CSE 344
SYSTEMS PROGRAMMING
SPRING 2021

HOMEWORK 4
REPORT

TURKER TERCAN
171044032

HOMEWORK'S CHALLANGE:

- Solving a communication in a multiprogram with threads that we have solved similarly with processes before.

- To get familiar with the pthread API

- Communication in a multithreaded program without mutexes and condition variables.

DESIGN CHOICES:

Communication and Synchronization:

- The problem is very similar to that we've solved before homeworks. And it is also similar to Producer-Consumer problem with one producer and multiple consumers.

- I managed the communication between h_thread, student_thread and the main thread through the fifos

- I detached h_thread, so it won't be needed for the cleanup process.

- And also, I used a semaphore to check if there is any students available, if it is not any students available, then, main_thread must wait.

- In order to store the homeworks, I implemented basic queue interface and used it.

H_THREAD:

- H_thread produces homeworks from the given file in the homeworkPath. It inserts the homework to the queue and sends a dummy message to the main_thread that works like a signal.

- Once there is no homework to come, instead of sending a dummy signal, it sends a character E which means exit.

- And it terminates. It created in main_thread with detached attribute, so there is no need to wait for this thread to finish.

MAIN_THREAD:

- Main thread reads the student file and makes a fifo for every student to communicate.

- It creates threads with pthread_create and there is no attribute for the student_thread.

- It waits for the fifo from the h_thread so that it can continue.

- Once a signal arrived, it decreases the semaphore, dequeues item from the homework queue, selects a student according to the input homework, writes to selected student's fifo. And does this until the H's money is over or there is no homework to come, or it receives a signal that is termination signal (SIGINT)

- After the all the work is done. It waits for the student_threads to finish and frees all the recourses that it is created.

STUDENT_THREAD:

- Student thread is less complicated than the other threads.

- It receives homework and the how much money is left in the H's wallet. Then, it sleeps for x = 6 - it's speed seconds.

- And the homework is done, so it can continue to work.

TESTS AND VALGRIND:

```
ttwicer@ttwicer-tuf:~/CLionProjects/SystemProgramming/HW4$ make
gcc program.c queue.c -o program -Wall -lrt -lpthread -ggdb3
```

```
ttwicer@ttwicer-tuf:~/CLionProjects/SystemProgramming/HW4$ ./program homeworks.txt students.txt 10000
5 students-for-hire threads have been created
Name Q S C
odtulu 5 3 900
bogazicili 4 5 1000
itulu 4 4 800
ytulu 3 4 650
sakaryali 1 2 150
bogazicili is waiting for a homework
ytulu is waiting for a homework
odtulu is waiting for a homework
itulu is waiting for a homework
sakaryali is waiting for a homework
sakaryali is solving homework C for 150, H has 9850 left.
bogazicili is solving homework S for 1000, H has 8850 left.
odtulu is solving homework Q for 900, H has 7950 left.
ytulu is solving homework C for 650, H has 7300 left.
bogazicili is waiting for a homework
bogazicili is solving homework S for 1000, H has 6300 left.
ytulu is waiting for a homework
bogazicili is waiting for a homework
ytulu is solving homework C for 650, H has 4750 left.
odtulu is waiting for a homework
odtulu is solving homework Q for 900, H has 5400 left.
bogazicili is solving homework S for 1000, H has 3750 left.
sakaryali is waiting for a homework
bogazicili is waiting for a homework
sakaryali is solving homework C for 150, H has 2700 left.
ytulu is waiting for a homework
bogazicili is solving homework S for 1000, H has 1700 left.
bogazicili is waiting for a homework
ytulu is solving homework C for 650, H has 1050 left.
odtulu is waiting for a homework
odtulu is solving homework Q for 900, H has 2850 left.
ytulu is waiting for a homework
sakaryali is waiting for a homework
odtulu is waiting for a homework
odtulu is solving homework Q for 900, H has 150 left.
odtulu is waiting for a homework
Money is over, closing.
Homeworks solved and money made by students
Name Q S C
odtulu 5 3 3600
bogazicili 4 5 4000
ytulu 3 4 1950
sakaryali 1 2 300
Money left at G's account: 150TL
```

```
==9443== Memcheck, a memory error detector
==9443== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==9443== Using Valgrind-3.15.0 and LibVEX; rerun with -h for copyright info
==9443== Command: ./program homeworks.txt students.txt 10000
==9443==
5 students-for-hire threads have been created
Name Q S C
odtulu 5 3 900
bogazicili 4 5 1000
itulu 4 4 800
ytulu 3 4 650
sakaryali 1 2 150
odtulu is waiting for a homework
ytulu is waiting for a homework
itulu is waiting for a homework
bogazicili is waiting for a homework
sakaryali is waiting for a homework
bogazicili is solving homework S for 1000, H has 8850 left.
ytulu is solving homework C for 650, H has 7300 left.
sakaryali is solving homework C for 150, H has 9850 left.
odtulu is solving homework Q for 900, H has 7950 left.
bogazicili is waiting for a homework
bogazicili is solving homework S for 1000, H has 6300 left.
ytulu is waiting for a homework
bogazicili is waiting for a homework
ytulu is solving homework C for 650, H has 4750 left.
odtulu is waiting for a homework
odtulu is solving homework Q for 900, H has 5400 left.
bogazicili is solving homework S for 1000, H has 3750 left.
sakaryali is waiting for a homework
bogazicili is waiting for a homework
sakaryali is solving homework C for 150, H has 2700 left.
ytulu is waiting for a homework
bogazicili is solving homework S for 1000, H has 1700 left.
bogazicili is waiting for a homework
ytulu is solving homework C for 650, H has 1050 left.
odtulu is waiting for a homework
odtulu is solving homework Q for 900, H has 2850 left.
```

```
ytulu is waiting for a homework
sakaryali is waiting for a homework
odtulu is waiting for a homework
odtulu is solving homework Q for 900, H has 150 left.
odtulu is waiting for a homework
Money is over, closing.
Homeworks solved and money made by students
Name Q S C
odtulu 5 3 3600
bogazicili 4 5 4000
ytulu 3 4 1950
sakaryali 1 2 300
Money left at G's account: 150TL
==9443==
==9443== HEAP SUMMARY:
==9443==     in use at exit: 0 bytes in 0 blocks
==9443==   total heap usage: 16 allocs, 16 frees, 4,501 bytes allocated
==9443==
==9443== All heap blocks were freed -- no leaks are possible
==9443==
==9443== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
```