Logics for Data and Knowledge Representation: 09 June 2014

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1. [6 PT] Say (mark with an X) whether the following statements are true (T) or false (F).

a)	**Validity in DL can be decided in polynomial time**	□ T □ F
b)	**In S-Match, the problem of matching two concepts is reduced to logical satisfiability of the corresponding formula in DL**	□ T □ F
c)	**In a lightweight ontology the semantics of the links between nodes is given by logical subsumption**	□ T □ F
d)	**In OWL DL, it is allowed to use the intersectionOf construct with any number of classes**	□ T □ F
e)	**The logic that provides the formal basis for OWL 2 EL allows the use of disjunction and universal restrictions**	□ T □ F
f)	**OWL 2 QL is suitable for answering complex queries (in particular, unions of conjunctive queries) over the instance level (ABox) of the DL knowledge base**	□ T □ F

2. [3 PT] Provide the formation rules of FL0 and FL-

FL- is AL with the elimination of $\top$, $\bot$ and $\neg$

<Atomic> ::= A | B | ... | P | Q | ...

<wff> ::= <Atomic> | <wff> $\sqcap$ <wff> | $\forall$R.C | $\exists$R.$\top$

FL0 is FL- with the elimination of $\exists$R.$\top$

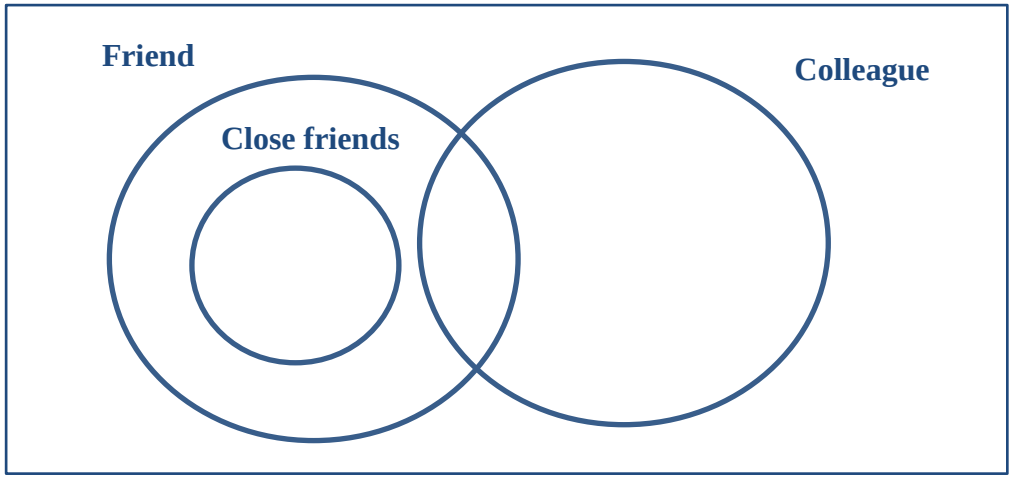
<Atomic> ::= A | B | ... | P | Q | ...

<wff> ::= <Atomic> | <wff> $\sqcap$ <wff> | $\forall$R.C

3. [2 PT] Provide the formal semantics of $\exists$R.C in DL

$I(\exists R.C) = \{a \in \Delta \mid$ there exists b s.t. $(a, b) \in I(R), b \in I(C)\}$

4. **[6 points] Given the following problem: "In a social network there are only 3 categories of users: colleagues, friends and close friends. Colleagues can be friends but they cannot be close friends. Close friends are a subset of the all friends. Files are of two main kinds: photos and working documents. They can be accessed in read, write and download modalities. Download is seen as more restrictive than write, that in turn is seen as more restrictive than read. Close friends can read/write/download photos but they cannot read/write/download working documents. Friends can only read photos and cannot read/write/download working documents. Colleagues can read/write/download working documents, and cannot access photos".**
   (a) Draw a Venn diagram showing how the 3 categories of users relate to each other;
   (b) Formalize the problem in DL;



User ≡ Friend ⊔ Close-Friend ⊔ Colleague

Close-Friend ⊑ Friend

Colleague ⊑ ¬ Close-Friend

File ⊑ Photo ⊔ Working-Doc

Download ⊑ Write

Write ⊑ Read

Close-Friend ⊑ ∃Download.Photo ⊓ ¬∃Download.Working-Doc

Friend ⊑ ∀Read.Photo ⊓ ¬∃Write.Photo ⊓ ¬∃ Download.Working-Doc

Colleague ⊑ ∃Download.Working-Doc ⊓ ¬∃Download.Photos

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5. **[4 PT] Consider the TBox T = {C ≡ S ⊓ T, D ≡ S ⊓ ¬ T} and ABox A= {C(a), S(b)}.**
   (a) Provide a formal proof that C and D are disjoint;
   (b) Provide the expansion of the ABox A w.r.t. the TBox T;
   (c) Provide the instance retrieval of S.

(a) $T \models C \sqcap D \sqsubseteq \bot \Rightarrow (S \sqcap T) \sqcap (S \sqcap \neg T) \Rightarrow S \sqcap (T \sqcap \neg T) \equiv \bot$

(b) A' = {C(a), S(a), T(a), S(b)}

(c) R(S) = {a, b}

6. **[3 PT] The Linked Data approach forms the basis of data publishing guidelines underlining how data from government, public and private sectors can be more valuable for the consumers. Briefly describe the principles associated to Linked Data publishing.**

the use of http URIs as the identifiers of things (concepts, entities and attributes)
the provision of meaningful content published in RDF for each such URI reference
the production of navigable content via links

7. **[4 PT] Produce an RDF triple (subject, predicate, object) representation of the ships, their maiden voyage and other dates provided in the table below.**

Name	Maiden Voyage	Next Departure	Decommission Date	Destruction Date
Titanic	April 10, 1912			April 14, 1912
MV 16	May 23, 2001	November 29, 2013		
MV 22	June 8, 1970		February 10, 1998	

Subject	Predicate	Object
ship:Titanic	ship:name	Titanic
ship:Titanic	ship:maidenVoyage	April 10, 1912
ship:Titanic	ship:destructionDate	April 14, 1912
ship:MV_16	ship:name	MV 16
ship:MV_16	ship:maidenVoyage	May 23, 2001
ship:MV_16	ship:nextDeparture	November 29, 2013
ship:MV_22	ship:name	MV 22
ship:MV_22	ship:maidenVoyage	June 8, 1970
ship:MV_22	ship:decommissionDate	February 10, 1998

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8. [2 PT] As shown below, the two datasets Dataset 1 and Dataset 2 are made available at two different SPARQL Endpoints.

At endpoint http://people.example.org/sparql
DATASET 1:

```
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix : <http://example.org/> .
:people1 foaf:name "Tim BL" .
:people2 foaf:name "James" .
:people3 foaf:name "Jerome" .
:people3 foaf:interest <http://www.w3.org/2001/sw/rdb2rdf/> .
```

At endpoint http://people2.example.org/sparql
DATASET 2:

```
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix : <http://example.org/> .
:people1 foaf:knows :people21 .
:people21 foaf:name " Chris" .
:people3 foaf:knows :people22 .
:people22 foaf:name “Frank" .
```

Report the result of the following SPARQL Query:

```
QUERY:
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
SELECT ?person ?interest ?known
WHERE
{
    SERVICE <http://people.example.org/sparql>
        {
           ?person foaf:name ?name .
           OPTIONAL { ?person foaf:interest ?interest .
                    SERVICE <http://people2.example.org/sparql>
                          { ?person foaf:knows ?known . }
                     }
         }
}
```

RESULT:

person	interest	known
:people1		
:people2		
:people3	<http://www.w3.org/2001/sw/rdb2rdf/>	:people22

9. **[3 PT] Within a family, :spouseOf, :marriedTo and :siblingOf relations are applicable in both directions (from subject to object, and vice versa) whereas :brotherOf and :sisterOf not always.**
    a) **Which property holds in the relations that are applicable in both directions?**
    b) **In which basic category this property belongs?**
    c) **How can we represent these (bi-directional) relations in OWL?**

Symmetric property holds in these relations

The symmetric property is an object property.

They can be represented as follows:

:spouseOf	**rdf:type**	**owl:SymmetricProperty**
:marriedTo	**rdf:type**	**owl:SymmetricProperty**
:siblingOf	**rdf:type**	**owl:SymmetricProperty**