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Lab 6
Documentation

Requirement

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

Regular algorithm:

- multiply two polynomials term by term; take ever term of first polynomial and multiply it with every term of second polynomial.

Karatsuba algorithm:

Then the product $C(x) = A(x)B(x) = \sum_{i=0}^{2n-2} c_i x^i$ can be determined by using the following values of c_i:

$$c_0 = D_0$$
$$c_{2n-2} = D_{n-1}$$

$$c_i = \begin{cases} \sum_{p+q=i, q>p \geq 0} D_{p,q} - \sum_{p+q=i, q>p \geq 0} (D_p + D_q), & \text{for odd values of } i, 0 < i < 2n-2 \\ \sum_{p+q=i, q>p \geq 0} D_{p,q} - \sum_{p+q=i, q>p \geq 0} (D_p + D_q) + D_{i/2}, & \text{for even values of } i, 0 < i < 2n-2 \end{cases} \quad (16)$$

Performance:

-degree 5:

5 degree polynomials on one thread: 231 nanoseconds

5 degree polynomials on one thread (Karatsuba): 231 nanoseconds

5 degree polynomials on 4 threads: 204165 nanoseconds

5 degree polynomials on 4 threads (Karatsuba): 157994 nanoseconds

-degree 100:

100 degree polynomials on one thread: 28194 nanoseconds

100 degree polynomials on one thread (Karatsuba): 38181 nanoseconds

100 degree polynomials on 25 threads: 836199 nanoseconds

100 degree polynomials on 25 threads (Karatsuba): 591139 nanoseconds

100 degree polynomials on 75 threads: 2731026 nanos

100 degree polynomials on 75 threads (Karatsuba): 2719630 nanos

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-degree 1000

1000 degree polynomials on one thread: 2784221 nanoseconds

1000 degree polynomials on one thread (Karatsuba): 2433860 nanoseconds

1000 degree polynomials on 500 threads: 20786677 nanoseconds

1000 degree polynomials on 500 threads (Karatsuba): 14811141 nanoseconds

1000 degree polynomials on 5000 threads: 125373067 nanoseconds

1000 degree polynomials on 5000 threads (Karatsuba): 85254132 nanoseconds