

# Database Management System

## Qualification Exam

December 9, 2004

NAME:

**Note:** 80 points are required for a clear pass.

1. (40 points) Consider the following enterprise, which includes books, authors and publishers. Authors are people with normal attributes, like name, date of birth, etc., but in addition they wrote one or more books. A book has the usual attributes, such as title, ISBN, publication date, etc. Publishers are companies that publish books. They have an address, phone numbers (typically more than one), name, etc. A book can be written by more than one author, but it can be published by only one publisher. Books do not write themselves and do not publish themselves (hint: these are constraints). An author can write more than one book and to be called an author one, of course, has to write at least one book.

(a) Represent the above as an E-R diagram; include all relevant constraints.

**Note.** If you do not follow the notation used in the book by Kifer, Bernstein, and Lewis, please specify the convention that you use.

(b) Translate the above diagram into the relational model by supplying the appropriate CREATE TABLE statements. Note that ISBN is a 10-digit string ( which can have leading zeros), sex can have only two values, 'M' or 'F', and a phone number is a 10 digit number that never starts with a zero. Specify these as domains. Specify all the key and foreign key constraints. Try to preserve as many participation constraints as possible. List all the participation constraints that are present in the E-R diagram, but not in its translation to SQL.

2. (30 points) Consider the following database schema, where the keys are underlined:

```
Flight(FltNumber, From, To, DepartureDateTime, ArrivalDateTime)
Ticket(Id, TravelAgent, Passenger)
Itinerary(TicketNum, FltNumber)
```

The table `Flight` contains information about each flight. Each `flight` has an origin (`From`), a destination (`To`), its departure date and time (`DepartureDateTime`), and its arrival date and time (`ArrivalDateTime`).

The table `Ticket` contains the sale information: which travel agent (`TravelAgent`) sales the ticket (`Id`) to the passenger (`Passenger`).

The table `Itinerary` relates the ticket and the flight tables: which ticket is for which flight.

- (a) Use both the relational algebra and SQL to answer the following query: Find all possible trips from LA to NYC, which consist of two connecting flights. (Flights connect if flight 1 arrives at the airport from where flight 2 leaves and the arrival time of flight 1 is less than the departure time of flight 2. You can use  $<$  to compare the times.)
  - (b) Use SQL only to answer the following query: Find the travel agents who issued more than a half of all tickets originating in LA.
  - (c) Use relational algebra only to answer the following query: Find all the airports with more than 2 outgoing flights each day (you can use the function `date(X)` to find the date of from `X`).
- 3.** (15 points) Assume a relation schema, `R`, that has attributes `A`, `B`, `C`, `D`, and `E`. The only functional dependencies (FD's) are  $AB \rightarrow CDE$ ,  $D \rightarrow E$ , and  $CD \rightarrow B$ .
- (a) What is a key of `R`?
  - (b) What does the FD  $D \rightarrow E$  mean?
- 4.** (15 points) Transaction system in DBMS must satisfy the ACID properties. Name the four properties indicated by this acronym. Demonstrate the necessity of two out of the about four properties using the database schema in Question 2 using an example.