

CUDA Programming

Requirement

Perform the multiplication of 2 polynomials. Use either the regular $O(n^2)$ algorithm and the Karatsuba algorithm (bonus for both).

Solution

$O(n^2)$ - sequential

A simple solution is to one by one consider every term of first polynomial and multiply it with every term of second polynomial.

For each element from the first array we multiply on GPU with all the elements from the second array.

Karatsuba - sequential - complexity: $O(n^{\log 3})$

A fast multiplication algorithm that uses a divide and conquer approach to multiply two numbers. It reduces the multiplication of two n -digit numbers to at most $n^{\log 3}$ approx $n^{1.58}$ single-digit multiplications in general (and exactly $n^{\log 3}$ when n is a power of 2).

We have on GPU a function that calls a recursive function that divides the array in the 4 components needed and computes the result by recursively calling the karatsuba function.

Hardware

Processor: Intel(R) Core(™) i7-8750H CPU @ 2.20GHz 2.21 GHz

GPU: NVIDIA GeForce GTX 1050 Ti

RAM: 16 GB

System type: 64-bit OS

Platform: Windows 10

Tests

Polynomials sizes	Number of threads	Method	Time taken
70 x 70	1	$O(n^2)$ sequential	0.00046 s
70 x 70	1	$O(n^2)$ CUDA	1 ms
70 x 70	1	Karatsuba sequential	0.009595 s
70 x 70	1	Karatsuba CUDA	2 ms

