Fall Semester 14, Dr. Punch. Exam #3 (12/10), form 3 A

Last name (printed): ________________________________

First name (printed): ________________________________

Directions:

a) **DO NOT OPEN YOUR EXAM BOOKLET UNTIL YOU HAVE BEEN TOLD TO BEGIN.**

b) You have 120 minutes to complete the exam (7:45-9:45)

c) This exam booklet contains 40 multiple choice questions, each weighted equally (5 points). **7 double-sided pages in total**

d) You may use one 8.5" x 11" note sheet during the exam. No other reference materials or calculating devices may be used during the examination.

e) Questions will not be interpreted during the examination.

f) You should choose the single best alternative for each question, even if you believe that a question is ambiguous or contains a typographic error.

g) Please fill in the requested information at the top of this exam booklet.

h) Use a #2 pencil to encode any information on the OMR form.

i) Please encode the following on the OMR form:
   - Last name and first initial
   - MSU PID
   - Exam form (see the title of this page)

j) Please sign the OMR form.

k) Only answers recorded on your OMR form will be counted for credit.

l) Completely erase any responses on the OMR form that you wish to delete.

m) You must turn in this exam booklet and the OMR form when you have completed the exam. When leaving, please be courteous to those still taking the exam.

Good luck.

**Timing tip.** A rate of 2.75 minutes per multiple choice problem leaves 10 minutes to go over any parts of the exam you might have skipped.
1) For the program in Figure 1, what output is given by Line 1?
   a) 0
   b) 1
   c) 2
   d) 1234
   e) None of the above.
2) For the program in Figure 1, what output is given by Line 2?
   a) 0
   b) 1
   c) 2
   d) 1234
   e) None of the above.
3) For the program in Figure 1, what output is given by Line 3?
   a) 0
   b) 1
   c) 2
   d) 1234
   e) None of the above.
4) For the program in Figure 1, what output is given by Line 4?
   a) 2
   b) 4
   c) 8
   d) 10
   e) None of the above.

5) For the program in Figure 1, what output is given by Line 5?
   a) 2
   b) 4
   c) 8
   d) 10
   e) None of the above.
6) Which Big-Oh notation below represents the "slowest" algorithm?
   a) $O(n^2)$
   b) $O(\log(n))$
   c) $O(n \cdot \log(n))$
   d) $O(n^n)$
   e) None of the above

7) Which of the following is true about the C++ container `map`?
   a) requires two types to declare the container
   b) can modify the key of a map once it is set
   c) iteration through a map yields the key each time
   d) All of the above
   e) None of the above

8) Which of the following is true about C++ iterators?
   a) act as pointers to a container value
   b) are required to use generic algorithms such as `sort` or `accumulate`
   c) are typed specifically to the container they are used with.
   d) All of the above
   e) None of the above

9) Which of the following are true about a basic array data structure (not the C++ array)?
   a) It's size can change during the course of execution.
   b) Cannot be used with generic algorithms under any circumstances.
   c) Its first element is always at index 1.
   d) All of the above.
   e) None of the above

10) Which of the following is an advantage of a single linked list data structure?
    a) can change its size during execution
    b) is efficient at inserting an element at a particular position
    c) uses pointers to track the next element in the list
    d) All of the above
    e) None of the above

11) What is the rule of three mean when you are defining a new class?
    a) If you need to define a destructor, you also need operator= and a constructor.
    b) If you define the default constructor, you need to define two more constructors.
    c) You should not define more than three private variables for efficiency.
    d) All of the above
    e) None of the above

12) What is (approximately) the largest value a 4 byte `unsigned int` can hold?
    a) 2 billion
    b) 4 billion.
    c) 1 million
    d) 32 million
    e) None of the above
13) For the program in Figure 2, what type is yielded by `d1.begin()` on Line 1?
   a) long&
   b) long
   c) vector<long>
   d) int
   e) None of the above

14) For the program in Figure 2, what value is output on Line 2?
   a) 220
   b) 210
   c) 2
   d) 1
   e) None of the above
15) For the program in Figure 2, what value is output on Line 3?
   a) 1
   b) 2
   c) 3
   d) 4
   e) None of the above

16) For the program in Figure 2, what value is output on Line 4.
   a) 1
   b) 2
   c) 3
   d) 4
   e) None of the above

17) For the program in Figure 2, what value is output on Line 5.
   a) 10
   b) 20
   c) 30
   d) 40
   e) None of the above

18) For the program in Figure 2, what value is output on Line 6.
   a) 1
   b) 2
   c) 3
   d) 4
   e) None of the above
```cpp
#include<iostream>
using std::cout; using std::endl;
#include<string>
using std::string;
#include<map>
using std::map;
#include<fstream>
using std::ifstream;

int f1(ifstream &f, map<string, string> &m){
    string s, temp;
    long c = 0;
    while(f>>s){
        temp = s;
        sort(temp.begin(), temp.end());
        m[temp] = s;
        c++;
    }
    return c;
}

int f2(map<string, string> &m, string s){
    long c = 0;
    for (auto e : m){
        if (e.first < s){
            m[e.first] = e.first + e.second;
            c++;
        }
    }
    return c;
}

int main(){
    ifstream f("input.txt");
    map<string,string> m;
    cout << f1(f,m) << endl;   // Line 1
    cout << m.size() << endl;  // Line 2
    cout << f2(m, "carl") << endl; // Line 3

    if (m.count("bill") != 0)   // Line 4
        cout << m["bill"] << endl;
    else
        cout << "nope" << endl;

    if (m.count("fred") != 0)   // Line 5
        cout << m["fred"] << endl;
    else
        cout << "nope" << endl;
}
```

Figure 3
19) For the program in Figure 3, what output is produced by Line 1?
   a) 1
   b) 2
   c) 3
   d) 4
   e) None of the above

20) For the program in Figure 3, what output is produced by Line 2?
   a) 1
   b) 2
   c) 3
   d) 4
   e) None of the above

21) For the program in Figure 3, what output is produced by Line 3?
   a) 1
   b) 2
   c) 3
   d) 4
   e) None of the above

22) For the program in Figure 3, what output is produced by the if statement on Line 4?
   a) nope
   b) llib
   c) illb
   d) bill
   e) None of the above

23) For the program in Figure 3, what output is produced by the if statement on Line 5?
   a) nope
   b) edfr
   c) redf
   d) fred
   e) None of the above
24) For the program in Figure 4, what type is \( i \) on Line 1?  
   a) `array::iterator`  
   b) `long*`  
   c) `long`  
   d) `int`  
   e) None of the above

25) For the program in Figure 4, what output is produced by Line 2?  
   a) 0  
   b) 1  
   c) 32  
   d) 64  
   e) None of the above

26) For the program in Figure 4, what output is produced by Line 3?  
   a) 0  
   b) 1  
   c) 32  
   d) 64  
   e) None of the above
27) For the program in Figure 4, what output is produced by Line 4?
   a) 0
   b) 1
   c) 32
   d) 64
   e) None of the above

28) For the program in Figure 4, what output is produced by Line 5?
   a) 0
   b) 1
   c) 32
   d) 64
   e) None of the above
```cpp
#include <iostream>
using std::cout; using std::endl; using std::ostream;
#include <string>
using std::string;

class MyClass{
private:
    string s_; // private data
    long l_;     // private data
    void m0(); // private method
public:
    MyClass(string);    // constructor
    char m1(char);      // public method
    string m2(string); // public method
    friend ostream& operator<<(ostream& out, MyClass& c) {
        out << c.s_ << "(" << c.l_ << ")";
        return out;
    }
};

void MyClass::m0(){
    for(int i=0; i<s_.size(); i++){
        if (s_[i] > s_[l_])
            l_ = i;
    }
}

MyClass::MyClass(string param_s){
    s_ = param_s;
    l_ = 0;
    m0();
}

char MyClass::m1(char param_c){
    char result = s_[l_];
    s_[l_] = param_c;
    m0();
    return result;
}

string MyClass::m2(string param_s){
    string result = s_; // Line 1
    string f = s_.substr(0, l_);
    string b = s_.substr(l_+1);
    s_ = f + param_s + b;
    m0();
    return result;
}

int main(){
    MyClass mc("xyzab");
    cout << mc << endl;  // Line 2
    cout << mc.m1('c') << endl;  // Line 3
    cout << mc << endl;  // Line 4
    cout << mc.m2("qrs") << endl;  // Line 5
    cout << mc << endl;  // Line 6
}
```

Figure 5
29) For the program in Figure 5, which of the below are equivalent to Line 1?
   a) this.m0();
   b) this::m0();
   c) this->m0();
   d) *this.m0();
   e) None of the above

30) For the program in Figure 5, what output is produced on Line 2?
   a) xyzab
   b) xyzab(0)
   c) xyzab(1)
   d) xyzab(2)
   e) None of the above

31) For the program in Figure 5, what output is produced by Line 3?
   a) c
   b) a
   c) b
   d) z
   e) None of the above

32) For the program in Figure 5, what output is produced by Line 4?
   a) xyzab
   b) xyzab(0)
   c) xyzab(1)
   d) xyzab(2)
   e) None of the above

33) For the program in Figure 5, what output is produced by Line 5?
   a) xycab
   b) xyzab
   c) xyqrszab
   d) xqrszab(0)
   e) None of the above

34) For the program in Figure 5, what output is produced by Line 6?
   a) xycab(1)
   b) xyzab(2)
   c) xqrszab(0)
   d) xqrszab(1)
   e) None of the above
// for the sake of readability, assume all the right includes are provided

template<typename T>
struct AStruct{
  T d_;
};

template<typename T>
bool f(const AStruct<T>& a, const AStruct<T>& b){
  return a.d_ > b.d_;
}

template<typename T>
class AClass{
private:
  AStruct<T> a_;
  long s_;
public:
  AClass(long, initializer_list<T> l);
  T operator[](long);
  T m1();
};

template<typename T>
AClass<T>::AClass(long s, initializer_list<T> l){
  a_ = new AStruct<T>[s];
  s_ = s;
  long cnt = 0;
  for (auto e : l){
    a_[cnt].d_ = e;
    cnt++;
  }
  sort(a_, a_+s_, f);
}

template<typename T>
T AClass<T>::operator[](long l){
  if (l >= 0 && l < s_)
    return a_[l].d_;
  else
    return T0;
}

template<typename T>
T AClass<T>::m1(){
  T temp = T0;
  long cnt = 0;
  while (cnt < s_){
    temp += a_[cnt].d_;
    cnt++;
  }
  return temp;
}

int main(){
  AClass<string> ac_s(3, {"bcd", "aab", "ghl"});
  AClass<long> ac_l(3, {100, 2000, 3});
  cout << ac_s(2) << endl;  // Line 1
  cout << ac_l(2) << endl;  // Line 2
  cout << ac_l(5) << endl;  // Line 3
  cout << ac_s.m1() << endl; // Line 4
  cout << ac_l.m1() << endl; // Line 5
}
35) For the program in Figure 6, what output is produced by Line 1?
   a) aaa
   b) bcd
   c) ghi
   d) aaabcdghi
   e) None of the above

36) For the program in Figure 6, what output is produced on Line 2?
   a) 0
   b) 2000
   c) 3
   d) 2103
   e) None of the above

37) For the program in Figure 6, what output is produced by Line 3?
   a) 0
   b) 2000
   c) 3
   d) 2103
   e) None of the above

38) For the program in Figure 6, what output is produced by Line 4?
   a) aaa
   b) bcd
   c) ghi
   d) aaabcdghi
   e) None of the above

39) For the program in Figure 6, what output is produced by Line 5?
   a) 100
   b) 2000
   c) 3
   d) 2103
   e) None of the above

40) What does the term "strongly typed" mean when referring to C++?
   a) types are powerful and should be respected
   b) every variable must have a type
   c) STL containers do not require type information
   d) only the basic types are important to C++ (the strong types).
   e) None of the above