

Swansea University College of Science  
Prifysgol Abertawe Coleg Gwyddoniaeth

January 2019

# **CSCM41**

## **Programming in Java**

Time Available: 2 hours

**Coordinator: Dr O Kullmann**

*Queries:* The Exams Office hold contact details for this paper

*Dictionaries Allowed?* Available on Request

*Calculators Allowed?* Not Required

Attempt 2 out of 3 questions.

## Question 1

- (a) Assume two `int` variables  $a, b$  have been defined, and now we want to compute a fraction  $f = \frac{a}{b}$ , so that for example for  $a = 12$ ,  $b = 5$ , the value of  $f$  is 2.4. Consider the code fragment

```
int a = 12, b = 5;
final int f = a / b;
System.out.println(1.6 + f);
```

- (i) What is the printed value? Explain the Java-rules you applied to determine this value. **[3 marks]**
  - (ii) How can you change the definition of variable  $f$  (changing only this second line), so that the expected result is obtained (printing then 4.0 in the third line)? Explain your reasoning. **[3 marks]**
- (b) Write a **function** `minmax_sum`, which takes three (single) integers as arguments, and returns their minimum, their maximum and their sum in an array of size three (in this order). Take care to have a correct function-signature (the “header line”). For example, `minmax_sum(1,2,3)` returns an array with the `int`’s 1,3,6. Your answer must not use any Java-library-function, but just the basic programming means. **[6 marks]**
- (c) Private versus Public:
- (i) State succinctly when to use the access specifier `private` and when to use `public` for *methods* of a class. **[2 marks]**
  - (ii) Outline one *concrete and meaningful example*, where using `public` instead of `private` for methods can lead to serious problems. **[2 marks]**
  - (iii) Explain the Java rules about accessing a private instance *variable or method* from another class. **[2 marks]**
- (d) Define a class `Data`, which has one `String` instance variable `name`, and one `double` instance variable `sum`. You need only to provide one constructor (there is only one natural choice), and the method `equals`, which determines in the natural way whether two `Data`-objects are equal or not (namely if *name and sum* are equal). **[7 marks]**

## Question 2

(a) Loops, functions and programs

- (i) Write a **function** `has_two_values`, which takes an integer array `A` and returns **true** if the array contains at least two *different* numbers, while **false** is returned otherwise.

For full marks, the function must return an appropriate **boolean** under all circumstances (must *never* raise/throw an exception). For the extreme cases of `A`, say in words what the function should compute, and why. **[7 marks]**

- (ii) Write a complete Java program which reads integers  $x_1, \dots, x_n$ ,  $n \geq 0$ , from the command line, and which outputs **true** in case the values contain at least two different values, and **false** otherwise, **using** the above function `has_two_values`. Assume here that the function exists, whether you could answer the first part or not. Ignore possible wrong command-line inputs. **[4 marks]**

(b) Classes

- (i) Write a class `VoteCounter`,

- which contains a string and an integer,
- which can be constructed from a string,
- where we can obtain the data via methods `name` and `counter`,
- and where the counter can be incremented by method `inc`.

This method checks for overflow: if an overflow would occur, then no increment is performed, and the **boolean** `false` is returned, while if there is no overflow with the increment, then it is performed, and the **boolean** `true` is returned.

**[10 marks]**

- (ii) Write some example code which uses all constructors and methods of class `VoteCounter`. **[4 marks]**

### Question 3

- (a) Give an example of a complete Java program which reads two integers from the command-line and prints the sum of these two numbers. [4 marks]

- (b) Consider the code

```
final Image I = new Image(100,100);  
I.set(1,1);
```

which creates an `Image` object `I` of dimensions  $100 \times 100$ , and then sets the point at coordinates  $(1,1)$ . The code compiles — explain, why this is the case, despite the `final`, which seems to suggest that the image is “finalised” after creation. [4 marks]

- (c) Arrays and loops

- (i) Consider the following function:

```
static int unknown(int[] A, int x) {  
    int i = A.length;  
    while (i > 0) {  
        if (A[i] == x) return i;  
        --i;  
    }  
    return -1;  
}
```

- (ii) What is the *intended* meaning of this function (that is, what should be the meaning of the returned integer)? Your answer should include the output in case *A* is empty (has length zero) or `null`. [3 marks]
- (iii) Under which circumstances will `unknown` fail (an error occurs, and an exception is raised)? Which error occurs precisely, and what is the reason for this error? [3 marks]
- (iv) Rewrite the function `unknown`, improving the *coding standard* and correcting the error, so that the implementation shall now work under all circumstances (fulfilling the specification as worked out under (ii)). [4 marks]

- (d) Static versus non-static:

- (i) Create a class, which contains data (has an instance variable), and has a *static function* (static method) as well as a *non-static function* (instance method). You need to provide definitions only for the instance variable and these two functions. [3 marks]
- (ii) Explain why the specifiers “static” respectively “non-static” are appropriate for your functions/methods (your example must make some sense), and give examples of using them. [4 marks]

**End of Paper**