Programming Languages G22.2110 Summer 2007 hw06

Assigned Th 6/29/2007, due Th 7/5/2007 at 1pm.

How to Submit Homework Assignments

Email your answers, in either plain text format or as pdf, to `Abhijit Guria <guria@cs.nyu.edu>`. Assignments are due on Wednesdays at 1pm. This deadline will be strictly enforced.

Reading Assignments

- For lecture on 6/28/2007: Scott 7.1.0-7.1.3, 7.2.0-7.2.2;
  Wheeler 1-6, 8-9 (http://www.adahome.com/Tutorials/Lovelace/master.htm)
- For lecture on 7/5/2007: Scott 9.1, 9.4.3;
  Sections from Java tutorial (http://java.sun.com/docs/books/tutorial/java/TOC.html) about Classes, Objects, More on Classes, Interfaces, Inheritance, Strings, Packages

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Homework Assignments

1. Structural equivalence ($16 = 4 + 4 + 4 + 4$ points)
   Consider the following definition of structural equivalence:

   > Two types T_1 and T_2 are equivalent if they allow the same sequence of field selections, array subscripts, and pointer dereferences to be applied, and if a sequence of such operations applied on type T_1 and ending in a primitive type always ends in the same primitive type when applied to type T_2.

   1a. (4 points) Are `struct A` and struct B structurally equivalent? Explain briefly.

   ```
   struct A { double d; struct A* pa; };
   struct B { double d; struct B* pb; };
   ```

   1b. (4 points) Are `struct C` and `struct D` structurally equivalent? Explain briefly.

   ```
   struct C { struct C* p; int i[5]; };
   struct D { struct D* p; int i[5]; };
   ```

   1c. (4 points) Are `struct E` and `struct F` structurally equivalent? Explain briefly.

```
struct E { struct C* q; struct F* r; };
struct F { struct D* q; struct E* r; };
```

1d. (4 points) Are `struct G` and `struct H` structurally equivalent? Explain briefly.

```
struct G { struct A a; };
struct H { struct A a; };
```

2. Ada ($8 = 0 + 2 + 3 + 3$ points)
The code at the following URLs defines an Ada package `Int_Stacks` and a driver for it:
http://www.cs.nyu.edu/courses/summer07/G22.2110-001/hw06-ada-driv.txt
http://www.cs.nyu.edu/courses/summer07/G22.2110-001/hw06-ada-spec.txt
http://www.cs.nyu.edu/courses/summer07/G22.2110-001/hw06-ada-body.txt

   2a. (0 points) Download the files, and rename them to `driver.adb`, `int_stacks.ads`, and `int_stacks.adb`, respectively. Compile and run the program, and test it with some inputs.

   2b. (2 points) The "`with`" clause of the `Int_Stacks` module body imports a system library. What is the URL for this library in the Ada RM?

   2c. (3 points) Remove the "`use Ada.Text_IO`" clause from the driver, then change the code until it compiles and runs again without that clause. What did you need to change?

   2d. (3 points) What would happen if the programmer forgot the line `Free_Int_Array(S.Data);` in the implementation of `Push`?

3. Ada ($6 = 3 + 3$ points)
While you write the Ada code for answering Question 4 below, you will probably get some error messages. Describe two error messages using the following format:

   – Code: *a very short piece of code that triggers the error*
   – Symptom: *the error message itself*
   – Cause: *an explanation for what triggered the error message*
   – Solution: *how to fix the code to prevent the error*

4. Ada ($20 = 5 + 5 + 5 + 5$ points)
Write Ada-95 programs exercising the fundamental features.

   4a. I/O (5 points)
   Write a program that prompts the user for his or her name, reads the name from input, then politely greets the user by name. You can assume that the user response does not exceed 100 characters. Here is an example interactive session:

```
What is your name?
Bob
Hello, Bob, nice to meet you!
```

   4b. Libraries (5 points)
   Write a program that uses Ada-95 library functions to compute $\sqrt{2}$, $\sin(3.5)$, and $e^{2.5}$, and then prints the results like this (don't worry if the numbers are displayed in a slightly different format):

```
square root of 2.0:     1.41421E+00
sine of 3.5:           -3.50783E-01
e to the power of 2.5:  1.21825E+01
```

4c. Types (5 points)
The following code creates a variable `C` with the character value `'Z'`, and then prints a description and the value of the variable:

```
C : Character := 'Z';
Put_Line("name C, type Character, value " & Character'Image(C));
```

Extend this program by creating and printing more variables of different types. Your program should produce the following output:

```
name C, type Character, value 'Z'
name F, type Float, value  3.14100E+00
name I, type Integer, value  42
name IA, type array of Integer, value ( 1,  4,  9,  16)
name S, type String, value hello
```

4d. Control flow (5 points)
Write an Ada function `CountOccurrences` that takes two parameters, a string and a character, and returns the number of occurrences of the character in the string. For example, `CountOccurrences("hello", 'l')` should return `2`.

5. Java (0 points)
Start teaching yourself Java by doing the following:

5a. If possible, find peers (other students who want to learn Java together with you) and gurus (people who already know Java, whom you can ask questions when you get stuck).

5b. Make sure you have access to a Java 1.5 compiler (javac) and virtual machine (java). These and other tools come bundled in a JDK (Java developer kit) for J2SE (Java 2 standard edition) from vendors like Sun, IBM, or BEA. Ask your guru if you are having problems with this step.

5c. Go to http://java.sun.com/docs/books/tutorial/java/TOC.html and read at least the following sections: Classes, Objects, More on Classes, Interfaces, Inheritance, Strings, Packages. Along the way, try things out with the Java compiler and virtual machine from Step 5b. You might want to skim earlier sections as needed. You do not need to read the following sections: Nested Classes, Enum Types, Annotations, Numbers, Characters, Generics.

5d. Familiarize yourself with the structure of the online Java documentation, so you can find information quickly when you need it. In particular, find the URLs for the Java Language Specification and the J2SE API specification.

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http://www.cs.nyu.edu/courses/summer07/G22.2110-001/hw06.pdf
Total points: 50.