Homework 3: The Programming Language Core

Due: problems 2–5, 8, on Tuesday Feb. 27; problems 12, 17 on Thursday, Feb 29; problem 19 on March 19.

In this homework you will learn about the basics of type systems and semantics, from Schmidt's chapter 1.

All problems except for problem 19 are individual problems. Only problem 19 is a group problem. Please make a careful distinction, as it is cheating to share answers or code for individual problems.

For all Haskell programs, you must run your code with a Haskell interpreter (such as `hugs`). You must also provide evidence that your program is correct (for example, test cases). Hand in a printout of your code and your testing. Some questions just require an answer in English. Be sure to clearly label what problem each function solves with a comment.

Read Schmidt's book, chapter 1.

1. (suggested practice) Do problems 1.1, 1.2, and 2.1 on page 24 of Schmidt's book.
2. (30 points) Do problem 2.2 on page 24 of Schmidt's book. However, use Haskell notation. That is modify the Haskell version of the book's notation as discussed in class instead of just revising figures 1.1 and 1.4. See the class's newsgroup or the following file to start.

   ```
   ~leavens/WWW/ComS541/homework/corelang.lhs
   ```

   You should devise your own test cases to show that your code works.
3. (20 points) Do problem 2.3 on page 24 of Schmidt's book. As in the previous problem, use Haskell notation.
4. (30 points) Do problem 6.1 on page 25 of Schmidt's book. Be sure to do each part 2 ways (once with the given store, and once without a store). This is to be done in Schmidt's notation. Your answer can be handwritten, although you may find it easier to manipulate this kind of calculation from inside a text editor.
5. (20 points) Do problem 6.2, parts a and b on page 25 of Schmidt's book. This is to be done in Schmidt's notation. Your answer can be handwritten.
6. (20 points, extra credit) Do problem 6.2, part c on page 25 of Schmidt's book.
7. (20 points, extra credit) Do problem 6.3 on page 25 of Schmidt's book. Use Haskell notation.
8. (30 points) Do problem 6.4 on page 25 of Schmidt's book. However, use Haskell notation. For error meanings, you can either use the Haskell error primitive, or define a data type to hold the error values.
9. (80 points, extra credit) Do problem 6.5 on pages 25-26 of Schmidt's book. Use Haskell notation.
10. (50 points, extra credit) Do problem 7.2 on page 27 of Schmidt's book.
11. (40 points, extra credit) Do problem 7.3 on page 27 of Schmidt's book.
12. (30 points) Do problem 8.1 on page 25 of Schmidt's book. For this you should only use the given store, as it makes no sense to do such a calculation without it. This is to be done in Schmidt's notation. Your answer can be handwritten, although you may find it easier to manipulate this kind of calculation from inside a text editor.
13. (50 points, extra credit) Do problem 8.2 on page 27-28 of Schmidt's book.

14. (10 points, extra credit) Do problem 8.4, part a, on pages 28-29 of Schmidt's book.

15. (40 points, extra credit) Automate, in Haskell the semantics in problem 8.4 page 28 of Schmidt's book.

16. (10 points, extra credit) Do problem 8.5, part a, on page 29 of Schmidt's book.

17. (15 points) Do problem 8.6, parts a-c, on pages 29-30 of Schmidt's book.

18. (35 points, extra credit) Do problem 8.6, part d, on pages 29-30 of Schmidt's book.

19. (75 points) This is a group problem. Select one of the alternatives of problem 9.2 of Schmidt's book, on page 30, and work the problem for that alternative. Do this both on paper, in Schmidt's notation, and also in Haskell. Test your Haskell code.