**Homework #12**

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In comparing the performance of CuPy and NumPy for solving a large system of 30,000 by 30,000 equations, it is evident that CuPy significantly outperforms NumPy as shown in Table 1. CuPy required approximately 4.68 seconds to create matrices and solve the system, whereas NumPy took about 12.89 seconds. This substantial reduction in time, with CuPy being almost three times faster, underscores its efficiency in handling large-scale computations while obtaining the same result as can be seen in the vector ***u:*** in Figure 1 and Figure 2. The speed-up factor of approximately 2.75 highlights the benefits of leveraging GPU acceleration, as CuPy does, over traditional CPU-based computations like those performed by NumPy. This advantage is particularly crucial in numerical computing, where operations involve large matrices. Organizations involved in large-scale data computations may find it beneficial to integrate GPU-accelerated libraries such as CuPy into their workflows to optimize performance.

Table 1 - Performance analysis.



A computer screen with white text

Description automatically generated

Figure 1 - Cupy output.

A computer screen shot of numbers and letters

Description automatically generated

Figure 2 - Numpy output.

In conclusion, for tasks that demand high computational efficiency and involve heavy matrix operations, CuPy is highly recommended due to its effective use of GPU resources, leading to quicker computation times compared to CPU-based alternatives.