

CSCI 4333 Design of Database Systems
Fall 2024
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 the 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.

Simple Projects and Employees (SPE)

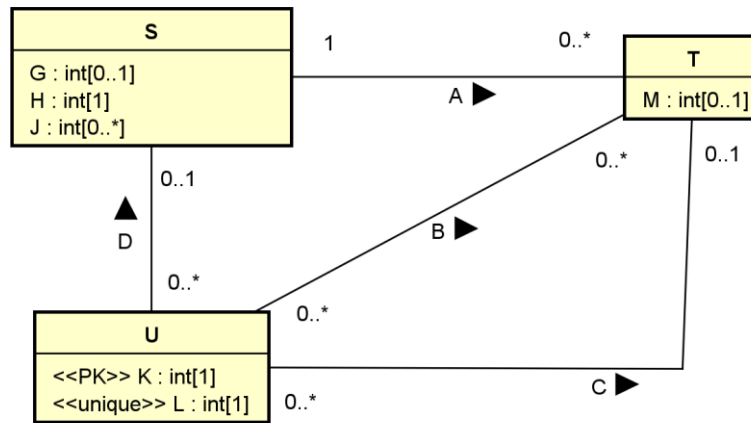
There are employees with unique member ids serving as an identifier. The last names, first names, and email addresses of employees are stored, together with any number of phone numbers. An employee may have another employee as her direct supervisor, except for the head of the company.

There are projects with unique project ids and names. Project names are not unique. A project has an optional description. SPE maintains the skills needed by projects. Each skill has a unique name and may come with a description. A project may demand many skills. A skill has a unique name and may have a description. A project may have an employee as the project leader. When a project is initially created, its project leader may not have been identified. Other than the project leader, a project has employees working on it as project members. SPE notes the skills a project member will contribute to a project. When an employee works for a project, there is a unique role. SPE maintains a list of roles, such as “developer”, “manager”, or “tester.”

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

(3) [26 points] True or False. *Circle* the choice or write 'T' or 'F' *clearly*.

- (a) [T or F] In the relational model, a relation always has exactly one primary key.
- (b) [T or F] In UML, the class diagram is an example of a static diagram.
- (c) [T or F] When comparing to a file system, an important advantage of a DBMS is its better support of concurrent access.
- (d) [T or F] If A, B and C are prime attributes of $R(A,B,C,D)$, then ABC must be a candidate key.
- (e) [T or F] The relational model is object-based, but not object-oriented.
- (f) [T or F] $R(A,B,C)$ has two rows. $S(D,E)$ has three rows. As a result, “SELECT * FROM R INNER JOIN S” returns six tuples.
- (g) [T or F] A derived attribute can have an independent value.
- (h) [T or F] A class in a class diagram may have more than one multi-valued attribute.
- (i) [T or F] It is possible for a relation $R(A,B,C,D,E)$ to have four foreign keys.
- (j) [T or F] A primary key of a relation cannot have a null value.
- (k) [T or F] Relational Calculus can be considered as a functional language.
- (l) [T or F] In the instance of toyu distributed to you, “SELECT * FROM student WHERE advisor = 'NULL';” returns three rows.
- (m) [T or F] It is possible for $R(A,B,C,D,E)$ to have no non-prime attribute.

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 name, classId and grade of every student enrolled in a class taught by the faculty 1012 in the following manner.

```
+-----+-----+-----+-----+
| stuId | student | classId | grade |
+-----+-----+-----+-----+
| 100000 | Tony Hawk | 10002 | B+ |
| 100002 | David Hawk | 10002 | B+ |
| 100000 | Tony Hawk | 11001 | D |
+-----+-----+-----+-----+
3 rows in set
```

(b) List the names of departments and their school names for those departments with both an assistant professor and an associate professor as faculty members.

```
+-----+-----+
| department | school |
+-----+-----+
| Computer Science | Science and Engineering |
+-----+-----+
1 row in set
```

(c) List the course names that have been taught by instructor 1011 and but have not been taught by 1012 in the following manner.

```
+-----+
| course |
+-----+
| CSCI 3333: Data Structures |
+-----+
1 row in set
```