Lab 5 - Parallelizing techniques

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Goal

The goal of this lab is to implement a simple but non-trivial parallel algorithm.

Requirement

Perform the multiplication of 2 polynomials. Use both the regular *$O(n^2)$* algorithm and the Karatsuba algorithm, and each in both the sequencial form and a parallelized form. Compare the 4 variants.

The documentation will describe:

- the algorithms,
- the synchronization used in the parallelized variants,
- the performance measurements

Short Description of the Implementation

Algorithms: • Regular Polynomial Multiplication

• Karatsuba Algorithm

Regular Polynomial Multiplication

• Complexity: O(n^2)

• *Sequential Form*: multiply every term of the first polynomial with every term of the second polynomial (multiply the coefficient and add the exponents)

• *Parallel Form*: each thread will calculate a part of the resulting polynomial. When the previous step is calculated a new thread is launched

Karatsuba algorithm

- A fast multiplication algorithm that uses a divide and conquers approach to multiply two numbers
- Complexity: O(n^log3)
- *Sequential Form*: the polynomials are split into lower and higher parts which have equal length. The algorithm is called recursively for the lower part, higher part and for the sum of the lower and higher part.
- *Parallel Form*: the method is the same but instead of calling the functions sequentially we called them asynchronously so the parallelization occurs when the higher, middle and lower parts are calculated.

Computer Specification

- CPU: Intel Core i7-10750H, 2.6 (5)Ghz
- RAM: 16 GB
- System Type: Windows 10 Home 64 bit

Performance

Algorithm \ Degree	**5**	**10**	**15**
Sequential Normal	0.0099	0.0	0.0149
Parallel Normal	0.0069	0.0169	0.0179
Seq Karatsuba	0.0	0.0	0.0
Parallel Karatsuba	0.0059	0.006	0.0169