

CSE 444 Midterm --- Fall 2006

Name _____ Student ID _____

#	1	2	3	Total (100)
Score				

Time: 50 minutes. Number of Total Points: 100.

1. [40 points] A manufacturing company maintains a database of their technical manuals. Their schema are described as following:

MANUAL(mid, mTitle, year) /* key= mid */
CHAPTER(cid, mid, number, cTitle, text) /* key= (cid,mid) */
CITES(mid, cid, position, midRef) /* key = everything */
WORD(wid, word) /* key= wid */
OCCURS(wid, cid, mid, position) /* key = everything */

Chapters have a foreign key to the manuals where they belong, and a chapter number (typically 1, 2, 3, ... for the chapters in a manual). The text in a chapter may have a reference to another manual, and this is recorded in CITES. For example a record in CITES:

('m832', 'c432', 120, 'm7702')

means that the chapter with key ('m832', 'c432') has a reference to the manual 'm7702', and this reference occurs on position 120 of the text. Finally WORDS represents the collection of all the words in all the manuals, and OCCURS is a many to many relationship recording every occurrence of a word in a chapter.

a. [10 points] Typically each reference is to a manual written earlier. Write a query that returns all manuals that contain some reference to a manual written later (i.e. in a later year). Your query should return **mid**, **mTitle** pairs.

[This page is intentionally left blank. Use it to write your answer.]

```
Select m1.mid, m1.mTitle  
from MANUAL m1, m2, CITES c  
where m1.mid = c.mid and  
      c.midRed = m2.mid and  
      m1.year < m2.year
```

b. [10 points] Write a query that computes for each word the total number of occurrences in all manuals. That is, if the word **'bearing'** occurs in manual 1, chapter 1, positions 10 and 20, then in chapter 2, positions 5,10, and 30, and then again in manual 2, chapter 1, position 20, then you will return (**'bearing'**, **6**). If the word 'database' doesn't occur anywhere then you will return (**'database'**, **0**).

```
select wid, count(OCCURS.wid)
from WORD left outer join OCCURS
on WORD.wid = OCCURS.wid
group by WORD.wid
```

or

```
select w.word, (select count(*) from occurs o where w.wid = o.wid)
from word w
```

c. [10 points] Write a query that computes for every word in how many manuals it occurs. For the example above, you would return ('bearing', 2) and ('database', 0).

```
select wid, count(distinct OCCURS.mid)
from WORD left outer join OCCURS
on WORD.wid = OCCURS.wid
group by WORD.wid
```

Or

```
select w.word, (select count(distinct(o.mid)) from occurs o where w.wid = o.wid)
from word w
```

d. [10 points] For each pair of queries below say whether they are equivalent, i.e. return exactly the same answers. You have to answer 'yes' or 'no'.

(i)

Q1: **select** **distinct** c1.mid
from CHAPTER c1, CHAPTER c2, CITES r1, CITES r2
where c1.cid = r1.cid and c1.mid = r1.mid
and c2.cid = r2.cid and c2.mid = r2.mid
and r1.position < 200 and r2.position < 300

Q2: **select** **distinct** c1.mid
from CHAPTER c1, CITES r1, CITES r2
where c1.cid = r1.cid and c1.mid = r1.mid
and r1.position < 200 and r2.position < 300

Are they equivalent?: Y

(ii)

Q1: **select** **distinct** m.mid, m.title
from MANUAL m, CHAPTER c1, CITES r, MANUAL m2
where m.mid = c1.mid
and c1.number > 5
and c1.mid = r.mid and c1.cid = r.cid
and r.midRef = m2.mid
and m2.year = m.year

Q2: **select** **distinct** m.mid, m.title
from MANUAL m, CHAPTER c1, CHAPTER c2, CITES r, MANUAL m2

where m.mid = c1.mid and m.mid = c2.mid
 and c1.number > 5 and c2.number > 3
 and c1.mid = r.mid and c1.cid = r.cid
 and r.midRef = m2.mid
 and m2.year = m.year

Are they equivalent?: Y

(iii)

Q1: **select** c.cid, c.mid
from CHAPTER c
where c.cid not in (**select** r.cid
from CITES r
where r.mid = c.mid)

Q2: **select** c.cid, c.mid
from CHAPTER c, CITES r
group by c.cid, c.mid
having count(*) > 0

Are they equivalent?: N

2. [30 points]

a. [15 points] Design an E/R diagram for an application domain consisting of the following entity sets::

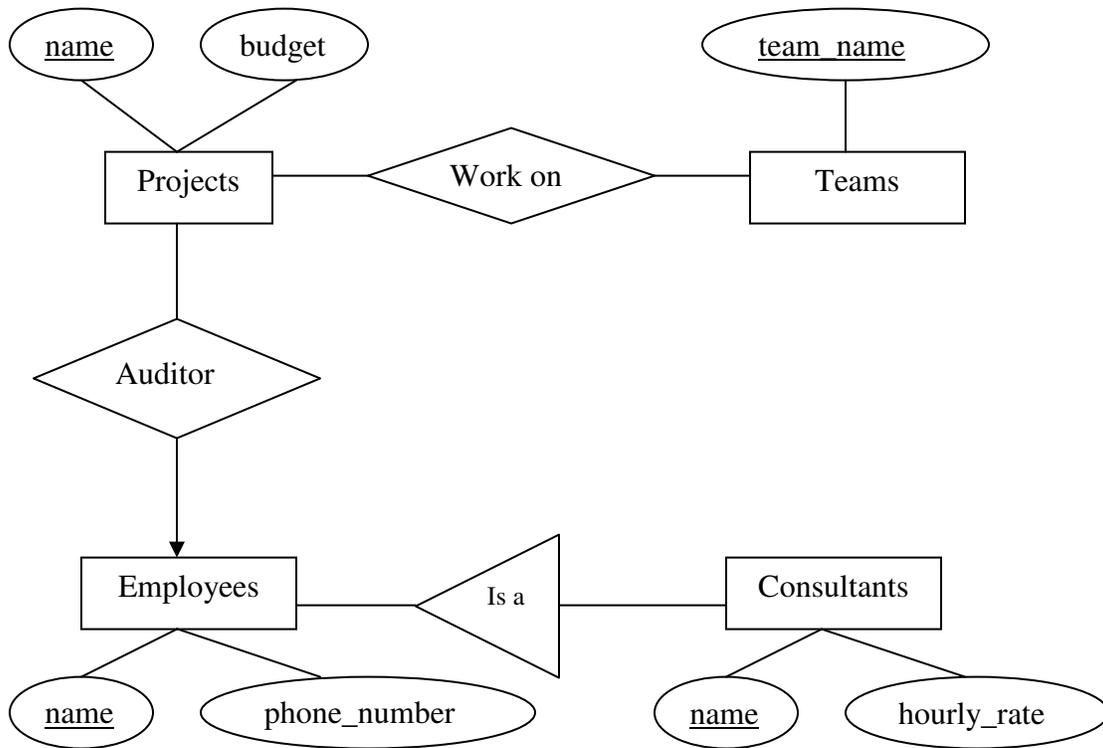
- **Projects.** Attributes: **name, budget**
- **Teams.** Attributes: **team_name**
- **Empolyees.** Attributes: **name, phone_number**
- **Consultants.** Attributes: **name, phone_number, hourly_rate**

And the following relationships:

- Each team works on one or more projects.
- Each project has an auditor, who is an employee
- Consultants are employees

Your answer should consist of an E/R diagram with entity sets, attributes (make sure you create appropriate keys: you may incorporate new attributes if **needed**), relationships, and inheritance.

[This page is intentionally left blank. Use it to write your answer.]



b. [15 points] Create in SQL the tables for the E/R diagram in the previous point. All your attributes should be of type **varchar**(. . .), except for **budget** and **hourly_rate**, which are integers. (Pick appropriate types for the key attributes). Indicate all keys and all foreign keys. You have to turn in several CREATE TABLE statements.

```
CREATE TABLE Employees(  
    name VARCHAR(30) PRIMARY KEY,  
    phone_number VARCHAR(30)  
);
```

```
CREATE TABLE Teams(  
    team_name VARCHAR(30) PRIMARY KEY  
);
```

```
CREATE TABLE Projects (  
    name VARCHAR(30) PRIMARY KEY,  
    budget INT,  
    auditor VARCHAR(30) REFERENCES Employees(name)  
);
```

```
CREATE TABLE WorkOn(  
    team_name VARCHAR(30) REFERENCES Teams(name),  
    project_name VARCHAR(30) REFERENCES Projects(name),  
    PRIMARY KEY (team_name, project_name)  
);
```

```
CREATE TABLE Consultants(  
    name VARCHAR(30) REFERENCES Employees(name),  
    hourly_rate INT,  
    PRIMARY KEY(name)  
);
```

3.[30 points]

a.[10 points] X, Y are sets of attributes. Indicate for each statement below if it is **true** or **false**:

if $X \rightarrow Y$ then the set X^+ contains Y^+

Your Answer: T

if $X, Y \rightarrow Z$ then $X \rightarrow Z$

Your Answer: F

if $X \rightarrow Y$ and $Y, U \rightarrow V$ then $X, U \rightarrow V$

Your Answer: T

if the set X^+ is contained in Y^+ then X is contained in Y.

Your Answer: F

b. [10 points] Consider two relations $R(A,B,C,D)$ and $S(C,D,E,F)$, and suppose the following functional dependencies hold:

in R : $A \rightarrow C$, $B \rightarrow D$, $D \rightarrow B$

in S : $C, E \rightarrow F$, $F \rightarrow E$

Now consider the following table $T(A,B,C,D,E,F)$ defined by a SQL view:

```
create view T as  
select distinct R.A, R.B, R.C, R.D, S.E, S.F  
from R, S  
where R.B = 'bbb' and R.C = S.C and R.D = S.D
```

Compute all the keys in T .

Since B is fixed, and $B \rightarrow D$, $D \rightarrow B$, so D is fixed.

Thus all the other attributes will $\rightarrow BD$. We can reduce T to (A,C,E,F) .

Then AE , AF are the keys for T .

[This page is intentionally left blank. Use it to write your answer.]

c. [10 points] Decompose the table $R(A,B,C,D,E)$ in BCNF, assuming the following functional dependencies hold on R :

$$A,B,C \rightarrow D$$

$$B,D \rightarrow A$$

$$B, E \rightarrow A$$

Show your steps.

$R_1 = ABCD$ $R_2 = ABCE$ ($ABC \rightarrow D$ ruled out)

then

$R_3 = ABD$ $R_4 = BDC$ $R_2 = ABCE$

then

$R_3 = ABD$ $R_4 = BDC$ $R_5 = BEA$ $R_6 = BEC$

Or ABD $BCDE$

Or ABE $BCDE$