Introduction to Parallel Computing
MPI – Message Passing Interface
Assignment

Vistas in Advanced Computing / Summer 2017

UNIVERSITY of HOUSTON
CENTER FOR ADVANCED COMPUTING & DATA SYSTEMS

Implement the following 3 problems in parallel using MPI

1. Find prime numbers
   - using a completely naïve algorithm. For each integer I, it simply checks whether any smaller J evenly divides it. The total amount of work for a given N is thus roughly proportional to 1/2*N^2. (https://en.wikipedia.org/wiki/Sieve_of_Eratosthenes)
   - use collective operations
   - Measure timings for up to 16 processes (2, 4, 8, 16)
   - Calculate speedup/efficiency

2. Calculate Pi using 2 different methods
   - A) using the integral of 4/(1+x*x) between 0 and 1.
   - B) using Monte Carlo Method
   - Compare the 2 methods

Pi using Monte Carlo

If a circle of radius R is inscribed inside a square with side length $2R$, then the area of the circle will be $\pi * R^2$ and the area of the square will be $(2R)^2$. So the ratio of the area of the circle to the area of the square will be $\frac{pi}{4}$.

So we pick N points at random inside the square. The random selection of points makes the method stochastic. We checkt to see of the point is in fact inside the circle, this is done by checking the following inequality

$$x^2 + y^2 < R^2$$

We keep track of the number of points that reside inside the circle, M. PI is them approximated as

$$\pi \approx \frac{4*M}{N}$$

Implement the following 3 problems in parallel using MPI

3. Solution to the Poisson equation
   - Poisson equation in a rectangle, using the Jacobi iteration to solve the linear system, and MPI to carry out the Jacobi iteration in parallel.