UNIVERSITY OF EAST ANGLIA

School of Computing Sciences

Main Series UG Examination 2015/16

PROGRAMMING 2

CMP-5015Y

Time allowed: 2 hours

Answer four questions.

All questions carry *equal weight*.

Notes are not permitted in this examination.

Do not turn over until you are told to do so by the Invigilator.

1. (a) Describe, with the aid of diagrams, the three types of structure commonly employed in parallel computing systems and give examples of when each structure is commonly used. [8 marks]

   (b) Explain the difference between a process and a thread. [4 marks]

   (c) Describe, with the aid of code segment examples, how you define a class that can be threaded and how an object of that class could be run in its own thread. [8 marks]

   (d) Describe, with code examples, different ways of claiming a monitor lock in Java with the keyword `synchronized`. [10 marks]

2. (a) What is an `enum` type in Java? Give an example of defining and declaring a simple `enum` type in Java. [5 marks]

   (b) How do Java `enum` types differ from C++ `enum` types? [4 marks]

   (c) What are the benefits of using `enum` in Java? [5 marks]

   (d) Write a Java class `Card`. Each card should have a suit (clubs, diamonds, hearts or spades) and a rank (two, three, four, five, six, seven, eight, nine, ten, jack, queen, king, ace). You should model this with `enum` types. Include a constructor to initialise a card based on arguments passed. [8 marks]

   (e) Write a Java class `Deck` that contains a List of `Card` objects. Include in the class `Deck` a constructor that creates the List of `Card` objects where each card has a unique suit and rank. [8 marks]

3. (a) In the context of Java, what is meant by **Serialization**? [2 marks]

   (b) Explain, with simple code segment examples, how basic serialization is implemented in Java. [6 marks]

   (c) What is a `transient` variable? Why would we make a variable `transient`? [4 marks]

   (d) Explain, with code examples, the difference between the implementation of two dimensional arrays in Java and C++. [4 marks]

   (e) In the context of Java, what is meant by **Reflection**? Explain, with code segment examples, how it can be used. [8 marks]

   (f) What is an **Exception** in Java? What are the benefits of using Exceptions? [6 marks]

4. (a) The Fibonacci series is a series of integers starting 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, ... Each element of the series is the sum of the two preceding elements. Write a C++ function that returns a dynamically allocated array of unsigned integers containing the first 1024 elements of the series. [10 marks]

   (b) Describe the differences between inheritance in the C++ programming language and in Java. [10 marks]

   (c) Write a C++ template function, called `withinRange`, with three parameters of the same type, that returns `true` if the first argument is greater than or equal to the second, but less than or equal the third. [10 marks]

5. (a) A palindrome is a sequence of characters that reads the same backward or forward, for example ”kayak”. Write a C function that takes a null terminated string as an argument and returns a value representing true if the string is palindromic and a value interpreted as false otherwise. The function must not use any functions declared in the string library header `string.h`. [10 marks]

   (b) What are the types of the variables created in each of the following declarations? Where the declaration will not compile, explain why this is the case. Where the declaration will only compile if certain conditions are met, state those conditions. [10 marks]

   (i) `int n = 10L;`

   (ii) `struct Foo *sp = &s;`

   (iii) `double wombat[10] = {0.1, 0.2, 0.3, 0.4};`

   (iv) `int *do = &n;`

   (v) `int* const p = &n;`

   (c) Write a C code fragment that creates a file called "factorial.txt" containing a table of the factorials of the integers from 0 to 10. The factorial of a positive integer n, denoted $n!$, is the product of all the integers 1 to n, i.e. $n! = n \times (n-1) \times \ldots \times 3 \times 2 \times 1$. The factorial of zero, is defined to as $0! = 1$. The table should have two columns, the first giving n and the second $n!$. [10 marks]

6. (a) Write a C++ class representing a date, described by the day of month, the month of year and the year. The class should include appropriate constructors, accessor methods and overloaded operators supporting the use of stream-based I/O, and the overloading of the binary subtraction operator, such that subtracting one `Date` object from another gives an integer representing the number of days separating the two dates. A full set of relational operators should also be provided. For convenience, assume leap years do not exist and that February has 28 days, April, June, September, and November each have 30 days and January, March, May, July, August October and December each consist of 31 days. [30 marks]

END OF PAPER