CSE 321 - Introduction to Algorithm Design
Homework 02

Deadline: 23:55 November 7th, 2016

Write pseudocode of algorithms in Python.

1. Sort the array A = {3, 44, 38, 5, 47, 15} in increasing order by selection sort, bubble sort, insertion sort, quick sort. Show steps of sorting algorithms as well.

2. Briefly explain your answers for questions below.

a) Is selection sort stable?

b) Is bubble sort stable?

c) Is it possible to implement selection sort for linked lists with the same $\Theta(n2)$ efficiency as the array version?

d) Is it possible to implement insertion sort for sorting linked lists? Will it have the same $O(n^2)$ efficiency as the array version? Recall that we can access elements of a singly linked list only sequentially.

3. *Alternating disks*: You have a row of 2n disks of two colors, n dark and n light. They alternate: dark, light, dark, light, and so on. You want to get all the dark disks to the right-hand end, and all the light disks to the left-hand end. The only moves you are allowed to make are those which interchange the positions of two neighboring disks.
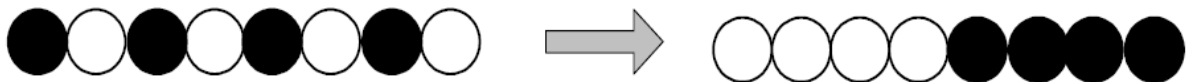
Design an algorithm for solving this puzzle and determine the number of moves it makes. Hint: Thinking about the puzzle as a sorting-like problem may and may not lead you to the most simple and efficient solution.

4. Give an example of a text of length n and a pattern of length m that constitutes the worst-case input for the brute-force string-matching algorithm. Exactly how many character comparisons are made for such input? Hint: It will suffice to limit your search for an example to binary texts and patterns.

5. Consider the problem of counting, in a given text, the number of substrings that start with an A and end with a B. For example, there are four such substrings in CABAAXBYA.

a) Design a brute-force algorithm for this problem and determine its efficiency class.

b) Design a more efficient algorithm for this problem.

6. *Ferrying soldiers*: A detachment of n soldiers must cross a wide and deep river with no bridge in sight. They notice two 12-year-old boys playing in a rowboat by the shore. The boat is so tiny, however, that it can only hold two boys or one soldier. How can the soldiers get across the river and leave the boys in joint possession of the boat? How many times does the boat need to pass from shore to shore? Hint: Solve the problem for n=1.

7. *Celebrity problem*: A celebrity among a group of n people is a person who knows nobody but is known by everybody else. The task is to identify a celebrity by only asking questions to people of the form: "Do you know him/her?" Design an efficient algorithm to identify a celebrity or determine that the group has no such person. How many questions does your algorithm need in the worst case? Hint: Solve first a simpler version in which a celebrity must be present.

8. *Flipping pancakes*: There are n pancakes all of different sizes that are stacked on top of each other. You are allowed to slip a flipper under one of the pancakes and flip over the whole sack above the flipper. The purpose is to arrange pancakes according to their size with the biggest at the bottom.

a) Design an algorithm to solve this problem.

b) Test your algorithm with [1] [2] [10] [7] [8] [3] number labelled pancakes. 1 is at the top, 3 is at the bottom and use | to show flipper position. Show your result step by step applying your algorithm.

c) Analyze your algorithm for best case and worst case scenario.

9. Consider the problem of finding, for a given positive integer n, the pair of integers whose sum is n and whose product is as large as possible. Design an efficient algorithm for this problem and indicate its efficiency class.

10. During World War II, mathematician Alan Turing tries to crack the enigma code with help from fellow mathematicians. Watch The Imitation Game movie and write an essay. (It should be minimum half page A-4 paper size or maximum one page A-4 paper size. Also you are expected to use 1,5 text-space and Times New Roman font family in your essay.)