Healthy Food Recommendation and Explanation Generation using a Semantically-Enabled Framework

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Motivation

Knowledge-driven recommendations can utilize semantic resources effectively for greater personalization

Explanations about the system are valuable to develop user trust and to better understand the recommendations

Food Recommendation Use Case

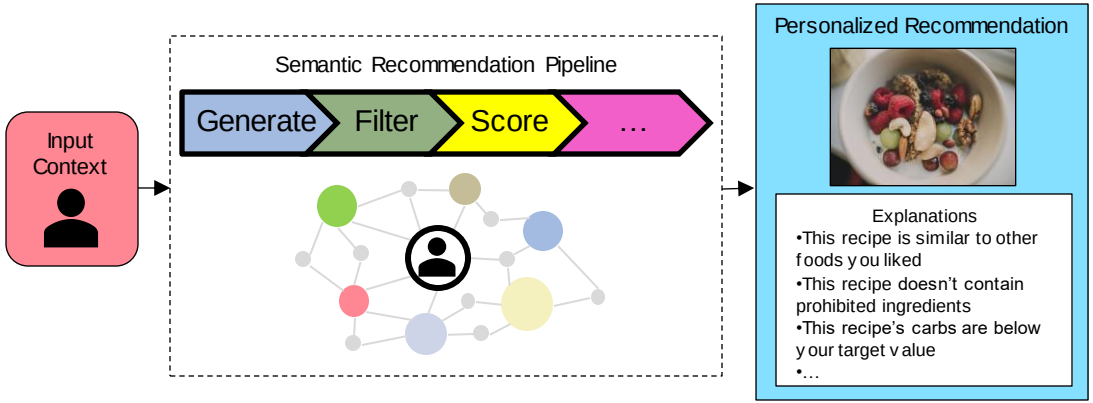
Leverage linked data surrounding ingredient classification to avoid recommending recipes containing allergens

Score recipes based on nutritional values and adherence to healthy eating guidelines

Our Approach - FREx

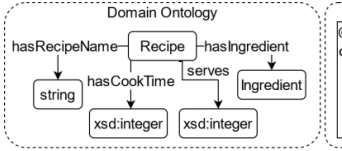
We have created a Python framework, FREx (**F**ramework for **R**ecommendations with **Ex**planations)

Support development of knowledge-driven recommendation pipelines that integrate explanations for each pipeline stage into the final recommendation output



Object-Oriented Workflow

Convert query results from RDF to Python objects



Python Class Implementation

```
@dataclass
class Recipe(DomainObject):
    has_recipe_name: str
    has_cook_time: int
    serves: int
    hasIngredient: List[Ingredient]
```

Knowledge-Driven Pipeline Stages

Extensible pipeline stages to generate new candidate items or filter/score candidates passing through the pipeline

```
class ProhibitedIngredientFilter(CandidateFilterer):
    def filter(self, *, candidate) -> bool:
        # define your filter function here!
```

Minimally define a single function and supply an explanation

Future Work

Integrate common recommendation algorithms for easier re-use

Provide greater insight into the input context used in systems

Acknowledgements

This work is partially supported by IBM Research AI through the AI Horizons Network.

Contact: shiras2@rpi.edu
Resource Link: https://tetherless-world.github.io/FREx

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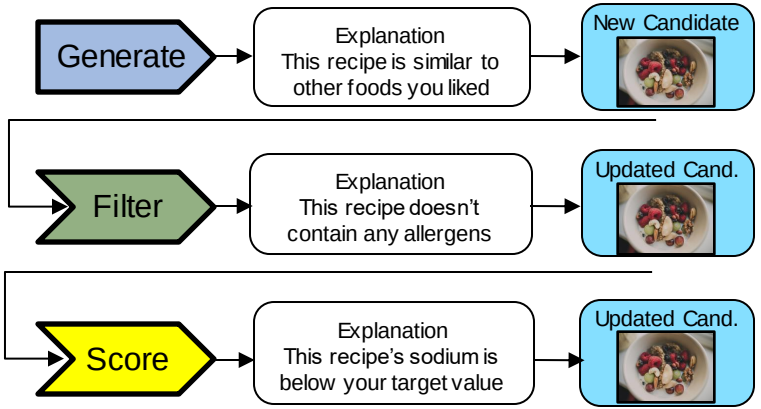
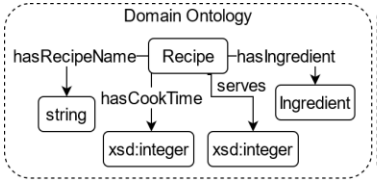
Recommendation Pipeline

- Define custom functions to generate new candidate recommendations or update candidates from prior stages
- Supply explanations for each pipeline stage, attach explanations to the candidates as they pass through
- Provide output recommendations containing all explanations



Object-Oriented Workflow

- Generate Python dataclasses based on ontology models
- Provide useful structure for tools like IDEs, e.g. to enable code completion



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```

Knowledge-Driven Pipeline Stages

- **Generate**, **Filter**, and **Score** candidates
- Minimally define a single function and explanation for a pipeline stage
- Define pipelines as a combination of sequential pipeline stages

```
class ProhibitedIngredientFilter(CandidateFilterer):
 def filter(self, *, candidate: RecipeCandidate)  -> bool:
      return  any(
         ing.uri in candidate.context.target_user.prohibited_ingredient_uri_set
         for ing in candidate.domain_object.ingredient_set
      )
```

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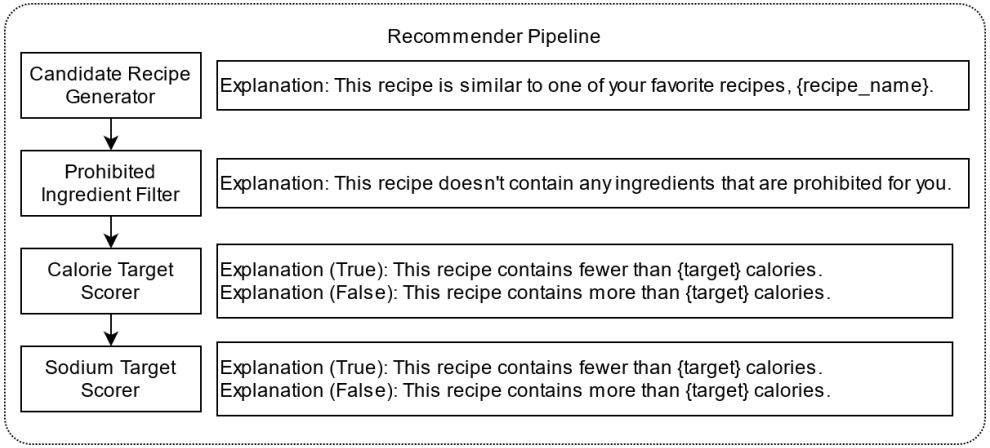
Healthy Eating Use Case

- Identify relevant healthy-eating guidelines to apply based on user profile
- Leverage semantics of food classification to filter prohibited ingredients based on class hierarchy
- Calculate recipe nutrition through FoodKG's linked data



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Example Recommendation Output

RecipeRecommendation

Recipe= **FoodKgRecipe**
`Name="Basil Tomato Mozarella Salad",`
`Ingredients=[...],NutritionalInformation=[...]`

ExplanationContent=[
"This recipe had a similarity score of 0.989 to one of your favorite recipes, Open-Face Portabella Sandwiches",
"This recipe does not contain any ingredients that are prohibited by you",
"This recipe adheres to the guideline: As for the general population, people with diabetes should limit sodium consumption to <2,300 mg/day."]

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