Parallel Computing Lab
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Lab 2

Write a C program which counts the number of Primes between 1 & n using MPI for parallel execution.

Code:

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

int Default = 9999999;
int cnt_proccess;
int rank_user;

int range_rtn(int argc, char **argv){
   if(argc<2||!argv[1]){
      return Default;
   }

   int range = atoi(argv[1]);

   if(range<2*cnt_proccess){
      return Default;
   }

   return range;

}

int prime_check(int n){
   int high,d;
   high = (int)(sqrt((double)n)+0.0001);
   for(d=2;d<=high;d++)
      if(n%d==0){
         return 0;
   }
   return 1;
```

```
}

void worker(int argc,char**argv){

   int range=range_rtn(argc,argv);
   double chng=(double)range/cnt_proccess;
   int lower;
   int upper;

   lower=(rank_user==0)?2:(int)(rank_user*chng)+1;
   upper=(rank_user== cnt_proccess-1)?range:(int)((rank_user+1)*chng);

   int count=0;
   int i;

   if(rank_user!=0){
      for(i=lower;i<= upper;i++)
         if (prime_check(i)){
            count++;
            }
      int data_to_send[3];
      data_to_send[0]=count;
      data_to_send[1]=lower;
      data_to_send[2]=upper;
      MPI_Send(data_to_send,3,MPI_INT,0,0,MPI_COMM_WORLD);
   }else{
      double start=MPI_Wtime();
      for(i=lower;i<=upper;i++)
         if(prime_check(i)){
            count++;
            }
      printf("\nThere are %d primes between 0 and %d counted by process
18.\n", count, upper);
      int ct;
      for (ct = 1; ct < cnt_proccess; ct++) {
         int data_received[3];
         MPI_Status status;
         MPI_Recv( data_received, 3, MPI_INT, MPI_ANY_SOURCE,
                        MPI_ANY_TAG, MPI_COMM_WORLD, &status );
         count += data_received[0];
```

```
         printf("\nThere are %d primes between %d and %d counted by
process %d.\n", data_received[0], data_received[1],
data_received[2],status.MPI_SOURCE);
      }
      printf("\nThe workers counted %d primes till %d.\n", count,range);
      double elapsed = MPI_Wtime() - start;
      printf("\nTime taken:  %1.3f seconds.\n", elapsed);
   }
}


int main(int argc, char **argv) {

   MPI_Init(&argc, &argv);
   MPI_Comm_rank(MPI_COMM_WORLD, &rank_user);
   MPI_Comm_size(MPI_COMM_WORLD, &cnt_proccess);

   worker(argc, argv);

   MPI_Finalize();

}
```

Input/Output and Time Taken:

```
nilay@Nilay-PC:~$ mpicc -o mpi lab2.c -lm
nilay@Nilay-PC:~$ mpiexec -n 18 ./mpi 2582022

There are 13294 primes between 0 and 143445 counted by process 18.

There are 11692 primes between 143446 and 286891 counted by process 1.

There are 11197 primes between 286892 and 430337 counted by process 2.

There are 10931 primes between 430338 and 573782 counted by process 3.

There are 10724 primes between 573783 and 717228 counted by process 4.

There are 9997 primes between 1577903 and 1721348 counted by process 11.

There are 10556 primes between 717229 and 860674 counted by process 5.

There are 10324 primes between 1004120 and 1147565 counted by process 7.

There are 10263 primes between 1147566 and 1291011 counted by process 8.

There are 9966 primes between 1721349 and 1864793 counted by process 12.

There are 9719 primes between 2295131 and 2438576 counted by process 16.

There are 10418 primes between 860675 and 1004119 counted by process 6.

There are 10091 primes between 1434457 and 1577902 counted by process 10.

There are 9810 primes between 2151686 and 2295130 counted by process 15.

There are 10128 primes between 1291012 and 1434456 counted by process 9.

There are 9932 primes between 1864794 and 2008239 counted by process 13.

There are 9766 primes between 2438577 and 2582022 counted by process 17.

There are 9854 primes between 2008240 and 2151685 counted by process 14.

The workers counted 188662 primes till 2582022.

Time taken:  0.492 seconds.
nilay@Nilay-PC:~$
```