Assignment 4

Task 1

1. ∀ s : Student • ∃ a : Appointment • (a, s) ∈ Books

- Explanation: For all students "s", there exists an appointment "a" such that the pair (a, s) is in the Books relation, meaning the student "s" has booked an appointment "a".
- Set or Predicate: Predicate
- Evaluates to: True, if every student has at least one appointment booked.

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2. {a : Appointment | ∃ s : Student • (a, s) ∈ Books}

- Explanation: A set of appointments "a" such that there exists a student "s" who has booked the appointment "a".
- Set or Predicate: Set
- Evaluates to: A set of appointments booked by any student.

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3. {t : Tutor | ∃ sub : Subject • (t , sub) ∈ Signs up for}

- Explanation: A set of tutors "t" who have signed up for at least one subject "sub".
- Set or Predicate: Set
- Evaluates to: A set of tutors who have signed up for a subject.

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4. ∃ s : Student • s.credit < 3 ∧ #{a : Appointment | (s, a) ∈ Books} > 1

- Explanation: There exists a student "s" whose credit is less than 3, and the number of appointments booked by that student "s" is greater than 1.
- Set or Predicate: Predicate
- Evaluates to: True, if there is any student who has less than 3 credits and has booked more than one appointment.

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5. ∃ t : Tutor • ∃ sub : Subject • sub.name = SER ∧ (t , sub) ∈ Signs up for ∧ ∃ a : Appointment • a.time = 12 : 00 ∧ (t , a) ∈ Oversees

- Explanation: There exists a tutor "t" who has signed up for a subject "sub" with the name "SER", and there exists an appointment "a" at 12:00 that the tutor "t" oversees.
- Set or Predicate: Predicate
- Evaluates to: True, if there is a tutor who signed up for the SER subject and oversees an appointment at 12:00.

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6. {s : Student | ∃ a : Appointment • (s, a) ∈ Books ∧ ∃ t : Tutor • (t , a) ∈ Oversees ∧ t .name = David ∧ s.credits < 5}

- Explanation: A set of students "s" who have booked an appointment "a" overseen by tutor "David", and the student's credits are less than 5.
- Set or Predicate: Set
- Evaluates to: A set of students who have booked an appointment overseen by David and have fewer than 5 credits.

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7. {a : Appointment | ∃ t : Tutor • (t , a) ∈ Oversees ∧ ∃ sub : Subject • (t , sub) ∈ Signs up for ∧ sub.name = HistoryOfEngineering ∧ ∄s : Student • (s, a) ∈ Books}

- Explanation: A set of appointments "a" that are overseen by a tutor "t", where the tutor has signed up for the "HistoryOfEngineering" subject, and no student has booked the appointment.
- Set or Predicate: Set
- Evaluates to: A set of appointments that are overseen by a tutor signed up for History of Engineering, with no student booking them.

Task 2

1. Set of all appointments where the time is 13:30. Which appointments are in this set?

- Z-Notation:
  {a : Appointment | a.time = 13:30}
- Evaluates to: All appointments scheduled at 13:30.

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2. Predicate evaluating to true if there is a student who has booked Appt7791. Would this be true or false?

- Z-Notation:
  ∃ s : Student • (s, Appt7791) ∈ Books
- Evaluates to: True, if any student has booked Appt7791.

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3. Set of all appointments booked by Jim. Which appointments are in this set?

- Z-Notation:
  {a : Appointment | ∃ s : Student • s.name = "Jim" ∧ (s, a) ∈ Books}
- Evaluates to: All appointments booked by Jim.

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4. Set of all tutors who have signed up for more than 1 subject. Which tutors are in this set?

- Z-Notation:
  {t : Tutor | #{sub : Subject | (t, sub) ∈ Signs up for} > 1}
- Evaluates to: Tutors who have signed up for more than one subject.

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5. Set of all subjects Jacob has signed up for. Which subjects are in this set?

- Z-Notation:
  {sub : Subject | ∃ t : Tutor • (t, sub) ∈ Signs up for ∧ t.name = "Jacob"}
- Evaluates to: All subjects Jacob has signed up for.

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6. The number of appointments Kelly oversees. How many appointments is this?

- Z-Notation:
  #{a : Appointment | ∃ t : Tutor • t.name = "Kelly" ∧ (t, a) ∈ Oversees}
- Evaluates to: The number of appointments Kelly oversees.

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7. Predicate that evaluates to true if each appointment has at least 1 student booked. Would this evaluate to true or false?

- Z-Notation:
  ∀ a : Appointment • ∃ s : Student • (s, a) ∈ Books
- Evaluates to: True, if every appointment has at least one student booked.

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8. Predicate that evaluates to true if student X still has enough credit to book an appointment and does not have an appointment at time Y yet. For which values of X and Y would this evaluate to true?

- Z-Notation:
  ∀ X : Student • ∃ Y : Time • X.credit > 3 ∧ ¬(∃ a : Appointment • a.time = Y ∧ (X, a) ∈ Books)
- Evaluates to: True for students who have enough credit and do not have an appointment at the specified time.

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9. Predicate that evaluates to true if all tutors oversee more than 1 appointment. Does this evaluate to true or false?

- Z-Notation:
  ∀ t : Tutor • #{a : Appointment | (t, a) ∈ Oversees} > 1
- Evaluates to: False, unless every tutor oversees more than one appointment.

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10. Set of all students with the name X that are booked for an appointment with id Y.

- Z-Notation:
  {s : Student | s.name = "X" ∧ ∃ a : Appointment • a.id = Y ∧ (s, a) ∈ Books}
- Evaluates to: The set of students named X who have an appointment with ID Y.