`$Id: cmps109-2013q3-exam2.mm,v 1.30 2013-08-07 20:09:43-07 - - $`

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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. If we are writing a mathematical calculator application and want to store functions like `sqrt`, `sin`, `cos`, etc. in a map, write two `typedef`s : Define `mathfn` to be a pointer to any function with a `double` argument which returns a `double` result. Define `mathmap` to be a map whose keys are `string`s and whose values are `mathfn`s. **[1✔]**

2. Write a function `sum` that takes a `vector<int>` and returns the sum of all the integers in the vector. **[1✔]**

3. Assume we have the declaration `map<string,size_t> freq;` which has words found in a document as keys and the counts of the number of times each word appears. Write a function which will print out the 100 most frequently-used words in descending order of frequency. If any words appear with the same frequency, print them in lexicographical order. This is done in several steps.

   (a) Write two `typedefs`, defining a `wordmap` as the type given above, and a `wordpair` as the type of the `value_type` of that map. **[1✔]**

   (b) Write a function called `precedes` which takes two `wordpair` values by constant reference and returns true if the first one should precede the second. If the counts are different, the larger count precedes. If the counts are the same, the lexicographically least word precedes. **[2✔]**

   (c) Write the function `printmap`, which returns `void`, whose argument is map of the type described above.

      (i) Declare a vector capable of holding all map elements. Use an iterator to copy all of the elements of the map into a vector. **[2✔]**

      (ii) Sort the vector using the `sort` function, whose arguments are a beginning iterator, an ending iterator, and a function which returns true when its first argument should precede its second. Example : `sort(b,e,f)` will sort the range `[b,e)` using the function `f` as a comparator. **[1✔]**

      (iii) Print out the first 100 elements of the vector, or all the vector if there are fewer than 100 elements. Each line of output is a field of width 10 with the count, then a space, then the word. The manipulator `setw(10)` will set the next field to be printed using 10 characters. Example : `cout<<setw(10)<<n` works like `printf("%10d",n)`. **[2✔]**

4. Define the class `shape`. Define `circle` and `rectangle` which inherit from shape. ***Code all methods inline.***

   (a) Define the class `shape`, as a base class for the others, giving its methods the appropriate protection classification, and making them pure virtual as appropriate. Make sure `objects` can not be copied. ***Code all methods inline.*** **[2✔]**

   (b) Define the class `circle`, inheriting from `shape`. It has a field `radius`. Its explicit constructor takes one argument with a default value of 0. It has a method `area`, which returns its area , and a method `boundary`, which returns its circumference. The math library in C++ defines `M_PI` with the appropriate value. Reminder (for those who failed algebra) : $A = \pi r^2$ and $C = 2\pi r$. ***Code all methods inline.*** **[2✔]**

   (c) Define the class `rectangle`, with fields `width` and `height`. Its explicit constructor takes two arguments, width and height, in that order. Both have default values of 0. It also has the methods `area` and `boundary`. ***Code all methods inline.*** **[2✔]**

5. Write a function to merge two vectors of integers into a single vector of integers, which is then returned. Assume both input vectors are sorted into increasing order and make sure the output vector is sorted in the same way. Use iterators. Scan both vectors, copying elements to the output vector, until all elements of one vector is exhausted. Then write two loops following that which will copy the remainder of the unscanned elements to the output vector. **[4✔]**

```
vector<int> merge (const vector<int> v1, const vector<int> v2) {
```

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. **[12✓]**

number of correct answers		× 1 =	= a
number of wrong answers		× ½ =	= b
number of missing answers		× 0 =	0
column total $c = \max(a - b, 0)$	12		= c

1. Suppose we have the declarations
   `vector<shared_ptr<string>> vec;`
   `auto i = vec.cbegin();`
   What statement will print a string in the vector ?
   (A) `cout << i;`
   (B) `cout << *i;`
   (C) `cout << **i;`
   (D) `cout << ***i;`

2. If we wish to put pointers to nodes in several containers, where a node may be pointed at from several containers, the safest way to do this is to use what kind of container elements ?
   (A) `auto_ptr<node>`
   (B) `node*`
   (C) `shared_ptr<node>`
   (D) `unique_ptr<node>`

3. A protected field of class `foo` in C++ may be used in :
   (A) class `foo` and all classes in the same namespace as `foo`.
   (B) class `foo` and all of its subclases.
   (C) class `foo` and all of its superclasses.
   (D) class `foo` and any class that names `foo` as a friend.

4. By default, members of a class are __(x)__, and members of a struct are __(y)__.
   (A) (x) = private and (y) = private
   (B) (x) = private and (y) = public
   (C) (x) = public and (y) = private
   (D) (x) = public and (y) = public

5. What is the signature of a move constructor for class `foo` ?
   (A) `foo (const foo &&);`
   (B) `foo (const foo &);`
   (C) `foo (foo &&);`
   (D) `foo (foo &);`

6. Given the following definitions, which statement will compile without error, and will not lose information ?
   `class B {};`
   `class D: public B {};`
   `B *b; D *d;`
   (A) `*b = *d;`
   (B) `*d = *b;`
   (C) `b = d;`
   (D) `d = b;`

7. What statement will create one vector with 10 elements in it ?
   (A) `new vector->int (10)`
   (B) `new vector::int [10]`
   (C) `new vector<int> (10)`
   (D) `new vector<int> [10]`

8. If `i` is an integer, and `p` is a pointer or direct-access iterator, which of the following is illegal ?
   (A) `i + i`
   (B) `i + p`
   (C) `p + i`
   (D) `p + p`

9. In a `Makefile`, what symbol is used to fill in the blank ?
```
%.o : %.cpp
        ${COMPILECPP} -c __
```
   (A) `$$`
   (B) `$<`
   (C) `$?`
   (D) `$@`

10. If a class has any virtual functions, then what else must be declared virtual ?
    (A) all constructors
    (B) all non-constant fields
    (C) all other function members
    (D) the destructor

11. If we have a function `foo f()` whose last statement returns a locally constructed `foo` object, and it is called from the statement `h = f()`, what member of `foo` is used at the return statement ?
    (A) `foo &operator= (const foo &);`
    (B) `foo &operator= (foo &&);`
    (C) `foo (const foo &);`
    (D) `foo (foo &&);`

12. What do the following statements do ?
    `x = 3, 14; y = (3, 14);`
    (A) `x = 14; y = 14;`
    (B) `x = 14; y = 3;`
    (C) `x = 3; y = 14;`
    (D) `x = 3; y = 3;`