Database Systems
Fall 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.

Fencer Organization DB

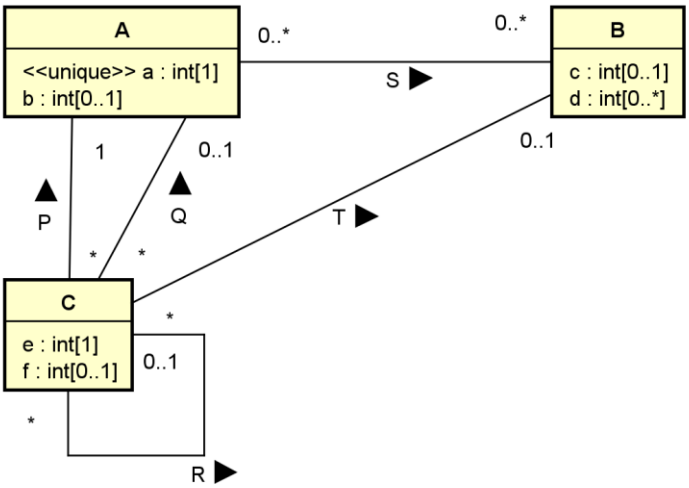
Fencers can join the fencer organization to compete in games of events. A unique id must be stored for every fencer, together with his name, phone and an optional email address. A fencer may have any number of other fencers as buddies. The organization keeps track of buddy relationships.

The fencer organization organizes events. An event has a date, time and venue. A venue has a name and a phone, and it can be used to host many events. An event includes many competition games for fencers. A game is a match between two fencers in a specific type of competition, such as foil, Sabre, etc. The scores, called hits, of the fencers in a game need to be recorded.

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] Comparing to a file system, an advantage of DBMS is the provision of a higher-level logical model.

(b) [T or F] The relational model is object-based.

(c) [T or F] It is possible for R(A,B,C,D) to have no foreign key.

(d) [T or F] It is possible for R(A,B,C,D) to have 15 candidate keys.

(e) [T or F] The relational model is based on a two-dimensional array model.

(f) [T or F] Null values should not be used in a relational database.

(g) [T or F] In the relational model, a relation can have more than one primary key.

(h) [T or F] It is possible for a relation to have no prime attribute.

(Note: a prime attribute is an attribute that appears in a candidate key.)

(i) [T or F] It is possible that executing an UPDATE statement in SQL may update no row.

(j) [T or F] In MySQL, a table may not have any row.

(k) [T or F] In relational databases, a derived attribute has a constant value.

(l) [T or F] If R(A, B) has five rows and S(A,C) has two rows, the SQL statement "SELECT * FROM R, S;" may return 0 to 10 rows.

(m) [T or F] In MySQL, an INSERT statement can be used to insert more than one row.

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) List the course titles, semesters and grades of all courses enrolled by the student with id 100000 in the following manner.

course	semester	year	grade
Data Structures	Fall	2019	A
Design of Database Systems	Fall	2019	A
DBMS	Fall	2019	B+
Introduction to Information Systems	Fall	2019	C
Web Application Development	Fall	2019	A-
Design of Database Systems	Spring	2020	D

6 rows in set

(b) List the names of faculty members, their departments and schools in the following manner. List only those faculty members who have taught at least one class.

faculty	department	school
Art Allister	Arts	Human Sciences and Humanities
Daniel Kim	Computer Information Systems	Science and Engineering
Andrew Byre	Computer Information Systems	Science and Engineering
Paul Smith	Computer Science	Science and Engineering
Mary Tran	Computer Science	Science and Engineering
David Love	Computer Science	Science and Engineering
Sharon Mannes	Computer Science	Science and Engineering
Katrina Bajaj	English	Human Sciences and Humanities
Benjamin Yu	Information Technology	Science and Engineering

9 rows in set

(c) List the names of all students who have enrolled in the class with id 10000, but not enrolled in the class with id 10002 in the following manner.

```
+-----------+----------------------+
| student   | grade in class 10000 |
+-----------+----------------------+
| Mary Hawk | NULL                 |
+-----------+----------------------+
1 row in set
```