Q1

Sequential

export OMP_NUM_THREADS=1

$ ./csr 1000 0.05 60

Matrix creation time: 0.006328 seconds
CSR conversion time**:** 0.008530 seconds

$ ./csr 1000 0.2 60

Matrix creation time: 0.006357 seconds
CSR conversion time: 0.010355 seconds

$ ./csr 1000 0.5 60

Matrix creation time: 0.006606 seconds
CSR conversion time: 0.015454 seconds

Parallel

export OMP_NUM_THREADS=2

$ ./csr 1000 0.5 60

Matrix creation time: 0.003034 seconds
CSR conversion time: 0.008037 seconds

$ ./csr 1000 0.2 60

Matrix creation time: 0.002691 seconds
CSR conversion time: 0.005519 seconds

$ ./csr 1000 0.05 60

Matrix creation time: 0.003273 seconds
CSR conversion time: 0.005315 seconds

export OMP_NUM_THREADS=3

$ ./csr 1000 0.05 60

Matrix creation time: 0.002835 seconds
CSR conversion time: 0.003444 seconds

./csr 1000 0.2 60

Matrix creation time: 0.002306 seconds
CSR conversion time: 0.004336 seconds

$ ./csr 1000 0.5 60

Matrix creation time: 0.002069 seconds
CSR conversion time: 0.005021 seconds

export OMP_NUM_THREADS=4

$ ./csr 1000 0.5 60

Matrix creation time: 0.002758 seconds
CSR conversion time: 0.003959 seconds

$ ./csr 1000 0.2 60

Matrix creation time: 0.002149 seconds
CSR conversion time: 0.003362 seconds

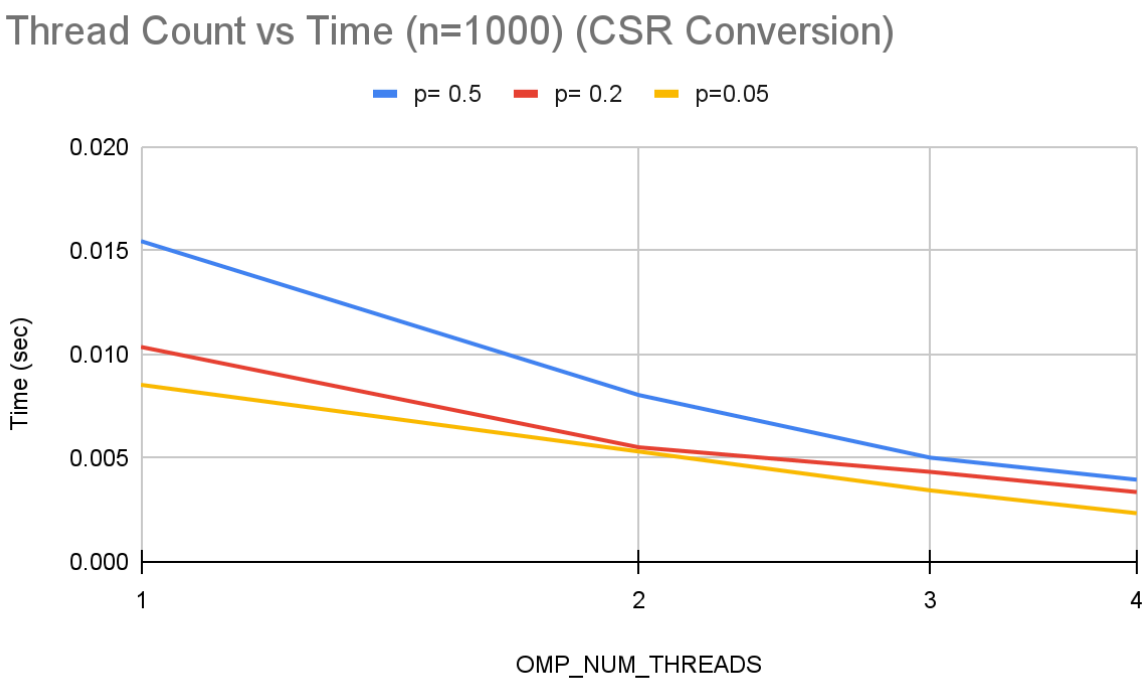
$ ./csr 1000 0.05 60

Matrix creation time: 0.001808 seconds
CSR conversion time: 0.002344 seconds

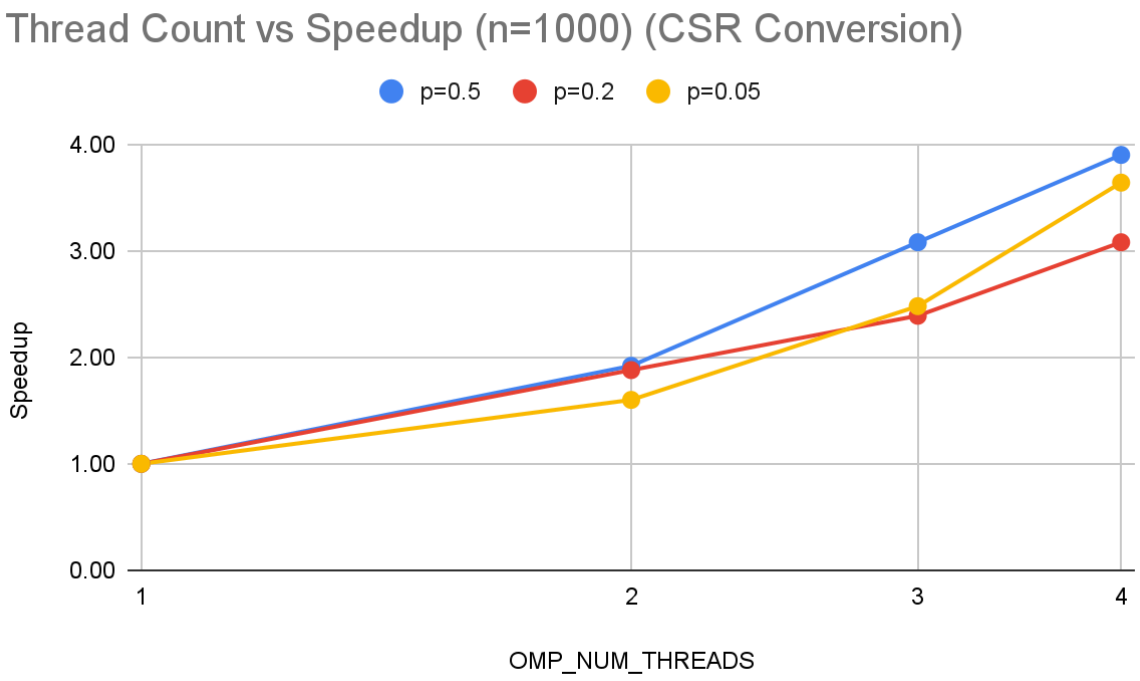
Graphs

Data graphically shows decrease in time taken to execute and consistent speedup for single and multithreaded executions.

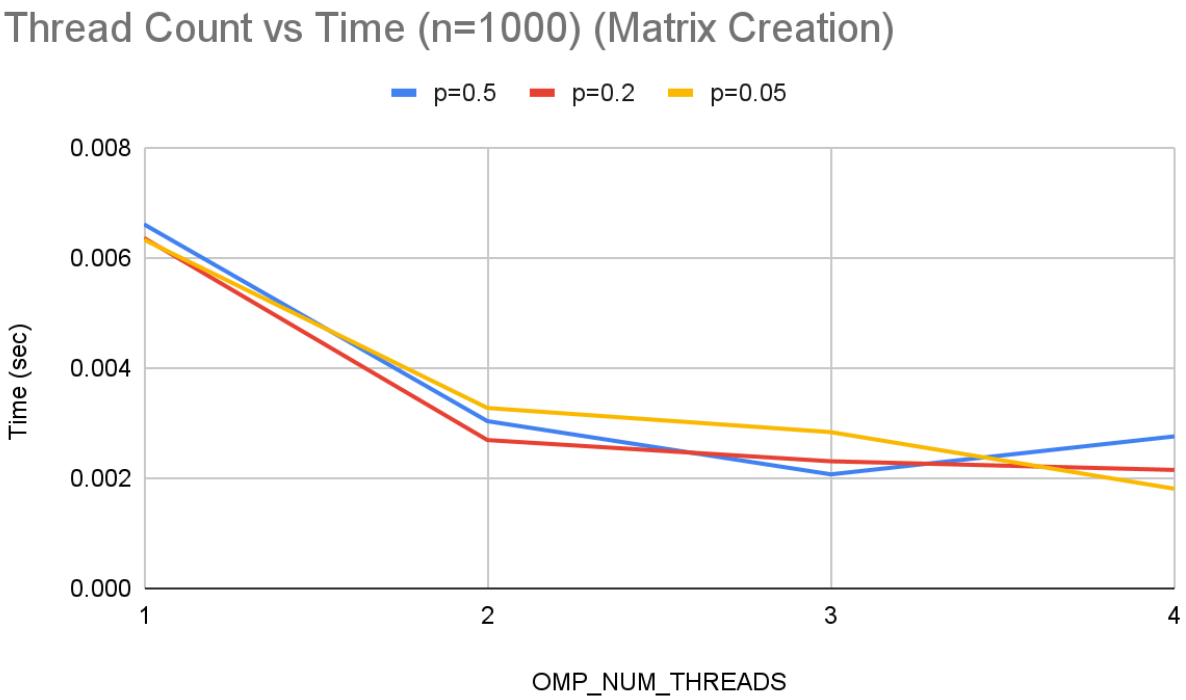
CSR Conversion Performance:



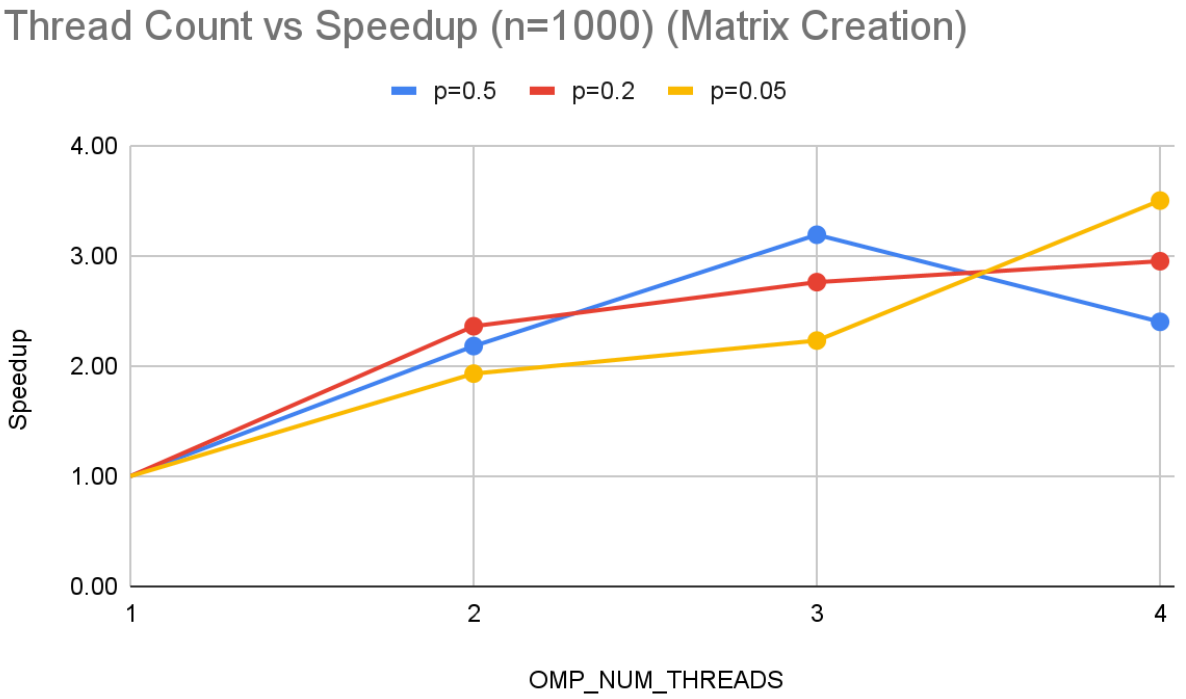
Speedup:



Matrix Creation Performance:



Speedup:



Analysis:

There is a consistent speedup at all p=0.05,0.2,0.5. As the thread count increases, we can compare the relative improvement in performance at large value n=1000, comparing the single threaded vs multithreaded time for execution.