The assignment will be graded out of 100 points.

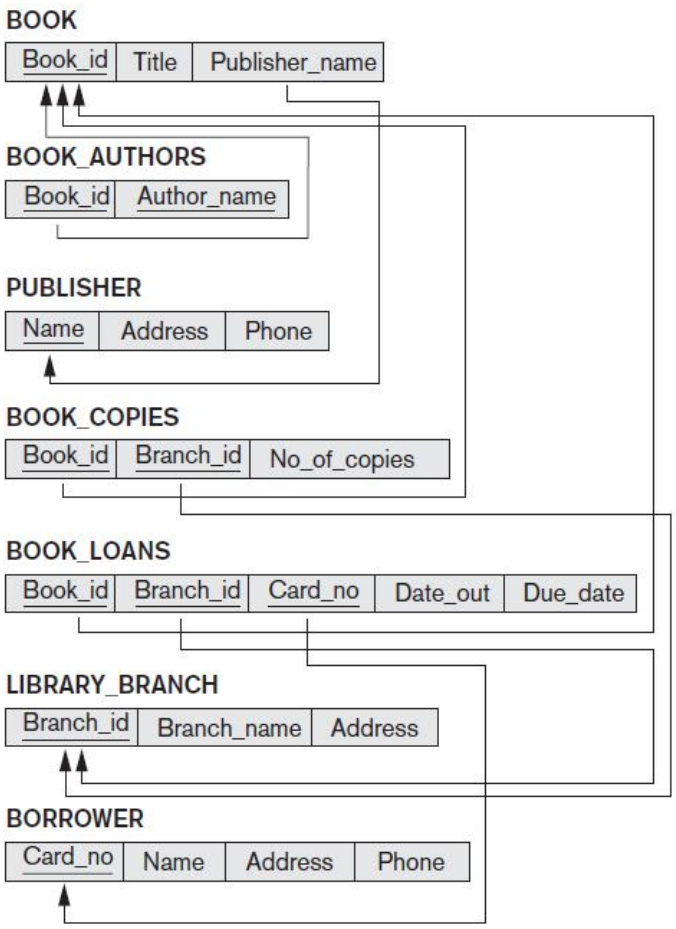
Due on Friday, October 5, 2018 by 11:59:59 PM

Submission Guidelines:

- The assignment should be submitted via Blackboard.
- **For your convenience, the answers can be typed as a document or handwritten and scanned for THIS assignment only.**
- Make sure your name and your student ID are listed in your document.
- Name files as assignment5_<net-id>.<format>
- Accepted document formats are (.pdf, .doc or .docx). If you are using OpenOffice or LibreOffice, make sure to save as .pdf or .doc
- Please do not submit .txt files.
- If there are multiple files in your submission, zip them together as assignment5_<net-id>.zip and submit the .zip file.
- The maximum points one can get in this assignment is 100.
- You may resubmit the project at any time. Late submissions will be accepted at a penalty of 10 points per day. Maximum latency is 5 days beyond which a grade of zero will be assigned. This penalty will apply regardless of whether you have other excuses.

Assignment specification:

1. Consider the LIBRARY relational database schema shown in Figure shown below, which is used to keep track of books, borrowers, and book loans. Referential integrity constraints are shown as directed arcs in figure. Write down relational expressions for the following queries: (**20 pts**.)



a) Retrieve the number of copies of the book titled “The Lost Tribe” are owned by the library branch whose name is ‘Sharpstown’?

b) Retrieve the number of copies of the book titled The Lost Tribe are owned by each library branch?

c) Retrieve the names of all borrowers who do not have any books checked out.

d) For each library branch, retrieve the branch name and the total number of books loaned out from that branch.

2. Consider the two tables T1 and T2 shown in Figure below. Show the results of the following operations: (**12 pts.)**

TABLE T1

P	Q	R
10	a	5
15	b	8
25	a	6

TABLE T2

A	B	C
10	b	6
25	c	3
10	b	5

a) $T1 \bowtie_{T1.P = T2.A} T2$
b) $T1 \bowtie_{T1.Q = T2.B} T2$
c) $T1 \cup T2$
d) $T1 \bowtie_{(T1.P = T2.A \text{ AND } T1.R = T2.C)} T2$

3. Specify the following queries on the **COMPANY** relational database state shown in Figure below (next page) using the concept of nested queries and the relational operators. (**30 pts.**)

a. Find the names of all employees who are directly supervised by ‘Franklin Wong’.

b. Retrieve the names of all employees who do not work on any project.

c. For each department, retrieve the department name and the average salary of all employees working in that department.

d. List the names of all employees who work in the department that has the employee with the highest salary among all employees.

e. List the names of all employees whose supervisor’s supervisor has '888665555' for SSN.

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

4. Consider the following set of requirements for a UNIVERSITY database that is used to keep track of student's transcripts. (**15 pts**.)

a. The university keeps track of each student's name, student number, Social Security number, current address and phone number, permanent address and phone number, birth date, sex, class (freshman, sophomore, ..., graduate), major department, minor department (if any), and degree program (B.A., B.S., ..., Ph.D.). Some user applications need to refer to the city, state, and ZIP Code of the student's permanent address and to the student's last name. Both Social Security number and student number have unique values for each student.

b. Each department is described by a name, department code, office number, office phone number, and college. Both name and code have unique values for each department.

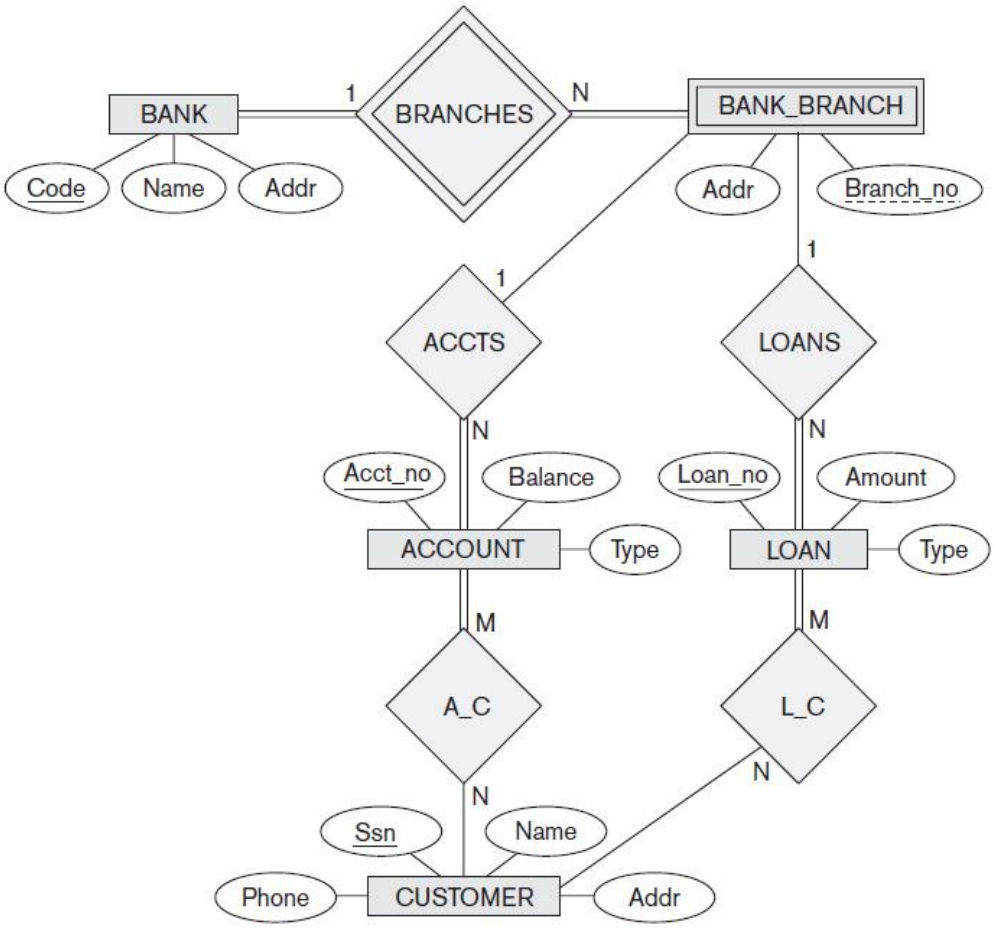
c. Each course has a course name, description, course number, number of semester hours, level, and offering department. The value of the course number is unique for each course.

d. Each section has an instructor, semester, year, course, and section number. The section number distinguishes sections of the same course that are taught during the same semester/year; its values are 1, 2, 3, ..., up to the number of sections taught during each semester.

e. A grade report has a student, section, letter grade, and numeric grade (0,1, 2, 3, or 4).

Design an ER schema for this application, and draw an ER diagram for the schema. Specify key attributes of each entity type, and structural constraints on each relationship type. Note any unspecified requirements, and make appropriate assumptions to make the specification complete.

5. Consider the ER diagram shown in the figure below for part of a BANK database. Each bank can have multiple branches, and each branch can have multiple accounts and loans (**16 pts.**).



a. List the strong (non-weak) entity types in the ER diagram.

b. Is there a weak entity type? If so, give its name, partial key, and identifying relationship.

c. What constraints do the partial key and the identifying relationship of the weak entity type specify in this diagram?

d. List the names of all relationship types, and specify the (min, max) constraint on each participation of an entity type in a relationship type. Justify your choices.

6. Cardinality ratios often dictate the detailed design of a database. The cardinality ratio depends on the real-world meaning of the entity types involved and is defined by the specific application. For the following binary relationships, suggest cardinality ratios based on the common-sense meaning of the entity types. Clearly state any assumptions you make. (**7 pts.**)

	Entity 1	Cardinality Ratio	Entity 2
1.	STUDENT	_____	SOCIAL_SECURITY_CARD
2.	STUDENT	_____	TEACHER
3.	CLASSROOM	_____	WALL
4.	COUNTRY	_____	CURRENT_PRESIDENT
5.	COURSE	_____	TEXTBOOK
6.	STUDENT	_____	CLASS
7.	CLASS	_____	INSTRUCTOR