

Esc101N, Jan-Apr 2005, Second Quiz Solutions

Tue 05 Apr 2005, Duration: 45 min (11:05-11:50), Total marks: 70

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Note: This exam is open hand-written (your own) notes. No xerox copies, books, other printed material, or electronic material is allowed. Please answer in the space provided for each question.

Question 01: Order the orders [16 marks]

Order the following nine functions in terms of their complexity. You may use < or = symbols in-between functions while ordering them. For example: $O(n) = O(3n+2) < O(n^2)$.

[1] $\log_2(n) \times \log_2(n)$, [2] $\log_{10}(n)$, [3] $\log_2(n)$, [4] $2^{\log_2(n)}$,
[5] $2^{\sqrt{n}}$, [6] n , [7] $2^{\log_{10}(n)}$, [8] $\log_2(n^2)$, [9] $\log_2(\log_2(n))$

$$\log_2(\log_2(n)) < \log_{10}(n) = \log_2(n) = \log_2(n^2) < \log_2(n) \times \log_2(n) \\ < 2^{\log_{10}(n)} < 2^{\log_2(n)} = n < 2^{\sqrt{n}}$$

Marking: -2 for incorrect order or symbol (= instead of < or vice versa) between each adjacent pair

Question 02: What is the Complexity? [4+5+6+7 = 22 marks]

In the following, n is the size of the input, $f(n)$ is an arbitrary function of n , and $g()$ is a method whose execution time is independent of n . Express the complexity of each of the following in terms of $f(n)$.

Marking: 4 for (a), 5 for (b), 6 for (c), and 7 for (d). -2 in (d) if complexity is not expressed in its simplest terms.

Case (a)

```
for(int i = 0; i < f(n); i++) { g(); }
```

Answer for (a): $O(f(n))$

Case (b)

```
i = 1;
while(i < f(n)) { g(); i *= 2; }
```

Answer for (b): $O(\log(f(n)))$

Case (c)

```
for(int i = 0; i < f(n); i++) {
    for(int j = i+1; j < f(n); j++) { g(); }
} // End for(i)
```

Answer for (c): $O(f(n) \times f(n))$

Case (d)

```
for(int i = 0; i < f(n); i++) {
    for(int j = log(f(n)); j < f(n); j++) { g(); }
} // End for(i)
```

Answer for (d): $O(f(n) \times f(n))$

Question 03: Compilation and run-time errors [4 x 8 = 32 marks]

There are at least eight mistakes in the following program. Find them, and also mention whether each is a compile-time error or a run-time error.

```
class SomeClass {
    void getNextLine(BufferedReader br) throws IOException {
        return br.readLine();
    }
    static void reverse(String[] s) {
        // Reverse the array of strings (not each string)
        for(int i = 0; i < s.length; i++) {
            String temp = s[i];
            s[i] = s[s.length - i];
            s[s.length - i] = temp;
        }
    }
    static void read_and_reverse() {
        // Assume that file input.dat has 15 lines
        FileReader fin = new FileReader("input.dat");
        BufferedReader br;
        String[] s = new String[15];
        for(;;) {
            int index = 0;
            String line = getNextLine(br);
            if(line.length() == 0) break;
            s[index] = line;
            index++;
        } // End for(;;)
        reverse(s);
        for(int i = 0; i < s.length; i++) {
            System.out.println(s[i]);
        }
    } // End read_and_reverse()
    public static void main(String[] args) { read_and_reverse(); }
} // End class SomeClass
```

Error-1: getNextLine should return String (Compile-time error)

Error-2: getNextLine should be a static method (Compile-time error)

Error-3: for loop in reverse should be $i < s.length/2$ (Run-time error)

Error-4: In the exchange in reverse, the index should be $s.length-i-1$ (Run-time error)

Error-5: read_and_reverse should throw IOException (Compile-time error)

Error-6: "br" should be initialized (Run-time error)

Error-7: index=0 should be initialized outside the for(;;) loop (Run-time error)

Error-8: Condition for break should be $line == null$ (Run-time error)

Marking: 3 marks for identifying each error, and 1 for classifying compile-time/run-time