**PDP Lab. 7**

**-documentation-**

**Algorithms:**

* The algorithms use divide and conquer for computing the result of multiplication of two polynomials of same size s=2^n, for every n ϵ N\*.
* The first MPI host (i.e., having rank=0) starts the algorithm by calling the recursive function for multiplying the polynomials.
* The other hosts call the worker function for multiplying the polynomials.

**Distribution & Communication:**

* In order to compute the result of the multiplication, one must compute other partial results. These partial results imply 4 more multiplications for the regular algorithm and 3 more multiplications for the Karatsuba algorithm, respectively. One of the multiplications is computed by the current MPI host, not before assigning the remaining ones to other MPI hosts, if available; if not, those multiplications are computed by the same MPI host.
* The formula used for distributing the MPI host is:

where:

* r = rank of current host
* m = no. of partial multiplications required by the alg. (3 or 4)
* p = power (increases as the level of recursion does), p= 0,1,..
* i = index of partial multiplication, iϵ[0,1,..,m)
* The communication between MPI hosts is synchronous. Used methods are *Send(…)* and *Recv(…)*

**Performance:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| First Pol. | Second Pol. | Result Pol. | MPI hosts | | | | | |
| 1 | | 4 | | 16 | |
| Reg. (µs) | Kar. (µs) | Reg. (µs) | Kar. (µs) | Reg. (µs) | Kar. (µs) |
| 1\*x^0 | 2\*x^0 | 2\*x^0 | 3052 | 1121 | 4762 | 4128 | 11476 | 18459 |
| 1\*x^1+2\*x^0 | 3\*x^1+4\*x^0 | 3\*x^2+10\*x^1+8\*x^0 | 778 | 1028 | 8372 | 5324 | 31382 | 17026 |
| 1\*x^3+2\*x^2+3\*x^1+4\*x^0 | 5\*x^3+6\*x^2+7\*x^1+8\*x^0 | 5\*x^6+16\*x^5+34\*x^4+60\*x^3+61\*x^2+52\*x^1+32\*x^0 | 40 | 32 | 9627 | 8463 | 31750 | 26534 |
| 1\*x^7+2\*x^6+3\*x^5+4\*x^4+5\*x^3+6\*x^2+7\*x^1+8\*x^0 | 9\*x^7+10\*x^6+11\*x^5+12\*x^4+13\*x^3+14\*x^2+15\*x^1+16\*x^0 | 9\*x^14+28\*x^13+58\*x^12+100\*x^11+155\*x^10+224\*x^9+308\*x^8+408\*x^7+427\*x^6+428\*x^5+410\*x^4+372\*x^3+313\*x^2+232\*x^1+128\*x^0 | 412 | 104 | 10645 | 9279 | 60468 | 55887 |