

CPT 113 / CPM 213  
Programming Methodology and Data Structures  
Quiz

1.	The constructor with no parameters is called the _____ (CLO1, PO1, C1)
2.	_____ automatically executes when the class object goes out of scope. (CLO1, PO1, C1)
3.	A class and its members can be described graphically using a notation known as the _____ notation. (CLO1, PO1, C1)
4.	If inheritance occurs, state <b>two (2)</b> class members of the base class which will not inherit into derived class (CLO1, PO1, C1)
5.	Consider the following class definition.  <pre>class dClass: protected bClass {     //class members list };</pre> <p>All private members of the based class will be _____ of the derived class (CLO1, PO1, C1)</p>
6.	If the derived class <code>classD</code> overrides a public member method <code>print()</code> of the base class <code>classB</code> , give a statement to specify a call method to that public member method of the base class. _____ (CLO1, PO1, C2)
7.	_____ is the ability to use the same expression to denote different operations. (CLO1, PO1, C1)

	<p>Question 8 and 9 is based the following classes definition:</p> <div style="display: flex; justify-content: space-between;"> <pre>class A {     int x;     public:         void getX(){return x}; };</pre> <pre>class B {     int y;     public:         void showMultiply();         cout &lt;&lt; ..... ; };</pre> </div>
8.	<p>Give C++ statement in class B so that class B has data member as an object of class A</p> <p>(CLO1, PO1, C2)</p>
9.	<p>Give C++ statement in method showMultiply() which will display the value of multiplication between x and y.</p> <p>(CLO1, PO1, C2)</p>
10.	<p>In multiple inheritance, the derived class has _____.</p> <p>(CLO1, PO1, C1)</p>
11.	<p>Inheritance is a _____ relation</p> <p>(CLO1, PO1, C1)</p>
12.	<p>_____ is the ability to combine data, and operations on that data, in a single unit.</p> <p>(CLO1, PO1, C1)</p>
13	<p>Which operator is used to allocate an object dynamically of a class in C++?</p> <p>A. Scope resolution operator B. Conditional operator C. New operator D. Membership access</p> <p>(CLO1, PO1, C1)</p>
14	<p>int *p = new int[100]; is an example of</p> <p>A. Static array declaration B. Dynamic array declaration C. Multi-dimensional array declaration D. Both A and B</p> <p>(CLO1, PO1, C1)</p>

15	<p>When does a memory leak happen?</p> <p>A. Browser does not release memory from objects unnecessary</p> <p>B. Browser releases too many memories</p> <p>C. Browser releases memory iteratively</p> <p>D. Browser releases memory quickly</p> <p>(CLO1, PO1, C2)</p>
16	<p>In a circular linked list</p> <p>A. Components are all linked together in some sequential manner.</p> <p>B. There is no beginning and no end.</p> <p>C. Components are arranged hierarchically.</p> <p>D. Forward and backward traversal within the list is permitted.</p> <p>(CLO1, PO1, C2)</p>
17	<p>A linear collection of data elements where the linear node is given by means of pointer is called?</p> <p>A. Linked list</p> <p>B. Node list</p> <p>C. Primitive list</p> <p>D. None</p> <p>(CLO1, PO1, C1)</p>
18	<p>Which of the following operations is performed more efficiently by doubly linked list than by singly linked list?</p> <p>A. Deleting a node whose location is given</p> <p>B. Searching of an unsorted list for a given item</p> <p>C. Inverting a node after the node with given location</p> <p>D. Traversing a list to process each node</p> <p>(CLO1, PO1, C2)</p>
19	<p>A variant of linked list in which last node of the list points to the first node of the list is?</p> <p>A. Singly linked list</p> <p>B. Doubly linked list</p> <p>C. Circular linked list</p> <p>D. Multiply linked list</p> <p>(CLO1, PO1, C1)</p>
20	<p>In doubly linked lists, traversal can be performed?</p> <p>A. Only in forward direction</p> <p>B. Only in reverse direction</p> <p>C. In both directions</p> <p>D. None</p> <p>(CLO1, PO1, C1)</p>
21	<p>A variation of linked list is circular linked list, in which the last node in the list points to first node of the list. One problem with this type of list is?</p> <p>A. It waste memory space since the pointer head already points to the first node and thus the list node does not need to point to the first node.</p> <p>B. It is not possible to add a node at the end of the list.</p> <p>C. It is difficult to traverse the list as the pointer of the last node is now not NULL</p> <p>D. All of above</p> <p>(CLO1, PO1, C2)</p>

22	<p>A variant of the linked list in which none of the node contains NULL pointer is?</p> <p>A. Singly linked list B. Doubly linked list C. Circular linked list D. None</p> <p>(CLO1, PO1, C1)</p>
23	<p>In circular linked list, insertion of node requires modification of?</p> <p>A. One pointer B. Two pointer C. Three pointer D. None</p> <p>(CLO1, PO1, C2)</p>
24	<p>Which of the following statements about linked list data structure is/are TRUE?</p> <p>A. Addition and deletion of an item to/ from the linked list require modification of the existing pointers B. The linked list pointers do not provide an efficient way to search an item in the linked list C. Linked list pointers always maintain the list in ascending order D. The linked list data structure provides an efficient way to find kth element in the list</p> <p>(CLO1, PO1, C2)</p>
25	<p>Consider the function X defined here:</p> <pre>int X (ListNode *p) {     return ( (p==NULL)    ( (p-&gt;next==NULL)    (p-&gt;data&lt;=p-&gt;next-&gt;data&amp;&amp;(p-&gt;next) ) ) ); }</pre> <p>For a given linked list p, the function X returns 1 if and only if</p> <p>A. the list is empty or has exactly one element B. the element in the list are sorted in non-decreasing order of data value C. the element in the list are sorted in non-increasing order of data value D. not all element in the list have the same data value</p> <p>(CLO1, PO1, C2)</p>
26	<p>A linear list of elements in which deletion can be done from one end (front) and insertion can take place only at the other end (rear) is known as a ?</p> <p>A. Queue B. Stack C. Tree D. Linked list</p> <p>(CLO1, PO1, C1)</p>
27	<p>Which one of the following is an application(s) of Queue Data Structure?</p> <p>A. When a resource is shared among multiple consumers B. When data is transferred asynchronously between the two processes. C. Load balancing D. all the above</p> <p>(CLO1, PO1, C2)</p>

28	<p>In linked list implementation of a queue, front and rear pointers are tracked. Which of these pointers will change during an insertion into a NONEMPTY queue?</p> <p>A. Only front pointer  B. Only rear pointer  C. Both front and rear pointer  D. None of the front and rear pointer</p> <p>(CLO1, PO1, C2)</p>
29	<p>In linked list implementation of a queue, front and rear pointers are tracked. Which of these pointers will change during an insertion into EMPTY queue?</p> <p>A. Only front pointer  B. Only rear pointer  C. Both front and rear pointer  D. None</p> <p>(CLO1, PO1, C2)</p>
30	<p>Convert the following prefix expression into infix expression:  --*+ABC*-DE+FG--*+ABC*-DE+FG</p> <p>(CLO1, PO1, C2)</p>
	<p>Question <b>31</b> and <b>32</b> is based on the following statement:</p>
31	<p>Among the following list, which one is the best data structure to check whether an arithmetic expression has balanced parenthesis.</p> <p>(A) Queue  (B) Stack  (C) Tree  (D) List</p> <p>(CLO1, PO1, C1)</p>
32	<p>Explain <b>why</b> select that data structure?</p>
	<p>Question <b>33</b> and <b>34</b> is based on the following specification:  Assuming an input sequence in this order: 1, 2, 3, 4, 5, for a stack data structure</p>
33	<p>Which of the following permutation can be obtained in the output by using a stack operations?</p> <p>(A) 3, 4, 5, 1, 2  (B) 3, 4, 5, 2, 1  (C) 1, 5, 2, 3, 4  (D) 5, 4, 3, 1, 2</p> <p>(CLO1, PO1, C2)</p>
34	<p>Identify the sequence of operations that may resulting your choice of answer.</p> <p>(CLO1, PO1, C1)</p>
35	<p>Consider the following two functions.</p> <pre>void fun1 (int n) {     if (n == 0) return;     cout &lt;&lt; n;</pre>

	<pre>         fun2 (n - 2);         cout &lt;&lt; n;     }      void fun2 (int n) {         if (n == 0) return;         cout &lt;&lt; n;         fun1 (++n);         cout &lt;&lt; n;     } </pre> <p>What is the output printed when fun1 (5) is called (the answer is a 14 digit)? (CLO1, PO1, C2)</p>
36	<p>Consider the following recursive C++ function.</p> <pre> void get (int n){     if (n&lt;1) return;     get (n-1);     get (n-3);     cout &lt;&lt; n; } </pre> <p>If get (6) function is being called in main() then how many times will the get() function be invoked before returning to the main()? (CLO1, PO1, C2)</p>
	<p>Question 37 to 40 is based on the following binary tree.</p> <pre> graph TD     10((10)) --&gt; 8((8))     10 --&gt; 15((15))     8 --&gt; 5((5))     5 --&gt; N1[ ]     5 --&gt; 6((6))     15 --&gt; 12((12))     15 --&gt; 23((23))     12 --&gt; 11((11))     12 --&gt; 13((13))     13 --&gt; N2[ ]     13 --&gt; 14((14))     style N1 fill:none,stroke:none     style N2 fill:none,stroke:none </pre>
37	Identify inorder sequence. (CLO1, PO1, C1)
38	What is the height of the tree? (CLO1, PO1, C1)
39	What is the length of the tree? (CLO1, PO1, C1)
40	What is the level for node 14? (CLO1, PO1, C1)

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Programming Methodology & Data Structures

Case Study

Question 1:

Duration: 2 hours (400 words)

Marks: 30/100

Recently, the world faces major challenges due to Coronavirus known as Covid-19 spreads to all over countries. Travelling by air has been identified as one of the main causes that is fastly spreading virus from one place to another place. As a programmer, you are required to develop an application to screen the arrival passengers' health status at the airport. The application should store the following information:

- Passenger Information: name, passport number and gender.
- Screening Information: body temperature and age.

Given the following class definition:

```
class passengerInfo{
    private:
        string name;
        string passportNo;
        string gender;

    public:
        string getName() { return name;}
        string getpNo() { return passportNo;}
        string getGender() { return gender;}
        void setData(string n,string pNo,string gen){
            name=n;
            passportNo=pNo;
            gender=gen; }
        passengerInfo() {...}
        ~passengerInfo() {...}
};
```

- (a) (i) Define class definition namely class Screening which consists of appropriate data and methods such as setData(), getData(), display(), constructor and destructor. (CLO1,P1,C1)

(5/100)

- (ii) Demonstrate a class definition namely class healthStatus which inherits publicly from class passengerInfo. class healthStatus should have additional data members as follow:

- Status typed bool
- An object of class Screening
- Appropriate methods such as

- setData () to set data into object
- getStatus () to return status of passenger's health
- display () to display a passenger's information, screening data information and health status of a passenger.
- determineHealth () to determine health status of passengers.
- Constructor and destructor. (CLO1,P1,C2)

(6/100)

(iii) Show a complete code of the method determineHealth () of class healthStatus. If body temperature  $\geq 37.5$ , then assign **True** to Status. Otherwise assign **False** to Status. True means unhealthy status and false means healthy status. (CLO1,P1,C3)

(5 /100)

(iv) Use class healthStatus to do the following tasks in main () function:

- Declare an array of object typed class healthStatus.
- Accept input from a user for N numbers of passenger.
- Determine health status of each passenger
- Display a list of passengers' information that is unhealthy status. (CLO1,P1,C3)

(7/100)

(b) Given the following class definition:

```
class abc {
    private:
        int id;
        string city_origin;
    public:
        ...
        ...
        ...
        abc ();
        ~abc ();
};
```

(i) Define friend function prototype named userInput (...) in class abc.

(CLO1,P1,C1)

(2/100)

(ii) Show a complete code of friend function which is defined in (b) (i). (CLO1,P1,C3)

(5/100)



Question 2:

Duration: 2 hours (400 words)

Marks: 35/100

Given the following phase in a hospital where patients come for treatments.

Phase A: Every patient has to register their name and undergo screening test at one (1) outpatient counter for temperature and symptoms (cough and shortness of breath) based on whoever register first will be tested first. Those having high temperature and all symptoms will be admitted into ward Red and categorized as high risk, whereas those having high temperature and at least one of the symptoms will be admitted into ward Yellow which is considered low risk. Both wards have unlimited beds.

Phase B: In ward Red, patients rest in their bed and wait to be transferred into Intensive Care Unit (ICU) for treatments whenever there is an available bed. Again, the transfer is based on whoever was admitted first into ward Red with an additional condition of having previous medical history will be prioritized for treatment. There is only one (1) doctor and five (5) beds with medical equipment available in the ICU. The doctor will treat all patients simultaneously. Bed will be available when patient is discharged (either patients got well or died). The process will repeat until all patients in ward Red are treated.

PART I

- (a) (i) Distinguish (Select) the suitable data structures for each Phase A and Phase. (CLO3, PO3, C4)

(3/100)

- (ii) What ideas justify your selection? (CLO3, PO3, C4)

(4/100)

- (b) Differentiate (Compare) between the data structures used in Phase A and Phase B in terms of their functionalities. (CLO3, PO3, C4)

(8/100)

PART II

- (a) Produce the suitable header files to include in the solution. (CLO3, PO3, C3)

(3/100)

- (b) Illustrate the complete process flow from Phase A to Phase B using flowcharts. (CLO3, PO3, C3)

(5/100)

- (c) Show (Construct) the complete main program using C++ codes to execute the process flow. (CLO3, PO3, C3)

(12/100)

## Case Study

### Question 3:

Duration: 2 hours (400 words)

Marks: 35/100

- (a) (i) Given stackCopy function is a member of a class myStack. Construct the function using minimal number of objects and only using the stack's ADT. Assume the following ADT is available for stack:

```
const myStack& operator=(const myStack&);  
bool isEmptyStack() const;  
bool isFullStack() const;  
void initializeStack(); //Function to initialize the  
stack to an empty state.  
void push(const int& newItem);  
void pop(const int& item);  
myStack();  
~myStack();
```

(CLO3, PO3,C3)

(4/100)

- (ii) Given the operators +, -, × are left associative and ^ is right associative. The order of precedence (from highest to lowest) is ^, ×, +, -. What is the postfix expression corresponding to the infix expression a+b×c-d^e^f ? Trace your answer based on the following table.

Current Infix Notation	Stack (operators)	Postfix Expression
a		a

(CLO3, PO3,C4)

(6/100)

- (b) (i) The following function performs a sequential search on an array list of type int. If the function seqSearch returns a value greater than or equal to 0, it is a successful search; otherwise, it is an unsuccessful search.

```
int seqSearch(const int list[], int listLength, int  
searchItem)  
{  
    int loc;  
    bool found = false;  
    loc = 0;  
    while (loc < listLength && !found)  
        if (list[loc] == searchItem)  
            found = true;  
    else loc++;  
    if (found)  
        return loc;
```

```

        else
            return -1;
    }

```

Implement a recursive version of the sequential search algorithm.

(CLO3, PO3,C4)

(5/100)

(c) Given:

$$abc(x, y) = \begin{cases} x & \text{if } y = 0 \\ abc(y, x \% y) & \text{if } y \neq 0 \end{cases}$$

(i) What does the program actually do?. Infer in one sentence only

(CLO3, PO3,C2)

(2/100)

(ii) Write a recursive function abc, as the above formula (probe).

(CLO3, PO3,C4)

(3/100)

(d) Consider the following C++ function.

```

int fun(int n)
{
    int x = 1, k;
    if (n == 1)
        return x;
    for (k = 1; k < n; ++k)
        x = x + fun(k) * fun(n-k);
    return x;
}

```

Show the tracing for fun (5) and final answer.

(CLO3, PO3,C4)

(5/100)

(e) The following lists the nodes in a binary tree in two different orders:

Preorder: d u c v h a e o n g r a i e k b e

Inorder: h v a c e u o d r g a n e i b k e

(i) Construct the binary tree above.

(CLO3, PO3,C4)

(5/100)

(ii) Based on the constructed tree, give the postorder traversal.

(CLO3, PO3,C2)

(3/100)

(f) Suppose that we have numbers between 1 and 100 in a binary search tree and want to search for the number 55. Which of the following sequences CANNOT be the sequence of nodes examined and WHY?

(A) {10, 75, 64, 43, 60, 57, 55}

(B) {90, 12, 68, 34, 62, 45, 55}

(C) {9, 85, 47, 68, 43, 57, 55}

(D) {79, 14, 72, 56, 16, 53, 55}

(CLO3, PO3,C4)

(2/100)