University College Dublin
An Coláiste Ollscoile, Baile Átha Cliath

SEMESTER I EXAMINATION – 2012/2013

COMP 20080

Computer Science for Engineers II

Prof. A. Mille

Mr. J. Dunnion

Prof. L. Murphy*

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 calculators is prohibited.

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

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

```
const int N=1000;
class Queue{
// a class to represent a First-In First-Out (FIFO) queue:
// items are serviced in the order they arrive to the queue

private:
   int head;     // location of least-recently-added item
   int tail;     // first available empty location
   int items[N];
public:
   Queue();
   bool isEmpty();
   bool isFull();
   int length();
   void enqueue(int item);
   int dequeue();
};
```

A queueing system consists of a queue (waiting area) and a server. An item is ***enqueued*** (stored in the queue) when it arrives, and is later ***dequeued*** (removed from the queue) and serviced when it is the least-recently-added item in the queue and the server becomes available. Only the queue (not the server) is to be implemented here.

Implement the above methods in another C++ file **`Queue.cpp`** according to the following specifications:

i. The constructor **`Queue()`** sets up an object of the class **`Queue`** which is initially empty (no items in the queue). **[5 marks]**

ii. The method **`isEmpty()`** returns true if there are no items in the queue, and false otherwise. **[7 marks]**

iii. The method **`isFull()`** returns true if no more items can be added to the queue, and false otherwise. **[7 marks]**

iv. The method **`length()`** returns the number of items stored in the queue. **[7 marks]**

v. The method **`enqueue()`** stores the given item in the queue at the first available empty location, if the queue is not already full. An item which arrives when the queue is full is simply ignored (not stored). **[7 marks]**

vi. The method **`dequeue()`** removes the least-recently-added item, if the queue is not empty, and returns this item. If the queue is empty, this method returns 0. **[7 marks]**

NOTE: you are **not** required to write another C++ program containing a **`main()`** function.

Questions 2–21 are worth 3 marks each

2. An **Abstract Data Type** (ADT) consists of: *(choose all that apply)*

(a) a set of abstract variables

(b) a data structure

(c) statements that describe the data in the ADT

(d) statements that access or modify the data in the ADT

3. **True** or **False** *(no explanation required)* – a C++ programmer can define more than one constructor with the same argument list for a class, provided the code implementing the different constructors is different.

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

(a) is a function which is declared within a `class` statement

(b) can be called from external code if the class name and `::` are placed immediately before the method's name

(c) has direct access to the private data fields of its associated class

(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)* – for any C++ class, the compiler will provide a default constructor if the programmer does not define a constructor.

6. The **substitution principle** as applied to C++ classes states: *(choose the correct answer)*

(a) any code which manipulates an object of a base class will work correctly if it is supplied with an object of another class immediately preceded by the name of the base class and `:`

(b) any code which manipulates an object of a derived class will work correctly if it is supplied with an object of the corresponding base class

(c) any code which manipulates an object of a base class will work correctly if it is supplied with an object of any derived class of this base class

7. **Software engineering** aims to produce software which is: *(choose all that apply)*

(a) able to meet changing or uncertain user requirements

(b) minimum-cost

(c) aligned with the latest advances in software technology and development

(d) understandable by multiple "stakeholders" such as developers and maintainers

8. A **software process model** specifies: *(choose all that apply)*

(a) the activities that should be done in each phase of software development

(b) the programming language(s) that should be used in software development

(c) the testing tool(s) that should be used to test the software developed

(d) the personnel who should be involved in each phase of software development

9. **True** or **False** *(no explanation required)* – software ***validation*** involves ensuring that the program conforms to its specification.

10. Which of the following statements are true about a **class diagram** that is produced as part of an objected-oriented design approach? *(choose all that apply)*

(a) Interactions between the classes are represented by labelled arrows

(b) The class diagram shows the static structure of the system being designed

(c) Some classes shown in the class diagram may not be part of the problem domain, but instead are part of the software system solution to the problem

11. Which of the following programs are typically used to convert a C or C++ source program into **executable code**? *(choose all that apply)*

(a) pre-compiler

(b) performance profiler

(c) compiler

(d) linker

12. **True** or **False** *(no explanation required)* – after a cache miss, when a data value must be loaded from main memory, usually a **block of contiguous values** are loaded together into the cache.

13. What is stored in one RAM **memory address**? *(choose all that apply)*

(a) one bit of information

(b) one byte of information

(c) one integer variable used in a high-level program

(d) one floating-point variable used in a high-level program

14. **True** or **False** *(no explanation required)* – in C++ it is legal to use a **reference variable** as an argument passed to a function, even if the function does not modify any of its arguments.

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

(a) elimination of common sub-expressions

(b) loop assembling

(c) move loop invariants outside their loops

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

16. In the ISO Reference Model for Open System Interconnection (OSI), which layers operate in devices **within** a communications subnet? *(choose all that apply)*

(a) Session layer

(b) Transport layer

(c) Network layer

(d) Datalink layer

17. The **communication service** in which each message is sent independently of any other messages going from the same sender to the same receiver is called: *(choose the correct answer)*

(a) simplex

(b) connection-oriented

(c) connectionless

(d) datagram packet-switching

18. **True** or **False** *(no explanation required)* – both Time Division Multiplexing and Statistical Multiplexing divide a shared communications link into **independent** channels.

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

(a) Memory Manager

(b) Dispatcher

(c) Assembler

(d) Command Processor

20. The essential feature of a **preemptive multitasking** operating system is: *(choose the correct answer)*

(a) it makes available the resources a program needs by invoking the File and Resource Manager

(b) it allocates CPU time slices to each program which needs the CPU

(c) a program can control the CPU for as long as it needs it, but if it is not using the CPU, it allows another program to use it

21. **True** or **False** *(no explanation required)* – in C++, when a function is called, the **addresses** of the variables passed as arguments into the function are copied into the function's local lookup table.