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Relational data model exercise

Total points: 10

1. (5 pts.) Consider the following ORDER PROCESSING database schema. Underline the primary keys and draw an arrow from the foreign key to its parent relation.

   CUSTOMER (Cust#, Cname, City)

   ORDER (Order#, Odate, Cust#, Ord_Amt)

   ORDER_ITEM (Order#, Item#, Qty)

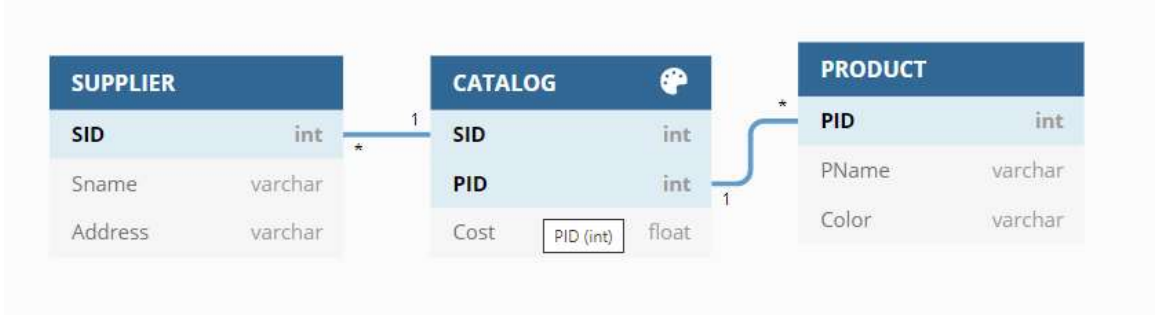
   ITEM (Item#, Unit_price)

   SHIPMENT (Order#, Warehouse#, Ship_date)

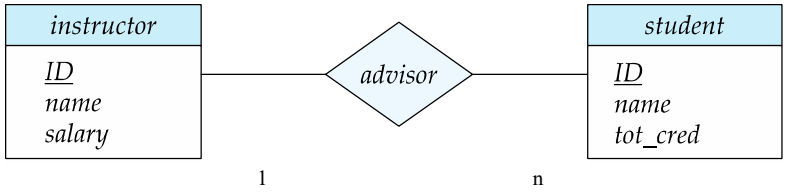
   WAREHOUSE (Warehouse#, City)

2. (2 pts.) Consider the following WOODWORK database schema. Primary keys are underlined and foreign keys are *italicized*.
   SUPPLIER (SID, SName, Address)
   PRODUCT (PID, PName, Color)
   CATALOG (*SID*, *PID*, Cost)

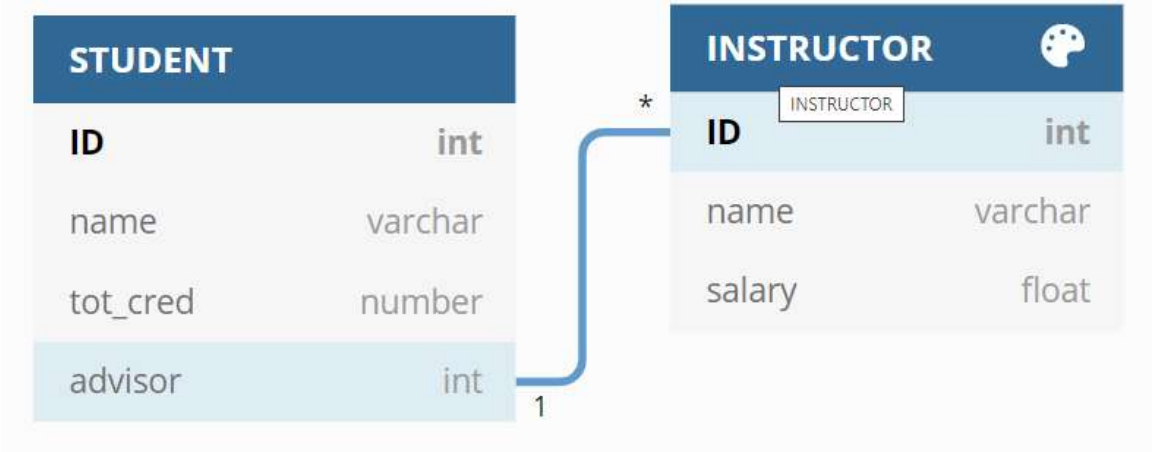
   Draw a schema diagram for this schema.



3. (3 pts.) Forward engineer this ER diagram to a relational schema.



INSTRUCTOR(ID, name, salary)
STUDENT (ID, name, tot_cred,advisor)



Relational Algebra exercise

Total points: 6

1. Consider the following WOODWORK database schema. Primary keys are underlined and foreign keys are *italicized*.
   SUPPLIER (SID, SName, Address)
   PRODUCT (PID, PName, Color)
   CATALOG (*SID*, *PID*, Cost)

   Write the following Relational Algebra queries on this database. Use proper notations for RA operations for full credit.

   a) List all products that are red in color.

   $$\Pi \text{ pid,PName,color } (\delta \text{ (color = 'red)' PRODUCT)}$$

   b) List ids of all products that cost over $10.

   $$\Pi \text{ PID } (\delta \text{ (cost > 10) CATALOG)}$$

   c) List supplier names and product names that they supply.

   $$\Pi \text{ sname,pname } (\text{SUPPLIER} \bowtie \text{CATALOG} \bowtie \text{PRODUCT })$$

SQL Exercise – DDL and simple queries

Total points: 10

Consider the following database schema. Primary keys are underlined and foreign keys are *italicized*.

MOVIE (Code, Title, Rating, Duration)

THEATER (Code, Name, *Movie*)

1. Write a DDL statement to create the Theater table.

```
CREATE TABLE Theater (
    Code int NOT NULL,
    Name varchar,
    Movie int,
    PRIMARY KEY (Code),
    FOREIGN KEY (Movie) REFERENCES Movie (Code)
);
```

2. Write a DML statement to insert one tuple into the Movie table.

   INSERT INTO MOVIE VALUES (1, 'Frozen-2','PG','01:30:00');

3. Write a select statement to find titles of all movies that are 90 minutes in duration.

   Select Title from Movie where Duration = '01:30:00';

4. Write a select statement to find all theaters that play the movie with code 123.

   Select Name from Theater where movie = '123';

5. Write a select statement to find the number of movies that have a PG rating.

   Select count(*) from movie where rating = 'PG';

SQL Exercise – Join queries

Total points: 10

Consider the following database schema. Primary keys are underlined and foreign keys are *italicized*.

MOVIE (Code, Title, Rating, Duration)

THEATER (Code, Name, *Movie*)

1. List all movie titles and the theater names that they are shown in.

```
Select movie.title, Theater.Name
From movie, theater
Where movie.code = theater.code;
```

2. For each rating, list the total number of movies that belong to that rating.

```
Select rating, count(*)
From movie
Group by rating;
```

3. List names of all movie theaters and the titles of all movies they are showing which have a rating of 'G'.

```
Select theater.name, movie.title from movie, theater where movie.code = theater.movie and
movie.rating = 'G' ;
```

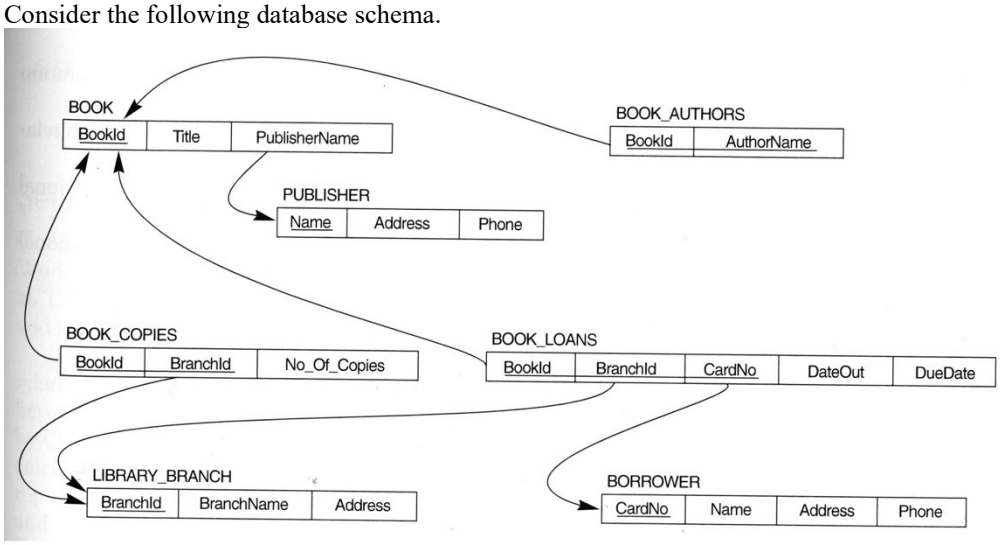
4. List all movie codes that are not playing in any theaters.

```
Select movie.code from movie where movie.code not in (select movie from theater );
```

SQL Exercise – Complex queries and views

Total points: 10

Consider the following database schema.



Source: Fundamentals of Database Systems by R. Elmasri & S. Navathe

1. List all book titles borrowed by Sue Adams, in alphabetical order.

   Select book.title
   From borrower, book_loans, book
   Where borrower.Name = 'Sue Adams'
   and book_loans.cardno = borrower.cardno
   and book_loans.book_id = book.bookid
   order by title;

2. For each library branch, retrieve the branch name and the total number of books loaned out from that branch.

   Select branch_name, count(book_loans.bookid)
   From library_branch,, book_loans, book
   Where library_branch.branchid = book_loans.branchid
   and book_loans.cardno = borrower.cardno
   and book_loans.book_id = book.bookid
   Group by book_loans.bookid

3. Create a view that includes all book titles, branch names that have them, and the number of copies held at each branch.

```
Create view view_book_titles as
Select book.title, library_branch.branch_name , book_copies.no_of_copies
From book, book_copies,library_branch
Where book.bookid = book_copies.bookid
And book_copies.branchid = library_branch.branch_id;
```

Indexes

Total points: 8

1. (2 pts.) How many primary indexes can you have for a table? How many secondary indexes?

There can be 1 primary index per table and any number of secondary indexes

2. (1 pts.) If you have a 4-level multi-level index, how many block accesses are required to access a record based on the index field?

   With a 4-level multi level index we would only need 4 block access to get a record.

4. (5 pts.) Compare the average number of block accesses needed to search for a specific record in an unordered data file with n blocks in each of the following configurations:
   1. with no index – **n2**
   2. with a single-level index on the search attribute which occupies m blocks - **Logn**
   3. with a three-level index on the search attribute -**3**

Normalization

Total points: 10

1. (3 pts.) Consider this table that keeps track of a dentist office appointments and its data. The primary key of this table is (staffNo, patNo, Appt date & time, roomNo).

staffNo	sName	patientNo	pName	Appt date & time	roomNo
S1011	Smith	P100	Gillian	12-Sept-04 10:00	S15
S1011	Smith	P105	Jill	12-Sept-04 12:00	S15
S1024	Pearson	P108	Ian	12-Sept-04 10:00	S10
S1032	Plevin	P105	Jill	14-Sept-04 2:00	S15
S1032	Plevin	P110	John	15-Sept-04 4:00	S13

   a) Give an example of an insertion anomaly.

      Adding a new row with all information without patientNo

   b) Give an example of a deletion anomaly.

      Deleting the record with pName Jill, deletes 2 records S1011 and S1032

   c) One would claim that this table is not in 1NF. Explain why or why not?

      This table is in 1NF since it satisfies 1 NF criteria which is A relation is in **1NF** if it contains an atomic value

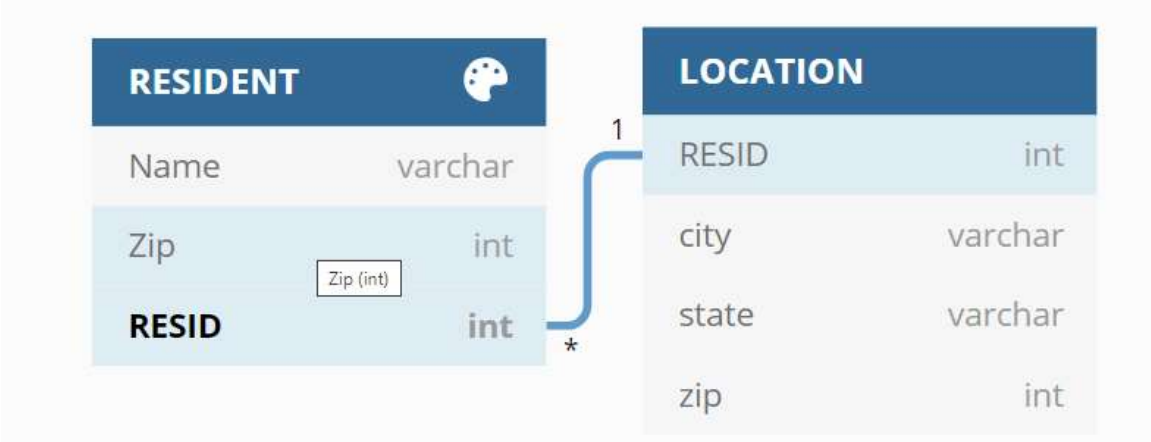
2. (3 pts.) Reduce the following relation with the given dependencies to 3NF. Specify which normal form is satisfied as you go through normalization.

   Resident (Name, Street, City, State, Zip)

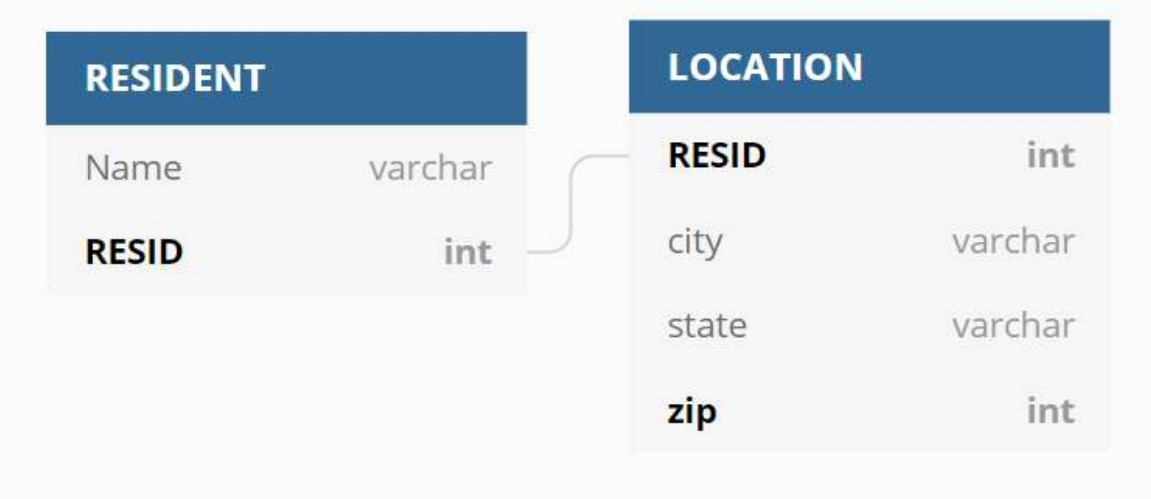
   - Zip -> City
   - Zip -> State


RESIDENT
Name varchar
Street varchar
City varchar
State varchar
Zip varchar

1 NF


RESIDENT
Name varchar
Zip int
RESID int
Zip (int)
1
*
LOCATION
RESID int
city varchar
state varchar
zip int

2 NF



3 NF

3. (4 pts.) Consider the relation R(A,B,C,D,E,F,G,H) in which ABC is the primary key. If the following dependencies hold in this relation, is this relation in 3NF? If not, which normal form does it satisfy? Reduce it to 3NF.

AB -> D
C -> H
EF-> G