University of California, Irvine
ICS 184 – Database Systems, Winter 2002
Final Exam, SOLUTIONS
Max. Points: 100

1. B.
2. A.
3. D.
4. C. Note that (A) is not right since an attribute-based check cannot prevent deletions, while (B) is a foreign key constraint in the wrong direction.
5. D. The two tuples (1,2) combine with the two tuples (2,5) to produce four tuples (1,2,5). The tuple (3,4) combines with (4,6) to produce (3,4,6). The dangling tuple (7,8) is padded to produce the tuple (`NULL`,7,8), a total of 6 tuples.
6. D. "ANY" means "at least one." If S.C is empty, then Q2 can be empty, while Q1 is nonempty.
7. B. Q1 will produce all occurrences of the maximum value of x in R whereas it will be produce only once in Q2
8. D.
9. B. (BE) is the only candidate key of R.
10. A. I is true because *DE->A* is also a BCNF violation for *R*. II is false: if we decompose using *DE->A,* we will get a relation with attributes *(A, D, E)*, which we will not get by decomposing with *B->D* first.
11. (1) Each table can have only one "primary" key, and multiple "unique" keys. (2) A "primary" key cannot be NULL, while a "unique" key can be NULL.
12. Answer: U, T, F, U, U.
13. After Q1:
    Emp: (Tom, NULL), (Mary, NULL), (Jack, 222), (Henry, 222)
    Dept: (222, LA), (333,SF)
    After Q2:
    Emp: (Tom, NULL), (Mary, NULL), (Jack, 444), (Henry, 444)
    Dept: (444, LA), (333,SF)

14. (a) CREATE TABLE Mgr(SSN CHAR(9) PRIMARY KEY,
    `assistantSSN CHAR(9) REFERENCES Emp(SSN));`

    (b)Modify the create table statement to read:

```
CREATE TABLE Dept(DNo INTEGER PRIMARY KEY,
                  name CHAR(30),
                  budget FLOAT CHECK budget <= 1000000);
```

(c) Modify the create table statement to read:

```
CREATE TABLE EMP(SSN CHAR(9) PRIMARY KEY,
   name CHAR(30),
   salary FLOAT,
   DNo INTEGER,
```

```
     CHECK ((salary <= 20000) OR NOT (DNo = 13) ));
```

(d)
```
CREATE ASSERTION SmallDepartmentsHaveFewManagers
CHECK (
  NOT EXISTS (
     SELECT  Dept.DNo
      FROM    Dept, Emp, Mgr
     WHERE   Dept.Dno = Emp.DNo AND
             Emp.SSN = Mgr.SSN AND
             Dept.budget < 1000000
    GROUP BY Dept.DNo
    HAVING COUNT (*) > 2)
);
```

(e) Answer: "We can never decrease the salary of the person named Tom Smith."

15.

(a)
```
SELECT       Name, SSN
FROM         Employee, Hourlog
WHERE        Hourlog.hours > 100 AND
             Employee.SSN = Hourlog.SSN;
```

(b)
```
(SELECT SSN FROM Employee)
   EXCEPT
(SELECT SSN FROM Hourlog);
```

"EXCEPT" an be replaced by "MINUS" (Oracle).

(c)
```
SELECT Name, SSN
FROM   Employee, Hourlog
WHERE  Employee.DNO = 10 AND
       Hourlog.SSN = Employee.SSN AND
       Hourlog.PNO = 345;
```

(d)
```
SELECT       Name, SSN
FROM         Employee, Hourlog H1, Hourlog H2
WHERE  EMPLOYEE.SSN = H1.SSN AND
       H1.SSN = H2.SSN AND
       H1.PNO < H2.PNO;
```

(e)
```
SELECT       PNO, SSN
FROM         HourLog H1
WHERE        hours = (SELECT MAX(hours)
                      FROM HourLog
                      WHERE PNO = H1.Pno);
```

16. (a) Candidate keys: (A), (E), (BC), (CD).

(b) B → D is a violation: decompose it to R1(B,D) and R2(A,B,C,E).

FDs on R1: B → D. So R1 is in BCNF.
FDs on R2: A→BC, A→E, E→A. So F2 is in BCNF.

(c) Yes. No 3NF violation.

17. (a) Solution: Let us assume A→→B and B→→C. We need to show that A→→C. Given two tuples t1 = (a1, b1, c1, d1) and t2 = (a1, b2, c2,d2) in R, we need to show that R also contains (a1,b2,c1,d2). As A→→B and R contains t1 and t2, the relation will also contain the tuples u1=(a1,b2,c1,d1) and u2=(a1,b1,c2,d2). Now as B→→C and R contains t2 and u1, the tuple (a1,b2,c1,d2) exists in R.

QED.

NOTE: we do not accept the proof that says "By the transitivity rule…", since we are asking you to prove this "transitivity rule."

(b) Solutions: No. The following is a counterexample.

A	B	C	D
3	2	1	0
5	4	1	0

This instance satisfies the FD and MVD restrictions. But if we swap B values, the new tuple (3,4,1,0) does not exist in the table.