Entropy Maximization in Sparse Matrix by Vector Multiplication

ABHISHEK JAIN, ISMAIL BUSTANY, HENRI FRAISSE, MANSMRAN BENIPAL, DINESH GAITONDE, and PAOLO D'ALBERTO

The peak performance of any SpMV accelerator depends primarily on the available DRAM memory bandwidth 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. GPUs along with some DSA ASIC's and new FPGA architectures exhibit very high bandwidth: utilizing this much bandwidth efficiently is difficult for large scale and highly sparse matrices due to very high random access pattern and workload imbalance. We propose a matrix permutation pre-processing step that aims to maximize the entropy of the distribution of the nonzero elements. We conjecture this would be most effective for matrices with no dense rows or columns and, as in preconditioning, when the matrix is reused. Unlike matrix ordering schemes that seek to reduce fill, we seek a permutation that uniformly distributes the non-zero elements' distribution, thereby generating a SpMV problem that is amenable to work load balancing or to speed up sort algorithms. We shall show that entropy maximization 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.

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1 INTRODUCTION

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To define the scope of this work, the obvious questions to ask are: first, what randomization or entropy maximization is in the context of sparse matrices; second, why would we use it; third, when it does work. We shall provide formal definitions in the following sections. Briefly, we will permute randomly the rows and columns of a sparse matrix before multiplying it with a dense vector (SpMV) with the aim of speeding this operation. Undoubtedly, this scheme requires some restrictions about the matrix structure, one among them is that is has no or few dense columns or rows. In the case, where there are dense columns or rows, a sparse/dense partitioning scheme should be used. For the remainder of this manuscript, we shall assume the former nonzero structure. We use randomization because it is the poor man's way for preconditioning SpMV in our restricted context, and we do not mean it in a pejorative sense.

Preconditioning speeds up the convergence rate of an iterative linear solver by linearly transforming the associated matrix into a form that affords a faster reduction of the residual error at every iteration. The cost of this transformation is justified by the runtime reduction it affords. Likewise, we foresee randomization playing a similar role for SpMV in the context of iterative linear solvers and other methods (e.g in convolutions) where the matrix is reused.

Sparse linear algebra and GraphBLAS kernels are memory bound and there is a common thread in the scientific computing community to develop acceleration libraries mostly for multi-core systems. These predominantly include

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multi-core processors and GPUs. The goal is a balanced work distribution and, when applicable, minimal communication [4, 6]. When storage strategy and algorithms must be considered together then GPUs provide the work horse for abundant thrust in research [1]. These works aim at optimal solutions and strive for a clear and complete understanding/exploitation of the software-hardware interface; usually the hardware is composed of symmetric computational units. Interestingly, the SpMV's space and time complexity, which are small, may not warrant more performance because we typically end up utilizing only one-thousandth fraction of the available hardware capacity.

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 saturate the 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.

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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 only has 2 DDR2-400 memory banks 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 at 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, Convey systems Inc. released the Convey HC-1 FPGA platform. It has 16 DDR2-677 memories resulting in overall 80 GB/s memory bandwidth **MISSING CITATION** [] . The accelerator logic runs 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 blocks for custom architecture solutions is a multi-ported buffer used to storing vector entries. During execution, multiple column indices are used as addresses to read corresponding vector entries; we shall provide more details in Section 2. Designing a buffer with a 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 causing loss of bandwidth. For example, hashing techniques and data duplication are possible solutions for this problem. However, another issue arises: When we distribute SpMV computations across p-nodes, some of the nodes, say k, finish later than the rest because of unbalanced work loads (ie. number of nonzero element) in row/column major traversal. This is a common phenomena for matrices where few rows or columns are dense. These k nodes are referred to as laggard nodes. By applying random permutation of columns/rows, we are attempting to balance the loads across all p workers so that there is are no laggards. From this hardware vantage point, randomization or maximizing the entropy of the non-zero element distribution is an optimization transform and provides a clear context for our work.

Clearly, optimally accelerating SpMV is a hard many-parameters optimization problem dependent on the choice of algorithm, data structures, and dedicated hardware (CPU, GPUs, FPGA's, Custom ASIC's). Rather, our goal is to Manuscript submitted to ACM

provide a tool, we may say a naive tool, to help understand how the structure of the matrix may impact the HW-SW solution. For the readers in the field of algorithms, SpMV can be mapped into a sorting algorithm. For example, finding elements $x_{i,j}$ and $x_{i,k>j}$ in a sparse matrix requires to find row i and then columns j and k. Sorting is a method to find if an element is in a list with no prior or limited knowledge of its contents. Sorting can be used to prepare the matrix and to find elements in between sparse matrices and sparse vectors. In custom architectures, sorting networks are used to route matrix and vector elements to functional units. In a sense, If one is stuck with a sorting algorithm and a poor distribution, randomization may alter the distribution and throttle performance. Interestingly, the best sorting algorithm is a function of the distribution of the elements [3, 5].

We organize this work as follows: In Section 2, we define the matrix by vector operation; in Section 3, we define what we mean by randomization (or entropy maximization). We use randomization to create a uniform distribution in Section 5 and measure uniformity by 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 task work loads for the given benchmarks in Section 7, and the complete set of measures for an AMD CPU and GPUs systems in Section 8.

85 2 BASIC NOTATIONS

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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 represented nor stored. Most of the experimental results in Section 8 are based on the classic addition (+) and multiplication (*) in floating point precision using 64 bits (i.e., double floating point precision) albeit are extensible to other semi-rings. For instance, it is well known that SpMV defined on the semi-ring (min,+) is a kernel in computing an all-pairs shortest paths starting with a graph adjacency matrix, and in 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 $\mathbb{M}\boldsymbol{x}$ is $O(M+N) \approx 2nnz$. Of course, the definition of sparsity may vary. We represent the matrix \mathbb{M} by using the coordinate list COO or and the compressed sparse row CSR^1 formats. The COO represents the non-zero of a matrix by a triplet (i, j, v); 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 format 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 i-th row starts (i.e., if row i exists). Accordingly, $M_{i,*}$ is stored in V[ROW[i]: ROW[i+1]]. The column indices are stored at COL[ROW[i]: ROW[i+1]] and sorted increasingly. The CSR format takes $2 \times nnz + M$ space and a row vector of the matrix can be found in O(1).

The computation $y_i = \sum_j M_{i,j} * x_j$ is a sequence of scalar products and, using the CSR format, is computed as follows:

$$Index = ROW[i] : ROW[i+1]$$
$$y_i = \sum_{\ell \in Index} V[\ell] * x_{COL[\ell]}$$

¹a.k.a. Compressed row storage CRS.

The matrix row is contiguous (in memory) and rows are stored in increasing order. However, the access of the dense vector \mathbf{x} has no particular pattern, well increasing.

The COO format can be endowed with certain properties. For example, we can sort the array by row and add row information to achieve the same properties of CSR. In contrast, transposing a "sorted" COO matrix simply entails swapping of the arrays ROW and COL. Think about matrix multiply. Each scalar 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 could compute a subset of the y_i and a clean data load balancing can go a long way. If we have 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 OR ENTROPY MAXIMIZATION

We define Randomization as row or column permutation transform of the matrix \mathbb{M} (thus a permutation of \mathbf{y} and \mathbf{x}), and we choose these by a pseudo-random process. The obvious question to as is why should we seek randomization (or entropy maximizing) transform? The sparsity of a given matrix \mathbb{M} has a non-zero element distribution induced by the nature of the original problem or by some imposed ordering on the respective nodes of its associated graph. This distribution may be computationally incompatible with the chosen algorithm or architecture. For instance, it can induce some load imbalance in the computation. We could break this load imbalance by seeking to maximize entropy for this distribution. Our conjecture is that would favor the average case performance rather than the worse case when operating on the "max-entropy transformed" matrix.

For linear system solvers, if we know the matrix \mathbb{M} , and we know the architecture, preconditioning (when affordable) is a better solution. Well, it is. If we run experiments long enough, we choose the best permutation(s) 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 Hardware. We are after an understanding when randomization is just enough: We seek to let the hardware do its best with the least effort, or at least with the appearance to be effortless.

Interestingly, this work stems from a sincere surprise about randomization efficacy and its application on custom SpMV. Here, we wish 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 \mathbf{x} we could exploit column load balancing and exploit better sorting algorithms: In practice, the reading of $\mathbf{x}_{COL[i]}$ can be reduced to a sorting, and there we know that different sparsity may require different algorithms. This may be lot to unpack but it translates to a better performance of the sequential algorithm without changing the algorithm or to improved bandwidth utilization.

We will show that (different) randomness affects architectures and algorithms differently, making randomization a suitable optimization transform especially when the application and hardware are at odds: Hardware (unless programmable) 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 optimization. For instance, matrices with dense rows or columns are better partitioned into sparse and dense components and operated on separately.

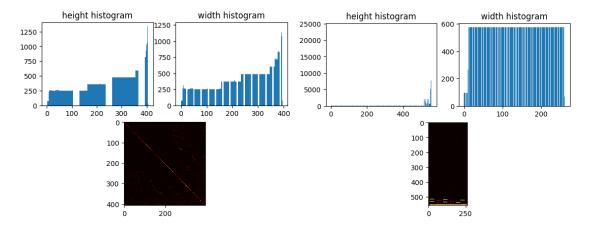


Fig. 1. Left: OPF 3754. Right: LP OSA 07. These are histograms where we represent normalized buckets and counts

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.

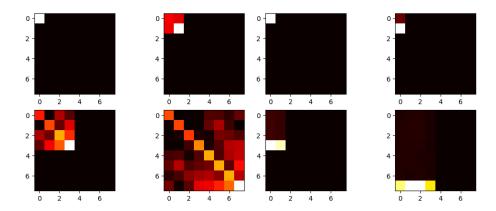


Fig. 2. Hierarchical 2D entropy for OPF 3754 (left) and LP OSA 07 (right).

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.

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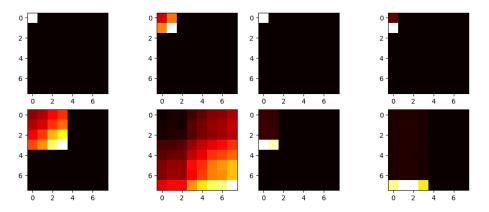


Fig. 3. Hierarchical 2D entropy after row and column random permutation for OPF 3754 (left) and LP OSA 07 (right).

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. It is reasonable that a slightly modified version of the original is still a random selection and unfortunately they seem too likely in practice. We need to compensate or help the randomization. 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 Manuscript submitted to ACM

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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.

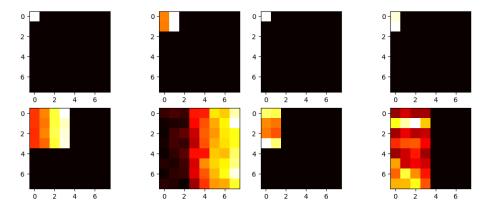


Fig. 4. Hierarchical 2D entropy after height gradient based shuffle and row random permutation for OPF 3754 (left) and LP OSA 07 (right).

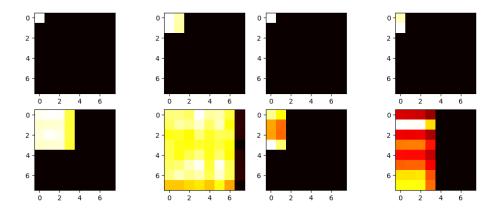


Fig. 5. Hierarchical 2D entropy after height and width gradient shuffle and row and column random permutation for OPF 3754 (left) and LP OSA 07 (right).

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

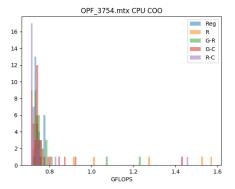
Whether or not this ever applied to the reader, when we have timed algorithms (i.e., measure execution time), we came to expect variation. The introduction of randomization may hide behind the ever present variance, after all these are algorithms on *small* inputs and small error can be comparable to 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. The figure is an histogram: The x is GFLOPS and the y label is the number of counts. Thus we show what is the performance distribution of an algorithm. We can see that the CSR algorithms are consistent and the Regular (i.e., the original) has always the best performance. Also the variance of the computation time is small and the shape is approximately Gaussian. Different story for the COO, the permutations introduce long tails, thus $2\times$ performance advantage.



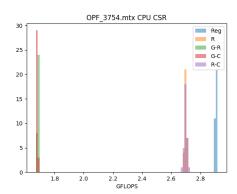


Fig. 6. CPU COO (left) and CPU CSR (left) for OPF 3754

If we take the original matrix and split into parts having the same number of rows, and execute them in parallel using different cores, we can see in Figure 7 that randomization is quite useful.

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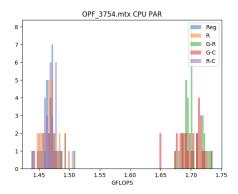
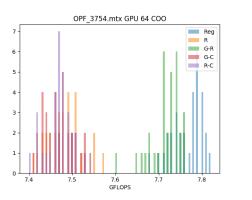


Fig. 7. Parallel CPU CSR for OPF 3754

In Figure 8, 9 and 10, 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.



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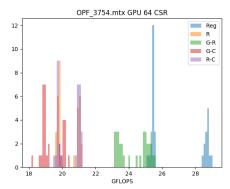


Fig. 8. Vega 20, GPU 64bits COO (left) and GPU CSR (right) for OPF 3754

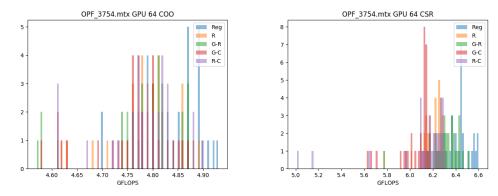


Fig. 9. Ellesmere, GPU 64bits COO (left) and GPU CSR (right) for OPF 3754

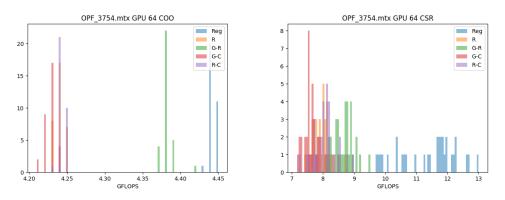


Fig. 10. Fiji, GPU 64bits COO (left) and GPU CSR (right) for OPF 3754

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

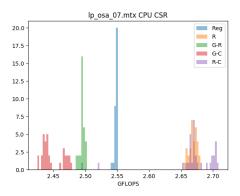


Fig. 11. CPU CSR for LP OSA 07

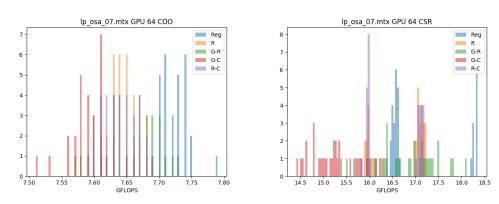


Fig. 12. Vega 20, GPU 64bits COO (left) and GPU CSR (right) for OPF 3754 $\,$

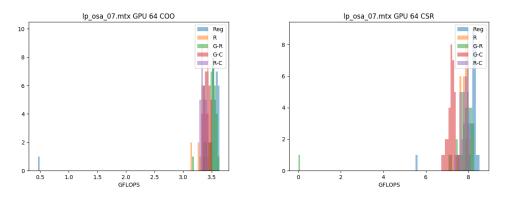
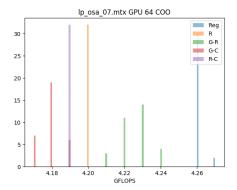


Fig. 13. Ellesmere, GPU 64bits COO (left) and GPU CSR (right) for OPF 3754



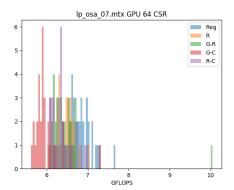
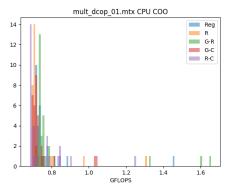


Fig. 14. Fiji, GPU 64bits COO (left) and GPU CSR (right) for OPF 3754

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.



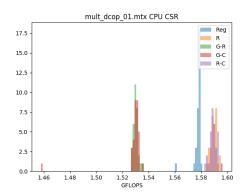


Fig. 15. CPU COO (left) and CPU CSR (right) for MULT DCOP 01

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.

7 WORKLOADS

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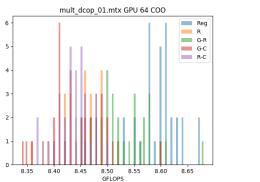
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In the previous sections, we defined what we mean for randomization and we present our tools of tricks for the measure of the effects of randomization. Here we describe the work loads, the applications, we use to test the effects of the randomization.



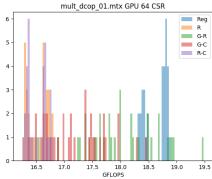
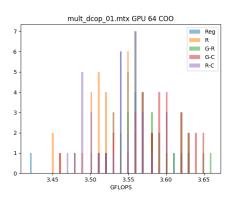


Fig. 16. Vega 20, GPU 64bits COO (left) and GPU CSR (right) for MULT DCOP 01



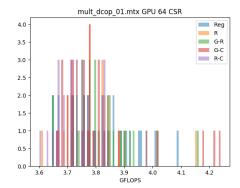
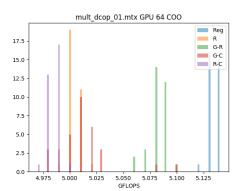


Fig. 17. Ellesmere, GPU 64bits COO (left) and GPU CSR (right) for MULT DCOP 01



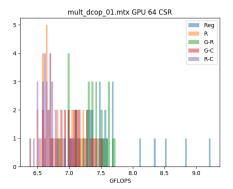


Fig. 18. Fiji, GPU 64bits COO (left) and GPU CSR (right) for MULT DCOP 01

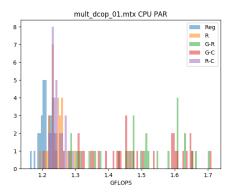


Fig. 19. Parallel CPU CSR for MULT DCOP 01

7.1 Python COO and CSR algorithms

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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

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 Manuscript submitted to ACM

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.

268 7.4 Randomization sometimes works

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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.

275 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 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:

- 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.

296	9 VEGA VII A	AND THREADRIPPER	369	mult_dcop_02.mtx	
207			370	Regular	
297	mult_dcop_03.mtx		371		CPU COO min 1.615 max* 1.677 mean 1.652
298 299	Regular	CPU COO min 0.728 max 0.880 mean 0.757	372		CPU CSR min 1.539 max 1.579 mean 1.575
300		CPU CSR min 1.563 max 1.581 mean 1.577	373		GPU 64 COO min 8.530 max* 8.700 mean 8.614
301		GPU 64 COO min 8.540 max* 8.670 mean 8.619	374		CSR min 18.290 max 18.890 mean 18.597
302		CSR min 18.320 max 18.930 mean 18.620	375		CPU PAR min 1.120 max 1.248 mean 1.211
303		CPU PAR min 1.170 max 1.269 mean 1.226	376		H min 9.689 max 9.689 mean 9.689
304		H min 9.689 max 9.689 mean 9.689	377	Row-Premute	
305	Row-Premute	11 1111 3.003 max 3.003 mean 3.003	378		CPU COO min 0.684 max 0.780 mean 0.705
306		CPU COO min 0.710 max 0.845 mean 0.724	379		CPU CSR min 1.558 max* 1.596 mean 1.588
307		CPU CSR min 1.549 max* 1.597 mean 1.589	380		GPU 64 COO min 8.360 max 8.490 mean 8.433
308		GPU 64 COO min 8.360 max 8.540 mean 8.442	381		CSR min 16.240 max 16.750 mean 16.552
309		CSR min 16.260 max 16.780 mean 16.551	382		CPU PAR min 1.182 max 1.277 mean 1.242
310		CPU PAR min 1.205 max 1.319 mean 1.263	383		H min 10.737 max 10.742 mean 10.740
311		H min 10.737 max 10.742 mean 10.740	384	Row-Gradient	
312	Row-Gradient		385		CPU COO min 0.704 max 1.373 mean 0.790
313		CPU COO min 0.706 max 1.603 mean 0.806	386		CPU CSR min 1.518 max 1.535 mean 1.529
314		CPU CSR min 1.493 max 1.534 mean 1.528	387		GPU 64 COO min 8.420 max 8.590 mean 8.517
315		GPU 64 COO min 8.430 max 8.610 mean 8.527	388		CSR min 16.680 max*19.550 mean 17.907
316		CSR min 17.070 max*18.970 mean 18.115	389 390		CPU PAR min 1.328 max* 1.713 mean 1.484 H min 10.572 max 10.585 mean 10.581
317		CPU PAR min 1.331 max 1.695 mean 1.513	391	Column-Gradient	11 III.11 10.372 III. 10.363 III. 10.361
318		H min 10.576 max 10.585 mean 10.580	392	COTUMN-OF AUTERIC	CPU COO min 0.697 max 1.460 mean 0.742
319	Column-Gradient		393		CPU CSR min 1.517 max 1.534 mean 1.527
320		CPU COO min 0.694 max* 1.632 mean 0.797	394		GPU 64 COO min 8.330 max 8.490 mean 8.420
321		CPU CSR min 1.491 max 1.534 mean 1.529	395		CSR min 16.020 max 18.390 mean 17.303
322		GPU 64 COO min 8.350 max 8.520 mean 8.429	396		CPU PAR min 1.321 max 1.709 mean 1.557
323		CSR min 15.970 max 18.180 mean 17.124	397		H min 10.823 max*10.843 mean 10.835
324		CPU PAR min 1.321 max* 1.728 mean 1.514	398	Row-Column-Permute	
325		H min 10.826 max*10.840 mean 10.833	399		CPU COO min 0.691 max 0.746 mean 0.698
326	Row-Column-Permute		400		CPU CSR min 1.568 max 1.595 mean 1.587
327		CPU COO min 0.688 max 0.757 mean 0.696 CPU CSR min 1.490 max 1.595 mean 1.584	401		GPU 64 COO min 8.350 max 8.500 mean 8.436
328			402		CSR min 16.250 max 16.780 mean 16.517
329		GPU 64 COO min 8.380 max 8.500 mean 8.445 CSR min 16.230 max 16.780 mean 16.513	403		CPU PAR min 1.187 max 1.280 mean 1.228
330 331		CSR min 16.230 max 16.780 mean 16.513 CPU PAR min 1.192 max 1.274 mean 1.237	404		H min 10.739 max 10.743 mean 10.740
332		H min 10.737 max 10.742 mean 10.740	405	lp_fit2d.mtx	
333	mult_dcop_01.mtx	11 IIII1 10.737 IIIAX 10.742 IIIEAII 10.740	406	Regular	
334	Regular		407		CPU COO min 0.774 max 0.804 mean 0.793
335	Negazar	CPU COO min 0.710 max 1.453 mean 0.761	408		CPU CSR min 2.538 max 2.550 mean 2.547
336		CPU CSR min 1.561 max 1.581 mean 1.578	409		GPU 64 COO min 7.060 max 7.170 mean 7.101
337		GPU 64 COO min 8.520 max 8.670 mean 8.597	410		CSR min 15.650 max*18.700 mean 18.031
338		CSR min 18.320 max 18.870 mean 18.636	411		CPU PAR min 1.537 max 1.645 mean 1.590
339		CPU PAR min 1.163 max 1.246 mean 1.212	412		H min 11.109 max 11.109 mean 11.109
340		H min 9.689 max 9.689 mean 9.689	413	Row-Premute	
341	Row-Premute		414		CPU COO min 0.740 max 0.776 mean 0.746
342		CPU COO min 0.699 max 1.305 mean 0.745	415		CPU CSR min 3.302 max* 3.328 mean 3.317
343		CPU CSR min 1.585 max 1.597 mean 1.590	416 417		GPU 64 COO min 7.040 max* 7.180 mean 7.098 CSR min 15.690 max 18.580 mean 16.732
344		GPU 64 COO min 8.360 max 8.520 mean 8.446	418		CPU PAR min 1.327 max 1.482 mean 1.422
345		CSR min 16.260 max 16.780 mean 16.528	419		H min 11.098 max 11.105 mean 11.101
346		CPU PAR min 1.192 max 1.298 mean 1.242	420	Row-Gradient	man rriose max rriose mean rrios
347		H min 10.738 max 10.742 mean 10.740	421		CPU COO min 0.739 max* 2.092 mean 1.091
348	Row-Gradient		422		CPU CSR min 2.539 max 2.546 mean 2.543
349		CPU COO min 0.709 max* 1.656 mean 0.819	423		GPU 64 COO min 7.040 max 7.150 mean 7.100
350		CPU CSR min 1.527 max 1.535 mean 1.530	424		CSR min 15.520 max 18.560 mean 17.547
351		GPU 64 COO min 8.450 max* 8.680 mean 8.527	425		CPU PAR min 1.401 max 1.661 mean 1.525
352		CSR min 16.520 max*19.480 mean 17.984	426		H min 11.109 max 11.109 mean 11.109
353		CPU PAR min 1.280 max 1.704 mean 1.485	427	Column-Gradient	
354	Caluma Candinat	H min 10.572 max 10.585 mean 10.581	428		CPU COO min 0.726 max 2.065 mean 1.011
355 356	Column-Gradient	CPU COO min 0.698 max 1.042 mean 0.737	429		CPU CSR min 2.539 max 2.550 mean 2.546
357		CPU CSR min 1.458 max 1.536 mean 1.528	430		GPU 64 COO min 6.800 max 7.140 mean 7.080
358		GPU 64 COO min 8.340 max 8.600 mean 8.443	431		CSR min 15.480 max 18.560 mean 16.866
359		CSR min 16.360 max 18.450 mean 17.247	432		CPU PAR min 1.391 max* 1.737 mean 1.563
360		CPU PAR min 1.307 max* 1.712 mean 1.494	433		H min 11.329 max 11.333 mean 11.331
361		H min 10.823 max*10.841 mean 10.835	434	Row-Column-Permute	
362	Row-Column-Permute		435		CPU COO min 0.746 max 0.782 mean 0.754
363		CPU COO min 0.683 max 1.247 mean 0.749	436		CPU CSR min 3.310 max 3.324 mean 3.318
364		CPU CSR min 1.583 max* 1.595 mean 1.590	437		GPU 64 COO min 7.030 max 7.160 mean 7.100
365		GPU 64 COO min 8.370 max 8.500 mean 8.435	438		CSR min 15.730 max 18.530 mean 17.362
366		CSR min 16.250 max 16.780 mean 16.518	439		CPU PAR min 1.340 max 1.451 mean 1.401
367		CPU PAR min 1.206 max 1.291 mean 1.243	440	1.1	H min 11.099 max 11.104 mean 11.102
368		H min 10.738 max 10.742 mean 10.740	441	bloweya.mtx	
			442	Regular	

443		CPU COO min 0.727 max* 1.815 mean 0.892	517	GPU 64 COO min 11.340 max*11.860 mean 11.441
444		CPU CSR min 2.867 max* 2.936 mean 2.917	518	CSR min 36.010 max*40.960 mean 38.048
445		GPU 64 COO min 0.000 max 0.000 mean 0.000	519	CPU PAR min 2.019 max 2.204 mean 2.130
446		CSR min 0.000 max 0.000 mean 0.000	520	H min 8.228 max 8.228 mean 8.228
447		CPU PAR min 1.680 max* 1.751 mean 1.719	521 Row-Premute	
448		H min 7.205 max 7.205 mean 7.205	522	CPU COO min 0.718 max 0.751 mean 0.732
449	Row-Premute		523	CPU CSR min 2.488 max 2.507 mean 2.498
450		CPU COO min 0.678 max 1.483 mean 0.746	524	GPU 64 COO min 10.810 max 11.090 mean 10.949
451		CPU CSR min 2.311 max 2.326 mean 2.320	525	CSR min 24.860 max 26.410 mean 25.527
452		GPU 64 COO min 6.840 max* 7.270 mean 6.930	526	CPU PAR min 1.978 max 2.290 mean 2.135
453		CSR min 15.650 max 16.800 mean 16.233	527	H min 11.836 max 11.840 mean 11.838
454		CPU PAR min 1.649 max 1.730 mean 1.682	528 Row-Gradient	
455		H min 11.026 max 11.031 mean 11.029	529	CPU COO min 0.722 max 1.794 mean 0.769
456	Row-Gradient		530	CPU CSR min 2.407 max 2.421 mean 2.416
457	now or dutent	CPU COO min 0.708 max 1.209 mean 0.779	531	GPU 64 COO min 11.210 max 11.480 mean 11.317
458		CPU CSR min 1.648 max 1.735 mean 1.709	532	CSR min 31.920 max 34.690 mean 33.246
459		GPU 64 COO min 6.920 max 7.080 mean 7.015	533	CPU PAR min 2.184 max* 2.302 mean 2.232
				H min 10.742 max 10.757 mean 10.748
460		CSR min 16.950 max 19.500 mean 17.794 CPU PAR min 1.497 max 1.743 mean 1.608	534 535 Column-Gradient	H min 10.742 max 10.757 mean 10.748
461				
462		H min 10.298 max 10.304 mean 10.301	536	CPU COO min 0.720 max 0.916 mean 0.742
463	Column-Gradient		537	CPU CSR min 2.395 max 2.410 mean 2.402
464		CPU COO min 0.709 max 1.536 mean 0.817	538	GPU 64 COO min 10.840 max 11.070 mean 10.946
465		CPU CSR min 1.705 max 1.753 mean 1.735	539	CSR min 24.340 max 26.140 mean 25.393
466		GPU 64 COO min 6.800 max 7.120 mean 6.865	540	CPU PAR min 2.184 max 2.272 mean 2.223
467		CSR min 15.480 max*17.710 mean 16.470	541	H min 11.873 max 11.882 mean 11.878
468		CPU PAR min 1.446 max 1.718 mean 1.591	542 Row-Column-Permute	
469		H min 10.880 max 10.886 mean 10.883	543	CPU COO min 0.707 max 0.748 mean 0.714
470	Row-Column-Permute		544	CPU CSR min 2.458 max 2.511 mean 2.506
471		CPU COO min 0.670 max 1.024 mean 0.706	545	GPU 64 COO min 10.880 max 11.070 mean 10.957
472		CPU CSR min 2.199 max 2.340 mean 2.326	546	CSR min 24.890 max 26.490 mean 25.642
473		GPU 64 COO min 6.880 max 6.980 mean 6.933	547	CPU PAR min 2.209 max 2.282 mean 2.240
474		CSR min 15.610 max 16.900 mean 16.227	548	H min 11.834 max*11.840 mean 11.838
475		CPU PAR min 1.598 max 1.668 mean 1.632	549 brainpc2.mtx	
476		H min 11.025 max*11.032 mean 11.029	550 Regular	
477	lp_osa_07.mtx		551	CPU COO min 0.732 max 0.751 mean 0.744
478	Regular		552	CPU CSR min 2.885 max* 2.916 mean 2.909
479		CPU COO min 0.715 max 1.798 mean 0.885	553	GPU 64 COO min 0.000 max 0.000 mean 0.000
480		CPU CSR min 2.495 max 2.551 mean 2.547	554	CSR min 0.000 max 0.000 mean 0.000
481		GPU 64 COO min 7.650 max* 7.790 mean 7.718	555	CPU PAR min 1.276 max 1.299 mean 1.286
482		CSR min 16.390 max*18.350 mean 17.093	556	H min 7.478 max 7.478 mean 7.478
		CPU PAR min 0.963 max 1.012 mean 0.995		11 IIII 7.470 IIIAX 7.470 IIIEAN 7.470
483				CDU COO 0 707 0 0FF 0 726
484	D D	H min 8.412 max 8.412 mean 8.412	558	CPU COO min 0.727 max 0.855 mean 0.736
485	Row-Premute		559	CPU CSR min 2.385 max 2.411 mean 2.397
486		CPU COO min 0.720 max* 2.078 mean 1.104	560	GPU 64 COO min 8.120 max 8.410 mean 8.206
487		CPU CSR min 2.656 max* 2.679 mean 2.669	561	CSR min 18.670 max 19.960 mean 19.536
488		GPU 64 COO min 7.610 max 7.690 mean 7.647	562	CPU PAR min 1.293 max 1.340 mean 1.314
489		CSR min 15.910 max 17.210 mean 16.750	563	H min 9.809 max 9.813 mean 9.811
490		CPU PAR min 0.890 max 0.940 mean 0.918	564 Row-Gradient	
491		H min 9.255 max 9.258 mean 9.256	565	CPU COO min 0.696 max* 1.546 mean 0.785
492	Row-Gradient		566	CPU CSR min 1.361 max 1.420 mean 1.411
493		CPU COO min 0.725 max 2.078 mean 1.041	567	GPU 64 COO min 8.190 max* 8.550 mean 8.302
494		CPU CSR min 2.487 max 2.502 mean 2.495	568	CSR min 18.700 max*21.000 mean 19.890
495		GPU 64 COO min 7.570 max 7.730 mean 7.655	569	CPU PAR min 1.435 max 1.666 mean 1.549
496		CSR min 15.370 max 18.100 mean 16.803	570	H min 9.721 max 9.727 mean 9.723
497		CPU PAR min 1.435 max 1.796 mean 1.592	571 Column-Gradient	
498		H min 8.637 max 8.678 mean 8.672	572	CPU COO min 0.698 max 1.467 mean 0.746
499	0.1		573	CPU CSR min 1.377 max 1.423 mean 1.414
	Column-Gradient			
500	Column-Gradient	CPU COO min 0.724 max 1.990 mean 1.000	574	GPU 64 COO min 8.110 max 8.290 mean 8.187
	Column-Gradient			GPU 64 COO min 8.110 max 8.290 mean 8.187 CSR min 18.090 max 20.190 mean 19.217
501	Column-Gradient	CPU CSR min 2.425 max 2.477 mean 2.448	575	CSR min 18.090 max 20.190 mean 19.217
501 502	Column-Gradient	CPU CSR min 2.425 max 2.477 mean 2.448 GPU 64 COO min 7.510 max 7.660 mean 7.596	575 576	CSR min 18.090 max 20.190 mean 19.217 CPU PAR min 1.345 max* 1.681 mean 1.518
501 502 503	Column-Gradient	CPU CSR min 2.425 max 2.477 mean 2.448 GPU 64 COO min 7.510 max 7.660 mean 7.596 CSR min 14.410 max 16.290 mean 15.267	575 576 577	CSR min 18.090 max 20.190 mean 19.217
501 502 503 504	Column-Gradient	CPU CSR min 2.425 max 2.477 mean 2.448 GPU 64 COO min 7.510 max 7.660 mean 7.596 CSR min 14.410 max 16.290 mean 15.267 CPU PAR min 1.238 max 1.774 mean 1.534	575 576 577 578 Row-Column-Permute	CSR min 18.090 max 20.190 mean 19.217 CPU PAR min 1.345 max* 1.681 mean 1.518 H min 10.369 max*10.372 mean 10.370
501 502 503 504 505		CPU CSR min 2.425 max 2.477 mean 2.448 GPU 64 COO min 7.510 max 7.660 mean 7.596 CSR min 14.410 max 16.290 mean 15.267	575 576 577 578 Row-Column-Permute 579	CSR min 18.090 max 20.190 mean 19.217 CPU PAR min 1.345 max* 1.681 mean 1.518 H min 10.369 max*10.372 mean 10.370 CPU COO min 0.698 max 1.390 mean 0.788
501 502 503 504 505 506	Row-Column-Permute	CPU CSR min 2.425 max 2.477 mean 2.448 GPU 64 COO min 7.510 max 7.660 mean 7.596 CSR min 14.410 max 16.290 mean 15.267 CPU PAR min 1.238 max 1.774 mean 1.534 H min 9.447 max* 9.603 mean 9.576	575 576 577 578 Row-Column-Permute 579 580	CPU COR min 18.090 max 20.190 mean 19.217 CPU PAR min 1.345 max* 1.681 mean 1.518 H min 10.369 max*10.372 mean 10.370 CPU CO0 min 0.698 max 1.390 mean 0.788 CPU CSR min 2.387 max 2.410 mean 2.399
501 502 503 504 505 506 507		CPU CSR min 2.425 max 2.477 mean 2.448 GPU 64 COO min 7.510 max 7.660 mean 7.596 CSR min 14.410 max 16.290 mean 15.267 CPU PAR min 1.238 max 1.774 mean 1.534 H min 9.447 max* 9.603 mean 9.576 CPU COO min 0.738 max 1.950 mean 1.071	575 576 577 578 Row-Column-Permute 579 580 581	CPU COO min 0.698 max 20.190 mean 19.217 CPU COO min 0.698 max 1.390 mean 0.788 CPU CSR min 12.387 max 1.390 mean 0.788 CPU CSR min 2.387 max 2.410 mean 2.399 GPU 64 COO min 8.120 max 8.260 mean 8.191
501 502 503 504 505 506 507 508		CPU CSR min 2.425 max 2.477 mean 2.448 GPU 64 COO min 7.510 max 7.660 mean 7.596 CSR min 14.410 max 16.290 mean 15.267 CPU PAR min 12.38 max 1.774 mean 15.34 H min 9.447 max* 9.603 mean 9.576 CPU COO min 0.738 max 1.950 mean 1.071 CPU CSR min 2.522 max 2.709 mean 2.675	575 576 577 578 Row-Column-Permute 579 580 581	CSR min 18.090 max 20.190 mean 19.217 CPU PAR min 1.345 max* 1.681 mean 1.518 H min 10.369 max*10.372 mean 10.370 CPU COO min 0.698 max 1.390 mean 0.788 CPU CSR min 2.387 max 2.410 mean 2.399 GPU 64 COO min 8.120 max 8.260 mean 8.191 CSR min 18.530 max 19.960 mean 19.307
501 502 503 504 505 506 507		CPU CSR min 2.425 max 2.477 mean 2.448 GPU 64 COO min 7.510 max 7.660 mean 7.596 CSR min 14.410 max 16.290 mean 15.267 CPU PAR min 1.238 max 1.774 mean 1.534 H min 9.447 max* 9.603 mean 9.576 CPU COO min 0.738 max 1.950 mean 1.071 CPU CSR min 2.522 max 2.709 mean 2.675 GPU 64 COO min 7.600 max 7.690 mean 7.641	575 576 577 578 Row-Column-Permute 579 580 581 582	CPU COO min 0.698 max 1.399 mean 19.217 CPU PAR min 1.345 max* 1.681 mean 1.518 H min 10.369 max*10.372 mean 10.370 CPU COO min 0.698 max 1.390 mean 0.788 CPU CSR min 2.387 max 2.410 mean 2.399 GPU 64 COO min 8.120 max 8.260 mean 8.191 CSR min 18.538 max 19.960 mean 19.307 CPU PAR min 1.295 max 1.347 mean 1.319
501 502 503 504 505 506 507 508		CPU CSR min 2.425 max 2.477 mean 2.448 GPU 64 COO min 7.510 max 7.660 mean 7.596 CSR min 14.410 max 16.290 mean 15.267 CPU PAR min 1.238 max 1.774 mean 9.576 CPU COO min 0.738 max 1.950 mean 1.071 CPU CSR min 2.522 max 2.709 mean 2.675 GPU 64 COO min 7.600 max 7.690 mean 7.641 CSR min 15.820 max 17.190 mean 16.572	575 576 577 578 Row-Column-Permute 579 580 581 582 583	CSR min 18.090 max 20.190 mean 19.217 CPU PAR min 1.345 max* 1.681 mean 1.518 H min 10.369 max*10.372 mean 10.370 CPU COO min 0.698 max 1.390 mean 0.788 CPU CSR min 2.387 max 2.410 mean 2.399 GPU 64 COO min 8.120 max 8.260 mean 8.191 CSR min 18.530 max 19.960 mean 19.307
501 502 503 504 505 506 507 508		CPU CSR min 2.425 max 2.477 mean 2.448 GPU 64 COO min 7.510 max 7.660 mean 7.596 CSR min 14.410 max 16.290 mean 15.267 CPU PAR min 1.238 max 1.774 mean 1.534 H min 9.447 max* 9.603 mean 9.576 CPU COO min 0.738 max 1.950 mean 1.071 CPU CSR min 2.522 max 2.709 mean 2.675 GPU 64 COO min 7.600 max 7.690 mean 7.641	575 576 577 578 Row-Column-Permute 579 580 581 582	CPU COO min 0.698 max 1.399 mean 19.217 CPU PAR min 1.345 max* 1.681 mean 1.518 H min 10.369 max*10.372 mean 10.370 CPU COO min 0.698 max 1.390 mean 0.788 CPU CSR min 2.387 max 2.410 mean 2.399 GPU 64 COO min 8.120 max 8.260 mean 8.191 CSR min 18.538 max 19.960 mean 19.307 CPU PAR min 1.295 max 1.347 mean 1.319
501 502 503 504 505 506 507 508 509 510		CPU CSR min 2.425 max 2.477 mean 2.448 GPU 64 COO min 7.510 max 7.660 mean 7.596 CSR min 14.410 max 16.290 mean 15.267 CPU PAR min 1.238 max 1.774 mean 9.576 CPU COO min 0.738 max 1.950 mean 1.071 CPU CSR min 2.522 max 2.709 mean 2.675 GPU 64 COO min 7.600 max 7.690 mean 7.641 CSR min 15.820 max 17.190 mean 16.572	575 576 577 578 Row-Column-Permute 579 580 581 582 583	CPU COO min 0.698 max 1.399 mean 19.217 CPU PAR min 1.345 max* 1.681 mean 1.518 H min 10.369 max*10.372 mean 10.370 CPU COO min 0.698 max 1.390 mean 0.788 CPU CSR min 2.387 max 2.410 mean 2.399 GPU 64 COO min 8.120 max 8.260 mean 8.191 CSR min 18.538 max 19.960 mean 19.307 CPU PAR min 1.295 max 1.347 mean 1.319
501 502 503 504 505 506 507 508 509 510		CPU CSR min 2.425 max 2.477 mean 2.448 GPU 64 COO min 7.510 max 7.660 mean 7.596 CSR min 14.410 max 16.290 mean 15.267 CPU PAR min 1.238 max 1.774 mean 1.534 H min 9.447 max* 9.603 mean 9.576 CPU COO min 0.738 max 1.950 mean 1.071 CPU CSR min 2.522 max 2.709 mean 2.675 GPU 64 COO min 7.600 max 7.690 mean 7.641 CSR min 15.820 max 17.190 mean 16.572 CPU PAR min 0.891 max 0.944 mean 0.924	575 576 577 578 Row-Column-Permute 579 580 581 582 583 584 585 shermanACb.mtx	CPU COO min 0.698 max 1.399 mean 19.217 CPU PAR min 1.345 max* 1.681 mean 1.518 H min 10.369 max*10.372 mean 10.370 CPU COO min 0.698 max 1.390 mean 0.788 CPU CSR min 2.387 max 2.410 mean 2.399 GPU 64 COO min 8.120 max 8.260 mean 8.191 CSR min 18.538 max 19.960 mean 19.307 CPU PAR min 1.295 max 1.347 mean 1.319
501 502 503 504 505 506 507 508 509 510 511 512	Row-Column-Permute	CPU CSR min 2.425 max 2.477 mean 2.448 GPU 64 COO min 7.510 max 7.660 mean 7.596 CSR min 14.410 max 16.290 mean 15.267 CPU PAR min 1.238 max 1.774 mean 1.534 H min 9.447 max* 9.603 mean 9.576 CPU COO min 0.738 max 1.950 mean 1.071 CPU CSR min 2.522 max 2.709 mean 2.675 GPU 64 COO min 7.600 max 7.690 mean 7.641 CSR min 15.820 max 17.190 mean 16.572 CPU PAR min 0.891 max 0.944 mean 0.924	575 576 577 578 Row-Column-Permute 579 580 581 582 583 584 585 shermanACb.mtx 586 Regular	CSR min 18.090 max 20.190 mean 19.217 CPU PAR min 1.345 max* 1.681 mean 1.518 H min 10.369 max*10.372 mean 10.370 CPU COO min 0.698 max 1.390 mean 0.788 CPU CSR min 2.387 max 2.410 mean 2.399 GPU 64 COO min 8.120 max 8.260 mean 19.307 CPU PAR min 18.530 max 19.960 mean 19.307 CPU PAR min 1.295 max 1.347 mean 1.319 H min 9.809 max 9.813 mean 9.811
501 502 503 504 505 506 507 508 509 510 511 512 513	Row-Column-Permute	CPU CSR min 2.425 max 2.477 mean 2.448 GPU 64 COO min 7.510 max 7.660 mean 7.596 CSR min 14.410 max 16.290 mean 15.267 CPU PAR min 1.238 max 1.774 mean 1.534 H min 9.447 max* 9.603 mean 9.576 CPU COO min 0.738 max 1.950 mean 1.071 CPU CSR min 2.522 max 2.709 mean 2.675 GPU 64 COO min 7.600 max 7.690 mean 7.641 CSR min 15.820 max 17.190 mean 16.572 CPU PAR min 0.891 max 0.944 mean 0.924	575 576 577 578 Row-Column-Permute 579 580 581 582 583 584 585 shermanACb.mtx 586 Regular	CPU COO min 8.090 max 20.190 mean 19.217 CPU PAR min 1.345 max* 1.681 mean 1.518 H min 10.369 max*10.372 mean 10.370 CPU COO min 0.698 max 1.390 mean 0.788 CPU CSR min 2.387 max 2.410 mean 2.399 GPU 64 COO min 8.120 max 8.260 mean 8.191 CSR min 18.530 max 19.960 mean 19.307 CPU PAR min 1.295 max 1.347 mean 1.319 H min 9.809 max 9.813 mean 9.811
501 502 503 504 505 506 507 508 509 510 511 512 513	Row-Column-Permute	CPU CSR min 2.425 max 2.477 mean 2.448 GPU 64 COO min 7.510 max 7.660 mean 7.596 CSR min 14.410 max 16.290 mean 15.267 CPU PAR min 1.238 max 1.774 mean 9.576 CPU COO min 0.738 max 1.750 mean 9.576 CPU CSR min 2.522 max 2.709 mean 1.671 CPU CSR min 5.820 max 17.190 mean 1.6572 CPU PAR min 0.891 max 0.944 mean 0.924 H min 9.255 max 9.258 mean 9.256	575 576 577 578 Row-Column-Permute 579 580 581 582 583 584 585 shermanACb.mtx 586 Regular 587	CPU COO min 0.712 max 1.201 mean 19.217 CPU COO min 0.698 max 1.399 mean 19.370 CPU CSR min 18.290 max 1.399 mean 0.788 CPU CSR min 2.387 max 2.410 mean 2.399 GPU 64 COO min 8.120 max 8.260 mean 8.191 CSR min 18.530 max 19.960 mean 19.307 CPU PAR min 18.590 max 19.960 mean 19.307 CPU COO min 0.809 max 9.813 mean 9.811 CPU COO min 0.712 max 1.201 mean 0.756 CPU CSR min 18.558 max 1.601 mean 1.596

501		CPU PAR		1 206	1 511	1 447	665	Davi Davanista					
591 592		H H			1.511 mean 8.600 mean		665 666	Row-Premute	CPU COO	min	0.724 max	1 100 moon	0 76E
593	Row-Premute	11	IIIIII	b.000 IIIax	0.000 illean	0.000	667		CPU CSR		2.581 max*		
594	NOW-F1 elliute	CPU COO	min	9 600 may	0.890 mean	0.704					7.170 max		
595		CPU CSR					668				17.360 max 1		
596					1.630 mean 7.180 mean		669 670		CPU PAR				
					17.240 mean				H PAR		1.494 max* 10.043 max 1		
597 598		CPU PAR			1.419 mean		671 672	Row-Gradient	п	IIIII	10.045 IIIax I	0.047 Illean	10.044
599		H H			10.380 mean		673	Now-Grautent	CPU COO	min	0.716 max	1 701 moon	0 001
600	Row-Gradient	п	IIIII I	0.3/0 IIIax	10.300 illean	10.379	674		CPU CSR		1.824 max		
601	ROW-Gradient	CPU COO		2 704	1.615 mean	0.000	675				7.220 max*		
602		CPU CSR			1.015 mean						17.540 max*2		
603					7.160 mean		676		CPU PAR		17.540 max*2		
							677		H PAR				
604		CPU PAR			16.290 mean		678	0.1	н	mın	9.681 max	9.706 mean	9.694
605		H PAR			1.520 mean 9.925 mean		679	Column-Gradient	CPU COO		0.711	1 000	0.746
606 607	Column-Gradient	п	IIIII	9.915 IIIax	9.925 Illean	9.921	680 681		CPU CSR		0.711 max 1.817 max		
608	COTUMN=Gradient	CPU COO		. 700	1 626	0.044					7.110 max		
		CPU COO			1.626 mean		682						
609		010 0011			1.374 mean		683				16.530 max 1		
610					7.210 mean		684		CPU PAR		1.390 max		
611					15.260 mean		685	D	Н	mın	10.612 max*1	0.659 mean	10.634
612		CPU PAR H			1.531 mean		686	Row-Column-Permute	CDII COO		0.710	1 201	0.756
613	D	н	min i	0.5/2 max	10.595 mean	10.590	687		CPU COO		0.719 max		
614	Row-Column-Permute						688		CPU CSR		2.546 max		
615		CPU COO			1.532 mean		689				7.190 max		
616		CPU CSR			1.634 mean		690				17.500 max 1		
617					7.110 mean		691		CPU PAR		1.465 max		
618					17.310 mean		692		Н	min	10.041 max 1	0.046 mean	10.044
619		CPU PAR			1.406 mean		693	TSOPF_FS_b9_c6.mtx					
620		Н	min 1	0.377 max	10.382 mean	10.379	694	Regular					
621	cvxqp3.mtx						695		CPU COO		0.705 max		
622	Regular						696		CPU CSR		3.028 max*		
623		CPU COO			0.720 mean		697				0.000 max		
624		CPU CSR			2.643 mean		698				0.000 max		
625					6.220 mean		699		CPU PAR		1.528 max*		
626					22.710 mean		700		Н	min	7.380 max	7.380 mean	7.380
627		CPU PAR			1.860 mean		701	Row-Premute					
628		Н	min	8.646 max	8.646 mean	8.646	702		CPU COO		0.733 max		
629	Row-Premute						703		CPU CSR		2.450 max		
630		CPU COO			1.577 mean		704				7.200 max		
631		CPU CSR			2.471 mean		705				17.420 max 1		
632					6.060 mean		706		CPU PAR		1.474 max		
633					19.130 mean		707		Н	min	10.042 max 1	0.046 mean	10.044
634		CPU PAR			1.833 mean		708	Row-Gradient					
635		Н	min 1	1.028 max	11.033 mean	11.030	709		CPU COO		0.712 max		
636	Row-Gradient						710		CPU CSR		1.819 max		
637		CPU COO			1.523 mean		711				7.210 max*		
638		CPU CSR			1.305 mean		712				17.550 max*2		
639					6.000 mean		713		CPU PAR	min	1.256 max	1.554 mean	1.495
640		CSR			18.410 mean		714		Н	min	9.666 max	9.704 mean	9.690
641		CPU PAR			1.485 mean		715	Column-Gradient					
642		Н	min 1	1.061 max	11.069 mean	11.064	716		CPU COO	min	0.710 max*	1.690 mean	0.791
643	Column-Gradient						717		CPU CSR		1.813 max		
644		CPU COO			1.521 mean		718				7.130 max		
645		CPU CSR			1.302 mean		719		CSI		16.550 max 1		
646		GPU 64 COC) min	5.900 max	6.060 mean	5.960	720		CPU PAR		1.385 max		
647		CSR	R min 1	6.620 max	18.330 mean	17.592	721		Н	min	10.611 max*1	0.659 mean	10.634
648		CPU PAR	min	1.372 max	1.464 mean	1.409	722	Row-Column-Permute					
649		Н	min 1	1.127 max*	11.135 mean	11.130	723		CPU COO	min	0.709 max	1.531 mean	0.963
650	Row-Column-Permute						724		CPU CSR	min	2.506 max	2.648 mean	2.622
651		CPU COO	min	0.704 max	1.503 mean	0.875	725		GPU 64 CO	min	7.140 max	7.330 mean	7.244
652		CPU CSR			2.468 mean		726				17.410 max 1		
653					5.980 mean		727		CPU PAR		1.466 max		
654					19.140 mean		728		Н	min	10.041 max 1	0.046 mean	10.044
655		CPU PAR			1.743 mean		729	OPF_6000.mtx					
656		Н	min 1	1.028 max	11.035 mean	11.030	730	Regular					
657	case9.mtx						731		CPU COO		0.714 max		
658	Regular						732		CPU CSR		2.667 max*		
659		CPU COO	min	0.721 max*	1.800 mean	1.177	733				12.310 max*1		
660		CPU CSR			3.046 mean		734		CSI		39.860 max*4		
661					0.000 mean		735		CPU PAR		1.735 max		
662					0.000 mean		736		Н	min	8.799 max	8.799 mean	8.799
663		CPU PAR			1.605 mean		737	Row-Premute					
664		Н	min	7.380 max	7.380 mean	7.380	738		CPU COO	min	0.689 max	0.710 mean	0.695

739		CPU CSR min 2.358 max 2.413 mean 2.392	813		CSR min 19.960 max 21.190 mean 20.696
740		GPU 64 COO min 11.430 max 11.770 mean 11.549	814		CPU PAR min 1.303 max 1.371 mean 1.345
741		CSR min 24.470 max 25.580 mean 24.785	815		H min 10.059 max 10.062 mean 10.061
742		CPU PAR min 1.758 max 1.896 mean 1.829	816	Row-Gradient	
743		H min 11.872 max 11.877 mean 11.875	817		CPU COO min 0.723 max 0.984 mean 0.753
744	Row-Gradient		818		CPU CSR min 1.781 max 1.809 mean 1.803
745		CPU COO min 0.716 max 0.775 mean 0.739	819		GPU 64 COO min 9.380 max 9.660 mean 9.464
746		CPU CSR min 1.651 max 1.689 mean 1.675	820		CSR min 15.770 max 19.090 mean 18.037
747		GPU 64 COO min 12.100 max 12.410 mean 12.205	821		CPU PAR min 1.775 max* 1.924 mean 1.868
748		CSR min 31.670 max 34.910 mean 33.370	822		H min 10.205 max 10.233 mean 10.219
749		CPU PAR min 2.079 max* 2.286 mean 2.207		Column-Gradient	11 III 10.203 IIIAX 10.233 IIICAN 10.213
				COTUMIN-OF AUTERIC	CPU COO min 0.715 max 0.926 mean 0.757
750		H min 11.111 max 11.116 mean 11.113	824		
751	Column-Gradient		825		Gro Colt III211 11725 IIIGA 11002 IIICGI1 11751
752		CPU COO min 0.715 max* 1.021 mean 0.743	826		GPU 64 COO min 9.080 max 9.270 mean 9.158
753		CPU CSR min 1.655 max 1.674 mean 1.666	827		CSR min 13.980 max 15.780 mean 14.938
754		GPU 64 COO min 11.340 max 11.560 mean 11.463	828		CPU PAR min 1.751 max 1.906 mean 1.846
755		CSR min 23.770 max 25.470 mean 24.489	829		H min 11.213 max*11.232 mean 11.222
756		CPU PAR min 2.056 max 2.172 mean 2.118	830	Row-Column-Permute	
757		H min 12.040 max*12.047 mean 12.043	831		CPU COO min 0.732 max 1.598 mean 0.785
758	Row-Column-Permute		832		CPU CSR min 2.594 max 2.602 mean 2.599
759		CPU COO min 0.677 max 0.785 mean 0.687	833		GPU 64 COO min 9.340 max 9.460 mean 9.394
760		CPU CSR min 2.325 max 2.434 mean 2.369	834		CSR min 19.950 max 21.500 mean 20.544
761		GPU 64 COO min 11.450 max 11.650 mean 11.538	835		CPU PAR min 1.326 max 1.374 mean 1.354
762		CSR min 24.330 max 25.560 mean 25.008	836		H min 10.059 max 10.062 mean 10.061
763		CPU PAR min 1.631 max 1.776 mean 1.709		hd4800a.mtx	11 III 10.033 IIIAX 10.002 IIICAN 10.001
				Regular	
764		H min 11.873 max 11.877 mean 11.875		кедитаг	
765	OPF_3754.mtx		839		CPU COO min 0.759 max 0.795 mean 0.780
766	Regular		840		CPU CSR min 2.479 max* 2.565 mean 2.557
767		CPU COO min 0.726 max 0.774 mean 0.747	841		GPU 64 COO min 5.490 max* 5.650 mean 5.552
768		CPU CSR min 2.898 max* 2.919 mean 2.908	842		CSR min 16.700 max 19.460 mean 18.004
769		GPU 64 COO min 7.680 max* 7.820 mean 7.766	843		CPU PAR min 1.456 max* 1.523 mean 1.492
770		CSR min 25.070 max*29.030 mean 26.756	844		H min 7.132 max 7.132 mean 7.132
771		CPU PAR min 1.437 max 1.508 mean 1.471	845	Row-Premute	
772		H min 8.393 max 8.393 mean 8.393	846		CPU COO min 0.695 max 0.943 mean 0.726
773	Row-Premute		847		CPU CSR min 2.480 max 2.488 mean 2.485
774		CPU COO min 0.714 max* 1.574 mean 0.817	848		GPU 64 COO min 5.410 max 5.490 mean 5.453
775		CPU CSR min 2.686 max 2.711 mean 2.699	849		CSR min 15.700 max 17.520 mean 16.678
776		GPU 64 COO min 7.410 max 7.570 mean 7.484	850		CPU PAR min 1.422 max 1.514 mean 1.474
777		CSR min 19.600 max 21.190 mean 20.307	851		H min 10.959 max 10.966 mean 10.963
				Row-Gradient	11 IIII 10.555 IIIAX 10.500 IIIEAN 10.503
778				KOW-Gradient	CRU 000 0 700 0 000
779		H min 11.267 max 11.272 mean 11.269	853		CPU COO min 0.723 max* 2.029 mean 0.990
780	Row-Gradient		854		CPU CSR min 2.411 max 2.427 mean 2.421
781		CPU COO min 0.723 max 1.232 mean 0.775	855		GPU 64 COO min 5.490 max 5.560 mean 5.534
782		CPU CSR min 1.672 max 1.691 mean 1.685	856		CSR min 16.350 max*19.560 mean 17.784
783		GPU 64 COO min 7.600 max 7.760 mean 7.716	857		CPU PAR min 1.441 max 1.509 mean 1.477
784		CSR min 23.160 max 25.590 mean 24.304	858		H min 9.512 max 9.526 mean 9.520
785		CPU PAR min 1.675 max* 1.736 mean 1.703	859	Column-Gradient	
786		H min 10.463 max 10.472 mean 10.468	860		CPU COO min 0.721 max 1.802 mean 0.871
787	Column-Gradient		861		CPU CSR min 2.393 max 2.408 mean 2.404
788		CPU COO min 0.726 max 1.431 mean 0.778	862		GPU 64 COO min 5.410 max 5.480 mean 5.453
789		CPU CSR min 1.671 max 1.685 mean 1.679	863		CSR min 15.680 max 17.870 mean 16.540
790		GPU 64 COO min 7.410 max 7.530 mean 7.467	864		CPU PAR min 1.429 max 1.488 mean 1.468
791		CSR min 18.140 max 20.350 mean 19.315	865		H min 10.931 max 10.945 mean 10.938
792		CPU PAR min 1.650 max 1.736 mean 1.699		Row-Column-Permute	
793		H min 11.393 max*11.401 mean 11.397	867		CPU COO min 0.728 max 1.646 mean 1.037
794	Row-Column-Permute		868		CPU CSR min 2.472 max 2.488 mean 2.480
795	cordilli i ci llace	CPU COO min 0.711 max 1.458 mean 0.751	869		GPU 64 COO min 5.410 max 5.480 mean 5.449
		CPU COO min 0.711 max 1.458 mean 0.751 CPU CSR min 2.678 max 2.717 mean 2.700			
796			870		CSR min 15.760 max 17.560 mean 16.654
797		GPU 64 COO min 7.400 max 7.540 mean 7.471	871		CPU PAR min 1.428 max 1.513 mean 1.474
798		CSR min 19.560 max 21.150 mean 20.453	872		H min 10.959 max*10.967 mean 10.963
799		CPU PAR min 1.440 max 1.499 mean 1.467		en4.mtx	
800		H min 11.266 max 11.272 mean 11.269		Regular	
801	c-47.mtx		875		CPU COO min 0.737 max 1.977 mean 1.431
802	Regular		876		CPU CSR min 2.674 max 2.688 mean 2.681
803		CPU COO min 0.754 max* 1.829 mean 1.204	877		GPU 64 COO min 5.900 max 6.000 mean 5.954
804		CPU CSR min 2.610 max* 2.624 mean 2.618	878		CSR min 13.650 max 15.410 mean 14.657
805		GPU 64 COO min 9.530 max* 9.870 mean 9.640	879		CPU PAR min 1.468 max 1.521 mean 1.491
806		CSR min 23.990 max*25.910 mean 24.992	880		H min 9.234 max 9.234 mean 9.234
807		CPU PAR min 1.311 max 1.380 mean 1.357		Row-Premute	
808		H min 8.364 max 8.364 mean 8.364	882		CPU COO min 0.740 max* 2.048 mean 1.121
809	Row-Premute	min 0.504 max 0.504 mean 0.504	883		CPU CSR min 2.777 max 2.798 mean 2.790
	NOW-F1 EIIIULE	CDU COO 0 740 0 005 0 755			GPU 64 COO min 5.910 max 5.970 mean 5.944
810		CPU CO0 min 0.740 max 0.885 mean 0.755	884		
811		CPU CSR min 2.574 max 2.611 mean 2.597	885		CSR min 13.700 max 15.370 mean 14.541
812		GPU 64 COO min 9.320 max 9.510 mean 9.397	886		CPU PAR min 1.468 max 1.546 mean 1.502

887		H min 10.250 max 10.255 mean 10.252	961	CPU COO min 0.735 max 1.806 mean 0.878
888	Row-Gradient		962	CPU CSR min 2.706 max 2.744 mean 2.726
889		CPU COO min 0.740 max 1.790 mean 0.994	963	GPU 64 COO min 6.390 max 6.500 mean 6.433
890		CPU CSR min 2.663 max 2.682 mean 2.674	964	CSR min 19.780 max 22.870 mean 20.936
891		GPU 64 COO min 5.890 max* 6.160 mean 5.946	965	CPU PAR min 1.710 max 1.865 mean 1.785
892		CSR min 13.780 max*17.520 mean 15.601	966	H min 10.251 max 10.267 mean 10.257
893		CPU PAR min 1.479 max* 1.619 mean 1.569	967 Column-Gradient	
894		H min 9.939 max 9.955 mean 9.948	968	CPU COO min 0.728 max 1.792 mean 0.986
895	Column-Gradient		969	CPU CSR min 2.521 max 2.720 mean 2.703
896		CPU COO min 0.743 max 1.991 mean 0.981	970	GPU 64 COO min 6.280 max 6.370 mean 6.327
897		CPU CSR min 2.620 max 2.654 mean 2.646	971	CSR min 18.000 max 19.720 mean 19.040
898		GPU 64 COO min 5.840 max 5.910 mean 5.885	972	CPU PAR min 1.649 max 1.741 mean 1.702
899		CSR min 13.130 max 17.040 mean 15.008	973	H min 11.113 max 11.121 mean 11.117
900		CPU PAR min 1.477 max 1.607 mean 1.559	974 Row-Column-Permute	
901		H min 10.858 max*10.876 mean 10.864	975	CPU COO min 0.714 max 1.525 mean 0.957
902	Row-Column-Permute		976	CPU CSR min 2.876 max 2.892 mean 2.884
903		CPU COO min 0.742 max 2.010 mean 1.124	977	GPU 64 COO min 6.280 max 6.370 mean 6.322
904		CPU CSR min 2.789 max* 2.800 mean 2.795	978	CSR min 17.960 max 19.670 mean 18.670
905		GPU 64 COO min 5.900 max 5.980 mean 5.941	979	CPU PAR min 1.667 max 1.754 mean 1.710
906		CSR min 13.640 max 15.410 mean 14.556	980	H min 11.162 max*11.168 mean 11.165
		CPU PAR min 1.462 max 1.540 mean 1.504		11 IIII1 11.102 IIIAX*11.108 IIIEAII 11.103
907 908		H min 10.250 max 10.253 mean 10.252	981 TSOPF_RS_b39_c7.mtx 982 Regular	
	W1 C	n IIII1 10.250 IIIax 10.253 IIIean 10.252	-	CDU COO 0 771 0 703 0 700
909	Maragal_6.mtx		983	CPU COO min 0.771 max 0.793 mean 0.780
910	Regular		984	CPU CSR min 3.219 max* 3.232 mean 3.227
911		CPU COO min 0.725 max 0.741 mean 0.729	985	GPU 64 COO min 11.070 max*11.200 mean 11.142
912		CPU CSR min 2.345 max 2.409 mean 2.372	986	CSR min 37.050 max*42.100 mean 39.040
913		GPU 64 COO min 18.200 max 18.770 mean 18.357	987	CPU PAR min 1.910 max 2.027 mean 1.982
914		CSR min 38.310 max*40.240 mean 39.477	988	H min 7.304 max 7.304 mean 7.304
915		CPU PAR min 0.789 max 0.813 mean 0.797	989 Row-Premute	
916		H min 9.930 max 9.930 mean 9.930	990	CPU COO min 0.701 max 0.722 mean 0.707
917	Row-Premute		991	CPU CSR min 2.931 max 2.952 mean 2.942
918		CPU COO min 0.709 max 0.779 mean 0.715	992	GPU 64 COO min 10.860 max 11.030 mean 10.928
919		CPU CSR min 2.675 max 2.715 mean 2.696	993	CSR min 28.730 max 30.880 mean 29.483
920		GPU 64 COO min 17.810 max 18.030 mean 17.935	994	CPU PAR min 1.760 max 1.922 mean 1.851
920		CSR min 29.650 max 30.580 mean 30.109	995	
				H min 10.537 max 10.541 mean 10.539
922		CPU PAR min 0.857 max 0.940 mean 0.904	996 Row-Gradient	
923		H min 10.777 max 10.779 mean 10.778	997	CPU COO min 0.747 max 0.808 mean 0.757
924	Row-Gradient		998	CPU CSR min 2.606 max 2.648 mean 2.624
925		CPU COO min 0.710 max* 1.566 mean 0.755	999	GPU 64 COO min 10.850 max 11.120 mean 10.999
926		CPU CSR min 2.042 max 2.159 mean 2.120	1000	CSR min 33.910 max 37.600 mean 35.909
927		GPU 64 COO min 18.460 max*18.960 mean 18.665	1001	CPU PAR min 2.154 max* 2.245 mean 2.203
928		CSR min 25.650 max 27.330 mean 26.549	1002	H min 9.636 max 9.646 mean 9.642
929		CPU PAR min 2.257 max 2.612 mean 2.416	1003 Column-Gradient	
930		H min 11.251 max 11.301 mean 11.285	1004	CPU COO min 0.718 max* 1.693 mean 0.802
931	Column-Gradient		1005	CPU CSR min 2.502 max 2.585 mean 2.547
932		CPU COO min 0.711 max 0.743 mean 0.725	1006	GPU 64 COO min 10.700 max 10.990 mean 10.804
933		CPU CSR min 2.036 max 2.161 mean 2.110	1007	CSR min 27.230 max 29.380 mean 28.488
		GPU 64 COO min 17.840 max 18.860 mean 18.149		CSR min 27.230 max 29.360 mean 26.466 CPU PAR min 2.128 max 2.227 mean 2.172
934			1008	
935		CSR min 19.410 max 20.690 mean 20.066	1009	H min 11.131 max*11.222 mean 11.208
936		CPU PAR min 2.174 max* 2.546 mean 2.349	1010 Row-Column-Permute	
937		H min 12.011 max*12.072 mean 12.052	1011	CPU COO min 0.709 max 0.726 mean 0.716
938	Row-Column-Permute		1012	CPU CSR min 2.917 max 2.958 mean 2.940
939		CPU COO min 0.712 max 0.971 mean 0.737	1013	GPU 64 COO min 10.840 max 11.030 mean 10.930
940		CPU CSR min 2.732 max* 2.751 mean 2.743	1014	CSR min 28.780 max 30.810 mean 29.578
941		GPU 64 COO min 17.720 max 18.070 mean 17.911	1015	CPU PAR min 1.757 max 1.834 mean 1.792
942		CSR min 29.600 max 30.500 mean 29.961	1016	H min 10.537 max 10.540 mean 10.539
943		CPU PAR min 0.827 max 0.954 mean 0.913		
944		H min 10.776 max 10.778 mean 10.777		
945	6.44		40 5115014	EDE
946	aft01.mtx			I E IZ E
	aft01.mtx Regular		1017 10 ELLESM	ILIXL
947	Regular	CPII COO min 0.735 may* 2 079 mean 1 069		ILKL
947		CPU COO min 0.735 max* 2.079 mean 1.069	1018 aft01.mtx	ILKL
948		CPU CSR min 3.132 max* 3.154 mean 3.145	1018 aft01.mtx 1019 Regular	
948 949		CPU CSR min 3.132 max* 3.154 mean 3.145 GPU 64 COO min 6.390 max* 6.610 mean 6.457	1018 aft01.mtx 1019 Regular 1020	GPU 64 COO min 4.080 max* 4.280 mean 4.186
948 949 950		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	1018 aft01.mtx 1019 Regular 1020 1021	GPU 64 COO min 4.080 max* 4.280 mean 4.186 CSR min 9.660 max*12.660 mean 11.485
948 949 950 951		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	1018 aft01.mtx 1019 Regular 1020	GPU 64 COO min 4.080 max* 4.280 mean 4.186
948 949 950		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	1018 aft01.mtx 1019 Regular 1020 1021	GPU 64 COO min 4.080 max* 4.280 mean 4.186 CSR min 9.660 max*12.660 mean 11.485
948 949 950 951		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	1018 aft01.mtx 1019 Regular 1020 1021	GPU 64 COO min 4.080 max* 4.280 mean 4.186 CSR min 9.660 max*12.660 mean 11.485
948 949 950 951 952	Regular	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	1018 aft01.mtx 1019 Regular 1020 1021 1022 1023 Row-Premute	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
948 949 950 951 952 953	Regular	CPU CSR min 3.132 max* 3.154 mean 3.145 GPU 64 COO min 6.390 max* 6.610 mean 6.457	1018 aft01.mtx 1019 Regular 1020 1021 1022 1023 Row-Premute 1024	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
948 949 950 951 952 953 954	Regular	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	1018 aft01.mtx 1019 Regular 1020 1021 1022 1023 Row-Premute 1024 1025 1026	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
948 949 950 951 952 953 954 955	Regular	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 CPU COO min 0.714 max 1.648 mean 0.840 CPU CSR min 2.864 max 2.892 mean 2.883	1018 aft01.mtx 1019 Regular 1020 1021 1022 1023 Row-Premute 1024 1025 1026	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
948 949 950 951 952 953 954 955	Regular	CPU CSR min 3.132 max* 3.154 mean 3.145 GPU 64 COO min 6.390 max* 6.610 mean 6.457	1018 aft01.mtx 1019 Regular 1020 1021 1022 1023 Row-Premute 1024 1025 1026 1027 Row-Gradient 1028	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
948 949 950 951 952 953 954 955 956	Regular	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 CPU COO min 0.714 max 1.648 mean 0.840 CPU CSR min 10.714 max 1.648 mean 0.840 CPU CSR min 6.280 max 6.380 mean 6.329 CSR min 17.980 max 19.700 mean 19.105 CPU PAR min 1.729 max 1.850 mean 1.782	1018 aft01.mtx 1019 Regular 1020 1021 1022 1023 Row-Premute 1024 1025 1026 1027 Row-Gradient 1028	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
948 949 950 951 952 953 954 955 956 957	Regular	CPU CSR min 3.132 max* 3.154 mean 3.145 GPU 64 COO min 6.390 max* 6.610 mean 6.457	1018 aft01.mtx 1019 Regular 1020 1021 1022 1023 Row-Premute 1024 1025 1026 1027 Row-Gradient 1028	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

1032		GPU 64 COO min 3.850 max 4.100 mean 4.012	1106	H min 7.380 max 7.380 mean 7.380
1033		CSR min 5.460 max 8.790 mean 6.005	1107 Row-Premute	CPU 64 000 min 4 000 min 4 040 min 4 050
1034	Daw Caluma Damusta	H min 11.112 max 11.122 mean 11.117	1108	GPU 64 COO min 4.820 max 4.940 mean 4.859 CSR min 5.080 max 6.520 mean 6.342
1035 1036	Row-Column-Permute	GPU 64 COO min 3.850 max 4.080 mean 3.990	1109 1110	H min 10.042 max 10.047 mean 10.044
1037		CSR min 5.420 max 6.760 mean 5.977	1111 Row-Gradient	11 IIII 10.042 IIIAX 10.047 IIICAN 10.044
1038		H min 11.162 max*11.169 mean 11.165	1112	GPU 64 COO min 4.810 max* 4.940 mean 4.876
1039	bloweya.mtx		1113	CSR min 6.100 max* 6.560 mean 6.307
1040	Regular		1114	H min 9.681 max 9.704 mean 9.694
1041		GPU 64 COO min 0.000 max 0.000 mean 0.000	1115 Column-Gradient	
1042		CSR min 0.000 max 0.000 mean 0.000	1116	GPU 64 COO min 4.810 max 4.930 mean 4.869
1043		H min 7.205 max 7.205 mean 7.205	1117	CSR min 4.820 max 6.460 mean 6.208
1044	Row-Premute		1118	H min 10.554 max*10.661 mean 10.638
1045		GPU 64 COO min 3.800 max 3.940 mean 3.875	1119 Row-Column-Permute	
1046		CSR min 3.710 max 4.570 mean 4.399	1120	GPU 64 COO min 4.810 max 4.940 mean 4.864
1047		H min 11.025 max 11.031 mean 11.028	1121	CSR min 5.930 max 6.520 mean 6.379
1048	Row-Gradient	GPU 64 COO min 3.800 max* 4.120 mean 3.962	1122	H min 10.041 max 10.047 mean 10.044
1049 1050		CSR min 4.340 max* 4.120 mean 3.962	1123 cvxqp3.mtx 1124 Regular	
1050		H min 10.296 max 10.307 mean 10.300	1124 Regular 1125	GPU 64 COO min 3.350 max* 3.590 mean 3.483
1051	Column-Gradient	11 IIII 10.230 IIIAX 10.307 IIIEAII 10.300	1126	CSR min 5.430 max* 9.260 mean 8.333
1053	COLUMN OF GULLITE	GPU 64 COO min 3.880 max 4.100 mean 3.978	1127	H min 8.646 max 8.646 mean 8.646
1054		CSR min 4.240 max 4.570 mean 4.412	1128 Row-Premute	
1055		H min 10.881 max 10.886 mean 10.883	1129	GPU 64 COO min 3.230 max 3.480 mean 3.371
1056	Row-Column-Permute		1130	CSR min 7.560 max 8.220 mean 7.900
1057		GPU 64 COO min 3.800 max 3.980 mean 3.885	1131	H min 11.027 max 11.033 mean 11.030
1058		CSR min 4.130 max 4.540 mean 4.399	1132 Row-Gradient	
1059		H min 11.025 max*11.033 mean 11.029	1133	GPU 64 COO min 3.240 max 3.510 mean 3.396
1060	brainpc2.mtx		1134	CSR min 6.990 max 7.890 mean 7.574
1061	Regular		1135	H min 11.060 max 11.069 mean 11.064
1062		GPU 64 COO min 0.000 max 0.000 mean 0.000	1136 Column-Gradient	
1063		CSR min 0.000 max 0.000 mean 0.000	1137	GPU 64 COO min 3.240 max 3.480 mean 3.374
1064		H min 7.478 max 7.478 mean 7.478	1138	CSR min 6.980 max 7.900 mean 7.557
1065	Row-Premute	GPU 64 COO min 3.840 max* 6.750 mean 4.110	1139 1140 Row-Column-Permute	H min 11.126 max*11.134 mean 11.130
1066 1067		CSR min 4.260 max* 4.500 mean 4.437	1140 ROW-COTUMN-Permute	GPU 64 COO min 3.110 max 3.470 mean 3.365
1068		H min 9.809 max 9.813 mean 9.811	1142	CSR min 4.810 max 8.210 mean 7.742
1069	Row-Gradient	11 11 3.003 max 3.013 mean 3.011	1143	H min 11.026 max 11.032 mean 11.030
1070		GPU 64 COO min 0.640 max 4.030 mean 3.864	1144 ex19.mtx	
1071		CSR min 4.270 max 4.470 mean 4.383	1145 Regular	
1072		H min 9.722 max 9.727 mean 9.724	1146	GPU 64 COO min 2.450 max* 2.610 mean 2.564
1073	Column-Gradient		1147	CSR min 4.490 max 4.760 mean 4.714
1074		GPU 64 COO min 0.640 max 4.070 mean 3.898	1148	H min 8.228 max 8.228 mean 8.228
1075		CSR min 4.230 max 4.500 mean 4.386	1149 Row-Premute	
1076		H min 10.368 max*10.372 mean 10.370	1150	GPU 64 COO min 2.000 max 2.040 mean 2.021
1077	Row-Column-Permute		1151	CSR min 4.640 max 4.780 mean 4.733
1078		GPU 64 COO min 3.980 max 4.110 mean 4.027	1152	H min 11.835 max 11.840 mean 11.838
1079		CSR min 4.320 max 4.490 mean 4.437 H min 9.809 max 9.813 mean 9.811	1153 Row-Gradient	CDII 64 COO min 2 240 mm 2 200 mm 2 220
1080 1081	c-47.mtx	n min 9.809 max 9.813 mean 9.811	1154 1155	GPU 64 COO min 2.240 max 2.390 mean 2.329 CSR min 4.570 max* 4.850 mean 4.807
1082	Regular		1156	H min 10.742 max 10.752 mean 10.747
1083	regular	GPU 64 COO min 3.980 max* 4.080 mean 4.026	1157 Column-Gradient	ii iii ii
1084		CSR min 4.760 max 4.850 mean 4.812	1158	GPU 64 COO min 2.010 max 2.050 mean 2.034
1085		H min 8.364 max 8.364 mean 8.364	1159	CSR min 4.570 max 4.760 mean 4.701
1086	Row-Premute		1160	H min 11.872 max*11.881 mean 11.878
1087		GPU 64 COO min 3.880 max 4.010 mean 3.942	1161 Row-Column-Permute	
1088		CSR min 4.040 max 4.900 mean 4.807	1162	GPU 64 COO min 2.000 max 2.040 mean 2.023
1089		H min 10.059 max 10.063 mean 10.061	1163	CSR min 0.770 max 4.780 mean 4.594
1090	Row-Gradient		1164	H min 11.835 max 11.840 mean 11.838
1091		GPU 64 COO min 3.900 max 4.050 mean 3.976	1165 gen4.mtx	
1092		CSR min 4.380 max 4.740 mean 4.630	1166 Regular	
1093	0.1	H min 10.201 max 10.228 mean 10.214	1167	GPU 64 COO min 4.880 max 4.980 mean 4.900 CSR min 10.020 max*11.300 mean 10.716
1094 1095	Column-Gradient	CPU 64 COO min 2 960 may 2 000 moan 2 026	1168 1169	H min 9.234 max 9.234 mean 9.234
1095		GPU 64 COO min 3.860 max 3.990 mean 3.936 CSR min 4.350 max 4.610 mean 4.525	1170 Row-Premute	11 IIIII 3.234 IIIdX 9.234 IIIedN 9.234
1090		H min 11.204 max*11.241 mean 11.222	1171 Kow-Fremute	GPU 64 COO min 4.860 max 4.930 mean 4.890
1098	Row-Column-Permute		1172	CSR min 0.330 max 11.200 mean 10.038
1099		GPU 64 COO min 3.890 max 4.020 mean 3.953	1173	H min 10.249 max 10.254 mean 10.252
1100		CSR min 4.490 max* 4.920 mean 4.840	1174 Row-Gradient	
1101		H min 10.058 max 10.063 mean 10.061	1175	GPU 64 COO min 4.860 max* 4.990 mean 4.908
1102	case9.mtx		1176	CSR min 9.160 max 11.240 mean 10.435
1103	Regular		1177	H min 9.939 max 9.961 mean 9.947
1104		GPU 64 COO min 0.000 max 0.000 mean 0.000	1178 Column-Gradient	
		CSR min 0.000 max 0.000 mean 0.000	1179	GPU 64 COO min 4.780 max 4.880 mean 4.816
1105		CSK MITH 0.000 Max 0.000 Mcarl 0.000		

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1180		CSR min 7.770 max 10.570 mean 9.407	1254 Row-Premute	CDU 54 000 - 1 4 400 - 1 500 - 1 445
1181		H min 10.851 max*10.876 mean 10.864	1255	GPU 64 COO min 4.420 max 4.520 mean 4.445
1182	Row-Column-Permute		1256	CSR min 10.520 max 10.880 mean 10.696
1183		GPU 64 COO min 4.850 max 4.950 mean 4.886	1257	H min 10.960 max*10.968 mean 10.963
1184		CSR min 10.220 max 11.280 mean 10.748	1258 Row-Gradient	
1185		H min 10.250 max 10.255 mean 10.252	1259	GPU 64 COO min 4.570 max 4.690 mean 4.605
1186	lp_fit2d.mtx		1260	CSR min 4.550 max 13.350 mean 12.479
1187	Regular		1261	H min 9.508 max 9.527 mean 9.520
1188		GPU 64 COO min 4.360 max* 4.640 mean 4.515	1262 Column-Gradient	
1189		CSR min 10.080 max 10.900 mean 10.491	1263	GPU 64 COO min 4.430 max 4.530 mean 4.461
1190		H min 11.109 max 11.109 mean 11.109	1264	CSR min 10.250 max 10.940 mean 10.603
1191	Row-Premute		1265	H min 10.934 max 10.945 mean 10.939
1192		GPU 64 COO min 4.170 max 4.630 mean 4.476	1266 Row-Column-Permute	
1193		CSR min 0.910 max 10.910 mean 10.257	1267	GPU 64 COO min 4.420 max 4.520 mean 4.450
1194		H min 11.098 max 11.104 mean 11.101	1268	CSR min 7.380 max 10.900 mean 10.598
1195	Row-Gradient		1269	H min 10.959 max 10.967 mean 10.963
1196		GPU 64 COO min 4.370 max 4.630 mean 4.529	1270 mult_dcop_01.mtx	
1197		CSR min 10.030 max 10.970 mean 10.624	1271 Regular	
1198		H min 11.109 max 11.109 mean 11.109	1272	GPU 64 COO min 3.420 max 3.630 mean 3.555
1199	Column-Gradient		1273	CSR min 3.650 max 4.090 mean 3.814
1200		GPU 64 COO min 4.250 max 4.640 mean 4.499	1274	H min 9.689 max 9.689 mean 9.689
1201		CSR min 8.510 max*11.010 mean 10.505	1275 Row-Premute	11 1111 3.003 max 3.003 mean 3.003
1201		H min 11.328 max*11.333 mean 11.331	1276	GPU 64 COO min 3.450 max 3.580 mean 3.521
1202	Row-Column-Permute	11 IIII 11.520 IIIAX*11.555 IIICAN 11.551	1277	CSR min 3.610 max 4.150 mean 3.785
	Kow-Column-Permute	CDU 64 COO min		
1204		GPU 64 COO min 4.350 max 4.640 mean 4.511	1278	H min 10.738 max 10.742 mean 10.740
1205		CSR min 10.040 max 10.790 mean 10.468	1279 Row-Gradient	
1206		H min 11.097 max 11.106 mean 11.101	1280	GPU 64 COO min 3.510 max* 3.660 mean 3.579
1207	lp_osa_07.mtx		1281	CSR min 3.650 max 4.160 mean 3.806
1208	Regular		1282	H min 10.576 max 10.585 mean 10.580
1209		GPU 64 COO min 0.460 max* 3.640 mean 3.456	1283 Column-Gradient	
1210		CSR min 5.570 max* 8.530 mean 8.106	1284	GPU 64 COO min 3.460 max 3.650 mean 3.584
1211		H min 8.412 max 8.412 mean 8.412	1285	CSR min 3.660 max* 4.240 mean 3.799
1212	Row-Premute		1286	H min 10.826 max*10.842 mean 10.836
1213		GPU 64 COO min 3.140 max 3.450 mean 3.367	1287 Row-Column-Permute	
1214		CSR min 7.600 max 8.070 mean 7.853	1288	GPU 64 COO min 3.470 max 3.580 mean 3.532
1215		H min 9.255 max 9.258 mean 9.256	1289	CSR min 3.600 max 3.980 mean 3.743
1216	Row-Gradient		1290	H min 10.738 max 10.742 mean 10.740
1217		GPU 64 COO min 3.190 max 3.610 mean 3.509	1291 mult_dcop_02.mtx	
1218		CSR min 0.000 max 8.260 mean 7.597	1292 Regular	
1219		H min 8.583 max 8.678 mean 8.670	1293	GPU 64 COO min 3.390 max 3.660 mean 3.585
1220	Column-Gradient		1294	CSR min 0.960 max 4.330 mean 4.162
1221		GPU 64 COO min 3.330 max 3.500 mean 3.416	1295	H min 9.689 max 9.689 mean 9.689
1222		CSR min 6.730 max 7.540 mean 7.199	1296 Row-Premute	
1223		H min 9.542 max* 9.604 mean 9.581	1297	GPU 64 COO min 3.310 max 3.600 mean 3.488
1224	Row-Column-Permute	11 3.512 max 5.501 mean 5.501	1298	CSR min 0.620 max 4.290 mean 4.132
1225	Now Column 1 Crimate	GPU 64 COO min 3.290 max 3.430 mean 3.365	1299	H min 10.738 max 10.743 mean 10.740
1226		CSR min 7.390 max 8.060 mean 7.832	1300 Row-Gradient	11 IIII 10.730 IIIAX 10.743 IIICAN 10.740
1227		H min 9.255 max 9.258 mean 9.256	1301	GPU 64 COO min 3.310 max* 3.670 mean 3.593
	Managal C mt	11 III11 9.255 IIIAX 9.256 IIIEA11 9.256		CSR min 4.130 max* 4.430 mean 4.331
1228	Maragal_6.mtx		1302	
1229	Regular		1303	H min 10.576 max 10.584 mean 10.580
1230		GPU 64 COO min 4.160 max 4.310 mean 4.217	1304 Column-Gradient	
1231		CSR min 4.940 max 4.960 mean 4.956	1305	GPU 64 COO min 0.550 max 3.660 mean 3.486
1232		H min 9.930 max 9.930 mean 9.930	1306	CSR min 3.890 max 4.410 mean 4.275
1233	Row-Premute		1307	H min 10.831 max*10.843 mean 10.836
1234		GPU 64 COO min 4.220 max 4.240 mean 4.225	1308 Row-Column-Permute	
1235		CSR min 4.750 max*13.040 mean 5.133	1309	GPU 64 COO min 3.470 max 3.590 mean 3.542
1236		H min 10.776 max 10.778 mean 10.777	1310	CSR min 4.190 max 4.290 mean 4.242
1237	Row-Gradient		1311	H min 10.738 max 10.742 mean 10.740
1238		GPU 64 COO min 4.180 max* 4.450 mean 4.245	1312 mult_dcop_03.mtx	
1239		CSR min 4.880 max 4.940 mean 4.915	1313 Regular	
1240		H min 11.259 max*11.302 mean 11.281	1314	GPU 64 COO min 3.360 max* 3.660 mean 3.550
1241	Column-Gradient		1315	CSR min 3.650 max 4.090 mean 3.813
1242		GPU 64 COO min 4.200 max 4.250 mean 4.236	1316	H min 9.689 max 9.689 mean 9.689
1243		CSR min 4.800 max 4.890 mean 4.859	1317 Row-Premute	
1244		H min 12.022 max 12.073 mean 12.051	1318	GPU 64 COO min 3.450 max 3.580 mean 3.521
1244	Row-Column-Permute		1319	CSR min 3.610 max 4.160 mean 3.784
1245	NOW COTOMITTED HIGHE	GPU 64 COO min 4.210 max 4.230 mean 4.222	1320	H min 10.738 max 10.743 mean 10.740
				IIII 10.740 IIIdX 10.743 IIIedii 10.740
1247		CSR min 4.860 max 4.890 mean 4.887	1321 Row-Gradient	CDU 64 000 m/m 2 470
1248		H min 10.776 max 10.778 mean 10.778	1322	GPU 64 COO min 3.470 max 3.660 mean 3.572
1249	mhd4800a.mtx		1323	CSR min 3.640 max 4.190 mean 3.809
1250	Regular		1324	H min 10.572 max 10.584 mean 10.580
1251		GPU 64 COO min 4.570 max* 4.710 mean 4.608	1325 Column-Gradient	
1252		CSR min 12.690 max*13.940 mean 13.369	1326	GPU 64 COO min 3.430 max 3.650 mean 3.562
1253		H min 7.132 max 7.132 mean 7.132	1327	CSR min 3.670 max* 4.290 mean 3.793

1328		Н	min	10.828 max	*10.840 mea	n 10.834	1402		GPU 64 COO mi	1 4.540 max 4.940 mean 4.8	374
1329	Row-Column-Permute						1403		CSR mi	n 6.280 max 6.520 mean 6.4	103
1330		GPU 64 COC	min	3.370 max	3.610 mea	n 3.502	1404		H min	1 10.042 max 10.047 mean 10.0	944
1331					3.970 mea		1405	Row-Gradient			
1332		Н			: 10.741 mea		1406	Now Gradient	CDU 64 COO	1 4.830 max 4.930 mean 4.8	75
	ODE 2754	"	IIIIII	10.730 IIIax	. 10.741 iilea	11 10.740					
1333	OPF_3754.mtx						1407			1 5.790 max* 6.560 mean 6.2	
1334	Regular						1408		H min	9.675 max 9.706 mean 9.6	192
1335		GPU 64 COC	min	4.700 max	* 4.930 mea	n 4.842	1409	Column-Gradient			
1336		CSR	min	6.230 max	* 6.600 mea	n 6.411	1410		GPU 64 COO mi	1 4.790 max* 4.960 mean 4.8	180
1337		Н	min	8.393 max	8.393 mea	n 8.393	1411		CSR min	1 5.760 max 6.450 mean 6.2	204
1338	Row-Premute						1412		H min	1 10.601 max*10.661 mean 10.6	26
1339		GPU 64 COC	min	4.620 max	4.890 mea	n 4.787	1413	Row-Column-Permute			
1340		CSR	min	5.780 max	6.310 mea	n 6.192	1414		GPU 64 COO mi	1 4.330 max 4.950 mean 4.8	345
1341		н			11.272 mea		1415			1 5.740 max 6.500 mean 6.3	
1342	Row-Gradient	"	IIIIII	11.203 IIIax	. 11.2/2 iilea	11 11.209	1416			1 0.041 max 10.046 mean 10.0	
	ROW-Gradient								u IIIII	1 10.041 Max 10.046 Mean 10.0	144
1343					4.870 mea		1417	TSOPF_RS_b39_c7.mtx			
1344					6.510 mea		1418	Regular			
1345		Н	min	10.464 max	10.473 mea	n 10.468	1419			4.300 max* 4.430 mean 4.3	
1346	Column-Gradient						1420		CSR min	1 4.480 max 4.750 mean 4.7	16
1347		GPU 64 COC	min	4.580 max	4.870 mea	n 4.756	1421		H min	7.304 max 7.304 mean 7.3	304
1348		CSR	min	5.630 max	6.180 mea	n 6.055	1422	Row-Premute			
1349		Н	min	11.394 max	*11.401 mea	n 11.397	1423		GPU 64 COO mi	1 4.260 max 4.400 mean 4.3	353
1350	Row-Column-Permute						1424		CSR mi	1 4.490 max 4.770 mean 4.7	/34
1351		CPIL 64 COC	min	4 610 may	4.900 mea	n 4 780	1425			1 10.536 max 10.541 mean 10.5	
								David Constitution	11 11111	1 10.530 max 10.541 mean 10.5	133
1352					6.300 mea		1426	Row-Gradient			
1353		Н	min	11.268 max	11.272 mea	n 11.270	1427			1 3.970 max 4.420 mean 4.3	
1354	OPF_6000.mtx						1428		CSR min	1 4.620 max* 4.820 mean 4.7	89
1355	Regular						1429		H min	n 9.638 max 9.644 mean 9.6	541
1356		GPU 64 COC	min	3.780 max	* 3.920 mea	n 3.864	1430	Column-Gradient			
1357		CSR	min	4.270 max	4.360 mea	n 4.332	1431		GPU 64 COO mi	1 4.240 max 4.430 mean 4.3	368
1358		Н	min	8.799 max	8.799 mea	n 8.799	1432		CSR mi	4.710 max 4.770 mean 4.7	/36
1359	Row-Premute						1433			11.129 max*11.222 mean 11.2	
1360	NOW I I CINGEE	CDII 64 COC		2 770	3.870 mea	- 2 021	1434	Row-Column-Permute		1 11.125 max*11.222 mean 11.2	.03
					: 3.070 mea :*11.050 mea			Row-Column-Permute			
1361							1435			1 4.260 max 4.410 mean 4.3	
1362		Н	mın	11.8/2 max	11.877 mea	n 11.8/5	1436			1 4.660 max 4.760 mean 4.7	
1363	Row-Gradient						1437		H min	10.537 max 10.541 mean 10.5	39
1364		GPU 64 COC	min	3.700 max	3.870 mea	n 3.795					
1365		CSR	min	4.330 max	4.440 mea						
1365 1366		CSR H				n 4.403		11 FIII			
	Column-Gradient				4.440 mea	n 4.403	1438	11 FIJI			
1366 1367	Column-Gradient	Н	min	11.109 max	4.440 mea	n 4.403 n 11.113		-			
1366 1367 1368	Column-Gradient	H GPU 64 COC	min) min	11.109 max	4.440 mea 11.116 mea 3.870 mea	n 4.403 in 11.113 in 3.804	1439	mult_dcop_03.mtx			
1366 1367 1368 1369	Column-Gradient	H GPU 64 COC CSR	min) min ? min	11.109 max 3.690 max 4.260 max	4.440 mea 11.116 mea 3.870 mea 4.340 mea	n 4.403 n 11.113 n 3.804 n 4.308	1439 1440	-	CDU 64 COO	5 140 ann 5 140 ann 5 1	40
1366 1367 1368 1369 1370		H GPU 64 COC	min) min ? min	11.109 max 3.690 max 4.260 max	4.440 mea 11.116 mea 3.870 mea	n 4.403 n 11.113 n 3.804 n 4.308	1439 1440 1441	mult_dcop_03.mtx		ı 5.140 max* 5.140 mean 5.1	
1366 1367 1368 1369 1370 1371	Column-Gradient Row-Column-Permute	H GPU 64 COC CSR H	min) min ? min min	3.690 max 4.260 max 12.041 max	4.440 mea 11.116 mea 3.870 mea 4.340 mea 4.12.045 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043	1439 1440 1441 1442	mult_dcop_03.mtx	CSR min	n 10.340 max*10.390 mean 10.3	365
1366 1367 1368 1369 1370 1371 1372		H GPU 64 COC CSR H GPU 64 COC	min) min ? min min) min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max	: 4.440 mea : 11.116 mea : 3.870 mea : 4.340 mea :*12.045 mea	n 4.403 in 11.113 in 3.804 in 4.308 in 12.043 in 3.819	1439 1440 1441 1442 1443	mult_dcop_03.mtx Regular	CSR min		365
1366 1367 1368 1369 1370 1371 1372 1373		H GPU 64 COC CSR H GPU 64 COC	min) min R min min) min R min	3.690 max 4.260 max 12.041 max 3.780 max 4.090 max	4.440 mea 11.116 mea 13.870 mea 14.340 mea 14.2045 mea 15.3.860 mea 16.4.290 mea	n 4.403 in 11.113 in 3.804 in 4.308 in 12.043 in 3.819 in 4.259	1439 1440 1441 1442	mult_dcop_03.mtx	CSR min	n 10.340 max*10.390 mean 10.3	365
1366 1367 1368 1369 1370 1371 1372		H GPU 64 COC CSR H GPU 64 COC	min) min R min min) min R min	3.690 max 4.260 max 12.041 max 3.780 max 4.090 max	: 4.440 mea : 11.116 mea : 3.870 mea : 4.340 mea :*12.045 mea	n 4.403 in 11.113 in 3.804 in 4.308 in 12.043 in 3.819 in 4.259	1439 1440 1441 1442 1443	mult_dcop_03.mtx Regular	CSR min	n 10.340 max*10.390 mean 10.3	365 589
1366 1367 1368 1369 1370 1371 1372 1373		H GPU 64 COC CSR H GPU 64 COC CSR	min) min R min min) min R min	3.690 max 4.260 max 12.041 max 3.780 max 4.090 max	4.440 mea 11.116 mea 13.870 mea 14.340 mea 14.2045 mea 15.3.860 mea 16.4.290 mea	n 4.403 in 11.113 in 3.804 in 4.308 in 12.043 in 3.819 in 4.259	1439 1440 1441 1442 1443	mult_dcop_03.mtx Regular	CSR min H min	n 10.340 max*10.390 mean 10.3 n 9.689 max 9.689 mean 9.6	365 589 980
1366 1367 1368 1369 1370 1371 1372 1373 1374	Row-Column-Permute	H GPU 64 COC CSR H GPU 64 COC CSR	min) min R min min) min R min	3.690 max 4.260 max 12.041 max 3.780 max 4.090 max	4.440 mea 11.116 mea 13.870 mea 14.340 mea 14.2045 mea 15.3.860 mea 16.4.290 mea	n 4.403 in 11.113 in 3.804 in 4.308 in 12.043 in 3.819 in 4.259	1439 1440 1441 1442 1443 1444 1445	mult_dcop_03.mtx Regular	H CSR min GPU 64 COO min CSR min	n 10.340 max*10.390 mean 10.3 n 9.689 max 9.689 mean 9.6 n 4.970 max 4.990 mean 4.9	365 589 980 125
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375	Row-Column-Permute	H GPU 64 COC CSR H GPU 64 COC CSR	min) min nin min) min) min nin	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max	4.440 mea 11.116 mea 13.870 mea 14.340 mea 14.2045 mea 15.3.860 mea 16.4.290 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876	1439 1440 1441 1442 1443 1444 1445	mult_dcop_03.mtx Regular Row-Premute	H CSR min GPU 64 COO min CSR min	1 10.340 max*10.390 mean 10.3 1 9.689 max 9.689 mean 9.6 1 4.970 max 4.990 mean 4.9 1 9.420 max 9.430 mean 9.4	365 589 980 125
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376	Row-Column-Permute	H GPU 64 COC CSR H GPU 64 COC CSR H	min) min min) min c min min) min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max	4.440 mea 11.116 mea 3.870 mea 4.340 mea **12.045 mea 3.860 mea 4.290 mea 11.877 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876	1439 1440 1441 1442 1443 1444 1445 1446 1447	mult_dcop_03.mtx Regular	CSR min H min GPU 64 COO min CSR min H min	10.340 max*10.390 mean 10.3 19.689 max 9.689 mean 9.6 10.4.970 max 4.990 mean 4.9 10.9.420 max 9.430 mean 9.4 10.739 max 10.739 mean 10.7	365 589 980 125 739
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377	Row-Column-Permute	H GPU 64 COC CSR H GPU 64 COC CSR H	min) min min) min min min) min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max	4.440 mea 11.116 mea 3.870 mea 4.340 mea 12.045 mea 4.290 mea 11.877 mea 11.877 mea 11.877 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449	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 10.3 10.689 max 9.689 mean 9.6 10.4.970 max 4.990 mean 4.9 10.739 max 10.739 mean 10.7 10.739 max 5.080 max 5.090 mean 5.0	365 589 980 125 739
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377 1378	Row-Column-Permute shermanACb.mtx Regular	H GPU 64 COC CSR H GPU 64 COC CSR H GPU 64 COC CSR CSR	min) min min) min min min) min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max	4.440 mea 11.116 mea 3.870 mea 4.340 mea **12.045 mea 3.860 mea 4.290 mea 11.877 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449	mult_dcop_03.mtx Regular Row-Premute	GPU 64 COO min CSR min H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min	10.340 max*10.390 mean 10.3 10.689 max 9.689 mean 9.6 11.4.970 max 4.990 mean 4.9 12.420 max 9.430 mean 9.4 13.739 max 10.739 mean 10.7 14.5.080 max 5.090 mean 5.0 15.080 max 10.300 mean 10.0	365 589 980 125 739 985
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377 1378 1379	Row-Column-Permute	H GPU 64 COC CSR H GPU 64 COC CSR H GPU 64 COC CSR H	min) min c min min) min min) min min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max	4.440 mea t 11.116 mea t 11.116 mea t 13.870 mea t 4.340 mea t 12.045 mea t 4.290 mea t 11.877 mea t 5.5980 mea t 8.600 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450	mult_dcop_03.mtx Regular Row-Premute Row-Gradient	GPU 64 COO min CSR min H min GPU 64 COO min CSR min H min GPU 64 COO min CSR min	10.340 max*10.390 mean 10.3 10.689 max 9.689 mean 9.6 10.4.970 max 4.990 mean 4.9 10.739 max 10.739 mean 10.7 10.739 max 5.080 max 5.090 mean 5.0	365 589 980 125 739 985
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377 1378 1379 1380	Row-Column-Permute shermanACb.mtx Regular	H GPU 64 COC CSR H GPU 64 COC CSR H GPU 64 COC CSR H GPU 64 COC GSR	min) min R min min) min min) min min) min min	11.109 max 3.690 max 4.260 max 12.041 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.760 max	4.440 mea 11.116 mea 2.3.870 mea 2.4.340 mea 2.4.340 mea 2.4.340 mea 2.3.860 mea 2.4.290 mea 2.11.877 mea 2.5.980 mea 2.5.980 mea 2.6.00 mea 2.3.020 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451	mult_dcop_03.mtx Regular Row-Premute	CSR min H min GPU 64 COO min CSR min GPU 64 COO min CSR min H min	10.340 max*10.390 mean 10.3 10.9689 max 9.689 mean 9.6 11.4.970 max 4.990 mean 4.9 11.9.420 max 9.430 mean 9.4 11.739 max 10.739 mean 10.7 11.5.080 max 5.090 mean 5.0 11.5.79 max 10.582 mean 10.5	980 125 739 985 910
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377 1378 1379 1380 1381	Row-Column-Permute shermanACb.mtx Regular	H GPU 64 COC CSR CSR CSR	min) min R min min) min R min) min min) min R min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.760 max 2.660 max	4.440 mea ca 11.116 mea ca 3.870 mea ca 4.340 mea ca 4.340 mea ca 4.340 mea ca 4.290 mea ca 11.877 mea ca 5.980 mea ca 8.600 mea ca 3.020 mea ca 5.830 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451 1452	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 GPU 64 COO min	10.340 max*10.390 mean 10.3 10.689 max 9.689 mean 9.6 10.4.970 max 4.990 mean 4.9 10.739 max 10.739 mean 10.7 10.739 max 10.739 mean 10.7 10.739 max 10.390 mean 10.0 10.579 max 10.582 mean 10.5 10.579 max 5.030 max 5.030 mean 5.0	865 589 980 425 739 985 910 580
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377 1378 1379 1380 1381 1382	Row-Column-Permute shermanACb.mtx Regular Row-Premute	H GPU 64 COC CSR H GPU 64 COC CSR H GPU 64 COC CSR H GPU 64 COC GSR	min) min R min min) min R min) min min) min R min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.760 max 2.660 max	4.440 mea 11.116 mea 2.3.870 mea 2.4.340 mea 2.4.340 mea 2.4.340 mea 2.3.860 mea 2.4.290 mea 2.11.877 mea 2.5.980 mea 2.5.980 mea 2.6.00 mea 2.3.020 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1450 1451 1452 1453	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 CSR min CSR min CSR min CSR min	10.340 max*10.390 mean 10.3 10.689 max 9.689 mean 9.6 11.4.970 max 4.990 mean 4.9 12.420 max 9.430 mean 9.4 13.10.739 max 10.739 mean 10.7 14.5.080 max 5.090 mean 10.0 15.080 max 10.390 mean 10.0 16.579 max 10.582 mean 10.5 17.5.030 max 5.120 mean 5.0 18.5.030 max 5.120 mean 5.0 19.330 max 9.770 mean 9.5	365 589 980 125 739 985 910 580
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377 1378 1379 1380 1381	Row-Column-Permute shermanACb.mtx Regular	H GPU 64 COC CSR CSR CSR	min) min R min min) min R min) min min) min R min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.760 max 2.660 max	4.440 mea c 11.116 mea c 3.870 mea c 4.340 mea c 4.340 mea c 4.340 mea c 5.980 mea c 5.980 mea c 8.600 mea c 5.980 mea c 5.830	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451 1452	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 CSR min CSR min CSR min CSR min	10.340 max*10.390 mean 10.3 10.689 max 9.689 mean 9.6 10.4.970 max 4.990 mean 4.9 10.739 max 10.739 mean 10.7 10.739 max 10.739 mean 10.7 10.739 max 10.390 mean 10.0 10.579 max 10.582 mean 10.5 10.579 max 5.030 max 5.030 mean 5.0	365 589 980 125 739 985 910 580
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377 1378 1379 1380 1381 1382	Row-Column-Permute shermanACb.mtx Regular Row-Premute	H GPU 64 COC CSR H	min) min c min min) min c min min) min c min c min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 2.760 max 2.760 max 10.377 max	4.440 mea c 11.116 mea c 3.870 mea c 4.340 mea c 4.340 mea c 4.340 mea c 5.980 mea c 5.980 mea c 8.600 mea c 5.980 mea c 5.830	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632 n 10.379	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1450 1451 1452 1453	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 CSR min CSR min CSR min CSR min	10.340 max*10.390 mean 10.3 10.689 max 9.689 mean 9.6 11.4.970 max 4.990 mean 4.9 12.420 max 9.430 mean 9.4 13.10.739 max 10.739 mean 10.7 14.5.080 max 5.090 mean 10.0 15.080 max 10.390 mean 10.0 16.579 max 10.582 mean 10.5 17.5.030 max 5.120 mean 5.0 18.5.030 max 5.120 mean 5.0 19.330 max 9.770 mean 9.5	365 589 980 125 739 985 910 580
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377 1378 1379 1380 1381 1382	Row-Column-Permute shermanACb.mtx Regular Row-Premute	H GPU 64 COC CSR	min) min c min min) min c min min) min c min c min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 6.600 max 2.760 max 2.660 max 2.660 max 2.760 max 2.800 max	4.440 mea 11.116 mea 1	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632 n 10.379 n 2.944	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451 1452 1453 1454	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient	CSR min H min GPU 64 COO min CSR min H min	10.340 max*10.390 mean 10.3 10.689 max 9.689 mean 9.6 11.4.970 max 4.990 mean 4.9 12.420 max 9.430 mean 9.4 13.10.739 max 10.739 mean 10.7 14.5.080 max 5.090 mean 10.0 15.080 max 10.390 mean 10.0 16.579 max 10.582 mean 10.5 17.5.030 max 5.120 mean 5.0 18.5.030 max 5.120 mean 5.0 19.330 max 9.770 mean 9.5	865 589 980 425 739 985 910 580 975 550 336
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377 1378 1379 1380 1381 1382 1383 1384	Row-Column-Permute shermanACb.mtx Regular Row-Premute	H GPU 64 COC CSR	min) min ? min) min ? min min) min min) min min min) min r min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.760 max 2.660 max 10.377 max	4.440 mea 11.116 mea 2.3.870 mea 2.4.340 mea 2.4.340 mea 2.4.340 mea 2.3.860 mea 2.4.290 mea 2.5.980 mea 2.5.980 mea 2.5.980 mea 2.5.980 mea 2.6.000 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632 n 10.379 n 2.944 n 5.742	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451 1452 1453 1454 1455	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient	CSR min H min GPU 64 COO min GSR min H min GPU 64 COO min	10.340 max*10.390 mean 10.3 10.689 max 9.689 mean 9.6 11.4.970 max 4.990 mean 4.9 12.420 max 9.430 mean 9.4 13.5.080 max 10.739 mean 10.7 14.5.080 max 5.090 mean 10.0 15.080 max 10.300 mean 10.0 16.579 max 10.582 mean 10.5 17.5.030 max 5.120 mean 5.0 18.5.030 max 5.120 mean 9.5 19.330 max 9.770 mean 9.5 10.835 max*10.838 mean 10.8	865 589 980 425 739 985 910 975 550 3336
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377 1378 1379 1380 1381 1382 1383 1384 1385	Row-Column-Permute shermanACb.mtx Regular Row-Premute	H GPU 64 COC CSR	min) min ? min) min ? min min) min min) min min min) min r min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.760 max 2.660 max 10.377 max	4.440 mea 11.116 mea 3.870 mea 4.340 mea 4.340 mea 4.340 mea 4.290 mea 5.380 mea 5.980 mea 5.980 mea 5.980 mea 6.090 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632 n 10.379 n 2.944 n 5.742	1439 1440 1441 1442 1443 1444 1445 1446 1447 1450 1450 1451 1452 1453 1454 1455	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient	CSR min H min GPU 64 COO min CSR min CSR min CSR min	10.340 max*10.390 mean 10.3 10.689 max 9.689 mean 9.6 10.4.970 max 4.990 mean 4.9 10.739 max 10.739 mean 10.7 11.5.080 max 5.090 mean 10.0 10.720 max 10.300 mean 10.0 10.579 max 10.582 mean 10.5 10.5930 max 5.120 mean 5.0 10.5930 max 5.120 mean 9.5 10.835 max*10.838 mean 10.8	865 589 980 425 739 985 910 580 975 550 336
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377 1378 1379 1380 1381 1382 1383 1384 1385 1386	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient	H GPU 64 COC CSR H	min) min c min min) min c min c min min c min min c min min min min min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 2.760 max 2.760 max 2.760 max 2.800 max 2.800 max 9.919 max	4.440 mea 11.116 mea 1	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632 n 10.379 n 2.944 n 5.742 n 9.922	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451 1452 1453 1454 1455 1456 1456 1457	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	CSR min H min GPU 64 COO min CSR min CSR min CSR min	10.340 max*10.390 mean 10.3 10.340 max*10.390 mean 10.3 10.9689 max 9.689 mean 9.6 11.4.970 max 4.990 mean 4.9 11.970 max 10.739 mean 10.7 11.970 max 10.739 mean 10.7 11.970 max 10.390 mean 10.0 11.970 max 10.390 mean 10.0 11.970 max 10.582 mean 10.5 11.970 max 10.582 mean 10.5 11.970 max 10.835 mean 10.8 11.970 max 10.835 max*10.838 mean 10.8 11.970 max 5.000 max 5.010 mean 5.000 max 9.460 mean 8.55	865 589 980 425 739 985 910 580 975 550 336
1366 1367 1368 1370 1371 1372 1373 1374 1375 1376 1377 1380 1381 1382 1383 1384 1385 1386	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient	H GPU 64 COC CSR H	min) min c min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.760 max 2.760 max 2.800 max 2.800 max 2.800 max 2.700 max 2.800 max 2.700 max 2.700 max 2.700 max 2.700 max	4.440 mea 11.116 mea 3.870 mea 4.340 mea 4.340 mea 4.340 mea 4.290 mea 5.380 mea 5.980 mea 5.980 mea 5.980 mea 6.00 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632 n 10.379 n 2.944 n 5.742 n 9.922 n 2.926	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451 1452 1453 1454 1455 1456 1457 1458	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx	CSR min H min GPU 64 COO min CSR min CSR min CSR min	10.340 max*10.390 mean 10.3 10.340 max*10.390 mean 10.3 10.9689 max 9.689 mean 9.6 11.4.970 max 4.990 mean 4.9 11.970 max 10.739 mean 10.7 11.970 max 10.739 mean 10.7 11.970 max 10.390 mean 10.0 11.970 max 10.390 mean 10.0 11.970 max 10.582 mean 10.5 11.970 max 10.582 mean 10.5 11.970 max 10.835 mean 10.8 11.970 max 10.835 max*10.838 mean 10.8 11.970 max 5.000 max 5.010 mean 5.000 max 9.460 mean 8.55	865 589 980 425 739 985 910 580 975 550 336
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1377 1378 1379 1380 1381 1382 1383 1384 1385 1386 1387 1388 1388 1388 1388	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient	H GPU 64 COC CSR CSR CSR CSR CSR CSR CSR CSR CSR CS	min) min c min c min c min c min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.760 max 2.660 max 10.377 max 2.800 max 5.330 max 9.919 max 2.720 max 0.000 max	4.440 mea 11.116 mea 2.3.870 mea 2.4.340 mea 2.4.340 mea 2.3.860 mea 2.4.290 mea 2.5.980 mea 2.5.980 mea 2.5.980 mea 2.5.980 mea 2.5.980 mea 2.5.830 mea 2.5.830 mea 2.6.020 mea 2.6.020 mea 2.7.830 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632 n 10.379 n 2.944 n 5.742 n 9.922 n 2.926 n 5.513	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451 1452 1453 1454 1455 1456 1457 1458 1459 1460	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 10.3 10.689 max 9.689 mean 9.6 11.4.970 max 4.990 mean 4.9 12.4.970 max 9.430 mean 9.4 13.5.080 max 5.090 mean 10.7 14.5.080 max 5.090 mean 10.5 15.030 max 10.582 mean 10.5 16.5.030 max 5.120 mean 5.0 17.530 max 10.383 mean 10.8 18.5.030 max 5.120 mean 5.0 19.330 max 9.770 mean 9.5 10.835 max*10.838 mean 10.8 10.759 max 10.740 mean 5.0 10.759 max 10.740 mean 8.5 10.759 max 10.740 mean 8.5	865 589 980 425 739 985 910 580 975 550 336
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377 1378 1381 1382 1383 1384 1385 1386 1387 1386 1387	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient	H GPU 64 COC CSR H	min) min c min c min c min c min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.760 max 2.660 max 10.377 max 2.800 max 5.330 max 9.919 max 2.720 max 0.000 max	4.440 mea 11.116 mea 3.870 mea 4.340 mea 4.340 mea 4.340 mea 4.290 mea 5.380 mea 5.980 mea 5.980 mea 5.980 mea 6.00 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632 n 10.379 n 2.944 n 5.742 n 9.922 n 2.926 n 5.513	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1451 1451 1452 1453 1454 1455 1456 1457 1458 1458	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx	CSR min H min GPU 64 COO min GPU 64 COO min	10.340 max*10.390 mean 10.3 10.9689 max 9.689 mean 9.6 11.4.970 max 4.990 mean 4.9 11.5.080 max 9.430 mean 9.4 11.5.080 max 5.090 mean 10.7 11.5.080 max 10.390 mean 10.0 11.5.79 max 10.380 mean 10.5 11.5.030 max 5.120 mean 10.5 11.5.030 max 5.120 mean 9.5 11.6.835 max*10.838 mean 10.8 11.5.030 max 5.100 mean 5.0 11.5.030 max 5.100 mean 5.0 11.5.030 max 10.741 mean 10.7	986 980 125 739 985 910 580 975 550 9336 905 740
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377 1378 1376 1381 1382 1383 1384 1385 1386 1387 1388 1388 1389 1390 1391 1391	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient	H GPU 64 COC CSR H	min) min c min min) min c min min) min c min min) min min c min min) min min min min) min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 2.760 max 2.760 max 2.760 max 2.800 max 2.800 max 2.760 max 2.760 max 2.760 max 2.760 max 2.760 max 3.77 max	4.440 mea 11.116 mea 11.116 mea 11.116 mea 12.116 mea 14.340 mea 14.340 mea 14.340 mea 14.290 mea 11.877 mea 1	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632 n 10.379 n 2.944 n 5.742 n 9.922 n 2.926 n 5.513 n 10.591	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451 1455 1456 1457 1458 1459 1460 1461	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx	CSR min H min GPU 64 COO min CSR min M	10.340 max*10.390 mean 10.3 10.340 max 9.689 mean 10.799 mean 10.739 mean 10.739 mean 10.739 mean 10.739 mean 10.739 mean 10.799 max 10.300 mean 10.801 mean 10.579 max 10.582 mean 10.591 mean 9.582 mean 10.801 max*10.838 max*10.838 mean 10.838 max*10.838 max*10.838 mean 10.838 max*10.838 mean 10.838 max*10.838 max*10.838 mean 10.838 max*10.838 mean 10.838 max*10.838 max*10.838 max*10.838 mean 10.838 max*10.839 mean 10.338 max*10.340 max*10.3390 mean 10.338 mean 10.338 mean 10.338 mean 10.338 mean 10.338 max*10.3390 mean 10.338 mean 10.338 mean 10.338 max*10.3390 mean 10.338 max*10.3390 mean 10.338 mean 10.	865 589 980 125 739 985 910 550 336 905 520 740
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1378 1379 1380 1381 1382 1383 1384 1385 1386 1387 1388 1389 1390 1391 1391	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient	H GPU 64 COC CSR	min) min comin min) min min) min min) min comin min) min comin min) min comin min) min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.760 max 2.760 max 2.800 max 2.800 max 2.700 max 2.800 max 2.700 max 2.800 max 2.700 max	4.440 mea 11.116 mea 3.870 mea 4.340 mea 4.340 mea 4.340 mea 4.290 mea 5.380 mea 4.290 mea 5.980 mea 6.5.980 mea 6.6020 mea 6.6020 mea 6.6020 mea 6.9925 mea 6.9025 mea 6.9030 mea 6.9030 mea 6.9030 mea 6.9030 mea 6.9030 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632 n 10.379 n 2.944 n 5.742 n 9.922 n 2.926 n 5.513 n 10.591 n 2.939	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1451 1451 1452 1453 1454 1455 1456 1457 1458 1458	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx	CSR min H min GPU 64 COO min CSR min M	10.340 max*10.390 mean 10.3 10.9689 max 9.689 mean 9.6 11.4.970 max 4.990 mean 4.9 11.5.080 max 9.430 mean 9.4 11.5.080 max 5.090 mean 10.7 11.5.080 max 10.390 mean 10.0 11.5.79 max 10.380 mean 10.5 11.5.030 max 5.120 mean 10.5 11.5.030 max 5.120 mean 9.5 11.6.835 max*10.838 mean 10.8 11.5.030 max 5.100 mean 5.0 11.5.030 max 5.100 mean 5.0 11.5.030 max 10.741 mean 10.7	865 589 980 125 739 985 910 550 336 905 520 740
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377 1378 1376 1381 1382 1383 1384 1385 1386 1387 1388 1388 1389 1390 1391 1391	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient	H GPU 64 COC CSR	min) min comin min) min min) min min) min comin min) min comin min) min comin min) min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.760 max 2.760 max 2.800 max 2.800 max 2.700 max 2.800 max 2.700 max 2.800 max 2.700 max	4.440 mea 11.116 mea 11.116 mea 11.116 mea 12.116 mea 14.340 mea 14.340 mea 14.340 mea 14.290 mea 11.877 mea 1	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632 n 10.379 n 2.944 n 5.742 n 9.922 n 2.926 n 5.513 n 10.591 n 2.939	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451 1455 1456 1457 1458 1459 1460 1461	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx	CSR min H min GPU 64 COO min CSR min M	10.340 max*10.390 mean 10.3 10.340 max 9.689 mean 10.799 mean 10.739 mean 10.739 mean 10.739 mean 10.739 mean 10.739 mean 10.799 max 10.300 mean 10.801 mean 10.579 max 10.582 mean 10.591 mean 9.582 mean 10.801 max*10.838 max*10.838 mean 10.838 max*10.838 max*10.838 mean 10.838 max*10.838 mean 10.838 max*10.838 max*10.838 mean 10.838 max*10.838 mean 10.838 max*10.838 max*10.838 max*10.838 mean 10.838 max*10.839 mean 10.338 max*10.340 max*10.3390 mean 10.338 mean 10.338 mean 10.338 mean 10.338 mean 10.338 max*10.3390 mean 10.338 mean 10.338 mean 10.338 max*10.3390 mean 10.338 max*10.3390 mean 10.338 mean 10.	865 589 980 125 739 985 910 550 336 905 520 740
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1378 1379 1380 1381 1382 1383 1384 1385 1386 1387 1388 1389 1390 1391 1391	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient	H GPU 64 COC CSR	min) min c min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.660 max 10.377 max 2.800 max 9.919 max 2.720 max 0.000 max 10.587 max 4.860 max	4.440 mea 11.116 mea 3.870 mea 4.340 mea 4.340 mea 4.340 mea 4.290 mea 5.380 mea 4.290 mea 5.980 mea 6.5.980 mea 6.6020 mea 6.6020 mea 6.6020 mea 6.9925 mea 6.9025 mea 6.9030 mea 6.9030 mea 6.9030 mea 6.9030 mea 6.9030 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632 n 10.379 n 2.944 n 5.742 n 9.922 n 2.926 n 5.513 n 10.591 n 2.939 n 5.667	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451 1452 1453 1454 1456 1457 1456 1457 1456 1457 1458 1459 1460 1461 1462	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular	CSR min H min GPU 64 COO min CSR min H min	10.340 max*10.390 mean 10.3 10.340 max 9.689 mean 10.799 mean 10.739 mean 10.739 mean 10.739 mean 10.739 mean 10.739 mean 10.799 max 10.300 mean 10.801 mean 10.579 max 10.582 mean 10.591 mean 9.582 mean 10.801 max*10.838 max*10.838 mean 10.838 max*10.838 max*10.838 mean 10.838 max*10.838 mean 10.838 max*10.838 max*10.838 mean 10.838 max*10.838 mean 10.838 max*10.838 max*10.838 max*10.838 mean 10.838 max*10.839 mean 10.338 max*10.340 max*10.3390 mean 10.338 mean 10.338 mean 10.338 mean 10.338 mean 10.338 max*10.3390 mean 10.338 mean 10.338 mean 10.338 max*10.3390 mean 10.338 max*10.3390 mean 10.338 mean 10.	365 589 980 425 739 985 910 580 975 975 9336 949 949 949 949 949 949 949 949 949 94
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1380 1381 1384 1385 1384 1385 1387 1388 1388 1389 1390 1391 1392	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient	H GPU 64 COC CSR CSR	min) min c min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.660 max 10.377 max 2.800 max 9.919 max 2.720 max 0.000 max 10.587 max 4.860 max	4.440 mea ca 11.116 mea ca 3.870 mea ca 4.340 mea ca 4.340 mea ca 4.290 mea ca 5.980 mea ca 5.980 mea ca 8.600 mea ca 5.5830 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632 n 10.379 n 2.944 n 5.742 n 9.922 n 2.926 n 5.513 n 10.591 n 2.939 n 5.667	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1450 1451 1452 1453 1454 1455 1456 1457 1458 1459 1460 1461 1462 1463	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular	CSR min H min GPU 64 COO min CSR min H min	10.340 max*10.390 mean 10.3 10.340 max*10.390 mean 10.3 10.689 max 9.689 mean 9.6 11.4.970 max 4.990 mean 4.9 11.9.420 max 9.430 mean 9.4 11.0.739 max 10.739 mean 10.7 11.5.080 max 5.090 mean 10.7 11.5.080 max 5.090 mean 10.8 11.5.030 max 5.120 mean 10.5 11.5.030 max 5.120 mean 10.8 11.5.030 max 9.770 mean 9.5 11.5.030 max 9.770 mean 9.5 11.5.030 max 9.460 mean 8.5 11.5.030 max 10.741 mean 10.7 11.5.140 max* 5.140 mean 5.1 11.5.140 max* 5.140 mean 9.6	365 589 980 125 739 985 910 580 336 905 550 336 905 5520 740
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1381 1382 1384 1385 1384 1385 1388 1389 1391 1390 1391 1392	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient	H GPU 64 COC CSR CSR	min) min c min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.660 max 10.377 max 2.800 max 9.919 max 2.720 max 0.000 max 10.587 max 4.860 max	4.440 mea ca 11.116 mea ca 3.870 mea ca 4.340 mea ca 4.340 mea ca 4.290 mea ca 5.980 mea ca 5.980 mea ca 8.600 mea ca 5.5830 mea	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632 n 10.379 n 2.944 n 5.742 n 9.922 n 2.926 n 5.513 n 10.591 n 2.939 n 5.667	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451 1452 1453 1454 1455 1456 1457 1458 1459 1460 1461 1462 1463 1464 1465	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular	CSR min H min GPU 64 COO min CSR min CSR min	10.340 max*10.390 mean 10.3 10.340 max*10.390 mean 10.3 10.689 max 9.689 mean 9.6 11.4.970 max 4.990 mean 4.9 11.739 max 10.739 mean 10.7 11.5.080 max 5.090 mean 10.7 11.5.080 max 5.090 mean 10.0 11.5.79 max 10.300 mean 10.0 11.5.79 max 10.582 mean 10.5 11.5.300 max 5.120 mean 5.0 11.5.300 max 5.120 mean 9.5 11.5.300 max 5.120 mean 5.0 11.5.300 max 10.380 mean 10.8 11.5.300 max 10.740 mean 10.8 11.5.300 max 10.741 mean 10.7 11.5.80 max 9.460 mean 8.5 11.5.140 max* 5.140 mean 5.1 11.5.140 max* 5.140 mean 10.7 11.5.140 max* 5.140 mean 10.7 11.5.140 max* 5.140 mean 10.3 11.5.140 max* 5.140 mean 10.3 11.5.140 max* 9.689 mean 10.3 11.5.689 max 9.689 mean 9.6	365 589 980 125 739 985 910 580 975 550 3336 975 550 3336 985 740
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1378 1379 1381 1382 1383 1384 1385 1386 1387 1399 1391 1392 1393 1394 1395 1396 1397	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	H GPU 64 COC CSR H	min) min c min min) min c min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.760 max 2.660 max 2.760 max 2.800 max 2.800 max 2.720 max 4.000 max 10.587 max 2.780 max 4.860 max	4.440 mea 11.116 mea 2 3.870 mea 2 4.340 mea 2 4.340 mea 2 4.294 mea 2 5.980 mea 2 5.830 mea 2 5.830 mea 2 5.830 mea 2 5.830 mea 2 5.840 m	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632 n 10.379 n 2.944 n 5.742 n 9.922 n 2.926 n 5.513 n 10.591 n 2.939 n 5.667 n 10.379	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1450 1451 1455 1456 1457 1458 1459 1460 1461 1462 1463 1465 1465	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular Row-Premute	CSR min H min GPU 64 COO min CSR min CSR min	10.340 max*10.390 mean 10.3 10.340 max*10.390 mean 10.3 10.9689 max 9.689 mean 9.6 110.4970 max 4.990 mean 4.9 110.739 max 10.739 mean 10.7 110.579 max 10.390 mean 10.0 110.579 max 10.582 mean 10.5 110.579 max 10.582 mean 10.5 110.835 max*10.838 mean 10.8 110.739 max 10.741 mean 10.7 110.340 maxx 5.140 mean 5.1 110.340 max*10.390 mean 10.3	365 589 980 125 739 985 910 580 975 550 3336 975 550 3336 985 740
1366 1367 1378 1379 1370 1371 1378 1376 1377 1378 1380 1381 1384 1385 1388 1389 1391 1392 1393 1394 1395 1396	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	H GPU 64 COC CSR H	min) min c min) min c min) min c min min c min min c min min) min min c min min) min min min) min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.760 max 2.660 max 2.660 max 2.800 max 2.919 max 4.000 max 2.720 max 4.000 max 4.000 max 4.000 max	4.440 mea 1.11.116 mea 1.3.870 mea 1.4.340 mea 1.4.340 mea 1.4.340 mea 1.4.290 mea 1.4.290 mea 1.4.290 mea 1.4.290 mea 1.4.290 mea 1.5.940 mea 1.5.940 mea 1.5.940 mea 1.5.940 mea 1.5.340	n 4.403 n 11.113 n 3.804 n 4.308 n 12.043 n 3.819 n 4.259 n 11.876 n 3.048 n 5.803 n 8.600 n 2.898 n 5.632 n 10.379 n 2.924 n 9.922 n 2.926 n 5.513 n 10.591 n 2.939 n 5.667 n 10.379	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1459 1451 1455 1456 1457 1458 1459 1460 1461 1462 1463 1466 1467	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular	CSR min H min GPU 64 COO min CSR min H min	10.340 max*10.390 mean 10.3 10.340 max*10.390 mean 10.3 10.689 max 9.689 mean 9.6 11.4.970 max 4.990 mean 4.9 11.5.080 max 9.430 mean 9.4 11.5.080 max 5.090 mean 10.7 11.5.080 max 10.390 mean 10.5 11.5.080 max 5.090 mean 10.5 11.5.030 max 5.120 mean 10.5 11.5.030 max 5.120 mean 10.8 11.5.030 max 9.770 mean 9.5 11.5.030 max 9.770 mean 9.5 11.5.030 max 9.460 mean 8.5 11.5.030 max 9.460 mean 8.5 11.5.140 max* 5.140 mean 10.7 11.5.140 max* 5.140 mean 10.7 11.5.140 max* 5.140 mean 9.6 11.5.140 max* 4.990 mean 4.9 11.5.140 max 4.990 mean 4.9 11.5.140 max 4.990 mean 4.9 11.5.140 max 4.990 mean 9.4 11.5.730 max 4.990 mean 9.4	365 589 980 425 739 985 910 985 975 975 980 425 739
1366 1367 1371 1372 1373 1374 1375 1376 1377 1378 1381 1382 1383 1384 1385 1386 1397 1391 1392 1393 1391 1392 1393 1394 1395 1396 1397	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	H GPU 64 COC CSR CSR	min) min c min) min c min min) min c min min) min c min min) min c min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.760 max 2.760 max 2.800 max 2.760 max 2.160 max 2.760 max 2.800 max 2.760 max 2.800 max 2.760 max 4.800 max 6.000 max	4.440 mea 1.1.116 mea 1.3.870 mea 1.4.340 mea 1.4.340 mea 1.4.340 mea 1.4.340 mea 1.4.290	m 4.403 m 11.113 m 3.804 m 4.308 m 12.043 m 3.819 m 4.259 m 11.876 m 3.048 m 5.803 m 8.600 m 2.898 m 5.632 m 10.379 m 2.944 m 5.742 m 9.922 m 2.926 m 5.513 m 10.591 m 2.939 m 5.667 m 10.379 m 0.000 m 0.000	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451 1455 1456 1457 1458 1459 1460 1461 1462 1463 1464 1465 1466 1467 1466	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular Row-Premute	CSR min H min GPU 64 COO min GSR min Min GPU 64 COO min GSR min Min GPU 64 COO min GSR min Min GPU 64 COO min Min Min GPU 64 COO min Min Min GPU 64 COO min M	10.340 max*10.390 mean 10.3 10.340 max*10.390 mean 10.3 10.689 max 9.689 mean 9.6 11.4.970 max 4.990 mean 4.9 11.739 max 10.739 mean 10.7 11.5.080 max 5.090 mean 10.0 11.5.080 max 5.090 mean 10.0 11.5.730 max 10.380 mean 10.3 11.5.730 max 10.741 mean 10.7 11.5.800 max 5.140 mean 5.0 11.5.140 max* 5.140 mean 10.7 11.5.140 max* 5.140 mean 10.7 11.5.140 max* 9.460 mean 10.7	365 589 980 425 739 985 910 985 975 965 975 980 425 739 980 425 739
1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1378 1379 1381 1382 1383 1384 1385 1389 1390 1391 1392 1393 1394 1395 1396 1397 1398	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	H GPU 64 COC CSR H	min) min c min) min c min min) min c min min) min c min min) min c min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.760 max 2.760 max 2.800 max 2.760 max 2.160 max 2.760 max 2.800 max 2.760 max 2.800 max 2.760 max 4.800 max 6.000 max	4.440 mea 1.11.116 mea 1.3.870 mea 1.4.340 mea 1.4.340 mea 1.4.340 mea 1.4.290 mea 1.4.290 mea 1.4.290 mea 1.4.290 mea 1.4.290 mea 1.5.940 mea 1.5.940 mea 1.5.940 mea 1.5.940 mea 1.5.340	m 4.403 m 11.113 m 3.804 m 4.308 m 12.043 m 3.819 m 4.259 m 11.876 m 3.048 m 5.803 m 8.600 m 2.898 m 5.632 m 10.379 m 2.944 m 5.742 m 9.922 m 2.926 m 5.513 m 10.591 m 2.939 m 5.667 m 10.379 m 0.000 m 0.000	1439 1440 1441 1442 1443 1444 1445 1446 1447 1451 1452 1453 1456 1457 1458 1459 1460 1461 1462 1463 1464 1465 1466 1467 1468 1469 1470 1471	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular Row-Premute	CSR min H min GPU 64 COO min CSR min	10.340 max*10.390 mean 10.3 10.340 max* 10.390 mean 10.3 10.689 max 9.689 mean 9.6 110.739 max 10.739 mean 10.7 110.739 max 10.739 mean 10.7 110.739 max 10.390 mean 10.6 110.579 max 10.300 mean 10.6 110.579 max 10.300 mean 10.6 110.579 max 10.582 mean 10.5 110.835 max*10.838 mean 10.8 110.739 max 10.740 mean 5.0 110.739 max 10.741 mean 10.7 110.340 max* 5.140 mean 5.1 110.340 max* 10.390 mean 10.3 110.340 max* 10.739 mean 10.739 max 10.739 mean 10.739 max 10.739 mean 10.739 mean 10.739 max 10.739 mean 10.739 mean 10.739 max 10.739 mean 10.739 mean 10.739 mean 10.739 mean 10.739 max 10.739 mean 10.73	9865 9880 1425 7739 9885 910 975 9550 9336 975 965 9740 140 965 965 9740 975 975 975 975 975 975 975 977 975 975
1366 1367 1371 1372 1373 1374 1375 1376 1377 1378 1381 1382 1383 1384 1385 1386 1397 1391 1392 1393 1391 1392 1393 1394 1395 1396 1397	Row-Column-Permute shermanACb.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	H GPU 64 COC CSR CSR	min) min c min) min c min min) min c min min) min c min min) min c min min	11.109 max 3.690 max 4.260 max 12.041 max 3.780 max 4.090 max 11.873 max 2.920 max 5.550 max 8.600 max 2.760 max 2.760 max 2.800 max 2.760 max 2.160 max 2.760 max 2.800 max 2.760 max 2.800 max 2.760 max 4.800 max 6.000 max	4.440 mea 1.1.116 mea 1.3.870 mea 1.4.340 mea 1.4.340 mea 1.4.340 mea 1.4.340 mea 1.4.290	m 4.403 m 11.113 m 3.804 m 4.308 m 12.043 m 3.819 m 4.259 m 11.876 m 3.048 m 5.803 m 8.600 m 2.898 m 5.632 m 10.379 m 2.944 m 5.742 m 9.922 m 2.926 m 5.513 m 10.591 m 2.939 m 5.667 m 10.379 m 0.000 m 0.000	1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451 1455 1456 1457 1458 1459 1460 1461 1462 1463 1464 1465 1466 1467 1466	mult_dcop_03.mtx Regular Row-Premute Row-Gradient Column-Gradient Row-Column-Permute mult_dcop_03.mtx Regular Row-Premute	CSR min H min GPU 64 COO min CSR min	10.340 max*10.390 mean 10.3 10.340 max*10.390 mean 10.3 10.689 max 9.689 mean 9.6 11.4.970 max 4.990 mean 4.9 11.739 max 10.739 mean 10.7 11.5.080 max 5.090 mean 10.0 11.5.080 max 5.090 mean 10.0 11.5.730 max 10.380 mean 10.3 11.5.730 max 10.741 mean 10.7 11.5.800 max 5.140 mean 5.0 11.5.140 max* 5.140 mean 10.7 11.5.140 max* 5.140 mean 10.7 11.5.140 max* 9.460 mean 10.7	365 589 980 425 739 985 910 580 550 3336 740 140 365 589 425 739

1473	Column-Gradient		1547	CSR min 6.360 max 7.450 mean 6.711
1474		GPU 64 COO min 5.030 max 5.120 mean 5.075	1548	H min 11.109 max 11.109 mean 11.109
1475		CSR min 9.330 max 9.770 mean 9.550	1549 Row-Premute	
1476		H min 10.835 max*10.838 mean 10.836	1550	GPU 64 COO min 3.950 max* 3.980 mean 3.953
1477	Row-Column-Permute		1551	CSR min 6.330 max 7.400 mean 6.661
1478		GPU 64 COO min 5.000 max 5.010 mean 5.005	1552	H min 11.098 max 11.104 mean 11.101
1479		CSR min 7.580 max 9.460 mean 8.520	1553 Row-Gradient	
1480		H min 10.739 max 10.741 mean 10.740	1554	GPU 64 COO min 3.960 max 3.980 mean 3.961
1481	mult_dcop_03.mtx		1555	CSR min 6.270 max*10.770 mean 7.017
1482	Regular		1556	H min 11.109 max 11.109 mean 11.109
1483		GPU 64 COO min 5.130 max* 5.220 mean 5.142	1557 Column-Gradient	
1484		CSR min 7.250 max* 9.320 mean 7.722	1558	GPU 64 COO min 3.940 max 3.960 mean 3.950
1485		H min 9.689 max 9.689 mean 9.689	1559	CSR min 6.270 max 7.370 mean 6.696
1486	Row-Premute		1560	H min 11.329 max*11.334 mean 11.331
1487	NOW IT CHILD'E	GPU 64 COO min 4.980 max 5.030 mean 4.999	1561 Row-Column-Permute	man rrises maximines mean rriss
1488		CSR min 6.460 max 8.470 mean 6.950	1562	GPU 64 COO min 3.950 max 3.960 mean 3.952
1489		H min 10.738 max 10.742 mean 10.740		CSR min 6.180 max 7.420 mean 6.641
	D	n min 10.738 max 10.742 mean 10.740	1563	
1490	Row-Gradient		1564	H min 11.098 max 11.105 mean 11.101
1491		GPU 64 COO min 5.070 max 5.140 mean 5.088	1565 bloweya.mtx	
1492		CSR min 6.780 max 8.700 mean 7.268	1566 Regular	
1493		H min 10.572 max 10.584 mean 10.580	1567	GPU 64 COO min 0.000 max 0.000 mean 0.000
1494	Column-Gradient		1568	CSR min 0.000 max 0.000 mean 0.000
1495		GPU 64 COO min 4.980 max 5.030 mean 5.010	1569	H min 7.205 max 7.205 mean 7.205
1496		CSR min 6.390 max 7.640 mean 6.982	1570 Row-Premute	
1497		H min 10.825 max*10.845 mean 10.836	1571	GPU 64 COO min 4.020 max 4.030 mean 4.023
1498	Row-Column-Permute		1572	CSR min 6.070 max 6.750 mean 6.340
1499		GPU 64 COO min 4.990 max 5.010 mean 4.997	1573	H min 11.025 max 11.031 mean 11.028
1500		CSR min 6.300 max 7.160 mean 6.636	1574 Row-Gradient	
1501		H min 10.738 max 10.743 mean 10.740	1575	GPU 64 COO min 4.090 max* 4.160 mean 4.111
1502	mult_dcop_01.mtx	11 IIII 10.730 IIIAX 10.743 IIICAN 10.740	1576	CSR min 5.980 max* 7.370 mean 6.678
1503	Regular		1577	H min 10.295 max 10.304 mean 10.300
1504		GPU 64 COO min 5.120 max* 5.140 mean 5.134	1578 Column-Gradient	
1505		CSR min 6.990 max* 9.230 mean 7.546	1579	GPU 64 COO min 3.980 max 4.010 mean 3.995
1506		H min 9.689 max 9.689 mean 9.689	1580	CSR min 5.880 max 6.780 mean 6.295
1507	Row-Premute		1581	H min 10.881 max*10.887 mean 10.883
1508		GPU 64 COO min 4.990 max 5.020 mean 5.004	1582 Row-Column-Permute	
1509		CSR min 6.370 max 7.220 mean 6.771	1583	GPU 64 COO min 4.020 max 4.030 mean 4.023
1510		H min 10.738 max 10.743 mean 10.740	1584	CSR min 5.970 max 6.420 mean 6.183
1511	Row-Gradient		1585	H min 11.025 max 11.033 mean 11.028
1512		GPU 64 COO min 5.060 max 5.100 mean 5.082	1586 lp_osa_07.mtx	
1513		CSR min 6.730 max 7.720 mean 7.317	1587 Regular	
1514		H min 10.574 max 10.585 mean 10.580	1588	GPU 64 COO min 4.260 max* 4.270 mean 4.261
1515	Column-Gradient		1589	CSR min 6.440 max 7.640 mean 6.863
1516	cordiiii or darciic	GPU 64 COO min 4.980 max 5.100 mean 5.012	1590	H min 8.412 max 8.412 mean 8.412
1517		CSR min 6.580 max 7.510 mean 7.054	1591 Row-Premute	11 IIII 0.412 IIIAX 0.412 IIICAII 0.412
1517				GPU 64 COO min 4.200 max 4.200 mean 4.200
	D	H min 10.828 max*10.842 mean 10.835	1592	
1519	Row-Column-Permute	CDU 54 000 - '- 4 070 5 000 4 005	1593	CSR min 6.020 max 7.030 mean 6.418
1520		GPU 64 COO min 4.970 max 5.000 mean 4.986	1594	H min 9.255 max 9.257 mean 9.256
1521		CSR min 6.390 max 7.050 mean 6.677	1595 Row-Gradient	
1522		H min 10.738 max 10.742 mean 10.740		
1523		H min 10.738 max 10.742 mean 10.740	1596	GPU 64 COO min 4.210 max 4.240 mean 4.226
	mult_dcop_02.mtx	11 III 10.736 IIIAX 10.742 IIICAN 10.746	1597	CSR min 6.070 max*10.050 mean 6.498
1524	Regular		1597 1598	
1524		GPU 64 COO min 5.120 max 5.140 mean 5.133	1597	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671
			1597 1598	CSR min 6.070 max*10.050 mean 6.498
1525		GPU 64 COO min 5.120 max 5.140 mean 5.133	1597 1598 1599 Column-Gradient	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671
1525 1526		GPU 64 COO min 5.120 max 5.140 mean 5.133 CSR min 6.950 max 7.590 mean 7.336	1597 1598 1599 Column-Gradient 1600	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 max 4.190 mean 4.180
1525 1526 1527	Regular	GPU 64 COO min 5.120 max 5.140 mean 5.133 CSR min 6.950 max 7.590 mean 7.336	1597 1598 1599 Column-Gradient 1600 1601	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 max 4.190 mean 4.180 CSR min 5.610 max 7.300 mean 5.988
1525 1526 1527 1528 1529	Regular	GPU 64 COO min 5.120 max 5.140 mean 5.133 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	1597 1598 1599 Column-Gradient 1600 1601 1602 1603 Row-Column-Permute	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 max 4.190 mean 4.180 CSR min 5.610 max 7.300 mean 5.988
1525 1526 1527 1528 1529 1530	Regular	GPU 64 COO min 5.120 max 5.140 mean 5.133 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	1597 1598 1599 Column-Gradient 1600 1601 1602 1603 Row-Column-Permute	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 max 4.190 mean 4.180 CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585
1525 1526 1527 1528 1529 1530 1531	Regular Row-Premute	GPU 64 C00 min 5.120 max 5.140 mean 5.133 CSR min 6.950 max 7.590 mean 7.336 H min 9.689 max 9.689 mean 9.689 GPU 64 C00 min 4.970 max 4.990 mean 4.984 CSR min 6.440 max 7.110 mean 6.719	1597 1598 1599 Column-Gradient 1600 1601 1602 1603 Row-Column-Permute 1604	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 max 4.190 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
1525 1526 1527 1528 1529 1530 1531 1532	Regular	GPU 64 COO min 5.120 max 5.140 mean 5.133 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	1597 1598 1599 Column-Gradient 1600 1601 1602 1603 Row-Column-Permute 1604 1605	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 max 4.190 mean 4.180
1525 1526 1527 1528 1529 1530 1531 1532 1533	Regular Row-Premute	GPU 64 COO min 5.120 max 5.140 mean 5.133 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	1597 1598 1599 Column-Gradient 1600 1601 1602 1603 Row-Column-Permute 1604 1605 1606 1607 ex19.mtx	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 max 4.190 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
1525 1526 1527 1528 1529 1530 1531 1532 1533 1534	Regular Row-Premute	GPU 64 COO min 5.120 max 5.140 mean 5.133 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	1597 1598 1599 Column-Gradient 1600 1601 1602 1603 Row-Column-Permute 1604 1605 1606 1607 ex19.mtx 1608 Regular	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 max 4.190 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
1525 1526 1527 1528 1529 1530 1531 1532 1533 1534 1535	Regular Row-Premute Row-Gradient	GPU 64 COO min 5.120 max 5.140 mean 5.133 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	1597 1598 1599 Column-Gradient 1600 1601 1602 1603 Row-Column-Permute 1604 1605 1606 1607 ex19.mtx 1608 Regular	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 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
1525 1526 1527 1528 1529 1530 1531 1532 1533 1534 1535	Regular Row-Premute	GPU 64 COO min 5.120 max 5.140 mean 5.133 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	1597 1598 1599 Column-Gradient 1600 1601 1602 1603 Row-Column-Permute 1604 1605 1606 1607 ex19.mtx 1608 Regular 1609	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 CPU 64 COO min 4.170 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 CPU 64 COO min 4.190 max 7.000 mean 6.386 H min 9.255 max 9.257 mean 9.256 CPU 64 COO min 6.140 max* 6.180 mean 6.159 CSR min 12.780 max*14.400 mean 13.328
1525 1526 1527 1528 1529 1530 1531 1532 1533 1534 1535 1536	Regular Row-Premute Row-Gradient	GPU 64 COO min 5.120 max 5.140 mean 5.133 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	1597 1598 1599 Column-Gradient 1600 1601 1602 Row-Column-Permute 1604 1605 1606 ex19.mtx 1608 Regular 1609	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 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
1525 1526 1527 1528 1529 1530 1531 1532 1533 1534 1535	Regular Row-Premute Row-Gradient	GPU 64 COO min 5.120 max 5.140 mean 5.133 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	1597 1598 1599	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 max 4.190 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
1525 1526 1527 1528 1529 1530 1531 1532 1533 1534 1535 1536	Regular Row-Premute Row-Gradient	GPU 64 COO min 5.120 max 5.140 mean 5.133 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	1597 1598 1599 Column-Gradient 1600 1601 1602 Row-Column-Permute 1604 1605 1606 ex19.mtx 1608 Regular 1609	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 CPU 64 COO min 4.170 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 CPU 64 COO min 4.190 max 7.000 mean 6.386 H min 9.255 max 9.257 mean 9.256 CPU 64 COO min 6.140 max* 6.180 mean 6.159 CSR min 12.780 max*14.400 mean 13.328
1525 1526 1527 1528 1529 1530 1531 1532 1533 1534 1535 1536 1537 1538	Regular Row-Premute Row-Gradient	GPU 64 COO min 5.120 max 5.140 mean 5.133 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	1597 1598 1599	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 max 4.190 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
1525 1526 1527 1528 1529 1530 1531 1532 1533 1534 1535 1536 1537 1538	Row-Premute Row-Gradient Column-Gradient	GPU 64 COO min 5.120 max 5.140 mean 5.133 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	1597 1598 1599 Column-Gradient 1600 1601 1602 1603 Row-Column-Permute 1604 1605 1606 1607 ex19.mtx 1608 Regular 1609 1610 1611 1612 Row-Premute	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 max 4.190 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
1525 1526 1527 1528 1529 1530 1531 1532 1533 1534 1535 1536 1537 1538 1539 1540	Row-Premute Row-Gradient Column-Gradient	GPU 64 COO min 5.120 max 5.140 mean 5.133 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	1597 1598 1599	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 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
1525 1526 1527 1528 1529 1530 1531 1532 1533 1534 1535 1536 1537 1538 1539 1540	Row-Premute Row-Gradient Column-Gradient	GPU 64 COO min 5.120 max 5.140 mean 5.133 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	1597 1598 1599	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 4.190 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
1525 1526 1527 1528 1529 1530 1531 1532 1533 1534 1535 1536 1537 1538 1539 1540 1541	Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	GPU 64 COO min 5.120 max 5.140 mean 5.133 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 GPU 64 COO min 4.970 max 5.050 mean 4.983 CSR min 6.440 max 7.380 mean 6.779	1597 1598 1599 Column-Gradient 1600 1601 1602 1603 Row-Column-Permute 1604 1605 1606 1607 ex19.mtx 1608 Regular 1609 1610 1611 1612 Row-Premute 1613 1614 1615 1616 Row-Gradient 1617	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 max 4.190 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 6.100 max 7.300 mean 6.386 H min 9.255 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
1525 1526 1527 1528 1529 1530 1531 1532 1533 1534 1535 1536 1537 1538 1539 1540 1541 1542	Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	GPU 64 COO min 5.120 max 5.140 mean 5.133 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 GPU 64 COO min 4.970 max 5.050 mean 4.983 CSR min 6.440 max 7.380 mean 6.779	1597 1598 1599 Column-Gradient 1600 1601 1602 Row-Column-Permute 1604 1605 1606 1607 ex19.mtx 1608 Regular 1609 1610 1611 1612 Row-Premute 1613 1614 1615 1616 Row-Gradient 1617 1618	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 max 4.190 mean 4.180 CSR min 5.610 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 6.190 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 GPU 64 COO min 6.070 max 6.120 mean 6.104 CSR min 11.290 max 6.120 mean 6.104
1525 1526 1527 1528 1529 1530 1531 1532 1533 1534 1535 1536 1537 1538 1539 1540 1541 1542	Row-Premute Row-Gradient Column-Gradient Row-Column-Permute	GPU 64 COO min 5.120 max 5.140 mean 5.133 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 GPU 64 COO min 4.970 max 5.050 mean 4.983 CSR min 6.440 max 7.380 mean 6.779	1597 1598 1599 Column-Gradient 1600 1601 1602 1603 Row-Column-Permute 1604 1605 1606 1607 ex19.mtx 1608 Regular 1609 1610 1611 1612 Row-Premute 1613 1614 1615 1616 Row-Gradient 1617	CSR min 6.070 max*10.050 mean 6.498 H min 8.607 max 8.678 mean 8.671 GPU 64 COO min 4.170 max 7.300 mean 5.988 H min 9.534 max* 9.601 mean 9.585 GPU 64 COO min 6.100 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 10.372 H min 11.836 max 11.840 mean 11.838 GPU 64 COO min 6.070 max 6.120 mean 6.104 CSR min 11.290 max 6.120 mean 6.104

1621		GPU 64 COO min 5.760 max 5.840 mean 5.813	1695	H min 7.380 max 7.380 mean 7.380
1622		CSR min 9.710 max 14.220 mean 10.376	1696 Row-Premute	
1623		H min 11.873 max*11.882 mean 11.878	1697	GPU 64 COO min 4.130 max 4.170 mean 4.134
1624	Row-Column-Permute		1698	CSR min 6.180 max* 9.200 mean 6.796
1625		GPU 64 COO min 5.810 max 5.860 mean 5.838	1699	H min 10.041 max 10.046 mean 10.044
1626		CSR min 9.920 max 10.820 mean 10.240	1700 Row-Gradient	
1627		H min 11.836 max 11.841 mean 11.838	1701	GPU 64 COO min 4.150 max* 4.220 mean 4.163
1628	brainpc2.mtx		1702	CSR min 6.410 max 7.500 mean 6.816
1629	Regular		1703	H min 9.682 max 9.706 mean 9.693
1630		GPU 64 COO min 0.000 max 0.000 mean 0.000	1704 Column-Gradient	
1631		CSR min 0.000 max 0.000 mean 0.000	1705	GPU 64 COO min 4.080 max 4.110 mean 4.096
1632		H min 7.478 max 7.478 mean 7.478	1706	CSR min 6.020 max 7.220 mean 6.309
1633	Row-Premute		1707	H min 10.597 max*10.658 mean 10.631
1634		GPU 64 COO min 4.760 max 4.790 mean 4.773	1708 Row-Column-Permute	
1635		CSR min 6.930 max 7.780 mean 7.310	1709	GPU 64 COO min 4.120 max 4.140 mean 4.130
1636		H min 9.810 max 9.813 mean 9.811	1710	CSR min 6.210 max 7.200 mean 6.609
1637	Row-Gradient		1711	H min 10.041 max 10.046 mean 10.044
1638		GPU 64 COO min 4.820 max* 4.840 mean 4.831	1712 TSOPF_FS_b9_c6.mtx	
1639		CSR min 7.220 max 8.290 mean 7.583	1713 Regular	
1640		H min 9.721 max 9.725 mean 9.723	1714	GPU 64 COO min 0.000 max 0.000 mean 0.000
1641	Column-Gradient		1715	CSR min 0.000 max 0.000 mean 0.000
1642		GPU 64 COO min 4.760 max 4.820 mean 4.779	1716	H min 7.380 max 7.380 mean 7.380
1643		CSR min 6.870 max* 8.300 mean 7.393	1717 Row-Premute	
1644	D	H min 10.368 max*10.373 mean 10.370	1718	GPU 64 COO min 4.120 max 4.140 mean 4.129
1645	Row-Column-Permute	CDU 64 000 - 1 4 750 - 1 7 700 - 1 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	1719	CSR min 6.170 max 7.160 mean 6.664
1646		GPU 64 COO min 4.750 max 4.780 mean 4.765 CSR min 6.940 max 7.580 mean 7.298	1720	H min 10.041 max 10.045 mean 10.043
1647			1721 Row-Gradient	CDU 64 000 min 4 150 mm 4 100 mm 4 160
1648	shermanACb.mtx	H min 9.809 max 9.814 mean 9.811	1722	GPU 64 COO min 4.150 max* 4.180 mean 4.162 CSR min 6.420 max 7.360 mean 6.723
1649			1723	
1650	Regular	CDU 64 000 4 000 4 120 4 110	1724	H min 9.682 max 9.706 mean 9.693
1651 1652		GPU 64 COO min 4.090 max* 4.130 mean 4.112 CSR min 6.320 max* 7.200 mean 6.779	1725 Column-Gradient 1726	GPU 64 COO min 4.080 max 4.120 mean 4.096
1653		H min 8.600 max 8.600 mean 8.600	1726	CSR min 5.880 max 7.090 mean 6.403
1654	Row-Premute	n min 8.000 max 8.000 mean 8.000	1727	H min 10.611 max*10.660 mean 10.637
1655	ROW-PT elliute	GPU 64 COO min 4.020 max 4.050 mean 4.036	1729 Row-Column-Permute	n IIIII 10.611 IIIax*10.660 IIIean 10.637
1656		CSR min 5.670 max 6.460 mean 6.014	1730 ROW-COTUMN-PET MICE	GPU 64 COO min 4.130 max 4.140 mean 4.130
1657		H min 10.376 max 10.382 mean 10.379	1731	CSR min 6.330 max* 7.390 mean 6.695
1658	Row-Gradient	11 IIII1 10.370 IIIAX 10.302 IIIEAII 10.379	1732	H min 10.042 max 10.047 mean 10.044
1659	NOW-GI AUTEIIL	GPU 64 COO min 4.050 max 4.100 mean 4.074	1733 OPF_6000.mtx	11 IIII1 10.042 IIIAX 10.047 IIIEAN 10.044
1660		CSR min 5.580 max 6.420 mean 5.996	1734 Regular	
1661		H min 9.918 max 9.924 mean 9.921	1735	GPU 64 COO min 7.270 max* 7.370 mean 7.293
1662	Column-Gradient	11 IIII 5.510 IIIAX 5.524 IIICAN 5.521	1736	CSR min 12.890 max*14.500 mean 13.566
1663	COTAMIN GLAGIETTE	GPU 64 COO min 4.010 max 4.080 mean 4.033	1737	H min 8.799 max 8.799 mean 8.799
1664		CSR min 0.000 max 6.320 mean 5.527	1738 Row-Premute	11 11211 0.733 max 0.733 medi 0.733
1665		H min 10.543 max*10.595 mean 10.589	1739	GPU 64 COO min 6.640 max 6.720 mean 6.678
1666	Row-Column-Permute		1740	CSR min 9.680 max 11.600 mean 10.040
1667		GPU 64 COO min 4.020 max 4.050 mean 4.036	1741	H min 11.873 max 11.877 mean 11.875
1668		CSR min 5.670 max 6.510 mean 6.092	1742 Row-Gradient	
1669		H min 10.377 max 10.381 mean 10.379	1743	GPU 64 COO min 7.090 max 7.140 mean 7.122
1670	cvxqp3.mtx		1744	CSR min 11.250 max 13.030 mean 12.142
1671	Regular		1745	H min 11.110 max 11.117 mean 11.114
1672		GPU 64 COO min 3.500 max* 3.540 mean 3.501	1746 Column-Gradient	
1673		CSR min 11.860 max*13.100 mean 12.694	1747	GPU 64 COO min 6.590 max 6.710 mean 6.644
1674		H min 8.646 max 8.646 mean 8.646	1748	CSR min 9.400 max 13.140 mean 9.991
1675	Row-Premute		1749	H min 12.040 max*12.046 mean 12.043
1676		GPU 64 COO min 3.360 max 3.370 mean 3.365	1750 Row-Column-Permute	
1677		CSR min 6.210 max 7.610 mean 6.631	1751	GPU 64 COO min 6.640 max 6.710 mean 6.679
1678		H min 11.027 max 11.032 mean 11.030	1752	CSR min 9.690 max 10.740 mean 10.050
1679	Row-Gradient		1753	H min 11.874 max 11.877 mean 11.875
1680		GPU 64 COO min 3.370 max 3.380 mean 3.376	1754 OPF_3754.mtx	
1681		CSR min 6.170 max 7.070 mean 6.499	1755 Regular	
1682		H min 11.059 max 11.068 mean 11.064	1756	GPU 64 COO min 4.430 max* 4.450 mean 4.443
1683	Column-Gradient		1757	CSR min 9.710 max*13.000 mean 11.377
1684		GPU 64 COO min 3.350 max 3.390 mean 3.371	1758	H min 8.393 max 8.393 mean 8.393
1685		CSR min 6.150 max 7.180 mean 6.531	1759 Row-Premute	
1686		H min 11.125 max*11.133 mean 11.130	1760	GPU 64 COO min 4.230 max 4.250 mean 4.240
1687	Row-Column-Permute		1761	CSR min 7.430 max 8.750 mean 7.986
1688		GPU 64 COO min 3.350 max 3.380 mean 3.364	1762	H min 11.266 max 11.272 mean 11.269
1689		CSR min 6.040 max 7.440 mean 6.603	1763 Row-Gradient	
1690		H min 11.028 max 11.033 mean 11.030	1764	GPU 64 COO min 4.370 max 4.420 mean 4.382
1691	case9.mtx		1765	CSR min 8.160 max 9.470 mean 8.682
1692	Regular		1766	H min 10.462 max 10.473 mean 10.468
1693		GPU 64 COO min 0.000 max 0.000 mean 0.000	1767 Column-Gradient	ONU 64 000 mile 4 010
1694		CSR min 0.000 max 0.000 mean 0.000	1768	GPU 64 COO min 4.210 max 4.240 mean 4.227

1769		CSR min 7.160 max 8.080 mean 7.595	1843 Row-Premute	
1770		H min 11.394 max*11.401 mean 11.398	1844	GPU 64 COO min 10.340 max 10.430 mean 10.362
1771	Row-Column-Permute	11 IIII 11.354 IIIAX^11.401 IIIEAN 11.356	1845	CSR min 12.880 max 13.340 mean 13.057
1772	KOW-COIUIIII-FEI IIIULE	GPU 64 COO min 4.230 max 4.250 mean 4.243	1846	H min 10.777 max 10.778 mean 10.777
				n min 10.777 max 10.778 mean 10.777
1773		CSR min 7.230 max 8.940 mean 8.056	1847 Row-Gradient	CDU C4 COO'- 10 CEO10 740 10 COO
1774	47	H min 11.264 max 11.271 mean 11.269	1848	GPU 64 COO min 10.650 max*10.740 mean 10.688
1775	c-47.mtx		1849	CSR min 12.310 max 13.670 mean 12.562 H min 11.247 max 11.300 mean 11.281
1776	Regular	CDU C4 CCC/- F 220 F 240 F 220	1850	H min 11.247 max 11.300 mean 11.281
1777		GPU 64 COO min 5.320 max* 5.340 mean 5.329	1851 Column-Gradient	
1778		CSR min 8.890 max* 9.590 mean 9.249	1852	GPU 64 COO min 10.340 max 10.440 mean 10.398
1779		H min 8.364 max 8.364 mean 8.364	1853	CSR min 9.480 max 10.110 mean 9.782
1780	Row-Premute		1854	H min 12.023 max*12.069 mean 12.047
1781		GPU 64 COO min 5.240 max 5.250 mean 5.241	1855 Row-Column-Permute	
1782		CSR min 7.790 max 8.890 mean 8.214	1856	GPU 64 COO min 10.330 max 10.380 mean 10.356
1783		H min 10.059 max 10.063 mean 10.061	1857	CSR min 12.840 max 13.530 mean 13.119
1784	Row-Gradient		1858	H min 10.776 max 10.778 mean 10.777
1785		GPU 64 COO min 5.230 max 5.260 mean 5.242	1859 aft01.mtx	
1786		CSR min 7.080 max 8.050 mean 7.673	1860 Regular	
1787		H min 10.206 max 10.226 mean 10.218	1861	GPU 64 COO min 3.680 max* 3.690 mean 3.688
1788	Column-Gradient		1862	CSR min 13.860 max*14.830 mean 14.560
1789		GPU 64 COO min 5.080 max 5.120 mean 5.105	1863	H min 7.811 max 7.811 mean 7.811
1790		CSR min 5.780 max 6.970 mean 6.359	1864 Row-Premute	
1791		H min 11.205 max*11.233 mean 11.222	1865	GPU 64 COO min 3.510 max 3.530 mean 3.513
1792	Row-Column-Permute		1866	CSR min 6.420 max 10.520 mean 7.265
1793		GPU 64 COO min 5.220 max 5.250 mean 5.227	1867	H min 11.161 max*11.170 mean 11.165
1794		CSR min 7.860 max 8.710 mean 8.247	1868 Row-Gradient	
1795		H min 10.059 max 10.064 mean 10.061	1869	GPU 64 COO min 3.630 max 3.670 mean 3.643
1796	mhd4800a.mtx		1870	CSR min 10.760 max 13.510 mean 12.199
1797	Regular		1871	H min 10.248 max 10.265 mean 10.258
1798		GPU 64 COO min 3.090 max* 3.100 mean 3.098	1872 Column-Gradient	
1799		CSR min 11.570 max*12.290 mean 12.092	1873	GPU 64 COO min 3.510 max 3.520 mean 3.519
1800		H min 7.132 max 7.132 mean 7.132	1874	CSR min 6.490 max 11.230 mean 7.645
1801	Row-Premute		1875	H min 11.112 max 11.121 mean 11.117
1802	NOW I I CIIIGEE	GPU 64 COO min 3.020 max 3.020 mean 3.020	1876 Row-Column-Permute	II IIII II.IIZ IIIdx III.IZI IIIcdii II.II7
1803		CSR min 5.560 max 7.270 mean 6.007	1877	GPU 64 COO min 3.510 max 3.540 mean 3.515
1804		H min 10.959 max*10.968 mean 10.963		CSR min 6.510 max 11.650 mean 7.311
1805	Daw Candinat	n	1878	
	Row-Gradient	CDU C4 COO/- 2 COO 2 100 2 000	1879	H min 11.161 max 11.168 mean 11.165
1806		GPU 64 COO min 3.080 max 3.100 mean 3.088	1880 TSOPF_RS_b39_c7.mtx	
1807		CSR min 10.250 max 12.150 mean 11.340	1881 Regular	
1808		H min 9.509 max 9.528 mean 9.520	1882	GPU 64 COO min 5.970 max* 6.010 mean 5.988
1809	Column-Gradient		1883	CSR min 12.470 max*21.120 mean 13.816
1810		GPU 64 COO min 3.020 max 3.050 mean 3.026	1884	H min 7.304 max 7.304 mean 7.304
1811		CSR min 5.530 max 10.580 mean 6.432	1885 Row-Premute	
1812		H min 10.933 max 10.946 mean 10.939	1886	GPU 64 COO min 5.840 max 5.870 mean 5.856
1813	Row-Column-Permute		1887	CSR min 10.780 max 15.810 mean 11.425
1814		GPU 64 COO min 3.020 max 3.020 mean 3.020	1888	H min 10.537 max 10.540 mean 10.539
1815		CSR min 5.510 max 6.830 mean 6.136	1889 Row-Gradient	
1816		H min 10.959 max 10.967 mean 10.963	1890	GPU 64 COO min 5.950 max 6.000 mean 5.975
1817	gen4.mtx		1891	CSR min 11.520 max 17.250 mean 12.799
1818	Regular		1892	H min 9.638 max 9.646 mean 9.641
1819		GPU 64 COO min 3.300 max* 3.320 mean 3.308	1893 Column-Gradient	
1820		CSR min 5.250 max 6.340 mean 5.705	1894	GPU 64 COO min 5.790 max 5.860 mean 5.827
1821		H min 9.234 max 9.234 mean 9.234	1895	CSR min 10.500 max 14.080 mean 11.237
1822	Row-Premute		1896	H min 11.128 max*11.223 mean 11.209
1823		GPU 64 COO min 3.290 max 3.310 mean 3.299	1897 Row-Column-Permute	
1824		CSR min 5.190 max 7.420 mean 5.683	1898	GPU 64 COO min 5.850 max 5.870 mean 5.855
1825		H min 10.249 max 10.254 mean 10.252	1899	CSR min 10.790 max 15.250 mean 11.718
1826	Row-Gradient		1900	H min 10.537 max 10.541 mean 10.539
1827		GPU 64 COO min 3.300 max 3.310 mean 3.301	1901 mult_dcop_03.mtx	
1828		CSR min 5.370 max 6.310 mean 5.659	1902 Regular	
1829		H min 9.934 max 9.958 mean 9.948	1903	GPU 64 COO min 5.130 max* 5.220 mean 5.142
1830	Column-Gradient	11 IIII 3.334 IIIAX 3.330 IIICAN 3.340	1904	CSR min 7.250 max* 9.320 mean 7.722
1831		GPU 64 COO min 3.240 max 3.260 mean 3.249	1905	H min 9.689 max 9.689 mean 9.689
1832		CSR min 5.090 max* 8.660 mean 5.546	1906 Row-Premute	mil. 3.003 max 3.003 mean 3.003
1832		H min 10.853 max*10.873 mean 10.864	1906 KOW-Premute 1907	GPU 64 COO min 4.980 max 5.030 mean 4.999
	David Calling David	ווווו בכס.שו וווווו מא mean וווווווווווווווווווווווווווווווווווו		
1834	Row-Column-Permute	CDII 64 COO min 2 200 min	1908	CSR min 6.460 max 8.470 mean 6.950
1835		GPU 64 COO min 3.290 max 3.320 mean 3.296	1909	H min 10.738 max 10.742 mean 10.740
1836		CSR min 5.190 max 7.550 mean 5.659	1910 Row-Gradient	CDU 64 000/- F 070
1837		H min 10.249 max 10.255 mean 10.252	1911	GPU 64 COO min 5.070 max 5.140 mean 5.088
1838	Maragal_6.mtx		1912	CSR min 6.780 max 8.700 mean 7.268
1839	Regular		1913	H min 10.572 max 10.584 mean 10.580
1840		GPU 64 COO min 10.580 max 10.620 mean 10.599	1914 Column-Gradient	
1841		CSR min 15.620 max*16.470 mean 15.832	1915	GPU 64 COO min 4.980 max 5.030 mean 5.010
1841 1842				GPU 64 COO min 4.980 max 5.030 mean 5.010 CSR min 6.390 max 7.640 mean 6.982

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