

4F03 Assignment 3

Finding Gaps in Sequences of Prime Numbers

26 February

Due date: 12 March

Given two consecutive prime numbers n_1 and n_2 , the gap between them is $n_2 - n_1$. For example, the gap between 11 and 13 is equal to 2. The gap between 503 and 509 is equal to 6.

- Write an MPI C program to determine the largest gap between a pair of consecutive prime numbers in a given interval $[a, b]$.
- You can use any of the Number Theoretic Functions implemented in GMP, GNU Multiple Precision Arithmetic Library, <http://gmplib.org/>, such as `mpz_probab_prime_p`, `mpz_nextprime`
- To link with the GMP library use `-lgmp`.
- Your program should be able to find the largest gap in $[2, 10^9]$.

Submit

- All your program files to SVN under directory A3.
- Hard copy of your programs.

You should have a makefile, such that when `make` is typed, the executable `primes` is created. It should take as input two integer numbers, e.g.

```
mpirun -np 4 ./primes 10 1000
```

Notes: I have programmed this in about 150 lines of C code, so your program should not be large. Try to finish this assignment as quickly as you can, as the final project will be challenging.

Only if you have missed the midterm. If you have missed the midterm, you need to complete this part, which is 5% of the final grade.

- Produce a speed up and an efficiency plots for $p = 1, 2, 4, 6, 8, \dots, 32$ processors, $a = 2$, and $b = 10^6, 10^8, 10^9$.

Submit both plots.

- For $p = 32$ and $b = 10^9$, output the CPU time of each process. If these times are not nearly the same, explain the difference.
- What is the largest b for which your program computes correctly? Explain.
- Can you compute up to $b = 10^{12}$? Explain.