Two hours - on line

The exam will be taken on line.
This is the paper format, which will be available as a backup
and to be handed out to students for reference immediately AFTER the examination starts

Please do NOT use the exam paper to write your answers

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Ontology Engineering for the Semantic Web

Date: Tuesday 25th January 2011
Time: 14:00 - 16:00

Please answer ALL questions provided and ALL their parts, worth 74 marks in total

This is a CLOSED book examination
The use of electronic calculators is NOT permitted
1. Ontology Engineering

a) Describe two techniques that might be used with a domain expert in order to help in determining an initial set of terms and definitions describing a domain. Include one technique that is useful for capturing explicit knowledge, and one which is useful for capturing implicit knowledge.

b) Violation of OntoClean constraints does not necessarily lead to logical inconsistency. Discuss why this is the case.

c) The following hierarchy has OntoClean properties identified for some of the classes.

   ![Ontology Diagram]

   i) Does Class B carry an Identity?
   ii) Is Class D Rigid, Not Rigid or Anti-Rigid?

2. Vocabularies, Ontologies and Linked Data

a) What is the key difference between the broader/narrower relationships found in SKOS vocabularies and the subsumption hierarchies of an OWL ontology?

b) Why is this distinction useful? Provide an example of an application where the use of a SKOS-vocabulary would be more appropriate than the use of an OWL ontology.

c) There are four “Principles” of publishing Linked Data. The fourth is Include links to other URIs, so that they can discover more things.

   i) State the other three principles
ii) If a data source follows the first three principles but ignores the fourth, is it still Linked Data? Is it still useful? (3 marks)

3. **Semantics and Model Theory**

a) Provide a definition of the term *ontology consistency*. (1 mark)

b) Provide a definition of the term *class satisfiability* (with respect to an ontology). (1 mark)

c) If a knowledge base contains an unsatisfiable class, can it be consistent? Provide an explanation of your answer or a counter-example as appropriate. (2 marks)

d) Provide a model (i.e. a domain together with the interpretation of named classes, properties and individuals) of the following ontology (presented in Manchester syntax). (4 marks)

```
ObjectProperty: R
ObjectProperty: S

Class: A
Class: B
  SubClassOf:
    A
Class: C
  EquivalentTo:
    B
    and (R some D)
Class: D

Individual: j
  Types:
    A and (R some C)
Individual: i
  Types:
    B and (R some D)
Individual: k
  Types:
    (S some A) and (S only (not (B)))
```
e) Assuming that the figures below completely describe three interpretations, provide an ALC concept definition $D$ such that $i : D$ is true in (I), but not in (II) or (III).

4. Expressivity and Complexity

   a) Describe (with examples) the tradeoffs between the (logical) expressivity of an ontology language and the computational complexity of its key reasoning services.
      (4 marks)

   b) Describe the relationship (with examples), positive or negative between the computational complexity of an ontology language and its cognitive complexity.
      (4 marks)

   c) Discuss what it is for an OWL 2 DL reasoner to be a “practical” implementation? What can we expect from two independently developed, “practical” reasoners?
      (3 marks)

5. Metalogical properties

   a) Give a case where it is reasonable to use an unsound inference procedure and explain why.
      (3 marks)

   b) Give a case where it is reasonable to use an incomplete inference procedure and explain why.
      (3 marks)

   c) "If an inference procedure is sound, complete, terminating, and gives me an answer, I can trust that answer."
      Is this a reasonable position for an ontology engineer? Why or why not?
      (4 marks)
6. Ontology Language Engineering

   a) Explain the benefits of using a (logic-based) ontology to represent a terminology. Distinguish the cases where the ontology is used at development time only and also at runtime. (3 marks)

   b) What are the advantages and disadvantages of building the Unique Name Assumption into your ontology language? (2 marks)

   c) What are the advantages and disadvantages of building the Open World Assumption into your ontology language? (2 marks)

   d) What does it mean to say that OWL 2 DL is a fragment of first order logic? (2 marks)

   e) Explain when it is, on balance, a good idea to introduce a new datatype into OWL, and what the costs are of doing so. (3 marks)

7. SPARQLing Queries

   a) How is conjunctive query more expressive an ASK language than OWL class expressions? Give an example of the difference. (3 marks)

   b) Describe a service over OWL ontologies that would be helpful and suitable as a DESCRIBE function and justify your design. E.g., given the query:

   ```
   PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
   DESCRIBE ?x ?y
   WHERE {?x rdfs:subClassOf ?y}
   
   or
   
   PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
   DESCRIBE ?C
   WHERE {<http://ex.org/bijan> rdf:type ?C}
   ```

   What would be useful to return to an ontology engineer? Be sure to detail the circumstances of use in your justification. (Note, that what’s returned might differ from query to query.) (4 marks)