$Id: cmps112-2008q1-exam2.mm,v 8.53 2008-05-02 13:16:28-07 - - $

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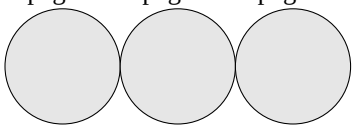

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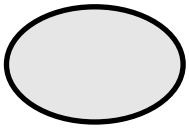

Please PRINT using keyboard letters :

Name :
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No books ; No calculator ; No computer ; No email ; No internet ; No notes ; No phone. Neatness counts ! Do your scratch work elsewhere and enter only your final answer into the spaces provided.

1. Using Scheme, define the function of one argument which produces Fibonacci numbers. Obviously you can't use a loop. Make your function tail recursive and run in $O(n)$ time. If needed, you may define an auxiliary function. To remind you, the mathematical definition is given here. **[2✔]**

   $F(0) = 0$

   $F(1) = 1$

   $F(n) = F(n-1) + F(n-2)$

   ```
   > (fib 8)
   21
   ```

2. Define the function **grep** in Scheme. Do not use any higher-order function inside it. Its first argument is a function of one argument which returns a boolean value. Its second argument is a list. Its result is a list containing all elements of its second argument for which the first argument returns true. **[2✔]**

   ```
   > (grep integer? '(1 (sqrt -1) 3.14 "foo" 'bar 10 ()))
   (1 10)
   ```

3. In C++, write a **typedef** that will define a **map** whose keys are **string**s and whose values are **int**s. Then write a loop that uses an **iterator** to print out each key and value pair, one pair per line. **[2✔]**

4. Using C++, give an example of operator or function **overriding**. **[2✔]**

5. What is the difference between structural and name equivalence of data types ? **[2✔]**

6. Name and describe two kinds of parameter passing. Using C++, give an example of each. **[2✔]**

7. Define the function **foldl** in Scheme. Its arguments are : a function to be applied between successive elements of the list, an unit element, and a list conforming to the requirements of the function and the unit. **[2✔]**

```
> (foldl + 0 '(1 2 3 4))
10
> (foldl (lambda (a b)
  (if (< a b) a b)) 0 '(-5 8 4 9))
-5
> (foldl (lambda (a b)
  (if (> a b) a b)) 0 '(-5 8 4 9))
9
> (foldl cons 0 '(1 2 3 4))
((((0 . 1) . 2) . 3) . 4)
```

8. Write a program in Perl which reads words and keeps track of their lengths. At end of file, print out a table of two columns, with each line consisting of the length of a word and the number of words of that length. Use **<>** to read lines. A word is any sequence of characters that matches the regex **m/\w+/**. The example output shows that for this input, there is 1 word of length 1, 4 words of length 3, and 3 words of length 5. **[2✔]**

example input	example output
foo bar baz x	1 1 3 4 5 3
hello world	
qux quuux	

9. Write code in either Java or C++ which shows how to declare an exception class. Define two functions, **f** and **g**, where **f** calls **g**, which throws that exception just defined, and **f** catches it and prints a message. **[2✔]**

10. Code a function which accepts two lists of integers sorted into ascending order, merges them, and returns a single list of integers also sorted into ascending order. Answer one or the other of the following two questions, ***but not both*** : **[2✔]**
    (a) Code in Scheme. **(define (merge list1 list2)** ...
    (b) Code in Perl, representing the lists as array references. **sub merge($$) { my ($aref1, $aref2) = @_;** ...

Multiple choice. To the ***left*** of each question, write the letter that indicates your answer. Write '***Z***' if you don't want to risk a wrong answer. Wrong answers are worth negative points. **[11✔]**

number of correct answers		× 1 =	= a
number of wrong answers		× ½ =	= b
number of missing answers		× 0 =	0
column total $c = \max(a - b, 0)$	11		= c

1. Which expression will produce the list `(3 4)`?
   (A) `(caar '(1 2 3 4))`
   (B) `(cadr '(1 2 3 4))`
   (C) `(cdar '(1 2 3 4))`
   (D) `(cddr '(1 2 3 4))`

2. Given the declarations in C++:
   `void foo (int a, int b);`
   `void foo (double a, double b);` Which statement will cause an overloading ambiguity?
   (A) `foo ('a', 'b');`
   (B) `foo (3, 4);`
   (C) `foo (3, 4.5);`
   (D) `foo (3.3, 4.4);`

3. In C and C++, which is an operator that uses lazy evaluation?
   (A) `&&`
   (B) `**`
   (C) `++`
   (D) `<<`

4. What is the proper way to define the C++ `operator=` for class `foo`?
   (A) `foo &operator= (const foo &);`
   (B) `foo &operator= (const foo);`
   (C) `foo operator= (const foo &);`
   (D) `foo operator= (const foo);`

5. Perl and Scheme are examples of languages whose type checking is
   (A) strong and dynamic
   (B) strong and static
   (C) weak and dynamic
   (D) weak and static

6. A heap-allocated structure used to hold escaping variables in a language that allows nested functions to refer to variables in the enclosing function is called a:
   (A) closure
   (B) stack frame
   (C) static link
   (D) tail call

7. Given the definition
   `(define f (lambda (x) (lambda (y) (+ x y))))`
   what will produce `7`?
   (A) `((f 3) 4)`
   (B) `(f (3 4))`
   (C) `(f 3 4)`
   (D) `f (3, 4)`

8. In a `Makefile` recipe, what `gmake` variable should replace the line of underscores?
```
%.o : %.cc
        ${CCC} ${CCCOPTS} ____ -c
```
   (A) `$$`
   (B) `$<`
   (C) `$@`
   (D) `${}`

9. In C++, which of the following problems are possible?
   (A) dangling pointers
   (B) memory leak
   (C) unsafe type conversions
   (D) all of the above

10. In Perl, to declare an array variable with lexical scope and allocate storage for it, what statement would be used?
    (A) `local @foo;`
    (B) `my @foo;`
    (C) `our @foo;`
    (D) `use @foo;`

11.
    (A) `awk`
    (B) `perl`
    (C) `python`
    (D) `ruby`

Total: 31 ✔