Database Systems (Spring 2020)

Written Assignment 1 (Due date: 2020/05/05)

1. **[15 points]** Explain the distinctions among DDL interpreter, DML interpreter and DML compiler. Also explain why they are used in SQL.

2. **[10 points]** Consider the ACID properties of transactions. Explain the functions of concurrency-control manager and recovery manager, respectively, and explain also which transaction properties they enforce, respectively.

3. **[10 points]** Explain why file manager and buffer manager are existent in both operating systems and database systems.

4. **[10 points]** Figure 1 and Figure 2 below show two relations *T* and *U*, respectively. Answer each of the following questions:
   (a) List all superkey(s) of *T* and *U*, respectively.
   (b) List all candidate key(s) of *T* and *U*, respectively.

T

A	B	C
6	2	3
3	3	1
5	1	8
5	2	5

Figure 1

U

D	E	F
1	5	2
4	7	9
1	4	2

Figure 2

5. **[10 points]** Consider the two relations presented in Figure 3 and Figure 4 below. Please show the result of the following relational algebra expressions:
   (a) $\Pi_{R.B,\, R.C,\, D}\ (\sigma_{R.B=S.B\ \wedge\ R.C=S.C}\ (s \times t))$
   (b) $\Pi_{A,\, C,\, D}\ (\sigma_{A=4}\ (s \infty t))$

R

A	B	C
4	5	6
7	9	7
6	1	3
8	7	8
1	3	4

Figure 3

S

B	C	D
3	5	5
5	6	2
3	5	9
3	5	1
9	7	8

Figure 4

Consider the following relational schemas of a library database. Answer questions 6 and 7 below based on this database. Note that primary keys are underlined.

students (stuno, name, gender, age)
books (isbn, title, authors, publisher)
borrow (stuno, isbn, date)

6. **[21 points]** Write the following queries in **relational algebra**.
   (a) List the titles of all books that are currently borrowed.
   (b) List all male students who have borrowed books published by MIT during this year (2020).
   (c) List the name of all female students who have borrowed books published by MIT, except those who are older than 20 years old.

7. **[24 points]** Give **SQL** statements for each of the following queries.
   (a) List the names of all students who have borrowed the most books.
   (b) List the names of all students whose name is the same as that of the author of a book.
   (c) Create the three tables in the library database.