A114 Midterm

1. (20 points) Briefly answer the following questions.

(a) What is a foreign key? Specify why knowing the foreign keys in a database supports database integrity. (You can use an example to illustrate your answer.)

(b) Consider the following two transactions named T1 and T2, respectively.

\begin{tabular}{c|c}

\hline
T1 & T2 \\
\hline
read(A) & read(A) \\
A := A+1 & A := A-1 \\
write(A) & write(A) \\
\hline
\end{tabular}

Assume that the initial value of the data object A on disk is 0.

i. Specify an interleaving of the operations of T1 and T2 such that the update of A by T1 is lost. What is the final value of A?

ii. Specify an interleaving of the operations of T1 and T2 such that neither the update of A by T1 nor the update of A by T2 are lost. What is the final value of A?

2. (30 points) Assume that we wish to maintain a database that contains the flight information of an airline. This database maintains information about flights, pilots, and assignments of pilots to flights. Each flight has a unique flight number, a departure city, a destination city, a departure time, and an arrival time. Each pilot has a unique company ID, a name, and an experience level. Pilots are assigned to fly certain flights on particular days of the year.

(a) Using this description of the database, identify the data objects and a relationship that need to be maintained in the database.

(b) For each data object specify its relevant attributes and identify its primary key.

(c) For the relationship, determine its attribute(s) and identify its foreign keys.
(d) Draw an entity-relationship diagram that conceptually represents this situation. Identify the type of the relationship in your diagram.

(e) Use relational tables to represent the data objects and relationships with their attributes and constraints.

3. (30 points) Consider the following table. Each row in such a table specifies a client (ClientSS#) and a food item (FoodItemName), the price of the food item, and the date (Date) when the client bought the food item.

<table>
<thead>
<tr>
<th>ClientSS#</th>
<th>FoodItemName</th>
<th>Price</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Consider the following queries. For each of the queries (1) identify whether its is a filtering query (horizontal, vertical, or both) or an aggregate query; (2) specify the query using the Query Construction Method.

(a) List the social security numbers of all clients.

(b) Specify the name and price of all food items bought by client 999-99-9999 on December 1, 1998.

(c) Find the amount paid for food item milk by all clients.

(d) For each client, find the amount of money spent by that client between January 1, 1999 and January 31, 1999.