

Name: _____

Student ID: _____

CS 411a/433a/538a — Databases II
Midterm, Oct. 14, 2005
50 Minutes

Answer all questions on the exam page

No aids; no electronic devices.

The marks total 55

Question	Maximum	Your Mark
1	20	
2	20	
3	10	
4	5	
Total	55	

1. (20 marks) For each of the following, state whether the statement is **true** or **false**. If it is false, correct the statement without changing the underlined text. If the statement is true, do not write anything more, just indicate true.
 - (a) Inheritance in an object-oriented database involves the methods but not the attributes.
F: both the methods and the attributes
 - (b) This operation: $R \bowtie S$ is called a right outer join.
F: called a semi-join
 - (c) In a distributed database, the fragmentation schema describes where replicated copies of relations are stored.
F: describes what fragments have been defined.
 - (d) Name conflicts arise in a distributed database when multiple copies of a relation exist at more than one site.
F: in an OO database/system when there is multiple inheritance
 - (e) An entity in an ER diagram is represented by an object class in an object-oriented database.
T
 - (f) Objects nested within persistent objects should not be made persistent in an object-oriented database.
F: should be made persistent
 - (g) If an OO query language query is defined to query an arbitrary set of objects, and each query produces a set of objects, then the query language is closed.
T
 - (h) Persistence in a database means that the query execution keeps trying until the query finally executes.
F: means that the data remains on the disc until you access it again.
 - (i) Objects in an object-oriented database must have a user-defined value-based key.
F: may have a value-based key, but have a system-generated object ID
 - (j) Given a set S and a tuple T, S and T are shallow equal if they have the same number of elements and the members are pairwise identical.
F: a set T, not a tuple
 - (k) In object-oriented querying, some queries produce literals, and some retrieve whole objects from the database.
T
 - (l) In O₂, it is impossible to have dangling references.
T, in persistent objects. You could write code in O2C with dangling references. This question was not marked.
 - (m) In answering a query on a relation which has been fragmented horizontally, to reconstruct the original relation, the union operator is used.
T

2. (20 marks) Consider the following O₂ code:

```

Class LibraryItem public type
  tuple(LibID : string,
        DateAcquired : MyDate) end;
Class Book inherit LibraryItem public type
  tuple(Title : string,
        Author : string,
        YearPublished : integer,
        LoanPeriod : integer) end;
Class MyDate public type
  tuple(Day : integer,
        Month : integer,
        Year : integer) end;

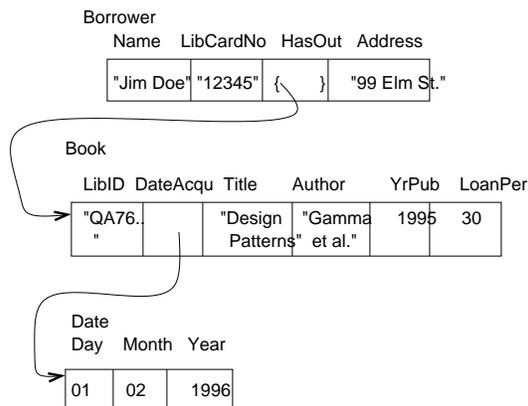
```

```

Class Borrower public type
  tuple(Name : string,
        LibCardNo: string,
        HasOut: unique set(Book),
        Address : string) end;
Class BookLoan public type
  tuple(WhichBook : Book,
        Who : Borrower,
        Date : MyDate) end;

```

(a) (12 marks) Show the AGGREGATION HIERARCHY for an instance of borrower where the borrower's name is "Jim Doe", their library card number is "12345", Jim Doe's address is 99 Elm St., and Jim has borrowed one book, whose title is "Design Patterns", with author "Gamma et al.", published in 1995, acquired on Feb. 1, 1996, with library card number "QA76.5.G000", and with a loan period of 30 days.



(b) (8 marks) List all the classes above whose instances contain a nested tuple-like object. In each case, say what class the nested tuple object is an instance of.

LibItem has a nested MyDate

Book inherits this MyDate

Borrower has a nested set of Book objects

Bookloan has a nested Book, Borrower, MyDate, and Book and Borrower have their nested tuples as above.

3. (10 marks) Consider the following relations for a relational database:

BOOKS(BookID, Title, Author, YearPub) primary key: {BookID}

BORROWERS(LibCardNo, Name, Address) primary key: {LibCardNo}

LOANS(BookID, LibCardNo, DueDate) primary key: {BookID, LibCardNo}

(a) (2 marks) Give the relational algebra expression to define the fragment of the BOOKS relation for books published before 1990. Call this fragment Frag1.

$\text{Frag1} < - \sigma_{\text{YearPub} < 1990}(\text{Books})$

(b) (1 mark) What kind of fragmentation is being defined in part (a)?

Horizontal Fragmentation or primary Horizontal Fragmentation

(c) (2 marks) Give the relational algebra expression for the fragment of the books relation containing BookID and Author information.

$\pi_{\text{BookID}, \text{Author}}(\text{Books})$

(d) (2 marks) Do the fragments in parts (a) and (c) represent a complete fragmentation? If so, how would you reconstruct the original relation? If not, why not?

Cannot reconstruct (so not a complete fragmentation). One is horizontal fragmentation, and one is vertical.

(e) (2 marks) Give the relational algebra expression for the fragment of the LOANS relation which will participate in the join with Frag1 in part (a).

$\text{Loans} \bowtie \text{Frag1}$

(f) (1 mark) What kind of fragmentation is being defined in part (e)?

Derived Horizontal Fragmentation

4. (5 marks) Answer **ONE** of the following (only the first one will be marked):
- (a) Give an example application where an object-oriented database would be a better choice than a relational database. Explain briefly why.
 - (b) Give an example application where a distributed relational database would be a better choice than a centralized relational database. Explain briefly why.
 - (c) Give an example of where comparing for identity would be used in an object-oriented database.
 - (d) Explain why it is sometimes necessary to declare classes to receive the answers to an O₂ query.