CSCI 5333 DBMS
Fall 2021
Mid-Term Examination

Last Name: ________________ **First Name:** ____________ **Student Id:** ________

Number: _________ **V:** _________

I hereby pledge that I will stay truth to UHCL's Honor Code.

Signature: **Date:**

Time allowed: Two hours. Total score: 100 points. *Closed* book examination.

Answer all questions. Write in the back of the question paper, if necessary. Turn in all additional answer papers and rough work.

Academic honesty policy will be followed strictly. Cheating will be pursued vigorously and will result in a failing grade of D or below, a permanent academic record and possibly other more serious penalty!

(1) [25 points] The goal is to build a toy prototype database to *partially* support a portion of a drastically simplified *student group system (SGS).* Construct 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 stereotype <<PK>> (primary key) when applicable.

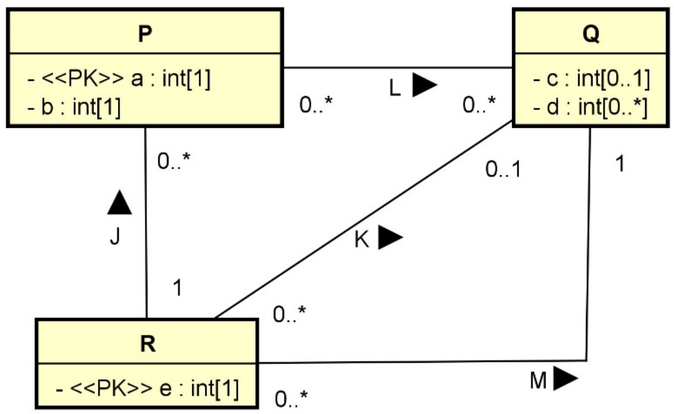
In SCS, students can form groups to do things and join these groups as members. The student id (an unique identifier that can serve as a key), name, email, and phone of a student should be recorded. All are mandatory fields with the exception of phone, which is optional. When a student joins a group as a member, the join time must be stored, together with an optional comment.

A group must have a unique id and a name. It may also have a description. It can be a top group or a lower level group. A group may have some subgroups, which are themselves groups, and thus may have their own subgroups. A top-level group must have a faculty supervisor, so a faculty id must be stored. A member can make comments on a top level group (but not a lower level group). Such comments should be recorded with the time they were made.

You may answer in the next page.

Answer for question (1):

(2) [15 points] Consider the data model in the following 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 not nullable. Ignore data types.



(3) [16 points]

(a) [T or F] In the relational model, a prime attribute may accept a null value.

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

(c) [T or F] In Tuple Relational Calculus, a variable can have a null value.

(d) [T or F] A class in a UML class diagram may have more than one association with other classes.

(e) [T or F] A relation may have more than 10 candidate keys.

(f) [T or F] It is possible that a relation may not have any foreign key.

(g) [T or F] If R(A,B,C,D) has two candidate keys and one of them is A, the minimum number of superkeys R may have is 9.

(4) [4 points] Short question.

It is known that R(A,B,C,D) has *exactly* four superkeys. How many candidate keys may have? Why?

Questions 5 to 7 use the following relations with an example of an instance shown below.

Supplier(SNum, SName, SCity, Status)
Part(PNum, PName, Color, Weight)
Supply(SNum, PNum, Quantity)

Supplier:

SNum	SName	SCity	Status
S1	ABC	Dallas	10
S2	DEF	Houston	20
S3	Go go	Houston	12
S4	P&G	Dallas	2
S5	Yap	Phoenix	5
S6	Yue	Dallas	1

Part:

PNum	PName	Color	Weight
P1	Drum	Green	10
P2	Hammer	Green	20
P3	Minipod	Red	4
P4	Micropod	Red	4
P5	Blue Spur	Blue	3
P6	Musical Box	Blue	13
P7	Bear	Blue	9
P8	Panda	White	10

Supply:

SNum	PNum	Quantity
S1	P1	10
S1	P2	3
S2	P1	11
S2	P2	1
S2	P4	6
S3	P4	1
S3	P5	2
S3	P6	12
S3	P7	5
S4	P2	1
S4	P5	10
S4	P7	4
S4	P8	10
S5	P1	11
S5	P3	5
S5	P4	10
S5	P5	14

(5) [15 points] Write the relational algebra expressions for the following queries. You may use either the mathematical notation *or* the syntax of the RA interpreter in HW #3.

(a) List the names and status of all Dallas suppliers that supply a green part. For example:

```
Number of tuples = 2
ABC:10:
P&G:2:
```

(b) List the part numbers of all parts that are supplied by a supplier in Houston, but not by any supplier from Dallas. For example:

```
Number of tuples = 2
P4:
P6:
```

(c) List the name and weight of all parts supplied by a supplier with a status greater than 10, or located in Houston, or both. For example:

```
Number of tuples = 6
Drum:10:
Hammer:20:
Micropod:4:
Blue Spur:3:
Musical Box:13:
Bear:9:
```

(6) [10 points] Write the DRC expressions for the following queries.

(a) List the names and status of all Dallas suppliers that supply a green part. For example: {('ABC',10), ('P&G',2)}

(b) List the supplier numbers of suppliers that supply at least two different blue parts. For example: {('S3'), ('S4'))}

(7) [15 points] Write SQL statements for the following queries.

(a) List the names and status of all Dallas suppliers that supply a green part. For example:

```
+-------+--------+
| sname | status |
+-------+--------+
| ABC   |     10 |
| P&G   |      2 |
+-------+--------+
```

(7) (b) List the part numbers of all parts that are supplied by a supplier in Houston, but not by any supplier from Dallas. For example:

```
+------+
| pnum |
+------+
| P4   |
| P6   |
+------+
```

(c) List the supplier numbers of suppliers that supply at least two different blue parts. For example:

```
+------+
| snum |
+------+
| S3   |
| S4   |
+------+
```