

# Database System Principle Final Examination

**Name:**\_\_\_\_\_ **Student ID:**\_\_\_\_\_ **Scores:**\_\_\_\_\_

Exam Rules:

- 1) Close book and notes, 100 minutes
- 2) Please write down your name and student ID number NOW.
- 3) If you think a problem is ambiguous, write down your assumptions, argue that they are reasonable, then work on the problem using those assumptions.
- 4) Please write your solutions in the spaces provided on the exam. Make sure your solutions are neat and clearly marked. You may use the blank areas and backs of the exam pages for scratch work. Please do not use any additional scratch paper.

**Question 1 选择题, 请将答案写在下面表格里, 可以选择多个答案[20 points]**

题号	1	2	3	4	5	6	7	8	9	10
答案										

1. 已知两个关系 $R(A, B)$ 和 $S(A, B)$ 具有同样的模式, 下列哪些等价的关系代数表达式成立?

I.  $R \cap S = R - (R - S)$       II.  $R \cap S = S - (S - R)$       III.  $R \cap S = R \bowtie S$

(A) I only    (B) I and II only    (C) I, II, and III    (D) None of the above

2. Consider relations  $R(A, B)$  and  $S(B, C)$  where  $T(R) = 5000$ ,  $T(S) = 3000$ , and  $B$  is a primary key on  $S$ . The expected number of tuples in  $R \bowtie S$  is (    )

- (A) less than or equal to 3000.                      (B) less than or equal to 5000.  
 (C) greater than 3000                                  (D) greater than 5000  
 (E) None of the above

3. 关系模式  $R(A, B, C, D, E)$  的一个关系示例见右图:

$A$	$B$	$C$	$D$	$E$
1	2	3	4	5
1	4	3	4	5
1	2	4	4	1

下列哪些函数依赖 (FD' s) 可能存在?

I.  $AB \rightarrow C$     II.  $B \rightarrow D$     III.  $DE \rightarrow A$

(A) I only    (B) II only    (C) I and III only    (D) II and III only

4. 关系代数中,  $\theta$  联接操作 (Theta-Join) 由\_\_\_\_\_操作组合而成。

- A) 笛卡儿积和选择                      B) 投影和笛卡儿积  
 C) 投影和选择                          D) 投影、选择和笛卡儿积

5. “年龄在 15 至 30 岁之间”这种约束属于 DBS 的\_\_\_\_\_功能。

- A) 恢复    B) 并发控制    C) 完整性    D) 安全性

6. 能消除多值依赖引起的冗余的是\_\_\_\_\_。
- A) 2NF      B) 3NF      C) 4NF      D) BCNF
7. 将查询 SC 表的权限授予用户 U1, 并允许该用户将此权限授予其他用户。实现此功能的 SQL 语句是\_\_\_\_\_。
- A) GRANT SELECT TO SC ON U1 WITH PUBLIC
- B) GRANT SELECT ON SC TO U1 WITH PUBLIC
- C) GRANT SELECT TO SC ON U1 WITH GRANT OPTION
- D) GRANT SELECT ON SC TO U1 WITH GRANT OPTION
8. SELECT 语句中“SELECT DISTINCT”表示查询结果中 \_\_\_\_\_。
- A) 属性名都不相同                      B) 去掉了重复的列
- C) 去掉了重复的行                      D) 属性值都不相同
9. 以下\_\_\_\_\_能预防死锁。(              )
- A) 一次封锁法      B) 三级封锁协议      C) 两段锁协议      D) 顺序封锁法
10. 以下哪个命令表明一个事务结束 \_\_\_\_\_。(              )
- A) REDO      B) ROLLBACK      C) COMMIT      D) UNDO      E) TRANSACTION

## Question 2– ER Diagrams [10 points]

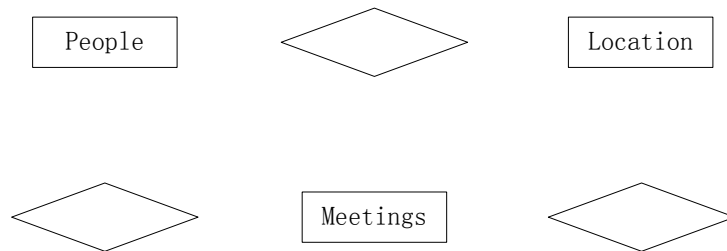
This question involves an address and date book application. The application is used to set up meetings with contacts to take place at certain locations, on certain dates. For example, I may set up a meeting called “Product Presentation” with Zhang San and Li Si on 4/1/05 at 4:00p.m at Building No.5.

Here are the rules of the system:

- A. A meeting has a date, time, and description. No two meetings can take place at the same time on the same day
- B. People have name, phone and e-mail. No two people in the world have the same e-mail
- C. Locations have address and name. No two locations share an address
- D. All people ‘live near’ at least one location, but not every location is near someone. For every place that a person ‘lives near’, there is a distance (in kilometers) that tells us how far from the place that person lives. A distance of 0 indicates that the location is actually the person’s home
- E. Every meeting has exactly one location
- F. Meetings can be attended by several people, and it’s possible to meet the same person in multiple meetings

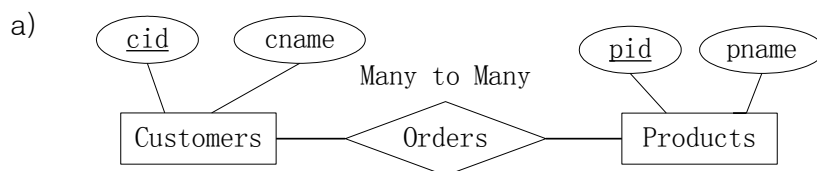
Complete the following Entity–Relation diagram according to the instructions in parts a)–c).

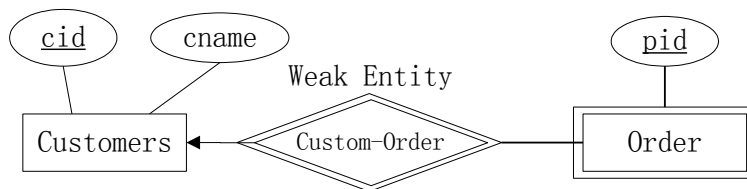
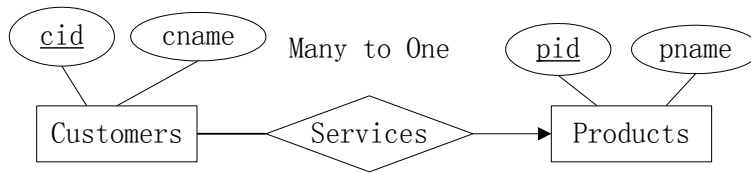
- Fill in the names of the relationship sets and connect the parts of the diagram to reflect the rules A–F. Make sure to make the distinctions among your lines clear.
- Add attributes to this diagram as needed by rules A–F.
- Underline the attributes that are keys.



### Question 3 – Data Models [2 parts, 15 points total]:

Show the SQL statements that create the tables including the foreign key and primary key indications according to E–R diagram.





b) (6 points) For the relational tables you generated in question 3(a), Describe which insert and delete operations in this database must be checked to ensure that referential integrity is not violated for that foreign key. Please state specifically which operations on which relations can cause problems.

(参照写法 : On insert(SC)  $\rightarrow$  exists(Student) and exist(Course);

On delete(Student)  $\rightarrow$  delete(SC) or not allowed)

Many to Many:

Many to One:

Weak Entity:

**Question 4 – Functional Dependencies [ 4 parts, 14 points]**

Consider a database table T with attributes ABCDE and a set of functional dependencies  $FD = \{AE \rightarrow BC, AC \rightarrow D, CD \rightarrow BE, D \rightarrow E\}$

a) [5 points] Give three (3) candidate keys (if there are more than three, choose any three you want), and explain why they are candidate keys (i.e., in addition to being superkeys).

b) [3 points] Is table T already in BCNF? Why or why not?

Now, consider the following table R with attributes ABCD and with the set of functional dependencies  $FD = \{A \rightarrow B, B \rightarrow C, C \rightarrow D\}$

c) [3 points] Say you decompose it into AB, CD, AC. Is this decomposition lossless? Explain why or why not.

d) [3 points] Give another BCNF decomposition of relation R, which is different from the one in part (c). Your decomposition should be lossless, but need not be dependency preserving.

### Question 5 – SQL [4 parts, 13 points total]

For parts a)–d), consider the following schema (primary keys are underlined):

Student (sname, sid, gpa, level, deptno)

Course (cno, cname, deptno, units)

Dept (dname, deptno)

Takes (sid, cno)

a) [4 points] Write a SQL query that returns the names (i.e., snames) of students who have taken more courses outside their department than inside their department. For this question, you can assume that all students in the database have taken at least one course inside their department.

(note: you should do scratch work elsewhere and just put your final answer here!)

b) [3 points] Which of the following queries returns the department numbers of those departments for which there are no courses being offered? **More than one choice may be correct.**

- A) 

```
SELECT D.deptno
FROM Dept D, Course C
WHERE D.deptno NOT EQUAL C.deptno;
```
- B) 

```
SELECT C.deptno, COUNT(C.deptno)
FROM Course C
GROUP BY C.deptno
HAVING COUNT (C.Deptno) = NULL;
```
- C) 

```
SELECT C.deptno
FROM Course C
WHERE C.deptno NOT IN (SELECT * FROM Dept);
```
- D) 

```
SELECT D.deptno
FROM Dept D
WHERE NOT EXISTS (SELECT * FROM Course C
                  WHERE C.deptno = D.deptno);
```
- E) None of the above

c) [3 points] Which of the following queries returns the id of the student with the highest GPA? **More than one choice may be correct.**

- A) SELECT S.sid  
FROM Students S  
WHERE S.gpa = MAX(S.gpa);
- B) SELECT S.sid, MAX(S.gpa);  
FROM Students S  
GROUP by S.gpa
- C) SELECT S.sid  
FROM Student S  
WHERE S.gpa > ALL (SELECT S.gpa FROM Student S);
- D) SELECT S.sid  
FROM Student S  
Where S.gpa = (SELECT MAX(S.gpa) FROM Student S);
- E) None of the above

d) [3 points] Which of the following queries returns the sid of the students and the total units they are taking? **More than one choice may be correct.**

- A) SELECT S.sid, sum(C.units)  
FROM Student S, Takes T, Course C  
GROUP BY S.sid  
HAVING S.sid = T.sid AND T.cno = C.cno;
- B) SELECT S.sid, sum(C.units)  
FROM Student S, Takes T, Course C  
Where S.sid = T.sid AND T.cno = C.cno;  
GROUP BY S.sid;
- C) SELECT S.sid, Temp.Sum1  
FROM Student S, (SELECT sum(C.units) AS Sum1  
FROM Takes T, Course C  
WHERE T.sid = S.sid AND T.cno = C.cno) AS Temp;
- D) SELECT S.sid, sum(C.units)  
FROM Student S, Takes T, Course C  
WHERE S.sid = T.sid AND T.cno = C.cno;
- E) None of the above



### Question 6 – Concurrency Control (12 points)

Examine the schedule given below. There are four transactions, T1, T2, T3, and T4.

	T1	T2	T3	T4
1				READ tax
2	READ salary			
3				WRITE tax
4		READ tax		
5		WRITE tax		
6	READ tax			
7	WRITE salary			
8			READ salary	
9	WRITE tax			
10			WRITE salary	
11				READ salary
12				WRITE salary

- Draw the precedence graph for this schedule.
- What is the equivalent serialization order for this schedule? If no order is possible, then state 'none' and explain reason.
- Assume that transaction T4 did not run at all. What is the precedence graph in this case?
- What is the equivalent serialization order for this second schedule? If no order is possible, then state 'none' and explain reason.

### Question 7 – Transaction Management (16 points)

Consider the following sequence of log records:

<START S>; <S,A,60,61>;<COMMIT S>; <START T>; <T,A,61,62>; <START U>;  
<U,B,20,21>; <START CKPT (T,U)>; <T,C,30,31>; <START V>; <U,D,40,41>;  
<V,F,70,71>; <COMMIT U>;<END CKPT>; <T,E,50,51>; <COMMIT T>;  
<V,B,21,22>; <COMMIT V>.

if there is a crash and the last log record to appear on disk is:

a) <T,E,50,51>

b) <COMMIT T>

- a) 当日志中的最后一条记录为<T,E,50,51>时，利用日志对数据库进行恢复后，恢复后的下列值应为多少？

A is set to \_\_\_\_\_

B is set to \_\_\_\_\_

C is set to \_\_\_\_\_

D is set to \_\_\_\_\_

E is set to \_\_\_\_\_

F is set to \_\_\_\_\_

此时恢复数据库完成后，应在日志文件中填入什么记录？

Write \_\_\_\_\_ and \_\_\_\_\_ records on the log.

- b) 当日志中的最后一条记录为<COMMIT T>时，利用日志对数据库进行恢复后，恢复后的下列值应为多少？

A is set to \_\_\_\_\_

B is set to \_\_\_\_\_

C is set to \_\_\_\_\_

D is set to \_\_\_\_\_

E is set to \_\_\_\_\_

F is set to \_\_\_\_\_