IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 2017

BEng Honours Degree in Computing Part I
MEng Honours Degrees in Computing Part I
for Internal Students of the Imperial College of Science, Technology and Medicine

This paper is also taken for the relevant examinations for the Associateship of the City and Guilds of London Institute

PAPER C130

DATABASES

Thursday 4 May 2017, 10:00
Duration: 80 minutes

Answer ALL TWO questions

Paper contains 2 questions
Calculators not required

1 a A student (Student) enrolls (Enrolled) in a course (Course). Each course takes place at a defined time and in a defined room and is given by a lecturer(Lecturer).

The following relations model this university example:

Student(snum, sname, degree, degreeyear, age)

Course(name, starts_at, room, lid)

lid references Lecturer.lid

Enrolled(snum, cname)

snum references Student.snum

cname references Course.name

Lecturer(lid, lname, deptid)

Given these relations, for each question below, write the according SQL query:

i) Find the names of lecturers for whom the combined enrollment of the courses that they teach is less than five students.

ii) Print the degreeyear and the average age of students for that degreeyear, for each degreeyear.

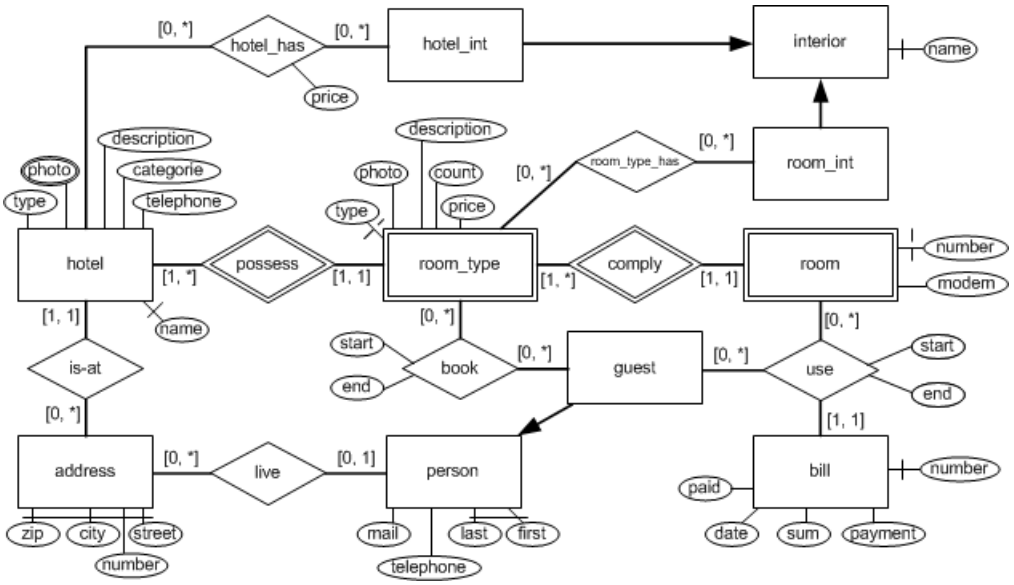
iii) Print the degreeyear and the average age of students for that degreeyear for all degreeyears except for degreeyear 1.

iv) Find the names of students who are enrolled in the maximum number of courses.

v) For each age value that appears in students, find the degreeyear value that appears most often. For example, if there are more 1st degreeyear students aged 18 than 2nd, 3rd, or 4th students aged 18, you should print the pair (18, 1).

All questions carry equal weight.

b Given the following E-R Model:



Write the equivalent relational model including table names, column names, primary keys (underlined), foreign keys as well as triggers, e.g.:

table(<u>column1</u>, column2)

column2 **references** othertable.column3 **on delete cascade**

Do this for entities interior, room_int, hotel_int, hotel, room_type, hotel and address as well as for **all** relationships between **these** specific entities. Do not specify data types.

The two parts carry equal marks.

2a Suppose that we decompose the schema $R = (A, B, C, D, E)$ into (A, B, C) and (A, D, E).

Show that this decomposition is a lossless-join decomposition if the following set F of functional dependencies holds:

$$A \rightarrow BC$$
$$CD \rightarrow E$$
$$B \rightarrow D$$
$$E \rightarrow A$$

b Decompose the relation $R = (A, B, C, D, E)$ into the third normal form (BCNF) based on the following set of functional dependencies:

$$A \rightarrow CD$$
$$B \rightarrow CE$$
$$E \rightarrow B$$

c Decompose the relation $R = (A, B, C, D, E)$ into the third normal form (3NF) based on the following set of functional dependencies:

$$A \rightarrow CD$$
$$B \rightarrow CE$$
$$E \rightarrow B$$

d Find a canonical cover of:

$$A \rightarrow BCE$$
$$B \rightarrow CEA$$
$$A \rightarrow E$$

The four parts carry equal marks.