Kennesaw State University

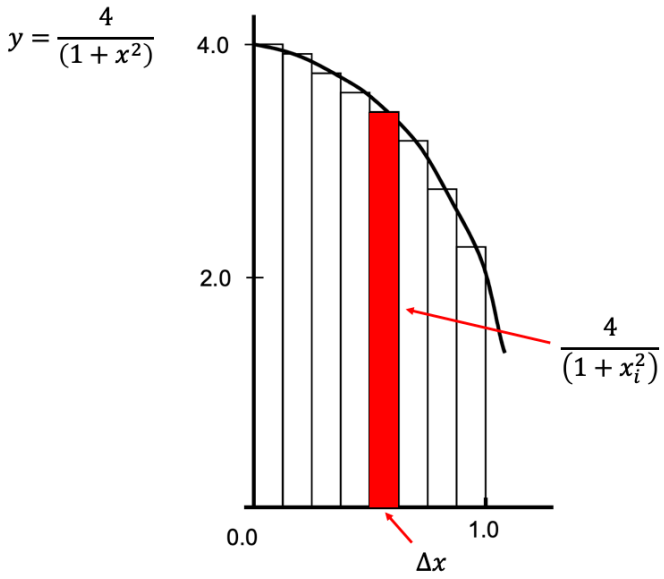
CS 7172 Parallel and Distributed Computing - Spring 2020

Project 3 – MPI

Instructor: Kun Suo
Points Possible: 100
Due date: check on the D2L

Mathematically, we know the following equation:

$$\int_0^1 \frac{4}{(1+x^2)}\,dx = \pi$$



We can approximate the value of π as a sum of rectangles:

$$\sum_{i=0}^{N} f(x_i)\Delta x \approx \pi$$

Where each rectangle has width Δx and height F(x_i) at the middle of interval i.

The following code implements the above calculation of PI. We divide the area between 0 and 1 into 100000 small rectangles and the value of PI is approximately equal to the sum of all rectangles' size. However, the program executes in the sequential implementation.

https://github.com/kevinsuo/CS7172/blob/master/pi.c

```
#include <stdio.h>
#include <stdlib.h>
#include <time.h>
#define NUMSTEPS 1000000

int main() {
        int i;
        double x, pi, sum = 0.0;
        struct timespec start, end;

        clock_gettime(CLOCK_MONOTONIC, &start);
        double step = 1.0/(double) NUMSTEPS;
        x = 0.5 * step;

        for (i=0;i<= NUMSTEPS; i++){
                x+=step;
                sum += 4.0/(1.0+x*x);
        }
        pi = step * sum;
        clock_gettime(CLOCK_MONOTONIC, &end);
        u_int64_t diff = 1000000000L * (end.tv_sec - start.tv_sec) + end.tv_nsec -
start.tv_nsec;

        printf("PI is %.20f\n",pi);
        printf("elapsed time = %llu nanoseconds\n", (long long unsigned int) diff);

        return 0;
}
```

Write a parallel program to calculate PI using MPI based on this sequential solution.

To compile the program with OpenMP, use:
$ mpicc -g program.c -o program.o

Please write a brief report introducing your implementation.

Submitting Assignment

Submit your assignment zip file through D2L using the appropriate assignment link. For task 1 and 2, please submit the ***source code*** , ***screenshot of output*** and ***report***.