Database System Principle Final Examination

Name:_____ Student ID:_____ Scores:_____

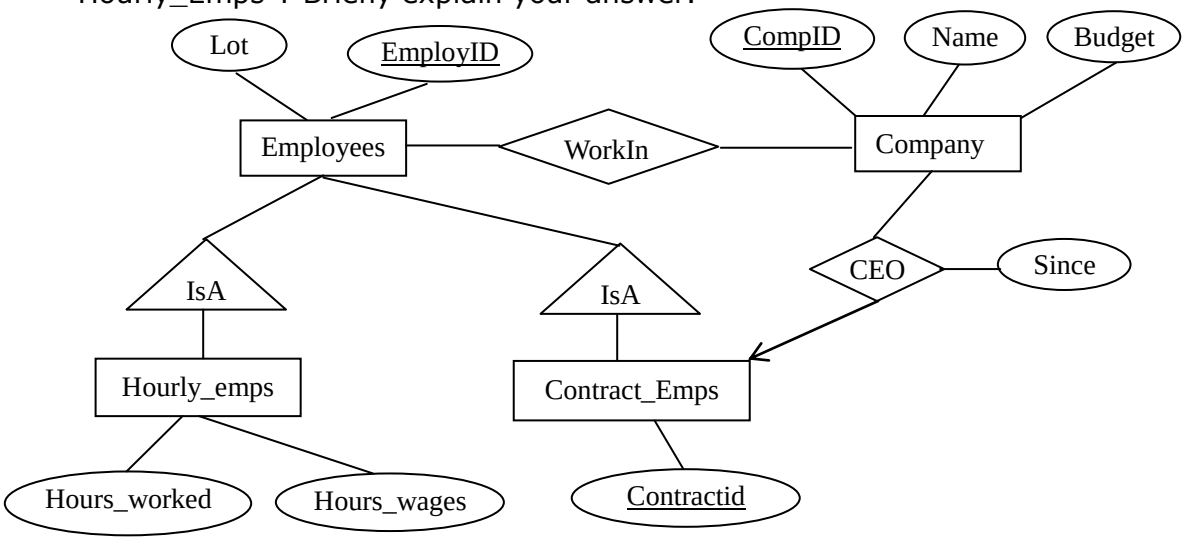
Exam Rules:

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.

1. (15 points) ER and Translation to Relational Model:

a. [10 points] Create a relational schema that captures this E/R diagram. For every relation in your schema, specify the key of that relation.

b. [5 points] What is the key for entity " Contract_Emps "? And what is the key for "Hourly_Emps"? Briefly explain your answer.



2. (10 points) Schema Refinement:

Consider the relation R(A,B,C,D,E) with the following functional dependencies:

(A, B)->E, (C, D)->E, A->C, C->A.

Is R in BCNF? If not, decompose R into a collection of BCNF relations. Show each step of the decomposition process.

3. (20 points, 5 points each) Relational Algebra and SQL Queries:

Consider a database schema with the following relations:

Student (ssn, name)

Prof (ssn, name)

Course (number, instructor-ssn, title, credits, room#)

Enroll (student-ssn, course#)

Room (number, capacity)

a. Write a relational algebra query that finds the names of all students who are enrolled in a class taught by "Jones".

b. Write an SQL query that finds the names of all students who are NOT enrolled in two classes held in the same room.

c. Write an SQL query that lists, in alphabetical order(按字母顺序), the title of all courses either taught by "Smith" OR are taught in room number 444. Do not list duplicate titles.

d. Write an SQL query that considers all the courses that have ever been taught by "Brown" and are of 3 credits, and groups them according to title. For each course, the query should compute the average capacity of rooms in which the course has been offered, then return only courses for which this average is more than 20.（请在横线上填入合适表达式完成该查询）

SELECT Course.title, AVG (Room.capacity)
FROM Prof, Course, Room
WHERE
_____

_____

GROUP BY _____

HAVING_____

4. (16 points) Transaction Management

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 _____

5. (9 points)Consider the following schedule involving three transactions T1, T2 and T3:

	T1	T2	T3
1.	W(A)		
2.	R(B)		
3.	R(C)		
4.			W(B)
5.	W(B)		
6.			W(C)
7.		R(C)	
8.		W(B)	
9.		W(C)	
10.			R(A)

a) Draw the precedence graph for this schedule.

b) Is this schedule conflict serializable? Why or why not? If it is conflict serializable, give the equivalent serial schedule (just write the order of the transactions).

6. (30 points)选择题,请将答案写在下面表格里。

题号	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
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. $R \cap S = R \overset{\cdot}{\bowtie} S$

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

2. Q1: SELECT DISTINCT a FROM R WHERE b>10

Q2: SELECT a FROM R WHERE b>10 GROUP BY a;

(A) Q1和Q2产生的结果一样 (B) Q1的结果总是包含Q2的结果

(C) Q2的结果总是包含Q1的结果 (D) Q1和Q2产生不同的结果

3. 已知关系模式：R(a, b, c)和S(d, e, f)，创建如下视图:

CREATE VIEW theView AS SELECT a,'cs145' AS class,f FROM R,S WHERE R.b = S.e;

并执行下列查询Q: SELECT a FROM theView WHERE theView.f>10;

以下哪个查询与Q结果相同?

(A) SELECT a FROM R,S WHERE R.class ='cs145' AND S.f>10;

(B) SELECT a FROM R NATURAL JOIN S WHERE S.f>10;

(C) SELECT a FROM R, S WHERE R.b= S.e AND S.f>10;

(D) SELECT a FROM theView,S WHERE S.f>10.

4. A 是一个一维关系，用下列SQL命令创建：CREATE TABLE A(i INT);以下是SQL触发器：

```
CREATE TRIGGER Mystery
 AFTER INSERT OR UPDATE ON A
 REFERENCING OLD AS OldTuple, NEW AS NewTuple
 WHEN (10>(SELECT MAX(I) FROM A))
 UPDATE A SET I=I+1
 FOR EACH ROW;
```

当A表中没有任何元组（即表为空）时， 执行命令: INSERT INTO A VALUES(1)

该命令的运行结果是：

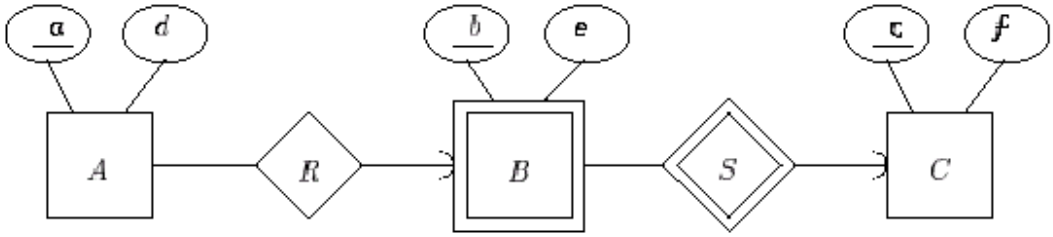
(A) A is left with a single tuple with value 10

(B) A is left with a single tuple with value 2

(C) A is left with tuples 2,3,…10

(D) The trigger never stops modifying tuples

The following two questions are based on the following figure:



5. If entity set A currently has 100 entities, which of the following could be the number of B entities?

Ⅰ. 1 ; Ⅱ. 100 ; Ⅲ. 200 ;

(A) Ⅰ or Ⅱ (B) Ⅱ or Ⅲ (C) Ⅱ only (D) Ⅰ, Ⅱ or Ⅲ

6. If we convert the E/R diagram to relations in the standard way described in the text, which set of attributes would not appear in the schema of some relation?

(A) (b,c,e) (B) (c,f) (C) (a,d) (D) (a,b)

7. Relation R(A，B，C) satisfies the multi-valued dependency A->->B, and has (possibly among others) the following tuples in its current instance: (0, 1, 2), (0, 3, 4), and (0, 5, 6). Which of the following tuples is not necessarily in the current instance of R?

(A) (0; 1; 4) (B) (0; 3; 2) (C) (0; 5; 2) (D) None of the above.

The following two questions refer to a relation R(A, B, C, D,E) with functional dependencies A->B, BC->E, and DE->A.

8. The number of keys of R is:

(A) 1 (B) 2 (C) 3 (D) 4

9. Which of the following functional dependency does not necessarily hold in R?

(A) AC -> E (B) AE -> C (C) BC -> B (D) DE -> B

10. Initially, user A is the owner of relation R, and no other user holds privileges on R. The following are executed:

by A: GRANT UPDATE ON R TO B

by A: GRANT UPDATE(a) ON R TO C WITH GRANT OPTION

by C: GRANT UPDATE(a) ON R TO B WITH GRANT OPTION

by A: REVOKE UPDATE(a) ON R FROM C CASCADE

Which of the following best describes the status of B's privileges on R?

(A) B can update any attribute of R except a but cannot grant that privilege.

(B) B has no privileges on R and cannot grant any.

(C) B can update any attribute of R except a, but can grant others the privilege to update R:a .

(D) B can perform any update on R but cannot grant that privilege.

11. 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 ⋈ 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

12. For a given SQL query, How many corresponding logical query execution plans and physical query execution plans can exist?

(A) one logical query execution plans and one physical query execution plan

(B) several logical query execution plans and several physical query execution plans

(C) one logical query execution plan and several physical query execution plans

(D) several logical query execution plans and one physical query execution plan

13. 下列描述语句中哪一句是正确的？

(A) For any data file, it is possible to construct two separate sparse indexes on different keys.

(B) For any data file, it is not possible to construct two separate dense indexes on different keys.

(C) It makes sense to construct a two-level index that has a dense first level and a sparse second level.

(D) It makes sense to construct a two-level index that has a dense first level and a

dense second level.

14. R（U,F）属于 3NF，下列说法哪个是正确的？

A）一定消除了插入和删除异常　　B）仍存在一定的插入和删除异常

C）一定属于 BCNF　　D）消除了所有冗余

15. 关系模式 R(A,B,C,D,E)的一个关系示例如下：

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