Sort Benchmark Home Page

New: We are happy to announce the 2022 winners listed below. The new, 2022 records are listed in green. Congratulations to the winners!

Background

Until 2007, the sort benchmarks were primarily defined, sponsored and administered by Jim Gray. Following Jim's disappearance at sea in January 2007, the sort benchmarks have been continued by a committee of past colleagues and sort benchmark winners. The Sort Benchmark committee members include:

- Chris Nyberg of Ordinal Technology Corp
- Mehul Shah of Aryn.ai
- George Porter of UC San Diego Computer Science & Engineering Dept

Top Results

	Daytona	Indy
Gray	2016, 44.8 TB/min **Tencent Sort** 100 TB in 134 Seconds 512 nodes x (2 OpenPOWER 10-core POWER8 2.926 GHz, 512 GB memory, 4x Huawei ES3600P V3 1.2TB NVMe SSD, 100Gb Mellanox ConnectX4-EN) Jie Jiang, Lixiong Zheng, Junfeng Pu, Xiong Cheng, Chongqing Zhao Tencent Corporation Mark R. Nutter, Jeremy D. Schaub	2016, 60.7 TB/min **Tencent Sort** 100 TB in 98.8 Seconds 512 nodes x (2 OpenPOWER 10-core POWER8 2.926 GHz, 512 GB memory, 4x Huawei ES3600P V3 1.2TB NVMe SSD, 100Gb Mellanox ConnectX4-EN) Jie Jiang, Lixiong Zheng, Junfeng Pu, Xiong Cheng, Chongqing Zhao Tencent Corporation Mark R. Nutter, Jeremy D. Schaub
Cloud	2016, $1.44 / TB **NADSort** 100 TB for $144 394 Alibaba Cloud ECS ecs.n1.large nodes x (Haswell E5-2680 v3, 8 GB memory, 40GB Ultra Cloud Disk, 4x 135GB SSD Cloud Disk) Qian Wang, Rong Gu, Yihua Huang Nanjing University Reynold Xin Databricks Inc. Wei Wu, Jun Song, Junluan Xia Alibaba Group Inc.	2022, $0.97 / TB **Exoshuffle-CloudSort** 100 TB for $97 40 Amazon EC2 i4i.4xlarge nodes 1 Amazon EC2 r6i.2xlarge node Amazon S3 storage Frank Sifei Luan UC Berkeley Stephanie Wang UC Berkeley and Anyscale Samyukta Yagati, Sean Kim, Kenneth Lien, Isaac Ong, Tony Hong UC Berkeley SangBin Cho, Eric Liang Anyscale Ion Stoica UC Berkeley and Anyscale
Minute	2016, 37 TB **Tencent Sort** 512 nodes x (2 OpenPOWER 10-core POWER8 2.926 GHz, 512 GB memory, 4x Huawei ES3600P V3 1.2TB NVMe SSD, 100Gb Mellanox ConnectX4-EN) Jie Jiang, Lixiong Zheng, Junfeng Pu, Xiong Cheng, Chongqing Zhao Tencent Corporation Mark R. Nutter, Jeremy D. Schaub	2016, 55 TB **Tencent Sort** 512 nodes x (2 OpenPOWER 10-core POWER8 2.926 GHz, 512 GB memory, 4x Huawei ES3600P V3 1.2TB NVMe SSD, 100Gb Mellanox ConnectX4-EN) Jie Jiang, Lixiong Zheng, Junfeng Pu, Xiong Cheng, Chongqing Zhao Tencent Corporation Mark R. Nutter, Jeremy D. Schaub
Joule 10^{10} recs	2021, 138 KJoules **RezSort** 72 K records sorted / joule Intel i7-10700, 16GB RAM, Nsort, Ubuntu 18.04.5 LTS, 2 SK hynix Gold P31 1TB SSDs, 1 Samsung 980 Pro 2TB SSD Waleed Reda Université catholique de Louvain, KTH Royal Institute of Technology Dejan Kostić KTH Royal Institute of Technology	2022, 63 KJoules **ELSAR** 159 K records sorted / joule Intel Core i5-12600K, 32GB RAM, Ubuntu 20.04 Server, 4 WD_BLACK SN850 2TB Ani Kristo, Brown University Padmanabhan Pillai, Intel Labs Tim Kraska, MIT and Amazon

Common Rules

All the sort benchmarks share the following ground rules:

- Must sort to and from operating system files on secondary storage.
- No raw disk usage allowed since we are trying to test the IO subsystem.
- File or device striping (RAID 0) are allowed (encouraged) to get bandwidth. If file striping is used then the concatenated files must form a sorted file.
- The output file must be created as part of the sort.
- Time includes the launching of the sort program.

- The sort input records must be 100 bytes in length, with the first 10 bytes being a random key.
- Use the gensort record generator to create the input records.
- The sort output file must be validated for correct key order and checksum.
- The hardware used should be commercially available (off-the-shelf), and unmodified (e.g. no processor over or under clocking).

Sort Benchmarks

GraySort	**Metric:** Sort rate (TBs / minute) achieved while sorting a very large amount of data (currently 100 TB minimum).
CloudSort	**Metric:** Minimum cost for sorting a very large amount of data on a public cloud. (currently 100 TB). Complete rules in the CloudSort short paper.
MinuteSort	**Metric:** Amount of data that can be sorted in 60.00 seconds or less. Originally defined in AlphaSort paper.
JouleSort	**Metric:** Amount of energy required to sort 10^8, 10^9, 10^{10}, or 10^{12} records (10 GB, 100 GB, 1 TB, or 100TB). Originally defined in JouleSort paper. The 10^8, 10^9 and 10^{12} records JouleSort benchmarks are now deprecated.
PennySort	**Metric:** Amount of data that can be sorted for a penny's worth of system time. Originally defined in AlphaSort paper. PennySort is now deprecated.
TeraByte Sort	**Metric:** Elapsed time to sort 10^{12} bytes of data. The TeraByte benchmark is now deprecated because it became essentially the same as MinuteSort.
Datamation Sort	**Metric:** Amount of time to sort one million records (100 MB). This is the original sort benchmark, defined in A Measure of Transaction Processing Power With 25 others Datamation, V 31.7, April 1985, pp 112-118. Originally, winners took 1 hour, now 1 second! So the benchmark is deprecated.

Benchmark Categories

For each sort benchmark, there are two categories:

Daytona (stock car)	Indy (formula 1)
Sort code must be general purpose.	Need only sort 100-byte records with 10-byte keys.

Complete Rules

For the detailed rules, see the frequently asked questions (FAQ) .

Process

Entries must include a document describing the algorithm and the hardware in enough detail so that others could reproduce the result. Click on the title of any previous winning sort to view sort description document.

New Entries

The submission deadline for the 2022 contest is still being decided.

Past Winners

Daytona	Indy
2015, 15.9 TB/min **FuxiSort** 100 TB in 377 seconds 3,134 nodes x (2 Xeon E5-2630 2.30Ghz, 96 GB memory, 12x2 TB SATA HD, 10 Gb/s Ethernet) + 243 nodes x (2 Xeon E5-2650v2 2.60Ghz, 128 GB memory, 12x2 TB SATA HD, 10 Gb/s Ethernet) Jiamang Wang, Yongjun Wu, Hua Cai, Zhipeng Tang, Zhiqiang Lv, Bin Lu, Yangyu Tao, Chao Li, Jingren Zhou, Hong Tang Alibaba Group Inc	2015, 18.2 TB/min **FuxiSort** 100 TB in 329 seconds 3,134 nodes x (2 Xeon E5-2630 2.30Ghz, 96 GB memory, 12x2 TB SATA HD, 10 Gb/s Ethernet) + 243 nodes x (2 Xeon E5-2650v2 2.60Ghz, 128 GB memory, 12x2 TB SATA HD, 10 Gb/s Ethernet) Jiamang Wang, Yongjun Wu, Hua Cai, Zhipeng Tang, Zhiqiang Lv, Bin Lu, Yangyu Tao, Chao Li, Jingren Zhou, Hong Tang Alibaba Group Inc
2014, 4.35 TB/min **TritonSort**	2014, 8.38 TB/min **BaiduSort**

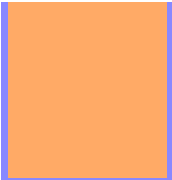|		
Gray	100 TB in 1,378 seconds 186 Amazon EC2 i2.8xlarge nodes x (32 vCores - 2.50Ghz Intel Xeon E5-2670 v2, 244GB memory, 8x800 GB SSD) Michael Conley, Amin Vahdat, George Porter University of California, San Diego **2014, 4.27 TB/min** **Apache Spark** 100 TB in 1,406 seconds 207 Amazon EC2 i2.8xlarge nodes x (32 vCores - 2.5Ghz Intel Xeon E5-2670 v2, 244GB memory, 8x800 GB SSD) Reynold Xin, Parviz Deyhim, Xiangrui Meng, Ali Ghodsi, Matei Zaharia Databricks **2013, 1.42 TB/min** **Hadoop** 102.5 TB in 4,328 seconds 2100 nodes x (2 2.3Ghz hexcore Xeon E5-2630, 64 GB memory, 12x3TB disks) Thomas Graves Yahoo! Inc. **2011, 0.725 TB/min** **TritonSort** 100 TB in 8,274 seconds 52 nodes x (2 Quadcore processors, 24 GB memory, 16x500GB disks) Cisco Nexus 5096 switch Alex Rasmussen, Michael Conley, George Porter, Amin Vahdat, University of California, San Diego **2009, 0.578 TB/min** **Hadoop** 100 TB in 173 minutes 3452 nodes x (2 Quadcore Xeons, 8 GB memory, 4 SATA) Owen O'Malley and Arun Murthy Yahoo Inc.	100 TB in 716 seconds 982 nodes x (2 2.10Ghz Intel Xeon E5-2450, 192 GB memory, 8x3TB 7200 RPM SATA) Dasheng Jiang Baidu Inc. and Peking University **2013, 1.42 TB/min** **Hadoop** 102.5 TB in 4,328 seconds 2100 nodes x (2 2.3Ghz hexcore Xeon E5-2630, 64 GB memory, 12x3TB disks) Thomas Graves Yahoo! Inc. **2011, 0.938 TB/min** **TritonSort** 100 TB in 6,395 seconds 52 nodes x (2 Quadcore processors, 24 GB memory, 16x500GB disks) Cisco Nexus 5096 switch Alex Rasmussen, Michael Conley, George Porter, Amin Vahdat, University of California, San Diego **2010, 0.582 TB/min** **TritonSort** 100 TB in 10,318 seconds 47 nodes x (2 Quadcore processors, 24 GB memory, 16x500GB disks) Cisco Nexus 5020 switch Alex Rasmussen, Radhika Niranjan Mysore, Harsha V. Madhyastha, Michael Conley, George Porter, Amin Vahdat, University of California, San Diego Alexander Pucher Vienna University of Technology **2009, 0.564 TB/min** **DEMSort** 100 TB in 10,628 seconds 195 nodes x (2 Quadcore processors, 16 GB memory, 4x250GB disks) 288-port InfiniBand 4xDDR switch Mirko Rahn, Peter Sanders, Johannes Singler and Tim Kieritz Karlsruhe Institute of Technology, Germany
Cloud	**2014, $4.51 / TB** **TritonSort** 100 TB for $451 330 Amazon EC2 r3.4xlarge nodes x (16 vCores - 2.50Ghz Intel Xeon E5-2670 v2, 122 GB memory, 320GB SSD, 8x135GB EBS gp2) Michael Conley, Amin Vahdat, George Porter University of California, San Diego	**2016, $1.44 / TB** **NADSort** 100 TB for $144 394 Alibaba Cloud ECS ecs.n1.large nodes x (Haswell E5-2680 v3, 8 GB memory, 40GB Ultra Cloud Disk, 4x 135GB SSD Cloud Disk) Qian Wang, Rong Gu, Yihua Huang Nanjing University Reynold Xin Databricks Inc. Wei Wu, Jun Song, Junluan Xia Alibaba Group Inc. **2014, $4.51 / TB** **TritonSort** 100 TB for $451 330 Amazon EC2 r3.4xlarge nodes x (16 vCores - 2.50Ghz Intel Xeon E5-2670 v2, 122 GB memory, 320GB SSD, 8x135GB EBS gp2) Michael Conley, Amin Vahdat, George Porter University of California, San Diego
	2015, 7.7 TB **FuxiSort** 3,134 nodes x (2 Xeon E5-2630 2.30Ghz, 96 GB memory, 12x2 TB SATA HD, 10 Gb/s Ethernet) + 243 nodes x (2 Xeon E5-2650v2 2.60Ghz, 128 GB memory, 12x2 TB SATA HD, 10 Gb/s Ethernet) Jiamang Wang, Yongjun Wu, Hua Cai, Zhipeng Tang, Zhiqiang Lv,	**2015, 11 TB** **FuxiSort** 3,134 nodes x (2 Xeon E5-2630 2.30Ghz, 96 GB memory, 12x2 TB SATA HD, 10 Gb/s Ethernet) + 243 nodes x (2 Xeon E5-2650v2 2.60Ghz, 128 GB memory, 12x2 TB SATA HD, 10 Gb/s Ethernet) Jiamang Wang, Yongjun Wu, Hua Cai, Zhipeng Tang, Zhiqiang Lv,

Bin Lu, Yangyu Tao, Chao Li, Jingren Zhou, Hong Tang
Alibaba Group Inc

2014, 3.7 TB

DeepSort
384 nodes x
(2 2.10Ghz Intel Xeon hexa-core, 64 GB memory, 8 7200 RPM hard drives)
Zheng Li, Juhan Lee
Samsung

2012, 1,401 GB

Flat Datacenter Storage
256 heterogeneous nodes, 1033 disks
Johnson Apacible, Rich Draves, Jeremy Elson, Jinliang Fan, Owen Hofmann, Jon Howell, Ed Nightingale, Reuben Olinksy, Yutaka Suzue
Microsoft Research

2009, 500 GB

Hadoop
1406 nodes x (2 Quadcore Xeons, 8 GB memory, 4 SATA)
Owen O'Malley and Arun Murthy
Yahoo Inc.

2007, 214 GB

TokuSampleSort
tx2500 disk cluster
400 nodes x (2 processors, 6-disk RAID, 8 GB memory)
Bradley C. Kuszmaul, MIT

2006, 40 GB

NeoSort
Windows, Fujitsu 32 Itanium2, 128 SAN disks
Chris Nyberg, Charles Koester
Ordinal Technology Corp

2004, 34 GB

Nsort
Windows, 32 Itanium2, 2,350 disks
Chris Nyberg, Charles Koester
Ordinal

2000, 12 GB

Nsort
SGI 32 cpu Origin IRIX

1998, 5.8 GB

Nsort
SGI 32 cpu Origin IRIX

1997, 3.5 GB

Nsort
IRIX Challenge
Ordinal Technology Corp

1995, 1.1 GB

AlphaSort
Nyberg

Minute

Bin Lu, Yangyu Tao, Chao Li, Jingren Zhou, Hong Tang
Alibaba Group Inc

2014, 7.0 TB

BaiduSort
993 nodes x
(2 2.10Ghz Intel Xeon E5-2450, 192 GB memory, 8x3TB 7200 RPM SATA)
Dasheng Jiang
Baidu Inc. and Peking University

2012, 1,470 GB

Flat Datacenter Storage
256 heterogeneous nodes, 1033 disks
Johnson Apacible, Rich Draves, Jeremy Elson, Jinliang Fan, Owen Hofmann, Jon Howell, Ed Nightingale, Reuben Olinksy, Yutaka Suzue
Microsoft Research

2011, 1353GB

TritonSort
52 nodes x
(2 Quadcore processors, 24 GB memory, 16x500GB disks)
Cisco Nexus 5096 switch
Alex Rasmussen, Michael Conley,
George Porter, Amin Vahdat,
University of California, San Diego

2010, 1014 GB

TritonSort
52 nodes x
(2 Quadcore processors, 24 GB memory, 16x500GB disks)
Cisco Nexus 5020 switch
Alex Rasmussen, Radhika Niranjan Mysore,
Harsha V. Madhyastha, Michael Conley,
George Porter, Amin Vahdat,
University of California, San Diego
Alexander Pucher
Vienna University of Technology

2009, 955 GB

DEMSort
195 nodes x
(2 Quadcore processors, 16 GB memory, 4x250GB disks)
288-port InfiniBand 4xDDR switch
Mirko Rahn, Peter Sanders,
Johannes Singler and Tim Kieritz
Karlsruhe Institute of Technology, Germany

2007, 264 GB

TokuSampleSort
tx2500 disk cluster
400 nodes x (2 processors, 6-disk RAID, 8 GB memory)
Bradley C. Kuszmaul, MIT

2005, 125 GB

SCS
Linux, 80 Itanium2, 2,520 SAN disks
Jim Wyllie, IBM Almaden Research

2004, 32 GB

Nsort
32 x Itanium2 WinServer
Chris Nyberg, Charles Koester
Ordinal Technology

2000, 21.8 GB

NOW+HPVMsort
64 nodes WinNT
Luis Rivera, Xianan Zhang, Andrew Chien
UCSD

1999, 10,3 GB

NOW+MPI HPVMsort
Luis Rivera, UIUC
Andrew Chien, UCSD

1998, 8.41 GB

	NowSort 95 UltraSparc + MyrinetSolaris UC Berkeley 1997, 3.5 GB **Nsort** SGI/Nyberg,Koester Nsort/Irix/Challenge 1995, 1.08 GB **AlphaSort** Nyberg

Joule
10^8 recs
(deprecated)

2013, 889 Joules	2013, 889 Joules
NTOSort 112,545 records sorted / joule Lenovo X220, 2.8 Ghz Intel i5-2640M, 16GB RAM, Nsort, Windows 8, 1 OCZ 120GB mSATA Nocti SSD, 2 Samsung 840 Pro 256GB SSDs Andreas Ebert Microsoft	**NTOSort** 112,545 records sorted / joule Lenovo X220, 2.8 Ghz Intel i5-2640M, 16GB RAM, Nsort, Windows 8, 1 OCZ 120GB mSATA Nocti SSD, 2 Samsung 840 Pro 256GB SSDs Andreas Ebert Microsoft

2012, 1,393 Joules	2012, 1,393 Joules
FAWNSort 71,800 records sorted / joule Intel Core i7-2700K 3.5 GHz, 16GB RAM, Nsort, 16 x 300 GB Intel 710 Series SSDs, 1 160 GB Intel 510 Series SSD Padmanabhan Pillai, Michael Kaminsky, Michael A. Kozuch, Intel Labs Pittsburgh David Andersen Carnegie Mellon University	**FAWNSort** 71,800 records sorted / joule Intel Core i7-2700K 3.5 GHz, 16GB RAM, Nsort, 16 x 300 GB Intel 710 Series SSDs, 1 160 GB Intel 510 Series SSD Padmanabhan Pillai, Michael Kaminsky, Michael A. Kozuch, Intel Labs Pittsburgh David Andersen Carnegie Mellon University

2011, 1,430 Joules	2011, 1,430 Joules
FAWNSort 69,900 records sorted / joule Intel Core i5-2400S 2.5 GHz, 16GB RAM, Nsort, 7 x 120 GB Intel 510 Series SSDs Padmanabhan Pillai, Michael Kaminsky, Michael A. Kozuch, Intel Labs Pittsburgh Vijay Vasudevan, Lawrence Tan, David Andersen Carnegie Mellon University	**FAWNSort** 69,900 records sorted / joule Intel Core i5-2400S 2.5 GHz, 16GB RAM, Nsort, 7 x 120 GB Intel 510 Series SSDs Padmanabhan Pillai, Michael Kaminsky, Michael A. Kozuch, Intel Labs Pittsburgh Vijay Vasudevan, Lawrence Tan, David Andersen Carnegie Mellon University

2010, 2.2 KJoules	2010, 2.2 KJoules
FAWNSort 44,900 records sorted / joule Intel Xeon L3426 1.86GHz, 12GB RAM, Nsort, Fusion-io ioDrive (80GB), 4 x Intel X25-E (3 x 32GB, 1 x 64GB) Vijay Vasudevan, Lawrence Tan, David Andersen Carnegie Mellon University Michael Kaminsky, Michael A. Kozuch, Padmanabhan Pillai Intel Labs Pittsburgh	**FAWNSort** 44,900 records sorted / joule Intel Xeon L3426 1.86GHz, 12GB RAM, Nsort, Fusion-io ioDrive (80GB), 4 x Intel X25-E (3 x 32GB, 1 x 64GB) Vijay Vasudevan, Lawrence Tan, David Andersen Carnegie Mellon University Michael Kaminsky, Michael A. Kozuch, Padmanabhan Pillai Intel Labs Pittsburgh

2010 Jan 1, 4.0 KJoules	2010, 2.3 KJoules
FlashSort 24,800 records sorted / joule Quad Core AMD Opteron 2373 2.01GHz, 16GB RAM 80GB FusionIO John D. Davis (Microsoft Research) Suzanne Rivoire (Sonoma State University)	**EcoSort** 42,600 records sorted / joule Intel Atom 330 1.6GHz, 4GB RAM, 4 x Super Talent UltraDrive GX MLC 256GB Andreas Beckmann, Ulrich Meyer Goethe University Frankfurt am Main, Germany Peter Sanders, Johannes Singler Karlsruhe Institute of Technology, Germany
2007, 8.6 KJoules **CoolSort** 11,600 records sorted / joule Mobile Core 2 Duo, 13 SATA laptop disks, 2GB RAM, Nsort Suzanne Rivoire (Stanford), Mehul A. Shah (HP Labs), Partha Ranganathan (HP Labs), Christos Kozyrakis (Stanford)	**2010 Jan 1, 2.8 KJoules** **EcoSort** 35,500 records sorted / joule Intel Atom 330 1.6GHz, 4GB RAM, 4 x SuperTalent UltraDrive GX MLC 256GB Andreas Beckmann, Ulrich Meyer Goethe University Frankfurt am Main, Germany Peter Sanders, Johannes Singler Karlsruhe Institute of Technology, Germany

2013, 12,092 Joules	2013, 12,092 Joules
NTOSort 82,697 records sorted / joule Lenovo X220, 2.8 Ghz Intel i5-2640M, 16GB RAM, Nsort, Windows 8, 1 OCZ 120GB mSATA Nocti SSD, 2 Samsung 840 Pro 256GB SSDs Andreas Ebert Microsoft	**NTOSort** 82,697 records sorted / joule Lenovo X220, 2.8 Ghz Intel i5-2640M, 16GB RAM, Nsort, Windows 8, 1 OCZ 120GB mSATA Nocti SSD, 2 Samsung 840 Pro 256GB SSDs Andreas Ebert Microsoft

Joule 10^9 **recs** (deprecated)	**2012, 21.0 KJoules** **FAWNSort** 47,500 records sorted / joule Intel Core i7-2700K 3.5 GHz, 8GB RAM, Nsort, 16 x 300 GB Intel 710 Series SSDs, 1 160 GB Intel 510 Series SSD Padmanabhan Pillai, Michael Kaminsky, Michael A. Kozuch, Intel Labs Pittsburgh David Andersen Carnegie Mellon University **2010, 27.9 KJoules** **Nsort** 35,800 records sorted / joule Intel Atom 330 1.6GHz, 4GB RAM, 4 x Super Talent UltraDrive GX MLC 256GB Andreas Beckmann, Ulrich Meyer Goethe University Frankfurt am Main, Germany Peter Sanders, Johannes Singler Karlsruhe Institute of Technology, Germany **2007, 88 KJoules** **CoolSort** 11,300 records sorted / joule Mobile Core 2 Duo, 13 SATA laptop disks, 2GB RAM, Nsort Suzanne Rivoire (Stanford), Mehul A. Shah (HP Labs), Partha Ranganathan (HP Labs), Christos Kozyrakis (Stanford)	**2012, 21.0 KJoules** **FAWNSort** 47,500 records sorted / joule Intel Core i7-2700K 3.5 GHz, 8GB RAM, Nsort, 16 x 300 GB Intel 710 Series SSDs, 1 160 GB Intel 510 Series SSD Padmanabhan Pillai, Michael Kaminsky, Michael A. Kozuch, Intel Labs Pittsburgh David Andersen Carnegie Mellon University **2010, 25.1 KJoules** **EcoSort** 39,900 records sorted / joule Intel Atom 330 1.6GHz, 4GB RAM, 4 x Super Talent UltraDrive GX MLC 256GB Andreas Beckmann, Ulrich Meyer Goethe University Frankfurt am Main, Germany Peter Sanders, Johannes Singler Karlsruhe Institute of Technology, Germany **2010 Jan 1, 27.5 KJoules** **EcoSort** 36,400 records sorted / joule Intel Atom 330 1.6GHz, 4GB RAM, 4 x SuperTalent UltraDrive GX MLC 256GB Andreas Beckmann, Ulrich Meyer Goethe University Frankfurt am Main, Germany Peter Sanders, Johannes Singler Karlsruhe Institute of Technology, Germany **2009, 87 KJoules** **OzSort** 11,600 records sorted / joule 2.6 Ghz AMD Athlon LE-1640, 4GB RAM, 7x160 GB 7200 RPM SATA, Linux Nikolas Askitis and Ranjan Sinha Univ. Melbourne, Australia
Joule 10^{10} **recs**	**2019, 163 KJoules** **TaichiSort** 61 K records sorted / joule Intel i7-9700, 32GB RAM, Nsort, Ubuntu 16.04.3 LTS, 2 Intel DC 3600 series PCIe NVMe SSD (1.2 TB), 1 Intel DC 3600 series PCIe NVMe SSD (2.0 TB) Ming Liu, Kaiyuan Zhang, Arvind Krishnamurthy University of Washington Simon Peter University of Texas at Austin **2013, 168 KJoules** **NTOSort** 59 K records sorted / joule Intel i7-3770K, 16GB RAM, Nsort, Windows 8, 16 Samsung 840 Pro 256GB SSDs, 1 Samsung 840 Pro 128GB SSD Andreas Ebert Microsoft **2012, 229 KJoules** **FAWNSort** 43,700 records sorted / joule Intel Core i7-2700K 3.5 GHz, 8GB RAM, Nsort, 16 x 300 GB Intel 710 Series SSDs, 1 160 GB Intel 510 Series SSD Padmanabhan Pillai, Michael Kaminsky, Michael A. Kozuch, Intel Labs Pittsburgh David Andersen Carnegie Mellon University **2011, 1,900 KJoules** **Nsort** 5,273 records sorted / joule 2 x Intel Xeon X5550 2.67 GHz, 48 GB RAM 8 x 1TB Seagate 7200RPM SATA HDD Andreas Beckmann, Ulrich Meyer Goethe University Frankfurt am Main, Germany Peter Sanders, Johannes Singler Karlsruhe Institute of Technology, Germany **2007, 2920 KJoules**	**2019, 89 KJoules** **KioxiaSort** 112 K records sorted / joule Intel i9-9900K, 64GB RAM, Ubuntu 19.04 Server, 8 CFD CSSD-M2B1TPG3VNF (1TB), 1 Toshiba XG5-P KXG50PNV2T04 (2TB) Shintaro Sano, Tomoya Suzuki Kioxia Corporation Zaid Mahmoud Princess Sumaya University for Technology **2013, 168 KJoules** **NTOSort** 59,444 records sorted / joule Intel i7-3770K, 16GB RAM, Nsort, Windows 8, 16 Samsung 840 Pro 256GB SSDs, 1 Samsung 840 Pro 128GB SSD Andreas Ebert Microsoft **2012, 229 KJoules** **FAWNSort** 43,700 records sorted / joule Intel Core i7-2700K 3.5 GHz, 8GB RAM, Nsort, 16 x 300 GB Intel 710 Series SSDs, 1 160 GB Intel 510 Series SSD Padmanabhan Pillai, Michael Kaminsky, Michael A. Kozuch, Intel Labs Pittsburgh David Andersen Carnegie Mellon University **2010, 572 KJoules** **DEMSort** 17,500 records sorted / joule Intel Atom 330 1.6GHz, 4GB RAM, 4 x Super Talent UltraDrive GX MLC 256GB Andreas Beckmann, Ulrich Meyer Goethe University Frankfurt am Main, Germany Peter Sanders, Johannes Singler Karlsruhe Institute of Technology, Germany **2010 Jan 1, 724 KJoules**

	CoolSort	DEMSort
	CoolSort 3,425 records sorted / joule Intel Xeon 5130 2GHz, 4GB RAM, 12 x Seagate Barracuda ES 7200rpm 500GB, Nsort Suzanne Rivoire (Stanford), Mehul A. Shah (HP Labs), Partha Ranganathan (HP Labs), Christos Kozyrakis (Stanford)	**DEMSort** 13,800 records sorted / joule Intel Atom 330 1.6GHz, 4GB RAM, 4 x SuperTalent UltraDrive GX MLC 256GB Andreas Beckmann, Ulrich Meyer Goethe University Frankfurt am Main, Germany Peter Sanders, Johannes Singler Karlsruhe Institute of Technology, Germany
Joule 10^{12} recs (deprecated)	2011, 132 MJoules **TritonSort** 7,595 records sorted / joule 52 nodes x (2 Quadcore processors, 24 GB memory, 16x500GB disks) Cisco Nexus 5096 switch Alex Rasmussen, Michael Conley, George Porter, Amin Vahdat, University of California, San Diego	2011, 103 MJoules **TritonSort** 9,700 records sorted / joule 52 nodes x (2 Quadcore processors, 24 GB memory, 16x500GB disks) Cisco Nexus 5096 switch Alex Rasmussen, Michael Conley, George Porter, Amin Vahdat, University of California, San Diego
Penny (deprecated)	2011, 286 GB **psort** 2.7 Ghz AMD Sempron, 4 GB RAM, 5x320 GB 7200 RPM Samsung SpinPoint F4 HD332GJ, Linux Paolo Bertasi, Federica Bogo, Marco Bressan and Enoch Peserico Univ. Padova, Italy 2009, 223 GB **psort** 2.6 Ghz AMD Athlon LE 1640, 4 GB RAM, 5x160 GB 7200 RPM SATA, Linux Paolo Bertasi, Marco Bressan and Enoch Peserico Univ. Padova, Italy 2008, 181 GB 1,812 M records in 2,408 seconds **psort** 2.4 Ghz AMD Athlon 64, 2 GB RAM, 4x160GB SATA disks Linux Paolo Bertasi, Marco Bressan and Enoch Peserico Univ. Padova, Italy 2007, 39 GB **TokuMergeSort** 330$ system 2 Ghz AMD Athlon 4200+, 512 MB RAM, 2x80GB SATA disks Bradley C. Kuszmaul , MIT 2006, 34 GB **Bytes-Split-Index Sort (BSIS)** $760 system 1.8 GHz AMD, 1 GB RAM, 4x80GB SATA disks, WindowsXP Xing Huang and BinHeng Song School of Software, Tsinghua U. , Beijing, China Bo Huang Math & CS, Hunan U. of Technology , Zhuzhou, China 2005, 15 GB **PostManSort** 979 sec on a $951 Wintel 2 SATA Robert Ramey 2004, 10 GB **THsort** (105 million records) 1098 seconds on a $857 Linux/AMD Peng Liu, Yao Shi, Li Zhang, Kuo Zhang, Tian Wang, ZunChong Tian, Hao Wang, Xiaoge Wang Tsinghua University, Beijing, China 2000, 4.5 GB **HMsort** Brad Helmkamp, Keith McCready Stenograph LLC 1999, 2.6 GB **HMsort** Brad Helmkamp, Keith McCready Stenograph LLC	2011, 334 GB **psort** 2.7 Ghz AMD Sempron, 4 GB RAM, 5x320 GB 7200 RPM Samsung SpinPoint F4 HD332GJ, Linux Paolo Bertasi, Federica Bogo, Marco Bressan and Enoch Peserico Univ. Padova, Italy 2010, 252 GB **OzSort 2.0** 2.8 Ghz AMD Athlon II 240, 4GB RAM, 6x160 GB 7200 RPM SATA-II, Linux Nikolas Askitis Univ. Melbourne, Australia 2009, 248 GB **psort** 2.6 Ghz AMD Athlon LE 1640, 4 GB RAM, 5x160 GB 7200 RPM SATA, Linux Paolo Bertasi, Marco Bressan and Enoch Peserico Univ. Padova, Italy 2009, 246 GB **OzSort** 2.7 Ghz AMD Kuma X2 7750+, 4GB RAM, 5x160 GB 7200 RPM SATA, Linux Nikolas Askitis and Ranjan Sinha Univ. Melbourne, Australia 2008, 190 GB **psort** 2.4 Ghz AMD Athlon 64, 2 GB RAM, 4x160GB SATA disks, Linux Paolo Bertasi, Marco Bressan and Enoch Peserico Univ. Padova, Italy 2006, 59 GB **GpuTeraSort** 3 GHz Pentium IV, 2 GB RAM, 7800GT Nvidia graphics card, 9x80GB SATA disks (4 data and 5 runs) WindowsXP Naga Govindaraju, Ritesh Kumar, Dinesh Manocha, Jim Gray U. North Carolina at Chapel Hill, USA 2003, 43 GB **SheenkSort** Linux/AMD system Lei Yang, Hui Huang, Zheng Wan, Tao Song Tsinghua University, Beijing, China 2001, 12 GB **DMsort** Araron Darling, Alex Mohr, U. Wisconsin, Madison 2000, 4.5 GB **HMsort** Brad Helmkamp, Keith McCready Stenograph LLC 1999, 2.6 GB

	1998, 1.3 GB **PostmanSort/NT** Robert Ramey Software	**HMsort** Brad Helmkamp, Keith McCready Stenograph LLC **1998, 1.5 GB** **NT Sort** Microsoft
TeraByte **(deprecated)**	**2008, 3.48 minutes** **Hadoop** 910 nodes x (4 dual-core processors, 4 disks, 8 GB memory) Owen OMalley, Yahoo **2007, 4.95 min** **TokuSampleSort** tx2500 disk cluster 400 nodes x (2 processors, 6-disk RAID, 8 GB memory) Bradley C. Kuszmaul , MIT **2004, 33 min** **Nsort** Windows, 32 Itanium2, 2,350 SAN disks Chris Nyberg, Charles Koester Ordinal Technology **2000, 49 min** **Tandem FastSort** 68x2 Compaq Tandem Sandia Daivd Cossock , Sam Fineberg, Pankaj Mehra , John Peck Tandem **1998, 151 min** **Nsort** SGI 32x Origin 2000 Chris Nyberg, Charles Koester Ordinal Technology	**2007, 3.28 minutes** **TokuSampleSort** tx2500 disk cluster 400 nodes x (2 processors, 6-disk RAID, 8 GB memory) Bradley C. Kuszmaul , MIT **2005, 7.25 min** **SCS** Linux, 80 Itanium2, 2,520 SAN disks Jim Wyllie , IBM Almaden Research **2000, 18 min** **SPsort** 1952 SP cluster 2168 disks Jim Wyllie , IBM Almaden Research **1998, 151 min** **Nsort** SGI 32x Origin 2000 Chris Nyberg, Charles Koester Ordinal Technology
Datamation **(deprecated)**		**2001, .44 sec** **Datamation 2001: A Sorting Odyssey** NOW-sort on 32 Linux PCs (2xP3(550 MHz), 1 GB, 5x9GB disks). Florentina Popovici, John Bent, Brian Forney, Andrea Arpaci Dusseau, Remzi Arpaci Dusseau **2000, .998 sec** **Mitsubishi DIAPRISM Hardware Sorter** HP 4 x 550MHz Xeon PC server + 32 SCSI disks, Windows NT4 Shinsuke Azuma, Takao Sakuma, Tetsuya Takeo, Takaaki Ando, Kenji Shirai Mitsubishi Electric Corp. **1999, 1.18 sec** **Millennium Sort** 16x2 Dell NT Myrinet Phillip Buonadonna, Spencer Low, Josh Coates UC Berkeley **1997, 2.4 sec** **NowSort** Arpaci-Dusseau UC Berkeley **1996, 4.2 sec** **Nsort** SGI Challenge Chris Nyberg, Charles Koester Ordinal Technology **1994, 7 sec** **AlphaSort** Nyberg, DEC **1993, 9 sec** **AlphaSort** Nyberg, DEC **1988, 28 sec**

Cray1
Weinberger

1987, 980 sec

Tandem
Tsukerman

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