Программа:

*//--------------------Подключаемые* *библиотеки--------------------//*

#include <headers/mpi.h>

#include <iostream>

#include <cstring>

#include <chrono>

#include <time.h>

*using* *namespace* std;

int **main**(int argc, char\* argv[])

{

*//--------------------Иициализация--------------------//*

int sizeX = 100;

int procNum, procRank, recv;

int m=5;*//кол-во* *итераций*

MPI\_Init(&argc, *&argv*);

MPI\_Comm\_size(MPI\_COMM\_WORLD, *&procNum*);

MPI\_Comm\_rank(MPI\_COMM\_WORLD, *&procRank*);

*//семя* *для* *функции* *rand(),* *смещено,* *чтобы* *было* *разное* *у* *разных* *процессов*

srand(time(0)+procRank + 314159 \* 451 % 42);

int allSum = 0;

*auto* start = std::chrono::steady\_clock::now();

*//--------------------Запуск* *цикла--------------------//*

*if* (procRank == 0) {

recv = 0;

cout << "Num of processors: " << procNum << endl;

cout << "Main process with rank: " << procRank << endl;

cout << "Start broadcasting" << endl;

MPI\_Bcast(*&recv*, 1, MPI\_INT, procRank, MPI\_COMM\_WORLD);

}

*//--------------------Главный* *цикл--------------------//*

*while*(*true*) {

int globalSum = 0;

int localSum = 0;

*for*(int i = 0; i < sizeX; ++i){

localSum += rand() % 100;

}

cout << "Local sum of process " << procRank << " is " << localSum << endl;

MPI\_Reduce(&localSum, *&globalSum*, 1, MPI\_INT, MPI\_SUM, 0, MPI\_COMM\_WORLD);

*if*(procRank == 0){

allSum += globalSum;

cout << "Global sum is " << globalSum << endl;

}

*//Вычисляем* *значение* *root,* *из* *которого* *будем* *получать* *сообщение*

int fromProc = (procNum+procRank-1) % procNum;

cout << "Processor " << procRank << " recv the message from root " << fromProc << endl;

*//Получаем* *сообщение*

MPI\_Bcast(*&recv*, 1, MPI\_INT, fromProc, MPI\_COMM\_WORLD);

cout << "Processor " << procRank << " recv the message " << recv << endl;

*//Увеличиваем* *значение* *счётчика* *на* *1*

int nextCount = recv + 1;

cout << "Processor " << procRank << " send the message " << nextCount << endl;

*//Потом* *отправляем* *сообщение*

MPI\_Bcast(*&nextCount*, 1, MPI\_INT, procRank, MPI\_COMM\_WORLD);

*//Проверяем* *завершение* *цикла,* *m* *кол-во* *итераций,* *а* *(recv-1)/procNum* *текующая* *итерация*

*if*((recv-1)/procNum == m-1){

*break*;

}

}

*if*(procRank == 0){

cout << "Final sum is " << allSum << endl;

}

*//--------------------Завершение* *работы* *MPI--------------------//*

MPI\_Finalize();

*auto* end = std::chrono::steady\_clock::now();

std::chrono::duration<double> elapsed\_seconds = end-start;

std::cout << "elapsed time: " << elapsed\_seconds.count() << "s\n";

*return* 0;

}

Вывод программы (4 процесса):

Local sum of process 1 is 5106

Local sum of process 3 is 4524

Local sum of process 2 is 4845

Num of processors: 4

Main process with rank: 0

Start broadcasting

Processor 1 recv the message from root 0

Processor 3 recv the message from root 2

Local sum of process 0 is 4980

Processor 1 recv the message 0

Processor 1 send the message 1

Processor 2 recv the message from root 1

Global sum is 19455

Processor 0 recv the message from root 3

Local sum of process 1 is 4663

Processor 1 recv the message from root 0

Processor 2 recv the message 1

Processor 2 send the message 2

Local sum of process 2 is 4755

Processor 3 recv the message 2

Processor 3 send the message 3

Local sum of process 3 is 5105

Processor 2 recv the message from root 1

Processor 3 recv the message from root 2

Processor 0 recv the message 3

Processor 0 send the message 4

Local sum of process 0 is 4690

Processor 1 recv the message 4

Global sum is 19213

Processor 1 send the message 5

Processor 0 recv the message from root 3

Processor 2 recv the message 5

Local sum of process 1 is 4850

Processor 2 send the message 6

Processor 1 recv the message from root 0

Processor 3 recv the message 6

Local sum of process 2 is 4975

Processor 3 send the message 7

Processor 0 recv the message 7

Local sum of process 3 is 4342

Processor 0 send the message 8

Processor 2 recv the message from root 1

Processor 3 recv the message from root 2

Processor 1 recv the message 8

Local sum of process 0 is 5020

Processor 1 send the message 9

Processor 2 recv the message 9

Global sum is 19187

Local sum of process 1 is 5155

Processor 2 send the message 10

Processor 3 recv the message 10

Processor 0 recv the message from root 3

Processor 1 recv the message from root 0

Local sum of process 2 is 4941

Processor 3 send the message 11

Processor 0 recv the message 11

Local sum of process 3 is 5109

Processor 2 recv the message from root 1

Processor 0 send the message 12

Processor 1 recv the message 12

Processor 3 recv the message from root 2

Local sum of process 0 is 5050

Processor 1 send the message 13

Processor 2 recv the message 13

Global sum is 20255

Local sum of process 1 is 4959

Processor 2 send the message 14

Processor 3 recv the message 14

Processor 0 recv the message from root 3

Processor 1 recv the message from root 0

Local sum of process 2 is 4932

Processor 3 send the message 15

Processor 0 recv the message 15

Local sum of process 3 is 4824

Processor 0 send the message 16

Processor 2 recv the message from root 1

Processor 3 recv the message from root 2

Processor 1 recv the message 16

Local sum of process 0 is 4459

Processor 1 send the message 17

Global sum is 19174

Processor 2 recv the message 17

Local sum of process 1 is 4571

Processor 0 recv the message from root 3

Processor 2 send the message 18

Processor 3 recv the message 18

Processor 1 recv the message from root 0

Processor 3 send the message 19

Processor 0 recv the message 19

Processor 0 send the message 20

Final sum is 97284

Processor 1 recv the message 20