POSSIBLE QUESTIONS
THERE WILL BE ALSO SQL QUERIES!

What is “functional” about functional dependencies? possiblq3.doc [4 pts]
2) List the steps of 3NF synthesis algorithm as described in class. [4 pts]
A
3) What is meant by the closure of a set of functional dependencies? [4 pts]
4) When are two sets of functional dependencies equivalent? How can we determine their equivalence?
[4 pts]
5). Multiple Choice Questions: [2pts each]
1. Consider relation R(A;B;C;D) with FD's A → D, B → D, and D → BC.
Which of the following is true about the decomposition of R into relations with schemas AB
and BCD? Explain your answer.
(a) The decomposition is neither lossless nor dependency-preserving.
(b) The decomposition is lossless, but not dependency-preserving.
(c) The decomposition is dependency-preserving, but not lossless.
(d) The decomposition is both lossless and dependency-preserving.
2. Suppose we have a relation R(A;B;C;D;E) and the FD's A → DE, D → B, and E → C.
If we project R (and therefore its FD's) onto schema ABC, what is true about the key(s)
for ABC? Explain why.
(a) Only ABC is a key
(b) Only A is a key
(c) Only DE is a key
(d) A, B, and C are each keys.

Exercise 2 : Functional Dependencies and Normalization

[80 points]

1) Consider the relation STUDENT (SNO, SNAME, CNO, CNAME, ADDRESS) where the following FDs hold:

SNO → SNAME

CNO → CNAME

SNO → ADDRESS

Let attribute set (SNO, CNO) be denoted by A. Compute the closure of A, i.e. A^+ [5pts]

2) Use your own words to explain how the closure of attribute set A, i.e. A^+, can be used to determine the containment of a FD in a closure F^+. [5pts]

3) Consider the relation R (CLASS, MEET_DAY, STUDENT, GRADE, COMPLEX, MANAGER) with the meaning:

• A STUDENT takes a CLASS that meets on several day or days every week (given by the attribute MEET_DAY).

• A STUDENT can take multiple classes.

• The STUDENT gets a GRADE in the CLASS.

• Each STUDENT lives in only one COMPLEX

• Each COMPLEX has only one MANAGER, but each manager can manage one or more COMPLEXes.

(a) Find all the non-trivial FDs (Functional Dependencies) that hold in R. [5pts]

(b) What kind of problems does relation R have? Give an explanation for each problem you found. [5pts]

4) Consider a relation R with four attributes, XYZW, and a set of functional dependencies F
F: XY → Z, XY → W, Z → X, W → Y
a. Identify the candidate key(s) for R.
b. Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF).
c. Is R in BCNF? If *R* is not in BCNF, decompose it into a set of BCNF relations that preserve the
dependencies.
[10 points]
5) Consider the relation
R1 (CLASS, MEET_DAY, STUDENT, GRADE, TRANSFER_CLASS, CREDITS_AWARDED)
with the following FDs:
{CLASS, STUDENT} → {GRADE}
{STUDENT, TRANSFER_CLASS} → {CREDITS_AWARDED}
Please decompose the relation *R1* into BCNF and list each step of your work. [10 points]
6) Let *AB* be a shortcut for {*A*, *B*}. Imagine that we have the relation *R2*(*ABCD*) with FDs
AB → *C*, *C* → *D*, *D* → *A*. Explain why this relation is not in BCNF, but is in 3NF. Why would it be
problematic to decompose *R2* into BCNF? [5 points]
7) Now consider the relation *R3* (*ABCDEFGH*), with FDs *BC* → *AD*, *E* → *FH*, *F* → *GH*. Please
decompose *R3* into BCNF and list each step of the process. [10 points]
8) Given the following relational schema R
R(A,B,C,D,E,F,G,H,I,J)
and functional dependencies:
B → E ; E → F,H ; B,C,D → G ; C,D → A ; A → J
I → B,C,D,E ; H → I
Answer these questions: [10 points]
(a) Does the functional dependency B → J hold?
(b) List the candidate keys of R.

(c) Normalize R into BCNF. Make sure to underline primary key fields.

9) Suppose functional dependency B → C holds in relation R(A;B;C;D).

For every additional functional dependency, state if it makes R to be in 3NF, BCNF or both. [5 points]

(a) D → AB

(b) AC → D

(c) CD → B

(d) AD → B

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Consider the relation for published books:

BOOK (Book_title, Authorname, Book_type, Listprice, Author_affil, Publisher)

Author_affil refers to the affliation of author. Suppose the following dependencies exist:

Book-title → Publisher, Book_type

Book_type → Listprice

Authorname → Author_affil

a. What normal form is the relation in? Explain you answer.

b. Apply normalization until you cannot decompose the relations further. State the reasons behind each decomposition.