METRO STATE UNIVERSITY
ICS 311 Database Management Systems
Summer 2023
Final Exam

Date: 8/3/23
Duration: 180 minutes
Points: 120

Cindy Chen

Name: _____

A) <u>**TRUE/FALSE**</u> **(15 Points)**

1) The number in which tuples appears in a relation is relevant.
   T-------------F

2) Most widely used structure for recording database modifications is called:
   Scheduling
   Buffering
   Log
   Blocking

3) Process of database in which entity-relationship model is widely used is said to be:
   Testing
   Implementation
   Retrieval
   Design

4) A trigger is a statement that is executed automatically by the system as a side effect of a modification to the database. T---F

5) Once a transaction commits, it will not be undone, even if a crash occurs very soon. T----- F

6) If a transaction is about to commit and a schema-level integrity constraint is violated, then the transaction will be aborted. T------------F

7) If we only allow serial executions of transactions, then the ACID properties are guaranteed.

T------------F

8) One weakness of triggers is that they can only be activated after an update/insert/delete, not before. T------------F

9) Which of the following gives a logical structure of the database graphically?
Entity-relationship diagram
Entity diagram
Database diagram
Architectural representation

10) The entity relationship set is represented in E-R diagram as:
Double diamonds
Undivided rectangles
Dashed lines
Diamond

11) The Rectangles divided into two parts represents
Entity set
Relationship set
Attributes of a relationship set
Primary key

12) Consider a directed line (->) from the relationship set advisor to both entity sets instructor and student. This indicates _____ cardinality

One to many
One to one
Many to many
Many to one

13) We indicate roles in E-R diagrams by labeling the lines that connect _____ to _____
 Diamond , diamond
Rectangle, diamond
Rectangle, rectangle

Diamond, rectangle

14) An entity set that does not have sufficient attributes to form a primary key is termed a _____
Strong entity set
Variant set
Weak entity set
Variable set

15) A collection of facts and figures is known to be as
Data
Database
Sequenced data
Structured data

B)   **<u>SHORT ANSWERS</u>   (30 Points)**

1) What is the order of execution of the following query:

```
Insert into A
select ID, name
from B
where  name = 'Joe';
```

FROM

SELECT

The select statement would be executed first and the data retrieved from it will be inserted into A

2) Write an SQL Query to find name of employee from Employees table whose name start with 'M'. Use EmpName as column name.

Select EmpName from Employees where EmpName like 'M%';

3) Explain the following SQL expression:

```
SELECT * FROM Customers
WHERE City LIKE '%es%';
```

List all information of customers from the customers table where the customer's city name contains 'es' between other letters.

4) List two reasons why we may choose to define a view.

- simplify database structure

- Allow users to access data without fully granting the access to the database

5) Are views separate copies of the data? Explain.

- No, views are separate views of the data, not separate copies of the identical data. The view itself is saved in the database, can be seen as a "shortcut" to SQL queries.

6) When is it preferable to use a dense index rather than a sparse index? Explain your answer.

- when the file isn't sorted in the index field. Because it allows the database engine to search each record of the index and go directly into the data table, as compared to having to get all databases and scan through. It needs less memory and executes faster.

7) What is the difference between a clustering index and a secondary index?

- clustering index refers to the search key defined in the sequential order of the file, also searches being defined as the primary key. Can also determine the physical order of data in a table
- secondary index are index entry for all search-key values, and a pointer to every file record. Doesn't affect eat physical order of the data

8) Explain why stable storage cannot be implemented.
- because all storage devices are made of hardware, and all hardware is vulnerable to device failures, doesn't survive system crashes

9) What benefit does strict two-phase locking provide? What disadvantages result?

- provides cascade less schedules, easier recovery

- Results in decreased concurrency

10) Under what conditions is it less expensive to avoid deadlock than to allow deadlocks to occur and then to detect them?

- when the consequences of aborting is more serious, or if there are high contention and high probability of deadlock as a result

11) During its execution, a transaction passes through several states, until it finally commits or aborts. List all possible sequences of states through which a transaction may pass. Explain why each state transition may occur.

- active to failed to aborted
- Active to partly committed to aborted
- Active to partly committed to committed

12) List two major problems with processing update operations expressed in terms of view.

- ambiguity in updates

- Limited update abilities

C) <u>**ER DIAGRAM**</u> **(30 Points)**

Part 1 --- 15 Points

In a university database we have information about professors (with SSN), courses (with courseid). Professors teach courses. Between these two items, there is Teaches relationship.

Professors can teach the same course in several semesters, and each offering must be recorded.

a) Draw an ER diagram for this specification.
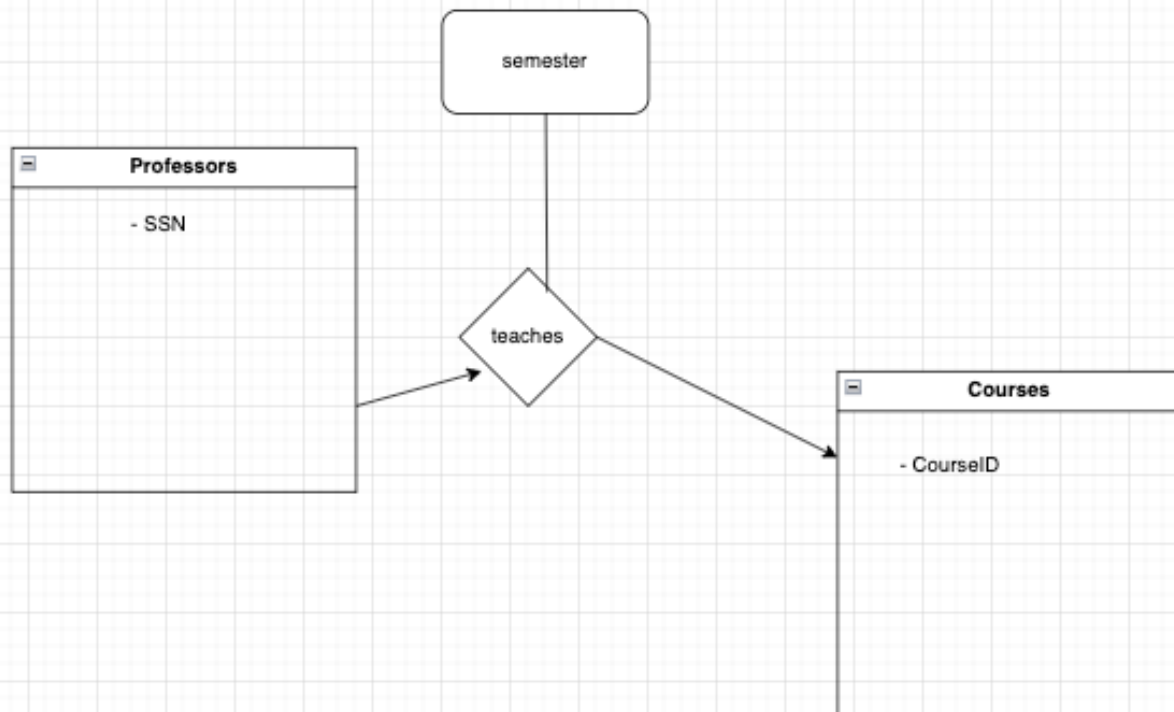
b) Consider the following specification and the following ER diagram and state if the given diagram matches the specification given below. If your answer is "No." Explain the problem.

Specification: Professors can teach the same course only once in a specific semester.
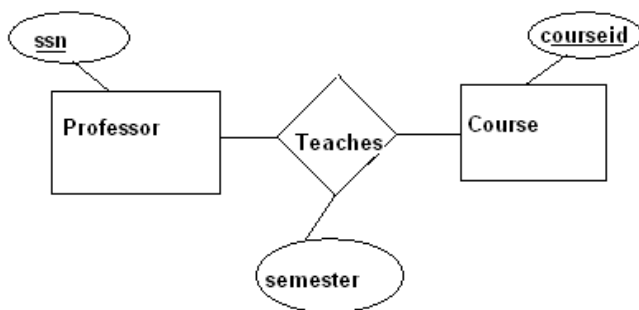
Yes, it matches

c) For the following ER diagram specify the relationship between the entities Professor and Course.
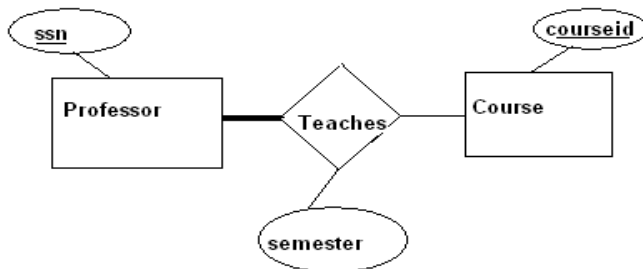
- relationship between Professor and Course is many to many, one course can be taught by more than one professor.

Part 2 (15 pts.)

Consider the relation instance for the Enroll(stuNo, stuName, Gpa, Hours) relation.

stuNo	stuName	Gpa	Hours
111	Ali	3.00	115
222	Veli	3.20	100
333	Hasan	4.00	110
444	Huseyin	2.00	128
555	Ahmet	4.00	90
666	Fatma	2.50	110

a) What will be displayed by the following query? Explain the purpose of the query.

```
SELECT   x.stuName, y.stuName
    FROM        Enroll x, Enroll y
    WHERE       x.Hours = y.Hours
```

Ali Ali

Veli Veli

Fatma Hatma
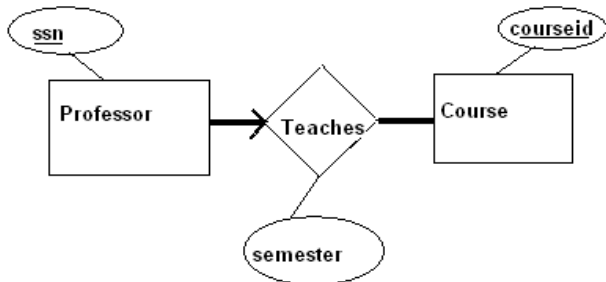
Hasan Hasan

Huseyin Hüseyin

Ahmet Ahmet

Fatma Fatma

Hasan Fatma

b) Write the CREATE TABLE SQL statement for the above relation.

CREATE TABLE Enroll (

  id INT NOT NULL AUTO_INCREMENT PRIMARY KEY,

  stuNo INT,

  stuName VARCHAR(255),

  Gpa FLOAT,

  Hours INT

);

c) For the following ER diagram specify the relationship between the entities Professor and Course.

- Many to one

D) **DATABASE DESIGN AND ER DIAGRAM (25 Points)**

Consider the following relational database that represents, books, publishers, and books published by publishers.

books

BNO	Title	Author	Date	Edition
231	The Soul of a New Machine	Tracy Kidder	1981	1
77	Programming Pearls	Jon Bentley	2000	2
23	Programming Pearls	Jon Bentley	1981	1
2	Tess of the d'Urbevilles	Thomas Hardy	1850	1

publishers

PNO	Publisher	City	Web Site
1	Back Bay Books	Boston	backbay.com
2	Addison Wesley	New York	addisonwesley.com
3	Modern Library	London	randomhouse.com
4	Penguin	New York	penguin.com

publishes

PNO	BNO	Pages	Copyright
1	231	293	1981
2	77	235	2001
2	23	200	1980
3	2	565	2001

| 4 | 2 | 540 | 1990 |

- If a book **b** is published by publisher **p** then **b** is in the **books** relation, **p** is in the **publishers** relation, and a row is added to the **publishes** relation.
- The date in the **books** relation represents the year when the book was originally issued.
- The date in the **publishes** table represents the copyright date when that particular publisher issued it.
- BNO numbers are unique book identifiers (similar to an ISBN number)
- PNO (publisher numbers) are unique publisher identifiers.

Part 1   (10 points)

1. Does this database schema allow for a book to have more than one publisher? Explain why or why not using an example.

- yes, there are 2 same books in the publishes entity

2. Does this database schema allow for a book to be currently out of print (not currently being published)? Explain why or why not using an example.

    - yes, it won't appear in the publishes entity

3. List three super keys of the *books* relation.

    - BNO, Author

    - BNO, Title

    - BNO, Date

4. List *all* candidate keys of the *books* relation.

- BNO

5. List all of the candidate keys of the *publishes* relation.

- PNO, BNO

Part II -   (15 Points)

1. Write an SQL expression that lists all titles by Jon Bentley.

   Select Title from books where Author = 'Jon Bentley';

2. Write an SQL expression that evaluates the union of the author and publisher attributes.

   - select Author from books union select Publisher from publishers;

3. Write an SQL expression that computes the set difference of the date and copyright attributes, *date - copyright*.

   - select distinct date from book where Date not in (select Copyright from publishes);

4. Write an SQL expression that computes the set intersection of the date and copyright attributes.

   - select distinct Date from books where Date in (select Copyright from publishes);

5. Write an SQL expression that lists each book with its publisher. The resulting table should have attributes title, author, and publisher.

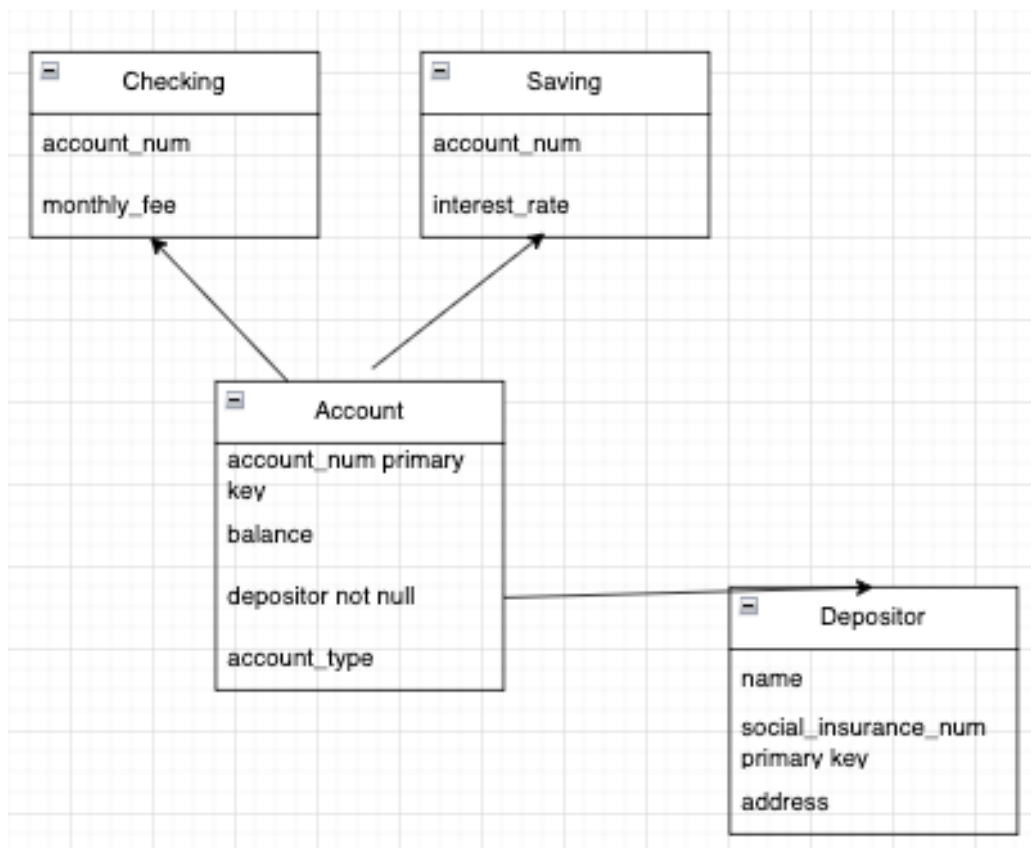   - select Title, Author, Publisher from books inner join publishers inner join publishes using (bno, pno);

E) **DATABASE DESIGN, ER DIAGRAM AND SQL** (20 Points)

Part 1 - 10 Points

Create an ER diagram for the following specification:

A bank has a database with accounts.

• For each account it records the (unique) account number and the current balance.

• There are two types of accounts: checking and savings. Savings accounts have an interest rate. Checking accounts have a monthly fee.

• The database also has information about depositors --- their name, (unique) social-insurance number, and a single address.

• The bank stores, for each account, the depositor or depositors (in the case of joint accounts), that own the account.

• Each account must have at least one depositor.

```
┌─────────────────────┐        ┌─────────────────────┐
│ ▣   Checking         │        │ ▣   Saving          │
├─────────────────────┤        ├─────────────────────┤
│ account_num         │        │ account_num         │
│ monthly_fee         │        │ interest_rate       │
└─────────────────────┘        └─────────────────────┘
           ▲                              ▲
            \                            /
             \                          /
              \                        /
        ┌──────────────────────┐
        │ ▣    Account          │
        ├──────────────────────┤
        │ account_num primary   │
        │ key                   │
        │ balance               │
        │ depositor not null    │──────────┐
        │ account_type          │   ┌──────────────────────┐
        └──────────────────────┘   │ ▣    Depositor        │
                                    ├──────────────────────┤
                                    │ name                 │
                                    │ social_insurance_num │
                                    │ primary key          │
                                    │ address              │
                                    └──────────────────────┘
```

Part 2 – 10 points

Consider the following database instance.
Table name: **Students** Primary key: **sid**

Sid	sname
1	Monica
2	Chandler
3	Mary
4	Nina

Table name: **Courses** Primary key: **cid**

cid	cname
1	Database
2	Compiler

Table name: **Register** Primary key: sid,cid
Foreign key: sid references Students(sid)
Foreign key: cid references Courses(cid)

sid	cid
1	2
2	2

For each of the following statements, show whether the statement is correctly executed or not (**assume that the statements are executed in order, which means that if a statement is correctly executed, its effect is reflected in the following statement**). If you say the statement is not executed, explain why.

a. INSERT INTO Students VALUES (3, 'Rick');

     - not executed, because there is already a student with Sid with value 3, due to entity integrity

b. INSERT INTO Students VALUES (6, 'Rick');
- correctly executed

c. INSERT INTO Register VALUES (1, 5);

- not executed, there is no course with cid of value 5, due to entity integrity

d. INSERT INTO Courses VALUES (5, 'Systems');

- correctly executes

e. INSERT INTO Register VALUES (1, 5);

- correctly executes