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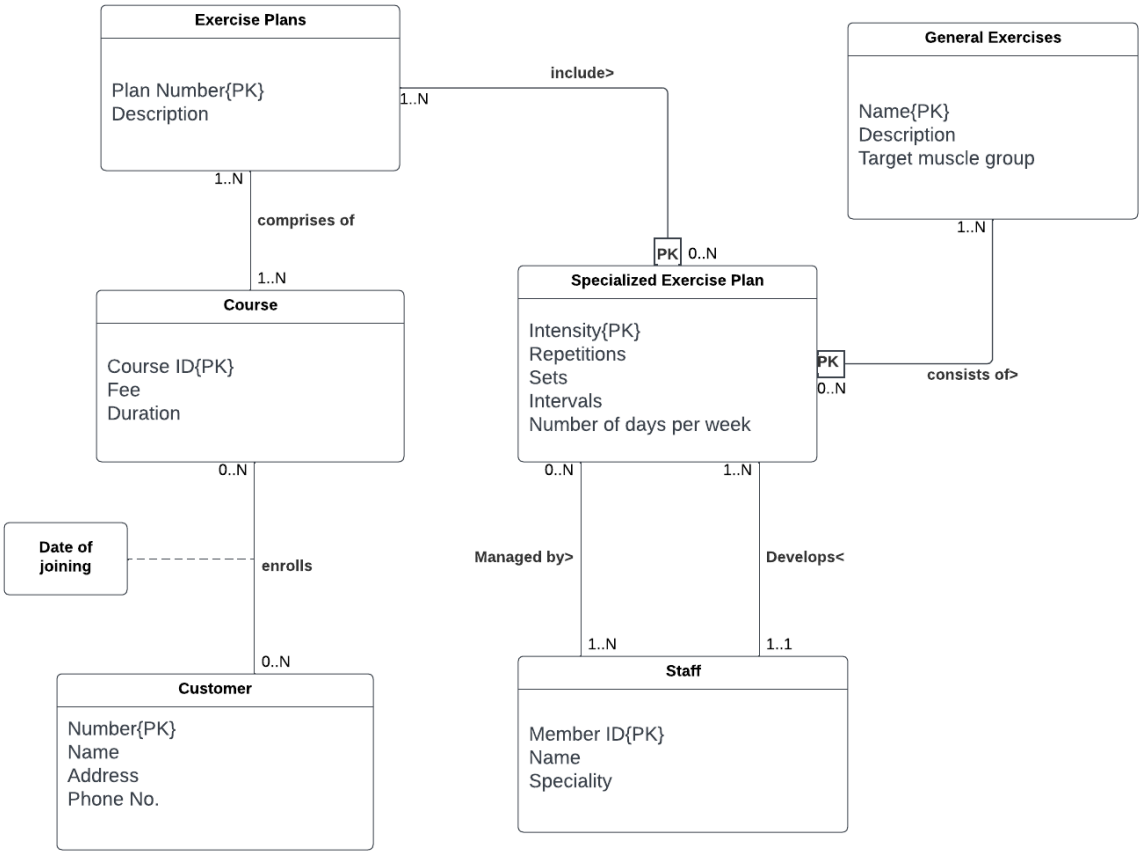
DATABASE CONCEPTS

ASSIGNMENT 1

- ALL PARTS ATTEMPTED

Task 1: Designing an Entity-Relationship Model

ANSWER



Assumptions

-

Strong Entities

- Customer
- Course
- Exercise Plans
- Staff
- General Exercises

Weak Entities

- Specialized Exercise Plan

Multi-Valued Attribute

- None

Keys

- Each entity has a primary or a partial key indicated by {PK} after the attribute name

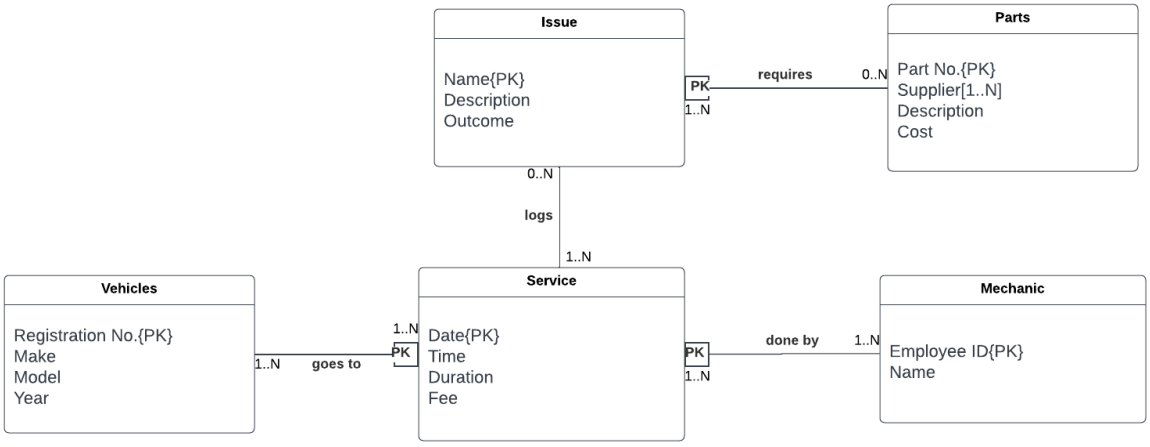
Relations

- 1:1- no such relation
- 1:N- managed by, develops
- N:N- consists of, enrolls, include, comprises of

Task 2: Designing an Entity-Relationship Model

Part A: Initial Design

ANSWER



Assumptions

- Each part has a unique part number, regardless of the supplier

Strong Entities

- Vehicles
- Issue
- Parts
- Mechanic

Weak Entities

- Service

Multi-Valued Attribute

- Parts_Supplier

Composite Attributes

- None

Keys

- Each entity has a primary or a partial key indicated by {PK} after the attribute name

Relations

- 1:1- no such relation
- 1:N- no such relation
- N:N- goes to, logs, requires, done by

Part B: Client Adjustments

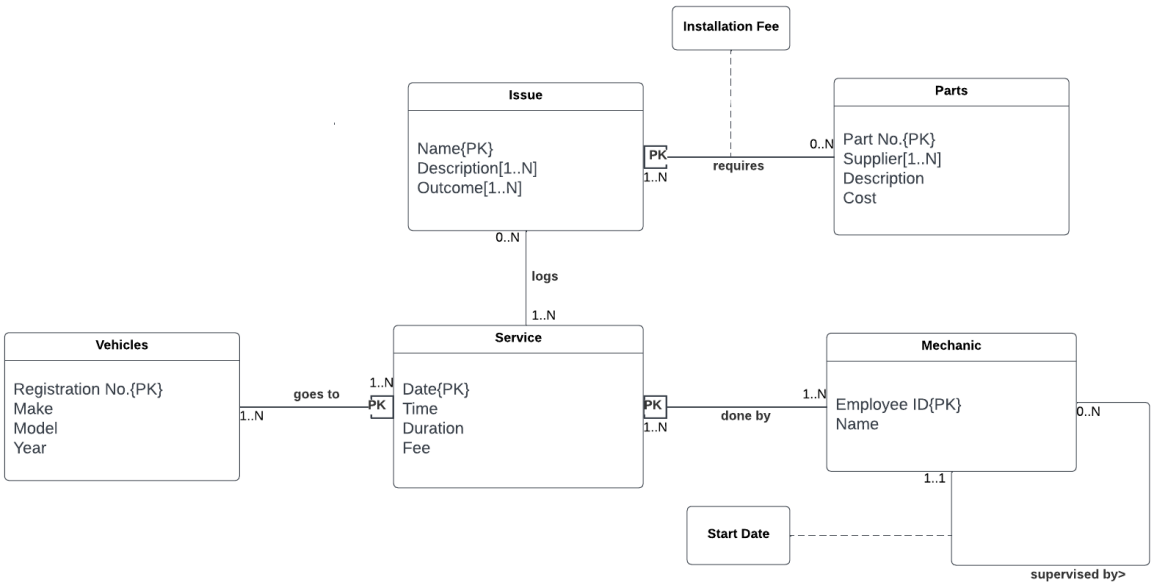
- Several mechanics may be involved in the service of a vehicle. The system need to be able to identify which mechanic installed each part and resolved each issue during the service.

- The system needs to record not just the cost of parts but also the installation fee.

- Some mechanics have higher seniority and may supervise other mechanics. Mechanics cannot
- have more than one supervisor. The date when they began supervising others is recorded.

- The same issue could come up with a different description or outcome during various services of vehicles.

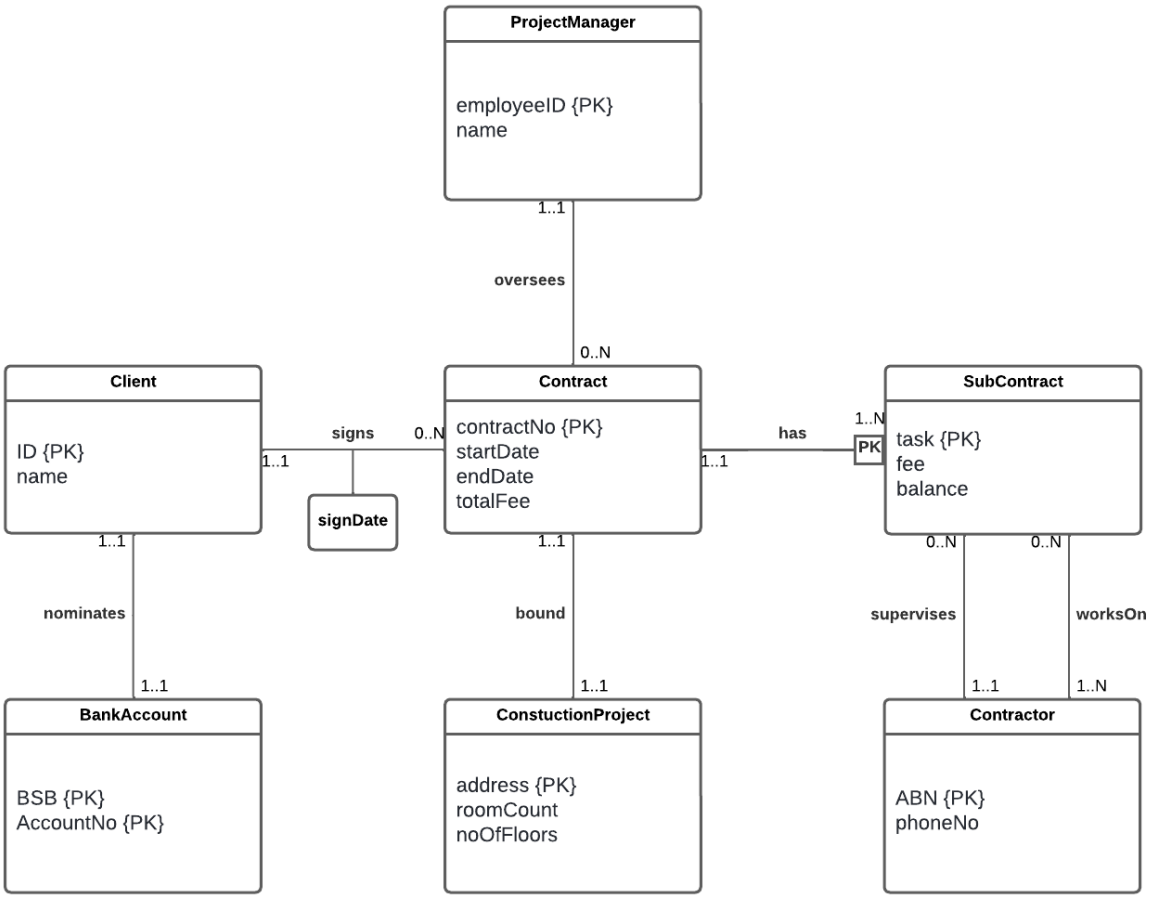
ANSWER



- Now, a 1:N relation is used on mechanic entity to make it a self associated entity, with a relation attribute, start date. This date specifies the date the supervisor began supervising.
- The relation requires has another attribute, installation fee, to record the money invested in installing the part.
- Issue.description and Issue.outcome are now multivalued attributes, to store different descriptions and outcomes that might turn up for the same issue of the same vehicle.

Task 3: Mapping an ER Model to a Relational Database Schema

Consider the following ER diagram, which shows aspects of a construction project management system.



You are requested to map the above ER diagram into a relational database schema. Show every step of the mapping.

No marks are awarded to the final schema if you do not show the partially built schema at the end of each step.

Clearly indicate the primary key (underlined) and foreign keys (with an asterisk) in each relation.

ANSWER

The relational database schema is shown below. Primary keys are underlined, and foreign keys are annotated with a *.

STEP 1: STRONG ENTITIES

- ProjectManager (employeeID, name)
- Client (ID, name)
- Contract (contractNo, startDate, endDate, totalFee)
- BankAccount (BSB, accountNo)
- ConstructionProject (address, roomCount, noOfFloors)
- Contractor (ABN, phoneNo)

STEP 2: WEAK ENTITIES

- SubContract (task, fee, balance, CcontractNo*)

STEP 3: 1:1 RELATIONSHIPS

- Client (ID, name, BankBSB, BankAccountNo)
- Contract (contractNo, startDate, endDate, totalFee, CPaddress, CProomCount,CPnoOfFloors)

STEP 4: 1:N RELATIONSHIPS

- Contract (contractNo, startDate, endDate, totalFee, PMemployeeID*)
- Contract (contractNo, startDate, endDate, totalFee, ClientID*, signDate)
- SubContract (task, fee, balance, CcontractNo*)
- SubContract (task, fee, balance, CcontractNo*, CTRABN*)

STEP 5: N:N RELATIONSHIPS

- worksOn (SCtask*, CTRABN*)

STEP 6: Multi-Valued Attributes

- None

STEP 7: Higher degree relations

- None

SCHEMA:

- ProjectManager (employeeID, name)
- Client (ID, name, BankBSB, BankAccountNo)
- Contract (contractNo, startDate, endDate, totalFee, PMemployeeID*, ClientID*, signDate, CPaddress, CProomCount,CPnoOfFloors)
- Contractor (ABN, phoneNo)
- SubContract (task, fee, balance, CcontractNo*, CTRABN*)
- worksOn (SCtask*, CTRABN*)

Task 4: Relational Database Model

QUESTION 4.1: Does the database schema ensure that there is a manager associated with each department?

Explain your answer.

ANSWER

Yes, the database schema ensures that there is a manager associated with each department. We can clearly see that the manager_id in departments table are 12, 66 and 18. And since manager_id is a foreign key from the employees table, the managers have the same employee_id and manager_id. The employees table has 12, 18 and 66 as the employee_id. This means there is a manager associated with every department.

Questions 4.2: What foreign key constraints are missing from Figure 3? Write down the missing constraints in the

format shown in figure 3. Show the updated schema for the corresponding relations.

ANSWER

The missing foreign key constraints from fig 3 are as follows:

Foreign Key	Primary Key
Employees.department_id	Department.department_id
Employees.empjob_id	Jobs.job_id

-

QUESTION 4.3: The IT Services department has recently changed to have two sub-departments (i.e., IT Support, and Software Devlopment). Now, each sub-department is supposed to have a separate manager. Additionally, the managers of all IT Services sub-departments now must report to a single Director (i.e., "Director of Support Services"). Temporarily and until the new managers are hired, Adam Jones has been appointed to the management of both sub-departments as well to the single role of Director of Support Services. His salary range is between $130,000 and 160,000.

The following SQL statements are intended to record all the changes required in the database instance. Will they work? If they are sufficient to achieve the requirements specified above, explicitly mention they are sufficient. If there are any shortcomings, identify them and briefly justify your answer.

```
UPDATE Departments SET department_name='IT Support' WHERE department_id=1;

INSERT INTO Departments VALUES(4, 'Software Development', 12, 10);
```

ANSWER

The SQL commands will function to add a new row for the Software Development department to the Departments table and update it. However, the IT Services department needs to be divided into two sub-departments, and each sub-department needs to have a different manager, thus it is necessary to record all the modifications needed in the database.

The manager_id for the IT Support and Software Development departments should be modified to relate to the two new managers when they are hired.

The Departments table must be changed to reflect Adam's new function as Director of Support Services, and the Employee table's salary row will also receive an update.

QUESTION 4.4: The employee named Jonny Deans changed his job to become a Senior Programmer on 6/06/2020..
The following SQL statement intends to make the required changes to reflect Jonny's promotion.

UPDATE Employees SET empjob_id=45, hire_date=6/06/2020 WHERE empjob_id=33;

Explain if there any issues with the outcome of the update and how it should be fixed?. After running the above
query, consider the request "find all the past contracts that Jonny Deans used to have". Can this request be
completed using the given database schema and after the above statement is run? If yes, explain how the request
can be answered. If no, explain what is missing and how it should be fixed.

ANSWER

There are following issues with the given SQL query:

- hire_date is not an integer value but a string value, and should be enclosed in quotes.
- empjob_id is not the primary key for employees table. Employee_id should be used instead as it is primary and unique for employees table.

The correct SQL statement would be (employee_id of Jonny Deans is 10) :

UPDATE Employees SET empjob_id=45 , hire_date="6/06/2020" WHERE employee_id=10;

To find all the past contracts that Jonny Deans used to have, we can use the following SQL

statement:

SELECT * FROM JobHistory WHERE employee_id=10;

QUESTION 4.5: Explain what the result of executing the following SQL statement on the database instance will be.
DELETE FROM LOCATIONS WHERE location_id=10;

Identify all changes that must be completed to allow this to successfully execute.

ANSWER

The given SQL statement is correct and will delete all the rows in the Locations table where the location_id is equal to 10. Although, for the statement to execute successfully, the following conditions must be met:

- There must be a location_id column in the Locations table and it needs to have a data type that can be compared to an integer.
- The Locations table must have a row with location_id=10, otherwise nothing will be deleted but the statement will still execute.
- There shouldn't be any foreign key restrictions referencing the location_id column in the Locations table. Before the statement may be run, any foreign key constraints that exist must be removed or altered.

QUESTION 4.6: Write an SQL statement to create the JobHistory table including all the constraints, assuming all the
tables that JobHistory depends on already exist in the database. Make reasonable assumptions for the data type
associated with each field. Your SQL statement must be valid for SQLite Studio environment and free of any errors.

ANSWER

The required SQL statement is as follows:

CREATE TABLE JobHistory (employee_id* INTEGER NOT NULL, start_date DATE NOT NULL, end_date

DATE NOT NULL, job_id* INTEGER NOT NULL, department_id* INTEGER NOT NULL);

QUESTION 4.7: Write an SQL statement to create the Jobs table including all the constraints, assuming all the tables
that Jobs depends on already exist in the database. Make reasonable assumptions for the data type associated with
each field. Your SQL statement must be valid for SQLite Studio environment and free of any errors.

ANSWER

The SQL statement to create the job table:

CREATE TABLE Jobs (job_id INTEGER PRIMARY KEY, job_title TEXT NOT NULL,

min_salary INTEGER NOT NULL, max_salary INTEGER NOT NULL);

QUESTION 4.8: On ‘01/01/2021’ Adam Smith is rehired with a new salary of $90,000. You are asked
to update the given database instance so that it includes ALL relevant changes required to store this
consistently across all relations. Your SQL statement must be valid for SQLite Studio environment,
free of any errors, and compatible/consistent with existing data in the instance in Figure 2.

ANSWER

The required SQL statement is as follows:

UPDATE Employees SET hire_date=”01/01/2021”, salary=90000 WHERE first_name=”Adam” AND last_name=”Smith”;a