

Lab1 Assignment

Selection Problem

Suppose you have a group of N integer numbers, and you would like to determine the k th largest number.

Write a program to solve this selection problem. Also estimate how much CPU time is used to solve the problem.

Consider solving this problem this way:

1. read from input file the following data
 - o value of N ,
 - o value of k | $0 < k \leq N$,
 - o and N numbers into a dynamic array,
2. sort the array in decreasing order via bubble sort, print the sorted array to an output file
3. and then find the array element at index $k-1$, print it to the output file also

Objective

1. learn input/output from/to files
2. learn how to estimate CPU time that is used by your program
3. learn sorting

Detailed Algorithm

1. $t1$ = current CPU time in nanoseconds
2. Read data (N, k, N integers) from **in.txt** input file to variables and to a dynamic array of size N
3. $t2$ = current CPU time in nanoseconds
4. Bubble sort the array
5. Find k th largest element
6. $t3$ = current CPU time in nanoseconds
7. Output (print) the sorted array and k th largest element to an output file
8. $t4$ = current CPU time in nanoseconds
9. Print statistics to the same output file
 - o print CPU time used during input ($di=t2-t1$)
 - o print CPU time used during calculations ($dc=t3-t2$)
 - o print CPU time used during output ($do=t4-t3$)

Input and Output Files

In the description below, **bold** text has to be used as-is. Actual values have to be used instead of *cursive* text.

Input file

Input file must be named **in.txt** and must have the following format

N k
integer1 integer2 ... integerN

The first line must contain two numbers – value of N and value of k .

The second line must contain N integer numbers. Numbers must be separated by whitespaces. Note that the input file must not have ..., actual numbers must be used instead.

Output file

Output file must be named **out.txt** and must have the following format

sorted1 sorted2 ... sortedN

kth largest is X

CPU time used during input = d_i nanoseconds

CPU time used during calculations = d_c nanoseconds

CPU time used during output = d_o nanoseconds

The first line must contain sorted array elements in descending order, separated by whitespaces. Note that ... must not be printed, actual array element must be printed instead.

The second line must contain string literals as specified above with actual values substituted for k and X .

The last 3 lines must contain string literals as specified above with actual values substituted for d_i , d_c , and d_o .

Example

Use this example to test your program

in.txt content

8 5

6 8 10 3 2 1 11 13

out.txt content

13 11 10 8 6 3 2 1

5th largest is 6

CPU time used during input = d_i nanoseconds

CPU time used during calculations = d_c nanoseconds

CPU time used during output = d_o nanoseconds