CSE – 344 Homework 5 Report

Süleyman Burak Yaşar
1901042662

Table of Contents

Usage Of Makefile

make: Compiles the code
run_test: valgrind ./MWCp 10 10 ../testdir/src/libvterm ../tocopy
run_test2: ./MWCp 10 4 ../testdir/src/ libvterm/src ../toCopy
run_test3: ./MWCp 10 10 ../testdir ../toCopy
clean: Remove MWCp

Changes made after HW4:

I had already used condition variables in HW4. I added a barrier as the new feature.

Barrier

In the updated code, barriers are used to ensure that all worker threads and the manager thread synchronize at a certain point before proceeding. This guarantees that all file copy operations are completed before any thread exits.

Initialization of the Barrier

The barrier is initialized to synchronize the number of worker threads plus the manager thread.

```
pthread_barrier_init(&buffer.barrier, NULL, num_workers + 1);
```

Manager Thread

The manager thread copies directories and files into the buffer. After setting the buffer.done flag and broadcasting to all worker threads that no more files will be added, it waits at the barrier to synchronize with all worker threads.

```
void *manager(void *arg) {
  char **dirs = (char **)arg;
  char *src_dir = dirs[0];
  char *dst_dir = dirs[1];
  copy_directory(src_dir, dst_dir, src_dir);

  pthread_mutex_lock(&buffer.mutex);
  buffer.done = 1;
  pthread_cond_broadcast(&buffer.not_empty);
  pthread_mutex_unlock(&buffer.mutex);
```

```
    pthread_barrier_wait(&buffer.barrier);

    return NULL;
}
```

Worker Threads

Each worker thread processes files from the buffer. Once the buffer is empty and buffer.done is set, they break out of the loop. After finishing their work, they wait at the barrier to ensure all threads have completed their tasks before any thread exits.

```
void *worker(void *arg) {
    while (1) {
        pthread_mutex_lock(&buffer.mutex);

        while (buffer.count == 0 && !buffer.done) {
            pthread_cond_wait(&buffer.not_empty, &buffer.mutex);
        }

        if (buffer.count == 0 && buffer.done) {
            pthread_mutex_unlock(&buffer.mutex);
            break;
        }

        FilePair file_pair = buffer.buffer[buffer.out];
        buffer.out = (buffer.out + 1) % buffer.buffer_size;
        buffer.count--;

        pthread_cond_signal(&buffer.not_full);
        pthread_mutex_unlock(&buffer.mutex);

        copy_file(file_pair.src_path, file_pair.dst_path);
    }

    pthread_barrier_wait(&buffer.barrier);

    return NULL;
}
```

Summary

- **Initialization**: pthread_barrier_init sets up the barrier.
- **Manager Thread**: Waits at the barrier after setting the done flag and broadcasting.
- **Worker Threads**: Wait at the barrier after completing their tasks.

This synchronization ensures all threads have completed their operations before the program terminates, preventing any premature exits and ensuring data consistency.

Test

Test 1

```
root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here# make run_test1
./MWCp 10 10 ../testdir/src/libvterm ../tocopy


Manager: All files copied.

----------------STATISTICS--------------------
Consumers: 10 - Buffer Size: 10
Number of Regular Files: 194
Number of FIFO Files: 0
Number of Directories: 7
TOTAL BYTES COPIED: 25009680
TOTAL TIME: 00:00.592 (min:sec.milli)

root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here#
```

Test 1 with memory leak check

```
root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here# make run_test1_valgrind
valgrind ./MWCp 10 10 ../testdir/src/libvterm ../tocopy
==366== Memcheck, a memory error detector
==366== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==366== Using Valgrind-3.18.1 and LibVEX; rerun with -h for copyright info
==366== Command: ./MWCp 10 10 ../testdir/src/libvterm ../tocopy
==366==


Manager: All files copied.

----------------STATISTICS--------------------
Consumers: 10 - Buffer Size: 10
Number of Regular Files: 194
Number of FIFO Files: 0
Number of Directories: 7
TOTAL BYTES COPIED: 25009680
TOTAL TIME: 00:00.965 (min:sec.milli)

==366==
==366== HEAP SUMMARY:
==366==     in use at exit: 0 bytes in 0 blocks
==366==   total heap usage: 20 allocs, 20 frees, 266,544 bytes allocated
==366==
==366== All heap blocks were freed -- no leaks are possible
==366==
==366== For lists of detected and suppressed errors, rerun with: -s
==366== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here#
```

Test 2

```
root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here# make run_test2
./MWCp 10 4 ../testdir/src/libvterm/src ../toCopy


Manager: All files copied.

----------------STATISTICS--------------------
Consumers: 4 - Buffer Size: 10
Number of Regular Files: 140
Number of FIFO Files: 0
Number of Directories: 2
TOTAL BYTES COPIED: 24873082
TOTAL TIME: 00:00.568 (min:sec.milli)

root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here#
```

Test 2 with memory leak check

```
root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here# make run_test2_valgrind
valgrind ./MWCp 10 4 ../testdir/src/libvterm/src ../toCopy
==421== Memcheck, a memory error detector
==421== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==421== Using Valgrind-3.18.1 and LibVEX; rerun with -h for copyright info
==421== Command: ./MWCp 10 4 ../testdir/src/libvterm/src ../toCopy
==421==


Manager: All files copied.

----------------STATISTICS--------------------
Consumers: 4 - Buffer Size: 10
Number of Regular Files: 140
Number of FIFO Files: 0
Number of Directories: 2
TOTAL BYTES COPIED: 24873082
TOTAL TIME: 00:00.674 (min:sec.milli)

==421==
==421== HEAP SUMMARY:
==421==     in use at exit: 0 bytes in 0 blocks
==421==   total heap usage: 9 allocs, 9 frees, 100,832 bytes allocated
==421==
==421== All heap blocks were freed -- no leaks are possible
==421==
==421== For lists of detected and suppressed errors, rerun with: -s
==421== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here#
```

Test 3

```
root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here# make run_test3
./MWCp 10 10 ../testdir ../toCopy


Manager: All files copied.

----------------STATISTICS--------------------
Consumers: 10 - Buffer Size: 10
Number of Regular Files: 3117
Number of FIFO Files: 0
Number of Directories: 151
TOTAL BYTES COPIED: 73528750
TOTAL TIME: 00:02.608 (min:sec.milli)

root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here#
```

Test 3 with memory leak check

```
root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here# make run_test3_valgrind
valgrind ./MWCp 10 10 ../testdir ../toCopy
==450== Memcheck, a memory error detector
==450== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==450== Using Valgrind-3.18.1 and LibVEX; rerun with -h for copyright info
==450== Command: ./MWCp 10 10 ../testdir ../toCopy
==450==


Manager: All files copied.

----------------STATISTICS--------------------
Consumers: 10 - Buffer Size: 10
Number of Regular Files: 3117
Number of FIFO Files: 0
Number of Directories: 151
TOTAL BYTES COPIED: 73528750
TOTAL TIME: 00:03.419 (min:sec.milli)

==450==
==450== HEAP SUMMARY:
==450==     in use at exit: 0 bytes in 0 blocks
==450==   total heap usage: 164 allocs, 164 frees, 4,992,048 bytes allocated
==450==
==450== All heap blocks were freed -- no leaks are possible
==450==
==450== For lists of detected and suppressed errors, rerun with: -s
==450== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here#
```

Test 4

```
root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here# make run_test4
./MWCp 1 1 ../testdir ../toCopy


Manager: All files copied.

---------------STATISTICS--------------------
Consumers: 1 - Buffer Size: 1
Number of Regular Files: 3117
Number of FIFO Files: 0
Number of Directories: 151
TOTAL BYTES COPIED: 73528750
TOTAL TIME: 00:04.083 (min:sec.milli)

root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here#
```

Test 4 with memory leak check

```
root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here# make run_test4_valgrind
valgrind ./MWCp 1 1 ../testdir ../toCopy
==476== Memcheck, a memory error detector
==476== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==476== Using Valgrind-3.18.1 and LibVEX; rerun with -h for copyright info
==476== Command: ./MWCp 1 1 ../testdir ../toCopy
==476==


Manager: All files copied.

---------------STATISTICS--------------------
Consumers: 1 - Buffer Size: 1
Number of Regular Files: 3117
Number of FIFO Files: 0
Number of Directories: 151
TOTAL BYTES COPIED: 73528750
TOTAL TIME: 00:04.393 (min:sec.milli)

==476==
==476== HEAP SUMMARY:
==476==     in use at exit: 0 bytes in 0 blocks
==476==   total heap usage: 155 allocs, 155 frees, 4,989,600 bytes allocated
==476==
==476== All heap blocks were freed -- no leaks are possible
==476==
==476== For lists of detected and suppressed errors, rerun with: -s
==476== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here#
```

Test 5

```
root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here# make run_test5
./MWCp 1 10 ../testdir ../toCopy


Manager: All files copied.

---------------STATISTICS--------------------
Consumers: 10 - Buffer Size: 1
Number of Regular Files: 3117
Number of FIFO Files: 0
Number of Directories: 151
TOTAL BYTES COPIED: 73528750
TOTAL TIME: 00:02.440 (min:sec.milli)

root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here#
```

Test 5 with memory leak check

```
root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here# make run_test5_valgrind
valgrind ./MWCp 1 10 ../testdir ../toCopy
==502== Memcheck, a memory error detector
==502== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==502== Using Valgrind-3.18.1 and LibVEX; rerun with -h for copyright info
==502== Command: ./MWCp 1 10 ../testdir ../toCopy
==502==


Manager: All files copied.

---------------STATISTICS--------------------
Consumers: 10 - Buffer Size: 1
Number of Regular Files: 3117
Number of FIFO Files: 0
Number of Directories: 151
TOTAL BYTES COPIED: 73528750
TOTAL TIME: 00:04.167 (min:sec.milli)

==502==
==502== HEAP SUMMARY:
==502==     in use at exit: 0 bytes in 0 blocks
==502==   total heap usage: 164 allocs, 164 frees, 4,992,048 bytes allocated
==502==
==502== All heap blocks were freed -- no leaks are possible
==502==
==502== For lists of detected and suppressed errors, rerun with: -s
==502== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here#
```

Signal Handling Test

```
root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here# make run_test3
./MWCp 10 10 ../testdir ../toCopy
^CInterrupt signal received. Cleaning up...


Manager: All files copied.

----------------STATISTICS--------------------
Consumers: 10 - Buffer Size: 10
Number of Regular Files: 1519
Number of FIFO Files: 0
Number of Directories: 102
TOTAL BYTES COPIED: 22106379
TOTAL TIME: 00:01.266 (min:sec.milli)


root@0fd75fa7cb8b:/workspace/HW5/hw4test/put_your_codes_here#
```