

MPI Programming

Requirement

Perform the multiplication of 2 polynomials, by distributing computation across several nodes using MPI. Use both the regular $O(n^2)$ algorithm and the Karatsuba algorithm.

Solution

$O(n^2)$

Each worker gets a chunk of the end result to commute. Let a and b - the polynoms to multiply. Now, let $r = n * m$. Each worked node will have to compute $r[a:b]$ - the result on the positions between a and b It's easy to see that because each worked will need to compute $r[a:b]$ it only needs the values $n[0:b]$ and $m[0:b]$.

Karatsuba

Complexity: $O(n^{\log 3})$

Divide the work throughout all the n workers which will execute the karatsuba algorithm on their parts of the arrays. The master assigns work for each of the workers which will send the result to the master again, which at the end will collect all the results and compare the final result with the correct one - the brute one.

Big numbers

For big numbers , they are generated in the same way, but the generator used is a function that returns only random digits, not numbers, the results of the computations being the same.

Hardware

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

RAM: 16 GB

System type: 64-bit OS

Platform: Windows 10

Tests

The karatsuba algorithm seems to execute faster than the naive one, which is to be expected but the MPI algorithms do not proceed faster.