NUI Galway
OÉ Gaillimh

Mock Examination 2021/2022

Course Instance Code(s)	1CSD1, 1CSD2, 1SPE1
Exam(s)	MSc in Computer Science (Data Analytics)
Module Code(s)	CT5166
Module(s)	Knowledge graphs
Paper No.	1
External Examiner(s)	Dr John Woodward
Internal Examiner(s)	Dr. Michael Madden *Dr. John McCrae

Instructions: Answer one question in each section. **Use a separate answer book for each section answered**.

Duration	2 hours
No. of Pages	6
Discipline(s)	Computer Science
Course Co-ordinator(s)	Dr. Frank Glavin

Requirements:

Release in Exam Venue	Yes
MCQ	No
Handout	None
Statistical/ Log Tables	None
Cambridge Tables	None
Graph Paper	None
Log Graph Paper	None
Other Materials	None
Graphic material in colour	No

Knowledge Graphs

Exam Duration: 2 Hours

Answer one question in each section

Section 1: Knowledge Graph Basics

Please answer Question 1 OR Question 2

Question 1

Question 1A **15** Marks

Consider the following paragraph

> *404 is a bus route in Galway. The bus route starts in Oranmore, it then stops at Wellpark, Eyre Square. The bus route ends at the Westside Shopping Centre. All of the bus stops are in County Galway.*

Draw a knowledge graph to represent the facts contained in the graph above

Question 1B **10** Marks

Write the knowledge graph you developed above as an RDF document in Turtle. You should define an appropriate namespace and use appropriate features such as continuations.

Question 2

Question 2A **10** Marks

What is wrong with the following Turtle code. Suggest at least **three** errors

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
“Galway” a rdf:City ;
  <ex:locatedIn> ex:Ireland ,
  <ex:population> “79000”@en .
```

Question 2B **15** Marks

Give a use case where you may use of each of the following to describe the structure of a knowledge graph:

- RDF Schemas
- RDF Shapes
- OWL Ontologies

Section 2: Working with Knowledge Graph

Please answer Question 3 OR Question 4

Question 3

Question 3A **25** Marks

Create an ontology that describes the domain of board games. Your ontology should model at least the following:

- Title
- Player count
- Playing time
- Minimum player age
- Designer
- Artist
- Publisher
- Genre
- Release date
- Relationships between games (e.g., one game reimplements the rules of another)

You should provide a diagram showing the structure of your ontology and a description of the elements in the ontology. You should use **at least four** of the following ontology features: subclasses/properties, disjoint classes, inverse properties, unions or intersections, property cardinality restrictions, domain/range restrictions.

Question 4

Question 4A **10** Marks

Explain by means of an example the difference between inductive and deductive reasoning on knowledge graphs.

Question 4B **5** Marks

What is a one-hot embedding of a graph? Why would you want to create a lower-dimensional embedding from the one-hot embedding?

Question 4C **10** Marks

Consider that we have a graph of movies and information about them. How can we use graph embeddings to make recommendations? What are the benefits of using a recurrent graph neural network to make this recommendation?

Section 3: Knowledge Graph Applications

Please answer Question 5 OR Question 6

Question 5

Question 5A **10** Marks

Give two reasons why knowledge graphs and formalism such as linked data can be useful for representing linguistic data

Question 5B **5** Marks

Consider that you are tasked with creating a part-of-speech tag set that covers all the world's languages. Suggest one challenge that you would have to solve to do this.

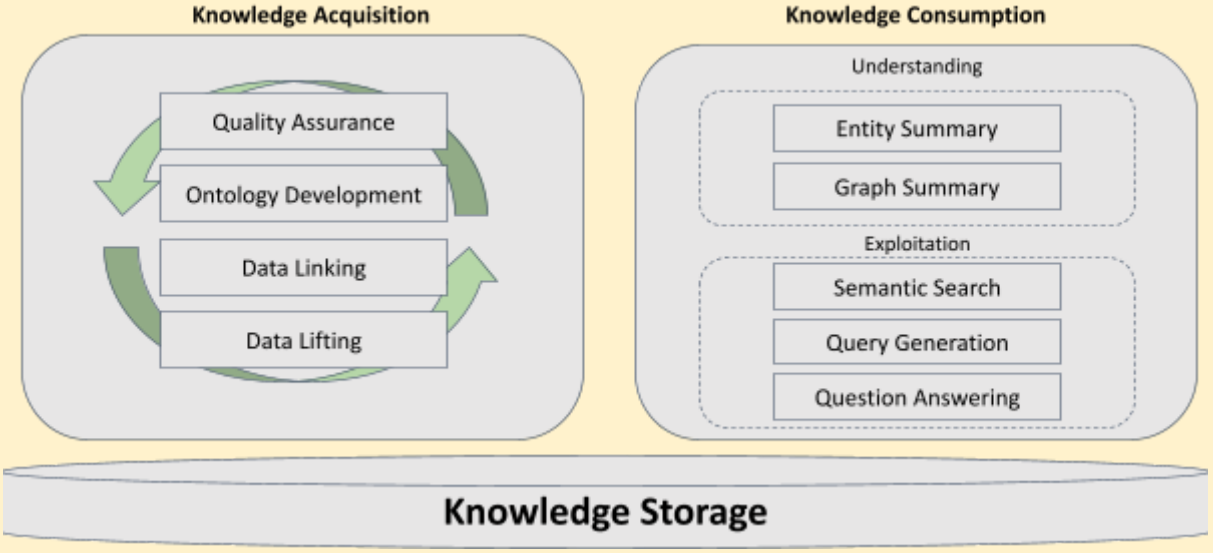
Question 5C **10** Marks

Model the following in OntoLex-Lemon using a Turtle representation or a diagram:

- A lexical entry for the word "vessel"
- Its part-of-speech is noun
- It has a plural form "vessels"
- It has two senses that refer to the following concepts in Wikidata:
  - https://www.wikidata.org/wiki/Q11446
  - https://www.wikidata.org/wiki/Q987767

Question 6

Question 6A **10** Marks



Consider the above diagram of the enterprise knowledge graph lifecycle. Consider that you are developing a customer service chatbot application that uses a knowledge graph for a large enterprise. Describe the knowledge acquisition process that you may use.

Question 6B **10** Marks

For the above scenario, describe a process by which you could develop a question answering system to help the chatbot answer questions.

Question 6C **5** Marks

When developing your solution your boss suggests that you use an SQL database to store the knowledge graph. Give one argument to convince him to use a different knowledge storage solution.