

Exercise 2: Knowledge Representation and Reasoning I

- (a) Please represent the following text in classical first-order logic: *Someone who lives in Dreadbury Mansion killed Aunt Agatha. Agatha, the butler, and Charles live in Dreadbury Mansion, and are the only people who live therein. A killer always hates his victim, and is never richer than his victim. Charles hates no one that Aunt Agatha hates. Agatha hates everyone except the butler. The butler hates everyone not richer than Aunt Agatha. The butler hates everyone Aunt Agatha hates. No one hates everyone. Agatha is not the butler.* Then represent the following claim: *Agatha killed herself.*

- (b) Please represent the following text in classical first-order logic: *Every student is enrolled in at least one course. Every professor teaches at least one course. Every course has at least one student enrolled. Every course has at least one professor teaching. The coordinator of a course teaches the course. If a student is enrolled in a course then the student is taught by every professor who teaches the course. Michael is enrolled in CSC410. Victor is the coordinator of CSC410.* Then represent the following claim: *Michael is taught by Victor.*

Exercise 3: Working with Automated Theorem Proving Systems

- (a) Convert your formal representations of the above puzzle scenarios in TPTP syntax and store in a file `AuntAgatha.p`.
Note: Please read the TPTP language description at <http://www.tptp.org/TPTP/QuickGuide/Problems.html>. Further information on the TPTP library and associated infrastructure is available at <http://www.tptp.org>.
- (b) Please use theorem provers for first-order logic (such as Vampire, E, CVC4, Spass) to show that the claims in exercises I and II indeed follow from the provided assumptions.
Note: You do not need to install systems; simply use them online via the SystemOnTPTP interface available at: <http://www.tptp.org/cgi-bin/SystemOnTPTP>

Exercise 4: Knowledge Representation and Reasoning II

- (a) Please try to represent the following text in classical first-order logic: *Peter loves Mary. Mary loves Ben. John knows that Mary loves Ben, but he does not know that Peter loves Mary.*
- (b) Try the use theorem provers or model finders available at SystemOnTPTP to show that your formal representation is consistent.

Exercise 5: Knowledge Representation and Reasoning III

- (a) Please try to represent the following text in propositional or classical first-order logic:
 - (i) Personal data shall be processed lawfully.
 - (ii) The data shall be kept, for the agreed purposes, if processed lawfully.
 - (iii) If personal data has been processed unlawfully, the controller has the obligation to erase the personal data in question without delay.
 - (iv) Some personal data has been processed unlawfully.
- (b) Try the use theorem provers or model finders available at SystemOnTPTP to show that your formal representation is consistent.