

Concordia University
Dept. of Computer Science & Software Engineering
Comp 353 - Databases
Winter 2024
Main Project

Title: A database application system for employees of the health facilities

Demos: on April 8, 9, and 10.

Reports: Submission through Moodle is due by April 15, 2024

Maximum Mark: 12%

Project Description

This system builds on and extends the application developed in the warm-up project. It adds new functionalities and also requires development of a Graphical User Interface (GUI) to facilitate interactions of the end-users with the system.

Recall from the description of the warm-up project that the system helps track status of employees in health facilities. The system, called HFESTS, would be practical and useful during pandemic situations, like COVID-19, used by health organizations in order to keep track and reduce the risk of spreading disease and contamination of employees in health sectors and people they live with. The system should maintain all the information related to the pandemic, including the employees of the facilities, people they work and/or live with. Other related information includes residence of employees and people infected, type of infection (s), date of infection, and nature of infection. The system also records and monitors information about the vaccination of every individual, including for every vaccination, the vaccination date, type of vaccination, and the dose number of the vaccination.

A facility could be a hospital, a CLSC, a clinic, a pharmacy, or a special installment. Facility information includes name, address, city, province, postal-code, phone number, web address, type (Hospital, CLSC, etc.), capacity (Maximum number of employees that the facility needs to operate). At any time, a facility can have one general manager and many other employees working in the facility.

A residence could be an apartment, a condominium, a semi-detached or detached house. Information about residence could include address, city, province, postal-code, phone number, and number of bedrooms.

The application must maintain information about every employee working in each facility. Also, the application must maintain information about every person who lives at the same address as the employee. The information includes first-name, last-name, date of birth, Social Security Number, Medicare card number, telephone number, address, starting date at that address, city, province, postal code, citizenship, email address, and occupation.

Every employee must be registered with the public health care system, which means that the Medicare card number cannot have null value. No two employees can have the same Medicare card number. Social Security Number cannot have null value for any person. Also, no two people can have the same Social Security Number. The role of every employee must be maintained by the system. The role could be a nurse, doctor, cashier, pharmacist, receptionist, administrative personnel, security personnel, or a regular employee (including all other tasks). A general manager is considered to be administrative personnel. For every person who lives with an employee, the relationship of the person with the employee must be registered, which could be of type: roommate, partner, parent, non-parent dependent, children.

An employee can work at multiple facilities at the same time. An employee can work at different facilities at different times. For every employee, the start date and end date working at each facility must be maintained. If the end date is null, it indicates that the employee is still working at the facility. An employee can work at the same facility at different time intervals. For example, Roger Smith who is a doctor could have worked at CLSC Cote Des Neiges from Jan 15th, 2022, to June 30th, 2022, then worked at Hospital Maisonneuve Rosemont from July 5th, 2022, to Dec 15th, 2022, and then worked at CLSC Cote Des Neiges from Dec 20th, 2022, till now.

The application must maintain information like whether the employee or people who live with the employee has been vaccinated or not. For each vaccination of the employee or people who live with the employee, the system must maintain information about the type of vaccination given and the dose number, the date and the facility location of each dose given. The type of vaccinations could be Pfizer, Moderna, AstraZeneca, Johnson & Johnson, etc. Also, the dose number could be the integers 1, 2, or more. For example: Alfred McDonald could have taken Pfizer as the 1st vaccination dose on 20th of January 2021 at CLSC Montréal South, and the 2nd vaccination dose Moderna on 25th of April 2022 at Olympic Stadium Montréal.

A person can have one primary residence at a time and can have multiple secondary residences at the same time. The system records and maintains information on all the current types of residences of a person. Every person in the system must have a primary residence in which she/he is currently living.

Also, the application must maintain information on whether the employee or people who live with the employee have been infected or not. The person could be infected more than once. Every time the person is infected, the application needs to record the date and type of the infection. The infection type could be COVID-19, SARS-Cov-2 Variant, etc.

The schedule of every employee at each facility is maintained by the system. For every facility, and for every employee working in the facility, the schedule includes the date, the start time, and the end time. Start time cannot be greater than the end time. An employee cannot be scheduled at two different conflicting times neither at the same facility nor at different facilities. If an employee is scheduled for two different periods on the same day either at the same facility or at different facilities, then at least two hours should be the duration between the first schedule and the second one. The history of the schedules is maintained by the system. A schedule of four weeks ahead of time is supported by the system. If a nurse or a doctor is infected by COVID-19, then she/he cannot be scheduled to work for at least two weeks from the date of infection. An employee cannot be

scheduled if she/he is not vaccinated, at least one vaccine for COVID-19 in the past six months prior to the date of the new schedule.

If an employee is infected by COVID-19, then the system should automatically cancel all the assignments for the infected employee for two weeks from the date of infection. Also, the system should send an email to inform/track all the employees who have been in contact by having the same work schedule as the infected employee. Each email should have as a subject “Warning” and as a body “One of your colleagues with whom you worked in the past two weeks has been infected with COVID-19 (or else...)”. Also, the system should send an email to the infected employee informing the employee about the cancellation of the employee’s assignment.

Every week on Sunday, for every employee working in each facility, the system should automatically send an email to every employee indicating the schedule of the employee in the facility for the coming week. The subject of the email should include the facility name, and the dates covered by the schedule. A subject example: “CLSC Outremont Schedule for Monday 20-Feb-2023 to Sunday 26-Feb-2023”. The email body should include the facility name, the address of the facility, the employee’s role, first-name, last-name, email address, and details of the schedule for the coming week. Details include the day of the week, start time and end time. The body of the message should also include an entry for every day of the week followed by the starting hour and end hour for that day. A message “No Assignment” is displayed if the employee is not scheduled for that specific entry.

A log table in the database contains information on every email generated by the system. The log includes date of the email, the sender of the email (name of the facility), the receiver of the email, the subject of the email, and the first 100 characters of the body of the email.

What you should do:

In the above, we provided the minimum/basic requirements for this application. You could add more details if you find suitable and useful. Considering the information so far, do the following steps in your database design process:

1. Develop an E/R diagram to represent the conceptual database design for the above application.
2. In the diagram, mark or express various constraints (keys, functional dependencies, cardinalities of the relationships, etc.). Identify any constraints that are not captured by the E/R diagram.
3. Convert your E/R diagram into a relational database schema. Make refinements to the DB schema if necessary. Identify various integrity constraints such as primary keys, foreign keys, functional dependencies, and referential constraints. Make sure that your database schema is at least in 3NF.
4. Are all your relations in the database in BCNF? (Explain which ones and why not)

5. For any relation in your database, if it is not in BCNF, then show that it is in 3NF.
6. Create at least one trigger to execute some of the requirements specified in the description above.

Express and evaluate the following DDL and DML types of SQL commands against your database in which every relation is populated with 'sufficient' representative tuples:

1. Create/Delete/Edit/Display a Facility.
2. Create/Delete/Edit/Display a Residence.
3. Create/Delete/Edit/Display a Person.
4. Create/Delete/Edit/Display an Employee.
5. Create/Delete/Edit/Display a Vaccination.
6. Create/Delete/Edit/Display an Infection.
7. Assign/Delete/Edit schedule for an Employee. (Attempt to schedule a conflicting assignment for an employee)
8. Get details of all the facilities recorded in the system. Details include facility name, address, city, province, postal-code, phone number, web address, type, capacity, name of the general manager, number of employees currently working at the facility, number of doctors currently working in the facility, and number of nurses currently working in the facility. Results should be displayed sorted in ascending order by province, then by city, then by type, then by number of doctors currently working for the facility.
9. Get details of all the employees currently working in a specific facility who have at least one secondary residence. Details include employee's first-name, last-name, start date of work, date of birth, Medicare card number, telephone-number, primary address, city, province, postal-code, citizenship, email address, and the number of secondary residences. Results should be displayed sorted in descending order by start date, then by first name, then by last name.
10. For a given employee, get the details of all the schedules she/he has been scheduled during a specific period of time. Details include facility name, day of the year, start time and end time. Results should be displayed sorted in ascending order by facility name, then by day of the year, then by start time.
11. For a given employee, get the details of all the people who live with the employee at the primary address and at all the secondary addresses. For every address the employee has, you need to provide the residence type for that address, and for every person who lives at that address, you need to provide the person's first name, last name, occupation of the person, and the relationship with the employee.
12. Get details of all the doctors who have been infected by COVID-19 in the past two weeks. Details include doctor's first-name, last-name, date of infection, the name of the facility that the doctor is currently working for, and the number of secondary residences the doctor has. Results should be displayed sorted in ascending order by the facility name, then by the number of secondary residences the doctor has.
13. For a given facility, list the emails generated for the cancellation of assignments during a specific period of time. The results should be displayed in descending order by the date of the emails.

14. For a given facility, generate a list of all the employees who have at least three secondary residences and who have been on schedule to work in the last four weeks. The list should include first-name, last-name, role, number of secondary residences. Results should be displayed in ascending order by role, then by the number of secondary residences.
15. Get details of nurses who are currently working at two or more different facilities and have been infected by COVID-19 in the last two weeks. Details include first-name, last-name, first day of work as a nurse, date of birth, email address, total number of times the nurse got infected by COVID-19, total number of vaccines the nurse had, total number of hours scheduled, and total number of secondary residences. Results should be displayed sorted in ascending order by first day of work, then by first name, then by last name.
16. Provide a report of all the employees working in all the facilities by role. Report should include for every role of the employees, the total number of employees currently working in the facilities, and the total number of employees currently infected by COVID-19. Report should be displayed in ascending order by role.
17. Provide a report of all the employees working in all the facilities by role. Report should include for every role of the employees, the total number of employees currently working in the facilities, and the total number of employees who have never been infected by COVID-19. Report should be displayed in ascending order by role.
18. For all provinces, give the total number of facilities, the total number of employees currently working in the facilities, the total number of employees currently working and infected by COVID-19, the maximum capacity of the facilities, and the total hours scheduled in all facilities during a specific period. Results should be displayed in ascending order by province.
19. You should show the trigger(s) used by your system. Explain the trigger(s) used and their benefits.
20. You need to demonstrate the integrity of all the requirements provided in the description. Example, the system should not allow a user to schedule an employee on two different conflicting time.
21. You need to demonstrate the generation of emails and the logs of the emails produced by the system.

What you should submit:

Your project report should include the E/R diagram, the DB-design, and its normalization (including the analysis of 3NF and BCNF), the SQL declarations of the relations, the implementation code, relation instances, and the SQL scripts for the queries and transactions, and at least 5 tuples of each query result. Build a useful web interface to facilitate interactions with the database application system. Also include in your report, a few snapshots of the user interface you developed. A schedule of time slots for the demos of your main project will be posted through the course Moodle in April which is assigned on a first come first served basis. All members of your team must be present during your project demo.