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High Performance Computing
Homework 3 - Question 5

      "Sparse matrix-vector multiplication on GPGPU clusters: A new storage format and a scalable implementation" was published at the 2012 IEEE 26th International Parallel and Distributed Processing Symposium Workshops & PhD Forum. This paper proposes a novel "padded jagged diagonals" (pJDS) format. This format was designed to reduce memory overhead inherent to ELLPACK-R, without making assumptions about the matrix's structure. Compared to ELLPACK-R, jPDS reduced the memory footprint by up to 70% while obtaining about 91-130% of the performance.  pJDS also had a 3.9-58% data reduction compared to a compressed row storage format. While CSR and CSC provide better performance on multicore CPUs, jPDS has major speedup benefits when employed on a GPU accelerator similar to ELLPACK. However, instead of achieving this by padding rows for a fixed length, rows are sorted in decreasing number of nonzeros and padded efficiently in blocks using the longest (top) row as seen below:
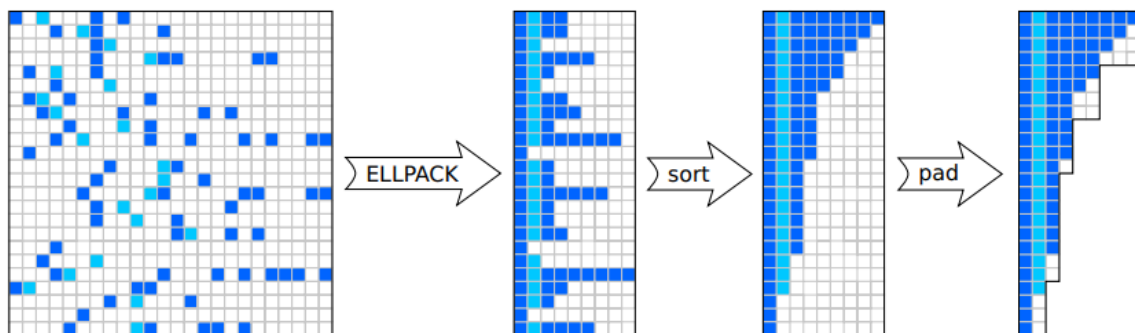


Figure 1: Derivation of the pJDS format from a sparse matrix. In the pJDS format a blocking size of $b_r = 4$ is used.

Figure 1. jPDS Format Visual

Source:

https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6270844