ODPReco - A Tool to Recommend Ontology Design Patterns

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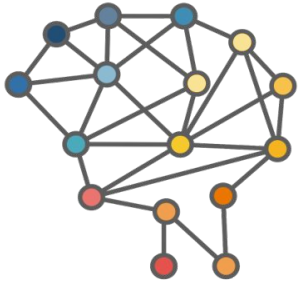
Ontology VS ODP

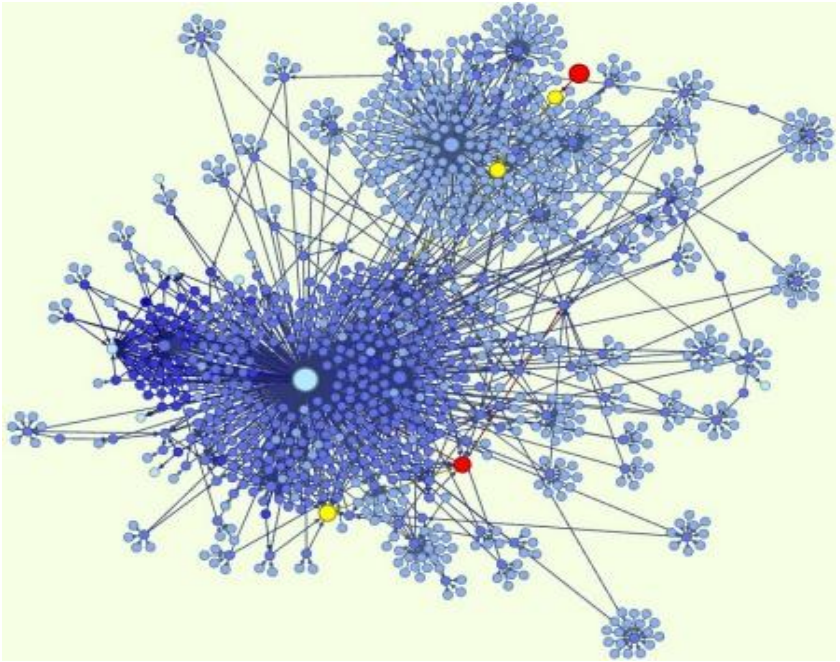
Ontology is the description of knowledge as a set of concepts and the relationship that holds between them.

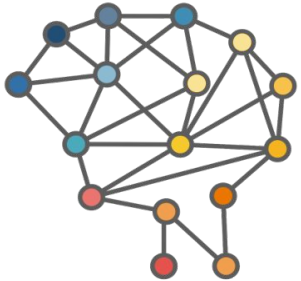
ODPs are the re-usable patterns that are used to improve quality of an ontology and make it more modular.



Why use ODP in an Ontology

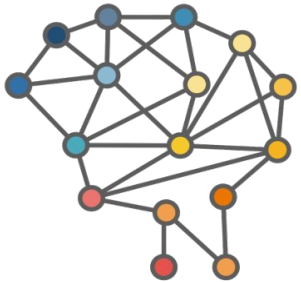
- Ontologies are non-modular
- Difficult to comprehend
- High maintenance cost





Approach

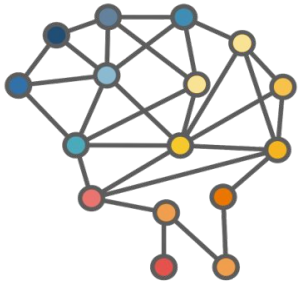
ODPReco analyzes the **lexical**,**structural** and **behavioural** aspects of an ontology and compares it with that of the ODPs in order to **recommend** an ODP.



DATASET

Dataset referred as **Collection**. It includes:

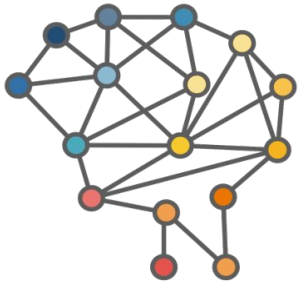
- ODPs from the ODP repository (220 ODPs)
- MODL: Modular Ontology Design Library



ODP Repository

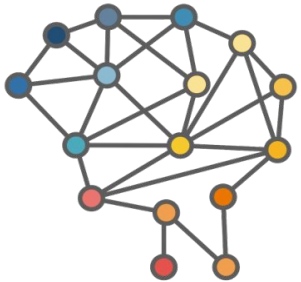
220 ODPs:

	Catalogue	Submissions	All
Content ODPs	0	157	157
Reengineering ODPs	0	12	12
Alignment ODPs	0	14	14
Logical ODPs	0	18	18
Architectural ODPs	0	2	2
Lexico-Syntactic ODPs	0	20	20



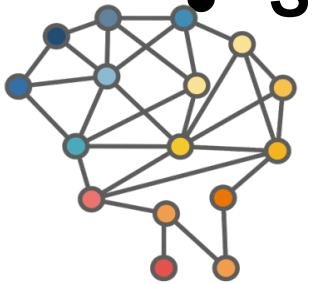
MODL

- Well-Documented ODPs.
- Collection of annotated OWL files with complete description of each pattern.



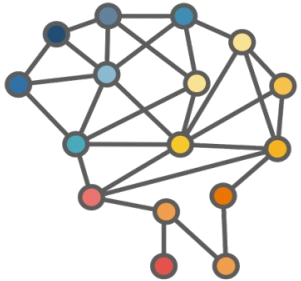
Ontology Analysis

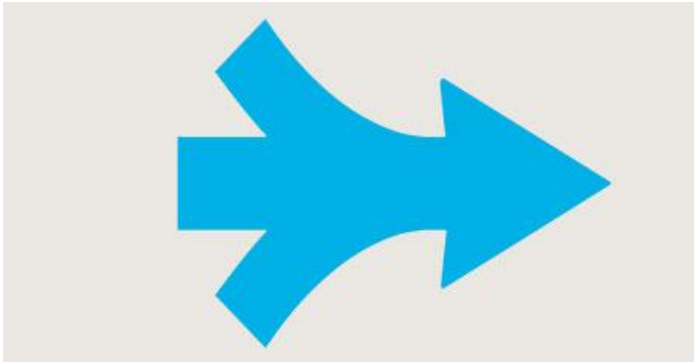
- **Lexical**- Description along with the names of classes, properties and individuals of an ontology compared against the collection.
- **Behavioural**- Competency questions being compared.
- **Structural**- Axioms being compared



Ontology Analysis

- Combining the scores of three and setting a threshold above which the list of ODPs can be recommended.

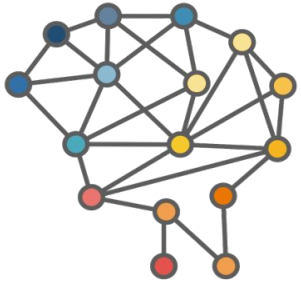




Machine Learning on existing ODPs

Features considered are:

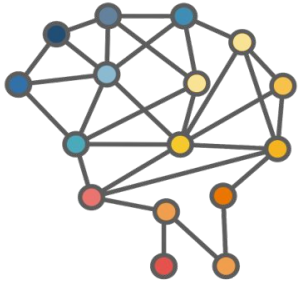
Lexical, Structural and behavioural.



Machine Learning on existing ODPs

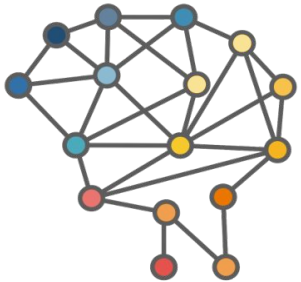
Some drawbacks with this approach are :

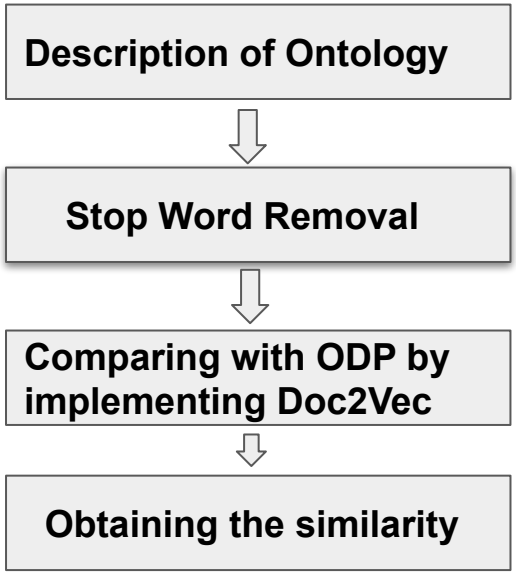
- Training data is limited
- Feature Selection is cumbersome
- Prediction might not be accurate



Work Done so far

Lexical Analysis:





GCD.java | Bulk.java | first_demo.java | App.java | merged_file.txt | mergedFile_... | Structural_...

```
1 beAWARE ontology an "all-around" lightweight crisis management ontology climate-related n
2 To represent that some agent is acting in order to forward the action of a social (non-ph
3 This pattern represents a flexible schema for linked data querying of chess games. Player
4 To formally represent a conceptualization or a descriptive context.This CP allows the des
5 The hazardous situation ontology design pattern provides a building block for modelling s
6 This pattern is a basic one, which allows to talk about attributes/parameters/dimensions,
7 The intent of the pattern is to be able to represent climatic zones for aquatic resources
8
```

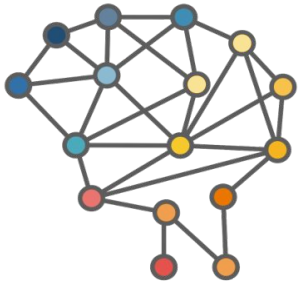
Markers | Properties | Servers | Data Source Explorer | Snippets | Console

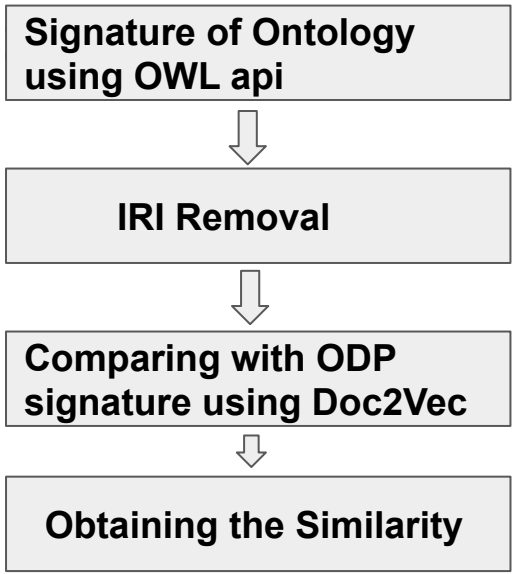
<terminated> ParagraphVectorsTextExample [Java Application] C:\Users\Admin\Desktop\java\bin\javaw.exe (Oct 20, 2019, 1:17:52 PM)

```
13:18:00,477 INFO  ~ Epoch [1] finished; Elements processed so far: [258];  Sequences proces
```

Lexical Analysis

Extracting the signature





GCD.java | Bulk.java | merged_file.txt | MegeFile_Sig... | mergedFile_... | Structural_...

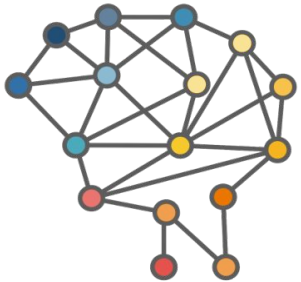
```
1 [<beAWARE_ontology#Agriculture>, <beAWARE_ontology#Animal>, <beAWARE_ontology#Asset>, <beAWAI
2 [<actingfor.owl#Agent>, <actingfor.owl#SocialAgent>, <actingfor.owl#actsFor>, <actingfor.owl#
3 [<ActingPlayerRole>, <Agent>, <AgentRole>, <AuthorRole>, <BlackPlayerRole>, <ChessCompetitior
4 [<climaticzone.owl#AquaticResource>, <climaticzone.owl#AquaticResourceObservation>, <climatic
5 [<description.owl#Concept>, <description.owl#Description>, owl:Thing, <description.owl#define
6 [<HazardousSituation#Cause>, <HazardousSituation#Consequence>, <HazardousSituation#Event>, <H
7 [<region.owl#Region>, owl:Thing, <region.owl#hasRegion>, <region.owl#isRegionFor>, <region.ow
8
```

Outlin

An outlin

Work Done so Far

Behavioural Analysis:



Competency Questions of Ontology

⇩

Stop Word Removal

⇩

Comparing with ODP by implementing Doc2Vec

⇩

Obtaining the similarity

GCD.java | merged_file.txt | MegeFile_Sig... | mergedFile_... | mergedFile_cq | Structural_... | 99+

```
1 natural disasters may lead natural disaster? are impacts caused by natural disaster Which cli
2 Who is working for which organization? Who is representing the company?
3 List all moves in a Fools Mate game where black wins after 2 moves by both players?What did P
4 Which are the assumptions under which a certain thing is described?Which are the concepts inv
5 What object (person or organization or equipment etc.) is exposed to a hazard ? To which haza
6 What is the value for the attribute of that entity ? Which entities have a certain value on t
7 What resource has what climatic zone?
8
```

Outline | Task List

An outline is not available.

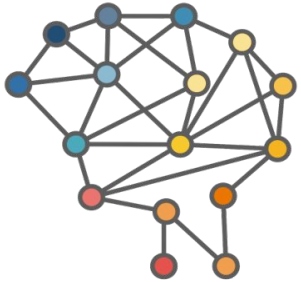
Markers | Properties | Servers | Data Source Explorer | Snippets | Console

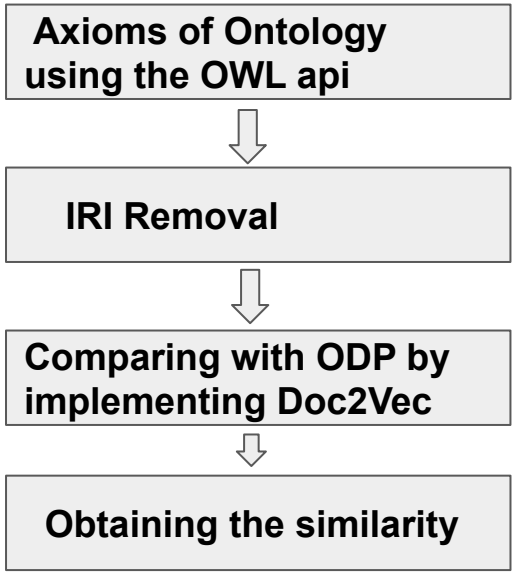
<terminated> ParagraphVectors_CQ [Java Application] C:\Users\Admin\Desktop\java\bin\javaw.exe (Oct 20, 2019, 1:38:52 PM)

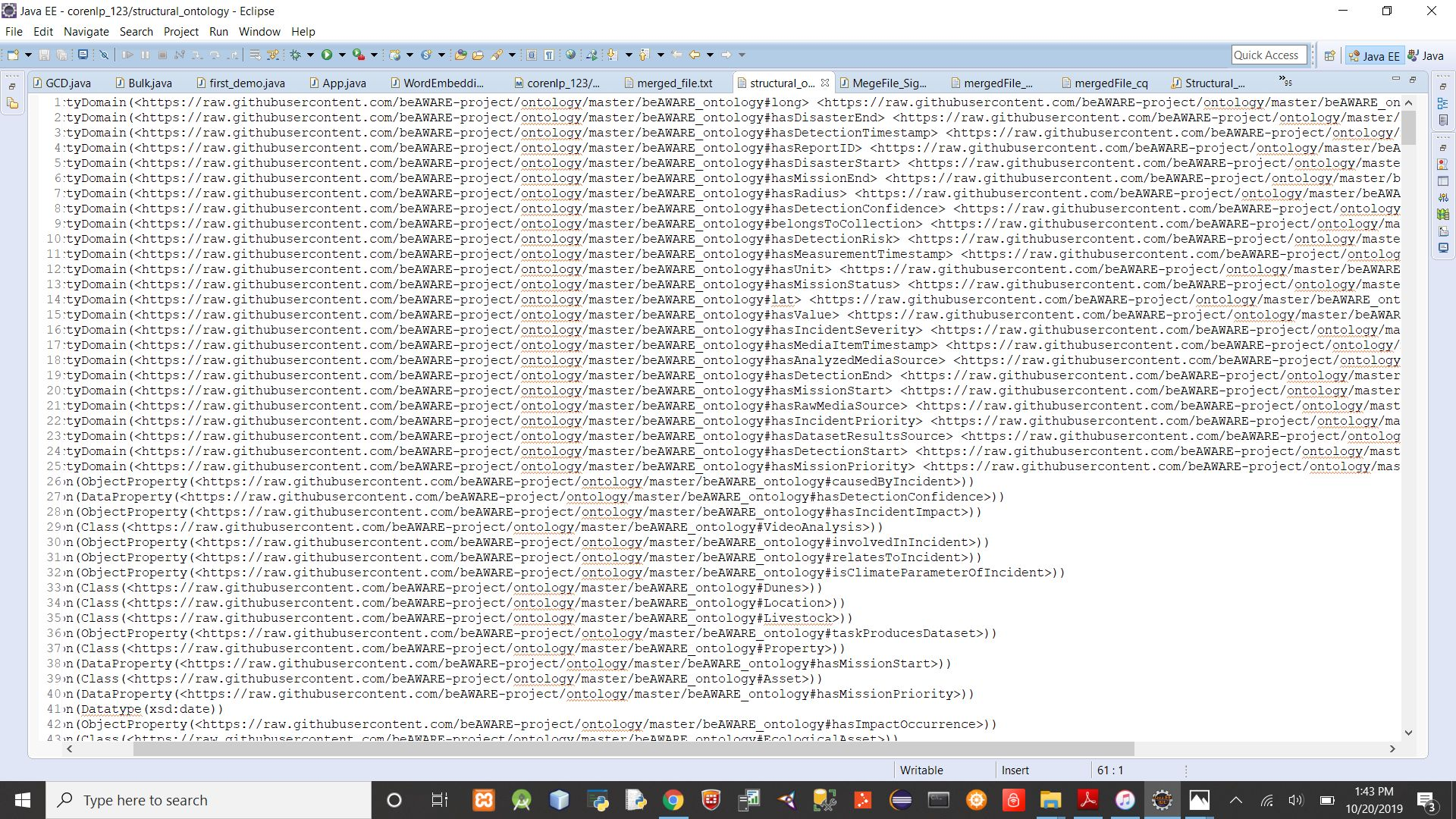
```
13:38:59,103 INFO  ~ Epoch [1] finished; Elements processed so far: [383];  Sequences processed: [7]
13:38:59,103 INFO  ~ Time spent on training: 2425 ms
-0.3953830897808075
-0.6110550761222839
-0.6789259314537048
-0.2430102378129959
0.23880203068256378
-0.4589129090309143
```

Work Done so Far

Structural Analysis:






Java EE - corenlp_123/structural_ontology - Eclipse
File Edit Navigate Search Project Run Window Help
Quick Access
Java EE
Java
GCD.java
Bulk.java
first_demo.java
App.java
WordEmbeddi...
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mergedFile_cq
Structural_...
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Type here to search
1:43 PM
10/20/2019

```
ObjectPropertyRange(<beAWARE_ontology#characterizesDisasterType> <beAWARE_ontology#NaturalDisasterType>)ObjectPropertyRange(<beAWARE_ontology#relatesToMediaItem> <beAWARE_ontolo
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ObjectPropertyRange(<HazardousSituation#exposedTo> <HazardousSituation#Hazard>)
ObjectPropertyRange(<region.owl#hasRegion> <region.owl#Region>)ObjectPropertyRange(<region.owl#isRegionFor> owl:Thing)

```
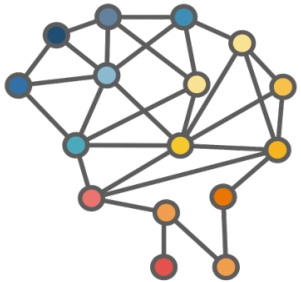

Conclusion

Using this tool, ODPs can be recommended for bulk ontologies and hence, can help in improving the quality of the ontology.



Questions to the community

1. Are there a set of ontologies that have the “before applying ODPs” and “after applying ODPs” versions?
2. Apart from the three features that are discussed, are there any other aspects that could be used as features in the ML algorithm?
3. Apart from user study, are there any other mechanisms to validate this tool?
4. What other features would you like to see in this tool?

THANK YOU

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