

CSE344 Homework 5 Report

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1. Problem Definition

Develop a directory copying utility called "MWCp" that copies files and sub-directories in parallel. Use a worker-manager approach to synchronize thread activity. Use POSIX and Standard C libraries.

2. General Structure

Information about condition variables and barrier

I used same condition structure with homework 4. Used one barrier. In barrier there are 3 possible waits. Two of them inside the while loop in worker thread.

First wait -> If file not opened correctly, thread will wait here until others copy files and wait in other barrier.

Second wait -> Copied file and wait after copied file in barrier

Third wait -> If any threads wait after copy and no other files left, it may stuck in first wait. If any threads stuck in first wait, others will wait in third wait to make sure they left correctly.

Code changes:

Added barrier_wait end of while loop in worker.

Modified if(file descriptors) for barrier_wait(explained above)

Added barrier_wait and its conditions after while loop in worker

Simplified version of the code. For detailly (signal handler, closing file etc.) implementation you can look code file.

```
pthread_mutex_t the_mutex; // Mutex for synchronization between threads
```

```
pthread_cond_t condc, condp; // Condition variables for controlling if buffer is full or empty
```

```
pthread_mutex_t flag; // Mutex for SIGINT
```

```
pthread_barrier_t workerBarrier; // Barrier for workers
```

```
typedef struct {
```

```
    int srcFd; // File descriptor for source file
```

```
    int destFd; // File descriptor for destination file
```

```
    char srcName[PATH_SIZE]; // Source file name
```

```
    char destName[PATH_SIZE]; // Destination file name
```

```
} Files;
```

typedef struct {

```
    int bufferSize; // Buffer size Files *buffer; // Buffer  
    int count; // Number of items in buffer  
    int head; // Head of buffer int last; // Last of buffer  
    int doneFlag; // Done flag
```

} Buffer;

manager(arg) {

```
    char **argv = (char **) arg;  
    createDirectory(argv[3], argv[4]);  
    lock(&thread_mutex);  
    buffer.doneFlag = 1;  
    broadcast(&condc);  
    unlock(&thread_mutex);
```

}

worker(arg) {

```
    while(1) {  
        item = remove_item();  
        if(item.srcFd == -1 or item.dest == -1) {  
            lock(&the_mutex);  
            if(activeWorker == numberOfWorkers) {  
                unlock(&the_mutex);  
                barrier_wait(&workerBarrier);  
            } else {  
                unlock(&the_mutex);  
            }  
            if(item.srcFd == -1 and item.dest == -1) {  
                lock(&the_mutex);  
                if(activeWorker == numberOfWorkers) wait = 1;  
                unlock(&the_mutex);  
                break;  
            }  
        }  
    }
```

```

        }
        continue;
    }
    while(bytes_read = read(item.src) > 0) {
        bytes_write = write(item.destFd);
        totalWritten += bytes_write;
    }
    close(item.srcFd);
    close(item.dstFd);
    lock(&thread_mutex);
    totalBytes += totalWritten;
    unlock(&thread_mutex);
    barrier_wait(&workerBarrier);
}

lock(&the_mutex);
activeWorker--;
if(wait == 1 && buffer.count == 0) {
    unlock(&the_mutex);
    barrier_wait(&workerBarrier);
} else {
    unlock(&the_mutex);
}

pthread_exit(0);
}

add_item(Files item) {
    lock(&thread_mutex);
    while(buffer.count == maxBuffer) cond_wait(&condp, &thread_mutex);
    buffer.buffer[buffer.last] = item;
    buffer.last = (buffer.last + 1) % buffer.bufferSize;
    buffer.count++;
    cond_signal(&condc);
}

```

```

        unlock(&thread_mutex);
    }
    remove_item() {
        lock(&thread_mutex);
        while(buffer.count == 0 && buffer.doneFlag == 0) cond_wait(&condc, &thread_mutex);
        if(buffer.count > 0) {
            item = buffer.buffer[buffer.head];
            buffer.head = (buffer.head + 1) % buffer.bufferSize;
            buffer.count--;
            cond_signal(&condp);
            unlock(&thread_mutex);
            return item;
        }
        unlock(&thread_mutex);
        return (Files) {-1, -1, "", ""};
    }
}

```

3. Tests

- Test1: valgrind ./MWCp 10 10 ../testdir/src/libvterm ../tocopy, #memory leak checking, buffer size=10, number of workers=10, sourceFile, destinationFile

```
@DESKTOP-SFOAM7: /mnt, X + -
Copied ../testdir/src/libvterm/t/18state_termprops.test to ../tocopy/t/18state_termprops.test
Copied ../testdir/src/libvterm/t/16state_resize.test to ../tocopy/t/16state_resize.test
Copied ../testdir/src/libvterm/t/17state_mouse.test to ../tocopy/t/17state_mouse.test
Copied ../testdir/src/libvterm/t/20state_wrapping.test to ../tocopy/t/20state_wrapping.test
Copied ../testdir/src/libvterm/t/21state_tabstops.test to ../tocopy/t/21state_tabstops.test
Copied ../testdir/src/libvterm/t/22state_save.test to ../tocopy/t/22state_save.test
Copied ../testdir/src/libvterm/t/25state_input.test to ../tocopy/t/25state_input.test
Copied ../testdir/src/libvterm/t/26state_query.test to ../tocopy/t/26state_query.test
Copied ../testdir/src/libvterm/t/27state_reset.test to ../tocopy/t/27state_reset.test
Copied ../testdir/src/libvterm/t/28state_dbt_Wh.test to ../tocopy/t/28state_dbt_Wh.test
Copied ../testdir/src/libvterm/t/29state_fallback.test to ../tocopy/t/29state_fallback.test
Copied ../testdir/src/libvterm/t/30pen.test to ../tocopy/t/30pen.test
Copied ../testdir/src/libvterm/t/40screen_ansi.test to ../tocopy/t/40screen_ansi.test
Copied ../testdir/src/libvterm/t/41screen_unicode.test to ../tocopy/t/41screen_unicode.test
Copied ../testdir/src/libvterm/t/42screen_damage.test to ../tocopy/t/42screen_damage.test
Copied ../testdir/src/libvterm/t/43screen_resize.test to ../tocopy/t/43screen_resize.test
Copied ../testdir/src/libvterm/t/44screen_pen.test to ../tocopy/t/44screen_pen.test
Copied ../testdir/src/libvterm/t/45screen_protect.test to ../tocopy/t/45screen_protect.test
Copied ../testdir/src/libvterm/t/46screen_extent.test to ../tocopy/t/46screen_extent.test
Copied ../testdir/src/libvterm/t/47screen_dbt_Wh.test to ../tocopy/t/47screen_dbt_Wh.test
Copied ../testdir/src/libvterm/t/48screen_termprops.test to ../tocopy/t/48screen_termprops.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_01-movement-2.test to ../tocopy/t/90vttest_01-movement-2.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_01-movement-4.test to ../tocopy/t/90vttest_01-movement-4.test
Copied ../testdir/src/libvterm/t/90vttest_02-screen-1.test to ../tocopy/t/90vttest_02-screen-1.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_02-screen-3.test to ../tocopy/t/90vttest_02-screen-3.test
Copied ../testdir/src/libvterm/t/90vttest_02-screen-4.test to ../tocopy/t/90vttest_02-screen-4.test
Copied ../testdir/src/libvterm/t/92tbl2inc.pl to ../tocopy/t/92tbl2inc.pl
Copied ../testdir/src/libvterm/t/run-test.pl to ../tocopy/t/run-test.pl
Copied ../testdir/src/libvterm/tbl2inc.c.pl to ../tocopy/tbl2inc.c.pl
Copied ../testdir/src/libvterm/t/harness.c to ../tocopy/t/harness.c
Copied ../testdir/src/libvterm/vterm.pc.in to ../tocopy/vterm.pc.in

-----STATISTICS-----
Consumers: 10 - Buffer Size: 10
Number of Regular File: 194
Number of FIFO File: 0
Number of Directory: 7
TOTAL BYTES COPIED: 25009680
TOTAL TIME: 00:01.019 (min:sec.mil)
==35==
==35== HEAP SUMMARY:
==35==       in use at exit: 0 bytes in 0 blocks
==35==   total heap usage: 27 allocs, 27 frees, 281,650 bytes allocated
==35==
==35== All heap blocks were freed -- no leaks are possible
==35==
==35== For lists of detected and suppressed errors, rerun with: -s
==35== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
```

Ad	Değiştirme tarihi	Tür	Boyut
bin	18.05.2024 23:19	Dosya klasörü	
doc	18.05.2024 23:19	Dosya klasörü	
include	18.05.2024 23:19	Dosya klasörü	
src	18.05.2024 23:19	Dosya klasörü	
t	18.05.2024 23:19	Dosya klasörü	
.bzignore	18.05.2024 23:19	BZIGNORE Dosyası	1 KB
.gitignore	18.05.2024 23:19	Git Ignore Kaynak ...	1 KB
LICENSE	18.05.2024 23:19	Dosya	2 KB
Makefile	18.05.2024 23:19	Dosya	4 KB
README	18.05.2024 23:19	Dosya	1 KB
tbl2inc.c.pl	18.05.2024 23:19	Perl Kaynak Dosyası	1 KB
vterm.pc.in	18.05.2024 23:19	IN Dosyası	1 KB

- Test2: ./MWCp 10 4 ./testdir/src/libvterm/src ./toCopy #buffer size=10, number of workers=4, sourceFile, destinationFile

```

a@DESKTOP-SF6OAM7: /mnt, x + v
Copied ../testdir/src/libvterm/src/if_ole.idl to ../tocopy/if_ole.idl
Copied ../testdir/src/libvterm/src/if_perl.xs to ../tocopy/if_perl.xs
Copied ../testdir/src/libvterm/src/if_perlsfio.c to ../tocopy/if_perlsfio.c
Copied ../testdir/src/libvterm/src/if_perl_msvc/stdbool.h to ../tocopy/if_perl_msvc/stdbool.h
Copied ../testdir/src/libvterm/src/if_python.c to ../tocopy/if_python.c
Copied ../testdir/src/libvterm/src/if_python3.c to ../tocopy/if_python3.c
Copied ../testdir/src/libvterm/src/if_ruby.c to ../tocopy/if_ruby.c
Copied ../testdir/src/libvterm/src/if_tcl.c to ../tocopy/if_tcl.c
Copied ../testdir/src/libvterm/src/if_xcmdsrv.c to ../tocopy/if_xcmdsrv.c
Copied ../testdir/src/libvterm/src/if_py_both.h to ../tocopy/if_py_both.h
Copied ../testdir/src/libvterm/src/iid_ole.c to ../tocopy/iid_ole.c
Copied ../testdir/src/libvterm/src/infplist.xml to ../tocopy/infplist.xml
Copied ../testdir/src/libvterm/src/indent.c to ../tocopy/indent.c
Copied ../testdir/src/libvterm/src/insexpand.c to ../tocopy/insexpand.c
Copied ../testdir/src/libvterm/src/INSTALLami.txt to ../tocopy/INSTALLami.txt
Copied ../testdir/src/libvterm/src/INSTALLmac.txt to ../tocopy/INSTALLmac.txt
Copied ../testdir/src/libvterm/src/INSTALL to ../tocopy/INSTALL
Copied ../testdir/src/libvterm/src/install-sh to ../tocopy/install-sh
Copied ../testdir/src/libvterm/src/installman.sh to ../tocopy/installman.sh
Copied ../testdir/src/libvterm/src/installml.sh to ../tocopy/installml.sh
Copied ../testdir/src/libvterm/src/INSTALLpc.txt to ../tocopy/INSTALLpc.txt
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/iscygpty.c to ../tocopy/iscygpty.c
Copied ../testdir/src/libvterm/src/iscygpty.h to ../tocopy/iscygpty.h
Copied ../testdir/src/libvterm/src/isl1551098739430.pdf to ../tocopy/isl1551098739430.pdf
Copied ../testdir/src/libvterm/src/json_test.c to ../tocopy/json_test.c
Copied ../testdir/src/libvterm/src/json.c to ../tocopy/json.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/keyword_test.c to ../tocopy/keyword_test.c
Copied ../testdir/src/libvterm/src/mouse.c to ../tocopy/mouse.c
Copied ../testdir/src/libvterm/src/parser.c to ../tocopy/parser.c
Copied ../testdir/src/libvterm/src/MRT10.pdf to ../tocopy/MRT10.pdf
Copied ../testdir/src/libvterm/src/rect.h to ../tocopy/rect.h
Copied ../testdir/src/libvterm/src/pen.c to ../tocopy/pen.c
Copied ../testdir/src/libvterm/src/termScreen.c to ../tocopy/termScreen.c
Copied ../testdir/src/libvterm/src/state.c to ../tocopy/state.c
Copied ../testdir/src/libvterm/src/utf8.h to ../tocopy/utf8.h
Copied ../testdir/src/libvterm/src/vterm_internal.h to ../tocopy/vterm_internal.h
Copied ../testdir/src/libvterm/src/unicode.c to ../tocopy/unicode.c
Copied ../testdir/src/libvterm/src/vterm.c to ../tocopy/vterm.c

-----STATISTICS-----
Consumers: 4 - Buffer Size: 10
Number of Regular File: 140
Number of FIFO File: 0
Number of Directory: 2
TOTAL BYTES COPIED: 24873082
TOTAL TIME: 00:00.254 (min:sec.mili)
a@DESKTOP-SF6OAM7: /mnt/c/Users/akif_/Desktop/System/SystemPro/Hw5/hw4test/put_your_codes_here$

```

Ad	Değiştirme tarihi	Tür	Boyut
gvim.txt	18.05.2024 23:23	Dosya klasörü	
if_perl_msvc	18.05.2024 23:23	Dosya klasörü	
autocmd.c	18.05.2024 23:23	C Kaynak Dosyası	66 KB
beval.c	18.05.2024 23:23	C Kaynak Dosyası	7 KB
beval.h	18.05.2024 23:23	C Header Kaynak ...	3 KB
bigvim.bat	18.05.2024 23:23	Windows Toplu İş ...	1 KB
bigvim64.bat	18.05.2024 23:23	Windows Toplu İş ...	1 KB
blob.c	18.05.2024 23:23	C Kaynak Dosyası	5 KB
blowfish.c	18.05.2024 23:23	C Kaynak Dosyası	24 KB
buffer.c	18.05.2024 23:23	C Kaynak Dosyası	143 KB
change.c	18.05.2024 23:23	C Kaynak Dosyası	59 KB
channel.c	18.05.2024 23:23	C Kaynak Dosyası	144 KB
charset.c	18.05.2024 23:23	C Kaynak Dosyası	49 KB
config.h.in	18.05.2024 23:23	İN Dosyası	12 KB
config.mk.dist	18.05.2024 23:23	DİST Dosyası	1 KB
config.mk.in	18.05.2024 23:23	İN Dosyası	5 KB
configure	18.05.2024 23:23	Dosya	1 KB
configure.ac	18.05.2024 23:23	AC Dosyası	145 KB
create_cmdids.vim	18.05.2024 23:23	VİM Dosyası	4 KB
crypt.c	18.05.2024 23:23	C Kaynak Dosyası	15 KB
crypt_zip.c	18.05.2024 23:23	C Kaynak Dosyası	4 KB
debugger.c	18.05.2024 23:23	C Kaynak Dosyası	22 KB
debug.py	18.05.2024 23:23	Python File	2 KB
dict.c	18.05.2024 23:23	C Kaynak Dosyası	21 KB
diff.c	18.05.2024 23:23	C Kaynak Dosyası	79 KB
digraph.c	18.05.2024 23:23	C Kaynak Dosyası	55 KB
dimen.idl	18.05.2024 23:23	Interface Definitio...	26 KB

- Test3: ./MWCp 10 10 ../testdir ../toCopy #buffer size=10, number of workers=10, sourceFile, destinationFile

```

@DESKTOP-SFGAM7: ~/ml, X + v
Copied ./testdir/src/VisVim/VsReadMe.txt to ../tocopy/src/VisVim/VsReadMe.txt
Copied ./testdir/src/which.sh to ../tocopy/src/which.sh
Copied ./testdir/src/winclip.c to ../tocopy/src/winclip.c
Copied ./testdir/src/xdiff/COPYING to ../tocopy/src/xdiff/COPYING
Copied ./testdir/src/xdiff/README.txt to ../tocopy/src/xdiff/README.txt
Copied ./testdir/src/xdiff/xdiff.h to ../tocopy/src/xdiff/xdiff.h
Copied ./testdir/src/window.c to ../tocopy/src/window.c
Copied ./testdir/src/xdiff/xdiff1.c to ../tocopy/src/xdiff/xdiff1.c
Copied ./testdir/src/xdiff/xdiff1.h to ../tocopy/src/xdiff/xdiff1.h
Copied ./testdir/src/xdiff/xemit.c to ../tocopy/src/xdiff/xemit.c
Copied ./testdir/src/xdiff/xemit.h to ../tocopy/src/xdiff/xemit.h
Copied ./testdir/src/xdiff/xhistogram.c to ../tocopy/src/xdiff/xhistogram.c
Copied ./testdir/src/xdiff/xinclude.h to ../tocopy/src/xdiff/xinclude.h
Copied ./testdir/src/xdiff/xmacros.h to ../tocopy/src/xdiff/xmacros.h
Copied ./testdir/src/xdiff/xpatience.c to ../tocopy/src/xdiff/xpatience.c
Copied ./testdir/src/xdiff/xprepare.c to ../tocopy/src/xdiff/xprepare.c
Copied ./testdir/src/xdiff/xprepare.h to ../tocopy/src/xdiff/xprepare.h
Copied ./testdir/src/xdiff/xtypes.h to ../tocopy/src/xdiff/xtypes.h
Copied ./testdir/src/xdiff/xutils.c to ../tocopy/src/xdiff/xutils.c
Copied ./testdir/src/xdiff/xutils.h to ../tocopy/src/xdiff/xutils.h
Copied ./testdir/src/xpm/COPYRIGHT to ../tocopy/src/xpm/COPYRIGHT
Copied ./testdir/src/xpm/arm64/Lib-vcl4/LibXpm.Lib to ../tocopy/src/xpm/arm64/Lib-vcl4/LibXpm.Lib
Copied ./testdir/src/xpm/include/sinx.h to ../tocopy/src/xpm/include/sinx.h
Copied ./testdir/src/xpm/include/xpm.h to ../tocopy/src/xpm/include/xpm.h
Copied ./testdir/src/xpm/README.txt to ../tocopy/src/xpm/README.txt
Copied ./testdir/src/xpm/x64/Lib/LibXpm.a to ../tocopy/src/xpm/x64/Lib/LibXpm.a
Copied ./testdir/src/xpm/x64/Lib/LibXpm.Lib to ../tocopy/src/xpm/x64/Lib/LibXpm.Lib
Copied ./testdir/src/xpm/x86/Lib/LibXpm.a to ../tocopy/src/xpm/x86/Lib/LibXpm.a
Copied ./testdir/src/xpm/x64/Lib-vcl4/LibXpm.Lib to ../tocopy/src/xpm/x64/Lib-vcl4/LibXpm.Lib
Copied ./testdir/src/xpm_x32.c to ../tocopy/src/xpm_x32.c
Copied ./testdir/src/xpm_x86/Lib/LibXpm.Lib to ../tocopy/src/xpm_x86/Lib/LibXpm.Lib
Copied ./testdir/src/xpm_x32.h to ../tocopy/src/xpm_x32.h
Copied ./testdir/src/xpm_x86/Lib-vcl4/LibXpm.Lib to ../tocopy/src/xpm_x86/Lib-vcl4/LibXpm.Lib
Copied ./testdir/src/xxd/Makefile to ../tocopy/src/xxd/Makefile
Copied ./testdir/src/xxd/Make_ming.mak to ../tocopy/src/xxd/Make_ming.mak
Copied ./testdir/src/xxd/Make_mvc.mak to ../tocopy/src/xxd/Make_mvc.mak
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/tools/rename.bat to ../tocopy/tools/rename.bat
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 File: 3116
Number of FIFO File: 0
Number of Directory: 151
TOTAL BYTES COPIED: 73520554
TOTAL TIME: 00:02.974 (min:sec.milis)

```