Programming Assignment III: MPI Programming

The purpose of this assignment is to familiarize yourself with MPI programming.

1 Statement of Problem 1

In this problem, you need to use MPI to parallelize the following serial program (`http://www.cs.nctu.edu.tw/~ypyou/courses/PP-f14/assignments/HW3/prime.c`), which takes a `long long int` argument as an input, finds the largest prime number that is smaller than the input, and counts the prime numbers that are smaller than the input.

```c
#include <stdio.h>
#include <stdlib.h>
#include <math.h>

int isprime(int n) {
  int i,squareroot;
  if (n>10) {
    squareroot = (int) sqrt(n);
    for (i=3; i<=squareroot; i=i+2)
      if ((n%i)==0)
        return 0;
    return 1;
  }
  else
    return 0;
}

int main(int argc, char *argv[])
{
  int pc,        /* prime counter */
      foundone; /* most recent prime found */
  long long int n, limit;

  sscanf(argv[1],"%llu",&limit);
  printf("Starting. Numbers to be scanned= %lld\n",limit);

  pc=4;      /* Assume (2,3,5,7) are counted here */

  for (n=11; n<=limit; n=n+2) {
    if (isprime(n)) {
      pc++;
      foundone = n;
    }
```

```
  }
  printf("Done. Largest prime is %d Total primes %d\n",foundone,
      pc);

  return 0;
}
```

2 Statement of Problem 2

In this problem, you need to use MPI to parallelize the following serial program (`http://www.cs.nctu.edu.tw/~ypyou/courses/PP-f14/assignments/HW3/integrate.c`), which integrates function sin(X) over the range from 0 to 2 using `N` intervals, where `N` is an argument of the program.

```c
#include <stdio.h>
#include <math.h>

#define PI 3.1415926535

int main(int argc, char **argv)
{
  long long i, num_intervals;
  double rect_width, area, sum, x_middle;

  sscanf(argv[1],"%llu",&num_intervals);

  rect_width = PI / num_intervals;

  sum = 0;
  for(i = 1; i < num_intervals + 1; i++) {

    /* find the middle of the interval on the X-axis. */

    x_middle = (i - 0.5) * rect_width;
    area = sin(x_middle) * rect_width;
    sum = sum + area;
  }

  printf("The total area is: %f\n", (float)sum);

  return 0;
}
```

3 Requirement

- Your submitted solution contains two source files: `prime.c` (or `prime.cpp`) for problem 1 and `integrate.c` (or `integrate.cpp`) for problem 2.

- Your programs take one command-line argument.

4 Developing and Execution Environment of MPI Programs

4.1 Using the NCTU virtual cluster

4.1.1 Login information

Master workstation IP: 140.113.110.141
User name & password: u+Student ID
Ex: Given a student ID 0256106,
user name: u0256106
password: u0256106
Please remember to change your password (by typing the `passwd` command) after first time logging in.

4.1.2 You can use SSH to log in to other slave machines

Hostname	IP
master	10.10.0.118
slave1	10.10.0.119
slave2	10.10.0.120
slave3	10.10.0.121

4.1.3 Writing your program and running

You have to copy your executable to each of the slave machines, and the file location should be the same as the location on your master machine.(Use the hostname defined above.)

5 Submission

Be sure to upload your zipped source codes, which includes no folder, to e-Campus system by the due date and name your file as "HW3_xxxxxxx.zip", where xxxxxxx is your student ID.

Due Date: 23:59, November 27, Thursday, 2014

6   References

- https://computing.llnl.gov/tutorials/mpi/