HOCHSCHULE FÜR TECHNIK STUTTGART
UNIVERSITY OF APPLIED SCIENCES

MASTER'S COURSE **S** OFTWARE **T** ECHNOLOGY

EXAMINATION in **WINTER SEMESTER 06/07**

MODULE:	**Databases**	NAME:	
DATE:	**23 January 2007**	SEMESTER:	
TIME:	**9.00 - 11.00 Uhr**		
EXAMINER:	**Prof. D. Koch**		

ALLOWED AIDS: All materials that were distributed in class and in the Blackboard, all your own notes, two text books of your choice, plus an English dictionary.
NOT ALLOWED: Mobile Phones and other communication devices
ANNEXES: None

Please write your name on each sheet that you turn in.

Turn in the problem sheets as well!

Problem	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	Σ
Maximum points	15	10	12	8	12	12	10	6	8	8	9	110
Achieved points												
Grade												

Problem 1. (3 times 5 points = 15 points)

Briefly explain the following:

a) Why is it important to design a good conceptual model for a database?

b) Why is it important to design a good physical model for a database?

c) What is more important when designing a new database: a good conceptual model or a good physical model? (Points are only given for an explanation).

Problem 2. (2 times 5 points = 10 points)

Consider all of the relations in the database schema in our example of a university database.
The attribute values for the title of a class (the columns named *classNr*) contain coded as part of the name the semester in which this class took place (e.g. "DTB-SS93" for the database class that took place in the summer semester 1993).
As a different approach, one could separate this column *classNr* into three different columns:

- *classTitle* (e.g. "Databases"),
- *year* (e.g. "1993"),
- and *summerOrWinter* (e.g. "summer").

Compare the two approaches: List one advantage for each approach, explaining why this approach is better in this respect than the other.
(Full points are only given if you explain the advantages you name).

Problem 3. (2 times 6 points = 12 points)

a) Briefly describe a scenario in which it is better to use a file system than a DBMS. Briefly explain why.

b) Briefly describe a scenario in which it is better to use a DBMS than a file system. Briefly explain why.

Problem 4. (8 points)

Describe a suitable file structure for the following application:
A file contains records with information about festivals in various countries. Each record contains fields for the year, month, day, name, and countries in which the festival is celebrated as well as a field with a verbal description of the festival. A graphical interface allows users to ask two kinds of queries to this little database:

- Given a name and a year, retrieve all information about this festival. (Example: Find all information about the Ugadi Festival in 2001).
- Make a list of all festivals with their relevant information for the next five months.

Describe a file structure that makes both of these queries fast and explain why.

Problem 5. (12 points)

A database stores information about countries and their relationships to other countries:
- An ambassador from one country resides in another country during a certain time period.
- Countries sign treaties with other countries.
- Countries are members in international organizations (UN, NATO, etc.)

The following assumptions are made here:
- At most one ambassador represents country A in country B.
- A country can be a member of an organization several times, during different time periods. These time periods do not overlap.

The system has the following schema:

Country (<u>cID</u>, cName, continent, capital, population)

Organization (<u>oID</u>, oName, purpose, address)

Treaty (<u>tID</u>, title, validDate, document)
(*validDate* is the date from which the treaty is legally valid. *document* is a reference to the actual text of the treaty).

Membership (<u>cID</u>, <u>oID</u>, <u>startDate</u>, endDate)
(Which countries have signed which treaties on which day. *cID* is a foreign key referencing *cID* in *Country*. *oID* is a foreign key referencing *oID* in *Organization*. *startDate* and *endDate* describe the time interval in which the membership persists).

Signed (<u>cID</u>, <u>tID</u>, dateSigned)
(*cID* is a foreign key referencing *cID* in *Country*).

Ambassador (<u>fromCountry</u>, <u>inCountry</u>, <u>startDate</u>, endDate, aName, address)
(*fromCountry* and *inCountry* are foreign keys referencing *cID* in *Country*. *startDate* and *endDate* describe the time interval in which the ambassador represents *fromCountry* in *inCountry*).

<u>Your task:</u>
Design a suitable entity relationship model that would result in the above relational schema after applying the algorithm described in class for transforming an ERM to a relational schema.

Problem 6. (2 times 6 points = 12 points)

This problem uses the relational database schema in the previous problem.
Express the following queries in SQL:

a) How many treaties were signed by countries that are or were members of the UN? List the treaty numbers by country names, for instance in the format: Germany 30, France 25, etc.
b) What are the names of all countries that never had an ambassador in North Corea?

Problem 7. (10 points)

A SELECT query in SQL can generally return
(a) any number of tuples
(b) with any number of columns
(c) of any data type the system provides.
Briefly explain the concepts by which JDBC enables a programmer to write a Java application that can handle the returned information of an arbitrary SELECT query, without the programmer having to know the query text at programming time:
Which two standard Java classes (actually they are interfaces) are especially relevant?
Refer explicitly to the information listed under (a), (b), and (c) and name the relevant methods with their classes in each case. Briefly mention what these methods do.

Use your own words. Programming code is not necessary and will not earn any points!

Problem 8. (6 points)

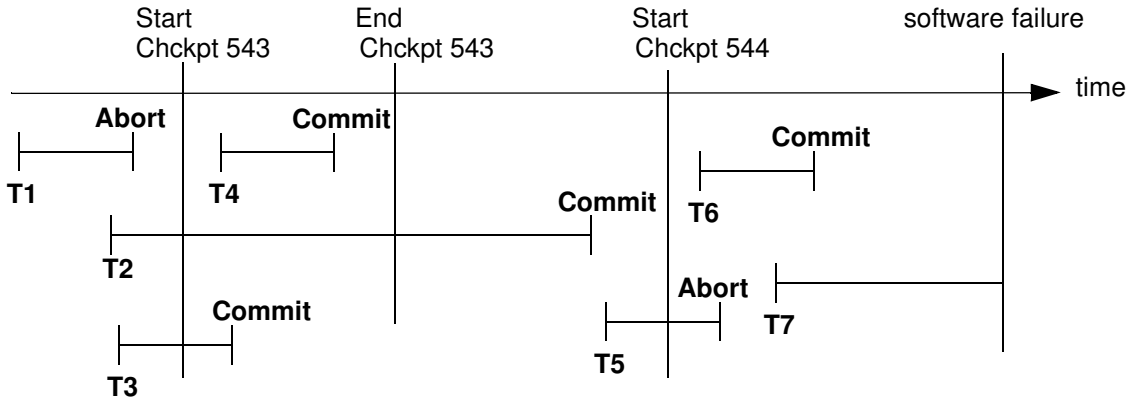
Suppose a DBMS does not allow the definition of integrity constraints. What is the consequence for the development of applications accessing this database?

Problem 9. (8 points)

Assume that in a DBMS the Force at Commit Rule for the log file is not applied.
Describe and explain an execution scenario that shows how this can lead to a problem.

Problem 10. (8 points)

Consider the following scenario with a log file where fuzzy checkpointing is used:



List which transactions the recovery manager must undo and which ones it must redo. Briefly explain your choice.

Problem 11. (8 points + 1 points = 9 points)

Consider the 2 Phase Locking Protocol.

a) (8 points)
Briefly describe a scenario where an inconsistency can occur if a transaction is allowed to release a write lock before its commit point. Explain.

b) (2 points)
Which important feature of transactions is violated in this case? (Just name it, no need to explain).