1 Matrix multiplication

Implement a parallel version of a matrix multiplication function (assume matrices with fixed sizes) with parallel tasks. Experiment with placing tasks at the cell and line level.

Use the incomplete file *matrix_multiplication.c* available in the source code, as a basis.

2 Quick Sort

Write a OpenMP program that sorts an array using quick sort with tasks. The size of the array can be fixed, and the array global. The decision on the pivot is irrelevant (e.g. take the first). Determine the time it takes to perform the sorting, and compare it to the sequential implementation.

Use the incomplete file *quick_sort.c* available in the source code, as a basis.

3 Area of Mandelbrot Set

The Mandelbrot Set is the set of complex numbers c for which the iteration $z = z^2 + c$ does not diverge. To determine (approximately) whether a point c belongs in the set, a finite number of iterations are performed, and if the condition $|z| > 2$ is satisfied then the point is considered to be outside the Set.

There is no known theoretical value to calculate the area of the set, but approaches exist to calculate estimates. The supplied program performs a sequential algorithm for this estimation. The method generates a grid of points in a box containing the upper half of the (symmetric) Mandelbrot Set. Then each point is iterated using the equation above a finite number of times. If within that number of iterations the threshold condition $|z| > 2$ is satisfied then that point is considered to be outside of the Mandelbrot Set. Then counting the number of points within the Set and those outside will give an estimate of the area of the Set.

Parallelize the calculation of the estimate of the area of the Mandelbrot Set with tasks. Compare the time to perform the calculation with the sequential and the provided worksharing implementation.

Use the incomplete file *mandelbrot.c* available in the source code, as a basis.

4 Cholesky decomposition

The Cholesky decomposition is a decomposition of a matrix into the product of a lower triangular matrix and its transpose. It is widely used in numerical methods, such as Monte Carlo Simulations.

Taking as a basis the provided parallel code (with worksharing constructs) of the Cholesky decomposition, available in the file *cholesky.c*, implement parallel versions (with blocks) which use tasks, with and without dependencies. Compare the time to perform the calculation among the different versions.

5 Gauss-seidel method

The Gauss–Seidel method, is an iterative method to solve systems of linear equations. The relevant aspect of the method is that in each iteration, instead of using only values from the previous iteration, it uses values already updated in the current iteration. Therefore, programs implementing the method, introduce loop iteration dependencies.

Taking as a basis the provided sequential code of the Gauss–Seidel method, in the file *heat.c*, implement a parallel version which uses task dependencies.