Healthcare-EHR-SynData

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course of Knowledge Graph Engineering

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Purpose and DoI

"A service which facilitates citizens to handle (their own) healthcare data, in a context in which the citizens moves around Europe "

- Improved productivity of physicians
- Improved patient care delivery
- Facilitated cross-border care
- Easier data processing

Resources

Knowledge resources:

- schema.org
- FHIR

Database used:

- Synthea
- EMRBOTS

Purpose formalization - personas, scenario, CQ

Pedro

cardiologist at La Fe university and polytechnic hospital in Valencia, Spain.

CQ: Pedro is a cardiologist at La Fe Hospital in Valencia. During its work time a foreign patient arrives to the hospital unconscious.To intervene the doctor needs to know the patient medical records in order to safely operate.

Sonia

Italian woman from Olmeneta, Italy.

CQ: Sonia is an Italian woman from Olmeneta, Italy. She is 67 years-old and decides to travel around Andalusia (Spain) for a couple of weeks. One day, during her trip she notices a cutaneous rush. She travels to the nearest emergency room but does not speak spanish.

Andreas

Biotechnologist at the university hospital in Berlin.

CQ: Andreas is a biotechnologist who works at the university hospital of Berlin. He usually perform analysis on the patients' lab samples.He need a records of the already performed tests in order to avoid running duplicate tests.

Inception phase - synthea

- Patient ID: unique identifier
- Name: name and surname of the patient
- Gender
- Birthdate
- Marital Status
- Address: complete address
- Language: spoken language
- Encounters: encounters conducted on the patient with the relative diagnosis description and code
- Careplans: description of the careplan for each encounter
- Devices: devices used by the patient (i.e.: wheelchair)
- Allergy
- Treatment: the treatment prescribed to the patient
- Dosage: dosage of the treatment
- Immunizations

Inception phase - EMRBOTS

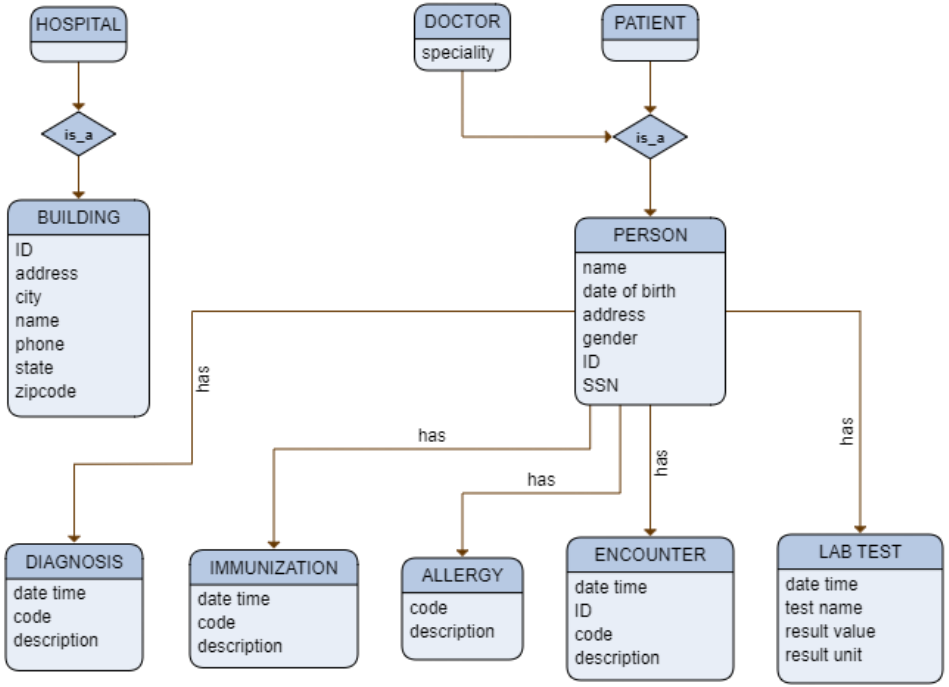
- Patient ID
- Gender
- Birthdate
- Population percentage below poverty
- Marital status
- Admission ID: unique identifier for the patient’s admission
- Admission start and end date and time
- Primary diagnosis code: ICD-10 code for the diagnosis
- Primary diagnosis description
- Lab test name
- Lab test result
- Lab test date

Informal Modeling

10 ETypes

2 Parent classes
building, person

3 Subclasses
hospital, patient, doctor

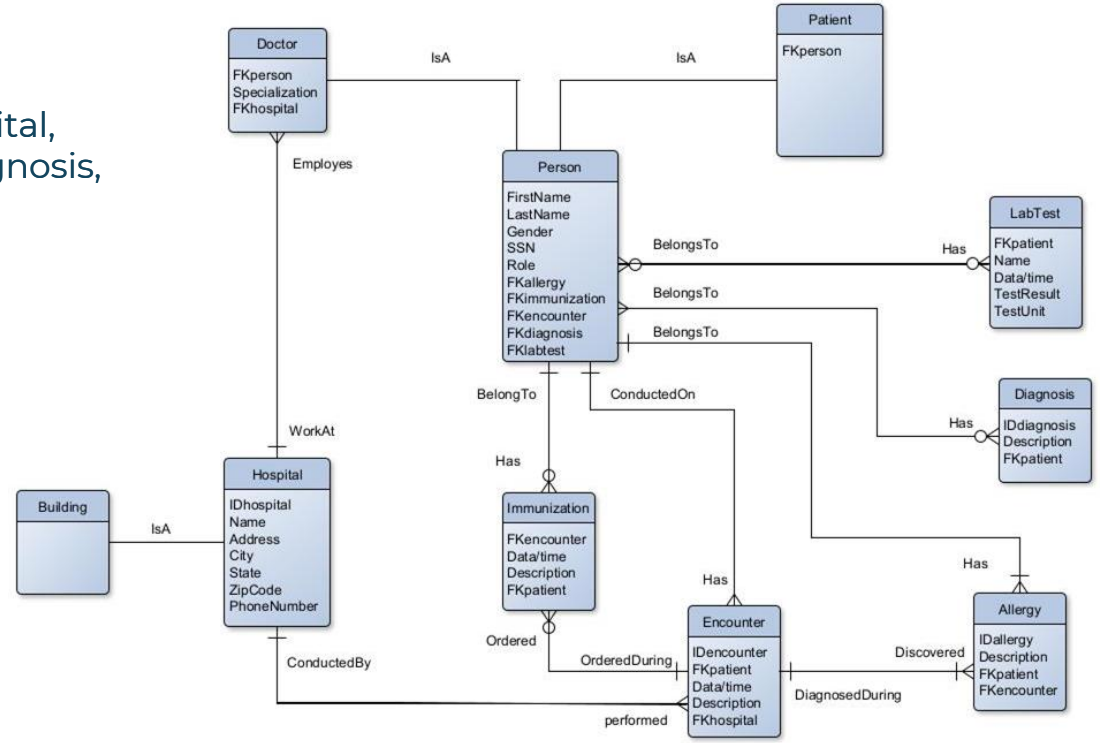


Informal Modeling

10 ETypes
person, patient, doctor, building, hospital, allergy, immunization, encounter, diagnosis, lab test

19 Object Properties

27 Data Properties



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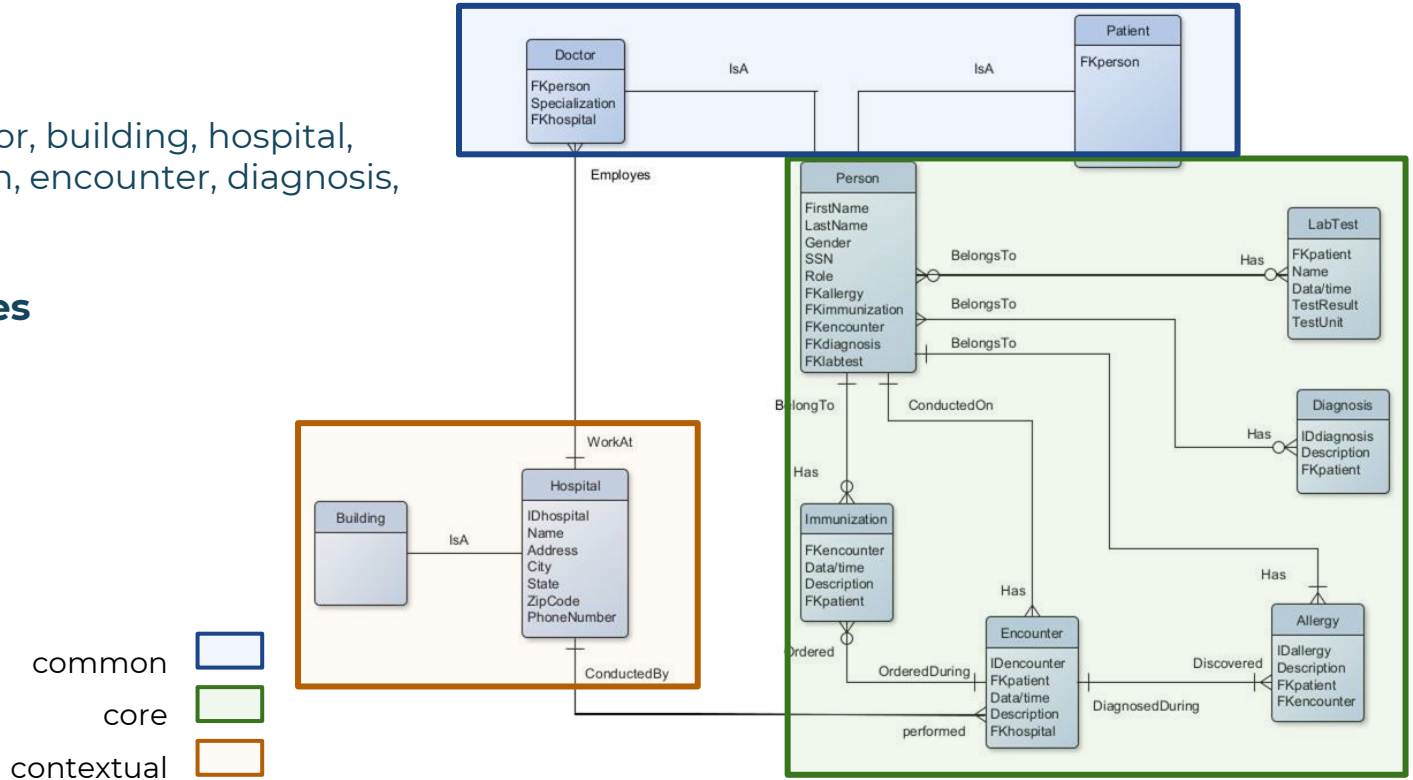
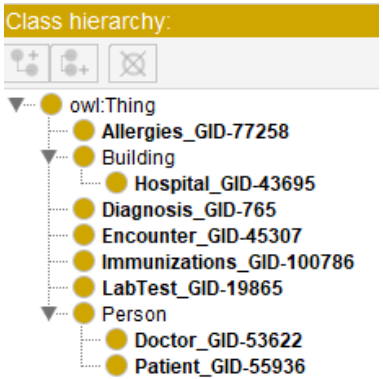


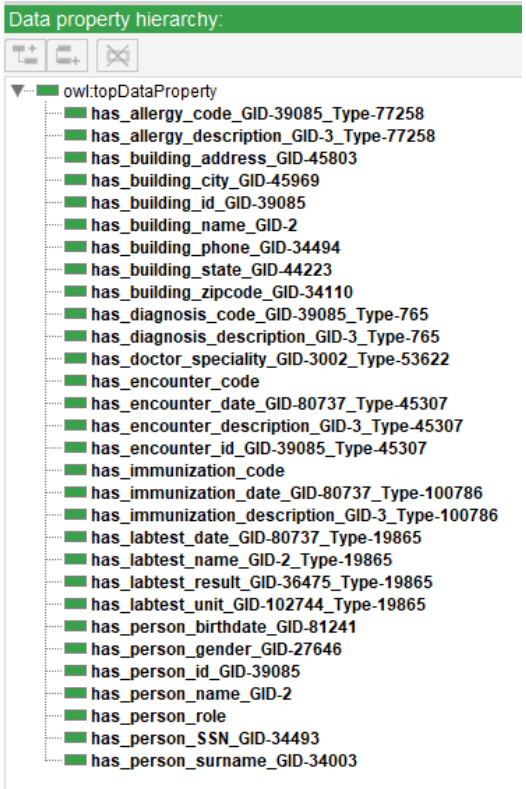
Formal Modeling

- **Schema building**

- Addressing **Language Misalignment**
  - data types misalignment
  - data value format misalignment

Integration of already present elements and new elements generated ad hoc using KOS

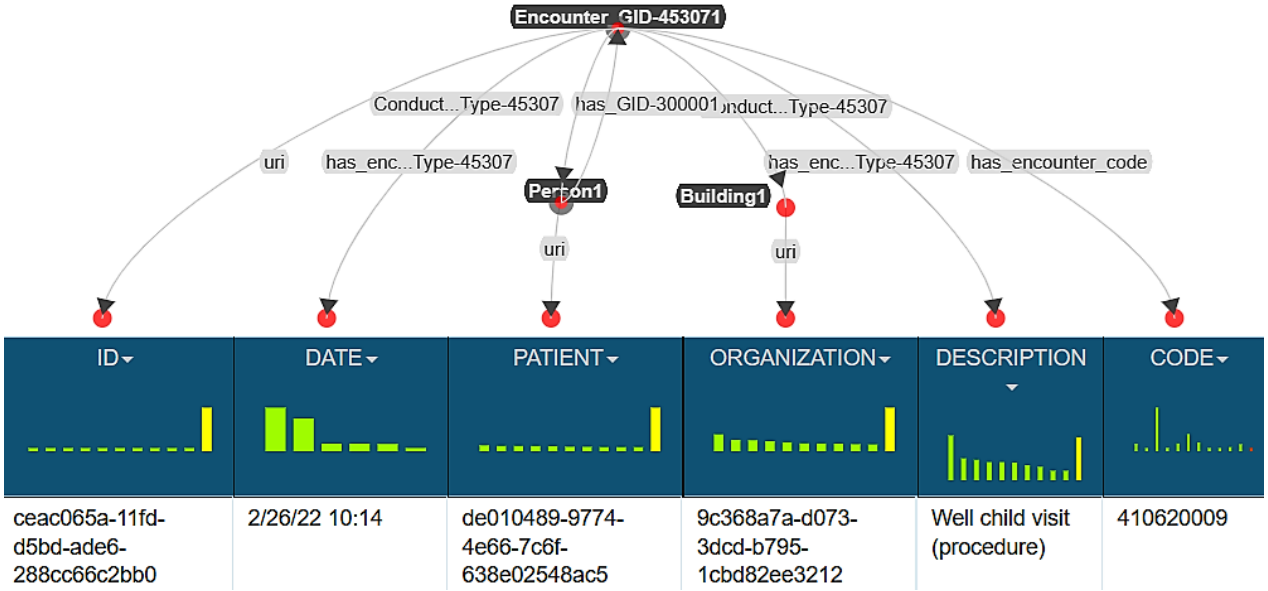




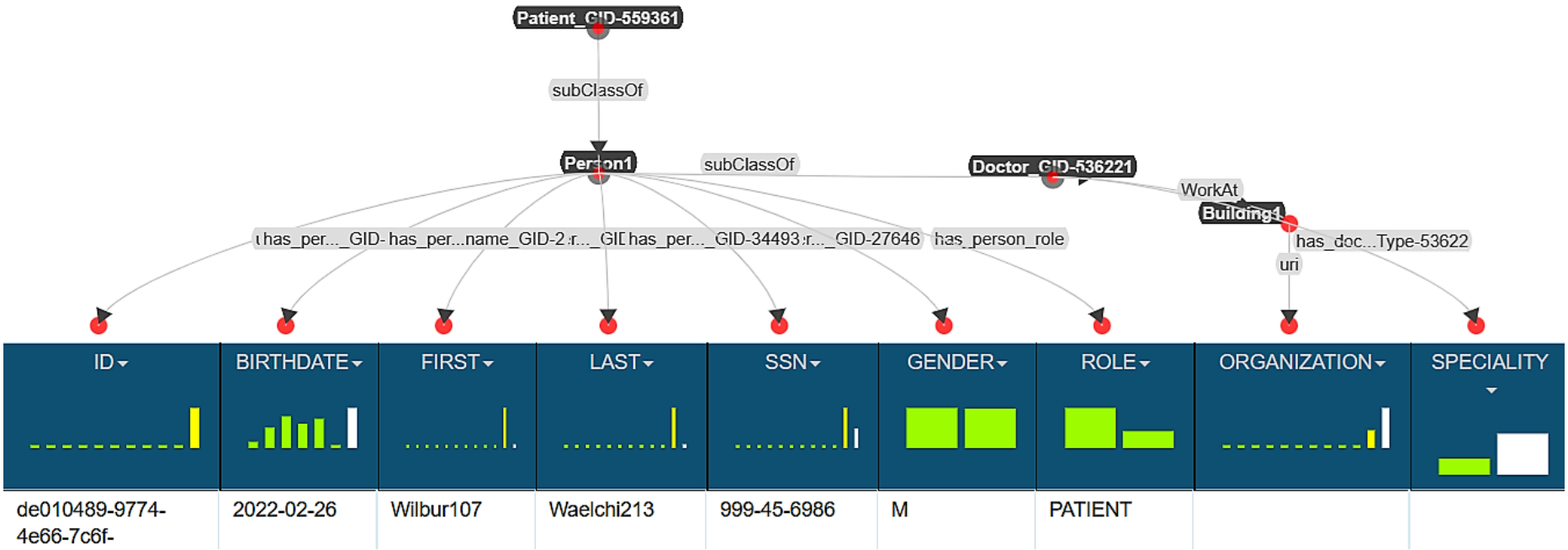
Data Integration

Mapping of **7** different **datasets** to the ETG
people, buildings, immunization, lab test, allergy, encounter, diagnosis

Karmalinker



Data Integration



SPARQL Query

Pedro 1.3 CQ

A list of the most recent blood test for a specific patient is returned with values associated

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

SELECT ?PersonName ?PersonSurname ?LabTestName ?LabTestValue ?LabtestUnit ?LabTestDate WHERE {
    ?Person a <http://knowdive.disi.unitn.it/etype#Person> ;
            <http://knowdive.disi.unitn.it/etype#has_person_name_GID-2> ?PersonName ;
            <http://knowdive.disi.unitn.it/etype#has_person_surname_GID-34003> ?PersonSurname.
    ?LabTest a <http://www.semanticweb.org/simone/ontologies/2021/10/untitled-ontology-34#LabTest_GID-19865> ;
             <http://www.semanticweb.org/simone/ontologies/2021/10/untitled-ontology-34#has_labtest_name_GID-2_Type-19865> ?LabTestName
;
             <http://www.semanticweb.org/simone/ontologies/2021/10/untitled-ontology-34#has_labtest_result_GID-36475_Type-19865> ?
LabTestValue ;
             <http://www.semanticweb.org/simone/ontologies/2021/10/untitled-ontology-34#has_labtest_unit_GID-102744_Type-19865> ?
LabtestUnit ;
             <http://www.semanticweb.org/simone/ontologies/2021/10/untitled-ontology-34#has_labtest_date_GID-80737_Type-19865> ?
LabTestDate .

    FILTER REGEX (?LabTestName, "^CBC*") .
    FILTER(?PersonName = "Bess947") .
}
```

SPARQL Query

Pedro 1.3 CQ

A list of the most recent blood test for a specific patient is returned with values associated

PersonName	PersonSurname	LabTestName	LabTestValue	LabtestUnit	LabTestDate
Bess947	Huels583	CBC: HEMATOCRIT	440	%	9/30/97 9:38
Bess947	Huels583	CBC: HEMATOCRIT	324	%	9/30/97 22:57
Bess947	Huels583	CBC: WHITE BLOOD CELL COUNT	91	k/cumm	9/30/97 16:56
Bess947	Huels583	CBC: MEAN CORPUSCULAR VOLUME	778	fl	9/30/97 16:52
Bess947	Huels583	CBC: ABSOLUTE NEUTROPHILS	728	%	9/30/97 16:41

Evaluation

- no polysemous attributes
- no repeated data properties
- classes are distincted

After the adjustments the graph is able to solve most of the CQs.

ENTITIES COVERAGE	10/10	1
PROPERTIES COVERAGE	(45 + 20 - 7)/(45 + 20)	0.89

Open Issues

- Datasets not fully representative DoI
- ETG had to be modified to make GraphDB work
- date data type issue

THANK YOU FOR YOUR ATTENTION !