**Question1**.

**Part1**:  
Compile Code:  
gcc -o q1p1 q1p1.c -lm

./q1p1

Analysis:

Particle amount is hard coded to 1024.

2-D array, [N][0] stores x, [N][1] stores y.

Core functions:   
double computeDistance(double particles[N][2], int i, int j) double findMinimumDistance(double particles[N][2])

Output:

A black background with white text

Description automatically generated

**Part2:**  
Compile Code:  
nvcc -arch=sm\_60 -O2 q1p2.cu

nvprof ./a.out

Analysis:

In order to simplify the logic, data structure change to:  
 particle[INDEX]

INDEX % 2 == 0 : x

INDEX % 2 == 1 : y

Core functions:

findMinimumDistance(float \*particles, float \*minDistance)

Output:

A screenshot of a computer

Description automatically generated

**Part3:**  
Compile Code:  
nvcc -arch=sm\_60 -O2 q1p3.cu

nvprof ./a.out

**Part 4 discussion:**  
Following points could be taken into account.

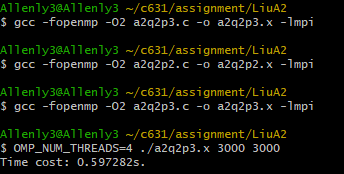
- Share Memory Usage  
- Optimize Reduction Algorithm

- Optimize traveling Algorithm

Etc.

**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  


BUT on School server, failed.   
A black screen with white text

Description automatically generated

**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:

A black screen with white text

Description automatically generated

**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:

  
or  
A screen shot of a computer

Description automatically generated

**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:

A black background with white text

Description automatically generated