

Due Date: 11-02-2018 (F), BEFORE the class begins

This assignment covers textbook Chapter 5, 7 and Chapter 1~4.

For question 1 and 2: please clearly specify (1) what the indicator random variable is and (2) what it represents, and (3) show how you use the linearity of expectation and lemma 5.1 to calculate the result. Only have a result can't get the full credits.

1. Indicator Random Variables (25 points)

Exercise 5.2.4 (P122)

2. Indicator Random Variables (25 points)

Exercise 5.2.5 (P122)

About **uniform random permutation** of $\langle 1, 2, \dots, n \rangle$. The definition is in page 125. A uniform random permutation is one in which each of the $n!$ possible permutations are equally likely.

3. QuickSort Algorithm (50 points)

Problem 7.2 (P186)

* Some textbooks contain typos for c, the below is the correct description.

- c. Modify the RANDOMIZED-PARTITION procedure to call PARTITION', and name the new procedure RANDOMIZED-PARTITION'. Then modify the QUICKSORT procedure to produce a procedure QUICKSORT'(A, p, r) that calls RANDOMIZED-PARTITION' and recurses only on partitions of elements not known to be equal to each other.

4. Algorithm Design and analysis (Extra credits: 25 points)

Design an efficient Divide and Conquer Algorithm to find the k^{th} smallest element in Array A (assuming elements are distinct). Hint: modify quicksort and the algorithm should be better than $\Theta(n \lg n)$.

Input: an array A contains n elements, and an integer k (a valid index, $1 \leq k \leq n$)

Output: the k^{th} smallest element (array A can be changed)

(1) (10 points) **Pseudocode**: *(please use textbook conventions)*

(2) (15 points) **Analysis**: Derive a recurrence for the running time of your algorithm. Justify your answer by listing the cost for executing each line of code and the number of executions for each line. Solve the recurrence.

Algorithms -- COMP.4040 Honor Statement
(Courtesy of Prof. Tom Costello and Karen Daniels with modifications)

Must be attached to each submission

Academic achievement is ordinarily evaluated on the basis of work that a student produces independently. Infringement of this Code of Honor entails penalties ranging from reprimand to suspension, dismissal or expulsion from the University.

Your name on any exercise is regarded as assurance and certification that what you are submitting for that exercise is the result of your own thoughts and study. Where collaboration is authorized, you should state very clearly which parts of any assignment were performed with collaboration and name your collaborators.

In writing examinations and quizzes, you are expected and required to respond entirely on the basis of your own memory and capacity, without any assistance whatsoever except such as what is specifically authorized by the instructor.

I certify that the work submitted with this assignment is mine and was generated in a manner consistent with this document, the course academic policy on the course website on Blackboard, and the UMass Lowell academic code.

Date: _____

Name (please print): _____

Signature: _____