Using OpenMP on the RIT RC computers, write sequential and multi-core parallel programs for the all pairs shortest paths problem that we learned in class. Measure the execution time as K changes from 1 to 10, and compute speedup and efficiency. Compare the row and column slicing cases.

All pairs shortest paths problem can be solved using the Floyd-Warshall algorithm for finding the shortest paths in weighted graph with positive or negative weight.

The graph with 1000 nodes was constructed and the execution time for multi-core parallel with different threads and sequential approach is as given in Table I and II corresponding to row slicing and column slicing. Speedup and efficiency is given for each thread which are calculated as:

Speedup: Speed up is calculated as:

Speed Up = Time taken by sequential / Time take by parallel

Efficiency: Efficiency is calculated as:

Efficiency = Speed Up / Number of threads

Table I (Row Slicing)

Mode	Executing time	Speed Up	Efficiency
Sequential	10.45		
Parallel (thread = 1)	12.16	0.859	0.859
Parallel (thread = 2)	6.27	1.667	0.8335
Parallel (thread = 3)	4.16	2.512	0.8373
Parallel (thread = 4)	3.13	3.338	0.8345
Parallel (thread = 5)	2.48	4.214	0.8428
Parallel (thread = 6)	2.12	4.929	0.8215
Parallel (thread = 7)	1.72	6.075	0.8678
Parallel (thread = 8)	1.42	7.359	0.9198
Parallel (thread = 9)	1.23	8.496	0.9440
Parallel (thread = 10)	1.08	9.676	0.9676

Table II (Column Slicing)

Mode	Executing time	Speed Up	Efficiency
Sequential	10.42		
Parallel (thread = 1)	22.70	0.459	0.459
Parallel (thread = 2)	11.94	0.873	0.437
Parallel (thread = 3)	8.17	1.275	0.425
Parallel (thread = 4)	6.46	1.613	0.403
Parallel (thread = 5)	5.32	1.959	0.392
Parallel (thread = 6)	4.65	2.241	0.3735
Parallel (thread = 7)	4.24	2.456	0.35
Parallel (thread = 8)	3.87	2.693	0.337
Parallel (thread = 9)	3.70	2.816	0.313
Parallel (thread = 10)	3.46	3.011	0.301

The comparison between row slicing and column slicing case is demonstrated using the graph of speed up and efficiency for both case.

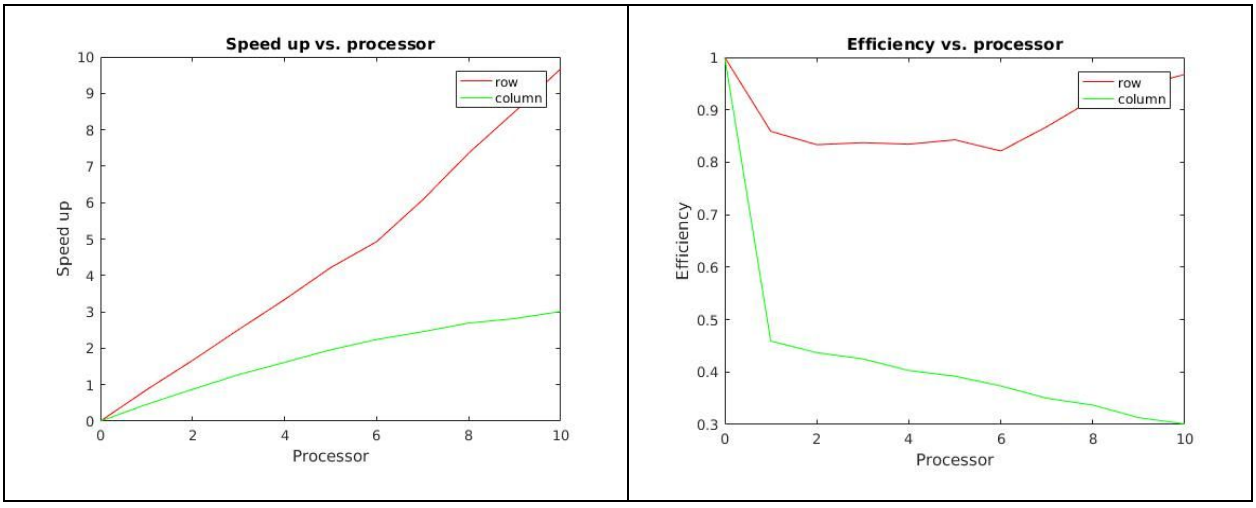
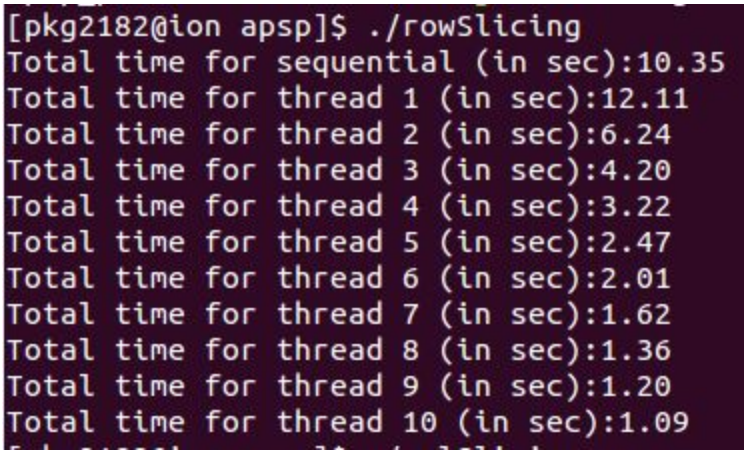


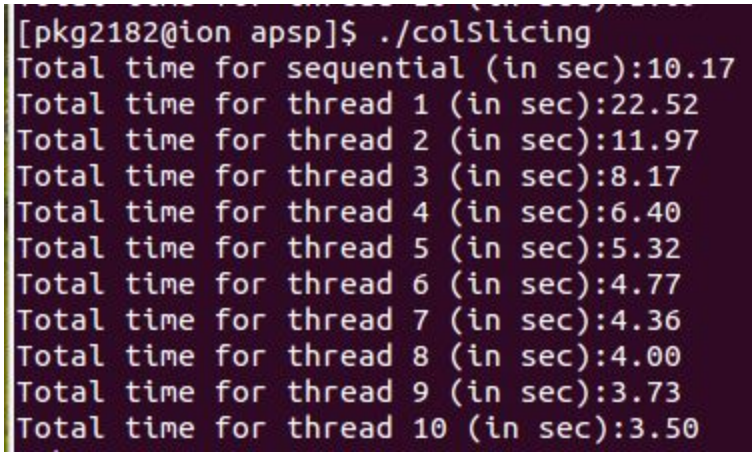
Figure: The graph of speed up vs processors(left) and the graph of efficiency vs processors(right) for different threads.

Snapshots of the result:

I. Row slicing



II. Column slicing



(This snapshots of the results has different time from the table as the calculation of speed up and efficiency was done on different result reported on the table. However, the behaviour are same. The time varies in millisecond order.)

Comments:

1. The presented results are from the observation when running the code in the Research Computing facilities of RIT.
2. The different results were observed when code was executed in the local machine. (8 core CPU)