CSE 344

SYSTEM PROGRAMMING

SPRING 2021

HOMEWORK 2

REPORT

TÜRKER TERCAN

171044032

What we are going to achieve:

The program will have 9 processes. One for parent and other 8 for child processes each one represents a row in the input file. The most difficult thing to do will be synchronize each process with the parent process with just signals.

Flow of the program:

- Parent process runs the program with below command line arguments

  ./program filePath

- After that it will open the file that is given by filePath. And then, process forked 8 times. Each one will represent one row in the opened file

- I created a mask that accepts only SIGUSR1 and SIGTERM signals and signal handlers for them. SIGUSR1 signal is the one that we will be using for waking up the process after sigsuspend.

- Parent process is waiting for all the children processes to send SIGUSR1 signal to it.

- Meanwhile, each child process reads their own line and restoring their x_0, y_0, x_1, y_1, … , x_7, y_7 values. After that it will compute Lagrange polynomial degree of 5 using 6 first coordinates of that row. It will estimate p(x_7) with below formula

$$P(x) = \sum_{i=1}^{n} \left(y_i \prod_{j \neq i} \frac{(x - x_j)}{(x_i - x_j)} \right)$$

- After that, each child process locks the file that is given by filePath for not allowing the other processes to write to file at the same time. Write estimated result to end of the row. When it finishes this job, unlocks the file for other processes to use it.

- It sends its parent processor SIGUSR1 signal for waking it up and waits for a SIGUSR1 to handle.

- When all child processes send SIGUSR1 signal to parent process, parent handles every signal and wakes up.

- It determines the absolute value for the each row by |f(x_7) - p(x_7)| this formula and prints calculated absolute estimation error for 5 degree.

- Than, parent process sends SIGUSR1 signal for the all child processes and child processes do this steps again for degree of 6.

- After that, each child process will estimate polynomial's coefficients with below formula, and it will print every coefficient.

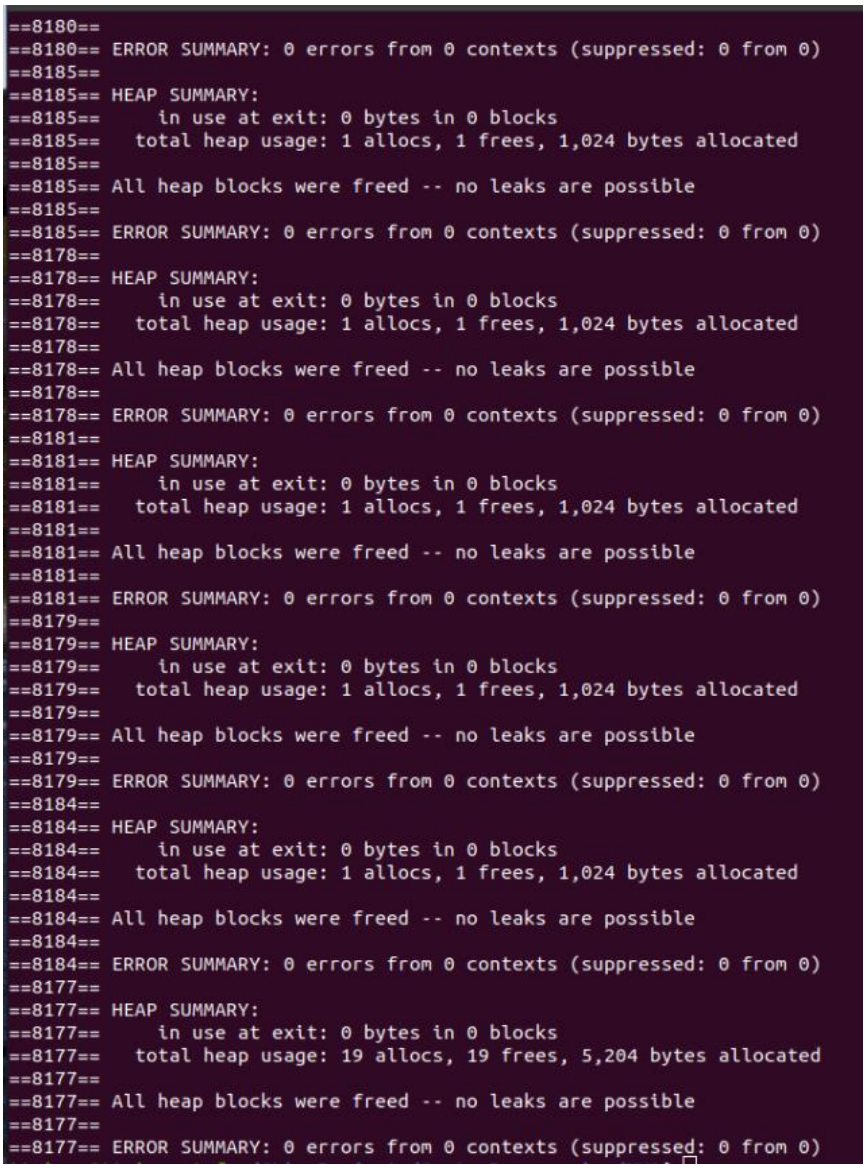
Lagrange Polynomial:

$$p(x) = L_1(x)y_1 + L_2(x)y_2 + L_3(x)y_3 + \ldots L_N(x)y_N$$

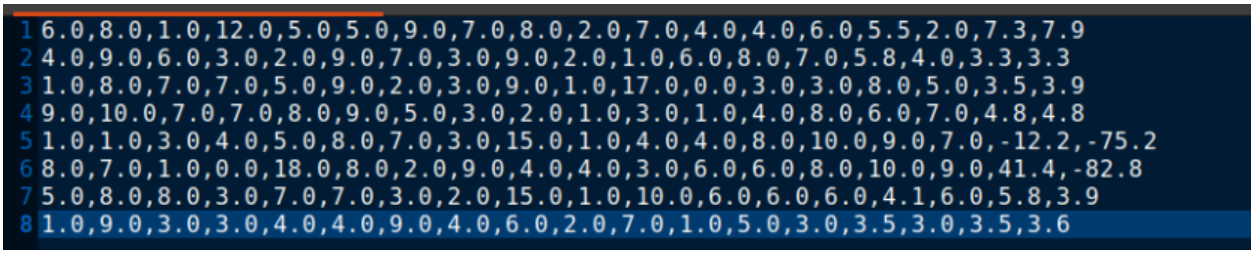
$$L_k(x) = \frac{(x-x_1)(x-x_2)\ldots(x-x_{k-1})(x-x_{k+1})\ldots(x-x_N)}{(x_k-x_1)(x_k-x_2)\ldots(x_k-x_{k-1})(x_k-x_{k+1})\ldots(x_k-x_N)}$$

Numerator of $L_k(x)$ is product of all $(x - x_i)$ except for $(x - x_k)$
Denominator of $L_k(x)$ is product of all $(x_k - x_i)$ except for $(x_k - x_k)$

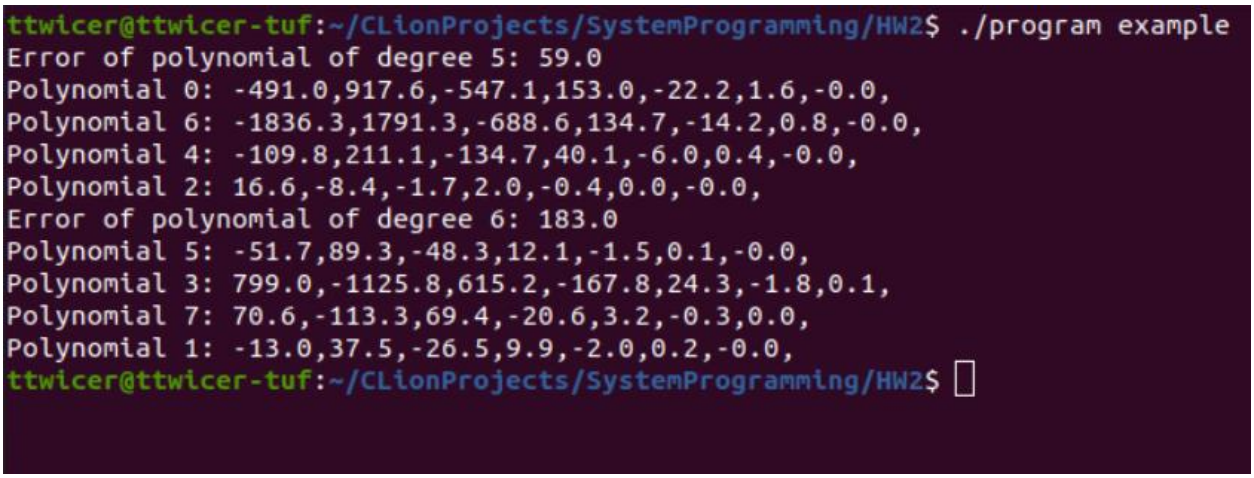
- No memory leaks - No errors:



- Example file after execution of the program



- Output of the program:



Final Notes:

- No busy waiting.
- Only sigsuspend is used for synchronization and only SIGUSR1 is used.
- File lock is used.
- Parent process cleans all child processes. No zombie processes.
- (*) If there is something wrong with deadlock, please kill the processes and run again. I think sometimes it misses some SIGUSR1 signals so may parent process never terminates but i faced it very few situations like this. I hope it’ll work fine.