

Homework 5 Report – CSE344

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1 Composition

For this project, I used one c file main.c and one makefile for compile and clean that for easy testability.

2 Program Logic

Multithreaded program that copies files and directories from a source directory to a destination directory. The program consists of a producer thread and one or more consumer threads working in a thread pool.

Initially, the program obtains input from the user, including buffer size, number of consumers, source directory, and destination directory. Data structures and locks necessary for the thread pool are created. A signal handler is defined to handle the SIGINT signal (Ctrl+C) and terminate the program. The producer thread scans the source directory for files and directories and adds copy requests to the pool. Consumer threads retrieve copy requests from the pool and copy files to the destination directory. Locks and conditional variables are used for synchronization between threads. When the process is completed, statistics are reported, and the program terminates.

Producer Thread:

The producer thread scans the specified source directory and stores files and directories in the pool. If a directory is found, a sub-producer thread is called to copy subdirectories. FIFO files are handled separately, and a FIFO file is created in the destination directory. If the copy request buffer in the pool is full, the producer thread waits.

Consumer Thread:

Consumer threads retrieve copy requests from the pool and copy files to the destination directory. Locks are used for synchronization during the copy operation. After copying, the copy request buffer and the thread pool status are updated. If the copy request buffer in the pool is empty, consumer threads wait.

Preventing Synchronization Problems and Race Conditions:

- +Operations on the thread pool are synchronized using locks and conditional variables.
- +The producer thread waits if the copy request buffer in the pool is full.
- +Consumer threads wait if the copy request buffer in the pool is empty.
- +The total number of bytes copied during the copy operation is synchronized and protected using a lock.
- +A signal handler is used to clean up the threads and terminate the program when a signal is caught.

3 Test

1)We are successfully sending all the files in the Source folder to destination.

```
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5$ ls -l
total 40
-rw-r--r-- 1 mahir mahir 11149 Jun  1 21:34 main.c
-rwxr-xr-x 1 mahir mahir 22952 Jun  1 21:37 pCp
drwxr-xr-x 3 mahir mahir 4096 Jun  1 21:35 src
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5$
```

1

```
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5/src$ ls -l
total 129788
-rw----- 1 mahir mahir 132896656 May 26 14:47 Telegram.exe
drwxr-xr-x 2 mahir mahir 4096 Jun  1 21:35 alt
prw-r--r-- 1 mahir mahir 0 Jun  1 21:32 test
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5/src$
```

2

```
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5/src/alt$ ls -l
total 129788
-rw-r--r-- 1 mahir mahir 132896656 May 26 14:47 'Telegram - Kopya.exe'
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5/src/alt$
```

3

1&2&3) files before copying

```
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5$ ./pCp 10 1 src destination
Copied file: src/Telegram.exe
Copied file: src/alt/Telegram - Kopya.exe
Elapsed time: 0.746 seconds
Total files copied: 3
Total bytes copied: 265793312
File type statistics:
Regular files: 2
Directories: 1
FIFO files: 0
Socket files: 0
Other files: 0
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5$ ls -l
total 44
drwx----- 3 mahir mahir 4096 Jun  1 21:39 destination
-rw-r--r-- 1 mahir mahir 11149 Jun  1 21:34 main.c
-rwxr-xr-x 1 mahir mahir 22952 Jun  1 21:37 pCp
drwxr-xr-x 3 mahir mahir 4096 Jun  1 21:35 src
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5$ cd destination/
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5/destination$ ls -l
total 129792
-rw----- 1 mahir mahir 132896656 Jun  1 21:39 Telegram.exe
drwx----- 2 mahir mahir 4096 Jun  1 21:39 alt
prw-r--r-- 1 mahir mahir 0 Jun  1 21:39 test
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5/destination$ cd ../src
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5/src$ ls -l
total 129788
-rw----- 1 mahir mahir 132896656 May 26 14:47 Telegram.exe
drwxr-xr-x 2 mahir mahir 4096 Jun  1 21:35 alt
prw-r--r-- 1 mahir mahir 0 Jun  1 21:32 test
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5/src$
```

4)

We can see that all the Copy operations are successful.

2) Change in copy time when changing the number of Threads

```
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5$ ./pCp 10 1 src destination
Copied file: src/Telegram.exe
Copied file: src/alt/Telegram - Kopya.exe
Elapsed time: 0.746 seconds
Total files copied: 3
Total bytes copied: 265793312
File type statistics:
Regular files: 2
Directories: 1
FIFO files: 0
Socket files: 0
Other files: 0
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5$ ls -l
```

1

```
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5$ ./pCp 10 4 src _destination
Copied file: src/Telegram.exe
Copied file: src/alt/Telegram - Kopya.exe
Elapsed time: 0.187 seconds
Total files copied: 3
Total bytes copied: 265793312
File type statistics:
Regular files: 2
Directories: 1
FIFO files: 0
Socket files: 0
Other files: 0
mahir@DESKTOP-9RRECEV:~/CSE344-SYSTEM/hw5$
```

2

1&2) I am using 1 thread in the first SS and using 4 threads in the 2nd SS, the time reduction shows that it is working correctly.