Information Systems and Databases

Project Assignment (part I)

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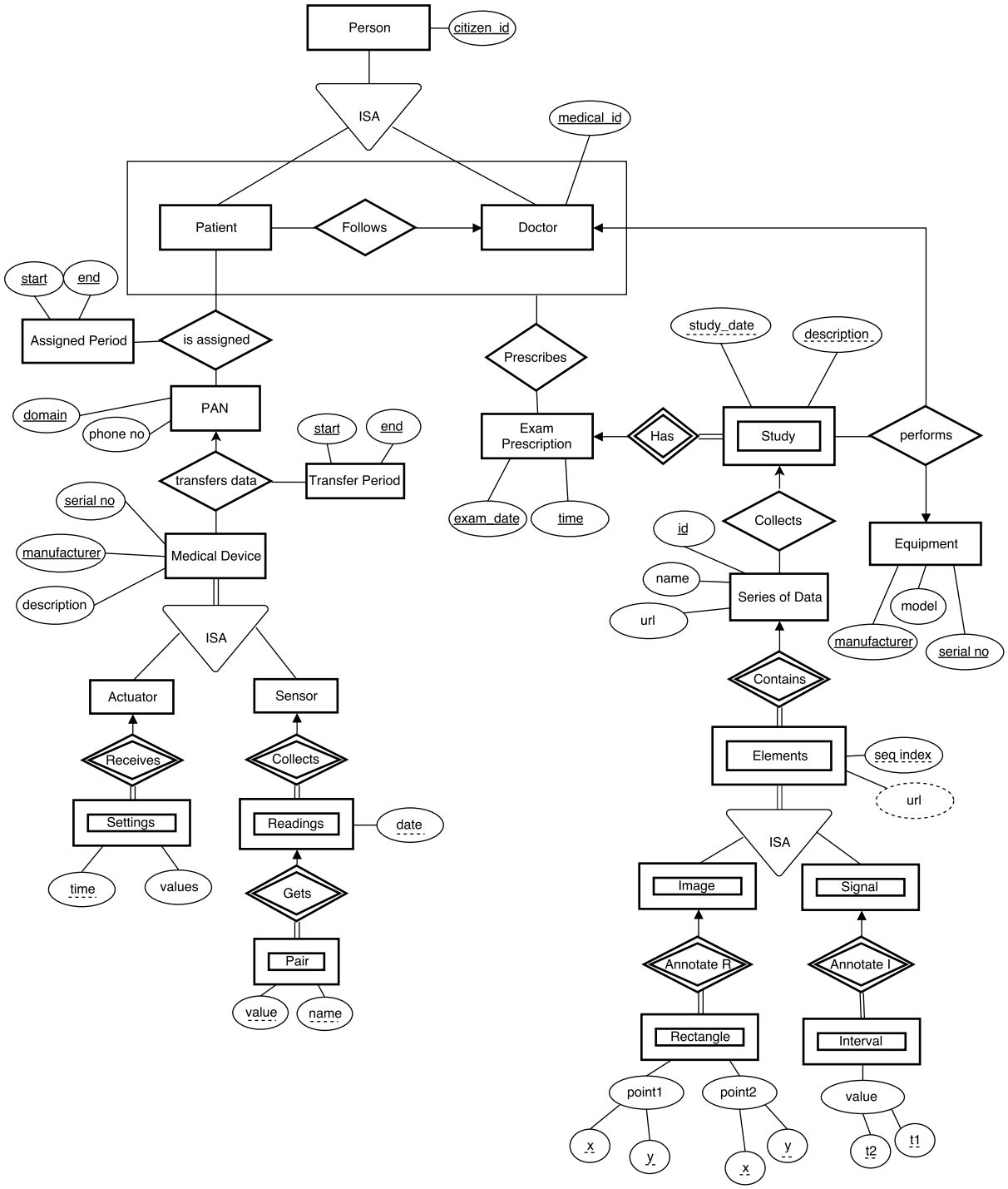
October 25, 2017

1 E-R Model


Person
citizen_id
ISA
medical_id
Patient
Follows
Doctor
start
end
Assigned Period
is assigned
Prescribes
study_date
description
PAN
domain
phone no
start
end
Exam Prescription
Has
Study
performs
transfers data
Transfer Period
exam_date
time
id
Collects
Equipment
serial no
manufacturer
Medical Device
name
Series of Data
model
description
url
manufacturer
serial no
ISA
Contains
Actuator
Sensor
Elements
seq index
Receives
Collects
url
Settings
Readings
date
ISA
time
values
Gets
Image
Signal
Pair
Annotate R
Annotate I
value
name
Rectangle
Interval
point1
point2
value
x
y
y
x
t2
t1

2 Table conversion

2.1 Strong Entities

Person(*citizen_id*)

PAN(*domain*, *phone_no*)

Medical_Device(*serial_no*, *manufacturer*, *description*)

Series_of_Data(*id*, *name*, *url*)

Exam_Prescription(*exam_date*, *time*)

Equipment(*serial_no*, *manufacturer*, *model*)

Assigned_Period(*start*, *end*)

Transfer_Period(*start*, *end*)

2.2 Specializations

Patient(*citizen_id*)
citizen_id : FK(*Person*)

Doctor(*citizen_id*, *medical_id*)
citizen_id : FK(*Person*)

Image(*seq_index*)
seq_index : FK(*Elements*)

Signal(*seq_index*)
seq_index : FK(*Elements*)

Actuator(*serial_no*, *manufacturer*)
serial_no, *manufacturer* : FK(*Medical_Device*)

Sensor(*serial_no*, *manufacturer*)
serial_no, *manufacturer* : FK(*Medical_Device*)

2.3 Weak entities

Settings(<u>*serial_no*</u>, <u>*manufacturer*</u>, <u>*time*</u>, *values*)
serial_no, *manufacturer* : FK(*Medical_Device*)

Readings(<u>*serial_no*</u>, <u>*manufacturer*</u>, <u>*date*</u>)
serial_no, *manufacturer* : FK(*Medical_Device*)

Study(<u>*exam_date*</u>, <u>*time*</u>, <u>*study_date*</u>, <u>*study_description*</u>)
exam_date, *time* : FK(*Exam_Prescription*)

Elements(<u>*id*</u>, <u>*seq_index*</u>)
id : FK(*Series_of_Data*)

Rectangle(<u>*id*</u>, <u>*seq_index*</u>, <u>*x1*</u>, <u>*y1*</u>, <u>*x2*</u>, <u>*y2*</u>)
id : FK(*Series_of_Data*)
seq_index : FK(*Elements*)

Image(<u>*id*</u>, <u>*seq_index*</u>, <u>*t1*</u>, <u>*t2*</u>)
id : FK(*Series_of_Data*)
seq_index : FK(*Elements*)

2.4 Relationships

follows(<u>*citizen_id*</u>, <u>*medical_id*</u>)
citizen_id : FK(*Patient*)
medical_id : FK(*Doctor*)

is_assigned(<u>*citizen_id*</u>, <u>*domain*</u>, <u>*start*</u>, <u>*end*</u>)
citizen_id : FK(*Patient*)
domain : FK(*PAN*)
start, *end* : FK(*Assigned_Period*)

transfers_data(<u>*domain*</u>, <u>*serial_no*</u>, <u>*manufacturer*</u>, <u>*start*</u>, <u>*end*</u>)
domain : FK(*PAN*)
serial_no, *manufacturer* : FK(*Medical_Device*)
start, *end* : FK(*Transfer_Period*)

prescribes(<u>*citizen_id*</u>, <u>*medical_id*</u>, <u>*exam_date*</u>, <u>*time*</u>)
citizen_id : FK(*Patient*)
medical_id : FK(*Doctor*)
exam_date, *time* : FK(*Exam_Prescription*)

performs(<u>*exam_date*</u>, <u>*time*</u>, <u>*study_date*</u>, <u>*description*</u>, <u>*medical_id*</u>, <u>*serial_no*</u>, <u>*manufacturer*</u>)
exam_date, *time* : FK(*Exam_Prescription*)
study_date, *description* : FK(*Study*)
medical_id : FK(*Doctor*)
serial_no, *manufacturer* : FK(*Equipment*)

3 Design Decisions

The first considerations we will make are related to the constraints we identified and couldn't model, such as:

- the date when the exam is performed must be posterior to when it is prescribed
- the doctor that performs the exam must be different from the one that prescribes it
- a medical device in use by a patient can only be connected to that patient's PAN
- the range (0.0, 1.0) of the region (rectangle or interval) annotated

Next, we will explain our choices regarding the weak entities. Since the *Readings* and the *Settings* couldn't be identified by themselves, because there could be several readings/settings of the same physical measure with the same date/time, their only unique identifier was the device that measured them. Therefore we modeled them as weak entites of *Sensor*/*Actuator*, respectively. The same reasoning is valid for the *Pair* weak entity, which is needed because the same reading can have a vector of values and if we didn't have this weak entity we wouldn't be able to associate all the values of to the same reading. All the values would be interpreted as several readings and not as only one reading.

We also modeled *Study* as a weak entity, since there could be several studies with the same date and description, and therefore those weren't unique identifiers. In order to identify a study, we had to do it by checking which *Exam Prescription* it belongs to. Here, we are assuming that *Exam Prescription* is a strong entity, since the exam date and time attributes are enough to make it unique.

Elements was also considered a weak entity because it didn't have a unique id. It has to be identified by the series of data to which it belongs to. Here we considered *Series_of_Data* a strong entity since it is said that the id is unique, therefore no two studies could have series of data with the same identifier.

Image and *Signal* were modeled as weak entities because they are a specialization of a weak entity and, because the key is the same, they had to be weak entities as well. We modeled this specialization as disjoint because an element cannot be an image and a signal at the same time. It must be one or the other.

Finally we decided to model *Rectangle* and *Interval* as weak entities because there could be several rectangles/intervals with the same coordinates/points and the only way to distinguish them was be the element to which they belonged.

Another important aspect is the reason behind modeling *Assigned_Period* as a strong entity. We did this in order to be able to model that a PAN could be associated with a patient in a specific period and then disconnected from that patient and connected to other patients for other periods of time. Similarly, *Transfer_Period* is also a strong entity, so that we can model that a medical device is connected to a PAN during a specific period of time and may be disconnected after some time or even reconnected.

Despite all the resemblances between the aforementioned entities, there is one crucial diference: while a PAN can only be assigned to one patient in a period of time, several medical devices can be connected to the same PAN in the same transfer period.