Uppsala University
Department of Information Technology

Exam 2013-10-24 – solutions.

Database Design I (1DL300)

Please notice that for most of the exercises there is not just a single correct solution and we cannot list all the possible alternatives. Therefore, use this document wisely.

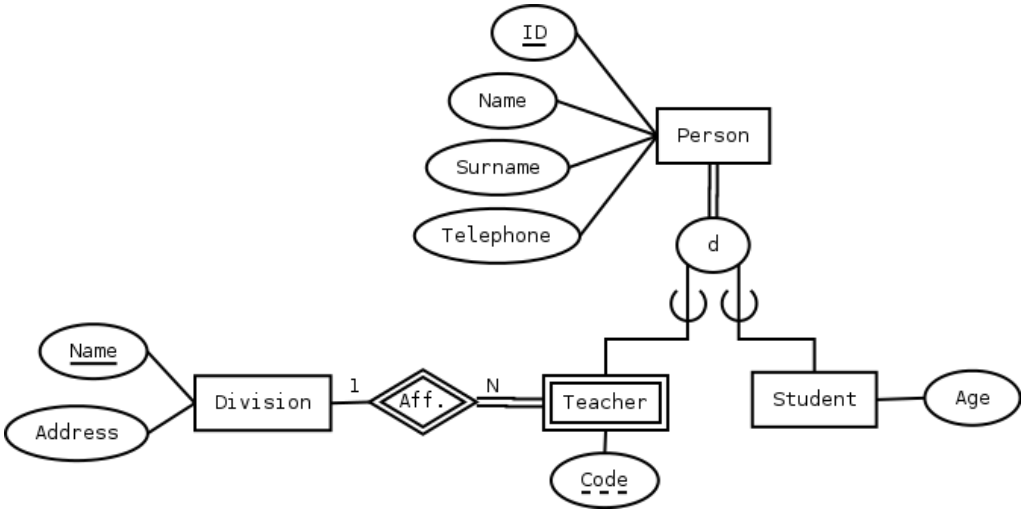
1) Questions on theory (12 points)

(a) 1
(b) 3
(c) 2
(d) 1

2) ER modeling (15 points)

a) Attribute Telephone is missing and the generalization should be disjoint.

b)



3) Translation to the Relational Model (12 points)

(a) PERSON(ID, Name, Surname, IsTeacher, IsStudent, Age)
(b) ID.
(c) Not in this translation.
(d) Age for sure. For the other attributes (except ID) you can choose.

You may also translate this diagram into two relations Teacher and Student: this is not the only possible solution.

4) SQL (15 points)

(a) SELECT DISTINCT StudentID FROM Registration JOIN Course ON CourseID=CID WHERE Cost>1000.

(b) SELECT StudentID FROM Registration JOIN Course ON CourseID=CID GROUP BY StudentID HAVING SUM(Cost)>5000.

(c) SELECT C.Name FROM Student S, Registration R, Course C WHERE CourseID=CID AND StudentID=SID GROUP BY CID, C.Name HAVING MIN(Age)<20 and MAX(Age)>40.

5) Relational Algebra (9 points)

(a) C(CID, CName,Cost) <- Course
S(SID, SName) <- $\pi_{SID, Name}$ (Student)
R(SID, CID) <- Registration
$\pi_{SName, CName}$ ($\sigma_{Cost>1000}$ (C $\bowtie$ R $\bowtie$ S))

(b) R1(SID, CID1) <- Registration
R2(SID, CID2) <- Registration
π_{SID} ($\sigma_{CID1<>CID2}$ (R1 $\bowtie$ R2)

6) Normalization (15 points)

a) Only one: (COURSE, STUDENT).

b) COURSE, STUDENT -> YEAR, CNAME, SNAME, GRADE.
COURSE -> CNAME.
STUDENT -> SNAME.

c) 1NF. It is not in 2NF because of the last two dependencies (not full-FD).

d) Having two different names for student S002.

e) Removing Who's grade for CS002 deletes all information about the course.

f)

Course

COURSE	CNAME
CS001	Database
CS002	Algorithm

Student

STUDENT	SNAME
S001	Smith
S002	Who
S003	Jensen

Grade

COURSE	STUDENT	YEAR	GRADE
CS001	S001	2012	A+
CS001	S002	2012	A
CS001	S003	2013	B
CS002	S002	2013	A

Foreign keys: Grade.Course to Course.Course and Grade.Student to Student.Student

g) See previous answer.

7) Physical Database Design (12 points)

a) An index on Day.

b) `CREATE INDEX Measure_day_idx on MEASURE(Day).`

c) $\pi_{\text{Location, Temperature}}$ ($\sigma_{\text{Day='2013-6-6'}}$ (SENSOR $\bowtie$ MEASURE)

$\pi_{\text{Location, Temperature}}$ (SENSOR $\bowtie$ $\sigma_{\text{Day='2013-6-6'}}$ (MEASURE)

d) The second, because the join does not involve measures done on other days. The selection of the relevant measures is fast thanks to the index.

8) Transactions (12 points)

a) 1: AD.WRITE(C2); AD.READ(C1); AD.WRITE(C2); AD.WRITE(C3); AD.WRITE(C3); EM.WRITE(B133); EM.WRITE(B132).

2: EM.WRITE(B133); EM.WRITE(B132); AD.WRITE(C2); AD.READ(C1); AD.WRITE(C2); AD.WRITE(C3); AD.WRITE(C3).

Both schedules do the same thing: the final price of C1 and C2 is the original price times .9, the final price of C3 is the original price times .9 * .9.

b) AD.WRITE(C2); AD.READ(C1); AD.WRITE(C2); AD.WRITE(C3); EM.WRITE(B133); AD.WRITE(C3); EM.WRITE(B132).

It is serializable because it gives the same result of the second serial schedule.

c) AD.WRITE(C2); AD.READ(C1); AD.WRITE(C2); AD.WRITE(C3); EM.WRITE(B133); EM.WRITE(B132); AD.WRITE(C3).

At the end of this schedule the three copies would have the same price. This does not happen after any serial schedule.

d) EM.WRITE(B133) cannot be executed because it tries to access C1, C2 and C3 but AD is holding locks on all theses objects.

9) Database terminology (8 points)

Please, consult the textbook or the slides for the definitions.