

Lab 5 - Software Programming (The “C” Language)

In this lab we will write a C program to find all the prime numbers less than 100. The method (algorithm) we will use is called the Sieve of Eratosthenes.¹

Let A denote an array of integers with index positions from 0 to 100; I.e. the array length is 101. We will use the value 1 to indicate “prime” and the value 0 to indicate “not prime”. We use the position in the array to represent the number in question. For example, $A[k]$ tells us whether the number k is prime or not.

An outline of the Sieve method is given below:

Fill the entire array with 1’s.

Set $A[0] = 0$ and $A[1] = 0$ since neither 0 nor 1 are prime numbers.

Cross out (set to zero) all positions in the array
which are multiples of 2 starting with position 4.

Cross out (set to zero) all positions in the array
which are multiples of 3 starting with position 6.

Cross out (set to zero) all positions in the array
which are multiples of 5 starting with position 10.

Cross out (set to zero) all positions in the array
which are multiples of 7 starting with position 14.

Any remaining numbers which are not crossed out are prime.

Use one final loop to scan the array and print all numbers which are not crossed out.

Your output should be:

2 3 5 7 11 13 17 19 23 29 31 37 41 43 47 53 59 61 67 71 73 79 83 89 97

- For this lab, we will use menehune again. Log into menehune.opt.wfu.edu using PuTTY as you did in Lab 4. A directory named “Lab5” has been created for you in your account. Change directory to “Lab5” and use the command `pico sieve.c` to write your program.
- You will notice that the operation of crossing out multiples of some number, starting in a certain position is an operation which you perform four times for the prime numbers up to 100. Whenever you find yourself doing the same thing several times, it is good programming practice to make that a function, and call it several times. **Your program MUST include a function** to perform the operation of crossing out multiples of a given number. The header for the required function should be:

¹Eratosthenes of Cyrene (276 BC to c. 195 BC) was an (ancient) Greek mathematician, geographer, poet, athlete, astronomer, and music theorist. He estimated the circumference of the earth while living and working in Egypt. In those days, distance was measured in “stadia” instead of kilometers or miles. Unfortunately, there were two standards for the unit: the “Attic stadion” and the “Egyptian stadion”. If we assume his unit of measure was the Egyptian stadion (a reasonable assumption, since he was living in Egypt at the time), Eratosthenes was able to estimate the circumference of the Earth with an error of less than 2%. Boom.

```
void cross_out( int A[], int start, int stride, int n )
```

where **A** is the array of zeros and ones, **start** is the first position you wish to cross off **stride** is the position increment, and **n** is the length of the array.

- Save your program as usual and exit **pico**. To compile your program, use the command `gcc sieve.c`. If you get error messages, correct your errors using **pico** before attempting to run it.
- Run your program by typing **a.out**. If you have written your program correctly, the output should match the sample given above.