6. Unit: Protégé, SWRL-Rules and Ontology construction

Imagine a fantasy medieval society in which there are different social classes. Each person lives in a building appropriate to their state and these buildings have certain room types (e.g. a chapel has a chancel and a craftsman's house has a workshop) and general room types that can occur in different buildings (each house can have a bedroom or a kitchen). Similarly, in each room there is furniture that is either general (e.g. a chair or a shelf) or only suitable for specific rooms (e.g. a stove or a bed). The overall goal is to create such an ontology, establish restrictions and rules to make those rooms and houses comprehensible. Then create a java program to generates houses, rooms and inhabitants, for given instances.

Exercise 6.1 Model the class structure in Protégé and decide which classes are disjoint and which are not. Note that this are not all classes needed for this exercise, model the necessary additional classes by yourselves. Read the entire exercise sheet first, to tailor the ontology to the requirement.

There are Persons, stands and Objects.

Person: *female, male, adult, child, married, unmarried*

Stands: *servants, peasants, craftsmen, merchants, cleric, nobles*

Object: *House, Room, Furniture*

For Objects the following types exists:

House: *castle, mansion, townhouse, hut*

Room: *bathroom, bedroom, dining room, hallway (staircase), kitchen, library, living-room, storeroom, workshop, shop*

Furniture: *decoration (pictures, sculptures), seatings (beds, chairs), storage (wardrobe, shelf, chest, drawers, bookshelf), table (desk, dining table, side table (bedside table)), workingStation (cookingStation, craftingStation, writingStation)*

Exercise 6.2 Extend the ontology with the following restrictions, rules and properties. Again not all is mentioned, find necessary or logical additions.

Persons

- Persons can be adults or children.
- Persons are either women or men. (It's medieval!)
- Man and woman have equal rights, they can both be of any stand and own objects (it's fantasy!)
- Women can only be married to one man and vice versa.
- Children cannot be married. (But not so much medieval!)
- If a person owns an object, this person also owns all objects this object has. (E.g if someone owns a house, she also owns the rooms and if she owns the room she also owns the furniture etc.)
- Each person has two parents (a mother and a father), a stand and lives in a house.
- Children are younger than 15
- Children have the same stand than their parents
- Marriage is only allowed between people of the same stand.
- A person owns everything her/his spouse owns.
- Each object is owned by at least one person.
- **Nobels**
  - always own the house they live in if they are adult
  - all furniture in their house is expensive
- Clerics
  - have always an altar in their houses
  - have always a writing station

- all furniture is mediocre or valuable
- Merchant
  - all furniture is mediocre
  - have a storage room and a shop
- Craftsman
  - have a working station in their house
  - all furniture is cheap or mediocre
- Peasant
  - all furniture is cheap

Houses have ...

- one or more entrances
- at least one room
- at least one owner
- at least one inhabitant
- at most one kitchen
- at most one library
- **Castels**
  - have a least 15 rooms at most 30
  - at least 4 bedrooms
  - are owed by a cleric or a nobel
  - have a workshop
  - have a library
  - have a kitchen
  - have a staircase
  - have a hallway
  - have a living-room
- **Mansions**
  - have at least 10 rooms at most 20
  - at least 3 bedrooms
  - are owed by a cleric or a nobel or a merchant
  - have a library
  - have a kitchen
  - have a hallway
  - have a living-room
  - do not have a workshop
- **Townhouses**
  - have at most 8 rooms
  - at least 2 bedrooms
  - are owed by a cleric or a craftsman or a merchant
  - can have a library
  - have a kitchen

- have a staircase
- have a hallway
- have a living-room
- **Huts**
  - have at most 2 rooms
  - can only have bedrooms or kitchens
  - are only owned by peasants or servants

Rooms have ...

- furniture
- at least one entrance
- can have windows
- a size that indicates how many pieces of furniture fit into a room at most.
- Assume that rooms cannot be used for different purposes (i.e. a room cannot be a bedroom and a kitchen at the same time).
- **Bathrooms**
  - contain a bathtub
  - contain a toilet
- **Bedroom**
  - contain at least one bed
  - contain at least one storage facility
  - only have one door
- **Dinning Room**
  - contain one or more tables
  - contain at least three chairs
- **Hallways**
  - have more than one door
  - have only furniture of type decoration, light source, storage or table
  - **Staircase**
    * have one or two stairs
- **Kitchens**
  - have one cooking station
  - have at least two storage facilities and one table
- **Libraries**
  - have at least 3 bookshelves
  - have some seating
  - have some writing stations
- **Living Room**
  - have at least four chairs
  - have some decoration
- **Storage Rooms**

- – have only storage facility as furniture
- **Workshop Room**
  - – have at least one working station
  - – have some storage facilities
  - – have no decoration.

Furniture

- can correspond to more than one class (e.g. a chandelier can be both a light source and a decoration and a bedside table can be both a table and a storage facility).
- have one value of {cheap, mediocre, expensive}

Exercise 6.3 Construct all individuals mentioned below (written in **bold** are named entities, otherwise they are blank). Use only explicit mentioned classes, properties etc. Decide which information are flavor text and which are actually useful and depictable information in context of the constructed Ontology.

- **Vladimir Petrovich** is a priest living in his small **chapel**. He is in front of his altar just finishing his prayer, he wants to go to the kitchen, grab something to eat, next he wants to get a book from the self and then go to his bed and read.
- **Rudolf Ivanovich** and his wife **Katrina lvanova** own the tavern **River Shine Inn**. They have two sons **Artjom** and **Andrej**. The boys share one room and the parents have a master bed room for their own. Further they have 3 guest rooms.
- **Baron Yesper Taltos** lives in his mansion with his wife and his son, further his servant **Miroslav Strazni** lives also in the house. His wife is known to give tea parties for some random citizens each saturday. Most people only come to see the impressive dinning room with seating for 12 people.
- **Victoria Oronova** is a rich merchant, but also is the head of a secret cult. While her two sons are not interested in the occult, her followers see her as the high priest of a dark deity. It is known that her library is full of ancient texts, but only she knows that the most valuable texts are in a bookshelf in a storage room behind a secret door.
- A old townhouse with a sign **Coffin maker** has been abandoned for a long time. Through the windows a room with a carpenter work bank and three shelves and four crates are seen. Another smaller room contains nothing but a stair. Rumors say that his five masterful carvings of landscapes (landscape portraits) are still at their places, one in each room of the upper floor.
- The peasants **Dragomir Szoldarovich** and **Marek Kurshkin** have married sisters, but their **mother-in-law** only likes Dragomir. She thinks that Marek should provide her daughter a house with a kitchen as well.

Exercise 6.4 Write a program that generates for a known house, the not mentioned rooms, doors and furniture, so that the Ontology is still valid. Use the list of x to generate objects randomly. Use "same as" and "subclassOf" to adapt them to your ontology.

Create a SPARLQ query to describe a house with all its rooms and a second query to describe a specific room (list all furniture and doors and where they lead to)

Generate the whole buildings for each Person/House mentioned in exercise 6.3

Exercise 6.5 Write a program which can find all ways form one room into another (without reentering a room again). Then answer the following questions with it.

- Through which rooms does **Vladimir Petrovich** go before he goes to bed? What does his bedroom looks like?
- **Artjom** and **Andrej** want to put a toad into one of their guest rooms bed, but their mother is in the taproom behind the bar and would not approve their idea. Is there another way to reach at least one guest room unseen?

- Which stand does **Dragomir Szoldarovich** and **Marek Kurshkin** mother-in-law have?
- A thief is planing to break into the **Coffin maker**, he wants to steal all five masterful carvings. But since nobody knows whats happening to the owner he wants to be as efficient as possible. What is the fastest way to all carvings.