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R2[RML]-ChatGPT Framework

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Motivation

- Creating high-quality mappings requires a lot of background knowledge
- Mapping quality issues can exponentially multiply into resulting data

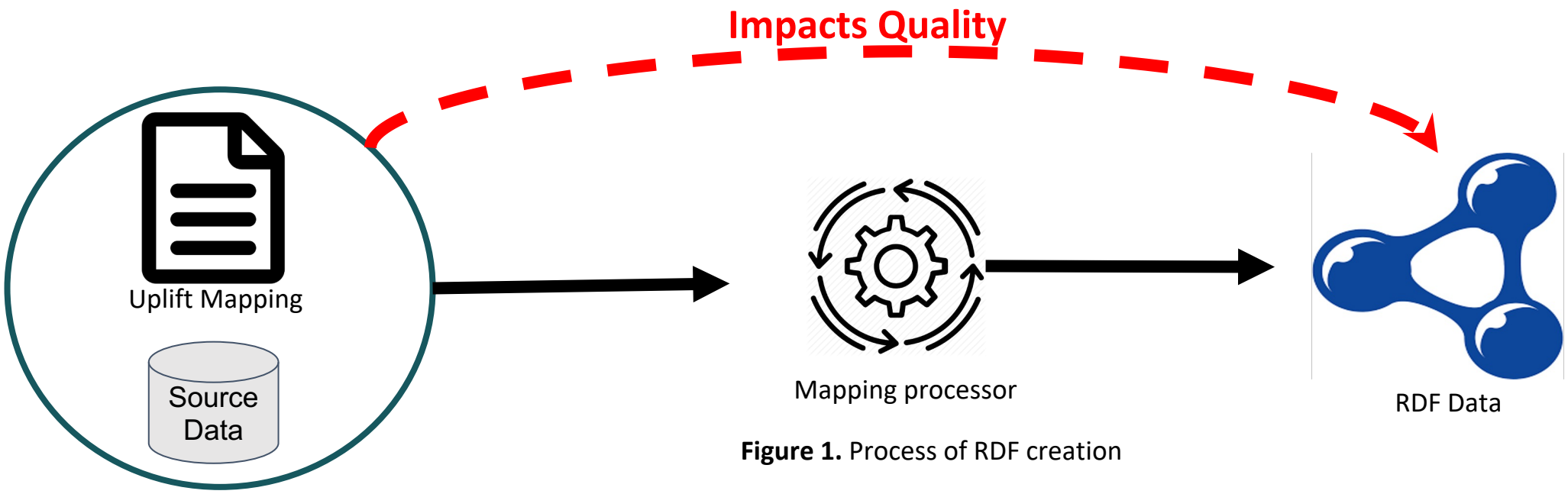

Figure 1. Process of RDF creation

Motivation

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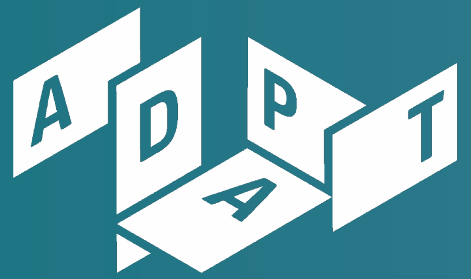
- Existing quality assessment approaches often restricted to knowledge in mappings and used ontologies

- Diverse knowledge available in LLMs

- Support mapping engineers during mapping creation
  - *What alternative concepts/ontologies are available?*
  - *Create sample instances which use this mapping concept?*
  - *Create a constraint to validate the range of this concept?*

Design and Implementation of Framework

R2[RML]-ChatGPT Framework



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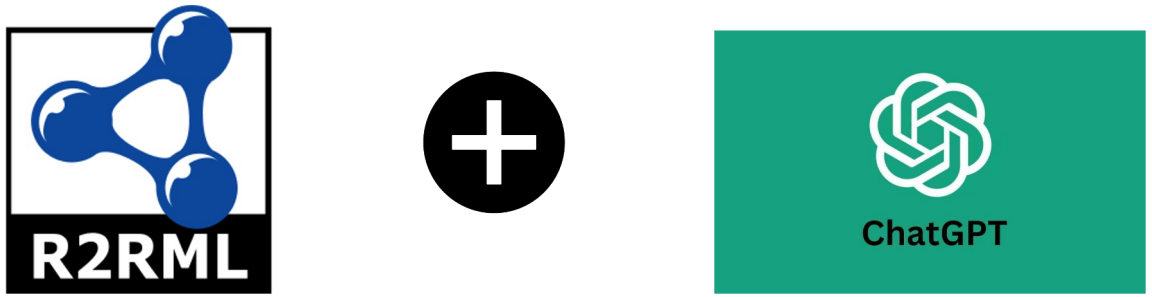
Design of Framework

- R2[RML] mapping uploaded to framework
- Pre-processing involves retrieving distinct concepts and inputting into prompt templates into ChatGPT 3.5 turbo
- Post-processing extracts, validates and improves returned code



Workflow of Framework

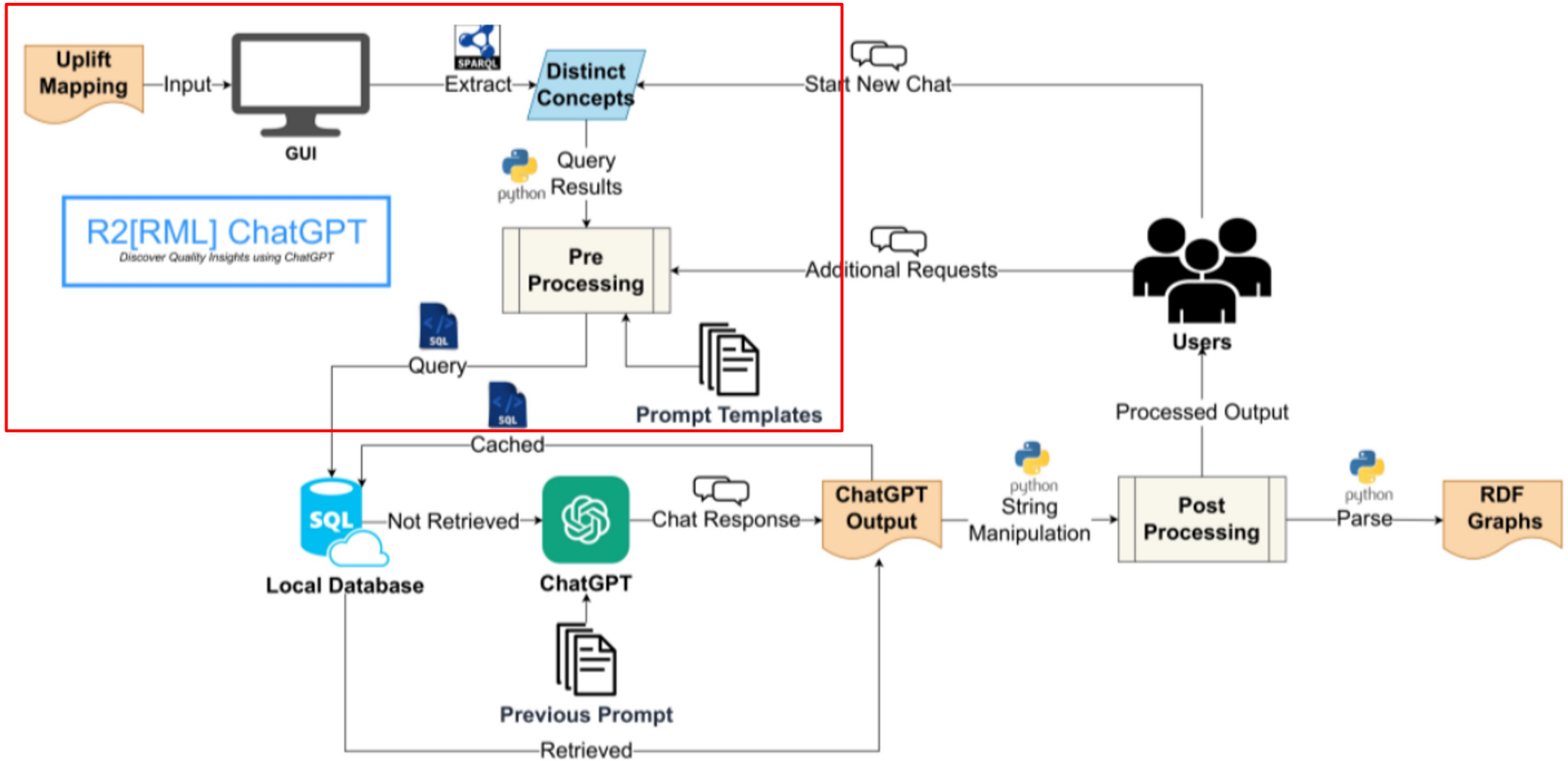
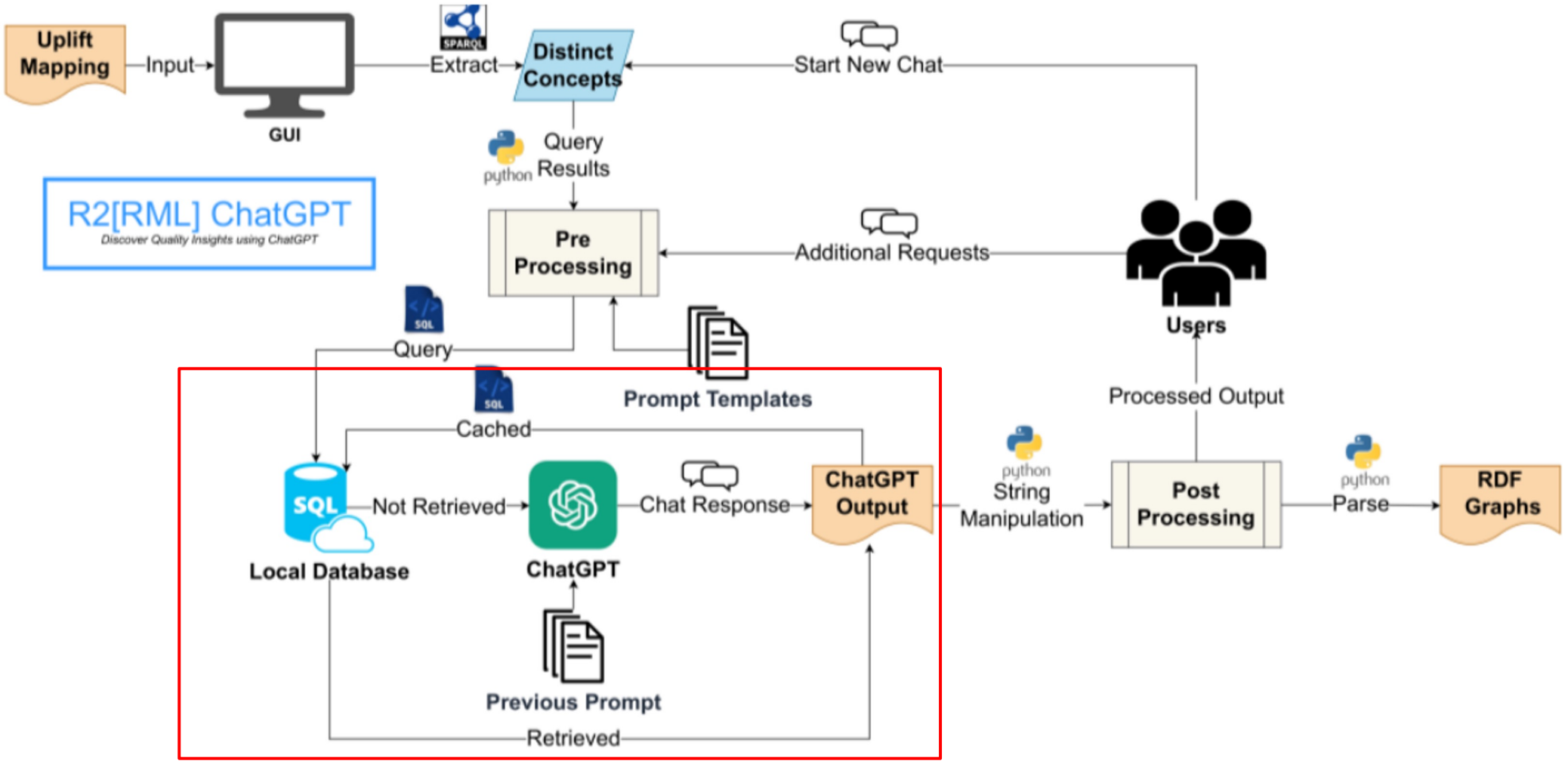


Figure 1: Workflow of the R2[RML]-ChatGPT Framework

Workflow of Framework



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Workflow of Framework

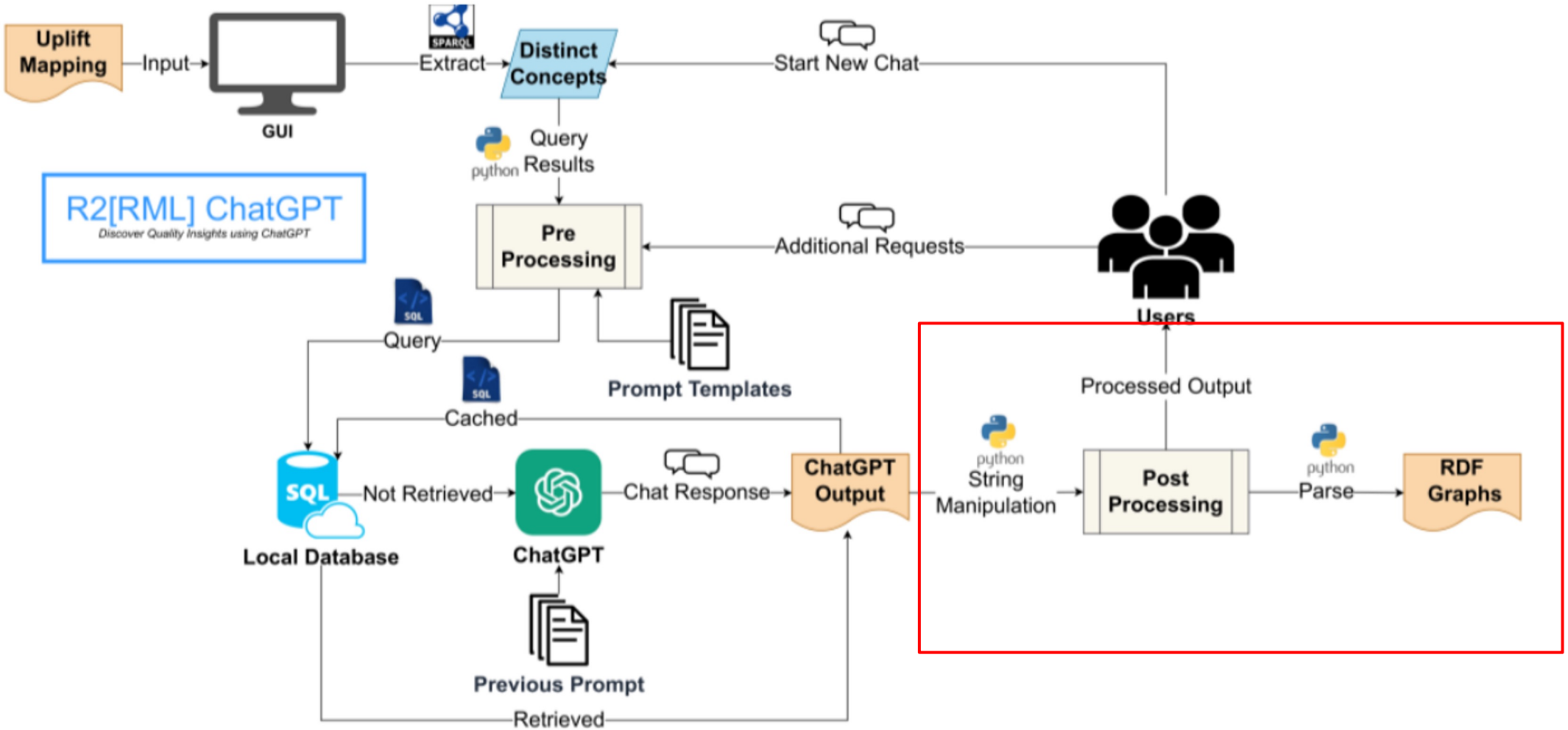

Figure 1: Workflow of the R2[RML]-ChatGPT Framework

Implementation of Framework

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- Several Python libraries used to implement framework

Library	Usage
Flask	Create web application for interface
SPARQLWrapper	Execute SPARQL queries
OpenAI	Communicate with ChatGPT
RDFLib	Syntax parser

Implementation of Framework

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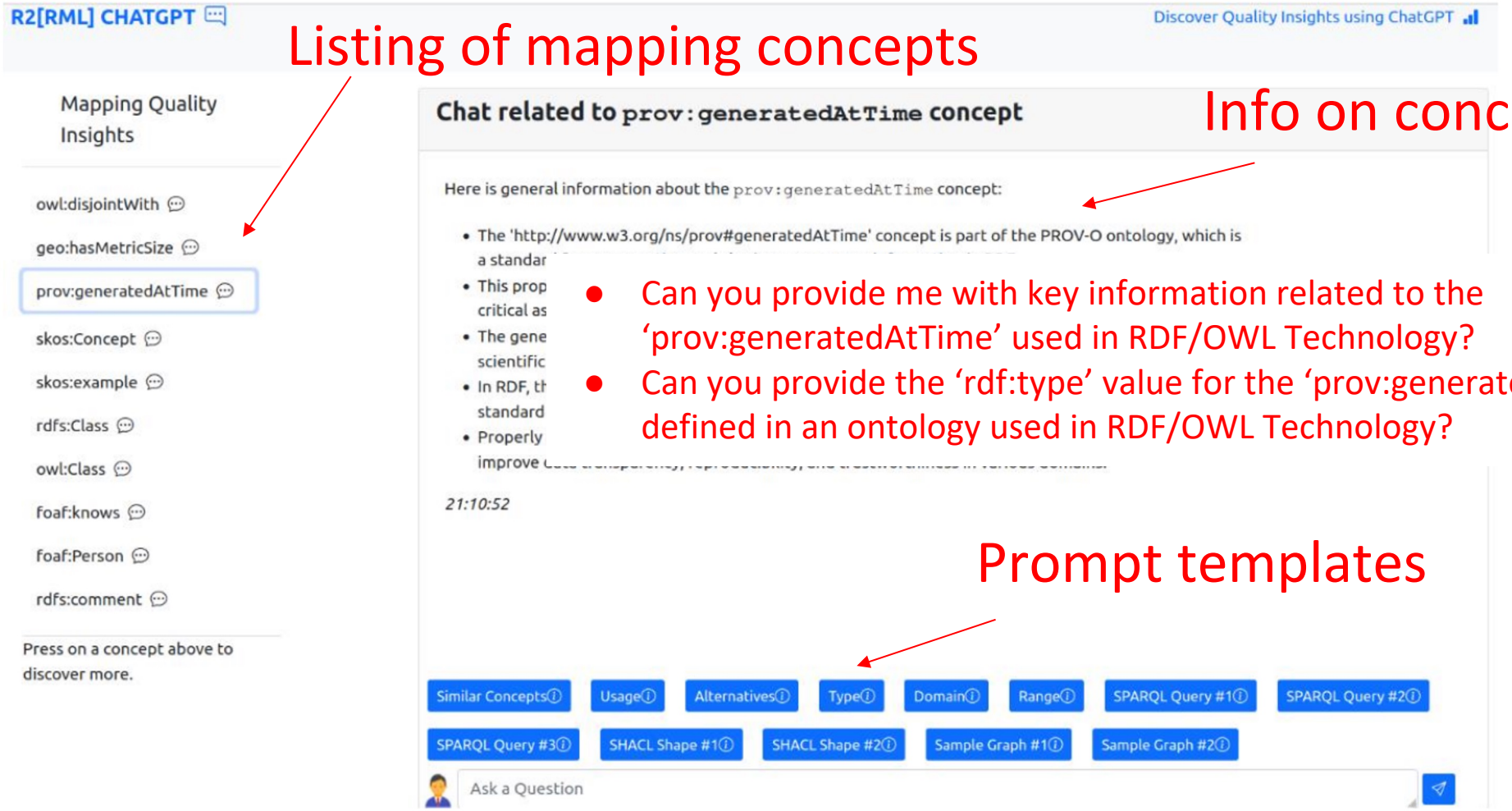


Figure 4: Screenshot of Implementation displaying information related to concepts in a mapping

Implementation of Framework

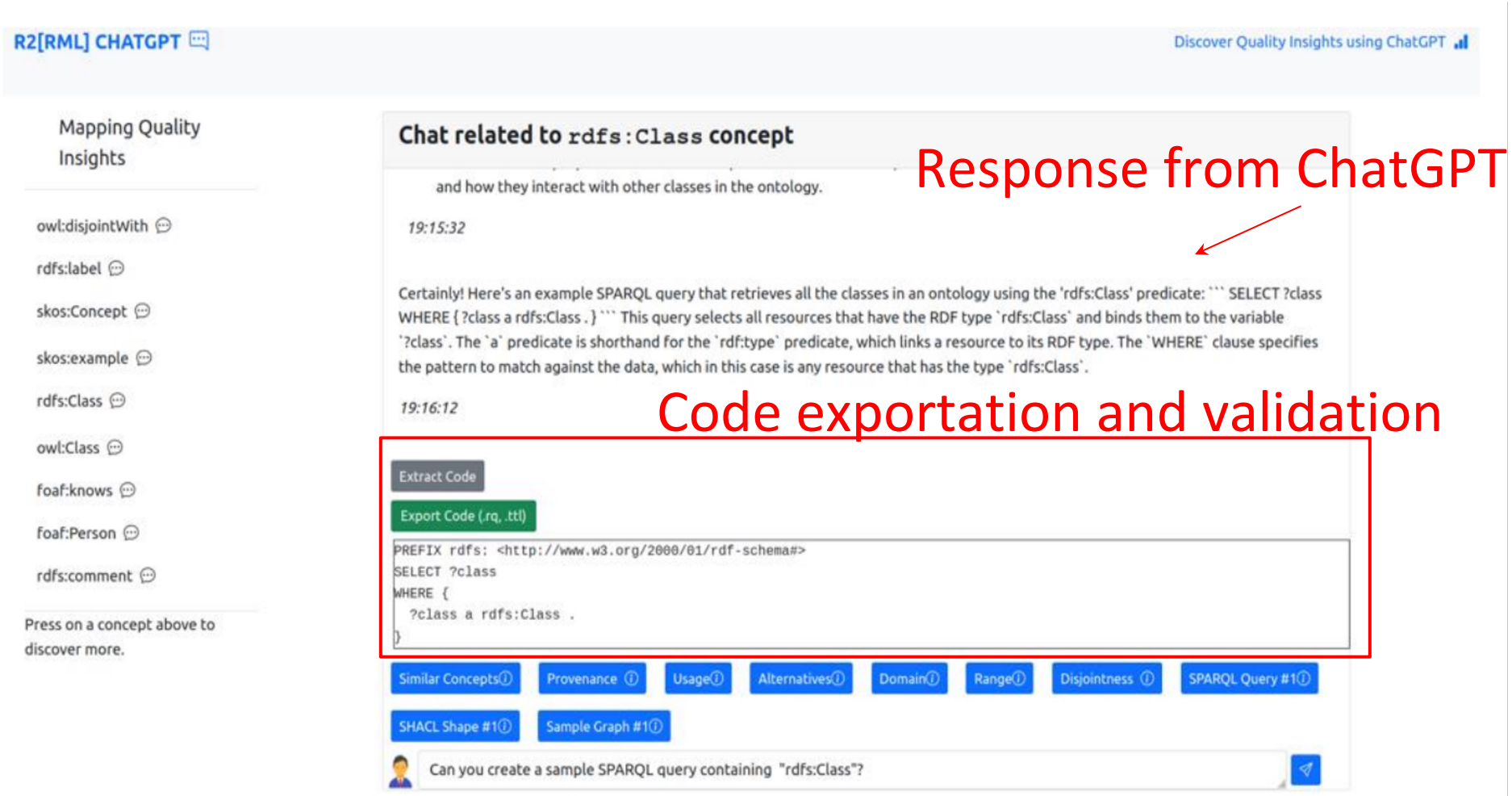
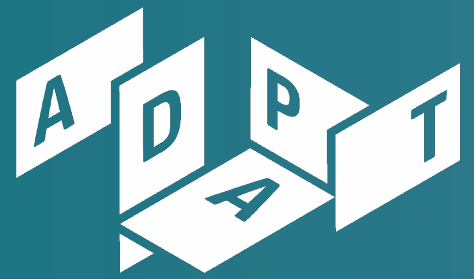


Figure 5: Screenshot of code validation and exportation available on the framework

Experimentation

Validating Syntax and Semantics



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Experiment Overview

- **RQ1:** To what extent will ChatGPT produce semantically correct data for certain values in a declarative uplift mapping (e.g. type, domain, range and label)?
- **RQ2:** To what extent will ChatGPT produce syntactically correct RDF data and SPARQL queries?

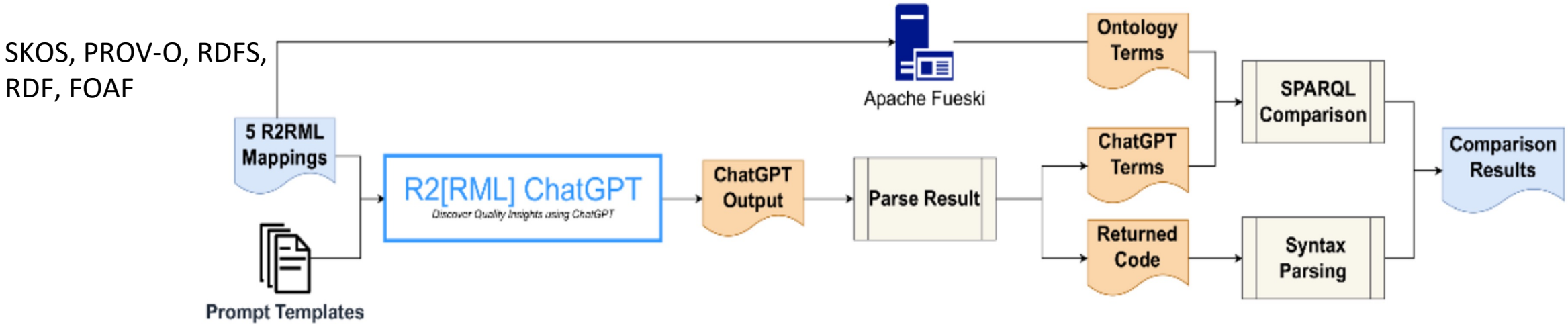

Figure 6: Overview of Activities involved in the Experimentation

Testing Semantic Correctness (RQ1)

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- 4 ontology terms (type, domain, range and label) retrieved for concepts in mappings
- Returned terms inserted in SPARQL ASK queries
- Queries executed on namespace ontology for comparison

Semantic Correctness (RQ1) Results

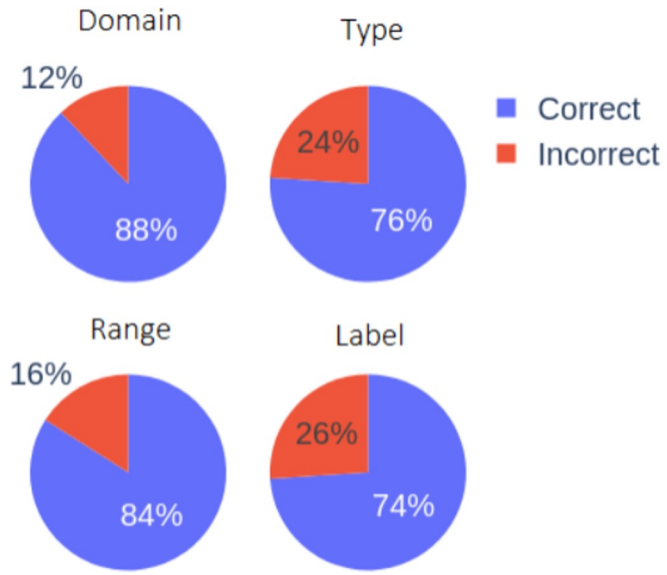

Figure 7: Results of correctness of each ontology term tested

- Domain and Range scored similar
- Type scored slightly worse with the name of tested concept returned in some cases
- Label scored worst with inferences resulting in incorrect results

Testing Syntactic Correctness (RQ2)

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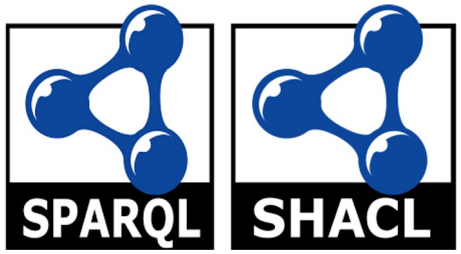
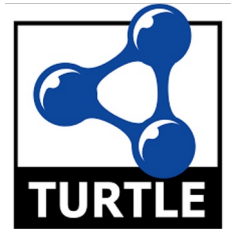
- 150 files containing Instances, SPARQL and SHACL generated





- Syntax validated using RDFLib parsers

- Invalid syntax improved by framework
  - Regular expressions applied on parser output
  - Added missing prefixes
  - Syntax validated again

Syntactic Correctness (RQ2) Results

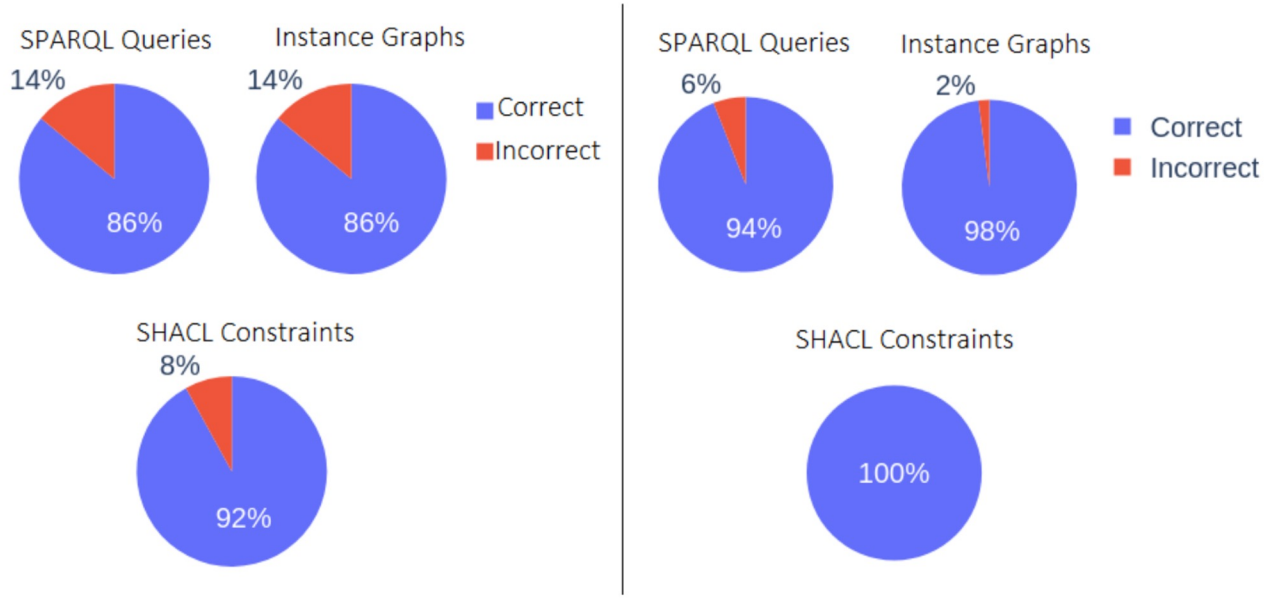
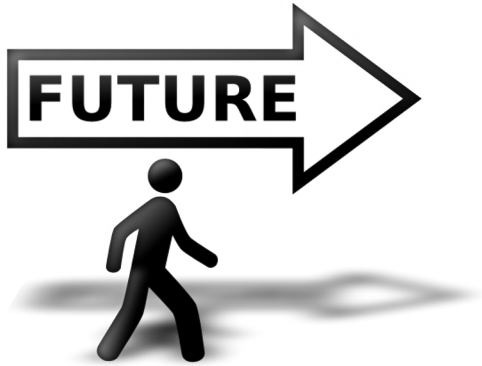


Figure 8: Results of occurrences of syntactic correctness for each category tested before (left) and after (right) post-processing by the framework

- Mean score of 42 (84%) out of 50 files correct
- SHACL constraints scored best which could be due to less prefixes
- Post-processing resolved most (14 out of 18) syntax issues

Future Work

- Usability testing of framework
- Testing of other ontologies
- Extending support to interlink mappings
- Comparison of results with other LLMs and ChatGPT versions



Conclusion

- Labels scored worst with some inferences (e.g. rdfs:rest -> rest of list)
- Most common syntax problem was missing prefixes (14 out of 18)
- Level of ontology documentation could impact scores (rdfs better than skos)

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CALL TO ACTION

Get involved in evaluating the VRTI-KG Explorer in coming months

… no technical or historical expertise needed!