

Milestone #2 - Benchmark

Analysis

Iteration Run (Fixed-Iteration Benchmark)

- Runs the function for a fixed number of iterations (10,000 total)
- Reports the average, minimum, and maximum time (in microseconds) for each group of 1,000 iterations.
- Useful for observing how performance changes across batches — often starts slower and improves as caches warm up.

Measured Time: Ranged from 34.417000 μ s to 1.833000 μ s with an average of ~ 2.504 μ s

Time-Based Run

- Runs the function continuously for a fixed duration (10 seconds).
- Reports timing statistics every 1,000 iterations until the time limit is reached.
- Measures steady-state performance after the system has stabilized and caches are fully utilized.

Measured Time Ranged from 128.333000 μ s to 1.125000 μ s with an average of ~ 1.7 μ s

These measurements differ. The iteration-based test measures short, fixed workloads where caching and warm-up effects are more noticeable. The time-based test runs longer, reaching a steady-state where performance stabilizes and becomes faster. Behavior differs due to cache warm-up and reuse of data in memory, operating system scheduling and background processes, and variations in CPU load and I/O buffering over time

Output

Iteration Run

=====

Calling: timeWrapper(readTest, top-output.txt, 10000)

Starting computation at Wed Oct 22 13:34:00 2025

end time	iter #	avg (μ s)	min (μ s)	max (μ s)
13:34:00	1000	3.587576	2.875000	34.417000
13:34:00	2000	3.049803	2.791000	28.666000
13:34:00	3000	2.975116	2.375000	34.833000
13:34:00	4000	2.539805	2.334000	24.250000
13:34:00	5000	2.563109	2.333000	40.875000
13:34:00	6000	2.268752	2.042000	15.292000
13:34:00	7000	2.209175	2.041000	18.750000
13:34:00	8000	2.154278	1.834000	14.916000
13:34:00	9000	1.977064	1.833000	16.750000
13:34:00	10000	1.982713	1.833000	16.875000

Finished computation at Wed Oct 22 13:34:00 2025

Total elapsed time: 0.0257775 seconds

Finished readTest.

Time Based Run

Calling: timeWrapperTimed(readTestTimed, top-output.txt)

13:27:25	1000	3.801417	3.333000	128.333000
13:27:25	2000	3.058658	2.791000	41.458000
13:27:25	3000	2.985199	2.375000	29.541000
13:27:25	4000	2.639860	2.375000	64.875000
13:27:25	5000	2.590994	2.375000	43.500000
13:27:25	6000	2.309849	2.083000	41.166000
13:27:25	7000	2.223818	2.083000	15.792000
13:27:25	8000	2.154638	1.875000	15.542000
13:27:25	9000	2.036944	1.833000	16.375000
13:27:25	10000	2.338835	1.875000	318.125000

.

.

(skipped middle output)

.

.

13:27:35	7801000	1.246590	1.166000	8.334000
13:27:35	7802000	1.213439	1.125000	11.208000
13:27:35	7803000	1.241965	1.125000	12.166000
13:27:35	7804000	1.235498	1.125000	8.167000
13:27:35	7805000	1.236233	1.166000	11.000000
13:27:35	7806000	1.223880	1.125000	8.167000
13:27:35	7807000	1.338464	1.125000	8.959000
13:27:35	7808000	1.297895	1.125000	15.583000
13:27:35	7809000	1.235586	1.125000	8.375000
13:27:35	7810000	1.246063	1.125000	12.000000
13:27:35	7811000	1.216637	1.125000	9.667000
13:27:35	7812000	1.226433	1.125000	12.709000

Finished 10-second timed run. Total iterations: 7812896

Finished readTestTimed.

vmstat baseline

procs -----memory----- ---swap-- ----io---- -system-- -----cpu-----

r	b	swpd	free	buff	cache	si	so	bi	bo	in	cs	us	sy	id	wa	st	gu
1	0	896	464336	62000	1759648	0	0	79	108	278	0	0	0	99	0	0	0
0	0	896	463580	62000	1759652	0	0	0	0	449	388	1	1	98	0	0	0
0	0	896	463580	62000	1759652	0	0	0	0	221	247	1	0	99	0	0	0
2	0	896	463580	62000	1759652	0	0	0	0	217	237	0	0	100	0	0	0
0	0	896	463580	62000	1759652	0	0	0	0	402	409	1	1	99	0	0	0
0	0	896	463580	62000	1759648	0	0	0	0	990	1224	0	0	100	0	0	0
0	0	896	463580	62008	1759648	0	0	0	64	157	147	1	0	99	0	0	0
0	0	896	463580	62008	1759648	0	0	0	0	182	178	0	0	100	0	0	0
0	0	896	463580	62008	1759648	0	0	0	0	145	147	0	0	100	0	0	0
0	0	896	463580	62008	1759648	0	0	0	0	256	282	0	0	100	0	0	0

vmstat During

procs	-----memory-----	---swap--	-----io-----	-system--	-----cpu-----												
r	b	swpd	free	buff	cache	si	so	bi	bo	in	cs	us	sy	id	wa	st	gu
1	0	896	339916	64052	1772484	0	0	77	105	288	0	0	0	99	0	0	0
1	0	896	339916	64052	1772548	0	0	0	0	4684	6280	16	21	63	0	0	0
1	0	896	339768	64052	1772640	0	0	0	0	2947	3364	7	19	74	0	0	0
1	0	896	339664	64052	1772672	0	0	0	0	2432	2489	7	18	74	0	0	0
1	0	896	339664	64060	1772748	0	0	0	56	2370	2406	7	19	75	0	0	0
1	0	896	339664	64060	1772812	0	0	0	0	2638	2898	7	19	74	0	0	0
1	0	896	339220	64060	1772948	0	0	0	0	2545	2693	7	19	74	0	0	0
1	0	896	339160	64060	1772952	0	0	0	0	2646	2875	6	20	74	0	0	0
1	0	896	339160	64060	1773060	0	0	0	0	2537	2673	7	18	75	0	0	0
0	0	896	339160	64068	1773072	0	0	0	700	2348	2677	5	12	83	0	0	0

Iostat Baseline

Linux 6.14.0-33-generic (cj-QEMU-Virtual-Machine)

10/22/2025

aarch64

(4 CPU)

avg-cpu: %user %nice %system %iowait %steal %idle

0.41 0.02 0.25 0.03 0.00 99.29

Device	tps	kB_read/s	kB_wrtn/s	kB_dscd/s	kB_read	kB_wrtn	kB_dscd
loop0	0.00	0.00	0.00	0.00	17	0	0
loop1	0.00	0.01	0.00	0.00	396	0	0
loop10	0.00	0.01	0.00	0.00	340	0	0
loop11	0.00	0.01	0.00	0.00	359	0	0
loop12	0.00	0.03	0.00	0.00	1166	0	0

loop2	0.02	0.33	0.00	0.00	11947	0	0
loop3	0.15	2.42	0.00	0.00	87012	0	0
loop4	0.12	0.55	0.00	0.00	19910	0	0
loop5	0.04	2.21	0.00	0.00	79476	0	0
loop6	0.00	0.05	0.00	0.00	1891	0	0
loop7	0.00	0.01	0.00	0.00	410	0	0
loop8	0.00	0.04	0.00	0.00	1479	0	0
loop9	0.00	0.01	0.00	0.00	401	0	0
vda	3.65	74.10	108.83	502.93	2669030	3920141	18115724

lostat During

avg-cpu: %user %nice %system %iowait %steal %idle
0.43 0.02 0.26 0.03 0.00 99.26

Device	tps	kB_read/s	kB_wrtn/s	kB_dscd/s	kB_read	kB_wrtn	kB_dscd
loop0	0.00	0.00	0.00	0.00	17	0	0
loop1	0.00	0.01	0.00	0.00	396	0	0
loop10	0.00	0.01	0.00	0.00	340	0	0
loop11	0.00	0.01	0.00	0.00	359	0	0
loop12	0.00	0.03	0.00	0.00	1166	0	0
loop2	0.02	0.32	0.00	0.00	11947	0	0
loop3	0.14	2.34	0.00	0.00	87012	0	0
loop4	0.12	0.53	0.00	0.00	19910	0	0
loop5	0.04	2.13	0.00	0.00	79476	0	0
loop6	0.00	0.05	0.00	0.00	1891	0	0
loop7	0.00	0.01	0.00	0.00	410	0	0
loop8	0.00	0.04	0.00	0.00	1479	0	0
loop9	0.00	0.01	0.00	0.00	401	0	0
vda	3.58	71.89	105.62	486.30	2677982	3934505	18115724