Computer Science 3005
2019 Winter
Midterm Examination

TIME: 75 minutes
INSTRUCTOR: Dr. M. Liu

STUDENT NUMBER: _____

NAME:_____
First Name Last Name

Instructions:
1. This is a closed book exam, with no additional material permitted.
2. Verify that your examination consists of 5 pages including this one.
3. Answer all questions in the spaces provided.
4. Please write as legibly as possible. Anything that cannot be read will be marked 0.
5. Total marks for the exam is **74** and you have **75** minutes. Allocate your time wisely.

Part 1 (24 marks)

Explain the following terms as complete as possible. Simply give full name is not acceptable. Each question is 3 marks.

1. Database System:

The database and the applications developed for the users on top of DBMS

2. Relation:

A relation consists of a schema and an instance that is a set of tuples.

3. Database designer:

Responsible to defining the content, the structure, the constraints, and functions or transactions against the database.

4. SQL:

Official language for relational databases that consists DDL, DML, DQL (or QL).

5. Three-Tier Client-Server architecture:

Consists of database server, client and application/web server (to provide more secure database access)

6. Referential Integrity Rule:

The value in the foreign key column (or columns) of the the **referencing relation** can be either a value of an existing primary key value of a corresponding primary key in the **referenced relation**, or just a **null**.

7. Program-data independence:

The capacity to change **data structure** without having to change the associated application programs.

8. Physical data independence:

The capacity to change the internal schema without having to change the conceptual schema.

Part 2 (50 marks)
Consider the following Supplier-Part database with three tables Suppler, Part, and SP. The primary keys are underlined and foreign keys are obvious. Use both relational algebra (ALG) and tuple calculus (TRC) to express the following queries. Each query is 10 marks: Each ALG/TRC is 4 marks and the result is 2 marks.

Supplier

S#	NAME	STATUS	CITY
S1	Smith	20	London
S2	Jones	30	Paris
S3	Blake	30	Paris
S4	Clark	20	London
S5	Adams	30	Athens

Part

P#	NAME	COLOR	WEIGHT	CITY
P1	Nut	Red	12.0	London
P2	Bolt	Green	17.0	Paris
P3	Screw	Blue	17.0	Oslo
P4	Screw	Red	14.0	London
P5	Cam	Blue	12.0	Paris
P6	Cog	Red	19.0	London

SP

S#	P#	QTY
S1	P1	300
S1	P2	200
S1	P3	400
S1	P4	200
S1	P5	100
S1	P6	100
S2	P1	300
S2	P2	400
S3	P2	200
S4	P2	200
S4	P3	300
S4	P4	400
S4	P5	500
S4	P6	600

1. Get the names of suppliers who supply P1.

   ALG> Project name Select P# = ‘P1’ (Supplier njoin SP)

   TRC> {S.name | S in Supplier and (exists R in SP)(R.S# = S.S# and R.P# = ‘P1’)};

   Result>
   Name
   Smith
   Jones

2. Get the names of suppliers who do not supply any part.
   ALG> T1 = Project S# (Supplier) – Project S# (SP)
   Project name (T1 njoin Suppiler)

   TRC> {S.name | S in Supplier and (not exists R in SP)(S.S# = R.S#)};

   Other solutions:
   {S.name | S in Supplier and (forall R in SP)(S.S# != R.S#)};

   Result>
   Name

Adams

3. Get names of suppliers who supply all parts.

ALG> T1 = Project S#, P#(SP) / Project P#(Part)
project name (T1 njoin Supplier)

TRC> {S.name | S in Supplier and (forall P in Part)((exists R in SP)(R.S# = S.S# and R.P# = P.P#))};

Other solutions:

{S.name | S in Supplier and not (exists P in Part)(
not (exists R in SP)(R.S# = S.S# and R.P# = PP#))};

Result>
Name
Smith

4. Get the names of suppliers who supply all parts except P1.

ALG> T1 = Project S#,P#(SP) / (Project P# Select P# != 'P1' (Part))
T2 = T1 – (Project S# (Select P# = 'P1' (Supplier njoin SP)))
Project name (T2 njoin Supplier)

TRC> {S.name | S in Supplier and (forall P in Part)(
P.P# = 'P1' AND not (exists R in SP)(R.P# = P.P# and S.S# = R.S#)
OR
P.P# != 'P1' AND (exists R in SP)(R.P# = P.P# and S.S# = R.S#))};

Other solutions:

{S.name | S in Supplier and (not exists P in Part)(
(P.P# != 'P1' OR (exists R in SP)(R.P# = P.P# and S.S# = R.S#))
AND
(P.P# = 'P1' OR not (exists R in SP)(R.P# = P.P# and S.S# = R.S#))
)};

{S.name | S in Supplier and (not exists P in Part)(
P.P# = 'P1' AND (exists R in SP)(R.P# = P.P# and S.S# = R.S#)
OR
P.P# != 'P1' AND not (exists R in SP)(R.P# = P.P# and S.S# = R.S#)
)};

Result>
Name
Clark

5. Get the names of suppliers who supply more than two parts using aggregate operations.
Both >2 and >=2 are acceptable.

ALG> T1(S#, count) = Aggregate S#, count(P#) (Supplier njoin SP);
Project name Select count > 2 (T1 njoin Supplier)

TRC> T(name, count) = {S.name, count(R.P#) | S in Supplier and R in SP and R.S# = S.S#};
{T.name | T in T and T.count > 2};

Result>
Name
Smith
Clark