

HPC HW 6

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The code is used to simply evaluate

$$\int_{-1}^1 \int_{-1}^1 f(x, y) dx dy = \int_{-1}^1 \int_{-1}^1 \frac{9}{4} x^2 y^2 dx dy \quad (1)$$

The method used is a simple rectangle rule. The number of intervals taken on each side are 240,000. The code ends up having to evaluate two massive loops. The most optimal way to parallelize this was found to be to use SIMD and to collapse two loops into one. Using SIMD also takes approximately similar time. Serial evaluation takes about 37.2 seconds and parallel evaluation with 12 threads takes about 9 seconds. SIMD with collapsing takes about 1.7 seconds.

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An algorithm to evaluate the mass matrix, which is a diagonal matrix, each of whose diagonal elements would be evaluated by an integral can be evaluated in a similar manner. The integrals can be evaluated like this and then writing the values can be distributed between cores.

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The number of intervals in the example of Part 2 is reduced to 24000 (In order to make the forking prominent for the example. In actual applications this need not be done). The algorithm used is :

- 1) First measure the time taken for both loops to operate no. Here, the process has forked and joined once.
- 2) Then, divide the first loop into two equal parts and parallelize each part separately. Here, the process has forked and joined twice.
- 3) Subtracting these two times, we get the forking time.

Here, the time taken for 1st parallel setup was 2.8755 seconds. The time taken for 2nd parallel setup was 3.142 seconds. Thus, the difference between the two is 0.2665 seconds.