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CSC 460 – Spring 22

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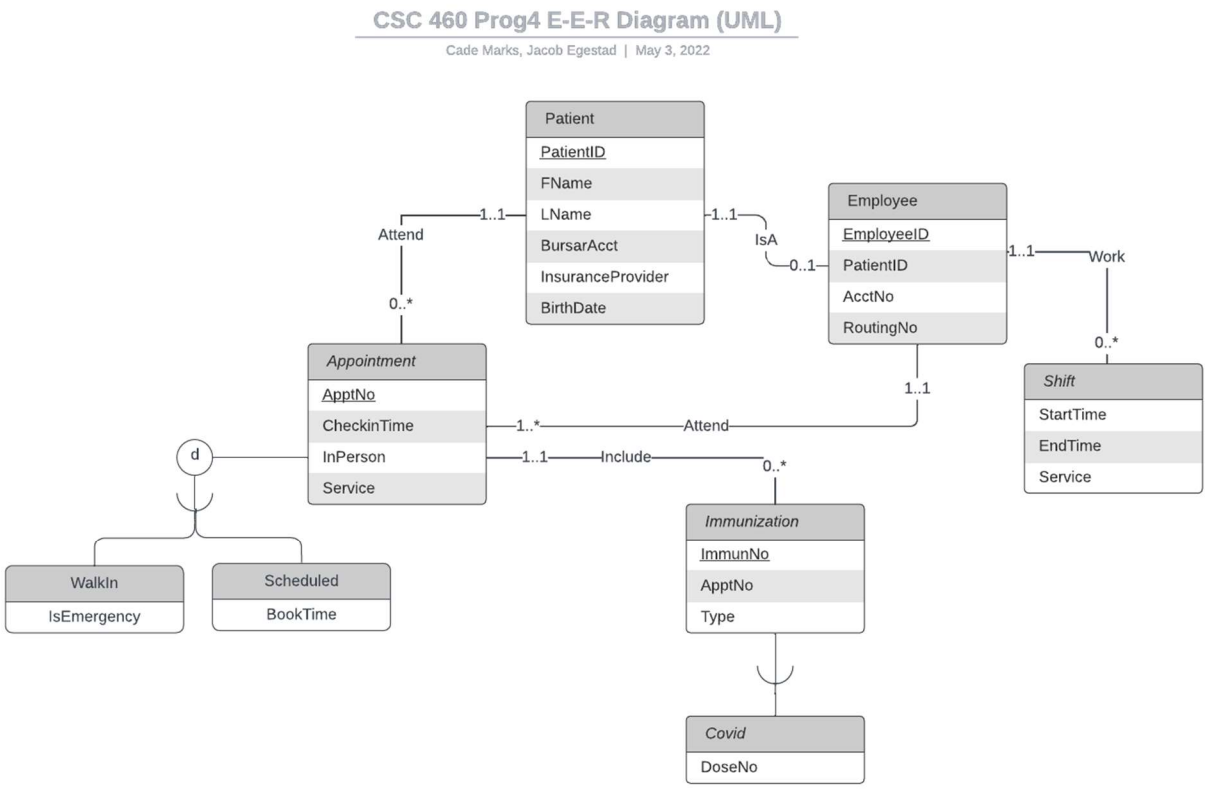
Program 4 Design Documentation

1. Conceptual database design



To begin with, it was obvious we needed a Patient, Employee, and Appointment relation. We realized that Employees are also Patients, though not necessarily the other way around. Rather than use specialization to represent this relationship, we decided to use a foreign key for employee to point to that employee's Patient record. We kept these separated in order to make organization of relationships with other relations more straightforward. For example, it doesn't make a lot of sense for a Patient to have a Shift.

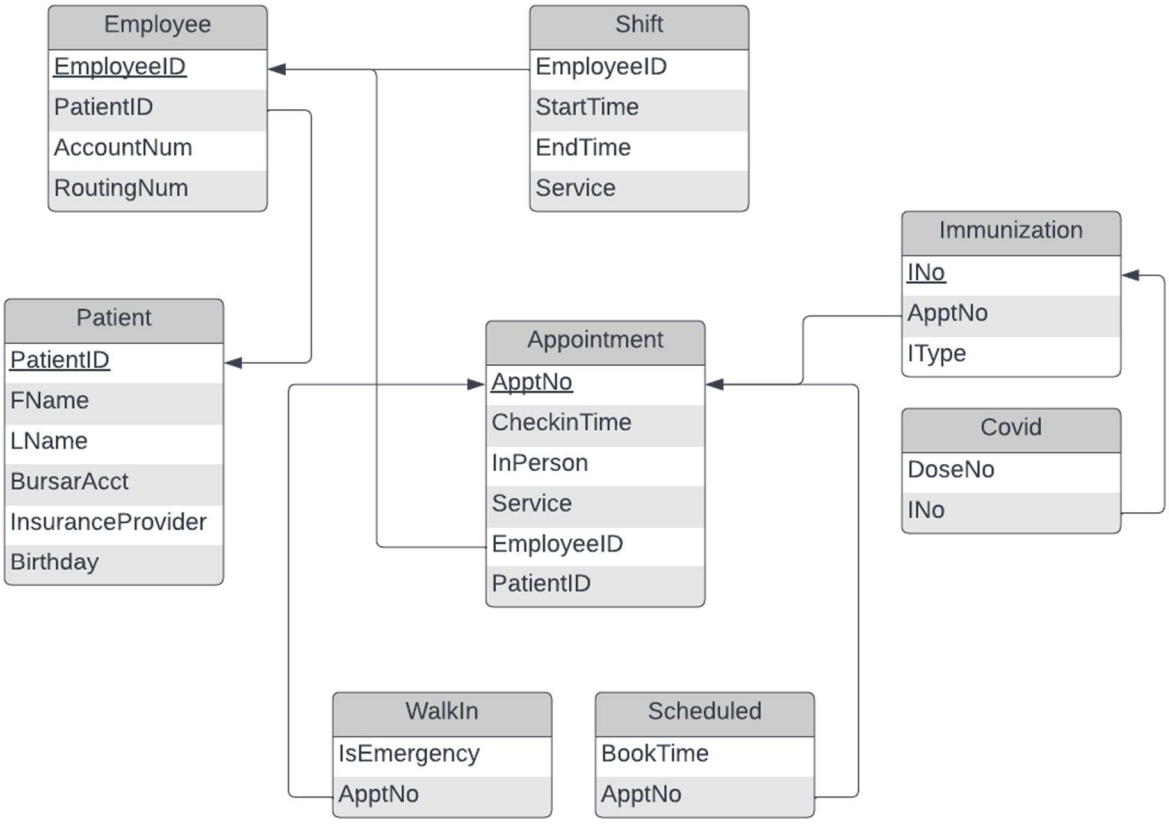
However, this meant we needed to add a restriction that Patients cannot be deleted from the Patient table if that patient's PatientID exists as a foreign key in the Employee table, so that we would not have invalid foreign keys for employee records. This makes sense because an employee cannot exist that is not also a patient.

We also added a Shift relation to track each employee's work schedules. Rather than include immunizations as an attribute of the Appointments relation, we made it its own relation, with specialization for COVID vaccinations, since they require us to track the additional information of a dose number. We also used disjoint specialization to model two different appointment types: walk-in and scheduled, since different information should be tracked for each.

Not displayed in our E-E-R diagram are various assertions we implemented to restrict entries into our tables. This includes preventing users from updating primary key values for each table, not allowing multiple appointments to overlap, and restricting the value of the binary InPerson attribute of the Appointment relation to 'Y' and 'N' values. Also not displayed in the diagram are most foreign keys, as they are implied by the relationships between the entities, though these are included in our SQL files for constructing each table. Additional restrictions include not allowing for two concurrent appointments and requiring patients over 50 have a fourth dose of the Covid-19 vaccine scheduled if the third has already been scheduled.

2. Logical database design

   The attribute names and primary-foreign key pairs match exactly the SQL implementation of our tables.



3. Normalization analysis

   Functional dependencies:

   - Employee
     - EmployeeID → {PatientID, AccountNum, RoutingNum}
     - PatientID → {EmployeeID, AccountNum, RoutingNum}
     - AccountNum → {PatientID, EmployeeID, RoutingNum}
   - Patient
     - PatientID → {FName, LName, BursarAcct, InsuranceProvider, Birthday}
     - BursarAcct → {PatientID, FName, LName, InsuranceProvider, Birthday}
   - Appointment
     - ApptNo → {CheckinTime, InPerson, Service, EmployeeID, PatientID}

    - CheckinTime → {ApptNo, InPerson, Service, EmployeeID, PatientID} (because appointments cannot overlap)
- Shift
    - {EmployeeID, StartTime} → {EndTime, Service}
    - {EmployeeID, EndTime} → {StartTime, Service}
- Immunization
    - INo → {ApptNo, IType}
- Covid
    - INo → DoseNo
- WalkIn
    - ApptNo → IsEmergency
- Scheduled
    - ApptNo → BookTime
    - BookTime →ApptNo (because appointments cannot overlap)

Because relations in Boyce-Codd Normal Form are a subset of those in 3NF, 2NF, and 1NF respectively, if we can prove these are all in BCNF, then they must too be in 3NF, 2NF, and 1NF. For each relation to be in BCNF, for each FD X → A in the relation, X must be a superkey (a set of attributes containing a candidate key). This holds for each of the above functional dependencies, and thus, these relations are all in Boyce-Codd Normal Form.

4. Query description

Our chosen query returns a list of patients' names who have been immunized for an illness input by the user, sorted by name, alphabetically. This could be used by the

Campus Health staff to get a wide view of how many and which individuals have been vaccinated for any illness, allowing them to then reach out to those not on the list or to just study this as a piece of valuable information.