

## Midterm: Part Two

### Note

This is an open-book exam. You may consult any books, papers, or notes, but discussion with others is strictly forbidden.

### Problems

1. (20 %) Prove the following sequents using *Natural Deduction* (in the sequent form). You may assume  $\Gamma \vdash A \vee \neg A$  to be an axiom (the Law of Excluded Middle) if it makes the proof simpler and shorter.

(a)  $(A \rightarrow C) \vee (B \rightarrow C) \vdash A \wedge B \rightarrow C$

(b)  $\neg A \vee \neg B \vdash \neg(A \wedge B)$

2. The following program computes the square of  $n$  and stores it in  $y$ .

```
 $x := n;$   
 $y := 0;$   
while  $x > 0$  do  
     $x, y := x - 1, y + 2x - 1$   
od
```

- (a) (5%) State the correctness requirement for the program.
  - (b) (15%) Prove that the program indeed satisfies the requirement.
3. (30 %) You have been assigned to design a computerized course enrollment system for a university. Among other things, you have managed to gather the following requirements:
    - (a) A student can be uniquely identified by her student ID.
    - (b) A course can be uniquely identified by its course ID and the year and semester when it is offered.
    - (c) Two courses must not be taken by a student at the same time if they have a time conflict.

- (d) No student should take more than 25 credit hours of courses in a semester.
- (e) Some courses may have prerequisite courses, so to take the course, a student must have taken and passed the prerequisite courses.

Now the next step should be to make all the above more precise for the design by drawing a UML class diagram and adding OCL constraints (in the diagram). Please carry out this step as thoroughly as possible; make assumptions wherever necessary.