FEDERAL STATE AUTONOMOUS EDUCATIONAL INSTITUTION OF HIGHER EDUCATION

ITMO UNIVERSITY

Report

on the practical task No. 1 "Experimental time complexity analysis"

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Goal

Experimental study of the time complexity of different algorithms

Formulation of the problem

Experimentally study the complexity of the following algorithms on different data and compare it with the expected complexity:

- *Constant function;*
- *Sum of elements;*
- *Product of elements;*
- *Direct calculation of polynomial;*
- *Horner's method for calculation polynomial;*
- *Bubble Sort;*
- *Quick Sort;*
- *Timsort;*
- *Matrix product.*

Brief theoretical part

Constant function - Theoretical time complexity is O(1)

Sum of elements - Theoretical time complexity is O(n)

Direct calculation of polynomial - Theoretical time complexity is O(nlog(n))

Horner's method for calculation polynomial - Theoretical time complexity is O(n)

Bubble Sort - Theoretical time complexity is O(n^2)
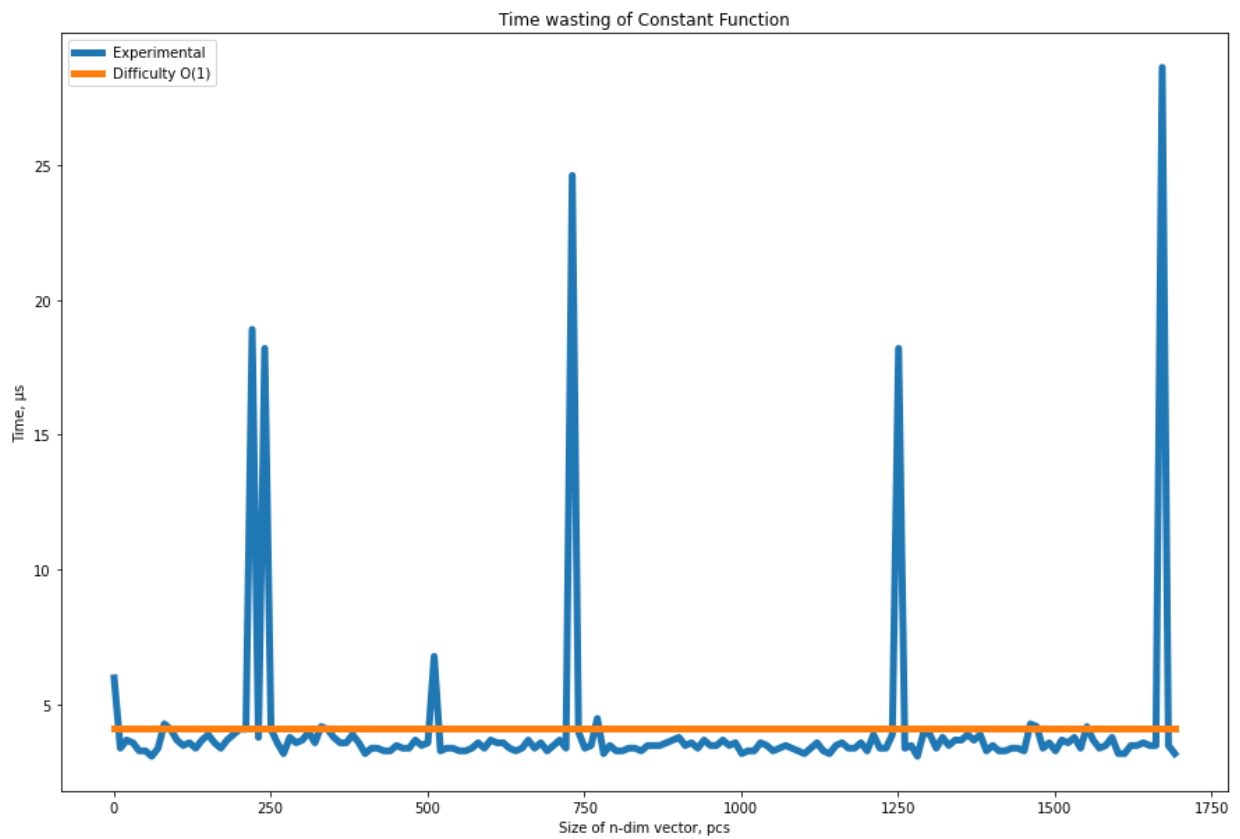
Quick Sort - Theoretical time complexity is O(nlog(n))

Timsort - Theoretical time complexity is O(nlog(n))

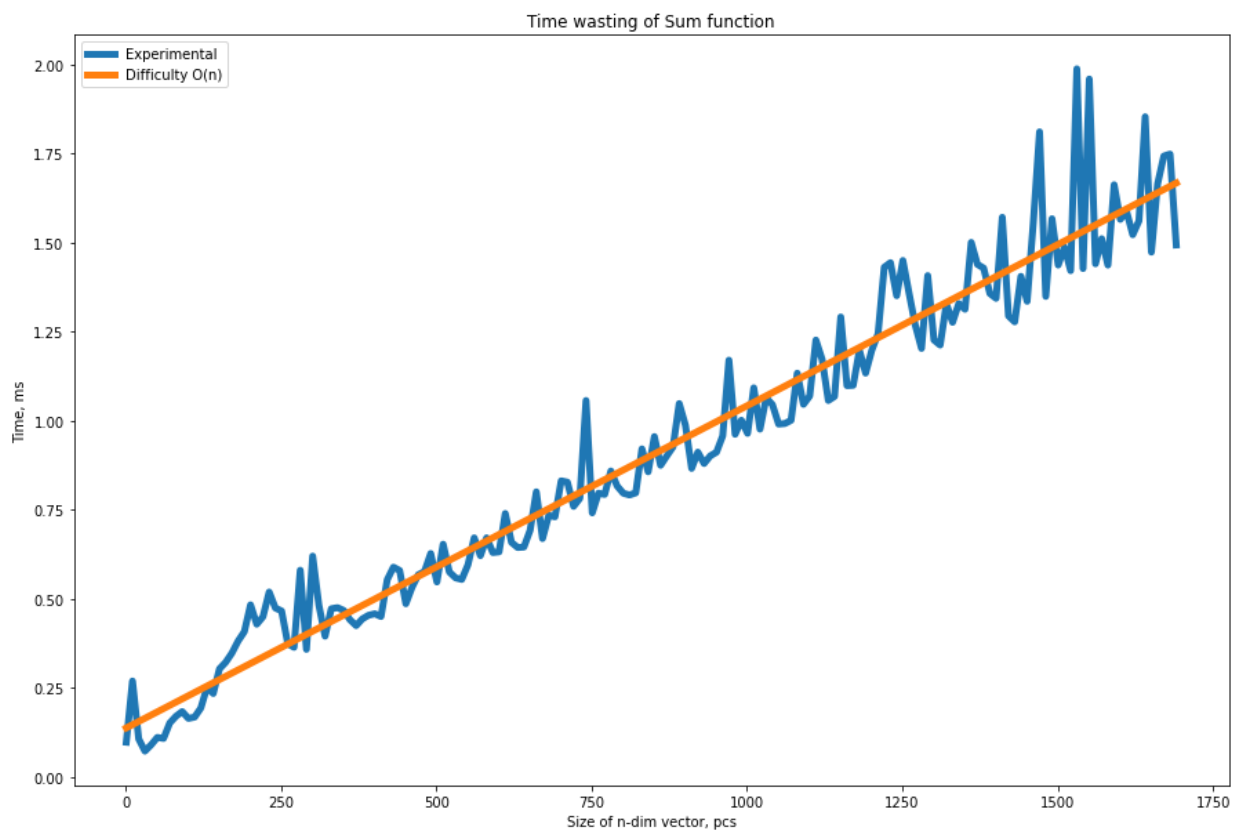*Matrix product - Theoretical time complexity is O(n^3)*

Results

*Charts showing the experimental and theoretical time complexity of algorithms:*
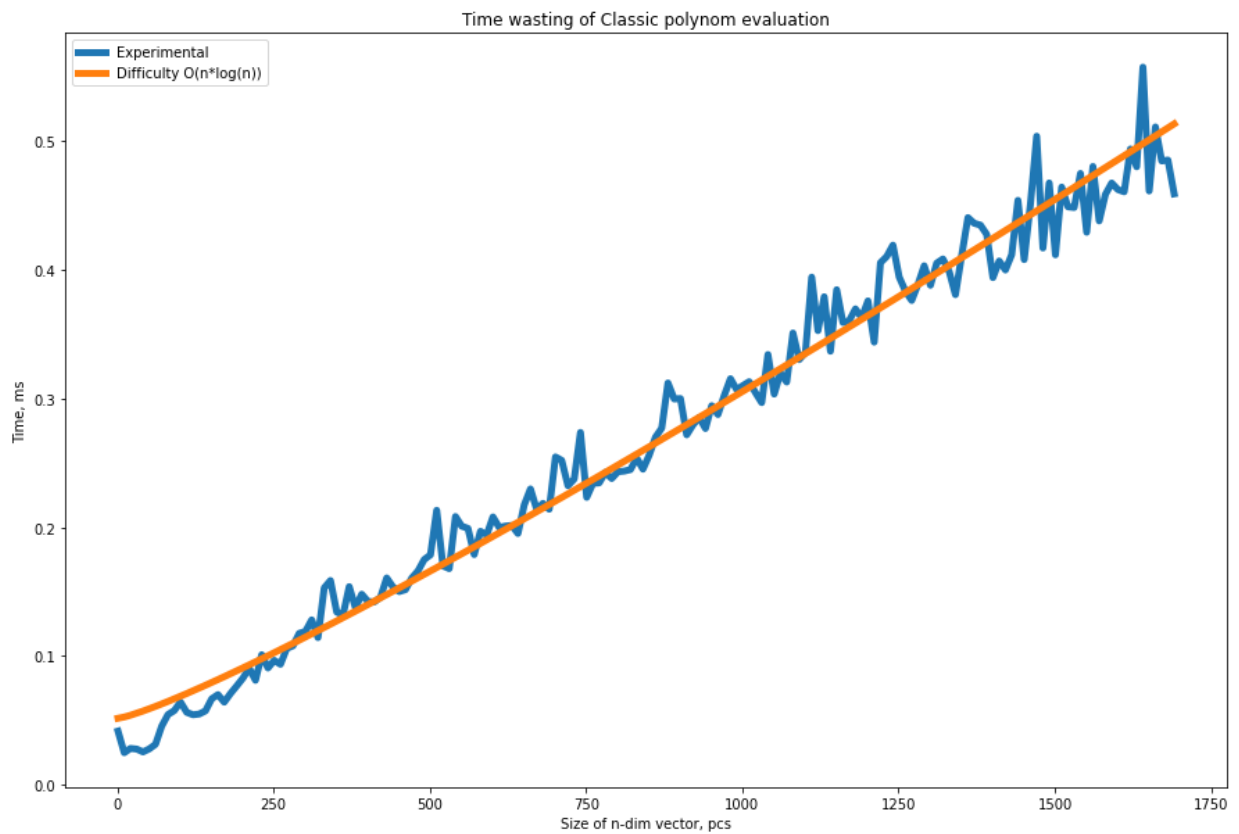
Constant function - Theoretical time complexity is O(1)

Time wasting of Constant Function

Sum of elements - Theoretical time complexity is O(n)

Time wasting of Sum function

Product of elements - Theoretical time complexity is O(n)

Time wasting of Product function

Direct calculation of polynomial - Theoretical time complexity is O(nlog(n))

Time wasting of Classic polynom evaluation

Horner's method for calculation polynomial - Theoretical time complexity is O(n)

Bubble Sort - Theoretical time complexity is O(n^2)
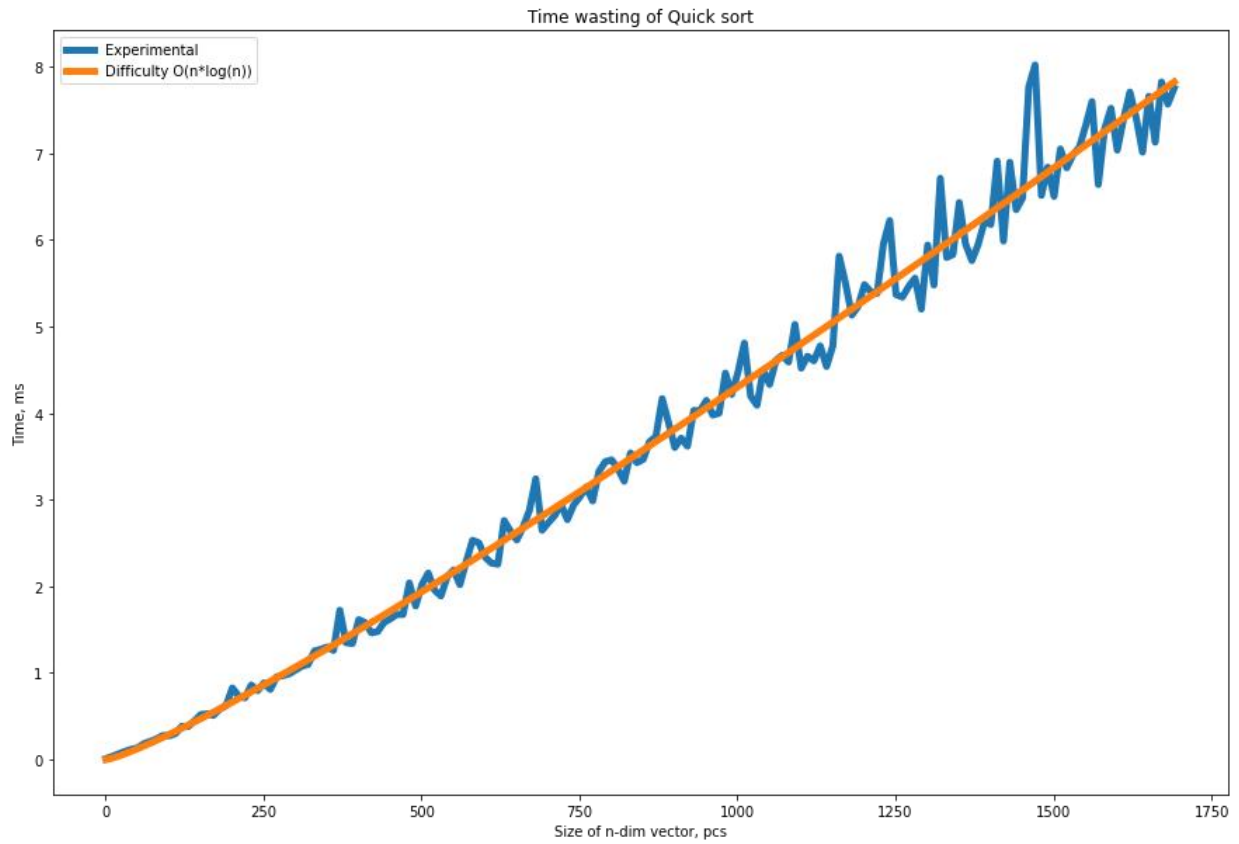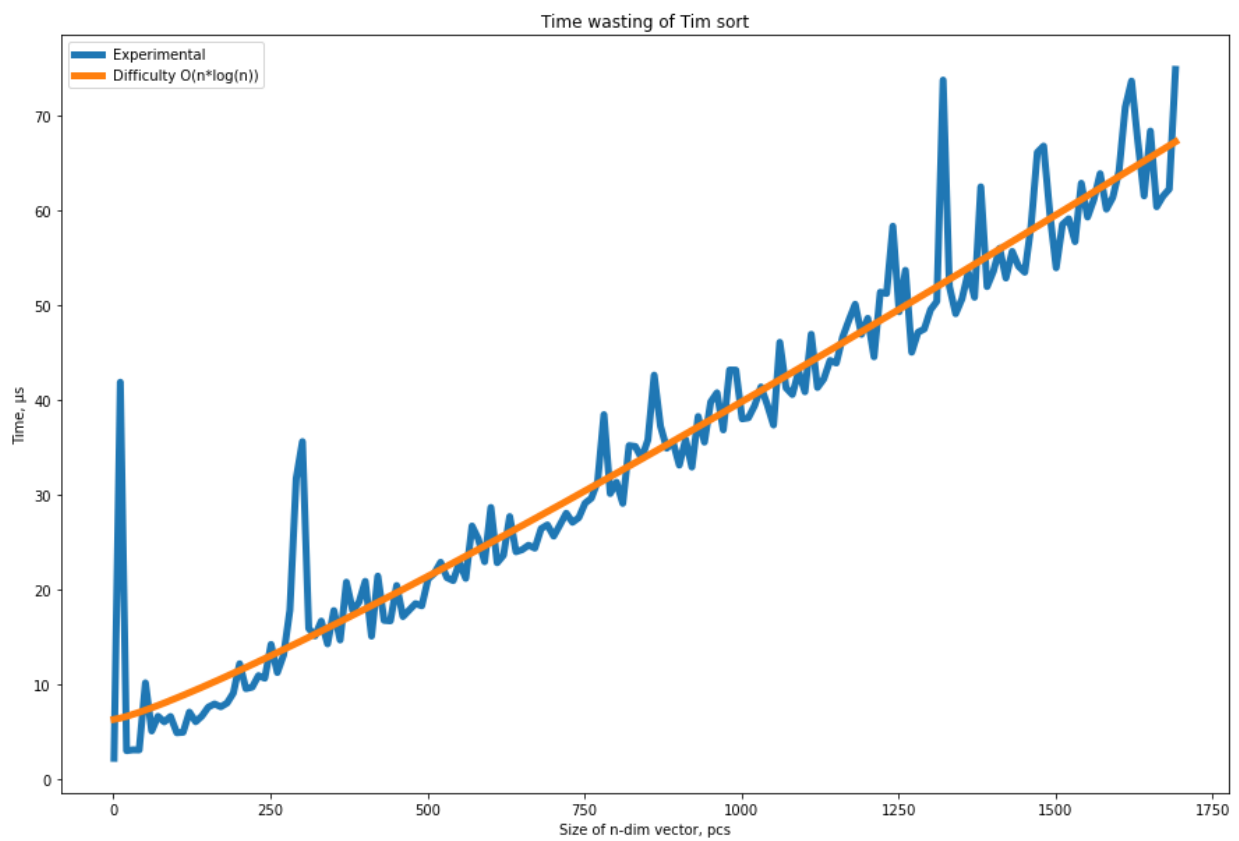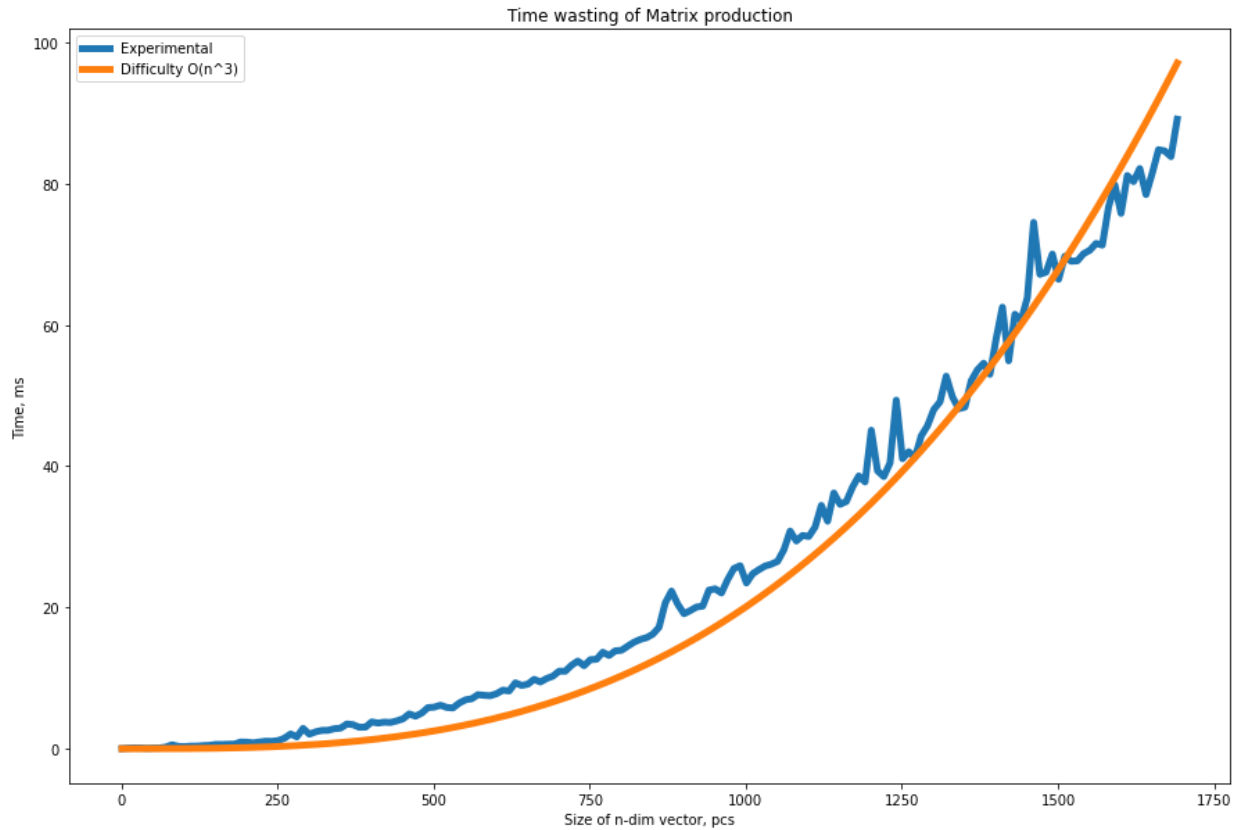
Quick Sort - Theoretical time complexity is O(nlog(n))

Timsort - Theoretical time complexity is O(nlog(n))

Matrix product - Theoretical time complexity is O(n^3)

Time wasting of Matrix production
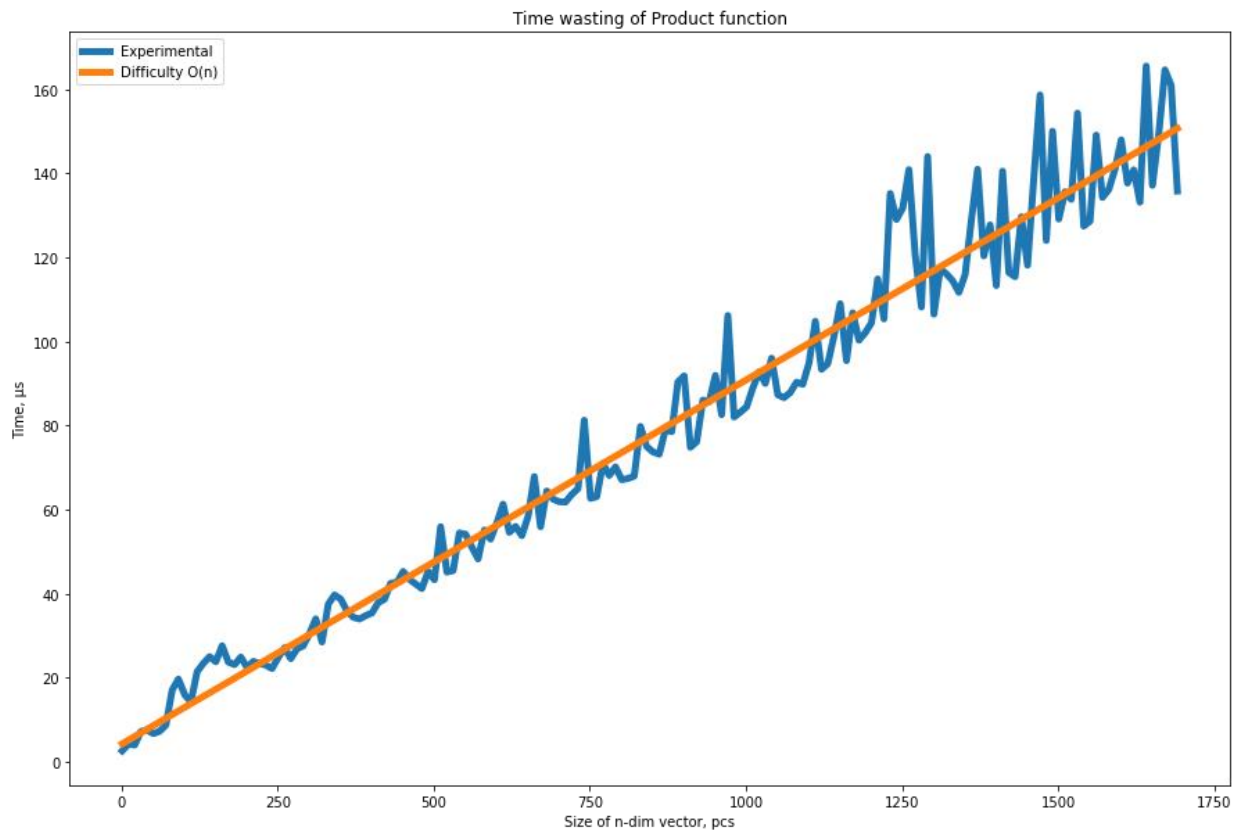
Comparing

Algorithm	Time complexity Experimental	Time complexity Theoretical	Is the same?
Constant function	O(1)	O(1)	☑
Sum of elements	O(n)	O(n)	☑
Product of elements	O(n)	O(n)	☑
Direct calculation of polynomial	O(n*log(n))	O(n*log(n))	☑
Horner's method for calculation polynomial	O(n)	O(n)	☑
Bubble Sort	$O(n^2)$	$O(n^2)$	☑
Quick Sort	O(n*log(n))	O(n*log(n))	☑
Timsort	O(n*log(n))	O(n*log(n))	☑
Matrix product	$O(n^3)$	$O(n^3)$	☑

Conclusions

From the obtained charts we can see that the experimental time complexity matches the theoretical one. Although there are periodic deviations from the theoretical complexity curve, they can be explained by the background processes of the system. The set goal has been achieved.

Appendix

https://github.com/AAYamoldin/TrainingPrograms/blob/master/Python/ITMO_algorithms_lab/task1_Experimental_time_complexity_analysis.ipynb