

## **i Plagiarism and declaration**

### **Plagiarism**

It is not accepted to submit papers/ essays/ exams that have previously been submitted for grading or evaluation, either by you or another student. Resubmitting a paper/ essay/ exam will be regarded as plagiarism, and can lead to serious consequences.

### **Declaration**

I hereby declare that the assignment which I am submitting is my own work and that

- it has not been used in another examination or been submitted or published at another educational institution in Norway or abroad
- it does not contain other people's work without this being stated
- it does not contain my own previous work without this being stated
- the bibliography contains all the literature and all the sources that I have used in my assignment, and that all references refer to this bibliography.

I am aware that any violation of these rules will be considered cheating.

All work you submit at the University of Bergen may be sent for an electronic plagiarism check.

## **i Part 1 - General theory**

**In this task, you will answer 25 questions.**

Scoring: each correct answer usually gives +0.5 points (\*).

Suggested time: 30 minutes.

Weight: ca 12.5% of the final grade.

(\*) A few questions allow multiple choices. Each correct choice then gives +0.25 and each incorrect choice gives -0.25. But the score for everything correct is still 0.5 (even if only one choice is correct) and the minimum is 0.0 (so no negative overall score on any question).

## 1 INFO216 - RDFS axioms

### Axioms in RDFS

Select one alternative:

- Are not a part of the RDFS semantics
- Must be defined by the user before executing entailment rules
- There are 22 axioms in RDFS
- Are built into the semantics of RDFS
- Are based on description logic (DL)

Maximum marks: 0.5

## 2 INFO216 - link prediction

When talking about graph embeddings, link prediction is to:

Select one alternative:

- Given two nodes, to find all property paths between them.
- Given a node, to find semantically similar nodes.
- Given a node and an edge type, to decide nodes that are candidates to form a plausible triple.
- Given two nodes and an edge type, to decide whether they form a plausible triple.

(Here, plausible means "likely to be true".)

Maximum marks: 0.5

### 3 INFO216 - hasFlightTo property

The hasFlightTo object property between two airports is  
Select one or more alternatives:

- Transitive
- Irreflexive
- Asymmetric
- Inverse functional
- Reflexive
- Functional

Maximum marks: 0.5

### 4 INFO216 - JSON-LD forms

JSON-LD is

Select one alternative:

- Logic description for JSON
- A JSON format for serialising linked data
- W3C's JSON Data Loader standard
- A tractable fragment of JSON logic
- Description logic reasoning in JSON

Maximum marks: 0.5

## 5 INFO216 - JSON-LD keywords

Which is NOT a reserved keyword in JSON-LD?

Select one alternative:

- @value: signifies that a value is a literal
- @type: signifies that the JSON object with the @type key has a particular RDF type (or several types)
- @context: signifies a JSON object that contains the context (or semantic mapping) for the other objects in the same JSON array
- @id: signifies that the JSON object with the @id key is identified by a particular URI
- @rule: signifies an entailment rule that applies to the object

Maximum marks: 0.5

## 6 INFO216 - RDFS expressiveness

Which one can be expressed in plain RDFS?

Select one alternative:

- The BirthNumber of a Person is unique
- A FootballTeam has 11 players, a VolleyballTeam only 6
- A Republic has exactly one President
- Two individuals with different URIs are actually different
- Every ancestor of an ancestor is an ancestor too
- Everyone who receives medical treatment is a patient
- A StringQuartet has two violins but only one viola and one cello
- A class is a negation of another class
- A class is a union (or intersection) of other classes
- Two properties with different URIs are actually the same

Maximum marks: 0.5

## 7 INFO216 - RDFS resource classes

What is true about RDFS resource classes?

Select one alternative:

- Provides Information hiding
- Resources have the same RDFS class throughout their lifetime
- The properties of a resource determines its RDFS class
- The properties of a resource are only visible to its neighbours
- Classes are templates for instantiating objects

Maximum marks: 0.5

## 8 INFO216 - why RDFS classes

What is NOT a reason that RDFS has resource classes?

Select one alternative:

- Classes are important for defining and using other RDFS concepts
- We can describe the class formally using RDFS and OWL DL
- Knowing the type (class) of a resource often means we can infer additional information about it (entailment)
- The type (class) of a resource is an important part of its semantics
- RDFS classes restrict which properties RDF resources can have

Maximum marks: 0.5

## 9 INFO216 - RDFS Schema

**RDF Schema (RDFS) is NOT**

**Select one alternative:**

- A small RDF vocabulary for more expressive graphs
- The foundation for SKOS, OWL and OWL2
- Used to query RDF graphs
- Used for defining other vocabularies

Maximum marks: 0.5

## 10 INFO216 - hasLocation property

**The isLocatedIn object property (between spatial regions) is**

**Select one or more alternatives:**

- Asymmetric
- Irreflexive
- Reflexive
- Symmetric
- Inverse functional
- Transitive

Maximum marks: 0.5

## 11 INFO216 - relation prediction

When talking about graph embeddings, relation prediction is to:

**Select one alternative:**

- Given a node, to find semantically similar nodes.
- Given two nodes, to find edge types that are candidates to form a plausible triple.
- Given two nodes and an edge type, to decide whether they form a plausible triple.
- Given a node, determine whether it plausibly represents a relation or not.

(Here, plausible means "likely to be true".)

Maximum marks: 0.5

## 12 INFO216 - RDF expressiveness

Which of these are supported by the RDF semantics?

**Select one alternative:**

- Legally owning a gun means owning a licensed weapon
- The object in a hasWorkHomepage triple is a URL
- The subject in a hasLicensePlate triple is a Vehicle
- Everything that is used as a predicate in a triple is an rdf:Property
- A Motorbike is a Vehicle

Maximum marks: 0.5



### 13 INFO216 - reification

**Reification is that**

**Select one alternative:**

- A resource represents a material thing or place
- A triple is unpacked into four new triples
- A URI answers HTTP requests and returns more information about a resource
- 303 redirection is used to return information about a resource

Maximum marks: 0.5

### 14 INFO216 - RDF lists

**It is true about an `rdf:List` (collection) that**

**Select one alternative:**

- It is typically used to represent alternatives
- New members cannot be added without deleting triples
- Cannot contain the same resource several times
- It is easy to add new members

Maximum marks: 0.5

## 15 INFO216 - RDFS containers

An RDFS container **CANNOT**

Select one alternative:

- Be an rdf:List
- Be an rdfs:Alt, rdfs:Bag or rdfs:Seq
- Be extended without deleting triples
- Have duplicate members

Maximum marks: 0.5

## 16 INFO216 - RDF resource types

An RDF resource

Select one alternative:

- always has rdfs:Class as its rdf:type
- may or may not have an rdf:type
- must have exactly one rdf:type
- always has at least one rdf:type

Maximum marks: 0.5

## 17 INFO216 - triple classificaiotn

When talking about graph embeddings, triple classification is to:

**Select one alternative:**

- Given a node, to find semantically similar nodes.
- Given two nodes and an edge type, to decide whether they form a plausible triple.
- Given two nodes, to find edge types that are candidates to form a plausible triple.
- Given a node and an edge type, to find nodes that are candidates to form a plausible triple.

(Here, plausible means "likely to be true".)

Maximum marks: 0.5

## 18 INFO216 - RDF resources can be

**An RDF resource can be**

**Select one alternative:**

- a property
- an information resource
- any of these
- a material phenomenon (including people and artefacts)
- a concept

Maximum marks: 0.5

## 19 INFO216 - not a LOD best practice

Which is NOT a best practice for data provisioning in the LOD cloud?

Select one alternative:

- Make proprietary vocabulary terms dereferencable
- Use terms from widely deployed vocabularies
- Refer to additional access methods (e.g., SPARQL)
- Map proprietary vocabulary terms to other vocabularies
- Use URIs that are standardised by the W3C
- Provide licensing metadata (e.g., CC)
- Provide provenance metadata (e.g., PROV)
- Provide dataset-level metadata (e.g., VANN, VS)

Maximum marks: 0.5

## 20 INFO216 - not a core LOD principle

Which is NOT one of the four core LOD principles?

Select one alternative:

- Use URIs that are language-independent.
- Use URIs that answer to HTTP requests
- URIs return information that contain URIs of related resources
- Use URIs to identify resources
- URIs return information about resources on standard semantic formats

Maximum marks: 0.5

## 21 INFO216 - LOD acronym

**LOD is an acronym for**

**Select one alternative:**

- Lean Open Data
- Linguistic Online Documents
- Linked Open Data
- Live Online Data

Maximum marks: 0.5

## 22 INFO216 - hasSibling property

**When we exclude half-siblings, the hasSibling object property between two people is**

**Select one or more alternatives:**

- Inverse functional
- Transitive
- Asymmetric
- Functional
- Reflexive
- Irreflexive
- Symmetric

Maximum marks: 0.5

## 23 INFO216 - connectedByRoad property (one-way streets)

The isConnectedByRoad object property between two locations (there can be one-way streets) is

Select one or more alternatives:

- Irreflexive
- Reflexive
- Symmetric
- Inverse functional
- Transitive
- Asymmetric
- Functional

Maximum marks: 0.5

**24 INFO216 - hasMother property**

The hasBirthMother object property between two persons is  
Select one or more alternatives:

- Irreflexive
- Symmetric
- Inverse functional
- Reflexive
- Asymmetric
- Transitive
- Functional

Maximum marks: 0.5

**25 INFO216 - hasNeighbour property**

The locatedNextTo object property between two locations is  
Select one or more alternatives:

- Irreflexive
- Symmetric
- Functional
- Transitive
- Inverse functional
- Reflexive
- Asymmetric

Maximum marks: 0.5

## i Part 2 - Programming

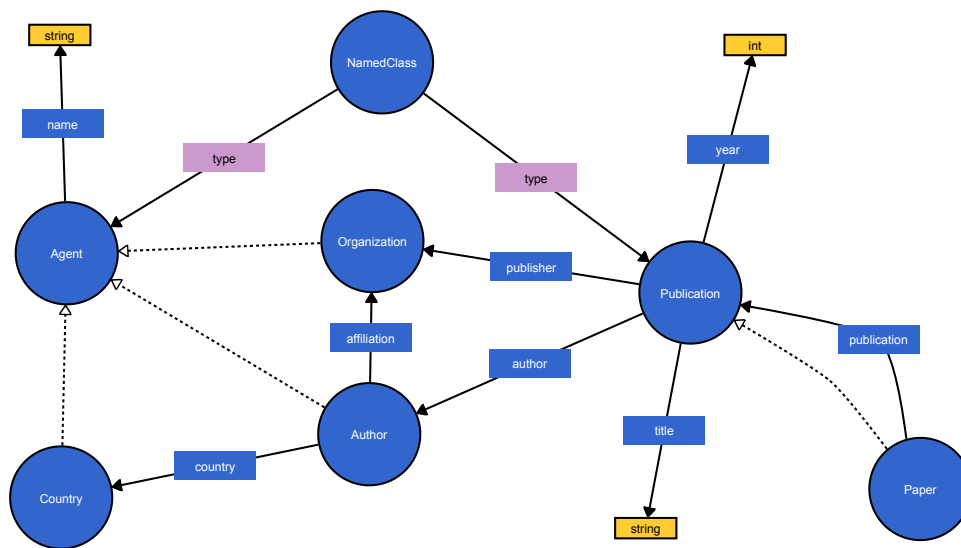
In this task, you will write a program that creates an ontology/knowledge graph, as described in the text and illustrated in the figure.

### Description:

Author-s, Country-s and Organization-s are Agent-s, which have name-s that are string-s. An Author can have affiliation (organization he/she works for) and country.

Paper-s are a type of Publication, and they can also be published in other Publication-s (such as books or journals). Publication-s have string title-s. They also have author-s, and they are published in a year that is described by an integer. A Publication can have a publisher, which is an Organization.

### Illustration:





## 26 Part 2a - Ontology programming

Write a program that creates the ontology using either `rdflib` or `owlready2`.

(If you use `rdflib`, SPARQL Updates are ok.)

Use the same example prefix `<http://ex.org#>` for all domain-specific classes and properties. In addition, you will need basic terms from RDF, RDFS, OWL, etc., *which should have the correct prefix*.

Scoring:

- you get up to 2 points for overall idea
- you get up to 4 points extra for code that compiles and runs
- you get up to 6 points for getting the ontology contents right

Suggested time: 30 minutes.

Weight: ca 12% of the final grade.

Here is a list of domain-specific classes and properties used, if you want to copy-and-paste:

Classes:	Properties:
:Agent :Author :Organization	:name :affiliation :title :publisher
:Country :Paper :Publication	:publication :author :country :year

**Fill in your answer here**

1

Maximum marks: 12

## 27 Part 2b: Knowledge-graph programming

Write a program that adds the following individuals and relations to the ontology/knowledge graph you just created. (When there are several triples of the same type, it is not critical that you add all of them.)

Use the same example prefix `<http://ex.org#>` for all domain-specific classes, properties, and individuals. In addition, you will need basic terms from RDF, RDFS, OWL, etc., *which should have the correct prefix.*

Title	Authors	Publication	Publisher	Year
:The_semantic_web	:Tim_Berners-Lee, :James_Hendler	:Scientific_American	:Springer_Nature	2001
:DBpedia_A_nucleus	:Soren_Auer, :Christian_Bizer	:The_semantic_web_book	:Springer_Nature	2007
:Linked_data_The_story_so_far	:Christian_Bizer, :Tim_Berners-Lee	:Semantic_services_interoperability_and_web_applications	:IGI_Global	2011

Author	Affiliation	Country
:Tim_Berners-Lee	:Massachusetts_Institute_of_Technology	:United_States
:Soren_Auer	:Leibniz_University_Hannover	:Germany
:Christian_Bizer	:University_of_Mannheim	:Germany
:James_Hendler	:Rensselaer_Polytechnic_Institute	:United_States

Scoring: you get up to 4 points for correct triples.

Suggested time: 15 minutes.

Weight: ca 4% of the final grade.

*Note* - in the table above, these URLs were split over two lines, but they are only two, not four resources:

- :Linked\_data\_The\_story\_so\_far
- :Semantic\_services\_interoperability\_and\_web\_applications

**Fill in your answer here**

1	
---	--

Maximum marks: 4

### **i Part 3 - Standard terms**

The classes and properties in the description and illustration in part 2 lack prefixes. But many similar classes and properties are already defined (exactly or closely matching) in standard vocabularies and ontologies.

**Which of these 12 standard terms do you think are best?**

Scoring: you get 0.8 points for each correct prefix or name.

Suggested time: 15 minutes.

Weight: ca 10% of the final grade.

**28 INFO216 - Terms 1**

For Agent I would use:

**Select one alternative:**

- dc:Agent
- sioc:Agent
- foaf:Agent

(In this part, you can assume that 'dc:' is either 'dce:' or 'dcterms:'.)

Maximum marks: 0.8

**29 INFO216 - Terms 2**

For type I would use:

**Select one alternative:**

- owl:type
- rdf:type
- dc:type

Maximum marks: 0.8

**30 INFO216 - Terms 3**

For NamedClass I would use:

**Select one alternative:**

- rdfs:NamedClass
- owl:NamedClass
- dbpedia-owl:NamedClass

Maximum marks: 0.8

**31 INFO216 - Terms 4**

For subClassOf I would use:

**Select one alternative:**

- rdf:subClassOf
- rdfs:subClassOf
- owl:subClassOf

Maximum marks: 0.8

**32 INFO216 - Terms 5**

For Organization I would use:

**Select one alternative:**

- foaf:Organization
- dc:Organization
- sioc:Organizarion

Maximum marks: 0.8

**33 INFO216 - Terms 6**

For name I would use:

**Select one alternative:**

- skos:name
- rdfs:name
- foaf:name

Maximum marks: 0.8

**34 INFO216 - Terms 7**

For string I would use:

**Select one alternative:**

- xsd:string
- rdf:string
- schema:string

Maximum marks: 0.8

**35 INFO216 - Terms 8**

For affiliation I would use:

**Select one alternative:**

- rdfs:affiliation
- dc:affiliation
- schema:affiliation

Maximum marks: 0.8



**36 INFO216 - Terms 9**

For title I would use:

**Select one alternative:**

- dc:title
- skos:title
- foaf:title

Maximum marks: 0.8

**37 INFO216 - Terms 10**

For publisher I would use:

**Select one alternative:**

- bibo:publisher
- foaf:publisher
- dc:publisher

Maximum marks: 0.8

### 38 INFO216 - Terms 11

For publication (i.e., that a Paper is published in another Publication I would use:

**Select one alternative:**

- dc:isPartOf
- bibo:inCollection
- foaf:publication

Maximum marks: 0.8

### 39 INFO216 - Terms 12

For author I would use:

**Select one alternative:**

- foaf:author
- dc:contributor
- rdfs:author

Maximum marks: 0.8

## i Part 4 - Restrictions and reasoning

Part 4 has two sub-parts.

**First you will write restrictions in RDFS, and then in OWL.**

Suggested time for *both sub-parts*: 40 minutes.

Weight: ca 16% of the final grade.

## i Part 4a - Simple restrictions in RDFS/OWL

Write the following 10 statements as RDFS/OWL triples in Turtle.

Continue to use the same example prefix as in Part 2: <http://ex.org#> for all domain-specific classes and properties, along with the basic terms from RDF, RDFS, OWL, etc.

*You do not have to write the prefix definitions yourself.* You can assume that the prefixes ':', 'rdf:', 'rdfs:', 'owl:', etc. are already defined.

Scoring: you get 0.8 points for each statement.

Suggested time: 20 minutes.

Weight: ca 8% of the final grade.

**40 INFO216 - Simple restrictions 1**

An Organization is a kind of Agent.

**Fill in your answer here**

1	
---	--

Maximum marks: 0.8

## 41 INFO216 - Simple restrictions 2

The object in an affiliation-triple is an Organization.

**Fill in your answer here**

1	
---	--

Maximum marks: 0.8

**42 INFO216 - Simple restrictions 3**

The subject in an affiliation-triple is an Author.

**Fill in your answer here**

1	
---	--

Maximum marks: 0.8

**43 INFO216 - Simple restrictions 4**

A Paper is published in only one Publication.

**Fill in your answer here**

1	
---	--

Maximum marks: 0.8

**44 INFO216 - Simple restrictions 5**

A Paper cannot have more than one publication year.

**Fill in your answer here**

1	
---	--

Maximum marks: 0.8



**45 INFO216 - Simple restrictions 6**

A Paper cannot be its own publication.

**Fill in your answer here**

1	
---	--

Maximum marks: 0.8

**46 INFO216 - Simple restrictions 7**

publication is a transitive relation.

**Fill in your answer here**

1	
---	--

Maximum marks: 0.8

**47 INFO216 - Simple restrictions 8**

Different Author-s have different name-s.

**Fill in your answer here**

1	
---	--

Maximum marks: 0.8

**48 INFO216 - Simple restrictions 9**

An Author is not an Organization.

**Fill in your answer here**

1	
---	--

Maximum marks: 0.8

**49 INFO216 - Simple restrictions 10**

A Publication title is a string.

**Fill in your answer here**

1	
---	--

Maximum marks: 0.8

## i Part 4b - Complex restrictions in OWL/RDFS

Write the following 5 statements as OWL/RDFS expressions in Turtle.

Continue to use the same example prefix as in Part 2: `<http://ex.org#>` for all domain-specific classes and properties, along with basic terms from RDF, RDFS, OWL, etc.

*You do not have to write the prefix definitions yourself.* You can assume that the prefixes ':', 'rdf:', 'rdfs:', 'owl:', etc. are already defined.

Scoring: you get 1.6 points for each statement.

Suggested time: 20 minutes.

Weight: ca 8% of the final grade.

**50 INFO16 - Complex restrictions 1**

A Paper must have at least one author.

**Fill in your answer here**

1	
---	--

Maximum marks: 1.6

**51 INFO216 - Complex restrictions 2**

A Paper has exactly one title.

**Fill in your answer here**

1	
---	--

Maximum marks: 1.6



**52 INFO216 - Complex expressions 3**

A year must be in range from 1900 to 2050 (inclusive).

**Fill in your answer here**

1	
---	--

Maximum marks: 1.6

**53 INFO216 - Complex expressions 4**

Author-s, Organization-s, and Country-s are disjoint.

**Fill in your answer here**

1	
---	--

Maximum marks: 1.6

**54 INFO216 - Complex expressions 5**

A Publisher must be either of ACM, IEEE CS, Springer Nature, or IGI Global.

**Fill in your answer here**

1	
---	--

Maximum marks: 1.6

## i Part 5 - Reasoning

In this part, we will run reasoning over the classes, properties, and individuals from Part 2, with the restrictions from Part 4 added. Then you will be asked about the results of reasoning.

Continue to use the same example prefix as in Part 2: `<http://ex.org#>` for all domain-specific classes and properties, along with basic terms from RDF, RDFS, OWL, etc.

Assume we have run `RDFS_OWLRL_Semantics` to execute RDFS entailments.

Scoring: you get 1.5 points for each correct choice.

Suggested time: 30 minutes.

Weight: ca 13.5% of the final grade.

### 55 INFO216 - Reasoning 1

After running entailments, it is true that:  
Christian Bizer has country Germany.

Select one alternative:

- Correct
- Incorrect

Maximum marks: 1.5

**56 INFO216 - Reasoning 2**

After running entailments, it is true that:

University of Mannheim has country Germany,

Select one alternative:

- Incorrect
- Correct

Maximum marks: 1.5

**57 INFO216 - Reasoning 3**

After running entailments, it is true that:

The semantic web has type Paper,

Select one alternative:

- Correct
- Incorrect

Maximum marks: 1.5

**58 INFO216 - Reasoning 4**

After running entailments, it is true that:  
The semantic web has type Publication,

Select one alternative:

- Incorrect
- Correct

Maximum marks: 1.5

**59 INFO216 - Reasoning 5**

After running entailments, it is true that:  
The semantic web book has type Paper,

Select one alternative:

- Correct
- Incorrect

Maximum marks: 1.5

**60 INFO216 - Reasoning 6**

After running entailments, it is true that:  
The semantic web book has type Publication,

Select one alternative:

- Incorrect
- Correct

Maximum marks: 1.5

## 61 INFO216 - Reasoning 7

Assume the following statement has been added as a triple:

The semantic web is published in The semantic web book.

Which of the following statements are now true?

**Select one or more alternatives:**

- Christian\_Bizer is now the OWL-same author as Time\_Berners-Lee.
- The\_semantic\_web paper is now OWL-same as the DBpedia\_A\_nucleus paper.
- RDFS-OWLRL reasoning halts due to an exception..
- RDFS-OWLRL reasoning goes through with no errors or warnings.
- The Scientific\_American publication is now OWL-same as The\_semantic\_web\_book.
- RDFS-OWLRL reasoning goes through, but it reports reasoning errors.

(Because you can choose multiple alternatives, each correct answer gives 1.5 and each incorrect one gives -1.5, but you cannot score negative on the task as a whole.)

Maximum marks: 4.5

## i Part 6 - SPARQL

**In this part you will write 16 SPARQL queries and updates to the ontology and instances from Part 2.**

Assume we have run an RDFS-OWLRL reasoner as in Part 5. Also assume the KG is complete so we can query with negation and cardinality restrictions.

Use the same names of classes, properties, individuals, and prefixes as before. You will only write the SPARQL query or update itself, not any of the program code needed to execute it.

*You do not have to write the prefix definitions yourself.* You can assume that the prefixes ':', 'rdf:', 'rdfs:', 'owl:', etc. are already defined.

Scoring: 1.0 point per correct query/update

Suggested time: 40 minutes.

Weight: 16% of the final grade.



**62 INFO216 - SPARQL query 1**

List all Paper title-s. (Example output below.)

**Fill in your answer here**

1	
---	--

Example output:

title

-----

"DBpedia A nucleus"

"Linked data The story so far"

"The semantic web"

Maximum marks: 1

**63 INFO216 - SPARQL query 2**

List all publisher Organization-s in alphabetical order.

**Fill in your answer here**

1	
---	--

Example output:

name

-----

"IGI Global"

"Springer Nature"

Maximum marks: 1

**64 INFO216 - SPARQL query 3**

List all Author-s along with the title-s of the Paper-s they have written.

**Fill in your answer here**

1	
---	--

Example output:

author | title

```
-----  
"Christian Bizer"|"DBpedia A nucleus"  
"Christian Bizer"|"Linked data The story so far"  
"James Hendler"|"The semantic web"  
"Jens Lehmann"|"DBpedia A nucleus"  
"Ora Lassila"|"The semantic web"  
"Soren Auer"|"DBpedia A nucleus"  
"Tim Berners-Lee"|"Linked data The story so far"  
"Tim Berners-Lee"|"The semantic web"  
"Tom Heath"|"Linked data The story so far"
```

Maximum marks: 1

**65 INFO216 - SPARQL query 4**

List all Country-s and numbers of Paper-s from that Country.

**Fill in your answer here**

1	
---	--

Example output:

country | number

-----  
"Germany" | "3"^^<...>

"United States" | "3"^^<...>

Maximum marks: 1

**66 INFO216 - SPARQL queries 5**

List all Author-s of more than one Paper in descending order (of paper numbers).

**Fill in your answer here**

1	
---	--

Example output.

author	number
"Christian Bizer"	"2"^^<...>
"Tim Berners-Lee"	"2"^^<...>

Maximum marks: 1

## 67 INFO216 - SPARQL queries 6

For each Author, write the first and last year they have published a Paper.

**Fill in your answer here**

1	
---	--

Example output:

name | min | max

-----  
-----

```
"Christian Bizer"|"2007"^^<...>|"2011"^^<...>
"James Hendler"|"2001"^^<...>|"2001"^^<...>
"Jens Lehmann"|"2007"^^<...>|"2007"^^<...>
"Ora Lassila"|"2001"^^<...>|"2001"^^<...>
"Soren Auer"|"2007"^^<...>|"2007"^^<...>
"Tim Berners-Lee"|"2001"^^<...>|"2011"^^<...>
"Tom Heath"|"2011"^^<...>|"2011"^^<...>
```

Maximum marks: 1

**68 INFO216 - SPARQL queries 7**

List all Authors that are not affiliated with an Organization in Germany.

**Fill in your answer here**

1	
---	--

Example output:

name

-----

"James Hendler"

"Tim Berners-Lee"

Maximum marks: 1

**69 INFO216 - SPARQL queries 8**

Is James Hendler the author of more than one Paper?

**Fill in your answer here**

1	
---	--

Example output:

False

Maximum marks: 1



## 70 INFO216 - SPARQL queries 9

Create a new graph of all Author-s that have author-ed a Paper with Christian Bizer, including their affiliation-s and country-s. (Example output below.)

Fill in your answer here

1	
---	--

Partial example output:

```
@prefix : <http://ex.org#> .
:Christian_Bizer a :Author ;
  :affiliation :University_of_Mannheim ;
  :country :Germany ;
  :name "Christian Bizer" .
```

Maximum marks: 1

## 71 INFO216 - SPARQL queries 10

Create a new graph of all Author-s that have author-ed a Paper with Christian Bizer, including their Paper-s, affiliation-s and country-s.

Fill in your answer here

1	
---	--

Partial example output:

```
@prefix : <http://ex.org#> .
:Christian_Bizer a :Author ;
  :affiliation :University_of_Mannheim ;
  :country :Germany ;
  :name "Christian Bizer" .
:DBpedia_A_nucleus a :Paper ;
  :author :Christian_Bizer, :Soren_Auer ;
  :title "DBpedia A nucleus" .
```

Maximum marks: 1

**72 INFO216 - SPARQL updates 1**

An Organization that is an Author's affiliation is an Institution.

**Fill in your answer here**

1	
---	--

Maximum marks: 1

**73 INFO216 - SPARQL updates 2**

If an Author has a country, the then that Author's affiliation Organization is locatedIn the same Country.

**Fill in your answer here**

1	
---	--

Maximum marks: 1

**74 INFO216 - SPARQL updates 3**

A Paper is producedBy the Organization-s its Author-s are affiliated with.

**Fill in your answer here**

1	
---	--

Maximum marks: 1

**75 INFO216 - SPARQL updates 4**

A Paper is produced in the Country-s of its Author-s Institutions are located in.

**Fill in your answer here**

1	
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Maximum marks: 1

**76 INFO216 - SPARQL updates 5**

Delete all direct (country) connections between Author-s and Country-s.

**Fill in your answer here**

1	
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Maximum marks: 1

**77 INFO216 - SPARQL updates 6**

If a Paper has more than one year, delete the most recent ones.

**Fill in your answer here**

1	
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Maximum marks: 1



## i Part 7 - rdflib understanding

In this part you are given a Python program that loads the ontology from Part 2a. It then reads the papers and authors from Part 2b from files. Finally, the program saves them together in a knowledge graph.

**Unfortunately, the program does not work yet. You must identify 8 errors that must be fixed before the program can run correctly.**

All the errors are somehow related to knowledge graphs and rdflib, none of them are "pure Python" errors.

Scoring: you get 2.0 point for each correctly identified error

Suggested time: 40 minutes.

Weight: 16% of the final grade.

Here are examples of input data to the program:

### **File papers.txt:**

The semantic web;Tim Berners-Lee,James Hendler;Scientific American;Springer Nature;2001

DBpedia A nucleus;Soren Auer,Christian Bizer;The semantic web book;Springer Nature;2007

Linked data The story so far;Christian Bizer,Tim Berners-Lee;Semantic services interoperability and web applications;IGI Global;2011

### **File authors.txt:**

Tim Berners-Lee;Massachusetts Institute of Technology;United States

Soren Auer;Leibniz University Hannover;Germany

Christian Bizer;University of Mannheim;Germany

James Hendler;Rensselaer Polytechnic Institute;United States

**78 INFO216 - rdflib errors**

**For each error you find in the exam program, copy the line where the error first appears. If the same error is repeated, you only copy the first line.**

Leave a blank line between each error line you find.

Attached you can find a file with 8 errors to identify.

**Fill in your answer here**

Maximum marks: 16

## 79 **Part 8 - Comments to the exam**

If you have any comments to the exam, you can enter them here:

**Fill in your answer here**

Maximum marks: 0