Name:_____

Student ID:_____

CS 411a/433a/538a — Databases II
Midterm, Oct. 18, 2006
50 Minutes

Answer all questions on the exam page

No aids; no electronic devices.

The marks total 55

Question	Maximum	Your Mark
1	25	
2	16	
3	9	
4	5	
Total	55	

1. (25 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) Object-oriented databases grew out of advanced ideas from the operating systems area.

   F, from ooprogramming or semantic data models1

   (b) The word "object-oriented" in object-oriented databases refers to the query language.

   F, the data model

   (c) To be considered a distributed database, a system must include more than one data model.

   F, must have data on more than one site

   (d) The semi-join operator in relational algebra is a fancy notation for right outer join.

   F, is a notation to help define derived horizontal fragments in distributed databases, or is an operator used in distributed databases

   (e) The conceptual schema is part of the software architecture of a database management system.

   F, part of the data architecture

   (f) A distributed database system is said to be heterogeneous if its component computer systems have different operating systems.

   F, if the component database systems are different

   (g) For horizontal fragmentation, we guarantee reconstruction by having 2 fragments defined by predicates that are the negation of one another.

   T

   (h) For vertical fragmentation, we use union to reconstruct the original relation.

   F, natural join

   (i) The entity and relationship in the ER model are examples of aggregation.

   T

   (j) Persistence by reachability means that all objects you want to reach are made persistent.

   F, means that all objects connected to a persisten anchor point are guaranteed to be persistent

   (k) With inheritance in an OO system, a subclass inherits methods but not attributes.

   F, inherits both attributes and methods

   (l) Closure in a query language means that every query runs to completion.

   F, means that the result of every query can be used as input to another query

   (m) If two object references compare "true" for identity, then they will also compare "true" for equality.

   T

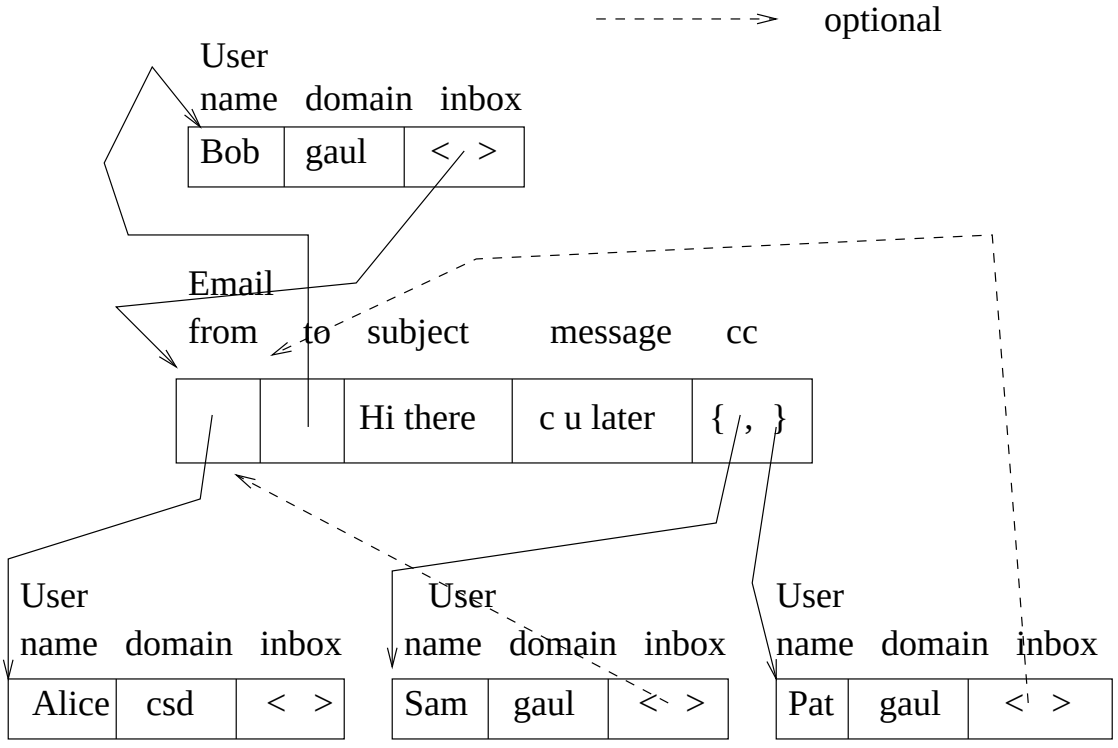
   (n) Path expressions are used only to see the top-level attributes of an object, in an OO query language.

   F, attributes at any level of nesting, also methods

2. (16 marks) Consider the following O_2 schema:

```
class User inherit Object public type
    tuple(name: string,
          domain: string,
          inbox: list(Email))
end;
class Email inherit Object public type
    tuple(from: User,
          to: User,
          subject: string,
          message: string,
          cc: unique set(User))
end;
```

(a) Show the AGGREGATION HIERARCHY for an instance of a User, whose name is Bob, domain is gaul, who has a single email message in his inbox, (which is obviously to Bob @ gaul), which is from Alice in domain csd, the subject of which is "Hi there", the message of which is "c u later?", and which has been cc'd to Sam at gaul and Pat at gaul. Any attribute values not mentioned can be assumed to be blank or null.



(b) What class above contains a set-valued attribute?

email

3. (9 marks) Consider the following relations for a relational database:

```
Messages(FromName, FromDomain, ToName, ToDomain, MessageID, Subject, Content)
       primary key: {MessageID}
EmailsCCd(CCName, CCDomain, MessageID}
       primary key: all attributes
```

   (a) Give the relational algebra expression for the fragment of the Messages relation where the attribute ToDomain has the value of "gaul".

   A $\leftarrow \sigma_{ToDomain="gaul"}$ (Messages)

   2 marks

   (b) What kind of fragmentation is being done in part (a)?

   horizontal

   1 mark

   (c) Give the relational algebra expression which goes along with your fragment in part (a) to guarantee completeness of the fragmentation.

   C $\leftarrow \sigma_{ToDomain\neq"gaul"}$ (Messages)

   1 mark, various forms of not taken

   (d) Give the relational algebra expression which reconstructs the Messages relation from your fragments in parts (a) and (c).

   A $\cup$ C

   1 mark

   (e) Give the relational algebra expression to produce that part of the EmailsCCd relation which will participate in the join with the fragment in part (a).

   EmailsCCd $\ltimes$ Messages

   2 marks

   (f) What is the fragmentation in part (e) called?

   derived horizontal fragmentation

   2 marks

4. (5 marks) Answer **ONE** of the following (only the first one will be marked):

   (a) Explain the reason for viewing Distribution, Heterogeneity and Autonomy as orthogonal concepts on separate axes in a diagram.

   (b) Why, in distributed databases, do designers bother with fragmentation?

   (c) Give 2 ways in which dealing with an object-oriented database differs from programming in an object-oriented programming language.

   (d) Explain why doing operations like relational algebra projection presents a problem for the implementors of object-oriented database systems to solve.