CSCI 4333 Design of Database Systems
Fall 2023
Section 1 Mid-Term Examination

Last Name: _____ **First Name:** _____ **Student Id:** _____

Number: _____

Time allowed: *1 hour 20 minutes.* Total score: 100 points. *Closed* book examination. *An information sheet prepared by yourself is allowed.*

Answer all questions. Turn in both question and answer sheets (if needed).

(1) [25 points] The goal is to build a highly simplified database to store a portion of information about a library system. Provide an UML class diagram to capture and model the partial requirements below. You should list class names, attributes with multiplicities, and associations with multiplicities. Roles of associations should also be provided when appropriate. Multiplicities should be as specific as possible. Show the stereotypes <<pk>> and <<unique>> (indicating that the value of the attribute must be unique for each object) when applicable. Since this is only a simplified part of the application, model your design in a flexible way.

The library system has many branches, each with a unique branch id and names. There are books. The system stores the ISBN (a unique identifier defined by the Library of Congress), title, publication year, the primary author, co-authors, and editors of a book. Authors and editors are persons in which the system stores their names. The database stores a unique Id for a person. A book may have only a primary author, and no co-author or editor. A person can be an author or editor of multiple books. Two persons may have the same name.

For example, for our textbook, "Database Illuminated," its ISBN is 978-284-05694 and the publication year is 2017. The primary author is Catherine Ricardo. The other author is Susan Urban, and there is no editor information.

The library system may acquire multiple copies of the same book. Each copy has a unique inventory id (for checking out) and the date of acquisition is recorded. A book copy may be lost. Otherwise, a book copy may be located in a branch. This information needs to be stored.

Please answer your question in the next page.

(1)   Your answer here:

(2) [15 points] Consider the following data model in the UML class diagram. Attribute multiplicity is included. Construct a reasonable set of relation schema to implement it. For each relation, list its candidate keys, foreign keys, and all attributes you know for sure that are nullable and non-nullable. Ignore data types.

R
<<PK>> A[1]
B[0..1]

0..*

W▶

0..*

0..*

T
C[1]

0..1

0..*

Z ▶

0..*

V

1

0..1

Y ▶

S
<<PK>> D[1]
E[0..*]
<<unique>> F[1]
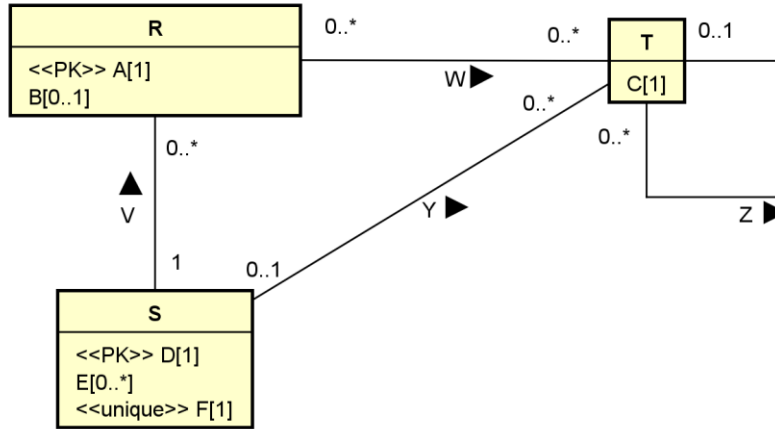
Answer: fill in the table below.

Relation		Relation	
[CK] [FK] [Nullable] [Non-nullable] [Note]		[CK] [FK] [Nullable] [Non-nullable] [Note]	
Relation		**Relation**	
[CK] [FK] [Nullable] [Non-nullable] [Note]		[CK] [FK] [Nullable] [Non-nullable] [Note]	
Relation		**Relation**	
[CK] [FK] [Nullable] [Non-nullable] [Note]		[CK] [FK] [Nullable] [Non-nullable] [Note]	

(3) [28 points] True or False. Circle the choice or write 'T' or 'F' clearly.

(a) [T or F] The relational model is an example of an object-oriented model.

(b) [T or F] A table in MS Access may have more than one sets of primary keys.

(c) [T or F] The Query Design tools in MS Access are based on relational algebra.

(d) [T or F] A SQL SELECT statement may have no FROM clause.

(e) [T or F] It is possible for the relation R(A,B,C,D) to have only one candidate key but two prime attributes.

(f) [T or F] In the relational model, a relation instance is a set of attribute names.

(g) [T or F] One advantage of DBMS as compared to file systems is its higher level of abstraction.

(h) [T or F] In MySQL, the command "CREATE SCHEMA f23;" creates a new database named "f23".

(i) [T or F] Logical data independence in relational database architectures refers to the independence of the conceptual database from the underlying physical storage structures.

(j) [T or F] In SQL, the execution of an INSERT statement may insert multiple rows into a table.

(k) [T or F] In a UML class diagram, it is possible to show just the name compartment of a class.

(l) [T or F] Knowing that {A, B} is the primary key of R(A,B,C,D), it is possible for R(A,B,C,D) to have three foreign keys.

(m) [T or F] Knowledge that R(A,B,C,D,E) has exactly four superkeys, it is possible that R has exactly four candidate keys.

(n) [T or F] Knowing that R(A,B,C,D,E) has exactly four prime attributes, it is possible that R has exactly six candidate keys.

Question 4 uses the following the toyu database, which is provided separately.

(4) [32 points] Write the *SQL* queries for the following data problems. Result orders are unimportant unless explicitly stated otherwise.

(a) Show all CSCI faculty members, their ids, names, and the number of advisees in the following manner. The result is shown in the descending order of the number of advisees.

```
+-------+--------------+--------------------+
| facId | faculty      | Number of advisees |
+-------+--------------+--------------------+
|  1011 | Paul Smith   |                  2 |
|  1012 | Mary Tran    |                  1 |
|  1013 | David Love   |                  0 |
|  1014 | Sharon Mannes|                  0 |
+-------+--------------+--------------------+
4 rows in set
```

(b) Show the ids and names of students who are advised by CSCI faculty advisors and have taken a CINF rubic class. List also the advisor's names in the following manner.

```
+--------+------------+------------+
| stuId  | student    | advisor    |
+--------+------------+------------+
| 100000 | Tony Hawk  | Paul Smith |
| 100002 | David Hawk | Mary Tran  |
+--------+------------+------------+
2 rows in set
```

(c) Show all students (id, names and # of CINF rubric classes) who have enrolled less
than 2 CINF rubric classes in the following manner.

```
+--------+-----------------+-------------------+
| stuId  | student         | # of CINF classes |
+--------+-----------------+-------------------+
| 100001 | Mary Hawk       |                 0 |
| 100002 | David Hawk      |                 1 |
| 100003 | Catherine Lim   |                 0 |
| 100006 | Lillian Johnson |                 1 |
| 100007 | Ben Zico        |                 0 |
| 100008 | Bill Ching      |                 0 |
| 100009 | Linda King      |                 0 |
| 100111 | Cathy Johanson  |                 0 |
+--------+-----------------+-------------------+
8 rows in set
```

(d) Show the ids and names of students who have enrolled in a CSCI class but not a CINF
class in the following manner.

```
+--------+-----------+
| stuId  | student   |
+--------+-----------+
| 100001 | Mary Hawk |
+--------+-----------+
1 row in set
```