Recipe Management Ontology

Student: Qëndresa Hajdari

Prof: Ermira Daka

Prishtine, January 2025

Table of content

Introduction

Recipe Management Ontology is designed to manage information related to cooking recipes, ingredients and kitchen categories. The ontology facilitates the organization, search and sharing of structured knowledge about cooking recipes and their ingredients.

The purpose of the ontology is:

- To support use cases such as recipe discovery,
- Filter recipes according to different preferences.

The ontology includes:

- Classes
- Object Properties and Data Properties
- Relationships between concepts and taxonomic hierarchy

Domain Analysis

In this project are identified:

- **Key Concepts**
  - Some of the main concepts are Recipes that represent the art of cooking, Ingredients – that represent the components needed for a recipe, Category – that represent food classifications, Cuisine – that represent a culinary culture, as well as others.
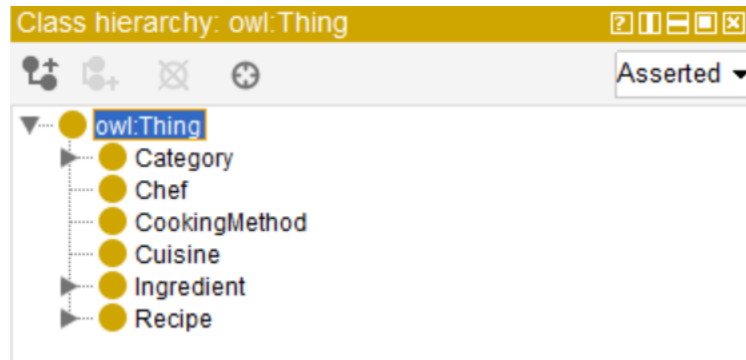
- **Relationships**
  - Here we have the links where the recipes have ingredients, then the recipes belong to a category, or are even linked to specific cuisines. For example, Recipes have ingredients (hasIngredients), recipes belong to a category (belongsToCategory), etc.
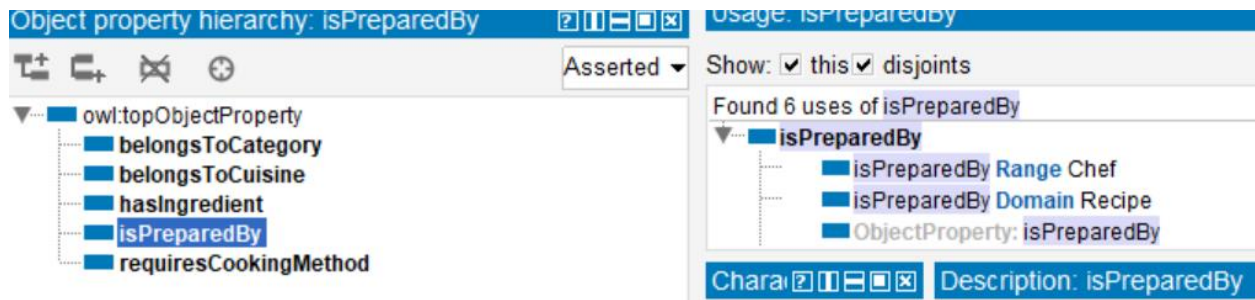
- **Hierarchies and Taxonomies**
  - In Hierarchies and Taxonomies - for example, we have in Category subclasses DietaryCategory and MealCategory, in Ingredients we have subclasses Proteins and Vegetables, and for Recipe we have subclasses AppetizerRecipe, DessertRecipe, DrinkRecipe and MainCourseRecipe.

```
Class hierarchy: owl:Thing                    [?][II][ ][□][✕]
 ⏫  ⏬  ⊠  ⊕                            Asserted ▾
 ▼── ● owl:Thing
       ▼── ● Category
               ─── ● DietaryCategory
               ─── ● MealCategory
       ─── ● Chef
       ─── ● CookingMethod
       ─── ● Cuisine
       ▼── ● Ingredient
               ─── ● Proteins
               ─── ● Vegetables
       ▼── ● Recipe
               ─── ● AppetizerRecipe
               ─── ● DessertRecipe
               ─── ● DrinkRecipe
               ─── ● MainCourseRecipe
```
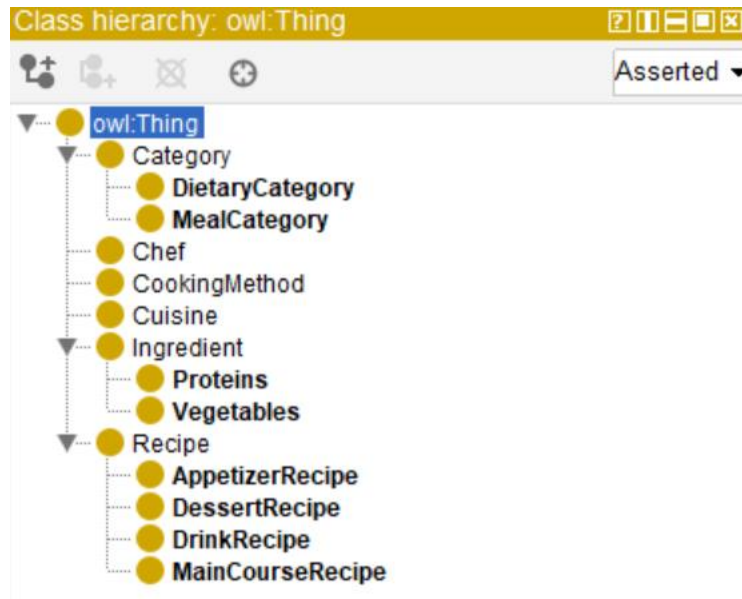
Ontology Specification

The Recipe Management Ontology is designed to answer several questions:

- What are the ingredients of a specific recipe?
- Which categories does a prescription belong to?
- Which cuisine does a recipe belong to?

While solving these problems:

- Facilitates searching for recipes
- Organizes recipes by categories and cuisines
- Different preferences for cuisines, diets, etc.

The main elements of Ontology

The classes and subclasses included in this ontology are:

- Category
  - o DietaryCategory
  - o MealCategory

- Chef

- CookingMethod

- Cuisine

- Ingredient

  o Proteins

  o Vegetables

- Recipe

  o AppetizerRecipe

  o DessertRecipe

  o DrinkRecipe

  o MainCourseRecipe

In object properties are included:

- hasIngredient, - Lidh recetat me përbërësit

- belongsToCategory – Lidh recetat me kategori të ushqimeve

- belongsToCuisine – Tregon kulturës e një recete prej nga vjen

- requiresCookingMethod – Tregon metodat e gatimit

- isPreparedBy – Lidh recetat me kuzhinierët

In data properties are included:

- creationDate, (dateTime)

- hasDescription (string)

- hasName (string)

- servingSize (integer)

- hasCalories (integer)

- cookingTime (integer)

- preparationTime (integer)

Ontology Development

The Ontology for Recipe Management was developed using the Protégé tool and exported in OWL format. The development process of this ontology contains:

- Creation of 14 main classes and subclasses

- Definition of 5 Object Properties

- Definition of 7 Data Properties

- Adding some instances/individuals such as "SpaghettiTomatoSauce", "Tomato", etc.

An example of the use of ontology can be: The recipe "SpaghettiTomatoSauce" has ingredients "Tomato", "OliveOil" and belongs to Italian cuisine.

Application Development

This application or this project includes the development of a web application, this is an integrated ontology created in Protégé, which is designed to manage and search for recipes according to their ingredients. The application uses semantic web technologies, including SPARQL queries, which pulls data from the ontology, and provides users with advanced search capabilities.

Functional Requirements

The application meets the following functional requirements:

1. Semantic querying using **SPARQL**
   A web application interface with an ontology that defines classes, properties, and people for recipes, chefs, ingredients, and foods. **SPARQL** is used to query ontology, allowing users to retrieve information such as:the recipe depends on the ingredients selected, recipes by type of food, food prepared by famous chefs.
   Queries are dynamically generated based on user input. It provides customized results.

2. Displaying results in an interactive and user-friendly interface
   This application uses modern UI libraries such as Material-UI to ensure a responsive and user-friendly design. Users can interact with the interface through features such as: text entry field for searching recipes by ingredients; table showing search results with sorting and filtering capabilities; action buttons such as "More Info" to show additional details about the recipe.

The results are displayed in a structured and attractive table format.

Recipe Management Ontology

Search Recipes by Ingredients

Enter ingredients   SEARCH RECIPES

Validation and Consistency Check

For validation was used HermiT Reasoner tool. According to this control, no inconsistencies were identified and all classes, properties and instances were verified as functional.

Tools and Technologies

- Ontology Development: Ontology is designed using Protégé with OWL2 format. For validation was used HermiT Reasoner tool.
- Semantic Querying: SPARQL, TriplyDB
- Web Development:
  - Frontend Development
    - Framework: ReactJS
    - Libraries: Material-UI
    - Axios for HTTP request to communicate with SPARQL endpoint
  - Backend Development
    - SPARQL endpoint

Conclusion

This web application demonstrates effective integration of ontology-based knowledge systems with practical applications. By using semantic search and user-friendly interface, makes it an attractive platform for recipes.