

Programming Languages G22.2110 Summer 2007 hw04

Assigned Th 6/7/2007, due We 6/13/2007 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. Please attach your answer to Question 1 as a separate file `main.scm` to your email to Abhijit Guria.

Reading Assignments

- For lecture on 6/7/2007: Scott 3.2, 3.3.0-3.3.3, 3.3.6
 - For lecture on 6/14/2007: Scott 7.7.0-7.7.1;
Drexel 1-10 (http://einstein.drexel.edu/courses/CompPhys/General/C_basics/)
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Homework Assignments

1. Scheme (15 = 5 + 5 + 5 points)
Practice your Scheme skills by writing some more code. You should write your entire Scheme code in just one file `main.scm`. Even if you initially develop your code using DrScheme, please make sure your code works with the `guile` interpreter installed on `access.cims.nyu.edu`. Please provide the file `main.scm` as a separate attachment to your email to Abhijit Guria when you submit hw04.
 - 1a. (5 points) Write a function `list-min` that takes one argument, a list `ls`, and returns the smallest number in that list. For example:

```
(list-min '(1 2 3 2)) ⇒ 1  
(list-min '(4 2 3 2)) ⇒ 2  
(list-min '()) ⇒ undefined / error
```

1b. (5 points) Write a function `remove-first` that takes two arguments, a number `n` and a list `ls`, and returns a version of the list with the first occurrence of `n` removed. For example:

```
(remove-first 3 '(1 2 3 2)) => (1 2 2)
(remove-first 2 '(1 2 3 2)) => (1 3 2)
(remove-first 4 '(1 2 3 2)) => (1 2 3 2)
```

1c. (5 points) Use your solutions from 1a and 1b to write a function `list-sort` that takes one argument, a list `ls`, and returns a version of the list that is sorted in non-descending order. For example:

```
(list-sort '()) => ()
(list-sort '(2 1)) => (1 2)
(list-sort '(1 2 3 2)) => (1 2 2 3)
```

2. Scoping (10 = 3 + 7 points)

Consider the following Python program:

```
a, b = 1, 2
def f():
    global b
    a, b = 3, 4
f()
print "a==%d, b==%d" % (a, b)
```

2a. (3 points) What does this program print?

2b. (7 points) Show the call stack just before `f()` returns. Your answer should extend the table below by filling in the values for `a` and `b` in `main`, and by adding another activation record for `f` with the appropriate variables and static and dynamic link.

addr	routine	variable	value
96	main	a	<i>fill in value</i>
97		b	<i>fill in value</i>
98		static link	-
99		dynamic link	-

3. First-class and higher-order functions (15 points)

Consider the following Scheme function:

```
(define (f-comp f g) (lambda (x) (g (f x))))
```

Show how Scheme evaluates the expression `((f-comp - (lambda (n) (+ n 1))) 42)` by rewriting (you should end up with 5 rewrite steps).

4. Scoping (10 = 3 + 7 points)
Consider the following Python program:

```
i = 1
def p():
    def q():
        print i
    def r():
        i = 3
        q()
    i = 2
    r()
p()
```

- 4a. (3 points) What does this program print?
- 4b. (7 points) Show the frames on the stack when `q()` has been called. Your answer should be a table with the same columns `addr` `routine` `variable` `value` as in Question 2.
5. C (0 points)
Start teaching yourself C by doing the following. (If you already know C, you can skip Step 5a, but please do Steps 5b-5d, and please offer your help to anyone who needs a “guru” for Step 5a.)
- 5a. Find peers (other students who want to learn C together with you) and gurus (people who already know C, whom you can ask questions when you get stuck).
- 5b. Make sure you have access to `gcc` (the GNU C compiler), and that you can compile and run programs. It should be installed on any Linux or Unix machine. Alternatively, you can install it on Windows with Cygwin, or on Mac OS X with the developer CD.
- 5c. Read the first 10 sections of the C tutorial (see reading assignment above). Along the way, try things out with `gcc`.
- 5d. Find an online version of the C standard library, and familiarize yourself with its organization. Unfortunately, the C language definition is not available online; if you are unfamiliar with C, I recommend you buy and read “The C Programming Language” (2nd edition) by Kernighan and Ritchie.

<http://www.cs.nyu.edu/courses/summer07/G22.2110-001/hw04.pdf>

Total points: 50.