CSc 8711 - Spring 2013
Exam 2 (Take Home) Due: Friday, May 3rd

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1. Using the individuals `john` and `cnets`, concepts `Course`, `Lecturer`, `MSc` and `BSc`, and roles `teaches` and `hasDegree`, represent the following knowledge base as an ALC knowledge base K:

   - Everybody who teaches a course must either have an MSc degree or be a lecturer.
   - Every lecturer teaches some course.
   - Every lecturer has a BSc degree.
   - Everybody with an MSc degree has a BSc degree as well.
   - John teaches the Computer Networks course.

   (a) Is the statement "John has an MSc degree" a logical consequence of the knowledge base K? Explain your answer (you do not have to use the tableaux method).

   (b) Is the statement "Everybody who teaches a course must have a BSc degree" a logical consequence of the knowledge base K? Explain your answer (you do not have to use the tableaux method).

2. Consider the TBox T with the following axioms:

$$\forall R.\neg B \sqsubseteq B$$
$$\exists R.(\exists R.C) \sqsubseteq \neg A \sqcup \neg B$$

   and the interpretation I over domain $\Delta^I = \{a, b, c, d, e, f\}$:

$$A^I = \{a, c, e\}$$
$$B^I = \{c, d, e, f\}$$
$$C^I = \{e\}$$
$$R^I = \{< a, f >, < a, c >, < b, d >, < d, c >, < c, e >, < f, a >\}$$

   Is I a model for T?

3. For each of the axioms given below, determine which of the three interpretations (I_1, I_2, and I_3) in the subsequent table satisfy it. Assume A, B, C, and D are atomic concepts and P is a role.

   (a) $B \sqsubseteq D$

   (b) $A \sqsubseteq B \sqcap \forall P.C$

   (c) $D \sqsubseteq B \sqcup \exists P.C$

Candidate Interpretations ($\Delta^I = \{a, b, c, d\}$)

Classes/Roles	I_1	I_2	I_3
A^I	$\{\}$	$\{a\}$	$\{b, c\}$
B^I	$\{a, b\}$	$\{a\}$	$\{b, c, d\}$
C^I	$\{b\}$	$\{b, d\}$	$\{a, b\}$
D^I	$\{\}$	$\{a, b\}$	$\{a, b, c, d\}$
P^I	$\{\}$	$\{< a, b >, < a, c >, < b, d >\}$	$\{< b, a >, < b, b >, < d, a >\}$

4. Consider the following knowledge base K:

$$\underline{\text{TBox}}$$
$$Human \sqsubseteq \exists hasParent.Human$$
$$Orphan \sqsubseteq Human \sqcap \forall hasParent.\neg Alive$$
$$\underline{\text{ABox}}$$
$$Orphan(harrypotter)$$
$$hasParent(harrypotter, jamespotter)$$

   Using the tableaux method show that $\neg Alive(jamespotter)$ is a logical consequence of K.

5. Show using the tableaux method that $(\exists r.E)(a)$ is a logical consequence of the knowledge base

$$K = \{C(a), C \sqsubseteq \exists r.D, D \sqsubseteq E \sqcup F, F \sqsubseteq E\}.$$

6. Show using the tableaux that the following knowledge base is unsatisfiable:

$$\underline{\text{TBox}}$$
$$Bird \sqsubseteq Flies$$
$$Penguin \sqsubseteq Bird$$
$$Penguin \sqcap Flies \sqsubseteq \bot$$
$$\underline{\text{ABox}}$$
$$Penguin(tweety)$$

7. SPARQL Queries on PeriodicTable KB (http://www.daml.org/2003/01/periodictable/PeriodicTable.owl): Write SPARQL queries to answer the following and make sure they are tested on the system:

   (a) Find element name, element symbol, atomic weight and color of all elements from the group with group name "Halogen".

   (b) Find element name, element symbol, atomic number and color of all elements with standardState "gas" and having an atomic number less than 10; Result should be sorted by atomic number (increasing).

   (c) List all the possible individuals of the StandardState class.

   (d) Find element name, element symbol, atomic number and color of all elements in period number 3 and group number 14 (ordered by atomic number).

   (e) For each group, list the group name and count of elements in it.

   On the next page is a run of the 5 queries - you should duplicate the results shown.

```
[raj@tinman pt]$ sdbquery --sdb=pt.ttl --query=1
-------------------------------------------------------------------------------
| NAME       | SYMBOL | ATOMICWEIGHT | COLOR                                  |
===============================================================================
| "iodine"   | "I"    | "126.90447"  | "violet-dark grey, lustrous"           |
| "fluorine" | "F"    | "18.9984032" | "pale yellow"                          |
| "astatine" | "At"   | "210"        | "metallic"                             |
| "bromine"  | "Br"   | "79.904"     | "red-brown, metallic lustre when solid" |
| "chlorine" | "Cl"   | "35.453"     | "yellowish green"                      |
-------------------------------------------------------------------------------
[raj@tinman pt]$ sdbquery --sdb=pt.ttl --query=2
-----------------------------------------------------------------------------------
| NAME       | SYMBOL | ATOMICNUMBER | COLOR                                    |
===================================================================================
| "hydrogen" | "H"    | "1"          | "colourless"                             |
| "helium"   | "He"   | "2"          | "colourless"                             |
| "nitrogen" | "N"    | "7"          | "colourless"                             |
| "oxygen"   | "O"    | "8"          | "colourless as a gas, liquid is pale blue" |
| "fluorine" | "F"    | "9"          | "pale yellow"                            |
-----------------------------------------------------------------------------------
[raj@tinman pt]$ sdbquery --sdb=pt.ttl --query=3
------------------------
| aa                   |
========================
| table:solid          |
| table:state_unknown  |
| table:gas            |
| table:liquid         |
------------------------
[raj@tinman pt]$ sdbquery --sdb=pt.ttl --query=4
-------------------------------------------------------------------------
| NAME      | SYMBOL | ATOMICNUMBER | COLOR                            |
=========================================================================
| "silicon" | "Si"   | "14"         | "dark grey with a bluish tinge" |
-------------------------------------------------------------------------
[raj@tinman pt]$ sdbquery --sdb=pt.ttl --query=5
----------------------------------------
| GROUPNAME              | NUMELEMENTS |
========================================
| "Noble gas"            | 7           |
| "Halogen"              | 6           |
| "Alkali metal"         | 7           |
| "Chalcogen"            | 6           |
| "Alkaline earth metal" | 6           |
| "Lanthanoid"           | 14          |
| "Coinage metal"        | 4           |
| "Actinoid"             | 14          |
| "Pnictogen"            | 6           |
----------------------------------------
```