



FACULTY OF SCIENCE

ACADEMY OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

MODULE CSC01B1
Introduction to data structures (C++)
CAMPUS APK

SSA FSAO / EXAM 2020

DATE: 2020-11-??

SESSION: ??

ASSESSOR(S)

PROF DA COULTER

INTERNAL MODERATOR

PROF DT VAN DER HAAR

DURATION 2 HOURS

MARKS 100

Please read the following instructions carefully

1. You must complete this test yourself within the prescribed time limits.
2. You are bound by all university regulations please special note of those regarding assessment, plagiarism, and ethical conduct.
3. You may not directly take any code from any source including your own previous submissions. All code must be written by yourself during this the test.
4. You must complete and submit the "Honesty Declaration : Online Assessment" document along with your submission to EVE. No submissions without an accompanying declaration will be marked.
5. You may submit scanned pages as per the instructions on EVE
6. Your answers to the question (in a single PDF format) together with the declaration must be submitted in a zip archive named in the following format.
STUDENTNUMBER_SURNAME_INITIALS_SUBJECTCODE_ASSESSMENT
e.g. 202012345_COULTER_DA_CSC01B1_EXAM_SSA.zip
7. Additional time for submission is allowed for as per the posted deadlines on EVE.
8. No communication concerning this test is permissible during the assessment session except with Academy staff members.

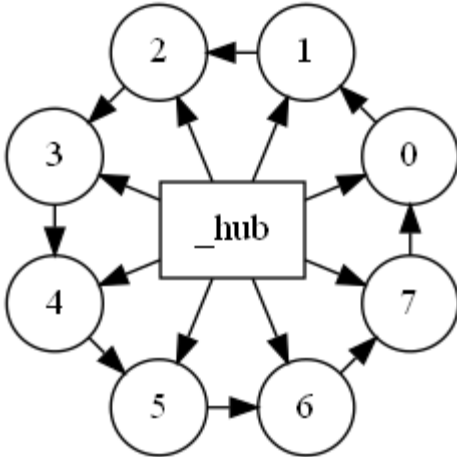
QUESTION 1

Draw the following					
1.1	- Identify classes (1) - Identify attributes (1) - Identify operations (1) - Identify has-a relationships (1) - Identify is-a relationships (1)				(5)
Write the most correct option(s)					
1.2	In order for overloading to occur member functions must have the same ...				
	A name	B parameters	C return type	D const-ness	E abstraction
1.3	Consider a class with the following member function declaration: virtual void m() = 0;				
	Select two options below that will probably describe the object-oriented approaches being used.				
	A inheritance	B polymorphism	C composition	D aggregation	E delegation
1.4	Operator overloading allows some problems to be solved that would be impossible without it.				
	True		False		無 ¹
1.5	In the approach adopted in this course which two file types would be used to create a templated data type?				
	A .h	B .cpp	C .imp	D .o	E .dll
1.6	Which of the following operators can be chained (select all that apply)				
	A =	B ==	C ->	D >>	E <<
Write your answers to the following					
1.7	Would you consider the following code to be an example of an abstract data type in use? int* aryData = new int [10]; Justify your answer with reference to the requirements of an abstract data type. No. Logical properties (collection of integers) not separated from implementation details (contiguous block of freestore allocated memory)				(3)
1.8	Consider implementing a programming language of your own. You wish to implement the ability for functions to be called recursively. i. What does this mean? -Functions can call themselves ii. What limitations does this impose? Memory needed to store data for each function iii. What data structure would you use to store the required data for each function invocation (e.g. local variables, return values, etc) given the choice between a Stack and a Queue? -Stack				(3)
1.9	Which object orientated concept is being described: i. A computer has peripherals -Aggregation (Composition 0.5) ii. IO devices are a kind of peripheral -Inheritance iii. Haptic gloves provide feedback to the user -General Association				(3)

¹ The Sino-Japanese ideogram Wu/Mu in this case represents a question which is flawed.

1.10	Which problem is being demonstrated in the given code: Diamond Problem <pre>class Q1 { public: virtual void act(); }; void Q1::act() { cout << "Q1" << endl; } class Q1d1 : public Q1 { public: void act(); }; void Q1d1::act() { cout << "Q1d1" << endl; } class Q1d2 : public Q1 { public: void act(); }; void Q1d2::act() { cout << "Q1d2" << endl; } class Q1d3 : public Q1d1, public Q1d2 {}</pre>	(1)
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QUESTION 2

Write your answers to the following		
2.1	Complete the following code in which a generic Q2 class encapsulates a 2D collection of arbitrary data along with a range of operations. a) Q2<T> b) this c) *this d) ostream& e) const f) sLHS g) () (0.5 for []) h) return i) T* j) tDefault	(10)
2.2	Define a hierarchy of exception classes where each of the operators is protected by its own exception class. <pre>class Exception {} class StreamException : public Exception {} class IndexException : public Exception {} class AssignException : public Exception {}</pre>	(2)
2.3	Rewrite the following main function to make use of the exception handling classes defined above: <pre>try catch catch order</pre>	(3)
Consider the following node-based data structure for the remaining sub-questions:  <pre>graph TD 0((0)) --> 1((1)) 1 --> 2((2)) 2 --> 3((3)) 3 --> 4((4)) 4 --> 5((5)) 5 --> 6((6)) 6 --> 7((7)) 7 --> 0 0 --> hub[_hub] 1 --> hub 2 --> hub 3 --> hub 4 --> hub 5 --> hub 6 --> hub 7 --> hub</pre> Where <code>_hub</code> is defined as a variable of the following type: <pre>struct Hub { vector<Node<T>*> vNodes; };</pre> It can be assumed that the index of a node in <code>vNodes</code> corresponds with its node number as depicted above.		
2.4	Provide code for a generic node structure compatible with the depicted data-structure. <pre>template <typename T> struct Node {</pre>	(5)

	<pre> T value; Node<T>* next; } </pre>	
2.5	Rewrite the following code so that it prints the contents of nodes 0 – 7 without using the vector (apart from for the purposes of accessing the first node) <pre> Node<T>* n0 = _hub.vectNodes[0]; cout << n0->value; Node<T>* node = n0->next; while (node != n0) { cout << node->value << ' '; node = node->next; } </pre>	(5)
2.6	Provide code for adding a new node between nodes 7 and 0 <pre> Node<T>* nodeNew = new Node; nodeNew->next = _hub.vectNodes[0]; _hub.vectNodes[7]->next = nodeNew; _hub.push_back(nodeNew); </pre>	(5)

[30]**QUESTION 3**

Write the necessary C++ code for the following statements and answer the remaining questions. Unless otherwise indicated you may assume that the necessary header files are included. **Most of the marks in this section are awarded for the file handling operations.**

3.1	• Opening file with input stream • Variables for each value • Reading in values • Check if CAT < 0 • Closing file	(5)
3.2	<pre> #pragma pack(push) #pragma pack(1) struct Document { char strISBN[13]; char strFN[13]; int intCategory; }; #pragma pack(pop) </pre>	(5)
3.3	<pre> void showCat(int intCategory) { Document recDoc; fstream f("bin-docs.dat", ios::binary ios::in); while(!f.EOF) { f.read(reinterpret_cast<char*>(&recDoc), sizeof(Document)); if(recDoc.intCategory == intCategory) cout << recDoc.strISBN << endl; } f.close(); } </pre>	(5)
3.4	<pre> Document getDoc(int intIndex) { Document recDoc; fstream f("bin-docs.dat", ios::binary ios::in); f.seekg(intIndex * sizeof(Document), ios::beg); f.read(reinterpret_cast<char*>(&recDoc), sizeof(Document)); f.close(); return recDoc; } </pre>	(5)

3.5	Analyse the below code asymptotically using Big-O notation. State any assumptions made. <pre> template <typename T> void LinkedList<T>::print(Node<T>* nodeCurrent) { if (nodeCurrent == nullptr) { cout << endl; return; } cout << nodeCurrent->value << endl; print(nodeCurrent->next); } </pre> Assumptions (4) Derivation (5) Result (1)	(10)
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QUESTION 4

Your software needs a DLL the header file for which has been lost. You know that the function was defined as a c-function with the following signature: void secret ();		
4.1	Recreate a compatible header file for this DLL based on the description above. <pre> #ifndef LIB_H #define LIB_H #ifdef BUILD_DLL #define DLL_FUN __declspec(dllexport) #endif #define DLL_FUN __declspec(dllimport) #endif extern "C" { DLL_FUN void secret(); } #endif </pre>	(5)
4.2	Write a batch file which compiles an executable which links implicitly to the DLL with the following assumptions: - The executable's name must be <code>q4.exe</code> - The DLLs name is <code>q4.dll</code> - The DLL is stored in the same directory as the executable <pre>g++ -o q4.exe -L. -lq4</pre>	(5)
4.3	Ransomware has renamed all of your DLLs! Write a program that reads in a list of DLLs from a text file and uses explicit linking to find the one file which contains the secret function, extracts it, then calls it. As in main test adjusted for this question	(10)

[20]