



# Математические библиотеки Intel

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# Что нового в высокопроизводительных библиотеках от компании Intel®?

Intel® Math Kernel Library – библиотека быстрых математических примитивов

Intel® Threading Building Blocks – Библиотека управления потоками для C++

Intel® Data Analytics Acceleration Library – Библиотека примитивов для анализа данных для C++/Python

Intel® Integrated Performance Primitives – Обработка изображений, сигналов и данных

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# Параллельная STL: Ускоренные алгоритмы C++ STL

## Intel® Threading Building Blocks версии 2018

### Параллельная библиотека стандартных шаблонов

- Поддержка черновика стандарта C++ 2017
- Методы для распараллеливания и векторизации с помощью компилятора и минимальными изменениями кода
- Выбор способа исполнения работы
- Способы могут выбираться отдельно для каждого задания
- Полностью использует многопоточность из библиотеки Intel® TBB
- Работает с компилятором Intel® C/C++ для векторизации

Пример

```
for_each(exec policy, begin, end, function)
```

|            | Exec Policy             | Режим               |
|------------|-------------------------|---------------------|
| Стандарт   | <i>seq</i>              | Последовательный    |
|            | <i>par</i>              | Параллельный        |
|            | <i>par_vec</i>          | Векторизованный     |
| Расширение | <i>fpga_policy_PSG</i>  | Для PSG FPGA (ПЛИС) |
|            | <i>my_policy_target</i> | Другое оборудование |

# Поддержка новейшего оборудования, улучшенная документация и прочее

## Intel® Data Analytics Acceleration Library версии 2018

- Улучшена страница с [документацией](#) для быстрого поиска нужной информации
- Добавлены некоторые модификации интерфейса для упрощения использования библиотеки и придания ему большей логичности
- Добавлена поддержка алгоритма «случайного леса» с вычислением индекса Джини.
- Добавлен переменный параметр скорости обучения в алгоритме стохастического градиентного спуска
- Улучшена производительность отдельных частей библиотеки

# Поддержка новейшего оборудования, ускоренное сжатие и прочее

## Intel® Integrated Performance Primitives версии 2018

### Оборудование

- Поддержка следующего поколения процессоров серии Intel® Xeon Phi™

### Криптография

- Ликвидирована зависимость от основного пакета Intel® IPP и его версии

### Сжатие

- Оптимизация алгоритма LZO (сжатие без потерь) с использованием инструкций SSE4.2 и AVX2
- Улучшенная производительность

# Intel® Math Kernel Library



Energy



Science & Research



Engineering Design



Financial Analytics

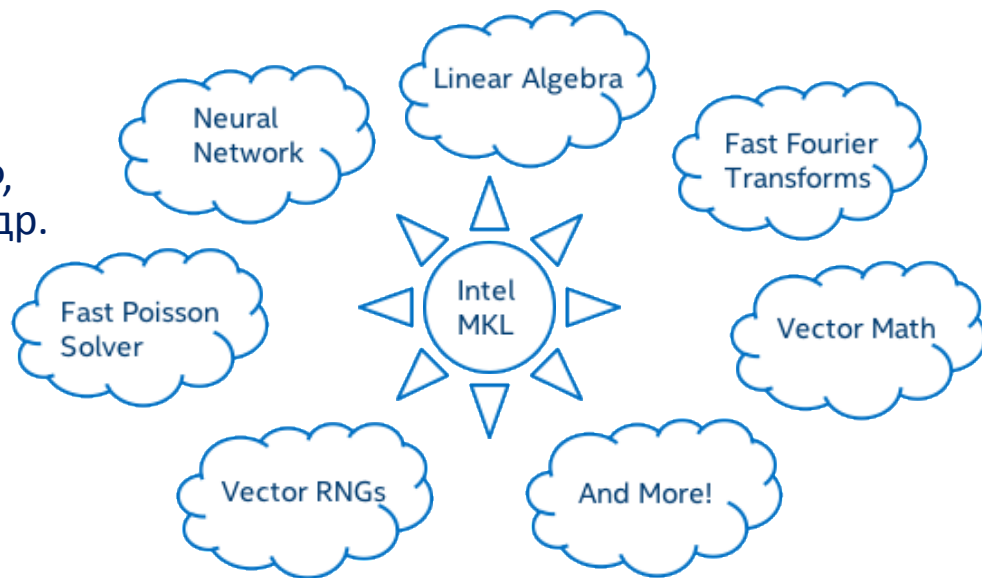


Signal Processing



Digital Content Creation

- Ускоряет математические вычисления в задачах машинного обучения, научных, финансовых и инженерных приложений
- Содержит функции для линейной алгебры (BLAS, LAPACK, PARDISO), БПФ, векторной математики, статистики и др.
- Использует имеющиеся на рынке стандартные интерфейсы для лёгкой смены библиотек
- Оптимизированные, параллелизованные и векторизованные программы для максимальной производительности



# Компоненты Intel® MKL 2018

## Линейная алгебра

- BLAS
- LAPACK
- ScaLAPACK
- Sparse BLAS
- Sparse Solvers
  - Iterative
  - PARDISO\*
- Cluster Sparse Solver

## Быстрые преобразования Фурье

- Многомерные
- FFTW интерфейсы
- Cluster FFT

## Векторные функции

- Тригонометрические
- Гиперболические
- Экспоненты
- Логарифмы
- Степенные
- Корни
- Генераторы случайных чисел

## Статистика

- Эксцесс
- Коэффициенты вариации
- Статистика рангов
- Min/max
- Дисперсия, ковариация

## А также

- Сплаины
- Интерполяция
- Trust Region
- Fast Poisson Solver
- Свёртки
- Нормализации
- И др. 😊

# Как Intel® Math Kernel Library (Intel® MKL) работает?

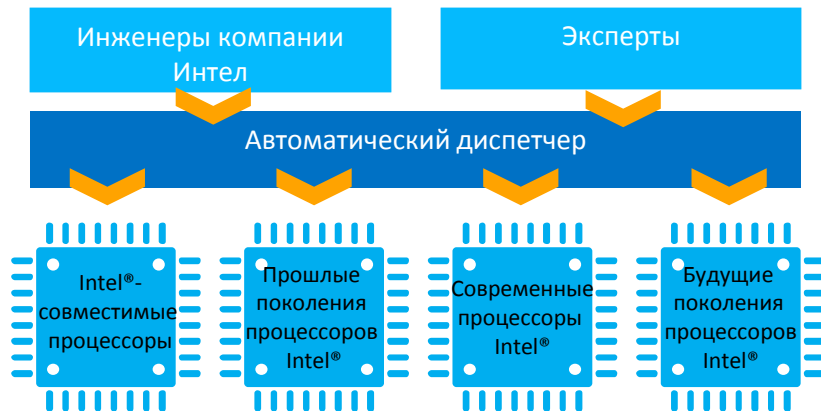
Оптимизированные математические примитивы

- Производительность – наше всё 😊!

Самая популярная библиотека математических примитивов в мире

- Используется везде 😊 (например, в Matlab, CADax)

Заточена под существующие и будущие процессоры компании Интел, НО работает на всех x86 совместимых процессорах



EDC North America  
Development Survey 2016,  
Volume I

Большинство пользователей  
математических библиотек используют  
MKL

**Знает всё о многоядерных  
процессорах и системах**

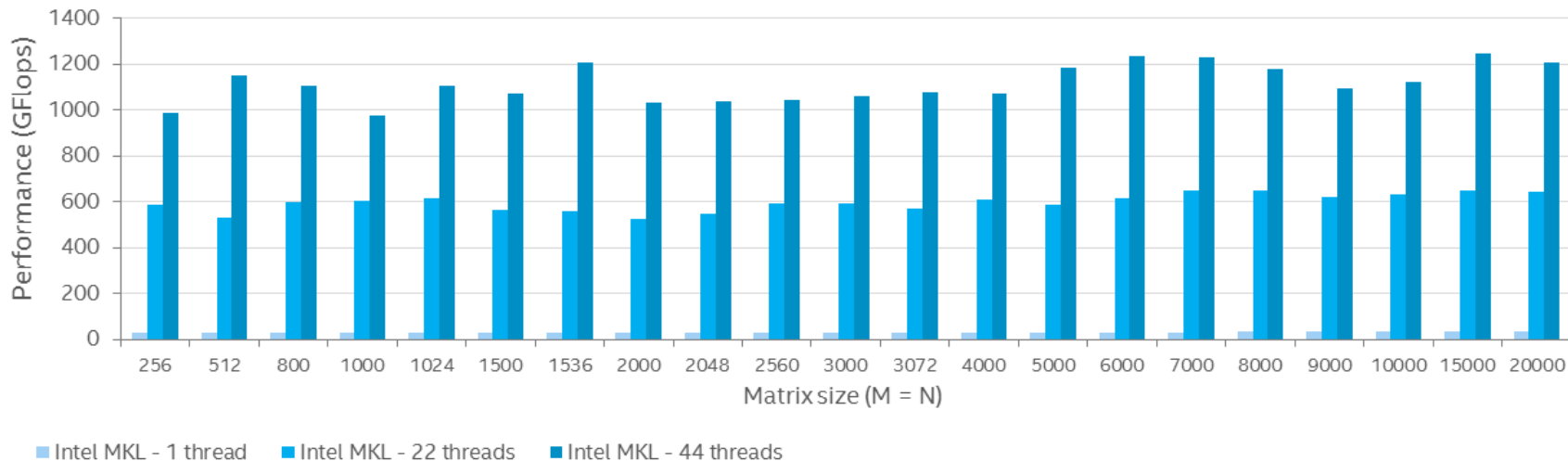
- Поддерживает все платформы
- Векторизована, параллельна и работает с кластерами



# Intel® MKL: оцените производительность на Зеонах!

## DGEMM Performance

On Intel® Xeon® Processor E5-2699 v4



Configuration Info - Versions: Intel® Math Kernel Library (Intel® MKL) 2017; Hardware: Intel® Xeon® Processor E5-2699 v4, 2 Twenty-two-core CPU (55MB smart cache, 2.2GHz), 64GB of RAM; Operating System: RHEL 7.2 GA x86\_64;

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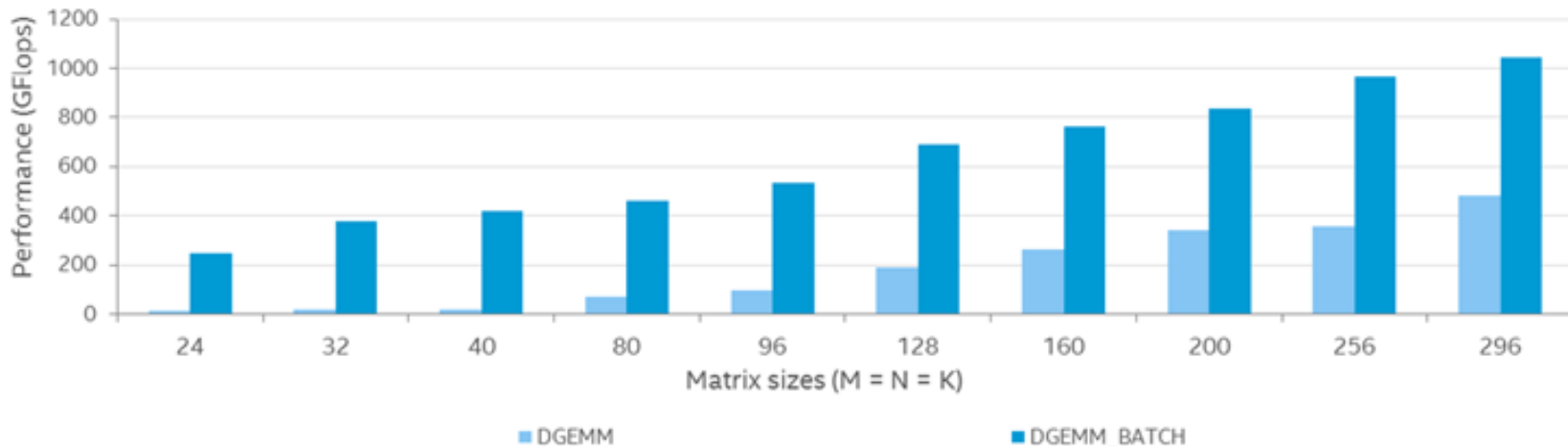
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# Intel® MKL: оцените производительность на Зеонах!

## Faster 1,000 Small Matrix Multiplications using Intel® MKL DGEMM\_BATCH DGEMM\_BATCH vs DGEMM, Intel® Xeon® Processor E5-2699 v4 (44 threads)



Configuration Info - Versions: Intel® Math Kernel Library (Intel® MKL) 2017; Hardware: Intel® Xeon® Processor E5-2699 v4, 2 Twenty-two-core CPU (55MB smart cache, 2.2GHz), 64GB of RAM; Operating System: RHEL 7.2 GA x86\_64;

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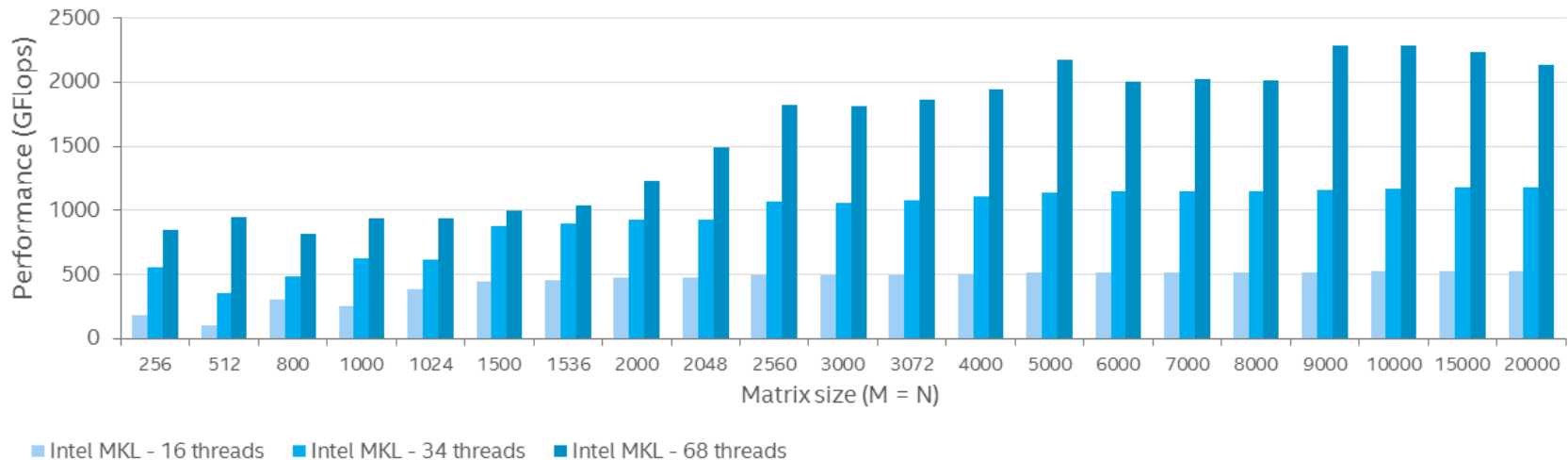
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# Intel® MKL: оцените производительность на Xeon Phi 😊!

## DGEMM Performance On Intel® Xeon Phi™ Processor 7250



Configuration Info - Versions: Intel® Math Kernel Library (Intel® MKL) 2017; Hardware: Intel® Xeon Phi™ Processor 7250, 68 cores (34MB L2 cache, 1.4GHz), 96 GB of DDR4 RAM and 16 GB MCDRAM; Operating System: RHEL 7.2 GA x86\_64;

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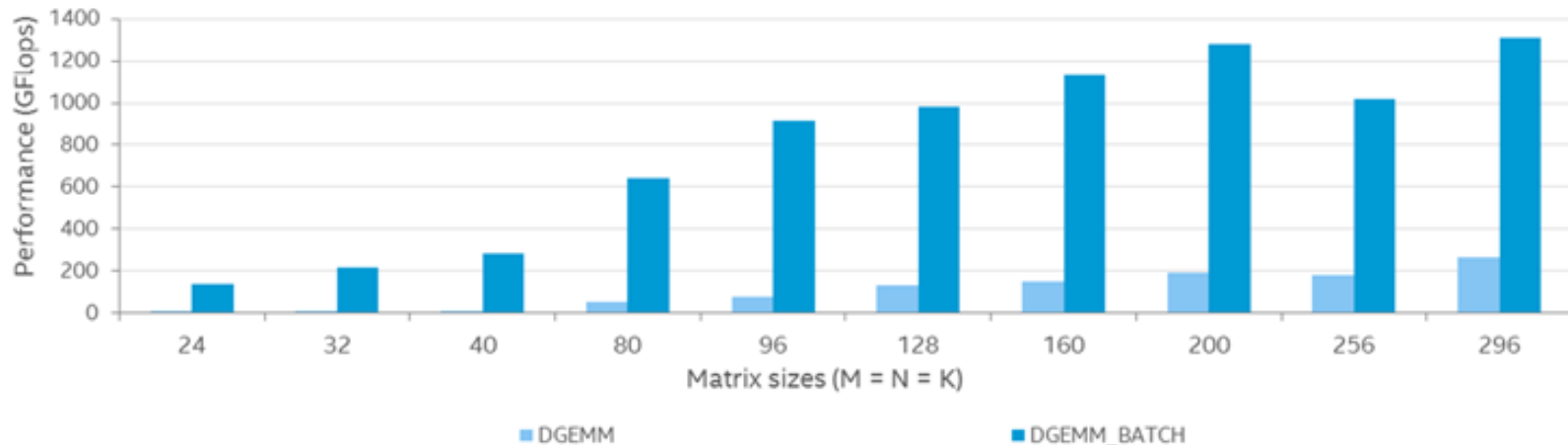
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# Intel® MKL: оцените производительность на Зеон Фи😊!

## Faster 1,000 Small Matrix Multiplications using Intel® MKL DGEMM\_BATCH DGEMM\_BATCH vs DGEMM, Intel® Xeon Phi™ Processor 7250 (68 threads)



Configuration Info - Versions: Intel® Math Kernel Library (Intel® MKL) 2017; Hardware: Intel® Xeon Phi™ Processor 7250, 68 cores (34MB L2 cache, 1.4GHz), 96 GB of DDR4 RAM and 16 GB MCDRAM; Operating System: RHEL 7.2 GA x86\_64;

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# Новые и дополненные математические функции Intel® Math Kernel Library версии 2018


## BLAS



Новые функции  
целочисленного  
умножения



Улучшенная  
производительность  
SGEMM




Оптимизированные  
свёртки и  
внутренние  
произведения

## BLAS Групповой интерфейс




Эффективность и  
производительность



Новый групповой  
интерфейс для решения  
треугольных матриц

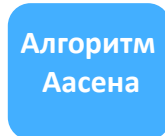


Ускоренный  
GEMM\_BATCH



Подходит для  
маленьких и  
средних  
матриц

## LAPACK



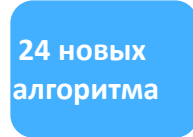
Алгоритм  
Аасена

Функции  
факторизации  
и решения  
систем



Улучшенная  
производительность

## Новые векторные функции



24 новых  
алгоритма

Богатый выбор  
оптимизированных  
функций

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<https://software.intel.com/en-us/performance-libraries>

ВОПРОСЫ

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