Question Paper

Exam Date & Time: 02-Dec-2023 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

SEVENTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, NOV-DEC 2023

Semantic Web [ICT 4036]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) A) Consider a taxonomy where 'vehicle' is a class, and 'car' is a subclass. Introduce a property 'fuelType' with a range of 'petrol' or 'electric.' Suggest a relevant constraint using OWL for the 'fuelType' property within the 'electric car' subclass. Discuss the feasibility of expressing this constraint in RDF Schema, possibly utilizing rdfs:range, and provide a justification for your stance (5)

B) Consider the following SPARQL query: (3)

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
PREFIX ex: <http://example.org/>

SELECT ?person ?name ?email
WHERE {
 ?person rdf:type foaf:Person .
 ?person foaf:name ?name .
 OPTIONAL { ?person foaf:email ?email }
 FILTER EXISTS {
  ?person ex:hasInterest ?interest .
  ?interest rdf:type ex:Programming .
 }
 FILTER NOT EXISTS {
  ?person ex:hasFriend ?friend .
  ?friend foaf:age ?friendAge .
  FILTER(?friendAge > 30)
 }
```

```
}
ORDER BY ?name
```

1. What is the interpretation of this query?
2. Draw the RDF graph corresponding to the graph patterns of the query.

C) How is structured data stored in RDBMS utilized for semantic web knowledge graph? (2)

2) Consider the RDF triples shown in the Figure. Write SPARQL queries to (5)

A)

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>.
@prefix foaf: <http://xmlns.com/foaf/0.1/>.
@prefix ex: <http://example.org/>.

ex:Book rdf:type rdfs:Class.
ex:Author rdf:type rdfs:Class.
ex:Genre rdf:type rdfs:Class.
ex:hasAuthor rdf:type rdf:Property.
ex:hasGenre rdf:type rdf:Property.

ex:book1 rdf:type ex:Book;
    ex:bookTitle "The Catcher in the
    ex:hasAuthor ex:author1;
    ex:hasGenre ex:Fiction.

ex:book2 rdf:type ex:Book;
    ex:bookTitle "To Kill a Mockingbir
    ex:hasAuthor ex:author2;
    ex:hasGenre ex:Fiction.

    ex:bookTitle "Introduction to Algorithms";
    ex:hasAuthor ex:author3;
    ex:hasGenre ex:NonFiction.

ex:author1 rdf:type ex:Author;
    ex:authorName "J.D. Salinger".

ex:author2 rdf:type ex:Author;
    ex:authorName "Harper Lee".

ex:author3 rdf:type ex:Author;
    ex:authorName "Thomas H. Cormen".

ex:Fiction rdf:type ex:Genre.
ex:NonFiction rdf:type ex:Genre.
```

a) Find all books and their authors in the Fiction genre.

b) List authors and the number of books they have written.

c) List all books and their authors along with available genres (if any).

B) Represent the following using basic predicate logic (3)

1. If a class *C* is a subclass of a class *C'*, then all instances of *C* are also instances of *C'*
2. *P* is a subproperty of *P'* if *P*(*x, y*) whenever *P*(*x, y*): *Type*(*subPropertyOf*, *Property*)

C) Consider the RDF triples shown in the Figure, (2)

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>.
@prefix foaf: <http://xmlns.com/foaf/0.1/>.
@prefix ex: <http://example.org/>.
```

```
ex:Book rdf:type rdfs:Class.
ex:Author rdf:type rdfs:Class.
ex:Genre rdf:type rdfs:Class.
ex:hasAuthor rdf:type rdf:Property.
ex:hasGenre rdf:type rdf:Property.

ex:book1 rdf:type ex:Book;
    ex:bookTitle "The Catcher in the
    ex:hasAuthor ex:author1;
    ex:hasGenre ex:Fiction.

ex:book2 rdf:type ex:Book;
    ex:bookTitle "To Kill a Mockingbir
    ex:hasAuthor ex:author2;
    ex:hasGenre ex:Fiction.

    ex:bookTitle "Introduction to Algorithms";
    ex:hasAuthor ex:author3;
    ex:hasGenre ex:NonFiction.

ex:author1 rdf:type ex:Author;
    ex:authorName "J.D. Salinger".

ex:author2 rdf:type ex:Author;
    ex:authorName "Harper Lee".

ex:author3 rdf:type ex:Author;
    ex:authorName "Thomas H. Cormen".

ex:Fiction rdf:type ex:Genre.
ex:NonFiction rdf:type ex:Genre.
```

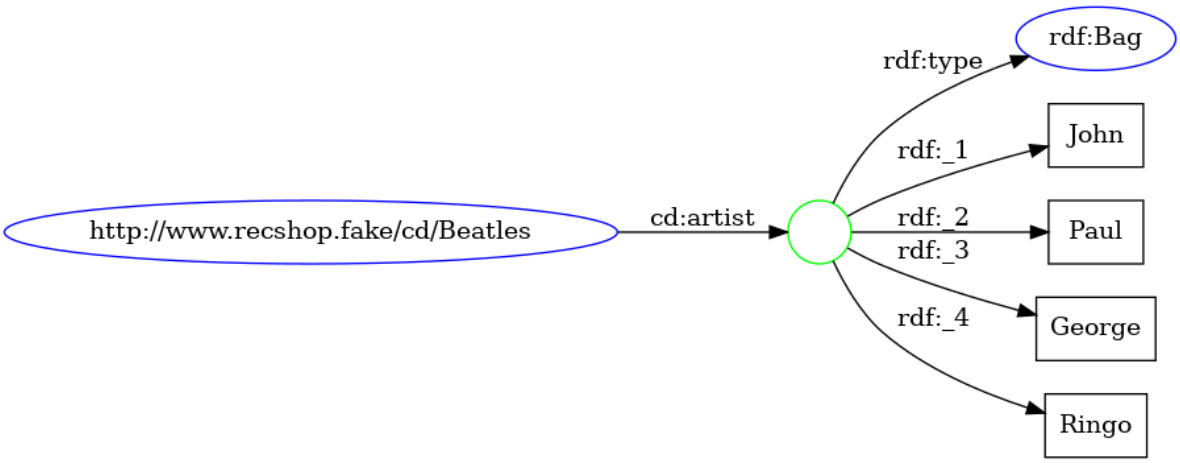
a. Write a SPARQL query to check if there are triples representing books in the Science Fiction genre.

b. Write a SPARQL query to create a new graph with books and their authors in the Science Fiction genre.

3) Non-monotonic rules are a type of rule that can change or retract their conclusions as new information is added. These rules in ontology are used to model incomplete and uncertain information containing contrary reasoning chains. How are these rules incorporated in dealing with competing situations in Semantic Web. (5)

A)

B) Represent the RDF graph given using RDF/XML and Turtle formats. (3)



Namespaces:
rdf: http://www.w3.org/1999/02/22-rdf-syntax-ns#
cd: http://www.recshop.fake/cd#

C) For the RDF given below identify all the Individuals, Properties, Literals, Objects, Subjects and Predicates. (2)

```
<rdf:Description rdf:about="http://example.org/person/john-doe">
    <!-- Predicate: Person has a name -->
    <dc:title>John Doe</dc:title>
    <!-- Predicate: Person has an age -->
    <ex:age
rdf:datatype="http://www.w3.org/2001/XMLSchema#integer">30</ex:age>
    <!-- Predicate: Person has an email address -->
```

```
    <ex:email>john.doe@example.org</ex:email>
  </rdf:Description>
  <!-- Another subject -->
  <rdf:Description rdf:about="http://example.org/book/my-book">
    <!-- Predicate: Book has a title -->
    <dc:title>My Book</dc:title>
    <!-- Predicate: Book has an author (reference to the person URI) -->
    <dc:creator rdf:resource="http://example.org/person/john-doe"/>
  </rdf:Description>
</rdf:RDF>
```

4) Provide 3 comparisons between traditional web and semantic web? How a semantic web layered architecture ensures Downward compatibility and upward partial understanding. (5)

A)

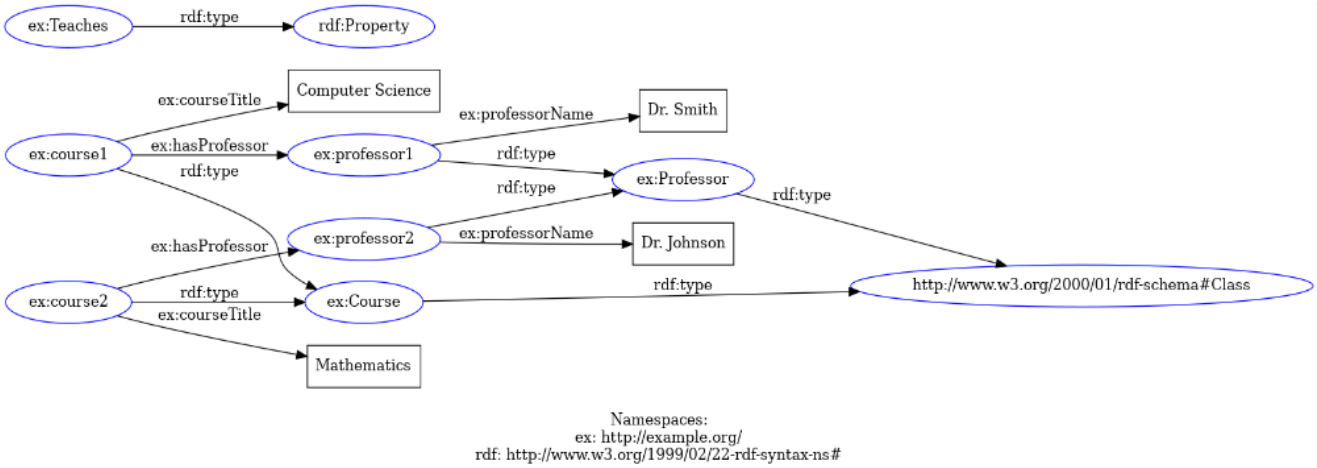
B) If an entity X works at an entity Y (where Y is a university) and Z is a student that X teaches, then X is considered a Professor of Z. Provide the RuleML representation for this rule and explain the components used. (3)

C) Represent the Object Property "HasDescendant" in OWL. Define it in a way that reflects the familial relationship: If person X is a descendant of person Y, and Y is a descendant of Z, then X is also a descendant of Z. Provide the OWL/XML representation for this object property and explain the axioms used. (2)

5) The healthcare sector in India is considering the adoption of semantic web technology to represent and manage health data comprehensively. Describe the steps involved in implementing semantic web technology for healthcare data representation. Discuss the advantages and challenges associated with this approach and explain how the semantic web can enhance the utilization of health data compared to current practices. (5)

A)

B) From the RDF graph given, infer all the RDF triple for each subject associated with Dr Smith. Also represent the triples in Turtle syntax, along with proper prefixes. (3)



C) How semantic web technology can help in improvising the existing question answering systems. (2)

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