Student number: 0000000 Signature: _____

UNIVERSITY OF VICTORIA
Faculty of Engineering

Department of Computer Science

CSC 370 (Database Systems)
Instructor: Daniel M. German

Midterm
18 June 2003

Duration: 75 minutes

This is a closed-book exam. You are only allowed one letter-size sheet of paper.

This examination paper consists of **9** pages and **5** sections. Please bring any discrepancy to the attention of an invigilator. The number in parenthesis at the start of each question is the number of points the question is worth.

Answer all questions.

Please write your answers clearly.

For instructor's use:

	Score
1 (10)	
2 (10)	
3 (8)	
4 (13)	
5 (9)	
Total (50)	

For this exam, consider the following schema and instances of the relations. Feel free to remove this page from the exam.

Attributes with an empty value should be assumed to be NULL.

```
Students(sid:integer, name:string, login:string,
         age: integer, gpa: real)
```

- Primary Key: **sid**

sid	*name*	*login*	*age*	*gpa*
53666	Mary Elizabeth	me@cs	18	7.4
53668	Quintin	quintin@ee	18	7.8
53650	Pierre	pierre@math	19	7.4
53831	Cathy	cathy@music	11	8
53832	Reuven	reuven@music	12	

```
Courses(cid: string, cname: string, credits: integer)
```

- Primary Key: **cid**

cid	*cname*	*credits*
SENG265	Introduction to Software Engineering	3
CSC370	Database Systems	3
CSC360	Introduction to Operating Systems	3
CSC320	Foundations in Computer Science	3

```
Enrolled(sid: integer, cid: string, grade: string)
```

- Primary Key: **sid,cid**
- Foreign Key: **cid** references Courses
- Foreign Key: **sid** references Students

sid	*cid*	*grade*
53666	SENG265	98
53666	CSC370	78
53668	CSC370	91
53832	SENG265	

1. Database Concepts

(a) [4] Give 4 advantages of using a DBMS to manage data. Be brief.

Any of the ones listed in page 9

- Data Independence
- Efficient Data access.
- Data Integrity and Security
- Data administration
- Concurrent access & Crash Recovery.
- Reduced application development

1 point each

(b) [2] Explain why physical data independence is important. Be Brief.

Application programs use the conceptual schema. As long this remains constant, we can alter the physical storage details without affecting these application programs.

(c) [3] List 3 of the tasks a DBA is responsible for.

- Design of the Conceptual Schema and Physical Schema
- Security & authorization
- Data availability & Recovery from failures
- D.B tuning.

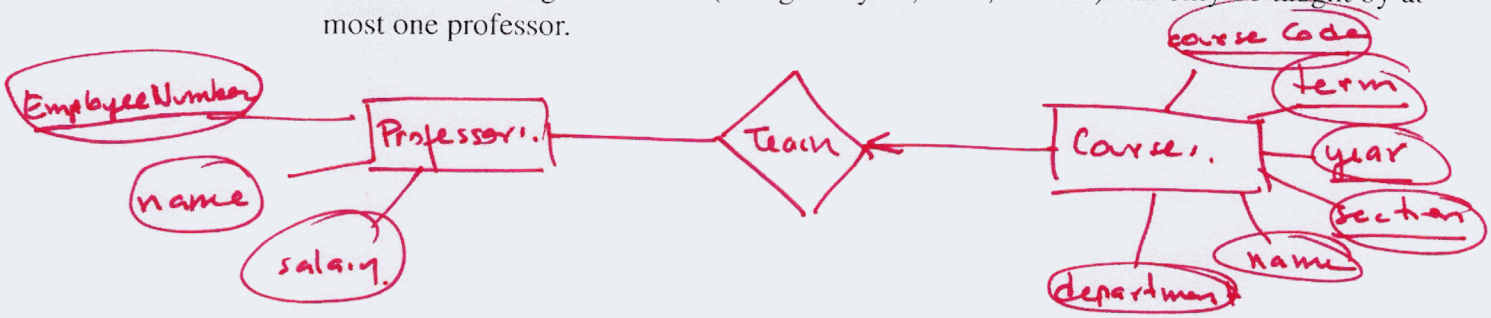
1 point each

(d) [1] Who invented the relational model for databases?

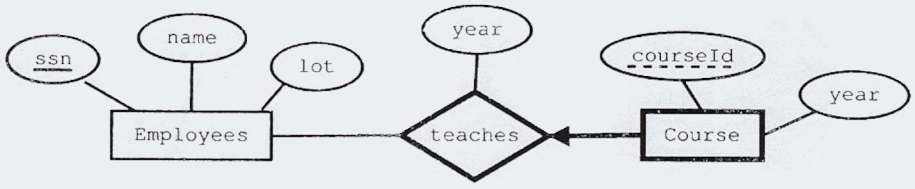
E. Codd

2. Database Design

(a) [5] Draw the Entity Relationship diagram for the following database: A university database contains information about professors (employeeNumber, name and salary) and courses (courseCode, term, year, section, name, and department). Professors can be uniquely identified by their employeeNumber, while courses can be uniquely identified by their courseCode, year, term and section. Professors teach courses, but there is the restriction that a given course (in a given year, term, section) can only be taught by at most one professor.



(b) [5] For the following diagram, provide `CREATE TABLE` statements for the entities `Employees`, `Courses` and for the relation `teaches`. Choose appropriate data types for each field and include any referential integrity constraints.




```
CREATE TABLE Employees (
    ssn char(10),
    name char(30),
    lot integer,
    PRIMARY KEY (ssn));

CREATE TABLE CourseTeaches
    courseid char(10),
    year integer,
    ssn char(10)
    yearTeaches integer
    PRIMARY KEY (courseid, ssn),
    FOREIGN KEY ssn REFERENCES
        Employees ON DELETE CASCADE );
```

3. Relational Model

(a) [2] What is the arity, cardinality and degree of the relation `Enrolled` in page 2?

3 4 3.

Give relational algebra expressions for the following questions using the schema in page 2.

(b) [3] The `cname` of the courses for which the student with `name` 'Jones' has a `grade` greater than 90.

$\pi_{cname}(((\sigma_{name = 'Jones} Students) \bowtie (\sigma_{grade > 90} Enrolled)) \bowtie Courses)$

(c) [3] The `cname` of each course that does not have students enrolled.

$\pi_{cname}((\pi_{cid} Courses - \pi_{cid} Enrolled) \bowtie Courses)$

4. Writing SQL queries

Answer the following questions using the schema in page 2.

(a) [3] Provide a SELECT statement that retrieves for every student enrolled in a course, their name and the name of the course (cname) in which he/she is enrolled.

```
Select name, cname from
    Students S, Enrolled E, Courses C
where S.sid = E.sid and
      E.cid = C.cid.
```

(b) [3] Provide a SELECT statement that retrieves the name of each course (cname) that does not have students enrolled.

```
Select cname from
    Courses C1
where
    NOT EXISTS( Select * from
                Enrolled where
                E.cid = C1.cid )
```

(c) [3] Provide a SELECT statement that retrieves every student id (sid) and the total number of credits they have completed (total number of credits of the courses for which they have received a grade).

```
Select S.Sid, sum(Credits) from
    Enrolled E, Students S, Courses C
where
    S.sid = E.sid and
    E.cid = C.cid and
    E.grade IS NOT NULL
group by
    S.sid
```

(d) [4] Provide a SELECT statement that groups students who are at least 18 years old by their age. For each of these groups output their age and their corresponding average gpa and order the result by age (in ascending order).

```
Select age, avg(gpa) from
    Students
where
    age >= 18
group by age
order by age
```

5. Interpreting SQL queries

Based on the instances of page 2, what is the answer to the following queries?

For attributes with a NULL value, leave their place empty (as it was done in page 2.

(a) [3]

```
SELECT count(gpa) as count, max(gpa) as Maximum,
       min(gpa) as Minimum
FROM Students
WHERE sid IN (SELECT sid FROM Enrolled)
```

count	maximum	minimum
2	7.8	7.4.

(b) [3]

```
SELECT C.cid, E.sid, E.grade  FROM
   Enrolled E NATURAL RIGHT OUTER JOIN Courses C
```

cid	sid	grade
CSC 320		
CSC 360		
CSC 370	53666	78
CSC 370	53668	91
SEng265	53668	98
SEng265	53832	

(c) [3]

```
SELECT S.sid, AVG(grade) as Average
   FROM Students S, Enrolled E
   WHERE S.age <= 18 and S.sid = E.sid
GROUP BY S.sid
HAVING count(grade) > 0
```

sid	average
53668	91
53666	88

End of examination
Total pages: 9
Total marks: 50