MULTIPLE FILE COPYING

LAB # 07

Fall 2023

CSE-302L

Systems Programming Lab

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Class Section: **A**

"On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work."

Student Signature: [illegible]

Submitted to:

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Sunday, January 28, 2024

Department of Computer Systems Engineering

University of Engineering and Technology, Peshawar

CSE 302L: SYSTEMS PROGRAMMING LAB

LAB ASSESSMENT RUBRICS

Criteria & Point Assigned	Outstanding 2	Acceptable 1.5	Considerable 1	Below Expectations 0.5	Score
Attendance and Attentiveness in Lab PLO08	Attended in proper Time and attentive in Lab	Attended in proper Time but not attentive in Lab	Attended late but attentive in Lab	Attended late not attentive in Lab	
Capability of writing Program/Algorithm/Drawing Flow Chart PLO1, PLO2, PLO3, PLO5	Right attempt/ no errors and well formatted	Right attempt/ no errors but not well formatted	Right attempt/ minor errors and not well formatted	Wrong attempt	
Result or Output/ Completion of target in Lab PLO9	100% target has been completed and well formatted.	75% target has been completed and well formatted.	50% target has been completed but not well formatted.	None of the outputs are correct.	
Overall, Knowledge PLO10,	Demonstrates excellent knowledge of lab	Demonstrates good knowledge of lab	Has partial idea about the Lab and procedure followed	Has poor idea about the Lab and procedure followed	
Attention to Lab Report PLO4,	Submission of Lab Report in Proper Time i.e., in next day of lab, with proper documentation.	Submission of Lab Report in proper time but not with proper documentation.	Late Submission with proper documentation.	Late Submission very poor documentation	

Instructor:

Name: ____________________________	Signature: ___________________________

Multiple File Copying

Objectives:

Learn about these concepts

- Handling of I/O from multiple sources
- Monitoring multiple files

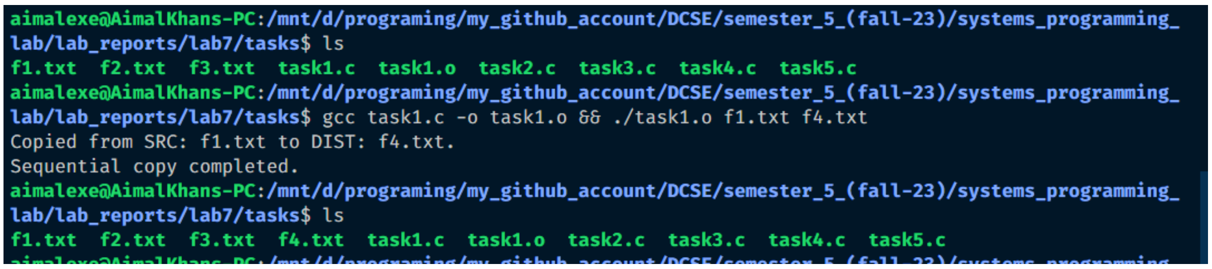
Tasks:

Task 1: Write a program that copies two files sequentially in a single process.

Code in C:

```
#include <stdlib.h>
#include <stdio.h>
#include <unistd.h>
#include "../../reusable_code_snippets/readWrite.h"

int main(int argc, char *argv[])
{
    if (argc < 3)
    {
        fprintf(stderr, "Usage: %s FILE_1 FILE_2 [FILE_N...]\n",
argv[0]);
        return 1;
    }

    if (argc % 2 == 0)
    {
        perror("Argument must be even in count.\n");
        return 1;
    }

    // int readWriteReturnValue;
    for (int i = 1, readWriteReturnValue; i < argc; i += 2)
    {
        readWriteReturnValue = readWrite(argv[i], argv[i + 1]);
        if (readWriteReturnValue < 0)
        {
            perror("Something went wrong while reading or writing a
file.\n");
            return 1;
        }
        printf("Copied from SRC: %s to DIST: %s.\n", argv[i], argv[i
+ 1]);
    }

    printf("Sequential copy completed.\n");

    return 0;
}
```

Output:



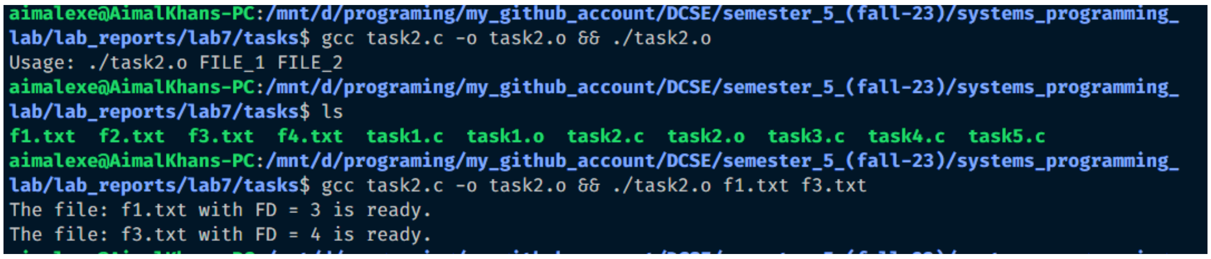
```
aimalexe@AimalKhans-PC:/mnt/d/programing/my_github_account/DCSE/semester_5_(fall-23)/systems_programming_lab/lab_reports/lab7/tasks$ ls
f1.txt  f2.txt  f3.txt  task1.c  task1.o  task2.c  task3.c  task4.c  task5.c
aimalexe@AimalKhans-PC:/mnt/d/programing/my_github_account/DCSE/semester_5_(fall-23)/systems_programming_lab/lab_reports/lab7/tasks$ gcc task1.c -o task1.o && ./task1.o f1.txt f4.txt
Copied from SRC: f1.txt to DIST: f4.txt.
Sequential copy completed.
aimalexe@AimalKhans-PC:/mnt/d/programing/my_github_account/DCSE/semester_5_(fall-23)/systems_programming_lab/lab_reports/lab7/tasks$ ls
f1.txt  f2.txt  f3.txt  f4.txt  task1.c  task1.o  task2.c  task3.c  task4.c  task5.c
```

Task 2: Write a program that monitors two files using 'select'.

Code in C:

```c
// Task 2: Write a program that monitors two files using 'select'.

#include <stdlib.h>
#include <stdio.h>
#include <unistd.h>
#include <sys/select.h>
#include "../../reusable_code_snippets/readWrite.h"

int main(int argc, char *argv[])
{
    if (argc != 3)
    {
        fprintf(stderr, "Usage: %s FILE_1 FILE_2\n", argv[0]);
        return 1;
    }

    // 1. Opening the two files.
    int file1 = open(argv[1], O_RDWR);
    if (file1 == -1)
    {
        fprintf(stderr, "Something went wrong while opening the
file: %s due to %s\n", argv[1], strerror(errno));
        return 1;
    }

    int file2 = open(argv[2], O_RDWR);
    if (file2 == -1)
    {
        fprintf(stderr, "Something went wrong while opening the
file: %s due to %s\n", argv[2], strerror(errno));
        return 1;
    }

    // 2. Collecting arguments for select function.
    int maxFd = file1 >= file2 ? file1 : file2;
    fd_set readset;
    FD_ZERO(&readset);
    FD_SET(file1, &readset);
    FD_SET(file2, &readset);

    // calling the function select.
    int readyFile = select(maxFd + 1, &readset, NULL, NULL, NULL);

    // Checking for ready file(S):
    if (FD_ISSET(file1, &readset))
        printf("The file: %s with FD = %d is ready.\n", argv[1],
file1);

    if (FD_ISSET(file2, &readset))
        printf("The file: %s with FD = %d is ready.\n", argv[2],
file2);

    // Closing the files:
    if (close(file1) == -1)
    {
        fprintf(stderr, "Something went wrong while closing the
file: %s due to %s\n", argv[1], strerror(errno));
        return 1;
    }

    if (close(file2) == -1)
    {
        fprintf(stderr, "Something went wrong while closing the
file: %s due to %s\n", argv[2], strerror(errno));
        return 1;
    }

    return 0;
}
```

Output:



```
aimalexe@AimalKhans-PC:/mnt/d/programing/my_github_account/DCSE/semester_5_(fall-23)/systems_programming_
lab/lab_reports/lab7/tasks$ gcc task2.c -o task2.o && ./task2.o
Usage: ./task2.o FILE_1 FILE_2
aimalexe@AimalKhans-PC:/mnt/d/programing/my_github_account/DCSE/semester_5_(fall-23)/systems_programming_
lab/lab_reports/lab7/tasks$ ls
f1.txt  f2.txt  f3.txt  f4.txt  task1.c  task1.o  task2.c  task2.o  task3.c  task4.c  task5.c
aimalexe@AimalKhans-PC:/mnt/d/programing/my_github_account/DCSE/semester_5_(fall-23)/systems_programming_
lab/lab_reports/lab7/tasks$ gcc task2.c -o task2.o && ./task2.o f1.txt f3.txt
The file: f1.txt with FD = 3 is ready.
The file: f3.txt with FD = 4 is ready.
```

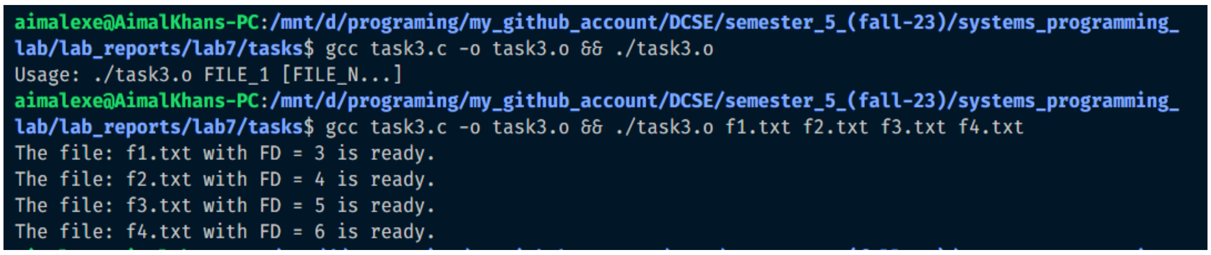
Task 3 : Write a program that monitors N files using 'select'

Code in C:

```c
// Task 3: Write a program that monitors N files using 'select'.

#include <stdlib.h>
#include <stdio.h>
#include <unistd.h>
#include <errno.h>
#include <fcntl.h>
```

```c
#include <string.h>
#include <sys/select.h>
#include <time.h>
#include "../../reusable_code_snippets/findMax.h"

int main(int argc, char *argv[])
{
    if (argc < 2)
    {
        fprintf(stderr, "Usage: %s FILE_1 [FILE_N...]\n", argv[0]);
        return 1;
    }

    int length = argc - 1;
    int fds[length];

    for (int i = 0; i < length; i++)
    {
        fds[i] = open(argv[i + 1], O_RDWR);
        if (fds[i] == -1)
        {
            fprintf(stderr, "Something went wrong while opening the
file: %s due to %s\n", argv[i + 1], strerror(errno));
            return 1;
        }
    }

    fd_set readSet;
    FD_ZERO(&readSet);

    int max = findMax(fds, &length);

    for (int i = 0; i < length; i++)
        FD_SET(fds[i], &readSet);

    int ret = select(max + 1, &readSet, NULL, NULL, NULL);

    for (int i = 0; i < length; i++)
        if (FD_ISSET(fds[i], &readSet))
            printf("The file: %s with FD = %d is ready.\n", argv[i +
1], fds[i]);

    for (int i = 0; i < length; i++)
        if (close(fds[i]) == -1)
        {
            fprintf(stderr, "Something went wrong while closing the
file: %s due to %s\n", argv[i + 1], strerror(errno));
            return 1;
        }

    return 0;
}
```

Output:



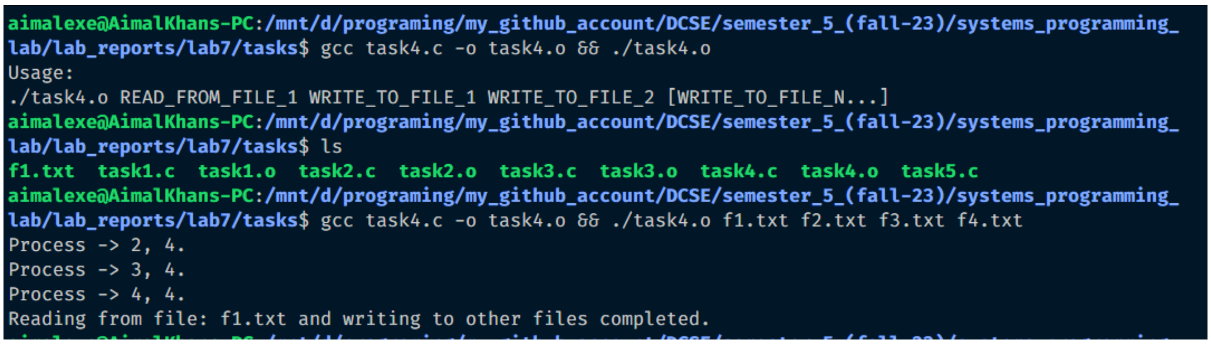
```
aimalexe@AimalKhans-PC:/mnt/d/programing/my_github_account/DCSE/semester_5_(fall-23)/systems_programming_
lab/lab_reports/lab7/tasks$ gcc task3.c -o task3.o && ./task3.o
Usage: ./task3.o FILE_1 [FILE_N...]
aimalexe@AimalKhans-PC:/mnt/d/programing/my_github_account/DCSE/semester_5_(fall-23)/systems_programming_
lab/lab_reports/lab7/tasks$ gcc task3.c -o task3.o && ./task3.o f1.txt f2.txt f3.txt f4.txt
The file: f1.txt with FD = 3 is ready.
The file: f2.txt with FD = 4 is ready.
The file: f3.txt with FD = 5 is ready.
The file: f4.txt with FD = 6 is ready.
```

Task 4: Write a program that creates two child processes, both child read from the same source and writes to two separate destination, make sure you use select to monitor if the source is ready to be read from.

Code in C:

```
/*
Task 4: Write a program that creates two child processes, both child
read from the
same source and writes to two separate destination, make sure you
use select to
monitor if the source is ready to be read from.
*/

#include <stdlib.h>
#include <stdio.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/select.h>
#include <sys/wait.h>
#include "../../reusable_code_snippets/readWrite.h"
#include "../../reusable_code_snippets/findMax.h"

int main(int argc, char *argv[])
{
    if (argc <= 3)
    {
        fprintf(stderr, "Usage:\n%s READ_FROM_FILE_1 WRITE_TO_FILE_1
WRITE_TO_FILE_2 [WRITE_TO_FILE_N...]\n", argv[0]);
        return 1;
    }

    int readFd = open(argv[1], O_RDONLY);
    if (readFd == -1)
    {
        fprintf(stderr, "Cannot open source file %s: %s\n", argv[1],
strerror(errno));
        return 1;
    }

    for (int i = 2; i < argc; i++)
    {
        pid_t pid = fork();
        if (pid == -1)
        {
            perror("Failed to create child process.\n");
            return 1;
        }
        else if (pid == 0)
        { // Child
            int writeFd = open(argv[i], O_WRONLY | O_TRUNC |
O_CREAT, S_IRWXU | S_IRGRP | S_IROTH);
            if (writeFd == -1)
            {
                fprintf(stderr, "Cannot open destination file %s:
%s\n", argv[i], strerror(errno));
                return 1;
            }

            fd_set readSet;
            FD_ZERO(&readSet);
            FD_SET(readFd, &readSet);

            // Child process has to select on the readFd again
because file descriptors are shared.
            if (select(readFd + 1, &readSet, NULL, NULL, NULL) > 0)
            {
                if (FD_ISSET(readFd, &readSet))
                    if (readWriteOnly(&readFd, &writeFd) == -1)
                    {
                        fprintf(stderr, "Error reading/writing
files.\n");
                        return 1;
                    }
            }
            else
            {
                perror("Error while monitoring files.\n");
                return 1;
            }

            if (close(writeFd) == -1)
            {
                fprintf(stderr, "Something went wrong while closing
the file: %s due to %s\n", argv[i], strerror(errno));
                return 1;
            }
            printf("Process -> %d, %d.\n", i, writeFd);
            return 0; // Child process exits after writing.
        }
    }

    // Parent process
    for (int i = 2; i < argc; i++)
        wait(NULL); // Wait for all children to finish.

    // Close the source file descriptor in the parent as well.
    if (close(readFd) == -1)
    {
        fprintf(stderr, "Something went wrong while closing the
file: %s due to %s\n", argv[1], strerror(errno));
        return 1;
    };

    printf("Reading from file: %s and writing to other files
completed.\n", argv[1]);
    return 0;
}
```

Output:



```
aimalexe@AimalKhans-PC:/mnt/d/programing/my_github_account/DCSE/semester_5_(fall-23)/systems_programming_
lab/lab_reports/lab7/tasks$ gcc task4.c -o task4.o && ./task4.o
Usage:
./task4.o READ_FROM_FILE_1 WRITE_TO_FILE_1 WRITE_TO_FILE_2 [WRITE_TO_FILE_N...]
aimalexe@AimalKhans-PC:/mnt/d/programing/my_github_account/DCSE/semester_5_(fall-23)/systems_programming_
lab/lab_reports/lab7/tasks$ ls
f1.txt  task1.c  task1.o  task2.c  task2.o  task3.c  task3.o  task4.c  task4.o  task5.c
aimalexe@AimalKhans-PC:/mnt/d/programing/my_github_account/DCSE/semester_5_(fall-23)/systems_programming_
lab/lab_reports/lab7/tasks$ gcc task4.c -o task4.o && ./task4.o f1.txt f2.txt f3.txt f4.txt
Process -> 2, 4.
Process -> 3, 4.
Process -> 4, 4.
Reading from file: f1.txt and writing to other files completed.
```

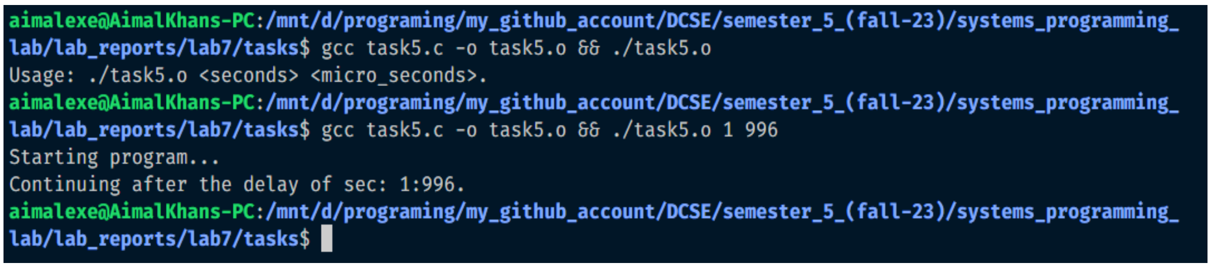
Task 5: Write a function that creates a delay of N seconds using select function. Pass N as an argument to the function

Code in C:

```
/*
Task 5: Write a function that creates a delay of N seconds using
select function. Pass
N as an argument to the function
*/

#include <stdlib.h>
#include <stdio.h>
#include <unistd.h>
#include <errno.h>
#include <string.h>
#include <sys/select.h>
#include <time.h>

int doDelay(int sec, int microSec)
{
    struct timeval t;
    t.tv_sec = sec;
    t.tv_usec = microSec;

    int ret = select(1, NULL, NULL, NULL, &t);

    return 0;
}
```

```
int main(int argc, char *argv[])
{
    if (argc != 3)
    {
        fprintf(stderr, "Usage: %s <seconds> <micro_seconds>.\n",
argv[0]);
        return 1;
    }

    printf("Starting program...\n");

    int ret = doDelay(atoi(argv[1]), atoi(argv[2]));

    printf("Continuing after the delay of sec: %d:%d.\n",
atoi(argv[1]), atoi(argv[2]));
    return 0;
}
```

Output:



```
aimalexe@AimalKhans-PC:/mnt/d/programing/my_github_account/DCSE/semester_5_(fall-23)/systems_programming_
lab/lab_reports/lab7/tasks$ gcc task5.c -o task5.o && ./task5.o
Usage: ./task5.o <seconds> <micro_seconds>.
aimalexe@AimalKhans-PC:/mnt/d/programing/my_github_account/DCSE/semester_5_(fall-23)/systems_programming_
lab/lab_reports/lab7/tasks$ gcc task5.c -o task5.o && ./task5.o 1 996
Starting program...
Continuing after the delay of sec: 1:996.
aimalexe@AimalKhans-PC:/mnt/d/programing/my_github_account/DCSE/semester_5_(fall-23)/systems_programming_
lab/lab_reports/lab7/tasks$
```

Reference:

To view my codes, please refer to my GitHub account: https://github.com/aimalexe/DCSE/tree/main/semester_5_(fall-23)/systems_programming_lab/lab_reports .

Conclusion:

In this lab I have learned different techniques about monitoring file like using multiple processes, a system call named *select* which monitor files for reading, writing and errors. It can also be used to stop the program for a while. Now I am able to manage my file monitoring with the findings.

The End.