

# Additional Exercises of Description Logics and OWL E2.1 Master SIS 2010-11

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These pages contain a few exercises on Description Logics and OWL *in addition* to those ones assigned during the course.

## 1 Exercises on DL

### Exercise 1

Consider the following interpretation:  $I = (\Delta, I)$  with:

$$\Delta = \{t_1, t_2, f_1, f_2, c_1, c_2, j, k, l, m, n\}$$

$$Person^I = \{j, k, l, m, n\}$$

$$Car^I = \{t_1, t_2, f_1, f_2, c_1, c_2\}$$

$$Ferrari^I = \{f_1, f_2\}$$

$$Toyota^I = \{t_1, t_2\}$$

$$likes^I = \{(j, f_1), (k, f_1), (k, t_2), (l, c_1), (l, c_2), (m, c_1), (m, t_2), (n, f_2), (n, c_2)\}$$

Find the interpretation in  $I$  of the following concepts:

$$\exists likes.Ferrari \sqcap \exists likes.Toyota$$

$$\exists likes.Ferrari \sqcap \forall likes.Ferrari$$

$$\exists likes.Ferrari \sqcap \exists likes.\neg Ferrari$$

$$\exists likes.Cars \sqcap \forall likes.\neg (Toyota \sqcup Ferrari)$$

### Exercise 2

Consider the following ABox:

$$HasChild(joe, ann)$$

$$HasChild(joe, eva)$$

$$HasChild(joe, mary)$$

$$(\leq 2HasChild)(joe)$$

Is it satisfiable? If yes, show an interpretation that satisfies it. Is it satisfiable under the Unique Name Hypothesis?

### Exercise 3

Use the tableau algorithm to check the validity of the following:

1.  $\exists HF.(Dr \sqcup It) \sqsubseteq \exists HF.Dr \sqcup \exists HF.It$
2.  $\exists HF.Dr \sqcup \exists HF.It \sqsubseteq \exists HF.(Dr \sqcup It)$
3.  $\forall HF.(Dr \sqcap It) \sqsubseteq \forall HF.Dr \sqcap \forall HF.It$
4.  $\forall HF.Dr \sqcap \forall HF.It \sqsubseteq \forall HF.(Dr \sqcap It)$

#### Exercise 4

Let us consider the following ABox  $\mathcal{A}$ :

*IsTutorOf*(ann, jim)  
*IsTutorOf*(ann, joe)  
*MasterStudent*(joe)  
*MasterStudent*(jim)

Check using the tableau method whether

$$\mathcal{A} \models (\forall IsTutorOf.MasterStudent)(ann)$$

#### Exercise 5

Check using the tableau algorithm whether the following are valid:

- (a)  $\exists HasFriend.(\geq 2 HasChild) \sqsubseteq \exists HasFriend.(\geq 3 HasChild)$
- (b)  $\exists HasFriend.(\geq 4 HasChild) \sqsubseteq \exists HasFriend.(\geq 3 HasChild)$

## 2 Exercise on OWL and DL: The Enterprises Knowledge Base

The objective is to specify in Description Logic and in OWL a Knowledge Base which contains some concepts and facts on enterprises.

### 2.1 TBOX

The KB makes use of the following roles, for some roles we introduce names for its inverses; moreover some roles are transitive:

- **has-part** is transitive and its inverse is **is-part-of**
- **is-managed-by** its inverse is **manages**). We specify also that **is-managed-by** is a **functional role**, that is to say an entity cannot be 'managed by' two different entities.
- **employs** its inverse **is-employed-by**

In the following, a **property** is a statement of **inclusion** between concepts and a **definition** is a statement of **equivalence** between concepts.

- (property) An enterprise is managed by someone and employs someone.
- (property) A department is a part of an enterprise.
- (property) An office is a part of a department.

- (definition) The department are exactly: Production, Research, Administration, Trade, HumanResources, PublicRelations.
- (definition) An employee is someone who is employed by an enterprise or by some part of an enterprise.
- (definition) An administrative-employee is someone who is employed by an administration department or by some part of an administration department.
- (property) If someone manages some entity is en employee.
- (definition) A high-tech enterprise is an enterprise which has a research department.
- (definition) An industrial enterprise is an enterprise which has a production department and has at least 100 employees.
- (definition) A small enterprise is an enterprise which employs at most 20 employees.
- (definition) A big enterprise is an enterprise which employs at least 80 employees.
- (definition) A family-based enterprise is an enterprise with at most 4 employees.
- (definition) A top manager is someone who manages a big enterprise.
- (definition) A manager is someone who manages a department.
- (definition) A boss is someone who manages an office.

## 2.2 ABOX

It contains the following facts:

- Alcatel is an enterprise which has 2000 employees.
- Alcatel has a research department RD1, an administration department AD1, and a HumanResources department HRD1; it has also a production department (whose name is unknown).
- OFF1 and OFF2 are offices and are part of RD1.
- OFF3 and OFF4 are offices and are part of AD1.
- Joe and Anne are employed by OFF3.
- Jim manages the department AD3.
- Bob manages OFF3.
- Jim manages Alcatel.
- SmithBrothers is a family-based enterprise.
- Frank, Lea, Dave, Kate, Dino are employed by SmithBrothers.

### Exercise:

1. Give a translation in OWL of the TBOX above.
2. Give a translation in Description Logic of *both* the TBOX and the ABOX above.
3. What conclusions can be derived from this TBOX+ABOX? Is it consistent?