Chapter 1
Reference models

Exercise 1.1 (Linguistic and analogical mental representations) Create an analogical representation using set theory for this linguistic mental representation.

- In(tree, lab)
- In (monkey1, lab)
- In(monkey2, lab)
- Eating(monkey1, banana)
- SittingOn(monkey2, tree)*
- Scratching(monkey2, hisHead)*

Exercise 1.2 (Linguistic and analogical mental representations) Create an analogical representation using knowledge graphs for this linguistic mental representation.

- In(tree, lab)
- In (monkey1, lab)
- In(monkey2, lab)
- Eating(monkey1, banana)
- SittingOn(monkey2, tree)*
- Scratching(monkey2, hisHead)*

Exercise 1.3 (Linguistic and analogical mental representations) Create an analogical representation using knowledge graphs for this linguistic mental representation. This time improve it using labels.

- In(tree, lab)
- In (monkey1, lab)
- In(monkey2, lab)
- Eating(monkey1, banana)
- SittingOn(monkey2, tree)*
- Scratching(monkey2, hisHead)*

Exercise 1.4 (Set Theory) The sets A and B consist of numbers from 0 to 9, such that: A = 4,7,9 and B = 1,2,3,4,5. Illustrate these sets in a Venn diagram.

**Exercise 1.5 (Set Theory)** 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
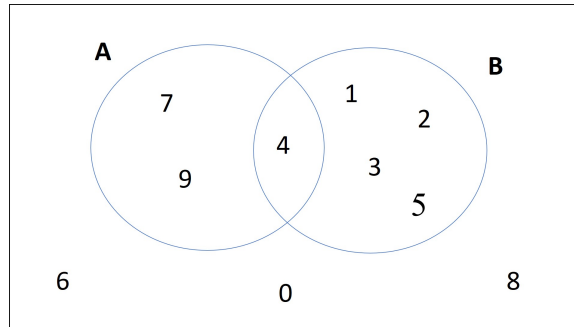
Exercise 1.6 (Set Theory) Provide 3 examples of relations between people that are (a) symmetric and transitive, and (b) anti-symmetric.
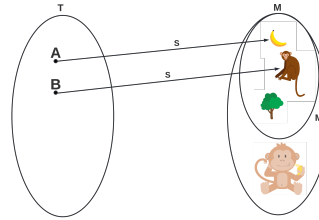
Exercise 1.7 (Complete and Correct?) Consider the sentences and the modeling of the theory. Say whether the theory T is complete, correct, complete and correct, incomplete, or incorrect, with respect to the model M.

  • A = "There is a banana"
  • B = "There is a monkey"
  • C = "There is a tree"
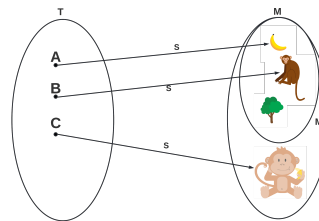 • D = "The monkey is eating a banana"
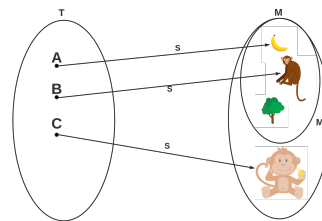
Exercise 1.8 (Complete and Correct?) Consider the sentences and the modeling of the theory. Say whether the theory T is complete, correct, complete and correct, incomplete, or incorrect, with respect to the model M.

- A = "There is a banana"
- B = "There is a monkey"
- C = "There is a tree"
- D = "The monkey is eating a banana"

Exercise 1.9 (Complete and Correct?) Consider the sentences and the modeling of the theory. Say whether the theory T is complete, correct, complete and correct, incomplete, or incorrect, with respect to the model MT.

- A = "There is a banana"
- B = "There is a monkey"
- C = "The monkey is eating a banana"
- D = "There is a tree"

Exercise 1.10 (Complete and Correct?) Consider the sentences and the modeling of the theory. Say whether the theory T is complete, correct, complete and correct, incomplete, or incorrect, with respect to the model M.

- A = "There is a banana"
- B = "There is a monkey"
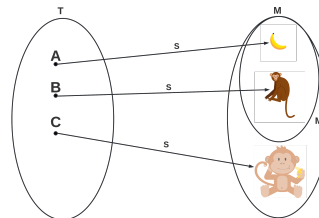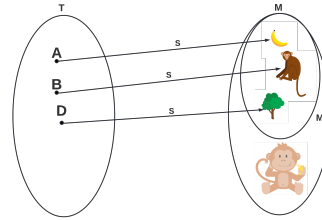- C = "There is a tree"
- D = "The monkey is eating a banana"

Exercise 1.11 (Complete and Correct?) Consider the sentences and the modeling of the theory. Say whether the theory T is complete, correct, complete and correct, incomplete, or incorrect, with respect to the model M.

- A = "There is a banana"
- B = "There is a monkey"
- C = "There is a tree"
- D = "The monkey is eating a banana"

Exercise 1.12 ($\mathcal{KG}$) What is a knowledge graph from the point of view of the graph theory?
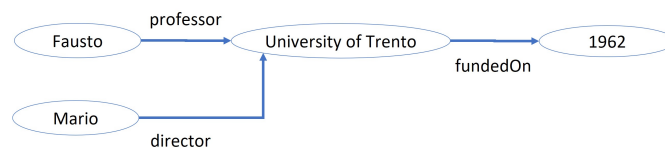
Exercise 1.13 (Design a Knowledge Graph) Represent with a knowledge graph the following model: "Fausto works for the University of Trento, that is located in Italy" and convert it into triples.

Exercise 1.14 (Design a Knowledge Graph) 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.

Exercise 1.15 (Design a Knowledge Graph) Represent with a knowledge graph the following linguistic model: "Mario is male and is born on 1969-09-26" and convert it into triples.

Exercise 1.16 (Knowledge Graph Reasoning) Given the knowledge graph below 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.
- The University of Trento was funded on 1962. Fausto and Mario work for the University of Trento.
- The University of Trento was funded on 1962. Fausto is a professor of the University of Trento.

Exercise 1.17 (Knowledge Graph Representation) 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 1.18 (Knowledge Graph Representation) 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.

Exercise 1.19 (Knowledge Graph Representation) 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 1.20 (Knowledge Graph Representation) Design a comprehensive knowledge graph from the following picture.