CS 275 Introduction to Databases
Midterm

1. (4 pts) What are **two of the four** options for ON UPDATE/DELETE when creating tables? Describe the differences among these options, including their designed behaviors and whether choosing an option will conflict with other constraints in the table definition.

2. (4 pts) What is a view? Describe the differences between a table and a view.

3. (6 points) What is the difference between a primary key and foreign key?

4. (6 points) What is the difference between an entity set and a relationship set?

5. (20 points) Notown Records has decided to store information about musicians who perform on its albums (as well as other company data) in a database. The company has wisely chosen to hire you as a database designer.

    - Each musician that records at Notown has an SSN, a name, an address, and a phone number. Poorly paid musicians often share the same address, and no address has more than one phone.
    - Each instrument used in songs recorded at Notown has a unique identification number, a name (e.g., guitar, synthesizer, flute) and a musical key (e.g., C, B-flat, E-flat).
    - Each album recorded on the Notown label has a unique identification number, a title, a copyright date, a format (e.g., CD or MC), and an album identifier.
    - Each song recorded at Notown has a title and an author.Each musician may play several instruments, and a given instrument may be played by several musicians.
    - Each album has a number of songs on it, but no song may appear on more than one album.
    - Each song is performed by one or more musicians, and a musician may perform a number of songs.
    - Each album has exactly one musician who acts as its producer. A musician may produce several albums, of course.

Design a conceptual schema for Notown and draw an ER diagram for your schema. The preceding information describes the situation that the Notown database must model. Be sure to indicate all key and cardinality constraints and any assumptions you make. Identify any constraints you are unable to capture in the ER diagram and briefly explain why you could not express them. State any assumptions you make.

6. (12 points) The following database was created according to the following SQL statements. Based on the definitions, decide exactly when each insert/delete/update statement will fail due to relational model constraints. If a statement will always succeed or fail, please say so. Justify your answers.

```
CREATE TABLE DEPT
(
        DeptID          VARCHAR(5)          NOT NULL,
        DeptName        VARCHAR(40)         NOT NULL,
        PRIMARY KEY (DeptID)
);

CREATE TABLE GRADEINDEX
(
        Grade           CHAR(2)             NOT NULL,
        PRIMARY KEY (Grade)
);

CREATE TABLE STUDENT
(
        SSN             CHAR(9)             NOT NULL,
        FName           VARCHAR(15)         NOT NULL,
        LName           VARCHAR(15)         NOT NULL,
        DeptID          VARCHAR(5)          NOT NULL,
        PRIMARY KEY (SSN),
        FOREIGN KEY (DeptID) REFERENCES Dept(DeptID)
);

CREATE TABLE COURSE
(
        CourseID        INT                 NOT NULL,
        Title           VARCHAR(40)         NOT NULL,
        DeptID          VARCHAR(5)          NOT NULL,
        PRIMARY KEY (CourseID),
        FOREIGN KEY (DeptID) REFERENCES Dept(DeptID)
);

CREATE TABLE SECTION
(
        SectionID       INT                 NOT NULL,
        CourseID        INT                 NOT NULL,
        Term            VARCHAR(10)         NOT NULL,
        Year            INT                 NOT NULL,
        Instructor      VARCHAR(40)         NOT NULL,
        TA_SSN          CHAR(9),
        PRIMARY KEY (CourseID),
```

```
        FOREIGN KEY (CourseID) REFERENCES Course(CourseID),
        FOREIGN KEY (TA_SSN) REFERENCES Student(SSN)
);

CREATE TABLE GRADEREPORT
(
        SectionID       INT             NOT NULL,
        SSN             CHAR(9)         NOT NULL,
        Grade           CHAR(1)         NOT NULL,
        PRIMARY KEY (SectionID, SSN),
        FOREIGN KEY (Grade) REFERENCES GradeIndex(Grade)
);
```

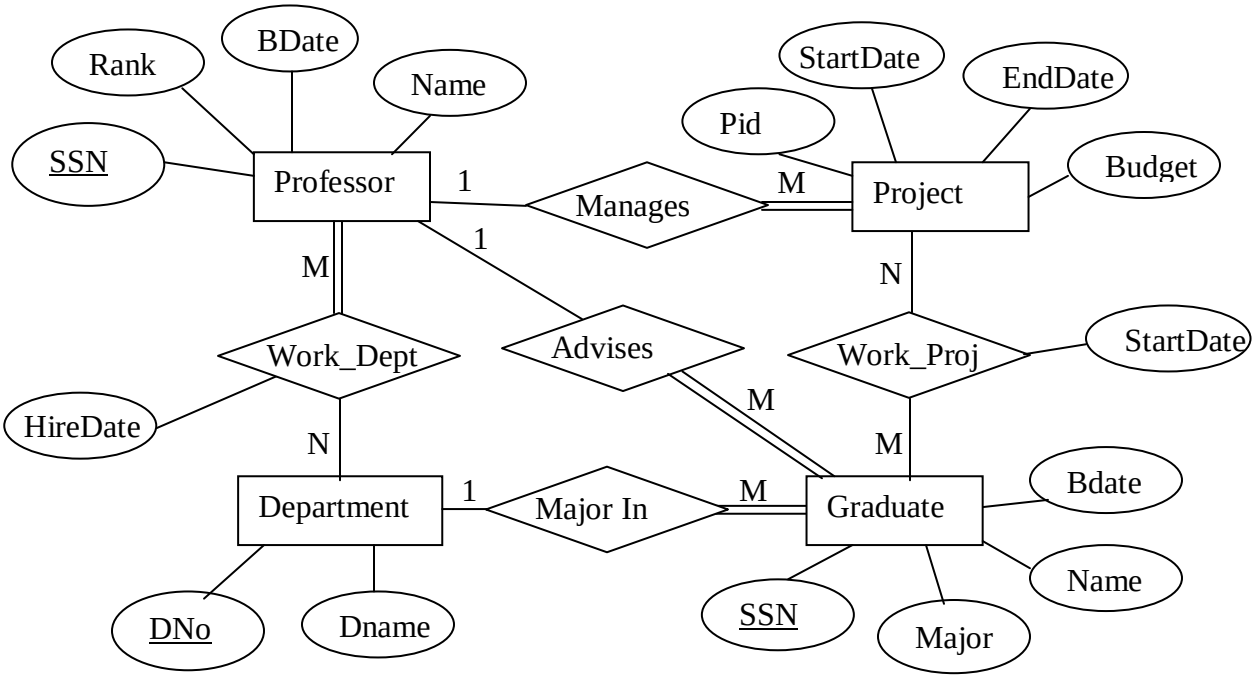
(a) Insert into SECTION (SectionID, CourseID, Term, Year, TA_SSN) values (10030, 'Spring', 2005, '120230340');

(b) Update DEPT Set DeptID = 'EECS' where DeptID = 'CS' or DeptID = 'ECE';

(c) Delete from STUDENT where SSN = 320430540;

(d) Update GRADEREPORT set Grade = 'A';

7. (20 points) Consider the following ER diagram. Write the relation schema corresponding to the entity sets and relationship sets including constraints.



8. (16 points) Consider the following schema:

Flights(*flno:* **integer**, *from:* **string**, *to:* **string**, *distance:* **integer**, *departs:* **time**, *arrives:* **time**, *price:* **real**)
Aircraft(*aid:* **integer**, *aname:* **string**, *cruisingrange:* **integer**)
Certified(*eid:* **integer**, *aid:* **integer**)
Employees(*eid:* **integer**, *ename:* **string**, *salary:* **integer**)

Note that the Employees relation describes pilots and other kinds of employees as well; every pilot is certified for some aircraft (otherwise, he or she would not qualify as a pilot), and only pilots are certified to fly.

Write the following query that the Relational Algebra is answering (4 pts each):

(a) $\pi_{eid}(\sigma_{aname='Boeing'}(Aircraft \bowtie Certified))$

(b) $\pi_{ename}(\sigma_{aname='Boeing'}(Aircraft \bowtie Certified \bowtie Employees))$

(c) $\rho(R1, \pi_{eid}(\sigma_{cruisingrange>3000}(Aircraft \bowtie Certified)))$

$\pi_{ename}(Employees \bowtie (R1 - \pi_{eid}(\sigma_{aname='Boeing'}(Aircraft \bowtie Certified))))$

(d) $\pi_{flno}(\sigma_{salary>100,000}((Flights \bowtie_{distance<cruisingrange} Aircraft) \bowtie Certified \bowtie Employees))$

9. (12 points) Consider the following schema:

Suppliers (*sid:* **integer**, *sname:* **string**, *address:* **string**)
Parts (*pid:* **integer**, *pname:* **string**, *color:* **string**)
Catalog (*sid:* **integer**, *pid:* **integer**, *cost:* **real**)

The key fields are underlined, and the domain of each field is listed after the field name. Therefore *sid* is the key for Suppliers, *pid* is the key for Parts, and *sid* and *pid* together form the key for Catalog. The Catalog relation lists the prices charged for parts by Suppliers.

Write relational algebra for the following SQL statements (4 pts each):

(e)
```
SELECT DISTINCT P.pname
FROM Parts P, Catalog C
WHERE P.pid = C.pid
```

(f)
```
SELECT S.sname
FROM Suppliers S, Catalog C, Parts P
WHERE (P.color = 'green' OR P.color = 'brown')
        AND P.pid = C.pid AND C.sid=S.sid
```

(g)
```
SELECT C1.sid, C2.sid
FROM Catalog C1, Catalog C2
WHERE C1.pid = C2.pid AND C1.sid != C2.sid AND C1.cost > C2.cost
```