



apache spark 5900HX

AMD Ryzen 9 5900HX testing with a ASUS G513QY v1.0 (G513QY.318 BIOS) and ASUS AMD Cezanne 512MB on Ubuntu 22.10 via the Phoronix Test Suite.

Automated Executive Summary

C had the most wins, coming in first place for 43% of the tests.

Based on the geometric mean of all complete results, the fastest (A) was 1.018x the speed of the slowest (B). D was 0.998x the speed of A, C was 0.999x the speed of D, B was 0.986x the speed of C.

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

Apache Spark (Row Count: 1000000 - Partitions: 1000 - SHA-512 Benchmark Time) at 1.104x

Apache Spark (Row Count: 1000000 - Partitions: 2000 - Broadcast Inner Join Test Time) at 1.081x

Apache Spark (Row Count: 20000000 - Partitions: 100 - Inner Join Test Time) at 1.073x

Apache Spark (Row Count: 20000000 - Partitions: 100 - Group By Test Time) at 1.065x

Apache Spark (Row Count: 10000000 - Partitions: 500 - Group By Test Time) at 1.063x

Apache Spark (Row Count: 1000000 - Partitions: 2000 - Inner Join Test Time) at 1.058x

Apache Spark (Row Count: 1000000 - Partitions: 500 - Broadcast Inner Join Test Time) at 1.057x

Apache Spark (Row Count: 1000000 - Partitions: 2000 - Group By Test Time) at 1.056x

Apache Spark (Row Count: 1000000 - Partitions: 1000 - Repartition Test Time) at 1.05x

Apache Spark (Row Count: 20000000 - Partitions: 500 - Group By Test Time) at 1.05x.

Test Systems:

A

Processor: AMD Ryzen 9 5900HX @ 3.30GHz (8 Cores / 16 Threads), Motherboard: ASUS G513QY v1.0 (G513QY.318 BIOS), Chipset: AMD Renoir/Cezanne, Memory: 16GB, Disk: 512GB SAMSUNG MZVLQ512HBLU-00B00 + 15GB Ultra USB 3.0, Graphics: ASUS AMD Cezanne 512MB (2500/1000MHz), Audio: AMD Navi 21/23, Monitor: LQ156M1JW25, Network: Realtek RTL8111/8168/8411 + MEDIATEK MT7921 802.11ax PCI

OS: Ubuntu 22.10, Kernel: 5.15.0-27-generic (x86_64), Desktop: GNOME Shell 42.3.1, Display Server: X Server + Wayland, OpenGL: 4.6 Mesa 22.1.3 (LLVM 14.0.6 DRM 3.42), Vulkan: 1.3.211, Compiler: GCC 11.3.0, File-System: ext4, Screen Resolution: 1920x1080

Kernel Notes: Transparent Huge Pages: madvise

Processor Notes: Scaling Governor: acpi-cpufreq schedutil (Boost: Enabled) - Platform Profile: balanced - CPU Microcode: 0xa50000c - ACPI Profile: balanced

Java Notes: OpenJDK Runtime Environment (build 11.0.16+8-post-Ubuntu-0ubuntu1)

Python Notes: Python 3.10.5

Security Notes: itlb_multihit: Not affected + l1tf: Not affected + mds: Not affected + meltdown: Not affected + spec_store_bypass: Mitigation of SSB disabled via prctl and seccomp + spectre_v1: Mitigation of usercopy/swaps barriers and __user pointer sanitization + spectre_v2: Mitigation of Retpolines IBPB: conditional IBRS_FW STIBP: always-on RSB filling + srbds: Not affected + tsx_async_abort: Not affected

B

C

D

Processor: AMD Ryzen 9 5900HX @ 3.30GHz (8 Cores / 16 Threads), Motherboard: ASUS G513QY v1.0 (G513QY.318 BIOS), Chipset: AMD Renoir/Cezanne, Memory: 16GB, Disk: 512GB SAMSUNG MZVLQ512HBLU-00B00 + 15GB Ultra USB 3.0, Graphics: ASUS AMD Cezanne 512MB, Audio: AMD Navi 21/23, Monitor: LQ156M1JW25, Network: Realtek RTL8111/8168/8411 + MEDIATEK MT7921 802.11ax PCI

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Python Notes: Python 3.10.5

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| | A | B | C | D |
|--|---------------|---------------|---------------------|-------------|
| Apache Spark - 1000000 - 100 - S.5.B.T (sec) | 4.02 | 4.13 | 4.11 | 4.13 |
| Normalized | 100% | 97.34% | 97.81% | 97.34% |
| Standard Deviation | 1.4% | 0.4% | | |
| Apache Spark - 1000000 - 100 - C.P.B (sec) | 153.79 | 153.24 | 152.15 | 152.20 |
| Normalized | 98.93% | 99.29% | 100% | 99.97% |
| Standard Deviation | 0.5% | 0.8% | | |
| Apache Spark - 1000000 - 100 - C.P.B.U.D (sec) | 8.84 | 8.91 | 8.76 | 8.91 |
| Normalized | 99.1% | 98.32% | 100% | 98.32% |
| Standard Deviation | 0.3% | 0.4% | | |
| Apache Spark - 1000000 - 100 - Group By Test Time (sec) | 3.69 | 3.69 | 3.56 | 3.63 |
| Normalized | 96.48% | 96.48% | 100% | 98.07% |
| Standard Deviation | 1.5% | 2.6% | | |
| Apache Spark - 1000000 - 100 - R.T.T (sec) | 2.69 | 2.88 | 2.86 | 2.77 |
| Normalized | 100% | 93.4% | 94.06% | 97.11% |
| Standard Deviation | 2.7% | 7% | | |
| Apache Spark - 1000000 - 100 - I.J.T.T (sec) | 2.28 | 2.42 | 2.20 | 2.26 |
| Normalized | 96.49% | 90.91% | 100% | 97.35% |
| Standard Deviation | 1.6% | 7% | | |
| Apache Spark - 1000000 - 100 - B.I.J.T.T (sec) | 1.89 | 1.98 | 1.94 | 1.95 |
| Normalized | 100% | 95.45% | 97.42% | 96.92% |
| Standard Deviation | 0.7% | 3.4% | | |
| Apache Spark - 1000000 - 500 - S.5.B.T (sec) | 4.25 | 4.42 | 4.32 | 4.36 |
| Normalized | 100% | 96.15% | 98.38% | 97.48% |
| Standard Deviation | 1.6% | 3.7% | | |
| Apache Spark - 1000000 - 500 - C.P.B (sec) | 153.082744800 | 154.32 | 151.83082485 | 153.13 |
| Normalized | 99.18% | 98.39% | 100% | 99.15% |
| Standard Deviation | 0.9% | 0.6% | | |
| Apache Spark - 1000000 - 500 - C.P.B.U.D (sec) | 8.85 | 8.95 | 8.79 | 8.88 |
| Normalized | 99.32% | 98.21% | 100% | 98.99% |
| Standard Deviation | 0.5% | 1.4% | | |
| Apache Spark - 1000000 - 500 - Group By Test Time (sec) | 4.07 | 4.10 | 4.25 | 4.11 |
| Normalized | 100% | 99.27% | 95.76% | 99.03% |
| Standard Deviation | 1.8% | 2.9% | | |
| Apache Spark - 1000000 - 500 - R.T.T (sec) | 2.93 | 2.94 | 2.89 | 2.96 |
| Normalized | 98.63% | 98.3% | 100% | 97.64% |
| Standard Deviation | 1.3% | 2.7% | | |
| Apache Spark - 1000000 - 500 - I.J.T.T (sec) | 2.65 | 2.70 | 2.71 | 2.75 |
| Normalized | 100% | 98.15% | 97.79% | 96.36% |
| Standard Deviation | 0.5% | 1.6% | | |

| | | | | |
|---------------------------------------|----------------------|---------------|----------------------|-------------|
| Apache Spark - 1000000 - 500 - | 2.28 | 2.31 | 2.41 | 2.30 |
| B.I.J.T.T (sec) | | | | |
| Normalized | 100% | 98.7% | 94.61% | 99.13% |
| Standard Deviation | 1.2% | 3% | | |
| Apache Spark - 1000000 - 1000 - | 4.53 | 4.72 | 4.98 | 4.51 |
| S.5.B.T (sec) | | | | |
| Normalized | 99.56% | 95.55% | 90.56% | 100% |
| Standard Deviation | 0.9% | 3.6% | | |
| Apache Spark - 1000000 - 1000 - C.P.B | 153.113723866 | 154.62 | 151.047000872 | 152.86 |
| (sec) | | | | |
| Normalized | 98.65% | 97.69% | 100% | 98.81% |
| Standard Deviation | 0.8% | 0.7% | | |
| Apache Spark - 1000000 - 1000 - | 8.86 | 8.91 | 8.90 | 8.77 |
| C.P.B.U.D (sec) | | | | |
| Normalized | 98.98% | 98.43% | 98.54% | 100% |
| Standard Deviation | 0.5% | 1.2% | | |
| Apache Spark - 1000000 - 1000 - | 4.54 | 4.55 | 4.47 | 4.42 |
| Group By Test Time (sec) | | | | |
| Normalized | 97.36% | 97.14% | 98.88% | 100% |
| Standard Deviation | 1.5% | 4.1% | | |
| Apache Spark - 1000000 - 1000 - R.T.T | 3.30 | 3.33 | 3.28 | 3.17 |
| (sec) | | | | |
| Normalized | 96.06% | 95.2% | 96.65% | 100% |
| Standard Deviation | 1.8% | 2.5% | | |
| Apache Spark - 1000000 - 1000 - | 3.22 | 3.34 | 3.27 | 3.33 |
| I.J.T.T (sec) | | | | |
| Normalized | 100% | 96.41% | 98.47% | 96.7% |
| Standard Deviation | 1.3% | 5.2% | | |
| Apache Spark - 1000000 - 1000 - | 2.76 | 2.89 | 2.69 | 2.77 |
| B.I.J.T.T (sec) | | | | |
| Normalized | 97.46% | 93.08% | 100% | 97.11% |
| Standard Deviation | 4.3% | 9.4% | | |
| Apache Spark - 1000000 - 2000 - | 5.09 | 5.21 | 5.02 | 5.09 |
| S.5.B.T (sec) | | | | |
| Normalized | 98.62% | 96.35% | 100% | 98.62% |
| Standard Deviation | 2.2% | 1.1% | | |
| Apache Spark - 1000000 - 2000 - C.P.B | 154.901816094 | 154.26 | 151.74 | 152.07 |
| (sec) | | | | |
| Normalized | 97.96% | 98.37% | 100% | 99.78% |
| Standard Deviation | 2.9% | 0.5% | | |
| Apache Spark - 1000000 - 2000 - | 8.87 | 8.86 | 8.89 | 8.77 |
| C.P.B.U.D (sec) | | | | |
| Normalized | 98.87% | 98.98% | 98.65% | 100% |
| Standard Deviation | 0.3% | 0.5% | | |
| Apache Spark - 1000000 - 2000 - | 5.43 | 5.61 | 5.36 | 5.31 |
| Group By Test Time (sec) | | | | |
| Normalized | 97.79% | 94.65% | 99.07% | 100% |
| Standard Deviation | 0.7% | 5.8% | | |
| Apache Spark - 1000000 - 2000 - R.T.T | 3.98 | 3.95 | 3.91 | 4.02 |
| (sec) | | | | |
| Normalized | 98.24% | 98.99% | 100% | 97.26% |
| Standard Deviation | 0.6% | 2% | | |

| | | | |
|---------------------------------------|---------------|--------|---------------|
| Apache Spark - 1000000 - 2000 - 4.50 | 4.48 | 4.59 | 4.34 |
| I.J.T.T (sec) | | | |
| Normalized | 96.44% | 96.88% | 94.55% |
| Standard Deviation | 0.8% | 2.7% | 100% |
| Apache Spark - 1000000 - 2000 - 3.47 | 3.58 | 3.74 | 3.75 |
| B.I.J.T.T (sec) | | | |
| Normalized | 100% | 96.93% | 92.78% |
| Standard Deviation | 0.8% | 1.4% | 92.53% |
| Apache Spark - 10000000 - 100 - 22.48 | 22.74 | 22.18 | 22.64 |
| S.5.B.T (sec) | | | |
| Normalized | 98.67% | 97.54% | 100% |
| Standard Deviation | 0.8% | 2% | 97.97% |
| Apache Spark - 10000000 - 100 - C.P.B | 153.420827140 | 152.83 | 153.294866064 |
| (sec) | | | |
| Normalized | 99.61% | 98.81% | 100% |
| Standard Deviation | 0.5% | 0.2% | 99.7% |
| Apache Spark - 10000000 - 100 - 8.82 | 8.92 | 8.78 | 8.88 |
| C.P.B.U.D (sec) | | | |
| Normalized | 99.55% | 98.43% | 100% |
| Standard Deviation | 0.3% | 1% | 98.87% |
| Apache Spark - 10000000 - 100 - 8.73 | 9.03 | 8.79 | 8.65 |
| Group By Test Time (sec) | | | |
| Normalized | 99.08% | 95.79% | 98.41% |
| Standard Deviation | 1.4% | 2.6% | 100% |
| Apache Spark - 10000000 - 100 - R.T.T | 14.47 | 14.40 | 14.37 |
| (sec) | | | |
| Normalized | 99.31% | 99.79% | 100% |
| Standard Deviation | 2.4% | 1.4% | 99.17% |
| Apache Spark - 10000000 - 100 - 16.60 | 16.83 | 16.77 | 16.12 |
| I.J.T.T (sec) | | | |
| Normalized | 97.11% | 95.78% | 96.12% |
| Standard Deviation | 3.7% | 2.9% | 100% |
| Apache Spark - 10000000 - 100 - 16.09 | 16.62 | 17.11 | 16.47 |
| B.I.J.T.T (sec) | | | |
| Normalized | 100% | 96.81% | 94.04% |
| Standard Deviation | 4.6% | 8.5% | 97.69% |
| Apache Spark - 10000000 - 500 - 21.95 | 22.33 | 21.86 | 22.07 |
| S.5.B.T (sec) | | | |
| Normalized | 99.59% | 97.9% | 100% |
| Standard Deviation | 0.7% | 1.3% | 99.05% |
| Apache Spark - 10000000 - 500 - C.P.B | 155.304388476 | 154.55 | 152.485567023 |
| (sec) | | | |
| Normalized | 97.94% | 98.42% | 99.75% |
| Standard Deviation | 3% | 0.7% | 100% |
| Apache Spark - 10000000 - 500 - 8.90 | 9.05 | 8.85 | 8.89 |
| C.P.B.U.D (sec) | | | |
| Normalized | 99.44% | 97.79% | 100% |
| Standard Deviation | 0.5% | 2.7% | 99.55% |
| Apache Spark - 10000000 - 500 - 8.85 | 9.24 | 8.69 | 8.90 |
| Group By Test Time (sec) | | | |
| Normalized | 98.19% | 94.05% | 100% |
| Standard Deviation | 0.7% | 3.7% | 97.64% |

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|--|---------------|--------|---------------|--------------|
| Apache Spark - 10000000 - 500 - R.T.T (sec) | 14.34 | 14.71 | 14.36 | 14.32 |
| Normalized | 99.86% | 97.35% | 99.72% | 100% |
| Standard Deviation | 0.7% | 3% | | |
| Apache Spark - 10000000 - 500 - I.J.T.T (sec) | 15.76 | 15.92 | 15.60365207 | 15.69 |
| Normalized | 99.01% | 98.01% | 100% | 99.45% |
| Standard Deviation | 0.6% | 2% | | |
| Apache Spark - 10000000 - 500 - B.I.J.T.T (sec) | 15.26 | 15.62 | 15.70 | 15.29 |
| Normalized | 100% | 97.7% | 97.2% | 99.8% |
| Standard Deviation | 1.7% | 1.7% | | |
| Apache Spark - 20000000 - 100 - S.5.B.T (sec) | 42.39 | 43.24 | 42.42 | 42.55 |
| Normalized | 100% | 98.03% | 99.93% | 99.62% |
| Standard Deviation | 0.1% | 0.2% | | |
| Apache Spark - 20000000 - 100 - C.P.B (sec) | 152.95 | 153.30 | 152.48 | 153.91 |
| Normalized | 99.69% | 99.47% | 100% | 99.07% |
| Standard Deviation | 0.3% | 0.5% | | |
| Apache Spark - 20000000 - 100 - C.P.B.U.D (sec) | 8.93 | 9.05 | 8.86 | 8.83 |
| Normalized | 98.88% | 97.57% | 99.66% | 100% |
| Standard Deviation | 1.7% | 1.6% | | |
| Apache Spark - 20000000 - 100 - Group By Test Time (sec) | 14.36 | 14.77 | 13.87 | 13.97 |
| Normalized | 96.59% | 93.91% | 100% | 99.28% |
| Standard Deviation | 1.5% | 3.9% | | |
| Apache Spark - 20000000 - 100 - R.T.T (sec) | 28.55 | 29.08 | 28.30 | 28.87 |
| Normalized | 99.12% | 97.32% | 100% | 98.03% |
| Standard Deviation | 2.2% | 0.9% | | |
| Apache Spark - 20000000 - 100 - I.J.T.T (sec) | 32.48 | 34.86 | 33.02 | 33.52 |
| Normalized | 100% | 93.17% | 98.36% | 96.9% |
| Standard Deviation | 4.2% | 1.2% | | |
| Apache Spark - 20000000 - 100 - B.I.J.T.T (sec) | 31.97 | 33.41 | 32.28 | 32.80 |
| Normalized | 100% | 95.69% | 99.04% | 97.47% |
| Standard Deviation | 3.1% | 0.8% | | |
| Apache Spark - 20000000 - 500 - S.5.B.T (sec) | 40.89 | 40.72 | 40.78 | 40.833205723 |
| Normalized | 99.58% | 100% | 99.85% | 99.72% |
| Standard Deviation | 0.1% | | | |
| Apache Spark - 20000000 - 500 - C.P.B (sec) | 153.119068372 | 154.85 | 151.756824107 | 152.44 |
| Normalized | 99.11% | 98% | 100% | 99.55% |
| Standard Deviation | 0.2% | | | |
| Apache Spark - 20000000 - 500 - C.P.B.U.D (sec) | 8.89 | 8.84 | 8.79 | 8.82 |
| Normalized | 98.88% | 99.43% | 100% | 99.66% |
| Standard Deviation | 0.4% | | | |

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|--|---------------|---------------|--------|
| Apache Spark - 20000000 - 500 - 13.73 | 14.17 | 13.52 | 13.49 |
| Group By Test Time (sec) | | | |
| Normalized | 98.25% | 95.2% | 99.78% |
| Standard Deviation | 0.4% | | 100% |
| Apache Spark - 20000000 - 500 - R.T.T 27.32 | 27.08 | 27.39 | 27.44 |
| (sec) | | | |
| Normalized | 99.12% | 100% | 98.87% |
| Standard Deviation | 0.2% | | 98.69% |
| Apache Spark - 20000000 - 500 - 30.15 | 30.37 | 30.052695298 | 30.41 |
| I.J.T.T (sec) | | | |
| Normalized | 99.68% | 98.96% | 100% |
| Standard Deviation | 1.1% | | 98.83% |
| Apache Spark - 20000000 - 500 - 29.47 | 29.31 | 29.58 | 29.66 |
| B.I.J.T.T (sec) | | | |
| Normalized | 99.46% | 100% | 99.09% |
| Standard Deviation | 0.4% | | 98.82% |
| Apache Spark - 40000000 - 100 - 78.85 | 79.62 | 78.73 | |
| S.5.B.T (sec) | | | |
| Normalized | 99.85% | 98.88% | 100% |
| Standard Deviation | 0.3% | | |
| Apache Spark - 40000000 - 100 - C.P.B 153.35 | 153.13 | 154.725760741 | |
| (sec) | | | |
| Normalized | 99.86% | 100% | 98.97% |
| Standard Deviation | 0.9% | | |
| Apache Spark - 40000000 - 100 - 8.88 | 8.90 | 8.97 | |
| C.P.B.U.D (sec) | | | |
| Normalized | 100% | 99.78% | 99% |
| Standard Deviation | 0.3% | | |
| Apache Spark - 40000000 - 100 - 39.49 | 39.697408925 | 39.35 | |
| Group By Test Time (sec) | | | |
| Normalized | 99.65% | 99.12% | 100% |
| Standard Deviation | 0.7% | | |
| Apache Spark - 40000000 - 100 - R.T.T 54.63 | 55.91 | 55.16 | |
| (sec) | | | |
| Normalized | 100% | 97.71% | 99.04% |
| Standard Deviation | 2.6% | | |
| Apache Spark - 40000000 - 100 - 60.58 | 61.03 | 61.47 | |
| I.J.T.T (sec) | | | |
| Normalized | 100% | 99.26% | 98.55% |
| Standard Deviation | 2.2% | | |
| Apache Spark - 40000000 - 100 - 58.79 | 58.70 | 58.36 | |
| B.I.J.T.T (sec) | | | |
| Normalized | 99.27% | 99.42% | 100% |
| Standard Deviation | 2.8% | | |
| Apache Spark - 40000000 - 500 - 78.90 | 79.36 | 79.95 | |
| S.5.B.T (sec) | | | |
| Normalized | 100% | 99.42% | 98.69% |
| Standard Deviation | 0.2% | | |
| Apache Spark - 40000000 - 500 - C.P.B 152.93 | 152.405492283 | 153.001401081 | |
| (sec) | | | |
| Normalized | 99.66% | 100% | 99.61% |
| Standard Deviation | 0.5% | | |

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|--|---------------|---------------|
| Apache Spark - 40000000 - 500 - 8.82 | 8.94 | 8.79 |
| C.P.B.U.D (sec) | | |
| Normalized | 99.66% | 98.32% |
| Standard Deviation | 0.1% | 100% |
| Apache Spark - 40000000 - 500 - 34.16 | 34.17 | 34.12 |
| Group By Test Time (sec) | | |
| Normalized | 99.88% | 99.85% |
| Standard Deviation | 1.8% | 100% |
| Apache Spark - 40000000 - 500 - R.T.T | 53.96 | 54.75 |
| (sec) | | 54.54 |
| Normalized | 100% | 98.56% |
| Standard Deviation | 0.7% | 98.94% |
| Apache Spark - 40000000 - 500 - | 59.91 | 62.21 |
| I.J.T.T (sec) | | 62.44 |
| Normalized | 100% | 96.3% |
| Standard Deviation | 0.2% | 95.95% |
| Apache Spark - 40000000 - 500 - 59.07 | 58.78 | 60.63 |
| B.I.J.T.T (sec) | | |
| Normalized | 99.51% | 100% |
| Standard Deviation | 0.9% | 96.95% |
| Apache Spark - 10000000 - 1000 - 22.26 | 22.16 | 22.30 |
| S.5.B.T (sec) | | |
| Normalized | 99.55% | 100% |
| Standard Deviation | 0.3% | 99.37% |
| Apache Spark - 10000000 - 1000 - | 151.93 | 152.074986269 |
| C.P.B (sec) | | 152.67 |
| Normalized | 100% | 99.9% |
| Standard Deviation | 0.4% | 99.52% |
| Apache Spark - 10000000 - 1000 - | 8.84 | 8.79 |
| C.P.B.U.D (sec) | | 8.83 |
| Normalized | 99.43% | 100% |
| Standard Deviation | 0.3% | 99.55% |
| Apache Spark - 10000000 - 1000 - | 9.40 | 9.29 |
| Group By Test Time (sec) | | 9.01 |
| Normalized | 95.85% | 96.99% |
| Standard Deviation | 1.8% | 100% |
| Apache Spark - 10000000 - 1000 - 14.63 | 14.87 | 14.59 |
| R.T.T (sec) | | |
| Normalized | 99.73% | 98.12% |
| Standard Deviation | 0.7% | 100% |
| Apache Spark - 10000000 - 1000 - 16.44 | 16.64 | 16.37 |
| I.J.T.T (sec) | | |
| Normalized | 99.57% | 98.38% |
| Standard Deviation | 0.1% | 100% |
| Apache Spark - 10000000 - 1000 - | 15.44 | 15.44 |
| B.I.J.T.T (sec) | | 15.40 |
| Normalized | 99.74% | 99.74% |
| Standard Deviation | 0.4% | 100% |
| Apache Spark - 10000000 - 2000 - 22.94 | 23.01 | 22.82 |
| S.5.B.T (sec) | | |
| Normalized | 99.48% | 99.17% |
| Standard Deviation | 1.2% | 100% |

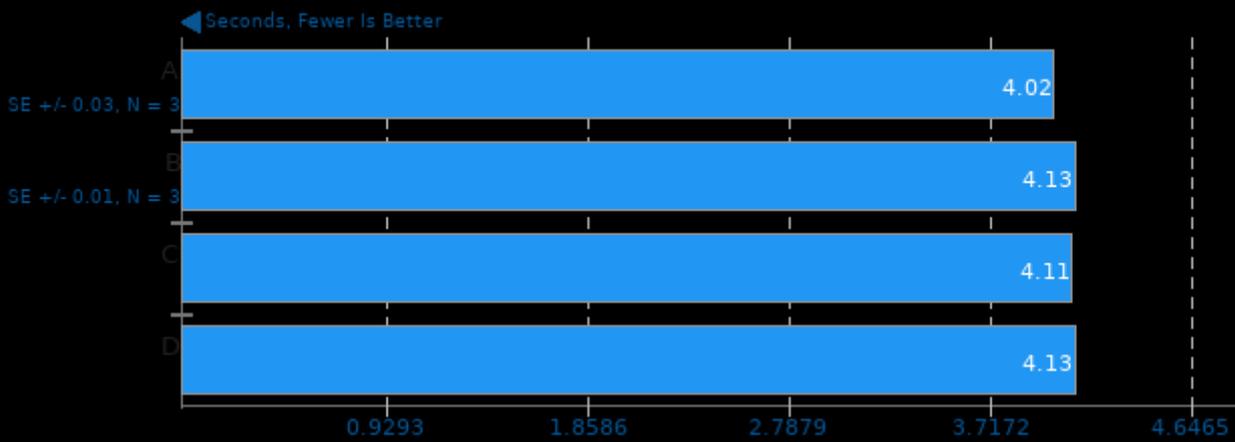
| | | | |
|---|---------------|--------------|--------------|
| Apache Spark - 10000000 - 2000 - C.P.B (sec) | 153.335959054 | 152.86366418 | 152.37 |
| Normalized | 99.37% | 99.68% | 100% |
| Standard Deviation | 0.3% | | |
| Apache Spark - 10000000 - 2000 - C.P.B.U.D (sec) | 8.80 | 8.73 | 8.81 |
| Normalized | 99.2% | 100% | 99.09% |
| Standard Deviation | 0.6% | | |
| Apache Spark - 10000000 - 2000 - Group By Test Time (sec) | 9.97 | 9.91 | 9.92 |
| Normalized | 99.4% | 100% | 99.9% |
| Standard Deviation | 1.9% | | |
| Apache Spark - 10000000 - 2000 - R.T.T (sec) | 15.36 | 15.57 | 15.48 |
| Normalized | 100% | 98.65% | 99.22% |
| Standard Deviation | 0.3% | | |
| Apache Spark - 10000000 - 2000 - I.J.T.T (sec) | 17.93 | 17.74 | 17.65 |
| Normalized | 98.44% | 99.49% | 100% |
| Standard Deviation | 0.7% | | |
| Apache Spark - 10000000 - 2000 - B.I.J.T.T (sec) | 16.43 | 16.25 | 16.381663148 |
| Normalized | 98.9% | 100% | 99.2% |
| Standard Deviation | 1.1% | | |
| Apache Spark - 20000000 - 1000 - S.5.B.T (sec) | 41.65 | 41.50 | 41.47 |
| Normalized | 99.57% | 99.93% | 100% |
| Standard Deviation | 0.7% | | |
| Apache Spark - 20000000 - 1000 - C.P.B (sec) | 153.271993439 | 153.68034104 | 152.53 |
| Normalized | 99.52% | 99.25% | 100% |
| Standard Deviation | 0.7% | | |
| Apache Spark - 20000000 - 1000 - C.P.B.U.D (sec) | 8.80 | 8.77 | 8.76 |
| Normalized | 99.55% | 99.89% | 100% |
| Standard Deviation | 0.9% | | |
| Apache Spark - 20000000 - 1000 - Group By Test Time (sec) | 14.11 | 13.908010157 | 14.14 |
| Normalized | 98.57% | 100% | 98.36% |
| Standard Deviation | 1.8% | | |
| Apache Spark - 20000000 - 1000 - R.T.T (sec) | 28.14 | 27.49 | 27.73 |
| Normalized | 97.69% | 100% | 99.13% |
| Standard Deviation | 1.9% | | |
| Apache Spark - 20000000 - 1000 - I.J.T.T (sec) | 31.77 | 30.61 | 30.87 |
| Normalized | 96.35% | 100% | 99.16% |
| Standard Deviation | 4.4% | | |
| Apache Spark - 20000000 - 1000 - B.I.J.T.T (sec) | 30.72 | 30.14 | 30.57 |
| Normalized | 98.11% | 100% | 98.59% |
| Standard Deviation | 2.8% | | |

| | | | |
|----------------------------------|---------------|----------------------|---------------------|
| Apache Spark - 20000000 - 2000 - | 41.96 | 41.95 | 41.64 |
| S.5.B.T (sec) | | | |
| Normalized | 99.24% | 99.26% | 100% |
| Standard Deviation | 0.5% | | |
| Apache Spark - 20000000 - 2000 - | 152.402151818 | 152.25 | 153.66 |
| C.P.B (sec) | | | |
| Normalized | 99.9% | 100% | 99.08% |
| Standard Deviation | 0.4% | | |
| Apache Spark - 20000000 - 2000 - | 8.80 | 8.87 | 8.88 |
| C.P.B.U.D (sec) | | | |
| Normalized | 100% | 99.21% | 99.1% |
| Standard Deviation | 0.2% | | |
| Apache Spark - 20000000 - 2000 - | 14.38 | 14.33 | 14.70 |
| Group By Test Time (sec) | | | |
| Normalized | 99.65% | 100% | 97.48% |
| Standard Deviation | 2.2% | | |
| Apache Spark - 20000000 - 2000 - | 28.52 | 28.52 | 28.26 |
| R.T.T (sec) | | | |
| Normalized | 99.09% | 99.09% | 100% |
| Standard Deviation | 0.7% | | |
| Apache Spark - 20000000 - 2000 - | 32.38 | 32.28 | 32.92 |
| I.J.T.T (sec) | | | |
| Normalized | 99.69% | 100% | 98.06% |
| Standard Deviation | 0.9% | | |
| Apache Spark - 20000000 - 2000 - | 31.01 | 30.91 | 30.84 |
| B.I.J.T.T (sec) | | | |
| Normalized | 99.45% | 99.77% | 100% |
| Standard Deviation | 1.5% | | |
| Apache Spark - 40000000 - 1000 - | 79.57 | 79.49 | 79.45 |
| S.5.B.T (sec) | | | |
| Normalized | 99.85% | 99.95% | 100% |
| Standard Deviation | 0.1% | | |
| Apache Spark - 40000000 - 1000 - | 152.831972628 | 157.251605514 | 151.70763895 |
| C.P.B (sec) | | | |
| Normalized | 99.26% | 96.47% | 100% |
| Standard Deviation | 0.8% | | |
| Apache Spark - 40000000 - 1000 - | 8.87 | 8.77 | 8.90 |
| C.P.B.U.D (sec) | | | |
| Normalized | 98.87% | 100% | 98.54% |
| Standard Deviation | 0.5% | | |
| Apache Spark - 40000000 - 1000 - | 32.91 | 32.75 | 32.49 |
| Group By Test Time (sec) | | | |
| Normalized | 98.72% | 99.21% | 100% |
| Standard Deviation | 1.6% | | |
| Apache Spark - 40000000 - 1000 - | 54.58 | 55.24 | 55.02 |
| R.T.T (sec) | | | |
| Normalized | 100% | 98.81% | 99.2% |
| Standard Deviation | 1.1% | | |
| Apache Spark - 40000000 - 1000 - | 60.92 | 62.68 | 61.73 |
| I.J.T.T (sec) | | | |
| Normalized | 100% | 97.19% | 98.69% |
| Standard Deviation | 1.3% | | |

| | | | |
|----------------------------------|---------------|----------------------|---------------|
| Apache Spark - 40000000 - 1000 - | 60.41 | 60.25 | 59.47 |
| B.I.J.T.T (sec) | | | |
| Normalized | 98.44% | 98.71% | 100% |
| Standard Deviation | 0.1% | | |
| Apache Spark - 40000000 - 2000 - | 80.93 | 80.26 | 80.56 |
| S.5.B.T (sec) | | | |
| Normalized | 99.17% | 100% | 99.63% |
| Standard Deviation | 0.4% | | |
| Apache Spark - 40000000 - 2000 - | 153.43 | 159.377497383 | 153.719046678 |
| C.P.B (sec) | | | |
| Normalized | 100% | 96.27% | 99.81% |
| Standard Deviation | 0.7% | | |
| Apache Spark - 40000000 - 2000 - | 8.88 | 8.89 | 8.82 |
| C.P.B.U.D (sec) | | | |
| Normalized | 99.32% | 99.21% | 100% |
| Standard Deviation | 0.9% | | |
| Apache Spark - 40000000 - 2000 - | 32.97 | 33.17 | 33.46 |
| Group By Test Time (sec) | | | |
| Normalized | 100% | 99.4% | 98.54% |
| Standard Deviation | 1.5% | | |
| Apache Spark - 40000000 - 2000 - | 55.50 | 56.26 | 55.94 |
| R.T.T (sec) | | | |
| Normalized | 100% | 98.65% | 99.21% |
| Standard Deviation | 0.8% | | |
| Apache Spark - 40000000 - 2000 - | 61.64 | 63.23 | 63.08 |
| I.J.T.T (sec) | | | |
| Normalized | 100% | 97.49% | 97.72% |
| Standard Deviation | 1.1% | | |
| Apache Spark - 40000000 - 2000 - | 60.46 | 61.19 | 61.50 |
| B.I.J.T.T (sec) | | | |
| Normalized | 100% | 98.81% | 98.31% |
| Standard Deviation | 1.5% | | |

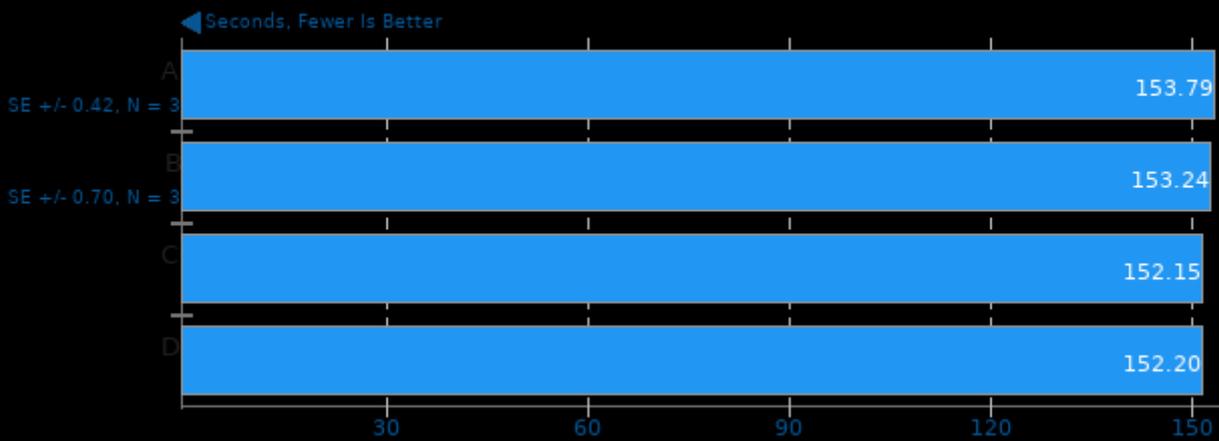
Apache Spark 3.3

Row Count: 1000000 - Partitions: 100 - SHA-512 Benchmark Time



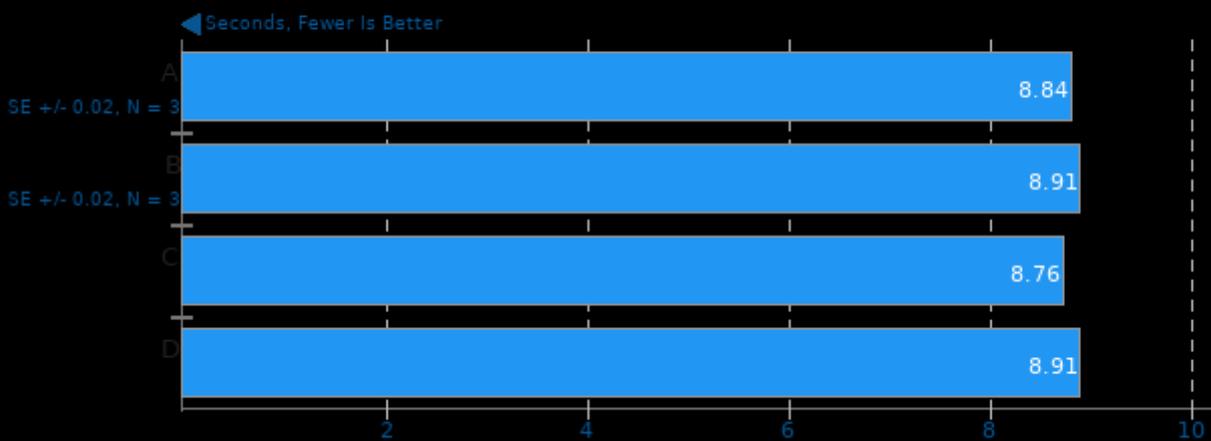
Apache Spark 3.3

Row Count: 1000000 - Partitions: 100 - Calculate Pi Benchmark



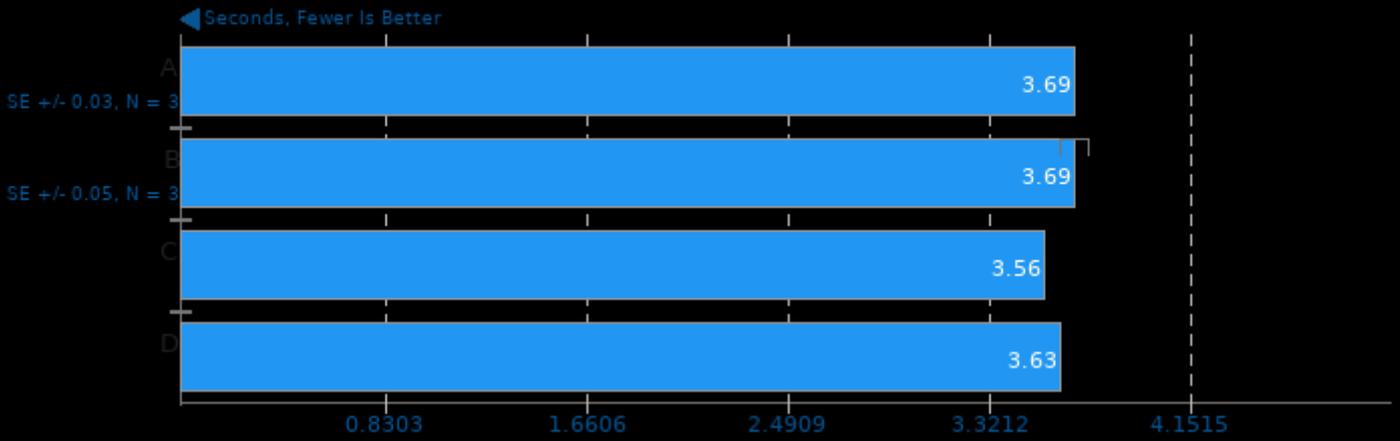
Apache Spark 3.3

Row Count: 1000000 - Partitions: 100 - Calculate Pi Benchmark Using Dataframe



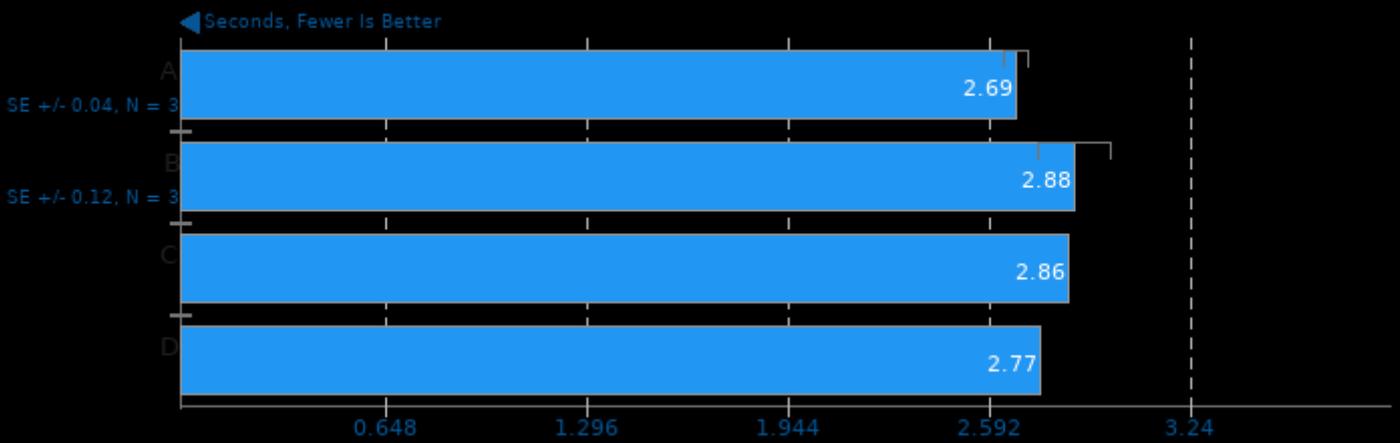
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Row Count: 1000000 - Partitions: 100 - Group By Test Time



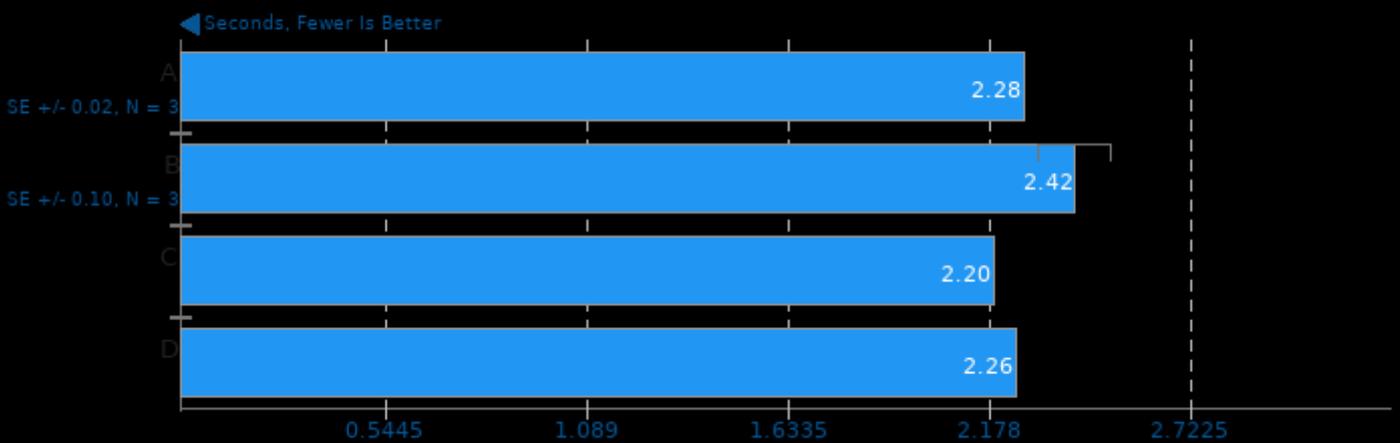
Apache Spark 3.3

Row Count: 1000000 - Partitions: 100 - Repartition Test Time



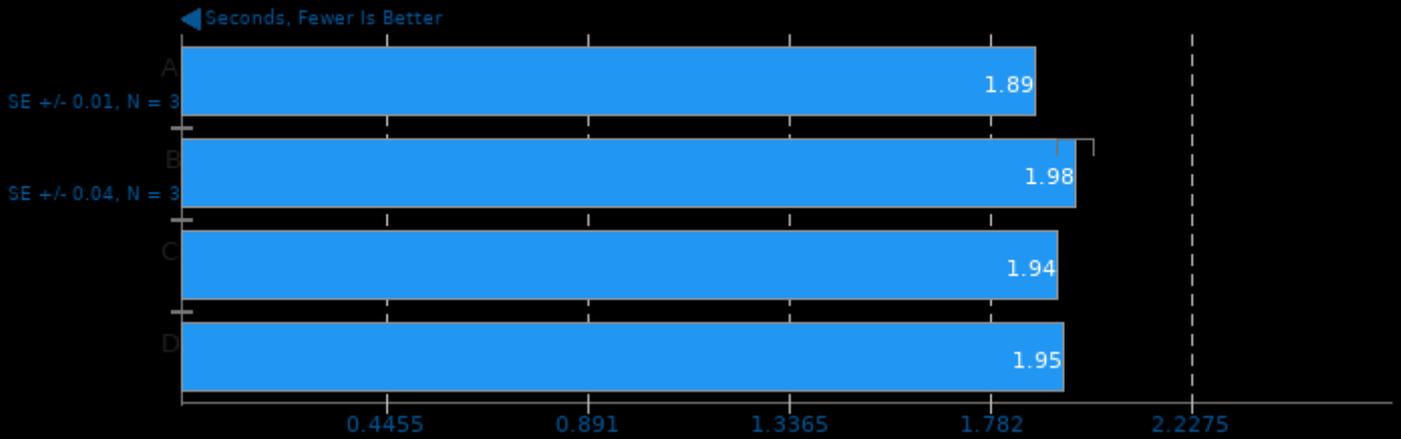
Apache Spark 3.3

Row Count: 1000000 - Partitions: 100 - Inner Join Test Time



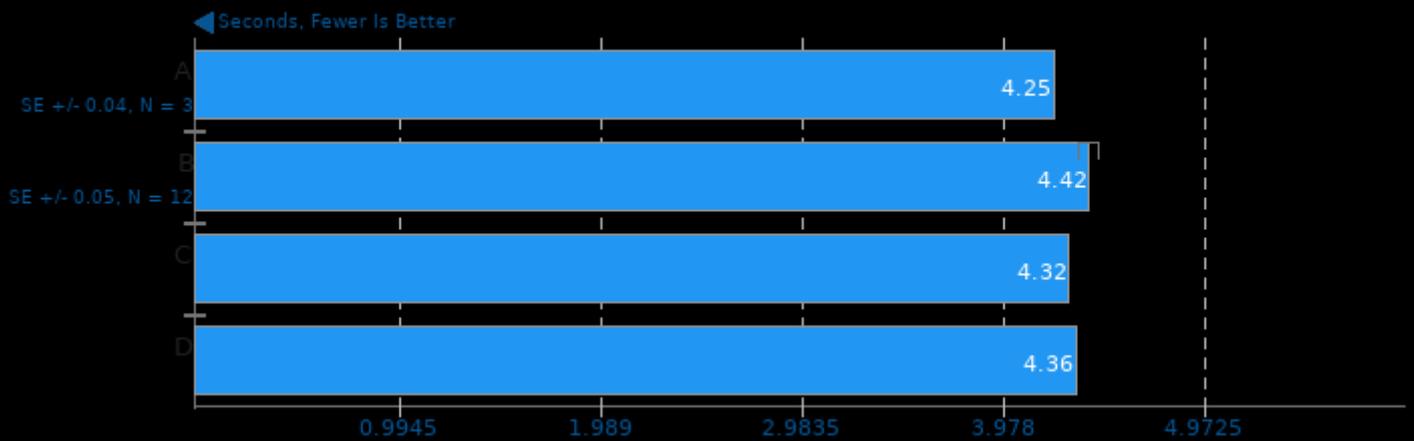
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Row Count: 1000000 - Partitions: 100 - Broadcast Inner Join Test Time



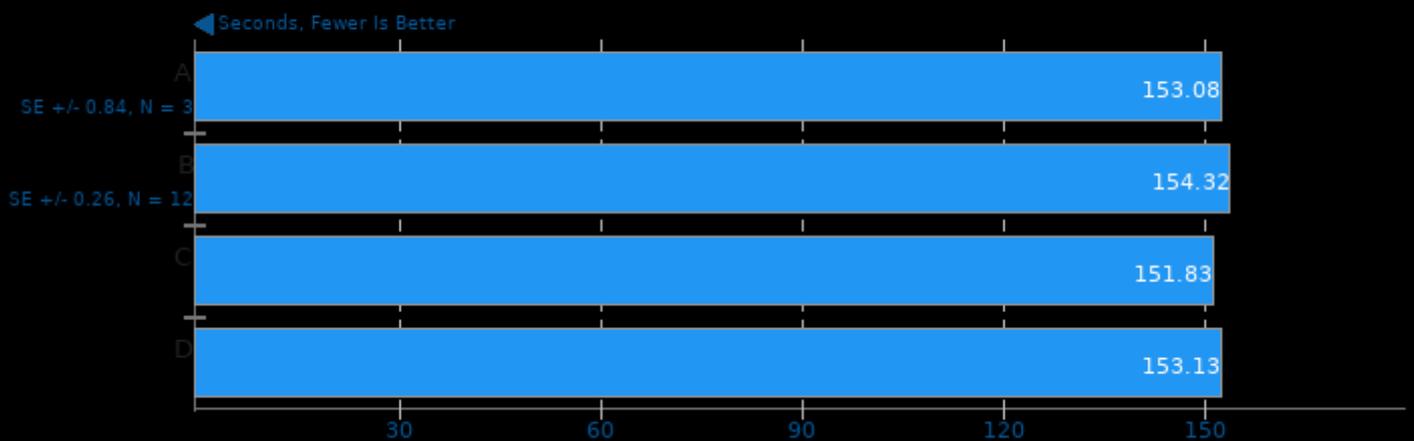
Apache Spark 3.3

Row Count: 1000000 - Partitions: 500 - SHA-512 Benchmark Time



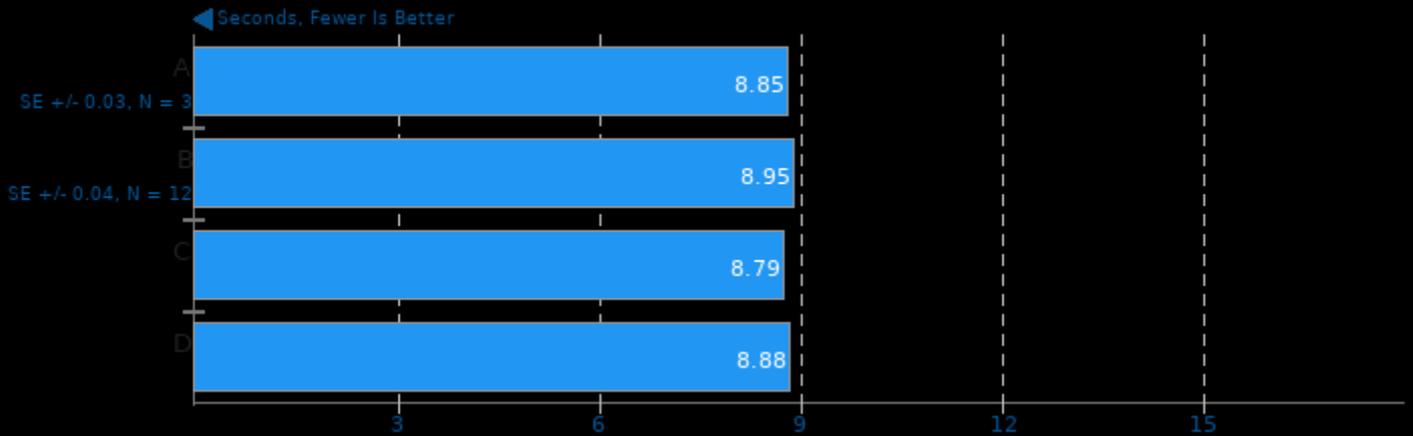
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Row Count: 1000000 - Partitions: 500 - Calculate Pi Benchmark



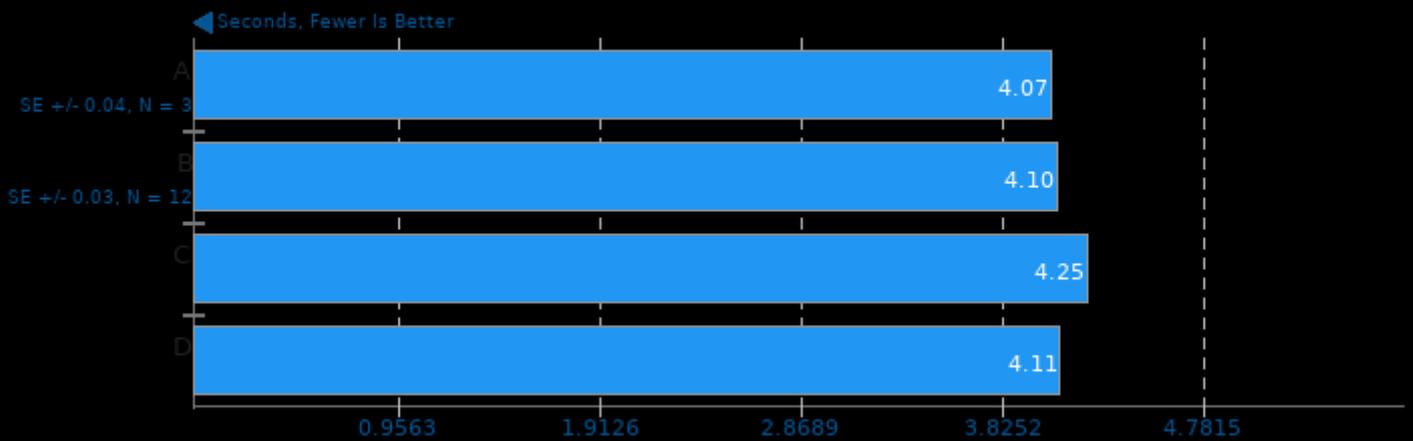
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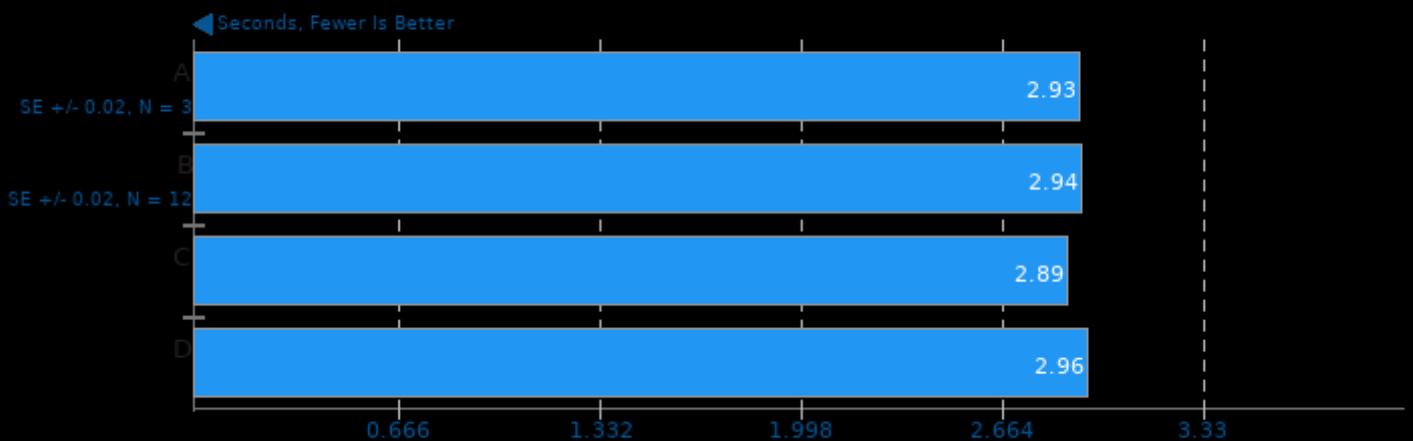
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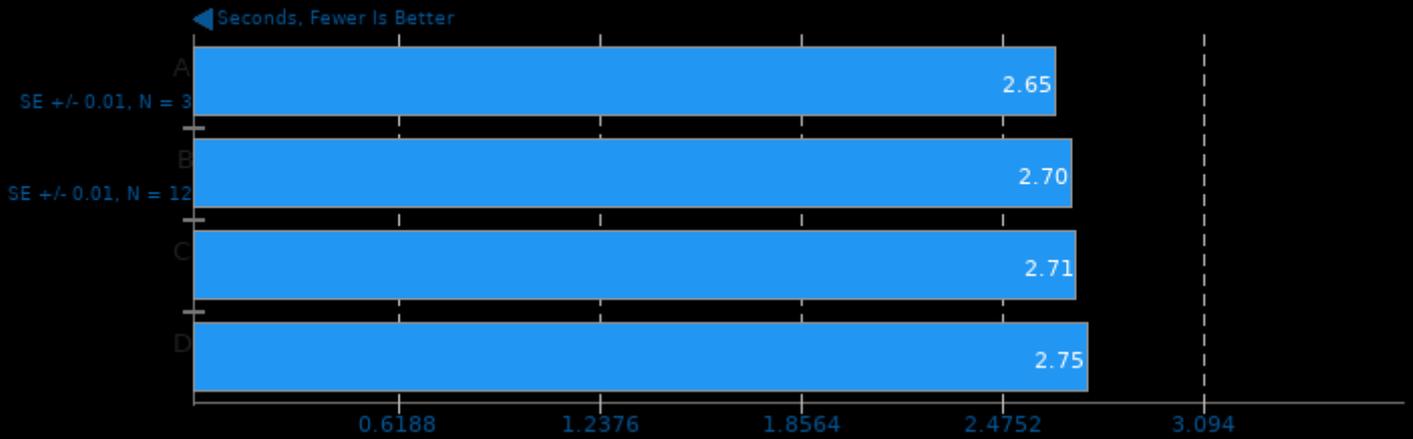
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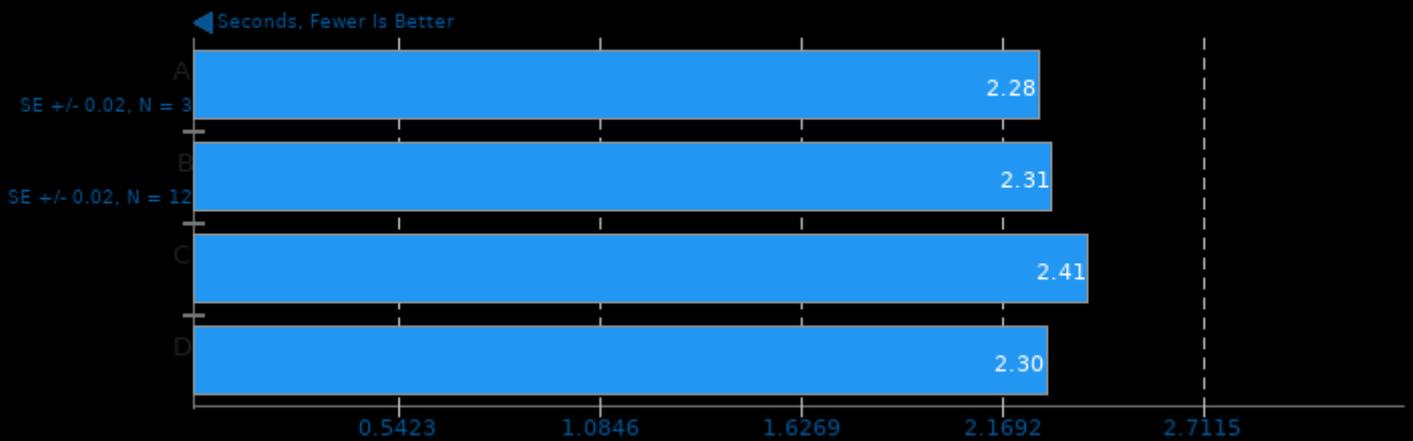
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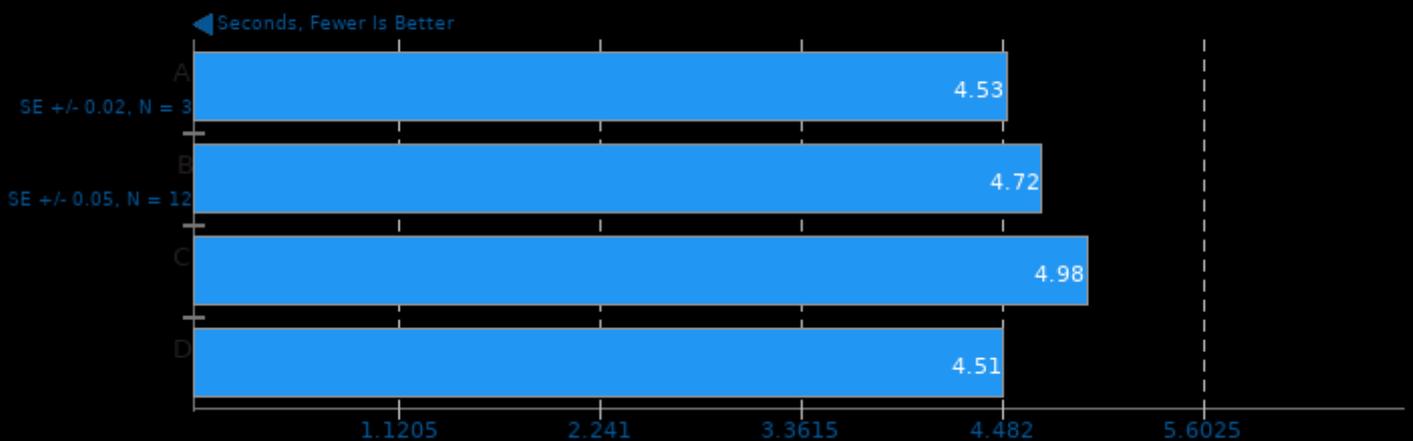
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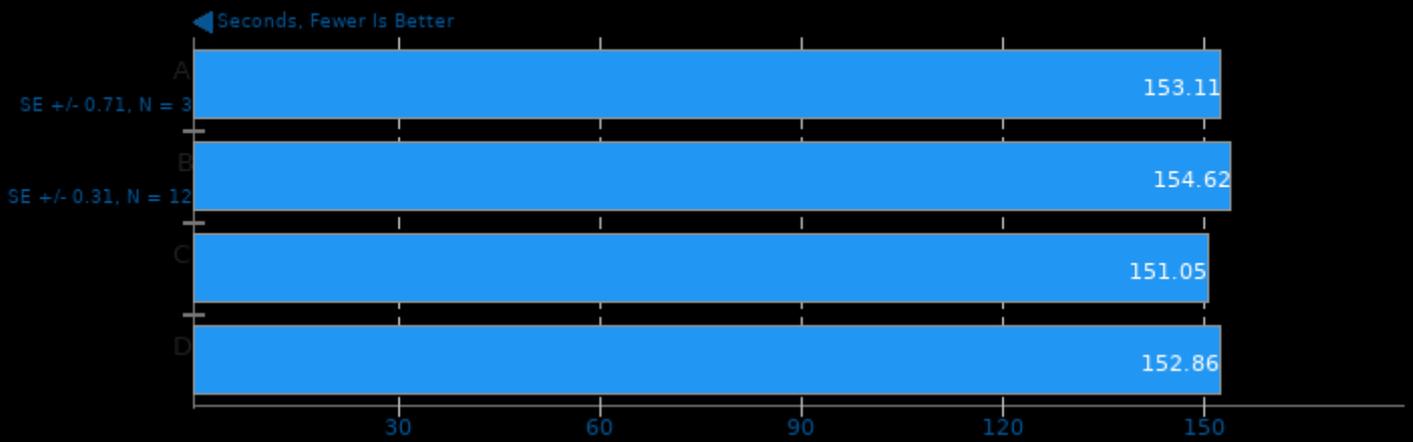
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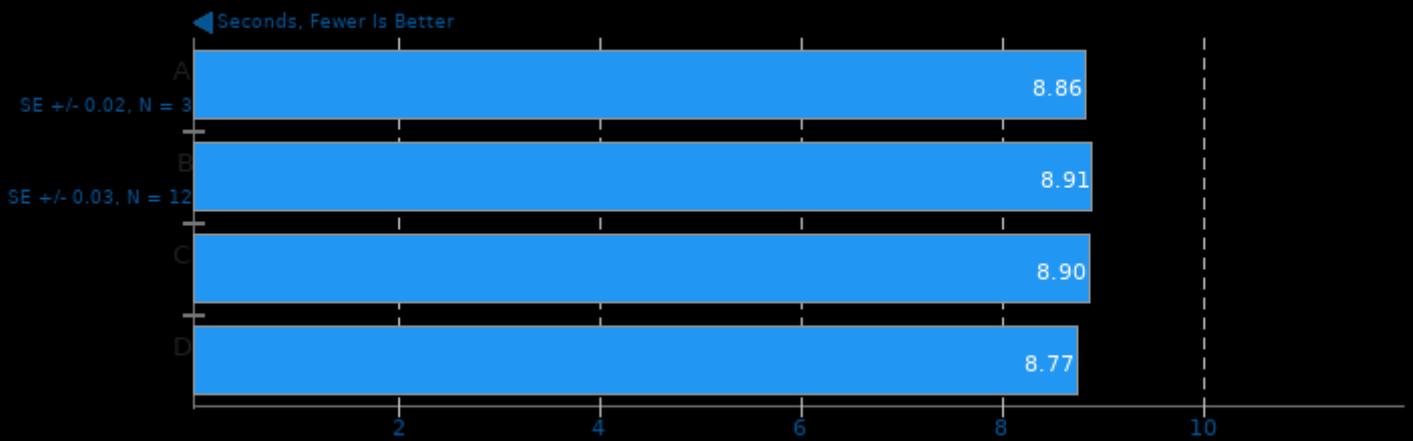
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Row Count: 1000000 - Partitions: 1000 - Calculate Pi Benchmark



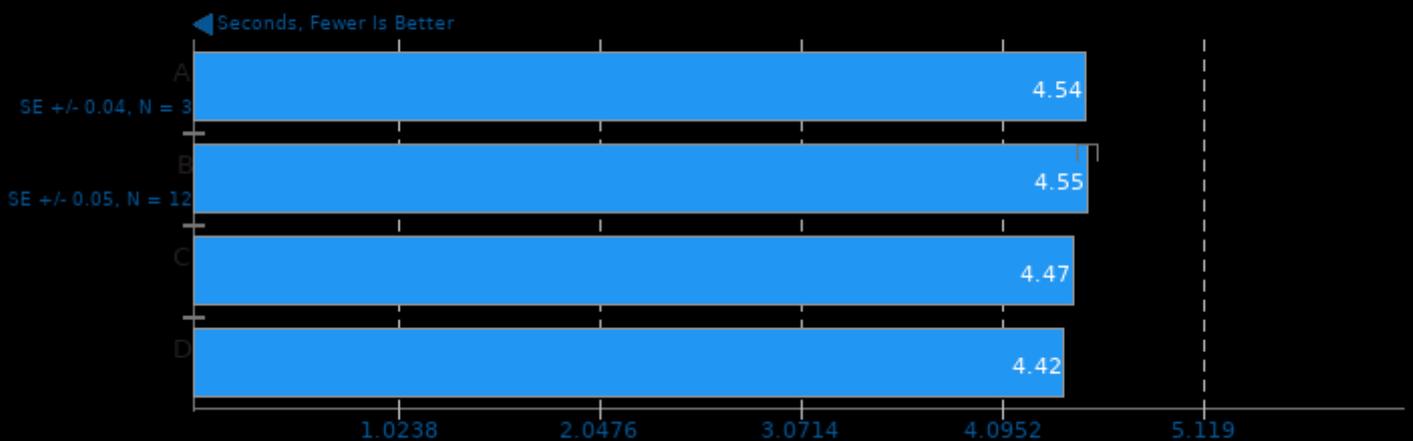
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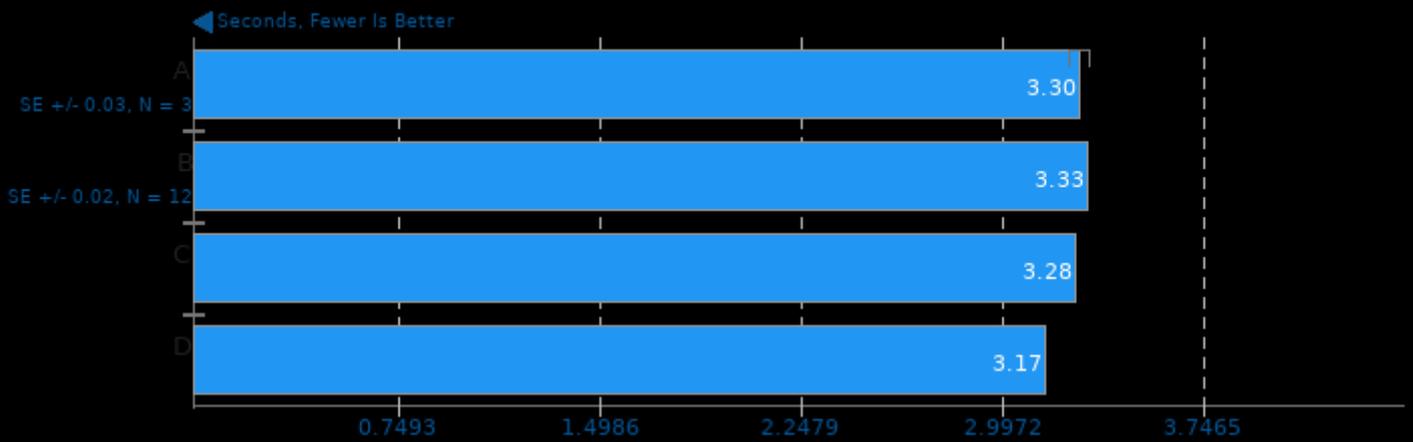
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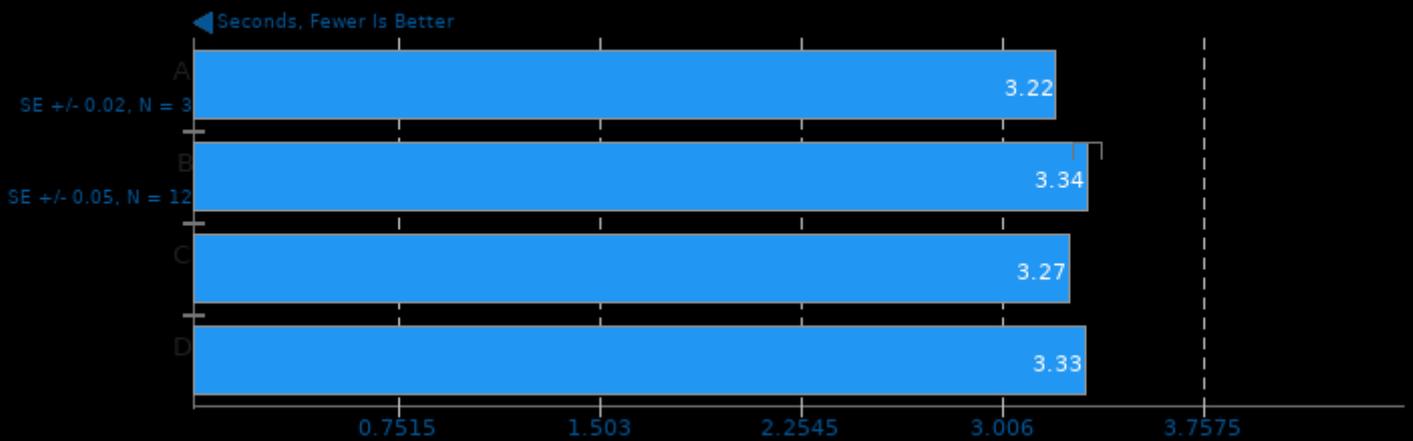
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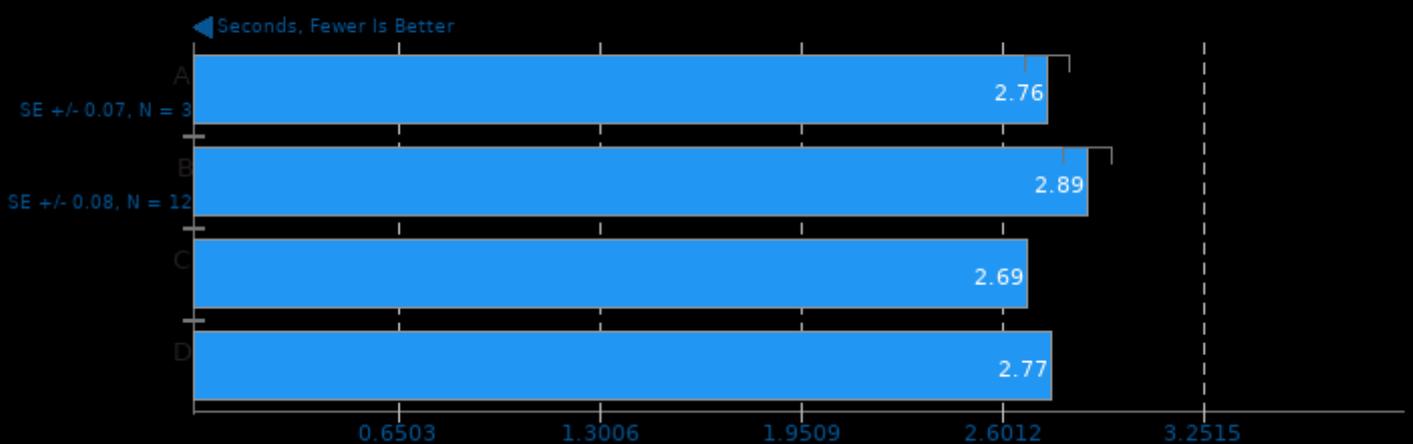
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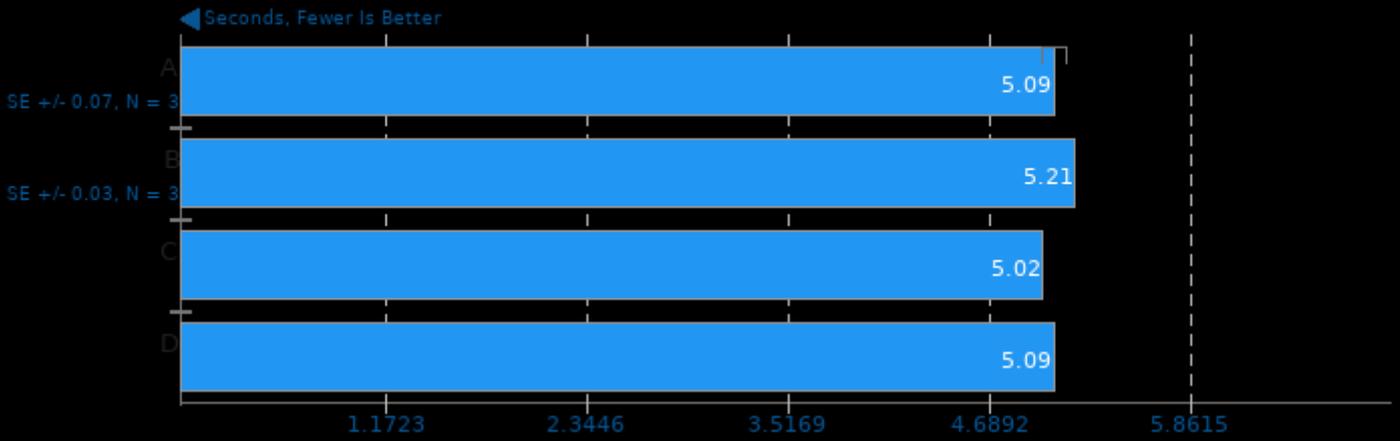
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Row Count: 1000000 - Partitions: 1000 - Broadcast Inner Join Test Time



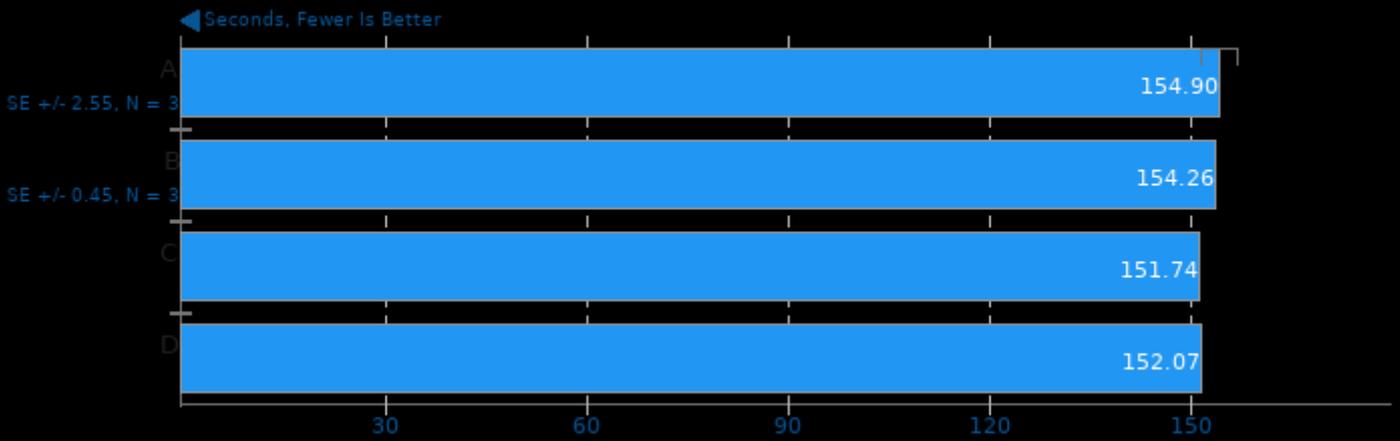
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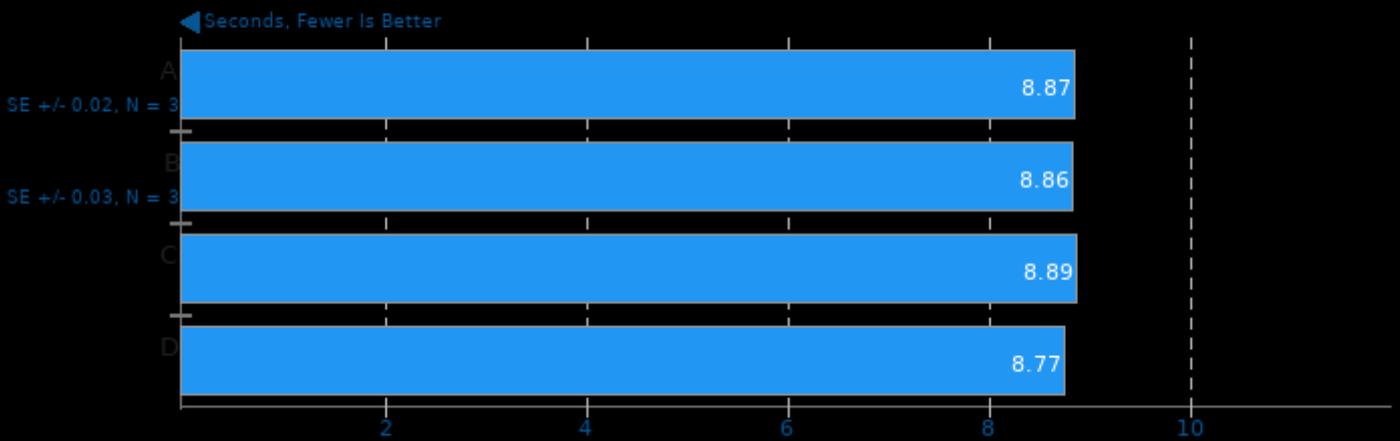
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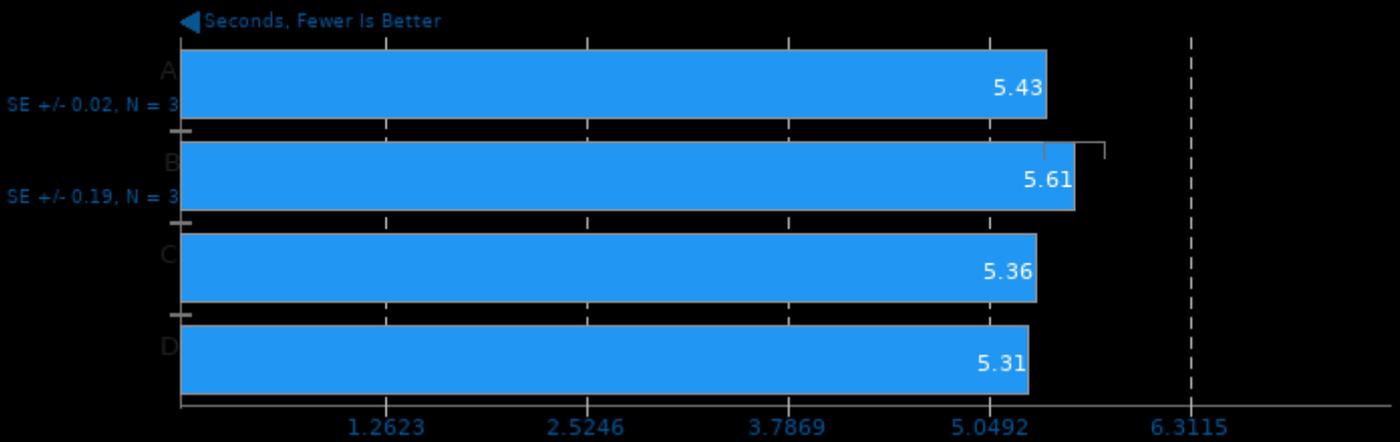
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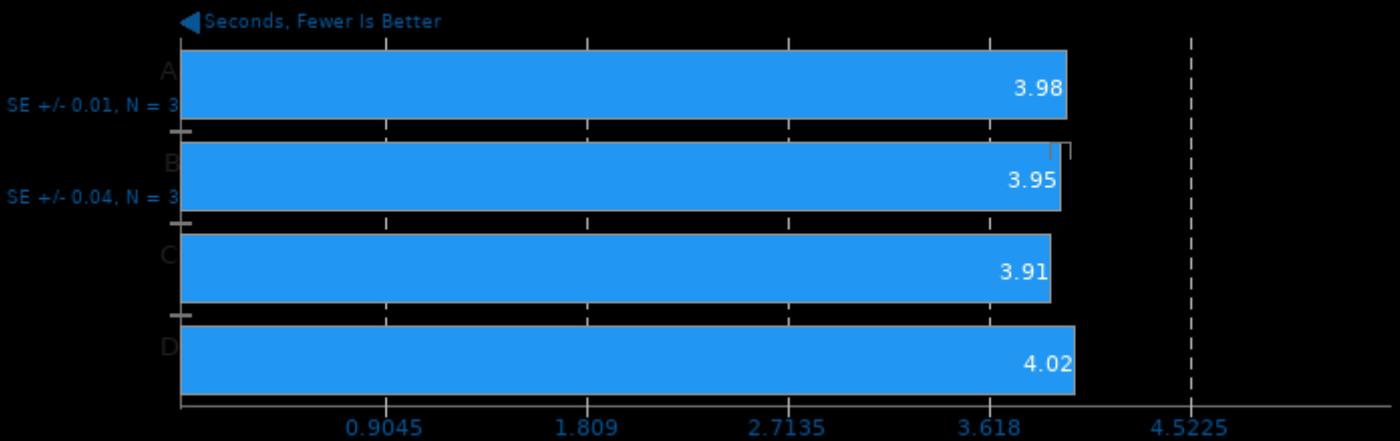
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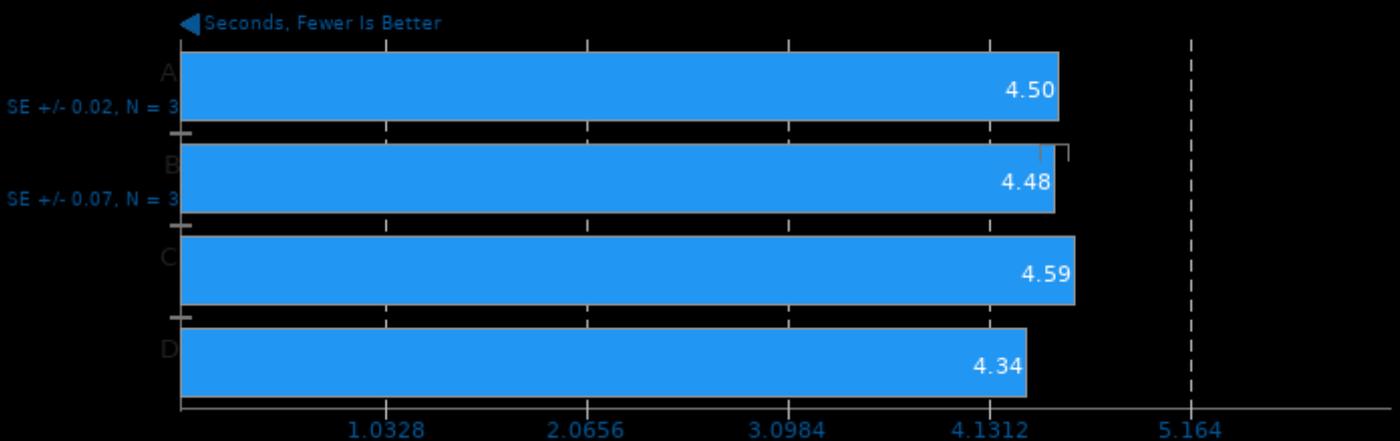
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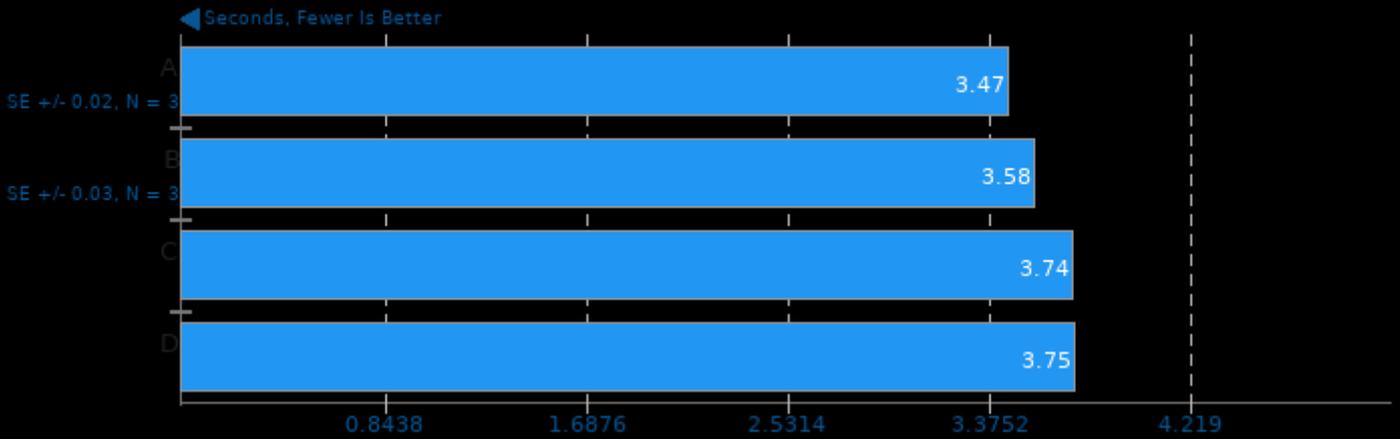
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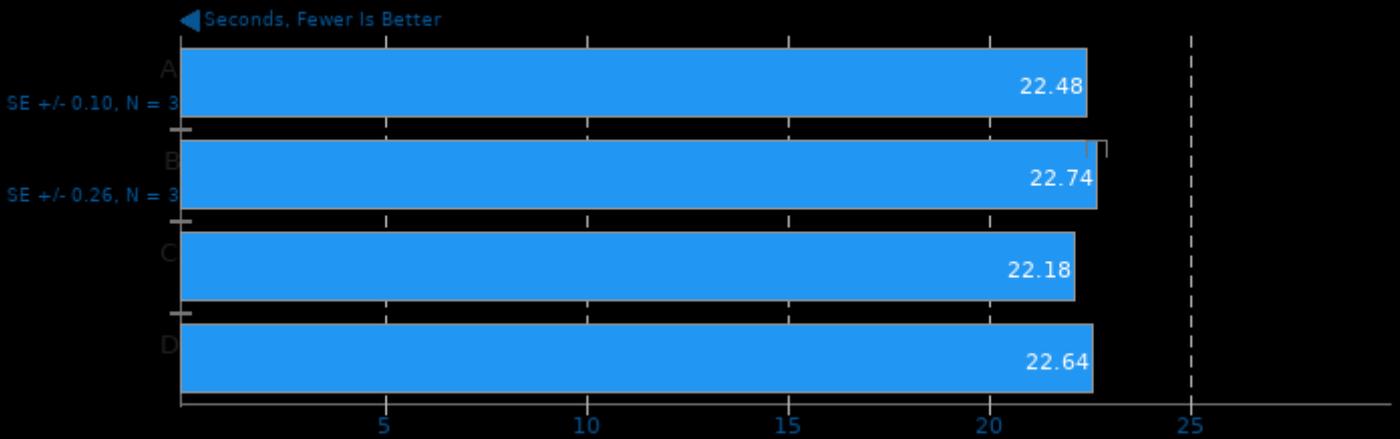
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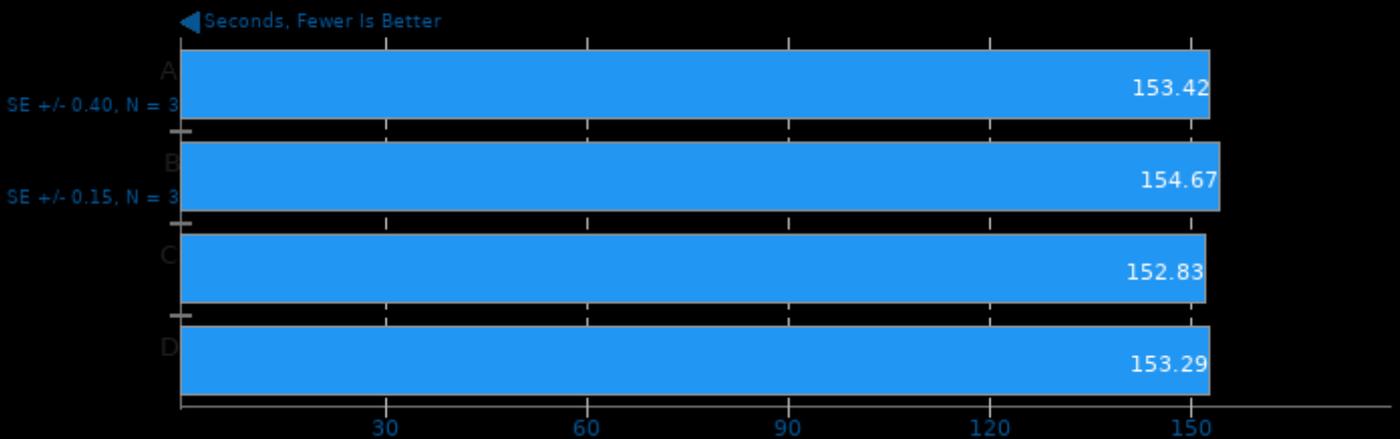
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Row Count: 10000000 - Partitions: 100 - SHA-512 Benchmark Time



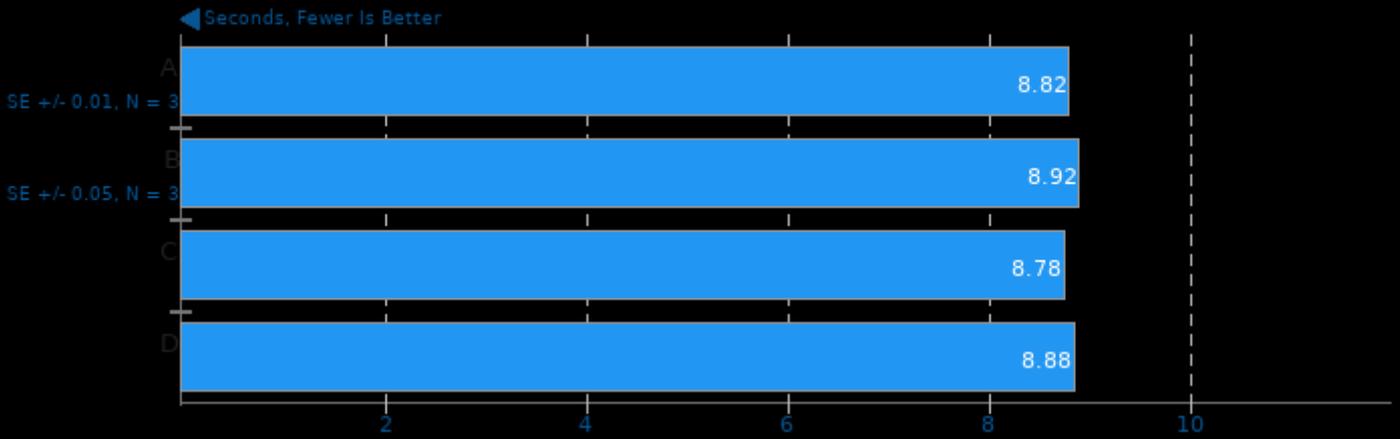
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Row Count: 10000000 - Partitions: 100 - Calculate Pi Benchmark



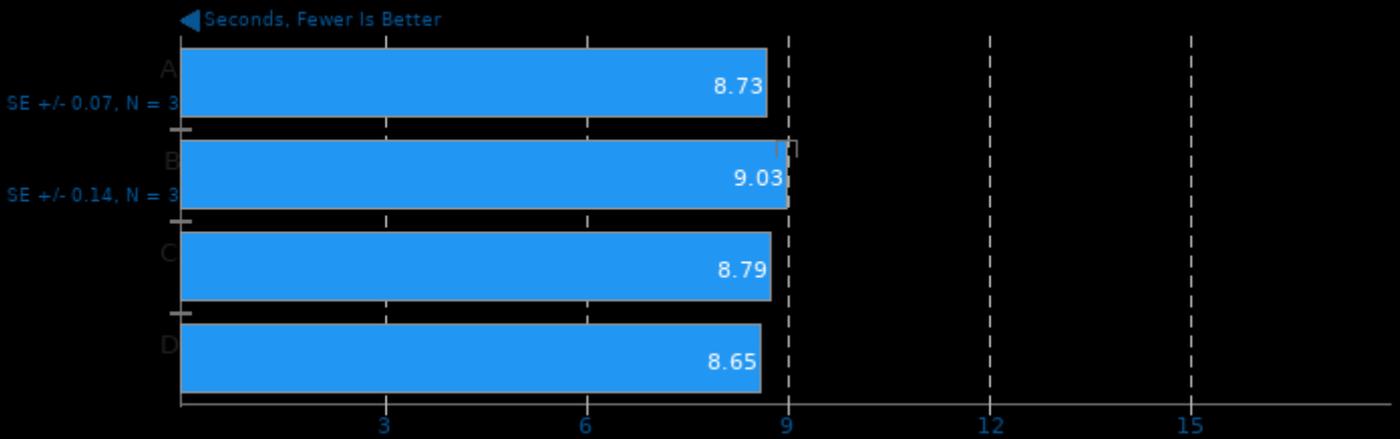
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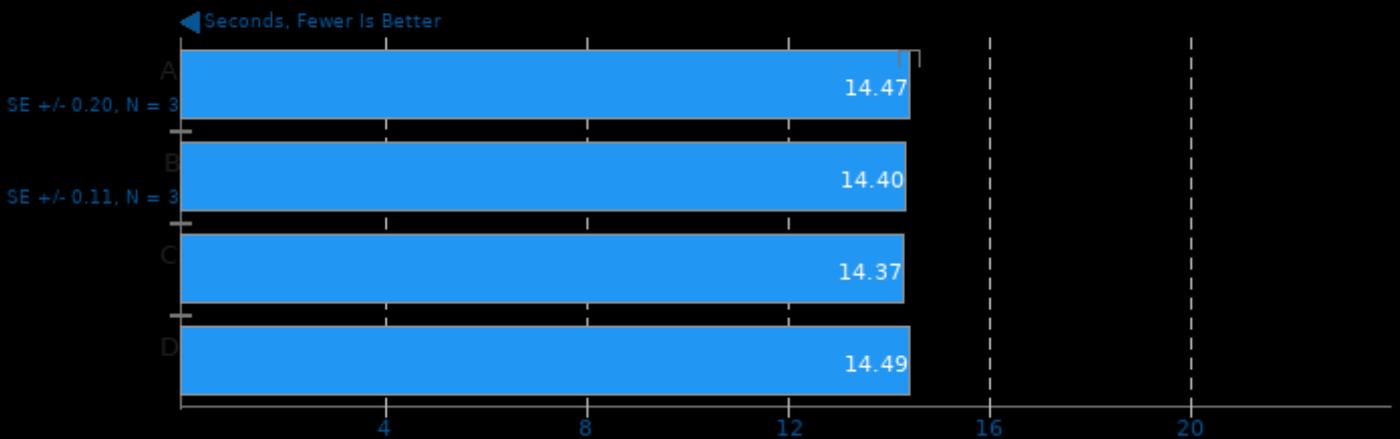
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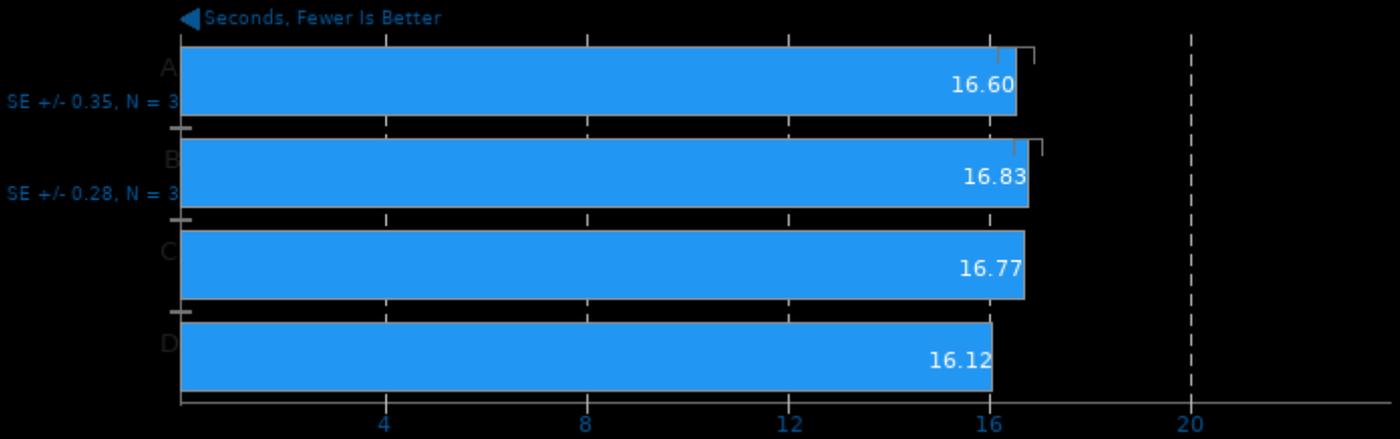
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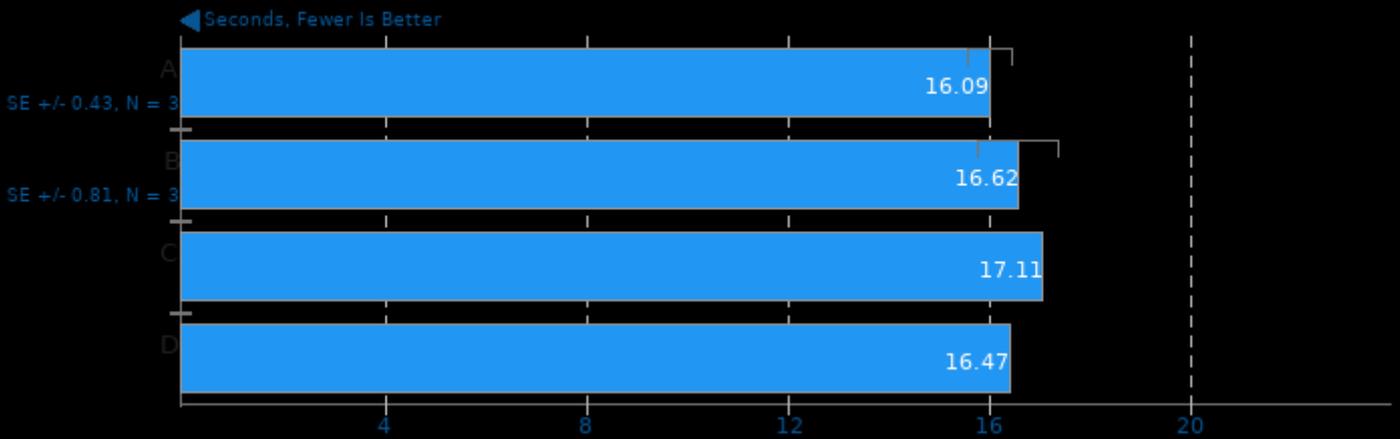
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Row Count: 10000000 - Partitions: 100 - Inner Join Test Time



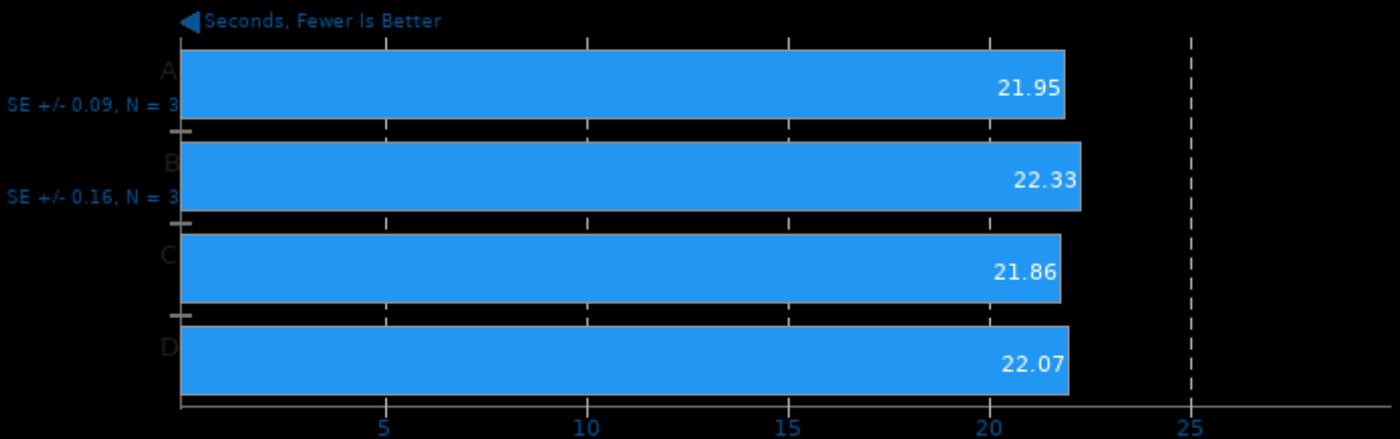
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Row Count: 10000000 - Partitions: 100 - Broadcast Inner Join Test Time



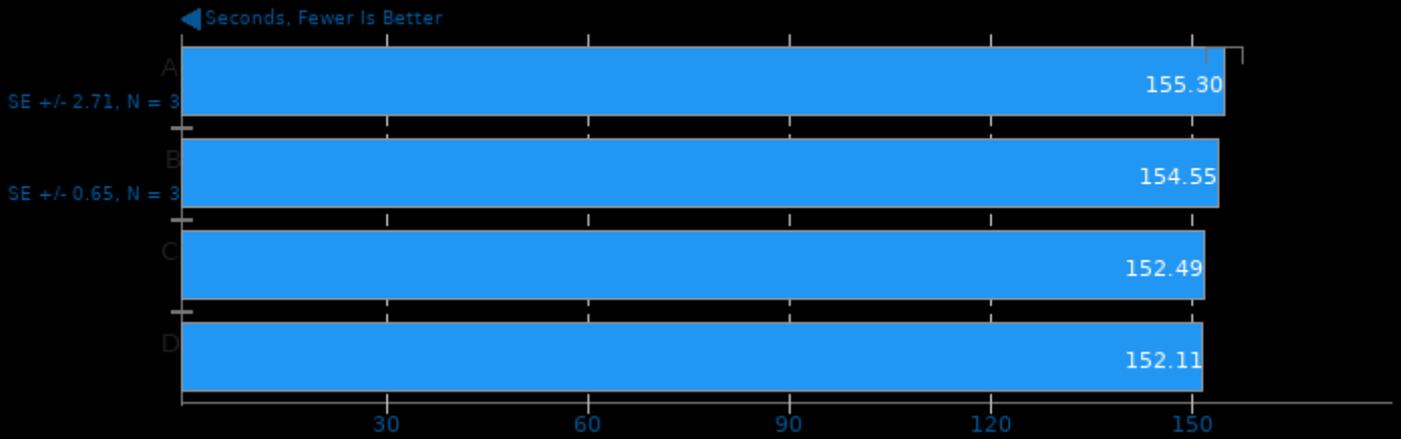
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Row Count: 10000000 - Partitions: 500 - SHA-512 Benchmark Time



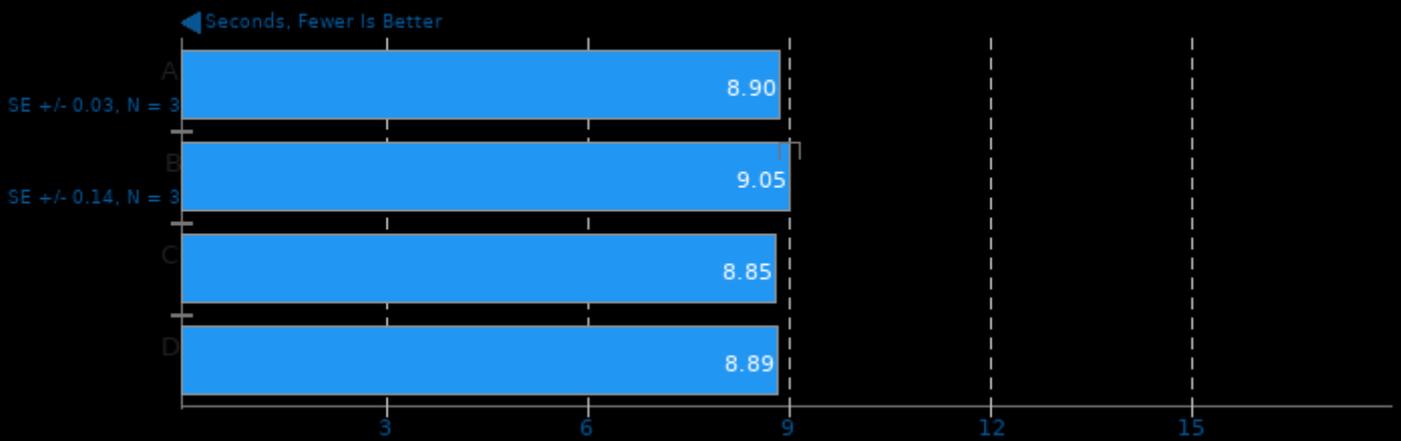
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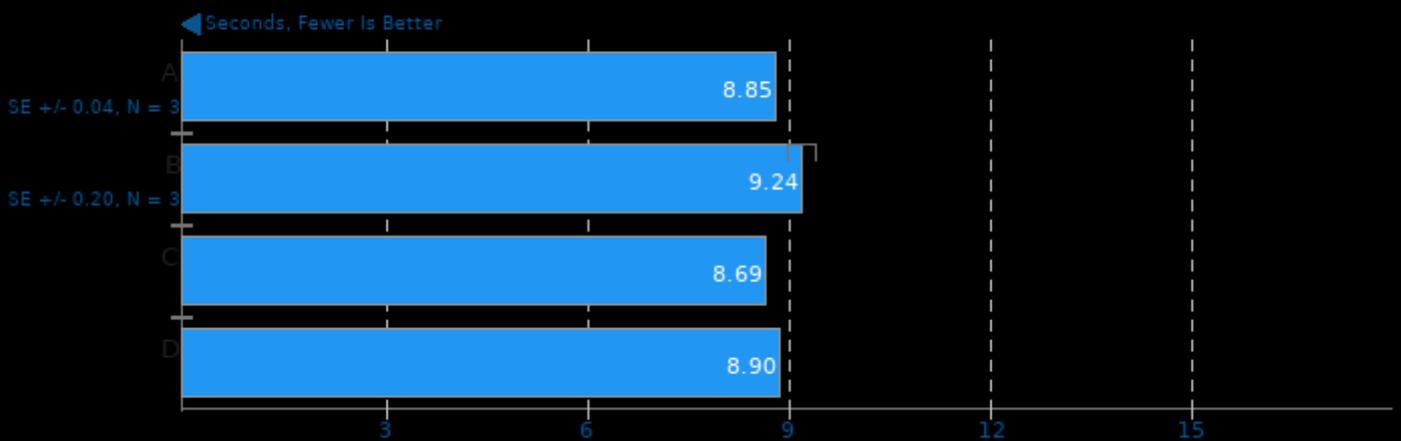
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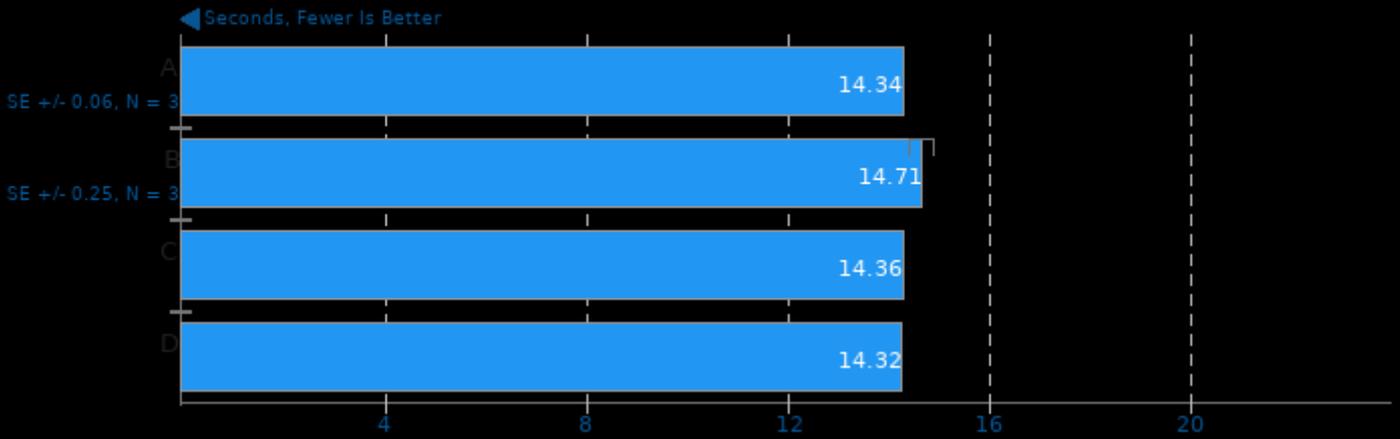
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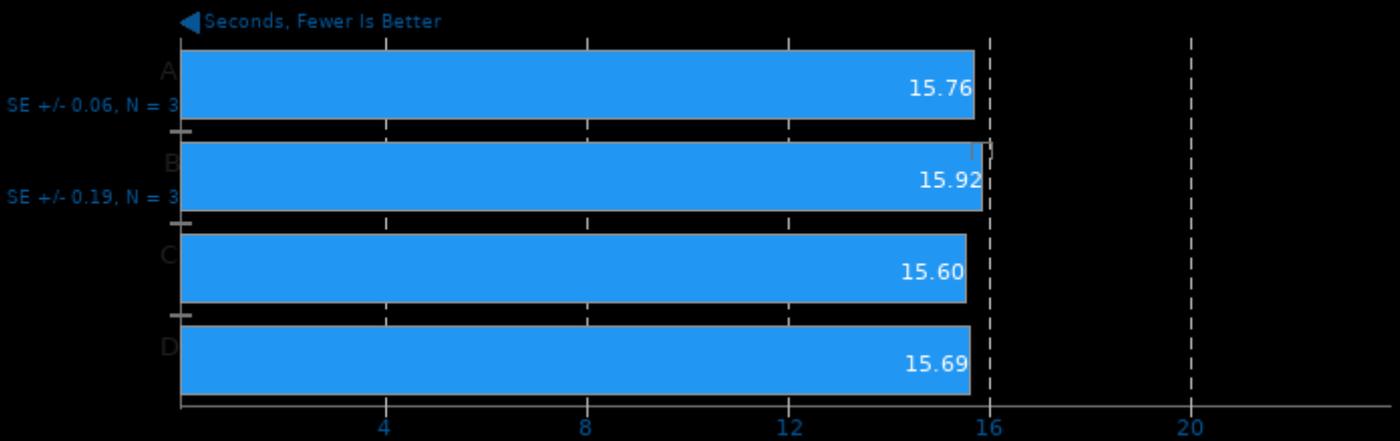
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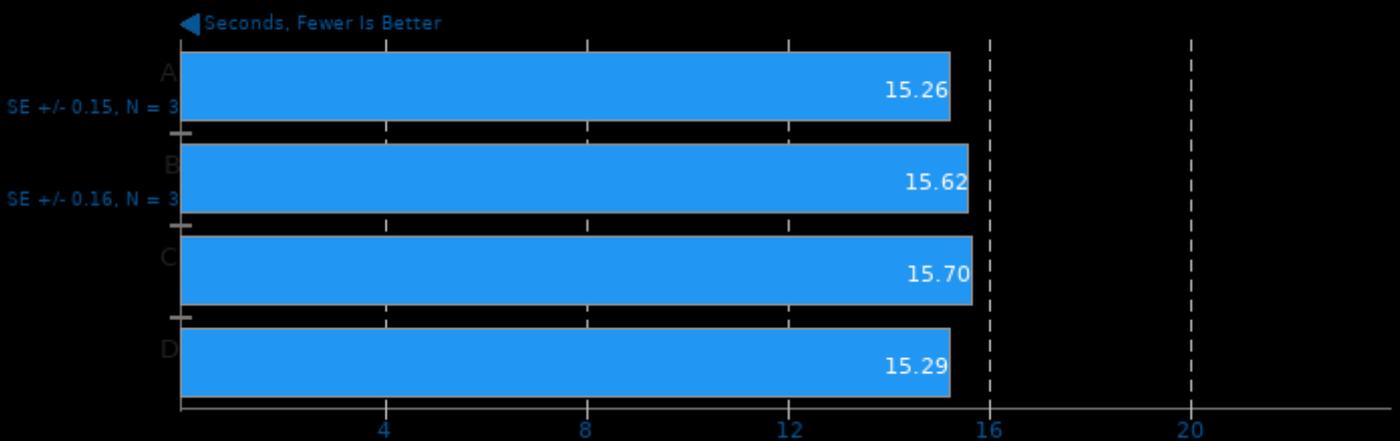
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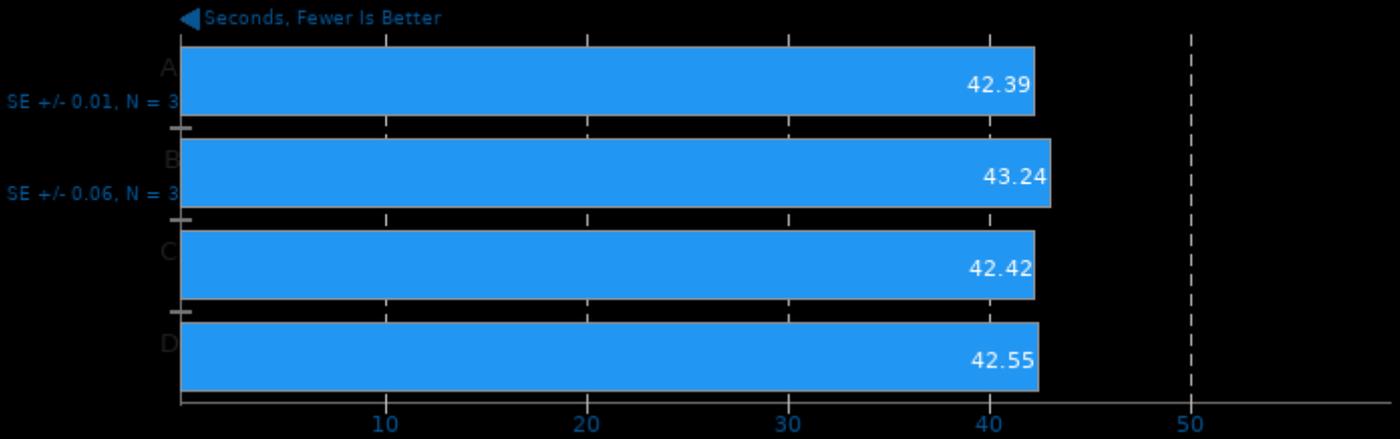
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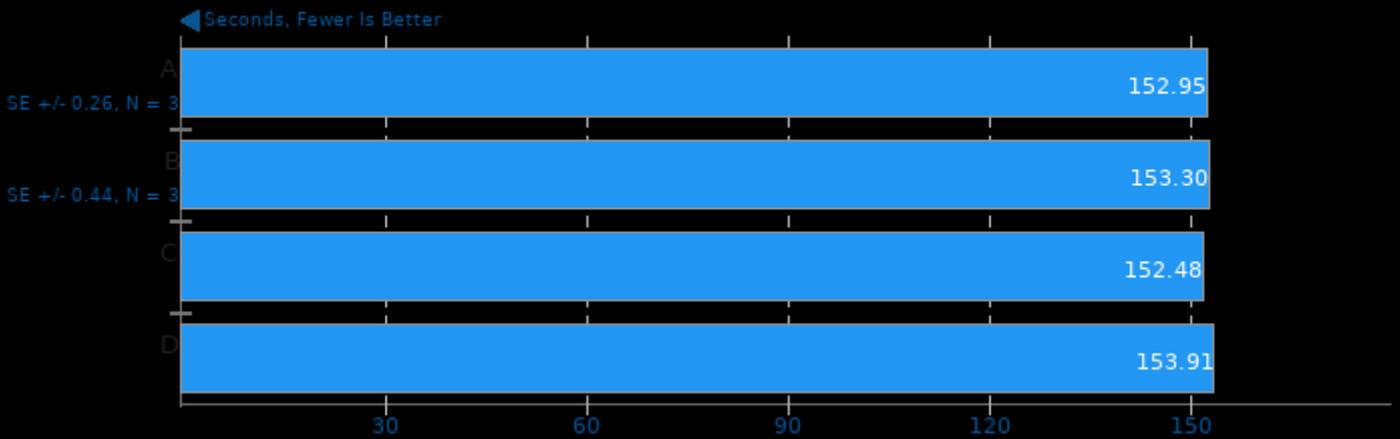
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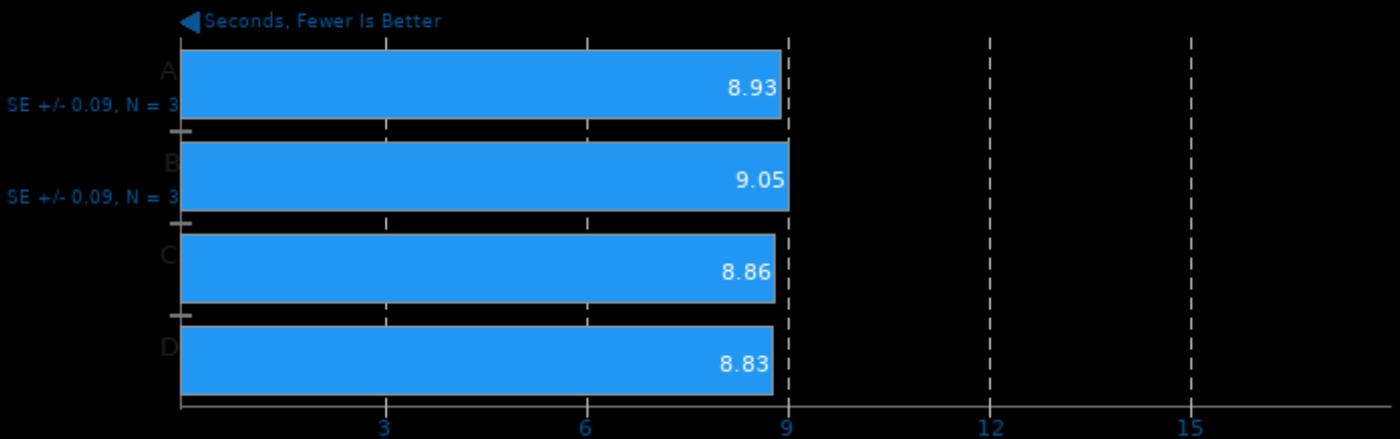
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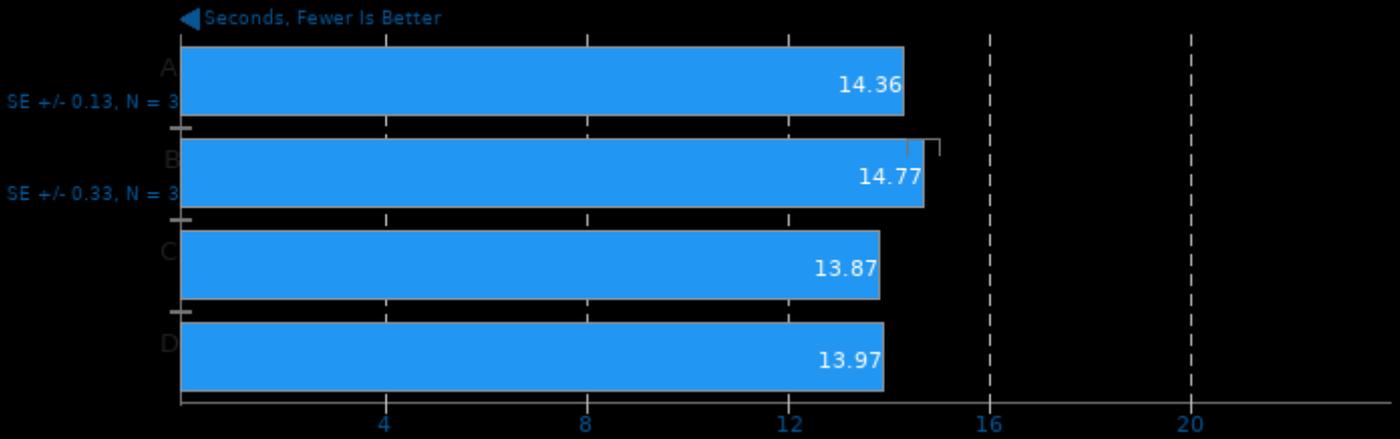
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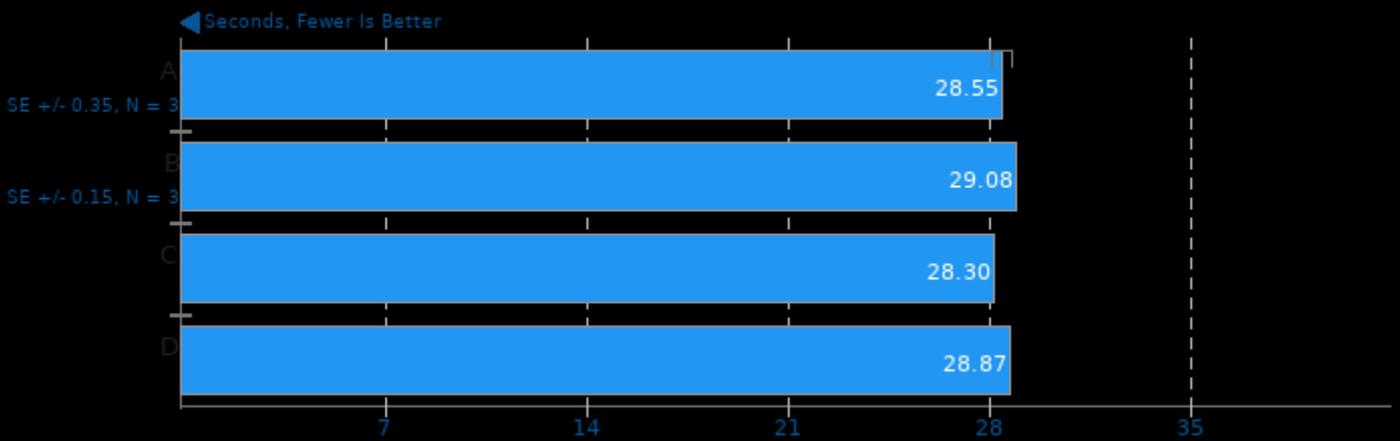
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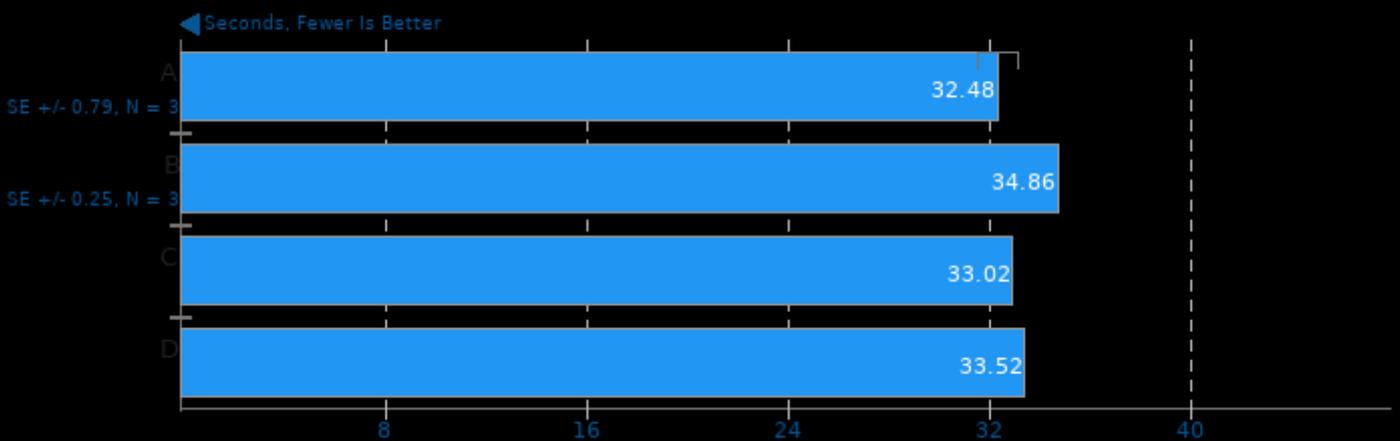
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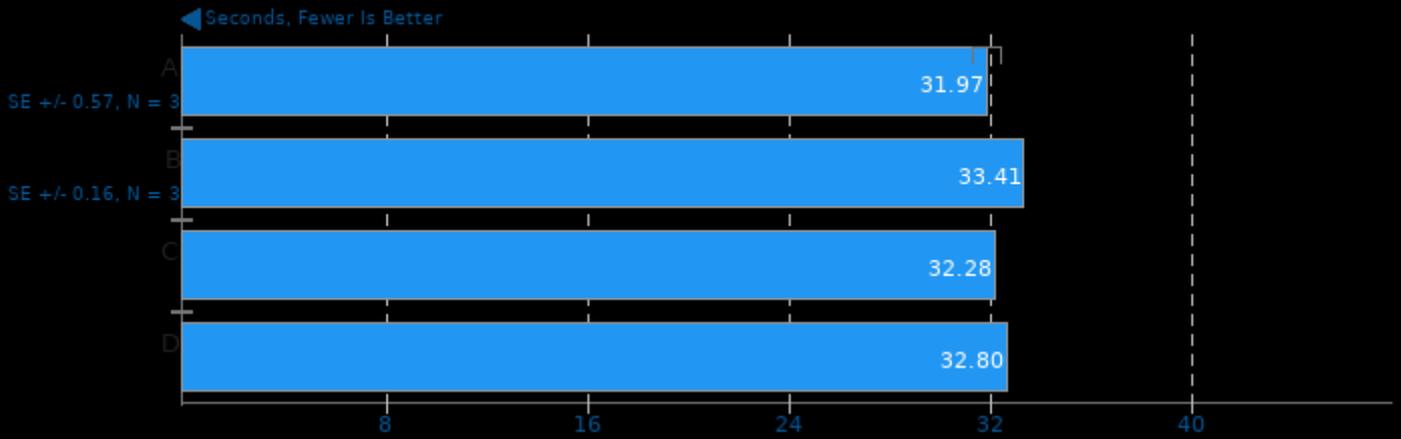
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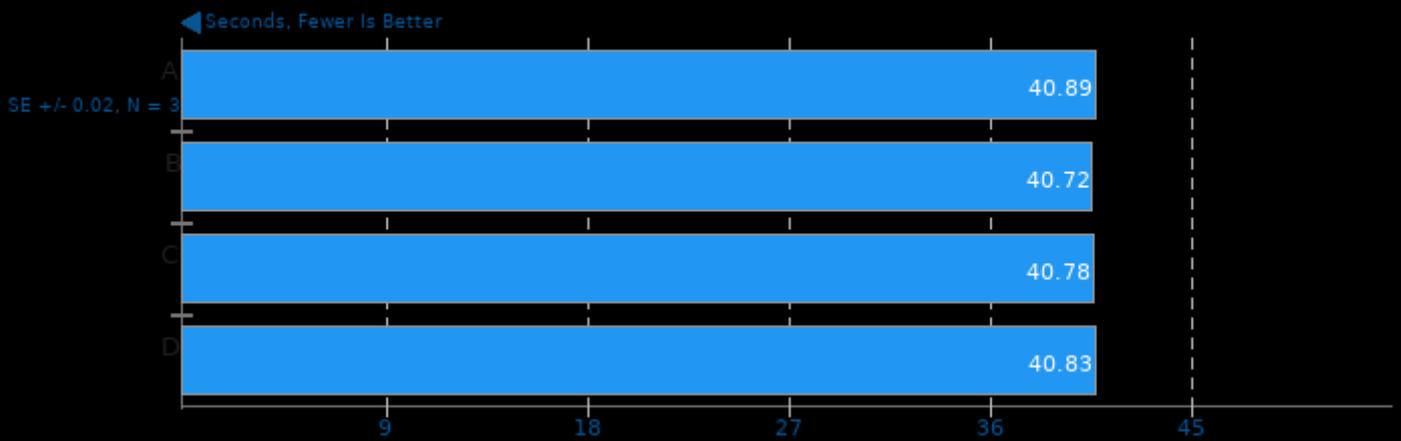
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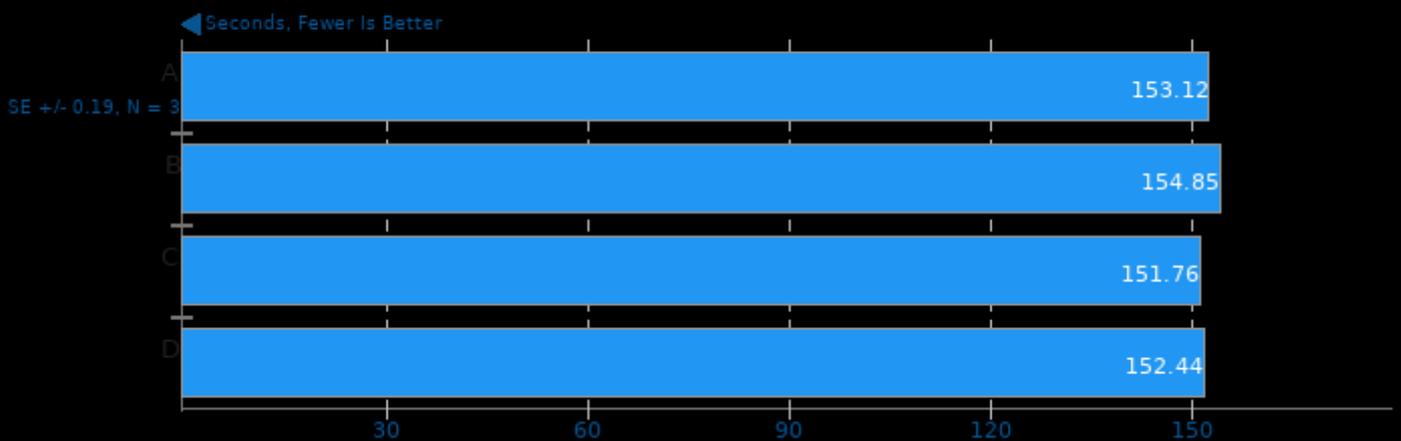
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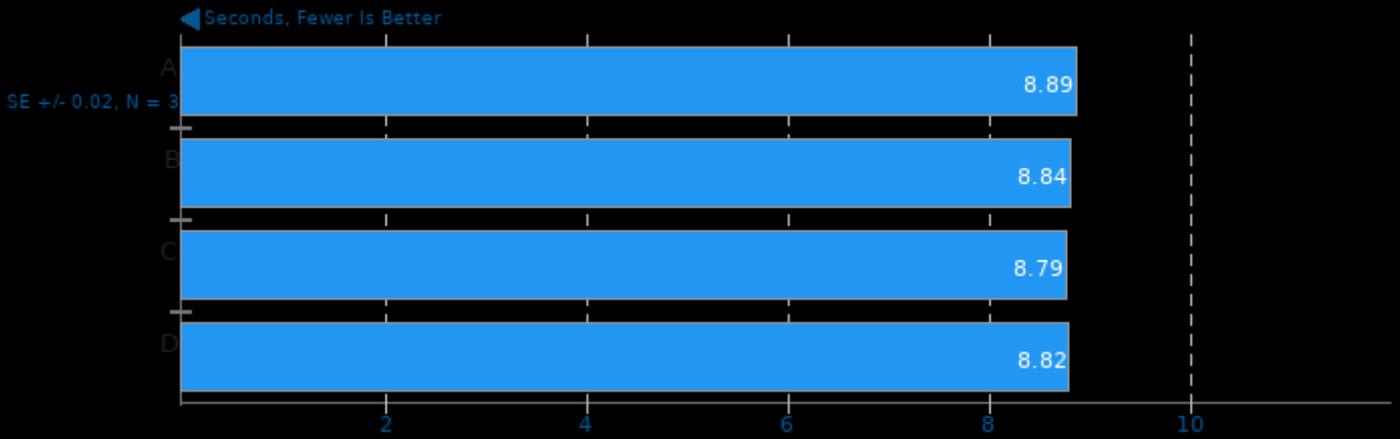
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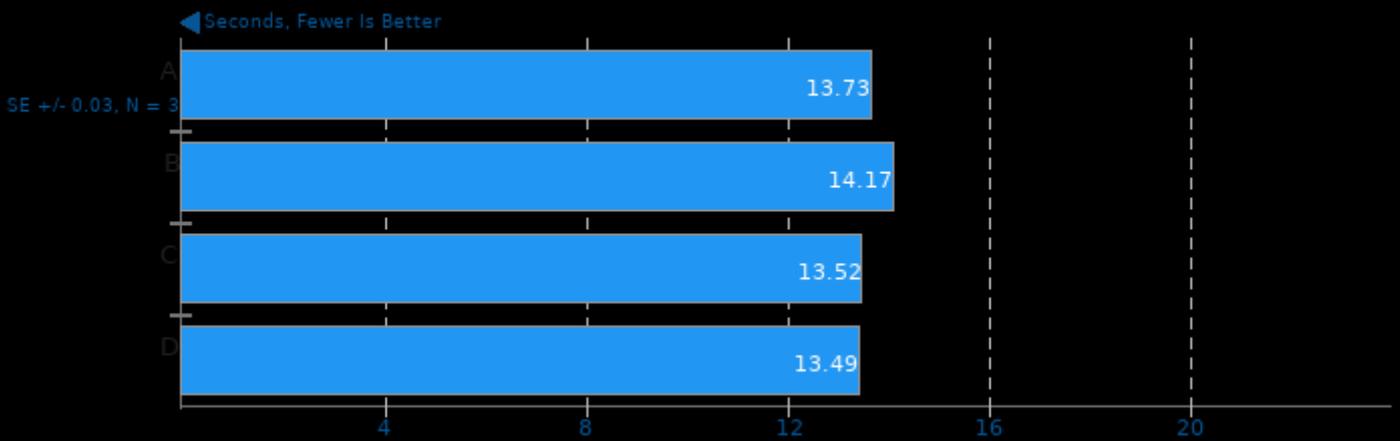
Apache Spark 3.3

Row Count: 20000000 - Partitions: 500 - Calculate Pi Benchmark Using Dataframe



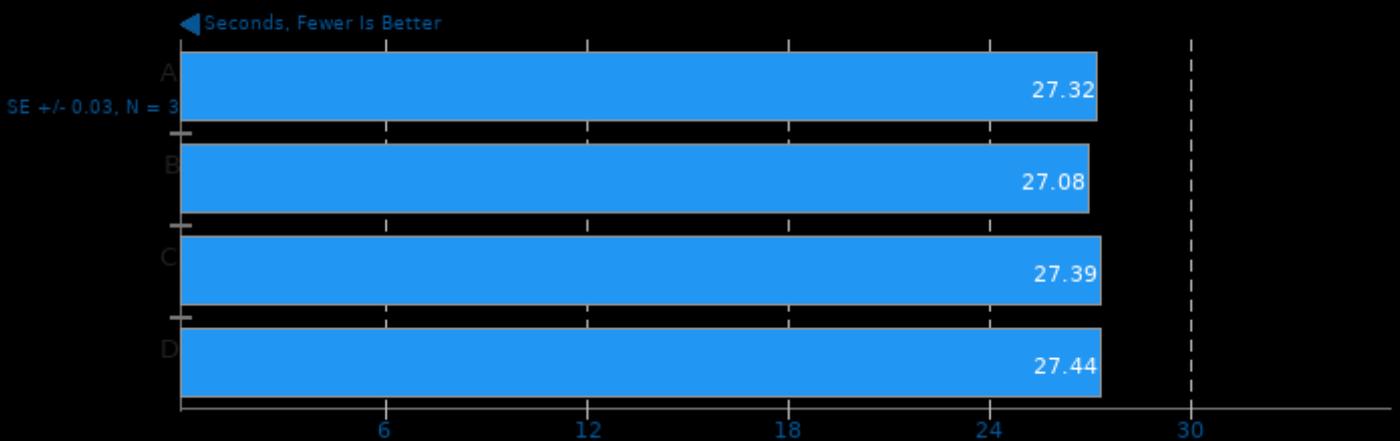
Apache Spark 3.3

Row Count: 20000000 - Partitions: 500 - Group By Test Time



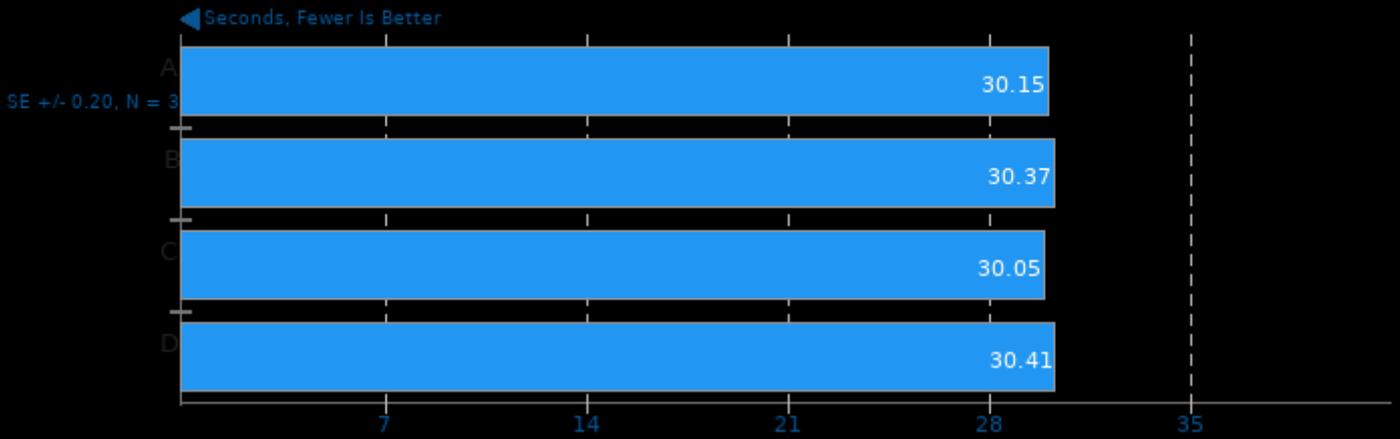
Apache Spark 3.3

Row Count: 20000000 - Partitions: 500 - Repartition Test Time



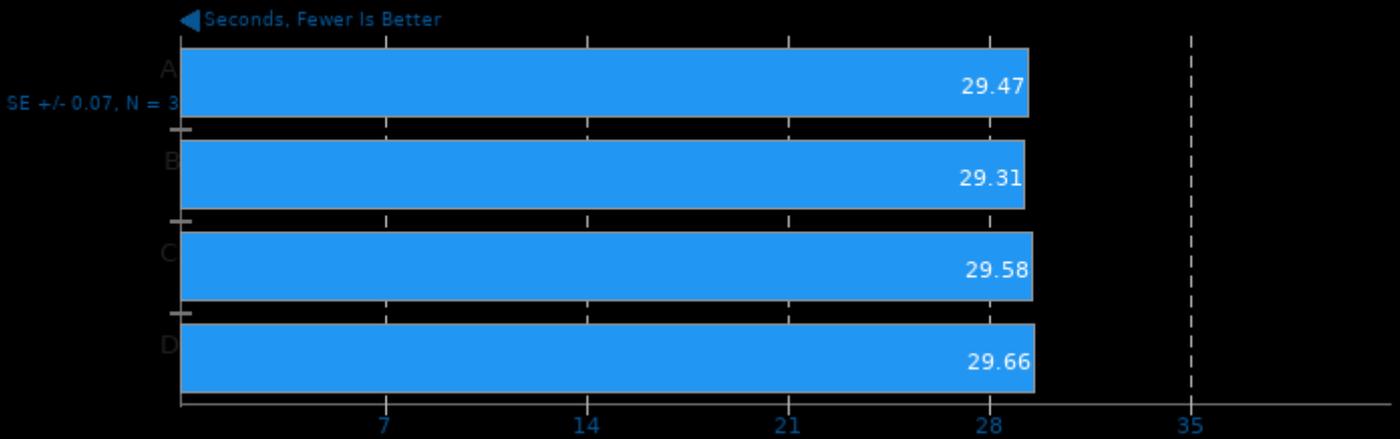
Apache Spark 3.3

Row Count: 20000000 - Partitions: 500 - Inner Join Test Time



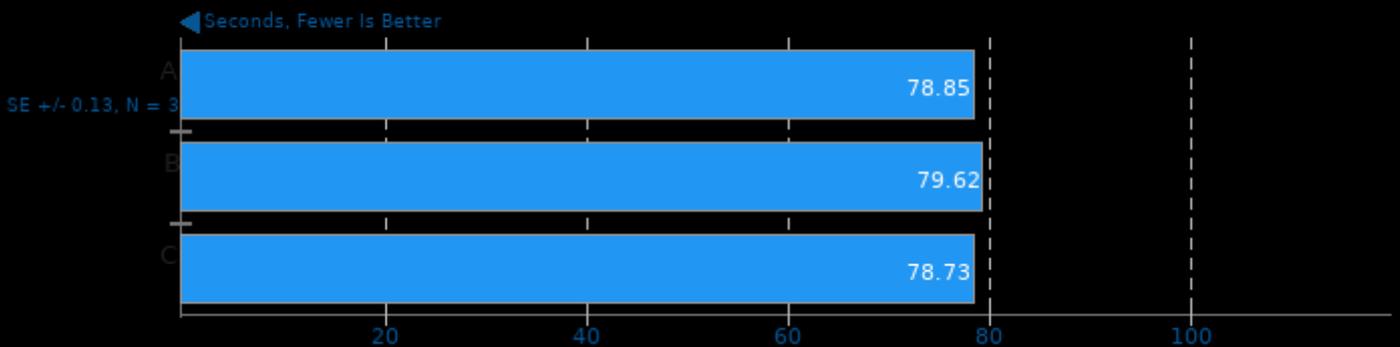
Apache Spark 3.3

Row Count: 20000000 - Partitions: 500 - Broadcast Inner Join Test Time



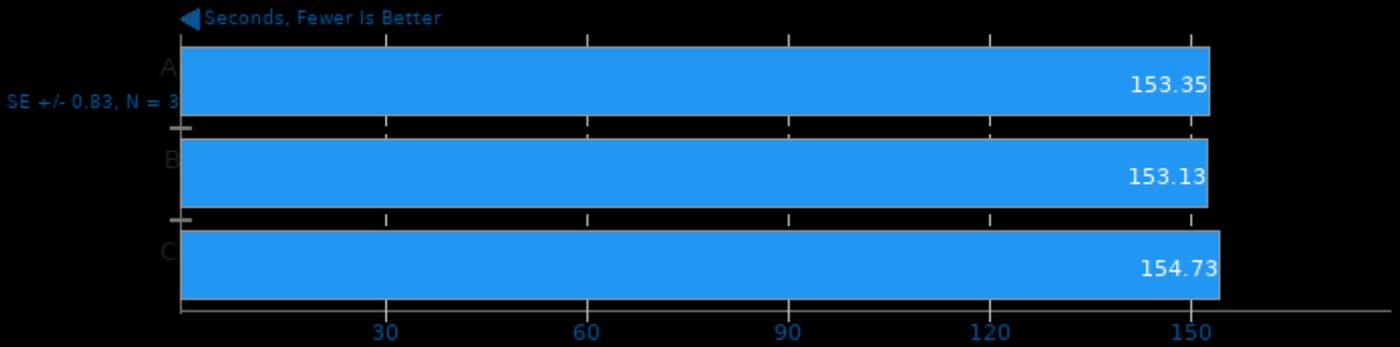
Apache Spark 3.3

Row Count: 40000000 - Partitions: 100 - SHA-512 Benchmark Time



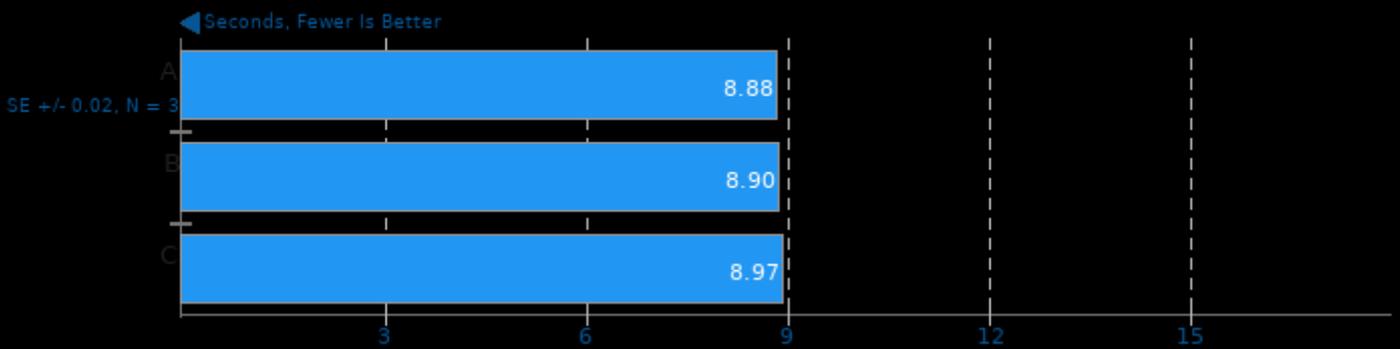
Apache Spark 3.3

Row Count: 40000000 - Partitions: 100 - Calculate Pi Benchmark



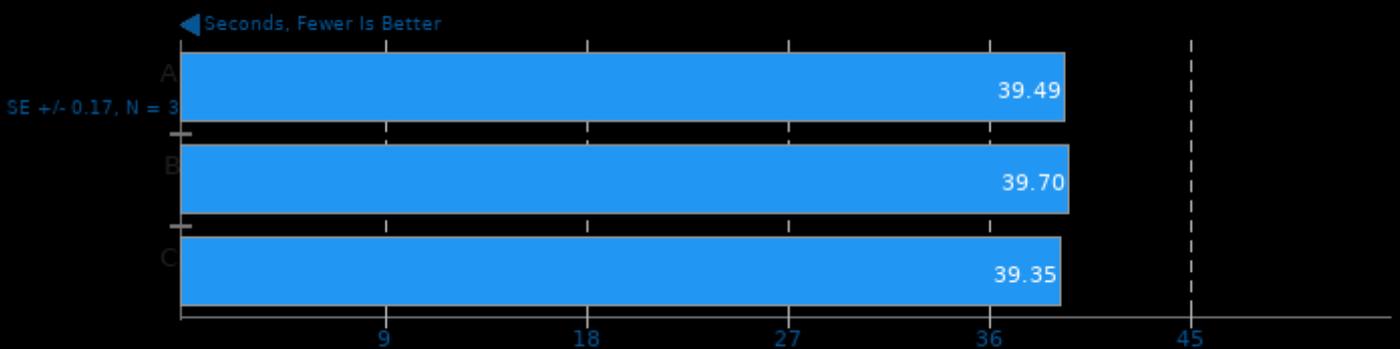
Apache Spark 3.3

Row Count: 40000000 - Partitions: 100 - Calculate Pi Benchmark Using Dataframe



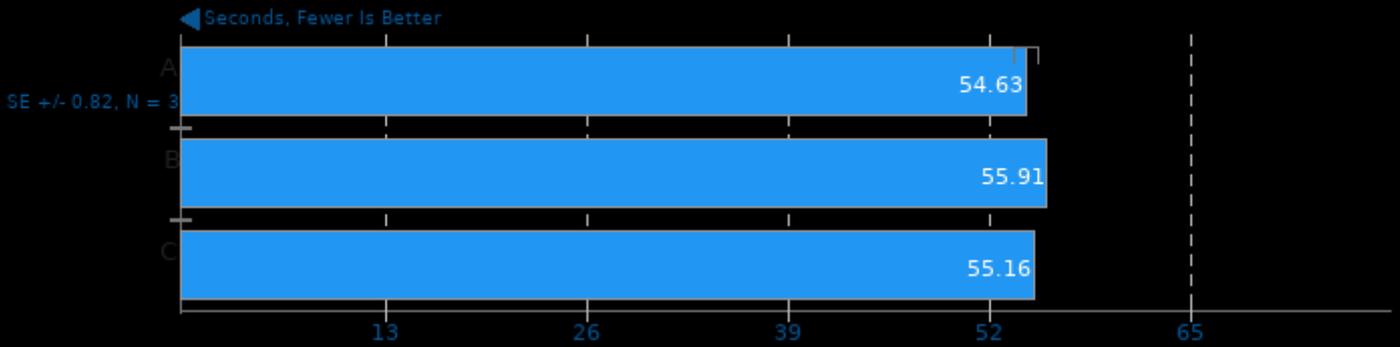
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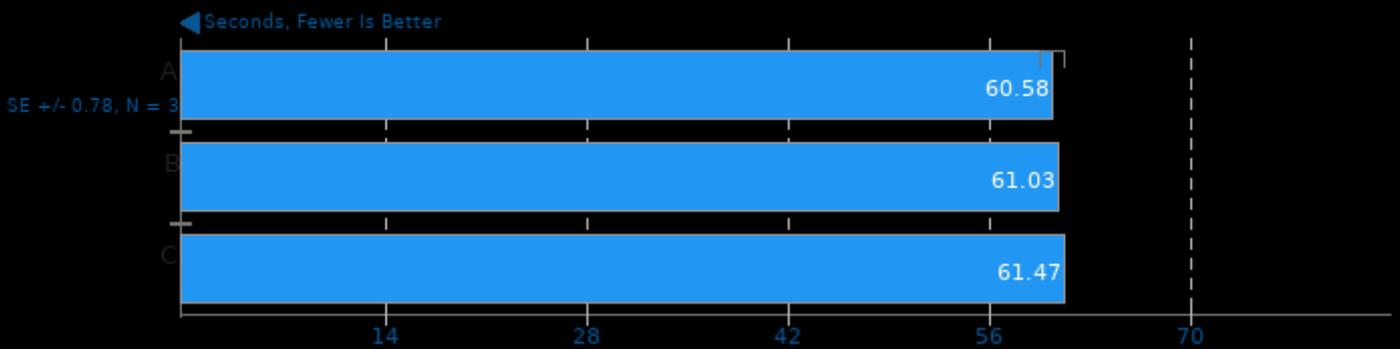
Apache Spark 3.3

Row Count: 40000000 - Partitions: 100 - Repartition Test Time



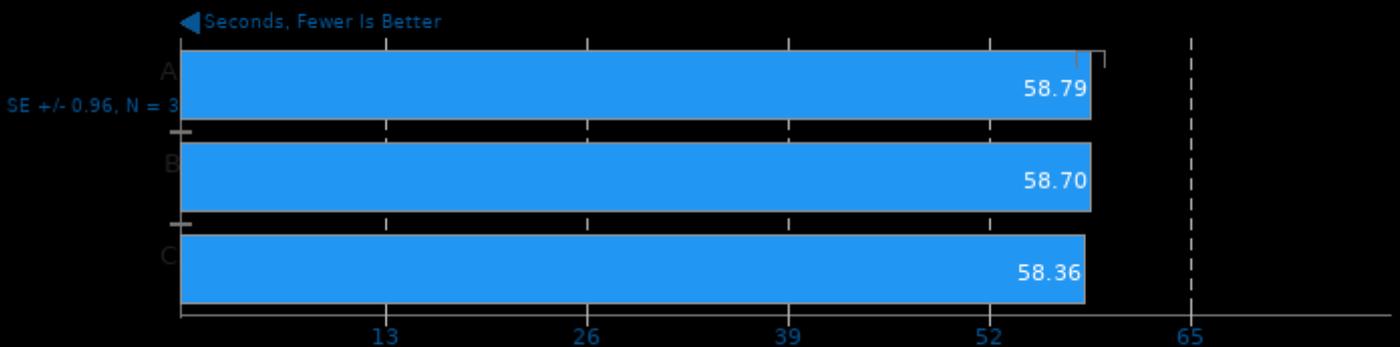
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Row Count: 40000000 - Partitions: 100 - Inner Join Test Time



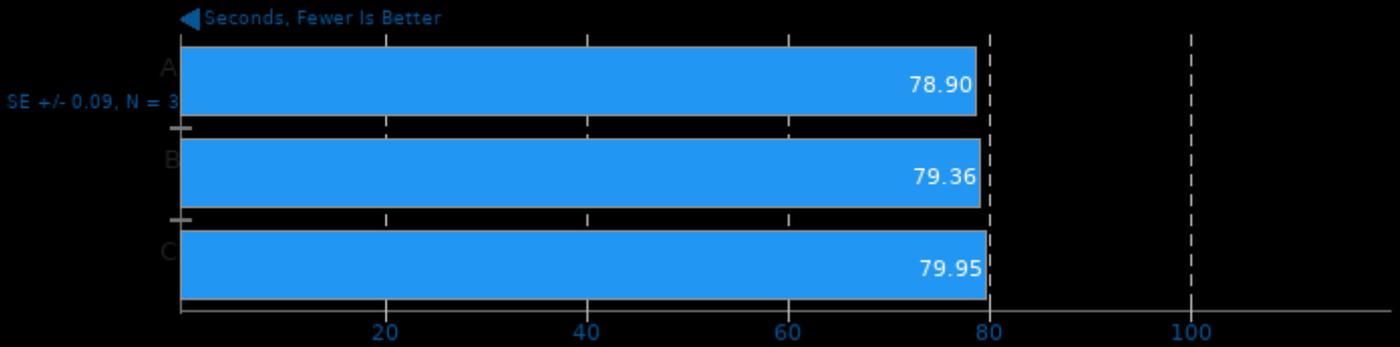
Apache Spark 3.3

Row Count: 40000000 - Partitions: 100 - Broadcast Inner Join Test Time



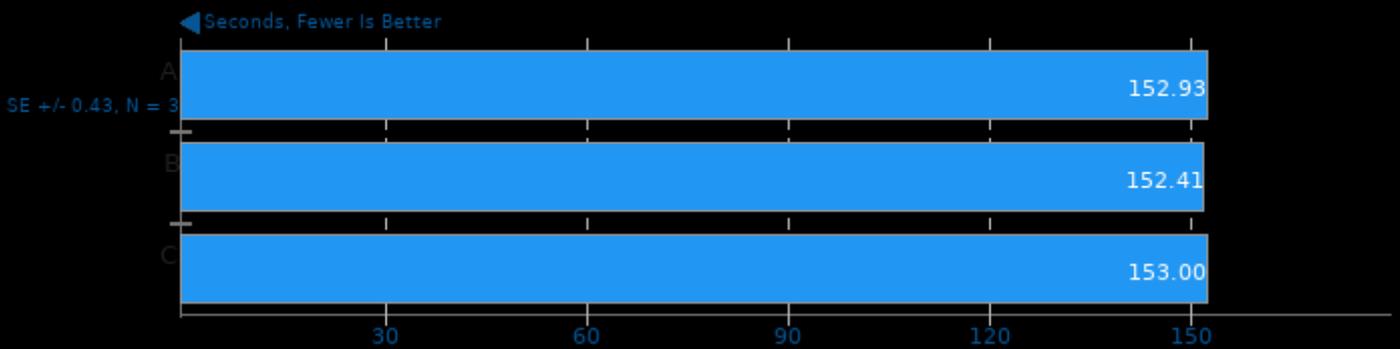
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Row Count: 40000000 - Partitions: 500 - SHA-512 Benchmark Time



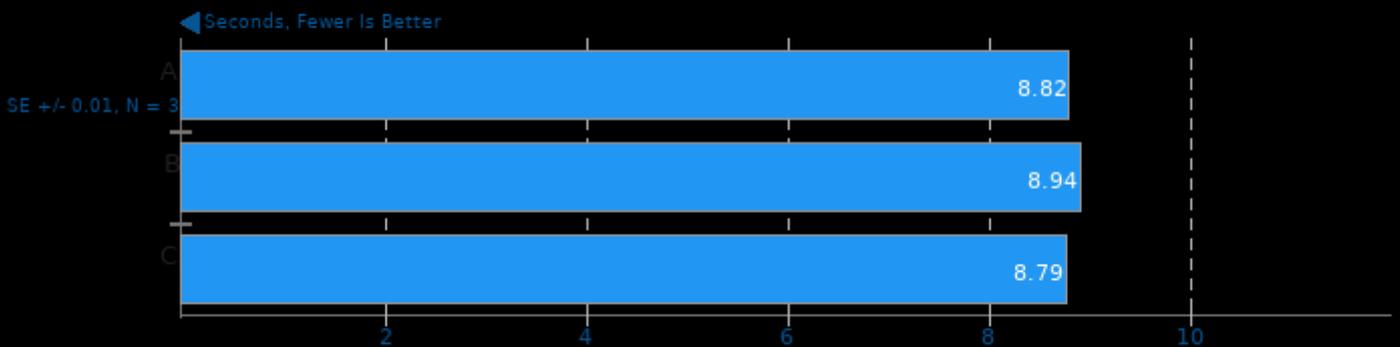
Apache Spark 3.3

Row Count: 40000000 - Partitions: 500 - Calculate Pi Benchmark



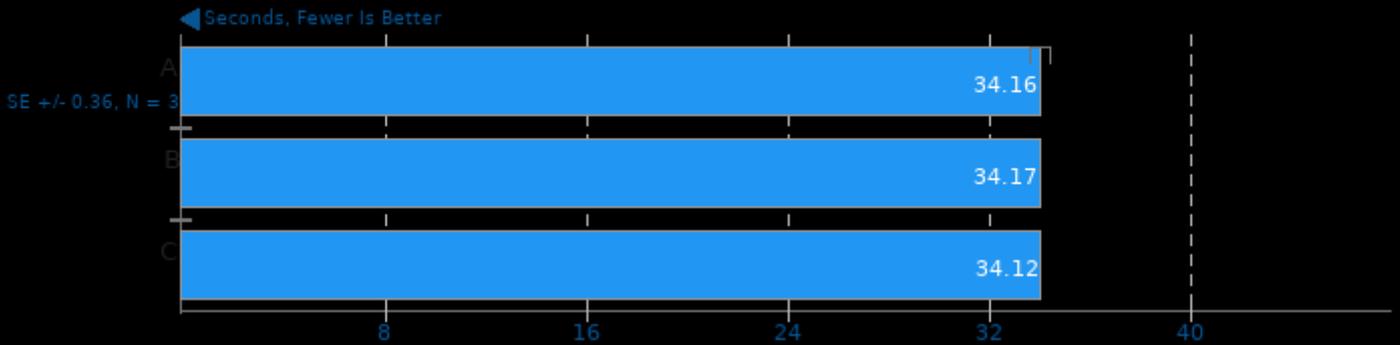
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Row Count: 40000000 - Partitions: 500 - Calculate Pi Benchmark Using Dataframe



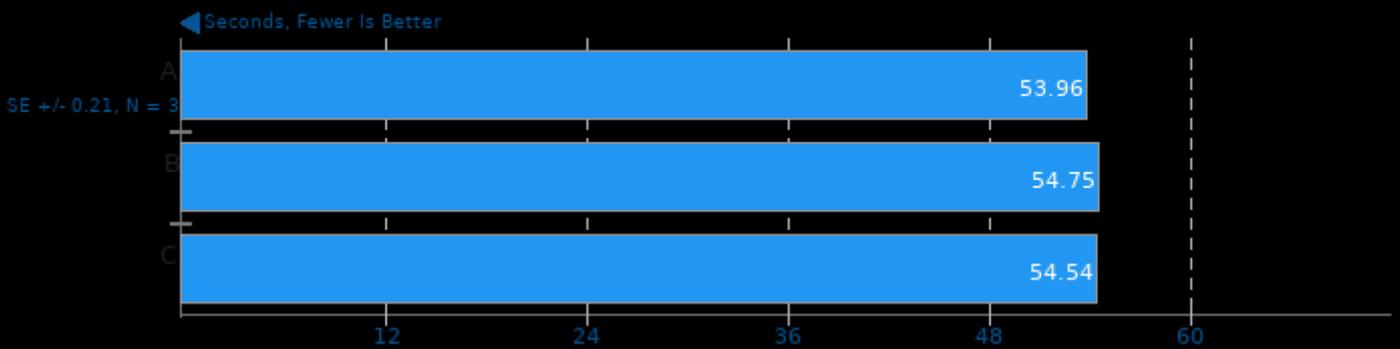
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Row Count: 40000000 - Partitions: 500 - Group By Test Time



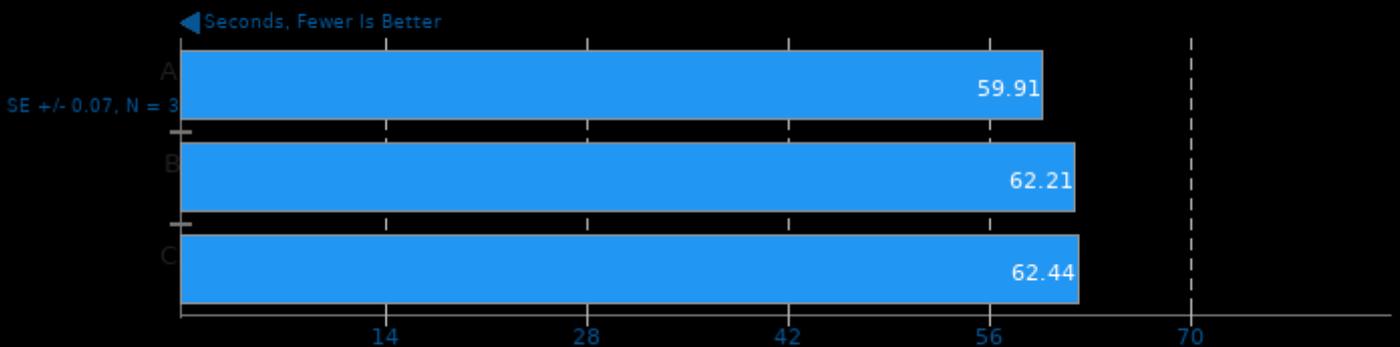
Apache Spark 3.3

Row Count: 40000000 - Partitions: 500 - Repartition Test Time



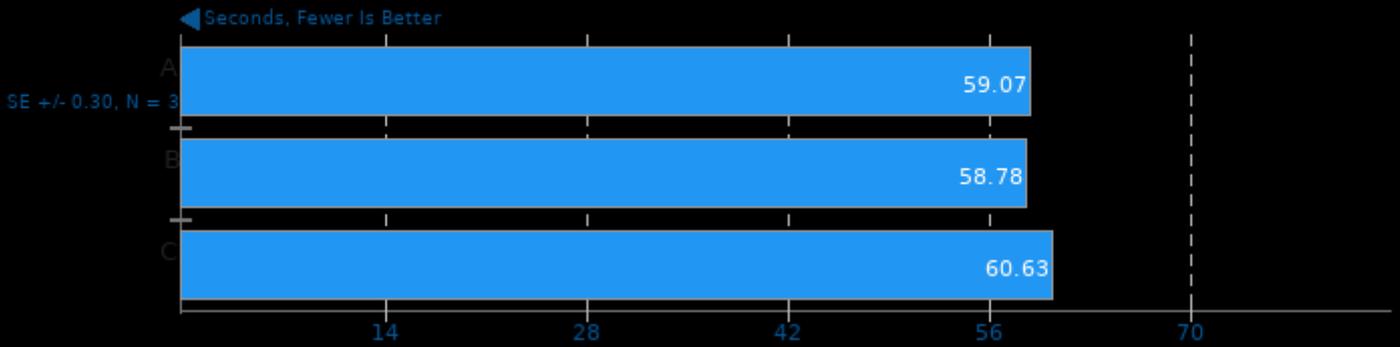
Apache Spark 3.3

Row Count: 40000000 - Partitions: 500 - Inner Join Test Time



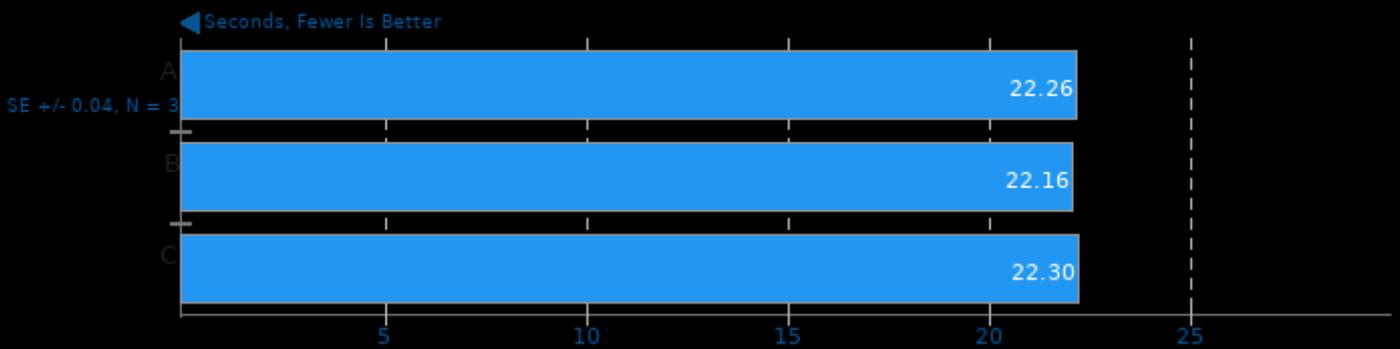
Apache Spark 3.3

Row Count: 40000000 - Partitions: 500 - Broadcast Inner Join Test Time



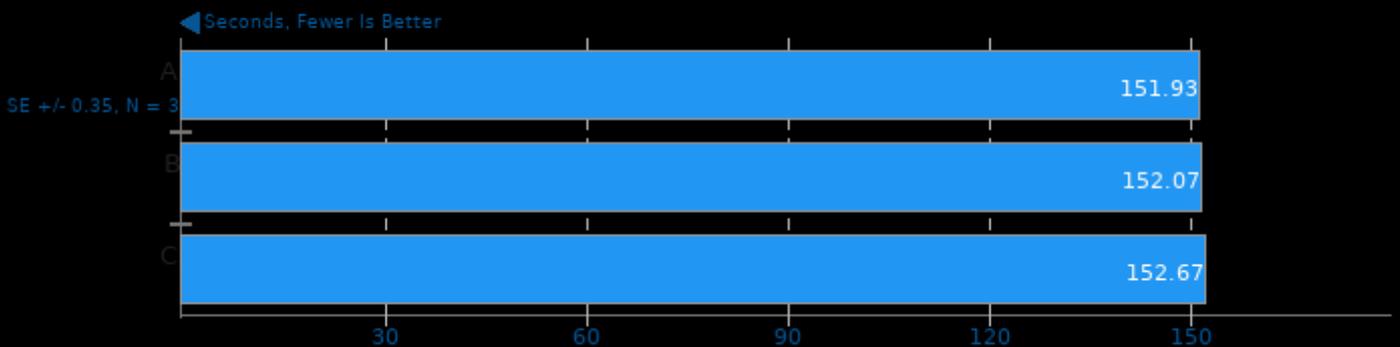
Apache Spark 3.3

Row Count: 100000000 - Partitions: 1000 - SHA-512 Benchmark Time



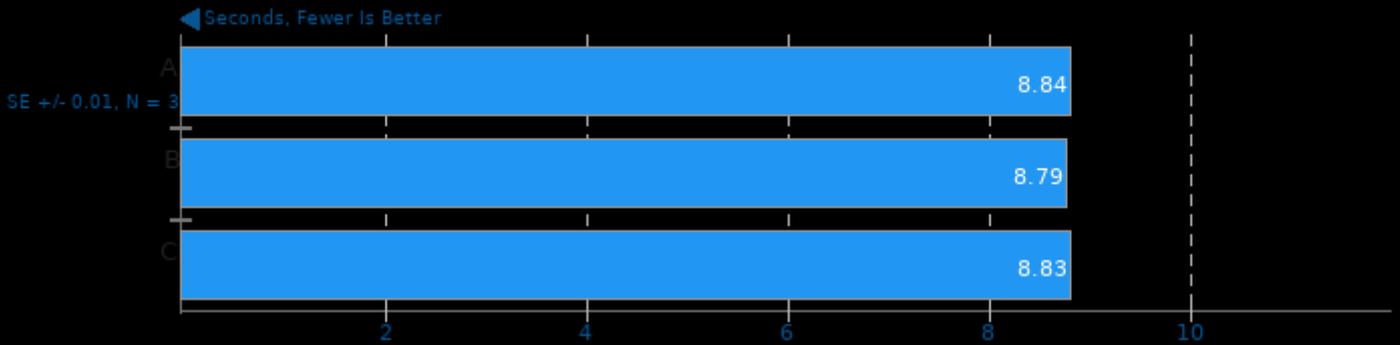
Apache Spark 3.3

Row Count: 100000000 - Partitions: 1000 - Calculate Pi Benchmark



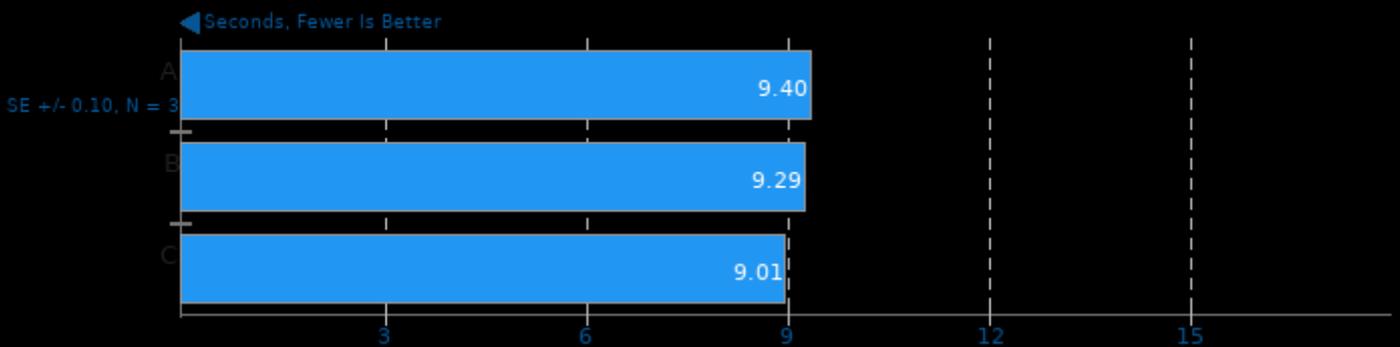
Apache Spark 3.3

Row Count: 10000000 - Partitions: 1000 - Calculate Pi Benchmark Using Dataframe



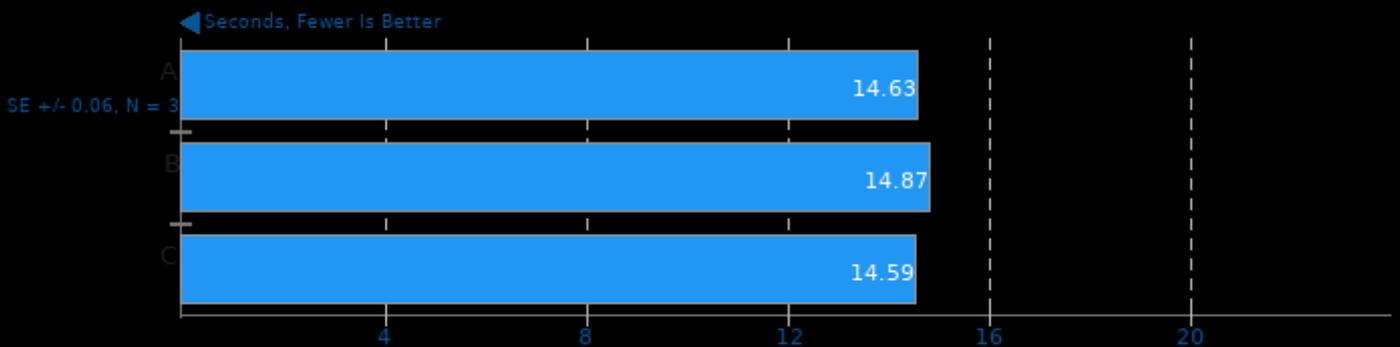
Apache Spark 3.3

Row Count: 10000000 - Partitions: 1000 - Group By Test Time



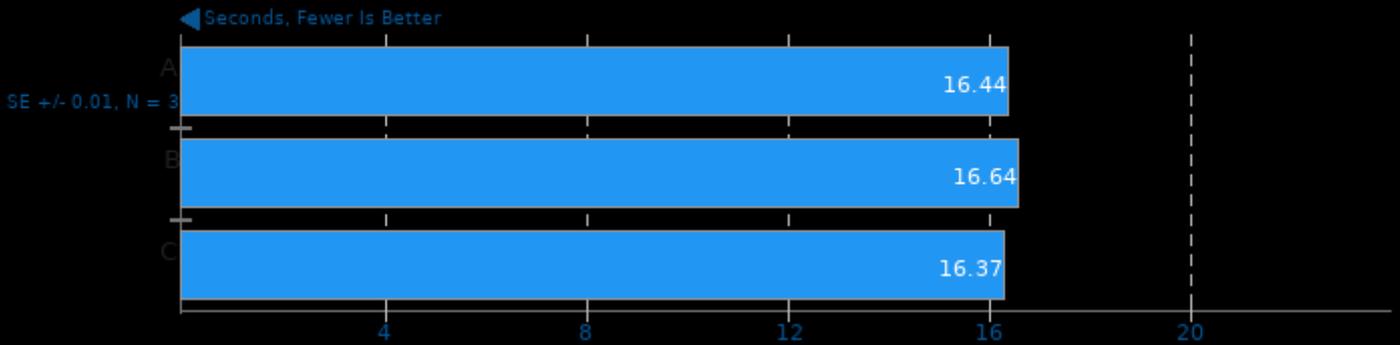
Apache Spark 3.3

Row Count: 10000000 - Partitions: 1000 - Repartition Test Time



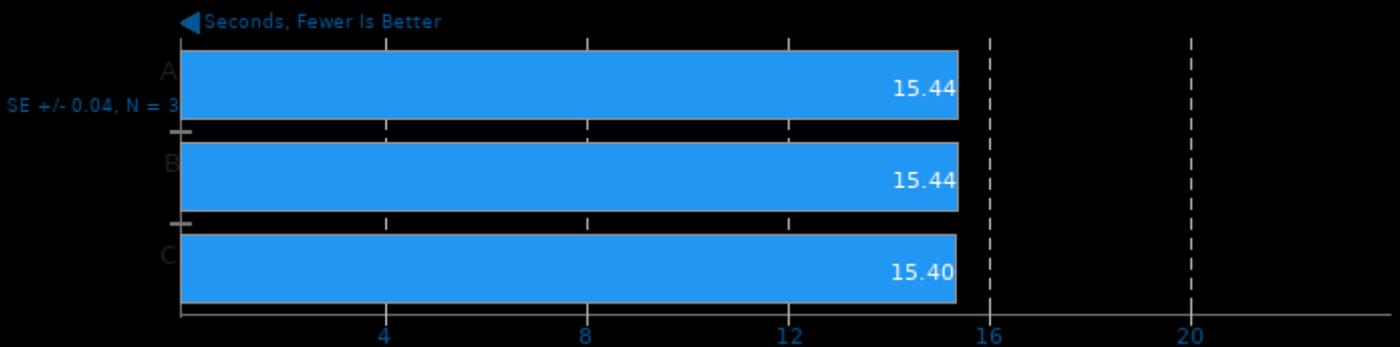
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Row Count: 10000000 - Partitions: 1000 - Inner Join Test Time



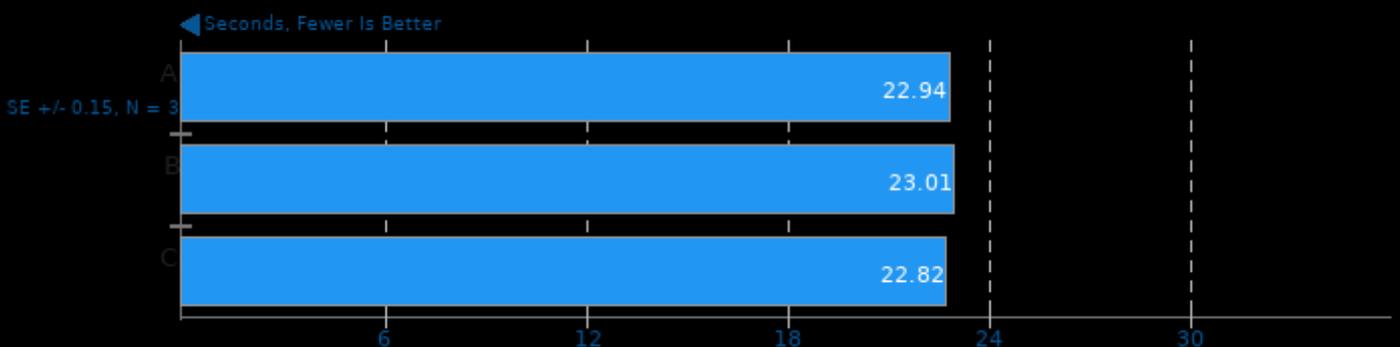
Apache Spark 3.3

Row Count: 10000000 - Partitions: 1000 - Broadcast Inner Join Test Time



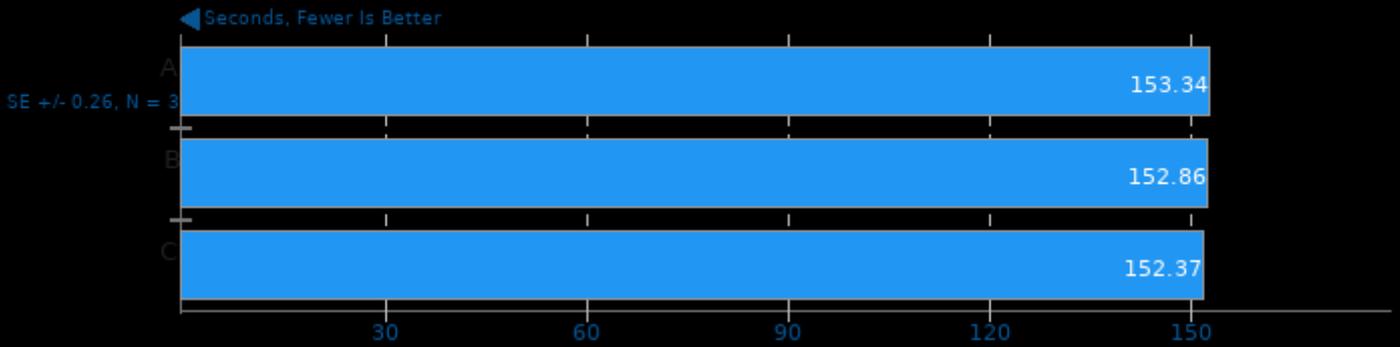
Apache Spark 3.3

Row Count: 10000000 - Partitions: 2000 - SHA-512 Benchmark Time



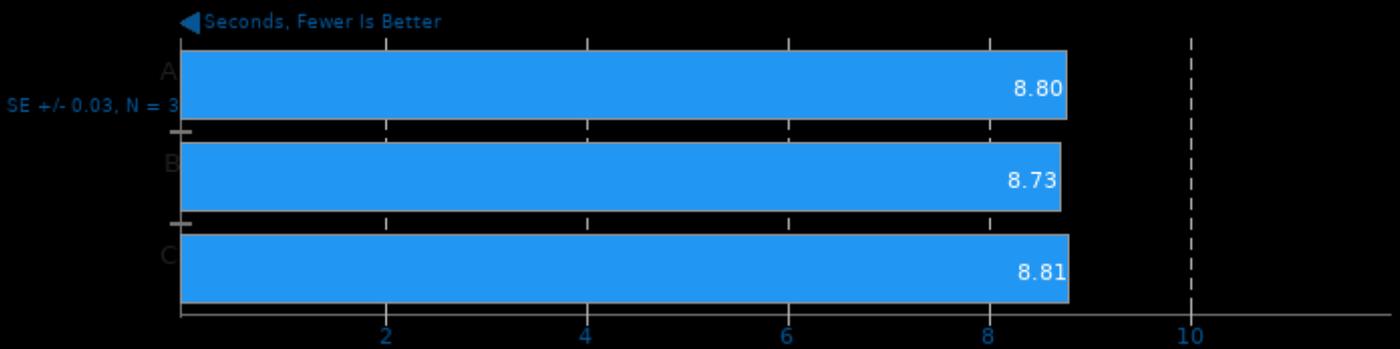
Apache Spark 3.3

Row Count: 10000000 - Partitions: 2000 - Calculate Pi Benchmark



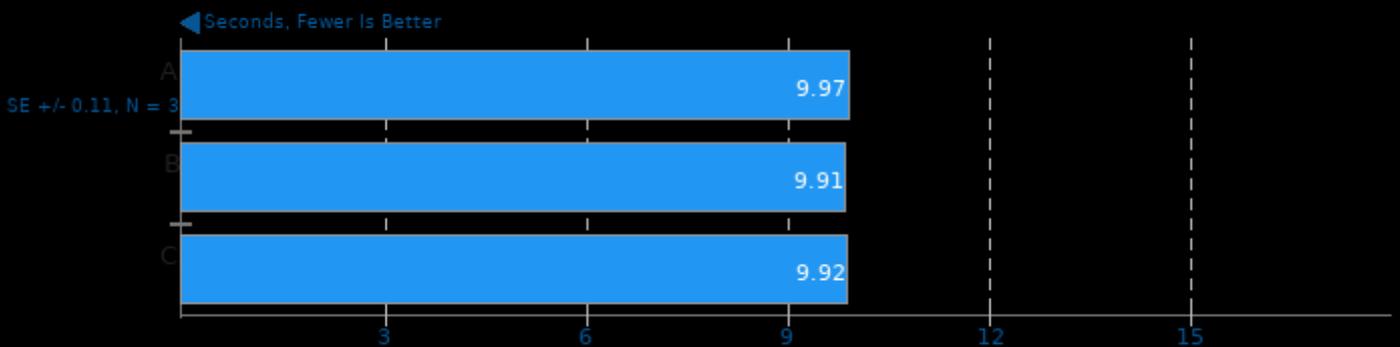
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Row Count: 10000000 - Partitions: 2000 - Calculate Pi Benchmark Using Dataframe



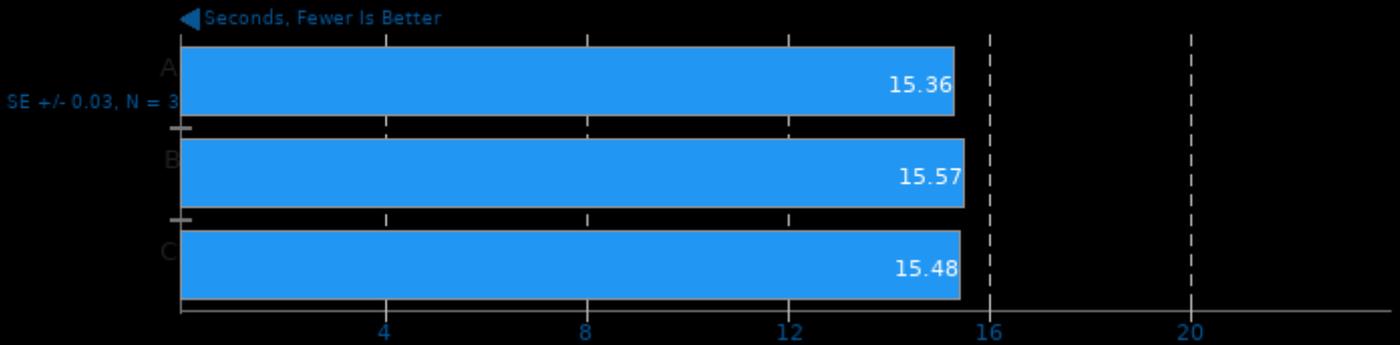
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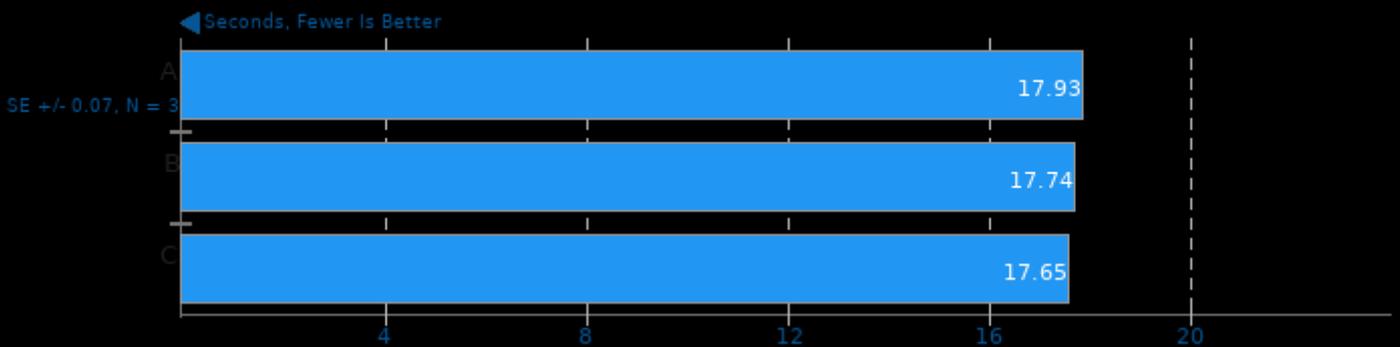
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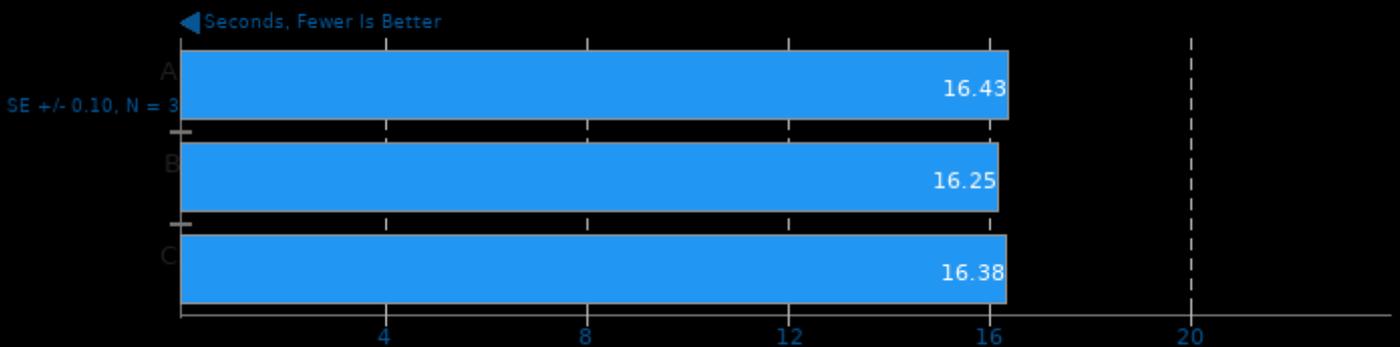
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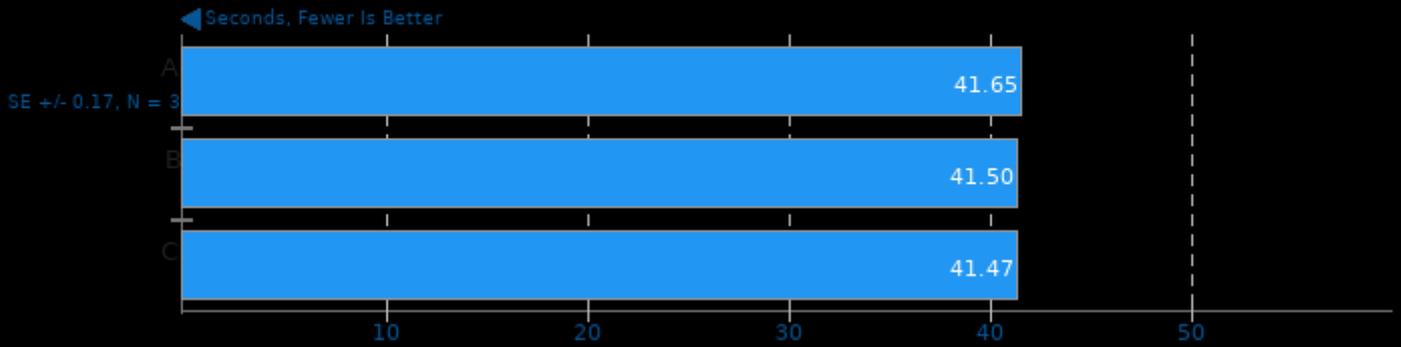
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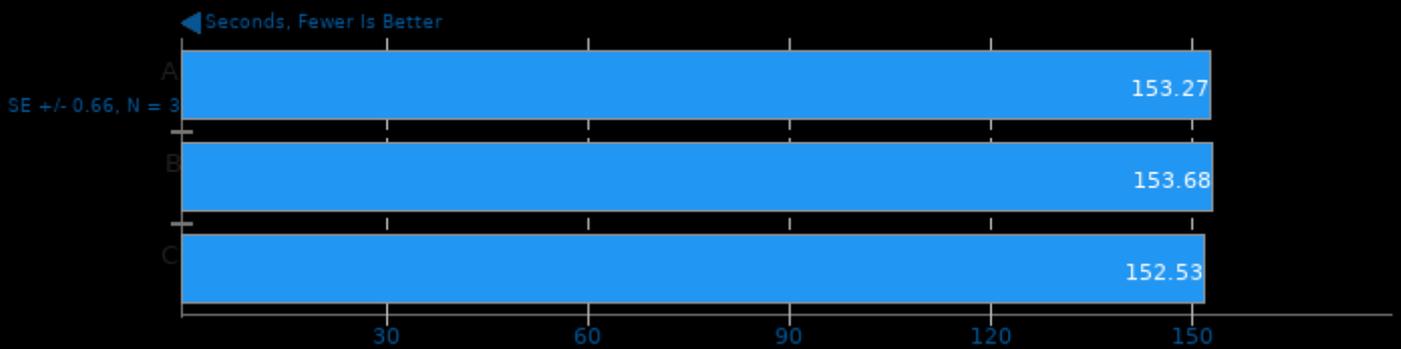
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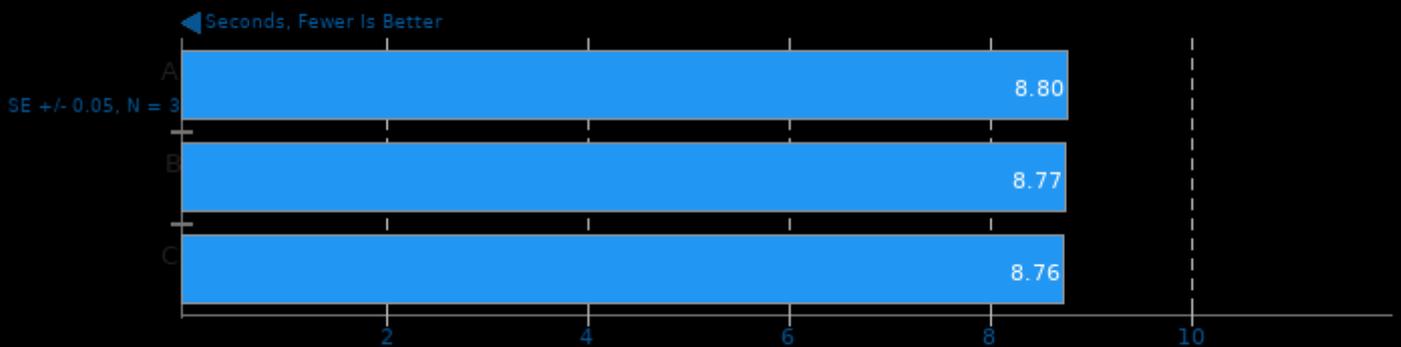
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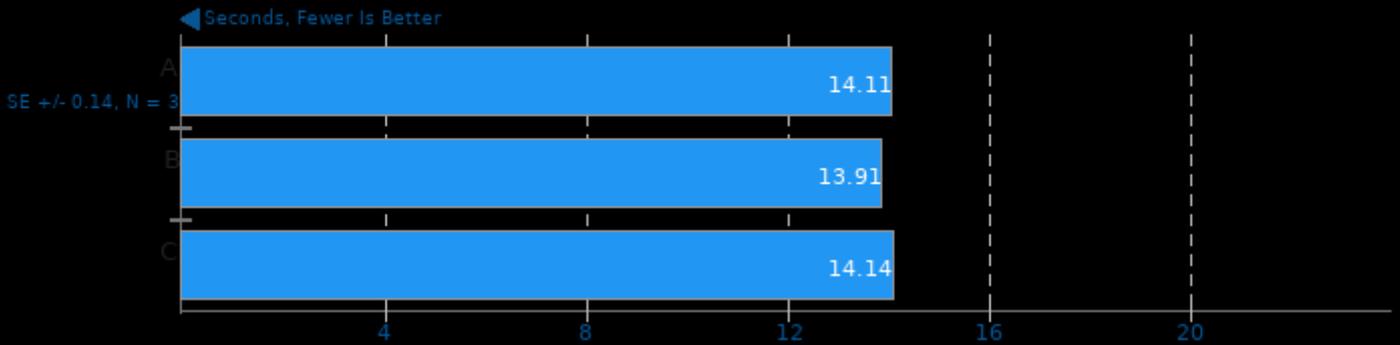
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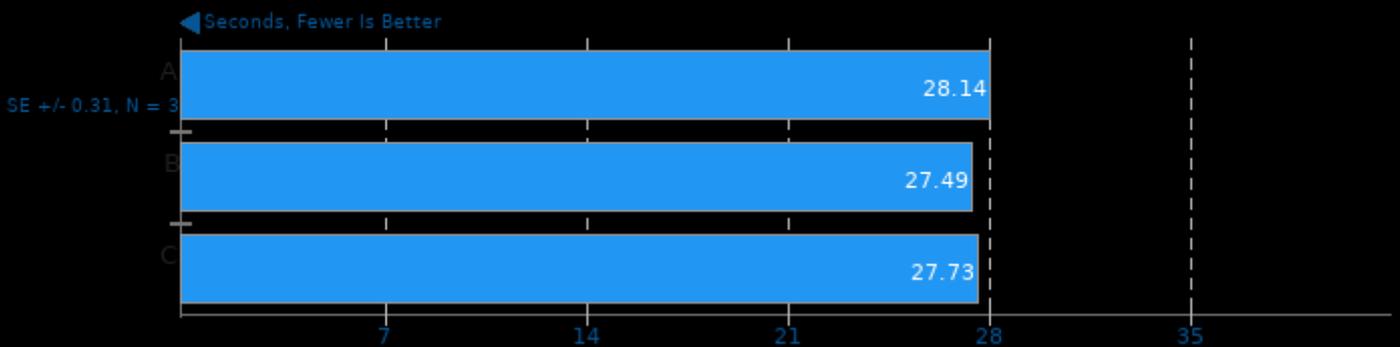
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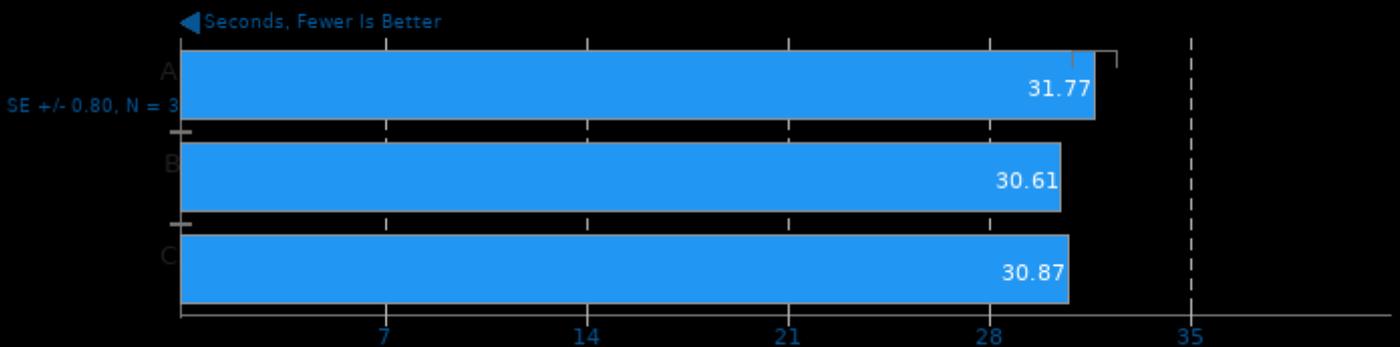
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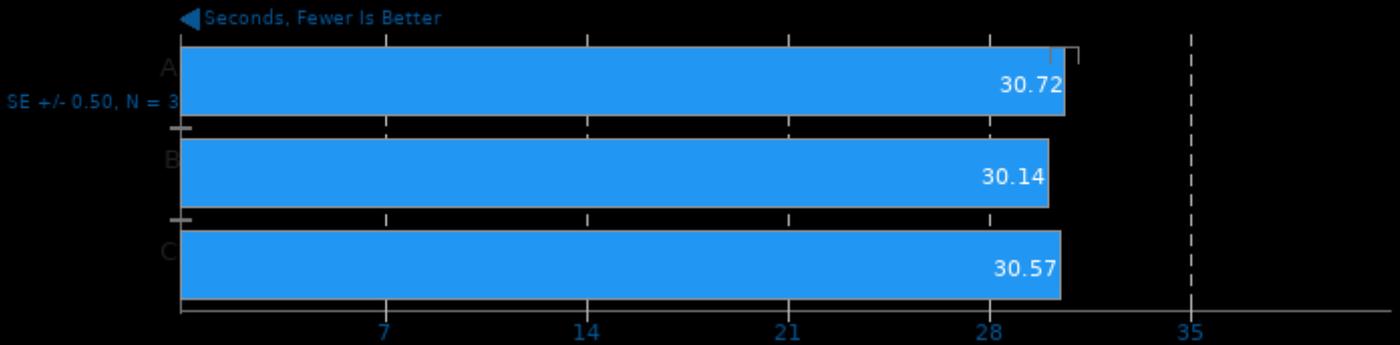
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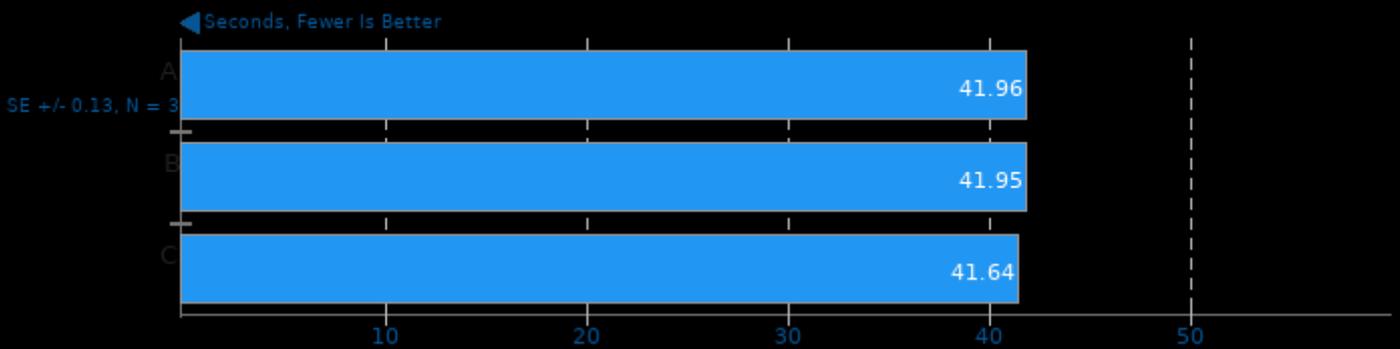
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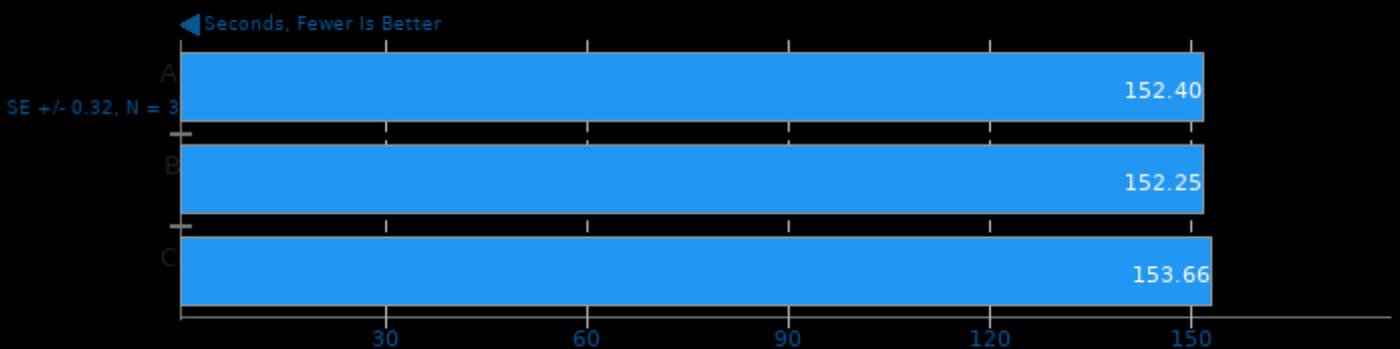
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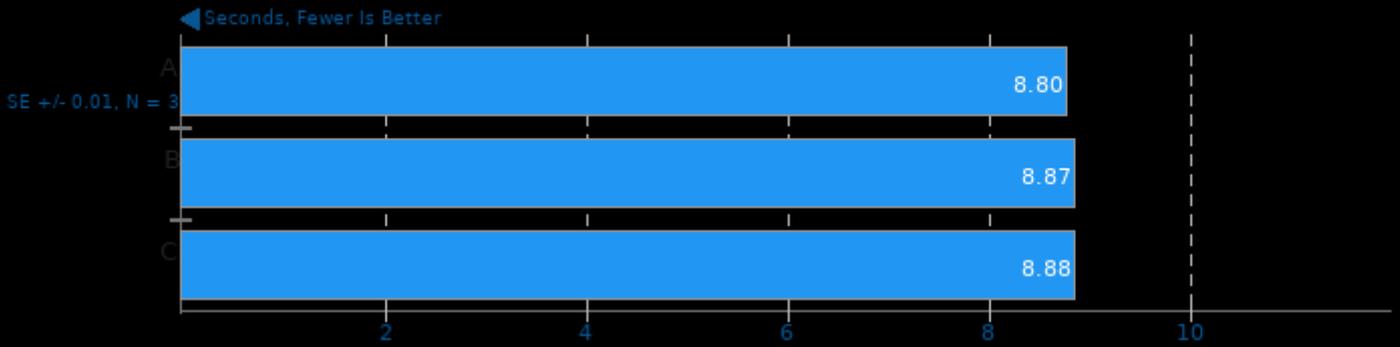
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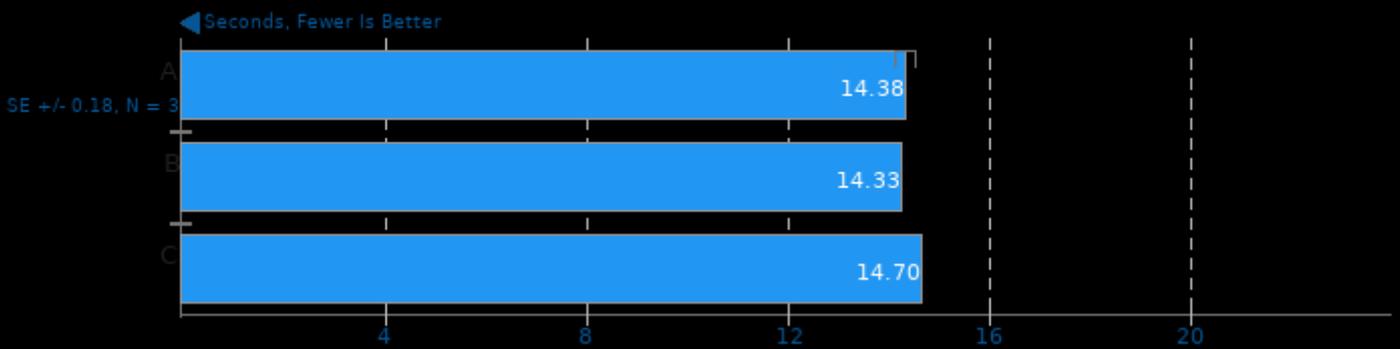
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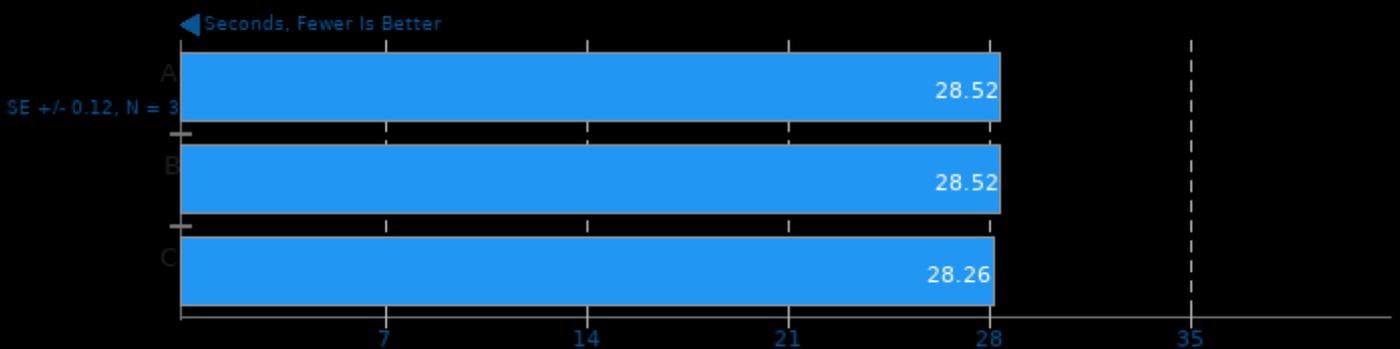
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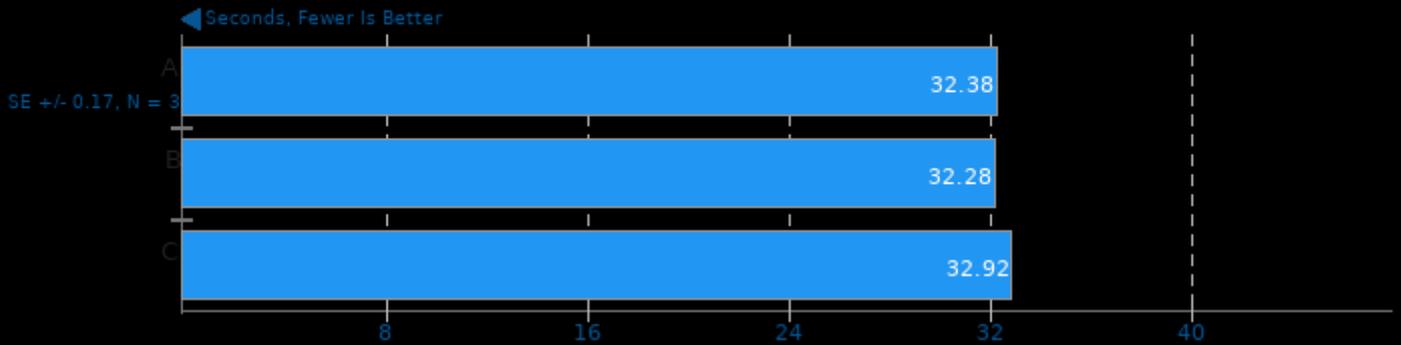
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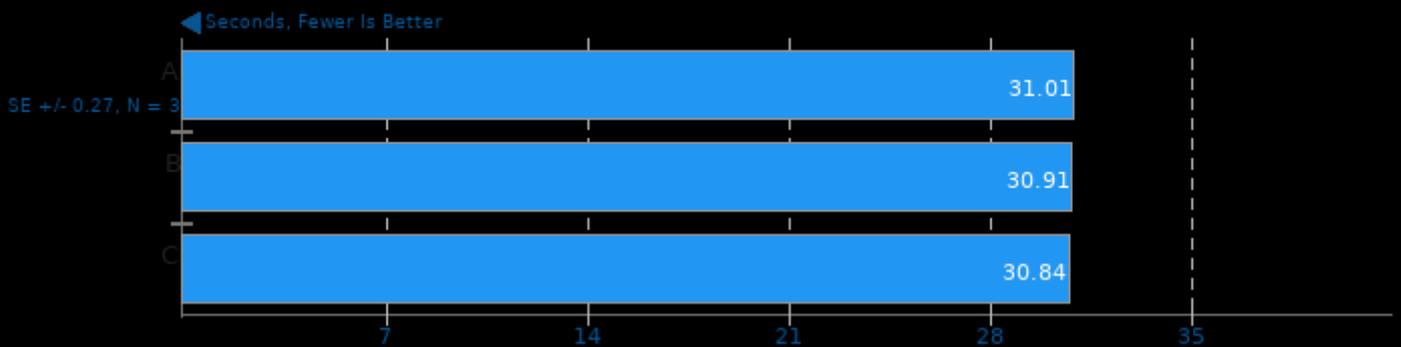
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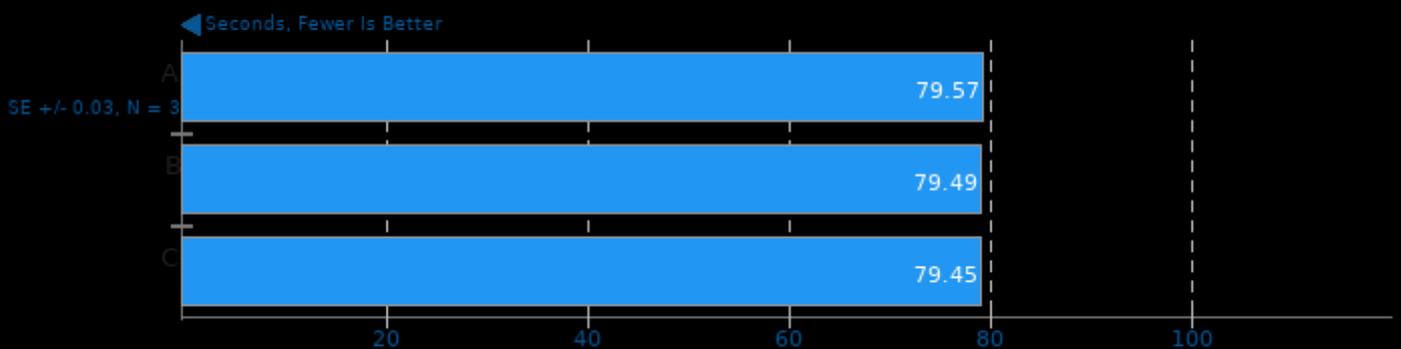
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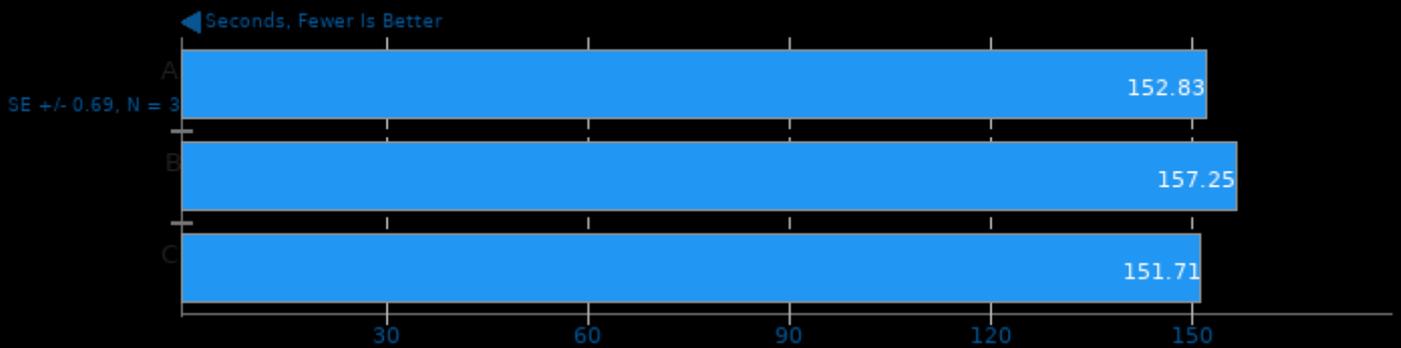
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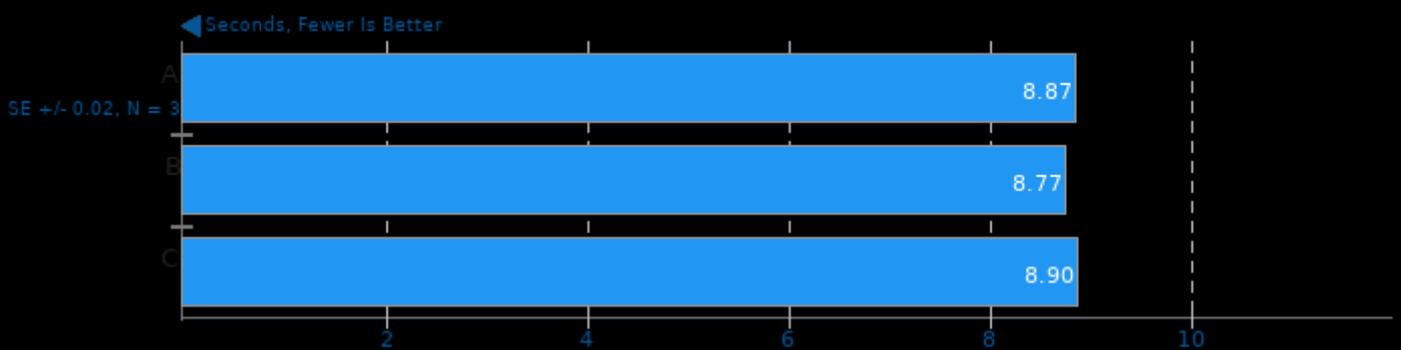
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Row Count: 40000000 - Partitions: 1000 - Calculate Pi Benchmark



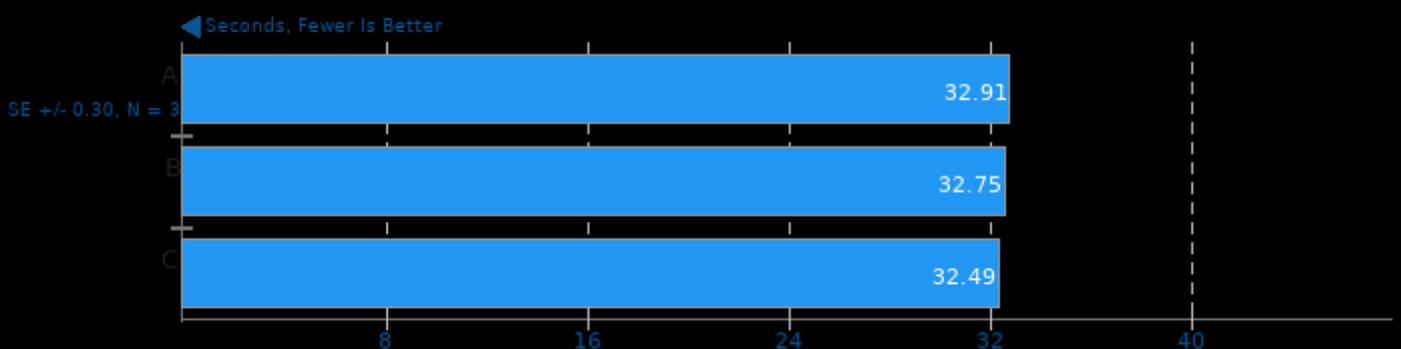
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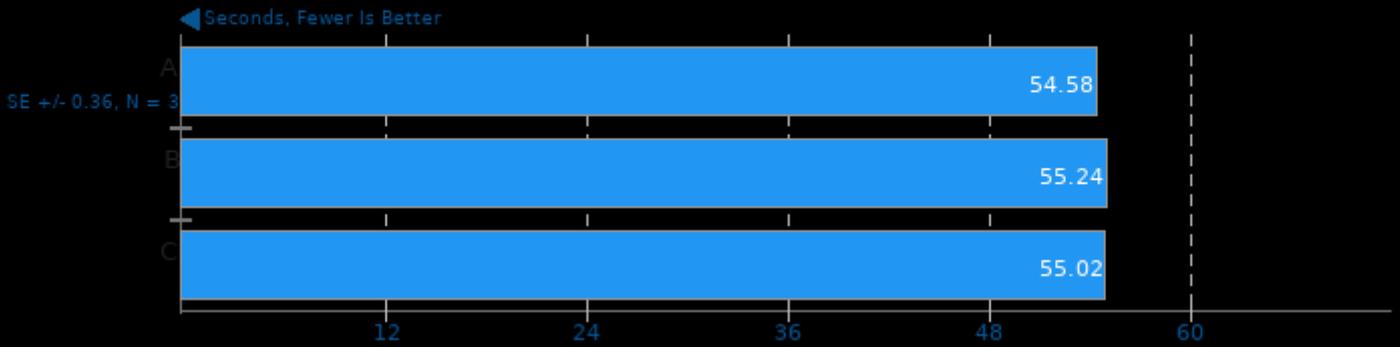
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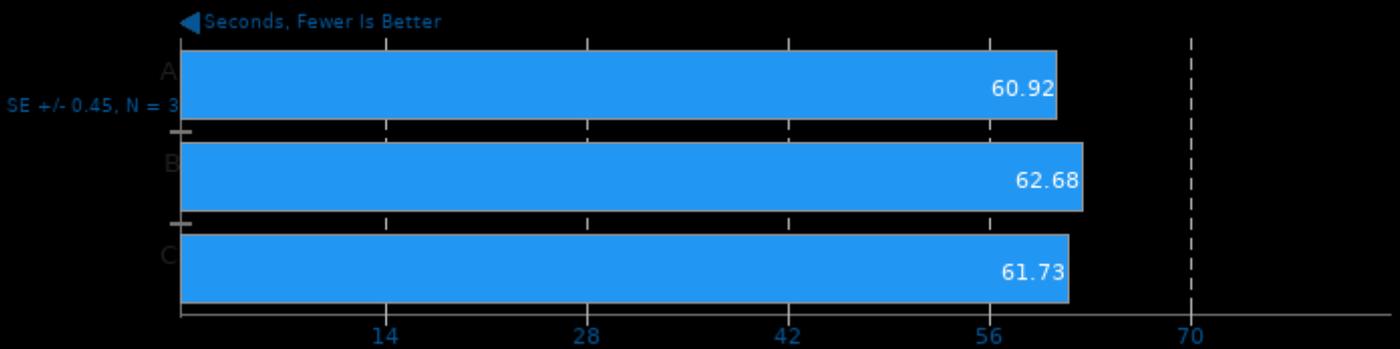
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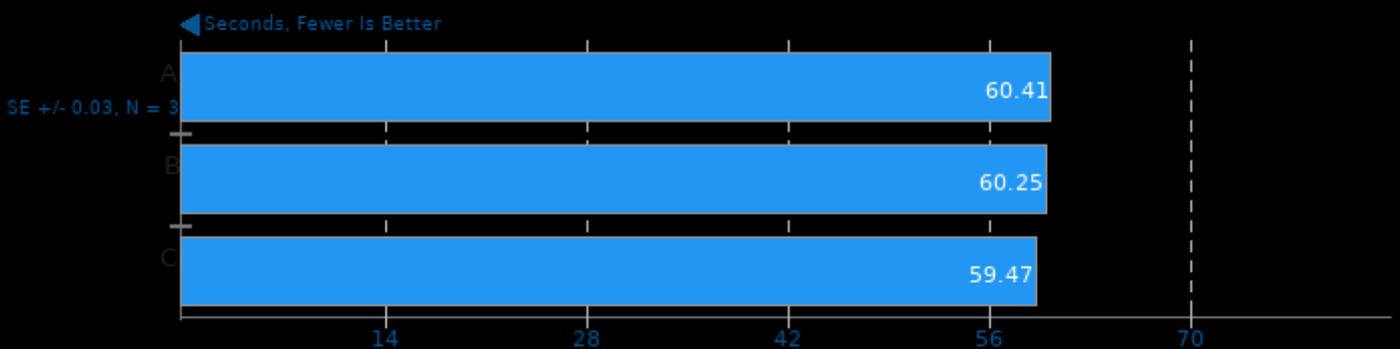
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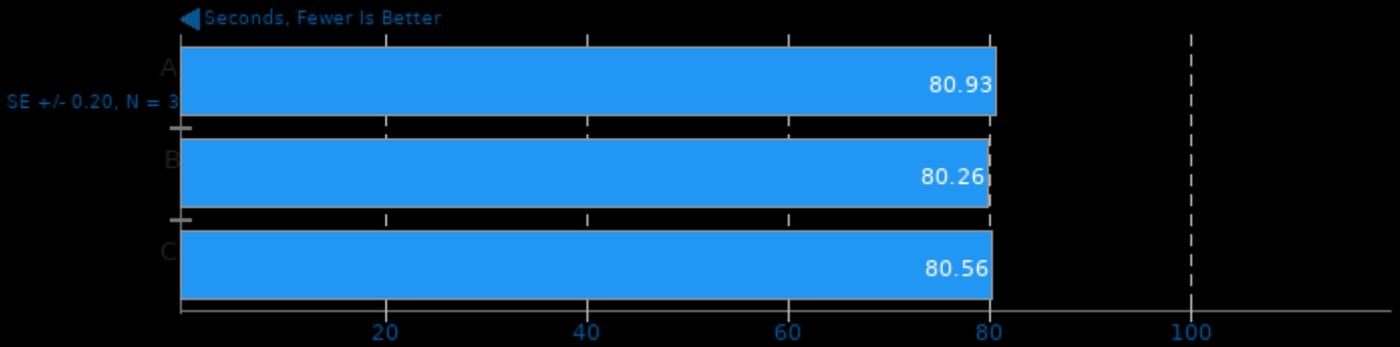
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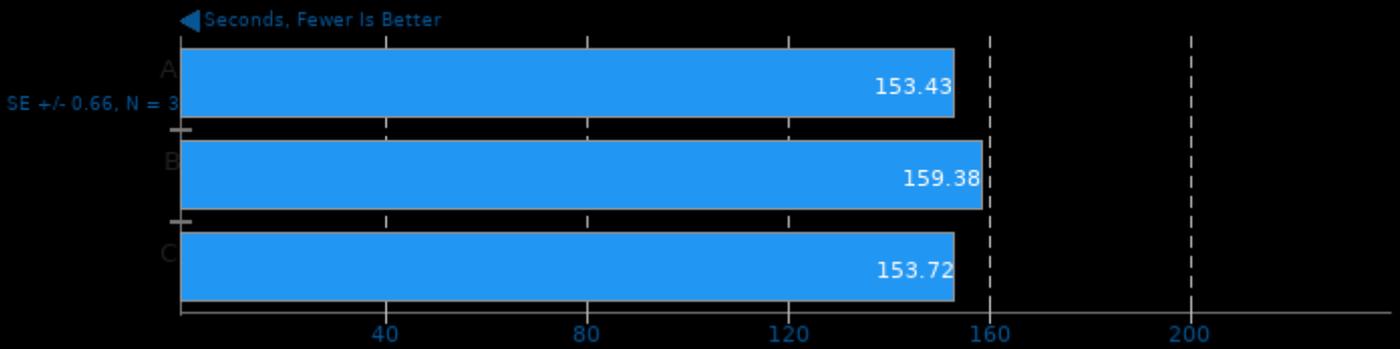
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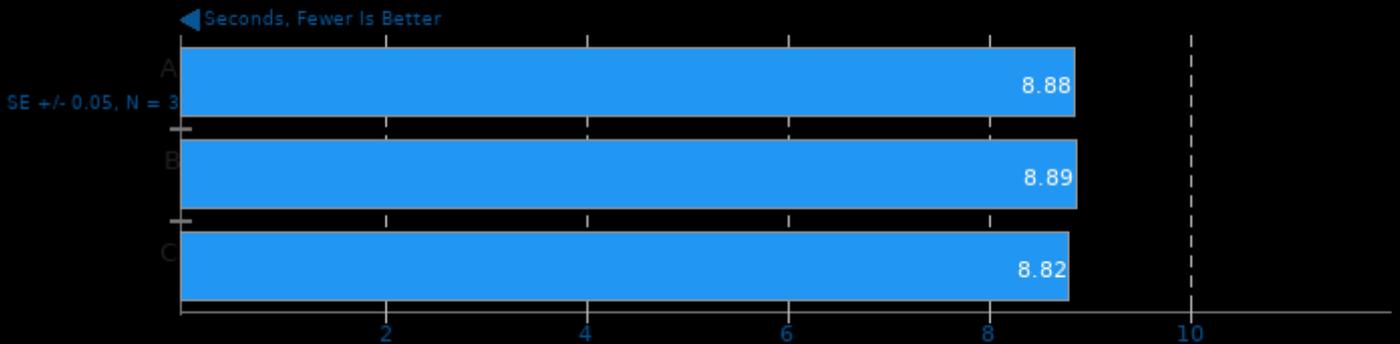
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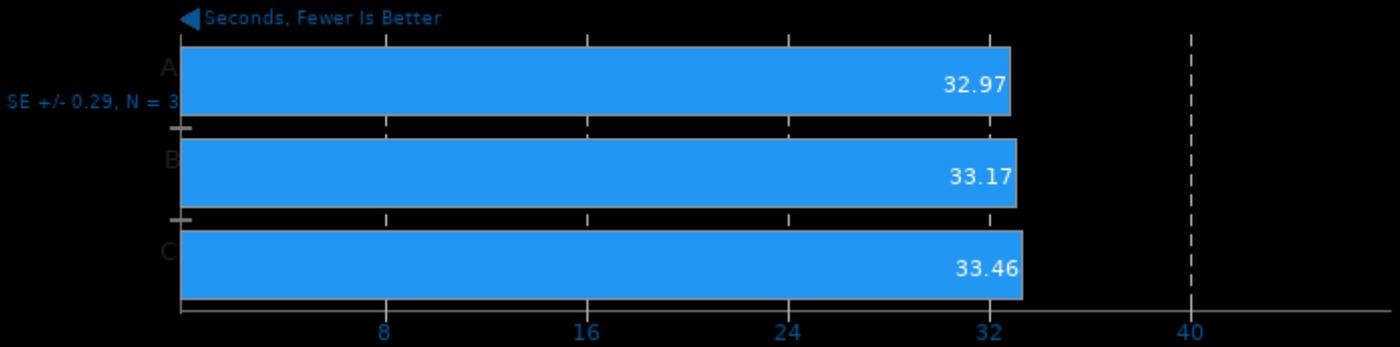
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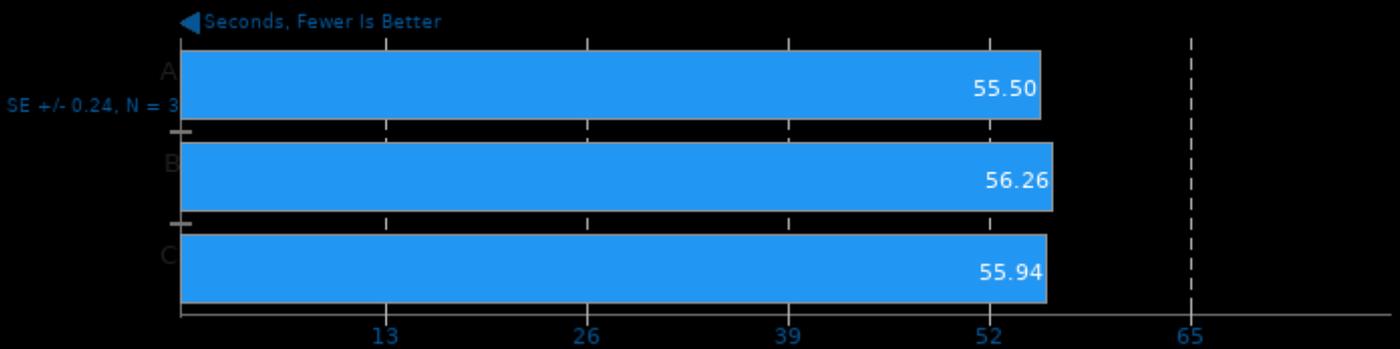
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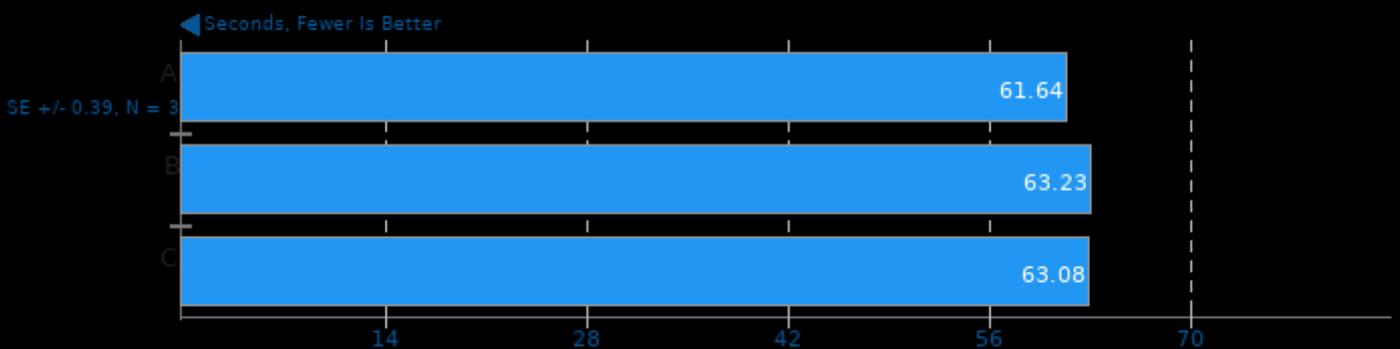
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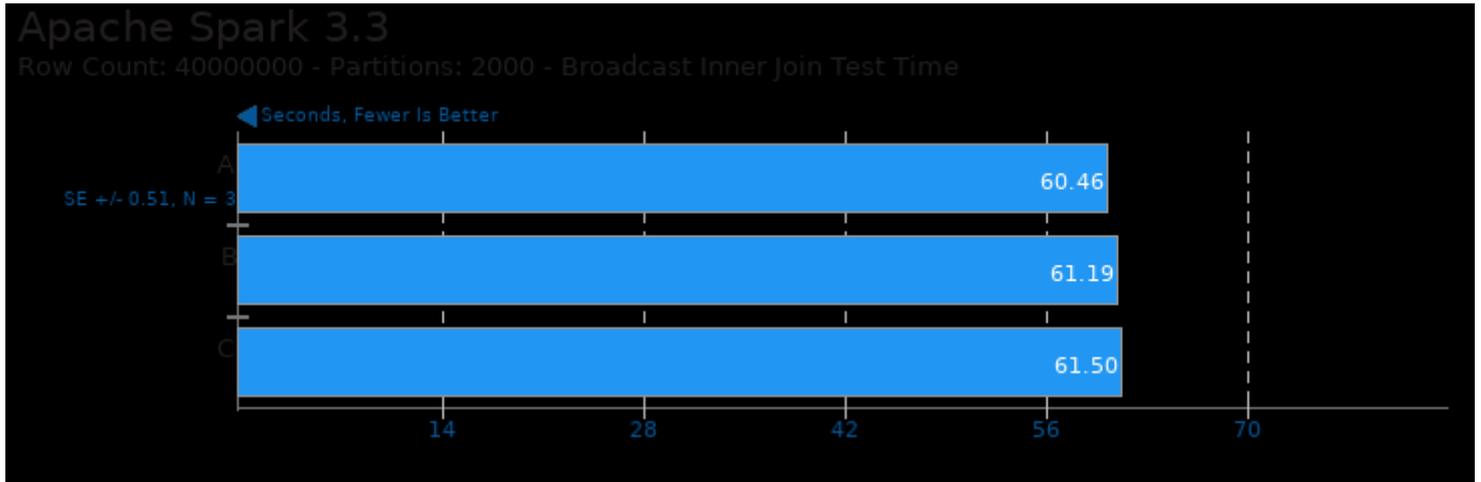
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Apache Spark 3.3

Row Count: 40000000 - Partitions: 2000 - Inner Join Test Time





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