

# Assignment 3

Write a parallel OpenMP program computing the norm of the product of two  $n \times n$  dense matrices on a p-processor SMP so that

- p threads are involved in the parallel computations.
- The 1-dimensional parallel algorithm of matrix multiplication is employed:
  - one of the matrices is partitioned in one dimension into p equal slices
  - there is one-to-one mapping between the partitions and threads
  - each thread is responsible for computation of the corresponding slice of the resulting matrix
- Computation of the norm of the resulting matrix employs the mutex synchronization mechanism.

You can use BLAS or ATLAS for local computations.

Experiment with the program and build/plot:

- The dependence of the execution time of the program on the matrix size n.
- The speedup over a serial counterpart of the program.

Explain the results.

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## Variants of the assignment:

1. Granularity of the program:
  - (a) Two successive steps:
    - i. Parallel matrix multiplication
    - ii. Parallel computation of the norm of the resulting matrix
  - (b) One-step algorithm. No intermediate resulting matrix.
2. Partitioning scheme:
  - (a) Left matrix is horizontally partitioned
  - (b) Right matrix is vertically partitioned
3. Matrix norm to be computed:
  - (a) The maximum absolute column sum norm (aka one-norm):
$$\|A\|_1 = \max_{0 \leq j < n} \sum_{i=0}^{n-1} |a_{ij}|$$
  - (b) The maximum absolute row sum norm (aka infinity-norm):
$$\|A\|_\infty = \max_{0 \leq i < n} \sum_{j=0}^{n-1} |a_{ij}|$$