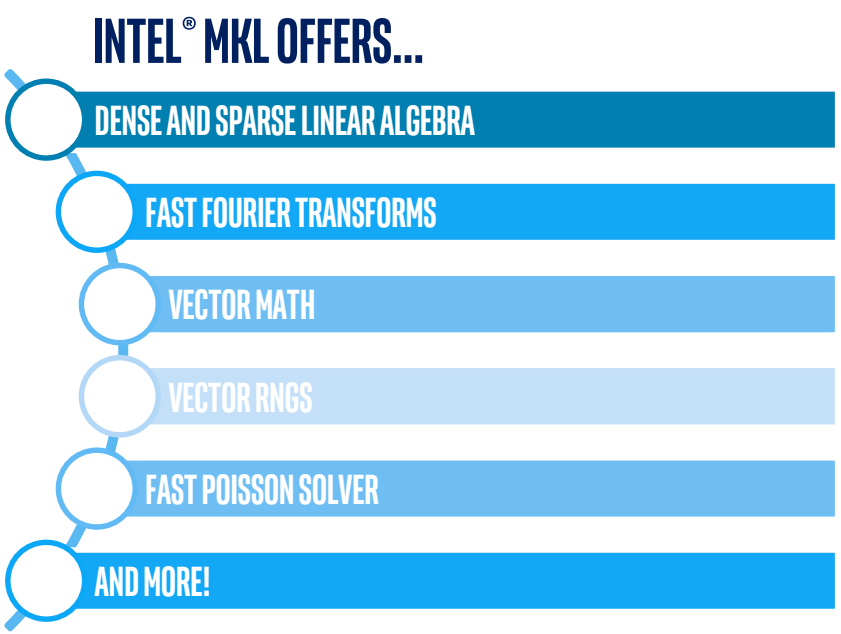
SOFTWARE SUSTAINABILITY CONSIDERATIONS FOR A PERFORMANCE LIBRARY

Intel® Math Kernel Library (Intel® MKL)

Faster, Scalable Code with Intel® Math Kernel Library

- Speeds computations for scientific, engineering, financial and machine learning applications by providing highly optimized, threaded, and vectorized math functions
- Provides key functionality for dense and sparse linear algebra (BLAS, LAPACK, PARDISO), FFTs, vector math, summary statistics, deep learning, splines and more
- Dispatches optimized code for each processor automatically without the need to branch code
- Optimized for single core vectorization and cache utilization
- Automatic parallelism for multi-core and many-core
- Scales from core to clusters
- Available at no cost and royalty free
- Great performance with minimal effort!



Available as standalone or as a part of Intel® Parallel Studio XE and Intel® System Studio

Intel® Architecture Platforms

Operating System: Windows*, Linux*, MacOS[1]*

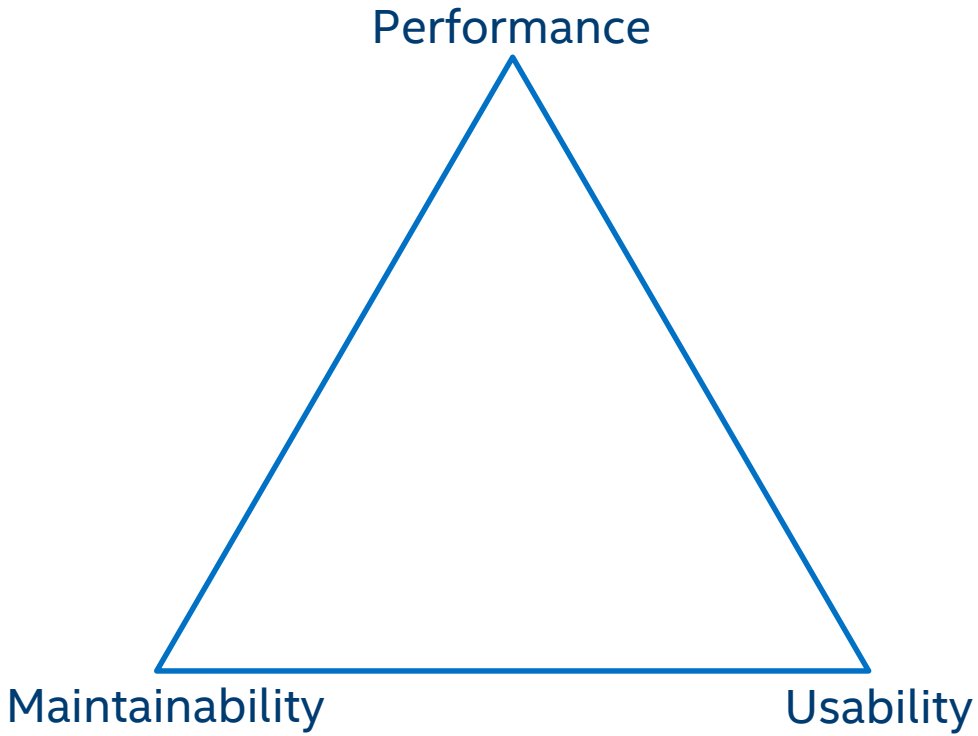
Optimization Notice
Copyright © 2019, Intel Corporation. All rights reserved.
*Other names and brands may be claimed as the property of others.

[1] Available only in Intel® Parallel Studio Composer Edition.

Intel MKL - 25 Years of Features and Performance

Year	Intel MKL Release	Processor	ISA	Features
1994	Intel® BLAS Library for Pentium Processor	Pentium	x87	BLAS
		Pentium II		
1996	Intel MKL 1.0			BLAS 3 Threaded
	2.0		MMX	2D FFTs
1998	2.1			Sparse Level 1 BLAS
	3.0	Pentium III	Intel® SSE	LAPACK
2000	4.0			Vector Math
	5.0	Pentium 4	Intel® SSE2	
2002	6.0	Itanium®		DFTI & Vector Statistics
	7.0			PARDISO* & ScaLAPACK
2004	7.1	EM64T (Prescott)	Intel® SSE3	
	8.0	Nacona		Sparse L2/L3 BLAS & F95
2006	9.0	Merom	Intel® SSSE3	Trig Transforms & Poisson Solver
	9.1	Penryn	Intel® SSE4.1	Trust Region & Linpack Benchmark
2008	10.0/10.1			Out-of-core PARDISO*
	10.2	Xeon E5* (Nehalem)	Intel® SSE4.2	LAPACK 3.2
2010	10.3			LAPACKE & Data Fitting
		Xeon E5* (Westmere)		
2012	11.0	E5 (Sandy Bridge) & Intel Xeon® Phi (KNC)	Intel® AVX	Reproducibility & Extended Eigensolver & Automatic Offload
	11.1	E5 V2 (Ivybridge)		Reproducibility Enhancements
2014	11.2	E5 V3 (Haswell)	Intel® AVX2	Cluster Direct Sparse Solver & LAPACK 3.5 & Verbose Mode
	11.3			Community Licenses & Sparse Inspector Executor & TBB Support
2016	2017	E5 V4 (Broadwell) & Intel Xeon® Phi (KNL)	Intel® AVX512	Deep Neural Networks
	2018	Intel Xeon® Processor (Skylake Server)		Compact BLAS and LAPACK & Integer GEMM
2018	2019			JIT GEMM & Sparse QR Solvers

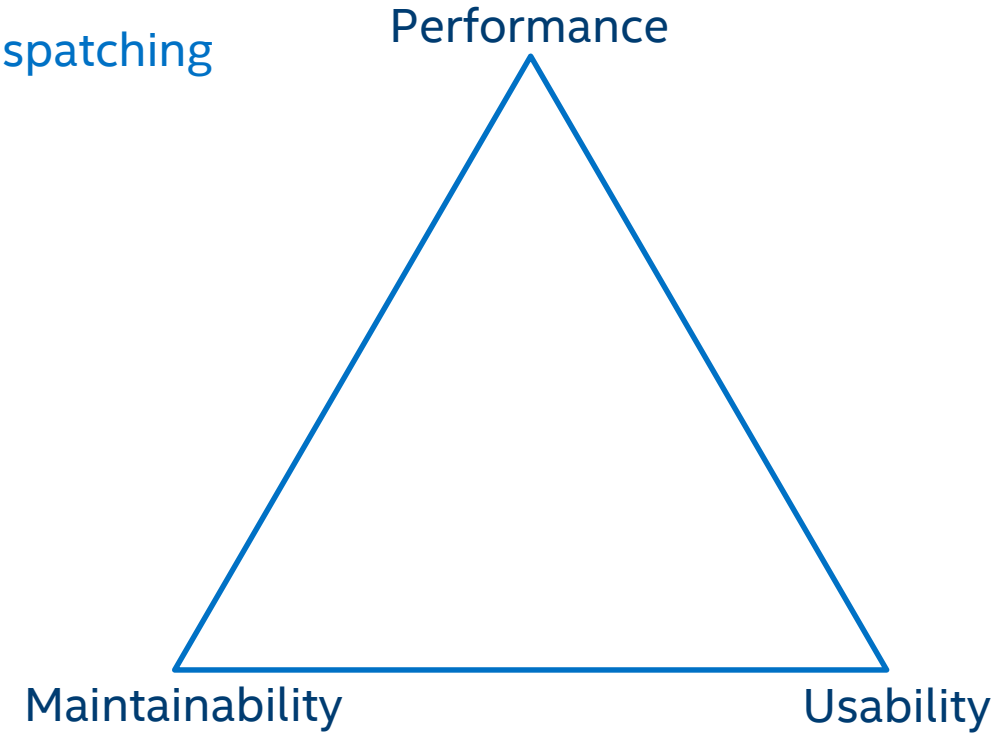
Software Sustainability Triangle



Optimization Notice
Copyright © 2019, Intel Corporation. All rights reserved.
*Other names and brands may be claimed as the property of others.

Software Sustainability Triangle

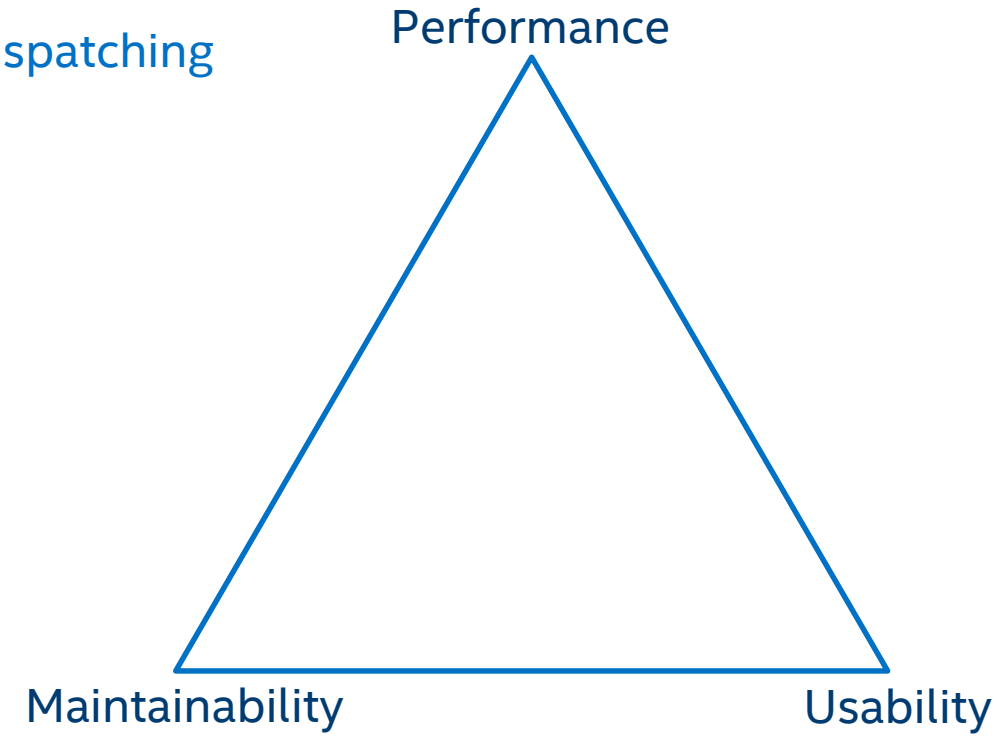
- Automatic dispatching



Optimization Notice
Copyright © 2019, Intel Corporation. All rights reserved.
*Other names and brands may be claimed as the property of others.

Software Sustainability Triangle

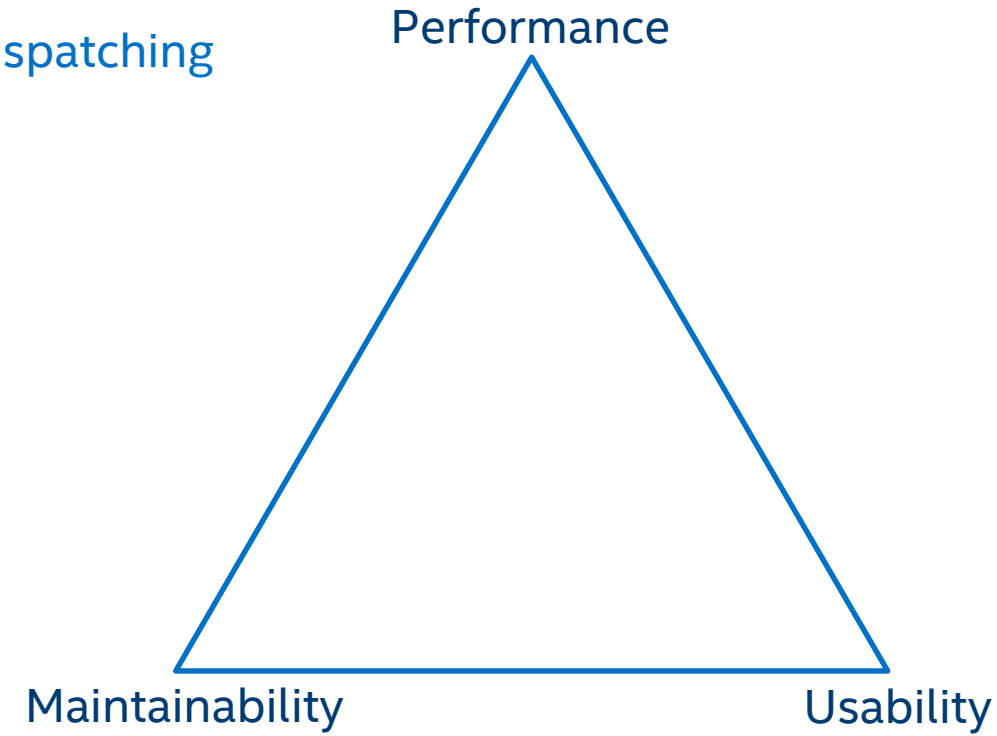
- Automatic dispatching
- APIs



Optimization Notice
Copyright © 2019, Intel Corporation. All rights reserved.
*Other names and brands may be claimed as the property of others.

Software Sustainability Triangle

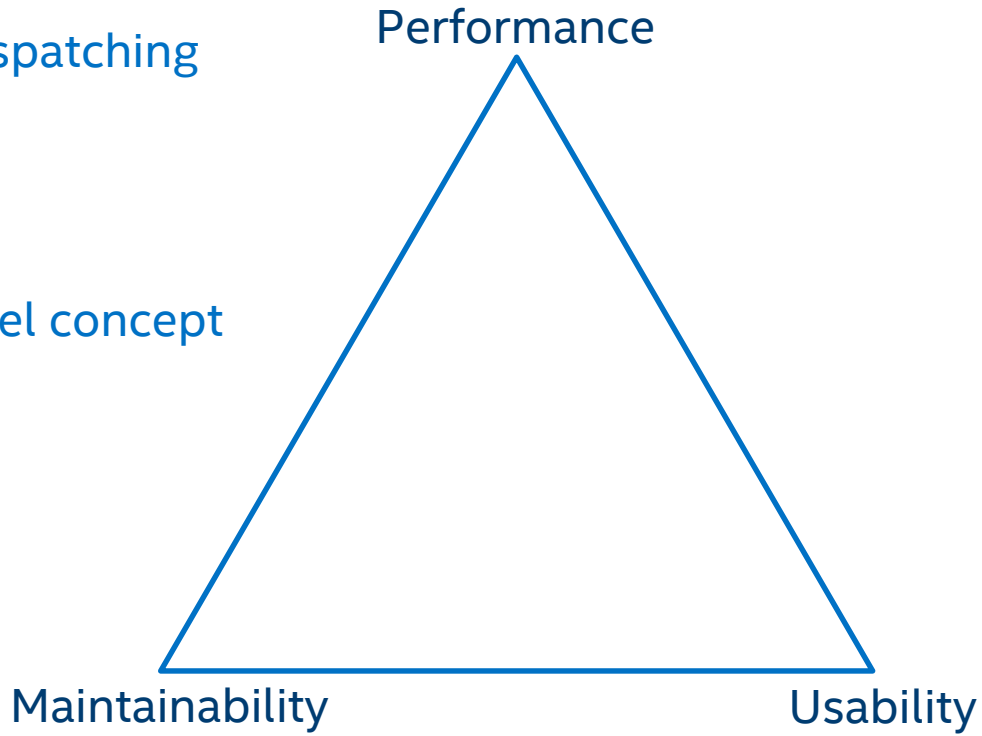
- Automatic dispatching
- APIs
- Portability



Optimization Notice
Copyright © 2019, Intel Corporation. All rights reserved.
*Other names and brands may be claimed as the property of others.

Software Sustainability Triangle

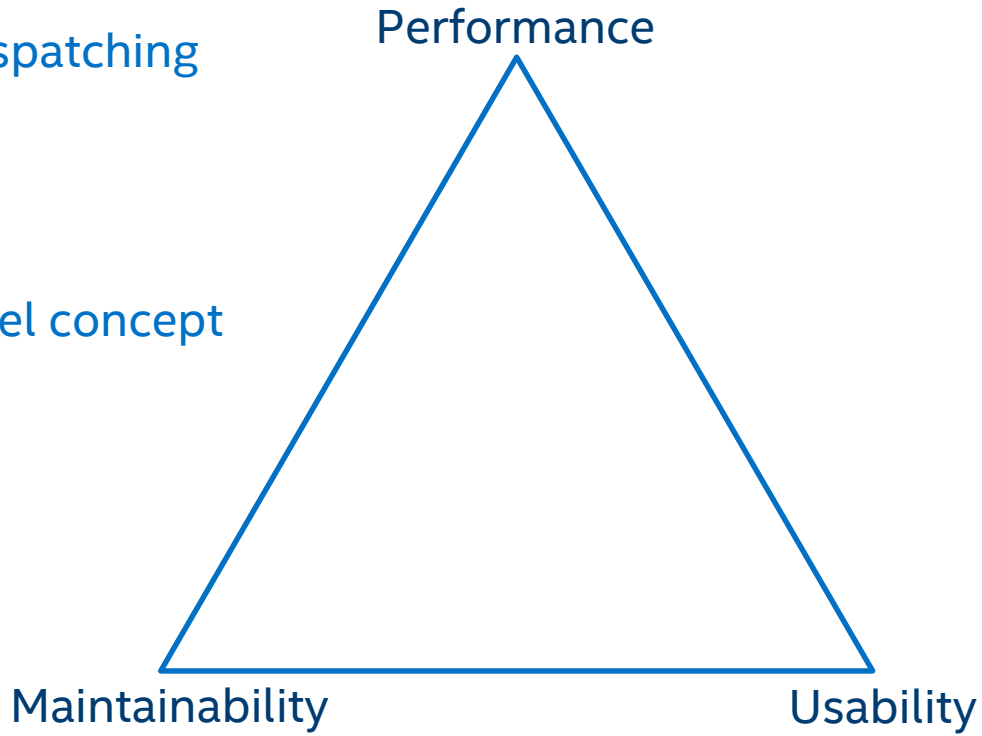
- Automatic dispatching
- APIs
- Portability
- Layered model concept



Optimization Notice
Copyright © 2019, Intel Corporation. All rights reserved.
*Other names and brands may be claimed as the property of others.

Software Sustainability Triangle

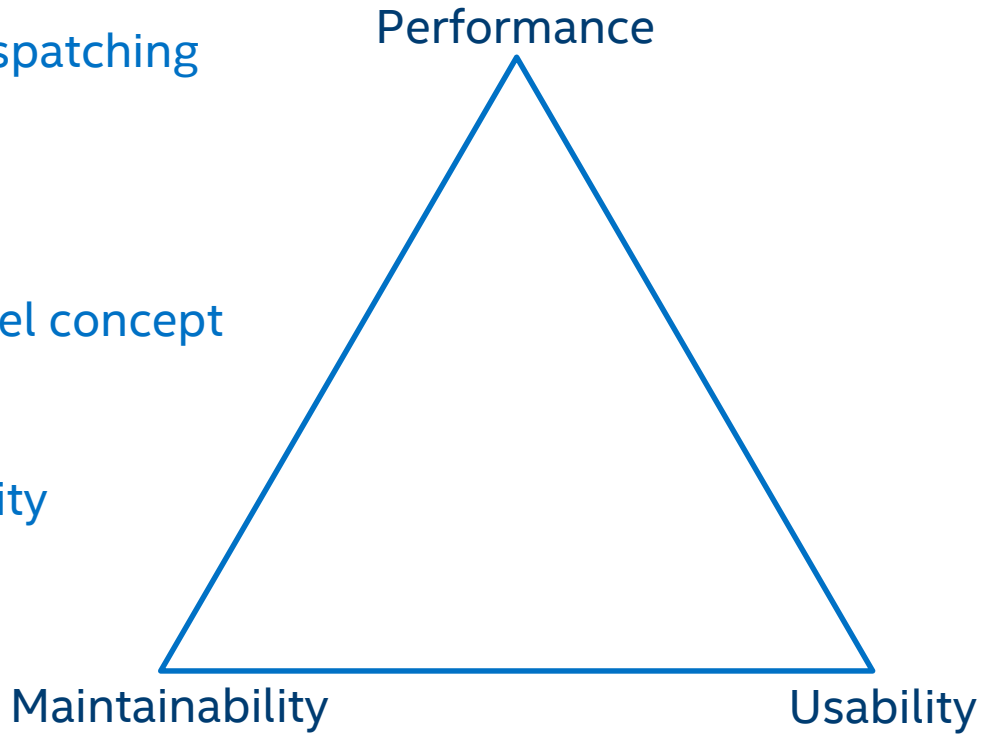
- Automatic dispatching
- APIs
- Portability
- Layered model concept
- Link line



Optimization Notice
Copyright © 2019, Intel Corporation. All rights reserved.
*Other names and brands may be claimed as the property of others.

Software Sustainability Triangle

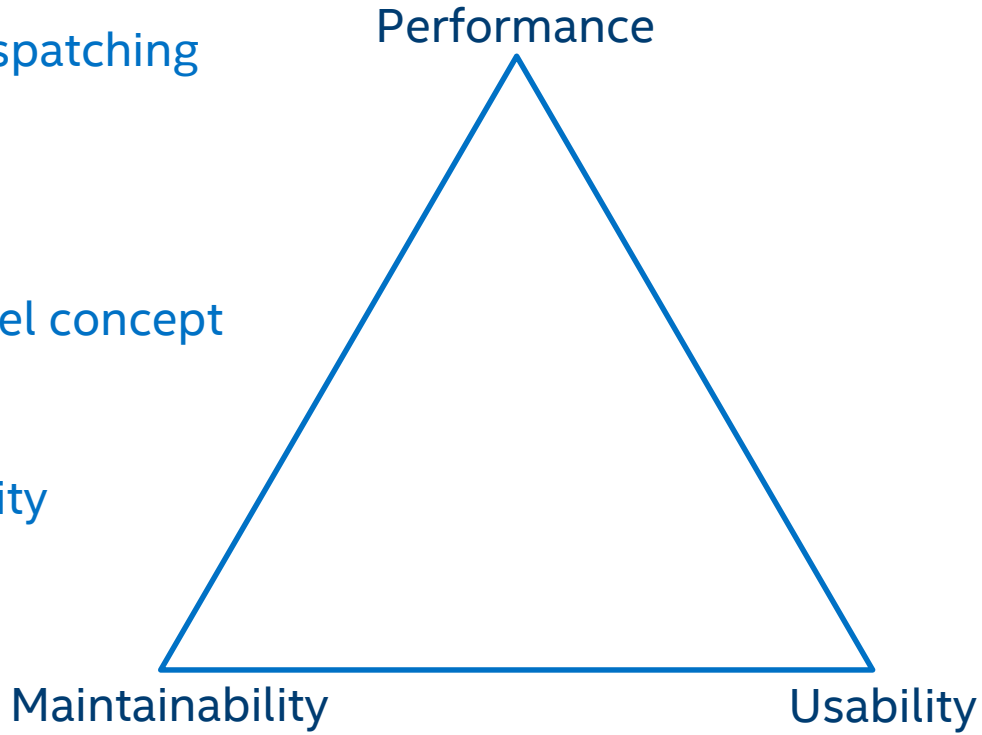
- Automatic dispatching
- APIs
- Portability
- Layered model concept
- Link line
- Customizability



Optimization Notice
Copyright © 2019, Intel Corporation. All rights reserved.
*Other names and brands may be claimed as the property of others.

Software Sustainability Triangle

- Automatic dispatching
- APIs
- Portability
- Layered model concept
- Link line
- Customizability

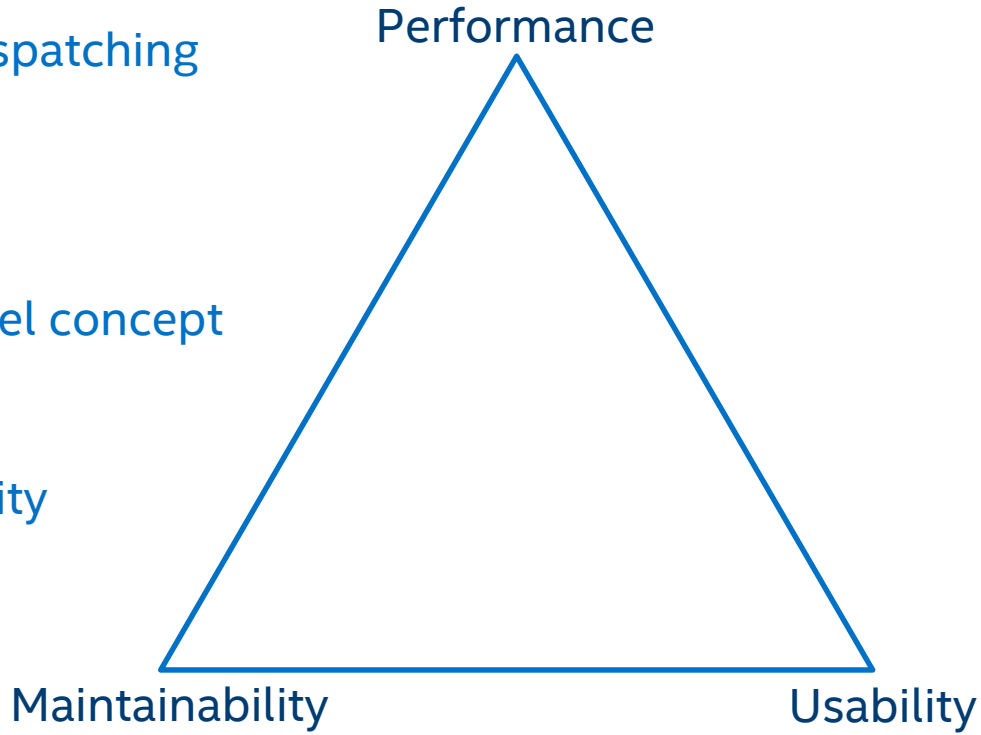


- Broad support

Optimization Notice
Copyright © 2019, Intel Corporation. All rights reserved.
*Other names and brands may be claimed as the property of others.

Software Sustainability Triangle

- Automatic dispatching
- APIs
- Portability
- Layered model concept
- Link line
- Customizability

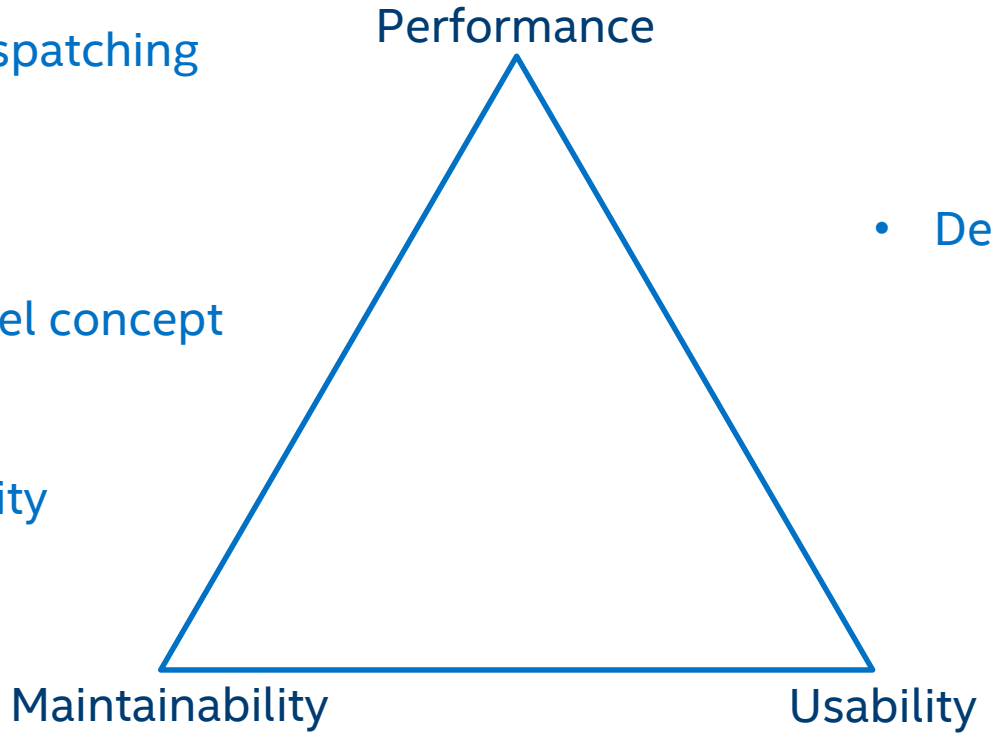


- Broad support
- General utility

Optimization Notice
Copyright © 2019, Intel Corporation. All rights reserved.
*Other names and brands may be claimed as the property of others.

Software Sustainability Triangle

- Automatic dispatching
- APIs
- Portability
- Layered model concept
- Link line
- Customizability

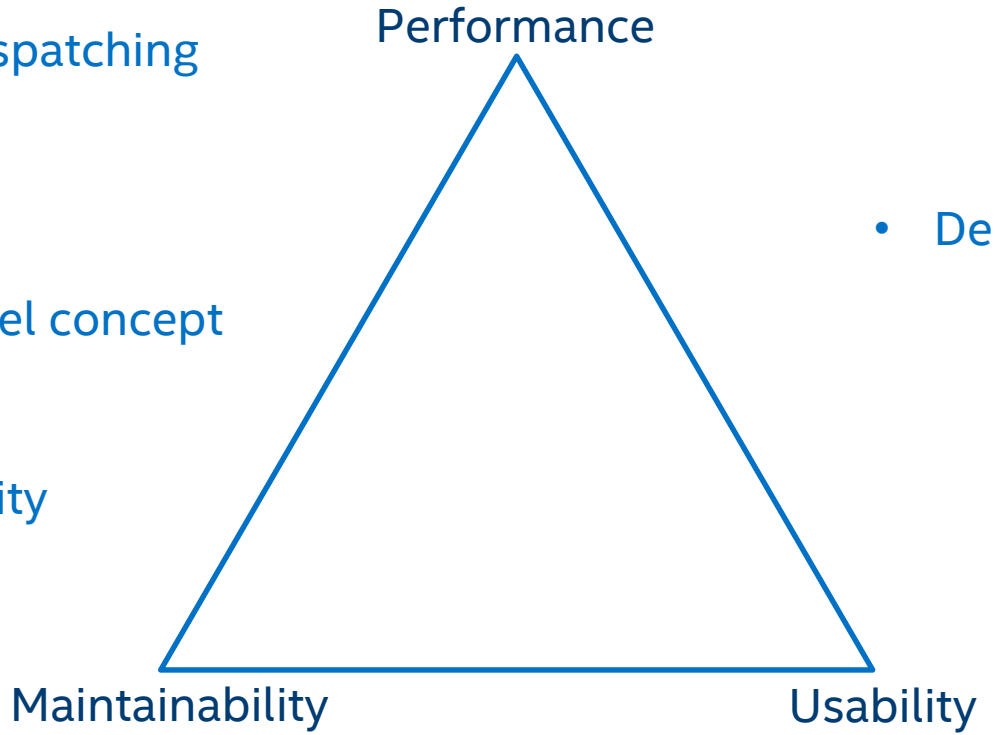


- Broad support
- General utility
- Deprecation process

Optimization Notice
Copyright © 2019, Intel Corporation. All rights reserved.
*Other names and brands may be claimed as the property of others.

Software Sustainability Triangle

- Automatic dispatching
- APIs
- Portability
- Layered model concept
- Link line
- Customizability

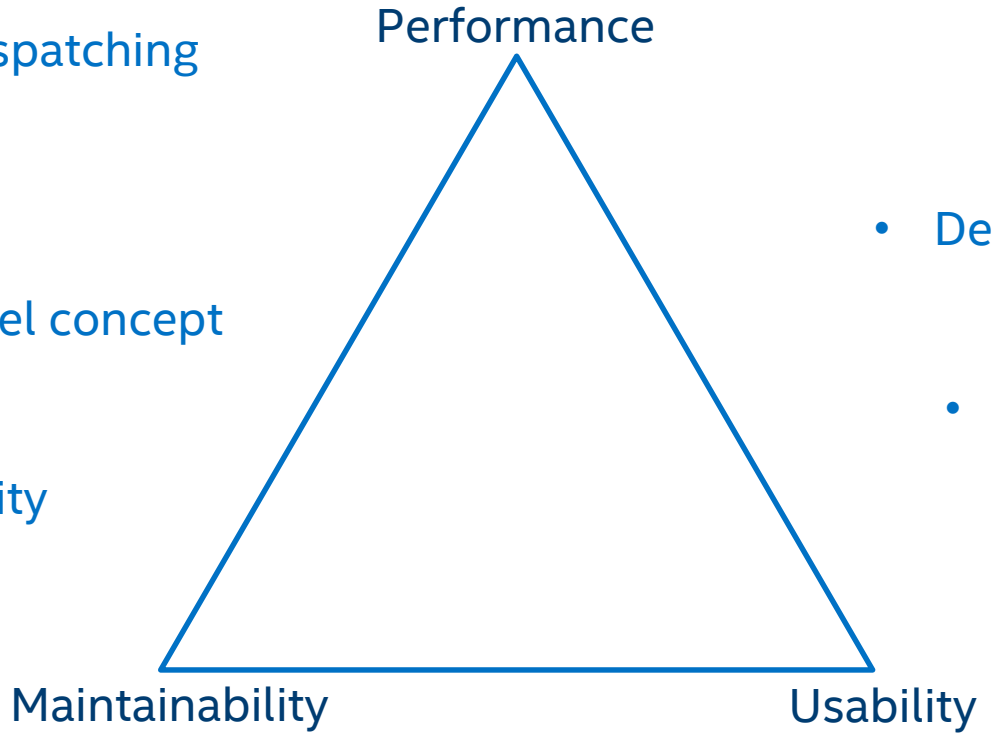


- Broad support
- General utility
- Deprecation process
- Tool changes

Optimization Notice
Copyright © 2019, Intel Corporation. All rights reserved.
*Other names and brands may be claimed as the property of others.

Software Sustainability Triangle

- Automatic dispatching
- APIs
- Portability
- Layered model concept
- Link line
- Customizability

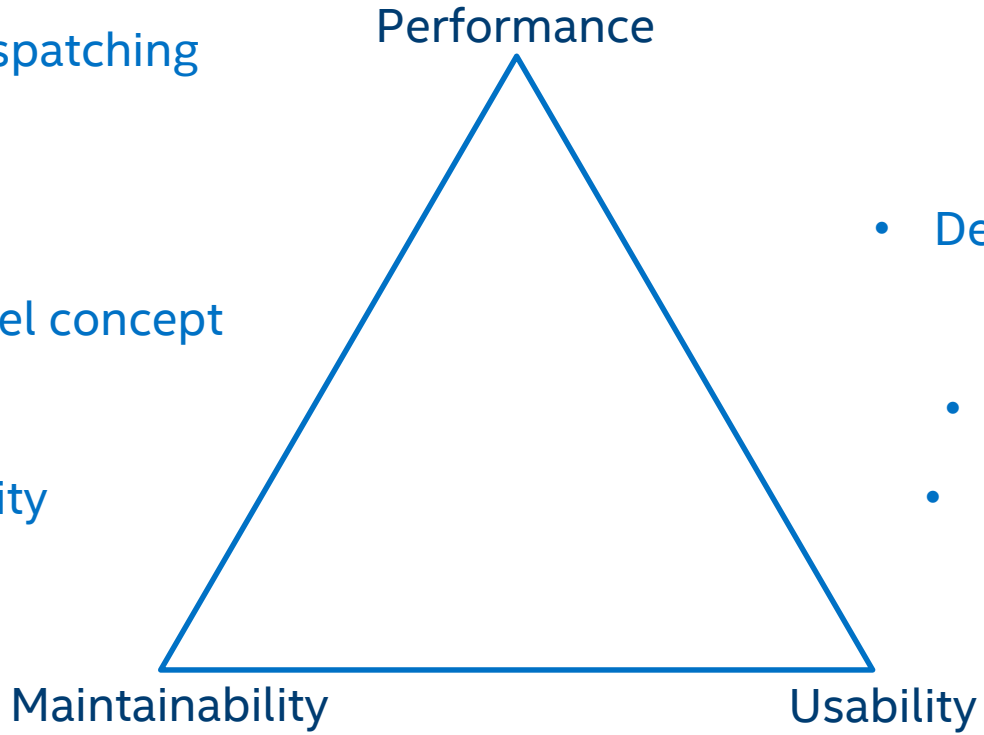


- Broad support
- General utility
- Deprecation process
- Tool changes
- Release schedule

Optimization Notice
Copyright © 2019, Intel Corporation. All rights reserved.
*Other names and brands may be claimed as the property of others.

Software Sustainability Triangle

- Automatic dispatching
- APIs
- Portability
- Layered model concept
- Link line
- Customizability



- Broad support
- General utility
- Deprecation process
- Tool changes
- Release schedule
- Community forum

Optimization Notice
Copyright © 2019, Intel Corporation. All rights reserved.
*Other names and brands may be claimed as the property of others.

Summary

- Intel MKL provides 25 years of features and performance
- Strive to be relevant over a long period of time
- Need to anticipate change
- Trade-off analysis between performance, maintainability, usability

Optimization Notice
Copyright © 2019, Intel Corporation. All rights reserved.
*Other names and brands may be claimed as the property of others.

Legal Disclaimer & Optimization Notice <w/o benchmarks>

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more complete information visit www.intel.com/benchmarks.

INFORMATION IN THIS DOCUMENT IS PROVIDED "AS IS". NO LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT. INTEL ASSUMES NO LIABILITY WHATSOEVER AND INTEL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY, RELATING TO THIS INFORMATION INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

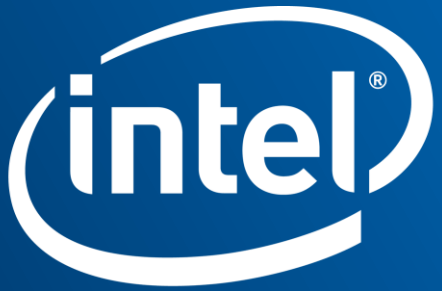
Copyright © 2019, Intel Corporation. All rights reserved. Intel, the Intel logo, Pentium, Xeon, Core, VTune, OpenVINO, Cilk, are trademarks of Intel Corporation or its subsidiaries in the U.S. and other countries.

Optimization Notice

Intel's compilers may or may not optimize to the same degree for non-Intel microprocessors for optimizations that are not unique to Intel microprocessors. These optimizations include SSE2, SSE3, and SSSE3 instruction sets and other optimizations. Intel does not guarantee the availability, functionality, or effectiveness of any optimization on microprocessors not manufactured by Intel. Microprocessor-dependent optimizations in this product are intended for use with Intel microprocessors. Certain optimizations not specific to Intel microarchitecture are reserved for Intel microprocessors. Please refer to the applicable product User and Reference Guides for more information regarding the specific instruction sets covered by this notice.

Notice revision #20110804

Copyright © 2019, Intel Corporation. All rights reserved.
*Other names and brands may be claimed as the property of others.



Software