Program Design
Final Test

6/23/2020

I. Matching (20 %)

g 1. Inheritance	c 2. virtual function
l 3. pure virtual function	h 4. "Is a" relationship
d 5. catch block	i 6. try block
o 7. Base class	p 8. override a virtual function
b 9. Indirect base class	t 10. Base-class initializer
f 11. Multiple inheritance	k 12. dynamic binding
q 13. Exception handling	r 14. terminate()
a 15. Single inheritance	m 16. polymorphism
j 17. Derived class	e 18. "Has a" relationship
h 19. abstract base class	s 20. bad_alloc

a. Deriving from only one base class.
b. Base class that is not listed explicitly in the derived class's definition.
c. Allows objects of different classes related by inheritance to respond differently to the same message.
d. Encloses the code that is executed when an exception is caught.
e. Composition.
f. Deriving from more than one base class.
g. New classes are created from existing classes.
h. Class that is defined, but never intended to be used by the programmer to create objects.
i. Encloses the code that may generate an exception.
j. Class that is created by inheriting from an existing class.
k. Occurs only off pointer or reference handles.
l. Function prototypes that end with "= 0."
m. Programming "in the general."
n. Inheritance.
o. Class from which others are derived.
p. Process of replacing an inherited base-class member function with a derived-class one.
q. Helps improve a program's fault tolerance.
r. When an exception is not caught in a program, this function is called.
s. Exception thrown when new fails.
t. Passes arguments to the base-class constructor.

II. Closing (10 %)

a. The nodes of a(n) _____ tree contain two link members.
b. The _____operator is used to dynamically allocate memory and construct an object; this operator returns a pointer to the object.
c. There are three common _____, _____, and _____ traversal algorithms for binary search trees.
d. A tree node that has no children is called a(n) _____ node.
e. The pointer to the next node in a linked list is referred to as a(n) _____.
f. The _____operator is used to destroy an object and release dynamically allocated memory.
g. A self- _____ structure is used to form dynamic data structures that can grow and shrink at execution time.
h. A(n) _____ is a nonlinear, two-dimensional data structure that contains nodes with two or more links.

III. In traditional C, a node of a data structure is usually defined as a self-referential structure. (20 %)

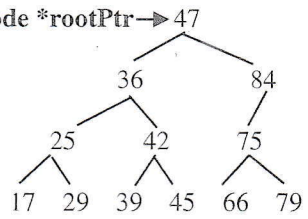
a. Please **define** in C a structure **ListNode** for an integer **linked list** and **define** the **four basic operations** as **functions** for the integer linked list. Please describe your definitions in detail. (**note :** by **define** it means **no implementation**)

b. Please **define** a **ListNode *getNewNode(int value)** function and **implement** it using **try-catch** mechanism which throws a *bad_alloc* exception when the heap run out of space. (**implement** means you need coding it)

c. The definition of **Queue** (FIFO) usually with ***enqueue*** and ***dequeue*** operations and **Stack** (FILO) with ***push*** and ***pop*** operations. Please **implement** these two operations respectively based on the four operations of the **linked list** defined in a.

d. The definition of **Stack** (FILO) usually with **push** and **pop** operations. Please implement these two operations respectively based on the four operations of the linked list defined in a.

IV. A **binary search trees** containing **integers** is built as in the figures below. (**Total 30%**)



a. Please **define** in C a structure **TreeNode** for an integer binary tree as above. (5%)

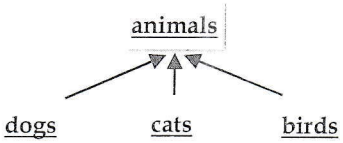
b. For a binary search tree, there are usually three **traversal algorithms** for visiting every binary tree nodes and processing the data in them. Please **implement** the three traversal algorithms which **prints out** the integers in the tree nodes. (5%)

c. Please manually travers the binary search tree above using the three traversal algorithms you implement in b. and write out the sequence of numbers visited. (5%)

d. Using a **TreeNode *getNewNode(int value)** function to get a new tree node, please **implement** a **recursive** function **insertANode** that can insert a new node into a **binary search tree**. (10%)

e. Please manually **insert** the following new node **16, 27, 92, 38, 58, 46, 69, 80, 83** into the binary search tree. Draw the entire final binary search tree. (5%)

V. A animal class hierarchy is as follows:(**Total 20%**)



a. **Define** and **implement** the animal inheritance classes hierarchy. The abstract class **animals** and all the derived classes should have a method **sound()** to print a sound string, "***making a sound***" for animal, "***woof***" for dogs, "***meow***" for cats, and "***tweet***" for birds. Implement all the classes so that they can demonstrate polymorphism when calling the **sound()** method.

b. Write a program segment in that creating a **vector** of **animal** pointers, creating objects of a dog, a cat, and a bird and puting them into the vector, and creating a loop to print out the sound strings of all the animal objects in the vector by calling their **sound()** method.