CSCI 4333 Design of Database Systems
Spring 2025
Section 1 Mid-Term Examination

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

Number: _____

Time allowed: *1 hour 20 minutes.* Total score: 101 points. *Closed* book examination. *A letter-size information sheet (both sides) prepared by yourself is allowed.*

Answer all questions. Turn in everything: question and answer papers, information sheet and sketch papers. They will be stapled together.

(1) [30 points] The goal is to build a toy prototype application below. Construct an UML class diagram to capture and model the partial requirements. You should list class names, attributes with multiplicities, and associations with multiplicities. The roles of associations should also be provided when appropriate. Multiplicities should be as specific as possible. Show the stereotypes <<pk>> and/or <<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.

Simplified Toy Library System (STLS)

The library system has many branches, each with a unique branch id and a unique name. Libraries have 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 people in which STLS 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 an editor of multiple books. Two people may have the same name.

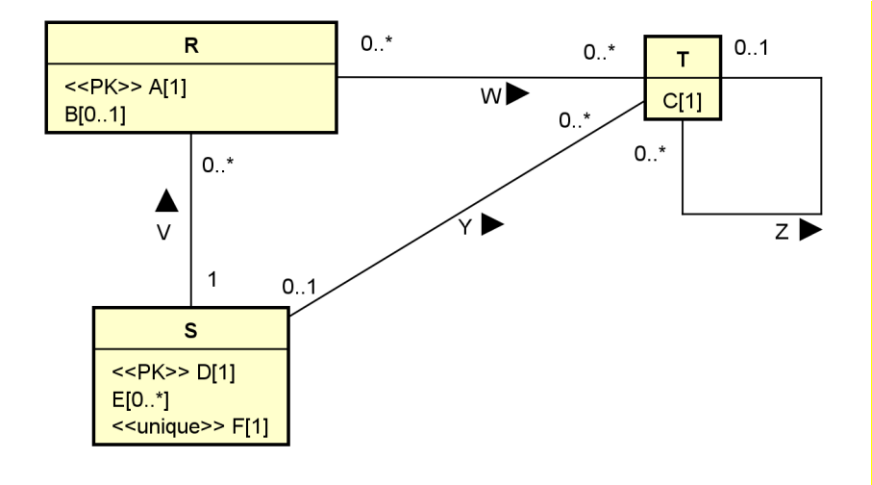
For example, for our textbook, "Database Illuminated," its ISBN is 978-284-05694 and the publication year is 2017. The primary author is Catherine Ricardo. The other author is Susan Urban, and there is no editor information.

The library system may acquire multiple copies of the same book. Each copy has a unique inventory Id. When available, the date of acquisition is recorded. A book copy may be lost. Otherwise, a book copy may be in a branch. This information needs to be stored.

Please answer your question on the next page.

(1) Your answer here:

(2) [15 points] Consider the following data model in the UML class diagram. Attribute multiplicities are 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. Indicate whether a surrogate primary key is created.



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) [26 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 SQL SELECT statement may have no WHERE clause.

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

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

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

(f) [T or F] In SQL, the execution of an INSERT statement can only insert one row into a table at a time.

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

(h) [T or F] Knowing that {A, B} is the primary key of R(A,B,C,D), R(A,B,C,D) may have four foreign keys.

(i) [T or F] The data model of Excel spreadsheet is based on two-dimensional arrays.

(j) [T or F] In SQL, the string ‘null’ represents missing or inapplicable information.

(k) [T or F] GPA can be a reasonable example of a derived attribute in databases.

(l) [T or F] If R(A, B) has six rows and S(A,C) has four rows, the SQL statement “SELECT * FROM R, S;” may return 0 to 24 rows.

(m) [T or F] A foreign key cannot have a null value.

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

(4) [30 points] Write the *SQL* queries for the following data problems. Result orders are unimportant unless explicitly stated otherwise.

(a) Show the names of all CSCI major students, and the classId and grades of their enrolled classes in the following manner.

```
+------------+---------+-------+
| student    | classId | grade |
+------------+---------+-------+
| Tony Hawk  |   10000 | A     |
| Tony Hawk  |   10001 | A     |
| Tony Hawk  |   10002 | B+    |
| Tony Hawk  |   10003 | C     |
| Tony Hawk  |   10004 | A-    |
| Tony Hawk  |   11001 | D     |
| Mary Hawk  |   10000 | NULL  |
| Mary Hawk  |   10001 | A-    |
| David Hawk |   10000 | B-    |
| David Hawk |   10002 | B+    |
| David Hawk |   10003 | D     |
+------------+---------+-------+
11 rows in set
```

(b) Show the ids and names of students who have a grade of A in one enrolled class and a grade of B+ in another enrolled class in the following manner.

```
+--------+---------------+
| stuId  | student       |
+--------+---------------+
| 100000 | Tony Hawk     |
| 100004 | Larry Johnson |
+--------+---------------+
2 rows in set
```

(c) Show the stuIds and names of students who have taken a class from the faculty Mary Tran in the following manner.

```
+--------+-----------------------------------------+
| stuId  | student enrolled in classes by Mary Tran |
+--------+-----------------------------------------+
| 100000 | Tony Hawk                               |
| 100002 | David Hawk                              |
+--------+-----------------------------------------+
2 rows in set
```