CSIE4105 Database Systems

Homework # 2
Due on 11/03/2022

1. (20%) We are designing a database for the college library system. The entities we need are as follows: Student, Book, Librarian, Lecturer, Course, Order. Entities have the following attributes:

    Student: <u>student id</u>, a name, and a birthday.
    Book: a title, an author, an ISBN, and <u>a call number</u>.
    Librarian: <u>SSN</u>, name, hours per week of work.
    Lecturer: <u>SSN</u>, name.
    Course: <u>course id</u>, number of students.
    Order: <u>order id</u>, number of books, price, book name.

    The following information regarding the relationships between the entities should be tracked.

    - Lecturers teach courses during a given semester.

    - Each student may borrow multiple books from the library at a time, but no book may be taken out by two students at the same time.

    - Books may be put on reserve for courses. One book can be reserved for multiple courses and multiple books may be on reserve for each course.

    - Lecturers can request librarians to order books for their courses. Lecturers can place orders for different books, but they cannot order the same book in different orders.

    - Librarians can order books and must record the purchase price.

    - Librarians report to a senior librarian. *(reflexive librarian)*

    - Students and lecturers can also be librarians, but not all librarians are students or lecturers. *(inheritance without coverage)*

    - Lecturers can also study in the college as students, but not all lecturers are students. *(overlap)*

    Draw an ER or EER schema diagram for this system. Be sure to indicate all **key** and **cardinality constraints** and any *assumptions* you make.

2. (25%) Consider a database system for a baseball organization such as the major leagues. The data requirements are summarized as follows:

    - The personnel involved in the league include players, coaches, managers, and umpires. Each is identified by a unique personnel id. They are also described by their first and last names along with the date and place of birth.

    - Players are further described by other attributes such as their batting

orientation (left, right, or switch) and have a lifetime batting average (BA).

- Within the players group is a subset of players called pitchers. Pitchers have a life time ERA (earned run average) associated with them.

- Teams are uniquely identified by their names. Teams are also described by the city in which they are located and the division and league in which they play (such as Central division of the American league).

- Teams have one manager, a number of coaches, and a number of players.

- Games are played between two teams with one designated as the home team and the other the visiting team on a particular date. The score (runs, hits, and errors) are recorded for each team. The team with more number of runs is declared the winner of the game.

- With each finished game, a winning pitcher and a losing pitcher are recorded. In case there is a save awarded, the save pitcher is also recorded.

- With each finished game, the number of hits (singles, doubles, triples, and home runs) obtained by each player is also recorded.

Draw an ER or EER schema diagram for this system. Be sure to indicate all **key** and **cardinality constraints** and any *assumptions* you make.

3. (30%, each 5%) Suppose that each of the following *Update* operations is applied directly to the database state shown in the following figure. Discuss ***all* integrity constraints** violated by each operation, if any, and the different ways of <u>enforcing these constraints</u>.

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

DEPT_LOCATIONS

Dnumber	Dlocation
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

WORKS_ON

Essn	Pno	Hours
123456789	1	32.5
123456789	2	7.5
666884444	3	40.0
453453453	1	20.0
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
999887777	10	10.0
987987987	10	35.0
987987987	30	5.0
987654321	30	20.0
987654321	20	15.0
888665555	20	NULL

PROJECT

Pname	Pnumber	Plocation	Dnum
ProductX	1	Bellaire	5
ProductY	2	Sugarland	5
ProductZ	3	Houston	5
Computerization	10	Stafford	4
Reorganization	20	Houston	1
Newbenefits	30	Stafford	4

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship
333445555	Alice	F	1986-04-05	Daughter
333445555	Theodore	M	1983-10-25	Son
333445555	Joy	F	1958-05-03	Spouse
987654321	Abner	M	1942-02-28	Spouse
123456789	Michael	M	1988-01-04	Son
123456789	Alice	F	1988-12-30	Daughter
123456789	Elizabeth	F	1967-05-05	Spouse

(a) Insert <'Robert', 'F', 'Scott', '943775543', '1972-06-21', '2365 Newcastle Rd, Bellaire, TX', M, 58000, '888665555', 1> into EMPLOYEE.

(b) Insert <'ProductA', 4, 'Bellaire', 2> into PROJECT.

(c) Delete the DEPENDENT tuples with Essn = '987654321'.

(d) Delete the PROJECT tuple with Pname = 'ProductX'.

(e) Modify the Super_ssn attribute of the EMPLOYEE tuple with Ssn = '999887777' to '943775543'.

(f) Modify the Pnumber attribute of the PROJECT tuple with Pnumber = 30 to 40

4. (25%) Translate this EER diagram into a relational database schema. Indicate the **primary key** and **foreign key** (if any) for each relation. (Note: please use the *foreign key approach* for 1:1 and 1:N relationships.)