Swansea University College of Science

Prifysgol Abertawe Coleg Gwyddoniaeth

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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) Loops, functions and programs

(i) Write a **function** `is_incremented`, which takes an integer array `A` and returns `true` if for each two consecutive members $A[i]$ and $A[i+1]$ holds $A[i+1] = A[i] + 1$, while otherwise `false` is returned.

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. **[6 marks]**

(ii) Write a complete Java program which reads integers $x_1, \ldots, x_n$, $n \geq 0$, from the command line, and which outputs `true` in case the values are incremented in the above sense, and `false` otherwise, **using** the above function `is_incremented` (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`.

[10 marks]

(ii) Write some example code which uses all constructors and methods of class `VoteCounter`. **[5 marks]**

Question 2

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

(b) Consider the code

```
final int[] A = new A[9];
A[8] = 1;
```

The code compiles — explain, why this is the case, despite the `final`.
[4 marks]

(c) Arrays and loops

(i) Consider the following function:

```
static int unknown(String[] S, String s) {
  for (int i = 1; i <= S.length; ++i)
    if (S[i-1].equals(s)) return i-1;
  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 S 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 static resp. non-static is appropriate for your example (your example should make some sense). **[2 marks]**

(iii) Explain the differences in usage of the static and the non-static function. **[2 marks]**

Question 3

(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 $a = 1$, $b = 2$, the value of f corresponds to 0.5. Consider the code fragment

```
assert(b != 0);
final int f = a / b;
```

(i) Explain, as precisely as possible, what actually is computed by f. **[3 marks]**

(ii) How can you change the second line, so that the expected result is obtained? Explain your reasoning. **[3 marks]**

(b) Write a **function** `min_max`, which takes three (single) integers as arguments, and returns their minimum and maximum in an array of size two (first the minimum). Take care to have a correct function-signature (the "header line"). For example, `min_max(1,2,3)` returns an array with the `int`'s 1 and 3. **[7 marks]**

(c) Private versus Public:

(i) Discuss in general when to use the access specifier `private` and when to use `public` for data members (instance variables) of a class. **[2 marks]**

(ii) Give one *concrete and meaningful example*, where using `public` instead of `private` can lead to serious problems. **[2 marks]**

(iii) Explain what happens when you access a private instance variable from another class. If an error should occur, specify when this error will happen, and explain the underlying motivation for this error. **[2 marks]**

(d) Define a class `Employee`, which has one `String` instance variable `name`, and one `int` instance variable `id`. You need only to provide one constructor (there is only one choice then), and the method `equals`, which determines in the natural way whether two employees are equal or not (namely if name *and* id are equal). **[6 marks]**

End of Paper