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CS 3010.02

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Problem Solution and Comparison of Naive vs. SPP Gaussian Elimination in Program

I originally hypothesized that Naive Gaussian would be faster and more efficient for matrices with a smaller size. However, as the size of the matrix would increase, the Scaled Partial Pivoting Gaussian elimination technique would become more efficient and less error prone.

I went on to test this hypothesis with my program with 3 separate matrices. First matrix would be of small size (3 x 3), second would be of medium size (6 x 6), and third would be of large size (9 x 9).

I have recorded the performance of both naive and spp gaussian techniques in the following table. I’ve also included the average time it took the program to come up with the answer in milliseconds (total of 5 runs each technique).

|  |  |  |
| --- | --- | --- |
|  | Naive Gaussian (Avg. time of 5 runs) | SPP Gaussian (Avg. time of 5 runs |
| Small (3 x 3):  3 4 3  1 5 -1  6 3 7  10 7 15 | 44.6 milliseconds | 46 milliseconds |
| Medium (6 x 6):  1 2 -2 1 3 -1  2 -1 1 2 1 -3  1 3 -3 -1 2 1  5 2 -1 -1 2 1  -3 -1 2 3 1 3  4 3 1 -6 -3 2  4 20 -15 -3 16 -27 | 69.6 milliseconds | 54.6 milliseconds |
| Large (9 x 9):  3 9 9 6 2 4 2 5 4  5 6 6 8 6 2 9 3 7  8 9 2 2 3 10 3 5 7  2 8 5 3 2 10 2 2 2  9 4 5 3 7 5 3 4 4  1 4 9 2 9 1 4 6 8  7 5 5 1 8 8 6 7 6  2 2 5 3 2 2 1 4 5  9 2 3 2 10 3 6 9 5  1 7 8 1 6 7 7 2 2 | 87.2 milliseconds | 52.4 milliseconds |

From these results, we can gather that my original hypothesis was correct. As the size of the matrix increases, the speed of finding a solution for the naive gaussian method gets overtaken by the SPP method which becomes faster and faster.

This is because with the SPP method, the equation with the greatest value is chosen to minimize the error and speed up execution. Thus, maximizing (Aik/Akk) in Aij = Aij - (Aik/Akk)Akj where most of the error comes from.

As for the solution to the linear system provided online, the following was the solution derived:

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0.0001 -5.0300 5.8090 7.8320

2.2660 1.9950 1.2120 8.0080

8.8500 5.6810 4.5520 1.3020

6.7750 -2.2530 2.9080 3.9700

9.5740 7.2190 5.7300 6.2910

Solution:

X1 = -2239910.5146211335

X2 = -17.520077378294843

X3 = 22.46334123552319

X4 = 1.9087733672288154