Project

Weight: 20% of your final grade

Due: after you have completed Unit 9

Complete all three modules, and upload your work here.

Project Module 1 (30 marks)

Study the information given below, and answer the questions.

For a long time, the Royal Victoria Hospital (RVH) worked with an information system that consisted of a mix of paper-based files and small independent databases developed within some departments. The new administration has created an information system (IS) department, and they hired you as information officer: head of the team in charge of the design and implementation of a new global information system. The following information was collected by the first team from the IS department, who conducted interviews with some of the hospital administration and staff to identify entity types for the hospital.

The hospital depends primarily on four groups of people: employees, physicians, patients, and volunteers. Of course, some common attributes are shared by all of these groups: person_ID (identifier), name, address, birth date, and phone number. Each group also has at least one unique attribute of its own. Employees have a date hired, volunteers have a skill, physicians have a specialty and a pager number, and patients have a contact date (date of the first contact with the hospital). Some people may belong to two or more of these groups at a given time (e.g., patient and volunteer).

Patient: A person who is either admitted to the hospital, or is registered in an outpatient program. One, and only one, physician is responsible for each patient. Patients are divided into two groups: resident and outpatient. Each outpatient is scheduled for zero or more visits. The entity visit has two attributes: date (partial identifier), and comments. Note that an instance of visit cannot exist without an outpatient owner entity. Only resident patients are assigned to a bed, and a bed may or may not be assigned to a patient.

Physician: A member of the hospital staff who may admit patients to the hospital, and who can administer medical treatments. A given physician can be responsible for zero or more patients at a given time.

A patient must be referred to the hospital by exactly one physician. A physician can refer any number of patients, or may not refer any patient.

Physicians may perform any number of treatments on behalf of any number of patients, or may not perform any treatment. A patient may have treatments performed by any number of physicians. For each treatment performed on behalf of a given patient by a particular physician, the hospital records the treatment date, treatment time, and results.

Employee: Any person employed as part of the hospital staff. Employees are subdivided into three groups: nurse, staff, and technician. Only nurse has the attribute certificate, which indicates a qualification (RN, LPN, etc.). Only staff has the attribute job class, and only technician has the attribute skill. Each nurse is assigned to one (and only one) care centre. Each technician is assigned to one or more laboratories.

Care centre: A treatment centre within the hospital. Examples of care centres are maternity, emergency, and cardiology. Attributes of care centre are name (identifier) and location. A care centre may have one or more nurses assigned to it. Also, one of the nurses assigned to each care centre is appointed nurse-in-charge. A nurse cannot be appointed nurse-in-charge of a care centre unless s/he has an RN certificate.

Each hospital employee is assigned to work in one or more care centre. Each care centre has at least one employee, and may have any number of employees. The hospital records the number of hours per week that a given employee works in a particular care centre. Each physician can be assigned to one or more care centres, and a care centre can have one or more physicians assigned to it.

Laboratory: A unit in the hospital where clinical tests (i.e., blood, urine, tissue, etc.) are performed to obtain information about the health of a patient. Attributes of laboratory include name (identifier) and location. A laboratory must have one or more technicians assigned to it.

Bed: A hospital bed that may be assigned to a resident patient who is admitted to the hospital. Each bed has a bed number, a room number, and a care centre ID. There may be no bed assigned to a care centre, or a care centre may have one or more beds assigned to it.

Item: Any medical or surgical item that is used in treating a patient. Each item has an item number, description, and unit cost.

A patient may optionally consume any number of items. A given item may be consumed by one or more patients, or may not be consumed. For each item consumed by a patient, the hospital records the date, time, quantity, and total cost (which can be computed by multiplying quantity by unit cost).

Treatment: Any test or procedure performed by a physician on behalf of a patient. Each treatment has a treatment ID, which consists of a treatment number and a treatment name.

a. Is the ability to model subtype/supertype relationships likely to be important in a hospital environment such as the RVH? **(4 marks)**
b. Can the business rules paradigm, and the ability to easily define, implement, and maintain business rules, be used as a competitive advantage in a hospital environment such as the RVH? **(4 marks)**
c. Do there appear to be any weak entities in the description of the data requirements in this project module? **(4 marks)**
d. Draw an EER diagram to accurately represent this set of requirements. State any assumption you had to make in developing the diagram. **(14 marks)**
e. Are there any universal data models that can be reused as a starting point for modeling RVH's data requirements? **(4 marks)**

Project Module 2 (30 marks)

Use the relational schema of the EER diagram you developed in Module 1 to answer the following questions.

a. Should the RVH use normalization when designing its database? **(3 marks)**
b. Why are entity integrity and referential integrity constraints of importance to the hospital?**(3 marks)**
c. Map the EER diagram to a relational schema, and transform the relation into 3NF. **(10 marks)**
d. Besides the 3NF relations, what additional types of information are required to create a physical database design? **(3 marks)**
e. Are there opportunities for horizontal or vertical partitioning of the database? Are there other opportunities to denormalize the relations of this database? If no, explain why? If yes, how might you denormalize the database? **(3 marks)**
f. Suppose the date treatment performed was not entered. What procedures are required to handle the missing data? **(3 marks)**
g. Consider the following query against the RVH database.

For each treatment performed in the past two weeks, list the physicians performing the treatment (grouped by treatment), and the number of times this physician performed that particular treatment, on that particular day. Order the list by treatment ID, and by reverse chronological order for each treatment ID.

Create secondary key indexes to optimize the performance of this query. State any assumptions. **(5 marks)**

Project Module 3 (40 marks)

Consider the following relations:

- Patients(pid, name, address, telephone, care_centre_id)
- Care_centres(cid, name, location, nurse_charge_id)
- Treatments(tid, patient_id, physician_id, treatment_name, date)
- Nurses(nid, name, care_centre_id, certificate_type, telephone, salary)
- Physicians(phid, name, pager_number, specialization, salary).

Use PostgreSQL or the DBMS selected for your Labs to complete the following tasks.

a. Create the tables that correspond to these relations in your PostgreSQL database. **(6 marks)**
b. If not automatically created by the DBMS, create indexes corresponding to the primary and foreign keys. **(6 marks)**
c. Populate these tables with some sample data, and write SQL queries that show the content of each table after entering the data. **(6 marks)**
d. For some strategic decisions, the president of the hospital needs summary data about the care centres. For each care centre, s/he needs to know the number of nurses holding an RN certificate, as well as their total and average salaries. Does the following view answer the president's request? If not, write the correct view that will satisfy the president's request. **(7 marks)**

```
CREATE VIEW NURSE_SUMMARY (D, C, TOTAL_S, AVERAGE_S)

AS SELECT cid, COUNT (*), SUM (salary), AVG (salary)

    FROM Care_centres, Nurses

    WHERE nurse_charge_id = nid and certificate_type like 'RN'

    GROUP BY cid;
```

e. State which of the following queries and updates would be allowed in this view. If a particular query or update would be allowed, show what the corresponding query or update on the base relations would look like, and give its result when applied to the database. **(5 marks)**

Q1. SELECT *

FROM NURSE_SUMMARY;

Q2. SELECT D, C

FROM NURSE_SUMMARY

WHERE TOTAL_S > 100000;

Q3. SELECT D, AVERAGE_S

FROM NURSE_SUMMARY

WHERE C > (SELECT C FROM NURSE_SUMMARY WHERE D=4);

Q4. UPDATE NURSE_SUMMARY

SET D=3

WHERE D=4;

Q5. DELETE FROM NURSE_SUMMARY

WHERE C > 4;

f. Use PostgreSQL or the database system you used for the Labs to create a view that displays the following information for each Patient: **(10 marks)**

Patient Number

Patient Name

Care Centre Name

Name of Nurse-in-Charge

Treatment ID

Treatment Name

Physician ID

Date

 **Note:** The list of treatments will need to be grouped for each patient.