Database Modeling

Information Systems and Databases

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1 Introduction

This project concerns the development of an information system supporting the day-to-day operations of a dental clinic. The relational database associated with this information system aims, not only to offer an all-purpose archive and organization tool for the different types of data generated during clinical practice, but also to provide a complete data mining platform.

2 Entity-Relationship Model

The Entity-Relationship (E-R) Model in Figure 1 describes the proposed database desgin.

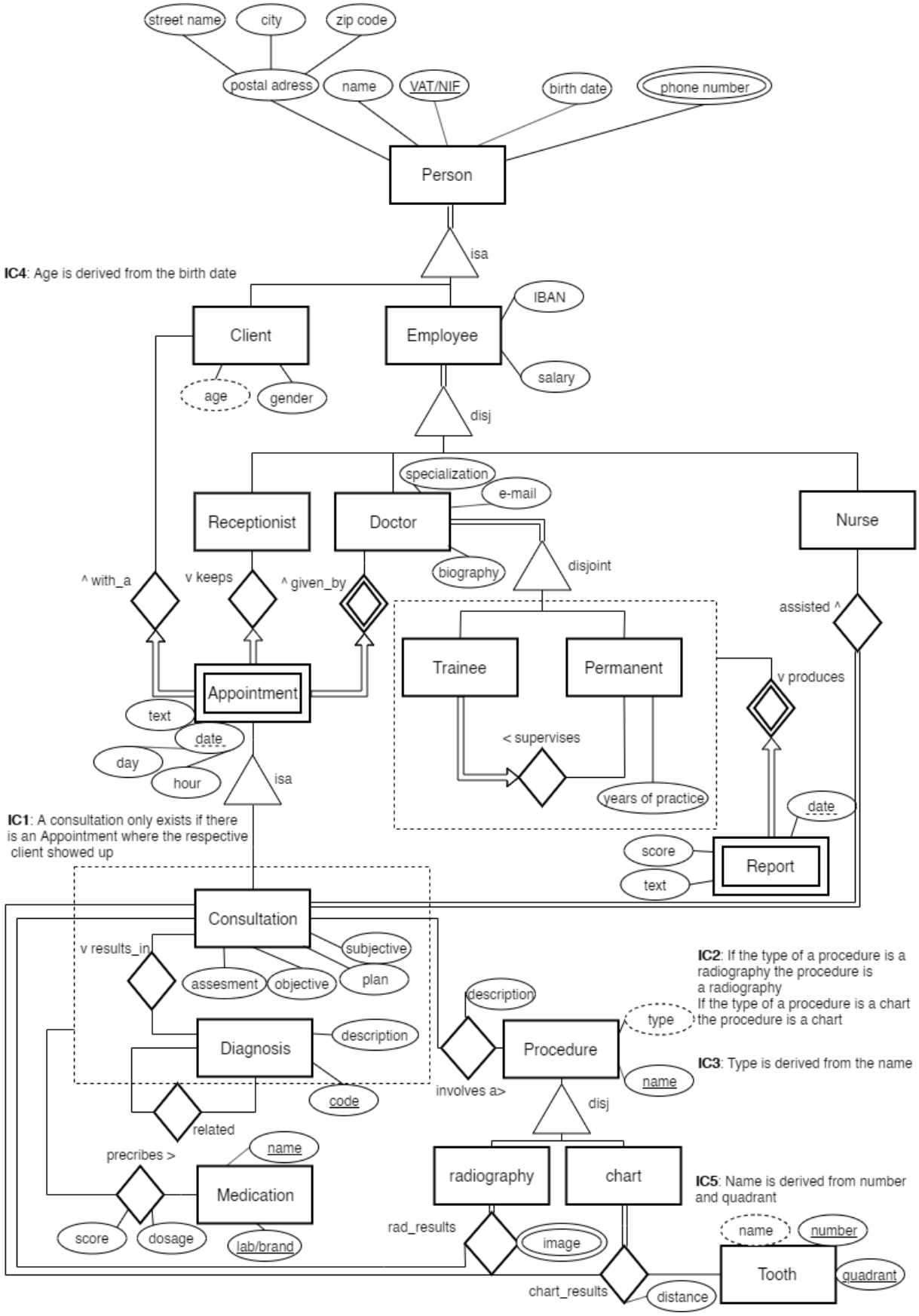

Figure 1: Entity-Relationship Model

2.1 Comments on the diagram

Person

Since every person that interacts with the Dental Clinic has a set of common attributes independently of it's role there, the entity "Person" was created to increase the model's simplicity and legibility, as well as it's extensibility. Nevertheless, all Employees still share certain attributes (salary and IBAN) that clients do not, so the "Employee" entity was created for the previously stated purpose. Since both clients and employees are people, they are all uniquely defined by their VAT or NIF number, we could also identify the employees by their IBAN, but clients do not have this attribute so it makes more sense to identify every person by the same attribute.

Report

The report was made a weak entity, since, besides the date, it also requires a Trainee and a Permanent doctor to be uniquely defined.

Appointments and Consultations

There can not be two consultations with the same Doctor in the same date (Day and time), so an Appointment must be uniquely defined by the responsible Doctor's id and by it's date. Therefore, an Appointment must be a weak entity.

A Consultation is a special case of an Appointment (it is only created if the client shows up), inheriting the appointment's date and the responsible doctor. Additionally, the SOAP annotations are available separately as Subjective, Plan, Objective and Assessment notes. Since these are optional, they can be null, which is not an issue when designing a database.

Procedures

Three type of procedures were found, Radiography exams which require a path to the resulting images, Dental charting exams which require the storage of each tooth's distance, and general procedures that do not require the storage of additional information other than the type and name of procedure. The first two procedures are special cases of the last one, hence the inheritance show in the model diagram. For this procedures, several loops were created (each entity explained above has a relation with the Consultation entity), this loops are justified with the need of having different attributes (mentioned before) associated with the relation of each special case of procedures and the consultation entity.

Diagnoses

To allow relations between diagnoses, the relationship "related" was created in order to allow a diagnose to relate to another diagnose, which by itself may be related to another diagnoses.

Medication

To avoid fake prescriptions, one must be associated with a consultation in which the responsible doctor was able to complete a diagnose, hence the relationship between the entity Medication and the aggregate with "results_in".

3 Relational Model

```
Person(VAT/NIF, birth date, name, street name, city , zip code)
Phone numbers(VAT/NIF, phone number)
    VAT/NIF : FK(Person)

Client(VAT/NIF, age, gender)
    VAT/NIF : FK(Person)

Employee(VAT/NIF, IBAN, salary)
    VAT/NIF : FK(Person)

Doctor(VAT/NIF, specialization, email, biography)
    VAT/NIF : FK(Employee)

Permanent(VAT/NIF, years of practice)
    VAT/NIF : FK(Doctor)

Trainee(VAT/NIF, permanent_id)
    VAT/NIF : FK(Doctor)
    permanent_id: FK(Permanent)

IC1: All doctors must be a trainee or a permanent, but not both

Receptionist(VAT/NIF)
    VAT/NIF : FK(Employee)

Nurse(VAT/NIF)
    VAT/NIF : FK(Employee)

IC2: An Employee must be a receptionist, a doctor or a nurse, but not
    more than one at the same time.

Diagnosis(code, description)

Medication(name, lab/brand)

Procedure(name,type)

Radiography(name)
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    name: FK(Procedure)

Dental Chart(name)
    name: FK(Procedure)

IC3: A procedure can be a radiography, a dental chart or other.

Tooth(number, quadrant, name)

IC4: Name is derived from number and quadrant

Appointment(doctor_id, date_day, date_hour, text, client_id,
   receptionist_id)
    doctor_id: FK(Doctor)
    client_id: FK(Client)
    receptionist_id: FK(Receptionist)

Consultation(doctor_id, date_day, date_hour, plan, subjective,
   objective, assessment)
    doctor_id, date_day, date_hour: FK(Appointment)

Report(trainee_id, date, permanent_id, text, score)
    trainee_id: FK(Trainee)
    permanent_id: FK(Permanent)

assisted(doctor_id, date_day, date_hour, nurse_id)
    doctor_id, date_day, date_hour: FK(Consultation)
    nurse_id: FK(Nurse)

IC5: Every primary key in Consultation should appear in Assisted

results_in(doctor_id, date_day, date_hour, code)
    doctor_id, date_day, date_hour: FK(Consultation)
    code: FK(Diagnosis)

related(code1,code2)
    code1: FK(Diagnosis)
    code2: FK(Diagnosis)

prescribes(doctor_id, date_day, date_hour, code, lab/brand, name,
   score, dosage)
    doctor_id, date_day, date_hour, code: FK(Results_in)
    lab/brand, name: FK(Medication)

involves_a(doctor_id, date_day, date_hour, name, description)
    doctor_id, date_day, date_hour: FK(Consultation)
    name: FK(Procedure)
```

```
rad_results(name, code,date_day,date_hour,doctor_id)
    name: FK(radiography)
    code date_day, date_hour,VAT/NIF: FK(results_in)
images(name, code, date_day, date_hour, doctor_id, images_key)

IC6: A Radiography must always have a rad_results

chart_results(number, quadrant, code, date_day, date_hour, doctor_id,
    distance)
    name: FK(chart)
    number, quadrant: FK(tooth)
    code date_day, date_hour,doctor_id: FK(results_in)

IC7: A Chart must always have a chart_results
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3.1 Comments on the Relational Model

Trainee

Every Trainee is supervised by one and only one permanent doctor making it possible to represent the "supervises" relation directly on the "Trainee" table, adding just one attribute corresponding to the identification of the supervisor.

Weak Entities

There are two weak entities on the proposed database (Appointment and Report). Each weak entity is completely characterized by it's attributes plus the primary key of the corresponding strong entity, which means that for the relational model we can simply store this primary key on the table of the weak entity as a foreign key, dropping the need to add more tables to model the relations between weak and strong entities.

Report

We considered the report as a special type of weak entity, because it is true that each report requires a relation between a permanent doctor and a trainee, but it is also true that each report is completely identified by the date and the trainee ID, this would lead us to only store one foreign key on the "report" table, corresponding to the trainee id. Even knowing this, We still decided to also store the identification of the permanent doctor who wrote the report, since on the eventuality of a trainee changing his supervisor we would lose completely the information of who wrote the reports before the change.