Last Name: _____   First Name: _____

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San José State University
Computer Engineering
CMPE180-92: Final Exam Fall 2015 (1)

1.-Create a C++ function using the stack STL to evaluate a postfix expression. Assume the postfix expression is given to your program in a string vector and assume you can use the atoi() function to turn an ASCII C style string into an integer. The function must return error codes on failures or the integer result on success. Assume the only valid operations are: +, - and *. Assume you have the functions isInteger(string) and isOperator(string) to identify integers and operators. (10 points)

Function Prototype

Function Body
{

} |

Last Name: _____   First Name: _____

(-5 points if any of the above left blank on any page)

2.-Write a C++ function that takes an integer vector as an argument and doubles the value of each entry in the vector using iterators. Use the most appropriate type of iterator for the task at hand. (10 points)

Function Prototype

Function Body
```
{





















}
```

Last Name: _____   First Name: _____

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3.-You are to create two classes: one that reads and writes from a file and another that reads and writes from a memory area. The interfaces used by the classes must have the following prototypes: int read(char *buffer, unsigned int size) and int write(const char * buffer, unsigned int size). **Define an interface class** from which the two classes may inherit and be required to implement the read and write interfaces.(10 points)

Interface Class Definition
class ReadWriteInterface {
}

Last Name: _____   First Name: _____

(-5 points if any of the above left blank on any page)

4.-Write a recursive function that reverses a linked list. State the time and memory complexity of your solution. Your function must return the head of the reversed list and the list must of course be NULL terminated. (10 points)

```
Struct node { int info; struct node * next; };
Typdef struct node node_t;

Node_t * reverse_linked_list( node_t * head) {




















}
```

Time Complexity (i.e. O(?)):

Memory Complexity (i.e. O(?)):

Last Name: _____   First Name: _____

(-5 points if any of the above left blank on any page)

5.-Given the following definition of a C++ class:

```
class dummyClass
{
public:
    ...
private:
    int listLength; // # of elements in the int array
    int *list;      // an array of int
    double salary;
    string name;
}
```

Write the definition/implementation of the destructor and copy constructor for the class
dummyClass. Assume the initial size of the array is passed as an argument to the constructor
and make sure your constructor acts as a default constructor. (10 points)

Constructor	
Destructor	

Last Name: _____   First Name: _____

(-5 points if any of the above left blank on any page)

6.-Given the node in a doubly linked list as

```
struct node {
      int data;
      node* prev;
      node* next;
};
```

The data structure of each node is allocated with the `new` operator. The head of the *unordered* doubly linked list is in a global variable `head` with data type `node*`. *Without* using any existing C++ classes, implement the following self-contained C++ function to remove a single/first occurrence of an integer `val` from the doubly linked list. `bool remove(int val)` The function returns `true` if the value `val` is found and removed; else it returns `false`. (10 points)

```
bool remove(int val)
{



}
```

Last Name: _____   First Name: _____

(-5 points if any of the above left blank on any page)

```
Part II: Multiple choice. (1 point each for a total of 15 points)

1.-State which statement is true given the following declaration:
class X
{
public:
   bool GetFlag() const;
private:
   bool m_flag;
   mutable int m_accessCount;
};
```

      ☐ *a.-The member function GetFlag can't change any data member of class X because it was declared constant.*

      ☐ *b.-The member function GetFlag can change m_flag but not m_accessCount.*

      ☐ *c.-The member function GetFlag can change m_accessFlag but not m_flag.*

      ☐ *d.-The member function GetFlag can't change any of the private data members.*

2.-The following declaration in C++ indicates:

Class X {

      virtual bool foobar()=0;

}

      ☐ *a. The foobar member function must be implemented by this class.*

      ☐ *b. The foobar member function must be implemented by this class and all derived classes.*

      ☐ *c. The foobar member function must be implemented by all derived classes but not by class X.*

3.-The average time complexity to remove (i.e. removeMin on a min-heap) all elements on heap in order is:

      ☐ *a. O(n)*

      ☐ *b. O(logn)*

      ☐ *c. $O(n^2)$*

      ☐ *d. O(nlogn)*

      ☐ *e. none of the above*

4.-The number of nodes in a complete binary tree of height h is:

      ☐ *a. 2^h+1*

      ☐ *b. $O(2^h+1)$*

      ☐ *c. $O(2^h)$*

      ☐ *d. O(h)*

      ☐ *e. O(logh)*

Last Name: _____   First Name: _____

(-5 points if any of the above left blank on any page)

5.-Which of the following is false?
　　❏ *a. Time-complexity of search on a balanced binary search tree can be O(n).*
　　❏ *b. Time-complexity of inserting into a hash with linear probing can be O(n).*
　　❏ *c. Time-complexity of deleting an item from a heap is O(log n).*
　　❏ *d. The time to find the min/max on a heap is O(log n)*
　　❏ *e. None of the above*

6.-Which of the following declares `strList` *to be a STL vector with component type std::string?*
　　❏ *a.* `vector<> string strList;`
　　❏ *b.* `vector::string strList;`
　　❏ *c.* `string.vector<> strList;`
　　❏ *d.* `vector<std::string> strList;`

7.-In C++, given the declaration std::vector<int>::iterator iv_it, which expression returns the element at the first position if there is at least one element?
　　❏ *a.* `&iv_it`
　　❏ *b.* `iv_it&`
　　❏ *c.* `iv_it.begin()`
　　❏ *d.* `*iv_it`
　　❏ *e.* `*iv_it.begin()`

8.-In C++, given the declaration std::vector<int>::iterator iv_it, which expression returns the element at the current position if there is at least one element?
　　❏ *a.* `&iv_it`
　　❏ *b.* `iv_it.current()`
　　❏ *c.* `iv_it.begin()`
　　❏ *d.* `*iv_it`
　　❏ *e.* `*iv_it.begin()`

9.-Which of the following is the average time-complexity for inserting an element on a heap?
　　❏ *a. O(nlogn)*
　　❏ *b. O(n)*
　　❏ *c. O(n^2)*
　　❏ *d. O(1)*
　　❏ *e. O(logn)*

10.-Which of the following is the average time-complexity for heap sort?
　　❏ *a. O(nlogn)*
　　❏ *b. O(n)*
　　❏ *c. O(n^2)*
　　❏ *d. O(1)*
　　❏ *e. O(logn)*

Last Name: _____   First Name: _____

(-5 points if any of the above left blank on any page)

11.-If you want a data member of a class to be shared among all instances of the class, then you declared it
      ☐ *a. virtual.*
      ☐ *b. static*
      ☐ *c. volatile.*
      ☐ *d. mutable.*

12.-A static member function can access the following data members of the class
      ☐ *a. All data members including private and protected for that class.*
      ☐ *b. Only public data members for that class.*
      ☐ *c. Only static data members for that class.*
      ☐ *d. Only mutable data members for that class.*
      ☐ *e. Only non-constant members of that class.*

13.-Proper operations for a queue do not include which of the following operation?
      ☐ *a. return the front element*
      ☐ *b. return any element*
      ☐ *c. remove the front element*
      ☐ *d. add an element to the back*

14.-Proper operations for a stack do not include which of the following operation?
      ☐ *a. push*
      ☐ *b. pop*
      ☐ *c. top*
      ☐ *d. get the n-th element*

15.-Which of the following is false?
      ☐ a. Time-complexity of searching an item through an unordered linked list is O(n).
      ☐ b. Time-complexity of inserting an item into an ordered linked list is O(n).
      ☐ c. Time-complexity of deleting an item from an unordered doubly linked list is O(n).
      ☐ d. The algorithms to implement the search, insert, and remove operations are the same for sorted and unsorted lists.
      ☐ e. C++ allows a user to pass an object of a derived class to a formal parameter of the base class.

Last Name: _____   First Name: _____

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Part III: Short problems

(6 pts) 1. Suppose there are five workers, in a shop, with IDs 167, 227, 657, 109, and 150.
Suppose hash table, HT, is of the size 7, indexed 0, 1, 2, . . ., 6. By using the notation "*HT*[*b*]←*a*",
which means "store the data of the worker with ID *a* into *HT*[*b*]," show how these workers' IDs,
in the order given, are inserted in HT using the hashing function h(k) = k % 7. Use linear probing
to resolve collision. (Note: % is the mod operator which returns the remainder of division.)
Fill in the "b" value of "*HT*[*b*]←*a*" in each cell and show the steps of how you derive the answer.

HT[ ]←167	*HT*[ ]← 227	*HT*[ ]← 657	*HT*[ ]← 109	*HT*[ ]←150

(6 pts) 2. Given

```
struct nodeType
{
  int info;
  nodeType *link;
};
nodeType *ptr,
*list;
```

What is the console
output produced by
each of the following
C++ code?

a.	b.

```list = new nodeType;```
```list->info = 10;```
```ptr = new nodeType;```
```ptr->info = 13;```
```ptr->link = NULL;```
```list->link = ptr;```
```ptr = new nodeType;```
```ptr->info = 18;```
```ptr->link = list->link;```
```list->link = ptr;```
```cout << list->info << " ";```
```cout << ptr->info;```
```ptr = ptr->link;```
```cout << " " << ptr->info;```
	```list = new nodeType;```
	```list->info = 20;```
	```ptr = new nodeType;```
	```ptr->info = 28;```
	```ptr->link = NULL;```
	```list->link = ptr;```
	```ptr = new nodeType;```
	```ptr->info = 30;```
	```ptr->link = list;```
	```list = ptr;```
	```ptr = new nodeType;```
	```ptr->info = 42;```
	```ptr->link = list->link;```
	```list->link = ptr;```
	```ptr = list;```
	```while (ptr != NULL)```
	```{ cout << ptr->info << " ";```
	``` ptr = ptr->link;```
	```};```

a.	b.

(6 pts) 3. Convert the following infix expressions to postfix notations:

a. A − (B + C) * D + E / (F − G)	b. A + B * (C + D) − E / F * G + H

a.	b.

(-5 points if any of the above left blank on any page)

(7 pts) 4. Given the following program, what is the output on the console?

```
class X
{public:
  X()  { cout << "Constructing X\n"; }
  ~X() { cout << "Destroying X\n"; }
};
class Base
{public:
  Base() { cout << "Constructing
Base\n"; }
  ~Base(){ cout << "Destroying Base\n"; }
  virtual void pr() {cout <<
"Base::pr\n"; }
  X obj;
};
class Derive : public Base
{public:
  Derive() { cout << "Constructing
Derive\n"; }
  ~Derive(){ cout << "Destroying
Derive\n"; }
  void pr() { cout << "Derive::pr\n";  }
  X *obj;
};
void main() {
  Base *basePtr = new Derive();
  basePtr->pr();
  delete basePtr;
};
```

Last Name: _____   First Name: _____

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FINAL EXAM INSTRUCTIONS: MUST READ THIS PAGE BEFORE ANSWERING ANY QUESTION

1. You must use pencil and eraser for this exam, if you use pen and don't have an eraser you will not be able to change or update any answer and only what you write in the space provided will count towards your grade.
2. No extra pages will be graded so be careful to fit your answer in the space provided. Anything out of the boxes provided will be disregarded.
3. TURN OFF YOUR PHONE AND DO NOT USE CALCULATOR, USE OF ANY OF THESE DEVICES WILL BE CONSIDERED CHEATING AND YOU WILL BE DISMISSED FROM THE EVALUATION WITH ZERO IN YOUR FINAL.
4. DO NOT LOOK TOWARDS YOUR SIDES, IF YOU DO YOU WILL BE DISMISSED FROM THE EXAM WITH A ZERO IN YOUR FINAL. If you need to rest your sight look to the ceiling.
5. Use the restroom BEFORE the test.
6. Do not mark more than one answer per question in the multiple choice question, if you do a point will be subtracted from your grade.
7. REPLY TO THE MULTIPLE CHOICE QUESTIONS BY EITHER FILLING THE CORRESPONDING SQUARE OR MARKING AN X RIGHT ON TOP OF THE SQUARE. Ambiguous marks that touch more than one option will result in -1 point.
8. DO NOT use any support material during the test, you should only have a pencil and eraser on your table.
9. You can use scratch paper but it will not be collected and/or graded.
10. DO NOT SPEAK IN class. Once done, raise your hand and call professor for collecting the exam. If you remain in class till the end, place the exam face down and leave the room when instructed. DO NOT SPEAK UNTIL YOU ARE OUT OF THE CLASSROOM, OTHERWISE you may be assumed to be procuring answers from other students and an academic integrity case will be filed against you.
11. There will be no questions after the first 15 minutes of the exam, so read the test thoroughly at the beginning and ask any questions then.
12. Read all the questions before you start answering.
13. Professor will not answer any technical question I the first 15 minutes, only syntax, typos will be addressed.
14. Do not write more than what you are being asked, if you do most likely you wont have space or time to complete your test.
15. Please stop working and pay close attention when the professor makes any correction or clarification during the test, not paying attention to it may have significant impact in your grade.
16. Name each and every page of the test before the exam and have your student ID on the table for the instructor to verify.

I have read and understand all the instructions and will abide by them:_____
        Signature