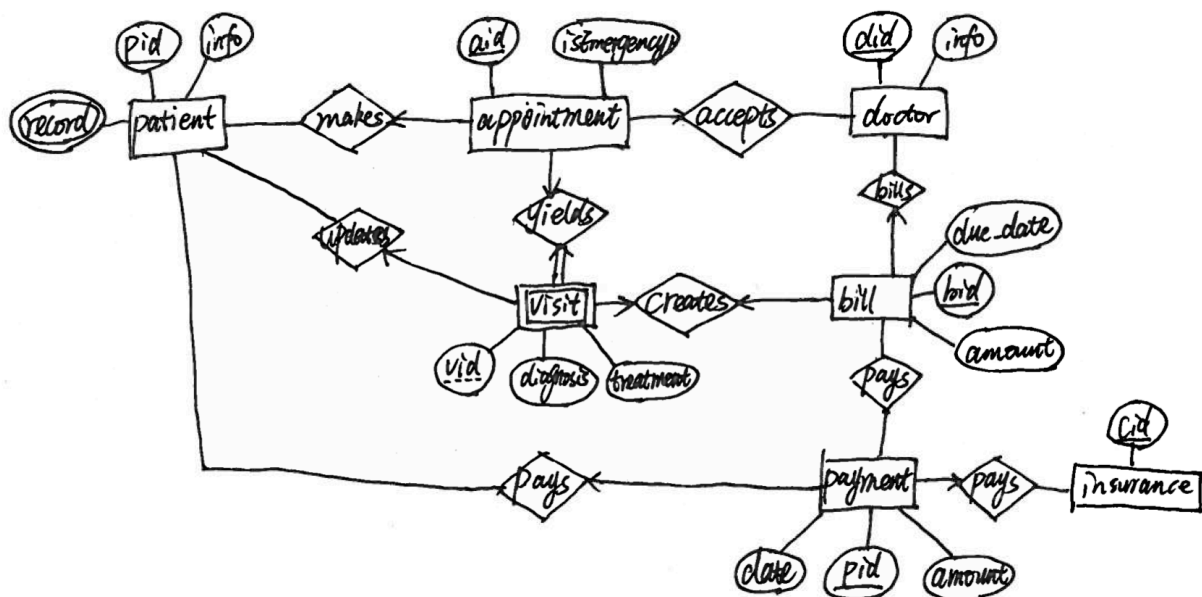
```
SELECT S.ShipperName, S.DepartureDate, SI.Value FROM SHIPMENT S inner
join SHIPMENT_ITEM SI on (S.ShipmentID = SI.ShipmentID) inner join ITEM I on
(SI.ItemID = I.ItemID) where exists (select * from ITEM I where I.City = 'Singapore'
and I.ItemID = SI.ItemID)
```

3) 20 pts

We would like to create a data model for a small clinic and here are the business rules for the clinic:

- A patient can make many appointments with one or more doctors in the clinic, and a doctor can accept appointments with many patients. However, each appointment is made with only one doctor and one patient.
- Emergency cases do not require an appointment. However, for appointment management purposes, an emergency is entered in the appointment book as “unscheduled.”
- If kept, an appointment yields a visit with the doctor specified in the appointment. The visit yields a diagnosis and, when appropriate, treatment.
- With each visit, the patient’s records are updated to provide a medical history.
- Each patient visit creates a bill. Each patient visit is billed by one doctor, and each doctor can bill many patients.
- Each bill must be paid. However, a bill may be paid in many installments, and a payment may cover more than one bill.
- A patient may pay the bill directly, or the bill may be the basis for a claim submitted to an insurance company.
- If the bill is paid by an insurance company, the deductible is submitted to the patient for payment.

a- Draw the ER diagram for this scenario, including all entities, attributes, relations, keys, participations and cardinalities.



Note that 'info' denotes fields like name, ~~sex~~ birthday, etc.
It's also reasonable to add a relationship between patient and insurance.

- b- Map the ER diagram to tables in a relational database. For each table, specify the table name, attributes, and all integrity constraints. For each foreign key, indicate which table it refers to.

patient (pid , name, records, birthday)

doctor (did , name, level, birthday)

appointment (aid , pid, did, isEmergency, time)

pid is Fk referencing patient

did is Fk referencing doctor

visit (vid , aid, diagnosis, treatment, time)

aid is Fk referencing appointment.

bill (bid , vid, amount, due date)

vid is Fk referencing visit

payment (payid , bid, amount, ~~type~~, pid, iid, date)

bid is Fk referencing bill

pid is Fk referencing patient

iid is Fk referencing insurance

insurance (iid , name, address)

4) 10 pts

Consider the R-tree R for 2-dimensional point data rooted at R_0 in Figure 1. The MBRs are represented by solid rectangles with their labels on the upper left corner inside them, respectively. And the points are represented by small circles with their labels beside.

- a- Draw the tree representation for this R-tree, assuming for all questions in this problem, the maximum number of entries in each node, denoted by M , is equal to 4.

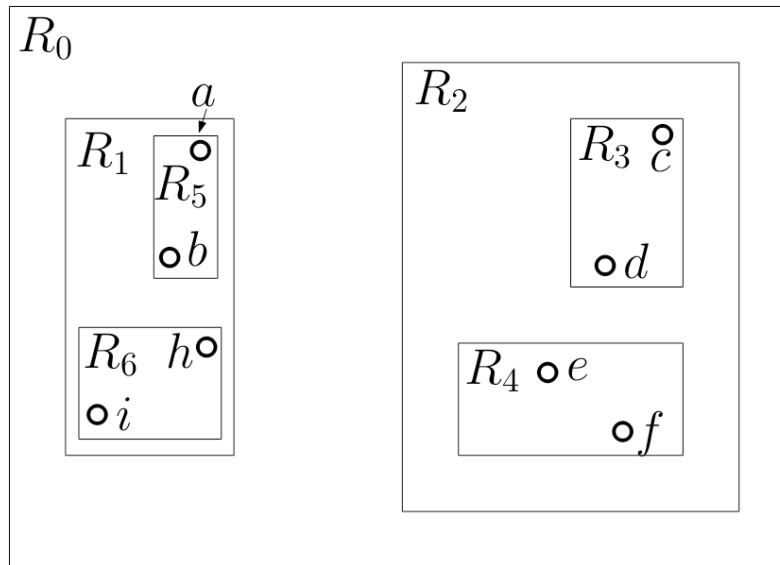
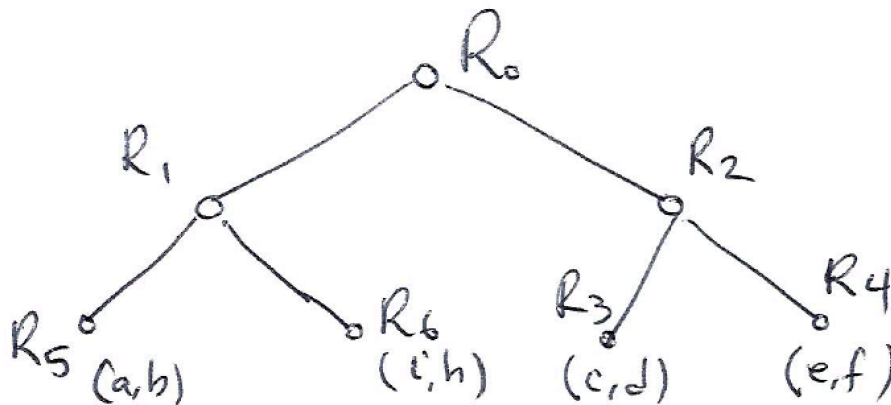
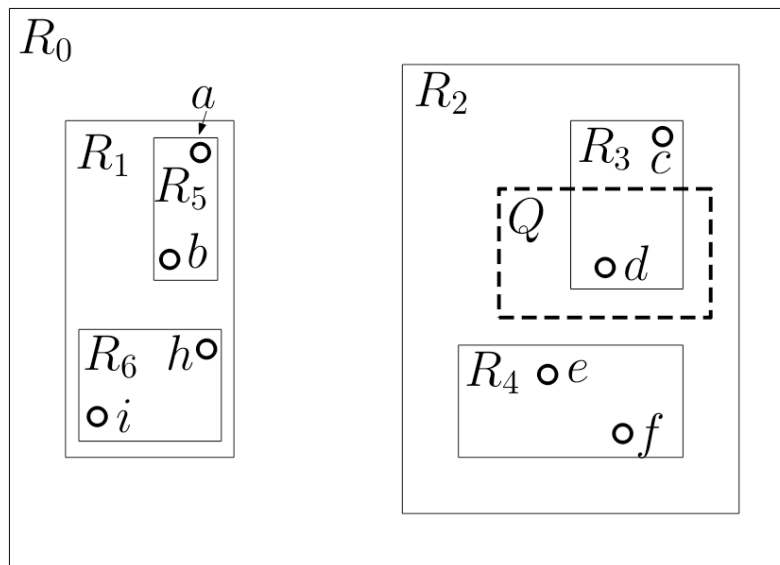


Figure 1



- b- Let m (>0) denote the minimum number of entries in each box. Based on the setting of Figure 1, what is/are the possible value/values for m ? 2

- c- Consider the following range query on R. In Figure 2, the query range is given by the dashed rectangle Q. In other words, the query is trying to find all objects in the tree that are within the rectangle called Q. To perform this range query describe,
- Which MBRs will be checked and their contents explored?
 - Which MBRs will be checked without exploring their contents
 - Which MBRs will not be checked at all

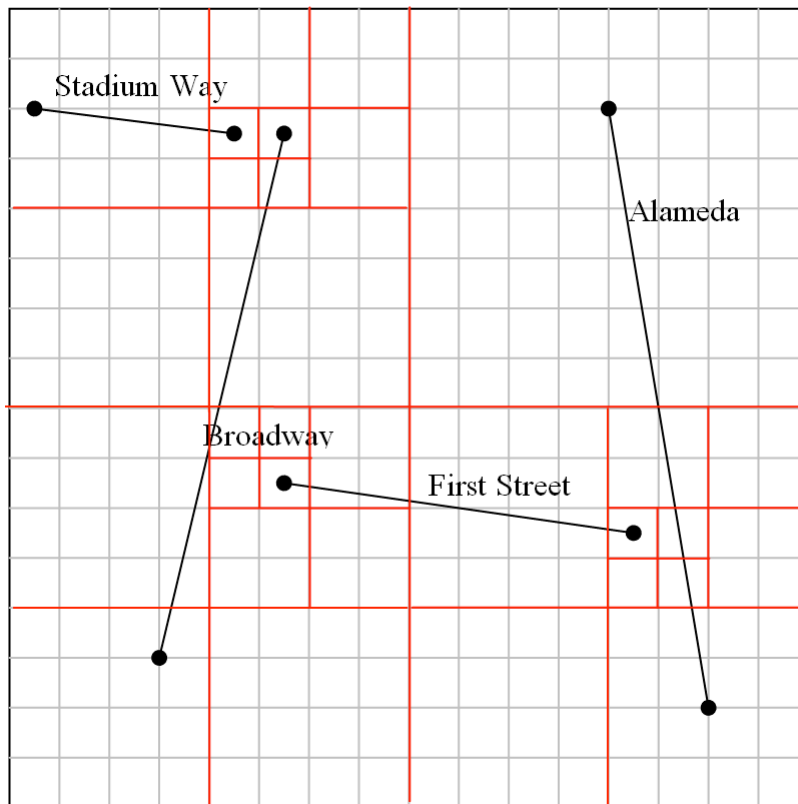


- R_0, R_2, R_3
- R_1, R_4
- R_5, R_6

5) 10 pts

Assume the following line segments representing some of the streets in Los Angeles are stored in a database with spatial support. Assume the streets are inserted in to the database in alphabetical order (from A to Z).

a- Decompose the following region based on the criteria of PM1 Quadtree.



Does the structure of the PM1 quad-tree depend on the order of object insertion? **No**

6) 15 pts

Briefly answer the following questions (5 pts each)

a- What is the main advantage of the JDBC architecture over embedded SQL.

JDBC architecture enables development of vendor independent applications. The application executables in the JDBC architecture are not database vendor dependent, so one application instance can be used to connect to various databases.

b- Describe the ways in which a spatial DBMS has been made to handle spatial objects efficiently

- spatial DBs have support for spatial index structures such as Quad trees and R-tree.
- They support operations on spatial objects within their query language.
- Use MBRs and filtering techniques for faster query performance
- They store MBR coordinates, computed areas, and perimeters to avoid calculating these values over and over.

Note: two of the above are enough to receive full score.

c- Given an example of a NoSQL database type (you do not need to name a vendor) and describe when this database type is preferred over an RDBMS.

One of the following is enough:

- 1- Graph DB – when we need to store a very large graph and be able to traverse the nodes of the graph.
- 2- OODBMS – when we have complex object models
- 3- Key-value Store – When we have a large number of variables and values without a schema
- 4- Document store – when we need to store a large number of documents