CHAPTER 3 – PROBLEMS

Problem 1. Given an array A as follow:

$$A =< -9, -9, -5, -2, 0, 3, 7, 7, 10, 15 >$$

a. Calculate the number of comparison operations to find $x = -9$ using two algorithms: sequential search and binary search (only count the comparison between the search key and array's elements). Give your comments about the results.
b. In case of using binary search, which value is returned (0 or 1)?

Problem 2. During a binary search, which elements in the array $A =< 4, 8, 12, 14, 20, 24 >$ are compared to the *key* when the *key* is:

a. 2
b. 8
c. 15

Problem 3. Given an array A of n integers. Write a search algorithm as follow:

- *Step 1:* Sort A using any sort algorithm that you like
- *Step 2:* Search for an integer x in A using sequential search, return i if $A[i] == x$ and returns -1 if $A[i] > x$.

a. Is this algorithm better the original sequential search algorithm which do not sort the array A beforehand? (Hint: observe the case that there exists x in A and the case that x does not appear in A)
b. Is this algorithm faster than a binary search algorithm?

Problem 4. ***Cutting sticks.*** A stick n meters long needs to be cut into n 1-m pieces. Outline an algorithm that performs this task with the minimum number of cuts if several pieces of the stick can be cut at the same time. Also give a formula for the minimum number of cuts.

Problem 5. The time efficiency of sequential search does not depend on whether a list is implemented as an array or as a linked list. Is it also true for searching a sorted list by binary search?

Problem 6. ***Picture guessing***. A version of the popular problem-solving task involves presenting people with an array of 42 pictures—seven rows of six pictures each— and asking them to identify the target picture by asking questions that can be answered yes or no. Further, people are then required to identify the picture with as few questions as possible. Suggest the most efficient algorithm for this problem and indicate the largest number of questions that may be necessary.

Problem 7. An array $A[0..n-2]$ contains $n-1$ integers from 1 to n in increasing order. (Thus one integer in this range is missing.) Design the most efficient algorithm you can to find the missing integer and indicate its time efficiency.