Question1.

File: a2q1.c

Compile Code:

mpicc -o a2q1.x a2q1.c

mpirun -np 4 ./test.x 10

On School's server, for running up to around 30s, can use:

mpirun -np 100 ./test.x 1000

Analysis:

Big O = n log n for one process, n = N/p

If based on Amdahl's Law, $$S \leq S_{max} \leq \frac{1}{f+\frac{1-f}{p}}$$,

After running 82% of time on execution.
f = 1 – 0.82 = 0.18

Max Speed (S) is when p is infinity, so Max S = 1/(0.18) = 5.556

When P = 100 , 1/(0.25 + 0.75/8) = 5.31

Output:

```
[yliu327@mcs1 assignment]$ mpirun -np 4 ./test.x 10
0: 0.039131 0.073177 0.073533 0.094125 0.139670 0.171961
Process 0 finished, Range: [0.000,0.250]

1: 0.271569 0.277200 0.356855 0.448457 0.463719 0.482333
Process 1 finished, Range: [0.250,0.500]

2: 0.501242 0.525340 0.550809 0.559197 0.609819 0.613811 0.628933 0.632150 0.658199 0.683728 0.699995 0.716899 0.72
5604 0.731634 0.734103 0.736163 0.747060
Process 2 finished, Range: [0.500,0.750]

3: 0.766066 0.808289 0.831590 0.850523 0.875448 0.890102 0.916080 0.935745 0.936293 0.949901 0.991998
Process 3 finished, Range: [0.750,1.000]

[yliu327@mcs1 assignment]$
```

Question2.

Headsup:

ON MY LOCAL I CAN COMPILE :

gcc -fopenmp -O2 NAME.c -o NAME.x -lmpi

OMP_NUM_THREADS=4 ./a2q2p2.x 3000 3000

```
Allenly3@Allenly3 ~/c631/assignment/LiuA2
$ gcc -fopenmp -O2 a2q2p3.c -o a2q2p3.x -lmpi

Allenly3@Allenly3 ~/c631/assignment/LiuA2
$ gcc -fopenmp -O2 a2q2p2.c -o a2q2p2.x -lmpi

Allenly3@Allenly3 ~/c631/assignment/LiuA2
$ gcc -fopenmp -O2 a2q2p3.c -o a2q2p3.x -lmpi

Allenly3@Allenly3 ~/c631/assignment/LiuA2
$ OMP_NUM_THREADS=4 ./a2q2p3.x 3000 3000
Time cost: 0.597282s.
```

BUT on School server, failed.

```
[yliu327@mcs1 assignment]$ gcc -fopenmp -O2 a2q2p3.c -o a2q2p3.x
a2q2p3.c:5:17: fatal error: mpi.h: No such file or directory
 #include <mpi.h>
                 ^
compilation terminated.
[yliu327@mcs1 assignment]$ gcc -fopenmp -O2 a2q2p3.c -o a2q2p3.x
a2q2p3.c:5:17: fatal error: mpi.h: No such file or directory
 #include <mpi.h>
                 ^
```

Part1 file: a2q2p1.c

Compile Code:

mpicc -o a2q2p1.x a2q2p1.c

./a2q2p1.x 3000 3000

Core Function:

```
void computeCumulativeSum(int rows, int cols, int **A, int **B)
```

Output:

```
[yliu327@mcsl assignment]$ mpicc -o a2q2p1.x a2q2p1.c
[yliu327@mcsl assignment]$ ./a2q2p1.x 3000 3000
Time cost: 0.073870s.
[yliu327@mcsl assignment]$
```

Part2 file: a2q2p2.c

Compile Code:

gcc -fopenmp -O2 a2q2p2.c -o a2q2p2.x -lmpi

OMP_NUM_THREADS=4 ./a2q2p2.x 3000 3000

or

mpirun -np 4 ./a2q2p2.x 3000 3000

Core Function:

```
void computeCumulativeSumParallel(int rows, int cols, int **A, int **B)
```

OUTPUT:

```
[yliu327@mcsl assignment]$ OMP_NUM_THREADS=4 ./a2q2p2.x 3000 3000
Time cost: 0.073777s.
```

or

```
[yliu327@mcsl assignment]$ mpirun -np 4 ./a2q2p2.x 3000 3000
Time cost: 0.072480s.
Time cost: 0.074107s.
Time cost: 0.074122s.
Time cost: 0.074304s.
```

Part3 File: a2a2p3.c

Compile Code:

gcc -fopenmp -O2 a2q2p3.c -o a2q2p3.x -lmpi

OMP_NUM_THREADS=4 ./a2q2p3.x 3000 3000

Core Function:

```
void computeBlock(int start_row, int end_row, int start_col, int end_col, int
**A, int **B)
```

OUTPUT:

```
[yliu327@mcsl assignment]$ mpicc -o a2q2p3.x a2q2p3.c
[yliu327@mcsl assignment]$ OMP_NUM_THREADS=4 ./a2q2p3.x 3000 3000
Time cost: 0.094369s.
[yliu327@mcsl assignment]$
```