University College Dublin
An Coláiste Ollscoile, Baile Átha Cliath

SEMESTER I EXAMINATION – 2014/2015

COMP 20080

Computer Science for Engineers II

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Time allowed: 2 hours

Instructions for candidates

Answer ALL questions. Question 1 is worth 40 marks. All other questions are worth 3 marks each.

Write your answers in the Answer Books provided.

Instructions for invigilators

Loose Rough Work sheets are not to be distributed or used.

Use of all calculators is prohibited.

1. ***[40 marks]***

Consider the following contained in a C++ file **`Time.h`**:

```
class Time
{
   private:
   int hours;
   int minutes;
   int seconds;

   public:
   Time(int h, int m, int s);
   Time(int totalSeconds);
   Time operator+(Time t);
   void zeroTime();
   void printTime();
   int getHours(); // returns the value of hours
   int getMinutes(); // returns the value of minutes
   int getSeconds(); // returns the value of seconds
};
```

(a) Implement the **first 5** of the above methods in another C++ file **`Time.cpp`** according to the following specifications:

i. The constructor **`Time(int h, int m, int s)`** sets up a **`Time`** object with the given values of hours, minutes, and seconds **[4 marks]**

ii. The constructor **`Time(int totalSeconds)`** sets up a **`Time`** object with the values of hours, minutes, and seconds calculated from the given total number of seconds, such that the values are in *canonical form* where **`seconds`** and **`minutes`** are both in the range 0–59 **[8 marks]**

iii. The method **`operator+(Time t)`** adds two **`Time`** objects and returns the sum with values in *canonical form* as above **[8 marks]**

iv. The method **`zeroTime()`** sets the value of **`hours`**, **`minutes`** and **`seconds`** for the object it is called on to 0 **[4 marks]**

v. The method **`printTime()`** prints to the screen the values of **`hours`**, **`minutes`** and **`seconds`** for the object it is called on **[4 marks]**

(b) The following program uses the **`Time`** class from part (a) – you may assume all methods have been correctly implemented. Find and correct **3** compiler errors in this program. **[12 marks]**

```
#include "Time.h"
int main()
{
      Time t1(3661), t2(2,45), t3=t1+t2;
      t3.printTime();
      t1.seconds = 0;
      t2 = t2.zeroTime();
      t3=t1+t2;
      t3.printTime();
}
```

Questions 2–21 are worth 3 marks each

2. Which of the following statements are true about an **Abstract Data Type** (ADT)? *(choose all that apply)*

(a) An ADT consists of a data structure, and the functions that access and modify that structure.

(b) The ADT concept is a core element of the functional abstraction approach.

(c) When implemented in C++, each ADT used in an application must be written in a separate source file.

(d) When implemented in C++, all ADTs used in an application may be written in a single source file.

3. **True** or **False** *(no explanation required)* – a C++ class constructor **cannot** be declared to have a return type.

4. In C++, a **method**: *(choose all that apply)*

(a) can be declared `private` within a `class` statement

(b) cannot be called directly from external code (i.e. outside the class in which the method is defined)

(c) has direct access to all data fields of its associated class, even if they are `private`

(d) cannot be used in a derived class unless it is overridden by code in the derived class

5. **True** or **False** *(no explanation required)* – in C++, all data fields in a base class are automatically inherited and accessible by a derived class of this base class.

6. Given the C++ statements `int x = 0; int *y = &x; int& z = x;` which of the following is correct: *(choose **one** only)*

(a) `y` is an alternative name for `x` and `z` is a pointer to `x`

(b) `z` is an alternative name for `x` and `y` is a pointer to `x`

(c) `y` and `*z` both evaluate to the address of `x`

(d) `*y` and `&z` both evaluate to the value of `x`

7. Well-engineered software should have the attributes: *(choose all that apply)*

(a) reliability

(b) transparency

(c) usability

(d) standards-compliant

8. Which of the following statements are true about a **Formal Transformation** software process model? *(choose all that apply)*

(a) The software procurer is typically consulted after each transformation stage, to get their feedback on what has been produced in that stage.

(b) Formal transformation software process models are widely used in the software engineering industry.

(c) A formal specification, which captures the pre and post conditions for all functions to be developed, is used as input to the transformation process.

(d) A formal specification must state what changes, if any, are made to each function's input parameters.

9. **True** or **False** *(no explanation required)* – **structured language** and **class diagrams** are techniques used by software engineers to capture system requirements.

10. Which of the following statements are true about a **top-down testing strategy**? *(choose all that apply)*

(a) At each level, the components of the level below are represented by stubs for testing purposes.

(b) At each level, the components of the level below are represented by test drivers for testing purposes.

(c) Top-down testing is popular because it produces test output which is easy to observe.

11. Which of the following is produced by the **lexical analysis** phase of compilation? *(choose **one** only)*

(a) parse tree

(b) 3-address code representation

(c) symbol table

12. **True** or **False** *(no explanation required)* – if you power down your computer, the contents of its system memory (RAM) are lost.

13. Which of the following is typically done after a **cache miss**? *(choose all that apply)*

(a) A system request to increase the size of the cache is submitted

(b) A block of contiguous values is loaded from main memory into the cache

(c) A set of values is flushed from the cache to main memory

(d) A set of values is transferred to the Register File

14. A ***private*** data field of a C++ class can be accessed by *(choose **one** only)*

(a) any statement in any C++ program, if the class header file is included.

(b) any statement in any C++ program, if the data field name is immediately preceded by **`private:`**

(c) any statement in any method of this class, provided the method is also **`private`**

(d) any statement in any method of this class.

15. Which of the following are commonly used **compiler optimisation techniques**? *(choose all that apply)*

(a) elimination of loop invariants

(b) loop unrolling

(c) move loop invariants outside their loops

(d) put multiple code statements on the same line of the program

16. Which of the following are layers in the TCP/IP Reference Model? *(choose all that apply)*

(a) Transport layer

(b) Session layer

(c) Radio layer

(d) Internet layer

17. In **virtual-circuit packet switching**, which of the following are essential: *(choose all that apply)*

(a) a route is set up in the network between the sender and the receiver

(b) each packet contains the address of the receiver

(c) intermediate nodes have routing tables telling them which output link to use for each virtual circuit passing through them

(d) none of the above

18. **True** or **False** *(no explanation required)* – in the client-server communications model, the client and server processes may be running on the same physical machine.

19. Which of the following are typical layers in a modern Operating System? *(choose all that apply)*

(a) Memory Manager

(b) Linker

(c) Dispatcher

(d) Compiler

20. In a **demand paging** virtual memory system, which of the following is done when a program tries to use a page that is not in memory: *(choose all that apply)*

(a) a page fault interrupt is generated;

(b) the OS finds a free frame in memory, reads the desired page from disk, and updates the page table;

(c) the instruction which caused the page fault is restarted after the page table has been updated.

21. **True** or **False** *(no explanation required)* – in C++, the **`new`** operator is used to indicate to the compiler that a new datatype is being declared in the program.