Towards Food and Health Knowledge Graphs: From Language Models to Food Semantic Resources

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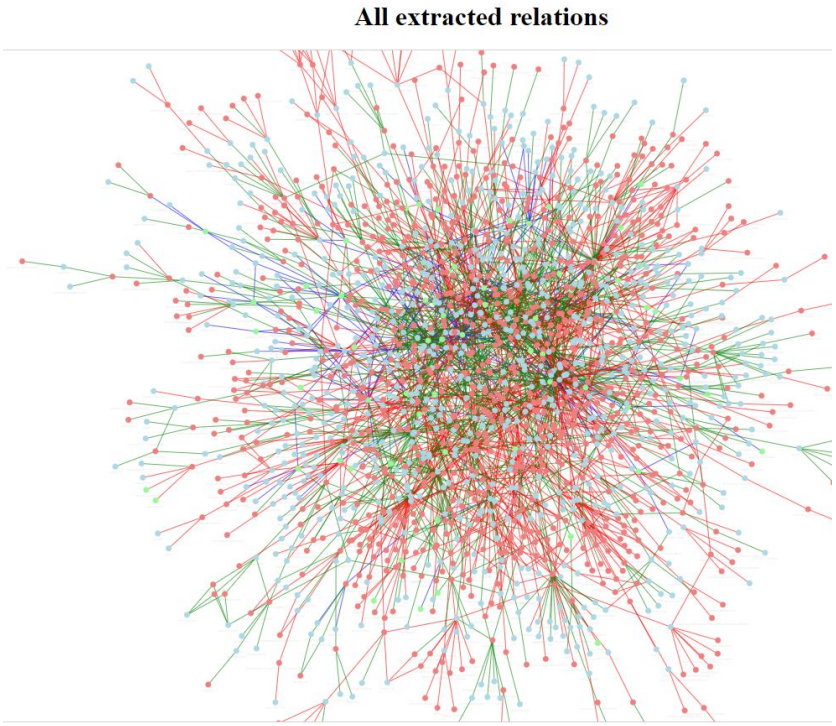
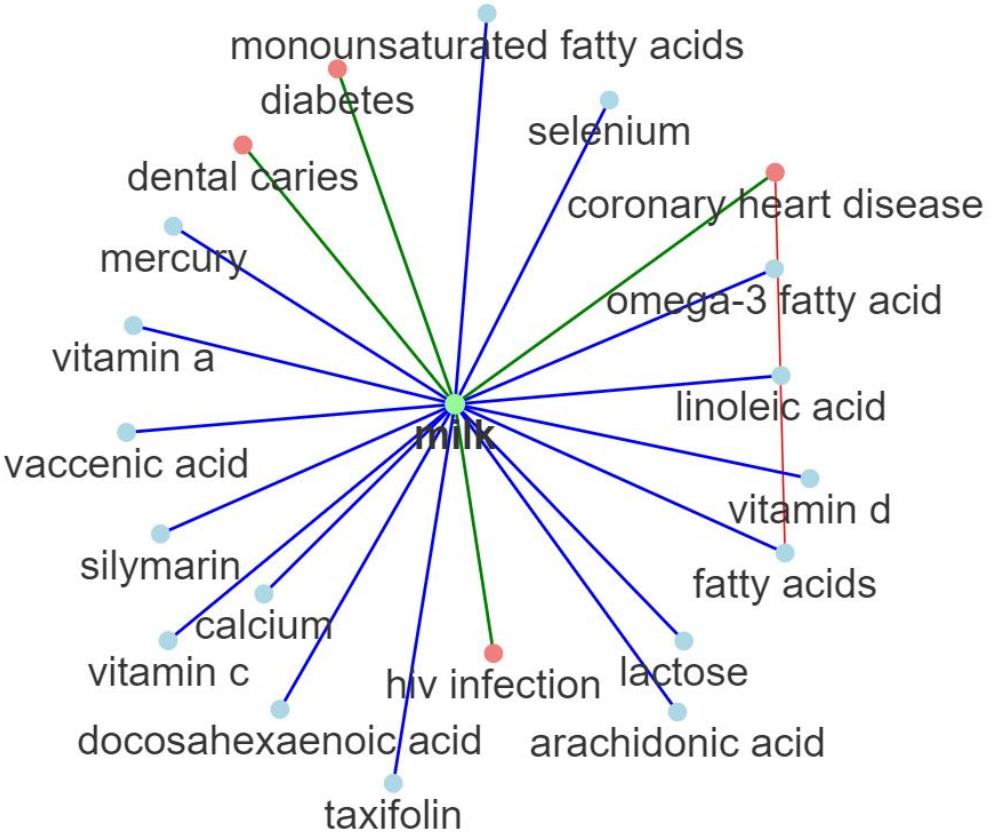
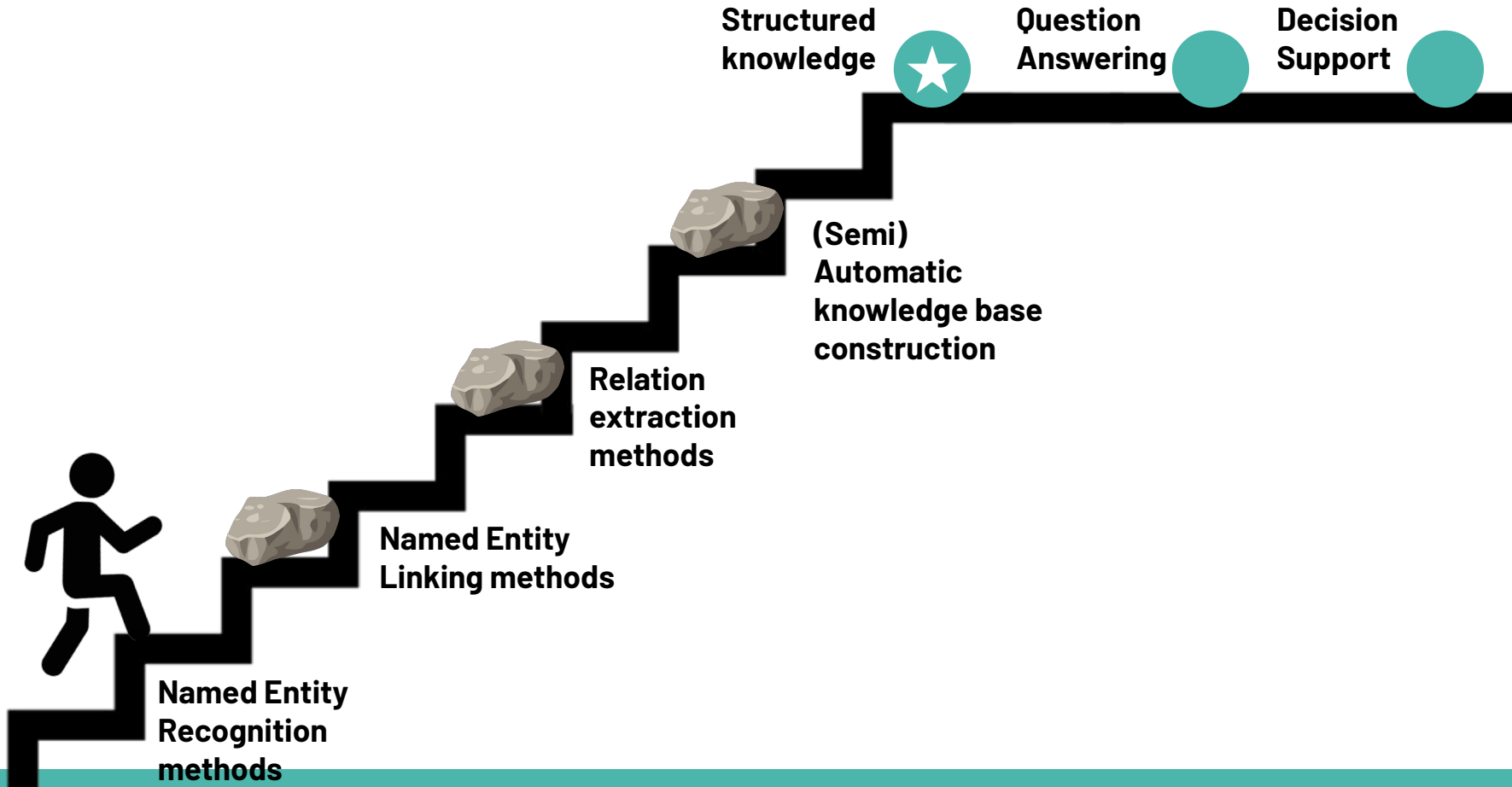
Motivation


All extracted relations


monounsaturated fatty acids
diabetes
selenium
dental caries
coronary heart disease
mercury
omega-3 fatty acid
vitamin a
linoleic acid
milk
vaccenic acid
vitamin d
silymarin
fatty acids
calcium
vitamin c
hiv infection
lactose
docosahexaenoic acid
arachidonic acid
taxifolin

From Language Technologies to Decision Support



Information Extraction (IE)

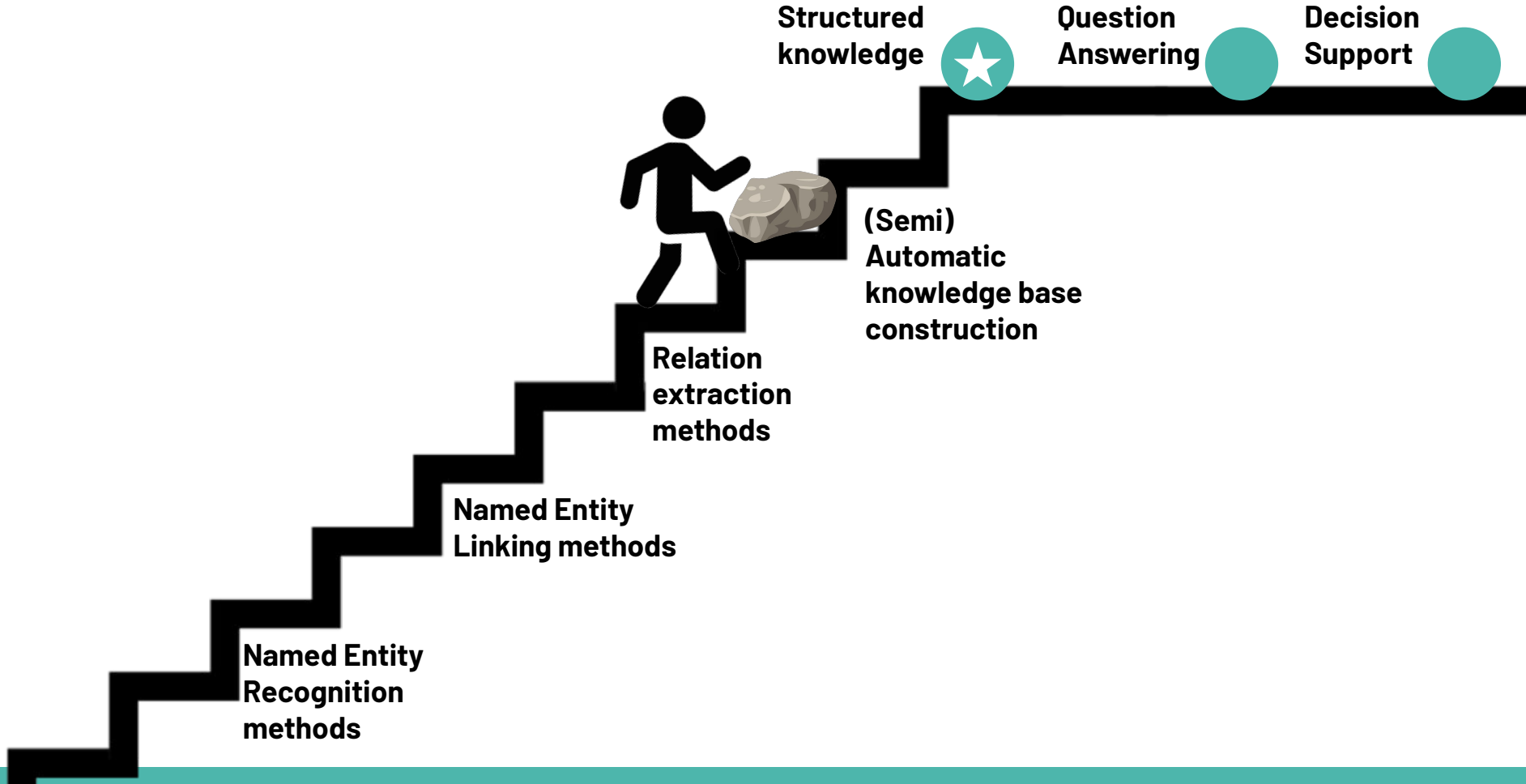
Named-Entity Recognition (NER)

Excessive salt intake has been associated with a higher incidence of heart disease.

Named-Entity Linking (NEL)

Excessive salt **[00002 (FOODB)]** intake has been associated with a higher incidence of heart disease **[0001 (UMLS)]**.

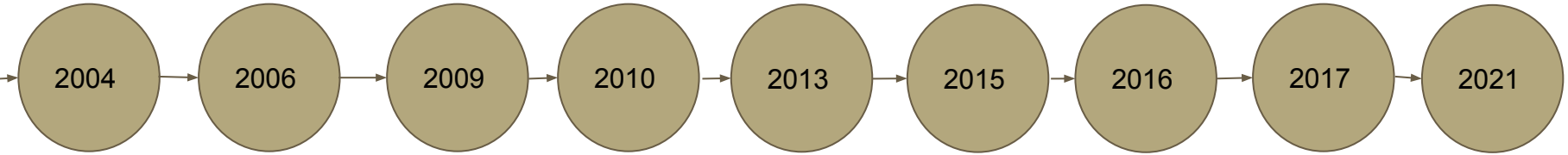
State in the Biomedical Domain



Bio-IE During the Years

Several Bio-shared workshops

- BioNLP, BioCreative, ...



- Gene mentions in text
- Linking protein database entries to abstracts

- Gene mention tagging
- Gene normalization
- Extraction of protein-protein interactions from text

- Protein mentions
- Protein - protein interactions

- Cross-species gene normalization
- Protein-protein interactions
- Gene indexing and retrieval task

- Chemical and Drug Named Entity Recognition
- Gene ontology curation

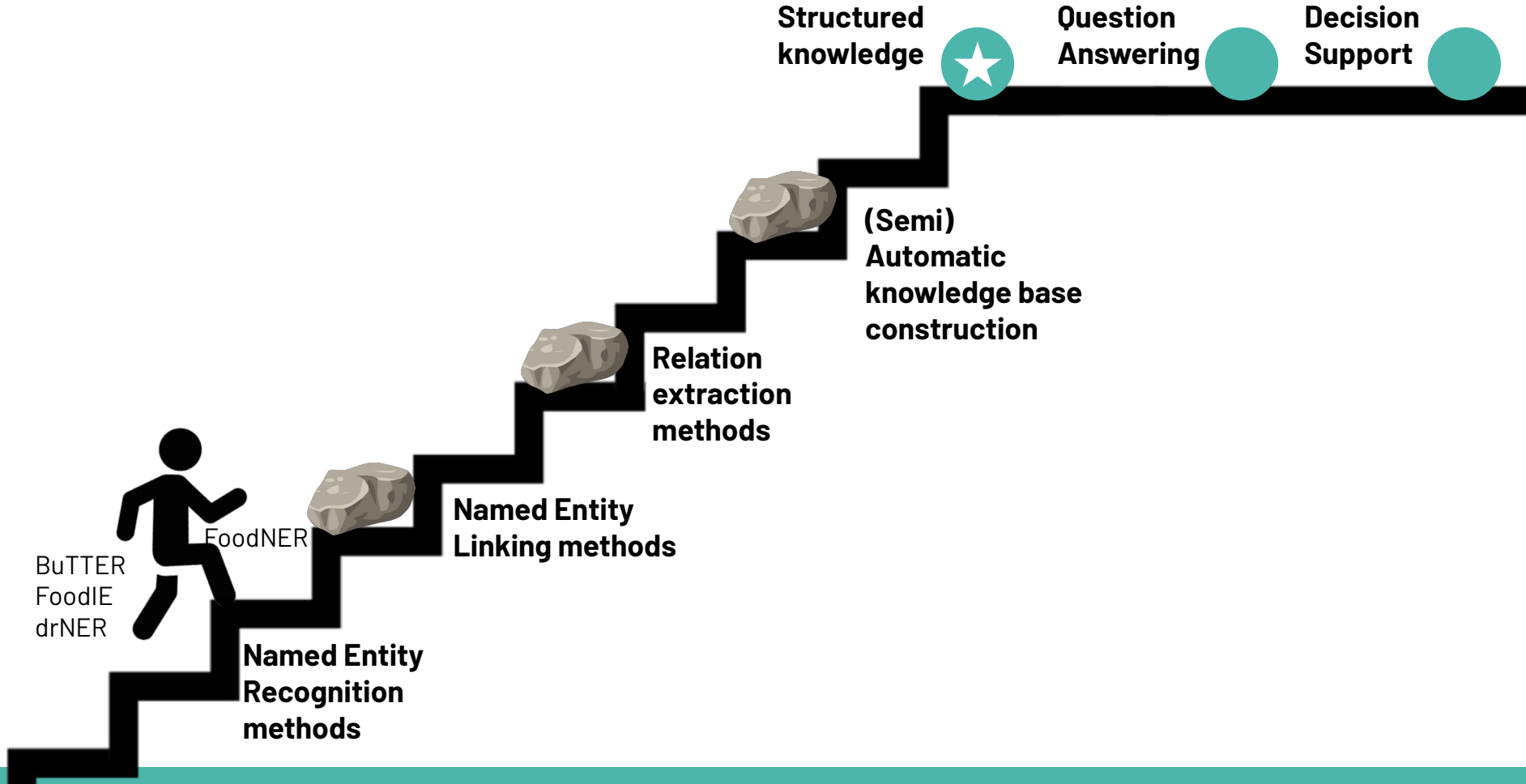
- Identification of chemical compounds and of relevant biological context in patents
-Chemical-disease relation

- Chemical Entity Mention recognition
- Gene and Protein Related Object recognition

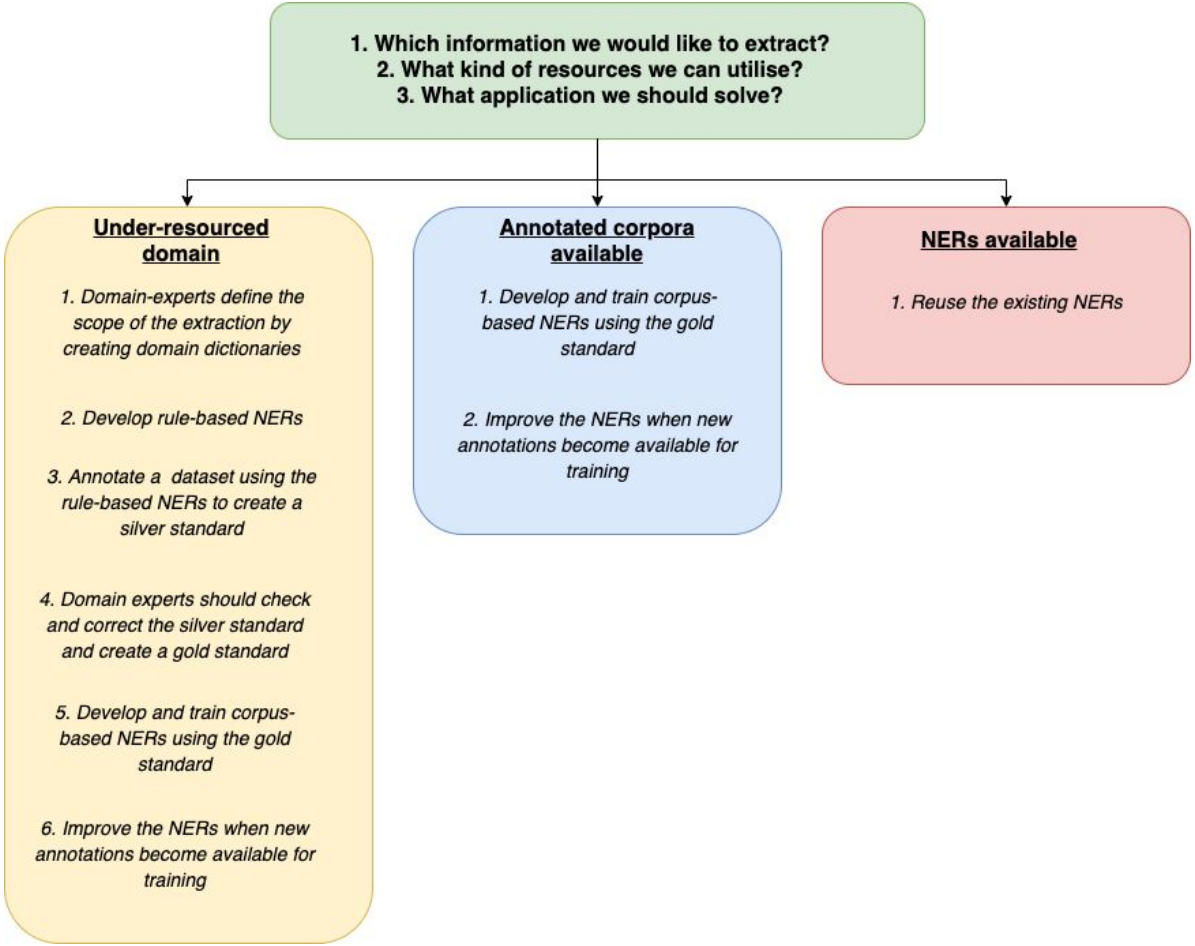
- Mining protein interactions and mutations for precision medicine
- Chemical-protein interactions

- Drug/chemical - protein interactions
- Chemical Identification and Indexing in PubMed articles
- LitCovid track Multi-label topic classification for COVID-19 literature annotation

State in the Food Domain



CAFETERIA Pipeline



CAFETERIA Methods

- Rule-based methods:
  - spaCy + different food dictionaries
  - NCBO annotator with different food ontologies

- Corpus-based methods:
  - BuTTeR - bidirectional LSTM
    - ~ 94% macro averaged F1 score
  - FoodNER - fine-tuning BERT language model
    - ~ 94% macro averaged F1 score
    - ~ 73 - 78% macro averaged scores with regard to FoodOn, SNOMED-CT, and Hansard taxonomy

Human-Computer Interaction Tool

Recognized Entities for recipe **0recipe101**

Preheat oven to 350 degrees F (175 degrees C) . In a 12 inch skillet over medium heat , cook and stir the garlic and white parts of the green onions in canola oil until tender . Mix in shredded chicken, salt and pepper. Toss until well coated with oil. Stir in the salsa. Arrange tortilla chips on a large baking sheet . Spoon the chicken mixture over tortilla chips. Top with Cheddar / Monterey Jack cheese blend and tomato. Bake in the preheated oven 10 minutes , or until cheese has melted . Remove from heat and sprinkle with green onion tops before serving .

Entity tags

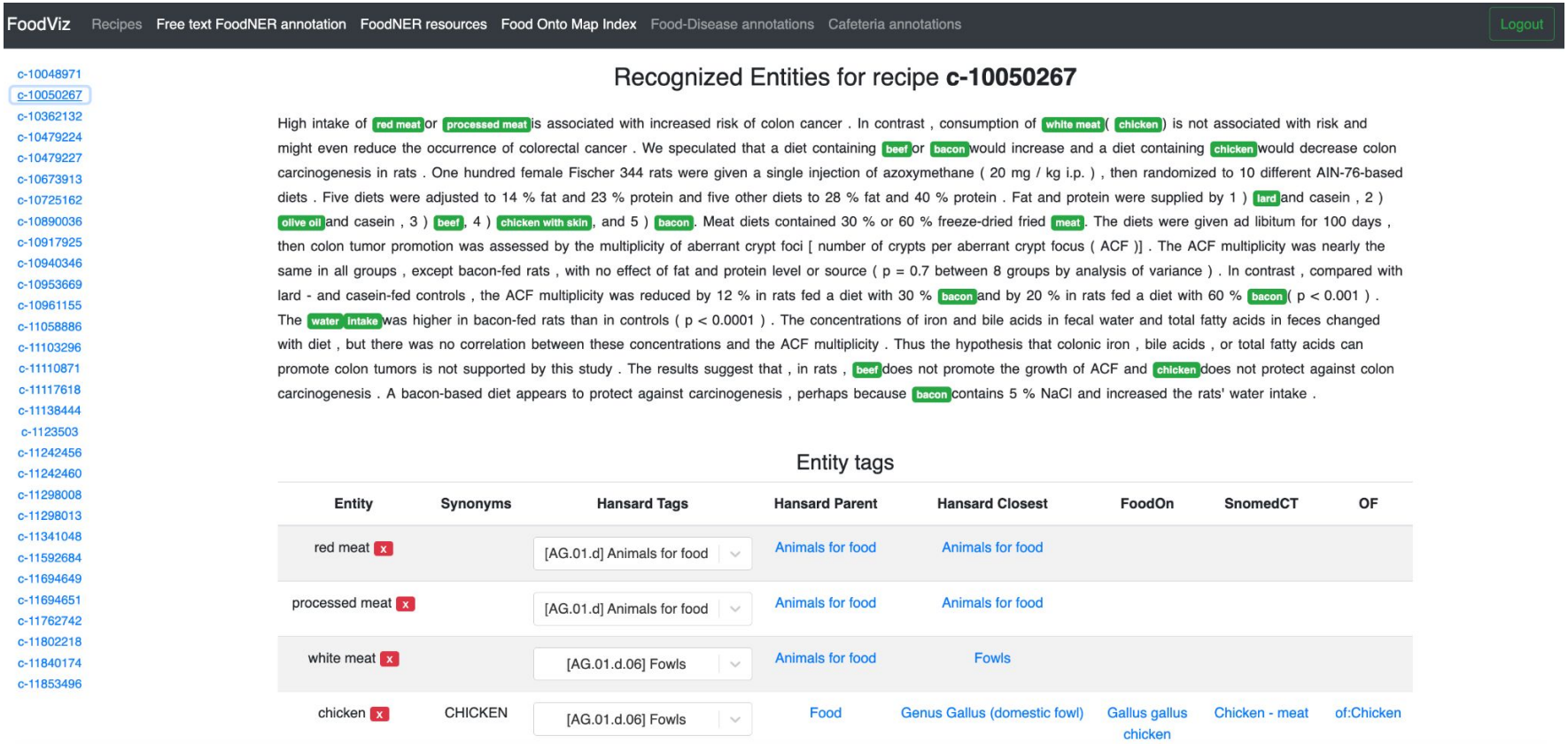
Entity	Synonyms	Hansard Tags	Hansard Parent	Hansard Closest	FoodOn	SnomedCT	OF
garlic x	GARLIC	AG.01.h.02.e [Onion/leek/garlic]	AG.01.h	AG.01.h.02.e	obo:NCBITaxon_4682	smct:735030001	of:Garlic
green onions x		AG.01.h.02.e [Onion/leek/garlic]					
canola oil x	CANOLA OIL	AG.01.f [Fat/oil]	AG.01.f	AG.01.f	obo:FOODON_03310387 obo:FOODON_03302578	smct:713648000 smct:226908006	
shredded chicken x	SHREDDED CHICKEN CHICKEN	AG.01.d.06 [Fowls]	AG.01.d	AG.01.d.06	obo:NCBITaxon_9031 obo:FOODON_03411457	smct:226955001	of:Chicken
salt x	SALT	AG.01.l.01 [Salt]	AG.01.w	AG.01	obo:CHEBI_24866		
pepper x		AG.01.l.03 [Spice]					
oil x	OIL	AG.01.f [Fat/oil]	AG.01.f	AG.01	obo:FOODON_03310387		
salsa x	SALSA	AG.01.l.04 [Sauce/dressing]	AG.01.l	AG.01.l.04	obo:FOODON_03310086		

CAFETERIA Outcomes

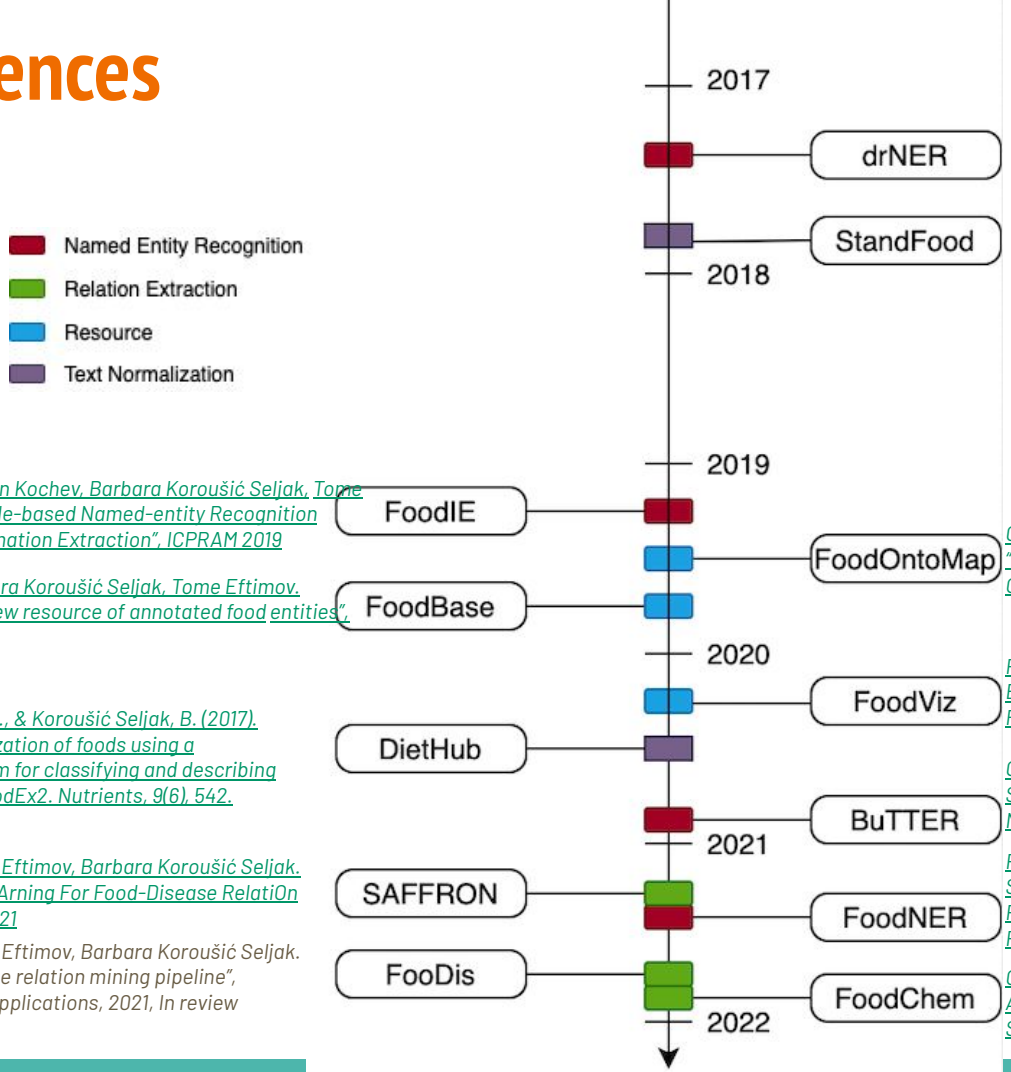
- Annotated food consumption data:
  - 1000 recipes annotated with regard to Hansard, SNOMED-CT and FoodON
  - BioC format

- Annotated scientific abstracts :
  - 500 scientific abstracts annotated with regard to Hansard, SNOMED-CT and FoodON
  - BioC format

An Example of Annotated Scientific Abstract



References



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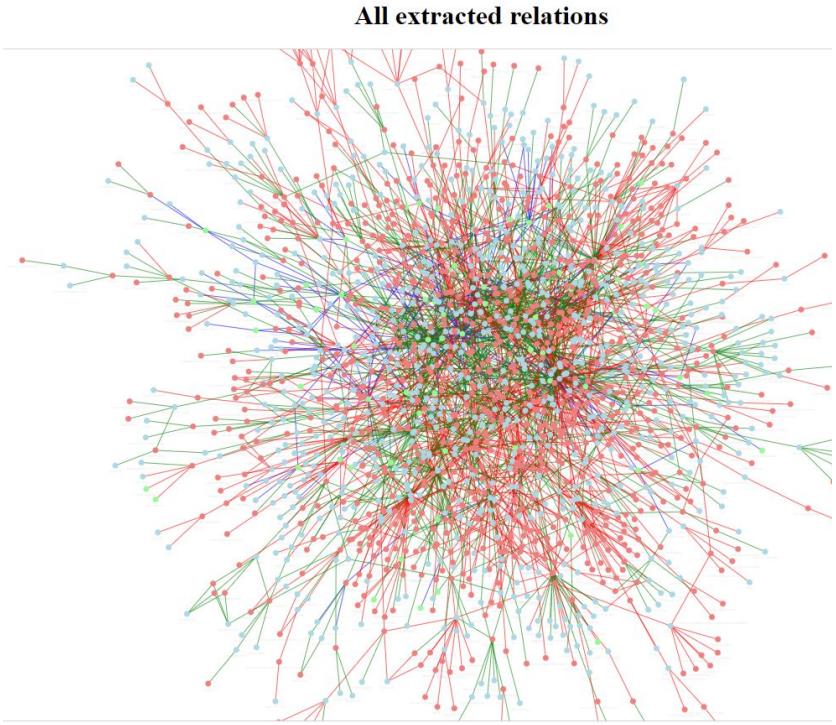
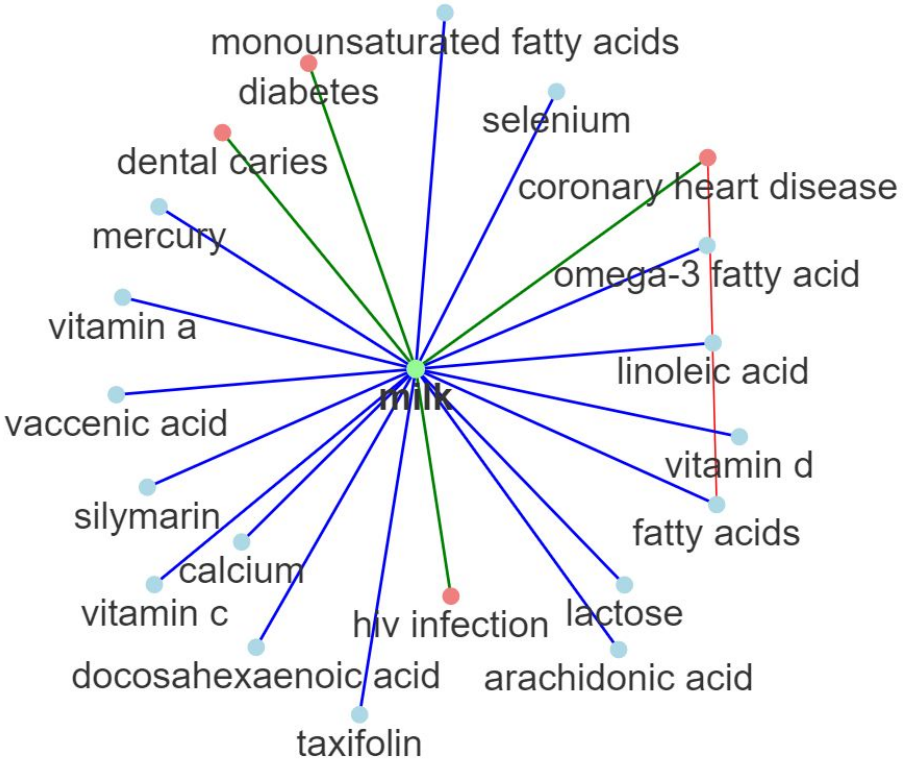
Towards Knowledge Graphs





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