

Graphol: a graphical ontology language

Survey and User Evaluation Study

Purpose of the Questionnaire

Evaluate the usability of the Graphol language for ontology modeling through a series of comprehension tasks.

Pre-questionnaire

We would like for you to provide some personal and professional background information, regarding experience with ontology modelling, knowledge representation, and ontology languages (OWL2, Description Logics). Please fill in the following short survey.

1. Sex ☐ Male ☐ Female

2. How old are you? _____

3. Please describe your occupation/profession and role?

4. What is type and field of your highest completed education degree?

5. Roughly how many years of experience with ontologies do you have (0 if none)? _____

6. On a scale from 1 to 5, how would you rate your knowledge of conceptual modeling?
None ☐—☐—☐—☐—☐ Very high

7. On a scale from 1 to 5, how would you rate your knowledge of ontologies?
None ☐—☐—☐—☐—☐ Very high

8. Which ontology editors are you familiar with?
☐ Protégè ☐ TopBraid Composer ☐ NeOn Toolkit ☐ OWLGrEd
☐ OntoStudio ☐ OntoUML ☐ Other:

9. Which knowledge representation and conceptual modeling formalisms are you familiar with?
☐ OWL2 ☐ E-R ☐ Description Logics ☐ UML Class Diagrams
☐ ORM ☐ Other:












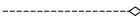

10. Have you ever had experience in manually creating or editing an ontology (Y/N)? _____

11. Have you ever had experience in working with medium- or large-scale ontologies in real-life projects (Y/N)? _____

12. Which ontology visualization tools are you familiar with?
☐ OntoGraf ☐ OWLViz ☐ GROWL ☐ OWLGrEd ☐ Other:

Graphol Cheat Sheet - 1

Graphical symbols

Symbol	Meaning	Symbol	Meaning	Symbol	Meaning
	Concept		Intersection		Domain restriction
	Role		Union		Range restriction
	Attribute		Complement		Inclusion edge
	Value domain		Inverse		Parameter input edge
	Disjoint Union				

Restriction types:

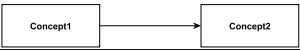

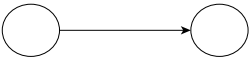
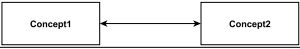






- existential: “exists”
- universal: “forall”
- cardinality: “x,y”, with $y \geq x$, and $x = “-”$ if no minimum cardinality is specified, and $y = “-”$ if no maximum cardinality is specified

If the restriction type label on a white or black square is missing, then the existential restriction is implied.

Graphol Cheat Sheet - 2


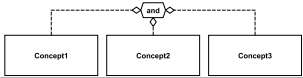
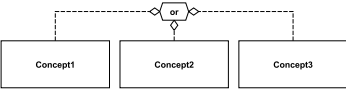
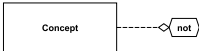

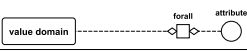
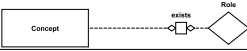
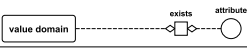
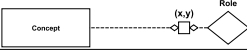
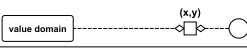

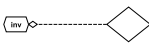

Intentional assertions

In the following table, the “Concept” and “Role” nodes in the Graphol column can be replaced with complex concepts and roles.

Meaning	Graphol
Concept inclusion	
Role inclusion	
Attribute inclusion	
Concept equivalence	
Role equivalence	
Attribute equivalence	
Globally functional role	
Globally inverse functional role	
Globally functional and inverse functional role	
Globally functional attribute	

Graphol Cheat Sheet - 3

In the following table we provide the most common expressions. Graphol n -ary operators with $n > 2$ are represented as having 3 input parameters. Restrictions for Graphol role domains exist also for role ranges. The “Concept” and “Role” nodes in the Graphol column can be replaced with complex concepts and roles.

Meaning	Graphol
Concept	
Concept intersection	
Concept union	
Concept complement	
Universal role domain restriction	
Universal attribute domain restriction	
Existential role domain restriction	
Existential attribute domain restriction	
Min. and max. cardinality role restriction	
Min. and max. cardinality attribute restriction	
Role	
Inverse role	
Attribute	

Graphol Cheat Sheet - 4

In the following table you can see some of the more typical examples of conceptual design in Graphol. The “Concept” and “Role” nodes in the Graphol column can be replaced with complex concepts and roles.

Relation	Graphol
ISA between classes	
Disjointness between classes	
ISA between roles	
Disjointness between roles	
Typings of the domain and range of a role	
Typings of the domain and range of an attribute	
Cardinality restriction on the mandatory participation of concepts to roles/attributes	
Global functionality assertions	

Comprehension Task

You have been provided a printout of a simple Graphol model which depicts an extract of the Lehigh University Benchmark (LUBM) ontology (also see Appendix A). The model represents a university domain ontology.

Please answer the following questions.

1. Must a GraduateStudent attend only GraduateLevelCourses(Y/N)? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

2. List the pairs of atomic sub-concepts of Employee in which the two concepts are disjoint from each other.

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

3. Can a Research Assistant work for a School(Y/N)? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

4. Can Student and Employee have a common instance(Y/N)? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

5. For each of the following roles and attributes, state whether the given concept can participate in it, and, if so, specify if the participation is mandatory.

- | | | | |
|------------------------------|------------------------------|-----------------------------|------------------------------------|
| a) Employee - worksFor: | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Mandatory |
| b) Student - attends: | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Mandatory |
| c) Person - telephoneNumber: | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Mandatory |
| d) University - hasAlumnus: | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Mandatory |
| e) Person - title: | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Mandatory |
| f) PostDoctorate - teaches: | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Mandatory |

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

6. Specify whether the following roles and attributes are functional, inverse functional, or both.

- | | | |
|--------------|-------------------------------------|---------------------------------------------|
| a) title: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| b) worksFor: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| c) teaches: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| d) email: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

7. List the typings of the domain and range of the following attributes.

- | | | |
|----------|---------------|--------------|
| a) title | Domain: _____ | Range: _____ |
| b) name | Domain: _____ | Range: _____ |
| c) age | Domain: _____ | Range: _____ |

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

8. List the typings of the domain and range of the following roles.

- | | | |
|------------------|---------------|--------------|
| a) hasAlumnus | Domain: _____ | Range: _____ |
| b) publishes | Domain: _____ | Range: _____ |
| c) hasDegreeFrom | Domain: _____ | Range: _____ |
| d) worksFor | Domain: _____ | Range: _____ |

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

9. Name two roles that are one the inverse of the other.

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

10. Must each Person have a telephone number(Y/N)? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

Post-test questionnaire

Please answer the following questions at the end of your test.

1. How would you rate the general difficulty of the comprehension tasks of the test?

Very easy ☐—☐—☐—☐—☐ Very difficult

2. How would you rate the difficulty of learning the symbols of the Graphol language?

Very easy ☐—☐—☐—☐—☐ Very difficult

3. How would you rate the general difficulty of using Graphol for reading ontologies?

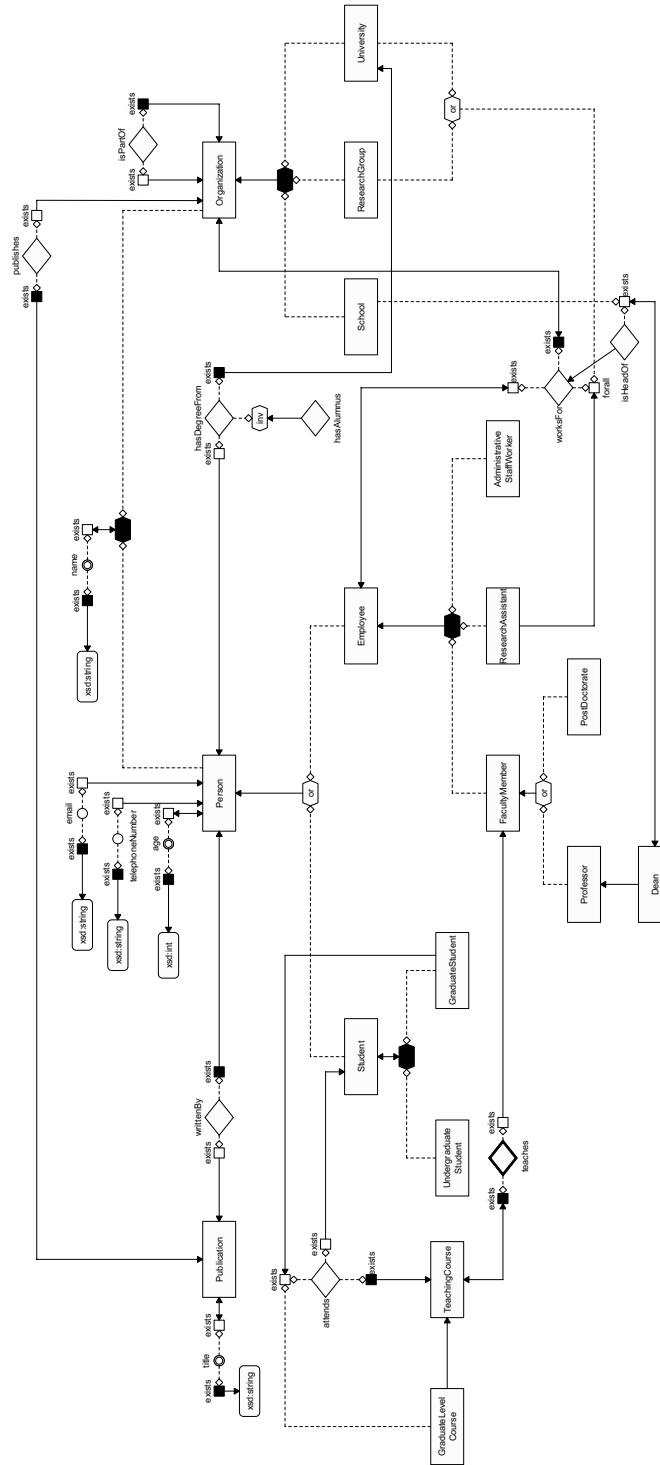
Very easy ☐—☐—☐—☐—☐ Very difficult

4. (Optional) Aspects of the Graphol language that you particularly like:

5. (Optional) Aspects of the Graphol language that you would like to see improved/changed:

Appendix A

Model used for Graphol Comprehension Task



OWLGrEd: a graphical ontology language

Survey and User Evaluation Study

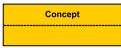




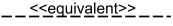
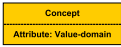




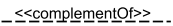

Purpose of the Questionnaire

Evaluate the usability of the OWLGrEd language for ontology modeling through a series of comprehension tasks.

OWLGrEd Cheat Sheet - 1

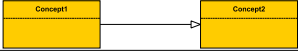
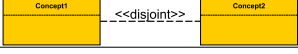
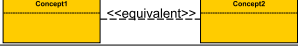
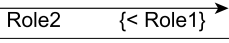
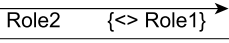
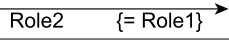
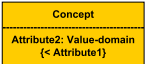
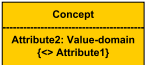
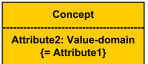
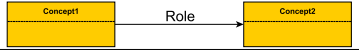
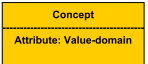
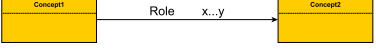
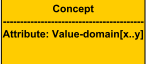
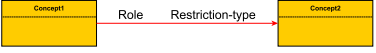
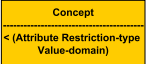
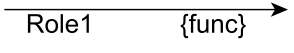
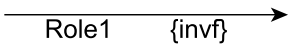
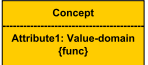
Graphical symbols

The “Concept”, “Role”, “Attribute”, and “Value-domain” labels on the symbols indicate the name of the respective ontology predicate.

Symbol	Meaning	Symbol	Meaning	Symbol	Meaning
	Concept		Disjoint hierarchy connector		Restriction edge
	Role		Complete hierarchy connector		Equivalence edge
	Attribute		Inclusion edge		Disjunction edge
	Value domain		Input edge		Complement edge
	Hierarchy connector				

OWLGrEd Cheat Sheet - 2

In the following table you can see some of the more typical examples of conceptual design in OWLGrEd. The “Concept” label on concept nodes in the OWLGrEd column can be replaced with a complex expression label, which indicates that the concept node represents a concept expression such as the union or intersection of concepts. In OWLGrEd, concept inclusion can alternatively be represented through an inclusion label, “ \leq ”, followed by the including concept, in the concept node.

Relation	Graphol
ISA between concepts	
Disjointness between concepts	
Equivalence between concepts	
ISA between roles	
Disjointness between roles	
Equivalence between roles	
ISA between attributes	
Disjointness between attributes	
Equivalence between attributes	
Typings of the domain and range of a role	
Typings of the domain and range of an attribute	
Cardinality of roles/attributes	 
Restriction on roles/attributes	  Restriction-type = some/only/exactly x/max x/min x
Functionality assertions	  

Comprehension Task

You have been provided a printout of a simple OWLGrEd model which depicts an extract of the Lehigh University Benchmark (LUBM) ontology (also see Appendix A). The model represents a university domain ontology.

Please answer the following questions.

1. Must a GraduateStudent attend only GraduateLevelCourses(Y/N)? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

2. List the pairs of atomic sub-concepts of Employee in which the two concepts are disjoint from each other.

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

3. Can a Research Assistant work for a School(Y/N)? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

4. Can Student and Employee have a common instance(Y/N)? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

5. For each of the following roles and attributes, state whether the given concept can participate in it, and, if so, specify if the participation is mandatory.

- | | | | |
|------------------------------|------------------------------|-----------------------------|------------------------------------|
| a) Employee - worksFor: | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Mandatory |
| b) Student - attends: | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Mandatory |
| c) Person - telephoneNumber: | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Mandatory |
| d) University - hasAlumnus: | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Mandatory |
| e) Person - title: | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Mandatory |
| f) PostDoctorate - teaches: | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Mandatory |

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

6. Specify whether the following roles and attributes are functional, inverse functional, or both.

- | | | |
|--------------|-------------------------------------|---------------------------------------------|
| a) title: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| b) worksFor: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| c) teaches: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| d) email: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

7. List the typings of the domain and range of the following attributes.

a) title	Domain: _____	Range: _____
b) name	Domain: _____	Range: _____
c) age	Domain: _____	Range: _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

8. List the typings of the domain and range of the following roles.

a) hasAlumnus	Domain: _____	Range: _____
b) publishes	Domain: _____	Range: _____
c) hasDegreeFrom	Domain: _____	Range: _____
d) worksFor	Domain: _____	Range: _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

9. Name two roles that are one the inverse of the other.

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

10. Must each Person have a telephone number(Y/N)? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

Post-test questionnaire

Please answer the following questions at the end of your test.

1. **How would you rate the general difficulty of the comprehension tasks of the test?**
Very easy ☐—☐—☐—☐—☐ Very difficult
2. **How would you rate the difficulty of learning the symbols of the OWLGrEd language?**
Very easy ☐—☐—☐—☐—☐ Very difficult
3. **How would you rate the general difficulty of using OWLGrEd for reading ontologies?**
Very easy ☐—☐—☐—☐—☐ Very difficult
4. **(Optional) Aspects of the OWLGrEd language that you particularly like:**

5. **(Optional) Aspects of the OWLGrEd language that you would like to see improved/changed:**

Model used for Comprehension Task

Graphol: a graphical ontology language

Survey and User Evaluation Study

Purpose of the Questionnaire

Evaluate the usability of the Graphol language for ontology modeling through a series of comprehension tasks.

Pre-questionnaire

We would like for you to provide some personal and professional background information, regarding experience with ontology modelling, knowledge representation, and ontology languages (OWL2, Description Logics). Please fill in the following short survey.

1. Sex ☐ Male ☐ Female

2. How old are you? _____

3. Please describe your occupation/profession and role?

4. What is type and field of your highest completed education degree?

5. Roughly how many years of experience with ontologies do you have (0 if none)? _____

6. On a scale from 1 to 5, how would you rate your knowledge of conceptual modeling?
None ☐—☐—☐—☐—☐ Very high

7. On a scale from 1 to 5, how would you rate your knowledge of ontologies?
None ☐—☐—☐—☐—☐ Very high

8. Which ontology editors are you familiar with?
☐ Protégè ☐ TopBraid Composer ☐ NeOn Toolkit ☐ OWLGrEd
☐ OntoStudio ☐ OntoUML ☐ Other:

9. Which knowledge representation and conceptual modeling formalisms are you familiar with?
☐ OWL2 ☐ E-R ☐ Description Logics ☐ UML Class Diagrams
☐ ORM ☐ Other:












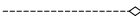

10. Have you ever had experience in manually creating or editing an ontology (Y/N)? _____

11. Have you ever had experience in working with medium- or large-scale ontologies in real-life projects (Y/N)? _____

12. Which ontology visualization tools are you familiar with?
☐ OntoGraf ☐ OWLViz ☐ GROWL ☐ OWLGrEd ☐ Other:

Graphol Cheat Sheet - 1

Graphical symbols

Symbol	Meaning	Symbol	Meaning	Symbol	Meaning
	Concept		Intersection		Domain restriction
	Role		Union		Range restriction
	Attribute		Complement		Inclusion edge
	Value domain		Inverse		Parameter input edge
	Disjoint Union				

Restriction types:

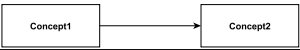

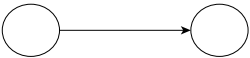
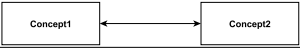






- existential: “exists”
- universal: “forall”
- cardinality: “x,y”, with $y \geq x$, and $x = “-”$ if no minimum cardinality is specified, and $y = “-”$ if no maximum cardinality is specified

If the restriction type label on a white or black square is missing, then the existential restriction is implied.

Graphol Cheat Sheet - 2


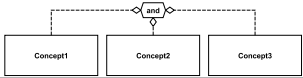
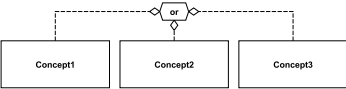
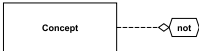

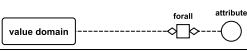
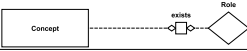
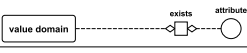
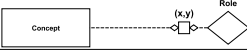
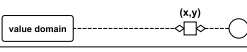

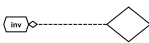

Intentional assertions

In the following table, the “Concept” and “Role” nodes in the Graphol column can be replaced with complex concepts and roles.

Meaning	Graphol
Concept inclusion	
Role inclusion	
Attribute inclusion	
Concept equivalence	
Role equivalence	
Attribute equivalence	
Globally functional role	
Globally inverse functional role	
Globally functional and inverse functional role	
Globally functional attribute	

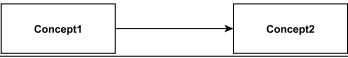
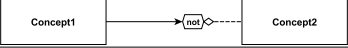
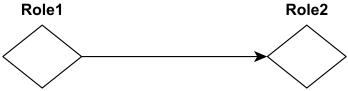
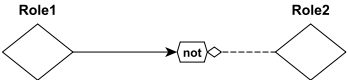
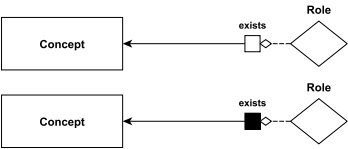
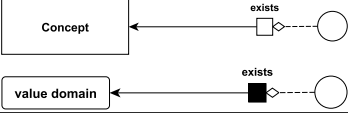
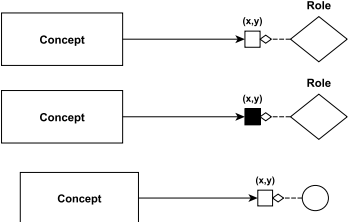
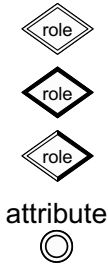
Graphol Cheat Sheet - 3

In the following table we provide the most common expressions. Graphol n-ary operators with $n > 2$ are represented as having 3 input parameters. Restrictions for Graphol role domains exist also for role ranges. The “Concept” and “Role” nodes in the Graphol column can be replaced with complex concepts and roles.

Meaning	Graphol
Concept	
Concept intersection	
Concept union	
Concept complement	
Universal role domain restriction	
Universal attribute domain restriction	
Existential role domain restriction	
Existential attribute domain restriction	
Min. and max. cardinality role restriction	
Min. and max. cardinality attribute restriction	
Role	
Inverse role	
Attribute	

Graphol Cheat Sheet - 4

In the following table you can see some of the more typical examples of conceptual design in Graphol. The “Concept” and “Role” nodes in the Graphol column can be replaced with complex concepts and roles.

Relation	Graphol
ISA between classes	
Disjointness between classes	
ISA between roles	
Disjointness between roles	
Typings of the domain and range of a role	
Typings of the domain and range of an attribute	
Cardinality restriction on the mandatory participation of concepts to roles/attributes	
Global functionality assertions	

Comprehension Task

You have been provided a printout of a simple Graphol model which depicts an extract of the popular Pizza ontology (also see Appendix A). The model essentially represents the fact that a pizza is composed of a base and one or more toppings, and shows how different toppings are matched with different kinds of pizza.

Please answer the following questions.

1. List the typings of the domain and range of the following roles.

- | | | |
|------------------|---------------|--------------|
| a) hasIngredient | Domain: _____ | Range: _____ |
| b) hasTopping | Domain: _____ | Range: _____ |
| c) hasBase | Domain: _____ | Range: _____ |

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

2. Must a Napoletana Pizza have a SpicyTopping(Y/N)? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

3. Specify whether the following roles and attributes are functional, inverse functional, or both.

- | | | |
|-------------------|-------------------------------------|---------------------------------------------|
| a) hasIngredient: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| b) hasTopping: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| c) hasBase: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| d) calories: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| e) depth: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

4. Must a QuattroFormaggi pizza have only CheeseyTopping toppings(Y/N)? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

5. How many toppings must an InterestingPizza have? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

6. List the pairs of atomic sub-concepts of Pizza in which the two concepts are disjoint from each other.

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

7. What are the toppings that must go on an American pizza?

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

8. For each of the following roles and attributes, state whether the Pizza concept can participate in it.

- | | | |
|-------------------|------------------------------|-----------------------------|
| a) hasIngredient: | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| b) hasBase: | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| c) calories: | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| d) depth: | <input type="checkbox"/> Yes | <input type="checkbox"/> No |

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

9. How many different kinds of toppings can an American Pizza have at most? Which are they?

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

10. Can an IceCream have a PizzaTopping as a topping(Y/N)? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

Post-test questionnaire

Please answer the following questions at the end of your test.

1. How would you rate the general difficulty of the comprehension tasks of the test?

Very easy ☐—☐—☐—☐—☐ Very difficult

2. How would you rate the difficulty of learning the symbols of the Graphol language?

Very easy ☐—☐—☐—☐—☐ Very difficult

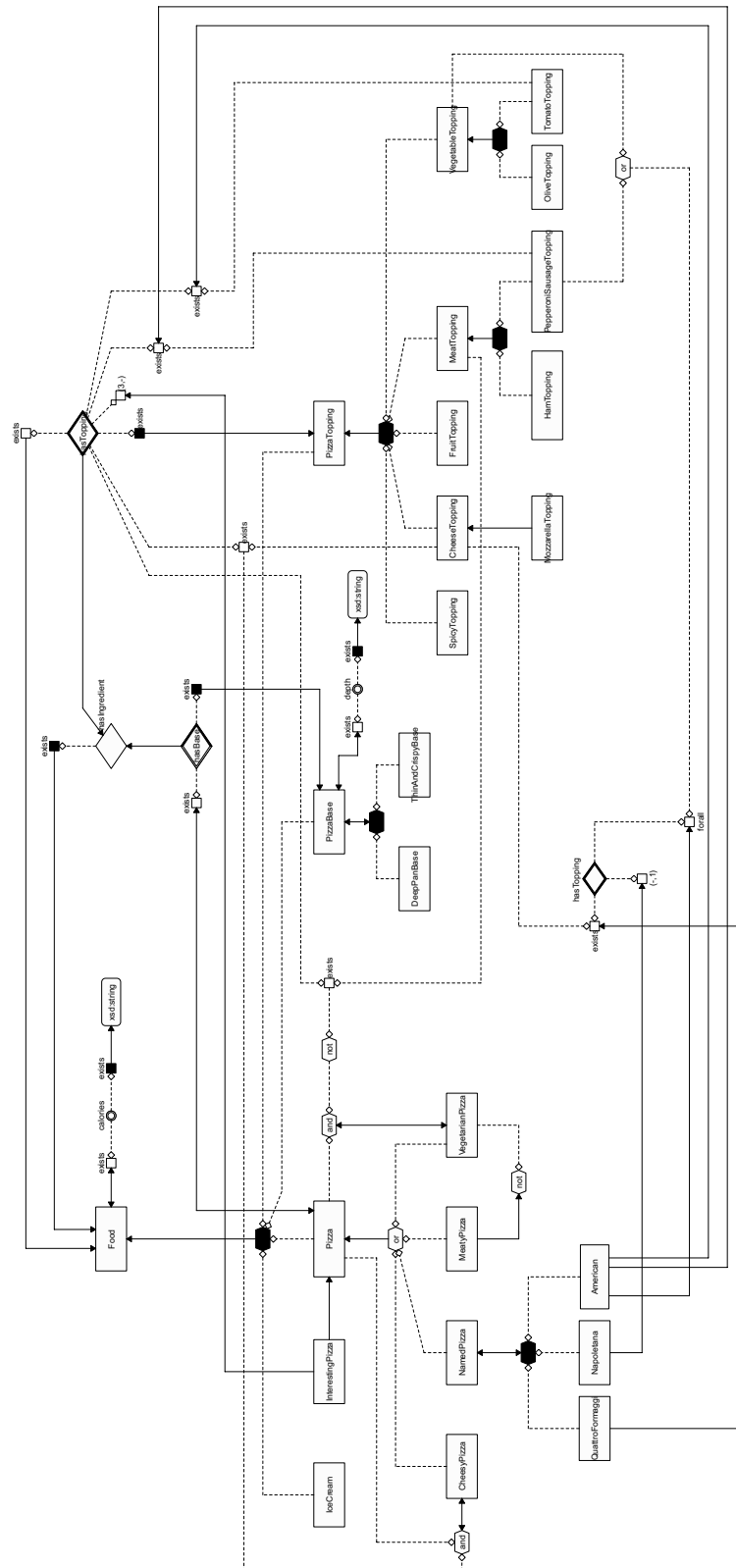
3. How would you rate the general difficulty of using Graphol for reading ontologies?

Very easy ☐—☐—☐—☐—☐ Very difficult

4. (Optional) Aspects of the Graphol language that you particularly like:

5. (Optional) Aspects of the Graphol language that you would like to see improved/changed:

Model used for Comprehension Task



OWLGrEd: a graphical ontology language

Survey and User Evaluation Study

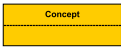




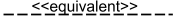
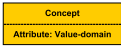




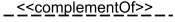

Purpose of the Questionnaire

Evaluate the usability of the OWLGrEd language for ontology modeling through a series of comprehension tasks.

OWLGrEd Cheat Sheet - 1

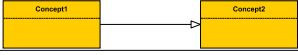
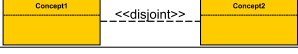
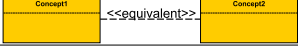
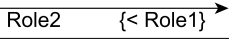
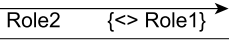
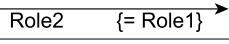
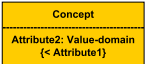
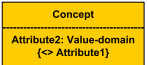
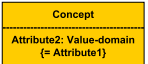
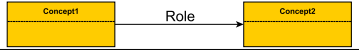
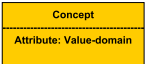
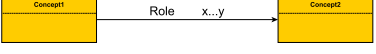
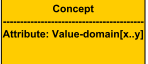
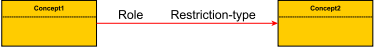
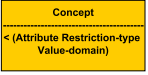
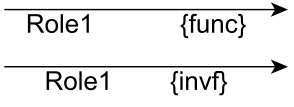
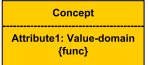
Graphical symbols

The “Concept”, “Role”, “Attribute”, and “Value-domain” labels on the symbols indicate the name of the respective ontology predicate.

Symbol	Meaning	Symbol	Meaning	Symbol	Meaning
	Concept		Disjoint hierarchy connector		Restriction edge
	Role		Complete hierarchy connector		Equivalence edge
	Attribute		Inclusion edge		Disjunction edge
	Value domain		Input edge		Complement edge
	Hierarchy connector				

OWLGrEd Cheat Sheet - 2

In the following table you can see some of the more typical examples of conceptual design in OWLGrEd. The “Concept” label on concept nodes in the OWLGrEd column can be replaced with a complex expression label, which indicates that the concept node represents a concept expression such as the union or intersection of concepts. In OWLGrEd, concept inclusion can alternatively be represented through an inclusion label, “ \leq ”, followed by the including concept, in the concept node.

Relation	Graphol
ISA between concepts	
Disjointness between concepts	
Equivalence between concepts	
ISA between roles	
Disjointness between roles	
Equivalence between roles	
ISA between attributes	
Disjointness between attributes	
Equivalence between attributes	
Typings of the domain and range of a role	
Typings of the domain and range of an attribute	
Cardinality of roles/attributes	 
Restriction on roles/attributes	  Restriction-type = some/only/exactly x/max x/min x
Functionality assertions	 

Comprehension Task

You have been provided a printout of a simple OWLGrEd model which depicts an extract of the popular Pizza ontology (also see Appendix A). The model essentially represents the fact that a pizza is composed of a base and one or more toppings, and shows how different toppings are matched with different kinds of pizza.

Please answer the following questions.

1. List the typings of the domain and range of the following roles.

- | | | |
|------------------|---------------|--------------|
| a) hasIngredient | Domain: _____ | Range: _____ |
| b) hasTopping | Domain: _____ | Range: _____ |
| c) hasBase | Domain: _____ | Range: _____ |

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

2. Must a Napoletana Pizza have a SpicyTopping(Y/N)? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

3. Specify whether the following roles and attributes are functional, inverse functional, or both.

- | | | |
|-------------------|-------------------------------------|---------------------------------------------|
| a) hasIngredient: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| b) hasBase: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| c) calories: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| d) depth: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

4. Must a QuattroFormaggi pizza have only CheeseyTopping toppings(Y/N)? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

5. How many toppings must an InterestingPizza have? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

6. List the pairs of direct sub-concepts of Pizza in which the two concepts are disjoint from each other.

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

7. What are the toppings that must go on an American pizza?

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clearWere you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely**8. For each of the following roles and attributes, state whether the Pizza concept can participate in it.**

- | | | |
|-------------------|------------------------------|-----------------------------|
| a) hasIngredient: | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| b) hasBase: | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| c) calories: | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| d) depth: | <input type="checkbox"/> Yes | <input type="checkbox"/> No |

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clearWere you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely**9. How many different kinds of toppings can an American Pizza have at most? Which are they?**

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clearWere you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely**10. Can an IceCream have a PizzaTopping as a topping(Y/N)? _____**

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clearWere you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

Post-test questionnaire

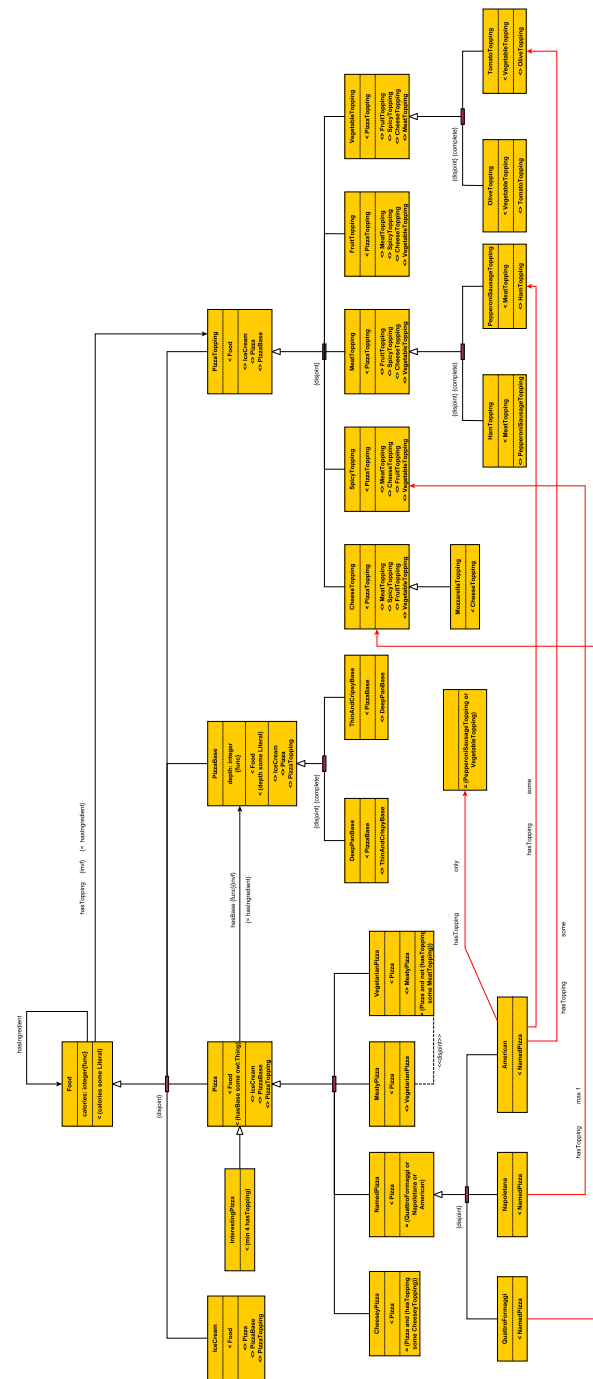
Please answer the following questions at the end of your test.

1. **How would you rate the general difficulty of the comprehension tasks of the test?**
Very easy ☐—☐—☐—☐—☐ Very difficult
2. **How would you rate the difficulty of learning the symbols of the OWLGrEd language?**
Very easy ☐—☐—☐—☐—☐ Very difficult
3. **How would you rate the general difficulty of using OWLGrEd for reading ontologies?**
Very easy ☐—☐—☐—☐—☐ Very difficult
4. **(Optional) Aspects of the OWLGrEd language that you particularly like:**

5. **(Optional) Aspects of the OWLGrEd language that you would like to see improved/changed:**

Appendix A

Model used for Comprehension Task



Graphol: a graphical ontology language

Survey and User Evaluation Study

Purpose of the Questionnaire

Evaluate the usability of the Graphol language for both comprehension and editing.

Pre-questionnaire

We would like for you to provide some personal and professional background information, regarding experience with ontology modelling, knowledge representation, and ontology languages (OWL2, Description Logics). Please fill in the following short survey.

1. Your name: _____
2. How old are you? _____
3. Please describe your occupation/profession and role?

4. What is type and field of your highest completed education degree?















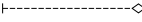

5. Roughly how many years of experience with ontologies do you have (0 if none)? _____
6. On a scale from 1 to 5, how would you rate your knowledge of conceptual modeling?
None ☐—☐—☐—☐—☐ Very high
7. On a scale from 1 to 5, how would you rate your knowledge of ontologies?
None ☐—☐—☐—☐—☐ Very high
8. Which ontology editors are you familiar with?
☐ Protégè ☐ TopBraid Composer ☐ NeOn Toolkit ☐ OWLGrEd
☐ OntoStudio ☐ OntoUML ☐ Other:

9. Which knowledge representation and conceptual modeling formalisms are you familiar with?
☐ OWL2 ☐ E-R ☐ Description Logics ☐ UML Class Diagrams
☐ ORM ☐ Other:

10. Have you ever had experience in manually creating or editing an ontology (Y/N)? _____
11. Have you ever had experience in working with medium- or large-scale ontologies in real-life projects (Y/N)? _____
12. Which ontology visualization tools are you familiar with?
☐ OntoGraf ☐ OWLViz ☐ GROWL ☐ OWLGrEd ☐ Other:

Graphol Cheat Sheet - 1

Graphical symbols

Symbol	Meaning	Symbol	Meaning	Symbol	Meaning
	Concept		Intersection		Domain restriction
	Role		Union		Restriction
	Attribute		Complement		Inclusion edge
	Value domain		Inverse		Parameter input edge
	Disjoint Union		Role chain		Global functionality edge
	Enumeration				

Restriction types:



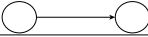
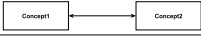
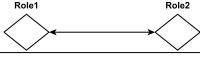
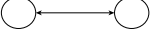




- existential: “exists”
- universal: “forall”
- cardinality: “x,y”, with $y \geq x$, and $x = “-”$ if no minimum cardinality is specified, and $y = “-”$ if no maximum cardinality is specified

If the restriction type label on a white or black square is missing, then the existential restriction is implied.

Graphol Cheat Sheet - 2

Graphol intentional assertions


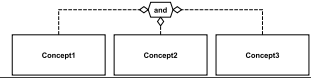
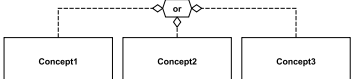

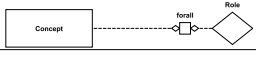
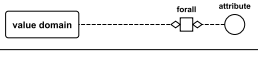

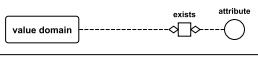
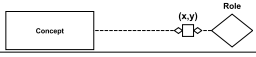
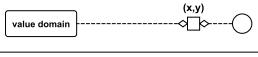
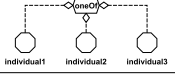


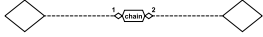

In the following table, the “Concept” and “Role” nodes in the Graphol column can be replaced with complex concepts and roles.

Graphol Expression	Meaning	Graphol Expression	Meaning
	Concept inclusion		Role inclusion
	Attribute inclusion		Concept equivalence
	Role equivalence		Attribute equivalence
	Globally functional role		Globally inverse functional role
	Globally functional and inverse functional role		Globally functional attribute

Each concept or role expression is a tree whose edges are exclusively parameter input edges or global functionality edges. The root of the tree is the “most external” operator. The inclusion arrow connects two such roots.

Graphol expressions






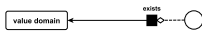




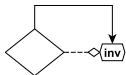
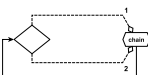
In the following tables we provide the most common expressions. N-ary operators with N greater than 2 are represented as having three input parameters. Restrictions for role domains exist obviously also for role ranges.

Graphol Expression	Meaning	Graphol Expression	Meaning
	Concept		Concept intersection
	Concept union		Concept complement
	Universal role domain restriction		Universal attribute domain restriction
	Existential role domain restriction		Existential attribute domain restriction
	Max. and min. cardinality role restriction		Max. and min. cardinality attribute restriction
	Value enumeration		Role
	Inverse role		Role chain
	Attribute		

Graphol Cheat Sheet - 3

Axiom examples

In the following table we show some common logical axiom examples and their equivalent Graphol expression.

Graphol Expression	Logical axiom	Graphol Expression	Logical axiom
	Disjoint concepts		Inverse roles
	Role domain typing		Role range typing
	Attribute domain typing		Attribute range typing
	Global role functionality		Global inverse role functionality
	Global attribute functionality		Role reflexivity
	Role symmetry		Role transitivity

Comprehension Task

You have been provided a printout of a simple Graphol model which depicts an extract of the popular Pizza ontology (also see Appendix A). The model essentially represents the fact that a pizza is composed of a base and one or more toppings, and shows how different toppings are matched with different kinds of pizza.

Please answer the following questions.

1. List the typings of the domain and range of the following roles.

- | | | |
|------------------|---------------|--------------|
| a) hasIngredient | Domain: _____ | Range: _____ |
| b) hasTopping | Domain: _____ | Range: _____ |
| c) hasBase | Domain: _____ | Range: _____ |

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

2. Specify whether the following roles and attributes are globally functional, globally inverse functional, or both.

- | | | |
|-------------------|-------------------------------------|---------------------------------------------|
| a) hasIngredient: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| b) hasTopping: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| c) hasBase: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| d) calories: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |
| e) depth: | <input type="checkbox"/> Functional | <input type="checkbox"/> Inverse functional |

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

3. How many toppings must an InterestingPizza have? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

4. Two sub-concepts of Pizza are equivalent to complex concepts. List which sub-concepts they are and describe in natural language or in any OWL2 syntax what they are equivalent to.

- a) _____
Equivalent to: _____
- b) _____
Equivalent to: _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

5. List the pairs of atomic sub-concepts of Pizza in which the two concepts are disjoint from each other.

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

6. What are the toppings that must go on a Diavola pizza?

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

7. What are the toppings that can go on a Diavola pizza?

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

8. For each of the following roles and attributes, state whether the Pizza concept can participate in it, and, if so, specify if the participation is mandatory.

- | | | | |
|-------------------|------------------------------|-----------------------------|------------------------------------|
| a) hasIngredient: | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Mandatory |
| b) hasBase: | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Mandatory |
| c) calories: | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Mandatory |
| d) depth: | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Mandatory |

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

9. What role is transitive in the model? _____

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

10. The model defines which Country is the country of origin for two kinds of Pizza. Which are they and what is their Country of origin?

- | | |
|----------|--------------------------|
| a) _____ | Country of origin: _____ |
| b) _____ | Country of origin: _____ |

Start time: _____ Finishing time: _____

Was the question clear? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to easily answer this question? Not at all ☐—☐—☐—☐—☐ Absolutely

Editing Task

On your screen you see a simple Graphol model which depicts some of the relations that can occur between persons in a family (also see Appendix B). Please use the provided Graphol palette for the yEd editor to perform the tasks described below. Feel free to repeat, if necessary, the concept, role, attribute or operator symbols in the ontology, and do not concern yourself with layout issues in the model, just worry about the syntactic and semantic correctness of the changes or additions to the model.

1. Model the fact that the domain of the hasChild role is either a Father or a Mother.

Start time: _____ Finishing time: _____

Was it clear to you how to perform this task? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to quickly and easily perform this task? Not at all ☐—☐—☐—☐—☐ Absolutely

2. Add the following attributes, with the listed properties, to the Person concept.

a) name

- Domain: Person
- Range: xsd:string
- Person has mandatory participation
- Globally functional

b) telephoneNumber

- Domain: Person
- Range : xsd:string

Start time: _____ Finishing time: _____

Was it clear to you how to perform this task? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to quickly and easily perform this task? Not at all ☐—☐—☐—☐—☐ Absolutely

3. Model the fact that the hasChild role is inverse of the hasParent role.

Start time: _____ Finishing time: _____

Was it clear to you how to perform this task? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to quickly and easily perform this task? Not at all ☐—☐—☐—☐—☐ Absolutely

4. The hasParent role is used to link a Person with another Person which is his parent. Model the fact that a Person has exactly two parents.

Start time: _____ Finishing time: _____

Was it clear to you how to perform this task? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to quickly and easily perform this task? Not at all ☐—☐—☐—☐—☐ Absolutely

5. Model the fact that the range of the hasSister role is not a Male.

Start time: _____ Finishing time: _____

Was it clear to you how to perform this task? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to quickly and easily perform this task? Not at all ☐—☐—☐—☐—☐ Absolutely

6. Model the fact that each Father must have a child and that each Mother must have a child.

Start time: _____ Finishing time: _____

Was it clear to you how to perform this task? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to quickly and easily perform this task? Not at all ☐—☐—☐—☐—☐ Absolutely

7. Model the fact that both hasFather and hasMother are functional roles.

Start time: _____ Finishing time: _____

Was it clear to you how to perform this task? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to quickly and easily perform this task? Not at all ☐—☐—☐—☐—☐ Absolutely

8. Model the fact that a Non-european Person cannot have citizenship in a European Nation.

Start time: _____ Finishing time: _____

Was it clear to you how to perform this task? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to quickly and easily perform this task? Not at all ☐—☐—☐—☐—☐ Absolutely

9. Model the fact that hasAncestor is a transitive role.

Start time: _____ Finishing time: _____

Was it clear to you how to perform this task? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to quickly and easily perform this task? Not at all ☐—☐—☐—☐—☐ Absolutely

10. Model the fact that hasSibling is a symmetric role.

Start time: _____ Finishing time: _____

Was it clear to you how to perform this task? Not clear at all ☐—☐—☐—☐—☐ Very clear

Were you able to quickly and easily perform this task? Not at all ☐—☐—☐—☐—☐ Absolutely

Post-test questionnaire

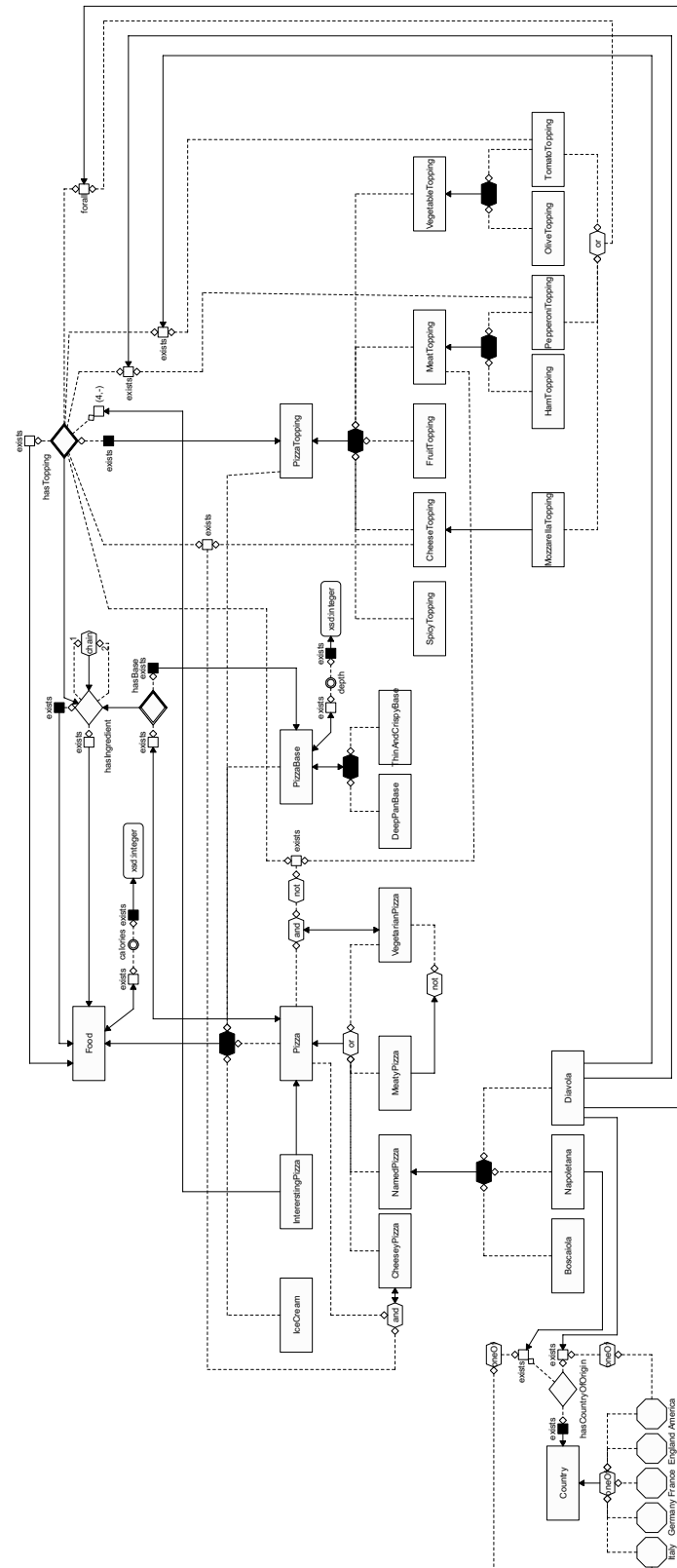
Please answer the following questions at the end of your test.

1. **How would you rate the general difficulty of the comprehension tasks of the test?**
Very easy ☐—☐—☐—☐—☐ Very difficult
2. **How would you rate the general difficulty of the editing tasks of the test?**
Very easy ☐—☐—☐—☐—☐ Very difficult
3. **How would you rate the difficulty of learning the symbols of the Graphol language?**
Very easy ☐—☐—☐—☐—☐ Very difficult
4. **How would you rate the general difficulty of using Graphol for reading or editing ontologies?**
Very easy ☐—☐—☐—☐—☐ Very difficult
5. **Would you use Graphol for editing ontologies?**
Absolutely ☐—☐—☐—☐—☐ Not at all
6. **(Optional) Aspects of the Graphol language that you particularly like:**

7. **(Optional) Aspects of the Graphol language that you would like to see improved/changed:**

Appendix A

Model used for Comprehension Task



Appendix B

Model used for Editing Task

