Spring Semester 14, Dr. Punch. Exam #3 (4/29), 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) Given the input `abc123 3` what output is produced by Line 1 in Figure 1?
   a) 0  
   b) 1  
   c) 2  
   d) 3  
   e) None of the above.

2) Given the input `abc123 3` what output is produced by Line 2 in Figure 1?
   a) 0  
   b) 1  
   c) 2  
   d) 3  
   e) None of the above.

3) Given the input `abc123 3` what output is produced by Line 3 in Figure 1?
   a) a  
   b) b  
   c) c  
   d) 1  
   e) None of the above.

4) Given the input `abc123 3` what output is produced by Line 4 in Figure 1?
   a) abc123  
   b) 321bca  
   c) 123abc  
   d) 23abc1  
   e) None of the above.
5) Which Big-Oh notation below represents the "fastest" algorithm?
   a) O(n²)
   b) O(n³)
   c) O(n • log(n))
   d) O(n⁵)
   e) None of the above

6) What is the return type of a class constructor?
   a) an instance of the class
   b) void
   c) an int (the size of the class in bytes)
   d) a string (the name of the class)
   e) None of the above

7) Which of the following represent differences between a C++ class and a struct?
   a) struct cannot have associated methods
   b) only a class can have private data members
   c) there are no constructors or destructors for a struct.
   d) All of the above
   e) None of the above.

8) Which of the following are true about the special variable this?
   a) It is a pointer.
   b) You cannot change what it points to.
   c) It is bound to the calling instance of a method
   d) All of the above.
   e) None of the above

9) Which of the following is not a sequence (cannot respond to [] or .at)?
   a) vector
   b) deque
   c) list
   d) map
   e) None of the above

10) Under which of the below circumstances is a class's destructor called?
    a) When an instance goes out of scope.
    b) When delete is called on a pointer to a class instance.
    c) When the programmer manually calls the destructor.
    d) All of the above
    e) None of the above

11) Which of the following are true about basic C++ arrays?
    a) they are fixed size.
    b) they have associated methods to manipulate the underlying data.
    c) they cannot be dynamically created during runtime.
    d) All of the above
    e) None of the above
12) For the program in Figure 2, what type is element in Line 1?
   a) long&
   b) long
   c) vector<long>
   d) int
   e) None of the above

13) For the program in Figure 2, what value is output on Line 2?
   a) 0
   b) 1
   c) 2
   d) 3
   e) None of the above

14) For the program in Figure 2, what value is output on Line 3?
   a) 0
   b) 1
   c) 2
   d) 3
   e) None of the above

15) For the program in Figure 2, what value is output on Line 4.
   a) 10
   b) 9
   c) 0
   d) -1
   e) None of the above
```cpp
#include <iostream>
using std::cout; using std::endl; using std::cin;
#include <vector>
using std::vector;
#include <map>
using std::map;
#include <string>
using std::string;
#include <fstream>
using std::ifstream;
#include <sstream>
using std::stringstream;
#include <iostream>
using std::ios;

void f1(string n, map<string, vector<long>>& m, string l){
    vector<long> v;
    istringstream iss(l);
    long num;
    while(iss >> num)
        v.push_back(num);
    m[n]=v;
}

int f2(map<string, vector<long>>& m, string n){
    long result;
    for (auto element : m) { // Line 1
        if (element.first == n)
            result = accumulate(element.second.begin(),
                                 element.second.end(),
                                 0);
    
        return result;
    }

int main(){
    ifstream f_in("text.txt");
    string line, name;
    vector<long> v;
    map<string, vector<long>> my_map;
    while (f_in >> name){
        getline(f_in, line);
        f1(name, my_map, line);
    }
    cout << my_map["bill"].size() << endl; // Line 2
    cout << my_map["sammy"][0] << endl; // Line 3
    cout << my_map["fred"][0] << endl; // Line 4
    cout << f2(my_map, "bill") << endl; // Line 5
    cout << f2(my_map, "fred") << endl; // Line 6
    }
```

```
16) For the program in Figure 3, what type is element on Line 1?
   a) string
   b) long
   c) vector<long>
   d) map<string, vector<long>>
   e) None of the above

17) 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

18) For the program in Figure 3, what output is produced by Line 3?
   a) 27
   b) 32
   c) 0
   d) 59
   e) None of the above

19) For the program in Figure 3, what output is produced by Line 4?
   a) 4
   b) 5
   c) 6
   d) 7
   e) None of the above

20) For the program in Figure 3, what output is produced by Line 5?
   a) 4
   b) 5
   c) 6
   d) 7
   e) None of the above

21) For the program in Figure 3, what output is produced by Line 6?
   a) 4
   b) 5
   c) 6
   d) 7
   e) None of the above
```cpp
#include<iostream>
using std::cout; using std::endl;
#include<vector>
using std::vector;
#include<string>
using std::string; using std::to_string;
#include<sstream>
using std::ostringstream;
#include<algorithm>
using std::pair; using std::make_pair;
using std::sort;

template<typename T>
pair<T, T> f1(vector<T> &v){
    T result1 = v[0];
    T result2 = v[0];
    for(auto itr=v.begin(); itr<v.end(); itr++){
        if (*itr > result1)
            result1 = *itr;
        if (*itr < result2)
            result2 = *itr;
    }
    return make_pair(result1, result2);
}

template<typename T>
string f2(pair<T, T> p){
    ostringstream oss;
    oss << p.first << "::" << p.second;
    return oss.str();
}

template<typename T>
T f3(vector<T> &v){
    sort(v.begin(), v.end());
    int half = v.size()/2;
    return v[half];
}

int main(){
    vector<string> v_s = {"hi", "mom", "how", "are", "you", "today"};
    vector<long> v_l = {1,2,3,4,5,6,7};
    auto res1 = f1(v_s); // Line 1
    auto res2 = f1(v_l); // Line 2
    cout << f2(res1) << endl; // Line 3
    cout << f2(res2) << endl; // Line 4
    cout << f3(v_s) << endl; // Line 5
    cout << f3(v_l) << endl; // Line 6
}
```

Figure 4
22) For the program in Figure 4, what type is res1 on Line 1?
   a) pair<T, T>
   b) string
   c) long
   d) vector<string>
   e) None of the above

23) For the program in Figure 4, what value is returned by res2.first on Line 2?
   a) 7
   b) 1
   c) {1, 2, 3, 4, 5, 6, 7}
   d) 0
   e) None of the above

24) For the program in Figure 4, what output is produced by Line 3?
   a) hi:mom
   b) you:are
   c) 0:5
   d) you:today
   e) None of the above

25) For the program in Figure 4, what output is produced by Line 4?
   a) 1:2
   b) 0:7
   c) 7:1
   d) 6:7
   e) None of the above

26) For the program in Figure 4, what output is produced by Line 5?
   a) hi
   b) mom
   c) you
   d) are
   e) None of the above

27) For the program in Figure 4, what output is produced by Line 6?
   a) 1
   b) 2
   c) 3
   d) 4
   e) None of the above
```cpp
#include<iostream>
using std::cout; using std::endl; using std::ostream;
#include<string>
using std::map;

class MyClass{
    private:
        string s_; 
        map<string, long> m_; 
    public:
        MyClass() : s_(string()), m_(map<string, long>()) {};
        MyClass(string s) : s_(s), m_(map<string, long>()) {};
        void method1(string s, long l) { m_[s] = l; };
        long method2(string s) { return m_[s]; };
        double method3();
        string method4();
        friend ostream& operator<<(ostream &out, MyClass &mc);
    }

double MyClass::method3(){
    double result = 0;
    for(auto element : m_)
        result += element.second;
    return result/m_.size();
}

string MyClass::method4(){
    string s;
    long l=0;
    for(auto element : m_){
        if (element.second > l){
            s = element.first;
            l = element.second;
        }
    } 
    return s;
}

ostream& operator<<(ostream& out, MyClass &mc){
    out << mc.s_ << " : ";
    for(auto element : mc.m_)
        out << element.first << "-" << element.second << ", " ;
    return out;
}

int main() { 
    MyClass fc ("fred's class");
    fc.method1("bill", 10);
    fc.method1("sally", 20);
    fc.method1("jane", 30);
    cout << fc << endl; // Line 1
    cout << fc.method2("bill") << endl; // Line 2
    cout << fc.method3() << endl; // Line 3
    cout << fc.method4() << endl; // Line 4
}
Figure 5
```
28) For the program in Figure 5, what output is produced by Line 1?
   a) fred's class: bill-10, jane-30, sally-20,
   b) bill-10, jane-30, sally-20, 10:abc
   c) fred's class
   d) bill-10
   e) None of the above

29) For the program in Figure 5, what output is produced on Line 2?
   a) 10
   b) 20
   c) 30
   d) 0
   e) None of the above

30) For the program in Figure 5, what output is produced by Line 3?
   a) 10
   b) 20
   c) 30
   d) 0
   e) None of the above

31) For the program in Figure 5, what output is produced by Line 4?
   a) fred
   b) bill
   c) sally
   d) jane
   e) None of the above

32) For the program in Figure 5, which of the following are inlined?
   a) operator<<
   b) method2
   c) method3
   d) method4
   e) None of the above
```cpp
#include<iostream>
using std::cout; using std::endl; using std::ostream;
#include<string>
using std::string;
#include<exception>
using std::out_of_range;
#include<vector>
using std::vector;

template<typename T>
class MyClass{
private:
    T *ary_;
    int sz_;
    int indx_;
public:
    MyClass(size_t s) : sz_(s), indx_(-1) { ary_ = new T[s]; };
    ~MyClass() { delete [] ary_; };
    T method1();
    void method2();
    void method3(T val);
};

template<typename T>
T MyClass<T>::method1(){
    if (indx_ == 0)
        return ary_[ indx_ ];
    else
        throw out_of_range("empty error");
}

template<typename T>
void MyClass<T>::method2(){
    indx_--;
}

template<typename T>
void MyClass<T>::method3(T val){
    if (++indx_ < sz_)
        ary_[ indx_ ] = val;
    else
        throw out_of_range("full error");
}

int main(){
    MyClass<long> mc_l(2);
    mc_l.method3(200);
    cout << mc_l.method1() << endl; // Line 1
    mc_l.method3(100);
    mc_l.method2();
    cout << mc_l.method1() << endl; // Line 2
    mc_l.method2();

    MyClass<vector<long>> mc_v(2);
    mc_v.method3(vector<long>{1,2,3});
    cout << mc_v.method1()[1] << endl; // Line 3
    cout << mc_v.method1() << endl; // Line 4
}
```

Figure 6
33) For the program in Figure 6, what output is produced by Line 1?
   a) 100
   b) 200
   c) throws a "full error"
   d) throws an "empty error"
   e) None of the above

34) For the program in Figure 6, what output is produced on Line 2?
   a) 100
   b) 200
   c) throws a "full error"
   d) throws an "empty error"
   e) None of the above

35) For the program in Figure 6, what output is produced by Line 3?
   a) 1
   b) 2
   c) 3
   d) \{1, 2, 3\}
   e) None of the above

36) For the program in Figure 6, what output is produced by Line 4?
   a) 100
   b) 200
   c) throws a "full error"
   d) throws an "empty error"
   e) None of the above
```cpp
#include<iostream>
using std::cout; using std::endl; using std::ostream;

template<typename T>
struct MyStruct{
  public:
    T val_; 
    MyStruct<T> *p_; 
    MyStruct(T v): val_(v), p_(nullptr) {};
};

template<typename T>
class MyClass{
  private:
    MyStruct<T> *h_; 
  public:
    MyClass(T val) { h_ = new MyStruct<T>(val); } ;
    void method1(T val) ;
    void method2(T val1, T val2);
    ostream& method3(ostream&);
};

template<typename T>
void MyClass<T>::method1(T val){
  auto n = new MyStruct<T>(val);
  n->p_ = h_; 
  h_ = n;
}

template<typename T>
void MyClass<T>::method2(T val1, T val2){
  for(auto itr=h_; itr != nullptr; itr = itr -> p_)
    if (!itr->val_ == val1){
      auto n = new MyStruct<T>(val2);
      n->p_ = itr->p_; 
      itr->p_ = n;
    }
}

ostream& MyClass<T>::method3(ostream &out){
  for(auto itr=h_; itr != nullptr; itr = itr -> p_)
    out << itr->val_ << ", ";
  return out;
}

int main(){
  MyClass<long> mc(10);
  mc.method2(20);
  mc.method3(cout) << endl; // Line 1 
  mc.method1(30);
  mc.method3(cout) << endl; // Line 2 
  mc.method2(20, 40);
  mc.method3(cout) << endl; // Line 3
}
```

Figure 7
37) For the program in Figure 7, what output is produced by Line 1?
   a) 20
   b) 10
   c) 10, 20,
   d) 20, 10,
   e) None of the above
38) For the program in Figure 7, what output is produced on Line 2?
   a) 20
   b) 10
   c) 10, 20,
   d) 20, 10,
   e) None of the above
39) For the program in Figure 7, what output is produced by Line 3?
   a) 30, 40, 20, 10,
   b) 30, 20, 40, 10,
   c) 30, 20, 10, 40,
   d) 10, 20, 30, 40,
   e) None of the above
40) For the program in Figure 7, which of the following statements are correct for MyClass?
   a) There is no default constructor
   b) It leaks memory
   c) It has a copy constructor
   d) All of the above
   e) None of the above