Exam Databases 1, 26 augustus 2009

Ranking

1		**20**
2		**10**
3a	10	
3b	12	
3c	13	
3		**35**
4a	3	
4b	3	
4c	5	
4d	5	
4		**16**
5a	3	
5b	3	
5c	3	
5		**9**
for free		**10**
total		**100**

1. UML class diagram

Give a UML-class diagram of the following administartion of faculty members.

Our administration involves faculty members of a university. The university is divided into departments (each department has a unique name), each member is working for a department. Most members work full time, some of them work part time and some of them may even work for more then one department. Hence, each involvement of a member with a department can be given by a percentage, within each department a member has a certain level determining his/her salary.

The faculty campus consists of a number of buildings, each belonging to a department. The rooms in the building each have a room number, which is unique within that building. A faculty member may have a room within a building that belongs to its department. Members may share a room, their telephone number is unique for the room.

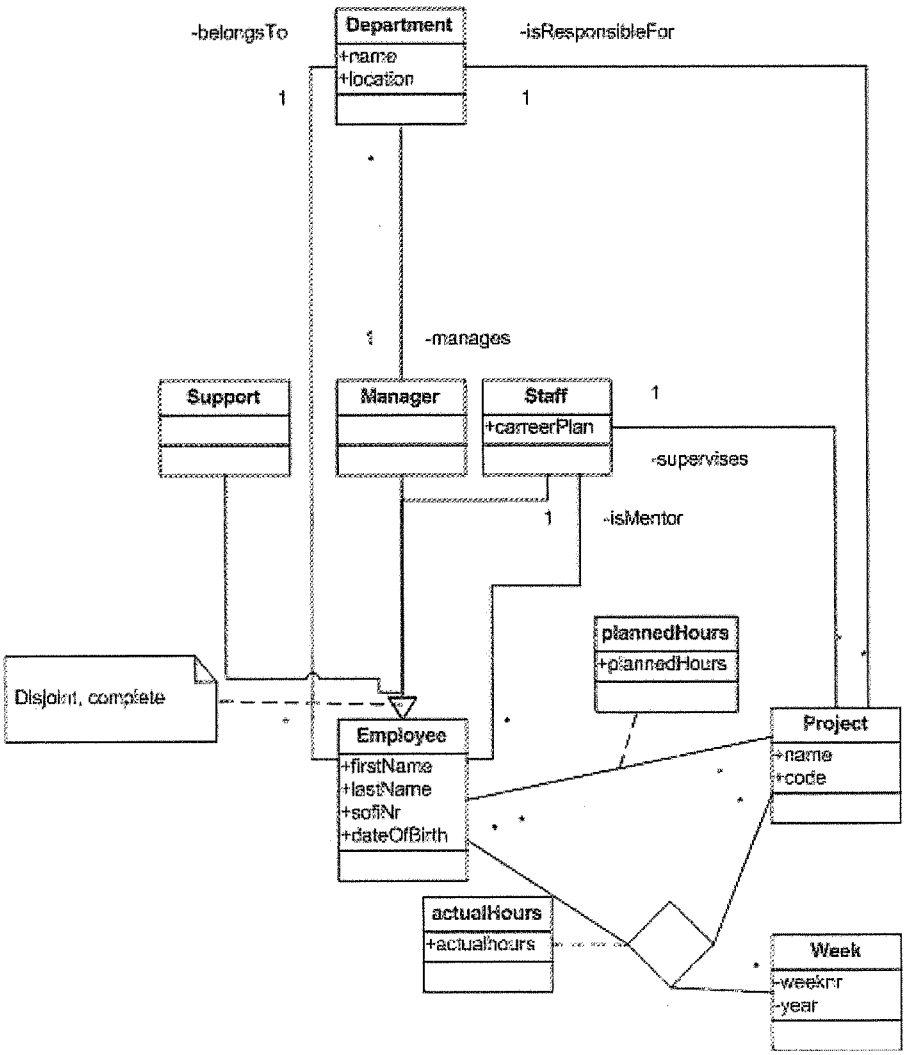
Most faculty members are staff members, before a staff member gets his/her job his/her degrees are checked. A typical degree is contains information about the level (like `"MS"` for Master), the study (like `"Computer Science"`), the year (like `"1990"`) and the university (like `"University of Utrecht"`). These degrees have to be archived, in case of future promotions. Next to staff members, there are student members who assist the staff members in their tasks. For each student we maintain its study (like `"Computer Science"`, or `"mathematics"`) and its student number as a link with the student administration. In order to assign student members properly to their tasks we have to keep track of the courses they have successfully taken. Each course has a

name, and for each course and student member we maintain the grade and the year he/she got this grade.

Finally we have the support members, as final category of faculty members. Each support member has a specialization, like `"secretary"`, `"administration"`, or `"IT-helpdesk"`. For each member we maintain the first name, last name, a SOFI number and a unique internal member number. There are some faculty members who fall in neither of the three subcategories, like the department manager. Certain members fall in more subcategories, like student members who work as a support member on the IT-helpdesk.

2. Relational scheme

Below you see a UML class-diagram of the project administration of a company. Give the associated relational scheme.



3. SQL

First we give the (simplified) SQL data model of the library case which also has been used in the practical of the Database 1 course.

```
create table Customer (
    custId INT NOT NULL AUTO_INCREMENT,
    custFirstName VARCHAR (100),
    custLastName  VARCHAR (100),
    custPhone      VARCHAR (100),
    PRIMARY KEY (custId));

create table Loan (
    custId INT NOT NULL,
    copyId INT NOT NULL,
    dateTimeOut DATETIME,
    scannerId INT,
    dateDue DATE,
    dateReturned DATE,
    PRIMARY KEY (dateTimeOut, scannerId);

create table BookOnShelf (
    copyId INT NOT NULL AUTO_INCREMENT,
    bookId INT NOT NULL,
    copyNumber INT,
    PRIMARY KEY (copyId)) AUTO_INCREMENT=1;

create table Publisher (
    pubId INT NOT NULL AUTO_INCREMENT,
    pubName VARCHAR (255) NOT NULL,
    pubPhone BIGINT,
    PRIMARY KEY (pubId));

create table CatalogEntry (
    bookId INT NOT NULL AUTO_INCREMENT,
    pubId  INT,
    ISBN   VARCHAR(20),
    title  VARCHAR (255),
    pubYear int,
    PRIMARY KEY (bookId));

create table Author (
    authId INT NOT NULL AUTO_INCREMENT,
    authFirstName VARCHAR (100) NOT NULL,
    authLastName  VARCHAR (100) NOT NULL,
    authDateOfBirth DATE NOT NULL,
    pubId INT,
    PRIMARY KEY (authId));

create table AuthorOfBook (
    bookId INT NOT NULL,
    authId INT NOT NULL,
    number INT,
```

```
PRIMARY KEY (bookId, authId));
```

Please, formalize the following queries in SQL, based on this data model.

A. Give the names of customers who have borrowed at least one book in 2008.
B. Give the names of the books that have not been borrowed by any customer in 2008.
C. Give the customers that have borrowed all books of the publisher O'Reilly.

4. Normalisation

Consider the the table with the following attributes

- (CC) CourseCode
- (CN) CourseName
- (YR) Year
- (L C) Lecturer
- (RN) Rank
- (CR) ClassRoom
- (ST) StudentNumber
- (GR) Grade

The key of this table is (CC, YR, ST), it has the following functional dependencies

- CC $\rightarrow$ CN
- CC, YR $\rightarrow$ LC, CR
- LC $\rightarrow$ RN
- CC, YR, ST $\rightarrow$ GR

4.A Explain the design problems of this table
4.B Explain the normal form (NF) of this table
4.C Decompose the table (if needed) such that the resulting tables are in 3 NF
4.D Show that this decomposition satisfies the lossless join property

Concurrency

Given the two processes ("*r* " stands for "read", "*w*" stands for "write"):

- P1: r1(X); X := X+10; w1(X); r1(Y); Y := Y -20; w1(Y)
- P2: r2(X); X := 42 * X; w2(X)

These two processes can be executed according to different schedules, (aschedule is a sequence of actions of P1 and P2).

5.A..Give an example of a serial schedule
5.B. Give an example of a serializable schedule, give also the dependency graph and the associated serial schedule.
5.C Give a conflicting schedule that suffers from the lost update problem, show the conflict in the dependency graph.