

UNIVERSITY OF EAST ANGLIA

School of Computing Sciences

Main Series UG Examination 2013/14

PROGRAMMING 2

CMPC2M3Y

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 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. [6 marks]
 - (b) What are the differences between `wait/notify` and `sleep/interrupt` mechanisms of thread communication? [8 marks]
 - (c) What does synchronization mean in the context of Java? How is it enforced? [4 marks]
 - (d) What effect does the `volatile` access modifier have on a variable? [4 marks]
 - (e) Explain the two ways in which synchronization is implemented in Java. Illustrate with small code examples. [8 marks]
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2. (a) In the context of the Java `Collections` hierarchy, describe the differences between sets and maps and give an overview of the implementation of the classes `HashMap`, `TreeMap`, `HashSet` and `TreeSet`, including a summary of the complexity of operations `contains`, `insert` and `delete`. [15 marks]
 - (b) Generally, when would it be better to use a `TreeMap` rather than a `HashMap`? [3 marks]
 - (c) What is an `Iterator` in Java? Explain, with code examples, how you use an `Iterator` [8 marks]
 - (d) Explain how you can make a data structure compatible with the `for...each` control structure. [4 marks]

3. Explain how C++ and Java differ in relation to the following processes and language features:

- (a) Code compilation; [8 marks]
- (b) Inheritance, including abstract methods/member function; [8 marks]
- (c) Pointers and references; [7 marks]
- (d) Generic data structures via generics in Java and templates in C++. [7 marks]

4. (a) Write a template for a C++ function, called `increasing`, that takes three arguments, `a`, `b` and `c`, of the same type, and returns `true` if `a` is less than `b` and `b` is less than `c` and `false` otherwise. [10 marks]
- (b) Write a C++ class definition describing a date, where the year, month of year and day of month are represented as integers. The class should include appropriate constructors, accessor methods, overloaded operators supporting the use of stream I/O, and overloading of the addition operator that has `Date` left hand side argument and an integer right hand side, and returns a `Date` that is the left hand side advanced by the right hand side number of days. So, for example, 6th November 2013 + 10 = 16th November 2013. Assume there are no leap years, such that there are 28 days in February, 30 in April, June, September and November, and 31 in January, March, May, July, August, October and December. [20 marks]

5. (a) Explain the function of the following C++ code fragment. What are the values in the array `numbers` on completion? [5 marks]

```
int numbers[] = {-8, 9, 10, -3, 2, 3, -4, 9};

for (int i = 0; i < 8; i++)
{
    if (numbers[i] < 0)

        if (numbers[i]%2)

            numbers[i] = -numbers[i] + 1;

    else

        numbers[i] = -numbers[i];
}
```

- (b) The following C++ code does not function as the programmer apparently intended. Identify and explain the error in the code and suggest how it could be modified to function correctly. Could this type of error occur in a Java program? [10 marks]

```
const int UNDER_ATTACK = 1;
const int ALL_QUIET     = 0;

int status = ALL_QUIET;

if (status = UNDER_ATTACK)
{
    launchFullCounterStrike();
}
else
{
    dontWorry();
}
```

- (c) What kind of variable is created in the declarations below (where the declaration will not compile, explain why this is the case)? [5 marks]

- (i) `int &b = c;`
- (ii) `Date today();`

(iii) `char str[] = {"Hello", "world", "!"};`

(iv) `int *p = &b;`

(v) `long **a[5];`

- (d) Explain the purpose of destructors in C++ programs. Include in your answer a comparison with the closest equivalent facility provided by the Java programming language.

[10 marks]

6. (a) Given the MATLAB array: `M = [8 5 7 ; 1 2 3 ; 9 6 3];`, what would be the result of the following operations?

(i) `numel(M(2, :))`

(ii) `M(end, end)`

(iii) `M([], [])`

(iv) `M([1, 2], [2, 3])`

(v) `M(:, 3)`

If the result is a vector or matrix, be sure to make the orientation of the vector clear in your answer. If the operation would result in an error, explain why.

[5 marks]

- (b) Given the following sequence of operations in MATLAB

```
>> C = [8 6 4 ; 3 9 2 ; 1 2 3];
```

```
>> C(:, 2) = [];
```

```
>> a = mean(C, 2);
```

```
>> b = mean(C(C < 3));
```

```
>> idx = find(mod(C, 2));
```

```
>> c = reshape(repmat(a, 1, 2), 2, 3);
```

- (i) Explain the operation performed by the second statement, i.e.

`C(2, :) = []`.

- (ii) Write the result of the assignment to `a`.

- (iii) Write the result of the assignment to `b`.
- (iv) Write the result of the assignment to `idx`.
- (v) Write the result of the assignment to `c`.

If the result is a vector or matrix, be sure to make the orientation of the vector clear in your answer. If the operation would result in an error, explain why.

[10 marks]

- (c) Describe, with illustrative code fragments for a suitable example of your choice, how object oriented programming is supported by the MATLAB programming language.

[8 marks]

- (d) Give MATLAB code fragments that could be used to implement the following checks on the arguments of a MATLAB function with function header:

```
function [x, y, z] = afunction(a, b, c, d)
```

In each case, the code fragment should report a suitable error message if the check fails.

- (i) Check that there are between two and four input arguments. [2 marks]
- (ii) Check that there is at least two output argument. [2 marks]
- (iii) Check that `c` is a non-empty numeric row vector containing finite real integer values. [3 marks]

END OF PAPER