ORDRE DES INGÉNIEURS DU QUÉBEC

MAY 2018 SESSION

Open-book examination
Calculators: only authorized models
Duration: 3 hours

14-IF-A4 Program Design and Data Structures

Programming languages are C, C++ and Java.

1. [10 points] Give the values of variables or indicate that there is an error in the expression:
   (a) **int** a = (**int**) (2.3 + 5 − 20 % 3 / 18 / 12) + 7 ∗ 2 / 4;
   (b) **double** b = (**double**)(2.3f + 5) − 20 / 3.4 / (18.1 / 12);
   (c) **float** c = (2.3f + 5) − 20 / 3 / 18 / 12;
   (d) **float** d = (2.3f + 5) − 20 / 3 / (18 / 12);
2. [10 points] Give the values of variables or indicate that there is an error in the expression:
   (a) **boolean** aa = (25 >= 21) || !((33 − 12)> 3 || **false**) & (**true** && **false**);
   (b) **boolean** bb = !(18−3 < 15) | (18−2 < 15) && (1 < 39%2 −1);
   (c) **boolean** cc = !(18−3 < 15) | !!(18−2 < 15) && !(15 < 37/2 −1);
   (d) **boolean** dd = ((**double**)2.3 + 5) == (**double**)7.3;
3. [10 points]
   Give the steps that you use when you code using TDD, Test-Driven Development.
4. [10 points]
   Write a fonction to find all permutations of the letters in a particular string s.
5. [10 points]
   Write a recursive method or a recursive function for determining if a string s has more vowels than consonants.

6. [10 points]
   What are potential efficiency disadvantages of having very deep inheritance trees, that is, a large set of classes A, B, C, ..., such that B extends A, C extends B ...?
7. [10 points]
   What are potential efficiency disadvantages of having very shallow inheritance trees, that is, a large set of classes A, B, C, ..., such that all of these classes extend a single class Z.
8. [10 points]
   Write, using pseudocode or Java or C; a method or a fonction for multiplying an $n \times m$ matrix A and an $m \times p$ matrix B. Recall that the product $C = AB$ is defined so that $C[i][j] = \sum_{k=1}^{m} A[i][k] \cdot B[k][j]$. What is the running time of your method?
9. [10 points]
   Give a recursive algorithm to compute the product of two positive integers m and n using only addition.
10. [10 points]
    Indicate true or false and justify.
    (a) Is $\sum_{i=1}^{n} 3^i = \Theta(3^n - 1)$?
    (b) Is $\sum_{i=1}^{n} 3^i = \Theta(3^n)$?

End of exam.