Försättsblad till skriftlig tentamen vid Linköpings universitet

(fylls i av ansvarig)

Datum för tentamen	19 oktober 2013
Sal	TER1
Tid	8.00-12.00
Kurskod	TDDD12
Provkod	TEN1
Kursnamn/benämning	Databasteknik
Institution	*IDA*
Antal uppgifter som ingår i tentamen	7
Antal sidor på tentamen (inkl. försättsbladet)	5
Jour/Kursansvarig	Jose M. Peña
Telefon under skrivtid	0708229596
Besöker salen ca kl.	Nej
Kursadministratör (namn + tfnnr + mailadress)	Madeleine Häger Dahlqvist, 013 282360, madeleine.hager.dahlqvist@liu.se
Tillåtna hjälpmedel	Ordbok
Övrigt (exempel när resultat kan ses på webben, betygsgränser, visning, övriga salar tentan går i m.m.)	
Vilken typ av papper ska användas, rutigt eller linjerat	
Antal exemplar i påsen	

Institutionen för datavetenskap
Linköpings universitet

EXAM
TDDD12 Databasteknik
TDDD46 Databasteknik

October 21, 2013, 14.00-18.00

Help

Dictionary.

Grades

You can get max 30 points. To pass the exam, grade 3, you need 7.5 points in both the practical and theoretical part of the exam. For grade 4 and 5, you need 21 and 27 points, respectively.

Questions

Fang Wei-Kleiner and Jose M. Peña will visit the room at 16.00.

Instructions

You can answer in Swedish or English. Write clearly. Give relevant and motivated answers only to the questions asked. State the assumptions you make besides those in the questions. None of these additional assumptions should change the spirit of the exercises.

Good luck!

Practical part (15 points)

Question 1. Data modeling with EER diagram (4 + 1 = 5 p):

1. We want to create a database to store information about the allergies a group of people suffer. Specifically, we want to store the allergies each person has. For food allergies, we want to store the ingredient that causes the allergy as well as the products that contain such an ingredient, so that the person is aware of them when shopping. We also want to store the family relations that may exist between these people: Who is married to whom, and who is parent to whom.

   Draw an EER diagram for the description above. Clearly write down your choices and assumptions in case you find that something in the information above is not clear.

2. Some researchers want to check whether some allergies only occur every second generation (i.e. children of affected parents are free from the allergy but the children of the children of affected parents have the allergy). Could you get that information from your database ? If so, how ?

Question 2. SQL (1 + 2 + 2 = 5 p):

Consider the following database schema

Country(Name, Code, Capital, Area, Population)
Organization(Name, Abbreviation, Established)
IsMember(Organization, Country, Joined)

The attribute *Organization* in the table IsMember is a foreign key reference to *Abbreviation* in the table Organization.
The attribute *Country* in table IsMember is a foreign key reference to *Code* in the table Country.

Examples of the tuples from the above relational schema are as follows:

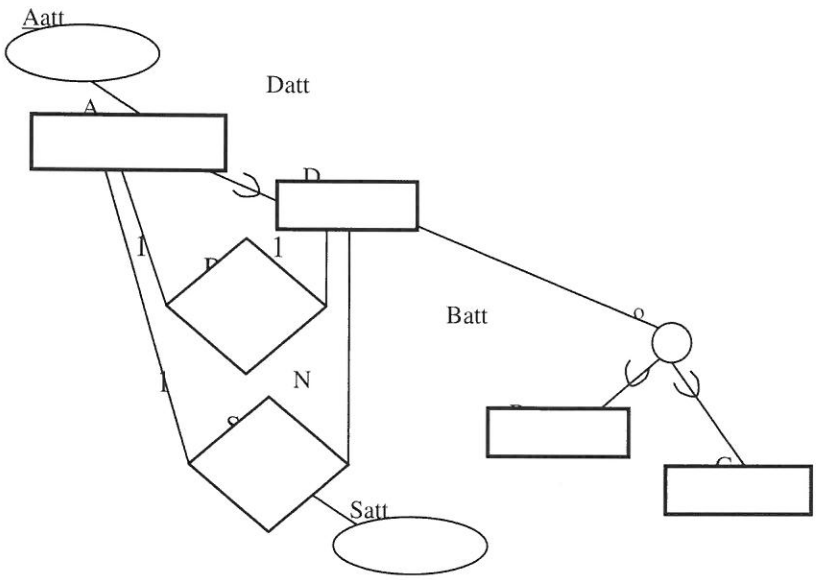
Country(Sweden, SWE, Stockholm, 449964, 9514000)
Organization(European Union, EU, 1952)
IsMember(EU, SWE, 1995-01-01)

1. List the name of all the organizations of which Sweden (Code: 'SWE') is a member.

2. Compute the sum of the populations from all the 'EU' countries.

3. List the name of all the countries that fulfill the following two conditions: (1) it is a member of both 'EU' and 'UN', and (2) it joined 'UN' after 'EU' (that is, the date it joined 'UN' is later than the date it joined 'EU').

Question 3. EER diagram and relational schema (2 + 2 + 1 = 5 p):



1. Translate the EER diagram above into a relational schema with more than one relation (i.e. table). Use the algorithm seen in the course.
2. Translate the EER diagram above into a relational schema with only one relation (i.e. table). Use the algorithm seen in the course. If you think that it is impossible, then explain why instead.
3. Discuss briefly advantages and disadvantages of having one versus several relations (i.e. tables) in a relational schema.

Theoretical part (15 points)

Question 4. Normalization (2 + 1 = 3 p):

1. Normalize (1NF→2NF→3NF→BCNF) the relation R(A, B, C, D, E, F, G, H, I) with functional dependencies {CDE→F, DE→G, E→H, I→E}. Explain your solution step by step. Bear in mind that a relation can have several candidate keys.
2. What is a candidate key?

Question 5. Data structures (2 + 3 = 5 p):

We have a file with 2000000 records. Each record is 20 bytes long. The records have two key attributes X and Y. The file is ordered on X. The database uses a block size of B=4000 bytes and unspanning allocation. Each index record is 4 bytes long.

1. Calculate the average number of block access needed to find a record with a given value for X when using (a) the primary access method and (b) a single level index.
2. Calculate the average number of block access needed to find a record with a given value for Y when using (a) the primary access method, (b) a single level index and (c) static multi-level index.

Recall that $\log_2 2^x = x$. That is, $\log_2 1 = 0$, $\log_2 2 = 1$, $\log_2 4 = 2$, $\log_2 8 = 3$, $\log_2 16 = 4$, $\log_2 32 = 5$, $\log_2 64 = 6$, $\log_2 128 = 7$, $\log_2 256 = 8$, $\log_2 512 = 9$, $\log_2 1024 = 10$, $\log_2 2048 = 11$, $\log_2 4096 = 12$, $\log_2 8192 = 13$, $\log_2 16384 = 14$ etc.

Question 6. Transactions and concurrency control (1 + 2 = 3 p):

Consider the following schedule:

T1	T2	T3
read(x)		
x=x+1		
write(x)		
	read(x)	
	x=x+1	
	write(x)	
	read(y)	
	y=y+1	
	write(y)	
		read(z)
		z=z+1
		write(z)
read(y)		
y=y+1		
write(y)		

1. Is the schedule serializable? Justify your claim.

2. Apply the two-phase locking protocol to the schedule above. Show how the transactions may interleave when the two-phase locking protocol is applied.

Question 7. Database recovery (3 + 1 = 4 p):

1. Apply the three recovery methods seen in the course to the system log below. Show all operations (in the correct order) that are performed during the recovery.

   Part of system log:
   Start-transaction T2
   Write-item T2, B, 3, 4
   Start-transaction T3
   Write-item T3, A, 7, 8
   Write-item T3, A, 8, 1
   Write-item T3, A, 1, 5
   Start-transaction T4
   Write-item T4, B, 4, 5
   Write-item T4, B, 5, 10
   Start-transaction T1
   Write-item T1, C, 8, 9
   Write-item T1, C, 9, 10
   Checkpoint
   Commit T2
   Commit T3
   Commit T4
   →system crash

2. Consider the following statement: Checkpoints are not needed in immediate update I (UNDO/NO-REDO). Is the statement true or false ?