Concordia University
Dept. of Computer Science and Software Engineering
COMP 353 – Databases
Winter 2023
Assignment 2

Submission through Moodle is due by Monday, Feb. 20th at 23:55

Maximum Points: 80.

1. [15 Points] Consider the following information about a database (DB) application that stores data about employees E and the departments D they work in, employee's immediate supervisor S, and the subordinates of S (employees working under S). The information on employees E include employee's name (EName), ID (EID), SIN, date of birth (DoB), and the department ID (DID) in which an employee works. For each department, the database records its location and manager. The database includes also information about the supervisor-subordinate relationships.

   (a) Use an E/R diagram to present the conceptual database design of this application.

   (b) Convert the diagram in (a) into a relational model and show the result.

   (c) For each relation schema, in (b), identify the key attribute(s), and alternate keys, if any. State any reasonable assumptions made to justify your answer in (c).

2. [15 Points] Consider an E/R diagram which includes the entity sets F={c,d}, G={e}, and H={g,h}; the key attributes are underlined. The diagram also includes a relationship S={f} between G and H, with f as its own attribute. There is also a weak entity set E={a,b} to which G is connected via an "isa" relationship. Finally, there is a many-to-one weak relationship R from E to F with a rounded arrow entering F. Convert this diagram into a relational database schema using the following approaches, and in each case show the relations obtained and underline the key attributes.

   (a) the E/R style

   (b) the OO approach

   (c) the null approach.

3. Design a genealogy database that includes one entity set only, called People. The database should contain all the information that exists about each individual, including their names, and their mother, father, and children's names.

   (a) [9 Points] Present your conceptual database design as an E/R diagram.

   (b) [6 Points] Following an E/R style, convert your E/R diagram into a relational database schema and show the result.

4. [15 Points] Modify your design of the database People in the previous question to include additional information about "types of people such as Females, Males, and being parents, etc. Use subclasses of people to present the "types" of people.

5. [20 Points] An E/R diagram includes a 3-way relationship R that connects and relates the entity sets E1, E2, and E3. Consider the following separate cases we may have about the type of connections between R and each of these entity sets.

   (a) The connection from R to E1 is a *sharp* arrow; the other two are simple lines.

   (b) The connections from R to both E1 and E2 are *sharp* arrows.

   (c) The connection from R to each one of the 3 entity sets is a sharp arrow.

   (d) The connection from R to E1 is a *sharp* arrow and from R to E2 is a *round* arrow.

   In each case, we convert the diagram into a relational database. Let e1, e2, and e3 respectively be the number of tuples in some *valid* instances of E1, E2, and E3. In each case, determine the range of values of $|R|$, or the exact value of $|R|$ if exists, in terms of the values e1, e2, and e3. (Note: $|R|$ is called the *size* or *cardinality* of relation R.)