REPORT:

Same as HW4 but barriers are added.

```
pthread_barrier_t barrier;   // Barrier to synchronize threads
```

In main : num_workers + manager(1) size barrier.

```
// Initialize buffer and barrier
init_buffer(&buffer, buffer_size);
pthread_barrier_init(&barrier, NULL, num_workers + 1);
```

```
// Manager thread function
void *manager_thread(void *arg) {
    char *source_dir = ((char **)arg)[0];
    char *dest_dir = ((char **)arg)[1];

    gettimeofday(&start_time, NULL); // Record start time
    //printf("Manager thread (Thread ID: %ld) started.\n", syscall(SYS_gettid));
    process_directory(source_dir, dest_dir); // Start processing directories

    pthread_mutex_lock(&buffer.mutex);
    buffer.done = 1;
    pthread_cond_broadcast(&buffer.not_empty);
    pthread_mutex_unlock(&buffer.mutex);
    //printf("Manager thread (Thread ID: %ld) signaling completion.\n", syscall(SYS_gettid));

    pthread_barrier_wait(&barrier); // Wait for all threads to reach the barrier

    return NULL;
}
```

After file copying , barrier_wait is there.

```
        //printf("Copying file: %s to %s (Thread ID: %ld)\n", file.source_path, file.dest_path, syscall(SYS_gettid));
        char buf[1024];
        ssize_t n;
        while ((n = read(source_fd, buf, sizeof(buf))) > 0) {
            if (write(dest_fd, buf, n) != n) {
                perror("Error writing to file");
                break;
            }
            pthread_mutex_lock(&total_bytes_mutex); // Lock mutex for updating total bytes copied
            total_bytes_copied += n;
            pthread_mutex_unlock(&total_bytes_mutex); // Unlock mutex
        }
        close(source_fd);
        close(dest_fd);
    }

    pthread_barrier_wait(&barrier);
    //printf("Worker thread (Thread ID: %ld) exiting after barrier.\n", syscall(SYS_gettid));

    return NULL;
}
```

In the end of main barrier is freed.

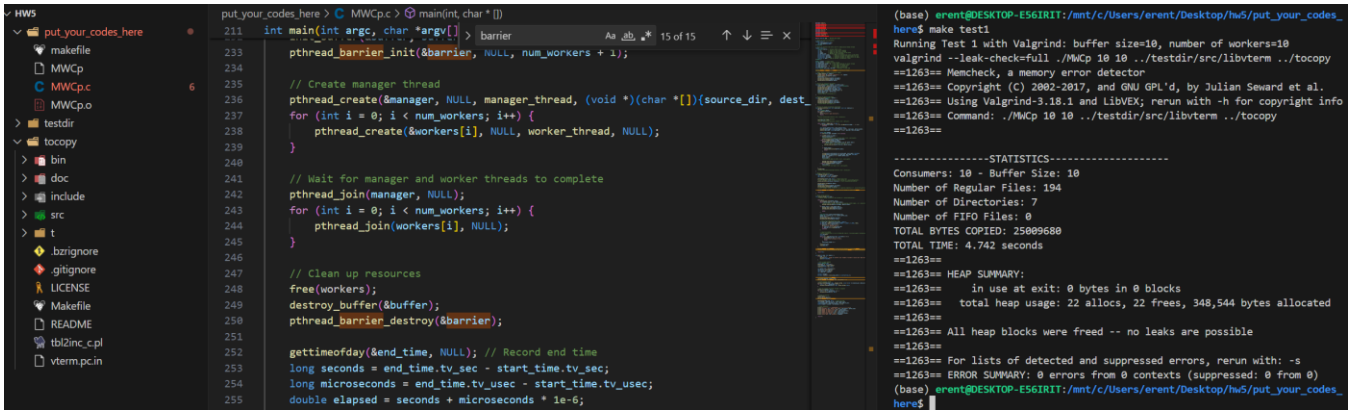
```
// Clean up resources
free(workers);
destroy_buffer(&buffer);
pthread_barrier_destroy(&barrier);
```

Signal handler (CTRL + C) :

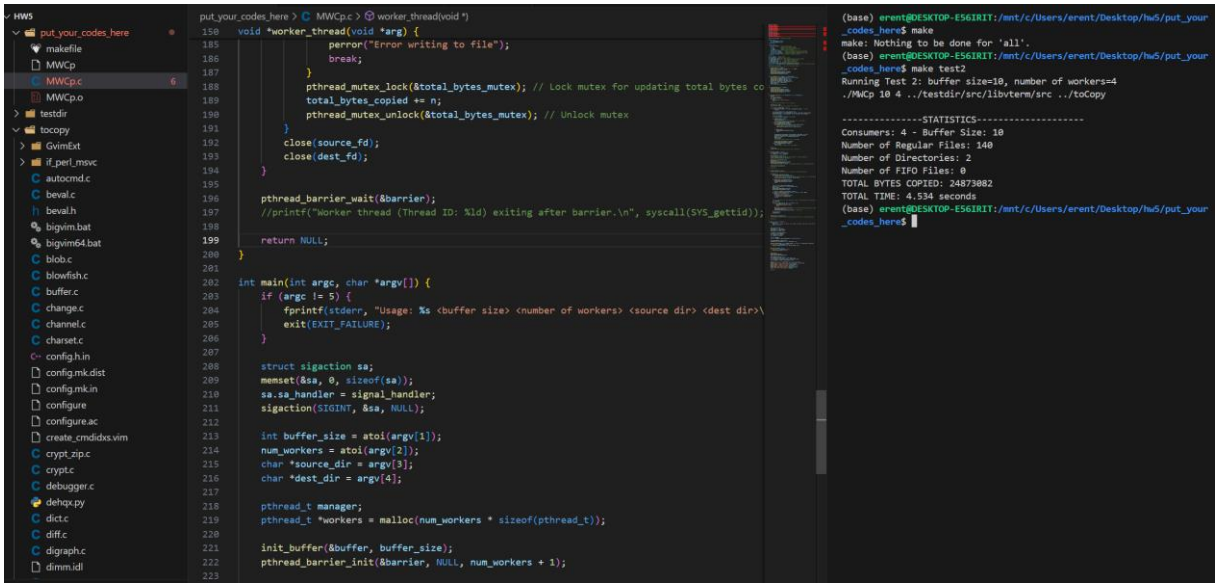
```
(base) erent@DESKTOP-E56IRIT:/mnt/c/Users/erent/Desktop/hw5/put_your_codes_
here$ make test3
Running Test 3: buffer size=10, number of workers=100
./MWCp 10 100 ../testdir ../toCopy
^CSignal 2 received, cleaning up...

----------------STATISTICS--------------------
Consumers: 100 - Buffer Size: 10
Number of Regular Files: 784
Number of Directories: 20
Number of FIFO Files: 0
TOTAL BYTES COPIED: 11376698
TOTAL TIME: 1.895 seconds
```

TEST1 :

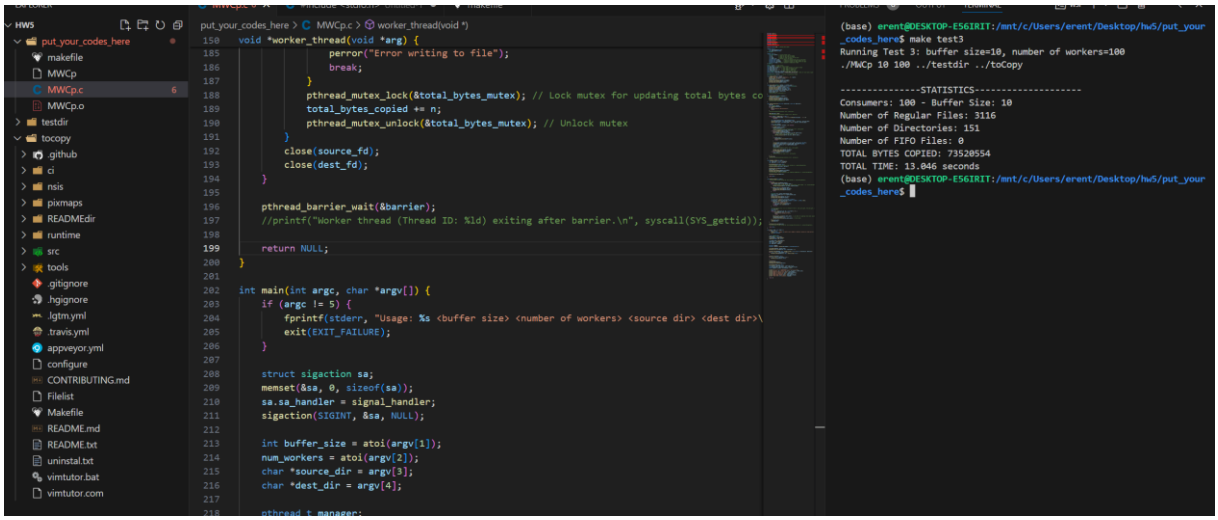
No memory leak.



TEST 2 :



TEST3 :



Barrier working well as we can see. If you uncomment printfs you can get output like this.

```
Worker thread (Thread ID: 2269) exiting after barrier.
Worker thread (Thread ID: 2318) exiting after barrier.
Worker thread (Thread ID: 2257) exiting after barrier.
Worker thread (Thread ID: 2294) exiting after barrier.
Worker thread (Thread ID: 2300) exiting after barrier.
Worker thread (Thread ID: 2302) exiting after barrier.
Worker thread (Thread ID: 2291) exiting after barrier.
Worker thread (Thread ID: 2285) exiting after barrier.
Worker thread (Thread ID: 2289) exiting after barrier.
Worker thread (Thread ID: 2278) exiting after barrier.
Worker thread (Thread ID: 2288) exiting after barrier.
Worker thread (Thread ID: 2301) exiting after barrier.
Worker thread (Thread ID: 2342) exiting after barrier.
Worker thread (Thread ID: 2280) exiting after barrier.
Worker thread (Thread ID: 2305) exiting after barrier.
Worker thread (Thread ID: 2316) exiting after barrier.
Worker thread (Thread ID: 2308) exiting after barrier.
Worker thread (Thread ID: 2267) exiting after barrier.
Worker thread (Thread ID: 2298) exiting after barrier.
Worker thread (Thread ID: 2282) exiting after barrier.
Worker thread (Thread ID: 2313) exiting after barrier.
Worker thread (Thread ID: 2319) exiting after barrier.
Worker thread (Thread ID: 2336) exiting after barrier.
Worker thread (Thread ID: 2339) exiting after barrier.
Worker thread (Thread ID: 2311) exiting after barrier.
Worker thread (Thread ID: 2252) exiting after barrier.
Worker thread (Thread ID: 2331) exiting after barrier.
Worker thread (Thread ID: 2306) exiting after barrier.
Worker thread (Thread ID: 2293) exiting after barrier.

---------------STATISTICS--------------------
Consumers: 100 - Buffer Size: 10
Number of Regular Files: 3116
Number of Directories: 151
Number of FIFO Files: 0
TOTAL BYTES COPIED: 73520554
TOTAL TIME: 14.749 seconds
```