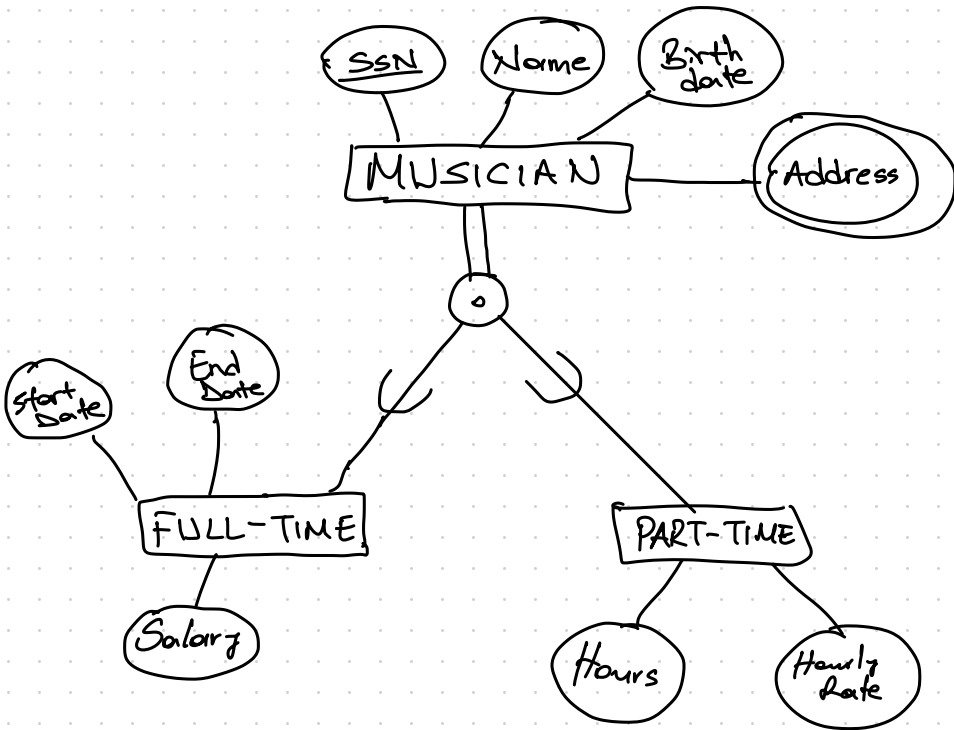


Serkan Berk Bilgiç

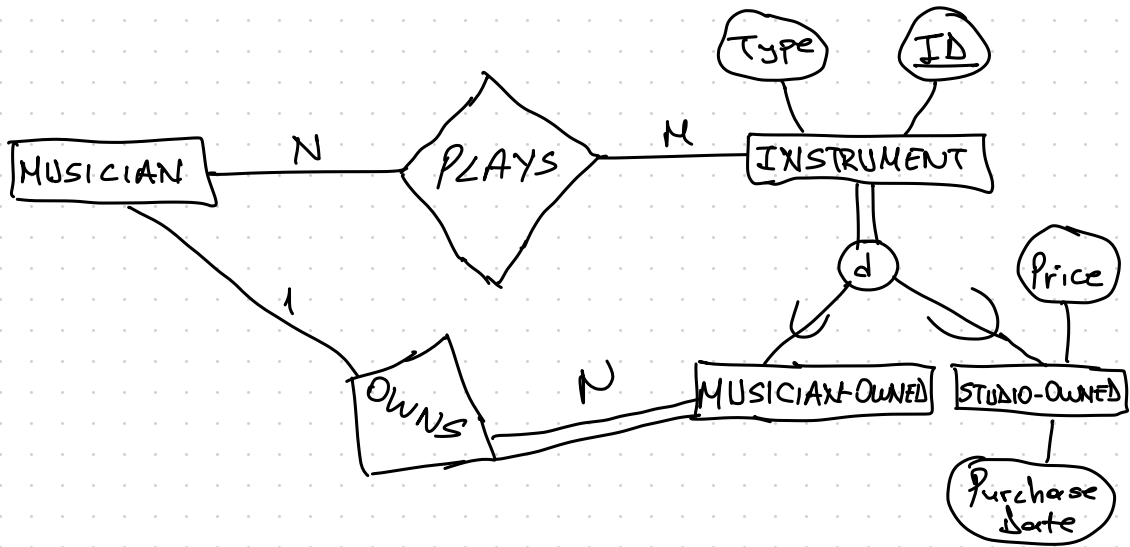
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Question 1:

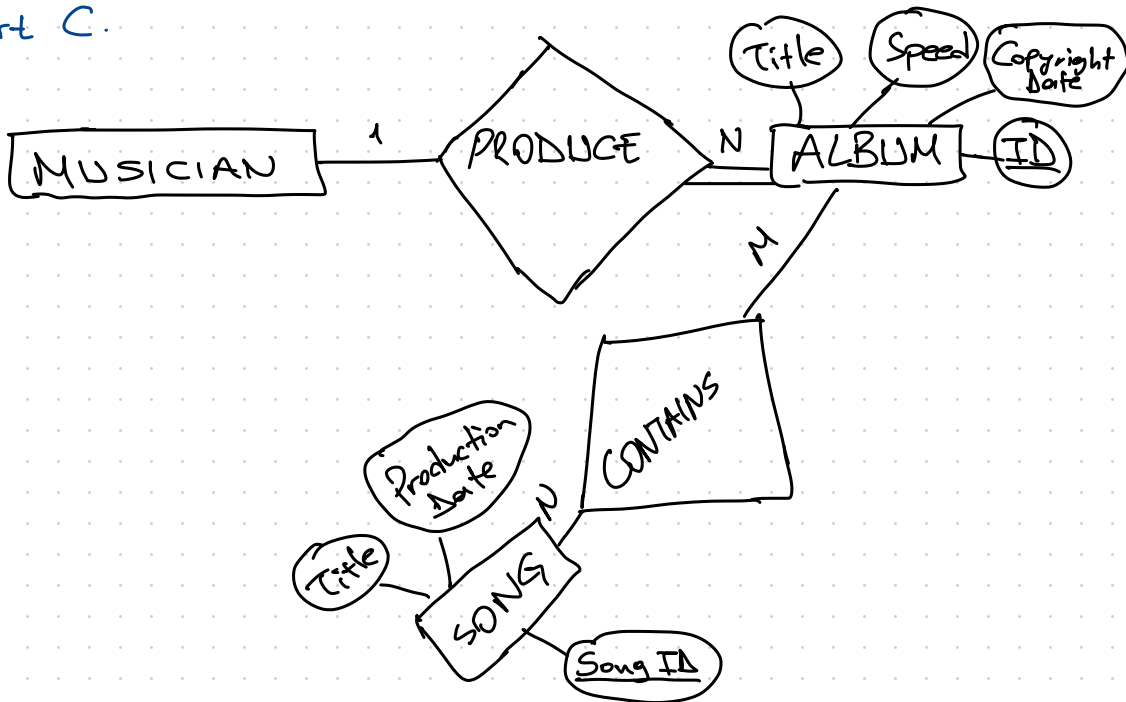
Part A).



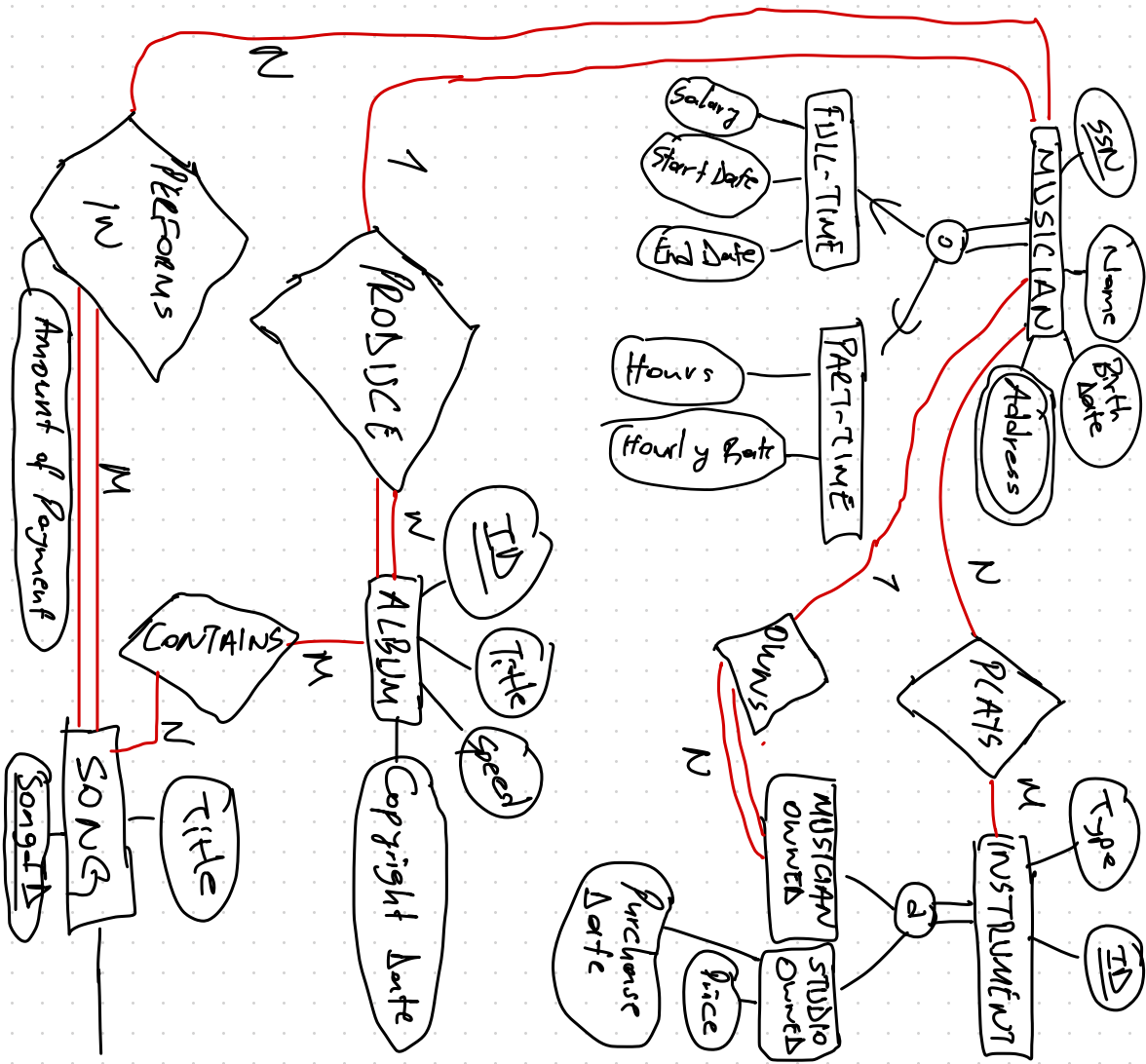
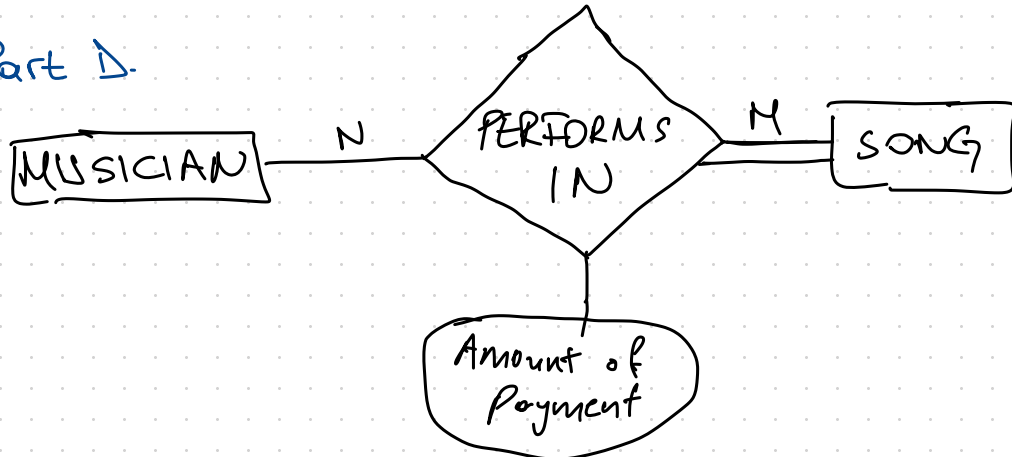
## Part B.

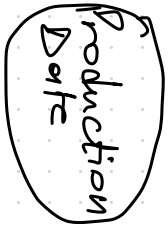


## Part C.



## Part D.





## Question 2 °

STEP 1 : Mapping of regular entities, Subclass / Superclass

CREATE TABLE BOOK

( ISBN: INTEGER,  
title: CHAR(30),  
price: REAL,  
front-cover-type: CHAR(10),  
num-of-pages: CHAR(10),  
PRIMARY KEY (ISBN) )

CREATE TABLE AUTHOR

( ID: INTEGER,  
name: CHAR(30),  
PRIMARY KEY (ID) )

CREATE TABLE CUSTOMER

( ID: INTEGER,  
name: CHAR(30),  
PRIMARY KEY (ID) )

CREATE TABLE REGISTERED\_CUSTOMER

( ID: INTEGER,  
reg date: DATE,  
PRIMARY KEY (ID),  
FOREIGN KEY IN  
REFERENCES CUSTOMER )

```
CREATE TABLE VISITING_CUSTOMER
( ID: INTEGER,
  address: CHAR(30),
  phone_num: CHAR(15),
  PRIMARY KEY (ID),
  FOREIGN KEY ID
  REFERENCES CUSTOMER)
```

## STEP 2 : Mapping of Weak Entities

No weak entity pass this step.

## STEP 3: Mapping of Binary 1:1 Relationships

No binary 1:1 relationship pass this step.

## STEP 4: Mapping of Binary 1:N Relationships

From Book - Customer Buys Relationship

```
CREATE TABLE BOOK
```

```
( ISBN: INTEGER,
  title: CHAR(30),
  Price: REAL,
  front_cover_type: CHAR(10),
  num_of_pages: CHAR(10),
  PRIMARY KEY (ISBN),
  customer_id: INTEGER,
  FOREIGN KEY customer_id
  REFERENCES CUSTOMER,
  payment_method: CHAR(10),
  purchase_date: DATE )
```

From Book - Registered Customer Borrows Relationship

```
CREATE TABLE BOOK
```

```
( ISBN: INTEGER,
  title: CHAR(30),
  Price: REAL,
  front_cover_type: CHAR(10),
  num_of_pages: CHAR(10),
  PRIMARY KEY (ISBN)
```

registered\_cust\_id: INTEGER,  
 FOREIGN KEY registered\_cust\_id  
 REFERENCES REGISTERED\_CUSTOMER,  
 borrow\_date: DATE,  
 return\_date: DATE)

Combine them

CREATE TABLE BOOK

(ISBN: INTEGER,  
 title: CHAR(30),  
 price: REAL,  
 front\_cover\_type: CHAR(10),  
 num\_of\_pages: CHAR(10),  
 customer\_id: INTEGER,  
 payment\_method: CHAR(10),  
 purchase\_date: DATE,  
 registered\_cust\_id: INTEGER,  
 borrow\_date: DATE,  
 return\_date: DATE,  
 FOREIGN KEY customer\_id  
 REFERENCES CUSTOMER  
 FOREIGN KEY registered\_cust\_id  
 REFERENCES REGISTERED\_CUSTOMER  
 PRIMARY KEY (ISBN))

STEP 5: Mapping of Binary M:N Relationships

CREATE TABLE WRITTEN-BY

(book\_isbn: INTEGER,  
 author\_id: INTEGER,  
 FOREIGN KEY book\_isbn  
 REFERENCES BOOK,  
 FOREIGN KEY author\_id  
 REFERENCES AUTHOR,  
 PRIMARY KEY (book\_isbn, author\_id))

STEP 6: Mapping of Multivalued Attributes

CREATE TABLE CUSTOMER\_EMAILS

(customer\_id: INTEGER,  
 email: CHAR(30),  
 FOREIGN KEY customer\_id  
 REFERENCES CUSTOMER  
 PRIMARY KEY (customer\_id, email))

## STEP 7: Mapping of N-ary Relationships

No N-ary relationship pass this step

### FINAL 8

#### CREATE TABLE BOOK

```
( ISBN: INTEGER,  
  title: CHAR(30),  
  price: REAL,  
  front_cover_type: CHAR(10),  
  num_of_pages: CHAR(10),  
  customer_id: INTEGER,  
  payment_method: CHAR(10),  
  purchase_date: DATE,  
  registered_cust_id: INTEGER,  
  borrow_date: DATE,  
  return_date: DATE,  
  FOREIGN KEY customer_id  
    REFERENCES CUSTOMER  
  FOREIGN KEY registered_cust_id  
    REFERENCES REGISTERED_CUSTOMER  
  PRIMARY KEY (ISBN))
```

#### CREATE TABLE AUTHOR

```
( ID: INTEGER,  
  name: CHAR(30),  
  PRIMARY KEY (ID))
```

#### CREATE TABLE CUSTOMER

```
( ID: INTEGER,  
  name: CHAR(30),  
  PRIMARY KEY (ID))
```

#### CREATE TABLE REGISTERED\_CUSTOMER

```
( ID: INTEGER,  
  reg_date: DATE,  
  PRIMARY KEY (ID),  
  FOREIGN KEY ID  
    REFERENCES CUSTOMER
```

```
CREATE TABLE VISITING_CUSTOMER
( ID: INTEGER,
  address: CHAR(30),
  phone_num: CHAR(15),
  PRIMARY KEY (ID)
  FOREIGN KEY ID
  REFERENCES CUSTOMER)
```

```
CREATE TABLE CUSTOMER_EMAILS
( customer_id: INTEGER,
  email: CHAR(30),
  FOREIGN KEY customer_id
  REFERENCES CUSTOMER
  PRIMARY KEY (customer_id, email))
```

```
CREATE TABLE WRITTEN-BY
( book_isbn: INTEGER,
  author_id: INTEGER,
  FOREIGN KEY book_isbn
  REFERENCES BOOK,
  FOREIGN KEY author_id
  REFERENCES AUTHOR,
  PRIMARY KEY (book_isbn, author_id))
```

- BOOK (ISBN, title, price, front\_cover\_type, num\_of\_pages, customer\_id, payment\_method, purchase\_date, registered\_cust\_id, borrow\_date, return\_date)
- AUTHOR (ID, name)
- CUSTOMER (ID, name)
- REGISTERED\_CUSTOMER (ID, reg\_date)
- VISITING\_CUSTOMER (ID, address, phone\_num)
- CUSTOMER\_EMAILS (customer\_id, email)
- WRITTEN-BY (book\_isbn, author\_id)



=> Black underlined means primary key, written in red means foreign key, written and underlined with red means both foreign and primary key

### Question 3 :

$$a)- A = \left[ \left( \pi_{\underline{Dnumber}} \left( \sigma_{Dname = \text{"Sales"}} \text{Department} \right) \right) \bowtie_{\substack{Dno = \underline{Employee} \\ Bdate \geq 01/01/1990}} \left( \sigma_{Bdate \geq 01/01/1990} \text{Employee} \right) \right]$$

$$\text{Result} = \pi_{\underline{Fname}, Bdate, \underline{Address}, Salary} A$$

$$b)- A = \left[ \left( \pi_{\underline{Pnumber}} \left( \sigma_{Pname = \text{"Data Privacy"}} \text{Project} \right) \right) \bowtie_{\substack{Project.Pnumber \\ = \\ Works\_On.Pno}} \text{Works\_On} \right]$$

$$B = \pi_{\underline{Essn}} \left( \sigma_{Hours > 20} A \right)$$

$$\text{Result} = \pi_{\underline{Fname}, Minit, \underline{Lname}} \left[ \left( B \right) \bowtie_{\substack{B.Essn \\ = \\ Employee.Ssn}} \text{Employee} \right]_{Dno=8}$$

$$c)- A = \left[ \left( \text{Works\_On} \right) / \left( \pi_{\underline{Pnumber}} \left( \sigma_{Dnum = 5} \text{Project} \right) \right) \right]_{\pi_{\underline{Essn}, Pno}}$$

$$B = A \bowtie_{\substack{A.Essn \\ = \\ Employee.Ssn}} \text{Employee}$$

$$\text{Result} = \pi_{\underline{Lname}, Salary} B$$

d)-

$$A = \pi_{Ssn} \left( \text{Employee} \bowtie_{\substack{\text{Employee.Ssn} \\ \text{Works\_On.Essn}}} \text{Works\_On} \right)$$

$$B = \pi_{\substack{Lname \\ Salary \\ Super\_Ssn}} \left[ \left( \pi_{Ssn}(\text{Employee}) - A \right) \bowtie \text{Employee} \right]$$

$$\text{Result} = \pi_{\substack{B.Lname, \\ \text{Employee.Lname}, \\ Salary}} \left( \sigma_{Lname, Ssn} \text{Employee} \right) \bowtie_{\substack{\text{Employee.Ssn} \\ B.super\_Ssn}} B$$

B.Lname employees last name while Employee.Lname is his/her supervisors Lname at the end, in result.

e)-

$$A = \pi_{Dnumber} \left( \sigma_{Dlocation = "Istanbul"} \text{Dept\_Locations} \right)$$

$$B = \pi_{Dnum} \left( \sigma_{Plocation = "Istanbul"} \text{Project} \right)$$

$$\text{Result} = \pi_{Dname} \left[ (A \cup B) \bowtie_{\substack{\text{Department.Dnumber} \\ = \\ Dnum}} \text{Department} \right]$$

f)-

$$A = \pi_{Pno} \left[ \pi_{Ssn} \left( \sigma_{Lname = "Gursoy"} \text{Employee} \right) \bowtie_{\substack{\text{Works\_On.Essn} \\ \text{Employee.Ssn}}} \text{Works\_On} \right]$$

$$B = \pi_{Dnumber} \left[ \left( \sigma_{Lname = "Gursoy"} \text{Employee} \right) \bowtie_{\substack{\text{Employee.Ssn} \\ \text{Department.Mgr\_Ssn}}} \text{Department} \right]$$

$$C = \pi_{Pnumber} \left( B \bowtie_{\substack{B.Dnumber \\ \text{Project.Dnum}}} \text{Project} \right)$$

$$\text{Result} = A \cap C$$

$$g) - A = \pi_{Mgr\_Ssn} \text{ Department}$$

$$B = \pi_{M\_Mgr\_Ssn} \left( \sigma_{M\_Mgr\_start\_date < Department\_Mgr\_start\_date} \left[ (p(D1, Department) \times Department) \right] \right)$$

$$Result = \pi_{\substack{Lname \\ Salary}} \left[ (A - B) \bowtie Department \bowtie Employee \right]$$

$$h) - A = \left( \pi_{\substack{Ssn, Bdate \\ Super\_Ssn}} Employee \right)$$

$$B = \pi_{A\_super\_Ssn} \left[ \sigma_{\substack{A\_Bdate < \\ Employee\_Bdate}} \left( A \bowtie_{\substack{A\_super\_Ssn = \\ Employee\_Ssn}} Employee \right) \right]$$

$$Result = \pi_{Fname, lname} (B \bowtie Employee)$$