#### **Uppsala University**

### **Department of Information Technology**

Database Design I (1DL300/1) - 2017-10-20

Instructions: Read through the complete exam and note any unclear directives before you start solving the questions. For each question there can be one or more correct answers, but you can choose only one. If you choose a correct answer, you gain 1 point. A wrong answer does not generate negative points – but the teacher reserves the right to penalize answers that are outrageously wrong. The questions are divided into three sections with 8 questions each. To achieve a grade of 3, you must gain at least 14 points in the whole exam. To achieve a grade of 4, you must gain at least 17 points in the whole exam. To achieve a grade of 5, you must collect at least 20 points in the whole exam. You are allowed to use dictionaries to and from English and a calculator, but no other material. Answers must be given exclusively on the answer sheet, at the end: answers given on the other sheets will be ignored.

## 1 General questions (useful for us)

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Question 1 * When have you attended the course?
A Period 1, 2017
B Period 2, 2016
C Period 1, 2016
D Period 2, 2015
E None of the previous answers
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Question 2 How many lectures have you attended?
A None or very few
B Around 25%
C Around 50%
D Around 75%
E Almost all

Question 3 ♣ What is your study program?

A F B STS C CS D X E IT

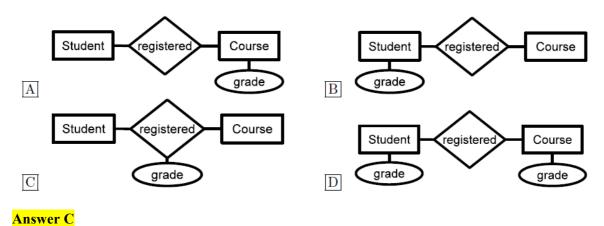
F None of the previous answers

Question 4 \* Have you attended the lecture on exam preparation? A Do not remember

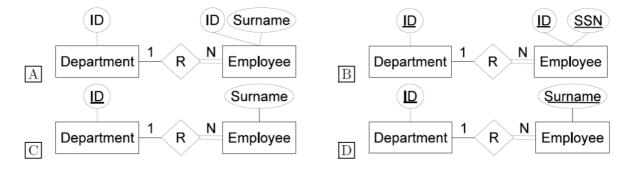
B Yes C No

## 1 Database design

**Question 1** Consider the scenario where a student can attend many courses and many students can attend a course. We want to record the grades of a student for each course. Which of the following ER diagrams is correct? (only a portion of the diagram has been visualized)

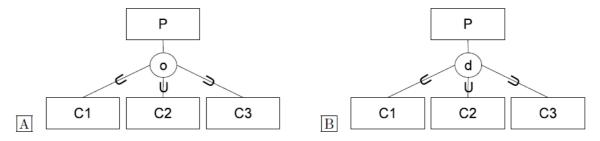


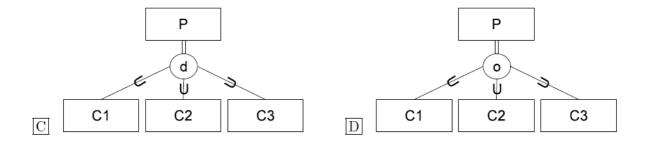
**Question 2** Choose the best among the following ER diagrams.



### **Answer b 2016-10-21**

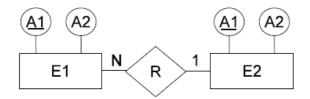
**Question 3** Entity type P can be either only one type of C1, C2, C3 types or none of them. Namely, it cannot belong to more than one types at the same time. However, it can belong to none of them. Which of the following ER diagrams corresponds to these specifications? (only a portion of the diagram has been visualized)





### Answer B

Question 4 Which relational schema corresponds to the following ER diagram?



- A E1(A1, A2), E2(A1, A2), R(E1, E2) (with R.E1 FK ref. E1.A1 and R.E2 FK ref. E2.A1)
- B E1(A1, A2), E2(A1, A2), R(E1, E2) (with R.E1 FK ref. E1.A1 and R.E2 FK ref. E2.A1)
- C None of the other answers
- D E1(A1, A2, E2), E2(A1, A2) (with E1.E2 FK ref. E2.A1)
- E E1(A1, A2), E2(A1, A2, E1) (with E2.E1 FK ref. E1.A1)
- F E1(E2, A1, A2), E2(A1, A2) (with E1.E2 FK ref. E2.A1)

### Answer D 2016-10-21

**Question 5** Consider a relation in 1NF  $R(\underline{A}, \underline{B}, C, D, E, F)$  with  $\{A, B\}$  as a composite primary key and the following dependencies:

- $\{A, B\} \rightarrow C, D, E, F$
- $C \rightarrow F$
- $E \rightarrow D$

Which of the following is true?

- A R is in 3NF but not in 2NF
- B R is in 2NF but not in 1NF
- C R is in 1NF but not in 2NF
- D R is in 2NF but not in 3NF

### Answer D

Consider the following Student data record. Where, 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	<b>Reg #:</b> 123456789
Course: Biochemistry		Year: 3
Module Code	Module Code Module Name	
GN 301 GN 302 GN 303  	Introduction to Genetic Engineering Advanced Genetic Engineering Social Consequences of Genetic Eng etc	
Project Details		
Project Code:	Project Code: PR370/94	
Project Title: Building a Group of Friends		
Project Supervisor: Frank N. Stein		

Question 6 Which of the following functional dependencies are true?

- A Reg#→ Course; {Reg#, Module Code}→Module Name
- B Reg# → Project Code; Project Code → Project Name; Module Code → Module Name
- C Project Code→ {Project Title, Project Supervisor}; {Reg#, Module Code}→Module Name
- D Student Name → Reg#; Project Code→ Project Title; Module Code→Module Name

### Answer B

**Question 7** Considering the above Student record and the following two relations:

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

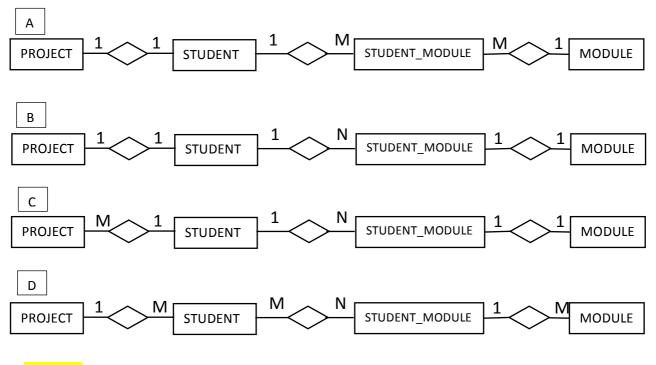
STUDENT MODULE (Reg#, Module Code, Module Name)

Which of the following is true?

- A STUDENT and STUDENT\_MODULE are both in 2NF
- B STUDENT and STUDENT MODULE are both in 3NF
- C STUDENT is in 3NF and STUDENT MODULE is 2NF
- D STUDENT is not in 3NF and STUDENT MODULE is not in 2NF

### Answer D

**Question 8** Considering the above Student record, which of the following physical ER diagrams is correct:



### Answer A

## 2 SQL

Consider the following database:

T1

T2

<b>C1</b>	C2
Α	В
Α	С
В	Α
Α	С

<b>C1</b>	C2
Α	С
Α	D
В	В
D	С

**Question 9** What is the result of the following SQL query? (showing only the content)

# SELECT DISTINCT T1.C1 FROM T1



B An empty table

C A B

D

A 3 B 1

E The SQL is incorrect

### answer. C

**Question 10** What is the result of the following SQL query? (showing only the content)

SELECT T2.C1 FROM T2 WHERE (T2.C2="D" OR T2.C2="B")



B An empty table

C A B

D

A 3 B 1

E The SQL is incorrect

### Answer C

**Question 11** What is the result of the following SQL query? (showing only the content)

SELECT T1.C1, T2.C2 FROM T1 Join T2 on T1.C1=T2.C1 WHERE T1.C2=T2.C2

A	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$
Answe	e <mark>r B</mark>
Questi	ion 12 What is the result of the following SQL query? (showing only the content)
FROM WHE	CT T1.C1, count(T2.C2) I T1 Join T2 on T1.C1=T2.C1 RE T1.C2=T2.C2 JP BY T1.C1
A	The SQL is incorrect $\begin{bmatrix} B \\ A \end{bmatrix}$ An empty table $\begin{bmatrix} C \\ B \end{bmatrix}$ $\begin{bmatrix} A \\ A \end{bmatrix}$ $\begin{bmatrix} A \\ B \end{bmatrix}$ $\begin{bmatrix} A \\ B \end{bmatrix}$
	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$
A	An empty table B $16$ C $\frac{6}{4}$ D The SQL is incorrect E $8$ F $2$ G $4$
Answe	er: F: 2
Ouesti	ion 14 What is the result of the following SQL query? (showing only the content)
SELE FROM	CT count(T1.C1)
<b>A</b> 1 <b>B</b> A	n empty table

C The SQL in incorrect

**D** 2

**E** 4

Answer: A: the answer is 1

Consider the following tables.

STUDENTS		
Student_ID	Stud_Name	Adv_ID
1	Nektarios	1
2	George	8
3	Anna	2
4	Iliada	3
5	Ioanikios	3
6	Chrys	1
7	Marina	3

ADVIDORS	
Advisor_ID	Adv_Name
1	Chris
3	Maria
5	Kypriani

**Question 15** What is the result of the following SQL query? (showing only the content)

 $\begin{array}{l} SELECT\ Stud\_Name,\ Adv\_Name\\ FROM \end{array}$ 

STUDENTS LEFT OUTER JOIN ADVISORS ON Advisor\_ID=Adv\_ID

Α

Stud_Name	Adv_Name
Nektarios	Chris
George	NULL
Anna	NULL
Iliada	Maria
Ioanikios	Maria
Chrys	Chris
Marina	Maria

В

Stud_Name	Adv_Name
Nektarios	Chris
Iliada	Maria
Ioanikios	Maria
Chrys	Chris
Marina	Maria

С

Stud_Name	Adv_Name
Nektarios	Chris
Iliada	Maria
Ioanikios	Maria
Chrys	Chris
Marina	Maria
NULL	Kypriani

D

Stud_Name	Adv_Name
Nektarios	Chris
Iliada	Maria
Chrys	Chris

Answer A

**Question 16** What is the result of the following SQL query? (showing only the content)

# SELECT Stud\_Name, Adv\_Name FROM

# STUDENTS INNER JOIN ADVISORS ON Advisor\_ID=Adv\_ID

А			
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Stud_Name	Adv_Name
Nektarios	Chris
George	NULL
Anna	NULL
Iliada	Maria
Ioanikios	Maria
Chrys	Chris
Marina	Maria

В

Stud_Name	Adv_Name
Nektarios	Chris
Iliada	Maria
Ioanikios	Maria
Chrys	Chris
Marina	Maria

С

Stud_Name	Adv_Name
Nektarios	Chris
Iliada	Maria
Ioanikios	Maria
Chrys	Chris
Marina	Maria
NULL	Kypriani

D

Stud_Name	Adv_Name
Nektarios	Chris
Iliada	Maria
Chrys	Chris

Answer B

## 3 Theory

**Question 17** One of the reasons normalization is needed is to eliminate Update, Insert and Delete anomalies. Considering the following relations, which of the following is true.

EMP PROJ(Emp#, Proj#, Ename, Pname, No hours)

EMP(Emp#, Ename)

PROJ(Proj#, Pname)

- A EMP PROJ and EMP suffer from Update and Delete anomalies
- B EMP\_PROJ suffer from Update, Insert and Delete anomalies
- PROJ suffers from Update, Insert and Delete anomalies
- D PROJ suffers from Update, Insert and Delete anomalies

### Answer B

**Question 18** If a table T has 10 rows, the SQL instruction delete from T:

- A None of the other answers
- B May delete more than 10 rows from T
- C Always deletes the 10 rows, but does not remove the table from the database schema
- D Removes the table from the database schema (and as a consequence also the 10 rows)
- E May delete less than 10 rows because of referential integrity constraints
- F The SQL is incorrect

## Answer E

Consider the database below. Where, the primary keys are underlined and the foreign key relationships are:

- {PROJECT.Dnum, DEPARTMENT.Dnumber},
- {PROJECT.Plocation, DEPT\_LOCATIONS.Dlocation},
- {DEPT\_LOCATIONS.Dnumber, DEPARTMENT.Dnumber},
- {DEPARTMENT.Dmgr\_ssn, EMPLOYEE.Ssn}
- {EMPLOYEE.Super ssn, EMPLOYEE.Ssn},
- {EMPLOYEE.Dno, 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	В	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	М	30000	333445555	5
Franklin	Т	Wong	333445555	1955-12-08	638 Voss, Houston, TX	М	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	М	38000	333445555	5
Joyce	Α	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	М	25000	987654321	4
James	Е	Borg	888665555	1937-11-10	450 Stone, Houston, TX	М	55000	NULL	1

#### **PROJECT**

Pname	<u>Pnumber</u>	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**

<u>Dnumber</u>	Dlocation
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

#### **DEPARTMENT**

Dname	Dnumber	Dmgr_ssn
Research	5	333445555
Administration	4	987654321
Headquarters	1	888665555

**Question 19** 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.

Insert <'ProductA', 4, 'Bellaire', 2 > into PROJECT

A No constraint violations.

B It violates the key constraint because there already exists a DEPARTMENT tuple with DNUMBER=4.
C It violates only referential integrity because DNUM=2 and there is no tuple in the DEPARTMENT relation with DNUMBER=2.
D It violates both key and referential integrity constraint.
Answer c
Question 20 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.
Insert < 'Production', 4, '943775543', '01-OCT-88' > into DEPARTMENT.
A No constraint violations.
B It violates only key constraint
C It violates only referential integrity constrain
D It violates both key and referential integrity constraint.
Answer D
Question 21 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.
Set the EMPLOYEE.Super_ssn attribute to '943775543' of the EMPLOYEE tuple with EMPLOYEE.Ssn= '999887777'.
A It violates the key constraint.
B It violates the referential integrity. We may enforce the constraint by: (i) rejecting the operation, or (ii) by inserting a new EMPLOYEE tuple with SSN='943775543'.
$\overline{\mathbb{C}}$ It violates the referential integrity. We may enforce the constraint by changing the SSN='943775543'.
D It does not violate the referential integrity.
Answer B

Answer the following questions considering the following Transactions and their Schedules.

<i>T</i> <sub>1</sub>	<b>T</b> <sub>2</sub>
read_item( $X$ ); X := X - N;	
<pre>write_item(X); read_item(Y);</pre>	
Y := Y + N; write_item(Y);	
	read_item( $X$ ); X := X + M; write_item( $X$ );

<i>T</i> <sub>1</sub>	<i>T</i> <sub>2</sub>
read_item( $X$ ); X := X - N; write_item( $X$ ); read_item( $Y$ ); Y := Y + N; write_item( $Y$ );	read_item( $X$ ); X := X + M; write_item( $X$ );

Schedule A

Schedule	В

<i>T</i> <sub>1</sub>	<i>T</i> <sub>2</sub>
read_item( $X$ ); X := X - N;	read_item(X);
write_item(X); read_item(Y);	X := X + M;
Y := Y + N; write_item(Y);	write_item(X);

<i>T</i> <sub>1</sub>	<i>T</i> <sub>2</sub>
read_item( $X$ ); X := X - N; write_item( $X$ );	
	read_item( $X$ ); X := X + M; write_item( $X$ );
read_item( $Y$ ); Y := Y + N; write_item( $Y$ );	

**Schedule C** 

Schedule D

### **Question 22**

- A Schedule C and Schedule D suffer from the temporary update problem
- B Schedule C suffers from the lost update problem
- C Schedule b and C suffer from the lost update problem
- D Schedule D suffers from the temporary update problem

### Answer B

Question 23 Consider the two serial schedules A and B.

- A Schedule C is serializable to Schedule B AND Schedule D is serializable to Schedule A
- B | Schedule C is serializable to Schedule A AND Schedule D is serializable to Schedule B
- C Schedule D is serializable to Schedule B
- D Schedule D is serializable to Schedule A

## Answer D

Question 24 Which of the following are ACID properties?

A Independence, Dependability, Aggregation

- B None of the other answers is true
- C Independence, Dependability, Atomicity
- D Isolation, Dependability, Atomicity
- E Isolation, Durability, Atomicity
- F Isolation, Dependability, Aggregation

## Answer E