Average Execution Time Heatmap (All 119 Benchmarks)
Sorted: Benchmarks by baseline time (slowest first), Optimizations in logical order

Benchmark (sorted by baseline time)	baseline	--dce	--lvn	--loops	--lvn --dce	--lvn --dce --loops
montecarlo	0.3771	0.3737	0.3665	0.3672	0.3662	0.3585
function_call	0.2996	0.2946	0.2984	0.2985	0.2960	0.2927
leibniz	0.0501	0.0501	0.0501	0.0425	0.0502	0.0425
harmonic-sum	0.0284	0.0288	0.0264	0.0231	0.0245	0.0212
delannoy	0.0254	0.0253	0.0240	0.0253	0.0212	0.0211
mandelbrot	0.0109	0.0111	0.0105	0.0108	0.0083	0.0083
ackermann	0.0101	0.0099	0.0100	0.0100	0.0100	0.0100
fnv1-hash	0.0101	0.0101	0.0101	0.0102	0.0101	0.0101
mat-mul	0.0091	0.0093	0.0093	0.0089	0.0094	0.0089
eight-queens	0.0065	0.0065	0.0065	0.0065	0.0064	0.0065
catalan	0.0052	0.0051	0.0052	0.0052	0.0051	0.0052
primes-between	0.0047	0.0048	0.0047	0.0044	0.0047	0.0045
random_walk	0.0046	0.0046	0.0046	0.0047	0.0045	0.0045
csrmv	0.0031	0.0031	0.0031	0.0032	0.0031	0.0032
cholesky	0.0027	0.0026	0.0027	0.0027	0.0027	0.0027
shufflesort	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027
dayofweek	0.0027	0.0026	0.0026	0.0026	0.0026	0.0026
quicksort-hoare	0.0026	0.0026	0.0026	0.0026	0.0026	0.0027
conjugate-gradient	0.0026	0.0027	0.0026	0.0026	0.0026	0.0026
primitive-root	0.0026	0.0027	0.0027	0.0025	0.0026	0.0026
adj2csr	0.0026	0.0027	0.0027	0.0027	0.0027	0.0027
riemann	0.0026	0.0025	0.0024	0.0025	0.0024	0.0025
vsmul	0.0026	0.0028	0.0027	0.0026	0.0027	0.0026
1dconv	0.0026	0.0025	0.0024	0.0025	0.0025	0.0025
pythagorean_triple	0.0026	0.0025	0.0025	0.0025	0.0025	0.0025
insertion-sort	0.0026	0.0025	0.0024	0.0025	0.0024	0.0024
cordic	0.0025	0.0026	0.0026	0.0026	0.0025	0.0026
gol	0.0025	0.0026	0.0025	0.0025	0.0025	0.0026
systolic	0.0025	0.0025	0.0026	0.0026	0.0026	0.0026
adler32	0.0025	0.0025	0.0025	0.0024	0.0025	0.0025
up-arrow	0.0025	0.0025	0.0024	0.0024	0.0024	0.0024
sqrt_bin_search	0.0025	0.0024	0.0024	0.0024	0.0024	0.0024
permutation	0.0025	0.0024	0.0025	0.0024	0.0024	0.0024
2dconvol	0.0025	0.0025	0.0025	0.0026	0.0027	0.0027
lis	0.0025	0.0024	0.0024	0.0023	0.0024	0.0024
mat-inv	0.0025	0.0024	0.0025	0.0025	0.0024	0.0024
quickselect	0.0025	0.0024	0.0024	0.0024	0.0024	0.0024
logistic	0.0025	0.0026	0.0025	0.0025	0.0025	0.0027
orders	0.0025	0.0025	0.0024	0.0024	0.0024	0.0024
bitshift	0.0025	0.0024	0.0024	0.0024	0.0024	0.0024
combination	0.0024	0.0024	0.0025	0.0025	0.0025	0.0025
karatsuba	0.0024	0.0023	0.0024	0.0024	0.0024	0.0024
dot-product	0.0024	0.0024	0.0024	0.0024	0.0024	0.0025
ray-bbox-intersection	0.0024	0.0023	0.0023	0.0024	0.0024	0.0023
sorting-network-five	0.0024	0.0025	0.0024	0.0022	0.0023	0.0023
gebmm	0.0024	0.0024	0.0024	0.0024	0.0025	0.0025
char-poly	0.0024	0.0025	0.0025	0.0025	0.0025	0.0025
pascals-row	0.0024	0.0025	0.0025	0.0024	0.0025	0.0024
check-primes	0.0024	0.0025	0.0024	0.0023	0.0025	0.0024
bbs	0.0024	0.0024	0.0024	0.0024	0.0025	0.0024
mountain	0.0024	0.0025	0.0025	0.0024	0.0025	0.0024
connected-components	0.0024	0.0024	0.0025	0.0025	0.0025	0.0024
two-sum	0.0024	0.0025	0.0026	0.0025	0.0025	0.0025
sum-sq-diff	0.0024	0.0024	0.0024	0.0025	0.0025	0.0024
tail-call	0.0024	0.0025	0.0024	0.0025	0.0024	0.0025
totient	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024
bin-search	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024
collatz	0.0024	0.0024	0.0501	0.0425	0.0502	0.0024
sum-divisors	0.0024	0.0024	0.0024	0.0024	0.0024	0.0025
rectangles-area-difference	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024
euclid	0.0024	0.0024	0.0025	0.0025	0.0025	0.0024
gpf	0.0024	0.0024	0.0024	0.0023	0.0024	0.0024
mod_pow	0.0024	0.0024	0.0025	0.0024	0.0025	0.0024
hamming	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024
norm	0.0024	0.0025	0.0024	0.0023	0.0024	0.0025
montgomery	0.0024	0.0024	0.0024	0.0024	0.0024	0.0025
fizz-buzz	0.0024	0.0027	0.0025	0.0025	0.0025	0.0027
major-elm	0.0024	0.0024	0.0024	0.0024	0.0023	0.0024
filter	0.0024	0.0024	0.0024	0.0024	0.0024	0.0025
lcm	0.0024	0.0024	0.0025	0.0025	0.0025	0.0025
mccarthy91	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024
sum-check	0.0024	0.0025	0.0024	0.0024	0.0025	0.0024
sum-bits	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024
fitsinside	0.0024	0.0024	0.0024	0.0023	0.0024	0.0025
binpow	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024
sqrt	0.0024	0.0025	0.0024	0.0025	0.0024	0.0024
palindrome	0.0024	0.0024	0.0024	0.0024	0.0024	0.0025
perfect	0.0024	0.0024	0.0024	0.0024	0.0024	0.0025
is-decreasing	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024
fib_recursive	0.0024	0.0024	0.0024	0.0024	0.0024	0.0025
fact	0.0024	0.0024	0.0024	0.0024	0.0024	0.0023
legendre	0.0024	0.0024	0.0024	0.0024	0.0025	0.0024
sum-of-cubes	0.0024	0.0024	0.0024	0.0023	0.0024	0.0024
sieve	0.0024	0.0024	0.0024	0.0025	0.0024	0.0024
armstrong	0.0024	0.0024	0.0025	0.0025	0.0025	0.0024
newton	0.0024	0.0025	0.0024	0.0024	0.0024	0.0024
digital-root	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024
grad_desc	0.0024	0.0023	0.0024	0.0023	0.0025	0.0024
triangle	0.0024	0.0023	0.0024	0.0024	0.0023	0.0024
birthday	0.0024	0.0024	0.0023	0.0023	0.0023	0.0023
bubblesort	0.0024	0.0024	0.0024	0.0026	0.0024	0.0025
rot13	0.0024	0.0023	0.0024	0.0024	0.0023	0.0023
loopfact	0.0024	0.0024	0.0024	0.0025	0.0024	0.0024
geometric-sum	0.0024	0.0024	0.0024	0.0024	0.0024	0.0023
gcd	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024
binary-fmt	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024
bitwise-ops	0.0024	0.0024	0.0023	0.0022	0.0024	0.0024
mod_inv	0.0024	0.0022	0.0024	0.0023	0.0024	0.0024
euler	0.0023	0.0024	0.0024	0.0024	0.0024	0.0023
quicksort	0.0023	0.0024	0.0024	0.0025	0.0025	0.0025
n_root	0.0023	0.0022	0.0022	0.0023	0.0023	0.0023
factors	0.0023	0.0023	0.0023	0.0023	0.0024	0.0023
sum-divisible-by-m	0.0023	0.0023	0.0024	0.0025	0.0024	0.0023
ray-sphere-intersection	0.0023	0.0023	0.0024	0.0024	0.0024	0.0023
kadane	0.0023	0.0023	0.0023	0.0017	0.0025	0.0024
graycode	0.0023	0.0023	0.0023	0.0024	0.0025	0.0024
reverse	0.0023	0.0024	0.0023	0.0023	0.0023	0.0023
sum-to-ten	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023
pow	0.0023	0.0023	0.0023	0.0023	0.0024	0.0024
max-subarray	0.0023	0.0024	0.0024	0.0024	0.0024	0.0024
binary-search	0.0023	0.0024	0.0023	0.0020	0.0021	0.0021
sum-digits	0.0023	0.0024	0.0023	0.0023	0.0022	0.0024
exponentiation-by-squaring	0.0022	0.0023	0.0024	0.0023	0.0023	0.0023
rgb2gray	0.0022	0.0023	0.0023	0.0022	0.0023	0.0024
fib	0.0022	0.0022	0.0023	0.0023	0.0023	0.0024
recfact	0.0021	0.0025	0.0025	0.0024	0.0024	0.0024
hanoi	0.0021	0.0025	0.0025	0.0023	0.0025	0.0024
quadratic	0.0020	0.0025	0.0025	0.0024	0.0025	0.0025
fast-inverse-sqrt	0.0018	0.0024	0.0024	0.0024	0.0024	0.0024

Optimization (baseline → single opts → combinations)

Average Execution Time (s)

Speedup Heatmap (All 119 Benchmarks)
Sorted: Benchmarks by max speedup (highest first), Optimizations in logical order

Dynamic Instruction Counts (All 119 Benchmarks)
Sorted: Benchmarks by baseline count (highest first), Optimizations in logical order

Benchmark	baseline	--dce	--loops	--lvn --dce	--lvn --dce --loops
montecarlo	110.3M	138.1M	134.4M	138.1M	134.4M
function_call	59.8M	65.4M	71.0M	65.4M	65.4M
leibniz	12.5M	17.5M	14.5M	17.5M	14.5M
harmonic-sum	11.0M	12.4M	10.2M	10.2M	8.8M
delannoy	5.7M	6.5M	6.5M	4.7M	4.7M
mandelbrot	2.7M	3.0M	3.0M	1.8M	1.8M
mat-mul	2.0M	2.3M	2.1M	2.3M	2.1M
fnv1-hash	1.8M	2.4M	2.4M	2.4M	2.4M
ackermann	1.5M	1.8M	1.8M	1.8M	1.8M
eight-queens	1.0M	1.1M	1.1M	1.1M	1.1M
catalan	659.4K	816.8K	816.8K	816.8K	816.8K
primes-between	574.1K	736.4K	611.5K	736.4K	611.5K
random_walk	516.8K	636.7K	620.1K	628.4K	611.9K
csrmv	121.2K	163.5K	164.1K	163.5K	163.5K
vsmul	86.0K	98.3K	98.3K	98.3K	98.3K
pythagorean_triple	61.5K	69.4K	61.8K	69.4K	61.8K
adj2csr	56.6K	67.8K	66.5K	67.8K	66.5K
shufflesort	36.6K	50.6K	50.6K	50.6K	50.6K
quicksort-hoare	27.3K	38.1K	38.1K	38.1K	38.1K
2dconvol	21.7K	25.0K	21.9K	25.0K	21.9K
primitive-root	11.0K	15.1K	15.1K	15.1K	15.1K
tail-call	10.5K	12.0K	12.0K	12.0K	12.0K
check-primes	8.5K	8.9K	7.6K	6.1K	5.4K
adler32	6.9K	10.2K	10.2K	10.2K	10.2K
orders	5.4K	7.4K	7.0K	7.4K	7.0K
sum-check	5.0K	7.0K	7.0K	7.0K	7.0K
cholesky	3.8K	4.2K	3.9K	3.8K	3.5K
fizz-buzz	3.7K	3.8K	3.0K	2.6K	2.0K
sieve	3.5K	4.2K	4.1K	4.2K	4.1K
sum-sq-diff	3.0K	3.4K	3.0K	2.7K	2.3K
gebmm	3.0K	4.4K	4.3K	4.4K	4.3K
fib_recursive	2.7K	2.9K	2.9K	2.1K	2.1K
lcm	2.3K	3.0K	2.7K	3.0K	2.7K
conjugate-gradient	2.0K	2.5K	2.4K	2.5K	2.4K
connected-components	2.0K	3.0K	3.0K	3.0K	3.0K
euler	1.9K	2.1K	2.1K	1.5K	1.5K
bitwise-ops	1.7K	2.3K	2.3K	2.3K	2.3K
karatsuba	1.5K	2.0K	1.9K	2.0K	1.9K
gol	1.4K	1.8K	1.8K	1.8K	1.8K
mccarthy91	1.4K	1.6K	1.6K	1.6K	1.6K
graycode	1.3K	1.6K	1.6K	1.6K	1.6K
logistic	1.1K	1.4K	1.4K	1.4K	1.4K
mat-inv	1.0K	1.4K	1.4K	1.4K	1.4K
quadratic	785	837	631	604	482
gpf	759	945	946	945	946
sqrt_bin_search	744	821	847	448	467
n_root	733	1.0K	1.0K	1.0K	1.0K
lis	583	697	690	697	690
euclid	563	668	650	486	467
mod_inv	558	661	590	479	449
systolic	527	698	709	698	689
cordic	517	623	575	575	525
norm	505	690	690	690	690
birthday	484	532	448	376	314
1dconv	391	487	479	487	479
char-poly	383	526	526	525	525
bin-search	358	457	431	377	362
sqrt	322	360	321	270	230
palindrome	298	437	465	440	465
riemann	298	386	379	386	379
sorting-network-five	284	326	341	292	292
quickselect	279	370	370	370	370
dayofweek	269	307	296	222	210
quicksort	264	349	349	349	349
totient	253	391	391	391	391
bubblesort	253	318	315	318	315
up-arrow	252	369	351	369	351
digital-root	247	308	308	308	308
mod_pow	243	293	275	225	211
perfect	232	305	305	305	305
grad_desc	229	275	237	275	237
fact	229	251	252	190	190
sum-digits	219	242	215	162	144
newton	217	294	294	294	294
max-subarray	193	289	289	289	289
triangle	188	265	265	265	265
exponentiation-by-squaring	187	283	278	283	278
combination	178	207	207	207	207
insertion-sort	170	204	204	204	204
collatz	169	187	187	187	187
bitshift	167	200	200	149	149
sum-divisors	159	241	241	241	241
kadane	157	223	223	223	223
legendre	153	180	171	146	140
pascals-row	146	155	140	99	93
sum-to-ten	143	165	147	145	126
ray-sphere-intersection	142	171	171	102	102
bbs	137	192	187	192	187
armstrong	133	182	182	182	182
permutation	130	154	143	135	123
is-decreasing	127	150	139	144	133
fib	121	149	149	149	149
hamming	117	150	150	150	150
loopfact	116	135	121	119	104
binpow	105	135	135	135	135
recfact	104	113	114	75	76
binary-fmt	100	136	136	136	136
mountain	100	131	131	131	131
hanoi	99	161	161	161	161
two-sum	98	95	107	96	98
filter	94	101	101	101	101
dot-product	88	104	104	104	104
binary-search	78	94	97	94	94
sum-bits	73	100	100	100	100
factors	72	90	90	90	90
major-elm	47	61	61	61	61
reverse	46	60	62	60	62
gcd	46	64	64	64	64
pow	36	42	41	38	36
geometric-sum	35	51	51	51	51
ray-bbox-intersection	33	61	61	61	61
fast-inverse-sqrt	28	34	34	31	31
montgomery	17	26	26	26	26
sum-divisible-by-m	16	19	19	11	12
rgb2gray	14	18	18	18	18
rectangles-area-difference	14	25	25	25	25
fitsinside	10	19	19	19	19
rot13	8	12	12	12	12
sum-of-cubes	8	10	10	9	9

Benchmark (sorted by baseline instruction count)

Optimization (baseline → single opts → combinations)

Dynamic Instructions

1e8

SSA-Only Instruction Counts (All 119 Benchmarks)
SSA Conversion Impact Only - Same count across all optimizations per benchmark

Benchmark (sorted by SSA instruction count)	baseline	--dce	--lvn	--loops	--lvn --dce	--lvn --dce --loops
montecarlo	138.1M	138.1M	138.1M	138.1M	138.1M	138.1M
function_call	71.0M	71.0M	71.0M	71.0M	71.0M	71.0M
leibniz	17.5M	17.5M	17.5M	17.5M	17.5M	17.5M
harmonic-sum	12.4M	12.4M	12.4M	12.4M	12.4M	12.4M
delannoy	6.5M	6.5M	6.5M	6.5M	6.5M	6.5M
mandelbrot	3.0M	3.0M	3.0M	3.0M	3.0M	3.0M
fnv1-hash	2.4M	2.4M	2.4M	2.4M	2.4M	2.4M
mat-mul	2.3M	2.3M	2.3M	2.3M	2.3M	2.3M
ackermann	1.8M	1.8M	1.8M	1.8M	1.8M	1.8M
eight-queens	1.1M	1.1M	1.1M	1.1M	1.1M	1.1M
catalan	816.8K	816.8K	816.8K	816.8K	816.8K	816.8K
primes-between	736.4K	736.4K	736.4K	736.4K	736.4K	736.4K
random_walk	636.7K	636.7K	636.7K	636.7K	636.7K	636.7K
csrmv	164.1K	164.1K	164.1K	164.1K	164.1K	164.1K
vsmul	98.3K	98.3K	98.3K	98.3K	98.3K	98.3K
pythagorean_triple	69.4K	69.4K	69.4K	69.4K	69.4K	69.4K
adj2csr	67.8K	67.8K	67.8K	67.8K	67.8K	67.8K
shufflesort	50.6K	50.6K	50.6K	50.6K	50.6K	50.6K
quicksort-hoare	38.1K	38.1K	38.1K	38.1K	38.1K	38.1K
2dconvol	25.0K	25.0K	25.0K	25.0K	25.0K	25.0K
primitive-root	15.1K	15.1K	15.1K	15.1K	15.1K	15.1K
tail-call	12.0K	12.0K	12.0K	12.0K	12.0K	12.0K
adler32	10.2K	10.2K	10.2K	10.2K	10.2K	10.2K
check-primes	8.9K	8.9K	8.9K	8.9K	8.9K	8.9K
orders	7.4K	7.4K	7.4K	7.4K	7.4K	7.4K
sum-check	7.0K	7.0K	7.0K	7.0K	7.0K	7.0K
gebmm	4.4K	4.4K	4.4K	4.4K	4.4K	4.4K
cholesky	4.2K	4.2K	4.2K	4.2K	4.2K	4.2K
sieve	4.2K	4.2K	4.2K	4.2K	4.2K	4.2K
fizz-buzz	3.8K	3.8K	3.8K	3.8K	3.8K	3.8K
sum-sq-diff	3.4K	3.4K	3.4K	3.4K	3.4K	3.4K
connected-components	3.0K	3.0K	3.0K	3.0K	3.0K	3.0K
lcm	3.0K	3.0K	3.0K	3.0K	3.0K	3.0K
fib_recursive	2.9K	2.9K	2.9K	2.9K	2.9K	2.9K
conjugate-gradient	2.5K	2.5K	2.5K	2.5K	2.5K	2.5K
bitwise-ops	2.3K	2.3K	2.3K	2.3K	2.3K	2.3K
euler	2.1K	2.1K	2.1K	2.1K	2.1K	2.1K
karatsuba	2.0K	2.0K	2.0K	2.0K	2.0K	2.0K
gol	1.8K	1.8K	1.8K	1.8K	1.8K	1.8K
graycode	1.6K	1.6K	1.6K	1.6K	1.6K	1.6K
mccarthy91	1.6K	1.6K	1.6K	1.6K	1.6K	1.6K
logistic	1.4K	1.4K	1.4K	1.4K	1.4K	1.4K
mat-inv	1.4K	1.4K	1.4K	1.4K	1.4K	1.4K
n_root	1.0K	1.0K	1.0K	1.0K	1.0K	1.0K
gpf	991	991	991	991	991	991
sqrt_bin_search	847	847	847	847	847	847
quadratic	839	839	839	839	839	839
systolic	718	718	718	718	718	718
lis	697	697	697	697	697	697
norm	690	690	690	690	690	690
euclid	669	669	669	669	669	669
mod_inv	662	662	662	662	662	662
cordic	624	624	624	624	624	624
birthday	533	533	533	533	533	533
char-poly	526	526	526	526	526	526
1dconv	487	487	487	487	487	487
bin-search	458	458	458	458	458	458
palindrome	440	440	440	440	440	440
totient	391	391	391	391	391	391
riemann	386	386	386	386	386	386
quickselect	370	370	370	370	370	370
up-arrow	369	369	369	369	369	369
sqrt	361	361	361	361	361	361
quicksort	349	349	349	349	349	349
sorting-network-five	341	341	341	341	341	341
bubblesort	318	318	318	318	318	318
dayofweek	312	312	312	312	312	312
digital-root	308	308	308	308	308	308
perfect	305	305	305	305	305	305
newton	294	294	294	294	294	294
mod_pow	293	293	293	293	293	293
max-subarray	289	289	289	289	289	289
exponentiation-by-squaring	283	283	283	283	283	283
grad_desc	275	275	275	275	275	275
triangle	265	265	265	265	265	265
fact	252	252	252	252	252	252
sum-digits	243	243	243	243	243	243
sum-divisors	241	241	241	241	241	241
kadane	223	223	223	223	223	223
combination	207	207	207	207	207	207
insertion-sort	204	204	204	204	204	204
bitshift	200	200	200	200	200	200
bbs	192	192	192	192	192	192
collatz	187	187	187	187	187	187
armstrong	182	182	182	182	182	182
legendre	180	180	180	180	180	180
ray-sphere-intersection	171	171	171	171	171	171
sum-to-ten	166	166	166	166	166	166
pascals-row	161	161	161	161	161	161
hanoi	161	161	161	161	161	161
permutation	155	155	155	155	155	155
is-decreasing	150	150	150	150	150	150
hamming	150	150	150	150	150	150
fib	149	149	149	149	149	149
loopfact	136	136	136	136	136	136
binary-fmt	136	136	136	136	136	136
binpow	135	135	135	135	135	135
mountain	131	131	131	131	131	131
recfact	114	114	114	114	114	114
two-sum	105	105	105	105	105	105
dot-product	104	104	104	104	104	104
filter	101	101	101	101	101	101
sum-bits	100	100	100	100	100	100
binary-search	97	97	97	97	97	97
factors	90	90	90	90	90	90
gcd	64	64	64	64	64	64
ray-bbox-intersection	61	61	61	61	61	61
major-elm	61	61	61	61	61	61
reverse	60	60	60	60	60	60
geometric-sum	51	51	51	51	51	51
pow	44	44	44	44	44	44
fast-inverse-sqrt	34	34	34	34	34	34
montgomery	26	26	26	26	26	26
rectangles-area-difference	25	25	25	25	25	25
sum-divisible-by-m	19	19	19	19	19	19
fitsinside	19	19	19	19	19	19
rgb2gray	18	18	18	18	18	18
rot13	12	12	12	12	12	12
sum-of-cubes	10	10	10	10	10	10

Optimization (all show same SSA-only count per benchmark)

SSA Only Instructions

Instruction Count Reduction by Optimization (Consistent Order)

Coefficient of Variation (CV) Distribution by Optimization (Consistent Order)

CV vs Average Execution Time