МИНОБРНАУКИ РОССИИ

Федеральное государственное автономное образовательное

учреждение высшего профессионального образования

«ЮЖНЫЙ ФЕДЕРАЛЬНЫЙ УНИВЕРСИТЕТ»

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Отчет

Тема: Блочные вычисления. Модели времени выполнения программ. Блочные размещения массивов, дополняющие блочные вычисления.

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**Формулировка задачи**

**Вариант 40**

Написать программу блочного умножения двух матриц C = A\*B.

Матрица A нижне-треугольная. Хранится в виде одномерного массива по блочным столбцам. Матрица B симметричная, хранится как верхне-треугольная. Хранится в виде одномерного массива по блочным столбцам. Распараллелить блочную программу умножения двух матриц C = A\*B с использованием технологии OpenMP двумя способами

• Перемножение каждых двух блоков выполнить параллельно

• В разных вычислительных ядрах одновременно перемножать разные пары блоков. Определить оптимальные размеры блоков в обоих случаях.

Провести численные эксперименты и построить таблицу сравнений времени выполнения различных программных реализаций решения задачи. Определить лучшие реализации. Проверить корректность (правильность) программ

**Алгоритм решения**

Блочное умножение матриц – умножение строки блоков матрицы А на столбец блоков матрицы В.

Первым и самым важным шагом алгоритма является построение матриц и определение их способа хранения. За это отвечают функции getA(i,j) и getB(i,j), которые позволяют по заданной строке и столбцу получить соответствующий элемент матрицы. Такое представление матриц возникает в связи с условием их хранения в виде одномерных массивов по блочным столбцам. Смещения служат способом доступа к началу соответствующего блока матрицы.

Непосредственно блочное умножение реализовано с помощью следующей функции:

void mul(int \*c, int n, int blockSize = 0, int blockNumb\_i = 0, int blockNumb\_j = 0, int posInBlock = 0)

{

if (blockSize == 0)

blockSize = n;

for (int i = blockNumb\_i; i < blockNumb\_i + blockSize; i++)

{

for (int j = blockNumb\_j; j < blockNumb\_j + blockSize; j++)

{

for (int k = posInBlock; k < posInBlock + blockSize; k++)

{

C[i \* n + j] += getA(i, k) \* getB(k, j);

}

}

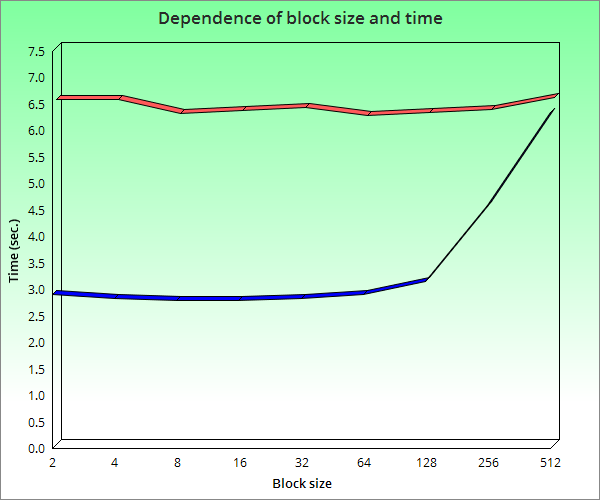
}

}

Размер блоков может быть задан пользователем в процессе программирования. Для стандартного перемножения матриц размеры блоков в самом начале равны нулю. Программа в результате отладки оповещает пользователя о том, блочный или не блочный вариант был использован. В качестве не блочного варианта подразумевается вариант, когда размер блока равен нулю.

**Полученные результаты**

При блочном умножении матриц получили результаты, которые можно представить в виде графика:



Красная линия – непараллельный вариант

Синяя линия – параллельный вариант

Результат работы программы:

OpenMP OK

amountElements = 10

Mullt. isBlocked–Mult : no size = 4 --- --- time is 2.73699e-05sec.

Mullt. isBlocked–Mult : yes size = 4 Threads : 1 blockSize = 4 time is 8.50421e-05sec. Mullt. isBlocked–Mult : yes size = 4 Threads : 2 blockSize = 2 time is 0.00789181sec. Mullt. isBlocked–Mult : yes size = 4 Threads : 2 blockSize = 4 time is 5.37623e-05sec. Mullt. isBlocked–Mult : yes size = 4 Threads : 4 blockSize = 2 time is 0.00679799sec. Mullt. isBlocked–Mult : yes size = 4 Threads : 4 blockSize = 4 time is 8.01547e-05sec. Mullt. isBlocked–Mult : yes size = 4 Threads : 8 blockSize = 2 time is 0.013224sec. Mullt. isBlocked–Mult : yes size = 4 Threads : 8 blockSize = 4 time is 5.4251e-05sec. Mullt. isBlocked–Mult : yes size = 4 Threads : 16 blockSize = 2 time is 0.0195871sec. Mullt. isBlocked–Mult : yes size = 4 Threads : 16 blockSize = 4 time is 2.73699e-05sec. Mullt. isBlocked–Mult : yes size = 4 Threads : 32 blockSize = 2 time is 0.0440728sec. Mullt. isBlocked–Mult : yes size = 4 Threads : 32 blockSize = 4 time is 0.000167152sec.

amountElements = 36 Mullt. isBlocked–Mult : no size = 8 --- --- time is 0.000246329sec. Mullt. isBlocked–Mult : yes size = 8 Threads : 1 blockSize = 8 time is 0.000252194sec. Mullt. isBlocked–Mult : yes size = 8 Threads : 2 blockSize = 2 time is 0.0186335sec. Mullt. isBlocked–Mult : yes size = 8 Threads : 2 blockSize = 4 time is 0.000161287sec. Mullt. isBlocked–Mult : yes size = 8 Threads : 2 blockSize = 8 time is 0.00025366sec. Mullt. isBlocked–Mult : yes size = 8 Threads : 4 blockSize = 2 time is 0.00806678sec. Mullt. isBlocked–Mult : yes size = 8 Threads : 4 blockSize = 4 time is 0.000307911sec. Mullt. isBlocked–Mult : yes size = 8 Threads : 4 blockSize = 8 time is 0.000234599sec. Mullt. isBlocked–Mult : yes size = 8 Threads : 8 blockSize = 2 time is 0.0128345sec. Mullt. isBlocked–Mult : yes size = 8 Threads : 8 blockSize = 4 time is 0.000122187sec. Mullt. isBlocked–Mult : yes size = 8 Threads : 8 blockSize = 8 time is 0.00021065sec. Mullt. isBlocked–Mult : yes size = 8 Threads : 16 blockSize = 2 time is 0.0515785sec. Mullt. isBlocked–Mult : yes size = 8 Threads : 16 blockSize = 4 time is 0.000478484sec. Mullt. isBlocked–Mult : yes size = 8 Threads : 16 blockSize = 8 time is 0.000516606sec. Mullt. isBlocked–Mult : yes size = 8 Threads : 32 blockSize = 2 time is 0.135522sec. Mullt. isBlocked–Mult : yes size = 8 Threads : 32 blockSize = 4 time is 0.000361673sec. Mullt. isBlocked–Mult : yes size = 8 Threads : 32 blockSize = 8 time is 0.000481905sec. amountElements = 136 Mullt. isBlocked–Mult : no size = 16 --- --- time is 0.00137338sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 1 blockSize = 16 time is 0.00118424sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 2 blockSize = 2 time is 0.0156062sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 2 blockSize = 4 time is 0.000923733sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 2 blockSize = 8 time is 0.00146282sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 2 blockSize = 16 time is 0.00118033sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 4 blockSize = 2 time is 0.0116092sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 4 blockSize = 4 time is 0.000885611sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 4 blockSize = 8 time is 0.000836248sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 4 blockSize = 16 time is 0.0016764sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 8 blockSize = 2 time is 0.0283317sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 8 blockSize = 4 time is 0.00200338sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 8 blockSize = 8 time is 0.00137143sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 8 blockSize = 16 time is 0.00164806sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 16 blockSize = 2 time is 0.0296338sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 16 blockSize = 4 time is 0.00233377sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 16 blockSize = 8 time is 0.000837714sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 16 blockSize = 16 time is 0.0134802sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 32 blockSize = 2 time is 0.0854624sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 32 blockSize = 4 time is 0.0016852sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 32 blockSize = 8 time is 0.00619146sec. Mullt. isBlocked–Mult : yes size = 16 Threads : 32 blockSize = 16 time is 0.00384889sec. amountElements = 528 Mullt. isBlocked–Mult : no size = 32 --- --- time is 0.0141576sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 1 blockSize = 32 time is 0.0104123sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 2 blockSize = 2 time is 0.0294871sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 2 blockSize = 4 time is 0.00719877sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 2 blockSize = 8 time is 0.00398134sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 2 blockSize = 16 time is 0.0083874sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 2 blockSize = 32 time is 0.0112959sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 4 blockSize = 2 time is 0.0107236sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 4 blockSize = 4 time is 0.00568609sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 4 blockSize = 8 time is 0.00685615sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 4 blockSize = 16 time is 0.00528581sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 4 blockSize = 32 time is 0.012899sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 8 blockSize = 2 time is 0.0176296sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 8 blockSize = 4 time is 0.00538111sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 8 blockSize = 8 time is 0.00441975sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 8 blockSize = 16 time is 0.00764841sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 8 blockSize = 32 time is 0.0115921sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 16 blockSize = 2 time is 0.0317456sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 16 blockSize = 4 time is 0.00413627sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 16 blockSize = 8 time is 0.00973977sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 16 blockSize = 16 time is 0.00827548sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 16 blockSize = 32 time is 0.00936001sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 32 blockSize = 2 time is 0.0713777sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 32 blockSize = 4 time is 0.00286651sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 32 blockSize = 8 time is 0.00444516sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 32 blockSize = 16 time is 0.0104025sec. Mullt. isBlocked–Mult : yes size = 32 Threads : 32 blockSize = 32 time is 0.013724sec. amountElements = 2080 Mullt. isBlocked–Mult : no size = 64 --- --- time is 0.0956758sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 1 blockSize = 64 time is 0.0740096sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 2 blockSize = 2 time is 0.0291763sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 2 blockSize = 4 time is 0.0310135sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 2 blockSize = 8 time is 0.0297691sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 2 blockSize = 16 time is 0.0269828sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 2 blockSize = 32 time is 0.0326782sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 2 blockSize = 64 time is 0.0973068sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 4 blockSize = 2 time is 0.022132sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 4 blockSize = 4 time is 0.0225714sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 4 blockSize = 8 time is 0.0206056sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 4 blockSize = 16 time is 0.0297647sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 4 blockSize = 32 time is 0.0371307sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 4 blockSize = 64 time is 0.100387sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 8 blockSize = 2 time is 0.0303874sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 8 blockSize = 4 time is 0.0200875sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 8 blockSize = 8 time is 0.0287521sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 8 blockSize = 16 time is 0.0237136sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 8 blockSize = 32 time is 0.0369826sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 8 blockSize = 64 time is 0.0804205sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 16 blockSize = 2 time is 0.0540291sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 16 blockSize = 4 time is 0.0187845sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 16 blockSize = 8 time is 0.0199957sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 16 blockSize = 16 time is 0.0159542sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 16 blockSize = 32 time is 0.0432786sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 16 blockSize = 64 time is 0.104319sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 32 blockSize = 2 time is 0.0899785sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 32 blockSize = 4 time is 0.0113433sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 32 blockSize = 8 time is 0.0171267sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 32 blockSize = 16 time is 0.0178931sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 32 blockSize = 32 time is 0.0373135sec. Mullt. isBlocked–Mult : yes size = 64 Threads : 32 blockSize = 64 time is 0.0971704sec. amountElements = 8256 Mullt. isBlocked–Mult : no size = 128 --- --- time is 0.459178sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 1 blockSize = 128 time is 0.425559sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 2 blockSize = 2 time is 0.14681sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 2 blockSize = 4 time is 0.118329sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 2 blockSize = 8 time is 0.127995sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 2 blockSize = 16 time is 0.130736sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 2 blockSize = 32 time is 0.182107sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 2 blockSize = 64 time is 0.171025sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 2 blockSize = 128 time is 0.548942sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 4 blockSize = 2 time is 0.141961sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 4 blockSize = 4 time is 0.104552sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 4 blockSize = 8 time is 0.0991386sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 4 blockSize = 16 time is 0.108662sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 4 blockSize = 32 time is 0.106202sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 4 blockSize = 64 time is 0.221786sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 4 blockSize = 128 time is 0.411516sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 8 blockSize = 2 time is 0.117817sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 8 blockSize = 4 time is 0.0843496sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 8 blockSize = 8 time is 0.0935634sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 8 blockSize = 16 time is 0.0855421sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 8 blockSize = 32 time is 0.113199sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 8 blockSize = 64 time is 0.211251sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 8 blockSize = 128 time is 0.50018sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 16 blockSize = 2 time is 0.102351sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 16 blockSize = 4 time is 0.0985931sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 16 blockSize = 8 time is 0.0825906sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 16 blockSize = 16 time is 0.0953459sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 16 blockSize = 32 time is 0.114551sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 16 blockSize = 64 time is 0.196353sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 16 blockSize = 128 time is 0.429075sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 32 blockSize = 2 time is 0.120649sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 32 blockSize = 4 time is 0.0805021sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 32 blockSize = 8 time is 0.102383sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 32 blockSize = 16 time is 0.0824703sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 32 blockSize = 32 time is 0.114628sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 32 blockSize = 64 time is 0.222566sec. Mullt. isBlocked–Mult : yes size = 128 Threads : 32 blockSize = 128 time is 0.51881sec. amountElements = 32896 Mullt. isBlocked–Mult : no size = 256 --- --- time is 3.43288sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 1 blockSize = 256 time is 3.68219sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 2 blockSize = 2 time is 1.1814sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 2 blockSize = 4 time is 1.03297sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 2 blockSize = 8 time is 1.02852sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 2 blockSize = 16 time is 1.0136sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 2 blockSize = 32 time is 0.976215sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 2 blockSize = 64 time is 1.10505sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 2 blockSize = 128 time is 1.36157sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 2 blockSize = 256 time is 3.49068sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 4 blockSize = 2 time is 0.712705sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 4 blockSize = 4 time is 0.683879sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 4 blockSize = 8 time is 0.688324sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 4 blockSize = 16 time is 0.693329sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 4 blockSize = 32 time is 0.751611sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 4 blockSize = 64 time is 0.808904sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 4 blockSize = 128 time is 1.31203sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 4 blockSize = 256 time is 3.62888sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 8 blockSize = 2 time is 0.677783sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 8 blockSize = 4 time is 0.587326sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 8 blockSize = 8 time is 0.600411sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 8 blockSize = 16 time is 0.60866sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 8 blockSize = 32 time is 0.660725sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 8 blockSize = 64 time is 0.876109sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 8 blockSize = 128 time is 1.34469sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 8 blockSize = 256 time is 3.61066sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 16 blockSize = 2 time is 0.64401sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 16 blockSize = 4 time is 0.581983sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 16 blockSize = 8 time is 0.61386sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 16 blockSize = 16 time is 0.583435sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 16 blockSize = 32 time is 0.660959sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 16 blockSize = 64 time is 0.869316sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 16 blockSize = 128 time is 1.34163sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 16 blockSize = 256 time is 3.79535sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 32 blockSize = 2 time is 0.665818sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 32 blockSize = 4 time is 0.563396sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 32 blockSize = 8 time is 0.579625sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 32 blockSize = 16 time is 0.587275sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 32 blockSize = 32 time is 0.662603sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 32 blockSize = 64 time is 0.841137sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 32 blockSize = 128 time is 1.30066sec. Mullt. isBlocked–Mult : yes size = 256 Threads : 32 blockSize = 256 time is 3.61245sec. amountElements = 131328 Mullt. isBlocked–Mult : no size = 512 --- --- time is 29.771sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 1 blockSize = 512 time is 29.5101sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 2 blockSize = 2 time is 8.51792sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 2 blockSize = 4 time is 7.84162sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 2 blockSize = 8 time is 7.9008sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 2 blockSize = 16 time is 7.9997sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 2 blockSize = 32 time is 7.80491sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 2 blockSize = 64 time is 8.29867sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 2 blockSize = 128 time is 8.92446sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 2 blockSize = 256 time is 10.3807sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 2 blockSize = 512 time is 30.2607sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 4 blockSize = 2 time is 5.47357sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 4 blockSize = 4 time is 5.01746sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 4 blockSize = 8 time is 4.84967sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 4 blockSize = 16 time is 5.06174sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 4 blockSize = 32 time is 5.14205sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 4 blockSize = 64 time is 5.42983sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 4 blockSize = 128 time is 6.23842sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 4 blockSize = 256 time is 10.6787sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 4 blockSize = 512 time is 29.6012sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 8 blockSize = 2 time is 4.85236sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 8 blockSize = 4 time is 4.58472sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 8 blockSize = 8 time is 4.5298sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 8 blockSize = 16 time is 4.68123sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 8 blockSize = 32 time is 4.79406sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 8 blockSize = 64 time is 5.14044sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 8 blockSize = 128 time is 6.20466sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 8 blockSize = 256 time is 10.4262sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 8 blockSize = 512 time is 29.1058sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 16 blockSize = 2 time is 4.79496sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 16 blockSize = 4 time is 4.51518sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 16 blockSize = 8 time is 4.45564sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 16 blockSize = 16 time is 4.5212sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 16 blockSize = 32 time is 4.69343sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 16 blockSize = 64 time is 5.18029sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 16 blockSize = 128 time is 6.73083sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 16 blockSize = 256 time is 11.0162sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 16 blockSize = 512 time is 29.0548sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 32 blockSize = 2 time is 4.83768sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 32 blockSize = 4 time is 4.48112sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 32 blockSize = 8 time is 4.43176sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 32 blockSize = 16 time is 4.60029sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 32 blockSize = 32 time is 4.81579sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 32 blockSize = 64 time is 5.1367sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 32 blockSize = 128 time is 6.26969sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 32 blockSize = 256 time is 10.8028sec. Mullt. isBlocked–Mult : yes size = 512 Threads : 32 blockSize = 512 time is 29.4241sec.

**Вычисления производились на компьютере со следующими характеристиками:**

Имя устройства: DESKTOP-5GQA7I5

Процессор: Intel® Core™ i3-5010U CPU @ 2.10GHz

Оперативная память: 4 ГБ

Тип системы: 64 разрядная операционная система, процессор x64

Ядра:2

Логических процессоров:4

**Вывод**

Непараллельный вариант работает медленно. Параллельный работает быстрее в 2 раза. Лучший вариант получается при размере блока от 2 до 128. Связано это с тем, что при большем разбиении блока получаем более быструю программу.