**Week-3 Lab Programs**

1) Write an OpenMP program to implement Matrix multiplication.
    a. Analyze the speedup and efficiency of the parallelized code.
    b. Vary the size of your matrices from 200, 400, 600, 800 and 1000 and measure the runtime with one thread and four threads.
    c. For each matrix size, change the number of threads from 2,4,6 and 8 and plot the speedup versus the number of threads. Compute the efficiency.

2) Write an OpenMP program to perform Matrix times vector multiplication. Vary the matrix and vector size and analyze the speedup and efficiency of the parallelized code.

3) Write an OpenMp program to read a matrix A of size 5x5. It produces a resultant matrix B of size 5x5. It sets all the principal diagonal elements of B matrix with 0. It replaces each row elements in the B matrix in the following manner. If the element is below the principal diagonal it replaces it with the maximum value of the row in the A matrix having the same row number of B. If the element is above the principal diagonal it replaces it with the minimum value of the row in the A matrix having the same row number of B. Analyze the speedup and efficiency of the parallelized code.

4) Write a parallel program using OpenMP that reads a matrix of size MxN and produce an output matrix B of same size such that it replaces all the non-border elements of A with its equivalent 1's complement and remaining elements same as matrix A. Also produce a matrix D as shown below.
   Example:
   A

| | | | |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| 6 | 5 | 8 | 3 |
| 2 | 4 | 10 | 1 |
| 9 | 1 | 2 | 5 |

   B

| | | | |
|---|---|---|---|
| 1 | 2 | 3 | 4 |

| | | | |
|---|---|---|---|
| 6 | **10** | **111** | 3 |
| 2 | **11** | **101** | 1 |
| 9 | 1 | 2 | 5 |

D

| | | | |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| 6 | **2** | **7** | 3 |
| 2 | **3** | **5** | 1 |
| 9 | 1 | 2 | 5 |

5) Write a parallel program in OpenMP to reverse the digits of the following integer array of size 9. Initialize the input array to the following values:
    a. Input array: 18, 523, 301, 1234, 2, 14, 108, 150, 1928
    b. Output array: 81, 325, 103, 4321, 2, 41, 801, 51, 8291