



University
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Logical Design MNHS

Data Management Course

UM6P College of Computing

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Repository Link	https://github.com/Data-Project-Hierarchy/

1 Introduction

Making the logical database from the ER diagram is like turning a rough sketch into something you can actually use. The ER diagram shows the main things and how they connect, and the logical design figures out exactly how to put it all into tables with keys so it works in a real database. If you mess this part up, the database won't work properly later.

2 Requirements and Methodology

Logical Design

Note:

- **Primary Keys** are underlined.
- **Foreign Keys** are in bold.

Relation [Have] (N:M)

Patient (IID: INTEGER, CIN: STRING, name: STRING, sex: CHAR(1), birth: DATE, blood_group: STRING, phone: STRING)

Contact_Location (CLID: INTEGER, city: STRING, province: STRING, street: STRING, number: STRING, postal_code: STRING, phone: STRING)

Have (CLID: INTEGER, IID: INTEGER)

Foreign Key (FK)

- Key **CLID** represents Contact_Location(CLID)
- Key **IID** represents Patient(IID)

Composite Key Have (CLID, IID): Relationship of type N:M between Patient and Contact_Location.

Relation [Covers] (N:M)

Patient (IID: INTEGER, CIN: STRING, name: STRING, sex: CHAR(1), birth: DATE, blood_group: STRING, phone: STRING)

Insurance (InsID: INTEGER, type: STRING)

Covers (InsID: INTEGER, IID: INTEGER)

Note: Since this is an N:M relationship, a new relation (Covers) is created. It inherits the primary keys from both related entities, which together form its composite primary key.

Foreign Key (FK)

- Key **InsID** represents Insurance(InsID)
- Key **IID** represents Patient(IID)

Composite Key Covers (InsID, IID): Relationship of type N:M between Patient and Insurance.

Relation [Expense_Attached] (1:M)

Patient (IID: INTEGER, CIN: STRING, name: STRING, sex: CHAR(1), birth: DATE, blood_group: STRING, phone: STRING)

Expense_Attached (ExID: INTEGER, total: DECIMAL, **InsID**: INTEGER)

*Note: Each Expense instance has **exactly one** Insurance instance, thus the merging between Expense and Attached.*

Foreign Key (FK)

- Key **InsID** represents Insurance(InsID)

ISA [Staff] (1:1 Total Specialization)

Practitioner (STAFF_ID: INTEGER, specialty: STRING, license_number: STRING)

Caregiving (STAFF_ID: INTEGER, grade: STRING, ward: STRING)

Technical (STAFF_ID: INTEGER, modality: STRING, certifications: STRING)

Foreign Key (FK)

- Key **STAFF_ID** represents Staff(STAFF_ID)

Relation [Work_In] (N:M)

Staff (STAFF_ID: INTEGER, name: STRING, status: STRING)

Department (DEP_ID: INTEGER, name: STRING, specialty: STRING)

Work_In (STAFF_ID: INTEGER, DEP_ID: INTEGER)

Note: Since this is an N:M relationship, a new relation (Work_In) is created. It inherits the primary keys from both related entities, which together form its composite primary key.

Foreign Key (FK)

- Key **STAFF_ID** represents Staff(STAFF_ID)
- Key **DEP_ID** represents Department(DEP_ID)

Composite Key **Work_In** (STAFF_ID, DEP_ID): Relationship of type N:M between Staff and Department.

Relation [Linked] (1:M)

Clinical_Activity (CAID: INTEGER, time: TIME, date: DATE, **staff_id**: INTEGER, **IID**: INTEGER, **ExID**: INTEGER, **DEP_ID**: INTEGER)

Staff (STAFF_ID: INTEGER, name: STRING, status: STRING)

Foreign Key (FK)

- Key **staff_id** represents Staff(STAFF_ID)

Relation [Has] (1:M)

Clinical_Activity (CAID: INTEGER, time: TIME, date: DATE, **staff_id**: INTEGER, **IID**: INTEGER, **ExID**: INTEGER, **DEP_ID**: INTEGER)

Patient (IID: INTEGER, CIN: STRING, name: STRING, sex: CHAR(1), birth: DATE, blood_group: STRING, phone: STRING)

Foreign Key (FK)

- Key **IID** represents Patient(IID)

Relation [Generates] (1:M)

Clinical_Activity (CAID: INTEGER, time: TIME, date: DATE, **staff_id**: INTEGER, **IID**: INTEGER, **ExID**: INTEGER, **DEP_ID**: INTEGER)

Expense_Attached (ExID: INTEGER, total: DECIMAL, **InsID**: INTEGER, Note: STRING)

Foreign Key (FK)

- Key **ExID** represents Expense_Attached(ExID)

Relation [Occurs] (1:M)

Clinical_Activity (CAID: INTEGER, time: TIME, date: DATE, **staff_id**: INTEGER, **IID**: INTEGER, **ExID**: INTEGER, **DEP_ID**: INTEGER)

Department (DEP_ID: INTEGER, name: STRING, specialty: STRING)

Foreign Key (FK)

- Key **DEP_ID** represents Department(DEP_ID)

ISA [Clinical_Activity] (1:1 Total Specialization)

Appointment (CAID: INTEGER, reason: STRING, status: STRING)

Emergency (CAID: INTEGER, triage_level: INTEGER, outcome: STRING)

Foreign Key (FK)

- Key **CAID** represents Clinical_Activity(CAID)

Relation [Generate] (1:M)

Clinical_Activity (CAID: INTEGER, time: TIME, date: DATE, **staff_id**: INTEGER, **IID**: INTEGER, **ExID**: INTEGER, **DEP_ID**: INTEGER)

Prescription (PID: INTEGER, DateIssued: DATE, **CAID**: INTEGER)

Note: The 1:M relationship indicates that each Prescription is generated by exactly one Clinical_Activity, and a Clinical_Activity can have 0 or 1 Prescription.

Foreign Key (FK)

- Key **CAID** represents Clinical_Activity(CAID)

Relation [Include] (N:M)

Prescription (PID: INTEGER, DateIssued: DATE, CAID: INTEGER)

Medication (drug_id: INTEGER, class: STRING, name: STRING, form: STRING, strength: STRING, active_ingredient: STRING, manufacturer: STRING)

Include (PID: INTEGER, drug_id: INTEGER, dosage: STRING, quantity: INTEGER, frequency: STRING)

Note: Since this is an N:M relationship, a new relation (Include) is created. It inherits the primary keys from both related entities, which together form its composite primary key.

Foreign Key (FK)

- Key **PID** represents Prescription(PID)
- Key **drug_id** represents Medication(drug_id)

Composite Key Include (PID, drug_id): Relationship of type N:M between Prescription and Medication.

Relation [Stock] (N:M)

Hospital (HID: INTEGER, name: STRING, city: STRING, region: STRING)

Medication (drug_id: INTEGER, class: STRING, name: STRING, form: STRING, strength: STRING, active_ingredient: STRING, manufacturer: STRING)

Stock (HID: INTEGER, drug_id: INTEGER, unit_price: DECIMAL, stock_timestamp: TIMESTAMP, qty: INTEGER, reorder_level: INTEGER)

Note: Since this is an N:M relationship, a new relation (Stock) is created. It inherits the primary keys from both related entities, which together form its composite primary key.

Foreign Key (FK)

- Key **HID** represents Hospital(HID)
- Key **drug_id** represents Medication(drug_id)

Composite Key Stock (HID, drug_id): Relationship of type N:M between Hospital and Medication.

Relation [Belongs] (1:M)

Hospital (HID: INTEGER, name: STRING, city: STRING, region: STRING)

Department (DEP_ID: INTEGER, name: STRING, specialty: STRING, **HID**: INTEGER)

Note: The constraint “each hospital has at least one department” is a participation constraint enforced by application logic or database triggers.

Foreign Key (FK)

- Key **HID** represents Hospital(HID)

3 Implementation & Results

Code SQL:

```
CREATE DATABASE MNHS;  
USE MNHS;
```

```
CREATE TABLE Patients (  
    iid INT PRIMARY KEY AUTO_INCREMENT,  
    cin VARCHAR(50),
```

```
        p_name VARCHAR(50),
        sex VARCHAR(10),
        birth DATE,
        blood_group VARCHAR(3),
        phone VARCHAR(15)
    );

CREATE TABLE Departement (
    did INT PRIMARY KEY AUTO_INCREMENT,
    d_name VARCHAR(50),
    specialty VARCHAR(50)
);

CREATE TABLE Clinical_Activities (
    caid INT PRIMARY KEY AUTO_INCREMENT,
    ca_time TIME,
    ca_date DATE,
    iid INT NOT NULL,
    did INT NOT NULL,
    FOREIGN KEY (iid) REFERENCES Patients(iid),
    FOREIGN KEY (did) REFERENCES Departement(did)
);

CREATE TABLE Appointment (
    caid INT PRIMARY KEY AUTO_INCREMENT,
    reason VARCHAR(50),
    a_status VARCHAR(100),
    FOREIGN KEY (caid) REFERENCES Clinical_Activities(caid)
);

CREATE TABLE Emergency (
    caid INT PRIMARY KEY AUTO_INCREMENT,
    triage_level VARCHAR(100),
    outcome VARCHAR(100),
    FOREIGN KEY (caid) REFERENCES Clinical_Activities(caid)
);

CREATE TABLE Hospital (
    hid INT PRIMARY KEY AUTO_INCREMENT,
    h_name VARCHAR(100),
    city VARCHAR(50),
    region VARCHAR(50),
    did INT NOT NULL,
    FOREIGN KEY (did) REFERENCES Departement(did)
);

INSERT INTO Patients (cin, p_name, sex, birth, blood_group, phone) VALUES
('CD908479', 'Youssef', 'Male', '2000-05-15', 'A+', '1234567890'),
```

```

('AB123456', 'Sara', 'Female', '1995-08-22', 'B-', '0987654321');

INSERT INTO Departement (d_name, specialty) VALUES
('Cardiology', 'Heart-related treatments'),
('Neurology', 'Brain and nervous system treatments');

INSERT INTO Clinical_Activities (ca_time, ca_date, iid, did) VALUES
('10:00:00', '2023-10-01', 1, 1),
('14:30:00', '2023-10-02', 2, 2);

INSERT INTO Appointment (caid, reason, a_status) VALUES
(1, 'Routine checkup', 'Scheduled'),
(2, 'Specialist consultation', 'Completed');

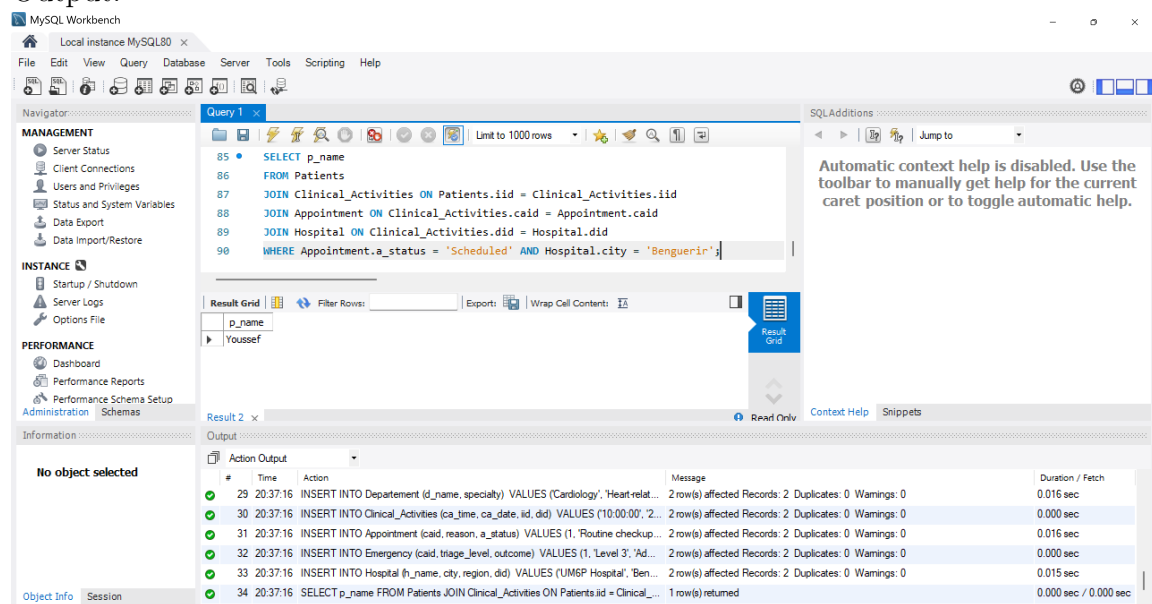
INSERT INTO Emergency (caid, triage_level, outcome) VALUES
(1, 'Level 3', 'Admitted'),
(2, 'Level 1', 'Discharged');

INSERT INTO Hospital (h_name, city, region, did) VALUES
('UM6P Hospital', 'Benguerir', 'Rehamna', 1),
('Moulay Ismail', 'Meknès', 'Fès-Meknès', 2);

SELECT p_name FROM Patients
JOIN Clinical_Activities ON Patients.iid = Clinical_Activities.iid
JOIN Appointment ON Clinical_Activities.caid = Appointment.caid
JOIN Hospital ON Clinical_Activities.did = Hospital.did
WHERE Appointment.a_status = 'Scheduled' AND Hospital.city = 'Benguerir';

```

Output:



The screenshot shows the MySQL Workbench interface. The main window displays the SQL editor with the following queries:

```

85 SELECT p_name
86 FROM Patients
87 JOIN Clinical_Activities ON Patients.iid = Clinical_Activities.iid
88 JOIN Appointment ON Clinical_Activities.caid = Appointment.caid
89 JOIN Hospital ON Clinical_Activities.did = Hospital.did
90 WHERE Appointment.a_status = 'Scheduled' AND Hospital.city = 'Benguerir';

```

The Results window shows the output of the queries. The first query (SELECT p_name) returned one row: 'Youssef'. The second query (INSERT INTO Departement) returned two rows: 'Cardiology' and 'Neurology'. The third query (INSERT INTO Clinical_Activities) returned two rows: '10:00:00' and '14:30:00'. The fourth query (INSERT INTO Appointment) returned two rows: 'Routine checkup' and 'Specialist consultation'. The fifth query (INSERT INTO Emergency) returned two rows: 'Level 3' and 'Level 1'. The sixth query (INSERT INTO Hospital) returned two rows: 'UM6P Hospital' and 'Moulay Ismail'. The seventh query (SELECT p_name) returned one row: 'Youssef'.

The Action Output window shows the execution details of the queries. The first query (SELECT p_name) returned 1 row(s) in 0.000 sec. The second query (INSERT INTO Departement) affected 2 records in 0.016 sec. The third query (INSERT INTO Clinical_Activities) affected 2 records in 0.016 sec. The fourth query (INSERT INTO Appointment) affected 2 records in 0.016 sec. The fifth query (INSERT INTO Emergency) affected 2 records in 0.015 sec. The sixth query (INSERT INTO Hospital) affected 2 records in 0.015 sec. The seventh query (SELECT p_name) returned 1 row(s) in 0.000 sec.

4 Discussion

- **Challenges faced:**

- Turning the ER diagram into relational tables was sometimes tricky, especially when deciding how to represent N:M relationships and which attributes should go where.
- Mapping ISA hierarchies like *Staff* and *Clinical Activity* into tables needed careful thought to make sure no data was lost and that foreign keys were correct.
- Some constraints from the conceptual design, like “each hospital must have at least one department,” cannot be fully represented in the tables, so we had to think about how they would be handled in the actual database.

- **Observations:**

- This step helped clarify parts of the ER diagram that were ambiguous. Translating everything into tables forced us to think more carefully about keys and relationships.
- We noticed that some rules from the real world cannot always be fully enforced in the schema itself and will need extra checks in the application or with database triggers.

- **Lessons learned:**

- Understanding the relationships between entities is key before creating tables.
- Choosing the right primary keys, foreign keys, and composite keys is really important for keeping the data correct.
- ISA hierarchies require careful planning so that the design stays efficient and normalized.

5 Conclusion

In this lab, we successfully converted the conceptual ER model of the **Moroccan National Health Services (MNHS)** into a logical database schema. We defined all the tables, attributes, keys, and handled N:M relationships and ISA hierarchies. This logical design gives us a clear plan for building the database, keeping data organized and consistent. Overall, this lab showed how important logical design is in turning ideas from an ER diagram into something we can actually implement in a database.