References

[1] Heath, T., Hepp, M., Bizer C. (eds.), (2006), *Linked data - the story so far*, International Journal on Semantic Web and Information Systems, Special Issue on Linked Data, [Online]. Available: http://tomheath.com/papers/bizer-heath-berners-lee-ijswis-linked-data.pdf

[2] Rajakaruna, G. M., Saminda, K. D., Kumara, H. K. S. R. C., Athukorala, P. A. P. R., Wijayaweera, W. J. L. N., Karunananda, A. S., (2011), *Agent technology to model evolvable ontologies*, In proceedings of the 6th International Conference on Industrial and Information Systems, Kandy, Sri Lanka, pp. 310-315

[3] Russell S. J., Norvig P., *Intelligent Agents*, in Artificial Intelligence - A Modern Approach, 2nd ed., Pearson Education, 2003, pp. 32-58

[4] Gruber, T. R., (1993), *Towards principles for the design of ontologies used for knowledge sharing*, Knowledge Systems Laboratory, Stanford University. [Online]. Available: http://ksl-web.stanford.edu/KSL_Abstracts/KSL-93-04.html

[5] Noy, N. F., Musen, M., (1999), *An Algorithm for Merging and Aligning ontologies: Automation and Tool Support*, In Proceedings of the Workshop on Ontology Management at the 16th National Conference on Artificial Intelligence, Orland, Florida

[6] Java Development Toolkit, (2012), [Online]. Available: http://www.java.com/en/

[7] Protégé, (2012), [Online]. Available: http://protege.stanford.edu

[8] Graphviz Visualization Plugin for Protégé, (2012), [Online]. Available: http://www.graphviz.org

[9] Ontology Bean Generator Plugin for Protégé, (2012), [Online]. Available: http://protegewiki.stanford.edu/wiki/OntologyBeanGenerator_4.0

[10] Java Agent Development Environment, (2012), [Online]. Available: http://jade.tilab.com

[11] Eclipse SDK, (2012), [Online]. Available: http://www.eclipse.org

[12] Namyoun Choi, Il-Yeol Song, Hyoil Han, (2006), *A survey on ontology mapping*, SIGMOD Record, Vol. 35, No. 3, pp. 34-41

[13] Kalfoglou, Y., Schorlemmer, M., (2003), *Ontology mapping: the state of the art*, The Journal of Knowledge Engineering Review, Vol. 18, pp. 1-31, Cambridge University Press, New York, USA

[14] Ontology Alignment Evaluation Initiative, (2012), [Online]. Available: http://oaei.ontologymatching.org

[15] Noy, N. F., Musen, M., (2000), *PROMPT: Algorithm and tool for automated ontology merging and alignment*, In proceedings of the 17th National Conference on Artificial Intelligence, Austin, TX, pp. 450-455

[16] Open Knowledge Base Connectivity Working Group, (2012), [Online]. Available: http://www.ai.sri.com/~okbc

[17] Noy, N. F., Musen, M. (2002), *PromptDiff: A Fixed-Point Algorithm for Comparing Ontology Versions*, In proceedings of the 18th National Conference on Artificial Intelligence, Edmonton, Alberta, pp. 744-750

[18] Moser, T., Schimper, K., Mordinyi, R., Anjomshoaa, A., (2009), *SAMOA - A semi-automated ontology alignment method for systems integration in safety-critical environments*, In proceedings of the 2nd IEEE Intl. Wsh. on Ontology, Fukuoka, Japan, pp. 724-729

[19] SVN, (2012), [Online]. Available: http://subversion.apache.org

[20] GIT, (2012), [Online]. Available: http://git-scm.com

[21] Ehrig, M., Sure, Y., (2005), *FOAM – Framework for Ontology Alignment and Mapping*, In proceedings of the Workshop on Integrating Ontologies. Vol. 156, pp. 72–76

[22] Jan, S., Li, M., Ghaidaa, A., Hamed, A., (2011), *Ontology alignment using rough Sets*, In proceedings of the 8th International Conference on Fuzzy Systems and Knowledge Discovery, Shanghai, China, pp. 2683-2686

[23] WordNet, (2012), *A Lexical Database for English*, [Online]. Available: http://wordnet.princeton.edu

[24] Kalfoglou, Y., Schorlemmer, M., (2002), *Information-flow-based ontology mapping*, In proceedings of the 1st International Conference on Ontologies, Databases and Applications of Semantics, Irvine, CA, USA

[25] Acampora, G., Avella, P., Loia, V., Salerno, S., Vitiello, A., (2011), *Improving ontology alignment through memetic algorithms*, In proceedings of the International Conference Fuzzy Systems, Taipei, pp. 1783-1790

[26] Jürgen, B., Alexander, L., Carsten, A., (2010), *Ontology alignment in the cloud*, In proceedings of the 9th International Semantic Web Conference, Shanghai, China, [Online]. Available: http://ceur-ws.org/Vol-689

[27] Zavitsanos, E., Paliouras, G., Vouros, G. A., (2011), *Gold Standard Evaluation of Ontology Learning Methods through Ontology Transformation and Alignment*, The Journal of Knowledge and Data Engineering, vol. 23, no. 11, pp. 1635-1648

[28] Nagy, M., Vargas-Vera, M., (2011), *Multi-agent ontology mapping framework for the semantic web*, IEEE Trans. Magn. on Systems, Man and Cybernetics, Part A: Systems and Humans, Vol. 41, No. 4, pp. 693-704

[29] Juanzi Li, Jie Tang, Yi Li, Qiong Luo, (2009), *RiMOM: A dynamic multi-strategy Ontology Alignment Framework*, IEEE Trans. Magn. on Knowledge and Data Engineering, Vol. 21, No. 8, pp. 1218-1232

[30] Mascardi, V., Locoro, A., Rosso, P., (2010), *Automatic ontology matching via upper ontologies: A Systematic Evaluation*, IEEE Trans. Magn. on Knowledge and Data Engineering, Vol. 22, No. 5, pp. 609-623

[31] Lenat, D., Guha, R, (1990), *Building Large Knowledge-Based Systems*, Addison Wesley

[32] Gangemi, A., Guarino, N., Masolo, C., Oltramari, A., Schneider, L., (2002), *Sweetening Ontologies with DOLCE*, In proceedings of the 13th International Conference on Knowledge Engineering and Knowledge Management, Ontologies and the Semantic Web, London, UK, pp. 166-181

[33] Niles, I., Pease, A., (2001), *Towards a Standard Upper Ontology*, In proceedings of the International Conference on Formal Ontology in Information Systems, New York, USA, pp. 2-9

[34] Resource Description Framework (RDF), W3C, (2012), [Online]. Available: http://www.w3.org/RDF

[35] RDF Vocabulary Description Language 1.0: RDF Schema, W3C, (2012), [Online]. Available: http://www.w3.org/TR/rdf-schema

[36] Web Ontology Language (OWL), W3C, (2012), [Online]. Available: http://www.w3.org/2004/OWL

[37] SPARQL Query Language for RDF, (2012), [Online]. Available: http://www.w3.org/TR/rdf-sparql-query

[38] Minsky, M., (1985), *The Society of Mind*, Simon & Schuster publishers

[39] EDAS Ontology, (2012), [Online]. Available: http://oaei.ontologymatching.org/2007/conference/data/edas.owl

[40] ACM-SIGKDD Ontology, (2012), [Online]. Available: http://oaei.ontologymatching.org/2007/conference/data/sigkdd.owl

[41] Sri Lanka Department of Agriculture, (2012), [Online]. Available: http://www.agridept.gov.lk

[42] Hector Kobbekaduwa Agrarian Research and Training Institute, (2012), [Online]. Available: http://www.harti.lk

Appendix A

Sample Agent Code

A.1 Sample code for Alignment Request Agent

Agent implementation class should override several JADE framework *Agent* class methods. The Agent should also bind to one of the agent behaviour types discussed in the implementation chapter. Following code illustrates how this has been done using the sample code from Alignment Request Agent.

```
public class AlignmentRequestAgent extends Agent {

   private static final Logger logger = Logger.getLogger(AlignmentRequestAgent.class);
   private OWLOntology targetOnt;
   private OntologyAligner oa;
   private OWLOntologyManager owlOntologyManager;
   private OWLClass baseCls;
   private AID[] ontologyAgents;
   private int step = 0;
   private int repliesCnt = 0;
   private int resourceAgentCount = 0;

   /**
     * Initialize the agent
   */
   protected void setup() {

      // initialize the arguments for the agent
      Object[] args = getArguments();
      oa = (OntologyAligner)args[0];
      owlOntologyManager = (OWLOntologyManager)args[1];
      targetOnt = (OWLOntology)args[2];
      baseCls = (OWLClass)args[3];

      // declare the agent's custom behavior
      addBehaviour(new TickerBehaviour(this, 20000) {

         protected void onTick() {

            // Select with what type of agents this should communicate
            DFAgentDescription template = new DFAgentDescription();
```

```
        ServiceDescription sd = new ServiceDescription();
        sd.setType("none-base-ontology");
        template.addServices(sd);
        try {
          DFAgentDescription[] result = DFService.search(myAgent, template);
          if (result.length == 0) {
            System.out.println("No concept resource agents found.");
          }

          ontologyAgents = new AID[result.length];
          for (int i = 0; i < result.length; ++i) {
            ontologyAgents[i] = result[i].getName();
          }
        } catch (FIPAException fe) {
          fe.printStackTrace();
        }

        myAgent.addBehaviour(new AlignmentRequestPerformer());
      }
    });
  }

  /**
    * Terminate the agent
   */
  protected void takeDown() {

    // increase completed agent count
    oa.setcompletedRequestAgentsCount();
  }

  // Implementation of the customized agent behaviour
            …

}
```

Appendix B

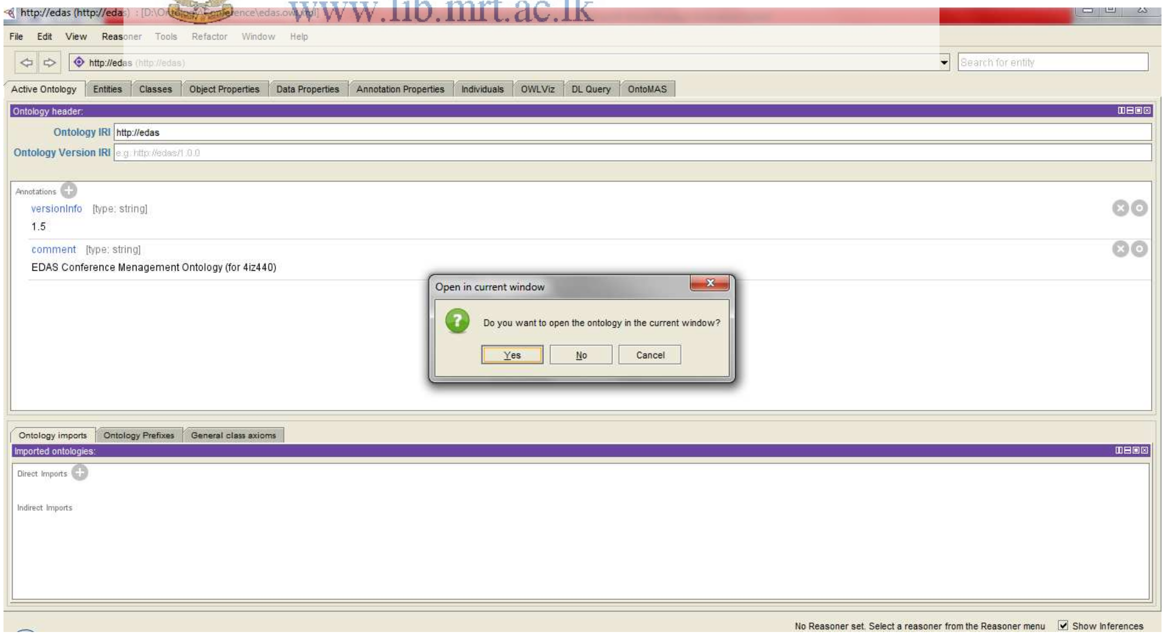
How OntoMAS System Works

B.1 Introduction

This section illustrates how the OntoMAS system could be used to ontology alignment. It also presents the flow of the OntoMAS plugin. This section can be considered as the user manual as well.

B.2 Execution Flow of OntoMAS

The ontologies to be aligned need to load in to the Protégé environment. This could be done by opening the relevant ontology file using the "Open" menu item in Protégé editor. Currently, it only allows to load a single ontology at a time. When try to open another ontology, the editor will prompt a message to confirm whether it should be loaded in the current window. Figure B.1 shows this message.



Ontology IRI: http://edas

Ontology Version IRI: e.g. http://edas/1.0.0

versionInfo [type: string]
1.5

comment [type: string]
EDAS Conference Menagement Ontology (for 4iz440)

Open in current window

Do you want to open the ontology in the current window?

No Reasoner set. Select a reasoner from the Reasoner menu ☑ Show Inferences

Figure B.1: Confirmation Message When Loading the Second Ontology

OntoMAS requires both ontologies to be loaded in the same window. Thus, the user should select the "Yes" option. A new menu item "Align Ontologies…" was introduced under the Refactor menu bar to execute OntoMAS. This is shown in Figure B.2.

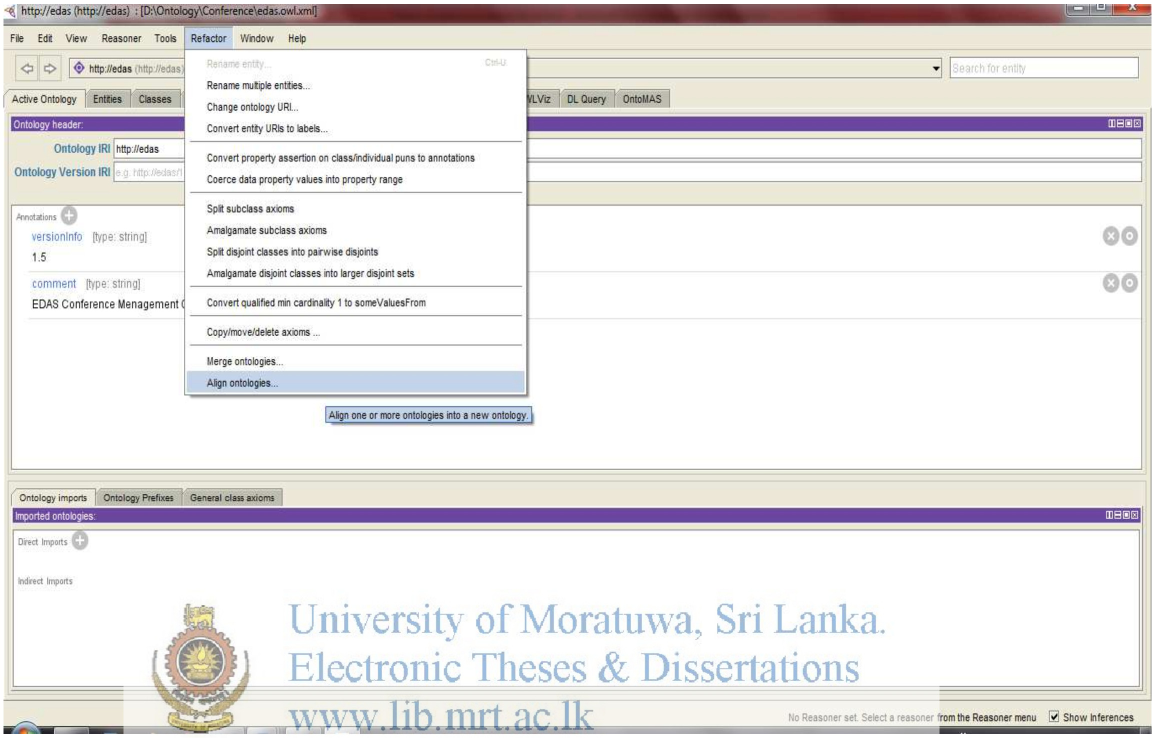
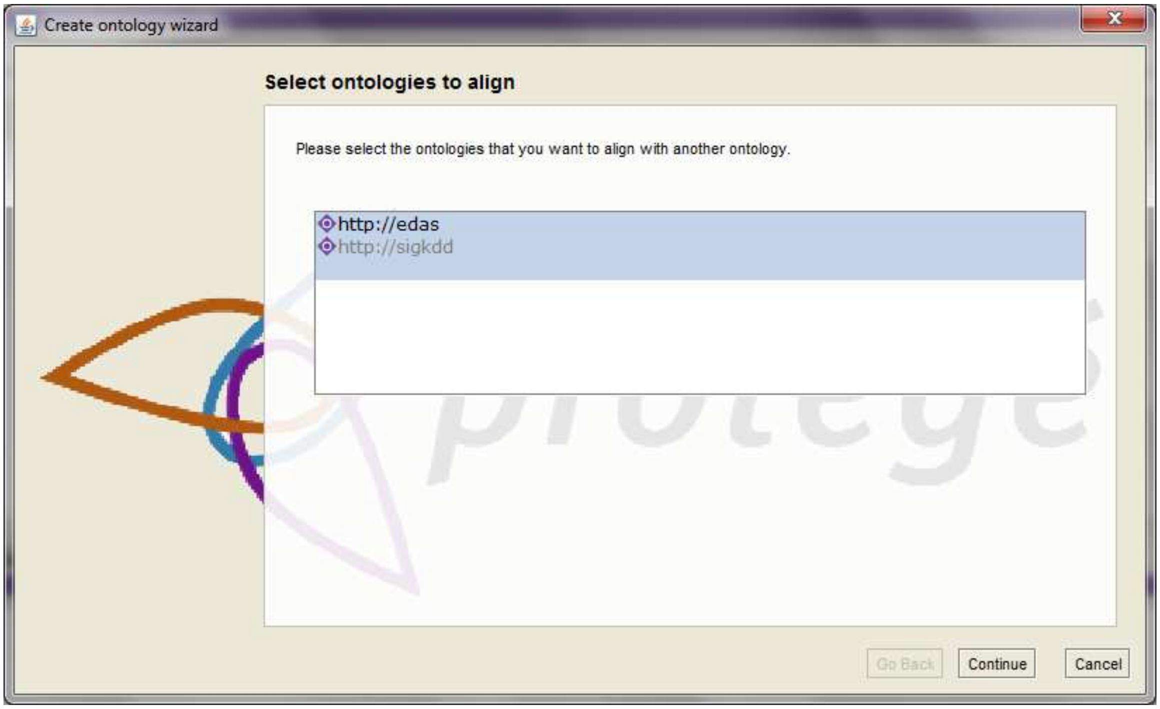

http://edas (http://edas) : [D:\Ontology\Conference\edas.owl.xml]
File
Edit
View
Reasoner
Tools
Refactor
Window
Help
http://edas (http://edas)
Search for entity
Active Ontology
Entities
Classes
VLViz
DL Query
OntoMAS
Ontology header:
Ontology IRI
http://edas
Ontology Version IRI
Annotations
versionInfo [type: string]
1.5
comment [type: string]
EDAS Conference Menagement
Rename entity...
Ctrl-U
Rename multiple entities...
Change ontology URI...
Convert entity URIs to labels...
Convert property assertion on class/individual puns to annotations
Coerce data property values into property range
Split subclass axioms
Amalgamate subclass axioms
Split disjoint classes into pairwise disjoints
Amalgamate disjoint classes into larger disjoint sets
Convert qualified min cardinality 1 to someValuesFrom
Copy/move/delete axioms ...
Merge ontologies...
Align ontologies...
Align one or more ontologies into a new ontology.
Ontology imports
Ontology Prefixes
General class axioms
Imported ontologies:
Direct Imports
Indirect Imports
No Reasoner set. Select a reasoner from the Reasoner menu
Show Inferences

Figure B.2: Menu Item to Execute OntoMAS

Once the user clicks the "Align Ontologies…" menu item, a wizard pops up. The first step in the wizard is to select ontologies the user wants to align. Since Protégé editor could have several loaded ontologies, the user needs to exactly select two ontologies. This step is presented by figure B.3

Then, as the next step, the user has to choose a base ontology among the two input ontologies. Figure B.4 shows this step of the wizard.

In next two steps, the user could select a unique identifier for newly created ontology and its physical location. Since the ontologies are developed to be shared publically, the common agreement is to use unique names to avoid any serious issues arise in the future. Figure B.5 and Figure B.6 present these steps.

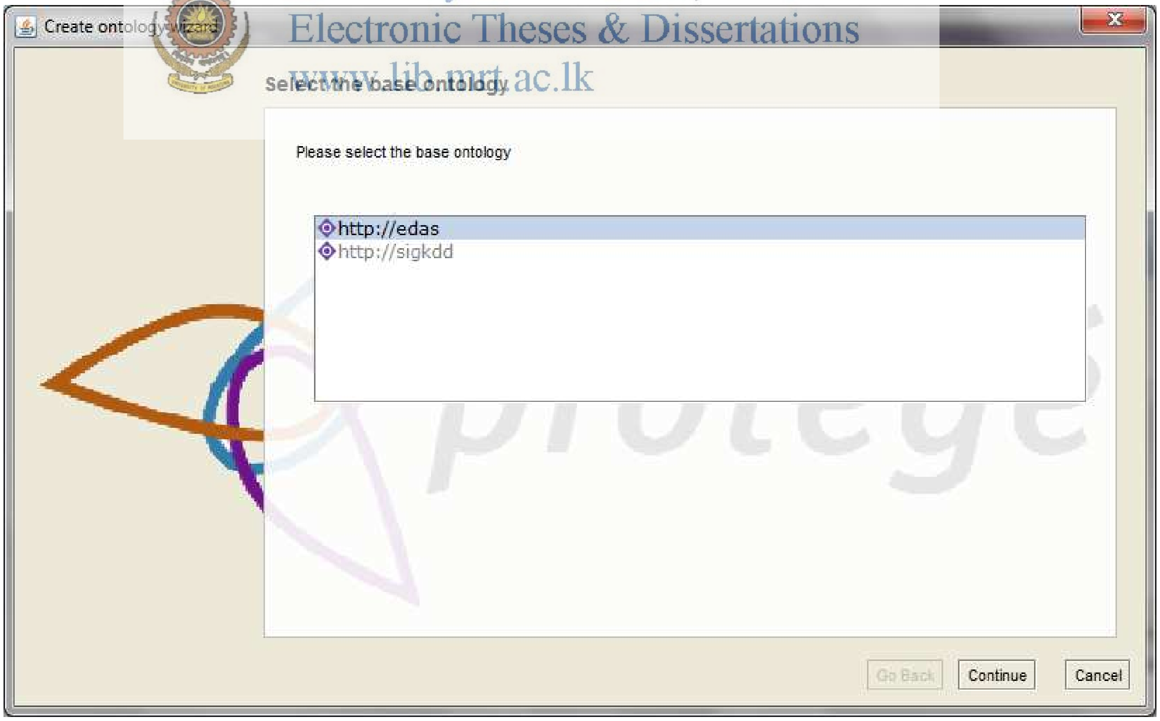

Create ontology wizard

Select ontologies to align

Please select the ontologies that you want to align with another ontology.

http://edas
http://sigkdd

Figure B.3: Selecting Two Input Ontologies for OntoMAS

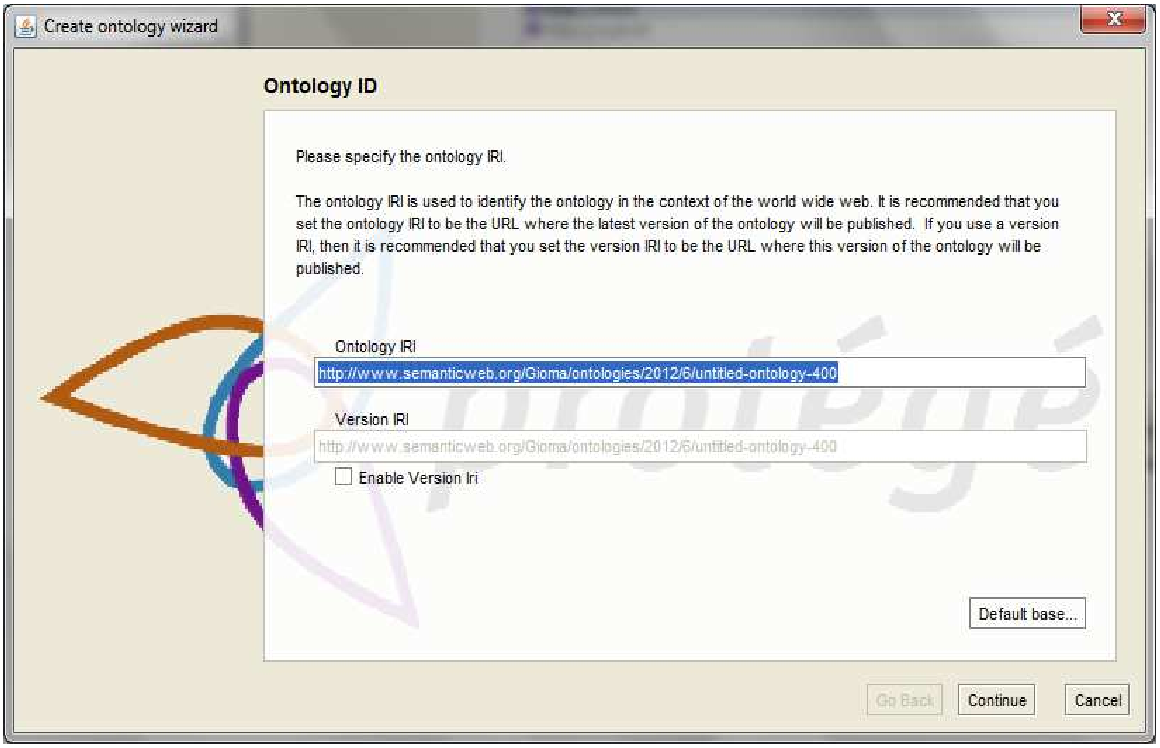

Create ontology wizard

Select the base ontology

Please select the base ontology

http://edas
http://sigkdd

Figure B.4: Selecting the Base Ontology



Ontology ID

Please specify the ontology IRI.

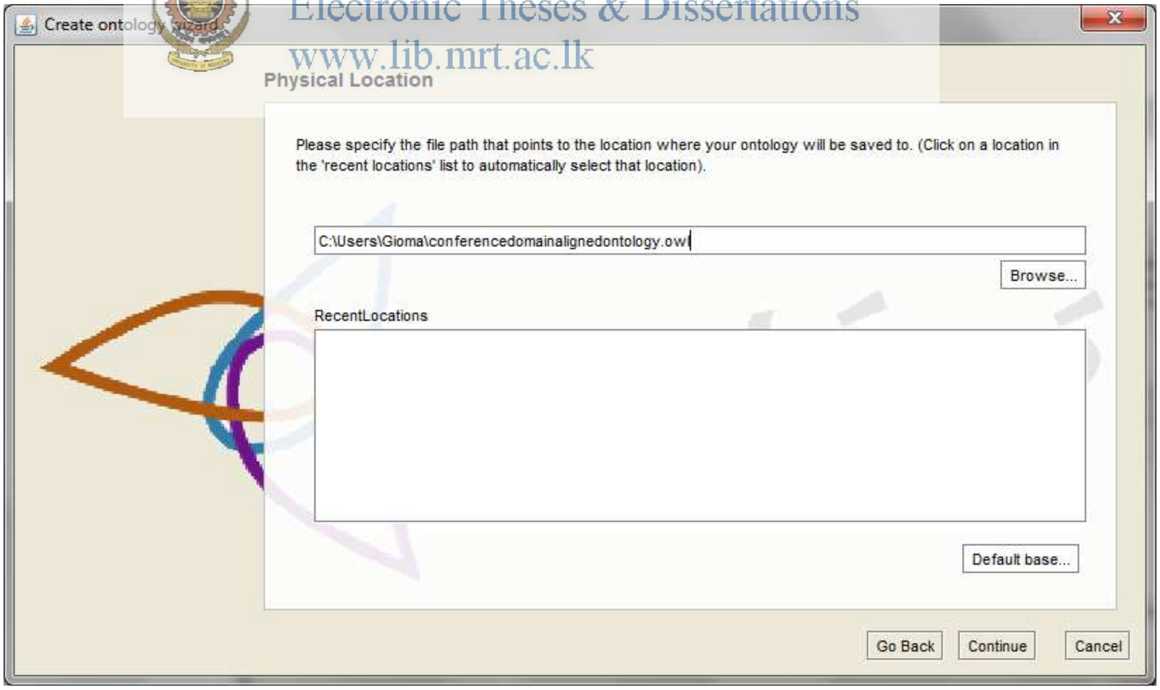
The ontology IRI is used to identify the ontology in the context of the world wide web. It is recommended that you set the ontology IRI to be the URL where the latest version of the ontology will be published. If you use a version IRI, then it is recommended that you set the version IRI to be the URL where this version of the ontology will be published.

Ontology IRI: http://www.semanticweb.org/Gioma/ontologies/2012/6/untitled-ontology-400

Version IRI: http://www.semanticweb.org/Gioma/ontologies/2012/6/untitled-ontology-400

□ Enable Version Iri

Figure B.5: Assigning an IRI for Generated Ontology



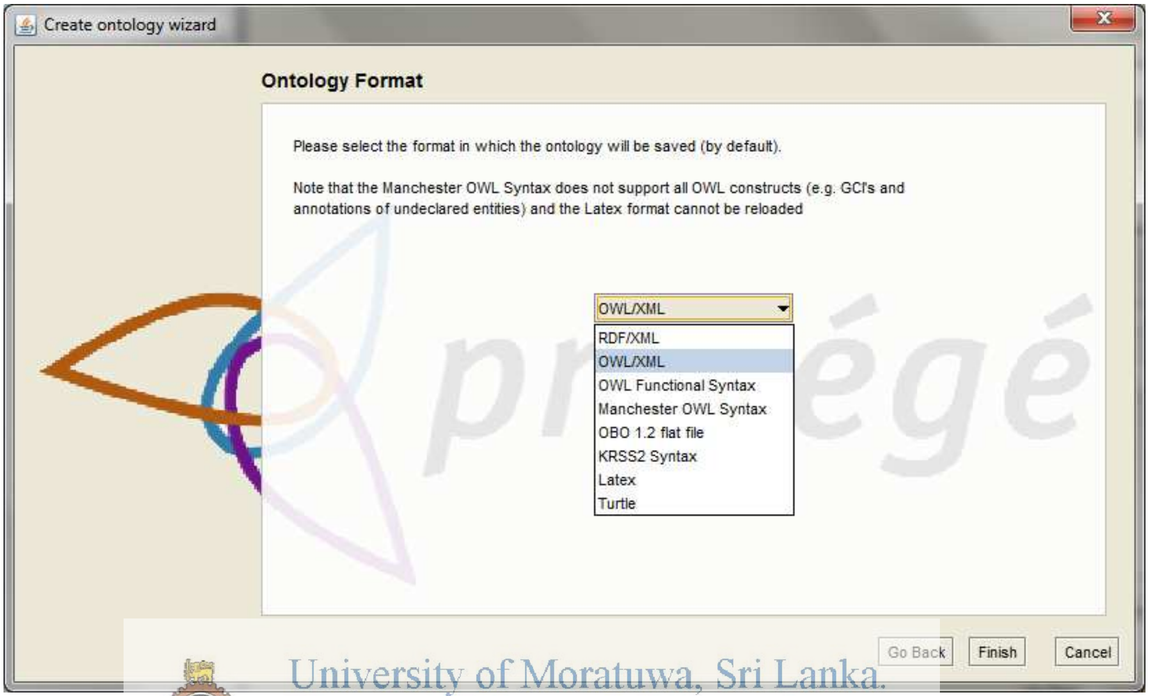
Physical Location

Please specify the file path that points to the location where your ontology will be saved to. (Click on a location in the 'recent locations' list to automatically select that location).

C:\Users\Gioma\conferencedomainalignedontology.owl

Figure B.6: Choosing the Path to Save the Generated Ontology

Subsequently, the format of the generated ontology is selected. The user must select either RDF/XML or OWL/XML formats. Figure B.7 prsents this step.



Please select the format in which the ontology will be saved (by default).

Note that the Manchester OWL Syntax does not support all OWL constructs (e.g. GCI's and annotations of undeclared entities) and the Latex format cannot be reloaded

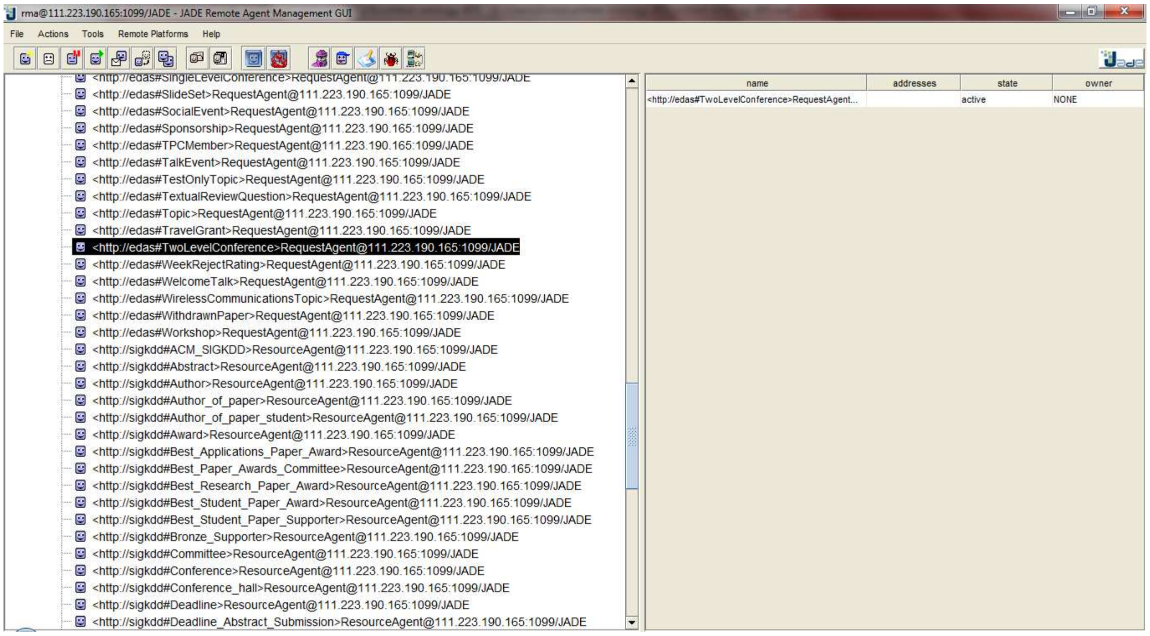
OWL/XML

Figure B.7: Selecting the Format for Generated Ontology

When the user clicks the “Finish” button, it will open the JADE Agent Management Console, and creates the required agents to represent the concepts in input ontologies. The user interface of JADE Agent Management Console is shown by figure B.8

JADE also has the facilities to visualize and trace the messgaes passed amoung the agents. Figure B.8 displays a snapshot of the message space during the agent execution. After performing the alignment task, all the agents are terminated, and the JADE framework also shutdowns.

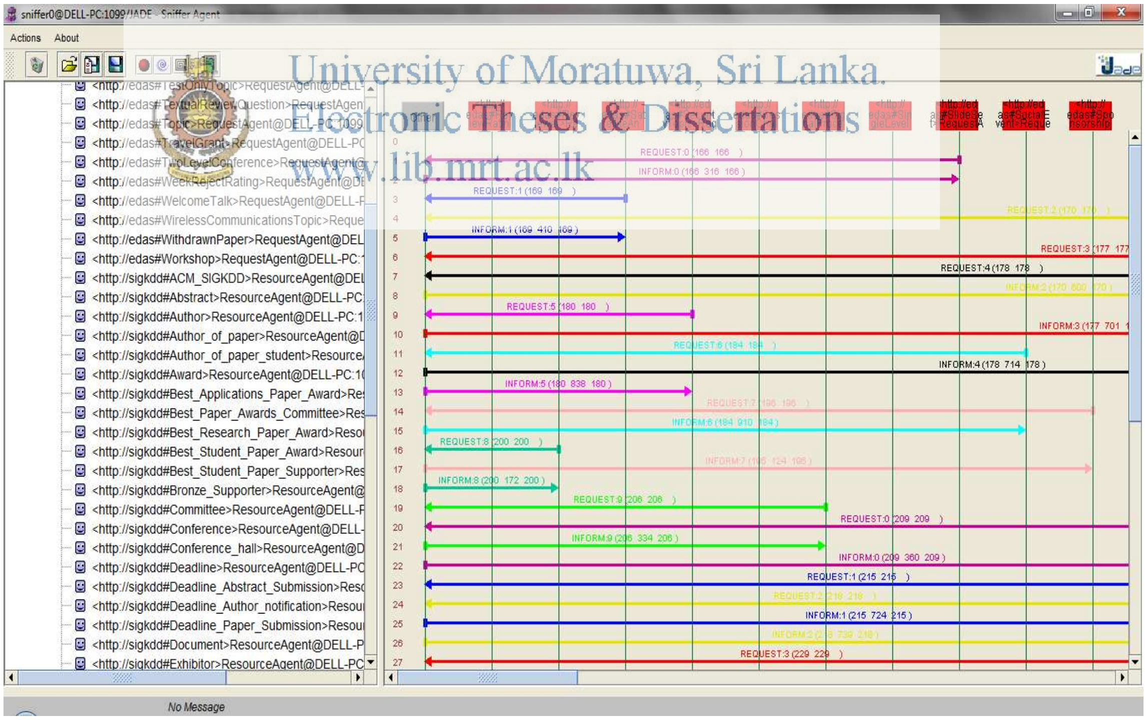
The user could use OntoMAS tab of the Protégé editor to visualize the semantic relationships generated during the alignment process. Figure B.10 demonstrates this.


rma@111.223.190.165:1099/JADE - JADE Remote Agent Management GUI
File
Actions
Tools
Remote Platforms
Help

```
<http://edas#SingleLevelConference>RequestAgent@111.223.190.165:1099/JADE
<http://edas#SlideSet>RequestAgent@111.223.190.165:1099/JADE
<http://edas#SocialEvent>RequestAgent@111.223.190.165:1099/JADE
<http://edas#Sponsorship>RequestAgent@111.223.190.165:1099/JADE
<http://edas#TPCMember>RequestAgent@111.223.190.165:1099/JADE
<http://edas#TalkEvent>RequestAgent@111.223.190.165:1099/JADE
<http://edas#TestOnlyTopic>RequestAgent@111.223.190.165:1099/JADE
<http://edas#TextualReviewQuestion>RequestAgent@111.223.190.165:1099/JADE
<http://edas#Topic>RequestAgent@111.223.190.165:1099/JADE
<http://edas#TravelGrant>RequestAgent@111.223.190.165:1099/JADE
<http://edas#TwoLevelConference>RequestAgent@111.223.190.165:1099/JADE
<http://edas#WeekRejectRating>RequestAgent@111.223.190.165:1099/JADE
<http://edas#WelcomeTalk>RequestAgent@111.223.190.165:1099/JADE
<http://edas#WirelessCommunicationsTopic>RequestAgent@111.223.190.165:1099/JADE
<http://edas#WithdrawnPaper>RequestAgent@111.223.190.165:1099/JADE
<http://edas#Workshop>RequestAgent@111.223.190.165:1099/JADE
<http://sigkdd#ACM_SIGKDD>ResourceAgent@111.223.190.165:1099/JADE
<http://sigkdd#Abstract>ResourceAgent@111.223.190.165:1099/JADE
<http://sigkdd#Author>ResourceAgent@111.223.190.165:1099/JADE
<http://sigkdd#Author_of_paper>ResourceAgent@111.223.190.165:1099/JADE
<http://sigkdd#Author_of_paper_student>ResourceAgent@111.223.190.165:1099/JADE
<http://sigkdd#Award>ResourceAgent@111.223.190.165:1099/JADE
<http://sigkdd#Best_Applications_Paper_Award>ResourceAgent@111.223.190.165:1099/JADE
<http://sigkdd#Best_Paper_Awards_Committee>ResourceAgent@111.223.190.165:1099/JADE
<http://sigkdd#Best_Research_Paper_Award>ResourceAgent@111.223.190.165:1099/JADE
<http://sigkdd#Best_Student_Paper_Award>ResourceAgent@111.223.190.165:1099/JADE
<http://sigkdd#Best_Student_Paper_Supporter>ResourceAgent@111.223.190.165:1099/JADE
<http://sigkdd#Bronze_Supporter>ResourceAgent@111.223.190.165:1099/JADE
<http://sigkdd#Committee>ResourceAgent@111.223.190.165:1099/JADE
<http://sigkdd#Conference>ResourceAgent@111.223.190.165:1099/JADE
<http://sigkdd#Conference_hall>ResourceAgent@111.223.190.165:1099/JADE
<http://sigkdd#Deadline>ResourceAgent@111.223.190.165:1099/JADE
<http://sigkdd#Deadline_Abstract_Submission>ResourceAgent@111.223.190.165:1099/JADE
```

name	addresses	state	owner
<http://edas#TwoLevelConference>RequestAgent...		active	NONE

Figure B.8: JADE Agent Management GUI

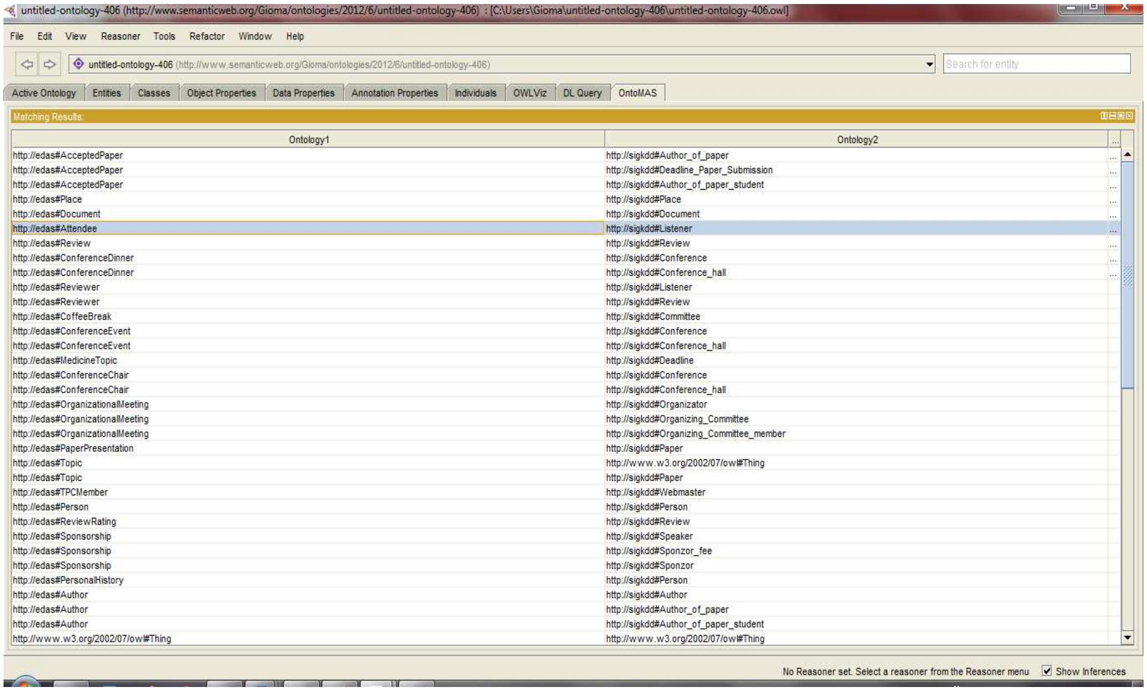


```
<http://edas#TestOnlyTopic>RequestAgent@DELL-
<http://edas#TextualReviewQuestion>RequestAgen
<http://edas#Topic>RequestAgent@DELL-PC:1099
<http://edas#TravelGrant>RequestAgent@DELL-PC
<http://edas#TwoLevelConference>RequestAgent@
<http://edas#WeekRejectRating>RequestAgent@DE
<http://edas#WelcomeTalk>RequestAgent@DELL-F
<http://edas#WirelessCommunicationsTopic>Reque
<http://edas#WithdrawnPaper>RequestAgent@DEL
<http://edas#Workshop>RequestAgent@DELL-PC:1
<http://sigkdd#ACM_SIGKDD>ResourceAgent@DEL
<http://sigkdd#Abstract>ResourceAgent@DELL-PC
<http://sigkdd#Author>ResourceAgent@DELL-PC:1
<http://sigkdd#Author_of_paper>ResourceAgent@D
<http://sigkdd#Author_of_paper_student>Resource
<http://sigkdd#Award>ResourceAgent@DELL-PC:1
<http://sigkdd#Best_Applications_Paper_Award>Res
<http://sigkdd#Best_Paper_Awards_Committee>Res
<http://sigkdd#Best_Research_Paper_Award>Reso
<http://sigkdd#Best_Student_Paper_Award>Resour
<http://sigkdd#Best_Student_Paper_Supporter>Res
<http://sigkdd#Bronze_Supporter>ResourceAgent@
<http://sigkdd#Committee>ResourceAgent@DELL-F
<http://sigkdd#Conference>ResourceAgent@DELL-
<http://sigkdd#Conference_hall>ResourceAgent@D
<http://sigkdd#Deadline>ResourceAgent@DELL-PC
<http://sigkdd#Deadline_Abstract_Submission>Reso
<http://sigkdd#Deadline_Author_notification>Resou
<http://sigkdd#Deadline_Paper_Submission>Resou
<http://sigkdd#Document>ResourceAgent@DELL-P
<http://sigkdd#Exhibitor>ResourceAgent@DELL-PC
```

```
REQUEST:0 (166  166   )
INFORM:0 (166  316  166 )
REQUEST:1 (169  169   )
REQUEST:2 (170  170   )
INFORM:1 (169  410  169 )
REQUEST:3 (177  177
REQUEST:4 (178  178   )
INFORM:2 (170  800  170 )
REQUEST:5 (180  180   )
INFORM:3 (177  701  1
REQUEST:6 (184  184   )
INFORM:4 (178  714  178 )
INFORM:5 (180  838  180 )
REQUEST:7 (196  196   )
INFORM:6 (184  910  184 )
REQUEST:8 (200  200   )
INFORM:7 (196  124  196 )
INFORM:8 (200  172  200 )
REQUEST:9 (206  206   )
REQUEST:0 (209  209   )
INFORM:9 (206  334  206 )
INFORM:0 (209  360  209 )
REQUEST:1 (215  215   )
REQUEST:2 (218  218   )
INFORM:1 (215  724  215 )
INFORM:2 (218  739  218 )
REQUEST:3 (229  229   )
```

No Message

Figure B.9: The Agent Message Space


untitled-ontology-406 (http://www.semanticweb.org/Gioma/ontologies/2012/6/untitled-ontology-406) : [C:\Users\Gioma\untitled-ontology-406\untitled-ontology-406.owl]
File
Edit
View
Reasoner
Tools
Refactor
Window
Help
untitled-ontology-406 (http://www.semanticweb.org/Gioma/ontologies/2012/6/untitled-ontology-406)
Search for entity
Active Ontology
Entities
Classes
Object Properties
Data Properties
Annotation Properties
Individuals
OWLViz
DL Query
OntoMAS

Matching Results:

Ontology1	Ontology2
http://edas#AcceptedPaper	http://sigkdd#Author_of_paper
http://edas#AcceptedPaper	http://sigkdd#Deadline_Paper_Submission
http://edas#AcceptedPaper	http://sigkdd#Author_of_paper_student
http://edas#Place	http://sigkdd#Place
http://edas#Document	http://sigkdd#Document
http://edas#Attendee	http://sigkdd#Listener
http://edas#Review	http://sigkdd#Review
http://edas#ConferenceDinner	http://sigkdd#Conference
http://edas#ConferenceDinner	http://sigkdd#Conference_hall
http://edas#Reviewer	http://sigkdd#Listener
http://edas#Reviewer	http://sigkdd#Review
http://edas#CoffeeBreak	http://sigkdd#Committee
http://edas#ConferenceEvent	http://sigkdd#Conference
http://edas#ConferenceEvent	http://sigkdd#Conference_hall
http://edas#MedicineTopic	http://sigkdd#Deadline
http://edas#ConferenceChair	http://sigkdd#Conference
http://edas#ConferenceChair	http://sigkdd#Conference_hall
http://edas#OrganizationalMeeting	http://sigkdd#Organizator
http://edas#OrganizationalMeeting	http://sigkdd#Organizing_Committee
http://edas#OrganizationalMeeting	http://sigkdd#Organizing_Committee_member
http://edas#PaperPresentation	http://sigkdd#Paper
http://edas#Topic	http://www.w3.org/2002/07/ow#Thing
http://edas#Topic	http://sigkdd#Paper
http://edas#TPCMember	http://sigkdd#Webmaster
http://edas#Person	http://sigkdd#Person
http://edas#ReviewRating	http://sigkdd#Review
http://edas#Sponsorship	http://sigkdd#Speaker
http://edas#Sponsorship	http://sigkdd#Sponzor_fee
http://edas#Sponsorship	http://sigkdd#Sponzor
http://edas#PersonalHistory	http://sigkdd#Person
http://edas#Author	http://sigkdd#Author
http://edas#Author	http://sigkdd#Author_of_paper
http://edas#Author	http://sigkdd#Author_of_paper_student
http://www.w3.org/2002/07/ow#Thing	http://www.w3.org/2002/07/ow#Thing

No Reasoner set. Select a reasoner from the Reasoner menu ☑ Show Inferences

Figure B.10: OntoMAS Tab of Protégé

Appendix C

Agricultural Ontologies

C.1 The Contents of the WikiGoviya Ontology

Table C.1: The Contents of the WikiGoviya Ontology

Commodity Type	Commodity Name
Big Onions	Big Onions Impt
Coconut	Coconut Large, Coconut Small
Dried Chilies	Dried Chilies Impt
Fruit	Ambul Plantain, Ambun Plantain, Anamalu, Avocado, Grapes, King Coconut, Kolikuttu Plantain, Orange, Papaw, Passion, Pineapple Large, Pineapple Medium, Pineapple Small, Seeni Plantain, Slim Apple, Wood Apple
Leafy Vegetable	Gotukola, Kankun, Mukunuwenna
Mango	Betti Mango, Karithakolomban, Kohu Mango, Vilad Mango
Potato	Potato Impt, Potato Nuwaraeliya
Pules	Cowpea Pules, Green Gram Pules, Mansour Dhal
Red Onions	Red Onions Impt, Red Onions Sinnan, Red Onions Vedaln
Rice	Nadu1, Nadu2, Raw Red, Raw White, Samba2, Samba3
Root Crops	Manioc, Sweet Potatoes
Vegetable	Ash Plantain, Bean Green, Beans Butter, BitterGuad, Brigauls, Cabbage, Capsicum, Carrot, Cucumber, Drumstick, Knolkhol, Ladies Fingers, Leeks, Lime, Long Beans, Luffa, Pumpkin, Raddish, SnakeGuad, Tomatoes

C.2 The Contents of the HARTI Ontology

Table C.2: The Contents of the HARTI Ontology

Commodity Type	Commodity Name
Bread Fruit	-
Coarse Grains	Finger Millet, Maize, Meneri, Sorghum
Fruits	Annona, Avocado, Banana, Beal, Citrus Fruits, Dragon Fruit, Durian, Guava, Mango, Mangos teen, Papaya, Pineapple, Pomegranate, Rambutan, Wood Apple
Mushroom	-
Other Field Crops	Condiments Big Onion, Chili, Red Onion Grain Legumes Blackgram, Cowpea, Mung Bean, Soya Bean Oil Crops
Paddy	-
Potato	-
Root & Tuber	-
Vegetables	Artichoke, Asparagus, Beans, Beetroot, Brinjal, Cabbage, Capsicum, Carrot, Cucumber, Drumstick, Elabatu, Knolkhol, Leafy Vegetables, Leeks, Luffa, Okra, Pumpkin, Raddish, Snake guad, Thibbatu, Thubakarawila, Tomato, Winged Beans