INFO 6210 Section 04 Hospital Management System

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SET 1:

CREATE DATABASE

```
CREATE SCHEMA IF NOT EXISTS `hospital_mgmt_sys` DEFAULT CHARACTER SET utf8;
```

USE

```
USE hospital_mgmt_sys;
```

DROP

```
DROP SCHEMA IF EXISTS `hospital_mgmt_sys` ;
```

CREATE TABLE:

```
CREATE TABLE IF NOT EXISTS `patient` (
 `patient_id` VARCHAR(15) NOT NULL COMMENT '',
 `patient_name` VARCHAR(100) NOT NULL COMMENT '',
`patient_dob` DATE NOT NULL COMMENT '',
  `patient_gender` VARCHAR(10) NOT NULL COMMENT '',

 `patient_street` VARCHAR(100) NOT NULL COMMENT '',
 `patient_city` VARCHAR(100) NOT NULL COMMENT '',
 `patient_zip` INT(11) NOT NULL COMMENT '',
 `patient_apt_no` VARCHAR(15) NULL COMMENT '',
 `patient_cont_no` VARCHAR(100) NOT NULL COMMENT '',
  PRIMARY KEY (`patient_id`)  COMMENT '',
  UNIQUE INDEX `Patientid_UNIQUE` (`patient_id` ASC)  COMMENT '')
ENGINE = InnoDB
DEFAULT CHARACTER SET = utf8;
```

INSERT INTO

```
INSERT INTO `hospital_mgmt_sys`.`patient` (`patient_id`, `patient_name`, `patient_dob`,
`patient_gender`, `patient_street`, `patient_city`, `patient_zip`, `patient_apt_no`, `patient_cont_no`)
VALUES ('p1', 'Kelsey Wise', '1960/02/21', 'Male', '728-1625 Mauris, St.', 'Boston', '41609', '41', '61302');
```

Set 2:

CREATE TABLE

```
DROP TABLE IF EXISTS `accounts`;

CREATE TABLE IF NOT EXISTS `accounts` (
`accounts_case_no` VARCHAR(15) NOT NULL COMMENT '',
`patient_id` VARCHAR(15) NOT NULL COMMENT '',
`accounts_bed_id` INT(11) NULL COMMENT '',
 `accounts_admitted_date` DATE NULL COMMENT '',
 `accounts_admitted_discharge_date` DATE NULL COMMENT '',
 `accounts_illness_detected` VARCHAR(40) NULL COMMENT '',
  PRIMARY KEY (`accounts_case_no `)  COMMENT '',
  CONSTRAINT `fk_bed_pat`
  FOREIGN KEY (`patient_id `)
  REFERENCES `PATIENT` (`patient_id`)
  ON DELETE CASCADE
  ON UPDATE CASCADE)
  ENGINE = InnoDB
  DEFAULT CHARACTER SET = utf8;
```

INSERT INTO

```
INSERT INTO `hospital_mgmt_sys`.`testlog` (`testlog_id`, `nurse_id`, `doctor_id`, `patient_id`, `test_type`, `test_date`, `test_result_date`) VALUES ('1', 'E21', 'E2', 'p7', 'MRI', '2015-02-01', '2015-02-04');
```

CREATE INDEX

```
CREATE INDEX EIndex

ON employee (employee_name);


CREATE INDEX PIndex

ON patient (patient_name);
```

SET 3:

SELECT:

```
select * from employee;
```

SELECT FROM GROUP BY:

```
SELECT employee_qualification, COUNT(*)
FROM   employee GROUP BY employee_qualification;
```

SELECT ORDER BY

```
SELECT * FROM patient
ORDER BY patient_city DESC;
```

SELECT GROUP BY HAVING

```
SELECT employee_name, MAX(employee_salary) FROM employee
  GROUP BY employee_qualification HAVING MAX(employee_salary) > 50000;
```

LIMIT

```
SELECT testlog_id, patient_id, test_type
FROM testlog
ORDER BY test_type ASC
LIMIT 7;
```

SET 4:

FUNCTIONS

```
SELECT patient_name, patient_city
FROM patient
WHERE patient_city LIKE 'B%';
```

```
SELECT employee_name, employee_salary, IF(employee_salary>= 1000000, 'High Salary', 'Low Salary')
AS Salary_level
FROM employee;
```

```
SELECT accounts_case_no,
      CONCAT('Admit Date(',
            CAST(accounts_admit_date AS date),
            ',',
             CAST(accounts_admit_discharge_date AS date),
     ')') patientDate
FROM accounts;

SELECT patient_name, SUBSTRING(patient_name,2,5) FROM patient
WHERE patient_gender='Male';

SELECT employee_name, SQRT(employee_salary)
FROM employee;

SELECT testlog_id, test_date, MONTH(test_date)
FROM testlog
WHERE MONTH(test_date)>02;

SELECT employee_name, employee_salary FROM employee
WHERE employee_salary>(SELECT AVG(employee_salary) FROM employee);

SELECT test_type, COUNT(*) FROM testlog
WHERE test_type = 'XRAY';
```

```
SELECT MIN(employee_salary) least, MAX(employee_salary) max FROM employee;


SELECT patient_name,patient_city,
REVERSE(patient_city)
FROM patient
WHERE patient_city='Chicago';
```

SET 5:

INNER JOIN

```
SELECT patient.patient_name, accounts.accounts_case_no
FROM patient
INNER JOIN accounts
ON patient.patient_id=accounts.patient_id
ORDER BY patient.patient_name;
```

LEFT JOIN

```
SELECT testlog.testlog_id, testlog.test_type, patient.patient_id
FROM testlog
LEFT JOIN patient
ON testlog.patient_id=patient.patient_id
ORDER BY testlog.test_type;
```

RIGHT JOIN

```
SELECT patient.patient_name, accounts.accounts_bed_id, account_illness_detected
FROM patient
RIGHT JOIN accounts
ON patient.patient_id=accounts.patient_id
ORDER BY accounts.accounts_case_no;
```

FULL JOIN

```
(SELECT patient.patient_name, patient.patient_gender, doctor_examines_patient.doctor_id
FROM patient
LEFT JOIN doctor_examines_patient
ON patient.patient_id=doctor_examines_patient.patient_id)
UNION
(SELECT patient.patient_name, patient.patient_gender, doctor_examines_patient.doctor_id
FROM patient
RIGHT JOIN doctor_examines_patient
ON patient.patient_id=doctor_examines_patient.patient_id);
```

```
SELECT  patient_name, accounts_admit_date, accounts_admit_discharge_date
    FROM patient, accounts;
```

SET 6:

SUBQUERIES

```
select patient_name from patient where patient_id IN (Select patient_id from accounts where account_illness_detected = 'myeloma');
```

```
select employee_name from employee where employee_id IN(Select doctor_id from testlog where patient_id
IN(Select patient_id from accounts where account_illness_detected = 'thyroid' ));
```

SET 7:

USER PRIVILEGES

```
CREATE USER SYS_ADMIN;
CREATE USER DEVELOPER;
CREATE USER SYS_TESTER;
CREATE USER USER;
```

```
GRANT ALL ON hospital_mgmt_sys.* TO SYS_ADMIN;

GRANT SELECT, INSERT, UPDATE, DELETE, CREATE, ALTER, TRIGGER, INDEX ON hospital_mgmt_sys.* TO
DEVELOPER;

GRANT SELECT, INSERT, UPDATE, DELETE ON hospital_mgmt_sys.* TO SYS_TESTER;

GRANT SELECT ON hospital_mgmt_sys.* TO USER;


REVOKE ALL ON hospital_mgmt_sys.* FROM SYS_ADMIN;

REVOKE SELECT, INSERT, UPDATE, DELETE, CREATE, ALTER, TRIGGER, INDEX ON hospital_mgmt_sys.*
FROM DEVELOPER;

REVOKE SELECT, INSERT, UPDATE, DELETE ON hospital_mgmt_sys.* FROM SYS_TESTER;

REVOKE SELECT ON hospital_mgmt_sys.* FROM USER;


DROP USER SYS_ADMIN;

DROP USER DEVELOPER;

DROP USER SYS_TESTER;

DROP USER USER;
```

SET 8:

STORED PROCEDURE

```
DROP PROCEDURE IF EXISTS EMPLOYEE_LUCKY_DRAW;

#PICK A LUCKY DRAW FOR EMPLOYEES

DELIMITER $$

CREATE PROCEDURE EMPLOYEE_LUCKY_DRAW ()


BEGIN

 DECLARE done INT DEFAULT FALSE;

 DECLARE LUCKY VARCHAR(100) DEFAULT "";

 DECLARE CAND VARCHAR(100) DEFAULT "";

 DECLARE CUR1 CURSOR FOR SELECT employee_id FROM employee;
```

```
 DECLARE CONTINUE HANDLER FOR NOT FOUND SET done = TRUE;

 SELECT (1+FLOOR(40*RAND())) INTO LUCKY FROM DUAL;

 OPEN CUR1;

 LUCK_TEST : LOOP
 FETCH CUR1 INTO CAND;
 IF done THEN
        LEAVE LUCK_TEST;
END IF;

 IF  CAND LIKE CONCAT("%e",LUCKY,"%") THEN
        SELECT CONCAT("e",LUCKY) as lucky_candidate FROM DUAL;
   LEAVE LUCK_TEST;
 END IF;

 END LOOP LUCK_TEST;
 CLOSE CUR1;
END$$

DELIMITER ;

CALL EMPLOYEE_LUCKY_DRAW();
```

STORED PROCEDURE 2:

```
DROP PROCEDURE IF EXISTS SAL_INCR_NIGHT_ALLOWANCE;

DELIMITER $$
```

```
CREATE PROCEDURE SAL_INCR_NIGHT_ALLOWANCE ()

BEGIN
 DECLARE done INT DEFAULT FALSE;
 DECLARE EMP_ID VARCHAR(100);
 DECLARE SAL INT DEFAULT 0;
 DECLARE SFT VARCHAR(100);
 DECLARE CUR1 CURSOR FOR SELECT employee_id,employee_shift,employee_salary FROM employee;
 DECLARE CONTINUE HANDLER FOR NOT FOUND SET done = TRUE;

 OPEN CUR1;

 SAL_ADJUST : LOOP
 FETCH CUR1 INTO EMP_ID,SFT,SAL;
 IF done THEN
        LEAVE SAL_ADJUST;
END IF;

 IF SFT = "Night" THEN
        UPDATE employee SET employee_salary = SAL + 200 WHERE employee_id = EMP_ID;
 END IF;

 END LOOP SAL_ADJUST;
 CLOSE CUR1;
END$$

DELIMITER ;
```

```
CALL SAL_INCR_NIGHT_ALLOWANCE();


SELECT * FROM EMPLOYEE WHERE employee_shift = "night";
```

SET 9:

TRANSACTIONS

```
START TRANSACTION;

LOCK TABLE employee WRITE;

SAVEPOINT SVPNT2;

UPDATE employee SET employee_name = "Shruti" WHERE employee_id = "E1";

UPDATE employee SET employee_name = "Jasmine" WHERE employee_id = "E11";

UPDATE employee SET employee_name = "Kenneth" WHERE employee_id = "E12";

ROLLBACK TO SVPNT2;

UNLOCK TABLE;
```

SET 10:

TRIGGER ON INSERT

```
DROP TRIGGER IF EXISTS trg_employee_ins;

DELIMITER &&

CREATE TRIGGER trg_employee_ins BEFORE INSERT ON employee

FOR EACH ROW

BEGIN

        DECLARE msg VARCHAR(100);

        IF NEW.employee_qualification LIKE '%MBBS%' OR '%DO%' OR '%MM%' OR '%MS%' AND
NEW.employee_salary < 1000000 THEN

                SET msg = concat('My Trigger: Doctors should get atleast $1000000');

                SIGNAL SQLSTATE '45000' SET MESSAGE_TEXT = msg;
```

```
        ELSEIF NEW.employee_qualification LIKE '%BSN%' OR '%MSN%'  AND NEW.employee_salary < 5000 THEN
                SET msg = concat('My Trigger: Nurse should get atleast $5000');
                SIGNAL SQLSTATE '46000' SET MESSAGE_TEXT = msg;
        END IF;
END
&&
DELIMITER &&

insert into employee values ('E50', 'Francis', 4000, '2015-03-14', 'BSN', 'Morning', 56789);
```

TRIGGER ON UPDATE:

```
DROP TRIGGER IF EXISTS trg_admit_upd;

DELIMITER &&
CREATE TRIGGER trg_admit_upd BEFORE UPDATE ON accounts
FOR EACH ROW
BEGIN
DECLARE msg VARCHAR(100);
IF old.accounts_admit_date > new.accounts_admit_discharge_date then
        set msg = concat('My Trigger: Admitted date cannot be greater than discharge date : ', cast(new.accounts_admit_discharge_date as char));
   signal sqlstate '30000' set message_text = msg;
 end if;
end
&&
delimiter ;

select * from accounts;
```

```
select * from patient;

update accounts

set accounts_admit_discharge_date = '2015-01-04'

where patient_id = 'p11';
```

TRIGGER ON DELETE:

```
create table employee_backup like employee;

alter table employee_backup add column resign_date date;

drop trigger if exists trg_employee_del;


DELIMITER &&

CREATE TRIGGER trg_employee_del BEFORE DELETE ON employee

FOR EACH ROW

BEGIN

DECLARE dt DATE;

SET dt = curdate();

INSERT INTO employee_backup VALUE(old.employee_id,old.employee_name,old.employee_salary,
old.employee_join_date,old.employee_qualification,old.employee_shift,employee_contact_no,dt);

END      &&

DELIMITER ;


select * from employee;

delete from employee where employee_id = 'E1';

select * from employee_backup;

commit;
```

SET 11:

VIEW

```
CREATE OR REPLACE VIEW Employee_List AS
```

```
SELECT employee_id,employee_name, employee_salary

FROM employee

WHERE employee_salary> 7000;


SELECT * from Employee_List;


CREATE OR REPLACE VIEW Patient_Account AS

SELECT patient.patient_name, accounts.accounts_bed_id, account_illness_detected,
accounts_admit_date, accounts_admit_discharge_date

FROM patient

RIGHT JOIN accounts

ON patient.patient_id=accounts.patient_id

ORDER BY accounts.accounts_case_no;

SELECT * from Patient_Account;


CREATE OR REPLACE VIEW Employee_Illness AS

SELECT employee_name FROM employee WHERE employee_id IN(SELECT doctor_id FROM testlog
WHERE patient_id

IN(SELECT patient_id FROM accounts WHERE account_illness_detected = 'thyroid' ));


SELECT * from Employee_Illness;
```

Create a backup plan of your choice, state your assumptions/constraints and explain your reasoning. Print your selection on a sample monthly calendar (say 30 day) with FB for Full Backup and IB for Incremental Backup

Sunday	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**
		1 Incremental Backup from last saturday	2 Incremental Backup from last saturday	3 Incremental Backup from last wednesday	4 Incremental Backup from last wednesday	5 Full Backup
6 Incremental Backup from last saturday	7 Incremental Backup from last saturday	8 Incremental Backup from last saturday	9 Incremental Backup from last saturday	10 Incremental Backup from last wednesday	11 Incremental Backup from last wednesday	12 Full Backup
13 Incremental Backup from last saturday	14 Incremental Backup from last saturday	15 Incremental Backup from last saturday	16 Incremental Backup from last saturday	17 Incremental Backup from last wednesday	18 Incremental Backup from last wednesday	19 Full Backup
20 Incremental Backup from last saturday	21 Incremental Backup from last saturday	22 Incremental Backup from last saturday	23 Incremental Backup from last saturday	24 Incremental Backup from last wednesday	25 Incremental Backup from last wednesday	26 Full Backup
27 Incremental Backup from last saturday	28 Incremental Backup from last saturday	29 Incremental Backup from last saturday	30 Incremental Backup from last saturday	31 Incremental Backup from last wednesday		

Assumptions:

- A full backup takes around 12 hours
- Incremental backup takes 2 hours
- Patients in the night as lesser than patients in the morning

Backup idea:

An incremental backup on Sunday, Monday, Tuesday and Wednesday takes around 2 hours so it can save changes from the previous 4 days. All these backups will record the changes made in the database since the last full backup on Saturday. In order to retrieve one of these backups the only thing that has to be done is apply previous full backup and then one incremental backup.

On Thursday night and Friday night an incremental backup since Wednesday is done. So if there is a need to restore data, restore data from last backup then the Wednesday night backup and then this backup.

4) What are Data Warehousing (DW) and Business Intelligence? Describe its components and its uses. How does DW the same or different with respect to Business Intelligence? Define and explain ETL operations.

Business Intelligence (BI) is the tools and systems that play an important role in the planning and growing process of the corporation. They allow a company to gather, store,access and analyze corporate data to aid in decision making process.

A data warehouse (DW) on the other hand is a relational database especially designed for query and analysis rather than for transaction processing. It contains historical data derived from transaction data, but this data could even come from other sources. It separates analysis workload from transaction workload and enables an organization to consolidate data from several sources.

Datawarehousing components:

Data sources: Data are sourced from operational systems and possibly from external data sources.

Data extraction. Data is extracted using custom-written or commercial software called ETL.

Data loading. In this stage data is loaded into a staging area. This data is then transformed and cleansed. Once data is transformed and cleansed it is ready to be loaded in the data warehouse.

Comprehensive database. This is the enterprise data warehouse that supports decision analysis by providing relevant summarized and detailed information.

Metadata. Metadata is data that describes other data. They are maintained for access by IT personnel and users. Metadata include rules for organizing data summaries that are easy to index and search.

Middleware tools. Middleware tools as the name suggests allows access to the data warehouse from a wide variety of front end applications.

Business Intelligence Components:

OLAP (Online Analytical Processing): OLAP refers to the computing process that enables business users to slice and dice their way through data using tools that allow the user to easily and selectively view data from different points of view.

Advanced Analytics or Corporate Performance Management (CPM): can also be referred as data mining, forecasting or predictive analytics. It takes advantage of statistical analysis techniques to predict or provide certainty measures on facts.

Real-time BI: Real time means near to zero latency and allows for the real time distribution of metrics through email, messaging systems and/or interactive displays.

Data Warehousing: Data warehousing focusses on capturing of data from various sources useful analysis and access. It helps in business as it helps business leaders to explore through subsets of data and examine interrelated components that can help drive business.

Data Sources: Data source as the name suggests is a source of data. The data sources can be relational database, file, any other computer software, tables, spreadsheets, or unstructured information, such as plaintext files or pictures and other multimedia information. The main purpose of data source is to gather the technical information needed to access the data from different sources.

Data warehouse and BI are different in the following ways:

Data warehouse is the technique of storing data and creating information through data marts. Data marts are segments of data or information that are combined together to provide useful information to those segments. Data warehouse does not need Business Intelligence to work. Reports can be easily generated from reporting tools.

Business Intelligence are a set of tools and methods that take raw data and transform it into useful information. This information can help make business decisions and recommendations through the use of statistical analysis tools and data mining tools.

ETL Process:

Extraction Transformation and loading

Extraction: Focuses on retrieving the data from the storage source. Common data source structures are relational databases and pure data files. Other sources of data could include non-relational database patterns or other data structures like virtual storage access method (VSAM), indexed sequential access method (ISAM). Data sources can even include external sources such as data coming from the Internet.

The transform phase is the second step of ETL process. In this stage a series of rules and operations are performed to retrieve pure data from the source to deliver the data for manipulation at the other end. Some data source may need little processing or may not need at all. Sometimes a combination of more than one transformation is done on the target database to meet the business requirements.

The loading stage is the last process of ETL. It aims at sending data to the receiving end. Either this process may be very difficult or easy depending on the needs of the application. Sometimes the receiving end may replace old data with cumulative data. Updating of data in the data storage is usually done on a periodic basis.

References: http://www.webopedia.com/TERM/B/Business_Intelligence.html

https://docs.oracle.com/cd/B10500_01/server.920/a96520/concept.htm

http://www.jatit.org/volumes/research-papers/Vol9No1/9Vol9No1.pdf

http://www.villanovau.com/resources/bi/overview-of-business-intelligence-bi-components/#.VnH9qEorJD9

http://datawarehouse.ittoolbox.com/documents/data-warehousing-vs-business-intelligence-18494

http://www.dataintegration.info/etl

5) What is unstructured database (like Hadoop, Casandra, No-SQL) and how is it different from the traditional DB and its application?

Unstructured data is data that does not traditionally be in row and column structure. It is typically opposite of structured data.

Hadoop: is an open-source framework that allows easy storing and processing big data in a distributed environment across clusters of computers using simple programming models. Hadoops allows business to quickly gain insight from structured and unstructured database.

Cassandra: is distributed database for managing large amounts of structured data across many commodity servers. It is not just limited to managing data but also providing availability of service and no single point of failure. Cassandra offers benefits that no other relational database or No SQL can provide: continuous availability, linear scale performance, operational simplicity and easy data distribution across multiple data centers and cloud availability zones.

No-SQL: A NoSQL database is a non-relational and largely distributed database system. It enables rapid, ad-hoc organization and analysis of extremely high-volume, disparate data types. They are also referred to as cloud databases, non-relational databases, Big Data databases etc.

How is it different from traditional DB:

- SQL databases are Relational Databases (RDBMS) whereas NoSQL database are non-relational or distributed database.
- No SQL supports semi-structured data and volatile data
- SQL databases are table based databases whereas NoSQL databases are document based, key-value pairs, graph databases or wide-column stores.
- SQL databases are vertically scalable whereas the NoSQL databases are horizontally scalable.
- SQL databases uses SQL (structured query language) for defining and manipulating the data, which is very powerful whereas in NoSQL database queries are focused on collection of documents.
- No-SQL supports Big data in volumes of Terra Bytes & Peta Bytes

- SQL databases are not best fit for hierarchical data storage but NoSQL database fits better for the hierarchical data storage. The reason being that No SQL follows key-value pair way of storing data.
- With Relational Database Management Systems, built-in clustering is difficult due to the ACID properties of transactions whereas clustering it is easier in No SQL.
- SQL databases emphasizes on ACID properties (Atomicity, Consistency, Isolation and Durability) whereas the NoSQL database follow the Brewers CAP theorem (Consistency, Availability and Partition tolerance)
- SQL databases are best fit for heavy duty transactional type applications whereas you can use NoSQL for transactions purpose but it is still not comparable and sable enough for complex transactional applications.

http://hortonworks.com/hadoop/

http://www.thegeekstuff.com/2014/01/sql-vs-nosql-db/

6) What is the mechanism behind secure delete in DB? Describe the steps/method to securely delete data from MySQL and/or MS SQL SERVER DB? How is the process any different from a DELETE call in SQL?

In MYSQL databases if we fire a delete query on the database the data gets deleted but it is not completely destroyed. The reason behind this is that deletion is logical data not deleted. Deletion is insecure. With simple analysis of databases and basic knowledge on database internals, we can reconstruct the deleted data item. Retrieval of data can take place using forensic recovery tools which can be clearly very risky for the company.

In order to make sure that the data is completely deleted from the system you can use the following mechanism:

1. Overwrite data with zeroes: First update the entire data with empty data of the same length. After that delete the rows and add few rows with random data. After entering the data delete these row. Drop the database and run a shrink command, re-index or compact command.

2. Store data in encrypted form and disposing the keys: In this stage encrypt the data and then delete it by throwing out the keys used in encryption algorithms. Reason behind this is now if the data is recovered the decryption of the data won't be possible without the use of keys.

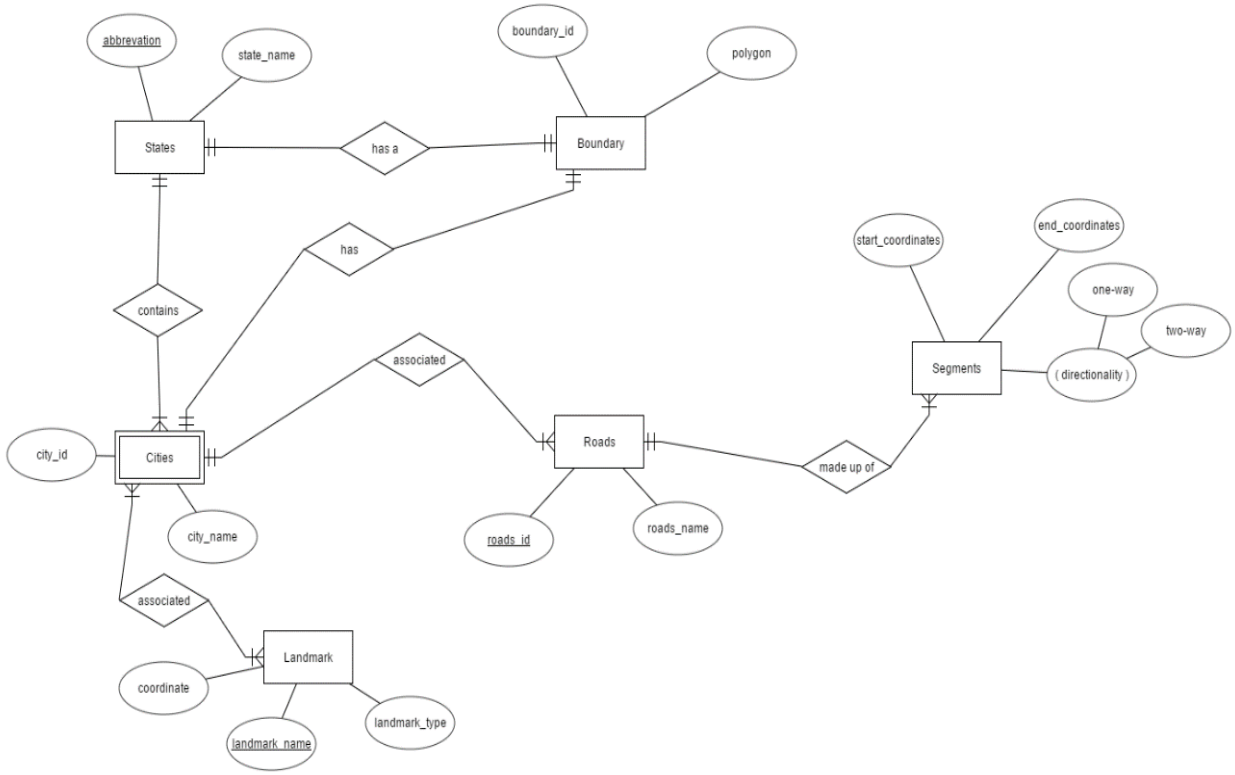
References: http://db.csail.mit.edu/nedbday08/slides/miklau.pdf

http://www.infosun.fim.uni-passau.de/publications/docs/GSK13.pdf

7) Suppose we are commissioned to design a schema for a new map and direction-finding site, Mondo Maps. Like MapQuest and Google Maps, our site needs to display route and map information.

Underneath it lies a database of cities, states, roads, and landmarks, in a two-dimensional plane (with longitude and latitude specifying a coordinate). • States have abbreviations (unique) and names, and each state has a unique boundary. • Cities are unique within states and have names, and each city has a single boundary. • A boundary corresponds to a city or state, and it has an ID and a polygon. (Assume there is a special polygon data type.) • Roads have IDs and names, and are made up of multiple segments. Assume that a road is associated with a single city. • A road segment has a start and an end coordinates, as well as directionality (one-way or two-way). • A landmark has a single coordinate, a name, and a type. Assume landmarks are associated with cities, and that landmark names are globally unique.

7a) Draw an ER diagram for this domain. Include participation constraints. You may need to add relationship sets that weren't explicitly specified. Many options were acceptable here. However, it is important to note that cities are weak entity sets as defined.



8) Provide definition and example of the following normal forms: 1NF, 2NF, 3NF and 3.5NF. Give two examples of each, a) when would you want to use normalization; b) when not to use normalization

A relation is in the first normal form if the values that are in the domain of each attribute of relation are atomic. 1NF has three basic rules:

- Remove identical columns from the same table.

- Identify every row with a unique column or set of columns (primary key)
- Develop separate table for every group of related values.

For eg:

Emp_id	Emp_name	Emp_address	Emp_mobile
101	John	Mumbai	96452120
102	Vita	Boston	78942351 85642354
103	Allen	Chicago	87246590
104	Neola	New York	12496354

The table is not in 1NF as each attribute in the table must have unique values.

Hence the 1NF form is as below:

Emp_id	Emp_name	Emp_address	Emp_mobile
101	John	Mumbai	96452120
102	Vita	Boston	78942351
102	Vita	Boston	85642354
103	Allen	Chicago	87246590
104	Neola	New York	12496354

2NF:

In 2NF the following rules are important:

- No partial dependency of any column on primary key
- Meet all the requirement of the first normal form
- For a table that has a concatenated primary key, each column in the table that is not part of the primary key must depend upon the entire concatenated key for its existence
- If any column depends only on one part of the concatenated key, then the table fails second normal form test

Student_id	Student_subject	Student_age
101	Maths	20
101	Physics	20
102	English	21
103	Computer	22
103	Chemistry	22

The table is in 1NF but not in 2NF as non-prime attribute student_age is dependent on student_id which is a subset of candidate key. Hence it is broken down into two tables

Student_details table:

Student_id	Student_age
101	20
102	21
103	22

Student_subject table:

Student_id	Student_subject
101	Maths
101	Physics
102	English
103	Computer
103	Chemistry

3NF form:

- Every non-prime attribute of table must be dependent on primary key
- Meet all the requirements of the second normal form AND no non-key fields depend on a field(s) that is not the primary key
- Remove columns that are not dependent upon the primary key

Emp_id	Last_name	First_name	Dept_num	Dept_name
1001	Pinto	Lee	2	Sales
1005	Wayne	Bruce	2	Sales
1029	Dsouza	John	1	Marketing

Information about department name is repeated and is liable to become inconsistent. The name of department is determined by more than one field – If empID = 1001 then department name is Sales – If dept_num is 2 is known, then it also yields Sales – There are two different fields determining the value of the department name

To convert into 3NF:

- Remove the field dept_name from original Employee table and putting it in a new table along with the field on which it depends (dept_num)

- The field dept_num will be the primary key of the new table and will also remain in the Employee table as a foreign key

Emp_id	Last_name	First_name	Dept_num
1001	Pinto	Lee	2
1005	Wayne	Bruce	2
1029	Dsouza	John	1

Dept_num	Dept_name
1	Sales
2	Marketing
3	Research

Normalization is part of successful database design. Without normalization, database systems can be inaccurate, slow, or inefficient. Normalizing database is important as if not normalized they may not produce the data you expect.

The primary goals of normalizing data are:

- Arranging data into logical groupings such that each group describes a small part of the whole - for eg consider the person table, it only represents information related to a person and no unrelated data.
- Minimizing the amount of duplicate data stored in a database – for eg: an employee may have multiple entries related to subjects taken which can then be stored into multiple tables.
- Building a database in which you can access and manipulate the data quickly and efficiently without compromising the integrity of the data in storage – for eg if you update the patient table any corresponding table dependent on patient table will get updated.

When not to use normalization:

- Performing joins on tables is very expensive. Less number of joins which means select queries work faster. Normalizing the data would increase the number of tables.

- A single table with all the required data allows efficient index usage. If the columns are indexed properly, then results can be filtered and sorted by utilizing the same index. While in the case of a normalized table, data would be spread out in different tables so efficient usage of indexes won't be possible.

  References: Lecture slides on normalization
  http://www.ovaistariq.net/199/databases-normalization-or-denormalization-which-is-the-better-technique/
  http://sqlmag.com/database-performance-tuning/sql-design-why-you-need-database--*/normalization

9) Describe the process and implementation of a database performance tuning?

Database tuning could be a difficult task especially when working with large-scale data where even the most minor change can have a positive or negative impact on performance.Even the performance of well-designed systems can degrade with use. Ongoing tuning is, therefore, an important part of proper system maintenance. For this, the database needs to be tuned properly using various tools.

Steps involved in the tuning process.

Tune the Business Rules - For optimal performance it is essential to adapt business rules. Configuration issues are considered at this level, such as whether to use a multi-threaded server system-wide. The planners ensure that the performance requirements of the system correspond directly to concrete business needs.**Tune the Data Design** –Determine what data is needed by your applications, what relations are important, and what their attributes are. Also structure the information to best meet performance goals. **Tune the Application Design** – Business executives and application designers should translate business goals into an effective system design. **Tune the Logical Structure of the Database** – Fine-tune the index design so that data to avoid over- nor under-indexed. In the data design phase identify the primary and foreign key indexes. In the logical structure design create additional indexes. **Tune Database Operations** –Use features such as Array processing, The Oracle optimizer, The row-level lock manager and PL/SQL based on the needs of your application:**Tune the Access Paths** – Use clusters, hash clusters, B*-tree indexes, bitmap indexes, and optimizer hints for efficient data access. Also consider analyzing tables and using histograms.**Tune Memory Allocation** – Allocating memory resources to Oracle memory structures will have a positive effect on performance.

References:

http://docs.oracle.com/cd/A87860_01/doc/server.817/a76992/ch2_meth.htm

https://docs.oracle.com/cd/E11882_01/server.112/e41573/perf_overview.htm#PFGRF02501