

CSE 344

Homework #4 Report

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1901042681

Compile and run:

```
make: *** [makefile:22: 1901042681_main.o] Error 1
berry@DESKTOP-092GAB6:/mnt/c/Users/lafci/Desktop/GTU/4. sınıf/4. sınıf 2. donem/System Programming/HW4/hw4test/put_your_codes_here$ make
gcc -Wall -Wextra -Werror -c 1901042681_main.c -o 1901042681_main.o
gcc -Wall -Wextra -Werror -o MWCP 1901042681_main.o
berry@DESKTOP-092GAB6:/mnt/c/Users/lafci/Desktop/GTU/4. sınıf/4. sınıf 2. donem/System Programming/HW4/hw4test/put_your_codes_here$ valgrind --leak-check=full ./MWCP 10 10 ../testdir/src/libvterm ../tocopyyyyy
==121== Memcheck, a memory error detector
==121== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==121== Using Valgrind-3.18.1 and LibVEX; rerun with -h for copyright info
==121== Command: ./MWCP 10 10 ../testdir/src/libvterm ../tocopyyyyy
```

Clean:

```
==121== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
berry@DESKTOP-092GAB6:/mnt/c/Users/lafci/Desktop/GTU/4. sınıf/4. sınıf 2. donem/System Programming/HW4/hw4test/put_your_codes_here$ make clean
rm -f MWCP 1901042681_main.o
berry@DESKTOP-092GAB6:/mnt/c/Users/lafci/Desktop/GTU/4. sınıf/4. sınıf 2. donem/System Programming/HW4/hw4test/put_your_
```

Logic of the code:

```
typedef struct {
    file_info_t buffer[MAX_BUFFER]; // Buffer to store file info
    int in;                          // Index to insert a file info
    int out;                         // Index to remove a file info
    int count;                       // Number of file info in the buffer
    pthread_mutex_t mutex;           // Mutex to protect the buffer
    pthread_cond_t not_empty;        // Condition variable to signal that the buffer is not empty
    pthread_cond_t not_full;         // Condition variable to signal that the buffer is not full
    int done;                        // Flag to indicate that the manager thread has finished
} buffer_t;
```

1. `file_info_t buffer[MAX_BUFFER]`:

- This is an array of `file_info_t` structures. Each `file_info_t` holds information about a file to be copied, including file descriptors and file paths.

2. `int in`:

- This integer is an index pointing to the next position in the buffer where the manager thread will place a new `file_info_t`.

3. `int out`:

- This integer is an index pointing to the next position in the buffer from which the worker threads will retrieve a `file_info_t`.

4. `int count`:

- This integer keeps track of the number of `file_info_t` elements currently present in the buffer.

5. **pthread_mutex_t mutex:**

- This mutex ensures that access to the buffer is synchronized between the manager and worker threads. Only one thread can modify the buffer at any given time, **preventing race conditions**.

6. **pthread_cond_t not_empty:**

- This condition variable is used by worker threads to wait if the buffer is empty.

7. **pthread_cond_t not_full:**

- This condition variable is used by the manager thread to wait if the buffer is full.

8. **int done:**

- This flag indicates whether the directory traversal and file addition process by the manager thread is complete.

```
void copy_directory(const char *src_dir, const char *dest_dir) {  
    DIR *dp = opendir(src_dir);
```

- Opens the source directory and iterates over its entries.
- **For directories**, it creates the destination directory and calls itself recursively.

```
// Check if the entry is a directory  
if (entry->d_type == DT_DIR) {  
    num_directories++;  
    mkdir(dest_path, 0755); // Create the directory in the destination directory  
    copy_directory(src_path, dest_path); // Recursive call to copy subdirectory  
}
```

- **For regular files,**

- opens the source and destination files,
- locks the buffer and enter critical region: **pthread_mutex_lock(&buffer.mutex);**
- waits if full,

```
// Wait while the buffer is full  
while (buffer.count == buffer_size && !sigint_received) {  
    pthread_cond_wait(&buffer.not_full, &buffer.mutex); // W  
}
```

- adds files to a shared buffer for the worker threads to process,

- signals the worker threads,
- unlocks the buffer and exit from the critical region

```
pthread_cond_signal(&buffer.not_empty); // Signal the worker threads
pthread_mutex_unlock(&buffer.mutex); // Unlock the mutex
```

- For **fifo files**, it creates the fifo with mkfifo.

```
// Check if the entry is a FIFO file
else if (entry->d_type == DT_FIFO) {
    num_fifo_files++;
    mkfifo(dest_path, 0644); // Create the FIFO file
}
```

```
void *manager_thread(void *arg) {
```

- Initializes the destination directory.
- Calls **copy_directory** to start copying files to the buffer.
- Locks the buffer, sets the **done** flag, and announces to wake up all worker threads to finish.

```
void *worker_thread() {
```

- Locks the buffer, waits if empty, processes files from the buffer, and updates statistics.
- Reads file information (file descriptors and paths) from the shared buffer.
- Performs the actual copying of file contents from the source to the destination using read and write operations.

```
while ((n = read(file.src_fd, buf, sizeof(buf))) > 0) {
    if (write(file.dest_fd, buf, n) != n) {
        perror("write");
        break;
    }
    total_bytes_copied += n;
}
```

- Signals the manager thread when the buffer is not full.

```

void sigint_handler() {
    printf("\nSIGINT received\n");

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

```

- Sets the **stop_signal_received** flag.
- Locks the buffer, sets the **done** flag, and broadcasts to all threads to wake up and stop.

```

int main(int argc, char *argv[]) {
    if (argc != 5) {

```

- Parses command-line arguments and initializes global variables.
- Sets up signal handling.
- Initializes the buffer and synchronization primitives.
- Creates the manager and worker threads.
- Waits for all threads to finish.
- Calculates and prints the statistics.
- Destroys the mutex and condition variables.

Test cases:

- Sigint:

```
Copied ../testdir/runtime/keymap/armenian-western_utf-8.vim to ../tocopysig/runtime/keymap/armenian-western_utf-8.vim
Copied ../testdir/runtime/keymap/belarusian-jcuken.vim to ../tocopysig/runtime/keymap/belarusian-jcuken.vim
Copied ../testdir/runtime/indent/vim.vim to ../tocopysig/runtime/indent/vim.vim
Copied ../testdir/runtime/keymap/bulgarian-phonetic.vim to ../tocopysig/runtime/keymap/bulgarian-phonetic.vim

SIGINT received
Copied ../testdir/runtime/keymap/canfr-win.vim to ../tocopysig/runtime/keymap/canfr-win.vim
Copied ../testdir/runtime/keymap/croatian.vim to ../tocopysig/runtime/keymap/croatian.vim
Copied ../testdir/runtime/keymap/croatian_cp1250.vim to ../tocopysig/runtime/keymap/croatian_cp1250.vim
Copied ../testdir/runtime/keymap/arabic_utf-8.vim to ../tocopysig/runtime/keymap/arabic_utf-8.vim
Copied ../testdir/runtime/keymap/armenian-eastern_utf-8.vim to ../tocopysig/runtime/keymap/armenian-eastern_utf-8.vim
Copied ../testdir/runtime/keymap/czech.vim to ../tocopysig/runtime/keymap/czech.vim
Copied ../testdir/runtime/keymap/czech_utf-8.vim to ../tocopysig/runtime/keymap/czech_utf-8.vim
Copied ../testdir/runtime/keymap/dvorak.vim to ../tocopysig/runtime/keymap/dvorak.vim
Copied ../testdir/runtime/keymap/esperanto.vim to ../tocopysig/runtime/keymap/esperanto.vim
Copied ../testdir/runtime/keymap/esperanto_utf-8.vim to ../tocopysig/runtime/keymap/esperanto_utf-8.vim
Copied ../testdir/runtime/keymap/greek.vim to ../tocopysig/runtime/keymap/greek.vim
Copied ../testdir/runtime/keymap/greek_cp1253.vim to ../tocopysig/runtime/keymap/greek_cp1253.vim
Copied ../testdir/runtime/keymap/greek_cp737.vim to ../tocopysig/runtime/keymap/greek_cp737.vim
Copied ../testdir/runtime/keymap/greek_iso-8859-7.vim to ../tocopysig/runtime/keymap/greek_iso-8859-7.vim
Copied ../testdir/runtime/keymap/greek_utf-8.vim to ../tocopysig/runtime/keymap/greek_utf-8.vim

-----STATISTICS-----
Consumers: 10 - Buffer Size: 10
Number of Regular Files: 855
Number of FIFO Files: 0
Number of Directories: 20
TOTAL BYTES COPIED: 11581876
TOTAL TIME: 00:01.563 (min:sec.mili)
berry@DESKTOP-092GAB6:/mnt/c/Users/lafci/Desktop/GTU/4. sınıf/4. sınıf 2. donem/System Programming/HW4/hw4test/put_your
```

- Sigint with valgrind:

```
gcc -Wall -Wextra -Werror -O3 -MCP 1001042001 main.o
berry@DESKTOP-092GAB6:/mnt/c/Users/lafci/Desktop/GTU/4. sınıf/4. sınıf 2. donem/System Programming/HW4/hw4test/put_your_codes_here$ valgrind --leak-check=full --show-leak-kinds=all ./MWCp 10 10 ../testdir ../tocopy
==30== Memcheck, a memory error detector
==30== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==30== Using Valgrind-3.18.1 and LibVEX; rerun with -h for copyright info

Copied ../testdir/runtime/ftplugin/manconf.vim to ../tocopy/runtime/ftplugin/manconf.vim
Copied ../testdir/runtime/ftplugin/markdown.vim to ../tocopy/runtime/ftplugin/markdown.vim
^C
SIGINT received
Copied ../testdir/runtime/ftplugin/matlab.vim to ../tocopy/runtime/ftplugin/matlab.vim

-----STATISTICS-----
Consumers: 10 - Buffer Size: 10
Number of Regular Files: 577
Number of FIFO Files: 0
Number of Directories: 16
TOTAL BYTES COPIED: 10781750
TOTAL TIME: 00:01.029 (min:sec.mili)
==30==
==30== HEAP SUMMARY:
==30==    in use at exit: 0 bytes in 0 blocks
==30==   total heap usage: 29 allocs, 29 frees, 564,960 bytes allocated
==30==
==30== All heap blocks were freed -- no leaks are possible
==30==
==30== For lists of detected and suppressed errors, rerun with: -s
==30== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
berry@DESKTOP-092GAB6:/mnt/c/Users/lafci/Desktop/GTU/4. sınıf/4. sınıf 2. donem/System Programming/HW4/hw4test/put_y
```

- Test1:

```

berry@DESKTOP-092GAB6:/mnt/c/Users/lafci/Desktop/GTU/4. sınıf/4. sınıf 2. donem/System Programming/HW4/hw4test/put_your_codes_here$ valgrind --leak-check=full ./MWCp 10 10 ../testdir/src/libvterm ../tocopy
==142== Memcheck, a memory error detector
==142== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==142== Using Valgrind-3.18.1 and LibVEX; rerun with -h for copyright info
==142== Command: ./MWCp 10 10 ../testdir/src/libvterm ../tocopy
==142==

Copied ../testdir/src/libvterm/t/22state_save.test to ../tocopy/t/22state_save.test
Copied ../testdir/src/libvterm/t/40screen_ascii.test to ../tocopy/t/40screen_ascii.test
Copied ../testdir/src/libvterm/t/42screen_damage.test to ../tocopy/t/42screen_damage.test
Copied ../testdir/src/libvterm/t/28state_dbl_wh.test to ../tocopy/t/28state_dbl_wh.test
Copied ../testdir/src/libvterm/t/43screen_resize.test to ../tocopy/t/43screen_resize.test
Copied ../testdir/src/libvterm/t/26state_query.test to ../tocopy/t/26state_query.test
Copied ../testdir/src/libvterm/t/48screen_termprops.test to ../tocopy/t/48screen_termprops.test
Copied ../testdir/src/libvterm/t/90vttest_01-movement-3.test to ../tocopy/t/90vttest_01-movement-3.test
Copied ../testdir/src/libvterm/t/90vttest_02-screen-1.test to ../tocopy/t/90vttest_02-screen-1.test
Copied ../testdir/src/libvterm/t/44screen_pen.test to ../tocopy/t/44screen_pen.test
Copied ../testdir/src/libvterm/t/90vttest_01-movement-4.test to ../tocopy/t/90vttest_01-movement-4.test
Copied ../testdir/src/libvterm/t/47screen_dbl_wh.test to ../tocopy/t/47screen_dbl_wh.test
Copied ../testdir/src/libvterm/t/90vttest_02-screen-2.test to ../tocopy/t/90vttest_02-screen-2.test
Copied ../testdir/src/libvterm/t/90vttest_01-movement-1.test to ../tocopy/t/90vttest_01-movement-1.test
Copied ../testdir/src/libvterm/t/90vttest_02-screen-3.test to ../tocopy/t/90vttest_02-screen-3.test
Copied ../testdir/src/libvterm/t/90vttest_01-movement-2.test to ../tocopy/t/90vttest_01-movement-2.test
Copied ../testdir/src/libvterm/t/90vttest_02-screen-4.test to ../tocopy/t/90vttest_02-screen-4.test
Copied ../testdir/src/libvterm/t/92lp1640917.test to ../tocopy/t/92lp1640917.test
Copied ../testdir/src/libvterm/vterm.pc.in to ../tocopy/vterm.pc.in
Copied ../testdir/src/libvterm/t/harness.c to ../tocopy/t/harness.c
Copied ../testdir/src/libvterm/src/isl1551098739430.pdf to ../tocopy/src/isl1551098739430.pdf
Copied ../testdir/src/libvterm/tbl2inc.c.pl to ../tocopy/tbl2inc.c.pl
Copied ../testdir/src/libvterm/t/run-test.pl to ../tocopy/t/run-test.pl

-----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: 00:04.225 (min:sec.mili)
==142==
==142== HEAP SUMMARY:
==142==    in use at exit: 0 bytes in 0 blocks
==142==    total heap usage: 20 allocs, 20 frees, 269,616 bytes allocated
==142==
==142== All heap blocks were freed -- no leaks are possible
==142==
==142== For lists of detected and suppressed errors, rerun with: -s
==142== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
berry@DESKTOP-092GAB6:/mnt/c/Users/lafci/Desktop/GTU/4. sınıf/4. sınıf 2. donem/System Programming/HW4/hw4test/put_your_codes_here$

```

- Test2:

```

berry@DESKTOP-092GAB6:/mnt/c/Users/lafci/Desktop/GTU/4. sınıf/4. sınıf 2. donem/System Programming/HW4/hw4test/put_your_codes_here$ ./MWCp 10 4 ../testdir/src/libvterm/src ../toCopy
Copied ../testdir/src/libvterm/src/beval.c to ../toCopy/beval.c
Copied ../testdir/src/libvterm/src/beval.h to ../toCopy/beval.h

```

```

Copied ../testdir/src/libvterm/src/INSTALLmac.txt to ../toCopy/INSTALLmac.txt
Copied ../testdir/src/libvterm/src/indent.c to ../toCopy/indent.c
Copied ../testdir/src/libvterm/src/installman.sh to ../toCopy/installman.sh
Copied ../testdir/src/libvterm/src/insexpand.c to ../toCopy/insexpand.c
Copied ../testdir/src/libvterm/src/installml.sh to ../toCopy/installml.sh
Copied ../testdir/src/libvterm/src/INSTALLvms.txt to ../toCopy/INSTALLvms.txt
Copied ../testdir/src/libvterm/src/INSTALLx.txt to ../toCopy/INSTALLx.txt
Copied ../testdir/src/libvterm/src/INSTALLpc.txt to ../toCopy/INSTALLpc.txt
Copied ../testdir/src/libvterm/src/iscygpty.c to ../toCopy/iscygpty.c
Copied ../testdir/src/libvterm/src/iscygpty.h to ../toCopy/iscygpty.h
Copied ../testdir/src/libvterm/src/json_test.c to ../toCopy/json_test.c
Copied ../testdir/src/libvterm/src/keyboard.c to ../toCopy/keyboard.c
Copied ../testdir/src/libvterm/src/keymap.h to ../toCopy/keymap.h
Copied ../testdir/src/libvterm/src/kword_test.c to ../toCopy/kword_test.c
Copied ../testdir/src/libvterm/src/mouse.c to ../toCopy/mouse.c
Copied ../testdir/src/libvterm/src/json.c to ../toCopy/json.c
Copied ../testdir/src/libvterm/src/parser.c to ../toCopy/parser.c
Copied ../testdir/src/libvterm/src/pen.c to ../toCopy/pen.c
Copied ../testdir/src/libvterm/src/rect.h to ../toCopy/rect.h
Copied ../testdir/src/libvterm/src/state.c to ../toCopy/state.c
Copied ../testdir/src/libvterm/src/termScreen.c to ../toCopy/termScreen.c
Copied ../testdir/src/libvterm/src/unicode.c to ../toCopy/unicode.c
Copied ../testdir/src/libvterm/src/utf8.h to ../toCopy/utf8.h
Copied ../testdir/src/libvterm/src/vterm.c to ../toCopy/vterm.c
Copied ../testdir/src/libvterm/src/vterm_internal.h to ../toCopy/vterm_internal.h
Copied ../testdir/src/libvterm/src/MRT10.pdf to ../toCopy/MRT10.pdf
Copied ../testdir/src/libvterm/src/isl1551098739430.pdf to ../toCopy/isl1551098739430.pdf

```

-----STATISTICS-----

```

Consumers: 4 - Buffer Size: 10
Number of Regular Files: 140
Number of FIFO Files: 0
Number of Directories: 2
TOTAL BYTES COPIED: 24651823
TOTAL TIME: 00:00.400 (min:sec.mili)

```

```

berry@DESKTOP-092GAB6:/mnt/c/Users/lafci/Desktop/GTU/4. sınıf/4. sınıf 2. donem/System Programming/HW4/hw4test/put_your_codes_here$ |

```

Test3:

```

berry@DESKTOP-092GAB6:/mnt/c/Users/lafci/Desktop/GTU/4.
berry@DESKTOP-092GAB6:/mnt/c/Users/lafci/Desktop/GTU/4.
codes_here$ ./MWCp 10 10 ../testdir ../toCopy
Copied ../testdir/.github/ISSUE_TEMPLATE/bug_report.md to
Copied ../testdir/.github/ISSUE_TEMPLATE/feature_request

```

```

Copied ../testdir/src/xpm_w32.c to ../toCopy/src/xpm_w32.c
Copied ../testdir/src/xpm/README.txt to ../toCopy/src/xpm/README.txt
Copied ../testdir/src/xpm/include/xpm.h to ../toCopy/src/xpm/include/xpm.h
Copied ../testdir/src/xxd/Make_amiga.mak to ../toCopy/src/xxd/Make_amiga.mak
Copied ../testdir/src/xpm/x64/lib-vc14/libXpm.lib to ../toCopy/src/xpm/x64/lib
Copied ../testdir/src/xxd/Make_mvc.mak to ../toCopy/src/xxd/Make_mvc.mak
Copied ../testdir/tools/rename.bat to ../toCopy/tools/rename.bat
Copied ../testdir/src/xxd/Make_vms.mms to ../toCopy/src/xxd/Make_vms.mms
Copied ../testdir/src/xxd/xxd.c to ../toCopy/src/xxd/xxd.c
Copied ../testdir/uninstal.txt to ../toCopy/uninstal.txt
Copied ../testdir/vimtutor.bat to ../toCopy/vimtutor.bat
Copied ../testdir/vimtutor.com to ../toCopy/vimtutor.com

```

-----STATISTICS-----

```

Consumers: 10 - Buffer Size: 10
Number of Regular Files: 3116
Number of FIFO Files: 0
Number of Directories: 151
TOTAL BYTES COPIED: 72598614
TOTAL TIME: 00:13.148 (min:sec.mili)

```

```

berry@DESKTOP-092GAB6:/mnt/c/Users/lafci/Desktop/GTU/4. sınıf/4. sınıf 2. donem/System Programming/HW4/hw4test/put_your_codes_here$ |

```


- Error arguments:

```
berry@DESKTOP-092GAB6:/mnt/c/Users/lafci/Desktop/GTU/4. sınıf/4. si  
codes_here$ ./MwCp 10 10 ../testdir  
Usage: ./MwCp <buffer_size> <num_workers> <src_dir> <dest_dir>  
berry@DESKTOP-092GAB6:/mnt/c/Users/lafci/Desktop/GTU/4. sınıf/4. si
```

- FIFO file:

```
berry@DESKTOP-092GAB6:~$ ls  
1901042681_main.c aaa.c deneme fifo1 fifo fifo.c makefile  
berry@DESKTOP-092GAB6:~$ make  
gcc -Wall -Wextra -Werror -c 1901042681_main.c -o 1901042681_main.o  
gcc -Wall -Wextra -Werror -o MwCp 1901042681_main.o  
berry@DESKTOP-092GAB6:~$ ./MwCp 10 4 deneme tocopy  
Copied deneme/denemee.c to tocopy/denemee.c  
Copied deneme/denemee to tocopy/denemee  
  
-----STATISTICS-----  
Consumers: 4 - Buffer Size: 10  
Number of Regular Files: 2  
Number of FIFO Files: 1  
Number of Directories: 0  
TOTAL BYTES COPIED: 16552  
TOTAL TIME: 00:00.003 (min:sec.mili)  
berry@DESKTOP-092GAB6:~$ ls  
1901042681_main.c MwCp deneme fifo makefile  
1901042681_main.o aaa.c fifo1 fifo.c tocopy  
berry@DESKTOP-092GAB6:~$
```