Comp 317: Semantics of Programming Languages

About the Class Test

The class test will count for 10% of your final grade. In the class test, you will be given three questions; you should answer all of them. The first question will be given to you one week before the class test, and you should prepare an answer to this question, which you will write out during the test itself. The idea is to test your ability to formulate an answer to a question that you understand, and whose answer you know, under exam conditions.

The exam paper you will be given in the test will give the previewed question and two further questions on Maude, as well as any background material that might be needed, such as a summary of the synatx and semantics of the SIMPLE programming language. You should not consult any books, papers or notes during the test.

The following will give you some idea of what the unseen questions on Maude will be like.

1. The following Maude module specifies the syntax of arithmetic expressions based on unary ('Peano') notation.

```
fmod EXP is

  sort  Exp .

  op  0 : -> Exp .
  op  succ : Exp -> Exp .
  op  _+_  : Exp Exp -> Exp .
  op  _*_  : Exp Exp -> Exp .
  op  _-_  : Exp Exp -> Exp .

endfm
```

   (a) Describe the signature of this module (i.e., since a signature is a pair (S, Σ), say what S and Σ are in this case). **[4 marks]**

   (b) Give an example of a model for the signature of this specification whose carrier set for sort `Exp` is the set $\{0, 1\}$. **[3 marks]**

   (c) Within this module, how would you declare a prefix unary minus operation? **[2 marks]**

   (d) Write a Maude module that imports both `EXP` and `INT`, and provides a semantics for `Exp`s by declaring an operation `[[_]]` that takes an `Exp` as input and returns an `Int`. Give equations to define this operation. **[5 marks]**

2. Give definitions of the following:

   (a) Signature **[3 marks]**

   (b) Σ-algebra **[4 marks]**

   (c) Term algebra **[4 marks]**