Sample/practice exam July, questions

Algorithms and Data Structures I (University of Victoria)

CSC 225 FALL 2019
ALGORITHMS AND DATA STRUCTURES I
MIDTERM EXAMINATION
UNIVERSITY OF VICTORIA

1. Student ID: _____
2. Name: _____
3. DATE: 22 OCTOBER 2019
   DURATION: 50 MINUTES
   INSTRUCTOR: RICH LITTLE
4. THIS QUESTION PAPER HAS **FOUR** PAGES INCLUDING THE COVER PAGE.
5. THIS QUESTION PAPER HAS **FOUR** QUESTIONS.
6. ALL ANSWERS TO BE WRITTEN ON THIS EXAMINATION PAPER.
7. IT IS SINGLE-SIDED SO YOU MAY USE THE BACK SIDE FOR MORE SPACE.
8. THIS IS A CLOSED BOOK EXAM. CALCULATORS ARE PERMITTED.
9. READ THROUGH ALL THE QUESTIONS AND ANSWER THE EASY QUESTIONS FIRST.

P2 (10)	
P3 (10)	
P4 (10)	
TOTAL (30) =	

1. (a). [2 marks] In how many ways can the symbols a,b,c,d,e,e,e,e,e be arranged so that no e is adjacent to another e?

(b). [3 marks] With n a positive integer, evaluate the following sum. (**Hint:** Binomial theorem)

$$\binom{n}{0} + 2\binom{n}{1} + 2^2\binom{n}{2} + \cdots + 2^k\binom{n}{k} + \cdots + 2^n\binom{n}{n}$$

(c). [5 marks] For the following algorithm, how many times is the inner-most assignment done?

Algorithm Loop(n):
$s \leftarrow 0$
for $i \leftarrow 1$ **to** n **do**
  for $j \leftarrow 1$ **to** i **do**
    for $k \leftarrow 1$ **to** j **do**
      $s \leftarrow s + 1$

2. (a). [2 Marks] State the definition of big-Oh.

(b). [3 Marks] Order the following functions by order of growth from slowest to fastest (i.e. by big-Oh order).

$5n, (\log n)^5, n^5, 5, 5^n$

(c). [5 Marks] Show that $\sum_{i=0}^{n} i \log i$ is $O(n^2 \log n)$ using the definition of big-Oh.

3. [6 Marks] Consider the following recurrence equation. Using induction, prove that $T(n) = 4n$ for all $n \geq 1$.

$$T(n) = \begin{cases} 4, & \text{if } n = 1 \\ T(n-1) + 4, & \text{otherwise} \end{cases}$$

4. [4 Marks] An array A contains $n - 1$ unique integers in the range $[0, n-1]$; that is, there is one number from this range that is not in A. Design an $O(n)$-time algorithm for finding the missing number.