Randomization of Sparse Matrix by Vector Multiplication

ABHISHEK JAIN, ISMAIL BUSTANY, and PAOLO D'ALBERTO

A sparse matrix by vector multiplication (SpMV) is simplified by the matrix non-zero elements and how we store them. There are many SpMV applications, many matrix storage formats, and thus algorithms. However, there is no optimality without considering the architecture: for example, the CPU is one among many.

By nature, randomization is resilient to counter techniques, thus suitable to avoid worst case scenarios because we tend to reduce to an average case; however, randomization does to the best case scenario the same thing it does to the worst case, it can nudge the optimal solution off. Like preconditioning, randomization is advantageous when the matrix is reused or a constant such as in the power method, Krilov's space, or convolutions for image classifications. Differently from preconditioning we do not change the values of the matrix, we randomize row and column of the matrix. We shall show that randomization is an optimization that any architecture may take advantage although in different ways. Most importantly, any developer can consider and deploy. We shall present cases where we can improve performance by 15% on AMD-based systems.

2 ACM Reference Format:

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1 INTRODUCTION

The obious questions are what is randomization and why would we use it? We shall provide formal definitions in the following sections, in this context, we randomly permute rows and column of a sparse matrix before a (sparse) matrix by a (dense) vector operation. We do this because randomization is the poor man's preconditioning and we do not mean it in a pejorative sense.

Preconditioning is a method to help the convergence of an iterative solution, for example a sequence of matrix by vector operations. Each iteration does a better job in searching the space and converging to a solution. In general, it means better numerical properties and well defined properties of the matrix itself. It does not mean that each iteration is faster. We want to make each iteration faster. From a mathematical and scientific point of view may seem uninteresting. From the engineering and deployment point of view is just the beginning.

There is a common thread in the scientific community to faster computations: multi-core systems. These are composed by multi-cores processors and GPUs. The main goal is a balanced work distribution and, when applicable, minimal communication [3, 4]. When storage strategy and algorithms must be considered together then GPUs provide the work horse for the current trust and research [1]. This research is towards optimal solutions and the authors strive for a clear and complete understanding of the software–hardware relation, and usually the hardware is composed of symmetric computational units. Interestingly, the SpMV's space and time complexity, which are small, may not warrant more

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performance because we end up using only one thousandth the capacity of the hardware. We may deploy efficient solutions: not necessarily faster but overall tailored for this.

The peak performance of any SpMV accelerator depends primarily on the available memory bandwidth (i.e., DRAM such as DDR or HBM) and the capability of the accelerator to effectively use it. Because SpMV is memory-bound, a more important metric than peak performance alone is the fraction of bandwidth utilized, which captures the overall efficiency of the architecture. GPU platforms exhibit very high bandwidth, see the experimental Section 8: Ellesmere DDR5 224GB/s, Fiji HBM 512GB/s, and Vega 20 HBM 1TB/s. Although utilizing this much bandwidth efficiently is difficult for large scale and highly sparse matrices due to very high random access pattern. Custom architectures based on FPGA or ASIC devices can maximize bandwidth utilization by highly customized data-paths and memory hierarchy designs MISSING CITATION [] . Most of the existing accelerators saturates relatively low memory bandwidth available on FPGA platforms (less than 80 GB/s) MISSING CITATION [] . Modern FPGA platforms have multiple HBM stacks to provide large memory bandwidth. However there is no implementation (currently available) that saturates all of the available DRAM bandwidth for SpMV kernel on HBM-enabled FPGA platforms. Scalability of accelerator design remains a major concern and it is an active area of research.

FPGA platforms used in early works exhibit low peak performance due to the scarcity of external memory bandwidth. For example, Microsoft's implementation of SpMV uses an FPGA platform which has only 2 DDR2-400 memory with a resulting bandwidth of 6.4 GB/s MISSING CITATION []. The accelerator is running at 100 MHz, it reads 64 Bytes of data every cycle, which corresponds to 5 non-zeros every cycle (a non-zero is about 12 Bytes). At best, the peak performance is 10 double precision operations every cycle at 100 MHz, which is 1 GFLOPS (only). In 2009, The Convey systems released Convey HC-1 FPGA platform with 16 DDR2-677 memories resulting in overall 80 GB/s memory bandwidth MISSING CITATION [] . The accelerator logic is allowed to run at 150 MHz, it consumes 512 Bytes of data every cycle, which corresponds to around 40 non-zeros every cycle. At best, the peak performance is 80 double precision operations every cycle at 150 MHz, which is 12 GFLOPS.

One of the key building block for custom solutions is a multi-ported buffer used to store vector entries. During execution, multiple column indexes are used as addresses to read corresponding vector entries; we shall provide more details in Section 2. Designing a buffer with very large number of read ports is challenging. One solution is banking as a mechanism to store partitioned vector entries. Although banking could allow very high throughput indexing unless the same entry is required multiple times and its reads are purely sequential and loss of bandwidth. For example, hashing techniques and data duplication are possible solutions. However another problem arise: when we distribute SpMV computations across p-nodes, some of the nodes finish early and k nodes finish later because of unbalanced load in row/column major traversal. This is common for matrices where few rows or columns are dense. The k nodes out of p finish late and refer to as straggler nodes. Using random permutation of column/row we are trying to balance the load across p workers so that there is no straggler. From this hardware prospective, randomization is an optimization and provide a clear context our current work.

At this stage, we have too many nobs and tools to tune: algorithms, data structures, and dedicated hardware (CPU, GPUs, Custom). This is a (very) hard problem and we are not here for the solution of the inverse problem: find the best Hardware-Software solution for the one matrix by vector product. We are here to provide tools, we may say naive tools, to help understand how the structure of the matrix may affect the HW-SW solution. Randomization, or versions of it, is already used by custom hardware to re-organize the data flow to reduce communications and computation bottle necks. We come to play in this arena to show *how* to use randomization if at all.

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For the readers in the field of algorithms, sparse matrix by (dense) vector is basically a sorting algorithm. Bare with us, Sorting is a method to find if an element is in a list without prior or limited knowledge of the list contents. Sorting is used to prepare the matrix and to find elements in between sparse matrices and sparse vectors. In custom architectures, sorting networks are used for routing elements of the matrix and vector to the proper functional unit. Interestingly, The best sorting algorithm is a function of the distribution of elements. If you are stuck with a sorting algorithm and the wrong distribution, randomization may change the distribution, and you do not need to talk to any HW designer. We organize our work as follows: In Section 2, we define the matrix by vector operation; in Section 3, we define what we mean for randomization. We use randomization to create a uniform distribution in Section 5 and we measure uniformity by nothing else than entropy in Section 4. We present how we drive our experiments to show the effects of randomization in Section 6. In the last sections we present a summary of the results: we present our work loads, benchmarks, in Section 7, and the complete set of measures for an AMD CPU and GPUs system in Section 8.

2 BASIC NOTATIONS

Let us start by describing the basic notations so we can clear the obvious (or not). A Sparse-matrix by vector multiplication SpMV on an (semi) ring based on the operations (+,*) is defined as $\mathbf{y} = \mathbb{M}\mathbf{x}$ so that $y_i = \sum_j M_{i,j} * y_j$ where $M_{i,j} = 0$ are not even represented and stored. Most of the experimental results in Section 8 are based on the classic addition (+) and multiplication (*) in floating point precision using 64bits (i.e., double floating point precision). SpMV based on semi-ring (min,+) is a short path algorithm based on an adjacent matrix of a graph, and using a Boolean algebra we can check if two nodes are connected, which is slightly simpler.

We identify a sparse matrix \mathbb{M} of size $M \times N$ as having O(M+N) non-zero elements, number of non zero nnz. Thus the complexity of $\mathbb{M}x$ is O(M+N)=2nnz. Of course, the definition of sparsity may vary. We represent the matrix \mathbb{M} by using the Coordinate COO or and the compressed sparse row CSR^1 format. The COO represents the non-zero of a matrix by a triplet (i, j, val), very often there are three identical-in-size vectors for the ROW, COLUMN, and VALUE. The COO format takes $3 \times nnz$ space and two consecutive elements in the value array are not bound to be neither in the same row nor column. In fact, we know only that $VALUE[i] = M_{ROW[i], COLUMN[i]}$.

The CSR stores elements in the same row and with increasing column values consecutively. There are three arrays V, COL, and ROW. The ROW is sorted in increasing order, its size is M, and ROW[i] is an index in V and COL describing where row-i starts (i.e., if row i exists). We have that $M_{i,*}$ is stored in V[ROW[i]:ROW[i+1]] and the column are at COL[ROW[i]:ROW[i+1]] and sorted increasingly. The CSR takes $2 \times nnz + M$ space and a row vector of the matrix can be found in O(1).

The computation as $y_i = \sum_i M_{i,j} * x_j$ is a sequence of dot products and the CSR representation is a natural:

$$Index = ROW[i] : ROW[i+1]$$

$$y_i = \sum_{\ell \in Index} V[\ell] * x_{COL[\ell]}$$

The matrix row is contiguous (in memory) and contiguous rows are contiguous. The access of the (dense) vector \mathbf{x} could have no pattern. The COO format could use a little preparation: For example, we can sort the array by row and add row information to achieve the same properties of CSR; however transposing a COO matrix is just a swap of the array ROW and COL. Think about matrix multiply. As today, each dot product achieves peak performance if the reads of the vector \mathbf{x} are streamlined as much as possible and so the reads of the vector V. If we have multiple cores, each

¹a.k.a. Compressed row storage CRS.

could compute a sub set of the y_i and a clean data load balancing can go a long way. If we have a few functional units, we would like to have a constant stream of independent * and + operations but with data already in registers: that is, data pre-fetch will go a long way especially for $x_{COL[i]}$, which may have an irregular pattern.

3 RANDOMIZATION

We refer to *Randomization* as row or column permutations of the matrix \mathbb{M} (thus a permutation of y and x) and we choose these by a pseudo-random process. Why we want to introduce uncertainty? The sparsity of our matrix \mathbb{M} has a pattern representing the nature of the original problem; such a pattern may exploit the wrong computation for an architecture; we could break such a pattern so that the only property left is a uniform distribution (of some sort). We must avoid the worst case and we would opt for an average case instead and we could do this to a class of \mathbb{M} .

If we know the matrix \mathbb{M} and we know the architecture, preconditioning must be a better solution. Well, it is. If we run experiments long enough, we choose the best permutations for the architecture, permute \mathbb{M} , and go on testing the next. On one end, preconditioning exerts a full understanding of both the matrix (the problem) and how the final solution will be computed (architecture). This is the culminating point of knowing and we must strive to it. On the other end, the simplicity of a random permutation requires no information about the matrix, the vector, and the architecture. Such a simplicity can be exploited directly in HW. We are after an understanding when randomization is just enough: we want to let the hardware do its best with the least effort, or at least with the appearance to be effortless. Also we shall show there are different flavors of random.

Interestingly, this work stems from a sincere surprise about randomization efficacy and its application on custom SpMV. Here, we want to study this problem systematically so that to help future hardware designs. Intuitively, if we can achieve a uniform distribution of the rows of matrix \mathbb{M} we can have provable expectation of its load balancing across multiple cores. If we have a uniform distribution of accesses on x we could exploit column load balancing and exploit better sorting algorithms: in practice the reading of $x_{COL[i]}$ can be reduces to a sorting and we know that different sparsity may require different algorithms. This is a lot to unpack but this translates to a better performance of the sequential algorithm without changing the algorithm or better HW utilization.

We will show that (different) randomness affects architectures and algorithms differently, making randomization a suitable optimization especially when the application and hardware are at odds, hardware is difficult to change and the matrix sparsity is simple to change. We want to show that there is a randomness hierarchy that we can distinguish as global and local; there are simple-to-find cases where the sparsity breaks randomness and the matrix has to be split into components. We want to show that this study uses common tool, open software tools and sometimes naive experiments; however, we can infer properties applicable to proprietary and custom solutions.

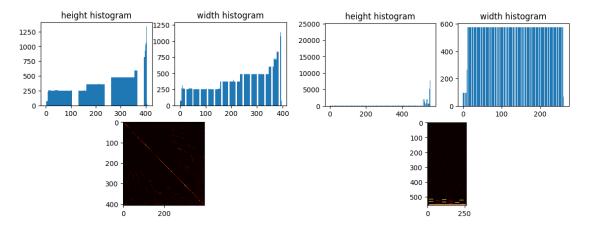


Fig. 1. Left: OPF 3754. Right: LP OSA 07. These are histograms where we represent normalized buckets and counts

4 ENTROPY

Patterns in sparse matrices are often visually pleasing, see Figure 1 where we present the height histogram, the width histograms and a two-dimensional histogram as heat map. We will let someone else using AI picture classification. Intuitively, we would like to express a measure of uniform distribution and here we apply the basics: *Entropy*. Given an histogram $i \in [0, M-1]$ $h_i \in \mathbb{N}$, we define $S = \sum_{i=0}^{M-1} h_i$ and thus we have a probability distribution function $p_i = \frac{h_i}{S}$. The *information* of bin i is defined as $I(i) = -\log_2 p_i$. If we say that the stochastic variable X has PDF p_i than the entropy of X is defined as.

$$H(x) = -\sum_{i=0}^{M-1} p_i \log_2 p_i = \sum_{i=0}^{M-1} p_i I(i) = E[I_x]$$
 (1)

The maximum entropy is when $\forall i, p_i = p = \frac{1}{M}$; that is, we are observing a uniform distributed event. There is no conceptual difference when the PDF represents a two dimensional distribution. Thus our randomization should aim at higher entropy numbers. The entropy for matrix LP OSA 07 is 8.41 and for OPF 3754 is 8.39. We use the entropy specified in the Scipy stats module. A single number is concise and satisfying. If you are pondering why they are so close contrary to their sparsity we discuss this next.

5 UNIFORM DISTRIBUTION

We know that we should **not** compare the entropy numbers of two matrices because entropy does not use any information about the order of the buckets only their probabilities. By construction, the matrices are quite different in sparsity and in shapes, however their entropy numbers are very close. Two matrices with the same number of non-zeros, spaced well enough in the proper number of bin, will have the same entropy. To appreciate their different sparsity, we should compare their entropy distributions by Jensen-Shannon measure (which is a symmetric measure, please do not use Kullback-Leibler KL divergence) [2]. Or we could use a representation of a hierarchical 2d-entropy, see Figure 2, where the entropy is split into 2x2, 4x4 and 8x8 (or fewer if the distribution is not square). We have a hierarchical entropy heat maps.

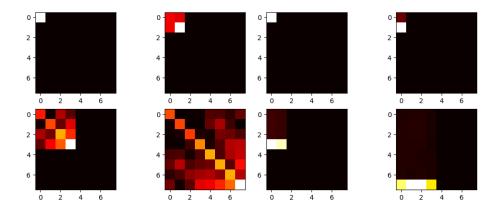


Fig. 2. Hierarchical 2D entropy for OPF 3754 (left) and LP OSA 07 (right).

We can see that a granular entropy summarizes better the nature of the matrix because it keep some spatial information. In this work, the entropy vector is used mostly for visualization purpose more than for comparison purpose. Of course, we can appreciate how the matrix LP OSA 07 has a few very heavy rows and they are clustered. This matrix will help us showing how randomization need some tips. Now we apply row and column random permutation once by row and one by column: Figure 3: OPF has now entropy 11.27 and LP 9.26. The numerical difference is significant. The good news is that for entropy, being an expectation, we can use simple techniques like bootstrap to show that the difference is significant or we have shown that Jensen-Shannon can be used and a significance level is available. What we like to see is the the hierarchical entropy heat map is becoming *more* uniform for at least one of the matrix.

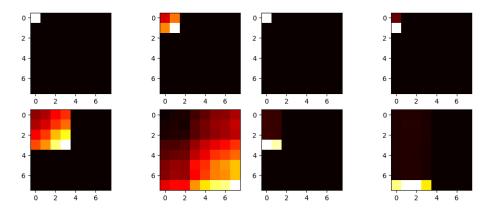


Fig. 3. Hierarchical 2D entropy after row and column random permutation for OPF 3754 (left) and LP OSA 07 (right).

In practice, permutations need some help especially for relatively large matrices. As you can see, the permutation affects locally the matrix. Of course, it depends on the implementation of the random permutation (we use numpy for this) but it is reasonable a slightly modified version of the original is still a random selection but unfortunately they seem more likely than they should. We need to compensate or help the randomization so that this current implementation does not get too lazy.

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If we are able to identify the row and column that divide high and low density, we could use them as pivot for a shuffle like in a quick-sort algorithm. We could apply a sorting algorithm but its complexity will the same of SpMV. We use a gradients operations to choose the element with maximum steepness, Figure 4 and 5

LP achieves entropy 8.67 and 9.58 and OPF achieves 10.47 and 11.40.

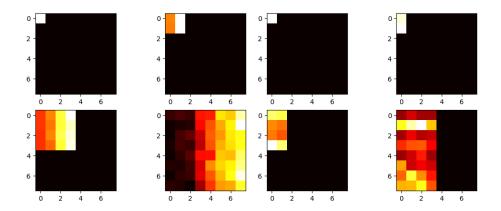


Fig. 4. Hierarchical 2D entropy after height gradient based shuffle and row random permutation for OPF 3754 (left) and LP OSA 07 (right).

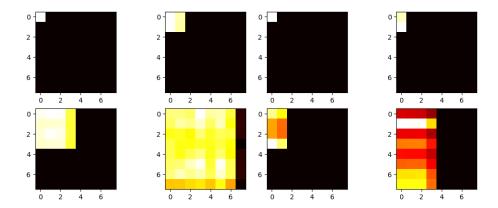


Fig. 5. Hierarchical 2D entropy after height and width gradient shuffle and row and column random permutation for OPF 3754 (left) and LP OSA 07 (right).

If the goal is to achieve a uniformly sparse matrix, it seems that we have the tools to compute and to measure such a sparsity. We admit that we do not try to find the best permutation. But our real goal is to create a work bench where randomization can be tested on different architectures and different algorithms. A randomization with a measurable uniform distribution is preferable than just random. We are interested to find out when random is enough or not enough. Also, consider that to achieve a uniform distribution, we do not need a random transformation and any permutation balancing the number of non-zero is possible, but for now not looked for.

6 MEASURING THE RANDOMIZATION EFFECTS

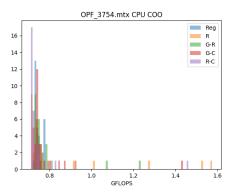
Whether or not this ever applied to the reader, when we have timed algorithms (i.e., measure execution time), we came to expect variation. The introduction of randomization may hide behind the ever present variance, after all these are algorithms on *small* inputs and small error can be comparable to the overall execution time. Here, we must address this concern even before describing the experiments.

First, we execute every algorithm between 1000 and 5000 times. The time of each experiment is in the seconds, providing a granularity for which we are confident the measuring time error is under control. Thus, for each experiment we provide an average execution time: we measure the time and we divide by the number of trials. Cold starts, the first iteration, are still accounted. To make the measure portable across platform we present GFLOPS, that is, Giga (10^{12}) floating operations per second: 2*nnz divided by the average time in seconds.

Then we repeat the same experiment 32 times. Permutations in *numpy* Python uses a seed that is time sensitive: thus every experiment is independent from the previous. The number 32 is an old statistic trick and it is a minimum number of independent trials to approximate a normal distribution. In practice, they are not but the number is sufficient for most of the cases and it is an excellent starting point.

A short hand legend: **Reg** is the matrix without any permutation and thus is the regular; **R** stands for random Row permutation; **G-R** stands for gradient-based row shuffle and random row permutation; **G-C** stands for gradient-based column shuffle and random column permutation; **R-C** stands for random row and column permutation. This legend is used in the pictures to be concise, in the tables in the following sections, we use a verbose description. We shall clarify the gradient based approach in the experimental results section 8. Intuitively, we help the random permutation by a quick targeting of high and low volume of the histogram (and thus the matrix).

In Figure 6, We show CPU performance using COO and CSR SpMV algorithms for the matrix OPF 3754. We can see that the CSR algorithms are consistent and the Regular (i.e., the original) has always the best performance. For the COO, permutations introduce long tails, thus performance advantage.



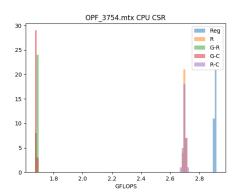
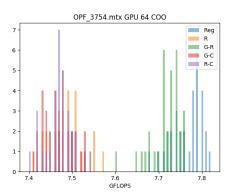


Fig. 6. CPU COO (left) and CPU CSR (left) for OPF 3754

In Figure 7, 8 and 9, randomization is harmful to the GPU implementation. The OPF 375 matrix is mostly diagonal, thus the vector \mathbf{x} is read in close quarters, randomization breaks it. If the load balance is fixed (i.e., by dividing the matrix by row and in equal row), randomization is beneficial.



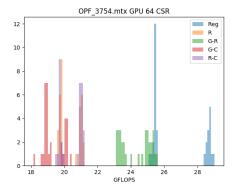
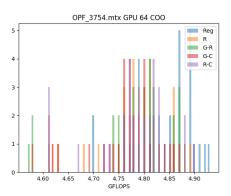


Fig. 7. Vega 20, GPU 64bits COO (left) and GPU CSR (right) for OPF 3754



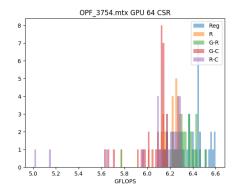
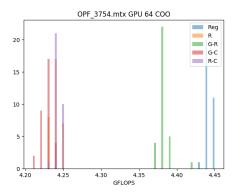


Fig. 8. Ellesmere, GPU 64bits COO (left) and GPU CSR (right) for OPF 3754



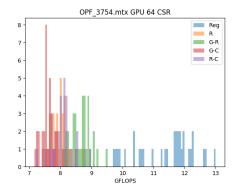


Fig. 9. Fiji, GPU 64bits COO (left) and GPU CSR (right) for OPF 3754

If we take the original matrix and split into part having the same number of rows, and execute them in parallel using different cores, we can see in Figure 10 that randomization is quite useful.

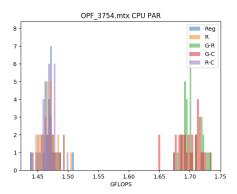


Fig. 10. Parallel CPU CSR for OPF 3754

For matrix LP OSA 07, randomization helps clearly only for CPU CSR as we show in Figure 11

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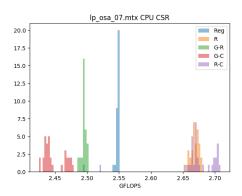


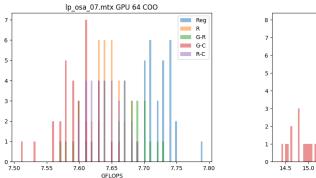
Fig. 11. CPU CSR for LP OSA 07

In Figure 12, 13, and 14, we can see that randomization is harmful but for one GPU, we can show that a single exception is possible (40% improvement).

An example, the matrix MULT DCOP 01, is where randomization is useful for the CPU, GPU, and the parallel version Figure 15, 16 - 19 and the gains can be up to 10-15%. Consider, we can achieve these improvements without any insights to the architecture, the algorithms and their relationships.

What does it mean when randomization does not work? The matrices we use in this work are not chosen randomly (pun not intended), they are the matrices that are difficult to handle in our custom SpMV engines using a combination of sorting networks and systolic arrays. If randomization does not work in our simplified work bench, will not work in our specialized architecture because the reorganization of the matrix or the input and output vector does not have the necessary parallelism, data locality, and data streaming. We need to do something else. In this case disrupting the memory pattern is not sufficient. Thus, if we cannot beat the pattern, we must exploit it, well not in this work.

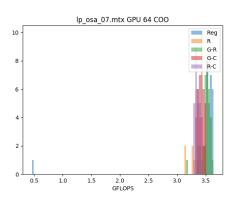
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Ip_osa_07.mtx GPU 64 CSR

8 - Reg R G-R
6 - G-R
3 - G-R
14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5 18.0 18.5 GFLOPS

Fig. 12. Vega 20, GPU 64bits COO (left) and GPU CSR (right) for OPF 3754



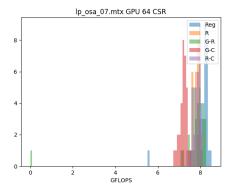
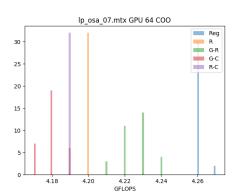


Fig. 13. Ellesmere, GPU 64bits COO (left) and GPU CSR (right) for OPF 3754



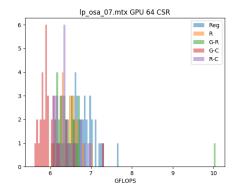


Fig. 14. Fiji, GPU 64bits COO (left) and GPU CSR (right) for OPF 3754

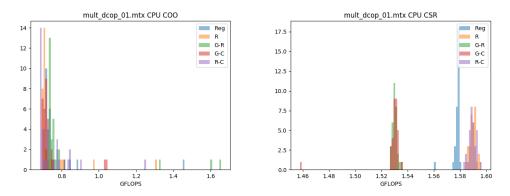


Fig. 15. CPU COO (left) and CPU CSR (right) for MULT DCOP 01

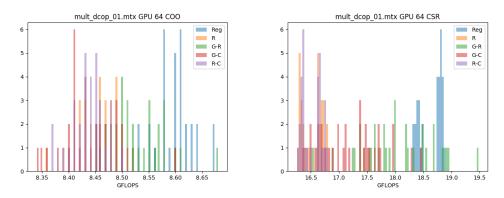


Fig. 16. Vega 20, GPU 64bits COO (left) and GPU CSR (right) for MULT DCOP 01

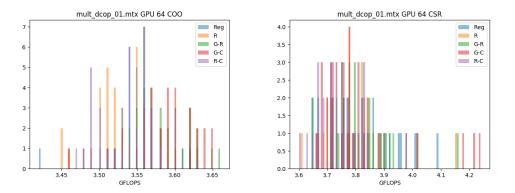
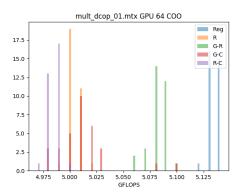


Fig. 17. Ellesmere, GPU 64bits COO (left) and GPU CSR (right) for MULT DCOP 01



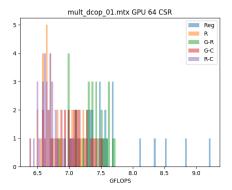


Fig. 18. Fiji, GPU 64bits COO (left) and GPU CSR (right) for MULT DCOP 01

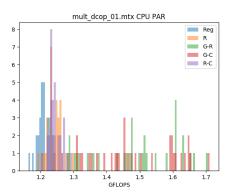


Fig. 19. Parallel CPU CSR for MULT DCOP 01

7 WORKLOADS

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In the previous sections, we defined what we mean for randomization and we present our tools of tricks for the measure of the effects of randomization. Here we describe the work loads, the applications, we use to test the effects of the randomization.

7.1 Python COO and CSR algorithms

The simplicity to compute the SpMV by the code z = A * b in Python is very rewarding. By change of the matrix storage format, A = A.tocsr(); z = A * b, we have a different algorithm. The performance exploitation is moved to the lower level. The CSR implementation is often two times faster but there are edge cases where the COO and COO with randomization can go beyond and be surprisingly better: MUL DCOP 03 is an example where COO can do well.

Intuitively, Randomization can affect the performance because the basic implementation is a sorting algorithm and it is a fixed algorithm. There are many sorting algorithms and each can be optimal for a different initial distribution. If we knew what is the sorting algorithm we could tailor the input distribution. Here we just play with it.

In Section 8, we present all the results for CPU and GPUS. Keep in mind that these problems are hard, in the sense they do not have fancy performance sheets (these architectures can achieve Tera FLOPs sustained performance for dense computations). If we go through diligently, we can see that there is a 15x performance difference between the single thread CPU and Vega 20 GPU (i.e, 3 vs 40 GFLOPS).

7.2 Parallel CSR using up to 16 cores

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Python provides the concept of Pool to exploit a naive parallel computation. We notice that work given to a Pool is split accordingly to the number of elements to separate HW cores. We also noticed that the work load move from a core to another, thus not ideal. Also we notice that Pool introduce a noticeable overhead: a Pool of 1, never achieves the performance of the single thread z = A * b. Using Pool allows us to investigate how a naive row partitioning without counting can scale up with number of cores. We tested by splitting the rows to 1–16 cores evenly (one thread per core) and we present the performance for only the best configuration. The randomization goal is to distribute the work uniformly: a balanced work distribution avoid the unfortunate case where a single core does all the work. We are pleased by the simplicity of the benchmark and we know we can do better.

7.3 GPU COO and CSR algorithms

In this work, we use AMD GPUs and *rocSPARSE* is their current software. The software has a few glitches but overall can be used for different generation of AMD GPUs. We use the COO and CSR algorithms and we provide performance measure for double precision only. The ideas of using different GPUs: it is important to verify that the randomization can be applied independently of the HW. We are not here to compare performance across GPUs and CPUs. Often the limitation is the software, how the software can exploit the hardware or how the software will make easy to use a specific GPU. For example, the Fiji architecture is clearly superior to the Ellesmere, however the latter have better support and the system overall is more stable and user friendly.

The performance of the CSR algorithm is about two times faster than the COO. Most of the algorithms count the number of sparse elements in a row and thus they can decide the work load partition accordingly. Counting give you an edge but without changing the order of the computation there could be cases where the work load is not balanced and a little randomization could help and it does.

8 7.4 Randomization sometimes works

For the majority of the cases we investigated and reported in the following sections, Randomization does not work. However, there are cases where randomization does work and does work for different algorithms and architectures. If you are in the business of preconditioning, permutations are pretty cheap. If you can find a good one just consider like a preconditioning matrix, which it is.

This shows also that HW has to be more conscious, well the HW designer should, and accept that there are options at software level, at matrix level and beyond.

8 EXPERIMENTAL RESULTS

The main hardware setup is a AMD Threadripper with 16 cores. We have three Radeon GPUs: Vega 20 7nm, Pro 2xFiji, and Pro 2xEllesmere.

Vega 20 can deliver 3.5TFLOPS in double precision and it has 1TB/s HBM memory. Each Fiji provides 0.5 TFLOPS in double precision and has 512GB/s HBM, the card has two chips. The Ellesmere provides 0.3TFLOPS in double precision Manuscript submitted to ACM

and has 224GB/s DDR5, the card has two chips. In the performance plots presented earlier and in the following, you will notice that the performance gap between these GPUs is not so marked. We can safely state that $vega \sim 2 \times Fiji$ and $Fiji \sim 2 \times ellesmere$

There are 4 basic randomization formats:

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- Random Row Permutation, we take the original matrix and permute the rows.
- Random Row and Column Permutation, we take the original matrix and permute the rows and the columns.
- Gradient based row permutation, we compute the row histogram and we compute the gradient: $h_{i+1} h_i$. We find a single point where the gradient is maximum, this is the pivot for a shuffle like a magician would shuffle a deck of cards. Then we permute the two parts randomly.
- Gradient based row and column permutation, As above but also for the columns.

For large matrices (large number of columns and rows) a permutation tends to be a close variation of the original, still a random permutation. The gradient allows us to describe two area of the original matrix where there is a clear and de-marked density variation: for example, there are two uniform distributed sub matrices but one denser than the other. A shuffle redistribute every other sample/card to different parts and these can be permuted locally.

We report in the following the performance results, we introduce a * following the best performance. This is tedious to read and, we assure, to write. The code and the results are available as software repository.

286	9 VEGA VII A	AND THREADRIPPER	359	mult_dcop_02.mtx	
207			360	Regular	
287	mult_dcop_03.mtx		361		CPU COO min 1.615 max* 1.677 mean 1.652
288	Regular		362		CPU CSR min 1.539 max 1.579 mean 1.575
289		CPU COO min 0.728 max 0.880 mean 0.757	363		GPU 64 COO min 8.530 max* 8.700 mean 8.614
290		CPU CSR min 1.563 max 1.581 mean 1.577	364		CSR min 18.290 max 18.890 mean 18.597
291		GPU 64 COO min 8.540 max* 8.670 mean 8.619	365		CPU PAR min 1.120 max 1.248 mean 1.211
292		CSR min 18.320 max 18.930 mean 18.620	366		H min 9.689 max 9.689 mean 9.689
293		CPU PAR min 1.170 max 1.269 mean 1.226	367	Row-Premute	
294		H min 9.689 max 9.689 mean 9.689	368		CPU COO min 0.684 max 0.780 mean 0.705
295	Row-Premute		369		CPU CSR min 1.558 max* 1.596 mean 1.588
296		CPU COO min 0.710 max 0.845 mean 0.724	370		GPU 64 COO min 8.360 max 8.490 mean 8.433
297		CPU CSR min 1.549 max* 1.597 mean 1.589	371		CSR min 16.240 max 16.750 mean 16.552
298		GPU 64 COO min 8.360 max 8.540 mean 8.442	372		CPU PAR min 1.182 max 1.277 mean 1.242
299		CSR min 16.260 max 16.780 mean 16.551	373		H min 10.737 max 10.742 mean 10.740
300		CPU PAR min 1.205 max 1.319 mean 1.263	374	Row-Gradient	
301		H min 10.737 max 10.742 mean 10.740	375		CPU COO min 0.704 max 1.373 mean 0.790
302	Row-Gradient		376		CPU CSR min 1.518 max 1.535 mean 1.529
303		CPU COO min 0.706 max 1.603 mean 0.806	377		GPU 64 COO min 8.420 max 8.590 mean 8.517
304		CPU CSR min 1.493 max 1.534 mean 1.528	378		CSR min 16.680 max*19.550 mean 17.907
305		GPU 64 COO min 8.430 max 8.610 mean 8.527	379		CPU PAR min 1.328 max* 1.713 mean 1.484
306		CSR min 17.070 max*18.970 mean 18.115	380		H min 10.572 max 10.585 mean 10.581
307		CPU PAR min 1.331 max 1.695 mean 1.513	381	Column-Gradient	
308		H min 10.576 max 10.585 mean 10.580	382		CPU COO min 0.697 max 1.460 mean 0.742
309	Column-Gradient		383		CPU CSR min 1.517 max 1.534 mean 1.527
310		CPU COO min 0.694 max* 1.632 mean 0.797	384		GPU 64 COO min 8.330 max 8.490 mean 8.420
311		CPU CSR min 1.491 max 1.534 mean 1.529	385		CSR min 16.020 max 18.390 mean 17.303
312		GPU 64 COO min 8.350 max 8.520 mean 8.429	386		CPU PAR min 1.321 max 1.709 mean 1.557
313		CSR min 15.970 max 18.180 mean 17.124	387		H min 10.823 max*10.843 mean 10.835
314		CPU PAR min 1.321 max* 1.728 mean 1.514	388	Row-Column-Permute	man rotors max rotors mean rotors
315		H min 10.826 max*10.840 mean 10.833	389	now column remade	CPU COO min 0.691 max 0.746 mean 0.698
316	Row-Column-Permute		390		CPU CSR min 1.568 max 1.595 mean 1.587
317		CPU COO min 0.688 max 0.757 mean 0.696	391		GPU 64 COO min 8.350 max 8.500 mean 8.436
318		CPU CSR min 1.490 max 1.595 mean 1.584	392		CSR min 16.250 max 16.780 mean 16.517
319		GPU 64 COO min 8.380 max 8.500 mean 8.445	393		CPU PAR min 1.187 max 1.280 mean 1.228
320		CSR min 16.230 max 16.780 mean 16.513	394		H min 10.739 max 10.743 mean 10.740
321		CPU PAR min 1.192 max 1.274 mean 1.237	395	lp_fit2d.mtx	11 11 10:735 max 10:715 mean 10:716
322		H min 10.737 max 10.742 mean 10.740	396	Regular	
323	mult_dcop_01.mtx		397	negata.	CPU COO min 0.774 max 0.804 mean 0.793
324	Regular		398		CPU CSR min 2.538 max 2.550 mean 2.547
325		CPU COO min 0.710 max 1.453 mean 0.761	399		GPU 64 COO min 7.060 max 7.170 mean 7.101
326		CPU CSR min 1.561 max 1.581 mean 1.578	400		CSR min 15.650 max*18.700 mean 18.031
327		GPU 64 COO min 8.520 max 8.670 mean 8.597	401		CPU PAR min 1.537 max 1.645 mean 1.590
328		CSR min 18.320 max 18.870 mean 18.636	402		H min 11.109 max 11.109 mean 11.109
329		CPU PAR min 1.163 max 1.246 mean 1.212	403	Row-Premute	man riches max riches mean riches
330		H min 9.689 max 9.689 mean 9.689	404	now i i cinace	CPU COO min 0.740 max 0.776 mean 0.746
331	Row-Premute		405		CPU CSR min 3.302 max* 3.328 mean 3.317
332		CPU COO min 0.699 max 1.305 mean 0.745	406		GPU 64 COO min 7.040 max* 7.180 mean 7.098
333		CPU CSR min 1.585 max 1.597 mean 1.590	407		CSR min 15.690 max 18.580 mean 16.732
334		GPU 64 COO min 8.360 max 8.520 mean 8.446	408		CPU PAR min 1.327 max 1.482 mean 1.422
335		CSR min 16.260 max 16.780 mean 16.528	409		H min 11.098 max 11.105 mean 11.101
336		CPU PAR min 1.192 max 1.298 mean 1.242	410	Row-Gradient	
337		H min 10.738 max 10.742 mean 10.740	411		CPU COO min 0.739 max* 2.092 mean 1.091
338	Row-Gradient		412		CPU CSR min 2.539 max 2.546 mean 2.543
339		CPU COO min 0.709 max* 1.656 mean 0.819	413		GPU 64 COO min 7.040 max 7.150 mean 7.100
340		CPU CSR min 1.527 max 1.535 mean 1.530	414		CSR min 15.520 max 18.560 mean 17.547
341		GPU 64 COO min 8.450 max* 8.680 mean 8.527	415		CPU PAR min 1.401 max 1.661 mean 1.525
342		CSR min 16.520 max*19.480 mean 17.984	416		H min 11.109 max 11.109 mean 11.109
343		CPU PAR min 1.280 max 1.704 mean 1.485	417	Column-Gradient	
344		H min 10.572 max 10.585 mean 10.581	418		CPU COO min 0.726 max 2.065 mean 1.011
345	Column-Gradient		419		CPU CSR min 2.539 max 2.550 mean 2.546
346		CPU COO min 0.698 max 1.042 mean 0.737	420		GPU 64 COO min 6.800 max 7.140 mean 7.080
347		CPU CSR min 1.458 max 1.536 mean 1.528	421		CSR min 15.480 max 18.560 mean 16.866
348		GPU 64 COO min 8.340 max 8.600 mean 8.443	422		CPU PAR min 1.391 max* 1.737 mean 1.563
349		CSR min 16.360 max 18.450 mean 17.247	423		H min 11.329 max 11.333 mean 11.331
350		CPU PAR min 1.307 max* 1.712 mean 1.494	424	Row-Column-Permute	
351		H min 10.823 max*10.841 mean 10.835	425		CPU COO min 0.746 max 0.782 mean 0.754
352	Row-Column-Permute		426		CPU CSR min 3.310 max 3.324 mean 3.318
353		CPU COO min 0.683 max 1.247 mean 0.749	427		GPU 64 COO min 7.030 max 7.160 mean 7.100
354		CPU CSR min 1.583 max* 1.595 mean 1.590	428		CSR min 15.730 max 18.530 mean 17.362
355		GPU 64 COO min 8.370 max 8.500 mean 8.435	429		CPU PAR min 1.340 max 1.451 mean 1.401
356		CSR min 16.250 max 16.780 mean 16.518	430		H min 11.099 max 11.104 mean 11.102
357		CPU PAR min 1.206 max 1.291 mean 1.243	431	bloweya.mtx	
358		H min 10.738 max 10.742 mean 10.740	432	Regular	

433		CPU COO min 0.727 max* 1.815 mean 0.892	507	GPU 64 COO min 11.340 max*11.860 mean 11.441
434		CPU CSR min 2.867 max* 2.936 mean 2.917	508	CSR min 36.010 max*40.960 mean 38.048
435		GPU 64 COO min 0.000 max 0.000 mean 0.000	509	CPU PAR min 2.019 max 2.204 mean 2.130
436		CSR min 0.000 max 0.000 mean 0.000	510	H min 8.228 max 8.228 mean 8.228
437		CPU PAR min 1.680 max* 1.751 mean 1.719	511 Row-Premute	
438		H min 7.205 max 7.205 mean 7.205	512	CPU COO min 0.718 max 0.751 mean 0.732
439	Row-Premute		513	CPU CSR min 2.488 max 2.507 mean 2.498
440		CPU COO min 0.678 max 1.483 mean 0.746	514	GPU 64 COO min 10.810 max 11.090 mean 10.949
441		CPU CSR min 2.311 max 2.326 mean 2.320	515	CSR min 24.860 max 26.410 mean 25.527
442		GPU 64 COO min 6.840 max* 7.270 mean 6.930	516	CPU PAR min 1.978 max 2.290 mean 2.135
443		CSR min 15.650 max 16.800 mean 16.233	517	H min 11.836 max 11.840 mean 11.838
444		CPU PAR min 1.649 max 1.730 mean 1.682	518 Row-Gradient	11 IIIII 11.030 IIIAX 11.040 IIIEAII 11.030
445		H min 11.026 max 11.031 mean 11.029	519	CPU COO min 0.722 max 1.794 mean 0.769
446	Row-Gradient		520	CPU CSR min 2.407 max 2.421 mean 2.416
447		CPU COO min 0.708 max 1.209 mean 0.779	521	GPU 64 COO min 11.210 max 11.480 mean 11.317
448		CPU CSR min 1.648 max 1.735 mean 1.709	522	CSR min 31.920 max 34.690 mean 33.246
449		GPU 64 COO min 6.920 max 7.080 mean 7.015	523	CPU PAR min 2.184 max* 2.302 mean 2.232
450		CSR min 16.950 max 19.500 mean 17.794	524	H min 10.742 max 10.757 mean 10.748
451		CPU PAR min 1.497 max 1.743 mean 1.608	525 Column-Gradient	
452		H min 10.298 max 10.304 mean 10.301	526	CPU COO min 0.720 max 0.916 mean 0.742
453	Column-Gradient		527	CPU CSR min 2.395 max 2.410 mean 2.402
454		CPU COO min 0.709 max 1.536 mean 0.817	528	GPU 64 COO min 10.840 max 11.070 mean 10.946
455		CPU CSR min 1.705 max 1.753 mean 1.735	529	CSR min 24.340 max 26.140 mean 25.393
456		GPU 64 COO min 6.800 max 7.120 mean 6.865	530	CPU PAR min 2.184 max 2.272 mean 2.223
457		CSR min 15.480 max*17.710 mean 16.470	531	H min 11.873 max 11.882 mean 11.878
				n IIIII 11.8/3 IIIAX 11.882 IIIEAN 11.8/6
458			532 Row-Column-Permute	
459		H min 10.880 max 10.886 mean 10.883	533	CPU COO min 0.707 max 0.748 mean 0.714
460	Row-Column-Permute		534	CPU CSR min 2.458 max 2.511 mean 2.506
461		CPU COO min 0.670 max 1.024 mean 0.706	535	GPU 64 COO min 10.880 max 11.070 mean 10.957
462		CPU CSR min 2.199 max 2.340 mean 2.326	536	CSR min 24.890 max 26.490 mean 25.642
463		GPU 64 COO min 6.880 max 6.980 mean 6.933	537	CPU PAR min 2.209 max 2.282 mean 2.240
464		CSR min 15.610 max 16.900 mean 16.227	538	H min 11.834 max*11.840 mean 11.838
465		CPU PAR min 1.598 max 1.668 mean 1.632	539 brainpc2.mtx	
466		H min 11.025 max*11.032 mean 11.029	540 Regular	
467	lp_osa_07.mtx		541	CPU COO min 0.732 max 0.751 mean 0.744
468	Regular		542	CPU CSR min 2.885 max* 2.916 mean 2.909
469		CPU COO min 0.715 max 1.798 mean 0.885	543	GPU 64 COO min 0.000 max 0.000 mean 0.000
470		CPU CSR min 2.495 max 2.551 mean 2.547	544	CSR min 0.000 max 0.000 mean 0.000
471		GPU 64 COO min 7.650 max* 7.790 mean 7.718	545	CPU PAR min 1.276 max 1.299 mean 1.286
472		CSR min 16.390 max*18.350 mean 17.093		H min 7.478 max 7.478 mean 7.478
			546	n IIIII 7.476 IIIdX 7.476 IIIedII 7.476
473		CPU PAR min 0.963 max 1.012 mean 0.995	547 Row-Premute	
474		H min 8.412 max 8.412 mean 8.412	548	CPU COO min 0.727 max 0.855 mean 0.736
475	Row-Premute		549	CPU CSR min 2.385 max 2.411 mean 2.397
476		CPU COO min 0.720 max* 2.078 mean 1.104	550	GPU 64 COO min 8.120 max 8.410 mean 8.206
477		CPU CSR min 2.656 max* 2.679 mean 2.669	551	CSR min 18.670 max 19.960 mean 19.536
478		GPU 64 COO min 7.610 max 7.690 mean 7.647	552	CPU PAR min 1.293 max 1.340 mean 1.314
479		CSR min 15.910 max 17.210 mean 16.750	553	H min 9.809 max 9.813 mean 9.811
480		CPU PAR min 0.890 max 0.940 mean 0.918	554 Row-Gradient	
481		H min 9.255 max 9.258 mean 9.256	555	CPU COO min 0.696 max* 1.546 mean 0.785
482	Row-Gradient		556	CPU CSR min 1.361 max 1.420 mean 1.411
483		CPU COO min 0.725 max 2.078 mean 1.041	557	GPU 64 COO min 8.190 max* 8.550 mean 8.302
484		CPU CSR min 2.487 max 2.502 mean 2.495	558	CSR min 18.700 max*21.000 mean 19.890
485		GPU 64 COO min 7.570 max 7.730 mean 7.655	559	CPU PAR min 1.435 max 1.666 mean 1.549
486		CSR min 15.370 max 18.100 mean 16.803	560	H min 9.721 max 9.727 mean 9.723
487		CPU PAR min 1.435 max 1.796 mean 1.592	561 Column-Gradient	
488		H min 8.637 max 8.678 mean 8.672	562	CPU COO min 0.698 max 1.467 mean 0.746
489	Column-Gradient	min 5.55, max 6.576 mean 6.572	563	CPU CSR min 1.377 max 1.423 mean 1.414
490	COTUMN OF BUTCHE	CPU COO min 0.724 max 1.990 mean 1.000		GPU 64 COO min 8.110 max 8.290 mean 8.187
			564	
491		CPU CSR min 2.425 max 2.477 mean 2.448	565	CSR min 18.090 max 20.190 mean 19.217
492		GPU 64 COO min 7.510 max 7.660 mean 7.596	566	CPU PAR min 1.345 max* 1.681 mean 1.518
493		CSR min 14.410 max 16.290 mean 15.267	567	H min 10.369 max*10.372 mean 10.370
494		CPU PAR min 1.238 max 1.774 mean 1.534	568 Row-Column-Permute	
495		H min 9.447 max* 9.603 mean 9.576	569	CPU COO min 0.698 max 1.390 mean 0.788
496	Row-Column-Permute		570	CPU CSR min 2.387 max 2.410 mean 2.399
497		CPU COO min 0.738 max 1.950 mean 1.071	571	GPU 64 COO min 8.120 max 8.260 mean 8.191
498		CPU CSR min 2.522 max 2.709 mean 2.675	572	CSR min 18.530 max 19.960 mean 19.307
499		GPU 64 COO min 7.600 max 7.690 mean 7.641	573	CPU PAR min 1.295 max 1.347 mean 1.319
500		CSR min 15.820 max 17.190 mean 16.572	574	H min 9.809 max 9.813 mean 9.811
501		CPU PAR min 0.891 max 0.944 mean 0.924	575 shermanACb.mtx	2.2.2
502		H min 9.255 max 9.258 mean 9.256	576 Regular	
502	ov10 mtv	min 5.255 max 5.256 mean 5.256		CPU COO min 0.712 max 1.201 mean 0.756
	ex19.mtx		577	
504	Regular	000 000	578	CPU CSR min 1.558 max 1.601 mean 1.596
505		CPU COO min 0.732 max* 1.837 mean 1.076	579	GPU 64 COO min 7.080 max* 7.370 mean 7.184
506		CPU CSR min 2.563 max* 2.586 mean 2.577	580	CSR min 17.580 max*19.480 mean 18.770

F0.1		CPU PAR	_:-	1 206	1 511	- 1 44		Daw Dannista				
581 582		H H			1.511 mea 8.600 mea			Row-Premute	CPU COO	min 0 724 may	1.100 mean 0.765	
583	Row-Premute	"	IIIIII	0.000 IIIax	0.000 IIIea	11 0.000	657				2.626 mean 2.609	
	NOW-F1 elliute	CPU COO	min	A 600 may	0.890 mea	n 0 70					7.340 mean 7.253	
584		CPU CSR									7.340 mean 7.253 18.500 mean 18.014	
585					1.630 mea 7.180 mea							
586					17.240 mea						1.607 mean 1.558 10.047 mean 10.044	
587 588		CPU PAR			1.419 mea			Row-Gradient	п	min 10.043 max	10.047 mean 10.044	
589		H H			10.380 mea			KOW-GI addellt	CPU COO	min 0 716 may	1.701 mean 0.804	
590	Row-Gradient	П	IIIII I	10.3/6 IIIax	10.300 IIIea	11 10.37	664				1.840 mean 1.832	
591	ROW=Gradient	CPU COO		0.704	1.615 mea	- 0.000					7.510 mean 7.303	
597		CPU CSR			1.370 mea						7.510 mean 7.303 20.710 mean 19.302	
593					7.160 mea						1.593 mean 1.526	
593												
		CPU PAR			16.290 mea			0.1	н	min 9.681 max	9.706 mean 9.694	
595		H PAR			1.520 mea 9.925 mea			Column-Gradient	CPU COO		1 000 0 746	
596	0.1	н	mın	9.915 max	9.925 mea	n 9.92					1.029 mean 0.746 1.834 mean 1.827	
597 598	Column-Gradient	CPU COO		0.700	. 1 626		671				7.270 mean 7.193	
		CPU COO			* 1.626 mea							
599		0.0 0010			1.374 mea						18.590 mean 17.574	
600					7.210 mea						1.574 mean 1.511	
601 602		CPU PAR			15.260 mea * 1.531 mea			Row-Column-Permute	Н	min 10.612 max*	10.659 mean 10.634	
603		H PAR			* 1.531 mea 10.595 mea			KOW-COTUMIN-Permute	CPU COO	-i- 0 710	1.391 mean 0.756	
	D	п	IIIII I	10.5/2 IIIdX	10.595 IIIea	11 10.594						
604	Row-Column-Permute	CDU COO		0.707	1 522		678				2.625 mean 2.611	
605		CPU COO			1.532 mea						7.320 mean 7.248	
606		CPU CSR			* 1.634 mea						18.640 mean 18.040	
607					7.110 mea						1.573 mean 1.533	
608					17.310 mea				Н	min 10.041 max	10.046 mean 10.044	
609		CPU PAR			1.406 mea			TSOPF_FS_b9_c6.mtx				
610		Н	min 1	10.377 max	10.382 mea	n 10.379		Regular				
611	cvxqp3.mtx						685				0.734 mean 0.718	
612	Regular						686				3.052 mean 3.045	
613		CPU COO			0.720 mea						0.000 mean 0.000	
614		CPU CSR			* 2.643 mea						0.000 mean 0.000	
615					* 6.220 mea						1.602 mean 1.568	
616					*22.710 mea				н	min /.380 max	7.380 mean 7.380	
617		CPU PAR			* 1.860 mea			Row-Premute				
618		Н	min	8.646 max	8.646 mea	n 8.646					1.640 mean 0.777	
619	Row-Premute						693				2.543 mean 2.525	
620		CPU COO			* 1.577 mea						7.320 mean 7.268	
621		CPU CSR			2.471 mea						18.540 mean 18.102	
622					6.060 mea						1.595 mean 1.546	
623					19.130 mea				Н	min 10.042 max '	10.046 mean 10.044	
624		CPU PAR			1.833 mea			Row-Gradient				
625		Н	min 1	11.028 max	11.033 mea	n 11.036					0.926 mean 0.750	
626	Row-Gradient						700				1.846 mean 1.832	
627		CPU COO			1.523 mea						7.370 mean 7.298	
628		CPU CSR			1.305 mea						20.740 mean 19.089	
629					6.000 mea						1.554 mean 1.495	
630					18.410 mea				Н	min 9.666 max	9.704 mean 9.690	
631		CPU PAR			1.485 mea			Column-Gradient				
632	0.1	Н	min i	п.иы тах	11.069 mea	n II.064					1.690 mean 0.791	
633	Column-Gradient	CDII COO	_4	0.603	1 501	- 0	707				1.836 mean 1.830	
634		CPU COO			1.521 mea						7.310 mean 7.211	
635		CPU CSR			1.302 mea						18.690 mean 17.617	
636					6.060 mea						1.539 mean 1.506	
637					18.330 mea				Н	min 10.611 max*	10.659 mean 10.634	
638		CPU PAR			1.464 mea			Row-Column-Permute				
639		Н	min 1	11.12/ max	*11.135 mea	n 11.136					1.531 mean 0.963	
640	Row-Column-Permute						714				2.648 mean 2.622	
641		CPU COO			1.503 mea						7.330 mean 7.244	
642		CPU CSR			2.468 mea						18.520 mean 18.148	
643					5.980 mea						1.574 mean 1.528	
644					19.140 mea			005 0000	Н	min 10.041 max 1	10.046 mean 10.044	
645					1.743 mea			OPF_6000.mtx				
646		Н	min 1	11.028 max	11.035 mea	n 11.036		Regular	ODII		0.721 2.511	
647	case9.mtx						721				0.731 mean 0.720	
648	Regular	ODU		0.707	. 1 055		722				2.770 mean 2.720	
649		CPU COO			* 1.800 mea						12.550 mean 12.425	
650		CPU CSR			* 3.046 mea						43.770 mean 42.075	
651		GPU 64 COC	mın	0.000 max	0.000 mea	n 0.000	725		CPU PAR	min 1./35 max	1.945 mean 1.845	
				0.000	0.000						0.700	
652		CSR	min		0.000 mea			Daw Danmet	Н	min 8.799 max	8.799 mean 8.799	
652 653 654		CSR	min min	1.508 max	0.000 mea 1.605 mea 7.380 mea	n 1.573	727	Row-Premute			8.799 mean 8.799 0.710 mean 0.695	

729		CPU CSR min 2.358 max 2.413 mean 2.392	803		CSR min 19.960 max 21.190 mean 20.696
730		GPU 64 COO min 11.430 max 11.770 mean 11.549	804		CPU PAR min 1.303 max 1.371 mean 1.345
731		CSR min 24.470 max 25.580 mean 24.785	805		H min 10.059 max 10.062 mean 10.061
732		CPU PAR min 1.758 max 1.896 mean 1.829	806	Row-Gradient	
733		H min 11.872 max 11.877 mean 11.875	807		CPU COO min 0.723 max 0.984 mean 0.753
734	Row-Gradient		808		CPU CSR min 1.781 max 1.809 mean 1.803
735		CPU COO min 0.716 max 0.775 mean 0.739	809		GPU 64 COO min 9.380 max 9.660 mean 9.464
736		CPU CSR min 1.651 max 1.689 mean 1.675	810		CSR min 15.770 max 19.090 mean 18.037
737		GPU 64 COO min 12.100 max 12.410 mean 12.205	811		CPU PAR min 1.775 max* 1.924 mean 1.868
738		CSR min 31.670 max 34.910 mean 33.370	812		H min 10.205 max 10.233 mean 10.219
739		CPU PAR min 2.079 max* 2.286 mean 2.207	813	Column-Gradient	11 IIII 10.203 IIIAX 10.233 IIICAN 10.213
				COTUMN-GI AUTENC	CPU COO min 0.715 max 0.926 mean 0.757
740		H min 11.111 max 11.116 mean 11.113	814		
741	Column-Gradient		815		CI O CON MILIT 1.725 Max 1.002 McGIT 1.751
742		CPU COO min 0.715 max* 1.021 mean 0.743	816		GPU 64 COO min 9.080 max 9.270 mean 9.158
743		CPU CSR min 1.655 max 1.674 mean 1.666	817		CSR min 13.980 max 15.780 mean 14.938
744		GPU 64 COO min 11.340 max 11.560 mean 11.463	818		CPU PAR min 1.751 max 1.906 mean 1.846
745		CSR min 23.770 max 25.470 mean 24.489	819		H min 11.213 max*11.232 mean 11.222
746		CPU PAR min 2.056 max 2.172 mean 2.118	820	Row-Column-Permute	
747		H min 12.040 max*12.047 mean 12.043	821		CPU COO min 0.732 max 1.598 mean 0.785
748	Row-Column-Permute		822		CPU CSR min 2.594 max 2.602 mean 2.599
749		CPU COO min 0.677 max 0.785 mean 0.687	823		GPU 64 COO min 9.340 max 9.460 mean 9.394
750		CPU CSR min 2.325 max 2.434 mean 2.369	824		CSR min 19.950 max 21.500 mean 20.544
751		GPU 64 COO min 11.450 max 11.650 mean 11.538	825		CPU PAR min 1.326 max 1.374 mean 1.354
752		CSR min 24.330 max 25.560 mean 25.008	826		H min 10.059 max 10.062 mean 10.061
753		CPU PAR min 1.631 max 1.776 mean 1.709		mhd4800a.mtx	11 MITH 10.035 Max 10.002 Mean 10.001
				Regular	
754		H min 11.873 max 11.877 mean 11.875	828	кедитаг	
755	OPF_3754.mtx		829		CPU COO min 0.759 max 0.795 mean 0.780
756	Regular		830		CPU CSR min 2.479 max* 2.565 mean 2.557
757		CPU COO min 0.726 max 0.774 mean 0.747	831		GPU 64 COO min 5.490 max* 5.650 mean 5.552
758		CPU CSR min 2.898 max* 2.919 mean 2.908	832		CSR min 16.700 max 19.460 mean 18.004
759		GPU 64 COO min 7.680 max* 7.820 mean 7.766	833		CPU PAR min 1.456 max* 1.523 mean 1.492
760		CSR min 25.070 max*29.030 mean 26.756	834		H min 7.132 max 7.132 mean 7.132
761		CPU PAR min 1.437 max 1.508 mean 1.471	835	Row-Premute	
762		H min 8.393 max 8.393 mean 8.393	836		CPU COO min 0.695 max 0.943 mean 0.726
763	Row-Premute		837		CPU CSR min 2.480 max 2.488 mean 2.485
764		CPU COO min 0.714 max* 1.574 mean 0.817	838		GPU 64 COO min 5.410 max 5.490 mean 5.453
765		CPU CSR min 2.686 max 2.711 mean 2.699	839		CSR min 15.700 max 17.520 mean 16.678
766		GPU 64 COO min 7.410 max 7.570 mean 7.484	840		CPU PAR min 1.422 max 1.514 mean 1.474
767		CSR min 19.600 max 21.190 mean 20.307	841		H min 10.959 max 10.966 mean 10.963
		CPU PAR min 1.443 max 1.505 mean 1.469	842	December 1	11 IIII1 10.555 IIIAX 10.500 IIIEAI1 10.503
768				Row-Gradient	CPU 000 0 702 2 000 0 000
769		H min 11.267 max 11.272 mean 11.269	843		CPU COO min 0.723 max* 2.029 mean 0.990
770	Row-Gradient		844		CPU CSR min 2.411 max 2.427 mean 2.421
771		CPU COO min 0.723 max 1.232 mean 0.775	845		GPU 64 COO min 5.490 max 5.560 mean 5.534
772		CPU CSR min 1.672 max 1.691 mean 1.685	846		CSR min 16.350 max*19.560 mean 17.784
773		GPU 64 COO min 7.600 max 7.760 mean 7.716	847		CPU PAR min 1.441 max 1.509 mean 1.477
774		CSR min 23.160 max 25.590 mean 24.304	848		H min 9.512 max 9.526 mean 9.520
775		CPU PAR min 1.675 max* 1.736 mean 1.703	849	Column-Gradient	
776		H min 10.463 max 10.472 mean 10.468	850		CPU COO min 0.721 max 1.802 mean 0.871
777	Column-Gradient		851		CPU CSR min 2.393 max 2.408 mean 2.404
778		CPU COO min 0.726 max 1.431 mean 0.778	852		GPU 64 COO min 5.410 max 5.480 mean 5.453
779		CPU CSR min 1.671 max 1.685 mean 1.679	853		CSR min 15.680 max 17.870 mean 16.540
780		GPU 64 COO min 7.410 max 7.530 mean 7.467	854		CPU PAR min 1.429 max 1.488 mean 1.468
781		CSR min 18.140 max 20.350 mean 19.315	855		H min 10.931 max 10.945 mean 10.938
782		CPU PAR min 1.650 max 1.736 mean 1.699	856	Row-Column-Permute	
783		H min 11.393 max*11.401 mean 11.397	857		CPU COO min 0.728 max 1.646 mean 1.037
784	Row-Column-Permute	min 11.555 max~11.401 mcan 11.557	858		CPU CSR min 2.472 max 2.488 mean 2.480
	Now-cotumn-termate	CDU COO 0 711 1 450 C 751			
785		CPU COO min 0.711 max 1.458 mean 0.751	859		GPU 64 COO min 5.410 max 5.480 mean 5.449
786		CPU CSR min 2.678 max 2.717 mean 2.700	860		CSR min 15.760 max 17.560 mean 16.654
787		GPU 64 COO min 7.400 max 7.540 mean 7.471	861		CPU PAR min 1.428 max 1.513 mean 1.474
788		CSR min 19.560 max 21.150 mean 20.453	862		H min 10.959 max*10.967 mean 10.963
789		CPU PAR min 1.440 max 1.499 mean 1.467	863	gen4.mtx	
790		H min 11.266 max 11.272 mean 11.269	864	Regular	
791	c-47.mtx		865		CPU COO min 0.737 max 1.977 mean 1.431
792	Regular		866		CPU CSR min 2.674 max 2.688 mean 2.681
793		CPU COO min 0.754 max* 1.829 mean 1.204	867		GPU 64 COO min 5.900 max 6.000 mean 5.954
794		CPU CSR min 2.610 max* 2.624 mean 2.618	868		CSR min 13.650 max 15.410 mean 14.657
795		GPU 64 COO min 9.530 max* 9.870 mean 9.640	869		CPU PAR min 1.468 max 1.521 mean 1.491
796		CSR min 23.990 max*25.910 mean 24.992	870		H min 9.234 max 9.234 mean 9.234
797		CPU PAR min 1.311 max 1.380 mean 1.357	871	Row-Premute	3.25. max 3.254 mean 3.254
798		H min 8.364 max 8.364 mean 8.364		now i remute	CPU COO min 0.740 max* 2.048 mean 1.121
	Davi Danamuti	ii iiiii 0.304 iiidx 0.304 iiiedii 0.304	872		
799	Row-Premute	CDU 000	873		CPU CSR min 2.777 max 2.798 mean 2.790
800		CPU COO min 0.740 max 0.885 mean 0.755	874		GPU 64 COO min 5.910 max 5.970 mean 5.944
801		CPU CSR min 2.574 max 2.611 mean 2.597	875		CSR min 13.700 max 15.370 mean 14.541
802		GPU 64 COO min 9.320 max 9.510 mean 9.397	876		CPU PAR min 1.468 max 1.546 mean 1.502

877		H min 10.250 max 10.255 mean 10.252	951	CPU COO min 0.735 max 1.806 mean 0.878
878	Row-Gradient		952	CPU CSR min 2.706 max 2.744 mean 2.726
879		CPU COO min 0.740 max 1.790 mean 0.994	953	GPU 64 COO min 6.390 max 6.500 mean 6.433
880		CPU CSR min 2.663 max 2.682 mean 2.674	954	CSR min 19.780 max 22.870 mean 20.936
881		GPU 64 COO min 5.890 max* 6.160 mean 5.946	955	CPU PAR min 1.710 max 1.865 mean 1.785
882		CSR min 13.780 max*17.520 mean 15.601	956	H min 10.251 max 10.267 mean 10.257
				11 IIII1 10.231 IIIAX 10.207 IIIEAII 10.237
883		CPU PAR min 1.479 max* 1.619 mean 1.569	957 Column-Gradient	
884		H min 9.939 max 9.955 mean 9.948	958	CPU COO min 0.728 max 1.792 mean 0.986
885	Column-Gradient		959	CPU CSR min 2.521 max 2.720 mean 2.703
886		CPU COO min 0.743 max 1.991 mean 0.981	960	GPU 64 COO min 6.280 max 6.370 mean 6.327
887		CPU CSR min 2.620 max 2.654 mean 2.646	961	CSR min 18.000 max 19.720 mean 19.040
888		GPU 64 COO min 5.840 max 5.910 mean 5.885	962	CPU PAR min 1.649 max 1.741 mean 1.702
889		CSR min 13.130 max 17.040 mean 15.008	963	H min 11.113 max 11.121 mean 11.117
890		CPU PAR min 1.477 max 1.607 mean 1.559	964 Row-Column-Permute	III III III III III III III III III II
891		H min 10.858 max*10.876 mean 10.864	965	CPU COO min 0.714 max 1.525 mean 0.957
892	Row-Column-Permute		966	CPU CSR min 2.876 max 2.892 mean 2.884
893		CPU COO min 0.742 max 2.010 mean 1.124	967	GPU 64 COO min 6.280 max 6.370 mean 6.322
894		CPU CSR min 2.789 max* 2.800 mean 2.795	968	CSR min 17.960 max 19.670 mean 18.670
895		GPU 64 COO min 5.900 max 5.980 mean 5.941	969	CPU PAR min 1.667 max 1.754 mean 1.710
896		CSR min 13.640 max 15.410 mean 14.556	970	H min 11.162 max*11.168 mean 11.165
897		CPU PAR min 1.462 max 1.540 mean 1.504	971 TSOPF_RS_b39_c7.mtx	
898		H min 10.250 max 10.253 mean 10.252		
		n	*	
899	Maragal_6.mtx		973	CPU COO min 0.771 max 0.793 mean 0.780
900	Regular		974	CPU CSR min 3.219 max* 3.232 mean 3.227
901		CPU COO min 0.725 max 0.741 mean 0.729	975	GPU 64 COO min 11.070 max*11.200 mean 11.142
902		CPU CSR min 2.345 max 2.409 mean 2.372	976	CSR min 37.050 max*42.100 mean 39.040
903		GPU 64 COO min 18.200 max 18.770 mean 18.357	977	CPU PAR min 1.910 max 2.027 mean 1.982
904		CSR min 38.310 max*40.240 mean 39.477	978	H min 7.304 max 7.304 mean 7.304
905		CPU PAR min 0.789 max 0.813 mean 0.797	979 Row-Premute	
		H min 9.930 max 9.930 mean 9.930		CPU COO min 0.701 max 0.722 mean 0.707
906		H min 9.930 max 9.930 mean 9.930	980	
907	Row-Premute		981	CPU CSR min 2.931 max 2.952 mean 2.942
908		CPU COO min 0.709 max 0.779 mean 0.715	982	GPU 64 COO min 10.860 max 11.030 mean 10.928
909		CPU CSR min 2.675 max 2.715 mean 2.696	983	CSR min 28.730 max 30.880 mean 29.483
910		GPU 64 COO min 17.810 max 18.030 mean 17.935	984	CPU PAR min 1.760 max 1.922 mean 1.851
911		CSR min 29.650 max 30.580 mean 30.109	985	H min 10.537 max 10.541 mean 10.539
912		CPU PAR min 0.857 max 0.940 mean 0.904	986 Row-Gradient	
913		H min 10.777 max 10.779 mean 10.778	987	CPU COO min 0.747 max 0.808 mean 0.757
	D C 11 1	11 IIII 10./// IIIax 10.//5 IIIeaii 10.//6		
914	Row-Gradient		988	CPU CSR min 2.606 max 2.648 mean 2.624
915		CPU COO min 0.710 max* 1.566 mean 0.755	989	GPU 64 COO min 10.850 max 11.120 mean 10.999
916		CPU CSR min 2.042 max 2.159 mean 2.120	990	CSR min 33.910 max 37.600 mean 35.909
917		GPU 64 COO min 18.460 max*18.960 mean 18.665	991	CPU PAR min 2.154 max* 2.245 mean 2.203
918		CSR min 25.650 max 27.330 mean 26.549	992	H min 9.636 max 9.646 mean 9.642
919		CPU PAR min 2.257 max 2.612 mean 2.416	993 Column-Gradient	
920		H min 11.251 max 11.301 mean 11.285	994	CPU COO min 0.718 max* 1.693 mean 0.802
921	Column-Gradient	ii	995	CPU CSR min 2.502 max 2.585 mean 2.547
	Column-Gradient			
922		CPU COO min 0.711 max 0.743 mean 0.725	996	GPU 64 COO min 10.700 max 10.990 mean 10.804
923		CPU CSR min 2.036 max 2.161 mean 2.110	997	CSR min 27.230 max 29.380 mean 28.488
924				
925		GPU 64 COO min 17.840 max 18.860 mean 18.149	998	CPU PAR min 2.128 max 2.227 mean 2.172
		GPU 64 COO min 17.840 max 18.860 mean 18.149 CSR min 19.410 max 20.690 mean 20.066	998 999	CPU PAR min 2.128 max 2.227 mean 2.172 H min 11.131 max*11.222 mean 11.208
926				
926 927		CSR min 19.410 max 20.690 mean 20.066	999	
927	Row-Column-Permute	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349	999 1000 Row-Column-Permute 1001	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716
927 928	Row-Column-Permute	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052	999 1000 Row-Column-Permute 1001 1002	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940
927 928 929	Row-Column-Permute	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737	999 1000 Row-Column-Permute 1001 1002 1003	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930
927 928 929 930	Row-Column-Permute	CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743	999 1000 Row-Column-Permute 1001 1002 1003	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578
927 928 929	Row-Column-Permute	CPU COO min 0.712 max 0.971 mean 20.066 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 17.720 max 18.070 mean 17.791	999 1000 Row-Column-Permute 1001 1002 1003	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792
927 928 929 930	Row-Column-Permute	CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743	999 1000 Row-Column-Permute 1001 1002 1003	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578
927 928 929 930 931	Row-Column-Permute	CPU COO min 0.712 max 0.971 mean 20.066 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 17.720 max 18.070 mean 17.791	999 1000 Row-Column-Permute 1001 1002 1003 1004	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792
927 928 929 930 931 932	Row-Column-Permute	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.700 max 18.070 mean 17.911 CSR min 29.600 max 30.500 mean 29.961	999 1000 Row-Column-Permute 1001 1002 1003 1004	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792
927 928 929 930 931 932 933 934		CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 18.070 mean 17.911 CSR min 29.600 max 30.500 mean 29.961 CPU PAR min 0.827 max 0.954 mean 0.913	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539
927 928 929 930 931 932 933 934 935	aft01.mtx	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 18.070 mean 17.911 CSR min 29.600 max 30.500 mean 29.961 CPU PAR min 0.827 max 0.954 mean 0.913	999 1000 Row-Column-Permute 1001 1002 1003 1004	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539
927 928 929 930 931 932 933 934 935 936		CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 18.070 mean 17.911 CSR min 29.600 max 30.500 mean 29.961 CPU PAR min 0.827 max 0.954 mean 0.913 H min 10.776 max 10.778 mean 10.777	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005 1006	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539
927 928 929 930 931 932 933 934 935 936	aft01.mtx	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 18.070 mean 17.911 CSR min 29.600 max 30.500 mean 29.961 CPU PAR min 0.827 max 0.954 mean 0.913 H min 10.776 max 10.778 mean 10.777	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005 1006 1007 10 ELLESM	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539
927 928 929 930 931 932 933 934 935 936 937	aft01.mtx	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 18.070 mean 17.911 CSR min 29.600 max 30.500 mean 29.961 CPU PAR min 0.827 max 0.994 mean 0.913 H min 10.776 max 10.778 mean 10.777 CPU COO min 0.735 max* 2.079 mean 1.069 CPU CSR min 3.132 max* 3.154 mean 3.145	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005 1006 1007 10 ELLESM 1008 aft01.mtx 1009 Regular	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539
927 928 929 930 931 932 933 934 935 936	aft01.mtx	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 10.700 mean 17.911 CSR min 29.600 max 30.500 mean 29.961 CPU PAR min 0.827 max 0.954 mean 0.913 H min 10.776 max 10.778 mean 10.777 CPU COO min 0.735 max* 2.079 mean 1.069 CPU CSR min 3.132 max* 3.154 mean 3.145 GPU 64 COO min 6.390 max* 6.610 mean 6.457	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005 1006 1007 10 ELLESM	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539
927 928 929 930 931 932 933 934 935 936 937	aft01.mtx	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 18.070 mean 17.911 CSR min 29.600 max 30.500 mean 29.961 CPU PAR min 0.827 max 0.994 mean 0.913 H min 10.776 max 10.778 mean 10.777 CPU COO min 0.735 max* 2.079 mean 1.069 CPU CSR min 3.132 max* 3.154 mean 3.145	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005 1006 1007 10 ELLESM 1008 aft01.mtx 1009 Regular	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539
927 928 929 930 931 932 933 934 935 936 937 938	aft01.mtx	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 10.700 mean 17.911 CSR min 29.600 max 30.500 mean 29.961 CPU PAR min 0.827 max 0.954 mean 0.913 H min 10.776 max 10.778 mean 10.777 CPU COO min 0.735 max* 2.079 mean 1.069 CPU CSR min 3.132 max* 3.154 mean 3.145 GPU 64 COO min 6.390 max* 6.610 mean 6.457	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005 1006 1007 10 ELLESMI 1008 aft01.mtx 1009 Regular 1010	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539 ERE
927 928 929 930 931 932 933 934 935 936 937 938 939	aft01.mtx	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 18.070 mean 17.911 CSR min 29.600 max 30.500 mean 29.961 CPU PAR min 0.827 max 0.954 mean 0.913 H min 10.776 max 10.778 mean 10.777 CPU COO min 0.735 max* 2.079 mean 1.069 CPU CSR min 3.132 max* 3.154 mean 3.145 GPU 64 COO min 6.738 max* 2.079 mean 1.069 CPU CSR min 3.132 max* 3.154 mean 3.145 GPU 64 COO min 6.790 max* 6.610 mean 6.457 CSR min 19.990 max*23.250 mean 21.820	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005 1006 1007 10 ELLESMI 1008 aft01.mtx 1009 Regular 1010	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539 ERE GPU 64 COO min 4.080 max* 4.280 mean 4.186 CSR min 9.660 max*12.660 mean 11.485
927 928 929 930 931 932 933 934 935 936 937 938 939 940	aft01.mtx	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 18.070 mean 17.911 CSR min 29.600 max 38.500 mean 29.961 CPU PAR min 0.827 max 0.954 mean 0.913 H min 10.776 max 10.778 mean 10.777 CPU COO min 0.735 max* 2.079 mean 1.069 CPU CSR min 3.132 max* 3.154 mean 3.145 GPU 64 COO min 6.390 max* 6.610 mean 6.457 CSR min 19.990 max* 23.250 mean 21.820 CPU PAR min 1.746 max* 1.865 mean 1.812	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005 1006 1007 10 ELLESMI 1008 aft01.mtx 1009 Regular 1010 1011 1012 1013 Row-Premute	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539 ERE GPU 64 COO min 4.080 max* 4.280 mean 4.186 CSR min 9.660 max*12.660 mean 11.485 H min 7.811 max 7.811 mean 7.811
927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942	aft01.mtx Regular	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.70 max 10.700 mean 17.911 CSR min 29.600 max 30.500 mean 29.961 CPU PAR min 0.827 max 0.954 mean 0.913 H min 10.776 max 10.778 mean 10.777 CPU COO min 0.735 max* 2.079 mean 1.069 CPU CSR min 3.132 max* 3.154 mean 3.145 GPU 64 COO min 6.390 max* 6.610 mean 6.457 CSR min 19.990 max*23.250 mean 21.820 CPU PAR min 1.746 max* 1.865 mean 1.812 H min 7.811 max 7.811 mean 7.811	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005 1006 1007 10 ELLESMI 1008 aft01.mtx 1009 Regular 1010 1011 1011 1012 1013 Row-Premute 1014	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539 ERE GPU 64 COO min 4.080 max* 4.280 mean 4.186 CSR min 9.660 max*12.660 mean 11.485 H min 7.811 max 7.811 mean 7.811 GPU 64 COO min 3.860 max 4.090 mean 4.001
927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942	aft01.mtx Regular	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 18.070 mean 17.911 CSR min 29.600 max 30.500 mean 29.961 CPU PAR min 0.827 max 0.954 mean 0.913 H min 10.776 max 10.778 mean 10.777 CPU COO min 0.735 max* 2.079 mean 1.069 CPU CSR min 3.132 max* 3.154 mean 3.145 GPU 64 COO min 6.736 max* 6.870 mean 12.820 CPU PAR min 1.746 max* 1.865 mean 1.812 H min 7.811 max 7.811 mean 7.811	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005 1006 1007 10 ELLESMI 1008 aft01.mtx 1009 Regular 1010 1011 1011 1012 1013 Row-Premute 1014 1015	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539 ERE GPU 64 COO min 4.080 max* 4.280 mean 4.186 CSR min 9.660 max*12.660 mean 11.485 H min 7.811 max 7.811 mean 7.811 GPU 64 COO min 3.860 max 4.090 mean 4.001 CSR min 9.520 max 10.340 mean 9.936
927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943	aft01.mtx Regular	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 18.070 mean 17.911 CSR min 29.600 max 30.500 mean 29.961 CPU PAR min 0.827 max 0.954 mean 0.913 H min 10.776 max 10.778 mean 10.777 CPU COO min 0.735 max* 2.079 mean 1.069 CPU CSR min 19.900 max* 6.610 mean 6.457 CSR min 19.900 max* 6.610 mean 6.457 CSR min 19.900 max* 23.250 mean 21.820 CPU PAR min 1.746 max* 1.865 mean 1.812 H min 7.811 max 7.811 mean 7.811 CPU COO min 0.714 max 1.648 mean 0.840 CPU CSR min 0.714 max 1.648 mean 0.840 CPU CSR min 2.864 max 2.892 mean 2.883	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005 1006 1007 10 ELLESMI 1008 aft01.mtx 1009 Regular 1010 1011 1012 1013 Row-Premute 1014 1015 1016	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539 ERE GPU 64 COO min 4.080 max* 4.280 mean 4.186 CSR min 9.660 max*12.660 mean 11.485 H min 7.811 max 7.811 mean 7.811 GPU 64 COO min 3.860 max 4.090 mean 4.001
927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945	aft01.mtx Regular	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 18.070 mean 17.911 CSR min 29.600 max 30.500 mean 29.961 CPU PAR min 0.827 max 0.954 mean 0.913 H min 10.776 max 10.778 mean 10.777 CPU COO min 0.735 max* 2.079 mean 1.069 CPU CSR min 13.132 max* 3.154 mean 3.145 GPU 64 COO min 6.390 max* 6.610 mean 6.457 CSR min 19.990 max*23.250 mean 21.820 CPU PAR min 1.746 max 1.865 mean 1.812 H min 7.811 max 7.811 mean 7.811 CPU COO min 0.714 max 1.648 mean 0.840 CPU CSR min 2.664 max 1.648 mean 0.840 GPU CSR min 2.664 max 2.892 mean 2.883 GPU 64 COO min 6.280 max 6.380 mean 6.329	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005 1006 1007 10 ELLESMI 1008 aft01.mtx 1009 Regular 1010 1011 1011 1012 1013 Row-Premute 1014 1015	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539 ERE GPU 64 COO min 4.080 max* 4.280 mean 4.186 CSR min 9.660 max*12.660 mean 11.485 H min 7.811 max 7.811 mean 7.811 GPU 64 COO min 3.860 max 4.090 mean 4.001 CSR min 9.520 max 10.340 mean 9.936 H min 11.161 max 11.167 mean 11.165
927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943	aft01.mtx Regular	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 18.070 mean 17.911 CSR min 29.600 max 30.500 mean 29.961 CPU PAR min 0.827 max 0.954 mean 0.913 H min 10.776 max 10.778 mean 10.777 CPU COO min 0.735 max* 2.079 mean 1.069 CPU CSR min 33.132 max* 3.154 mean 3.145 CPU COO min 6.736 max* 2.079 mean 1.820 CPU PAR min 1.746 max* 1.865 mean 1.812 H min 7.811 max 7.811 mean 7.811 CPU COO min 0.714 max 1.648 mean 0.840 CPU CSR min 2.864 max 2.892 mean 2.883 GPU 64 COO min 6.7280 max 19.700 mean 19.005	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005 1006 1007 10 ELLESMI 1008 aft01.mtx 1009 Regular 1010 1011 1012 1013 Row-Premute 1014 1015 1016	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539 ERE GPU 64 COO min 4.080 max* 4.280 mean 4.186 CSR min 9.660 max*12.660 mean 11.485 H min 7.811 max 7.811 mean 7.811 GPU 64 COO min 3.860 max 4.090 mean 4.001 CSR min 9.520 max 10.340 mean 9.936
927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945	aft01.mtx Regular	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 18.070 mean 17.911 CSR min 29.600 max 30.500 mean 29.961 CPU PAR min 0.827 max 0.954 mean 0.913 H min 10.776 max 10.778 mean 10.777 CPU COO min 0.735 max* 2.079 mean 1.069 CPU CSR min 13.132 max* 3.154 mean 3.145 GPU 64 COO min 6.390 max* 6.610 mean 6.457 CSR min 19.990 max*23.250 mean 21.820 CPU PAR min 1.746 max 1.865 mean 1.812 H min 7.811 max 7.811 mean 7.811 CPU COO min 0.714 max 1.648 mean 0.840 CPU CSR min 2.664 max 1.648 mean 0.840 GPU CSR min 2.664 max 2.892 mean 2.883 GPU 64 COO min 6.280 max 6.380 mean 6.329	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005 1006 1007 10 ELLESMI 1008 aft01.mtx 1009 Regular 1010 1011 1012 1013 Row-Premute 1014 1015 1016 1017 Row-Gradient	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539 ERE GPU 64 COO min 4.080 max* 4.280 mean 4.186 CSR min 9.660 max*12.660 mean 11.485 H min 7.811 max 7.811 mean 7.811 GPU 64 COO min 3.860 max 4.090 mean 4.001 CSR min 9.520 max 10.340 mean 9.936 H min 11.161 max 11.167 mean 11.165
927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946	aft01.mtx Regular	CSR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 18.070 mean 17.911 CSR min 29.600 max 30.500 mean 29.961 CPU PAR min 0.827 max 0.954 mean 0.913 H min 10.776 max 10.778 mean 10.777 CPU COO min 0.735 max* 2.079 mean 1.069 CPU CSR min 33.132 max* 3.154 mean 3.145 CPU COO min 6.736 max* 2.079 mean 1.820 CPU PAR min 1.746 max* 1.865 mean 1.812 H min 7.811 max 7.811 mean 7.811 CPU COO min 0.714 max 1.648 mean 0.840 CPU CSR min 2.864 max 2.892 mean 2.883 GPU 64 COO min 6.7280 max 19.700 mean 19.005	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005 1006 1007 10 ELLESMI 1008 aft01.mtx 1009 Row-Premute 1011 1012 1013 Row-Premute 1014 1015 1016 1017 Row-Gradient 1018	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539 ERE GPU 64 COO min 4.080 max* 4.280 mean 4.186 CSR min 9.660 max*12.660 mean 11.485 H min 7.811 max 7.811 mean 7.811 GPU 64 COO min 3.860 max 4.090 mean 4.001 CSR min 9.520 max 10.340 mean 9.936 H min 11.161 max 11.167 mean 11.165
927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945	aft01.mtx Regular	CPU PAR min 19.410 max 20.690 mean 20.066 CPU PAR min 2.174 max* 2.546 mean 2.349 H min 12.011 max*12.072 mean 12.052 CPU COO min 0.712 max 0.971 mean 0.737 CPU CSR min 2.732 max* 2.751 mean 2.743 GPU 64 COO min 17.720 max 18.070 mean 19.961 CPU PAR min 0.827 max 0.954 mean 0.913 H min 10.776 max 10.778 mean 10.777 CPU COO min 0.735 max* 2.079 mean 1.069 CPU CSR min 3.132 max* 3.154 mean 3.145 GPU 64 COO min 6.735 max* 2.079 mean 1.069 CPU CSR min 19.990 max* 6.100 mean 6.457 CSR min 19.990 max* 6.300 mean 1.812 H min 7.811 max 7.811 mean 7.811 CPU COO min 0.714 max 1.648 mean 0.840 CPU CSR min 2.864 max 2.892 mean 2.883 GPU 64 COO min 6.280 max 6.380 mean 6.329 CSR min 1.780 max 1.850 mean 1.762 CPU CSR min 1.7800 max 1.790 mean 19.105 CPU PAR min 1.729 max 1.850 mean 1.782	999 1000 Row-Column-Permute 1001 1002 1003 1004 1005 1006 1007 10 ELLESMI 1008 aft01.mtx 1009 Regular 1010 1011 1012 1013 Row-Premute 1014 1015 1016 1017 Row-Gradient 1018 1019	H min 11.131 max*11.222 mean 11.208 CPU COO min 0.709 max 0.726 mean 0.716 CPU CSR min 2.917 max 2.958 mean 2.940 GPU 64 COO min 10.840 max 11.030 mean 10.930 CSR min 28.780 max 30.810 mean 29.578 CPU PAR min 1.757 max 1.834 mean 1.792 H min 10.537 max 10.540 mean 10.539 ERE GPU 64 COO min 4.080 max* 4.280 mean 4.186 CSR min 9.660 max*12.660 mean 11.485 H min 7.811 max 7.811 mean 7.811 GPU 64 COO min 3.860 max 4.090 mean 4.001 CSR min 9.520 max 10.340 mean 9.936 H min 11.161 max 11.167 mean 11.165 GPU 64 COO min 4.010 max 4.240 mean 4.135 CSR min 5.890 max 11.350 mean 6.882

1022		GPU 64 COO min 3.850 max 4.100 mean 4.012	1096	H min 7.380 max 7.380 mean 7.380
1023		CSR min 5.460 max 8.790 mean 6.005	1097 Row-Premute	
1024		H min 11.112 max 11.122 mean 11.117	1098	GPU 64 COO min 4.820 max 4.940 mean 4.859
1025	Row-Column-Permute		1099	CSR min 5.080 max 6.520 mean 6.342
1026		GPU 64 COO min 3.850 max 4.080 mean 3.990	1100	H min 10.042 max 10.047 mean 10.044
1027		CSR min 5.420 max 6.760 mean 5.977	1101 Row-Gradient	
1028		H min 11.162 max*11.169 mean 11.165	1102	GPU 64 COO min 4.810 max* 4.940 mean 4.876
1029	bloweya.mtx		1103	CSR min 6.100 max* 6.560 mean 6.307
1030	Regular		1104	H min 9.681 max 9.704 mean 9.694
1031		GPU 64 COO min 0.000 max 0.000 mean 0.000	1105 Column-Gradient	
1032		CSR min 0.000 max 0.000 mean 0.000	1106	GPU 64 COO min 4.810 max 4.930 mean 4.869
1033		H min 7.205 max 7.205 mean 7.205	1107	CSR min 4.820 max 6.460 mean 6.208
1034	Row-Premute		1108	H min 10.554 max*10.661 mean 10.638
1035		GPU 64 COO min 3.800 max 3.940 mean 3.875	1109 Row-Column-Permute	
1036		CSR min 3.710 max 4.570 mean 4.399	1110	GPU 64 COO min 4.810 max 4.940 mean 4.864
1037		H min 11.025 max 11.031 mean 11.028	1111	CSR min 5.930 max 6.520 mean 6.379
1038	Row-Gradient		1112	H min 10.041 max 10.047 mean 10.044
1039		GPU 64 COO min 3.800 max* 4.120 mean 3.962	1113 cvxqp3.mtx	
1040		CSR min 4.340 max* 4.670 mean 4.546	1114 Regular	
1041		H min 10.296 max 10.307 mean 10.300	1115	GPU 64 COO min 3.350 max* 3.590 mean 3.483
1042	Column-Gradient	CDU 64 000 2 000 4 100 2 070	1116	CSR min 5.430 max* 9.260 mean 8.333
1043		GPU 64 COO min 3.880 max 4.100 mean 3.978	1117	H min 8.646 max 8.646 mean 8.646
1044 1045		CSR min 4.240 max 4.570 mean 4.412 H min 10.881 max 10.886 mean 10.883	1118 Row-Premute 1119	GPU 64 COO min 3.230 max 3.480 mean 3.371
1045	Row-Column-Permute	n 0.881	1120	CSR min 7.560 max 8.220 mean 7.900
1046	ROW-COTUMN-Permute	GPU 64 COO min 3.800 max 3.980 mean 3.885	1121	H min 11.027 max 11.033 mean 11.030
1047		CSR min 4.130 max 4.540 mean 4.399	1121 1122 Row-Gradient	H min II.027 max II.033 mean II.030
1048		CSK min 4.130 max 4.540 mean 4.399 H min 11.025 max*11.033 mean 11.029	1122 Row-Gradient 1123	GPU 64 COO min 3.240 max 3.510 mean 3.396
1050	brainpc2.mtx	n	1124	CSR min 6.990 max 7.890 mean 7.574
1050	Regular		1125	H min 11.060 max 11.069 mean 11.064
1051	Regular	GPU 64 COO min 0.000 max 0.000 mean 0.000	1126 Column-Gradient	n IIIII 11.000 IIIax 11.009 IIIean 11.004
1052		CSR min 0.000 max 0.000 mean 0.000	1126 CO1umin=Gradient	GPU 64 COO min 3.240 max 3.480 mean 3.374
1054		H min 7.478 max 7.478 mean 7.478	1128	CSR min 6.980 max 7.900 mean 7.557
1055	Row-Premute	11 IIII1 7.470 IIIAX 7.470 IIIEAII 7.470	1129	H min 11.126 max*11.134 mean 11.130
1056	NOW-F1 elliute	GPU 64 COO min 3.840 max* 6.750 mean 4.110	1130 Row-Column-Permute	11 IIII1 11.120 IIIax^11.134 IIIean 11.130
1057		CSR min 4.260 max* 4.500 mean 4.437	1131	GPU 64 COO min 3.110 max 3.470 mean 3.365
1058		H min 9.809 max 9.813 mean 9.811	1132	CSR min 4.810 max 8.210 mean 7.742
1059	Row-Gradient	11 11 3.003 max 3.013 medit 3.011	1133	H min 11.026 max 11.032 mean 11.030
1060	now diddicine	GPU 64 COO min 0.640 max 4.030 mean 3.864	1134 ex19.mtx	ii
1061		CSR min 4.270 max 4.470 mean 4.383	1135 Regular	
1062		H min 9.722 max 9.727 mean 9.724	1136	GPU 64 COO min 2.450 max* 2.610 mean 2.564
1063	Column-Gradient	11 11 3.722 max 3.727 mean 3.721	1137	CSR min 4.490 max 4.760 mean 4.714
1064		GPU 64 COO min 0.640 max 4.070 mean 3.898	1138	H min 8.228 max 8.228 mean 8.228
1065		CSR min 4.230 max 4.500 mean 4.386	1139 Row-Premute	
1066		H min 10.368 max*10.372 mean 10.370	1140	GPU 64 COO min 2.000 max 2.040 mean 2.021
1067	Row-Column-Permute		1141	CSR min 4.640 max 4.780 mean 4.733
1068		GPU 64 COO min 3.980 max 4.110 mean 4.027	1142	H min 11.835 max 11.840 mean 11.838
1069		CSR min 4.320 max 4.490 mean 4.437	1143 Row-Gradient	
1070		H min 9.809 max 9.813 mean 9.811	1144	GPU 64 COO min 2.240 max 2.390 mean 2.329
1071	c-47.mtx		1145	CSR min 4.570 max* 4.850 mean 4.807
1072	Regular		1146	H min 10.742 max 10.752 mean 10.747
1073		GPU 64 COO min 3.980 max* 4.080 mean 4.026	1147 Column-Gradient	
1074		CSR min 4.760 max 4.850 mean 4.812	1148	GPU 64 COO min 2.010 max 2.050 mean 2.034
1075		H min 8.364 max 8.364 mean 8.364	1149	CSR min 4.570 max 4.760 mean 4.701
1076	Row-Premute		1150	H min 11.872 max*11.881 mean 11.878
1077		GPU 64 COO min 3.880 max 4.010 mean 3.942	1151 Row-Column-Permute	
1078		CSR min 4.040 max 4.900 mean 4.807	1152	GPU 64 COO min 2.000 max 2.040 mean 2.023
1079		H min 10.059 max 10.063 mean 10.061	1153	CSR min 0.770 max 4.780 mean 4.594
1080	Row-Gradient		1154	H min 11.835 max 11.840 mean 11.838
1081		GPU 64 COO min 3.900 max 4.050 mean 3.976	1155 gen4.mtx	
1082		CSR min 4.380 max 4.740 mean 4.630	1156 Regular	
1083		H min 10.201 max 10.228 mean 10.214	1157	GPU 64 COO min 4.880 max 4.980 mean 4.900
1084	Column-Gradient		1158	CSR min 10.020 max*11.300 mean 10.716
1085		GPU 64 COO min 3.860 max 3.990 mean 3.936	1159	H min 9.234 max 9.234 mean 9.234
1086		CSR min 4.350 max 4.610 mean 4.525	1160 Row-Premute	
1087		H min 11.204 max*11.241 mean 11.222	1161	GPU 64 COO min 4.860 max 4.930 mean 4.890
1088	Row-Column-Permute		1162	CSR min 0.330 max 11.200 mean 10.038
1089		GPU 64 COO min 3.890 max 4.020 mean 3.953	1163	H min 10.249 max 10.254 mean 10.252
1090		CSR min 4.490 max* 4.920 mean 4.840	1164 Row-Gradient	CDU 64 COO -i- 4 960 4 000
1091	0	H min 10.058 max 10.063 mean 10.061	1165	GPU 64 COO min 4.860 max* 4.990 mean 4.908
1092	case9.mtx		1166	CSR min 9.160 max 11.240 mean 10.435
1093 1094	Regular	CPU 64 COO min	1167 1168 Column-Gradient	H min 9.939 max 9.961 mean 9.947
1094		GPU 64 COO min 0.000 max 0.000 mean 0.000 CSR min 0.000 max 0.000 mean 0.000	1168 Column-Gradient 1169	GPU 64 COO min 4.780 max 4.880 mean 4.816
1073		עסש. ש וובווו ששש.ש אווו ששש.ש וובווו אכש.ש	1107	G G G G COO HILL 4.700 HIAX 4.000 HEART 4.816

1170		CCD -i- 7 770 10 570 0 407	1244 Paul Promite	
1170		CSR min 7.770 max 10.570 mean 9.407	1244 Row-Premute	CDU C4 COO'- 4 420 4 520 4 445
1171		H min 10.851 max*10.876 mean 10.864	1245	GPU 64 COO min 4.420 max 4.520 mean 4.445
1172	Row-Column-Permute		1246	CSR min 10.520 max 10.880 mean 10.696
1173		GPU 64 COO min 4.850 max 4.950 mean 4.886	1247	H min 10.960 max*10.968 mean 10.963
1174		CSR min 10.220 max 11.280 mean 10.748	1248 Row-Gradient	
1175		H min 10.250 max 10.255 mean 10.252	1249	GPU 64 COO min 4.570 max 4.690 mean 4.605
1176	lp_fit2d.mtx		1250	CSR min 4.550 max 13.350 mean 12.479
1177	Regular		1251	H min 9.508 max 9.527 mean 9.520
1178		GPU 64 COO min 4.360 max* 4.640 mean 4.515	1252 Column-Gradient	
1179		CSR min 10.080 max 10.900 mean 10.491	1253	GPU 64 COO min 4.430 max 4.530 mean 4.461
1180		H min 11.109 max 11.109 mean 11.109	1254	CSR min 10.250 max 10.940 mean 10.603
1181	Row-Premute		1255	H min 10.934 max 10.945 mean 10.939
1182		GPU 64 COO min 4.170 max 4.630 mean 4.476	1256 Row-Column-Permute	
1183		CSR min 0.910 max 10.910 mean 10.257	1257	GPU 64 COO min 4.420 max 4.520 mean 4.450
1184		H min 11.098 max 11.104 mean 11.101	1258	CSR min 7.380 max 10.900 mean 10.598
1185	Row-Gradient		1259	H min 10.959 max 10.967 mean 10.963
1186		GPU 64 COO min 4.370 max 4.630 mean 4.529	1260 mult_dcop_01.mtx	
1187		CSR min 10.030 max 10.970 mean 10.624	1261 Regular	
1188		H min 11.109 max 11.109 mean 11.109	1262	GPU 64 COO min 3.420 max 3.630 mean 3.555
1189	Column-Gradient		1263	CSR min 3.650 max 4.090 mean 3.814
1190		GPU 64 COO min 4.250 max 4.640 mean 4.499	1264	H min 9.689 max 9.689 mean 9.689
1191		CSR min 8.510 max*11.010 mean 10.505	1265 Row-Premute	
1192		H min 11.328 max*11.333 mean 11.331	1266	GPU 64 COO min 3.450 max 3.580 mean 3.521
1193	Row-Column-Permute	11 111.520 max*11.555 mean 11.551	1267	CSR min 3.610 max 4.150 mean 3.785
1194	NOW COTAINT TETRICE	GPU 64 COO min 4.350 max 4.640 mean 4.511	1268	H min 10.738 max 10.742 mean 10.740
1195		CSR min 10.040 max 10.790 mean 10.468	1269 Row-Gradient	11 IIII 10.736 IIIAX 10.742 IIIEAII 10.740
				CDU C4 COO'- 2 F10 2 CC0 2 F70
1196	1	H min 11.097 max 11.106 mean 11.101	1270	GPU 64 COO min 3.510 max* 3.660 mean 3.579
1197	lp_osa_07.mtx		1271	CSR min 3.650 max 4.160 mean 3.806
1198	Regular		1272	H min 10.576 max 10.585 mean 10.580
1199		GPU 64 COO min 0.460 max* 3.640 mean 3.456	1273 Column-Gradient	
1200		CSR min 5.570 max* 8.530 mean 8.106	1274	GPU 64 COO min 3.460 max 3.650 mean 3.584
1201		H min 8.412 max 8.412 mean 8.412	1275	CSR min 3.660 max* 4.240 mean 3.799
1202	Row-Premute		1276	H min 10.826 max*10.842 mean 10.836
1203		GPU 64 COO min 3.140 max 3.450 mean 3.367	1277 Row-Column-Permute	
1204		CSR min 7.600 max 8.070 mean 7.853	1278	GPU 64 COO min 3.470 max 3.580 mean 3.532
1205		H min 9.255 max 9.258 mean 9.256	1279	CSR min 3.600 max 3.980 mean 3.743
1206	Row-Gradient		1280	H min 10.738 max 10.742 mean 10.740
1207		GPU 64 COO min 3.190 max 3.610 mean 3.509	1281 mult_dcop_02.mtx	
1208		CSR min 0.000 max 8.260 mean 7.597	1282 Regular	
1209		H min 8.583 max 8.678 mean 8.670	1283	GPU 64 COO min 3.390 max 3.660 mean 3.585
1210	Column-Gradient		1284	CSR min 0.960 max 4.330 mean 4.162
1211		GPU 64 COO min 3.330 max 3.500 mean 3.416	1285	H min 9.689 max 9.689 mean 9.689
1212		CSR min 6.730 max 7.540 mean 7.199	1286 Row-Premute	
1213		H min 9.542 max* 9.604 mean 9.581	1287	GPU 64 COO min 3.310 max 3.600 mean 3.488
1214	Row-Column-Permute		1288	CSR min 0.620 max 4.290 mean 4.132
1215		GPU 64 COO min 3.290 max 3.430 mean 3.365	1289	H min 10.738 max 10.743 mean 10.740
1216		CSR min 7.390 max 8.060 mean 7.832	1290 Row-Gradient	man recorde max records mean record
1217		H min 9.255 max 9.258 mean 9.256	1291	GPU 64 COO min 3.310 max* 3.670 mean 3.593
1218	Maragal_6.mtx	11 IIII 3.233 IIIAX 3.236 IIICAN 3.236	1292	CSR min 4.130 max* 4.430 mean 4.331
1219	Regular		1293	H min 10.576 max 10.584 mean 10.580
	Regulai	CDU 64 COO 4 160 4 210 4 217		11 IIII 10.370 IIIAX 10.364 IIIEAII 10.360
1220		GPU 64 COO min 4.160 max 4.310 mean 4.217	1294 Column-Gradient	
1221		CSR min 4.940 max 4.960 mean 4.956	1295	GPU 64 COO min 0.550 max 3.660 mean 3.486
1222		H min 9.930 max 9.930 mean 9.930	1296	CSR min 3.890 max 4.410 mean 4.275
1223	Row-Premute		1297	H min 10.831 max*10.843 mean 10.836
1224		GPU 64 COO min 4.220 max 4.240 mean 4.225	1298 Row-Column-Permute	
1225		CSR min 4.750 max*13.040 mean 5.133	1299	GPU 64 COO min 3.470 max 3.590 mean 3.542
1226		H min 10.776 max 10.778 mean 10.777	1300	CSR min 4.190 max 4.290 mean 4.242
1227	Row-Gradient		1301	H min 10.738 max 10.742 mean 10.740
1228		GPU 64 COO min 4.180 max* 4.450 mean 4.245	1302 mult_dcop_03.mtx	
1229		CSR min 4.880 max 4.940 mean 4.915	1303 Regular	
1230		H min 11.259 max*11.302 mean 11.281	1304	GPU 64 COO min 3.360 max* 3.660 mean 3.550
1231	Column-Gradient		1305	CSR min 3.650 max 4.090 mean 3.813
1232		GPU 64 COO min 4.200 max 4.250 mean 4.236	1306	H min 9.689 max 9.689 mean 9.689
1233		CSR min 4.800 max 4.890 mean 4.859	1307 Row-Premute	
1234		H min 12.022 max 12.073 mean 12.051	1308	GPU 64 COO min 3.450 max 3.580 mean 3.521
1235	Row-Column-Permute	man 12.022 max 12.073 mean 12.031	1309	CSR min 3.610 max 4.160 mean 3.784
1235	COTOMITTE INCLE	GPU 64 COO min 4.210 max 4.230 mean 4.222	1310	H min 10.738 max 10.743 mean 10.740
				IIII 10.730 IIIdX 10.743 IIIedII 10.740
1237		CSR min 4.860 max 4.890 mean 4.887	1311 Row-Gradient	CDU 64 000 m/m 2 470
1238		H min 10.776 max 10.778 mean 10.778	1312	GPU 64 COO min 3.470 max 3.660 mean 3.572
1239	mhd4800a.mtx		1313	CSR min 3.640 max 4.190 mean 3.809
1240	Regular		1314	H min 10.572 max 10.584 mean 10.580
1241		GPU 64 COO min 4.570 max* 4.710 mean 4.608	1315 Column-Gradient	
1242		CSR min 12.690 max*13.940 mean 13.369	1316	GPU 64 COO min 3.430 max 3.650 mean 3.562
1243		H min 7.132 max 7.132 mean 7.132	1317	CSR min 3.670 max* 4.290 mean 3.793

1318		H min	10.828 max*10.840 mean	10.834	1392		GPU 64 COO min	4.540 max 4.940 mean 4.874
1319	Row-Column-Permute				1393		CSR min	6.280 max 6.520 mean 6.403
1320		GPU 64 COO min	3.370 max 3.610 mean	3.502	1394		H min	10.042 max 10.047 mean 10.044
1321			3.610 max 3.970 mean		1395	Row-Gradient		
1322			10.738 max 10.741 mean		1396	non ordatene	CDII 64 COO min	4.830 max 4.930 mean 4.875
		п шти	10.736 max 10.741 mean					
1323	OPF_3754.mtx				1397			5.790 max* 6.560 mean 6.289
1324	Regular				1398		H min	9.675 max 9.706 mean 9.692
1325		GPU 64 COO min	4.700 max* 4.930 mean	4.842	1399	Column-Gradient		
1326		CSR min	6.230 max* 6.600 mean	6.411	1400		GPU 64 COO min	4.790 max* 4.960 mean 4.880
1327		H min	8.393 max 8.393 mean	8.393	1401		CSR min	5.760 max 6.450 mean 6.204
1328	Row-Premute				1402		H min	10.601 max*10.661 mean 10.626
1329		GPII 64 COO min	4.620 max 4.890 mean	4 787	1403	Row-Column-Permute		
			5.780 max 6.310 mean		1404	Now Column Termace	CDII 64 COO	4.330 max 4.950 mean 4.845
1330								
1331		H min	11.265 max 11.272 mean		1405			5.740 max 6.500 mean 6.375
1332	Row-Gradient				1406		H min	10.041 max 10.046 mean 10.044
1333		GPU 64 COO min	4.570 max 4.870 mean	4.776	1407	TSOPF_RS_b39_c7.mtx		
1334		CSR min	5.770 max 6.510 mean	6.302	1408	Regular		
1335		H min	10.464 max 10.473 mean	10.468	1409		GPU 64 COO min	4.300 max* 4.430 mean 4.364
1336	Column-Gradient				1410		CSR min	4.480 max 4.750 mean 4.716
1337		CPIL 64 COO min	4.580 max 4.870 mean		1411			7.304 max 7.304 mean 7.304
1338			5.630 max 6.180 mean		1412	Row-Premute		7.504 max 7.504 mean 7.504
						ROW-Premute	CDU 64 COO!	4 250 4 400 4 252
1339		H min	11.394 max*11.401 mean		1413			4.260 max 4.400 mean 4.353
1340	Row-Column-Permute				1414			4.490 max 4.770 mean 4.734
1341		GPU 64 COO min	4.610 max 4.900 mean	4.780	1415		H min	10.536 max 10.541 mean 10.539
1342		CSR min	5.010 max 6.300 mean	6.113	1416	Row-Gradient		
1343		H min	11.268 max 11.272 mean	11.270	1417		GPU 64 COO min	3.970 max 4.420 mean 4.338
1344	OPF_6000.mtx				1418		CSR min	4.620 max* 4.820 mean 4.789
1345	Regular				1419			9.638 max 9.644 mean 9.641
1346	Negutai	CDII 64 COO	3.780 max* 3.920 mean		1420	Column-Gradient		3.030 max 3.044 mean 3.041
						Column-Gradient		
1347			4.270 max 4.360 mean		1421			4.240 max 4.430 mean 4.368
1348		H min	8.799 max 8.799 mean	8.799	1422		CSR min	4.710 max 4.770 mean 4.736
1349	Row-Premute				1423		H min	11.129 max*11.222 mean 11.205
1350		GPU 64 COO min	3.770 max 3.870 mean	3.821	1424	Row-Column-Permute		
1351		CSR min	3.970 max*11.050 mean	4.439	1425		GPU 64 COO min	4.260 max 4.410 mean 4.359
1352		H min	11.872 max 11.877 mean	11.875	1426		CSR min	4.660 max 4.760 mean 4.738
1353	Row-Gradient				1427		H min	10.537 max 10.541 mean 10.539
1354		CPIL 64 COO min	3.700 max 3.870 mean					
		01 0 04 000 11111		3.733				
		ccn -i-	4 220 4 440	4 402				
1355			4.330 max 4.440 mean					
1356			4.330 max 4.440 mean 11.109 max 11.116 mean	11.113	1428	11 FIII		
	Column-Gradient	H min	11.109 max 11.116 mean	11.113	1428	11 FIJI		
1356	Column-Gradient	H min		11.113		11 FIJI mult_dcop_03.mtx		
1356 1357	Column-Gradient	H min	11.109 max 11.116 mean	3.804		•		
1356 1357 1358	Column-Gradient	H min GPU 64 COO min CSR min	11.109 max 11.116 mean 3.690 max 3.870 mean	11.113 3.804 4.308	1429	mult_dcop_03.mtx	GPU 64 COO min	5.140 max* 5.140 mean 5.140
1356 1357 1358 1359	Column-Gradient Row-Column-Permute	H min GPU 64 COO min CSR min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean	3.804 4.308 12.043	1429 1430	mult_dcop_03.mtx		
1356 1357 1358 1359 1360 1361		H min GPU 64 COO min CSR min H min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean	3.804 4.308 12.043	1429 1430 1431 1432	mult_dcop_03.mtx	CSR min	10.340 max*10.390 mean 10.365
1356 1357 1358 1359 1360 1361 1362		H min GPU 64 COO min CSR min H min GPU 64 COO min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean	3.804 4.308 12.043	1429 1430 1431 1432 1433	mult_dcop_03.mtx Regular	CSR min	
1356 1357 1358 1359 1360 1361 1362 1363		H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean	11.113 3.804 4.308 12.043 3.819 4.259	1429 1430 1431 1432 1433 1434	mult_dcop_03.mtx	CSR min H min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689
1356 1357 1358 1359 1360 1361 1362 1363 1364	Row-Column-Permute	H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean	3.804 4.308 12.043 3.819 4.259 11.876	1429 1430 1431 1432 1433 1434 1435	mult_dcop_03.mtx Regular	CSR min H min GPU 64 COO min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365	Row-Column-Permute	H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean	3.804 4.308 12.043 3.819 4.259 11.876	1429 1430 1431 1432 1433 1434 1435 1436	mult_dcop_03.mtx Regular	CSR min H min GPU 64 COO min CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365 1366	Row-Column-Permute	H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min H min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean	3.804 4.308 12.043 3.819 4.259 11.876	1429 1430 1431 1432 1433 1434 1435	mult_dcop_03.mtx Regular	CSR min H min GPU 64 COO min CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365	Row-Column-Permute	H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min H min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean	3.804 4.308 12.043 3.819 4.259 11.876	1429 1430 1431 1432 1433 1434 1435 1436	mult_dcop_03.mtx Regular	CSR min H min GPU 64 COO min CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365 1366	Row-Column-Permute	H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min H min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean	11.113 3.884 4.308 12.043 3.819 4.259 11.876	1429 1430 1431 1432 1433 1434 1435 1436 1437	mult_dcop_03.mtx Regular Row-Premute	CSR min H min GPU 64 COO min CSR min H min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365 1366 1367	Row-Column-Permute	H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min CSR min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean	11.113 3.884 4.388 12.043 3.819 4.259 11.876	1429 1430 1431 1432 1433 1434 1435 1436 1437 1438	mult_dcop_03.mtx Regular Row-Premute	CSR min H min GPU 64 COO min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365 1366 1367 1368	Row-Column-Permute	H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min CSR min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean	11.113 3.884 4.388 12.043 3.819 4.259 11.876 3.048 5.803 8.600	1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439	mult_dcop_03.mtx Regular Row-Premute	GPU 64 COO min CSR min H min CSR min H min GPU 64 COO min CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365 1366 1367 1368 1369	Row-Column-Permute ShermanACb.mtx Regular	H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min H min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean	11.113 3.804 4.308 12.043 3.819 4.259 11.876 3.048 5.803 8.600	1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439 1440	mult_dcop_03.mtx Regular Row-Premute Row-Gradient	GPU 64 COO min CSR min H min CSR min H min GPU 64 COO min CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365 1366 1367 1368 1369 1370	Row-Column-Permute ShermanACb.mtx Regular	H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min H min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean	11.113 3.804 4.308 12.043 3.819 4.259 11.876 3.048 5.803 8.600	1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439 1440 1441 1442	mult_dcop_03.mtx Regular Row-Premute	GPU 64 COO min GPU 64 COO min GPU 64 COO min GPU 64 COO min CSR min H min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371	Row-Column-Permute ShermanACb.mtx Regular	H min GPU 64 C00 min CSR min CSR min CSR min CSR min CSR min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 2.660 max 5.830 mean	11.113 3.884 4.388 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632	1429 1 1430 1 1431 1 1432 1 1433 1 1434 1 1435 1 1436 1 1437 1 1438 1 1439 1 1440 1 1441 1 1442 1 1443 1	mult_dcop_03.mtx Regular Row-Premute Row-Gradient	CSR min H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min H min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372	Row-Column-Permute shermanACb.mtx Regular Row-Premute	H min GPU 64 C00 min CSR min CSR min CSR min CSR min CSR min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean	11.113 3.884 4.388 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379	1429 1 1430 1 1431 1 1432 1 1433 1 1434 1 1435 1 1436 1 1437 1 1438 1 1440 1 1441 1 1442 1 1443 1 1444 1	mult_dcop_03.mtx Regular Row-Premute Row-Gradient	CSR min H	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.086 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372	Row-Column-Permute ShermanACb.mtx Regular	H min GPU 64 COO min CSR min H min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 10.377 max 10.381 mean	11.113 3.804 4.308 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379	1429 1 1430 1 1431 1 1432 1 1433 1 1434 1 1435 1 1436 1 1437 1 1438 1 1440 1 1441 1 1442 1 1443 1 1444 1 1445 1	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient	CSR min H	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372 1373 1374	Row-Column-Permute shermanACb.mtx Regular Row-Premute	H min GPU 64 COO min CSR min H min GPU 64 COO min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 2.760 max 5.830 mean 10.377 max 10.381 mean 2.800 max 3.040 mean	11.113 3.884 4.388 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944	1429 1 1430 1 1431 1 1432 1 1433 1 1434 1 1435 1 1436 1 1437 1 1438 1 1440 1 1441 1 1442 1 1443 1 1444 1	mult_dcop_03.mtx Regular Row-Premute Row-Gradient	CSR min H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min H min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372	Row-Column-Permute shermanACb.mtx Regular Row-Premute	H min GPU 64 COO min CSR min H min GPU 64 COO min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 10.377 max 10.381 mean	11.113 3.804 4.308 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944	1429 1 1430 1 1431 1 1432 1 1433 1 1434 1 1435 1 1436 1 1437 1 1438 1 1440 1 1441 1 1442 1 1443 1 1444 1 1445 1	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient	CSR min H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min H min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.086 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372 1373 1374	Row-Column-Permute shermanACb.mtx Regular Row-Premute	H min GPU 64 COO min CSR min min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 2.760 max 5.830 mean 10.377 max 10.381 mean 2.800 max 3.040 mean 5.330 max* 6.020 mean	11.113 3.884 4.388 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742	1429 1 1430 1 1431 1 1432 1 1433 1 1434 1 1436 1 1437 1 1438 1 1440 1 1441 1 1442 1 1443 1 1444 1 1445 1 1446 1	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient	CSR min H	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372 1373 1374 1375	Row-Column-Permute shermanACb.mtx Regular Row-Premute	H min GPU 64 COO min CSR min min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 2.760 max 5.830 mean 10.377 max 10.381 mean 2.800 max 3.040 mean 5.330 max* 6.020 mean	11.113 3.884 4.388 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742 9.922	1429 1 1430 1 1431 1 1432 1 1433 1 1434 1 1435 1 1436 1 1437 1 1438 1 1440 1 1441 1 1442 1 1443 1 1444 1 1445 1 1446 1 1447 1	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient	CSR min H GPU 64 COO min CSR min CSR min CSR min CSR min CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient	H min GPU 64 COO min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 2.760 max 5.830 mean 10.377 max 10.381 mean 2.800 max 3.040 mean 5.330 max* 6.020 mean	11.113 3.804 4.308 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742 9.922	1429 1 1430 1 1431 1 1432 1 1433 1 1435 1 1436 1 1436 1 1437 1 1438 1 1439 1 1441 1 1442 1 1443 1 1444 1 1445 1 1446 1 1447 1 1448 1 1449 1	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	CSR min H GPU 64 COO min CSR min CSR min CSR min CSR min CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836 5.000 max 5.010 mean 5.085 7.580 max 9.460 mean 8.520
1356 1357 1358 1360 1361 1362 1363 1364 1365 1366 1367 1370 1371 1372 1373 1374 1375 1376	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient	H min GPU 64 COO min CSR min min GPU 64 COO min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 2.760 max 10.381 mean 10.377 max 10.381 mean 2.800 max 3.040 mean 5.330 max* 6.020 mean 9.919 max 9.925 mean 2.720 max 3.010 mean	11.113 3.884 4.388 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742 9.922 2.926	1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1440 1441 1445 1446 1447 1448 1449 1450 1	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	CSR min H GPU 64 COO min CSR min CSR min CSR min CSR min CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836 5.000 max 5.010 mean 5.085 7.580 max 9.460 mean 8.520
1356 1357 1358 1360 1361 1362 1363 1364 1365 1366 1367 1371 1372 1373 1374 1375 1376 1377 1378	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient	H min GPU 64 C00 min CSR min min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 2.760 max 5.830 mean 10.377 max 10.381 mean 2.800 max 3.040 mean 5.330 max* 6.020 mean 9.919 max 9.925 mean 2.720 max 3.010 mean 0.000 max 5.840 mean	11.113 3.884 4.388 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742 9.922 2.926 5.513	1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	CSR min H min GPU 64 COO min CSR min H min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.910 10.579 max 10.582 mean 5.075 9.330 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836 5.000 max 5.010 mean 5.005 7.580 max 9.460 mean 8.520 10.739 max 10.741 mean 10.740
1356 1357 1358 1360 1361 1362 1363 1364 1365 1365 1367 1370 1371 1372 1373 1374 1375 1377 1378 1377 1378 1378	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient	H min GPU 64 C00 min CSR min min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 2.760 max 10.381 mean 10.377 max 10.381 mean 2.800 max 3.040 mean 5.330 max* 6.020 mean 9.919 max 9.925 mean 2.720 max 3.010 mean	11.113 3.804 4.308 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742 9.922 2.926 5.513 10.591	1429 1430 1431 1432 1433 1435 1436 1437 1438 1439 1440 1441 1442 1444 1444 1445 1445 1445 1455 14	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	CSR min H GPU 64 COO min CSR min CSR min H GPU 64 COO min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836 5.000 max 5.010 mean 5.005 7.580 max 9.460 mean 8.520 10.739 max 10.741 mean 10.740 5.140 max* 5.140 mean 5.140
1356 1357 1358 1359 1360 1361 1362 1363 1364 1365 1366 1367 1370 1371 1372 1373 1373 1373 1373 1375 1376 1377 1378 1379 1381 1381 1381	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient	H min GPU 64 COO min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 2.760 max 10.381 mean 2.800 max 3.040 mean 5.330 max* 6.020 mean 9.377 max 10.381 mean 2.800 max 3.040 mean 6.000 max 5.840 mean 9.1720 max 3.010 mean 0.000 max 5.840 mean 10.587 max*10.596 mean	11.113 3.804 4.308 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742 9.922 2.926 5.513 10.591	1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439 14440 1444 1444 1444 1444 1444 1445 1445	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	CSR min H CSR min CSR min H CSR min CSR min H CSR min H CSR min CSR min H CSR min H CSR min H CSR min H CSR min CSR min H CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836 5.000 max 5.010 mean 5.085 6.000 max 5.010 mean 5.005 7.580 max 9.460 mean 8.520 10.739 max 10.741 mean 10.740 5.140 max* 5.140 mean 5.140
1356 1357 1358 1360 1361 1362 1363 1364 1365 1366 1367 1368 1369 1371 1372 1373 1374 1375 1376 1377 1378 1379 1380 1381	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient	H min GPU 64 COO min CSR min H min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 2.760 max 10.381 mean 10.377 max 10.381 mean 2.800 max 3.040 mean 5.330 max* 6.020 mean 9.919 max 9.925 mean 2.720 max 3.010 mean 0.000 max 5.840 mean 10.587 max*10.596 mean 2.780 max 3.030 mean	11.113 3.884 4.388 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742 9.922 2.926 5.513 10.591 2.939	1429 1430 1431 1431 1432 1432 1435 1436 1436 1436 1437 1438 1439 1440 1441 1444 1444 1445 1446 1447 1448 1453 1454 1455 1455 1455 1455 1455 1455	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular	CSR min H CSR min CSR min H CSR min CSR min H CSR min H CSR min CSR min H CSR min H CSR min H CSR min H CSR min CSR min H CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836 5.000 max 5.010 mean 5.005 7.580 max 9.460 mean 8.520 10.739 max 10.741 mean 10.740 5.140 max* 5.140 mean 5.140
1356 1357 1358 1360 1361 1362 1363 1364 1365 1366 1367 1370 1371 1372 1373 1374 1375 1376 1377 1378 1377 1378 1378 1378 1378 1378	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient	H min GPU 64 COO min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 10.377 max 10.381 mean 10.377 max 10.381 mean 10.377 max 10.381 mean 2.800 max 3.040 mean 9.919 max 9.925 mean 2.720 max 3.010 mean 0.000 max 5.840 mean 10.587 max*10.596 mean 2.780 max 3.030 mean 4.860 max 3.030 mean 4.860 max 3.030 mean	11.113 3.804 4.388 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742 9.922 2.926 5.513 10.591 2.939 5.667	1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439 14440 1444 1444 1444 1444 1444 1445 1445	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	CSR min H CSR min H min CSR min H min CSR min H min CSR min H min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836 5.000 max 5.010 mean 5.005 7.580 max 9.460 mean 8.520 10.739 max 10.741 mean 5.740 5.140 max* 5.140 mean 5.140 10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689
1356 1357 1358 1360 1361 1362 1363 1364 1365 1366 1367 1368 1369 1371 1372 1373 1374 1375 1376 1377 1378 1379 1380 1381	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient	H min GPU 64 COO min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 2.760 max 10.381 mean 10.377 max 10.381 mean 2.800 max 3.040 mean 5.330 max* 6.020 mean 9.919 max 9.925 mean 2.720 max 3.010 mean 0.000 max 5.840 mean 10.587 max*10.596 mean 2.780 max 3.030 mean	11.113 3.884 4.388 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742 9.922 2.926 5.513 10.591 2.939 5.667	1429 1430 1431 1431 1432 1432 1435 1436 1436 1436 1437 1438 1439 1440 1441 1444 1444 1445 1446 1447 1448 1453 1454 1455 1455 1455 1455 1455 1455	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular	CSR min H CSR min H min CSR min H min CSR min H min CSR min H min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836 5.000 max 5.010 mean 5.085 6.000 max 5.010 mean 5.005 7.580 max 9.460 mean 8.520 10.739 max 10.741 mean 10.740 5.140 max* 5.140 mean 5.140
1356 1357 1358 1360 1361 1362 1363 1364 1365 1366 1367 1370 1371 1372 1373 1374 1375 1376 1377 1378 1377 1378 1378 1378 1378 1378	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient	H min GPU 64 COO min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 10.377 max 10.381 mean 10.377 max 10.381 mean 10.377 max 10.381 mean 2.800 max 3.040 mean 9.919 max 9.925 mean 2.720 max 3.010 mean 0.000 max 5.840 mean 10.587 max*10.596 mean 2.780 max 3.030 mean 4.860 max 3.030 mean 4.860 max 3.030 mean	11.113 3.804 4.308 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742 9.922 2.926 5.513 10.591 2.939 5.667 10.379	1429 1430 1431 1432 1432 1433 1434 1435 1436 1446 1446 1447 1445 1445 1455 1455 1455	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular	CSR min H GPU 64 COO min CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836 5.000 max 5.010 mean 5.005 7.580 max 9.460 mean 8.520 10.739 max 10.741 mean 5.740 5.140 max* 5.140 mean 5.140 10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689
1356 1357 1358 1360 1361 1362 1363 1364 1365 1366 1367 1369 1370 1371 1372 1373 1374 1375 1377 1378 1378 1379 1378 1379 1381 1382 1383 1381 1382 1383	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient	H min GPU 64 COO min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min CSR min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 10.377 max 10.381 mean 10.377 max 10.381 mean 10.377 max 10.381 mean 2.800 max 3.040 mean 9.919 max 9.925 mean 2.720 max 3.010 mean 0.000 max 5.840 mean 10.587 max*10.596 mean 2.780 max 3.030 mean 4.860 max 3.030 mean 4.860 max 3.030 mean	11.113 3.804 4.308 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742 9.922 2.926 5.513 10.591 10.591	1429 1433 1434 1435 1436 1446 1447 1445 1445 1455 1456	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular	CSR min H CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836 5.000 max 5.010 mean 5.005 7.580 max 9.460 mean 8.520 10.739 max 10.741 mean 10.740 5.140 max* 5.140 mean 5.440 10.340 max* 10.390 mean 10.365 9.689 max 9.689 mean 9.689
1356 1357 1358 1360 1361 1362 1363 1364 1365 1366 1367 1370 1371 1372 1373 1374 1375 1376 1377 1378 1379 1381 1381 1382 1383 1384	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	H min GPU 64 COO min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 10.377 max 10.381 mean 10.377 max 10.381 mean 10.377 max 10.381 mean 2.800 max 3.040 mean 9.919 max 9.925 mean 2.720 max 3.010 mean 0.000 max 5.840 mean 10.587 max*10.596 mean 2.780 max 3.030 mean 4.860 max 3.030 mean 4.860 max 3.030 mean	11.113 3.884 4.388 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742 9.922 2.926 5.513 10.591 2.939 5.667 10.379	1429 1430 1431 1431 1432 1432 1433 1434 1435 1436 1441 1445 1446 1446 1455 1455 1455 145	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular Row-Premute	CSR min H CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836 5.000 max 5.010 mean 5.095 7.580 max 9.460 mean 5.200 10.739 max 10.741 mean 10.740 5.140 max* 5.140 mean 5.140 10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425
1356 1357 1358 1360 1361 1362 1363 1364 1365 1367 1368 1369 1371 1372 1373 1374 1375 1376 1377 1378 1379 1380 1381 1382 1382 1383 1384 1385	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	H min GPU 64 COO min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 10.377 max 10.381 mean 10.377 max 10.381 mean 2.800 max 3.040 mean 5.330 max* 6.020 mean 9.919 max 9.925 mean 2.720 max 3.010 mean 0.000 max 5.840 mean 10.587 max*10.596 mean 2.780 max 3.030 mean 4.860 max 5.810 mean 10.376 max 10.382 mean	11.113 3.804 4.308 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742 9.922 2.926 5.513 10.591 2.939 5.667 10.379	1429 1430 1431 1432 1433 1434 1435 1436 1446 1447 1445 1455 1455 1455 1455 1455 1455	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular	CSR min H CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836 5.000 max 5.010 mean 5.005 7.580 max 9.460 mean 8.520 10.739 max 10.741 mean 5.740 5.140 max* 5.140 mean 5.140 10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 110.739 max 10.739 mean 10.739
1356 1357 1358 1360 1361 1362 1363 1364 1365 1367 1368 1370 1371 1372 1373 1374 1375 1376 1377 1378 1379 1380 1381 1382 1383 1384 1385 1386 1387	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	H min GPU 64 COO min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 2.760 max 10.381 mean 2.760 max 3.020 mean 2.760 max 9.925 mean 10.377 max 10.381 mean 2.800 max 3.040 mean 10.378 max 10.381 mean 2.800 max 3.040 mean 10.378 max 10.381 mean 2.780 max 3.040 mean 10.376 max 10.382 mean 10.376 max 10.382 mean 0.000 max 0.000 mean 0.000 max 0.000 mean	11.113 3.804 4.308 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742 9.922 2.926 5.513 10.591 2.939 5.667 10.379	1429 1430 1431 1432 1433 1434 1435 1436 1436 1437 1438 1439 1436 1437 1438 1449 1444 1445 1445 1445 1455 1456 1457 1458 1459 1460	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular Row-Premute	CSR min H CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836 5.000 max 5.010 mean 5.085 7.580 max 9.460 mean 8.520 10.739 max 10.741 mean 10.740 5.140 max* 5.140 mean 10.740 5.140 max* 10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 10.739 5.080 max 5.090 mean 10.739
1356 1357 1358 1360 1361 1362 1363 1364 1365 1366 1367 1370 1371 1372 1373 1374 1375 1376 1377 1377 1378 1379 1381 1382 1383 1384 1385 1385 1386 1387	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	H min GPU 64 COO min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 10.377 max 10.381 mean 10.377 max 10.381 mean 2.800 max 3.040 mean 5.330 max* 6.020 mean 9.919 max 9.925 mean 2.720 max 3.010 mean 0.000 max 5.840 mean 10.587 max*10.596 mean 2.780 max 3.030 mean 4.860 max 5.810 mean 10.376 max 10.382 mean	11.113 3.804 4.308 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742 9.922 2.926 5.513 10.591 10.379	1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439 1440 1441 1444 1445 1446 1455 1456 1457 1458 1456 1457 1458 1459 1460 1461	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular Row-Premute	CSR min H CSR min GPU 64 COO min CSR min H min CSR min H min CSR min H min CSR min H CSR min CSR min H CSR min CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836 5.000 max 5.010 mean 5.095 7.580 max 9.460 mean 5.200 10.739 max 10.741 mean 10.740 5.140 max* 5.140 mean 5.140 10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 10.739 5.080 max 5.090 mean 10.739
1356 1357 1358 1360 1361 1362 1363 1364 1365 1367 1368 1370 1371 1372 1373 1374 1375 1376 1377 1378 1379 1380 1381 1382 1383 1384 1385 1386 1387	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	H min GPU 64 COO min	11.109 max 11.116 mean 3.690 max 3.870 mean 4.260 max 4.340 mean 12.041 max*12.045 mean 3.780 max 3.860 mean 4.090 max 4.290 mean 11.873 max 11.877 mean 2.920 max* 3.140 mean 5.550 max 5.980 mean 8.600 max 8.600 mean 2.760 max 3.020 mean 2.760 max 10.381 mean 2.760 max 3.020 mean 2.760 max 9.925 mean 10.377 max 10.381 mean 2.800 max 3.040 mean 10.378 max 10.381 mean 2.800 max 3.040 mean 10.378 max 10.381 mean 2.780 max 3.040 mean 10.376 max 10.382 mean 10.376 max 10.382 mean 0.000 max 0.000 mean 0.000 max 0.000 mean	11.113 3.804 4.308 12.043 3.819 4.259 11.876 3.048 5.803 8.600 2.898 5.632 10.379 2.944 5.742 9.922 2.926 5.513 10.591 10.379	1429 1430 1431 1432 1433 1434 1435 1436 1436 1437 1438 1439 1436 1437 1438 1449 1444 1445 1445 1445 1455 1456 1457 1458 1459 1460	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular Row-Premute	CSR min H CSR min GPU 64 COO min CSR min H min CSR min H min CSR min H min CSR min H CSR min CSR min H CSR min CSR min	10.340 max*10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 5.085 9.720 max 10.300 mean 10.010 10.579 max 10.582 mean 10.580 5.030 max 5.120 mean 5.075 9.330 max 9.770 mean 9.550 10.835 max*10.838 mean 10.836 5.000 max 5.010 mean 5.085 7.580 max 9.460 mean 8.520 10.739 max 10.741 mean 10.740 5.140 max* 5.140 mean 10.740 5.140 max* 10.390 mean 10.365 9.689 max 9.689 mean 9.689 4.970 max 4.990 mean 4.980 9.420 max 9.430 mean 9.425 10.739 max 10.739 mean 10.739 5.080 max 5.090 mean 10.739 5.080 max 5.090 mean 10.739

1463	Column-Gradient		1537	CSR min 6.360 max 7.450 mean 6.711
1464		GPU 64 COO min 5.030 max 5.120 mean 5.075	1538	H min 11.109 max 11.109 mean 11.109
1465		CSR min 9.330 max 9.770 mean 9.550	1539 Row-Premute	
1466		H min 10.835 max*10.838 mean 10.836	1540	GPU 64 COO min 3.950 max* 3.980 mean 3.953
1467	Row-Column-Permute		1541	CSR min 6.330 max 7.400 mean 6.661
1468		GPU 64 COO min 5.000 max 5.010 mean 5.005	1542	H min 11.098 max 11.104 mean 11.101
1469		CSR min 7.580 max 9.460 mean 8.520	1543 Row-Gradient	
1470		H min 10.739 max 10.741 mean 10.740	1544	GPU 64 COO min 3.960 max 3.980 mean 3.961
1471	mult_dcop_03.mtx		1545	CSR min 6.270 max*10.770 mean 7.017
1472	Regular		1546	H min 11.109 max 11.109 mean 11.109
1473		GPU 64 COO min 5.130 max* 5.220 mean 5.142	1547 Column-Gradient	
1474		CSR min 7.250 max* 9.320 mean 7.722	1548	GPU 64 COO min 3.940 max 3.960 mean 3.950
1475		H min 9.689 max 9.689 mean 9.689	1549	CSR min 6.270 max 7.370 mean 6.696
1476	Row-Premute		1550	H min 11.329 max*11.334 mean 11.331
1477	NOW I I CINGEC	GPU 64 COO min 4.980 max 5.030 mean 4.999	1551 Row-Column-Permute	ii
1478		CSR min 6.460 max 8.470 mean 6.950	1552	GPU 64 COO min 3.950 max 3.960 mean 3.952
1479		H min 10.738 max 10.742 mean 10.740	1553	CSR min 6.180 max 7.420 mean 6.641
	Daw Candinat	n IIII 10.738 IIIax 10.742 IIIean 10.740		
1480	Row-Gradient		1554	H min 11.098 max 11.105 mean 11.101
1481		GPU 64 COO min 5.070 max 5.140 mean 5.088	1555 bloweya.mtx	
1482		CSR min 6.780 max 8.700 mean 7.268	1556 Regular	
1483		H min 10.572 max 10.584 mean 10.580	1557	GPU 64 COO min 0.000 max 0.000 mean 0.000
1484	Column-Gradient		1558	CSR min 0.000 max 0.000 mean 0.000
1485		GPU 64 COO min 4.980 max 5.030 mean 5.010	1559	H min 7.205 max 7.205 mean 7.205
1486		CSR min 6.390 max 7.640 mean 6.982	1560 Row-Premute	
1487		H min 10.825 max*10.845 mean 10.836	1561	GPU 64 COO min 4.020 max 4.030 mean 4.023
1488	Row-Column-Permute		1562	CSR min 6.070 max 6.750 mean 6.340
1489		GPU 64 COO min 4.990 max 5.010 mean 4.997	1563	H min 11.025 max 11.031 mean 11.028
1490		CSR min 6.300 max 7.160 mean 6.636	1564 Row-Gradient	
1491		H min 10.738 max 10.743 mean 10.740	1565	GPU 64 COO min 4.090 max* 4.160 mean 4.111
1492	mult_dcop_01.mtx		1566	CSR min 5.980 max* 7.370 mean 6.678
1493	Regular		1567	H min 10.295 max 10.304 mean 10.300
1494		GPU 64 COO min 5.120 max* 5.140 mean 5.134	1568 Column-Gradient	
1495		CSR min 6.990 max* 9.230 mean 7.546	1569	GPU 64 COO min 3.980 max 4.010 mean 3.995
1496		H min 9.689 max 9.689 mean 9.689	1570	CSR min 5.880 max 6.780 mean 6.295
1497	Row-Premute		1571	H min 10.881 max*10.887 mean 10.883
1498		GPU 64 COO min 4.990 max 5.020 mean 5.004	1572 Row-Column-Permute	
1499		CSR min 6.370 max 7.220 mean 6.771	1573	GPU 64 COO min 4.020 max 4.030 mean 4.023
1500		H min 10.738 max 10.743 mean 10.740	1574	CSR min 5.970 max 6.420 mean 6.183
1501	Row-Gradient	11 IIII1 10.736 IIIAX 10.743 IIIEAN 10.740	1575	H min 11.025 max 11.033 mean 11.028
1502	NOW-GLAUTELL	GPU 64 COO min 5.060 max 5.100 mean 5.082		11 IIII1 11.025 IIIAX 11.033 IIIEAII 11.020
1503		CSR min 6.730 max 7.720 mean 7.317	1577 Regular	
1504		H min 10.574 max 10.585 mean 10.580	1578	GPU 64 COO min 4.260 max* 4.270 mean 4.261
1505	Column-Gradient		1579	CSR min 6.440 max 7.640 mean 6.863
1506		GPU 64 COO min 4.980 max 5.100 mean 5.012	1580	H min 8.412 max 8.412 mean 8.412
1507		CSR min 6.580 max 7.510 mean 7.054	1581 Row-Premute	
1508		H min 10.828 max*10.842 mean 10.835	1582	GPU 64 COO min 4.200 max 4.200 mean 4.200
1509	Row-Column-Permute		1583	CSR min 6.020 max 7.030 mean 6.418
1510		GPU 64 COO min 4.970 max 5.000 mean 4.986	1584	H min 9.255 max 9.257 mean 9.256
1511		CSR min 6.390 max 7.050 mean 6.677	1585 Row-Gradient	
1512		H min 10.738 max 10.742 mean 10.740	1586	GPU 64 COO min 4.210 max 4.240 mean 4.226
1513	mult_dcop_02.mtx		1587	CSR min 6.070 max*10.050 mean 6.498
1514	Regular		1588	H min 8.607 max 8.678 mean 8.671
1515		GPU 64 COO min 5.120 max 5.140 mean 5.133	1589 Column-Gradient	
1516		GFU 04 COU IIIII 3.120 IIIAX 3.140 IIICAII 3.133	150) COTAMIN GLAGICITE	
1517		CSR min 6.950 max 7.590 mean 7.336	1590	GPU 64 COO min 4.170 max 4.190 mean 4.180
1517				GPU 64 COO min 4.170 max 4.190 mean 4.180 CSR min 5.610 max 7.300 mean 5.988
1518	Row-Premute	CSR min 6.950 max 7.590 mean 7.336	1590	
1518	Row-Premute	CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689	1590 1591 1592	CSR min 5.610 max 7.300 mean 5.988
1518 1519	Row-Premute	CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984	1590 1591 1592 1593 Row-Column-Permute	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585
1518 1519 1520	Row-Premute	CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 CPU 64 COO min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719	1590 1591 1592 1593 Row-Column-Permute 1594	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 4.190
1518 1519 1520 1521		CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984	1590 1591 1592 1593 Row-Column-Permute 1594	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 4.190 CSR min 6.070 max 7.000 mean 6.386
1518 1519 1520 1521 1522	Row-Premute	CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719 H min 10.738 max 10.742 mean 10.740	1590 1591 1592 1593 Row-Column-Permute 1594 1595	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 4.190
1518 1519 1520 1521 1522 1523		CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719 H min 10.738 max 10.742 mean 10.740 GPU 64 COO min 5.070 max* 5.150 mean 5.086	1590 1591 1592 1593 Row-Column-Permute 1594 1595 1596 1597 ex19.mtx	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 4.190 CSR min 6.070 max 7.000 mean 6.386
1518 1519 1520 1521 1522 1523 1524		CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719 H min 10.738 max 10.742 mean 10.740 GPU 64 COO min 5.070 max* 5.150 mean 5.086 CSR min 6.650 max* 7.930 mean 7.304	1590 1591 1592 1593 Row-Column-Permute 1594 1595 1596 1597 ex19.mtx 1598 Regular	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 4.190
1518 1519 1520 1521 1522 1523 1524 1525	Row-Gradient	CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719 H min 10.738 max 10.742 mean 10.740 GPU 64 COO min 5.070 max* 5.150 mean 5.086	1590 1591 1592 1593 Row-Column-Permute 1594 1595 1596 1597 ex19.mtx 1598 Regular	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 4.190 CSR min 6.070 max 7.000 mean 6.386 H min 9.255 max 9.257 mean 9.256
1518 1519 1520 1521 1522 1523 1524 1525 1526		CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719 H min 10.738 max 10.742 mean 10.740 GPU 64 COO min 5.070 max* 5.150 mean 5.086 CSR min 6.650 max* 7.930 mean 7.304 H min 10.574 max 10.587 mean 10.580	1590 1591 1592 1593 Row-Column-Permute 1594 1595 1596 1597 ex19.mtx 1598 Regular 1599 1600	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 4.190
1518 1519 1520 1521 1522 1523 1524 1525 1526 1527	Row-Gradient	CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719 H min 10.738 max 10.742 mean 10.740 GPU 64 COO min 5.070 max* 5.150 mean 5.086 CSR min 6.650 max* 7.930 mean 7.304 H min 10.574 max 10.587 mean 10.580	1590 1591 1592 1593 Row-Column-Permute 1594 1595 1596 1597 ex19.mtx 1598 Regular 1599 1600 1601	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 4.190 CSR min 6.070 max 7.000 mean 6.386 H min 9.255 max 9.257 mean 9.256
1518 1519 1520 1521 1522 1523 1524 1525 1526 1527 1528	Row-Gradient	CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719 H min 10.738 max 10.742 mean 10.740 GPU 64 COO min 5.070 max* 5.150 mean 5.086 CSR min 6.650 max* 7.930 mean 7.304 H min 10.574 max 10.587 mean 10.580 GPU 64 COO min 4.980 max 5.040 mean 5.012 CSR min 6.520 max 7.650 mean 7.139	1590 1591 1592 1593 Row-Column-Permute 1594 1595 1596 1597 ex19.mtx 1598 Regular 1599 1600 1601 1602 Row-Premute	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 6.386 H min 9.255 max 9.257 mean 9.256 GPU 64 COO min 6.140 max* 6.180 mean 6.159 CSR min 12.780 max*14.400 mean 13.328 H min 8.228 max 8.228 mean 8.228
1518 1519 1520 1521 1522 1523 1524 1525 1526 1527 1528 1529	Row-Gradient Column-Gradient	CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719 H min 10.738 max 10.742 mean 10.740 GPU 64 COO min 5.070 max* 5.150 mean 5.086 CSR min 6.650 max* 7.930 mean 7.304 H min 10.574 max 10.587 mean 10.580	1590 1591 1592 1593 Row-Column-Permute 1594 1595 1596 1597 ex19.mtx 1598 Regular 1599 1600 1601 1602 Row-Premute 1603	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 4.190 CSR min 6.070 max 7.000 mean 6.386 H min 9.255 max 9.257 mean 9.256 GPU 64 COO min 6.140 max* 6.180 mean 6.159 CSR min 12.780 max*14.400 mean 13.328 H min 8.228 max 8.228 mean 8.228 GPU 64 COO min 5.820 max 5.850 mean 5.833
1518 1519 1520 1521 1522 1523 1524 1525 1526 1527 1528	Row-Gradient	CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719 H min 10.738 max 10.742 mean 10.740 GPU 64 COO min 5.070 max* 5.150 mean 7.304 H min 10.574 max 10.587 mean 10.580 GPU 64 COO min 4.980 max 5.040 mean 5.012 CSR min 6.520 max 7.650 mean 7.139 H min 10.829 max*10.846 mean 10.836	1590 1591 1592 1593 Row-Column-Permute 1594 1595 1596 1597 ex19.mtx 1598 Regular 1599 1600 1601 1602 Row-Premute	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 4.190
1518 1519 1520 1521 1522 1523 1524 1525 1526 1527 1528 1529	Row-Gradient Column-Gradient	CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719 H min 10.738 max 10.742 mean 10.740 GPU 64 COO min 5.070 max* 5.150 mean 5.086 CSR min 6.650 max* 7.930 mean 7.304 H min 10.574 max 10.587 mean 10.580 GPU 64 COO min 4.980 max 5.040 mean 5.012 CSR min 6.520 max 7.650 mean 7.139 H min 10.829 max*10.846 mean 10.836	1590 1591 1592 1593 Row-Column-Permute 1594 1595 1596 1597 ex19.mtx 1598 Regular 1599 1600 1601 1602 Row-Premute 1603	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 4.190 CSR min 6.070 max 7.000 mean 6.386 H min 9.255 max 9.257 mean 9.256 GPU 64 COO min 6.140 max* 6.180 mean 6.159 CSR min 12.780 max*14.400 mean 13.328 H min 8.228 max 8.228 mean 8.228 GPU 64 COO min 5.820 max 5.850 mean 5.833
1518 1519 1520 1521 1522 1523 1524 1525 1526 1527 1528 1529 1530	Row-Gradient Column-Gradient	CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719 H min 10.738 max 10.742 mean 10.740 GPU 64 COO min 5.070 max* 5.150 mean 7.304 H min 10.574 max 10.587 mean 10.580 GPU 64 COO min 4.980 max 5.040 mean 5.012 CSR min 6.520 max 7.650 mean 7.139 H min 10.829 max*10.846 mean 10.836	1590 1591 1592 1593 Row-Column-Permute 1594 1595 1596 1597 ex19.mtx 1598 Regular 1599 1600 1601 1602 Row-Premute	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 4.190
1518 1519 1520 1521 1522 1523 1524 1525 1526 1527 1528 1529 1530	Row-Gradient Column-Gradient	CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719 H min 10.738 max 10.742 mean 10.740 GPU 64 COO min 5.070 max* 5.150 mean 5.086 CSR min 6.650 max* 7.930 mean 7.304 H min 10.574 max 10.587 mean 10.580 GPU 64 COO min 4.980 max 5.040 mean 5.012 CSR min 6.520 max 7.650 mean 7.139 H min 10.829 max*10.846 mean 10.836	1590 1591 1592 1593 Row-Column-Permute 1594 1595 1596 1597 ex19.mtx 1598 Regular 1599 1600 1601 1602 Row-Premute 1603 1604	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 4.190
1518 1519 1520 1521 1522 1523 1524 1525 1526 1527 1528 1529 1530 1531	Row-Gradient Column-Gradient	CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719 H min 10.738 max 10.742 mean 10.740 GPU 64 COO min 5.070 max* 5.150 mean 5.086 CSR min 6.550 max* 7.930 mean 7.304 H min 10.574 max 10.587 mean 10.580 GPU 64 COO min 4.980 max 5.040 mean 5.012 CSR min 6.520 max 7.650 mean 7.139 H min 10.829 max*10.846 mean 10.836 GPU 64 COO min 4.970 max 5.050 mean 4.983 CSR min 6.440 max 7.380 mean 6.779	1590 1591 1592 1593 Row-Column-Permute 1594 1595 1596 1597 ex19.mtx 1598 Regular 1599 1600 1601 1602 Row-Premute 1603 1604 1605 1606 Row-Gradient	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 6.386 H min 9.255 max 9.257 mean 9.256 GPU 64 COO min 6.140 max* 6.180 mean 6.159 CSR min 12.780 max*14.400 mean 13.328 H min 8.228 max 8.228 mean 8.228 GPU 64 COO min 5.820 max 5.850 mean 5.833 CSR min 9.870 max 11.070 mean 10.372 H min 11.836 max 11.840 mean 11.838
1518 1519 1520 1521 1522 1523 1524 1525 1526 1527 1528 1529 1530 1531 1532 1533	Row-Gradient Column-Gradient Row-Column-Permute	CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719 H min 10.738 max 10.742 mean 10.740 GPU 64 COO min 5.070 max* 5.150 mean 5.086 CSR min 6.550 max* 7.930 mean 7.304 H min 10.574 max 10.587 mean 10.580 GPU 64 COO min 4.980 max 5.040 mean 5.012 CSR min 6.520 max 7.650 mean 7.139 H min 10.829 max*10.846 mean 10.836 GPU 64 COO min 4.970 max 5.050 mean 4.983 CSR min 6.440 max 7.380 mean 6.779	1590 1591 1592 1593 Row-Column-Permute 1594 1595 1596 1597 ex19.mtx 1598 Regular 1599 1600 1601 1602 Row-Premute 1603 1604 1605 1606 Row-Gradient 1607	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 4.190 CSR min 6.070 max 7.000 mean 6.386 H min 9.255 max 9.257 mean 9.256 GPU 64 COO min 6.140 max* 6.180 mean 6.159 CSR min 12.780 max*14.400 mean 13.328 H min 8.228 max 8.228 mean 8.228 GPU 64 COO min 5.820 max 5.850 mean 5.833 CSR min 9.870 max 11.070 mean 10.372 H min 11.836 max 11.840 mean 11.838
1518 1519 1520 1521 1522 1523 1524 1525 1526 1527 1528 1529 1530 1531 1532 1533	Row-Gradient Column-Gradient Row-Column-Permute lp_fit2d.mtx	CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 COO min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719 H min 10.738 max 10.742 mean 10.740 GPU 64 COO min 5.070 max* 5.150 mean 5.086 CSR min 6.550 max* 7.930 mean 7.304 H min 10.574 max 10.587 mean 10.580 GPU 64 COO min 4.980 max 5.040 mean 5.012 CSR min 6.520 max 7.650 mean 7.139 H min 10.829 max*10.846 mean 10.836 GPU 64 COO min 4.970 max 5.050 mean 4.983 CSR min 6.440 max 7.380 mean 6.779	1590 1591 1592 1593 Row-Column-Permute 1594 1595 1596 1597 ex19.mtx 1598 Regular 1599 1600 1601 1602 Row-Premute 1603 1604 1605 1606 Row-Gradient 1607	CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 max 4.190 mean 4.190

1611		GPU 64 COO min 5.760 max 5.840 mean 5.813	1685	H min 7.380 max 7.380 mean 7.380
1612		CSR min 9.710 max 14.220 mean 10.376	1686 Row-Premute	
1613		H min 11.873 max*11.882 mean 11.878	1687	GPU 64 COO min 4.130 max 4.170 mean 4.134
1614	Row-Column-Permute		1688	CSR min 6.180 max* 9.200 mean 6.796
1615		GPU 64 COO min 5.810 max 5.860 mean 5.838	1689	H min 10.041 max 10.046 mean 10.044
1616		CSR min 9.920 max 10.820 mean 10.240	1690 Row-Gradient	
1617		H min 11.836 max 11.841 mean 11.838	1691	GPU 64 COO min 4.150 max* 4.220 mean 4.163
1618	brainpc2.mtx		1692	CSR min 6.410 max 7.500 mean 6.816
1619	Regular	CDU 64 000 0 000 0 000 0 000	1693	H min 9.682 max 9.706 mean 9.693
1620		GPU 64 COO min 0.000 max 0.000 mean 0.000	1694 Column-Gradient	CPU 64 000 min 4 000 min 4 110 min 4 006
1621 1622		CSR min 0.000 max 0.000 mean 0.000 H min 7.478 max 7.478 mean 7.478	1695 1696	GPU 64 COO min 4.080 max 4.110 mean 4.096 CSR min 6.020 max 7.220 mean 6.309
1623	Row-Premute	n IIII 7.4/6 IIIax 7.4/6 IIIean 7.4/6	1697	H min 10.597 max*10.658 mean 10.631
1624	Row-Prelifute	GPU 64 COO min 4.760 max 4.790 mean 4.773	1698 Row-Column-Permute	n IIIII 10.597 IIIax*10.658 IIIean 10.651
1625		CSR min 6.930 max 7.780 mean 7.310	1699 KOW-COTUMNI-FET MICE	GPU 64 COO min 4.120 max 4.140 mean 4.130
1626		H min 9.810 max 9.813 mean 9.811	1700	CSR min 6.210 max 7.200 mean 6.609
1627	Row-Gradient	11 3.010 max 3.013 mean 3.011	1701	H min 10.041 max 10.046 mean 10.044
1628		GPU 64 COO min 4.820 max* 4.840 mean 4.831	1702 TSOPF_FS_b9_c6.mtx	
1629		CSR min 7.220 max 8.290 mean 7.583	1703 Regular	
1630		H min 9.721 max 9.725 mean 9.723	1704	GPU 64 COO min 0.000 max 0.000 mean 0.000
1631	Column-Gradient		1705	CSR min 0.000 max 0.000 mean 0.000
1632		GPU 64 COO min 4.760 max 4.820 mean 4.779	1706	H min 7.380 max 7.380 mean 7.380
1633		CSR min 6.870 max* 8.300 mean 7.393	1707 Row-Premute	
1634		H min 10.368 max*10.373 mean 10.370	1708	GPU 64 COO min 4.120 max 4.140 mean 4.129
1635	Row-Column-Permute		1709	CSR min 6.170 max 7.160 mean 6.664
1636		GPU 64 COO min 4.750 max 4.780 mean 4.765	1710	H min 10.041 max 10.045 mean 10.043
1637		CSR min 6.940 max 7.580 mean 7.298	1711 Row-Gradient	
1638		H min 9.809 max 9.814 mean 9.811	1712	GPU 64 COO min 4.150 max* 4.180 mean 4.162
1639	shermanACb.mtx		1713	CSR min 6.420 max 7.360 mean 6.723
1640	Regular		1714	H min 9.682 max 9.706 mean 9.693
1641		GPU 64 COO min 4.090 max* 4.130 mean 4.112	1715 Column-Gradient	
1642		CSR min 6.320 max* 7.200 mean 6.779	1716	GPU 64 COO min 4.080 max 4.120 mean 4.096
1643		H min 8.600 max 8.600 mean 8.600	1717	CSR min 5.880 max 7.090 mean 6.403
1644	Row-Premute		1718	H min 10.611 max*10.660 mean 10.637
1645		GPU 64 COO min 4.020 max 4.050 mean 4.036	1719 Row-Column-Permute	
1646		CSR min 5.670 max 6.460 mean 6.014 H min 10.376 max 10.382 mean 10.379	1720	GPU 64 COO min 4.130 max 4.140 mean 4.130
1647 1648	Daw Candinat	H min 10.376 max 10.382 mean 10.379	1721 1722	CSR min 6.330 max* 7.390 mean 6.695 H min 10.042 max 10.047 mean 10.044
	Row-Gradient	GPU 64 COO min 4.050 max 4.100 mean 4.074	1722 1723 OPF_6000.mtx	H min 10.042 max 10.047 mean 10.044
1649 1650		CSR min 5.580 max 6.420 mean 5.996	1724 Regular	
1651		H min 9.918 max 9.924 mean 9.921	1725 Regulai	GPU 64 COO min 7.270 max* 7.370 mean 7.293
1652	Column-Gradient	11 IIII 3.310 IIIAX 3.324 IIICAN 3.321	1726	CSR min 12.890 max*14.500 mean 13.566
1653	cordinir or durent	GPU 64 COO min 4.010 max 4.080 mean 4.033	1727	H min 8.799 max 8.799 mean 8.799
1654		CSR min 0.000 max 6.320 mean 5.527	1728 Row-Premute	
1655		H min 10.543 max*10.595 mean 10.589	1729	GPU 64 COO min 6.640 max 6.720 mean 6.678
1656	Row-Column-Permute		1730	CSR min 9.680 max 11.600 mean 10.040
1657		GPU 64 COO min 4.020 max 4.050 mean 4.036	1731	H min 11.873 max 11.877 mean 11.875
1658		CSR min 5.670 max 6.510 mean 6.092	1732 Row-Gradient	
1659		H min 10.377 max 10.381 mean 10.379	1733	GPU 64 COO min 7.090 max 7.140 mean 7.122
1660	cvxqp3.mtx		1734	CSR min 11.250 max 13.030 mean 12.142
1661	Regular		1735	H min 11.110 max 11.117 mean 11.114
1662		GPU 64 COO min 3.500 max* 3.540 mean 3.501	1736 Column-Gradient	
1663		CSR min 11.860 max*13.100 mean 12.694	1737	GPU 64 COO min 6.590 max 6.710 mean 6.644
1664		H min 8.646 max 8.646 mean 8.646	1738	CSR min 9.400 max 13.140 mean 9.991
1665	Row-Premute		1739	H min 12.040 max*12.046 mean 12.043
1666		GPU 64 COO min 3.360 max 3.370 mean 3.365	1740 Row-Column-Permute	
1667		CSR min 6.210 max 7.610 mean 6.631	1741	GPU 64 COO min 6.640 max 6.710 mean 6.679
1//0			1742	CSR min 9.690 max 10.740 mean 10.050
1668		H min 11.027 max 11.032 mean 11.030	·· ·=	
1669	Row-Gradient		1743	H min 11.874 max 11.877 mean 11.875
1669 1670	Row-Gradient	GPU 64 COO min 3.370 max 3.380 mean 3.376	1743 1744 OPF_3754.mtx	
1669 1670 1671	Row-Gradient	GPU 64 COO min 3.370 max 3.380 mean 3.376 CSR min 6.170 max 7.070 mean 6.499	1743 1744 OPF_3754.mtx 1745 Regular	H min 11.874 max 11.877 mean 11.875
1669 1670 1671 1672		GPU 64 COO min 3.370 max 3.380 mean 3.376	1743 1744 OPF_3754.mtx 1745 Regular 1746	H min 11.874 max 11.877 mean 11.875 GPU 64 COO min 4.430 max* 4.450 mean 4.443
1669 1670 1671 1672 1673	Row-Gradient Column-Gradient	GPU 64 COO min 3.370 max 3.380 mean 3.376 CSR min 6.170 max 7.070 mean 6.499 H min 11.059 max 11.068 mean 11.064	1743 1744 OPF_3754.mtx 1745 Regular 1746 1747	H min 11.874 max 11.877 mean 11.875 GPU 64 COO min 4.430 max* 4.450 mean 4.443 CSR min 9.710 max*13.000 mean 11.377
1669 1670 1671 1672 1673 1674		GPU 64 COO min 3.370 max 3.380 mean 3.376 CSR min 6.170 max 7.070 mean 6.499 H min 11.059 max 11.068 mean 11.064 GPU 64 COO min 3.350 max 3.390 mean 3.371	1743 1744 OPF_3754.mtx 1745 Regular 1746 1747	H min 11.874 max 11.877 mean 11.875 GPU 64 COO min 4.430 max* 4.450 mean 4.443
1669 1670 1671 1672 1673 1674 1675		GPU 64 COO min 3.370 max 3.380 mean 3.376 CSR min 6.170 max 7.070 mean 6.499 H min 11.059 max 11.068 mean 11.064 GPU 64 COO min 3.350 max 3.390 mean 3.371 CSR min 6.150 max 7.180 mean 6.531	1743 1744 OPF_3754.mtx 1745 Regular 1746 1747 1748 1749 Row-Premute	H min 11.874 max 11.877 mean 11.875 GPU 64 COO min 4.430 max* 4.450 mean 4.443
1669 1670 1671 1672 1673 1674 1675	Column-Gradient	GPU 64 COO min 3.370 max 3.380 mean 3.376 CSR min 6.170 max 7.070 mean 6.499 H min 11.059 max 11.068 mean 11.064 GPU 64 COO min 3.350 max 3.390 mean 3.371	1743 1744 OPF_3754.mtx 1745 Regular 1746 1747 1748 1749 Row-Premute	H min 11.874 max 11.877 mean 11.875 GPU 64 COO min 4.430 max* 4.450 mean 4.443
1669 1670 1671 1672 1673 1674 1675 1676		GPU 64 COO min 3.370 max 3.380 mean 3.376	1743 1744 OPF_3754.mtx 1745 Regular 1746 1747 1748 1749 Row-Premute 1750	H min 11.874 max 11.877 mean 11.875 GPU 64 COO min 4.430 max* 4.450 mean 4.443 CSR min 9.710 max*13.000 mean 11.377 H min 8.393 max 8.393 mean 8.393 GPU 64 COO min 4.230 max 4.250 mean 4.240 CSR min 7.430 max 8.750 mean 7.986
1669 1670 1671 1672 1673 1674 1675 1676 1677	Column-Gradient	GPU 64 COO min 3.370 max 3.380 mean 3.376	1743 1744 OPF_3754.mtx 1745 Regular 1746 1747 1748 1749 Row-Premute 1750 1751	H min 11.874 max 11.877 mean 11.875 GPU 64 COO min 4.430 max* 4.450 mean 4.443
1669 1670 1671 1672 1673 1674 1675 1676 1677 1678	Column-Gradient	GPU 64 COO min 3.370 max 3.380 mean 3.376	1743 1744 OPF_3754.mtx 1745 Regular 1746 1747 1748 1749 Row-Premute 1750 1751 1752 1753 Row-Gradient	H min 11.874 max 11.877 mean 11.875 GPU 64 COO min 4.430 max* 4.450 mean 4.443
1669 1670 1671 1672 1673 1674 1675 1676 1677	Column-Gradient	GPU 64 COO min 3.370 max 3.380 mean 3.376	1743 1744 OPF_3754.mtx 1745 Regular 1746 1747 1748 1749 Row-Premute 1750 1751 1752 1753 Row-Gradient	H min 11.874 max 11.877 mean 11.875 GPU 64 COO min 4.430 max* 4.450 mean 4.443
1669 1670 1671 1672 1673 1674 1675 1676 1677 1678 1679	Column-Gradient Row-Column-Permute case9.mtx	GPU 64 COO min 3.370 max 3.380 mean 3.376	1743 1744 OPF_3754.mtx 1745 Regular 1746 1747 1748 1749 Row-Premute 1750 1751 1752 1753 Row-Gradient 1754 1755	H min 11.874 max 11.877 mean 11.875 GPU 64 COO min 4.430 max* 4.450 mean 4.443
1669 1670 1671 1672 1673 1674 1675 1676 1677 1678 1679 1680	Column-Gradient Row-Column-Permute	GPU 64 COO min 3.370 max 3.380 mean 3.376	1743 1744 OPF_3754.mtx 1745 Regular 1746 1747 1748 1749 Row-Premute 1750 1751 1752 1753 Row-Gradient	H min 11.874 max 11.877 mean 11.875 GPU 64 COO min 4.430 max* 4.450 mean 4.443 CSR min 9.710 max*13.000 mean 11.377 H min 8.393 max 8.393 mean 8.393 GPU 64 COO min 4.230 max 4.250 mean 4.240 CSR min 7.430 max 8.750 mean 7.986 H min 11.266 max 11.272 mean 11.269 GPU 64 COO min 4.370 max 4.420 mean 4.382 CSR min 8.160 max 9.470 mean 8.682
1669 1670 1671 1672 1673 1674 1675 1676 1677 1678 1679 1680 1681	Column-Gradient Row-Column-Permute case9.mtx	GPU 64 COO min 3.370 max 3.380 mean 3.376	1743 1744 OPF_3754.mtx 1745 Regular 1746 1747 1748 1749 Row-Premute 1750 1751 1752 1753 Row-Gradient 1755 1756	H min 11.874 max 11.877 mean 11.875 GPU 64 COO min 4.430 max* 4.450 mean 4.443 CSR min 9.710 max*13.000 mean 11.377 H min 8.393 max 8.393 mean 8.393 GPU 64 COO min 4.230 max 4.250 mean 4.240 CSR min 7.430 max 8.750 mean 7.986 H min 11.266 max 11.272 mean 11.269 GPU 64 COO min 4.370 max 4.420 mean 4.382 CSR min 8.160 max 9.470 mean 8.682

1750		CSR min 7.160 max 8.080 mean 7.595	1922 Pow-Promuto	
1759 1760		H min 11.394 max*11.401 mean 11.398	1833 Row-Premute 1834	GPU 64 COO min 10.340 max 10.430 mean 10.362
1761	Row-Column-Permute	11 IIII1 11.354 IIIAX^11.401 IIIEAN 11.356	1835	CSR min 12.880 max 13.340 mean 13.057
1762	NOW-COIUMIN-FEI MULE	GPU 64 COO min 4.230 max 4.250 mean 4.243	1836	H min 10.777 max 10.778 mean 10.777
1763		CSR min 7.230 max 8.940 mean 8.056	1837 Row-Gradient	II IIII 10.777 IIIAX 10.776 IIIEAII 10.777
1764		H min 11.264 max 11.271 mean 11.269	1838	GPU 64 COO min 10.650 max*10.740 mean 10.688
1765	c-47.mtx	11 IIII1 11.204 IIIAX 11.271 IIIEAN 11.209	1839	CSR min 12.310 max 13.670 mean 12.562
1766	Regular		1840	H min 11.247 max 13.300 mean 11.281
1767	regular	GPU 64 COO min 5.320 max* 5.340 mean 5.329	1841 Column-Gradient	11 IIII 11.247 IIIAX 11.300 IIICAN 11.201
1768		CSR min 8.890 max* 9.590 mean 9.249	1842	GPU 64 COO min 10.340 max 10.440 mean 10.398
1769		H min 8.364 max 8.364 mean 8.364	1843	CSR min 9.480 max 10.110 mean 9.782
1770	Row-Premute	11 IIII11 8.304 IIIAX 8.304 IIIEAI1 8.304	1844	H min 12.023 max*12.069 mean 12.047
1771	NOW-F1 ellique	GPU 64 COO min 5.240 max 5.250 mean 5.241	1845 Row-Column-Permute	11 III11 12.023 IIIAX^12.003 IIIEAI1 12.047
1772		CSR min 7.790 max 8.890 mean 8.214	1846	GPU 64 COO min 10.330 max 10.380 mean 10.356
1773		H min 10.059 max 10.063 mean 10.061	1847	CSR min 12.840 max 13.530 mean 13.119
1774	Row-Gradient	11 IIII1 10.039 IIIAX 10.003 IIIEAI1 10.001	1848	H min 10.776 max 10.778 mean 10.777
1775	Now-Grautent	GPU 64 COO min 5.230 max 5.260 mean 5.242	1849 aft01.mtx	II IIII 10.770 IIIAX 10.778 IIIEAII 10.777
1776		CSR min 7.080 max 8.050 mean 7.673	1850 Regular	
1777		H min 10.206 max 10.226 mean 10.218	1851	GPU 64 COO min 3.680 max* 3.690 mean 3.688
1778	Column-Gradient	11 IIII11 10.200 IIIAX 10.220 IIIEAI1 10.216	1852	CSR min 13.860 max*14.830 mean 14.560
1779	COTUMNI-OF AUTERIC	GPU 64 COO min 5.080 max 5.120 mean 5.105	1853	H min 7.811 max 7.811 mean 7.811
1780		CSR min 5.780 max 6.970 mean 6.359	1854 Row-Premute	11 IIII 7.011 IIIAX 7.011 IIIEAII 7.011
1781		H min 11.205 max*11.233 mean 11.222	1855	GPU 64 COO min 3.510 max 3.530 mean 3.513
1782	Row-Column-Permute	11 III. 11.203 III. 233 III. 211.222	1856	CSR min 6.420 max 10.520 mean 7.265
1783	Now Column Termate	GPU 64 COO min 5.220 max 5.250 mean 5.227	1857	H min 11.161 max*11.170 mean 11.165
1784		CSR min 7.860 max 8.710 mean 8.247	1858 Row-Gradient	III III III III III III III III III II
1785		H min 10.059 max 10.064 mean 10.061	1859	GPU 64 COO min 3.630 max 3.670 mean 3.643
1786	mhd4800a.mtx	11 IIII1 10.035 IIIAX 10.004 IIIEAI1 10.001	1860	CSR min 10.760 max 13.510 mean 12.199
1787	Regular		1861	H min 10.248 max 10.265 mean 10.258
1788	кедитаг	GPU 64 COO min 3.090 max* 3.100 mean 3.098	1862 Column-Gradient	11 IIII1 10.246 IIIAX 10.203 IIIEAII 10.238
1789		CSR min 11.570 max*12.290 mean 12.092	1863	GPU 64 COO min 3.510 max 3.520 mean 3.519
1790		H min 7.132 max 7.132 mean 7.132	1864	CSR min 6.490 max 11.230 mean 7.645
1791	Row-Premute	11 IIII1 7.132 IIIdX 7.132 IIIEdii 7.132	1865	H min 11.112 max 11.121 mean 11.117
1792	NOW I I CING CC	GPU 64 COO min 3.020 max 3.020 mean 3.020	1866 Row-Column-Permute	III IIII III. II III III III III III II
1793		CSR min 5.560 max 7.270 mean 6.007	1867	GPU 64 COO min 3.510 max 3.540 mean 3.515
1794		H min 10.959 max*10.968 mean 10.963	1868	CSR min 6.510 max 11.650 mean 7.311
1795	Row-Gradient	11 IIII 10.555 IIIAX*10.566 IIICAN 10.565	1869	H min 11.161 max 11.168 mean 11.165
1796	NOW OF BUTCHE	GPU 64 COO min 3.080 max 3.100 mean 3.088	1870 TSOPF_RS_b39_c7.mtx	III IIII III III III III III III III I
1797		CSR min 10.250 max 12.150 mean 11.340	1871 Regular	
1798		H min 9.509 max 9.528 mean 9.520	1872 Regulai	GPU 64 COO min 5.970 max* 6.010 mean 5.988
1799	Column-Gradient	11 IIII 5.505 IIIAX 5.526 IIICAN 5.520	1873	CSR min 12.470 max*21.120 mean 13.816
1800	COTUMNI-OF AUTERIC	GPU 64 COO min 3.020 max 3.050 mean 3.026	1874	H min 7.304 max 7.304 mean 7.304
1801		CSR min 5.530 max 10.580 mean 6.432	1875 Row-Premute	11 IIII1 7.304 IIIAX 7.304 IIIEAII 7.304
1802		H min 10.933 max 10.946 mean 10.939	1876	GPU 64 COO min 5.840 max 5.870 mean 5.856
1803	Row-Column-Permute	11 III.11 10.555 III. 10.546 III. 10.555	1877	CSR min 10.780 max 15.810 mean 11.425
1804	NOW-COIUMIN-FEI MULE	GPU 64 COO min 3.020 max 3.020 mean 3.020	1878	H min 10.537 max 10.540 mean 10.539
1805		CSR min 5.510 max 6.830 mean 6.136	1879 Row-Gradient	11 IIII 10.557 IIIAX 10.540 IIICAN 10.555
1806		H min 10.959 max 10.967 mean 10.963	1880	GPU 64 COO min 5.950 max 6.000 mean 5.975
1807	gen4.mtx		1881	CSR min 11.520 max 17.250 mean 12.799
1808	Regular		1882	H min 9.638 max 9.646 mean 9.641
1809	negazar	GPU 64 COO min 3.300 max* 3.320 mean 3.308	1883 Column-Gradient	
1810		CSR min 5.250 max 6.340 mean 5.705	1884	GPU 64 COO min 5.790 max 5.860 mean 5.827
1811		H min 9.234 max 9.234 mean 9.234	1885	CSR min 10.500 max 14.080 mean 11.237
1812	Row-Premute		1886	H min 11.128 max*11.223 mean 11.209
1813		GPU 64 COO min 3.290 max 3.310 mean 3.299	1887 Row-Column-Permute	
1814		CSR min 5.190 max 7.420 mean 5.683	1888	GPU 64 COO min 5.850 max 5.870 mean 5.855
1814 1815		CSR min 5.190 max 7.420 mean 5.683	1888 1889	GPU 64 COO min 5.850 max 5.870 mean 5.855 CSR min 10.790 max 15.250 mean 11.718
1815	Row-Gradient		1889	CSR min 10.790 max 15.250 mean 11.718
1815 1816	Row-Gradient	CSR min 5.190 max 7.420 mean 5.683 H min 10.249 max 10.254 mean 10.252	1889 1890	
1815 1816 1817	Row-Gradient	CSR min 5.190 max 7.420 mean 5.683 H min 10.249 max 10.254 mean 10.252 GPU 64 COO min 3.300 max 3.310 mean 3.301	1889 1890 1891 mult_dcop_03.mtx	CSR min 10.790 max 15.250 mean 11.718
1815 1816 1817 1818	Row-Gradient	CSR min 5.190 max 7.420 mean 5.683 H min 10.249 max 10.254 mean 10.252 GPU 64 COO min 3.300 max 3.310 mean 3.301 CSR min 5.370 max 6.310 mean 5.659	1889 1890 1891 mult_dcop_03.mtx 1892 Regular	CSR min 10.790 max 15.250 mean 11.718 H min 10.537 max 10.541 mean 10.539
1815 1816 1817	Row-Gradient Column-Gradient	CSR min 5.190 max 7.420 mean 5.683 H min 10.249 max 10.254 mean 10.252 GPU 64 COO min 3.300 max 3.310 mean 3.301	1889 1890 1891 mult_dcop_03.mtx	CSR min 10.790 max 15.250 mean 11.718 H min 10.537 max 10.541 mean 10.539 GPU 64 COO min 5.130 max* 5.220 mean 5.142
1815 1816 1817 1818 1819		CSR min 5.190 max 7.420 mean 5.683 H min 10.249 max 10.254 mean 10.252 GPU 64 COO min 3.300 max 3.310 mean 3.301	1889 1890 1891 mult_dcop_03.mtx 1892 Regular 1893	CSR min 10.790 max 15.250 mean 11.718 H min 10.537 max 10.541 mean 10.539 GPU 64 COO min 5.130 max* 5.220 mean 5.142 CSR min 7.250 max* 9.320 mean 7.722
1815 1816 1817 1818 1819 1820 1821		CSR min 5.190 max 7.420 mean 5.683 H min 10.249 max 10.254 mean 10.252 GPU 64 COO min 3.300 max 3.310 mean 3.301 CSR min 5.370 max 6.310 mean 5.659 H min 9.934 max 9.958 mean 9.948 GPU 64 COO min 3.240 max 3.260 mean 3.249	1889 1890 1891 mult_dcop_03.mtx 1892 Regular 1893 1894	CSR min 10.790 max 15.250 mean 11.718 H min 10.537 max 10.541 mean 10.539 GPU 64 COO min 5.130 max* 5.220 mean 5.142 CSR min 7.250 max* 9.320 mean 7.722
1815 1816 1817 1818 1819 1820		CSR min 5.190 max 7.420 mean 5.683 H min 10.249 max 10.254 mean 10.252 GPU 64 COO min 3.300 max 3.310 mean 3.301 CSR min 5.370 max 6.310 mean 5.659 H min 9.934 max 9.958 mean 9.948 GPU 64 COO min 3.240 max 3.260 mean 3.249 CSR min 5.090 max* 8.660 mean 5.546	1889 1890 1891 mult_dcop_03.mtx 1892 Regular 1893 1894	CSR min 10.790 max 15.250 mean 11.718 H min 10.537 max 10.541 mean 10.539 GPU 64 COO min 5.130 max* 5.220 mean 5.142 CSR min 7.250 max* 9.320 mean 7.722 H min 9.689 max 9.689 mean 9.689
1815 1816 1817 1818 1819 1820 1821 1822 1823	Column-Gradient	CSR min 5.190 max 7.420 mean 5.683 H min 10.249 max 10.254 mean 10.252 GPU 64 COO min 3.300 max 3.310 mean 3.301 CSR min 5.370 max 6.310 mean 5.659 H min 9.934 max 9.958 mean 9.948 GPU 64 COO min 3.240 max 3.260 mean 3.249 CSR min 5.090 max* 8.660 mean 5.546	1889 1890 mult_dcop_03.mtx 1892 Regular 1893 1894 1895 Row-Premute 1896 Row-Premute	CSR min 10.790 max 15.250 mean 11.718 H min 10.537 max 10.541 mean 10.539 GPU 64 COO min 5.130 max* 5.220 mean 5.142
1815 1816 1817 1818 1819 1820 1821 1822		CSR min 5.190 max 7.420 mean 5.683 H min 10.249 max 10.254 mean 10.252 GPU 64 COO min 3.300 max 3.310 mean 3.301	1889 1890 1891 mult_dcop_03.mtx 1892 Regular 1893 1894 1895 1896 Row-Premute 1897	CSR min 10.790 max 15.250 mean 11.718 H min 10.537 max 10.541 mean 10.539 GPU 64 COO min 5.130 max* 5.220 mean 5.142
1815 1816 1817 1818 1819 1820 1821 1822 1823 1824 1825	Column-Gradient	CSR min 5.190 max 7.420 mean 5.683 H min 10.249 max 10.254 mean 10.252 GPU 64 COO min 3.300 max 3.310 mean 3.301 CSR min 5.370 max 6.310 mean 5.659 H min 9.934 max 9.958 mean 9.948 GPU 64 COO min 3.240 max 3.260 mean 3.249 CSR min 5.090 max* 8.660 mean 5.546 H min 10.853 max*10.873 mean 10.864	1889 1890 1891 mult_dcop_03.mtx 1892 Regular 1893 1894 1895 1896 Row-Premute 1897 1898	CSR min 10.790 max 15.250 mean 11.718 H min 10.537 max 10.541 mean 10.539 GPU 64 COO min 5.130 max* 5.220 mean 5.142
1815 1816 1817 1818 1819 1820 1821 1822 1823 1824	Column-Gradient	CSR min 5.190 max 7.420 mean 5.683 H min 10.249 max 10.254 mean 10.252 GPU 64 COO min 3.300 max 3.310 mean 3.301	1889 1890 1891 mult_dcop_03.mtx 1892 Regular 1893 1894 1895 1896 Row-Premute 1897	CSR min 10.790 max 15.250 mean 11.718 H min 10.537 max 10.541 mean 10.539 GPU 64 COO min 5.130 max* 5.220 mean 5.142
1815 1816 1817 1818 1819 1820 1821 1822 1823 1824 1825 1826	Column-Gradient Row-Column-Permute	CSR min 5.190 max 7.420 mean 5.683 H min 10.249 max 10.254 mean 10.252 GPU 64 COO min 3.300 max 3.310 mean 3.301 CSR min 5.370 max 6.310 mean 5.659 H min 9.934 max 9.958 mean 9.948 GPU 64 COO min 3.240 max 3.260 mean 3.249 CSR min 5.090 max* 8.660 mean 5.546 H min 10.853 max*10.873 mean 10.864 GPU 64 COO min 3.290 max 3.320 mean 3.296 CSR min 5.190 max 7.550 mean 5.659	1889 1890 1891 mult_dcop_03.mtx 1892 Regular 1893 1894 1895 1896 Row-Premute 1897 1898 1899 1890 Row-Gradient 1901	CSR min 10.790 max 15.250 mean 11.718 H min 10.537 max 10.541 mean 10.539 GPU 64 COO min 5.130 max* 5.220 mean 5.142
1815 1816 1817 1818 1819 1820 1821 1822 1823 1824 1825 1826 1827 1828	Column-Gradient Row-Column-Permute Maragal_6.mtx	CSR min 5.190 max 7.420 mean 5.683 H min 10.249 max 10.254 mean 10.252 GPU 64 COO min 3.300 max 3.310 mean 3.301 CSR min 5.370 max 6.310 mean 5.659 H min 9.934 max 9.958 mean 9.948 GPU 64 COO min 3.240 max 3.260 mean 3.249 CSR min 5.090 max* 8.660 mean 5.546 H min 10.853 max*10.873 mean 10.864 GPU 64 COO min 3.290 max 3.320 mean 3.296 CSR min 5.190 max 7.550 mean 5.659	1889 1890 1891 mult_dcop_03.mtx 1892 Regular 1893 1894 1895 Row-Premute 1897 1898 1899 1900 Row-Gradient	CSR min 10.790 max 15.250 mean 11.718 H min 10.537 max 10.541 mean 10.539 GPU 64 COO min 5.130 max* 5.220 mean 5.142
1815 1816 1817 1818 1819 1820 1821 1822 1823 1824 1825 1826 1827 1828 1829	Column-Gradient Row-Column-Permute	CSR min 5.190 max 7.420 mean 5.683 H min 10.249 max 10.254 mean 10.252 GPU 64 COO min 3.300 max 3.310 mean 3.301 CSR min 5.370 max 6.310 mean 5.659 H min 9.934 max 9.958 mean 9.948 GPU 64 COO min 3.240 max 3.260 mean 3.249 CSR min 5.090 max* 8.660 mean 5.546 H min 10.853 max*10.873 mean 10.864 GPU 64 COO min 3.290 max 3.320 mean 3.296 CSR min 5.190 max 7.550 mean 5.659 H min 10.249 max 10.255 mean 10.252	1889 1890 1891 mult_dcop_03.mtx 1892 Regular 1893 1894 1895 1896 Row-Premute 1897 1898 1899 1900 Row-Gradient 1901 1902 1903	CSR min 10.790 max 15.250 mean 11.718 H min 10.537 max 10.541 mean 10.539 GPU 64 COO min 5.130 max* 5.220 mean 5.142
1815 1816 1817 1818 1819 1820 1821 1822 1823 1824 1825 1826 1827 1828	Column-Gradient Row-Column-Permute Maragal_6.mtx	CSR min 5.190 max 7.420 mean 5.683 H min 10.249 max 10.254 mean 10.252 GPU 64 COO min 3.300 max 3.310 mean 3.301 CSR min 5.370 max 6.310 mean 5.659 H min 9.934 max 9.958 mean 9.948 GPU 64 COO min 3.240 max 3.260 mean 3.249 CSR min 5.090 max* 8.660 mean 5.546 H min 10.853 max*10.873 mean 10.864 GPU 64 COO min 3.290 max 3.320 mean 3.296 CSR min 5.190 max 7.550 mean 5.659	1889 1890 1891 mult_dcop_03.mtx 1892 Regular 1893 1894 1895 1896 Row-Premute 1897 1898 1899 1890 Row-Gradient 1901	CSR min 10.790 max 15.250 mean 11.718 H min 10.537 max 10.541 mean 10.539 GPU 64 COO min 5.130 max* 5.220 mean 5.142
1815 1816 1817 1818 1819 1820 1821 1822 1823 1824 1825 1826 1827 1828 1829 1830	Column-Gradient Row-Column-Permute Maragal_6.mtx	CSR min 5.190 max 7.420 mean 5.683 H min 10.249 max 10.254 mean 10.252 GPU 64 COO min 3.300 max 3.310 mean 3.301 CSR min 5.370 max 6.310 mean 5.659 H min 9.934 max 9.958 mean 9.948 GPU 64 COO min 3.240 max 3.260 mean 3.249 CSR min 5.090 max* 8.660 mean 5.546 H min 10.853 max*10.873 mean 10.864 GPU 64 COO min 3.290 max 3.320 mean 3.296 CSR min 5.190 max 7.550 mean 5.659 H min 10.249 max 10.255 mean 10.252	1889 1890 1891 mult_dcop_03.mtx 1892 Regular 1893 1894 1895 Row-Premute 1897 1898 1899 1900 Row-Gradient 1901 1902 1903 1904 Column-Gradient	CSR min 10.790 max 15.250 mean 11.718 H min 10.537 max 10.541 mean 10.539 GPU 64 COO min 5.130 max* 5.220 mean 5.142

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1907 H min 10.825 max*10.845 mean 10.836

1908 Row-Column-Permute

1909 GPU 64 COO min 4.990 max 5.010 mean 4.997

1910 CR min 10.738 max 7.160 mean 10.738

1911 H min 10.738 max 10.743 mean 10.740
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