Assignment 4 - Z-Notation

Version: March 28, 2024

Prerequisites

1. The assigned reading Z-Notation

2. Video lecture/slides on Z-Notation and Operational Pattern

3. Watch the video about the old sample solution. It has similar statements.

Logic (51 points)

General Info

In this module, logic, sets, and quantifiers were discussed (the most important one for this assignment is the Z-Notation module). The specification language we use is Z.

There are different specification languages, but please make sure that you use the correct syntax for this assignment. Z is a language, and therefore, it has syntactic rules. You should follow them because otherwise, your specification will be wrong. On Canvas, I uploaded some additional material about the Z notation. I also uploaded a video where I go through an old (very) similar assignment. I advise you to watch it.

For all the following tasks

Create a Word or similar document which includes all your answers etc. for this assignment. For this and the next assignment I would advise you (you do not have to) to look into LaTeX. It is so much easier to do a specification in LaTeX than it is in Word (in my opinion). It is not difficult to set up but needs some getting used to, so I leave it up to you. In my opinion, though, it is a really good idea to learn to use LaTeX since it is (again IMHO) way better than Word, especially with larger documents that include code, math, etc. I would never write a thesis in Word again after being used to LaTeX. Most documents I created for this course are also done in LaTeX (assignments, kickoff document). I put some information on Canvas that you can use if you want to start using it.

You can also write the statements on paper (make sure they are readable) and take a picture or scan your answers. Or write it in Word, whatever you prefer, as long as it is readable and uses the correct syntax.

Given Diagram

Look at the object view provided for this assignment again. You will use it as a base for this assignment. The Domain Class model is the basis for this object view and it is

also valid for this assignment. The rules of the requirements you have still apply in this assignment.

Task 1: Understand Z-Notation (21 points - 3 each)

Answer the following questions about each of the given statements.

- What does this statement mean?

- Is this statement a set or a predicate?

- What does the statement evaluate to based on the current system state?

For E.g., if it is a set, then write what is contained in that set; if it is a predicate state, if it evaluates to true or false.

Examples:

- $\exists\, s : Student \bullet s.email = dwight@dundermifflin.com \wedge s.credit > 5$
  - Very explicit explanation: There exists a student "s" with ($\bullet$) the email dwight@dundermifflin.com and ($\wedge$) the member has more than 5 credits.

    Short version (this is what I expect from you): Predicate if there is a student with the email dwight@dundermifflin.com who has more than 5 credits.
  - predicate
  - true

- $\{a : Appointment \mid \exists\, t : Tutor \bullet t.name = Joe \wedge (t, a) \in Oversees\}$
  - Very explicit explanation: A set of Appointments for which ($\mid$) there exists a Tutor with ($\bullet$) the name Joe who oversees them.

    Short version (this is what I expect from you): Set of all appointments overseen by Joe.
  - set
  - $\{Appt1162\}$

- $\{a : Appointment \mid \exists\, s : Student \bullet s.email = jim@dundermifflin.com \wedge (s, a) \in Books\}$
  - Very explicit explanation: A set of Appointment objects for which ($\mid$) there exists a student with ($\bullet$) the email jim $\bullet$ dundermifflin.com who has a link to this Appointment object.

    Short version (this is what I expect from you): Set of all of Jim's booked appointments.
  - set
  - $\{Appt8923, Appt7136\}$

Your turn:

1. $\forall\, s : Student \bullet \exists\, a : Appointment \bullet (a, s) \in Books$

2. $\{a : Appointment \mid \exists\, s : Student \bullet (a, s) \in Books\}$

3. $\{t : Tutor \mid \exists\, sub : Subject \bullet (t, sub) \in Signs\_up\_for\}$

4. $\exists\, s : Student \bullet s.credit < 3 \wedge \#\{a : Appointment \mid (s, a) \in Books\} > 1$

5. $\exists\, t : Tutor \bullet \exists\, sub : Subject \bullet sub.name = SER \wedge (t, sub) \in Signs\_up\_for \wedge \exists\, a : Appointment \bullet a.time = 12 : 00 \wedge (t, a) \in Oversees$

6. $\{s : Student \mid \exists\, a : Appointment \bullet (s, a) \in Books \wedge \exists\, t : Tutor \bullet (t, a) \in Oversees \wedge t.name = David \wedge s.credits < 5\}$

7. $\{a : Appointment \mid \exists\, t : Tutor \bullet (t, a) \in Oversees \wedge \exists\, sub : Subject \bullet (t, sub) \in Signs\_up\_for \wedge sub.name = HistoryOfEngineering \wedge \nexists\, s : Student \bullet (s, a) \in Books\}$

Task 2: Write statements in Z-Notation (30 points - 3 each)

Now you should write statements (as the ones above) in Z-Notation for the following sets or predicates.
  Specify a

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

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

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

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

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

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

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

8. Predicate that evaluates to true if student X (use X as a placeholder for the name of the student) 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?

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

10. Set of all students with the name X (use X as a place holder for the name) that are booked for an appointment with id Y (use Y as a placeholder for the id).