

# Databases Exam

TDA357 (Chalmers), DIT620 (University of Gothenburg)

4 de enero de 2018

Department of Computer Science and Engineering

**Grades** Chalmers: 24 for 3, 36 for 4, 48 for 5. GU: 24 for G, 42 for VG.

**Help material** One cheat sheet, which is an A4 sheet with hand-written notes. You may write on both sides of that sheet. If you bring a sheet, it must be handed in with your answers to the exam questions. One English language dictionary is also allowed.

**Specific instructions** Answer questions in English. Begin the answer to each question (numbers 2 to 5) on a new page. The a,b,c,... parts with the same number can be on the same page. The multiple choice question must be answered in the corresponding boxes.

**Write clearly** unreadable = wrong! Fewer points are given for unnecessarily complicated solutions. Indicate clearly if you make any assumptions that are not given in the question. In SQL questions, use standard SQL or PostgreSQL. If you use any other variant (such as Oracle or MySQL), say this; but full points are not guaranteed since this may change the nature of the question.

**Multiple Choice Marks** right answer = +1, bad answer = -0,5; blank = 0.

# 1. Multiple Choice Questions (10p, 1p each subquestion)

If a relationship has a cascade updates constraint, then if \_\_\_\_\_ in the parent table is changed, then the same change will automatically be made to any corresponding foreign key value.:

- a) the primary key
- b) any alternate key
- c) a surrogate key
- d) a foreign key

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Which is the SQL statement that corresponds to  $\pi_{title,year}(\sigma_{year=2005}(\text{Articles}))$  (Duplicate elimination should be performed):

- a) SELECT UNIQUE title, authorID FROM Articles WHERE year=2005;
- b) SELECT DISTINCT title, authorID FROM Articles WHERE year=2005;
- c) SELECT title, authorID FROM Articles WHERE year=2005;
- d) SELECT title, authorID FROM Articles WHERE (year=2005 AND (title,authorID) is UNIQUE;)

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In which of the following is a single-entity instance of one type of related to a single-entity instance of another type?

- a) 1:1 Relationship
- b) 1:N Relationship
- c) N:N Relationship
- d) Composite Relationship

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Which of the following columns is(are) are required in a table?:

- a) A foreign key
- b) A surrogate key.
- c) A primary key
- d) An alternate key

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Given this SQL query:

**SELECT** a , b **FROM** p , q **WHERE** d>e **AND** f=g;

Which is the relation algebra statement that corresponds to that query?

- a)  $\pi_{a,b}(\sigma_{(d>e)\wedge(f=g)}(p\bowtie q))$
- b)  $\sigma_{a,b}(\pi_{(d>e)\wedge(f=g)}(p\times q))$
- c)  $\pi_{a,b}(\sigma_{(d>e)\wedge(f=g)}(p\times q))$
- d)  $\gamma_{a,b}(\sigma_{(d>e)\wedge(f=g)}(p\bowtie q))$

Given this SQL:

```
SELECT customer_T.customer_ID , order_T.customer_ID , name, order_ID  
FROM customer_T , order_T ;
```

Which is the type of that join?

- a) Equi-join
- b) Natural join
- c) Outer join
- d) Cartesian join

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Considering the following actions:

Transactions...

Commit;

Rollback;

What does Rollback do?

- a) Nothing
- b) Undoes the transaction before commit
- c) Redoes the transactions before commit
- d) Clears all transactions

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Given these definitions:

```
CREATE TABLE User (  
  userID INTEGER,  
  name CHAR(20),  
  password CHAR(30),  
  PRIMARY KEY (userID)  
);
```

```
CREATE TABLE Follows (  
  follower INTEGER,  
  followed INTEGER,  
  PRIMARY KEY (follower ,  
               followed),  
  FOREIGN KEY (follower)  
    REFERENCES User  
    ON DELETE CASCADE,  
  FOREIGN KEY (followed)  
    REFERENCES User  
    ON DELETE CASCADE  
);  
);
```

What is “Follows” in the E-R model?

- a) an entity
- b) a relationship
- c) a weak entity
- d) a weak relationship

Farm (fcode, description, nid, gcode)

Given the following database: Farmer (nid, name, address, telephoneNr)

Cattle (gcode, description, amount, nid)

The restriction between *Farmer* and *Farm* and between *Farmer* and *Cattle* is **DELETE CASCADE**. Which of the following statements is correct?

- a) Restriction between Cattle and Farm must be **DELETE RESTRICT**
- b) Restriction between Cattle and Farm must be **DELETE SET NULL**
- c) Restriction between Cattle and Farm must be **DELETE CASCADE**
- d) None of the above

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Given the relation  $R = \{A, B, C, D, E, F\}$  and the following Functional Dependencies:

$FD = \{BC \rightarrow D; D \rightarrow C; CE \rightarrow A; F \rightarrow E; A \rightarrow C; AD \rightarrow B\}$ . Which are the possible keys?

- a)  $\{FD, FAB\}$
- b)  $\{FA, FAB, FBC\}$
- c)  $\{FD, FB, FBC\}$
- d)  $\{FD, FAB, FBC\}$

## 2. Entity Relationship (2 parts, 8p)

3a. Given the following database schema:

Author (a\_code, name, nationality)

Book (b\_code, title, price, t\_code)

Writes (a\_code, b\_code, date)

Topic (t\_code, description)

**Draw** an Entity-Relationship diagram for the former schema (8p)

### 3. Functional Dependencies and Normal Forms (3 parts, 10p)

Suppose we have relation  $R(A, B, C, D, E, F)$  and functional dependencies  $FD = \{A \rightarrow F, CD \rightarrow A, F \rightarrow B, AB \rightarrow E, CB \rightarrow D\}$ .

- 2a. Extract the keys of the relation  $R$  and give the Normal Form of  $R$ . (3p)
- 2b. State, with reasons, which FD(s) of relation  $R$  violate BCNF. (2p)
- 2c. Decompose relation  $R$  to BCNF. Show each step in the normalisation process, and at each step indicate which functional dependency is being used. (5p)

## 4. Relational algebra (2 parts, 10p)

Assuming we have the following Relational DataBase:

Car(Nrplate, brand, Colour, engine, fuel)

Option(oID, description, price)

Have(Nrplate, oID)

- 4a. Write a relational algebra expression that finds the brand of those cars with all options. (5p)
- 4b. Write a relational algebra expression that finds the description of those options that only have the cars whose brand is “*Ovlov*”. (5p)

## 5. SQL, Views, Triggers (2 parts, 10p)

Given the following database schema:

Author (a\_code, name, nationality)

Book (b\_code, title, price, t\_code)

Writes (a\_code, b\_code, date)

Topic (t\_code, description)

- 5a.** Write an SQL query to get the average price of those books written by Swedish authors. This query must be written by using nesting queries (HIT: **IN**) (3p)
- 5b.** Write an SQL query that lists the authors who have only written about one and only one topic (5p)