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GCC 9 Compiler Tuning

Intel Core i9-7980XE compiler benchmarks by Michael Larabel for a future article.

Automated Executive Summary

-O3 -march=native had the most wins, coming in first place for 53% of the tests.

Based on the geometric mean of all complete results, the fastest (-O3 -march=native) was 1.837x the speed of the slowest (-O0). -O3 was 0.915x the speed of -O3 -march=native, -O2 -ftree-vectorize -ftree-slp-vectorize was 0.974x the speed of -O3, -O2 was 0.981x the speed of -O2 -ftree-vectorize -ftree-slp-vectorize, -O1 was 0.987x the speed of -O2, -Og was 0.975x the speed of -O1, -O0 was 0.647x the speed of -Og.

The results with the greatest spread from best to worst included:

*Smallpt (Global Illumination Renderer; 128 Samples) at 11.646x
FLAC Audio Encoding (WAV To FLAC) at 7.371x
Himeno Benchmark (Poisson Pressure Solver) at 7.102x
SciMark (Computational Test: Dense LU Matrix Factorization) at 6.503x
SciMark (Computational Test: Monte Carlo) at 6.395x
Timed ImageMagick Compilation (Time To Compile) at 4.519x
SciMark (Computational Test: Sparse Matrix Multiply) at 4.339x
SciMark (Computational Test: Composite) at 3.894x*

*Timed PHP Compilation (Time To Compile) at 3.85x
 C-Ray (Total Time - 4K, 16 Rays Per Pixel) at 3.796x.*

Test Systems:

-O0

-Og

-O1

-O2

-O2 -ftree-vectorize -ftree-slp-vectorize

-O3

-O3 -march=native

Processor: Intel Core i9-7980XE @ 4.20GHz (18 Cores / 36 Threads), Motherboard: ASUS PRIME X299-A (1602 BIOS), Chipset: Intel Sky Lake-E DMI3 Registers, Memory: 16384MB, Disk: 15GB Ultra USB 3.0 + Samsung SSD 970 EVO 500GB, Graphics: NVIDIA NV120 12GB, Audio: Realtek ALC1220, Monitor: ASUS PB278, Network: Intel I219-V

OS: Clear Linux OS 27030, Kernel: 4.19.13-680.native (x86_64), Desktop: GNOME Shell 3.30.2, Display Server: X Server 1.20.3, Display Driver: nouveau 1.0.15, OpenGL: 4.3 Mesa 19.0.0-devel, Compiler: GCC 9.0.0 20181228 + Clang 7.0.1 + LLVM 7.0.1, File-System: ext4, Screen Resolution: 2560x1440

Environment	Notes:	CXXFLAGS_OVERRIDE=-O3-march=native
CFLAGS=-g-O3-feliminate-unused-debug-types-pipe-Wall-Wp-D_FORTIFY_SOURCE=2-fexceptions-fstack-protector--param=ssp-buffer-size=32-Wl--copy-dt-needed-entries-m64-fasynchronous-unwind-tables-Wp-D_REENTRANT-ftree-loop-distribute-patterns-Wl-z-Wl		now-Wl-z-Wl
relo-malign-data=abi-fno-semantic-interposition-ftree-vectorize-ftree-loop-vectorize-Wl-sort-common-Wl--enable-new-dtags	MESA_GLSL_CACHE_DISABLE=0	
CFLAGS=-O3-march=native	CXXFLAGS=-O3-march=native	CFLAGS_OVERRIDE=-O3-march=native
FFLAGS=-g-O3-feliminate-unused-debug-types-pipe-Wall-Wp-D_FORTIFY_SOURCE=2-fexceptions-fstack-protector--param=ssp-buffer-size=32-Wl--copy-dt-needed-entries-m64-fasynchronous-unwind-tables-Wp-D_REENTRANT-ftree-loop-distribute-patterns-Wl-z-Wl		
relo-malign-data=abi-fno-semantic-interposition-ftree-vectorize-ftree-loop-vectorize-Wl--enable-new-dtags	THEANO_FLAGS=floatX=float32	openmp=true
gcc.cxxflags="-ftree-vectorize-mavx"		
Compiler Notes: --disable-multi-lib --disable-multilib --enable-checking=release		
Processor Notes: Scaling Governor: intel_pstate performance		
Security Notes: KPTI + __user pointer sanitization + Full generic retpoline IBPB: conditional IBRS_FW STIBP: conditional RSB filling + SSB disabled via prctl and seccomp + PTE Inversion; VMX: conditional cache flushes SMT vulnerable		

	-O0	-Og	-O1	-O2	-O2 -ftree-vectorize	-O3 -ftree-slp-ve ctorize	-O3 -march=nati ve
Timed HMMer Search - P.D.S (sec)	7.37	5.05	4.69	4.21	4.18	4.09	4.12
Normalized	55.5%	80.99%	87.21%	97.15%	97.85%	100%	99.27%
Standard Deviation	0.1%	0.6%	3.3%	0.6%	1.8%	1.5%	0.9%
SciMark - Composite (Mflops)	696	1809	2094	2019	2357	2453	2710
Normalized	25.68%	66.75%	77.27%	74.5%	86.97%	90.52%	100%
Standard Deviation	0.3%	0.4%	1.6%	0.4%	2.4%	0.8%	0.8%
SciMark - Monte Carlo (Mflops)	152	301	865	933	924	944	972
Normalized	15.64%	30.97%	88.99%	95.99%	95.06%	97.12%	100%
Standard Deviation	0%	0.3%	0%	0.1%	0.1%	0%	0%
SciMark - F.F.T (Mflops)	341	595	601	612	575	572	584
Normalized	55.72%	97.22%	98.2%	100%	93.95%	93.46%	95.42%
Standard Deviation	1.1%	4.7%	4.5%	2%	5.2%	4.1%	4.8%
SciMark - S.M.M (Mflops)	799	3261	3342	3404	3420	3400	3467
Normalized	23.05%	94.06%	96.39%	98.18%	98.64%	98.07%	100%
Standard Deviation	0%	0.9%	1.5%	1.1%	0.6%	0.4%	1.4%
SciMark - D.L.M.F (Mflops)	980	3659	4415	3938	5632	5742	6373
Normalized	15.38%	57.41%	69.28%	61.79%	88.37%	90.1%	100%
Standard Deviation	2.7%	0.1%	2.9%	0.2%	5.2%	1.2%	0.3%
SciMark - J.S.O.R (Mflops)	1208	1230	1250	1210	1234	1607	2156
Normalized	56.03%	57.05%	57.98%	56.12%	57.24%	74.54%	100%
Standard Deviation	2.7%	2.8%	2.7%	0.1%	1.8%	2.7%	2.8%
x264 - H.2.V.E (FPS)	96.58	135.54	140.42	140	139	142	139
Normalized	68.01%	95.45%	98.89%	98.59%	97.89%	100%	97.89%
Standard Deviation	0.2%	0.1%	0.8%	0.7%	2%	0.4%	1%
x265 - H.2.V.E (FPS)	59.26	59.31	59.12	59.07	59.06	59.12	59.91
Normalized	98.92%	99%	98.68%	98.6%	98.58%	98.68%	100%
Standard Deviation	0.2%	0.5%	0.3%	0.5%	0.3%	0.5%	0.6%
Himeno Benchmark - P.P.S (MFLOPS)	452	1515	1477	3044	3000	2988	3210
Normalized	14.08%	47.2%	46.01%	94.83%	93.46%	93.08%	100%
Standard Deviation	0.3%	0.7%	0.3%	0.3%	0.8%	0.9%	0.5%
ebizzy (Records/s)	598738	628510	663780	595906	641913	612542	648338
Normalized	90.2%	94.69%	100%	89.77%	96.71%	92.28%	97.67%
Standard Deviation	5%	5.8%	1%	2.6%	4%	4.4%	5.5%
Timed ImageMagick	5.82	8.69	17.73	23.63	24.39	26.30	26.22
Compilation - Time To Compile (sec)							
Normalized	100%	66.97%	32.83%	24.63%	23.86%	22.13%	22.2%
Standard Deviation	1.8%	0.9%	0.1%	0.4%	0.7%	0.6%	1%
Timed PHP Compilation - Time To Compile (sec)	13.65	17.68	22.99	40.49	41.22	52.07	52.55
Normalized	100%	77.21%	59.37%	33.71%	33.11%	26.21%	25.98%
Standard Deviation	0.1%	0.2%	0.5%	0.3%	0.3%	0.6%	0.4%

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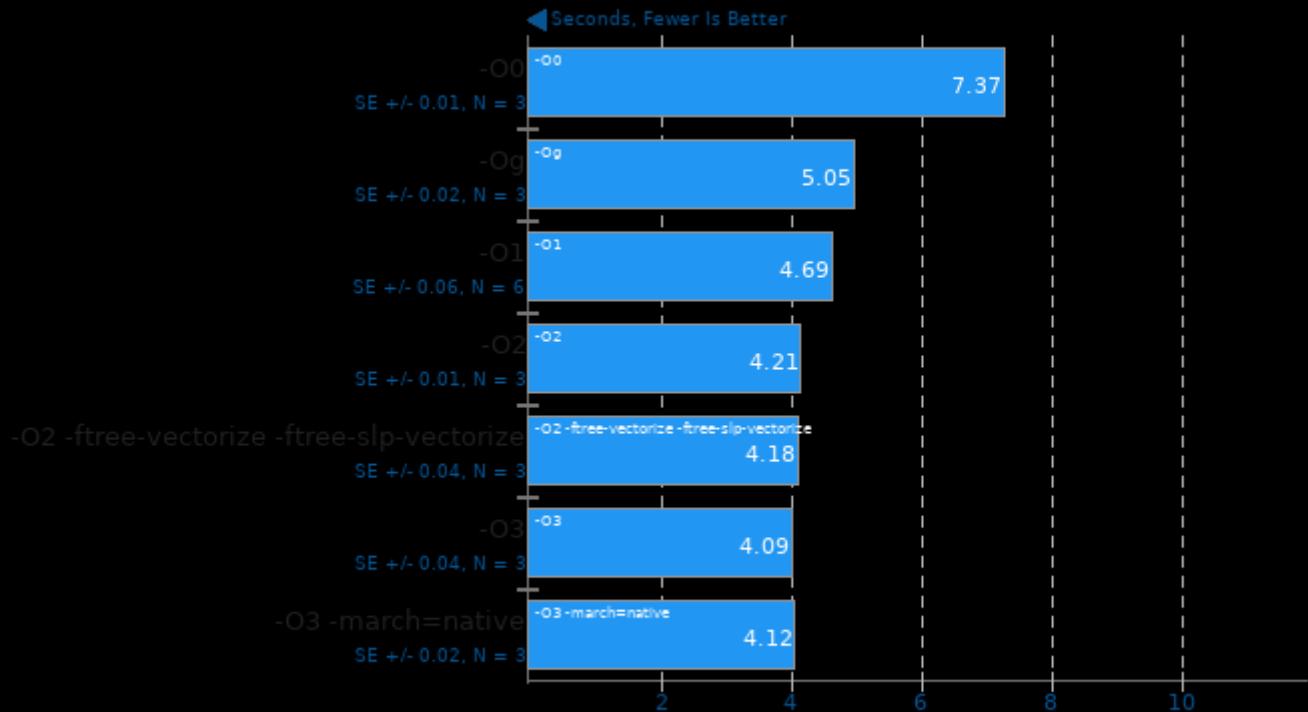
C-Ray - Total Time -	127.58	88.50	87.42	78.69	79.00	44.15	33.61
4.1.R.P.P (sec)							
Normalized	26.34%	37.98%	38.45%	42.71%	42.54%	76.13%	100%
Standard Deviation	0%	0%	0.1%	0.1%	0.1%	0%	0.1%
Smallpt - G.I.R.1.S (sec)	70.69	9.26	12.51	11.82	11.89	11.87	6.07
Normalized	8.59%	65.55%	48.52%	51.35%	51.05%	51.14%	100%
Standard Deviation	2.1%	0.2%	0.1%	0.1%	0%	0.1%	0.2%
AOBench - 2048 x 2048 -	65.32	54.40	56.56	53.26	51.48	50.03	30.81
Total Time (sec)							
Normalized	47.17%	56.64%	54.47%	57.85%	59.85%	61.58%	100%
Standard Deviation	0%	0%	0%	0.8%	0%	0.1%	0.2%
Bullet Physics Engine -	3.98	3.99	3.97	3.95	3.99	3.98	3.57
3000 Fall (sec)							
Normalized	89.7%	89.47%	89.92%	90.38%	89.47%	89.7%	100%
Standard Deviation	0.5%	0.8%	0.5%	0%	0.5%	0.6%	1.3%
Bullet Physics Engine -	4.75	4.70	4.72	4.68	4.72	4.67	3.93
1000 Stack (sec)							
Normalized	82.74%	83.62%	83.26%	83.97%	83.26%	84.15%	100%
Standard Deviation	1.8%	1.9%	1.8%	1.3%	1.2%	0.1%	0.5%
Bullet Physics Engine -	4.22	4.09	4.14	4.09	4.22	4.16	3.89
1000 Convex (sec)							
Normalized	92.18%	95.11%	93.96%	95.11%	92.18%	93.51%	100%
Standard Deviation	0.6%	2.7%	2.9%	4.1%	2.8%	3%	2.9%
XZ Compression -	108.34	78.08	76.44	75.01	75.55	72.66	73.06
C.u.1.0.3.s.i.i.C.L.9 (sec)							
Normalized	67.07%	93.06%	95.05%	96.87%	96.17%	100%	99.45%
Standard Deviation	0.1%	0.5%	0.4%	0.4%	0.2%	0.5%	1%
Zstd Compression -	18.34	10.54	10.08	10.19	10.31	10.31	10.29
C.u.1.0.3.s.i.i.C.L.1 (sec)							
Normalized	54.96%	95.64%	100%	98.92%	97.77%	97.77%	97.96%
Standard Deviation	0.2%	0.2%	0.5%	0.2%	0.5%	0.3%	0.7%
dav1d - Summer Nature	78.20	79.84	78.12	82.55	81.51	80.78	80.95
4K (sec)							
Normalized	99.9%	97.85%	100%	94.63%	95.84%	96.71%	96.5%
Standard Deviation	3.2%	2.9%	3.5%	8.3%	3.1%	3.3%	3.3%
dav1d - S.N.1 (sec)	22.57	19.40	19.17	18.63	20.00	19.75	19.67
Normalized	82.54%	96.03%	97.18%	100%	93.15%	94.33%	94.71%
Standard Deviation	4.4%	4.6%	5%	7.7%	4.3%	4.2%	5%
FLAC Audio Encoding -	68.11	12.27	11.29	10.38	10.47	10.46	9.24
WAV To FLAC (sec)							
Normalized	13.57%	75.31%	81.84%	89.02%	88.25%	88.34%	100%
Standard Deviation	0.1%	0.6%	0.6%	0.8%	0.2%	0.6%	0.2%
LAME MP3 Encoding -	31.87	13.64	11.76	11.73	10.20	10.05	9.24
WAV To MP3 (sec)							
Normalized	28.99%	67.74%	78.57%	78.77%	90.59%	91.94%	100%
Standard Deviation	0.1%	0.3%	0.1%	0.3%	0.7%	0.2%	0%
m-queens - Time To Solve (sec)	104.39	57.89	50.57	49.54	49.55	49.49	48.48
Normalized	46.44%	83.75%	95.87%	97.86%	97.84%	97.96%	100%
Standard Deviation	0.2%	0%	0.1%	0%	0%	0.1%	0.1%
Cpuminer-Opt - Ibry (kH/s - Hash Speed)		45080	52880	50180	53133	53793	53657
Normalized	83.8%	98.3%	93.28%	98.77%	100%	99.75%	

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Cpuminer-Opt - skein (kH/s - Hash Speed)	Standard Deviation Normalized Standard Deviation	1.4% 82.72% 0%	0% 98.89% 1.1%	0.2% 95.08% 0%	0.3% 100% 0%	3.2% 99.01% 98.61%	2.2% 61980
PostgreSQL pgbench -	314089	429547	452185	495259	499438	503005	503111
Buffer Test - Normal Load - Read Only (TPS)							
Normalized	62.43%	85.38%	89.88%	98.44%	99.27%	99.98%	100%
Standard Deviation	0.1%	0.2%	0%	0.1%	0.3%	0.2%	0.1%
Redis - GET (Req/sec)	3424738	3223612	3356679	3060926	3148044	3229670	3258540
Normalized	100%	94.13%	98.01%	89.38%	91.92%	94.3%	95.15%
Standard Deviation	0.6%	7%	2.1%	7.6%	0.7%	1.4%	7.1%
Redis - SET (Req/sec)	2390460	2322162	2202227	2323211	2305436	2349704	2291356
Normalized	100%	97.14%	92.13%	97.19%	96.44%	98.3%	95.85%
Standard Deviation	0.4%	4.9%	8.1%	3.9%	3.4%	1.7%	6.1%
NGINX Benchmark -	45556	37865	37172	45790	47967	47523	47670
S.W.P.S (Req/sec)							
Normalized	94.97%	78.94%	77.49%	95.46%	100%	99.07%	99.38%
Standard Deviation	0.9%	0.9%	3.8%	4.7%	0.4%	1%	1.1%

Timed HMMer Search 2.3.2

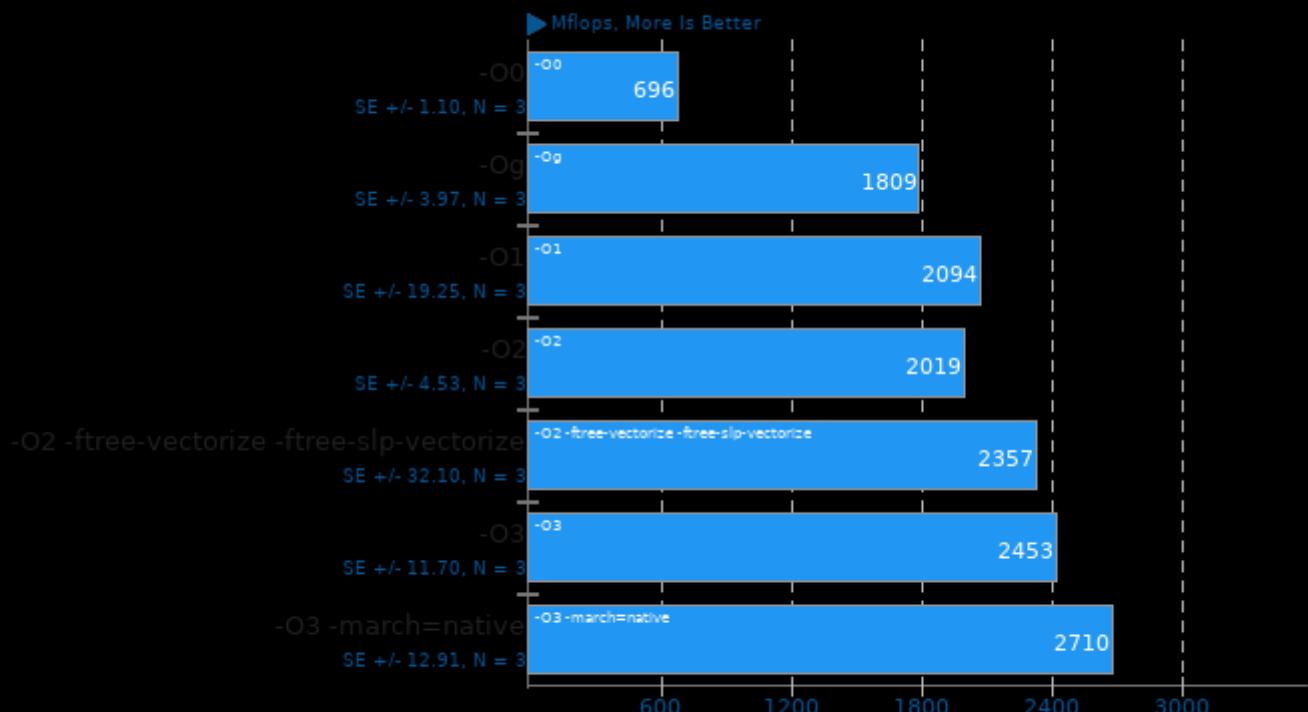
Pfam Database Search



1. (CC) gcc options: -pthread -lhmmer -lsquid -lm

SciMark 2.0

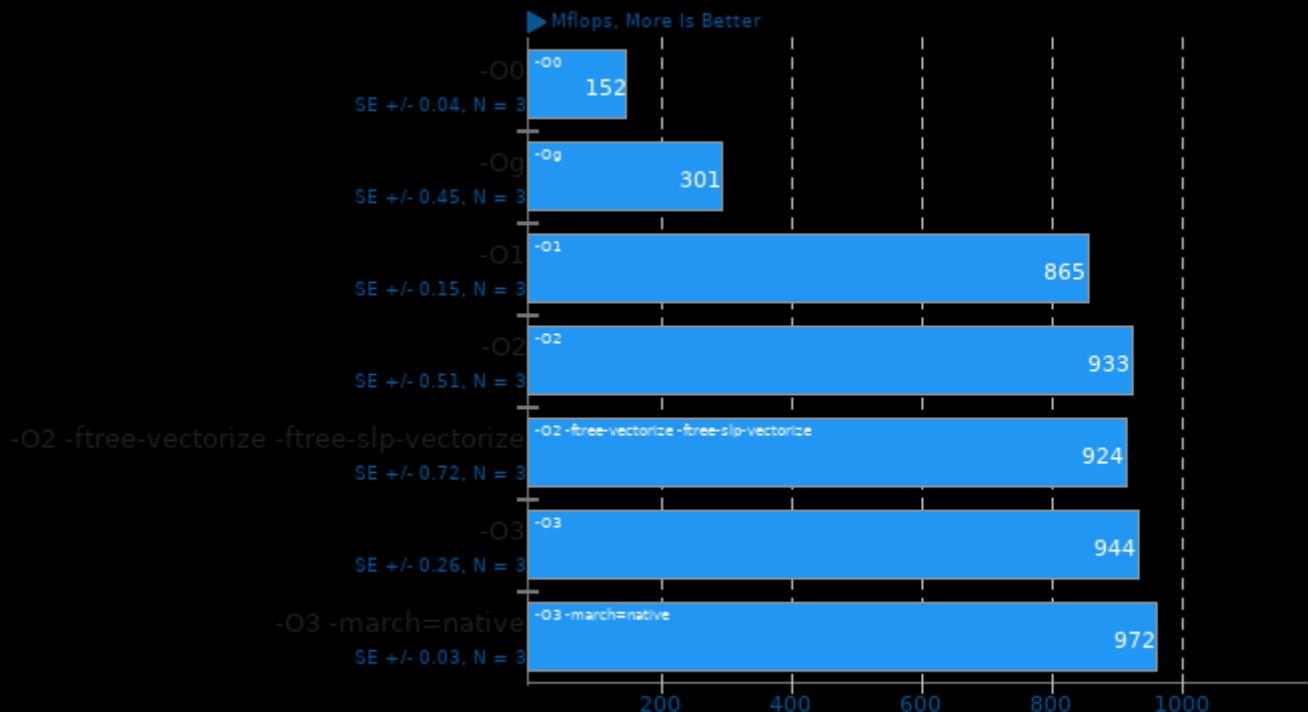
Computational Test: Composite



1. (CC) gcc options: -lm

SciMark 2.0

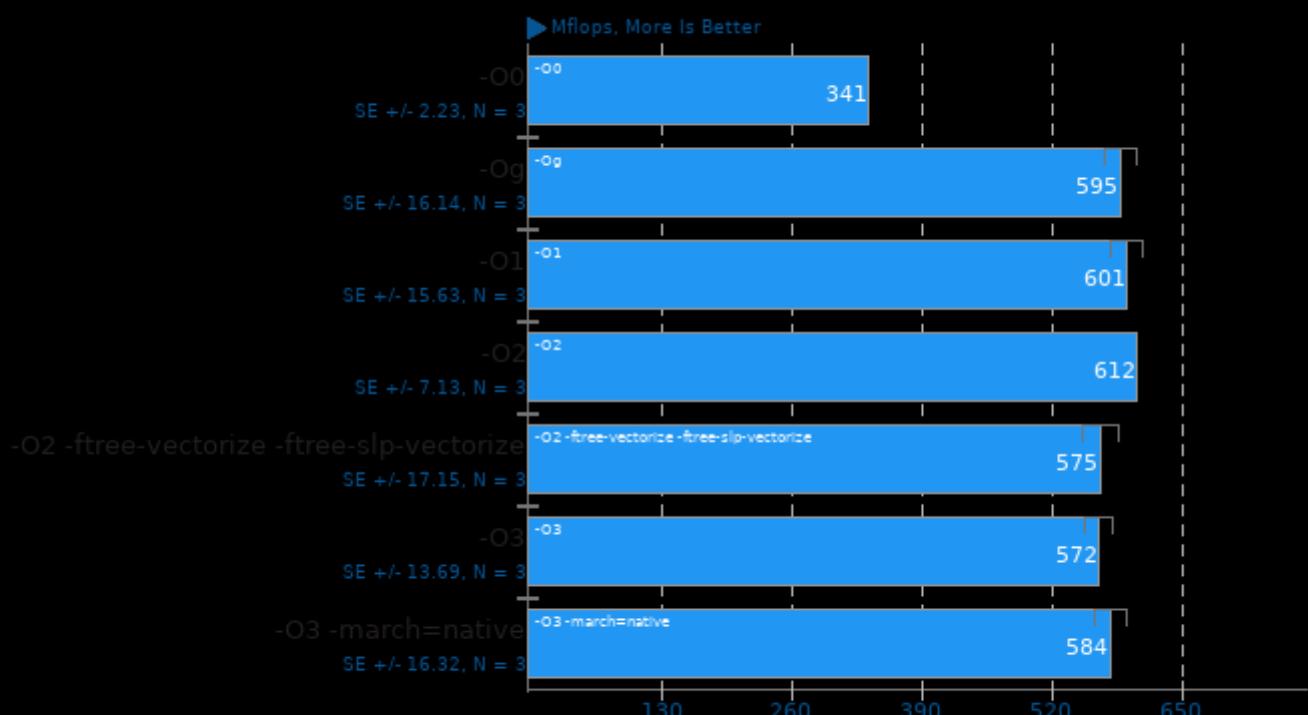
Computational Test: Monte Carlo



1. (CC) gcc options: -lm

SciMark 2.0

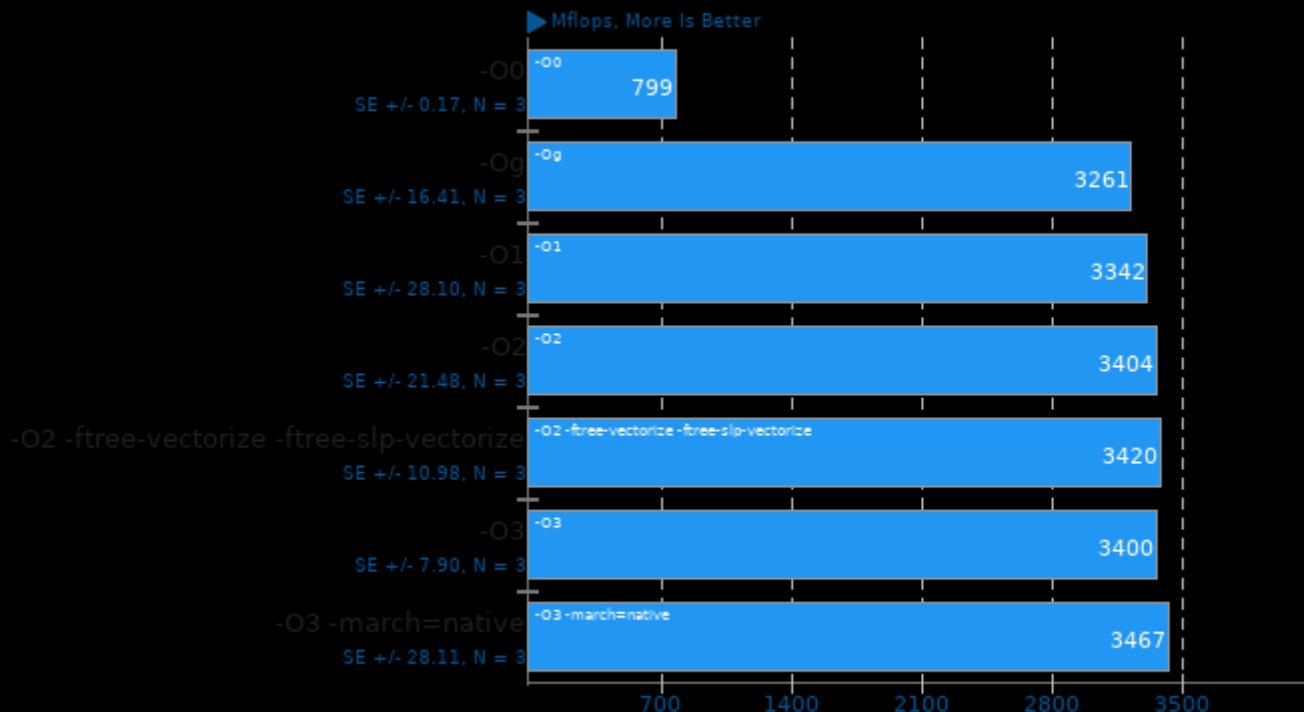
Computational Test: Fast Fourier Transform



1. (CC) gcc options: -lm

SciMark 2.0

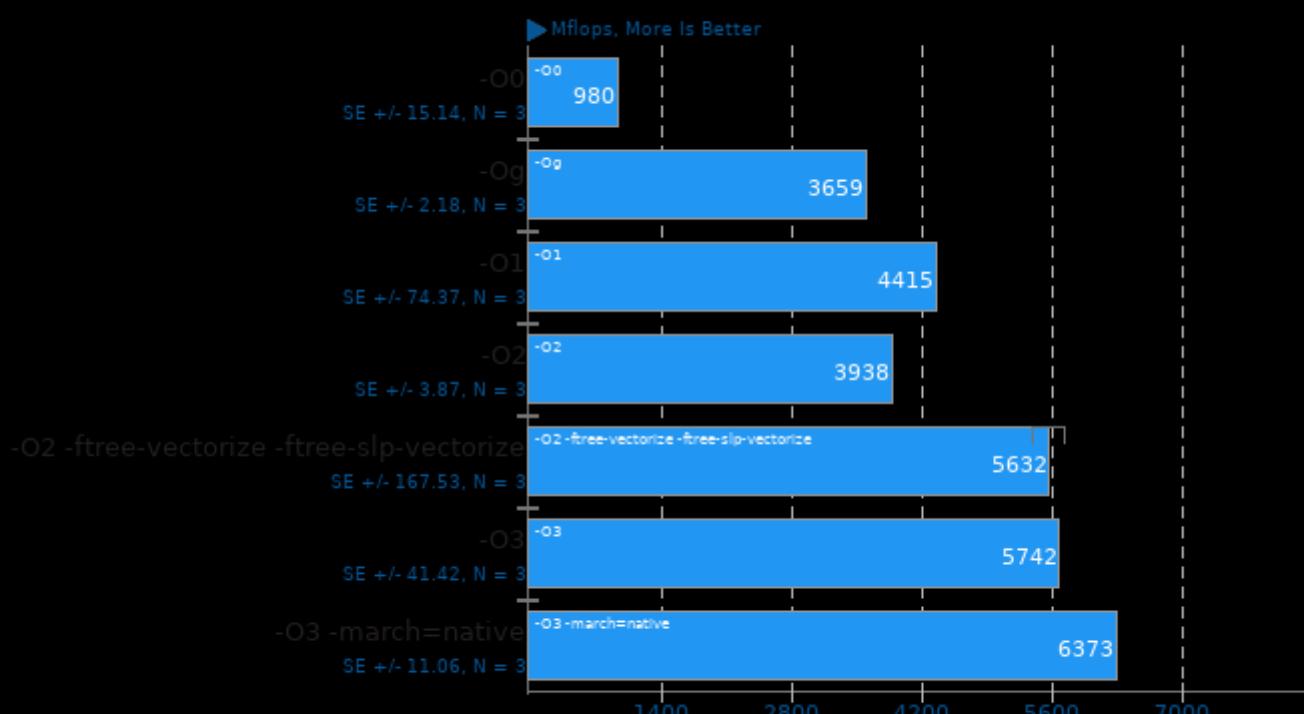
Computational Test: Sparse Matrix Multiply



1. (CC) gcc options: -lm

SciMark 2.0

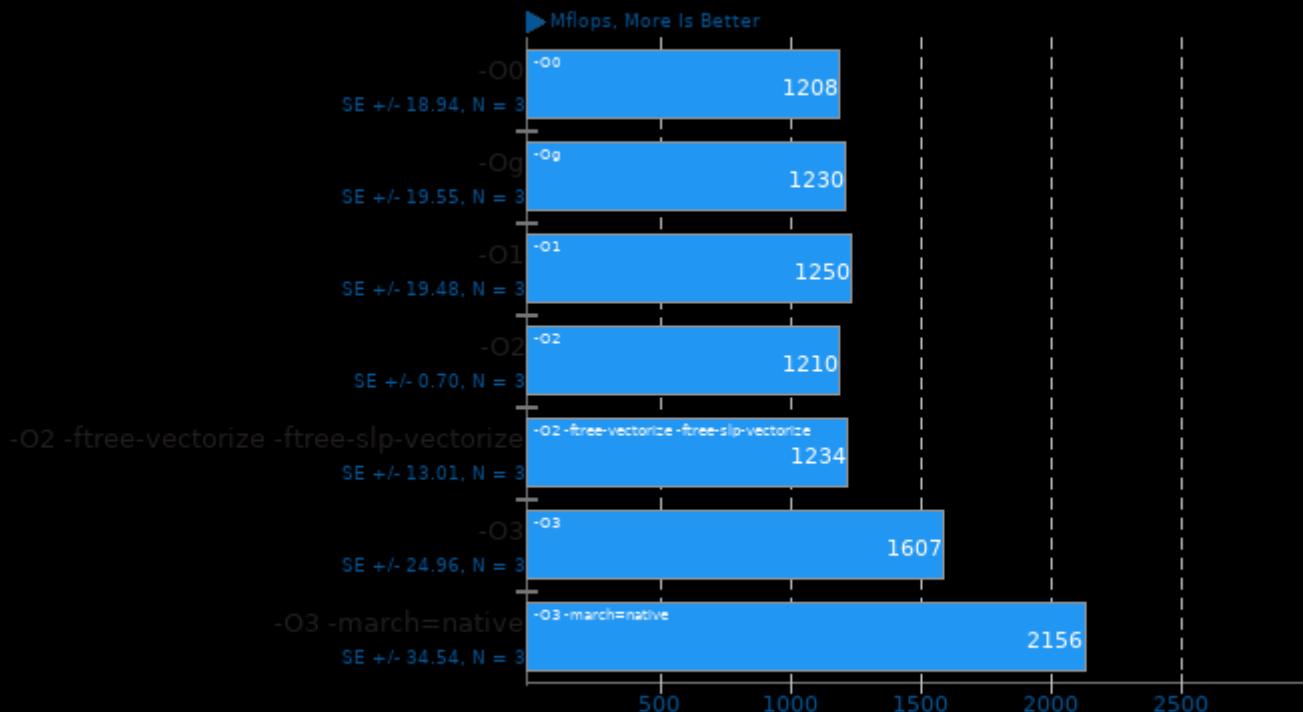
Computational Test: Dense LU Matrix Factorization



1. (CC) gcc options: -lm

SciMark 2.0

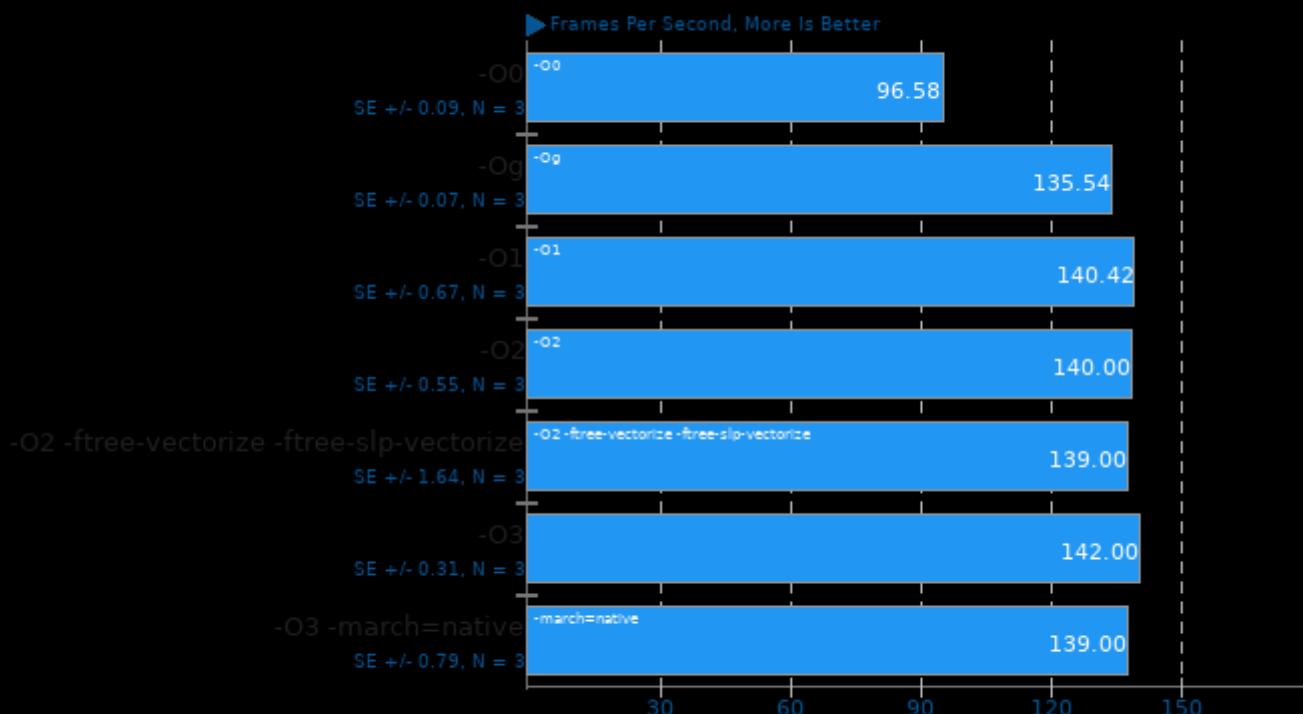
Computational Test: Jacobi Successive Over-Relaxation



1. (CC) gcc options: -lm

x264 2018-09-25

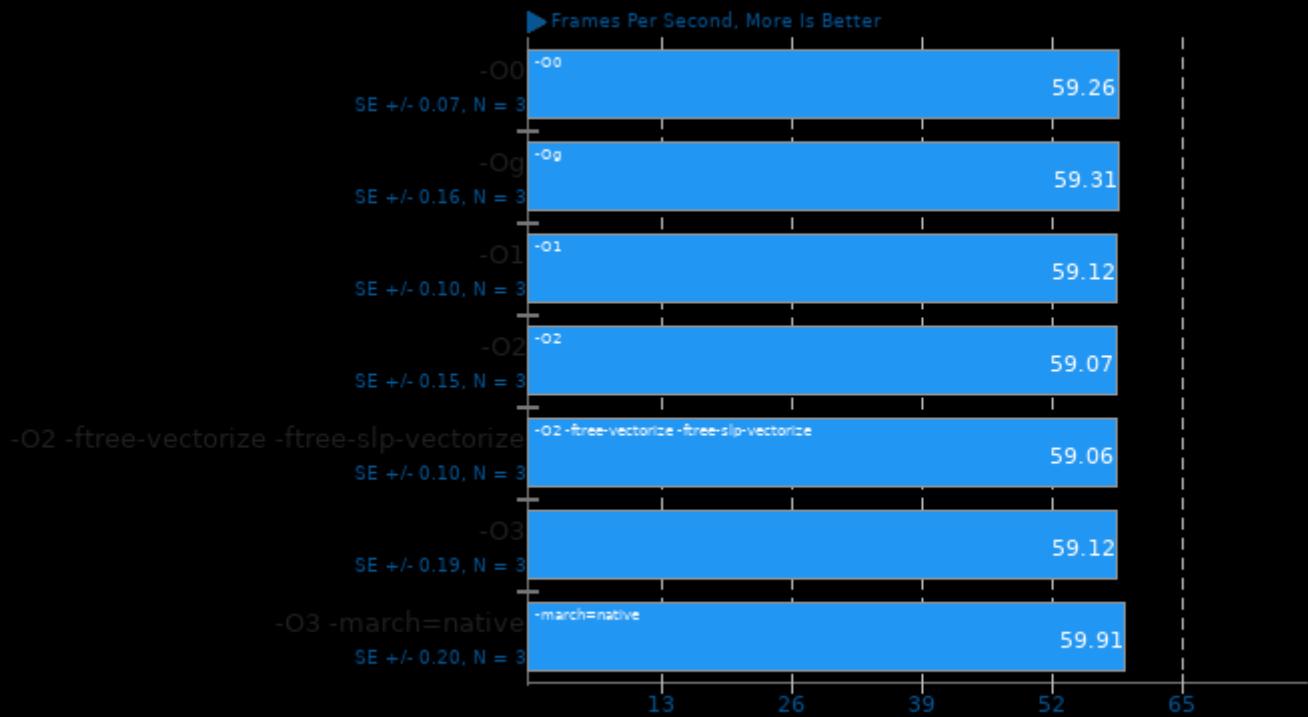
H.264 Video Encoding



1. (CC) gcc options: -ldl -m64 -lm -lpthread -O3 -ffast-math -std=gnu99 -fPIC -fomit-frame-pointer -fno-tree-vectorize

x265 2.8

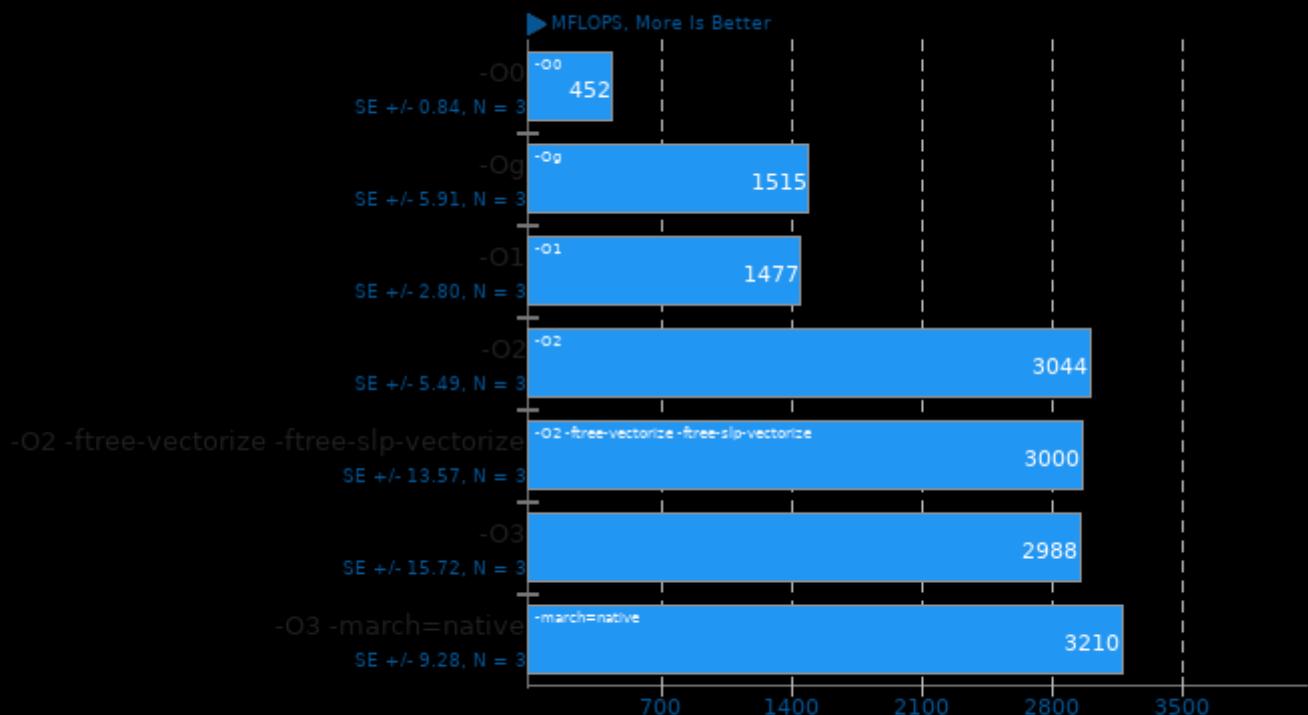
H.265 Video Encoding



1. (CXX) g++ options: -O3 -rdynamic -lpthread -lrt -ldl -lnuma

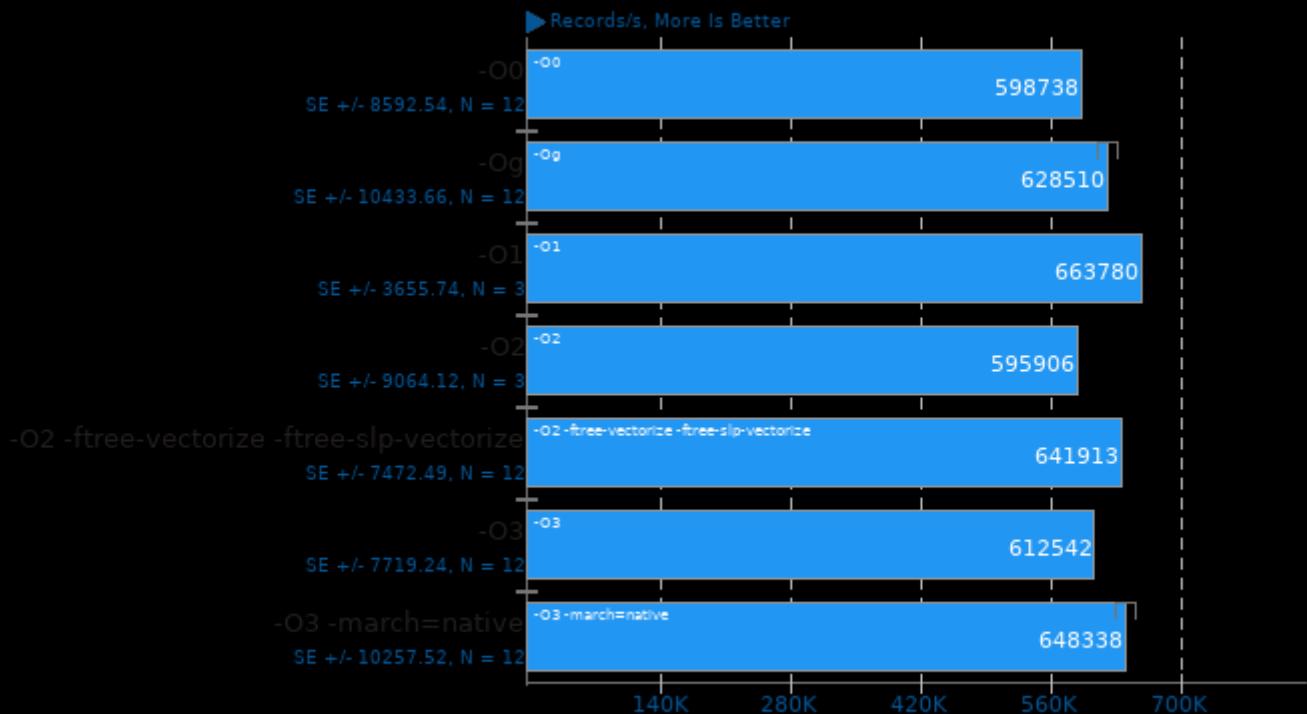
Himeno Benchmark 3.0

Poisson Pressure Solver



1. (CC) gcc options: -O3 -mavx2

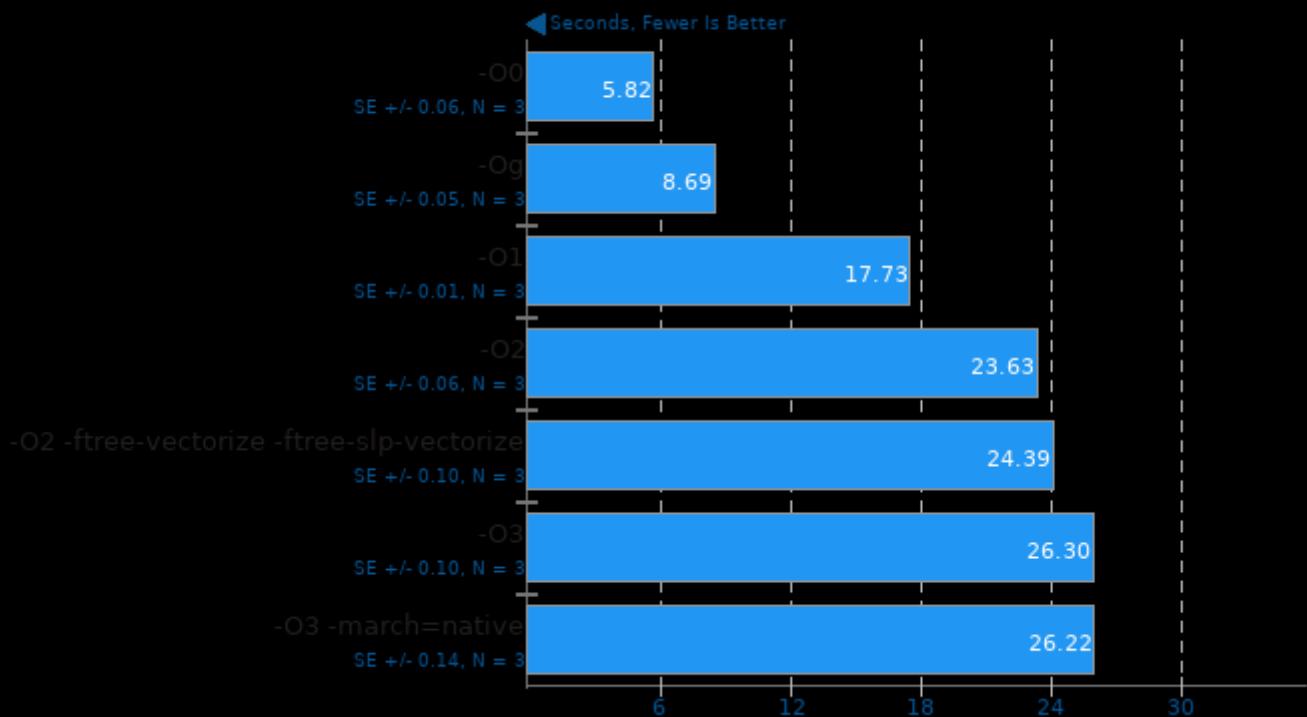
ebizzy 0.3



1. (CC) gcc options: -pthread -lpthread

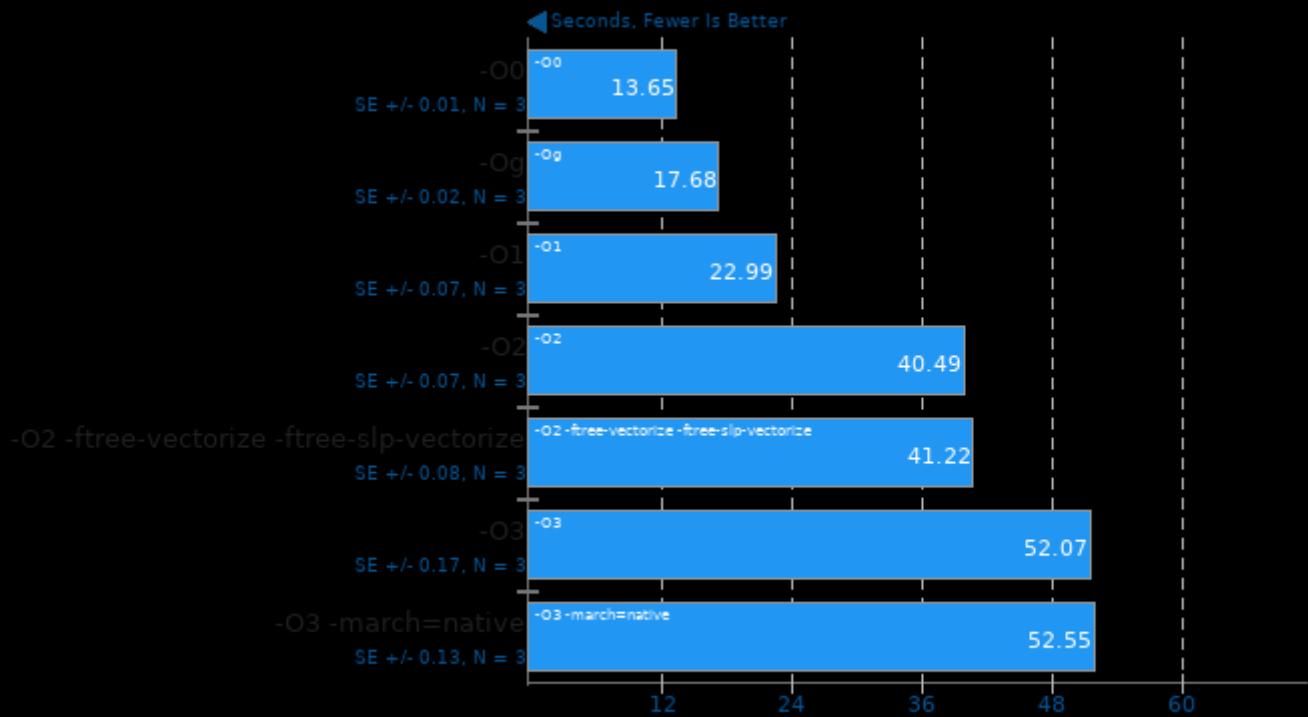
Timed ImageMagick Compilation 6.9.0

Time To Compile



Timed PHP Compilation 7.1.9

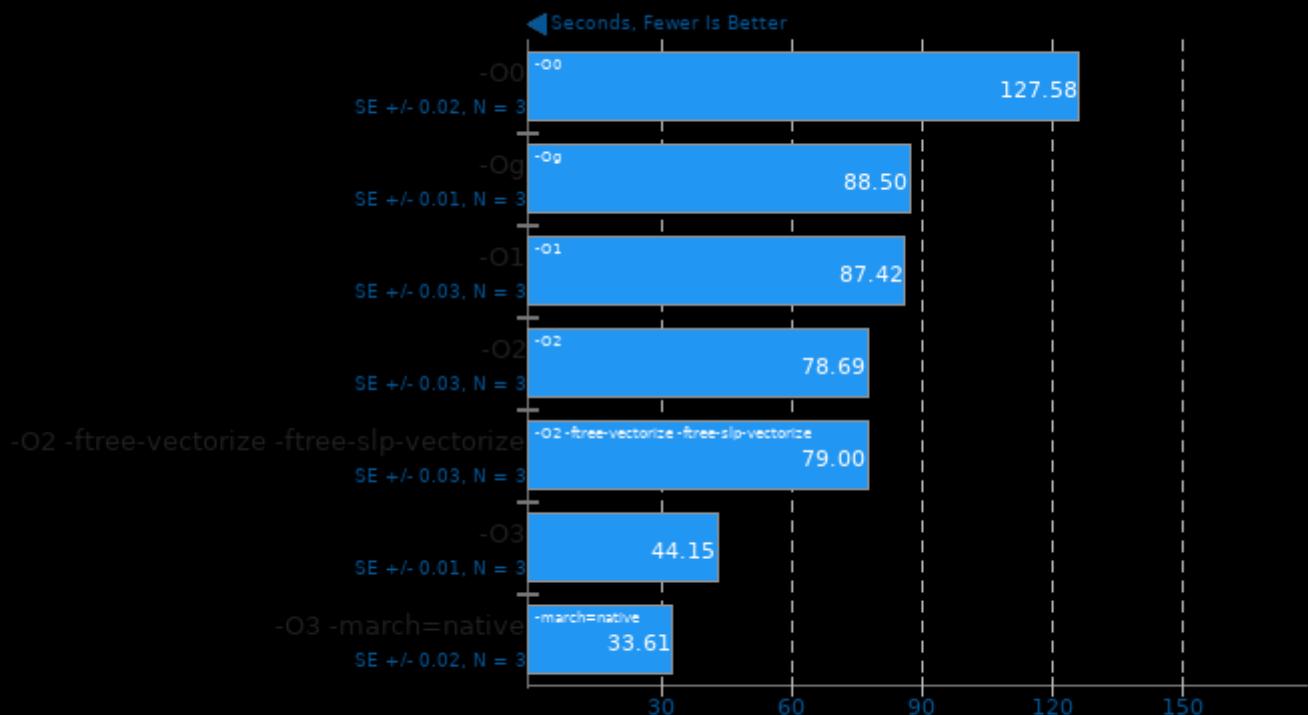
Time To Compile



1. (CC) gcc options: -pedantic -ldl -lz -lm

C-Ray 1.1

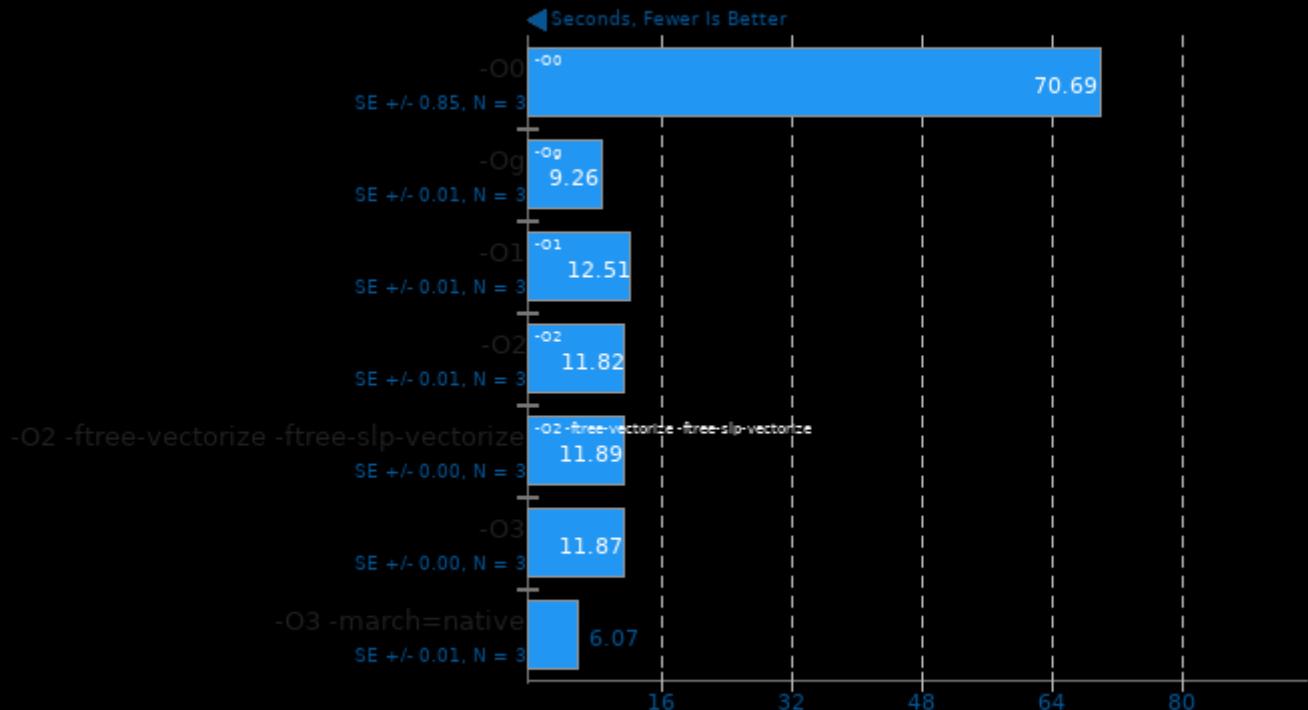
Total Time - 4K, 16 Rays Per Pixel



1. (CC) gcc options: -lm -lpthread -O3

Smallpt 1.0

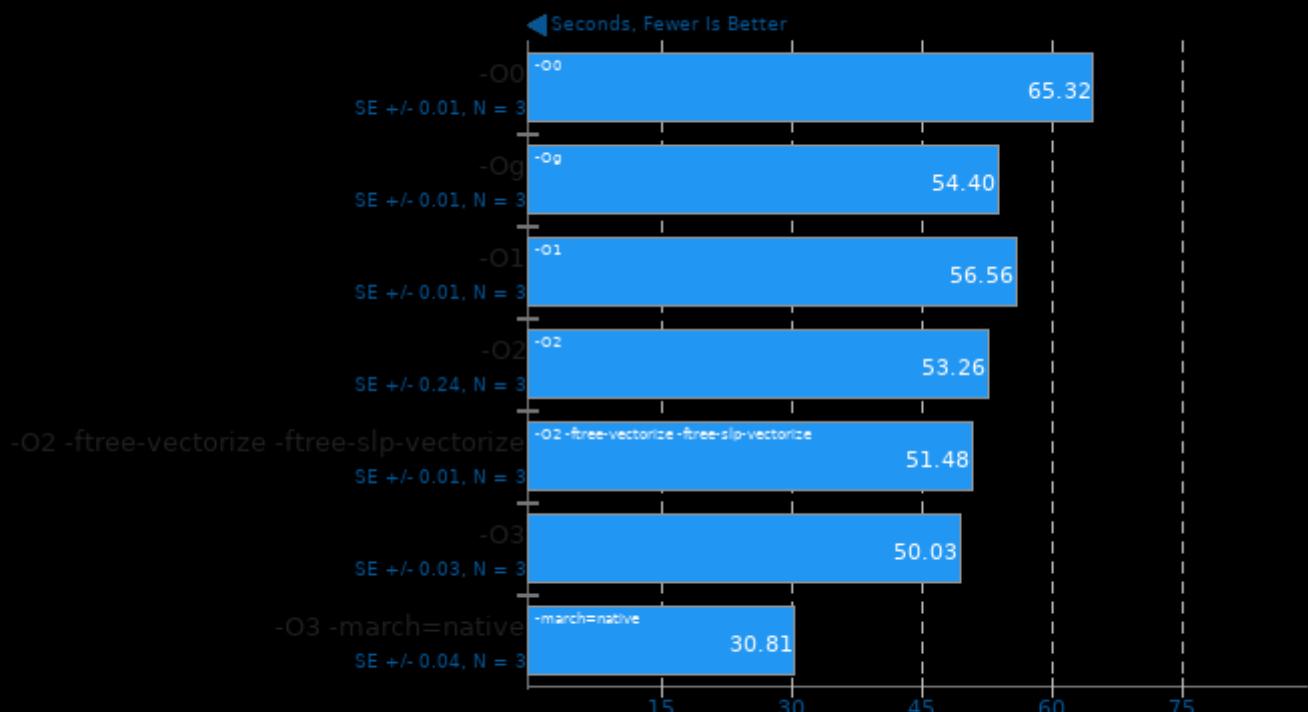
Global Illumination Renderer; 128 Samples



1. (CXX) g++ options: -fopenmp -O3

AOBench

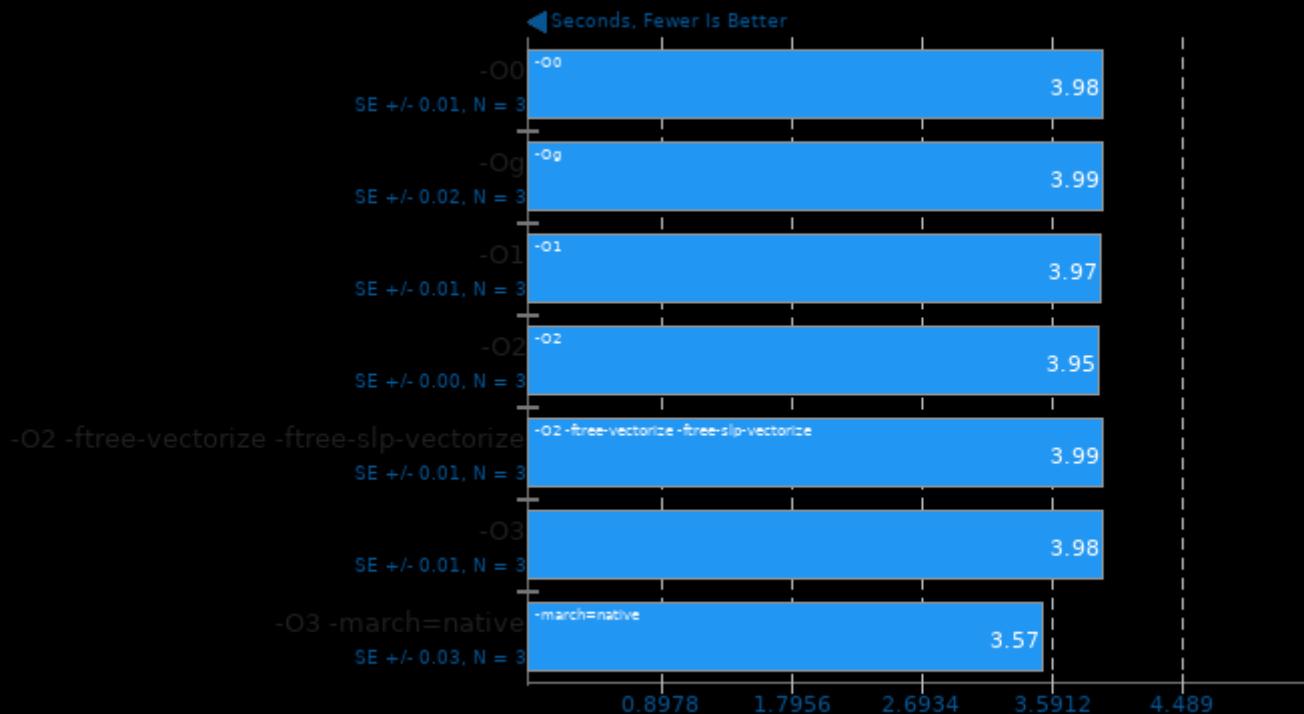
Size: 2048 x 2048 - Total Time



1. (CC) gcc options: -lm -O3

Bullet Physics Engine 2.81

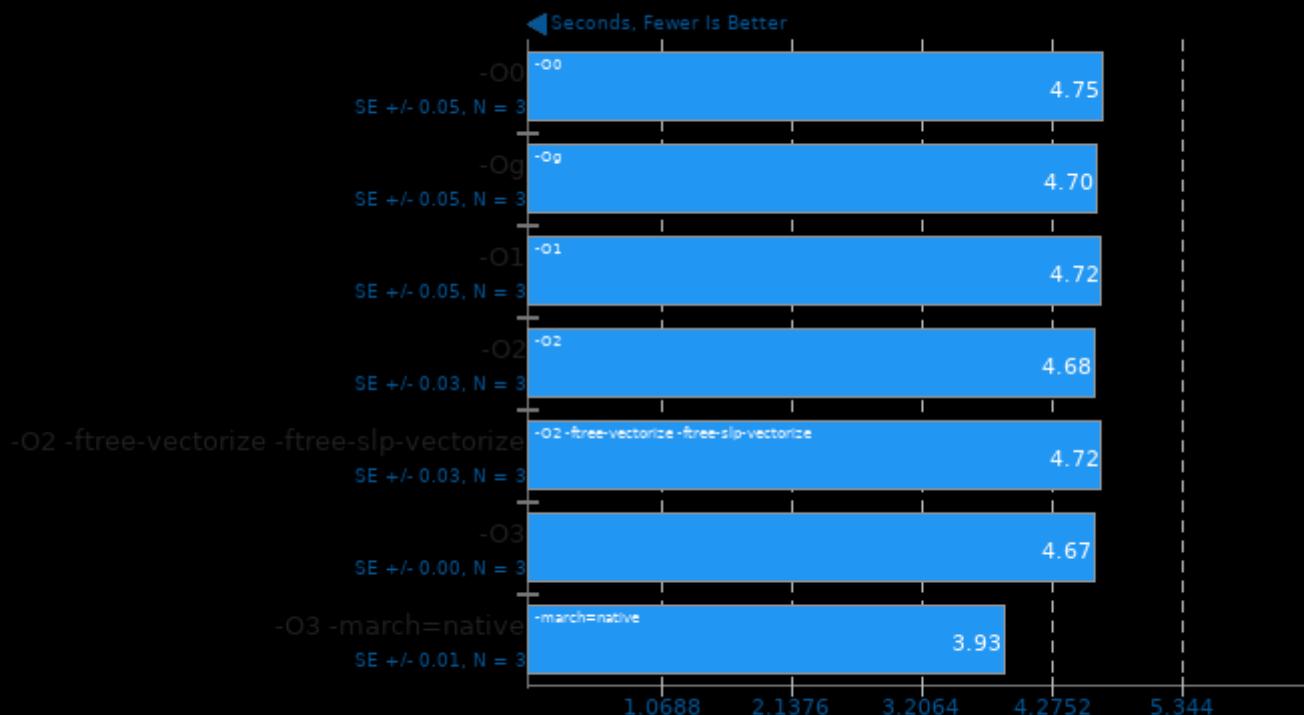
Test: 3000 Fall



1. (CXX) g++ options: -O3 -rdynamic -lglut -IGL -IGLU

Bullet Physics Engine 2.81

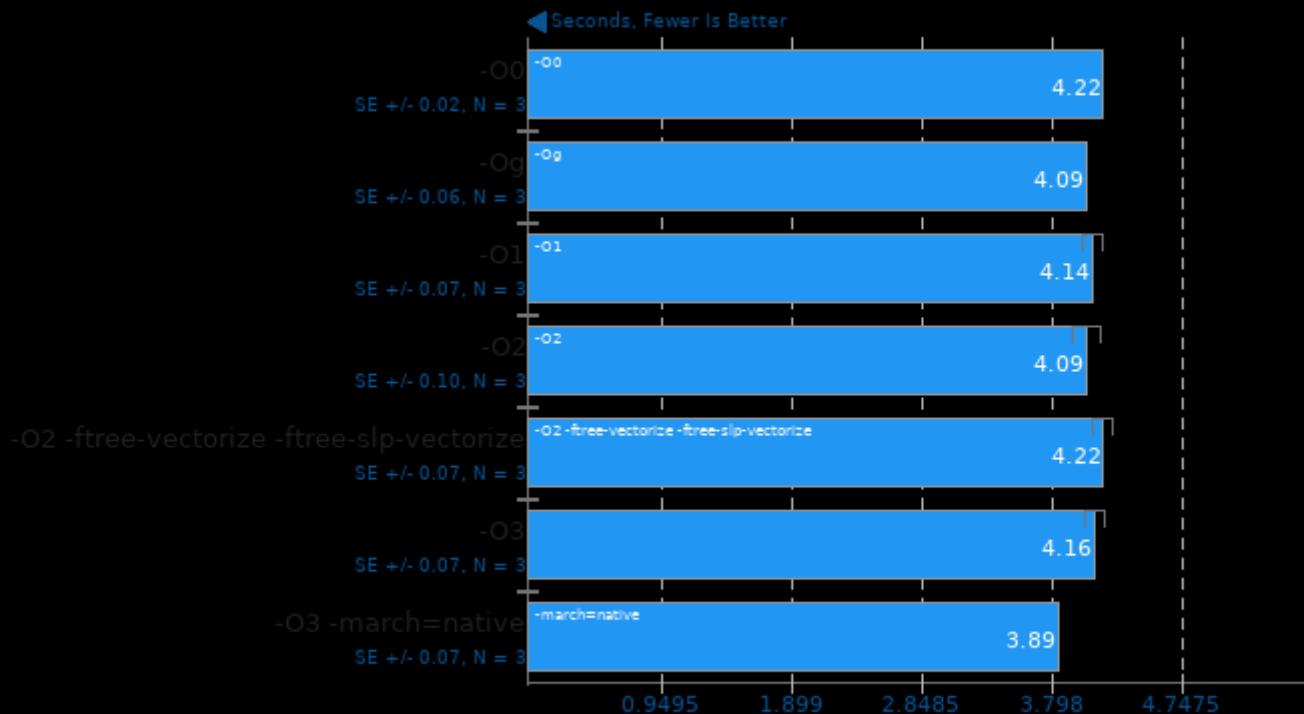
Test: 1000 Stack



1. (CXX) g++ options: -O3 -rdynamic -lglut -IGL -IGLU

Bullet Physics Engine 2.81

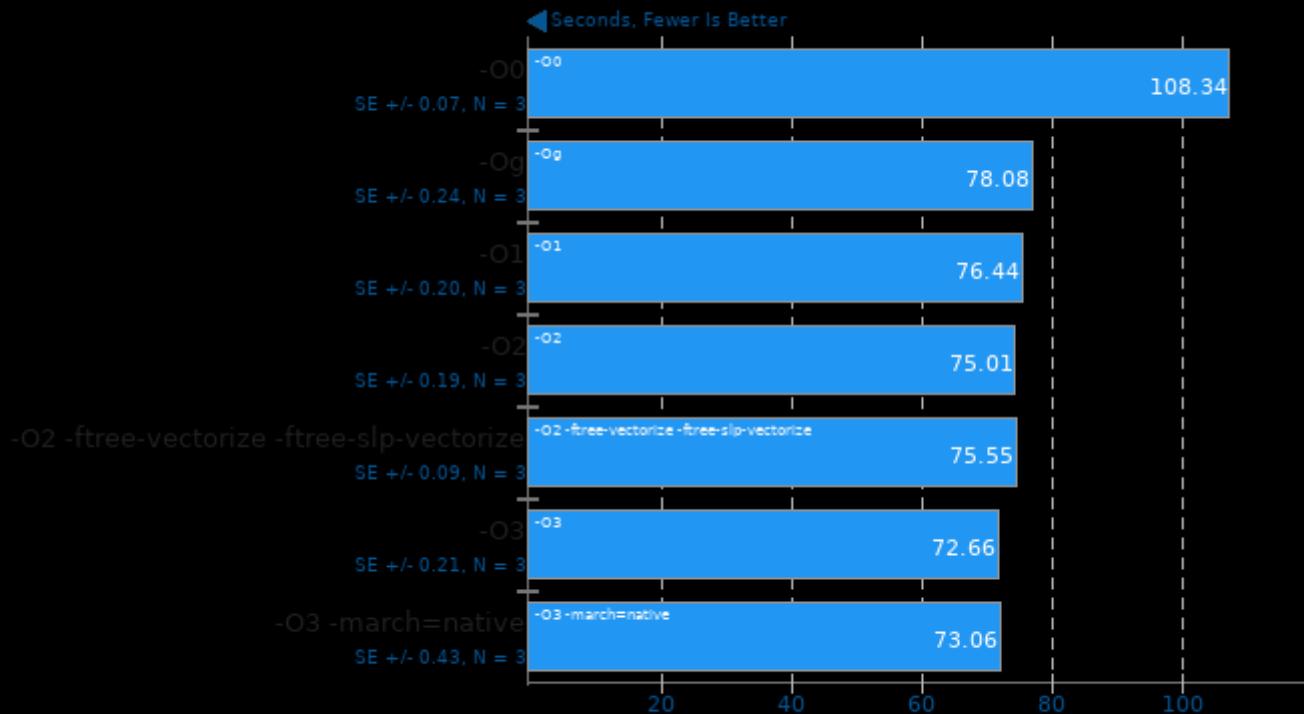
Test: 1000 Convex



1. (CXX) g++ options: -O3 -rdynamic -lglut -IGL -IGLU

XZ Compression 5.2.4

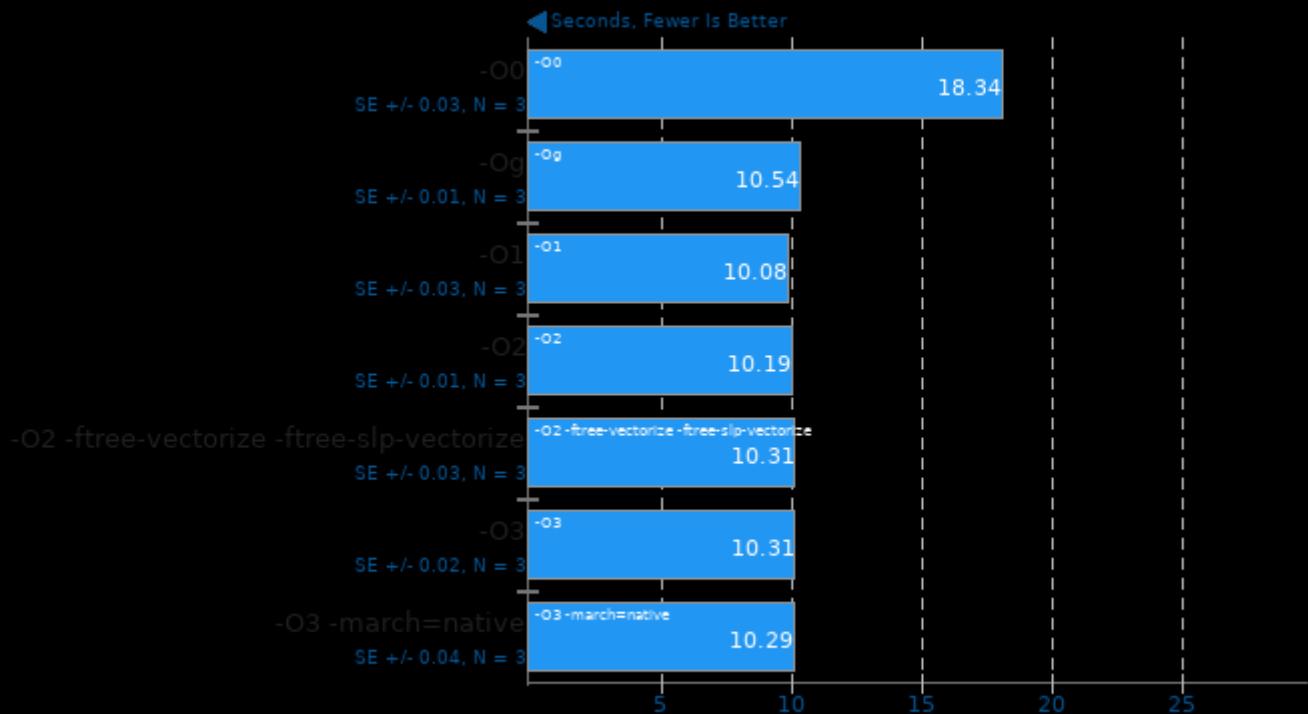
Compressing ubuntu-16.04.3-server-i386.img, Compression Level 9



1. (CC) gcc options: -pthread -fvisibility=hidden

Zstd Compression 1.3.4

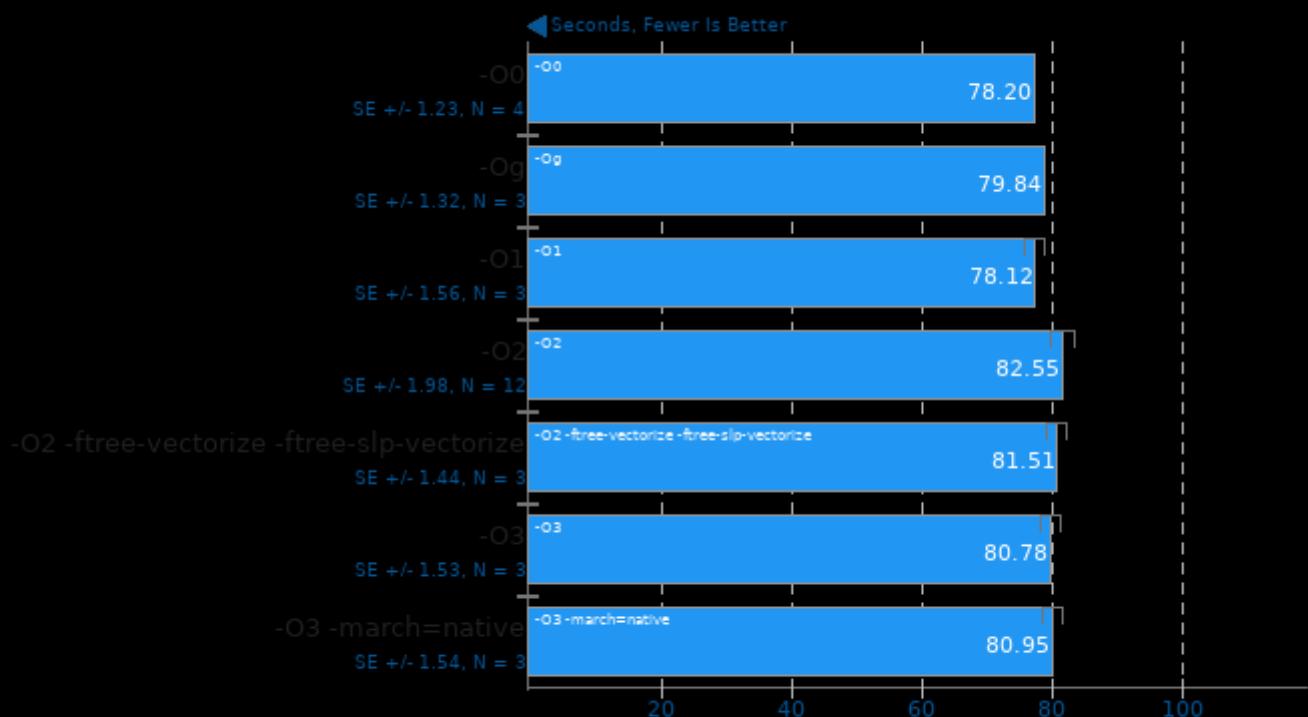
Compressing ubuntu-16.04.3-server-i386.img, Compression Level 19



1. (CC) gcc options: -pthread -lz -lzma -lz4

dav1d 0.1

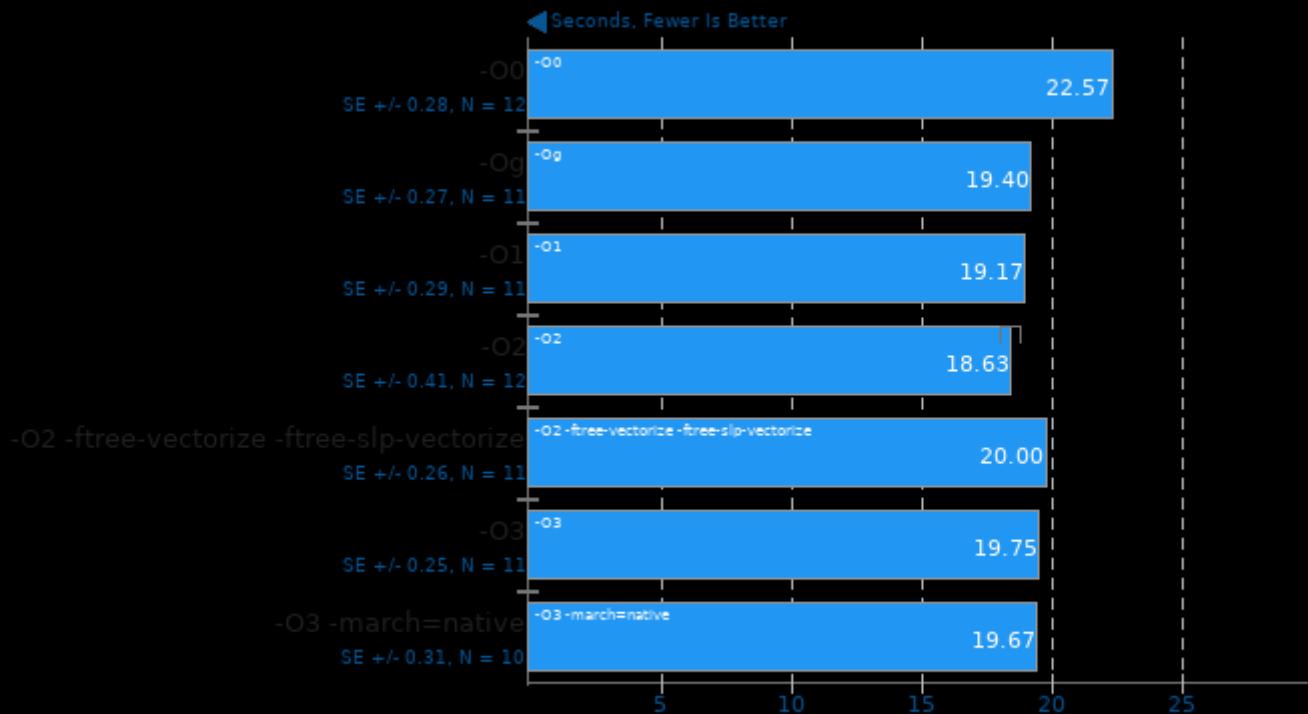
Video Input: Summer Nature 4K



1. (CC) gcc options: -pthread

dav1d 0.1

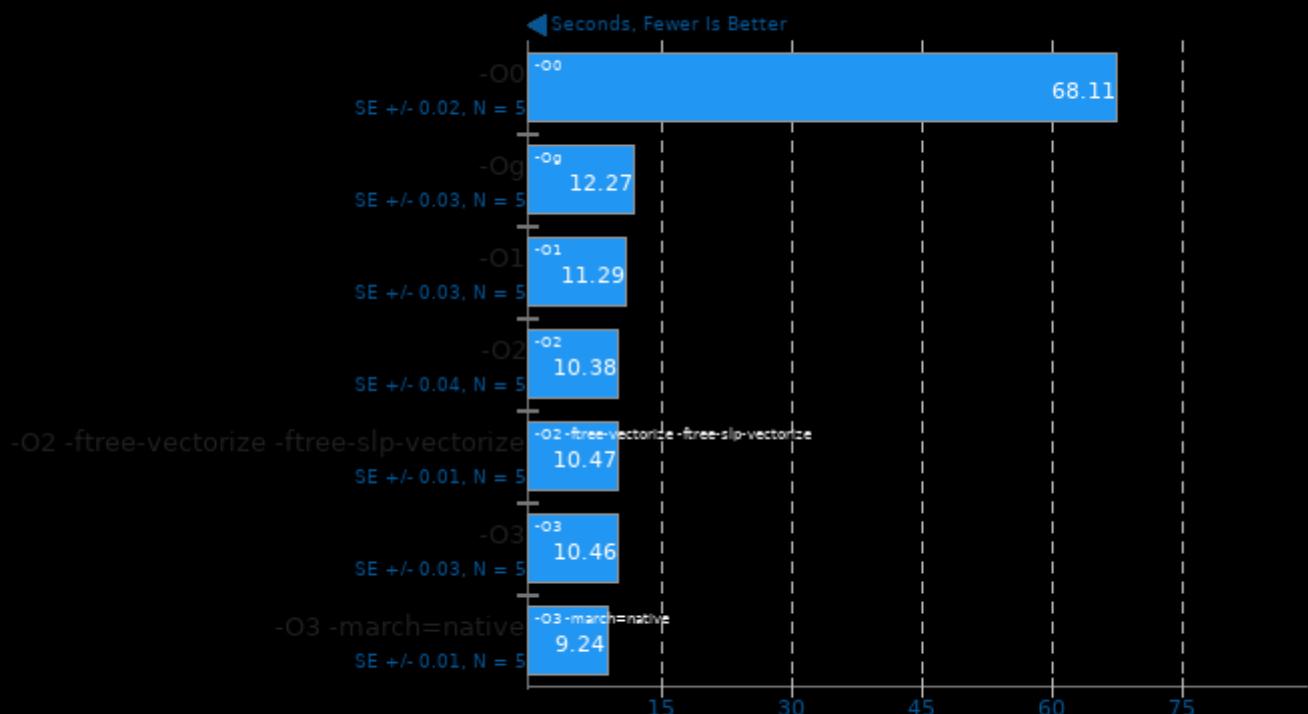
Video Input: Summer Nature 1080p



1. (CC) gcc options: -pthread

FLAC Audio Encoding 1.3.2

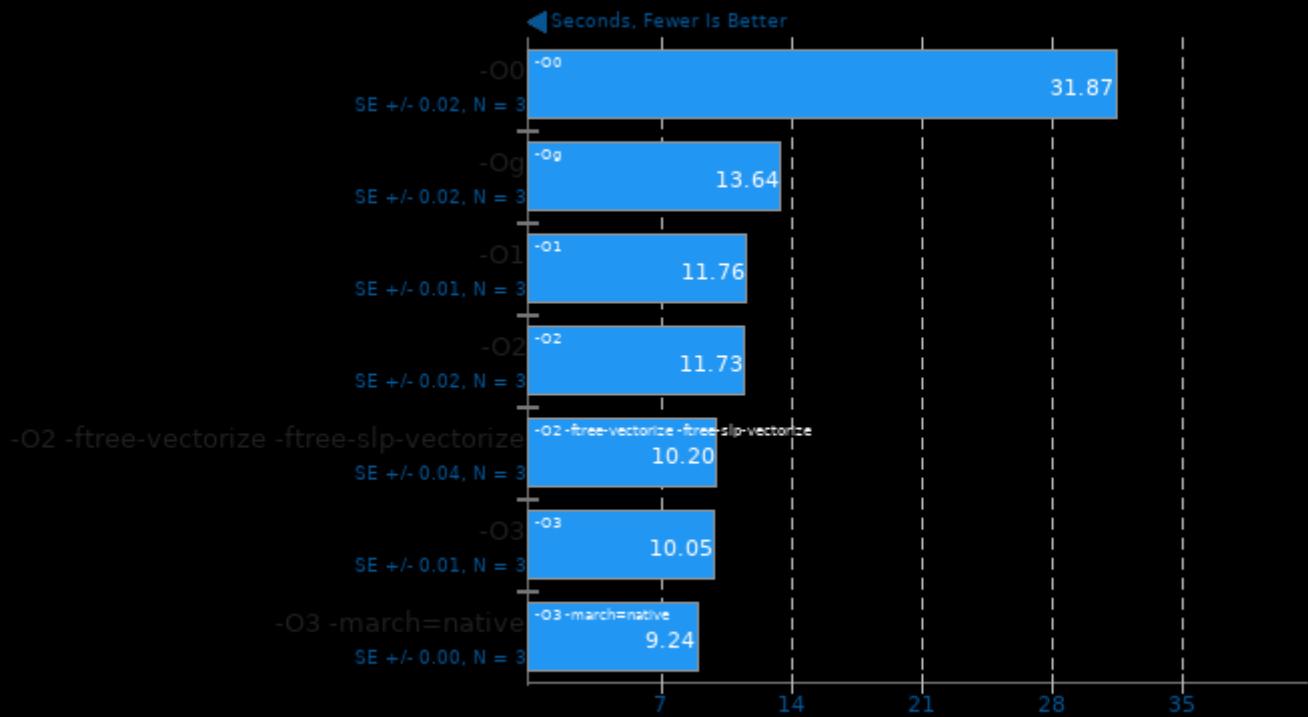
WAV To FLAC



1. (CXX) g++ options: -fvisibility=hidden -fno-rtti

LAME MP3 Encoding 3.100

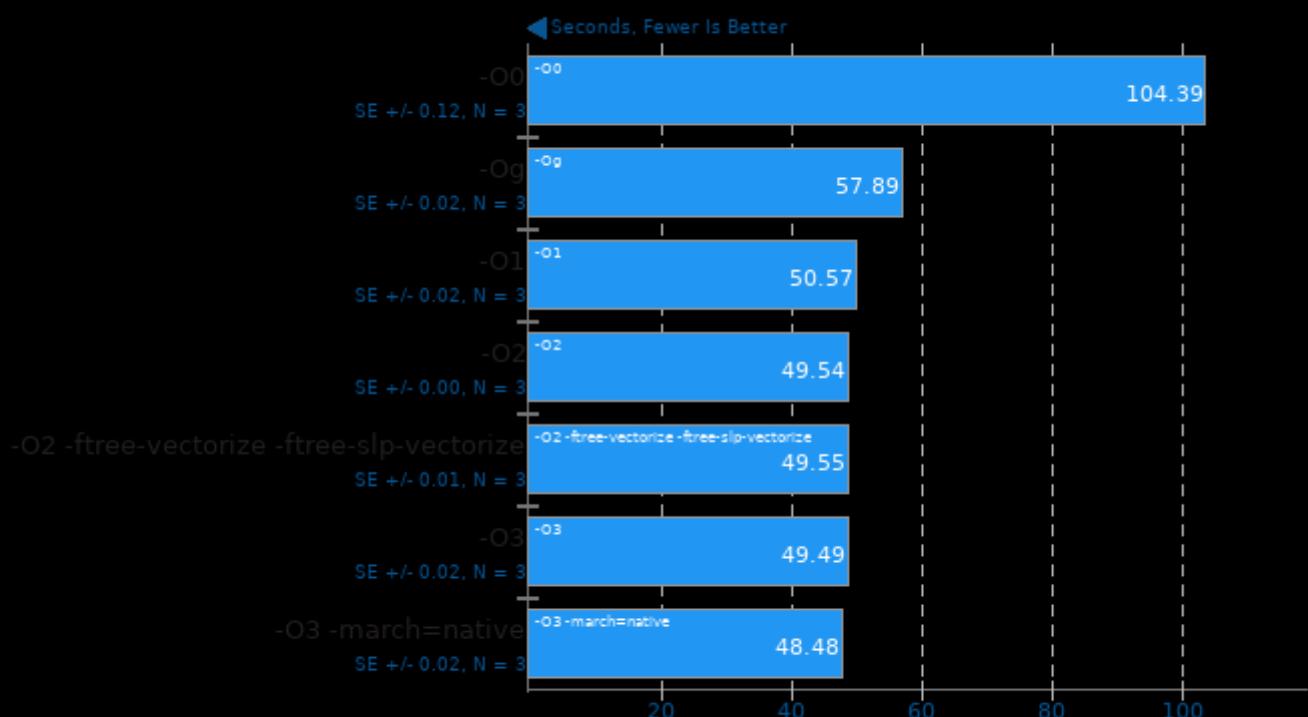
WAV To MP3



1. (CC) gcc options: -fincrustes -lm

m-queens 1.2

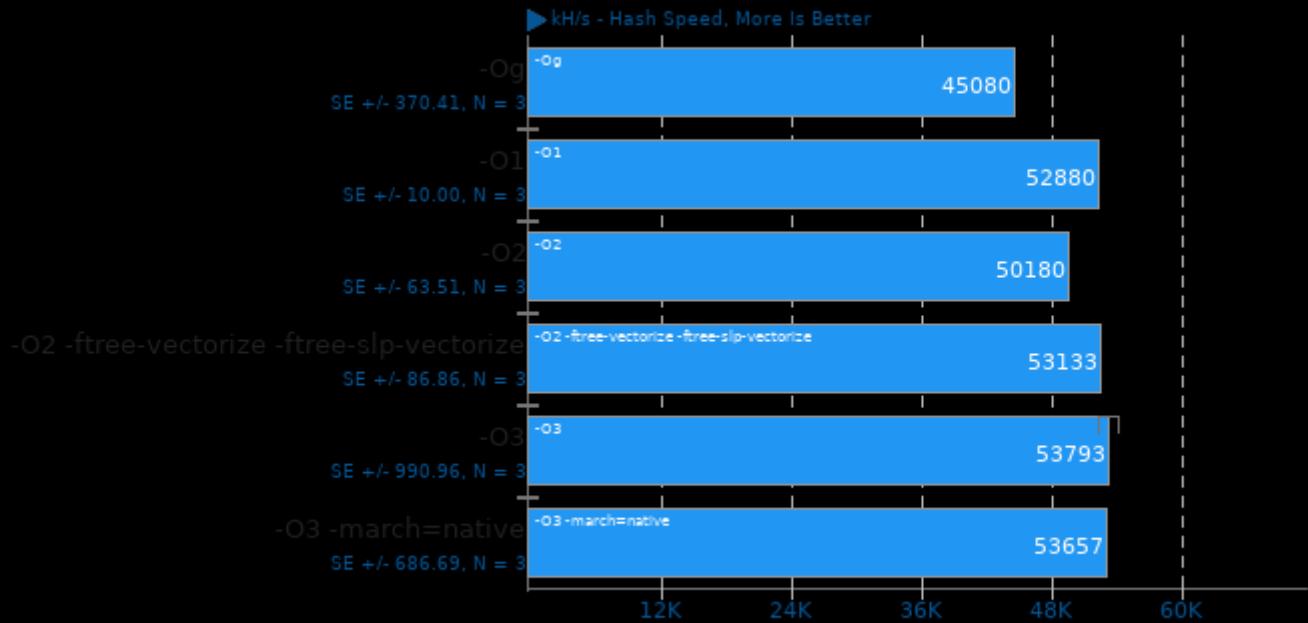
Time To Solve



1. (CXX) g++ options: -fopenmp

Cpuminer-Opt 3.8.8.1

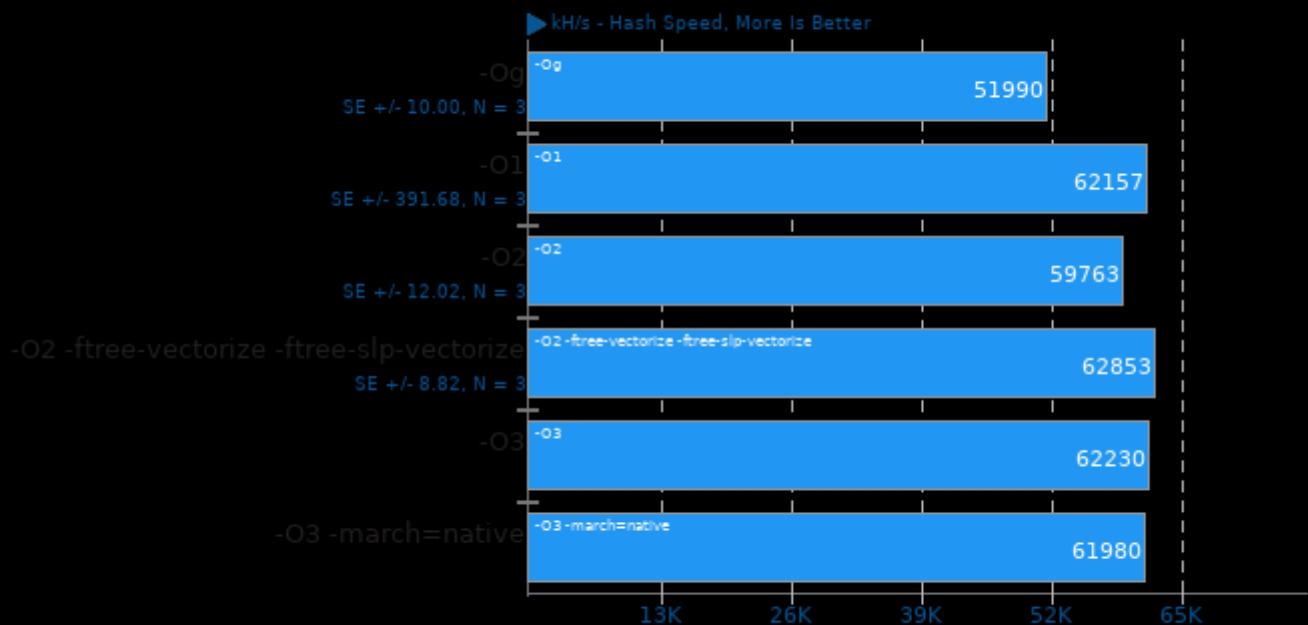
Algorithm: lbry



1. (CXX) g++ options: -lcurl -lz -lpthread -lssl -lcrypto -lgmp

Cpuminer-Opt 3.8.8.1

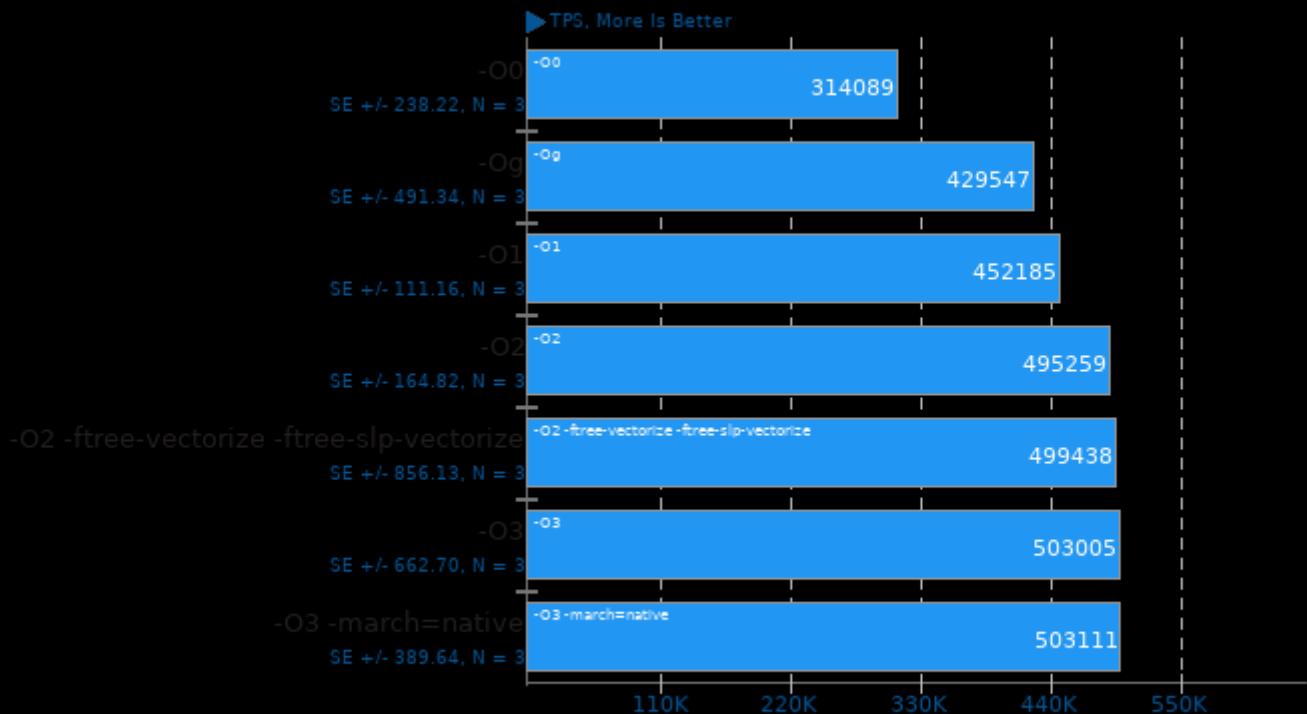
Algorithm: skein



1. (CXX) g++ options: -lcurl -lz -lpthread -lssl -lcrypto -lgmp

PostgreSQL pgbench 10.3

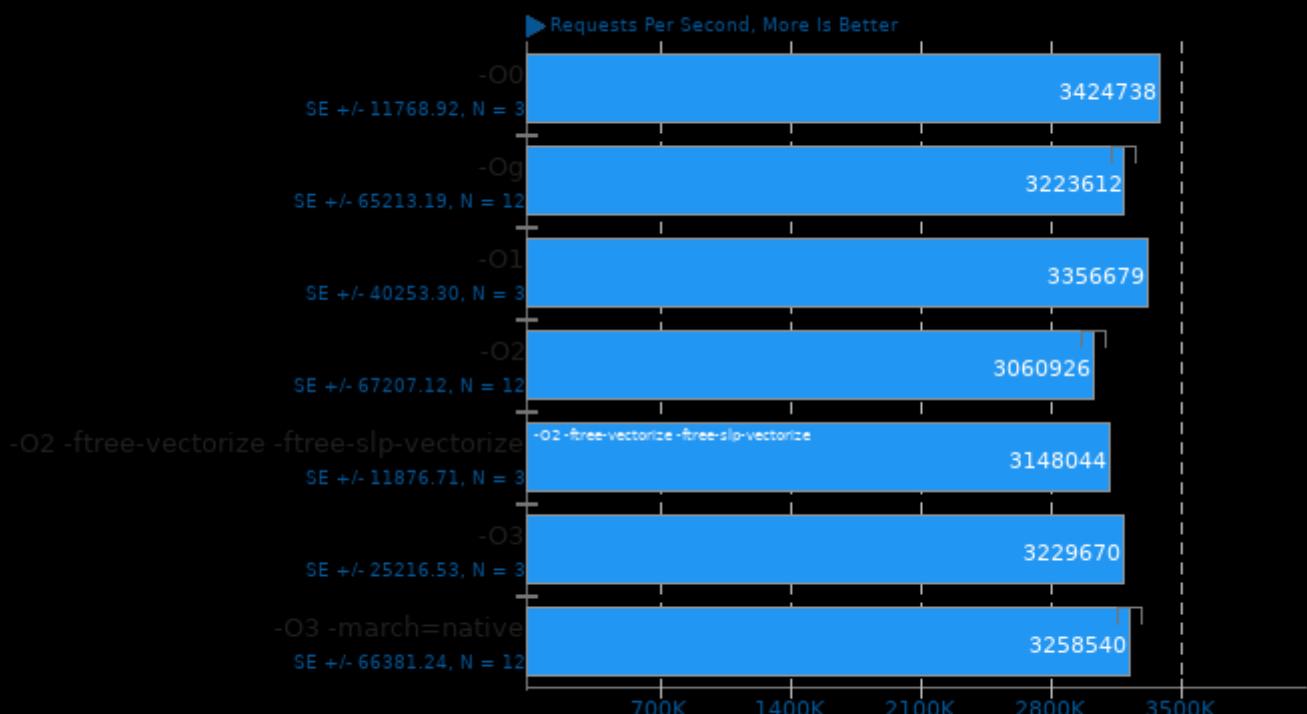
Scaling: Buffer Test - Test: Normal Load - Mode: Read Only



1. (CC) gcc options: -fno-strict-aliasing -fwrapv -lgcccommon -lgccport -lgcc -lpthread -lrt -lcrypt -ldl -lm

Redis 4.0.8

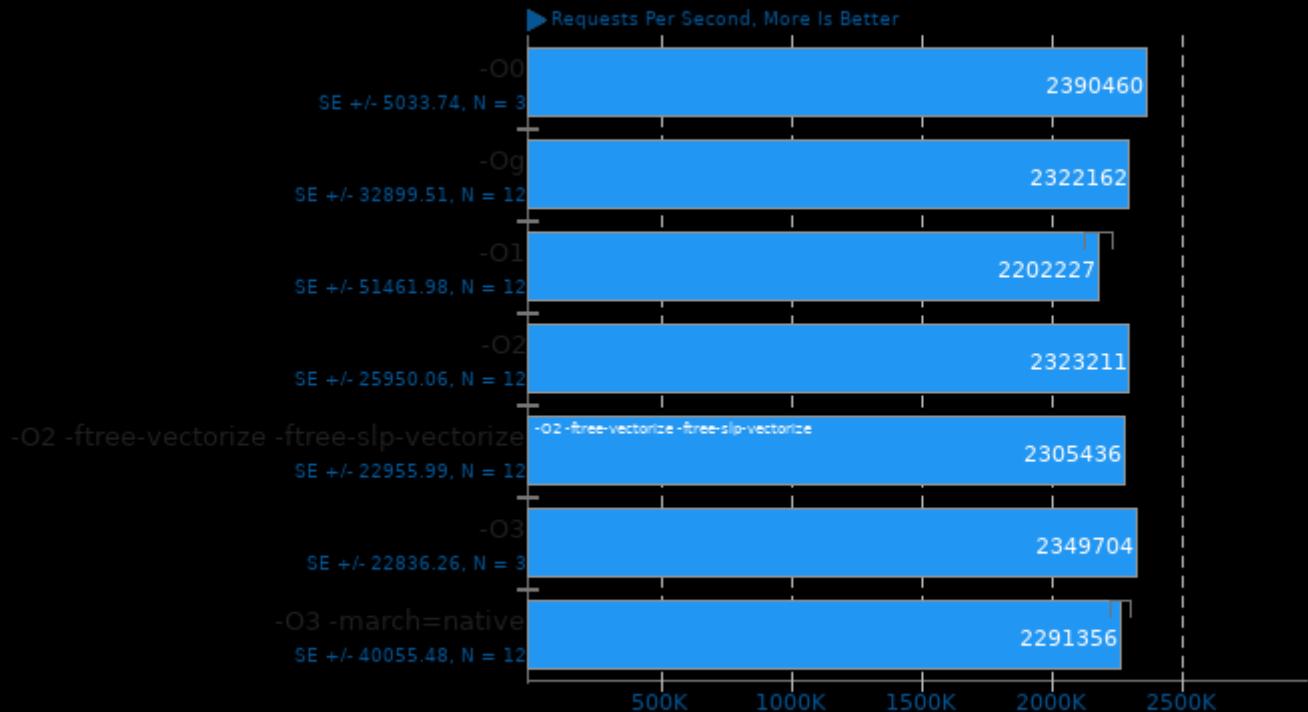
Test: GET



1. (CC) gcc options: -ggdb -rdynamic -lm -ldl -pthread

Redis 4.0.8

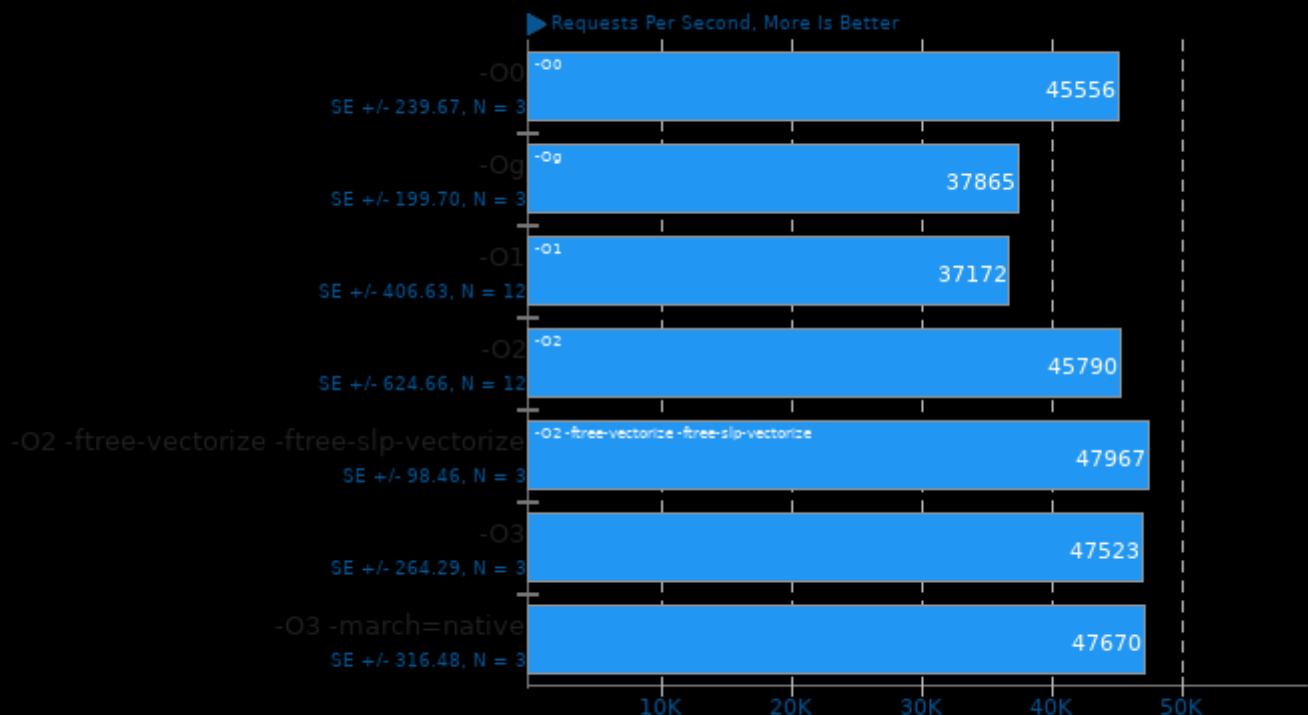
Test: SET



1. (CC) gcc options: -ggdb -rdynamic -lm -ldl -pthread

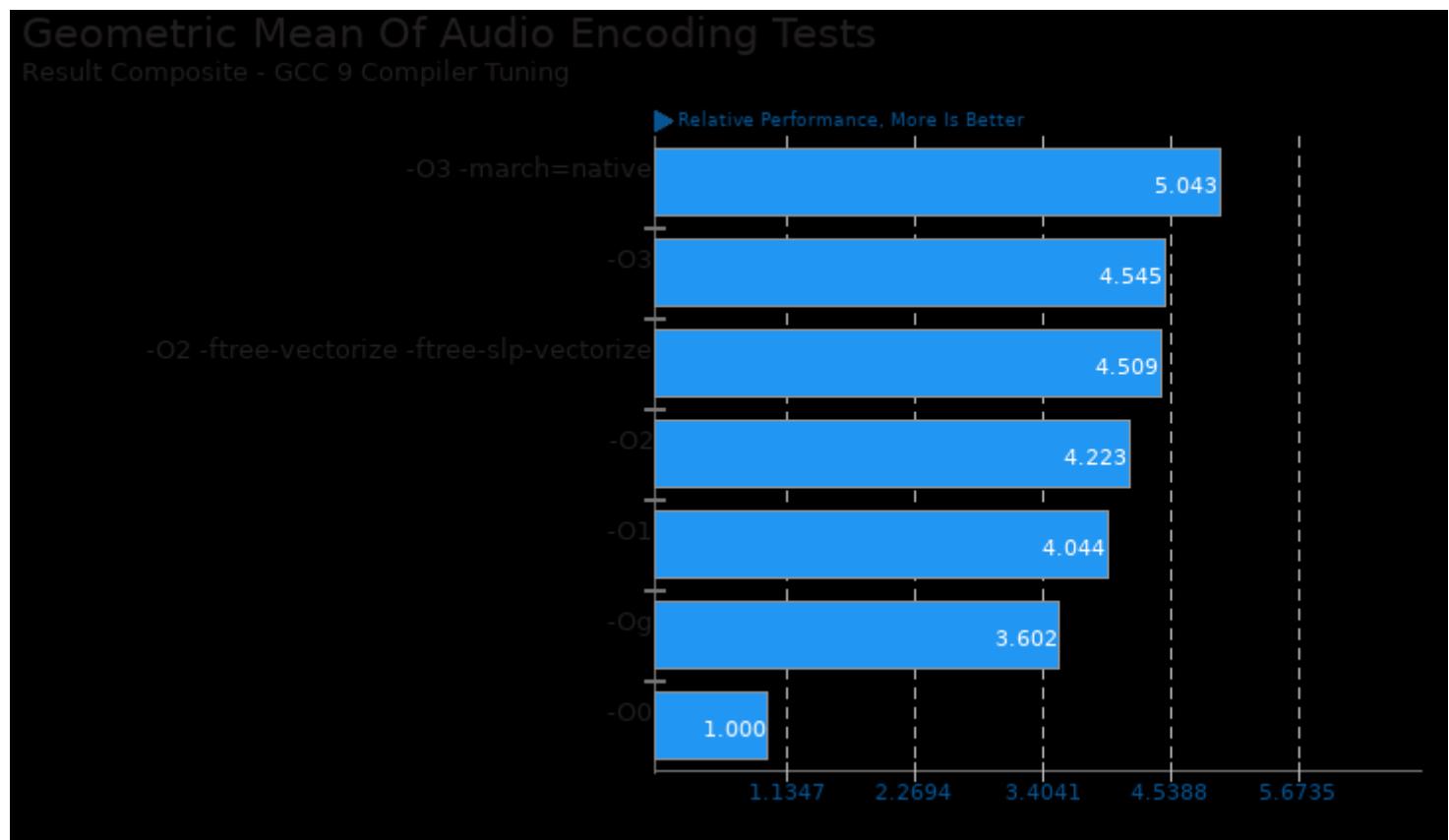
NGINX Benchmark 1.9.9

Static Web Page Serving

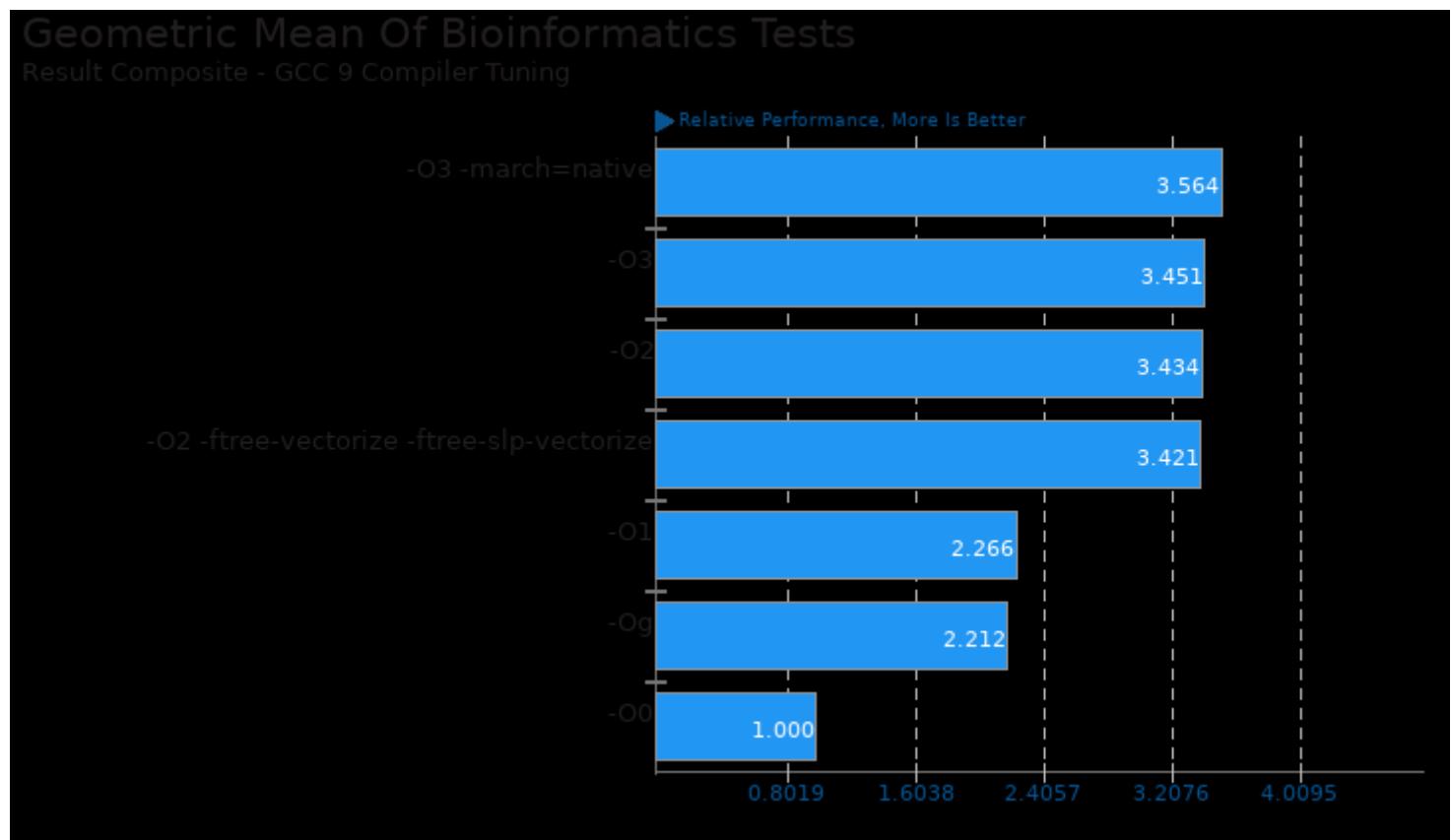


1. (CC) gcc options: -lpthread -lcrypt -lcrypto -lz -O3 -march=native

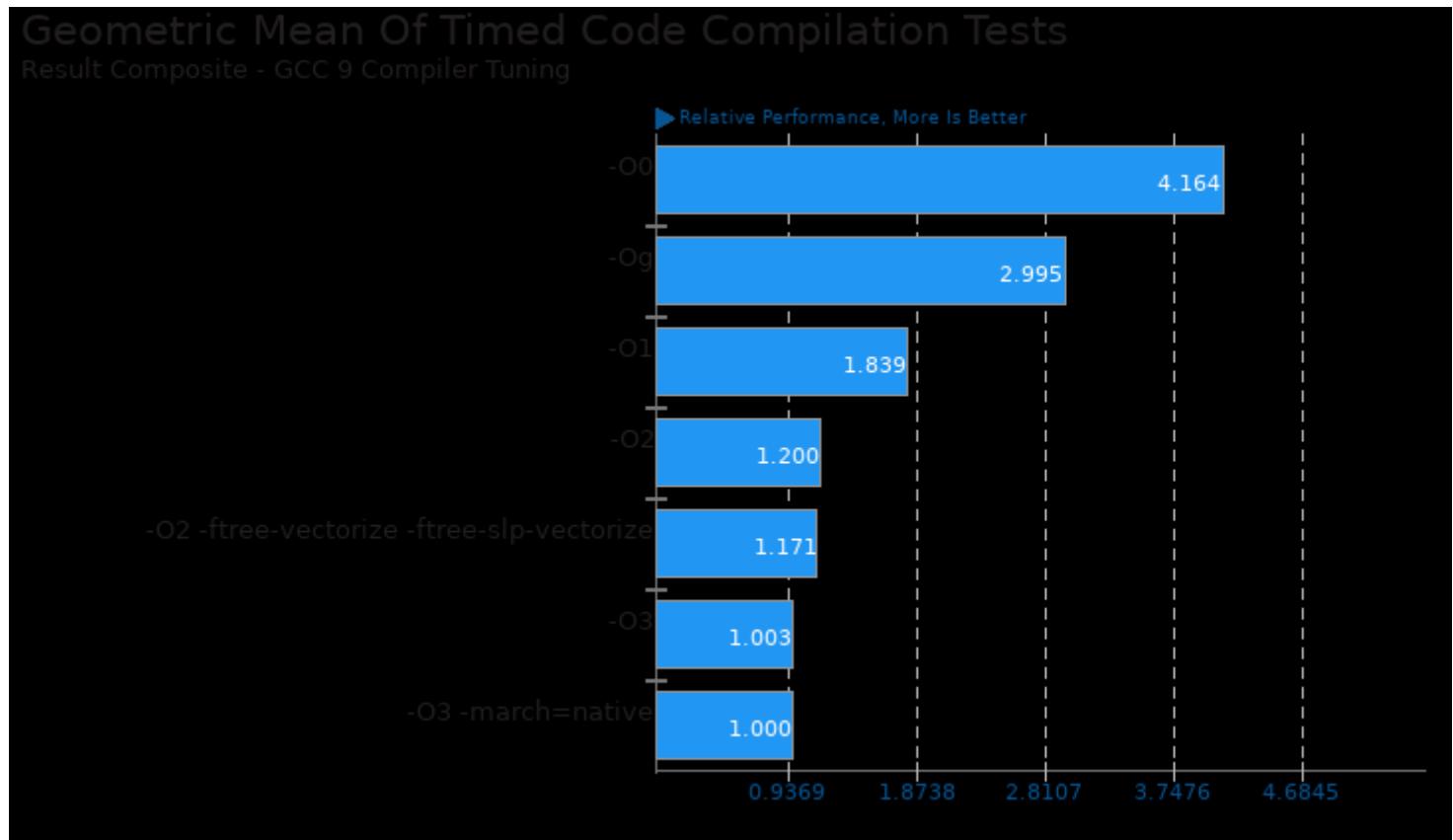
These geometric means are based upon test groupings / test suites for this result file.



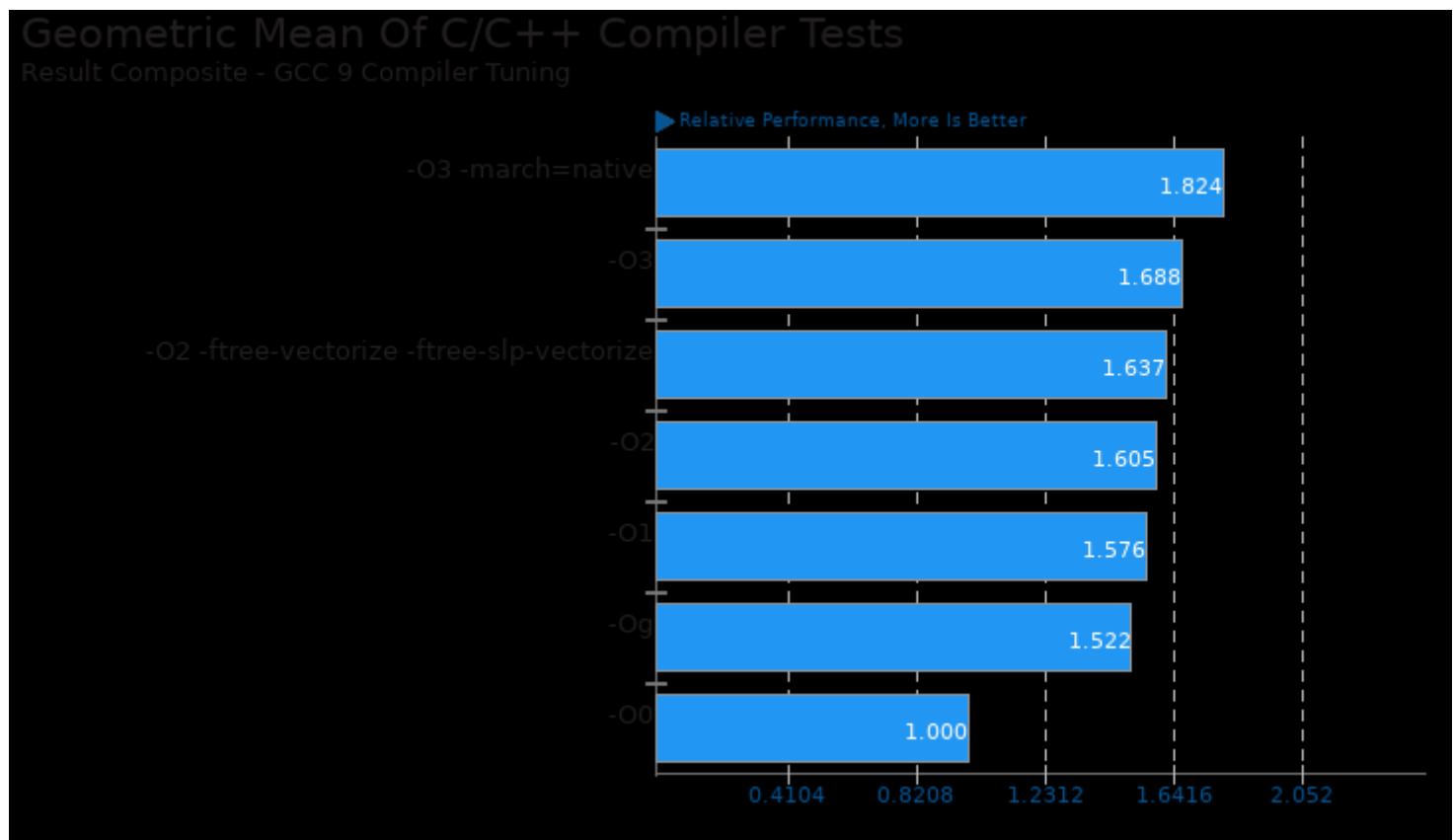
Geometric mean based upon tests: pts/encode-mp3 and pts/encode-flac



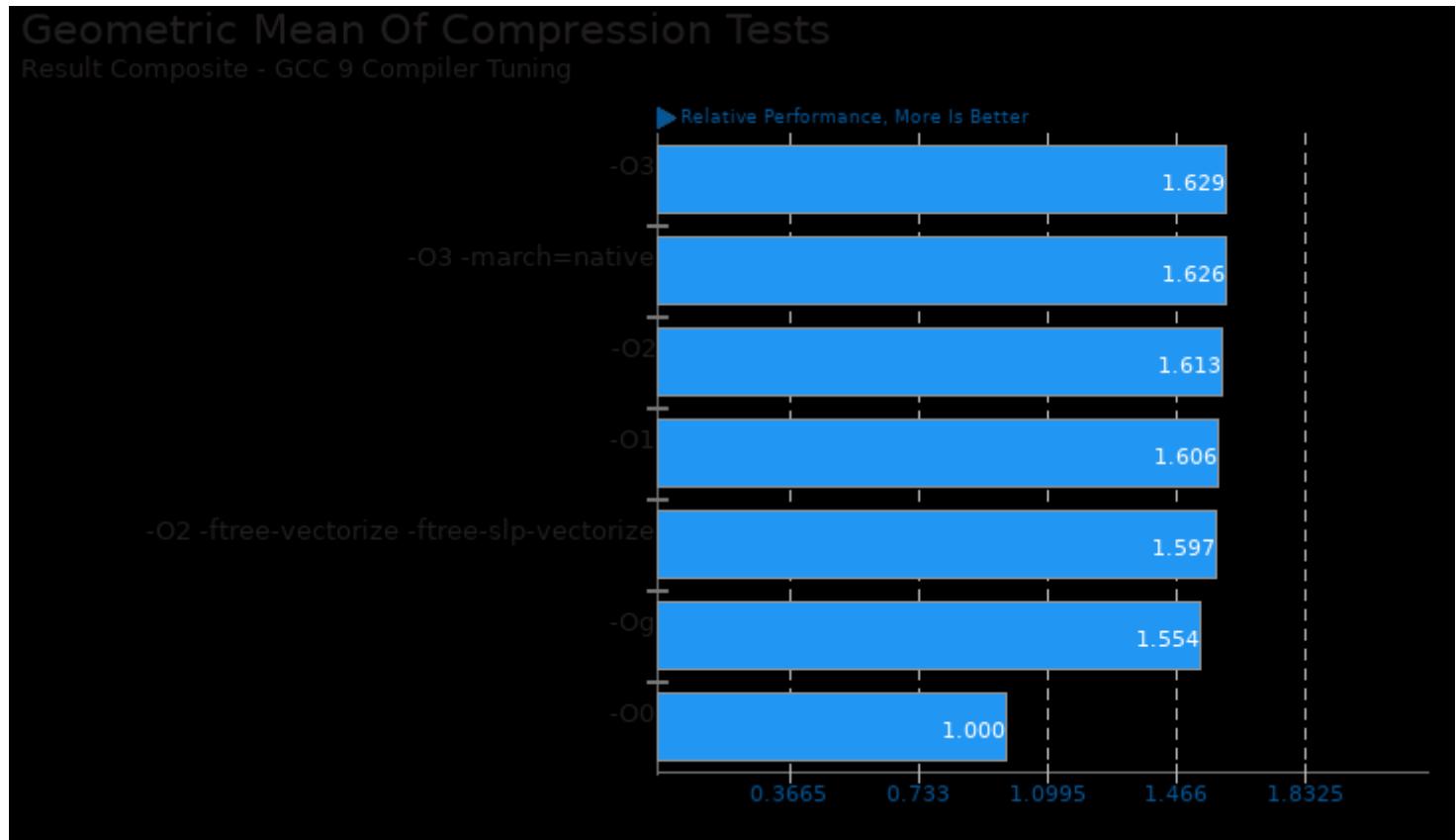
Geometric mean based upon tests: pts/himeno and pts/hmmer



Geometric mean based upon tests: pts/build-php and pts/build-imagemagick



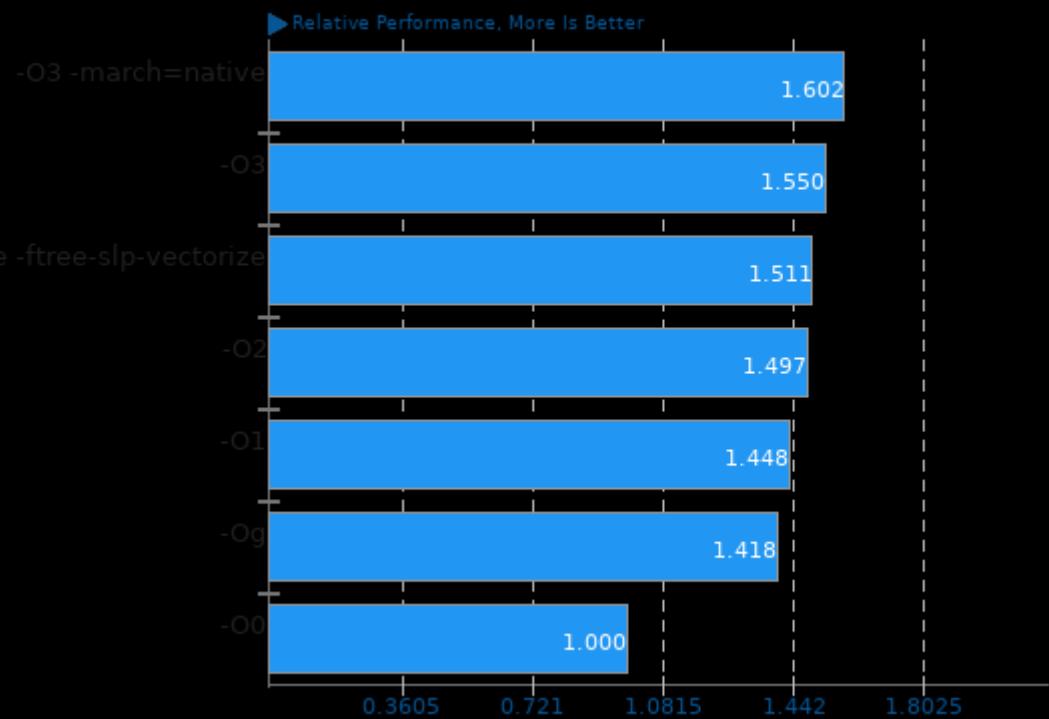
Geometric mean based upon tests: pts/scimark2, pts/aobench, pts/himeno, pts/hammer, pts/build-php, pts/build-imagemagick, pts/c-ray, pts/bullet, pts/encode-mp3, pts/encode-flac, pts/pgbench, pts/dav1d, pts/x264, pts/x265, pts/compress-xz, pts/compress-zstd and pts/nginx



Geometric mean based upon tests: pts/compress-zstd and pts/compress-xz

Geometric Mean Of CPU Massive Tests

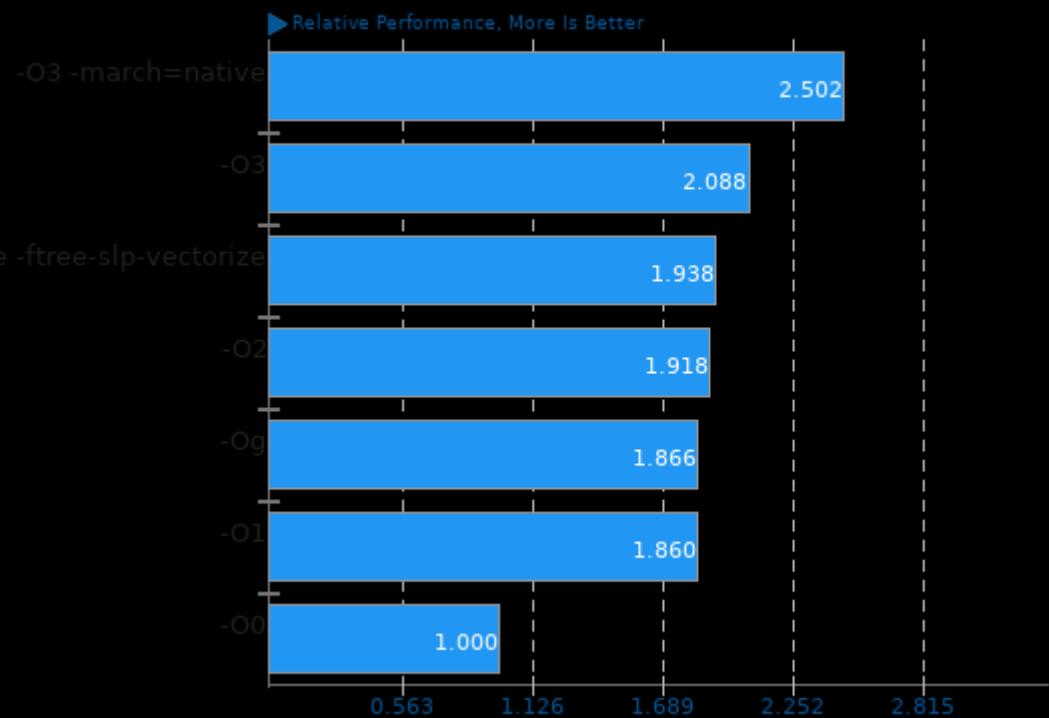
Result Composite - GCC 9 Compiler Tuning



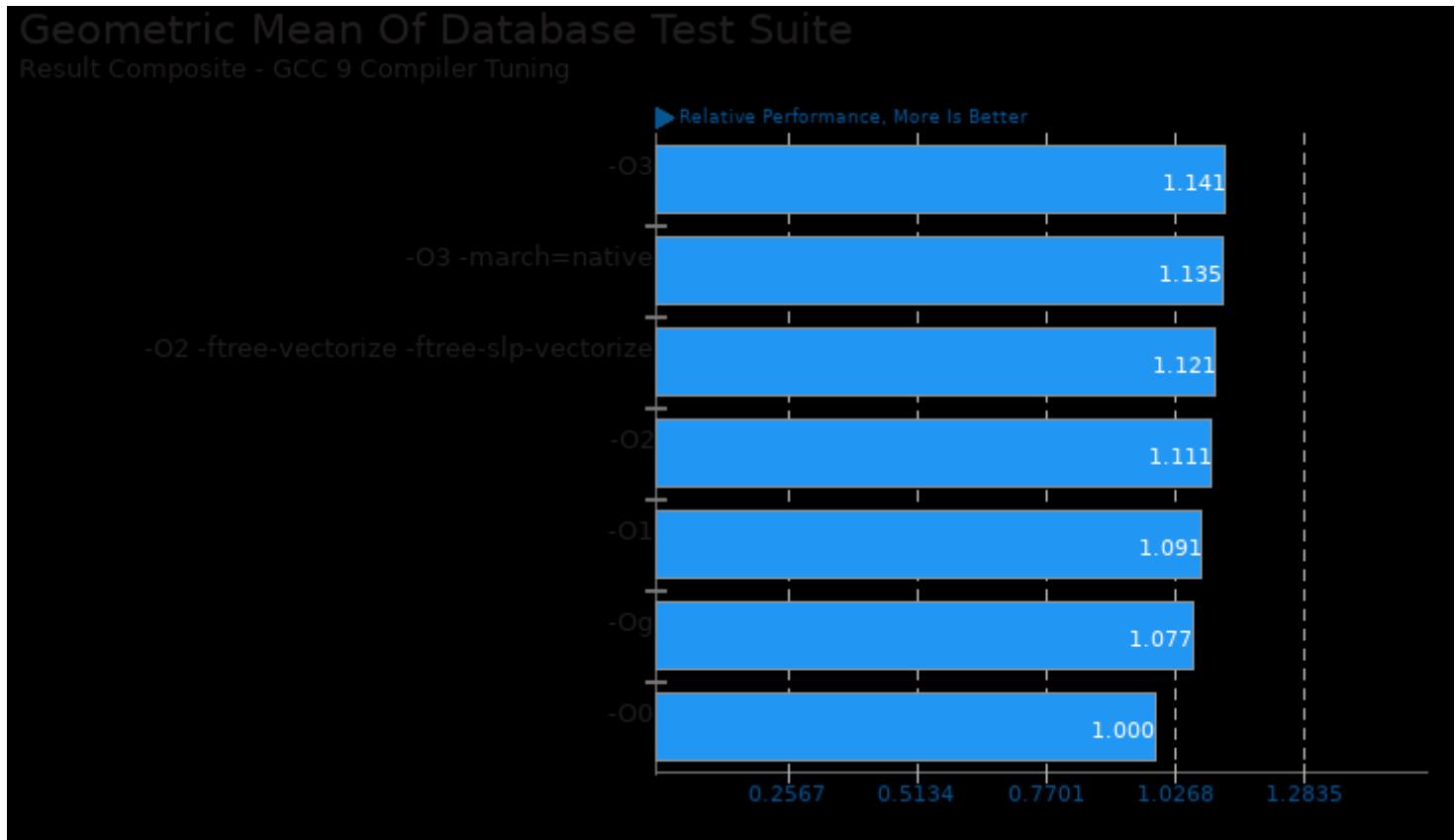
Geometric mean based upon tests: pts/build-php, pts/c-ray, pts/compress-xz, pts/compress-zstd, pts/dav1d, pts/x264, pts/x265, pts/ebizzy, pts/encode-flac, pts/encode-mp3, pts/himeno, pts/hmmer, pts/m-queens, pts/nginx, pts/pgbench, pts/redis and pts/cpuminer-opt

Geometric Mean Of Creator Workloads Tests

Result Composite - GCC 9 Compiler Tuning



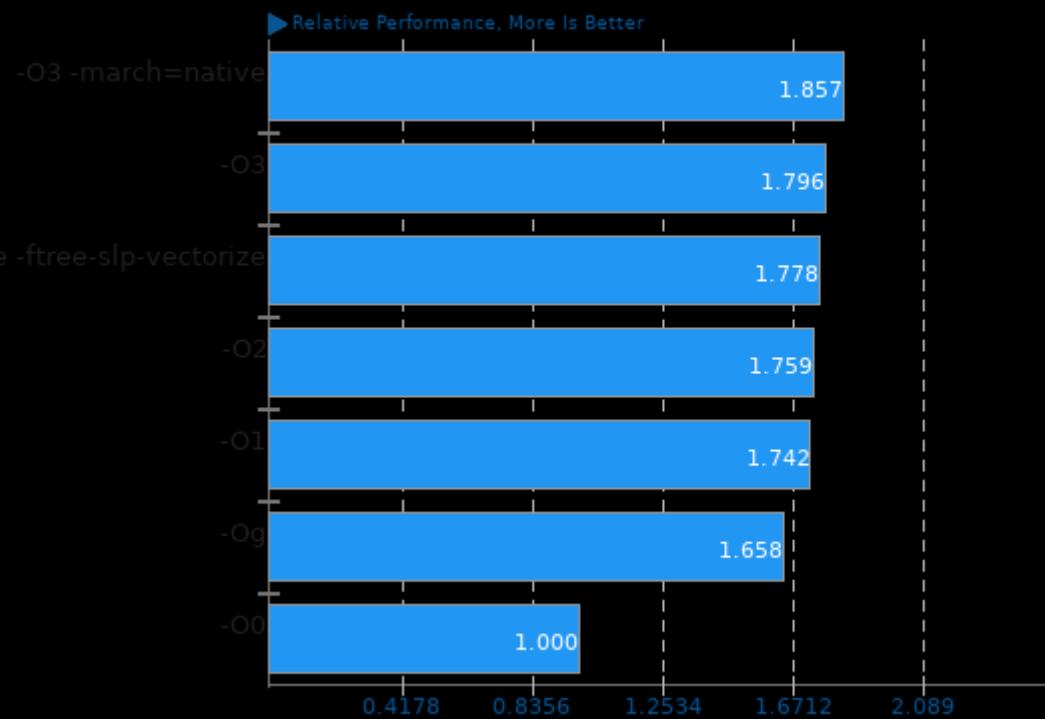
Geometric mean based upon tests: pts/c-ray, pts/aobench, pts/smallpt, pts/x264, pts/x265, pts/dav1d, pts/encode-mp3 and pts/encode-flac



Geometric mean based upon tests: pts/redis and pts/pgbench

Geometric Mean Of Encoding Tests

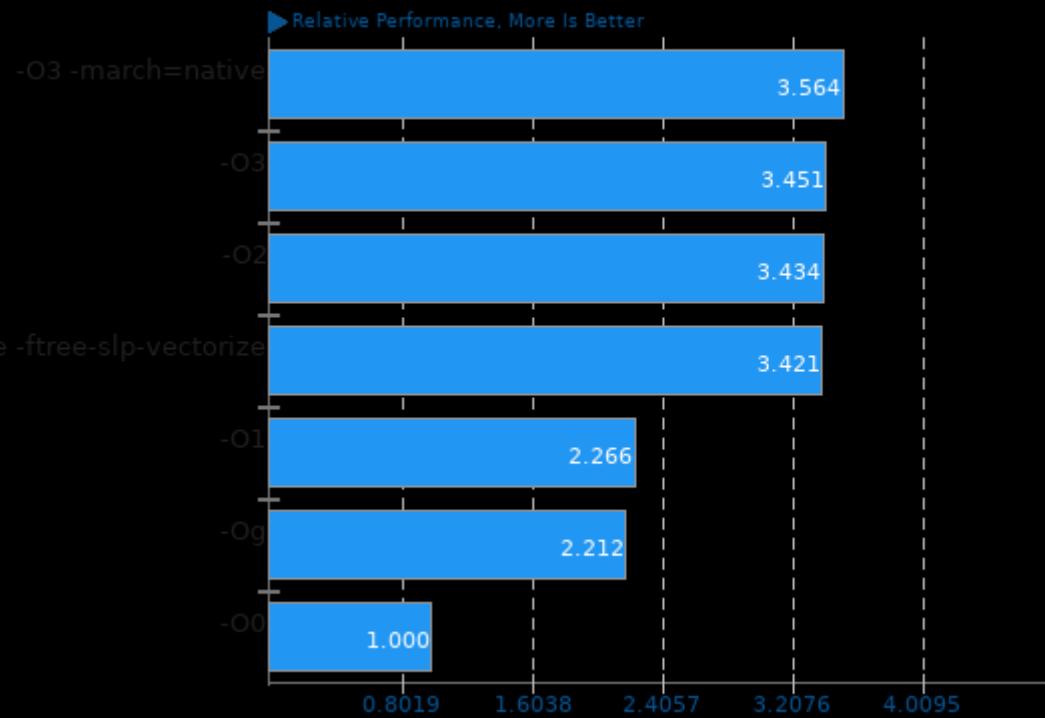
Result Composite - GCC 9 Compiler Tuning



Geometric mean based upon tests: pts/encode-mp3, pts/encode-flac, pts/x264, pts/x265 and pts/dav1d

Geometric Mean Of HPC - High Performance Computing Tests

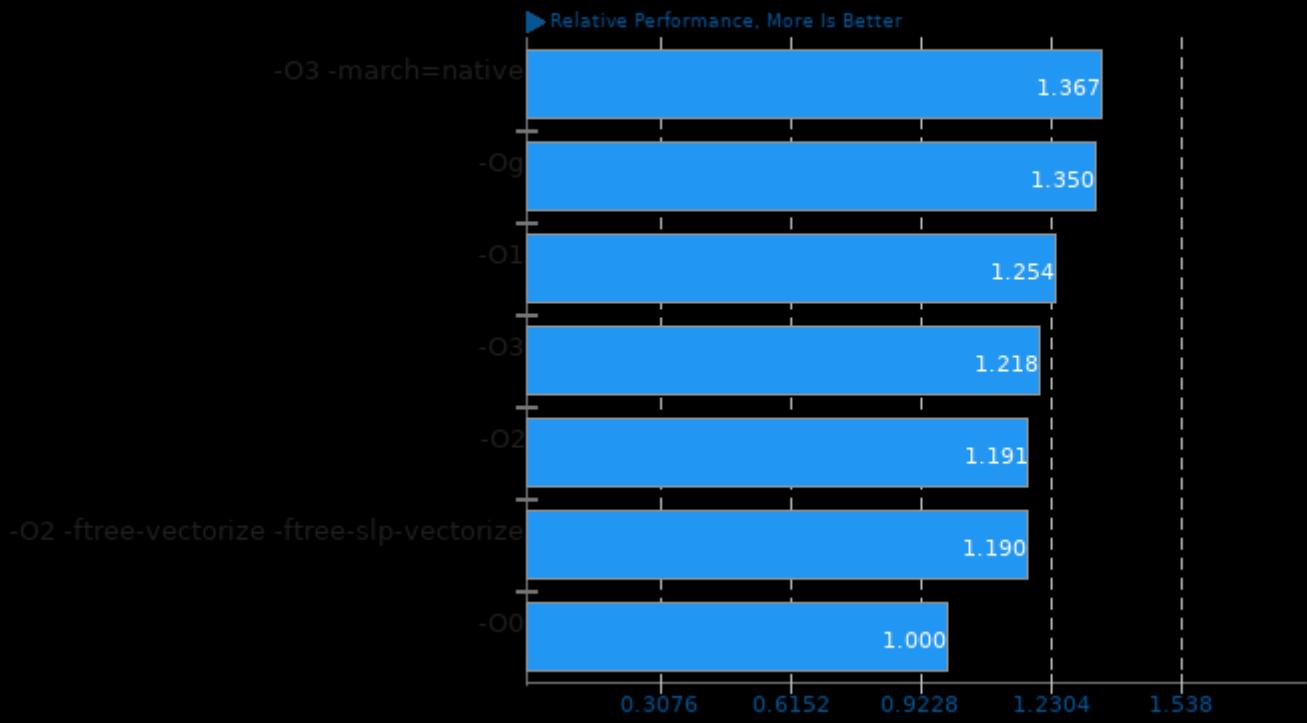
Result Composite - GCC 9 Compiler Tuning



Geometric mean based upon tests: pts/himeno and pts/hmmer

Geometric Mean Of Multi-Core Tests

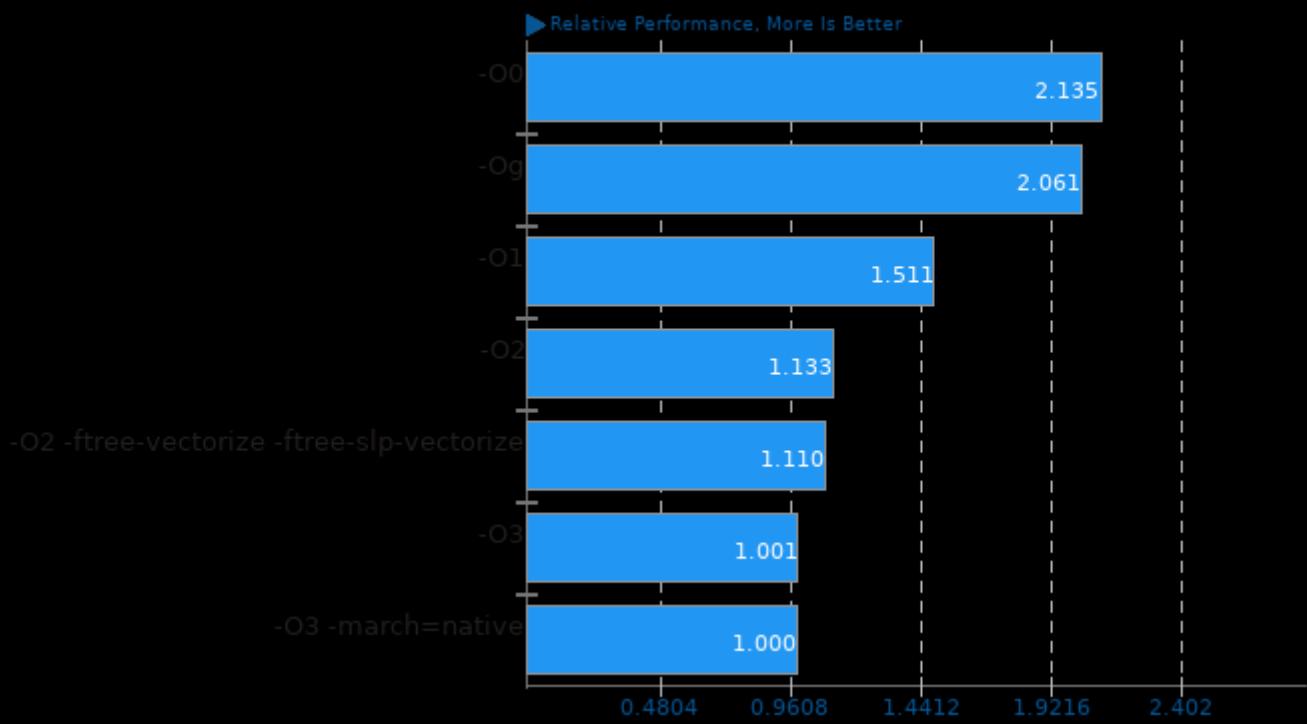
Result Composite - GCC 9 Compiler Tuning



Geometric mean based upon tests: pts/cpuminer-opt, pts/c-ray, pts/m-queens, pts/x264, pts/x265, pts/dav1d, pts/smallpt, pts/ebizzy, pts/compress-zstd, pts/build-php, pts/build-imagemagick, pts/aobench and pts/pgbench

Geometric Mean Of Programmer / Developer System Benchmarks Tests

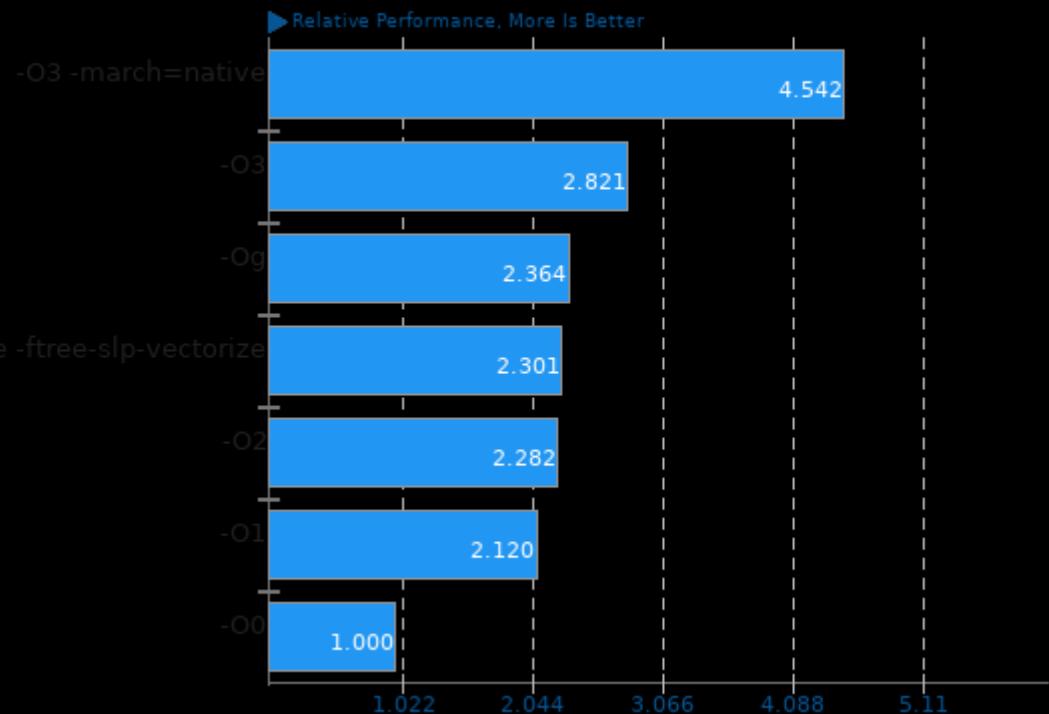
Result Composite - GCC 9 Compiler Tuning



Geometric mean based upon tests: pts/compress-zstd, pts/build-php and pts/build-imagemagick

Geometric Mean Of Renderers Tests

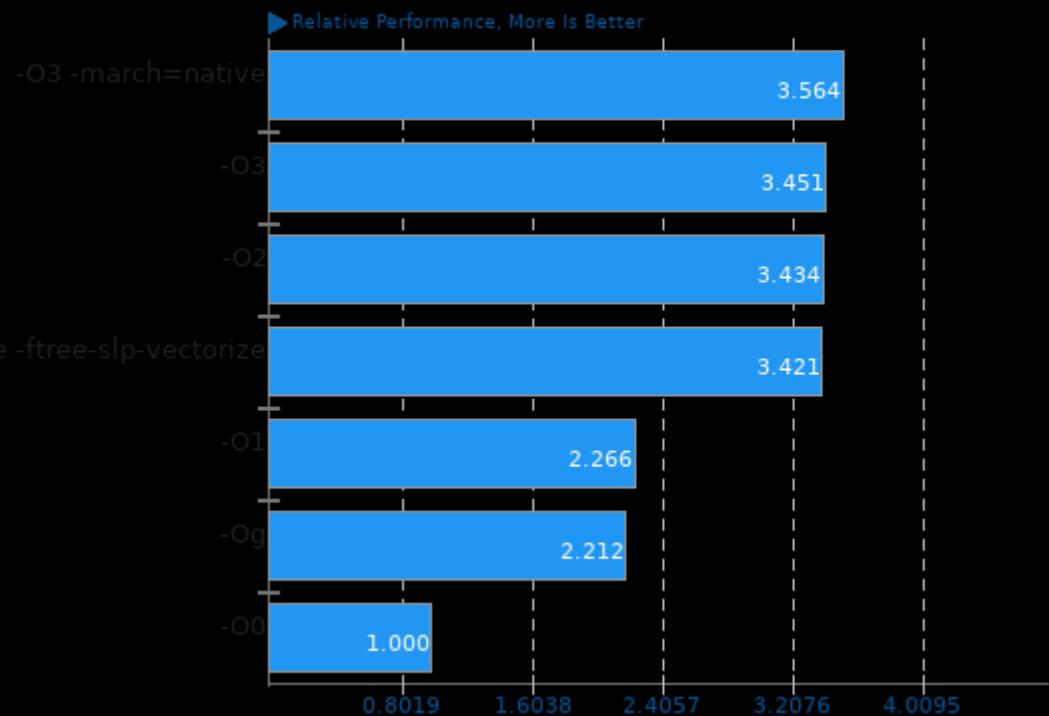
Result Composite - GCC 9 Compiler Tuning



Geometric mean based upon tests: pts/c-ray, pts/aobench and pts/smallpt

Geometric Mean Of Scientific Computing Tests

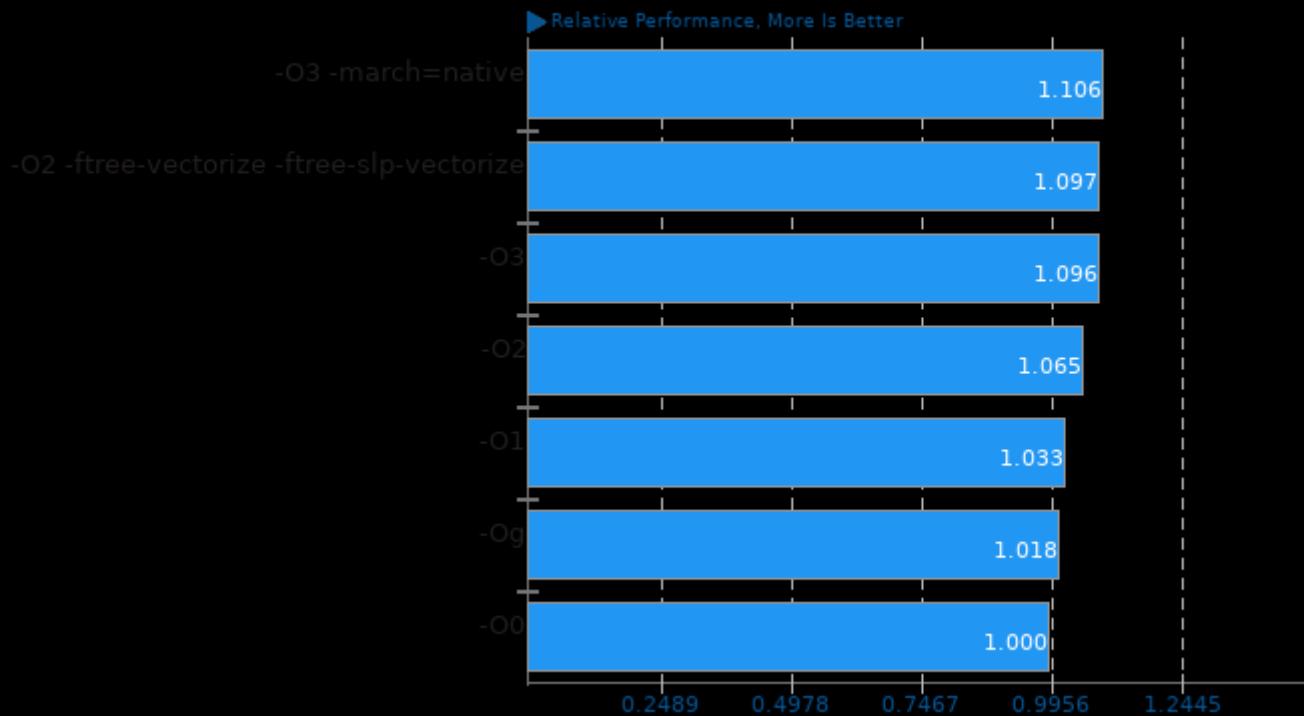
Result Composite - GCC 9 Compiler Tuning



Geometric mean based upon tests: pts/himeno and pts/hmmer

Geometric Mean Of Server Tests

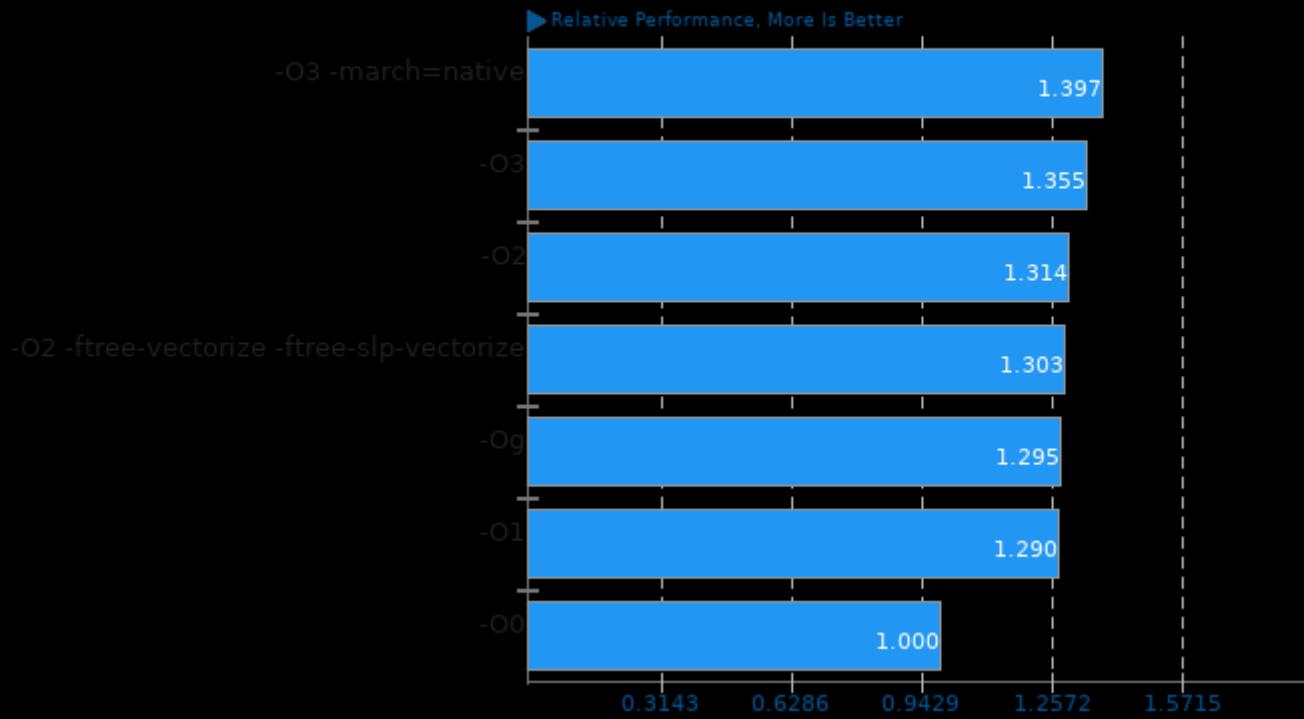
Result Composite - GCC 9 Compiler Tuning



Geometric mean based upon tests: pts/nginx, pts/ebizzy, pts/pgbench and pts/redis

Geometric Mean Of Server CPU Tests

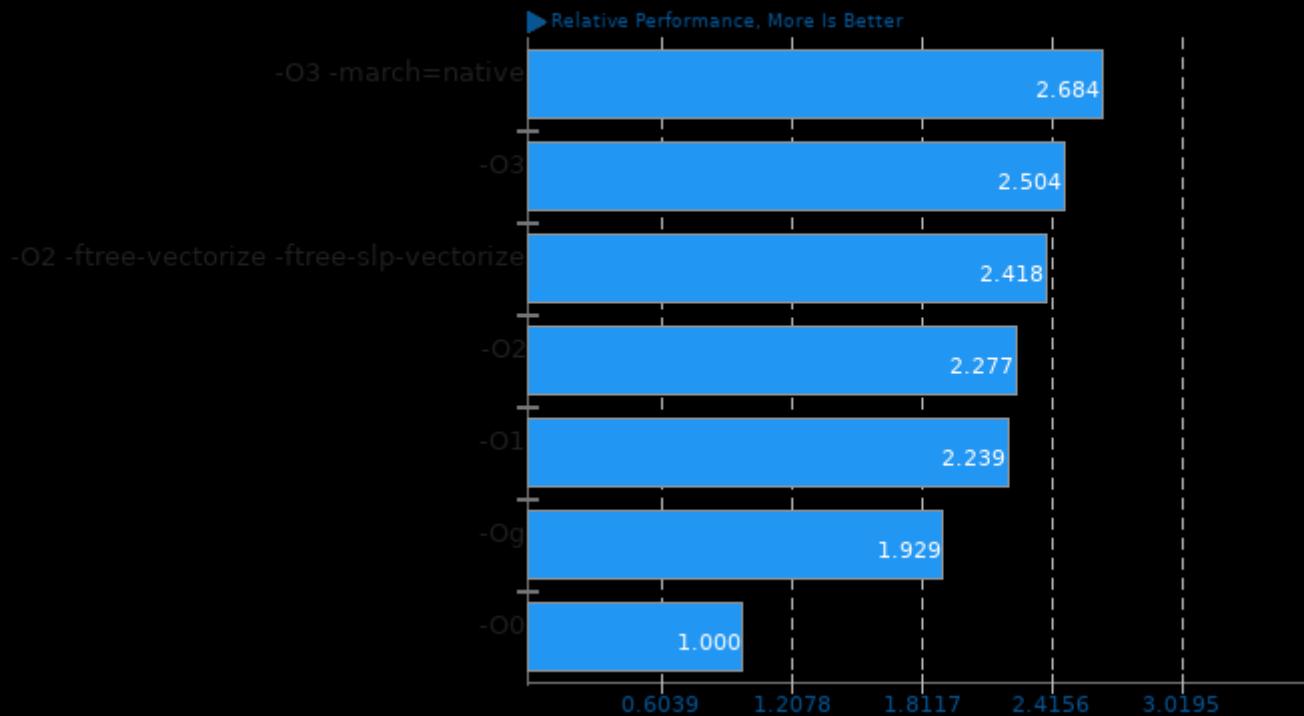
Result Composite - GCC 9 Compiler Tuning



Geometric mean based upon tests: pts/x264, pts/x265, pts/dav1d, pts/himeno, pts/build-php, pts/c-ray, pts/compress-zstd, pts/m-queens, pts/redis and pts/cpuminer-opt

Geometric Mean Of Single-Threaded Tests

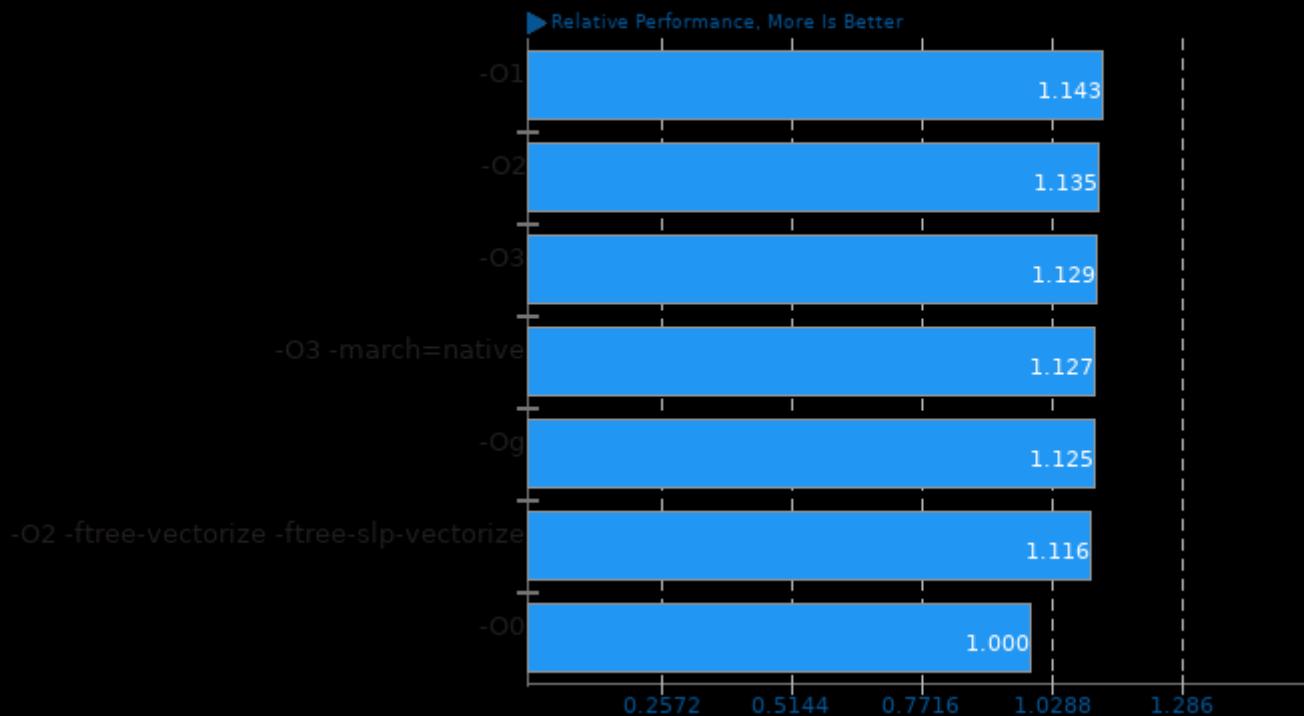
Result Composite - GCC 9 Compiler Tuning



Geometric mean based upon tests: pts/scimark2, pts/encode-flac, pts/encode-mp3, pts/redis and pts/nginx

Geometric Mean Of Video Encoding Tests

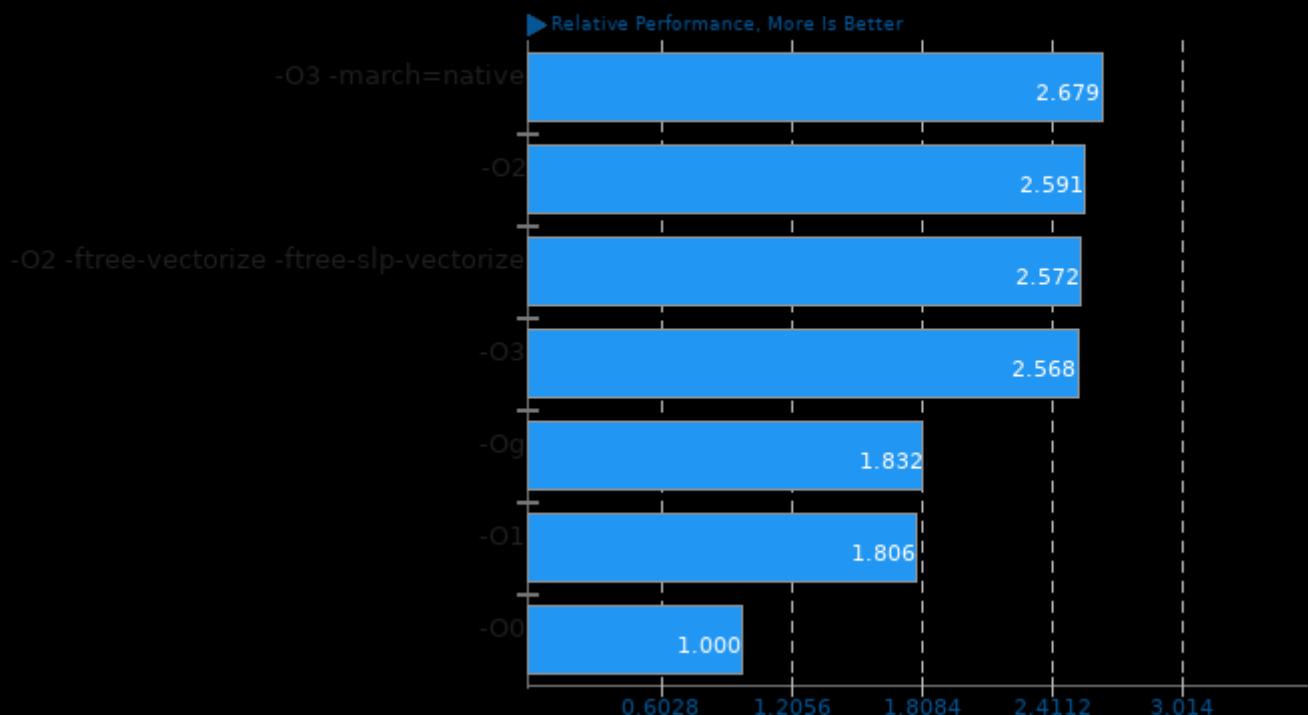
Result Composite - GCC 9 Compiler Tuning



Geometric mean based upon tests: pts/x264, pts/x265 and pts/dav1d

Geometric Mean Of Common Workstation Benchmarks Tests

Result Composite - GCC 9 Compiler Tuning



Geometric mean based upon tests: pts/himeno and pts/x265

This file was automatically generated via the Phoronix Test Suite benchmarking software on Friday, 29 March 2024 04:40.