Examination (Repetition)

Course:	Spatial Databases and Infrastructures	07.06.2019
Semester:	Winter Term 2018/2019	
Name:		
Student ID:		

1: Introduction (8 points)

a) Explain the terms database management system, database, and database system and draw a figure that illustrates how they are related. (4 points)
b) What advantages does it have to manage data in a database as opposed to in files? (3 points)
c) Name the three database models that are predominantly established in practice. (1 points)

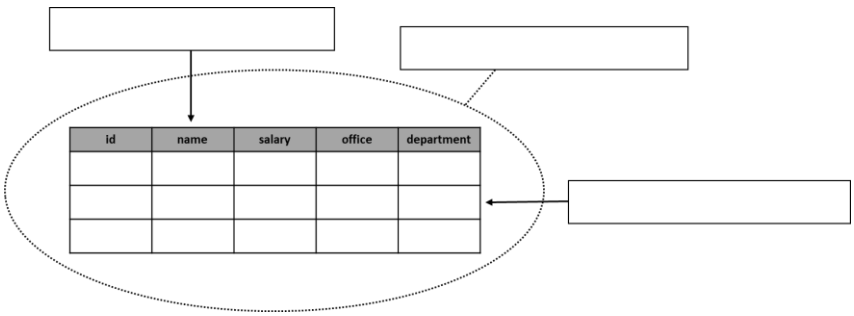
2: UML (15 points)

In your future job, your task is to create a conceptual model in UML for storing data for fast food chains in a spatial database. Each chain has a CEO (Chief Executive Officer). In the franchise system, there are independent operators (owners) who run one or even more restaurants. There are several persons working in a restaurant like cooks, cashiers, and managers. And each restaurant has one building with a (spatial) location.

Create a conceptual model for fast food chains in the form of a UML diagram incorporating the above information. Enrich this model with only a few, but meaningful attributes. Integrate the relationships between the individual classes as mentioned in the lecture and give a short textual explanation why you have chosen a specific relationship. Please integrate at least one geometrical attribute.

3: Relational Data Model (10 points)

a) Annotate the boxes in the following figure, which shows the structure in which data is stored in a relational database. Provide both the relational terms (the ones that are written in the brackets in the lecture slides) as well as the more practically oriented terms. (3 points) Also provide information on how often these structural elements occur. (1 point)



b) Name the three fundamental operations of the relational data model. Provide example queries in SQL and highlight the relevant parts that correspond to each fundamental operation. (3 points)
c) What is a primary key, a foreign key and how do they relate to each other? (3 points)

4: Object Oriented Modelling, Mapping UML to the Relational Model (12 points)

a) What is the difference between a class and an object? (3 points)
b) What is the difference between an abstract and a "regular" class? What are reasons to introduce abstract classes into a model? (3 points)
c) How are UML classes and their associations translated into the relational model? (3 points)
a) In which cases can the resulting tables be refined and how? (3 points)

5: Simple SQL Queries (10 points)

The following table, named "exp_per_dep", shows the expenditure per department (for a fictional enterprise):

position	department	responsible_person	payment
1	R&D	John Doe	15,953€
2	Marketing	Katie Marsh	94,627€
3	Manufacturing	Glen Reynolds	38,900€
4	R&D	Carlee Lawrence	7,084€
5	R&D	John Doe	54,346€
6	Manufacturing	Tom Ward	1,874€
7	Marketing	Sienna Mercado	77,103€
8	Human Resources	Cael Sharp	27,006€

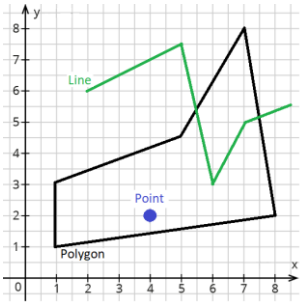
a) Provide an SQL query that returns only the names of all responsible persons in the marketing and manufacturing departments. (3 points)
b) Specify an SQL query that returns the number of (responsible) persons working in each department. (For example, there are 2 persons working in the 'Manufacturing' and only 1 in the 'Human Resources' department). (4 points)
c) Give an SQL query that provides the payments in US dollar. Assume the exchange rate is 0,90€ per US dollar. (3 points)

6: Simple Feature Access (8 points)

a) What is the simple feature access specification? What is the difference between part 1 and part 2 of this specification? (2 points)
b) What is the interior, boundary, and closure of a point, line, and polygon? (3 points)
c) How are polygons defined in this specification? (3 points)

7: Tables with Geometric Attributes (8 points)

For the next questions, assume the following spatial situation containing three discrete objects:



a) Specify the SQL query that generates a table to store features with their name and their geometric attribute. Assume that every kind of geometry is allowed to be stored. (2 points)
b) Give three SQL statements that adds these three objects (see figure) into the table. (2 points)
c) State the SQL query that returns the length of only the line feature. (2 points)
d) State the SQL query that returns the convex hull of only the polygon feature. (2 points)

8: Queries on Area-Like Geo-Objects (10 points)

Assume a database table named "hotels" that stores information about hotels in a metropolitan city with an identifier (ID), a name, an owner, a zip code, the number of rooms, and the geometric shape of the hotel's footprint as a polygon.

a) Specify the SQL query that generates this table. (3 points)
b) Give an SQL query that returns for each hotel its name, owner, and area of footprint. (2 points)
c) Change the query so that the total area of all hotel footprints is returned. Can the query still return the name and owner of the individual hotels with this query? Explain! (3 points)
d) How can the table be removed from the database using an SQL query? (2 point)

9: Joins (12 points)

The following two tables named 'Player' and 'Team' are given:

Player

id	name	team
100	Bob	1
200	Sherryl	3
300	John	3

Team

tid	name	logo
1	Pacific	Shark
2	Alliance	Lion
3	Red	Bull

Both tables are to be joined. For this, table 'Player' is always the left and table 'Team' the right table. The attribute to join on is in all cases 'team' of table 'Player' and 'tid' of table 'Team'.

a) Give the table that results from a general join of both tables. (3 points)
b) How do you have to change the tables so that you can use a natural join instead of a general join? With this change in mind, give the SQL query for the natural join of the two example tables. What is the difference in the resulting tables between the natural join and the general join? (4 points)
c) Give the table that results from a right outer join of both tables. (3 points)
d) When using a cross join, how many rows does the result have? Explain! (2 points)

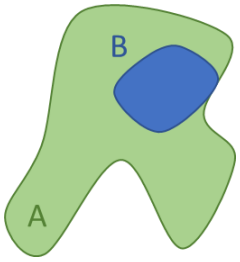
10: Spatial Joins (8 points)

Note that for the following sub questions, the geometric attributes are named "geom" in all tables. All tables contain a number of thematic attributes that should all be returned by the queries.

a) Assume there are two tables, one for roads with linestring geometry and one for rivers with polygon geometry. A road passes over a river by means of a bridge. Write an SQL query that returns exactly those roads that pass over a river/bridge. (4 points)
b) Assume there is one table for gas stations with point geometry. Provide an SQL query that returns all pairs of gas stations that are located closer than 200m from each other. (4 points)

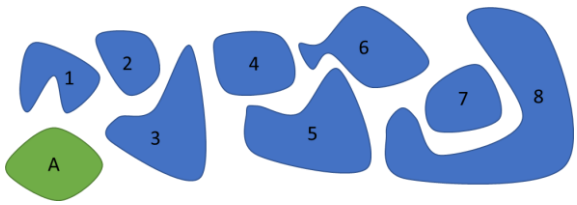
11: The 9-Intersection Model (4 points)

a) Give the result of the 9-intersection model (9IM) for the spatial objects A and B that are depicted in the figure below. What is this spatial relation called? (4 points)



12: R-tree (9 points)

a) Draw an R-tree that indexes the following eight blue (!) polygons for m=2 and M=4. Also draw the spatial extent that the non-leaf vertices of the R-tree enclose. (4 points)



b) What happens when the green polygon A is inserted? Draw the resulting R-tree. (3 points)
c) Explain the algorithm to determine for a given query point, if there is a polygon stored in the R-tree that contains this query point? (2 points)

13: Spatial Data Infrastructures (6 points)

a) What is the difference between a de jure standard and a de facto standard? (2 points)
b) Name three OGC web services that provide spatial data. (2 points)
c) How can you determine what kind of data a web service provides, in which format, etc.? (2 points)