

**School:** Computer Science  
**Institution:** University of Windsor  
**Term:** Winter 2024  
**Course:** Comp 3150 : Database Management Systems  
**Instructor:** Dr. C. I. Ezeife  
**Assignment #1 :** Total: 50 marks  
**Handed Out:** Thurs., Jan. 18, 2024; **Due:** Thurs., Feb. 1, 2024

---

**Objective of Assignment:** To test on knowledge of database concepts, its 3-level architecture necessary for designing databases and their applications as well as practice on use of entity-relationship (ER) model to design databases.

**Scope:** Assignment covers materials from Chapters 1, 2 and 3 of book discussed in class.

**Electronic Assignment Submission:** Done through <https://brightspace.uwindsor.ca/d2l/login>

**Marking Scheme :** The mark for each of the questions is indicated beside each question.

**Academic Integrity Statement:** Remember to submit only work that is yours and include the following confidentiality agreement and statement at the beginning of your assignment.

---

#### **CONFIDENTIALITY AGREEMENT & STATEMENT OF HONESTY**

I confirm that I will keep the content of this assignment/examination confidential.

I confirm that I have not received any unauthorized assistance in preparing for or doing this assignment/examination. I confirm knowing that a mark of 0 may be assigned for copied work.

HG

Henok Gebremichael

Student Signature

Student Name (please print)

110122007

2024-02-01

Student I.D. Number

Date

---

**Marking Scheme :** The mark for each question and sub question is shown with the question below. Place your solutions in tables provided for answers where possible.

#### **For office Use only**

Question	Mark
1	/10
2	/10
3	/10
4	/20
Total	/50



## CHAPTER 1: DATABASES AND DATABASE USERS

1. Given the simple Customer-Subscribesto\_phonecompany database schema which contains three files describing information about telephone company subscribers as follows, answer the following questions with regards to this database.

(Total for que 1 is 10 marks)

Customer (SSN: integer, CName: string, Caddress: string, balance: real)

Subscribesto (SSN: integer, CompId: string, phonetype: string, month: string, billamt: real)

PhoneCompany (CompId: string, CompName: string, Address: string, Numproducts:integer)

Note : SSN, CName, Caddress and balance stand for the customer's social security number, name, address and phone bill balance owing respectively. Also, CompId, phonetype, month and billamt stand for the phone company identifier, the phone type the customer subscribes to, the month of subscription and the phone bill amount for that month. The rest of the attributes are for the company's name, their address and the number of phone products they provide to customers.

- i) Create a valid instance of this database containing values for its records with at least four records in each file. (3 marks)
- ii) Provide 2 informal English queries (not SQL) for this database with their answers. Each query should involve (use) at least 2 of the files in the database and your answer should indicate the files (e.g., Customer, Subscribesto) needed to answer each query and specify what fields (attributes) are being retrieved as the result (e.g., CName, balance). Please, provide your solution in the 3 column table below. (4 marks)
- iii) Specify at least 3 relationships (one for each of the 3 database files) among the records of the database. For each file (e.g., Customer), list any relationships it has with the other files through its fields (or attributes) (e.g., SSN). Provide your solution using the table below. (3 marks)

Solution : (10 marks for que 1)

Query	Answer	Files involved
1. Create a valid instance of this database containing values for its records with at least four records in each file.	An instance of the Customer-Subscribesto_phonecompany database is: (308179207, John Smith, 529 University Avenue, 25.00) (308378101, Sarah James, 320 University Avenue, 15.00) (308501499, Karmen Roy, 453 University Avenue, 30.00) (308708806, Ali Ahmad, 433 University Avenue, 20.00)	Customer

<p>(3 marks)</p>	<p>An instance of the Subscribesto-Subscribesto_phonecompany database is:          (308179207, ROG, Cellphone, April, 45.00)          (308378101, TEL, Cellphone, May, 40.00)          (308501499, BEL, Telephone, July, 66.00)          (308708806, FID, Cellphone, January 35.00)</p> <p>An instance of the PhoneCompany-Subscribesto_phonecompany database is:          (ROG, Rogers, 44 University Avenue, 6)          (TEL, Telus, 31 University Avenue, 4)          (BEL, Bell, 35 University Avenue, 3)          (FID, Fido, 40 University Avenue, 4)</p>	<p>Subscribesto</p> <p>PhoneCompany</p>
<p>2. Provide 2 informal English (not SQL) queries</p>	<p>Queries are:</p>	

<p>from this database with their answers. Each query should involve (use) at least 2 of the files in the database and your answer should indicate the files (e.g., Customer, Subscribesto) needed to answer each query and specify what fields (attributes) are being retrieved as the result (e.g., CName, balance). (4 marks)</p>	<ol style="list-style-type: none"> <li>1. Retrieve payment history – list all payments for customer ‘Sarah James’ Fields being retrieved: Month, Billamt</li> <li>2. Retrieve Customer Information for Phone Company 'Rogers': Fields Being Retrieved: CName, Phonetype</li> </ol> <p>Result of query</p> <ol style="list-style-type: none"> <li>i. Payment history for Sarah James: May: \$40.00</li> <li>ii. Customers and phone types for Rogers: John Doe - Cellphone</li> </ol>	<p>(Customer, Subscribesto)</p> <p>(Customer, Subscribesto, PhoneCompany)</p>
<p>3. Specify at least 3 relationships (one for each of the 3 database files) among the records of the database. For each file (e.g., Customer), list any relationships it has with the other files through its fields (e.g., SSN). (3 marks)</p>	<p>Customer has a billing history in Subscribesto Relationship fields: (SSN)</p> <p>Subscribesto is a subscriber to PhoneCompany Relationship fields: (Compld)</p> <p>PhoneCompany is referenced by Subscribesto Relationship fields: (Compld)</p>	<p>Customer</p> <p>Subscribesto</p> <p>PhoneCompany</p>

2. Recall that a database has many types of users, each of whom may require a different view of the database. For example, Customer-Subscribesto\_phonecompany database schema of question 1 may be accessing and printing the details and balances owing of each customer frequently and thus a view for this user is created. Another view for this database is checking each uncleared customer's monthly subscription phone bill amounts so they can be added to the balance owing.

(Total for que 2 is 10 marks)

- i) Using this Customer-Subscribesto\_phonecompany database, give 2 additional views that may be needed by other user groups for the database. (5 marks)

Solution : (5 marks for que 2i)

- (a) Retrieve the current phone type subscription for each customer and make updates based on customer requests.
- (b) Generate a list of customers who have maintained subscriptions for an extended period and calculate their subscription duration. This allows the company to make targeted promotional offers for long-term subscribers.

- ii) Give 5 examples of integrity constraints that you think can apply to the Customer-Subscribesto\_phonecompany database of question 1. (5 marks)

Solution : (5 marks for que 2ii)

- GA : any 5 of the following can be used.**
- (a) Primary Key Constraint: The combination of (SSN, Compld, Month) in Subscribesto must uniquely identify each subscription
- (b) Foreign Key Constraint: The Compld in Subscribesto must reference a valid Compld in the PhoneCompany table.
- (c) Entity Integrity Constraint: Each record in the Customer table must have a unique SSN.
- (d) Semantic Constraint: The Subscribesto table must only include valid phone types offered by PhoneCompany
- (e) Unique Constraint: The combination of (CompName, Address) in PhoneCompany must be unique, ensuring no duplicate records with the same company name and address.

## CHAPTER 2: DATABASE SYSTEM CONCEPTS AND ARCHITECTURE

3.a. Design a simple database schema with 4 or less files for a University database system indicating all applicable constraints and information. In this University, students have majors and take courses which they receive grades for. These grades are used to compute the student grade point average at any point in time. As the database designer, you should decide the necessary attributes for students and courses. Also, show a sample database state for the database.

(5 marks for a)

b. Using your database, describe the differences between logical and physical data independence.

(5 marks for b)

(Total for que 3 is 10 marks)

Question	Answers
a. Design a simple database schema with 4 or less files for a University database system indicating all applicable constraints and information. Also, show a sample database state for the database. (5 marks)	<p>Student (StudentID: integer, StudName: string, Major: string, GPA: real)</p> <p>Course (CourseID: integer, CourseName: string)</p> <p>Grade (StudentID: integer, CourseID: integer, Grade: real)</p> <p>Constraints:</p> <p>Primary Key Constraint on CourseID. Each course must have a unique identifier.</p> <p>Foreign Key Constraint on StudentID: attribute StudentID in the Grade file must reference an existing student in the Student file.</p> <p>Domain Constraint on GPA and Grade: the value of the attributes must be between 0 and 100.</p> <p>Student (StudentID: integer, StudName: string, Major: string, GPA: real)</p> <p>(101, Jordan James, Computer Science, 84)</p> <p>(102, Karl Smith, Biology, 73)</p> <p>(103, Mike Johnson, Computer Science, 92)</p> <p>Course (CourseID: integer, CourseName: string)</p> <p>(201, Database Management)</p> <p>(202, Introduction to Biology)</p> <p>(203, Systems Programming)</p> <p>Grade (StudentID: integer, CourseID: integer, Grade: real)</p> <p>(101, 201, 82)</p> <p>(101, 202, 85)</p> <p>(102, 201, 72)</p> <p>(103, 203, 96)</p>

b. Using your database, describe the differences between logical and physical data independence	<p>Logical data independence:</p> <p>i. Adding a new field to the Student table without requiring changes to existing queries. (e.g., adding a "Minor" field) This should not affect how existing files retrieve or update data.</p> <p>ii. Physical data independence: Changing the file storage format or moving the file to a different location on disk without altering how queries or file updates interact with the file.</p>

### CHAPTER 3: DATA MODELING USING THE ENTITY-RELATIONSHIP (ER) MODEL

4. Windsor Records company has hired you as a database designer. One of your first jobs is to design a conceptual schema for Windsor records and draw an ER diagram for your schema using the following information. The database stores information about musicians who perform on Windsor Records albums and also stores other company data.

- i. Each Windsor Records musician has a unique social security number (SSN), a name, an address and a phone number.
- ii. Each instrument used in recorded songs has a unique name (e.g., guitar, flute, drum, etc.) and a musical key (e.g., C, B-flat, E-flat).
- iii. Each album on their label has a unique album identifier, an album title, a copyright date, a format (eg. CD, vinyl, MP3, etc.).



- iv. Each song recorded has a unique song title and an author.
- v. Each musician may play several instruments, and a given instrument may be played by several musicians.
- vi. Each album has a number of songs on it, but no song may appear on more than one album.
- vii. Each song is performed by one or more musicians, and a musician may perform a number of songs.
- viii. Each album has exactly one musician who acts as its producer. A musician may produce several albums.

Indicate all key and cardinality constraints and any assumptions that you make.

Design the Entity-Relationship (ER) model diagram for this database.

(Total for que 4 is 20 marks)

(Note : 10 marks for correct entity and relationship identifications with their attributes in the ER diagram. It is 0 with no ER diagram presented).

(5 for entities and 5 for relationships, 5 marks for correct constraints interpretations on the edge labels, 5 marks for correct verbal interpretations of the database being represented by the ER digram through use of correct symbols etc.).

Hint : Present the conceptual design first, showing (1) all the entities and their attributes, (2) all the relationships and their attributes, (3) all the constraints before drawing your ER.

(Total for que 4 is 20 marks) Conceptual information in table and ER diagram next

Specific Requeieement/Constraint Type	Requirements and Constraints for the ER diagram
Entities and attributes (5 marks) in ER	<p>Musician(SSN: integer, MName: string, MAddress: string, MPhone: integer)</p> <p>Instrument (InstrumentName: string, MusicalKey: string)</p> <p>Album (AlbumID: integer, AlbumTitle: string, CopyrightDate: date, Format: string, ProducerSSN: integer)</p> <p>Album (AlbumID: integer, AlbumTitle: string, CopyrightDate: date, Format: string, ProducerSSN: integer)</p> <p>Song (SongTitle: string, Author: string)</p> <p>AlbumTrack (AlbumID: integer, SongTitle: string)</p> <p>Performance (SSN: integer, SongTitle: string)</p>
Relationships and attributes (5 marks) in ER	<p>PlaysInstrument (SSN: integer, InstrumentName: string)</p> <p>ProducesAlbum (SSN: integer, AlbumID: integer)</p> <p>AlbumTrack (AlbumID: integer, SongTitle: string)</p>

Interpretation of each of the constraints represented on the edge labels (5 marks) in ER	<p>Each album has exactly one producer (Musician), and a musician may produce several albums.</p> <p>A Musician may play several instruments, and each instrument may be played by several musicians.</p> <p>Primary key constraint representing that each song may appear on only one album.</p>
Correct use of symbols in ER, etc (5 marks)	Show correct use of symbols for attributes, relationships, etc.

**ER Diagram goes next :**

You may attach a scanned copy of your hand-drawn ER diagram here. You can also draw it digitally if possible and attach. Note that in the ER diagram, the foreign key attributes that are part of the relationship schemas are not explicitly listed with the relationship but inherited from the entity the relationships are connected to.

The ER model Diagram for Windsor Records company database of Question 3 of Assignment 1.