Excercise 1.

Polynomial function vs exponential function.

We assume that we have several algorithms that solve a given (specific) problem

Consider the following computational complexity functions:

A1: O (nlogn)

A2: O (n^2)

A3: O (n^{10})

A4: O (2^n)

1. Find the fastest processor currently existing in the world (single 1-core computing unit) - frequency

2. Please use 10x faster processor for calculation

3. Assume that each processor clock cycle is a single "step" of the A1-A4 algorithms

4. For the sake of simplicity, it can be assumed that the indicated function shows the number of steps of a given algorithm

5. How long will it take to execute each of the mentioned algorithms, assuming they are n = 100 elements? Calculate in seconds for each of them.

6. Give conclusions between polynomial and exponential complexity

Exercise #1

Subject: Sorting algorithms
Requirements: Knowledge of the operation of the following algorithms:
- Insertion sort - IS
- Selection sort – SS
- Bubble sort - BS
- Heap sort - HS
- Quick sort - QS
- Merge sort MS
- Shell sort -ShS
- Counting sort – CS

Knowledge of the computational complexity of the above algorithms, their at worst, average and best case.

Exercise
I.1.Compare the speed of 4 sorting methods: BS, HS, CS, ShS for the array of integers randomly generated according to the uniform probability distribution. Submit a chart t=f(n) where: t - sorting time; n - number of elements of the sequence. The number of elements must be selected in such a way that measurements can be taken properly. The results are presented in one chart (at least 15 measuring points).
2 .Formulate conclusions on the computational complexity of the methods studied and their relationship with the efficiency of sorting and the memory activities of each method.

II.1.For different input types compare the effectiveness of 3 sorting algorithms. a)QS with middle selected pivot, b) HS and c) MS. Examine the performance for the following data types of the sequence:
- random (uniform distribution)
- constant value (e.g.equal to 0)
- increasing order (step equal to 1)
- descending order (step equal to 1)
- ascending-descending order (A shape – increase odd numbers - decrease even)
- descending-ascending order (V -shape – decrease odd numbers - increase even)

Prepare charts t=f(n) where: t - sorting time; n - number of array elements for different data types (2 consecutive types per chart - 6 characteristics).

The number of elements must be selected in such a way that measurements can be taken properly.
1.The results are presented in charts - one for two data types (at least 15 measuring points).
2.Draw conclusions on the computational complexity and computational efficiency of QS execution and the behavior of the algorithm in the worst case scenario and for the different types of data. What is the median effect on QS sorting time? What is it used for?
(2 weeks)

Exercise 2.

We have two identical machines, Ma and Mb.

We have n elements to be processed on these machines: j = 1, ..., n.

The processing time for each of these elements is specified (the time is any but definite): pj

One machine can process one element at a time and its processing must not be interrupted

Please provide the optimal algorithm that minimizes the processing time of all n elements.

What will be the complexity of the proposed algorithm?