The University of British Columbia

Computer Science 304

Midterm Examination

February 8, 2010

Time: 50 minutes Total marks: 50

Instructor: Rachel Pottinger

Name ANSWER KEY Student No

(PRINT) (Last) (First)

Signature

This examination has 5 pages.

Check that you have a complete paper.

This is a closed book, closed notes exam. No books or other material may be used.

Answer all the questions on this paper.

Give very **short but precise** answers.

State any assumptions you make

Work fast and do the easy questions first. Leave some time to review your exam at the end.

Good Luck

Question	Mark	Out of
1		7
2		18
3		10
4		15
Total		

1. {5 marks} Consider the schema R(A, B, C, D, E, F, G, H, I) together with the functional dependencies: A→B, C→D. Assume that R1(A,B,C,D,E) is a relation obtained through decomposition of R. Is R1 in BCNF? Why or why not? If not, decompose into a collection of BCNF relations using the method we used in class and the book and *circle the relations in your final answer*. *Show all your work.*

   This is question 19.5 part 1 from the book

   A+=AB
   C+=CD
   therefore A is not a key of R1. Decompose on A→B: R2(A,B), R3(A,C,D,E). R2 is in BCNF since it has only two attributes. R3 is not in BCNF since C is not a key of R3. Decompose on C→D: R4(C,D), R5(ACE). Final answer: R2(A,B),R4(C,D),R5(A,C,E)

2. {20 marks} Consider the schema S(A, B, C, D, E) together with the functional dependencies:

   BD → A
   AB→ C
   D→ A
   B→ C
   C→E

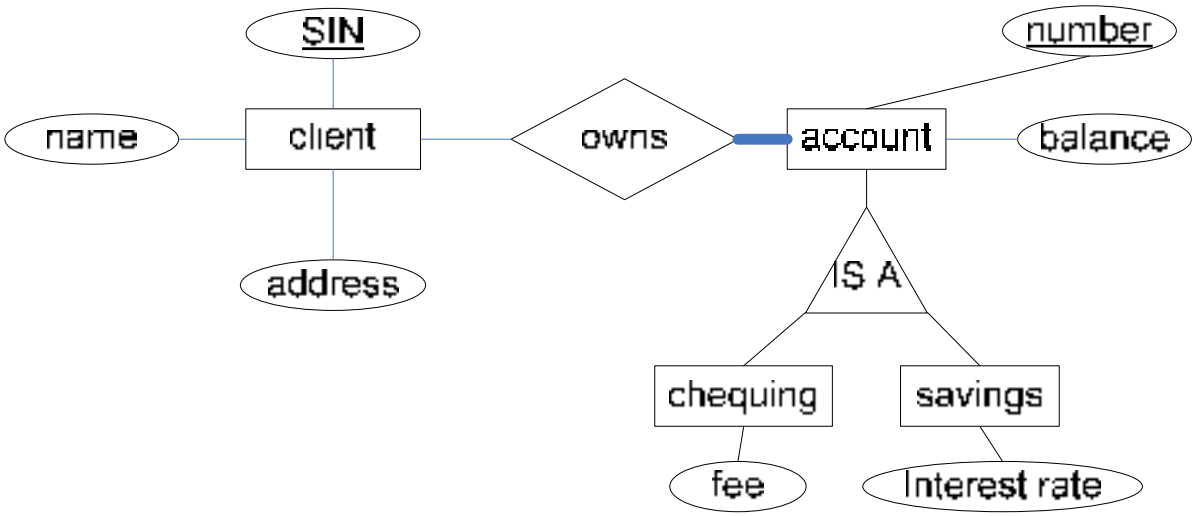
Is S in 3NF? Why or why not? If not, decompose into 3NF using the method we used in class and the book and *circle all relations in your final answer. Show all your work.*

AB+=ABCE
BD+=BDACE
D+=AD
B+=BCE
C+=CE
There is no way to get BD any other way, so BD is the only key. But the others do violate 3NF, so we need to decompose.

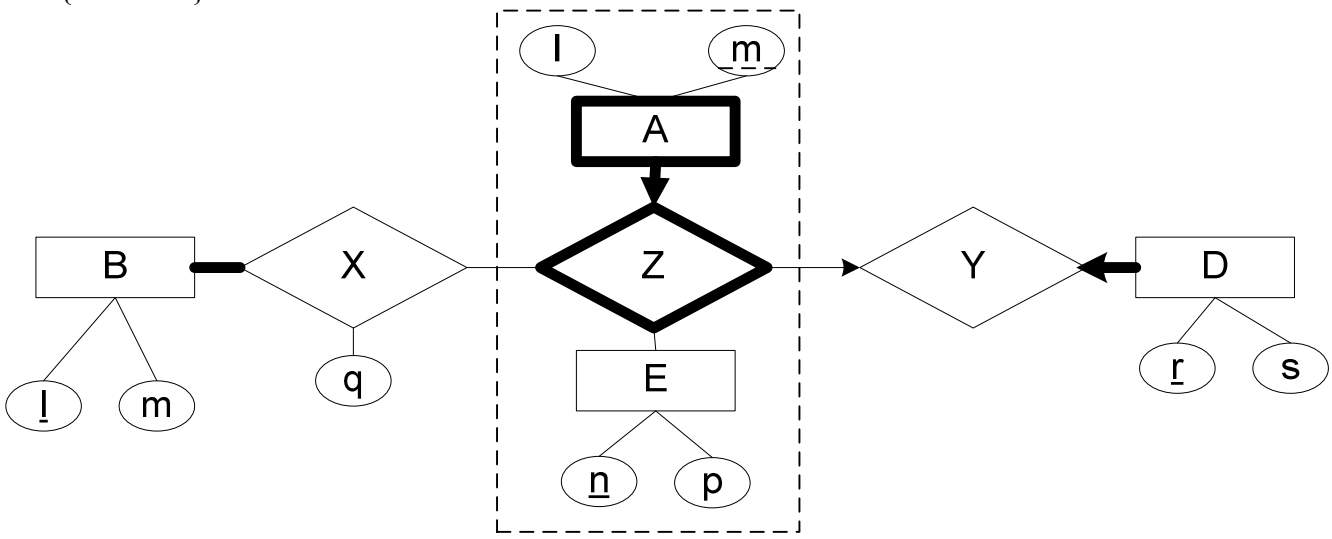
First we have to take the minimal cover. BD→A is redundant to D→A. AB→C is redundant to B→C. So the only functional dependencies to consider are D→A, B→C, and C→E. Note that because the cover only removes redundant functional dependencies, the original closures still holds. Start with D→A. D is not a key, so decompose: S1(A,D), S2(D,B,C,E). S1 is in BCNF since it is a two attribute relation. S2: B→C still holds, but B is not a key of S2, so decompose: S3(B,C), S4(B,D,E). S3 is in BCNF since it has only two attributes. S4 is not in BCNF since B→E holds in S4, but B is a key of S4. Decompose to S5(B,E), S6(B,D). All are two attribute relations, so all are in BCNF. At this point our answer set is S1(A,D), S3(B,C), S5(B,E), S6(B,D). Now, we consider if there are any functional dependencies that need to be added back in. D→A and B→C are both covered (S1 and S3 respectively). C→E is not. So we add in a new relation S5(C,E), brining our final answer to S1(A,D), S3(B,C), S5(B,E),S6(B,D),, S7(C,E)

3. {10 marks} Create an ER diagram for the following specification:

- A bank has a database with accounts.
- For each account it records the (unique) account number and the current balance.
- There are two types of accounts: chequing and savings. Savings accounts have an interest rate. Chequing accounts have a monthly fee.
- The database also has information about depositors --- their name, (unique) social-insurance number, and a single address.
- The bank stores, for each account, the depositor or depositors (in the case of joint accounts), that own the account.
- Each account must have at least one depositor.



4. {15 marks}



Transform the ER diagram into a relational schema using the methods discussed in class/the book. State any assumptions that you make – but your assumptions cannot contradict the facts given.

a. {12 marks} Give the SQL DDL necessary to create the relational schema. You do *not* have to include types for any attributes

Note that this problem is a modification of problem 4 on sample test 6.
First, determine the relations should be without any DDL. We start with the easy ones: E(n,p), B(l,m). Next we do the weak entity: AZ(m,n,l). X is many to many, so we have to include the keys of B and Z plus the attributes of X: X(l,m,n,q). Next we need Y. As mentioned on WebCT Vista, when doing 1:1 relationships, you want to pick either entity to combine with Y. Because D has a total participation constraint with Y, you want to choose D as the entity to combine, since that way you can chose to have AZ have a not null constraint, so get rid of your earlier D entity and replace it with DY(r,s,m,n) – and remember that you'll have to make m,n, not be null in the DDL.
Thus, the DDL is:

```
CREATE TABLE B(
l integer,
m integer,
primary key (l));
CREATE TABLE E(
n integer,
p integer
primary key (n));
```

```
CREATE TABLE DY(
r integer,
s integer,
m integer NOT NULL,
n integer NOT NULL,
primary key (r),
foreign key (m,n), references
        AZ(m,n)
CREATE TABLE AZ(
m integer,
n integer,
l integer,
primary key (m,n),
foreign key( n) references E);
```

```
CREATE TABLE X(
l integer,
m integer,
n integer,
q integer,
primary key (l,m,n),
foreign key (m,n) references AZ(m,n),
foreign key (l) references B);
```

b. {3 marks} Are there any constraints in the relational schema that cannot be modeled without using assertions? If so, which constraint(s)? If not, why not?

The constraint that B is total in X cannot be represented without assertions.