

CSCI 431: *Programming Languages*  
*Final Exam -- open book section*

The entire exam is to be turned in at 5:35 PM. Turn in the closed book section before you consult your books and notes to work on the open book section.

**Problem 1. (6 points)**

C, Pascal, and Ada all have different ways of enclosing groups of statements, such as the body of a for-loop. What are the three different approaches? Judge the three approaches according to two of the language evaluation criteria given in the first chapter of the book.

**Problem 2. (6 points)**

Design a BNF specification for describing legal file names in Unix. For the non-gurus, here are some example Unix file names:

```
/usr/users/toad/the.wet.sprocket  
indigo.girls  
k.d.Lang/Ingenu
```

Don't worry about weird characters in file names. Handling letters, periods, and slashes is good enough.

**Problem 3. (6 points)**

Describe, in English, the language generated by the following grammar:

```
S <- SX |  
X <- bXa | Xa |
```

**Problem 4. (6 points)**

Is the grammar described in Problem 3 ambiguous? Justify your answer.

**Problem 5. (6 points)**

Show how you declare an array of 50 integers in C, Pascal, Ada, and FORTRAN.

**Problem 6. (6 points)**

Compute the following weakest preconditions

```
wp( `B := A + 13", { B = 37 } )
```

```
wp( `X := 5; Y := X * Z", { Y = 100 } )
```

```
wp( `if X < 11 then Y := X + 3 else Y := X - 3", { Y = 10 } )
```

```
wp( `if X = Y then Y := X + 1", { X = Y } );
```

**Problem 7. (6 points)**

Return to our favorite abstract data type, that stack. Modify the Ada abstract data type given on pages 386 and 387 of the textbook by adding a new function `PUSHES` which returns the number of items that have been pushed on the stack since its creation. This is not the same operation as last midterm's `SIZE`! `SIZE` keeps up with the number that have been `PUSH`'ed and not `POP`'ed. `PUSHES` keeps up the number that have `PUSH`'ed.

**Problem 8. (6 points)**

Now modify the C++ abstract data type given on pages 391 and 392 of the textbook by adding a new function `PUSHES` which returns the number of items that have been pushed on the stack since its creation.

**Problem 9. (6 points)**

Look at the Ada task, `BUF_TASK`, show on page 426 of the textbook. Write a single task `P5` that does nothing other than insert the value 5 once into the queue of integers.

**Problem 10. (6 points)**

Suppose you written a difficult math function in C named `m` that is called with three `float` parameters, as in `m(x, y, z)`. Show how you can create two Pthreads to simultaneously compute `m(5.0, 6.0, 7.0)` and `m(10.0, 11.0, 12.0)`.