

# CSE344 – System Programming - HW5 REPORT

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## 1. Differences over HW4

I used condition variables in HW4 but did not use barriers. I simply added “thread barrier” logic over HW4 and made it in final form.

```
pthread_barrier_init(&barrier, NULL, num_workers); // Initialize barrier for workers only
```

- A barrier is initialized using pthread\_barrier\_init in this code section.

```
// Wait at the barrier to ensure all threads reach this point before finishing
printf("Worker thread %d waiting at barrier.\n", thread_id);
pthread_barrier_wait(&barrier);
printf("Worker thread %d passed the barrier.\n", thread_id);
```

- Each worker thread processes files from the buffer. When a worker thread finishes processing and recognizes there are no more files to process, it proceeds to wait at the barrier.

```
for (int i = 0; i < num_workers; i++) {
    pthread_join(workers[i], NULL);
}
```

```
pthread_barrier_destroy(&barrier);
```

- After all worker threads have passed the barrier, the main thread joins all worker threads to ensure they have completed execution. Then the barrier is destroyed to clean up resources.

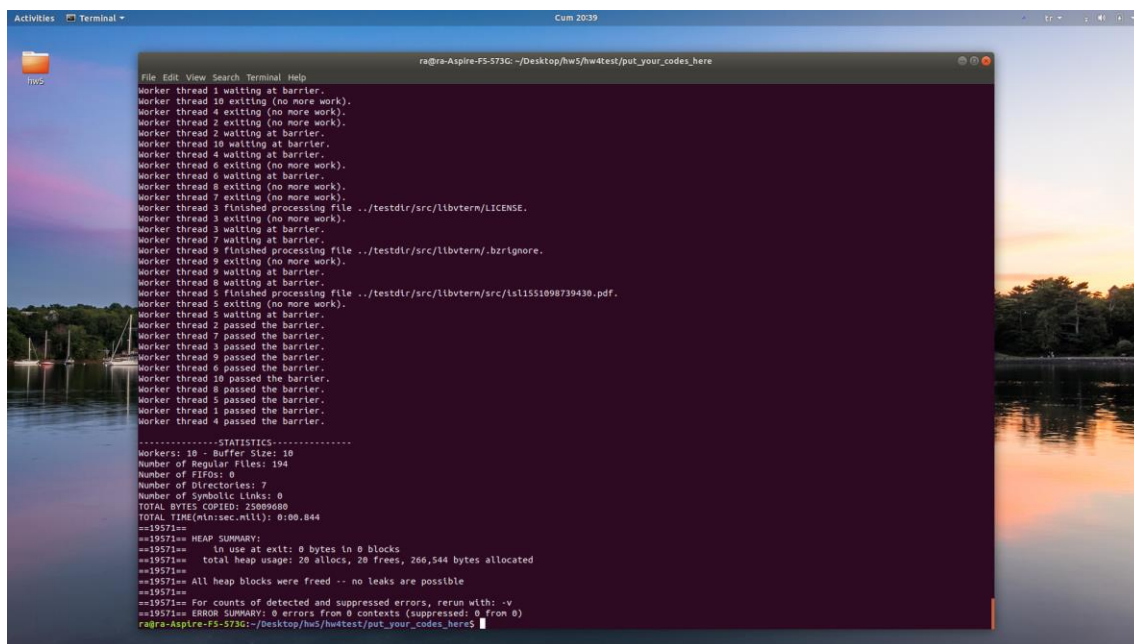
Using a barrier ensures that all worker threads complete their file processing tasks and synchronize at a specific point before proceeding. This synchronization is crucial for orderly completion and consistency.

## 2. Running and Test Cases

These test cases are the ones given in the pdf. I put the code into the directory called “put\_your\_codes\_here” then ran it.

I printed statements of each thread to see synchronization clearly.

### 2.1 Test 1 Output



```
ra@re-Aspire-F5-573G: ~/Desktop/hw5/hwttest/put_your_codes_here
File Edit View Search Terminal Help
Worker thread 1 waiting at barrier.
Worker thread 10 exiting (no more work).
Worker thread 4 exiting (no more work).
Worker thread 2 exiting (no more work).
Worker thread 10 waiting at barrier.
Worker thread 2 waiting at barrier.
Worker thread 10 waiting at barrier.
Worker thread 4 waiting at barrier.
Worker thread 6 exiting (no more work).
Worker thread 6 waiting at barrier.
Worker thread 8 exiting (no more work).
Worker thread 8 waiting at barrier.
Worker thread 7 exiting (no more work).
Worker thread 3 finished processing file ../testdir/src/libvterm/LICENSE.
Worker thread 3 exiting (no more work).
Worker thread 3 waiting at barrier.
Worker thread 7 waiting at barrier.
Worker thread 9 finished processing file ../testdir/src/libvterm/.bzignore.
Worker thread 9 exiting (no more work).
Worker thread 9 waiting at barrier.
Worker thread 8 waiting at barrier.
Worker thread 5 finished processing file ../testdir/src/libvterm/src/tst1551098739430.pdf.
Worker thread 5 exiting (no more work).
Worker thread 2 passed the barrier.
Worker thread 7 passed the barrier.
Worker thread 9 passed the barrier.
Worker thread 9 passed the barrier.
Worker thread 6 passed the barrier.
Worker thread 10 passed the barrier.
Worker thread 5 passed the barrier.
Worker thread 4 passed the barrier.
Worker thread 4 passed the barrier.
-----STATISTICS-----
Workers: 10 - Buffer Size: 10
Number of Regular Files: 194
Number of FIFOs: 0
Number of Directories: 7
Number of Symbolic Links: 0
TOTAL BYTES COPIED: 25089600
TOTAL TIME(min:sec.milli): 0:00.844
==19571==
==19571== HEAP SUMMARY:
==19571==    in use at exit: 0 bytes in 0 blocks
==19571==   total heap usage: 20 allocs, 20 frees, 266,544 bytes allocated
==19571==
==19571== All heap blocks were freed -- no leaks are possible
==19571==
==19571== For counts of detected and suppressed errors, rerun with: -v
==19571== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
ra@re-Aspire-F5-573G:~/Desktop/hw5/hwttest/put_your_codes_here
```

## 2.2 Test 2 Output

```
ra@ra-Aspire-F5-573G: ~/Desktop/hw5/hw4test/put_your_codes_here
File Edit View Search Terminal Help
Worker thread 2 waiting (buffer empty).
Manager added file ../testdir/src/libvterm/src/encoding.c to buffer.
Worker thread 1 finished processing file ../testdir/src/libvterm/src/flelo.c.
Worker thread 1 waiting (buffer empty).
Worker thread 4 finished processing file ../testdir/src/libvterm/src/ex_getln.c.
Worker thread 4 waiting (buffer empty).
Manager added file ../testdir/src/libvterm/src/crypt.c to buffer.
Worker thread 2 processing file ../testdir/src/libvterm/src/crypt.c.
Manager added file ../testdir/src/libvterm/src/pem.c to buffer.
Worker thread 1 processing file ../testdir/src/libvterm/src/pem.c.
Worker thread 1 finished processing file ../testdir/src/libvterm/src/pem.c.
Worker thread 1 waiting (buffer empty).
Worker thread 2 finished processing file ../testdir/src/libvterm/src/crypt.c.
Worker thread 2 waiting (buffer empty).
Manager added file ../testdir/src/libvterm/src/tf_perl_msvc/stdbool.h to buffer.
Worker thread 4 processing file ../testdir/src/libvterm/src/tf_perl_msvc/stdbool.h.
Worker thread 4 finished processing file ../testdir/src/libvterm/src/tf_perl_msvc/stdbool.h.
Worker thread 4 waiting (buffer empty).
Manager added file ../testdir/src/libvterm/src/configure.ac to buffer.
Worker thread 1 processing file ../testdir/src/libvterm/src/configure.ac.
Manager added file ../testdir/src/libvterm/src/dehqx.py to buffer.
Manager added file ../testdir/src/libvterm/src/dlff.c to buffer.
Manager finished processing directories.
Worker thread 1 finished processing file ../testdir/src/libvterm/src/configure.ac.
Worker thread 1 processing file ../testdir/src/libvterm/src/dehqx.py.
Worker thread 1 finished processing file ../testdir/src/libvterm/src/dehqx.py.
Worker thread 1 finished processing file ../testdir/src/libvterm/src/dlff.c.
Worker thread 1 finished processing file ../testdir/src/libvterm/src/dlff.c.
Worker thread 1 exiting (no more work).
Worker thread 1 waiting at barrier.
Worker thread 2 exiting (no more work).
Worker thread 2 waiting at barrier.
Worker thread 4 exiting (no more work).
Worker thread 4 waiting at barrier.
Worker thread 3 finished processing file ../testdir/src/libvterm/src/tls1551898739430.pdf.
Worker thread 3 exiting (no more work).
Worker thread 3 waiting at barrier.
Worker thread 3 passed the barrier.
Worker thread 2 passed the barrier.
Worker thread 1 passed the barrier.
Worker thread 4 passed the barrier.
-----STATISTICS-----
Workers: 4 - Buffer Size: 10
Number of Regular Files: 140
Number of FIFOs: 0
Number of Directories: 2
Number of Symbolic Links: 0
TOTAL BYTES COPIED: 24873082
TOTAL TIME(min:sec.milli): 0:00.114
ra@ra-Aspire-F5-573G: ~/Desktop/hw5/hw4test/put_your_codes_here$
```

## 2.3 Test 3 Output

```
ra@ra-Aspire-F5-573G: ~/Desktop/hw5/hw4test/put_your_codes_here
File Edit View Search Terminal Help
Manager added file ../testdir/README.txt to buffer.
Worker thread 2 finished processing file ../testdir/README/Contents.
Worker thread 2 processing file ../testdir/README.txt.
Manager added file ../testdir/FileList to buffer.
Worker thread 2 finished processing file ../testdir/README.txt.
Worker thread 2 processing file ../testdir/FileList.
Manager added file ../testdir/vintutor.bat to buffer.
Manager finished processing directories.
Worker thread 3 exiting (no more work).
Worker thread 3 waiting at barrier.
Worker thread 10 processing file ../testdir/vintutor.bat.
Worker thread 10 finished processing file ../testdir/vintutor.bat.
Worker thread 10 exiting (no more work).
Worker thread 10 waiting at barrier.
Worker thread 5 exiting (no more work).
Worker thread 5 waiting at barrier.
Worker thread 8 waiting at barrier.
Worker thread 1 exiting (no more work).
Worker thread 1 waiting at barrier.
Worker thread 2 finished processing file ../testdir/FileList.
Worker thread 2 exiting (no more work).
Worker thread 2 waiting at barrier.
Worker thread 9 exiting (no more work).
Worker thread 9 waiting at barrier.
Worker thread 4 exiting (no more work).
Worker thread 4 waiting at barrier.
Worker thread 7 exiting (no more work).
Worker thread 7 waiting at barrier.
Worker thread 6 exiting (no more work).
Worker thread 6 waiting at barrier.
Worker thread 6 passed the barrier.
Worker thread 10 passed the barrier.
Worker thread 3 passed the barrier.
Worker thread 5 passed the barrier.
Worker thread 8 passed the barrier.
Worker thread 1 passed the barrier.
Worker thread 2 passed the barrier.
Worker thread 9 passed the barrier.
Worker thread 4 passed the barrier.
Worker thread 7 passed the barrier.
-----STATISTICS-----
Workers: 10 - Buffer Size: 10
Number of Regular Files: 3116
Number of FIFOs: 0
Number of Directories: 151
Number of Symbolic Links: 0
TOTAL BYTES COPIED: 7352654
TOTAL TIME(min:sec.milli): 0:00.534
ra@ra-Aspire-F5-573G: ~/Desktop/hw5/hw4test/put_your_codes_here$
```