Uppsala University

Department of Information Technology

Database Design I (1DL300) – 2019/11/1

Instructions: Read through the whole exam paper and note any unclear directives before you start solving the questions.

This is a multiple-choice exam with two types of questions:
- If a **question is marked with ♥** you must **select ALL correct choices**. If you do not select all correct choices or you include any incorrect choice, your answer will be marked as incorrect.
- For all **other questions** you must **select only one choice** even if there are several correct choices. Your answer will be marked as correct if you select any of the correct choices. If you select an incorrect choice or select more than one choice, your answer will be marked as incorrect.

To achieve a grade of 3, you must gain at least 14 correct answers. To achieve a grade of 4, you must gain at least 17 correct answers. To achieve a grade of 5, you must collect at least 20 correct answers.

Answers must be given exclusively on the answer sheet, at the end: answers given on the other sheets will be ignored. If you feel you need a new clean answering sheet **please** ask for one.

Allowed aids: One A4 sheet with handwritten notes (both sides can be used) which must be handed in with your exam (remember to write your exam code in a corner). You are allowed to use dictionaries to and from English and a calculator.

General questions (useful for us)

Question G1 ♣ When have you attended the course?
A   Period 1, 2019
B   Period 2, 2018
C   Period 1, 2018
D   Period 2, 2017
E   Period 1, 2017
F   None of the previous answers

Question G2 ♣ How many lectures have you attended?
A   None or very few
B   Around 25%
C   Around 50%
D   Around 75%
E   Almost all

Question G3 ♣ What is your study program?
A   F
B   STS
C   CS
D   X
E   IT
F   None of the previous answers

Question 1 ♥ Based on the ER model depicted below and the semantics of ER models, which of the following statements are correct? (Select **all** correct choices)
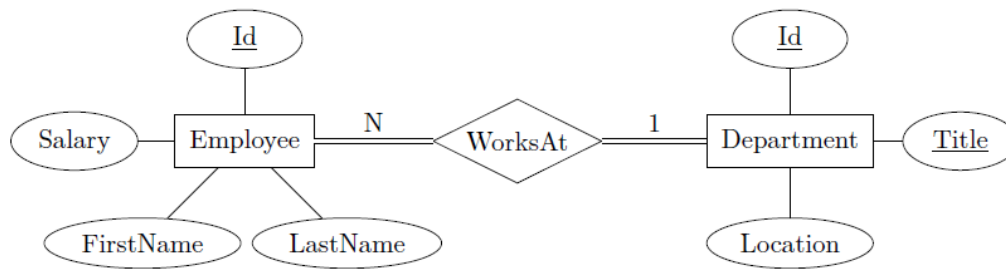

A Each employee works at exactly one department.

B Many employees can work at the same department.

C Each department has at least one employee.

D Each employee has a unique combination of the first and last name.

E Each department has at least two employees.

F A Department may have no employees.

Question 2 For the depicted ER model, select any of the following statements which is correct!
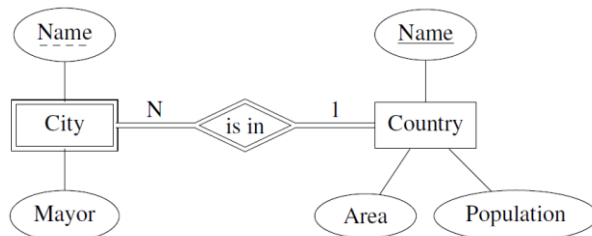

A Same person cannot be mayor of two cities.

B Each city is exactly in one country.

C The population of a country is always larger than 0.

D No two countries have exactly the same area and population.

E The name of a city must be different from the name of a country.

Question 3 Based on the EER model depicted below and the semantics of EER models, select a correct statement from the following.
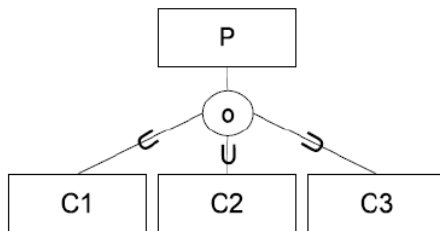
A An entity type P may belong to any of C1, C2, C3 sub-classes.

B An entity type P may be none of these sub-classes (i.e. C1, C2, or C3 sub-classes).

C An entity type P may belong to more than one sub-classes at the same time.

D An entity type P may belong to only one of the sub-class (i.e. C1, C2, C3 types) at the same time.

E None of the other answers is correct!

Question 4 Consider we want to convert the following diagram to the relational model. Choose a correct answer from the following.
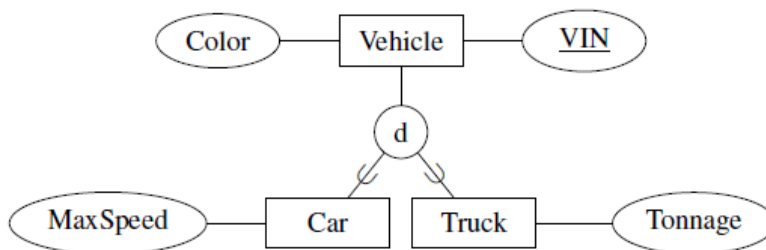
A Car(VIN, Color, MaxSpeed)
Truck(VIN, Color, Tonnage)

B Vehicle(VIN, Color)
Car(MaxSpeed)
Truck(Tonnage)

C Vehicle(VIN, Type, Color, MaxSpeed, Tonnage)

D Vehicle(VIN, Color)
Car(VIN, MaxSpeed)
Truck(VIN, Tonnage)

**Question 5** Consider we want to convert the following diagram to the relational model. Select a valid solution.
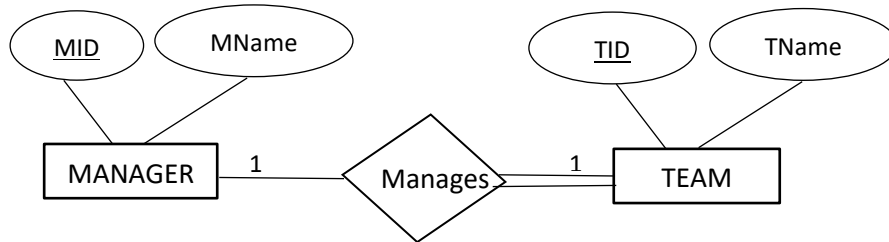
A MANAGER(<u>MID</u>, MName)
TEAM(<u>TID</u>, TName, MID) with MID $\xrightarrow{FK}$ MANAGER(MID)

B MANAGER(<u>MID</u>, MName, TID) with TID$\xrightarrow{FK}$ TEAM(TID)
TEAM(<u>TID</u>, TName)

C MANAGERTEAM(<u>MID</u>, <u>TID</u>, MName, TName)
MANAGER(<u>MID</u>, <u>TID</u>) with TID $\xrightarrow{FK}$MANAGERTEAM(TID) and MID $\xrightarrow{FK}$
MANAGERTEAM(MID)

D MANAGER(<u>MID</u>, MName)
TEAM(<u>TID</u>, TName, MID) with MID $\xrightarrow{FK}$ MANAGER(MID)
MANAGES(<u>MID, TID</u>)

Question 6 Convert the following ER model to a relational model.
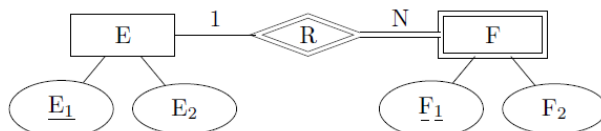
A E(<u>E$_1$</u>, E$_2$), F(<u>F$_1$</u>, F$_2$), R(<u>E$_1$, F$_1$</u>)

B None of the other answers

C F(<u>E$_1$, F$_1$</u>, E$_2$, F$_2$)

D E(<u>E$_1$</u>, E$_2$), F(<u>E$_1$, F$_1$</u>, F$_2$)

E E(<u>E$_1$</u>, E$_2$), F(E$_1$, <u>F$_1$</u>, F$_2$)

Consider the following Student Data Record and **answer questions 7-8**. Where, a student can take one course and a course consists of several modules. A Reg# is the unique registration number of a student; a Module code is a unique code of a module; a Project code is a unique code of a project (a project can be carried out by only one student and a student can carry out only one project).

Student Name: Geoff Crane	Reg #: 123456789
Course: Biochemistry	Year: 3

Module Code	Module Name
GN 301	Introduction to Genetic Engineering
GN 302	Advanced Genetic Engineering
GN 303	Social Consequences of Genetic Eng
.	.
.	.
.	.
etc	etc

Project Details	
Project Code: PR370/94	
Project Title: Building a Group of Friends	
Project Supervisor: Frank N. Stein	

Question 7 ♥ Which of the following full functional dependencies are true? (Select **all** correct choices)

A {Reg#, Module Code}→Module Name

B Reg#→ Course

C {Reg#, Project Code}→ {Project Title, Project Supervisor}

D Student Name → Reg#

E Module Code→Module Name

F Project Code→ {Project Title, Project Supervisor}

Question 8 ♥ Considering the above Student record and the following relations:

STUDENT (Reg#, Course, Year, Student Name, Project Code, Project Title, Project Supervisor)

STUDENT_MOD (Reg#, Module Code, Module Name)

Which of the following are true? (Select **all** correct choices)

A STUDENT is in 3rd Normal Form (3NF)

B STUDENT is in 2nd Normal Form (2NF)

C STUDENT is in 1st Normal Form (1NF)

D STUDENT_MOD is in 3NF

E STUDENT_MOD is in 2NF

F STUDENT_MOD is in 1NF

By considering the following database, **answer questions 9-16**.

T1		
C1	C2	C3
a	x	1
a	y	5
b	z	2
c	z	2
d	u	3

T2		
C1	C2	C3
a	z	4
a	x	3
b	z	2
b	x	1
c	u	2

Question 9 What is the result of the following SQL query?

```
SELECT COUNT(*)
FROM T1, T2
```

A 5

B 0

C The SQL is incorrect

D 2

E None of the other answers is correct!

F 16

Question 10 What is the result of the following SQL query?

> **SELECT Count(*)**
> **FROM T1, T2**
> **WHERE T1.C1=T2.C1**

A	5
B	0
C	The SQL is incorrect
D	2
E	None of the other answers is correct!
F	16

What is the result of the following SQL query?

> **SELECT DISTINCT T1.C1**
> **FROM T1, T2**
> **WHERE T1.C2=T2.C2**

a		a		a		a
b		a		a		b
c		b		a		c
d		b		a		
		c		b		
				b		
				c		

| **A** | **B** | **C** | **D** |

| E | None of the other answer is correct! |

Question 12 What is the result of the following SQL query?

```
SELECT T1.C2, AVG(T1.C3*T2.C3)
FROM T1, T2
WHERE T1.C2 = T2.C2
GROUP BY T1.C2
```

u	6
x	4
z	24

u	6
x	2
z	6

u	3.5
x	17.5
z	3.3

u	6
x	4
z	24

a	10.5
b	3
c	4

A   B   C   D   E

Question 13 What is the result of the following SQL query?

```
SELECT T1.C2, SUM(T1.C3*T2.C3)
FROM T1, T2
WHERE T1.C2 = T2.C2
GROUP BY T1.C2
HAVING SUM(T1.C3*T2.C3)>10
```

u	6
x	4
z	24

x	24

z	24

a	19

a	24

A   B   C   D   E

F   None of the other answers is correct!

Question 14 What is the result of the following SQL query?

```
SELECT count(*)
FROM T1 INNER T2 ON (T1.C1 = T2.C1)
```

A   1

B   An empty table

C   The SQL is incorrect

D   2

E   7

F   None of the other answers is correct!

Question 15 What is the result of the following SQL query?

```
SELECT T1.C1
FROM T1 INNER JOIN T2 ON (T1.C1 = T2.C1)
WHERE (T1.C3>2)
```

a
a
b
b

a
a

y
Y

a
A
NULL
NULL

A .   **B .**   **C .**   **D .**

E None of the other answers is correct!

Question 16 What is the result of the following SQL query?

```
SELECT T2.C2
FROM T1 LEFT OUTER JOIN T2 ON (T1.C2 = T2.C2)
```

x
x
NULL
z
z
z
z
u

x
x
z
z
z
z
u

x
z
u

x
NULL
z
u

A   **B**   **C**   **D**

Question 17 ♥ Considering the following relations (where underlined attributes indicate the relations' keys), which of the following choices are true? (Select **all** correct choices)

EMP_PROJ(EmpID, ProjID, Ename, Pname, No_hours)

EMP(EmpID, Ename)

PROJ(ProjID, Pname)

A None of these relations suffers from Update, Insert and Delete anomalies.

B EMP_PROJ suffers from Update anomalies.

C PROJ is at least in 3NF (i.e. 3rd Normal Form).

D EMP and EMP_PROJ are in 1NF (i.e. 1st Normal Form).

Question 18 ♥ Consider the relation **R(A, B, C, D, E, F)** with {A, B} as a composite primary key and the following dependencies:

- {A, B}→ C, D, E, F
- E→ D
- C→ F

Which of the following options are true? (Select **all** correct choices)

A R is in 3NF (i.e. 3rd Normal Form)

B R is in 2NF (i.e. 2nd Normal Form)

C R is in 1NF (i.e. 1st Normal Form)

D R is in 2NF but not in 3NF

E R is in 3NF but not in 2NF

Question 19 ♥ The following table shows the current state of a relation, where C_1 is the **key** of the relation. Which of the following options are correct? (Select **all** correct choices)

C_1	C_2	C_3	C_4
1	1	George	Anna
2	1	George	Chris
3	1	George	Iliada
4	2	John	Nek
5	2	John	Maria
6	3	Marina	Anna

A The functional dependency $C_1 \to C_2$ holds.

B The functional dependency $C_1 \to C_3$ holds.

C We cannot be certain whether the functional dependency $C_2 \to C_3$ holds.

D We cannot be certain whether the functional dependency $C_2 \to C_3$ does not hold.

E The functional dependency $C_2 \to C_4$ does not hold.

F The functional dependency $C_3 \to C_4$ may hold.

By considering the database below, answer **questions 20-22**. Where, the primary keys are underlined and the foreign key (FK) relationships are:

- PROJECT.Dnum is FK ref. DEPARTMENT.Dnumber;
- PROJECT.Plocation is FK ref. DEPT_LOCATIONS.Dlocation;
- DEPT_LOCATIONS.Dnumber is FK ref. DEPARTMENT.Dnumber;
- DEPARTMENT.Mgr_ssn is FK ref. EMPLOYEE.Ssn;
- EMPLOYEE.Super_ssn is FK ref. EMPLOYEE.Ssn;
- EMPLOYEE.Dno is FK ref. DEPARTMENT.Dnumber.

Suppose each of the following update operations is applied directly to this database.

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

PROJECT

Pname	Pnumber	Plocation	Dnum
ProductX	1	Bellaire	5
ProductY	2	Sugarland	5
ProductZ	3	Houston	5
Computerization	10	Stafford	4
Reorganization	20	Houston	1
Newbenefits	30	Stafford	4

DEPT_LOCATIONS

Dnumber	Dlocation
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

Question 20 ♥ Choose the correct statements regarding the constraints of the following operation when applied on the above database. (Select **all** correct choices)

Insert <'ProductX', 6, 'Bellaire', 1> into PROJECT

| A | No constraint violations. |

| B | It violates the key constraint. |

| C | It violates the referential integrity. |

| D | It violates the entity integrity constraints. |

Question 21 ♥ Choose the correct statements regarding the constraints of the following operation when applied on the above database. (Select **all** correct choices)

Insert < 'NULL', 5, '943775543', '1988-10-01' > into DEPARTMENT.

A No constraint violations.

B It violates the key constraint.

C It violates the referential integrity.

D It violates the entity integrity constraints.

♥ Choose the correct statement regarding the integrity constraints (i.e. key constraints and referential integrity constraint) of the following operation when applied on the above database. (Select **all** correct choices)

Set the EMPLOYEE.Ssn attribute to 'NULL' of the EMPLOYEE tuple with EMPLOYEE.Ssn= '987654321'.

A No constraint violations.

B It violates the key constraint.

C It violates the referential integrity.

D It violates the entity integrity constraints.

Question 23 Considering the following transactions and schedules, choose a correct statement.

T1	T2
R(A)	
W(A)	
	R(A)
	W(A)
R(B)	
W(B)	
	R(B)
	W(B)
	Commit
Commit	

Schedule A

T1	T2
	R(A)
	W(A)
R(A)	
	R(B)
	W(B)
W(A)	
R(B)	
W(B)	
	Commit
Commit	

Schedule B

T1	T2
R(A)	
W(A)	
	R(A)
	W(A)
	R(B)
	W(B)
	Commit
R(B)	
W(B)	
Commit	

Schedule C

A Schedule A suffers from the lost update problem.

B Schedule B suffers from the lost update problem.

C Schedule C suffers from the lost update problem.

D None of the schedules suffers from the lost update problem.

Question 24 ♥ In the context of Transactions, which of the following are ACID properties? (Select **all** correct choices)

A Atomicity.

B Isolation.

C Durability.

D Correctness.

E Integrity.

F Availability.

G Concurrency.