**Exam Introduction to Informationsystems
or Databases — April 9, 2009**

You can inspect your graded exam at the BOE (TBK/TM), or (Computing Science) at Jongejan, room BB 0366.

Remarks:

- Write **readable** and clearly, using a black or blue pen(cil).

- Put at the top of the first page all relevant data, such as your name, studentnumber, TM or TBK or CS, and the total number of pages you entered. Number your pages!

- The exam is "closed book".

- Always motivate your answers.

1. (**Theory: 6 points**)

    Answer the following questions:

    a) What are the 4 main differences between a flat file system and a database management system (hint: ACID)

    b) Why are NULL values a problem in DBMSs?

    c) When (in ORM) is it preferable to use objectification (nesting) instead of a n-ary predicate $(n \geq 3)$?

2. (**Modeling: 8 points**)

    Our Universe of Discourse (UoD) pertains to an information system (IS) used by a university to maintain details about its academic staff and academic departments. In the IS, academic staff is refered to as an employee; we keep track of employee number and employee name, the department the employee works in, the room that the employee occupies and the phone number at which an employee can be reached. A room is in some building, and buildings are given a name. Building number and room number uniquely determine a room. No two employees with the same name are allowed to work in the same department. Academic staff is either tenured (Dutch: in vaste dienst) or non-tenured, and all non-tenured academic staff have a contract stating the date that the contract expires. Academic staff have a rank: professor or teacher; it is allowed for staff to have two ranks. Each

professor heads a department, and if a professor is head of a department, he also works in that department. The IS also keeps track of the courses that academic staff teach. Not all staff teaches a course, and some courses can have more than one teacher. If a staff member teaches, his teaching in one or more courses may be evaluated and given a rating.

a) Construct an ORM model of the UoD as described above. Make systematic use of the CSDP method for constructing the model. Make sure that you capture all relevant constraints, and describe them accurately in the model.

b) Map the ORM model to a relational schema.

3. (**SQL: 6 points**)

Given is the following relational schema:

```
EMP (empnr, empname, mannr, jobtitle, salary)
     empnr is Primary Key, mannr is Foreign Key in EMP

CAR (carnr, licenceplate, color, drivernr)
     carnr is PK, drivernr is FK in EMP

PROJ (projnr, projectname, mannr, buildingnr)
     projnr is PK, mannr is FK in EMP
     buildingnr is FK in BUILD

BUILD (buildingnr, buildingname, address, numrooms)
     buildingnr is PK

WORKS (empnr, projnr, hours)
     (empnr,projnr) is PK
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a. Give the cars employee 14 is driving in.

b. Give for each employee his/her number and the total number of hours he/she works.

c. Give all employee names from employees working on a project with a manager 'Smith'.

d. Give for each project in building 144 the project number and the number of employees working on it, that have at most 10 employees working on it.

e. Update the salary of each employee working on project 13 with 10%.

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