



UNIVERSITÀ  
DI TRENTO



# Computational Logic Exercises

## Module II – Set theory and knowledge graphs

Vincenzo Maltese

## Avvisi

**Lezione del 3/11** sarà di Q&A, tenuta da Giunchiglia

Potete inviare a lui via email dubbi e/o esercizi che desiderate discutere il 3/11.

**Midterm exam 6/11** su piattaforma Moodle

Esame da prenotare su piattaforma ESSE3

Aule A201, A202, B106 con orario di arrivo alle ore 8:00

Durata sarà probabilmente 1h 30m – 1h 40m durata

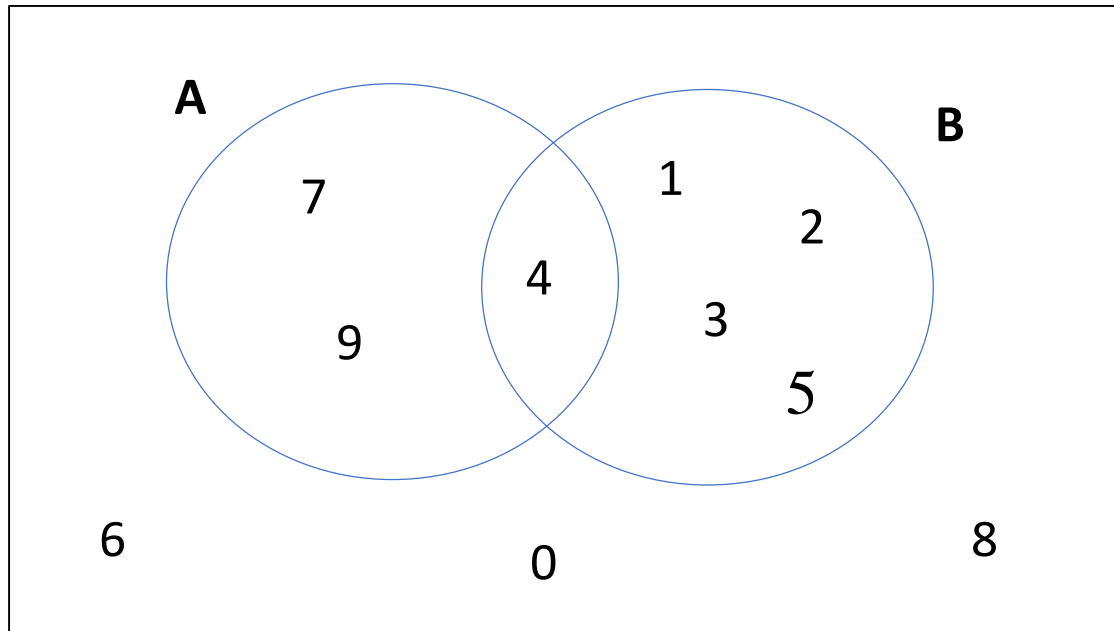
Avvisare Giunchiglia e la Didattica OnLine se c'è qualcuno che ha bisogni speciali per avere più tempo.

## Set theory (I)

The sets A and B consist of numbers from 0 to 9, such that:

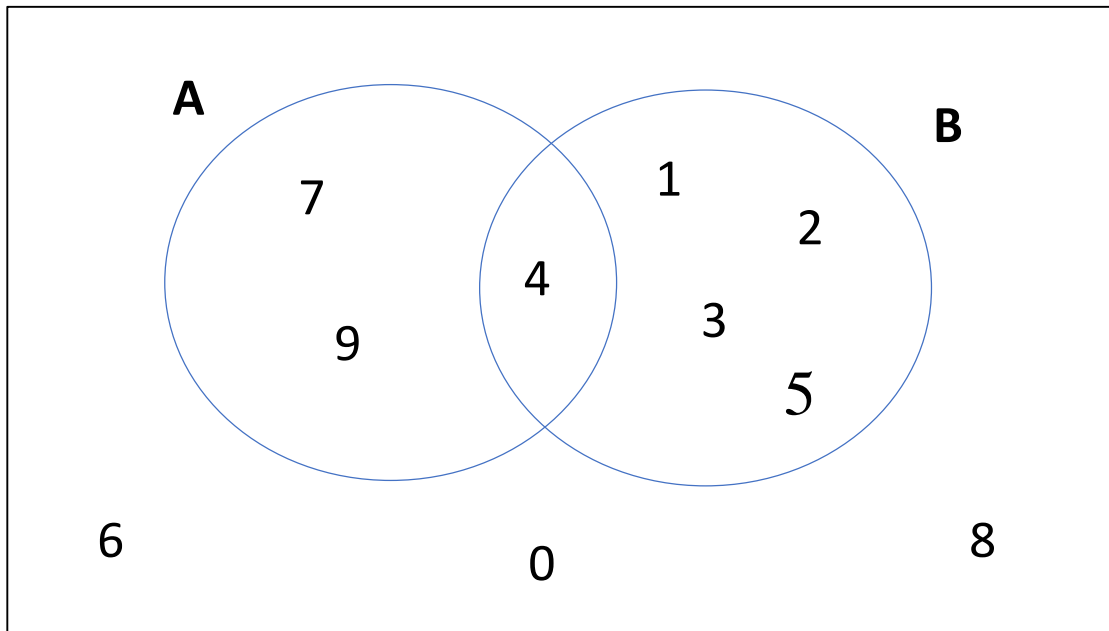
$$A = \{4, 7, 9\} \quad B = \{1, 2, 3, 4, 5\}$$

Illustrate these sets in a Venn diagram.



## Set theory (II)

Given the Venn diagram below, say which of the following statements are true.



- a. A is the empty set
- b.  $4 \in A$  and  $4 \in B$
- c.  $A \subseteq B$
- d.  $0 \notin A$
- e. The universal set U contains all the numbers from 0 to 9

**ANSWER:** b, d, e

## Set theory (III)

**Provide 3 examples of relations between people** that are (a) symmetric and transitive, and (b) anti-symmetric.

**ANSWER:**

(a) brother of, colleague of, roommate of;

**ANSWER:**

(b) parent of, mother of, manager of.

## Key questions

**What is a knowledge graph from the point of view of the graph theory?**

**ANSWER:** it is a directed labelled graph. Notice that it can be eventually cyclic, according to the phenomenon to be modelled.

## Designing knowledge graphs (I)

**Represent with a knowledge graph the following model: “Fausto works for the University of Trento, that is located in Italy” and convert it into triples.**



<Fausto> <worksFor> <University of Trento>

<University of Trento> <locatedIn> <Italy>

## Designing knowledge graphs (II)

**Represent with a knowledge graph the following linguistic model: “Fausto and Mario work for the University of Trento, that is located in Italy” and convert it into triples.**

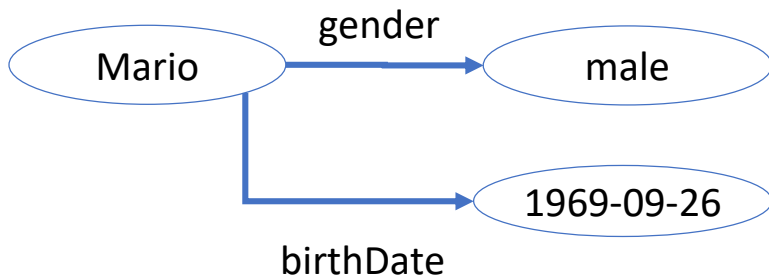


<Fausto> <worksFor> <University of Trento>  
<Mario> <worksFor> <University of Trento>  
<University of Trento> <locatedIn> <Italy>



## Designing knowledge graphs (III)

**Represent with a knowledge graph the following linguistic model: “Mario is male and is born on 1969-09-26” and convert it into triples.**




<Mario> <gender> <male>

<Mario> <birthDate> <1969-09-26>

## Designing knowledge graphs (IV)

Represent the content of the following webpage as a knowledge graph



**Fausto Giunchiglia**

**Full professor**

Department of Information Engineering and Computer Science

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tel. 0461 281533  
fausto.giunchiglia@unitn.it  
| <https://www.disi.unitn.it/~fausto/>

**Expertise:**

- Access control
- Artificial Intelligence
- Automated reasoning
- Big data
- Data integration
- Information & Communication Technology (ICT)
- Knowledge management
- Multi-agent systems
- Natural language processing
- Personal life
- Pervasive computing
- Privacy
- Semantic interoperability
- Semantic search
- Semantic web

Teaching Publications Dissertations and Theses **Projects** Office Hours


19 results






This section provides the list of research projects funded by external organizations, or by UniTrento, on a competitive basis, for which the person is the main scientific responsible person. Data source: UniTrento Projects Register





Title	Start date ↓	End date
Joint Industrial Data Exchange Pipeline	01/06/2022	31/05/2025
DELPhi - DiscovEring Life Patterns	29/08/2019	28/08/2023

# Designing knowledge graphs (V)

Represent the content of the following webpage as a knowledge graph



 HOME
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  EXPERTS AND COMPETENCES
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<b>Department of Cellular, Computational and Integrative Biology - CIBIO</b> academic department  Director: Paolo Macchi Via Sommarive, 9, Povo, 38123 TN <a href="http://www.cibio.unitn.it">http://www.cibio.unitn.it</a>	<b>Department of Civil, Environmental and Mechanical Engineering</b> academic department  Director: Oreste S. Bursi Via Mesiano, 77, 38123 Trento <a href="http://www.dicam.unitn.it/">http://www.dicam.unitn.it/</a>	<b>Department of Economics and Management</b> academic department  Director: Flavio Bazzana Via Vigilio Inama, 5, Trento, 38122 TN <a href="http://www.economia.unitn.it">http://www.economia.unitn.it</a>
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## Interpreting knowledge graphs

**Given the following knowledge graph, come up with an equivalent representation in natural language.**



**A POSSIBLE ANSWER:** The University of Trento was funded on 1962. Fausto is a professor of the University of Trento. Mario is a director of the University of Trento.

# Etype graphs (I)

## Movie

A Schema.org Type

Thing > CreativeWork > Movie

A movie.

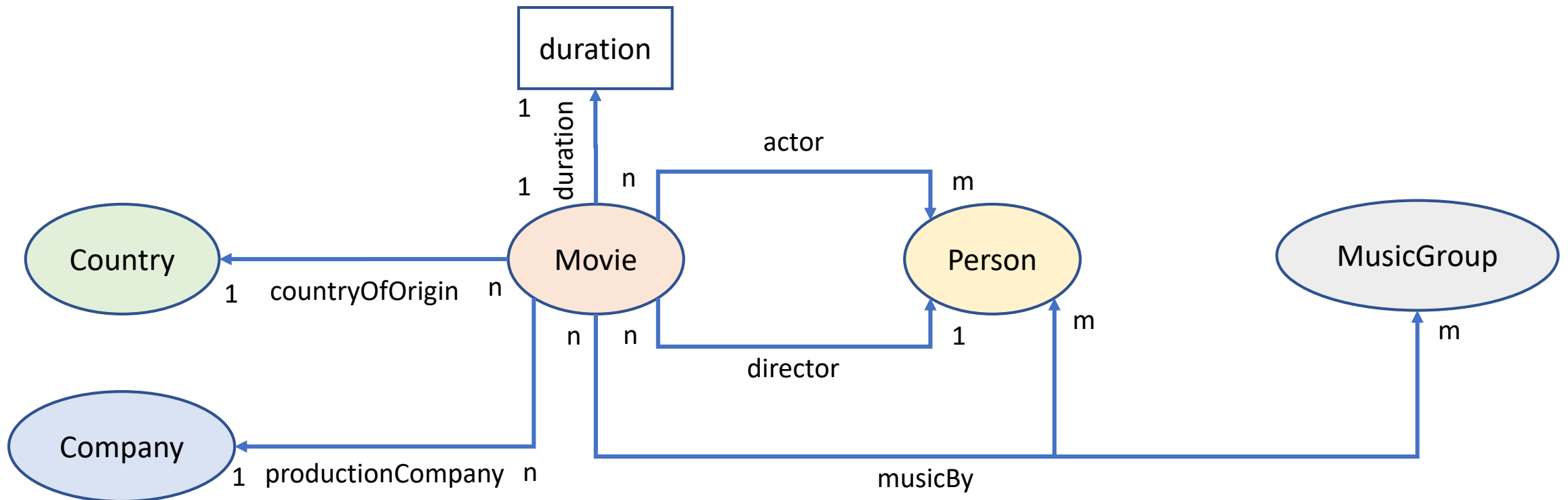
[more...]

**Schema.org** is an example of ETG.

Property	Expected Type	Description
<b>Properties from Movie</b>		
<b>actor</b>	Person	An actor, e.g. in TV, radio, movie, video games etc., or in an event. Actors can be associated with individual items or with a series, episode, clip. Supersedes <b>actors</b> .
<b>countryOfOrigin</b>	Country	<p>The country of origin of something, including products as well as creative works such as movie and TV content.</p> <p>In the case of TV and movie, this would be the country of the principle offices of the production company or individual responsible for the movie. For other kinds of <b>CreativeWork</b> it is difficult to provide fully general guidance, and properties such as <b>contentLocation</b> and <b>locationCreated</b> may be more applicable.</p> <p>In the case of products, the country of origin of the product. The exact interpretation of this may vary by context and product type, and cannot be fully enumerated here.</p>
<b>director</b>	Person	A director of e.g. TV, radio, movie, video gaming etc. content, or of an event. Directors can be associated with individual items or with a series, episode, clip. Supersedes <b>directors</b> .
<b>duration</b>	Duration	The duration of the item (movie, audio recording, event, etc.) in ISO 8601 date format.
<b>musicBy</b>	MusicGroup or Person	The composer of the soundtrack.
<b>productionCompany</b>	Organization	The production company or studio responsible for the item, e.g. series, video game, episode etc.

## Etype graphs (II)

Provide a graphical representation of the Movie etype as a Knowledge graph.



## Test yourself (a)

**Given the knowledge graph above and their corresponding representation in natural language say if they are mutually consistent and motivate your answer.**



**The University of Trento was funded on 1962. Fausto is a professor of the University of Trento. Mario is a director of the University of Trento.**

**ANSWER: YES, BECAUSE THERE IS AN EXACT CORRESPONDENCE.**

## Test yourself (b)

**Given the knowledge graph above and their corresponding representation in natural language say if they are mutually consistent and motivate your answer.**



**The University of Trento was funded on 1962. Fausto and Mario work for the University of Trento.**

**ANSWER: NO, BECAUSE WE DID NOT SPECIFY IN THE GRAPH THE “WORKS FOR” RELATION.**



## Test yourself (c)

**Given the knowledge graph above and their corresponding representation in natural language say if they are mutually consistent and motivate your answer.**



**The University of Trento was funded on 1962. Fausto is a professor of the University of Trento.**

**ANSWER: YES, IT IS CONSISTENT DESPITE NOT COMPLETE.**

## Homework (I)

### Answer to the following questions

1. What makes a modelling language formal?
2. What is the difference between a directed graph and an undirected graph?
3. Is a knowledge graph the result of a modelling activity?
4. What exactly do you represent with knowledge graphs?
5. What are the advantages of a knowledge graph w.r.t. other representations?
6. In the context of knowledge graphs, what is the difference between an entity type and a data type?
7. In the context of knowledge graphs, what is the difference between object properties and data properties?

## Homework (II)

**EXERCISE 1:** Represent with a knowledge graph the following model: “University of Trento (officially “Università degli Studi di Trento”) was founded on 1962. Its institutional address is via Calepina, 14 - 38122 Trento. Its web site is <https://www.unitn.it/>. It is research partner of Fondazione Edmund Mach” and convert it into triples.

**EXERCISE 2:** Represent with a knowledge graph the following linguistic model: “Alice and Bob both own a Fiat Panda. Alice bought a new one in 2023, while Bob’s was a second hand vehicle from 2013 that he bought in 2018.” and convert it into triples.

## Homework (III)

**EXERCISE 3:** Design a comprehensive knowledge graph from the following models

M1: cure A worked with patient 1 affected by disease X; patient 1 is male

M2: cure A worked with patient 2 affected by disease X; patient 2 is male

M3: cure A did not work with patient 3 affected by disease X; patient 3 is female

**EXERCISE 4:** Design a comprehensive knowledge graph from the following picture

