

CSE 3033  
OPERATING SYSTEMS  
Programming Assignment #3

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## Introduction

In this project, we are working with threads. There are four different type of threads, which are read threads, upper thread, replace threads and, write threads.

- **Read Thread:** These threads are responsible for reading from file line by line. Then, puts the readed line into array.
- **Upper Thread:** These threads are responsible for firstly read from the array then convert the readed lines to uppercase letters and write back to the same index of the array.
- **Replace Thread:** These types of the threads will read from the array, replace all spaces with underscore character and write back to the same index of the array.
- **Write Thread.** They will read from the array and store it to the text file, each line in the correct place.

Also there is a main thread which has a main task about creating all thread types.

## How to Work?

### **Read Threads**

Mutex name : readMutex

After the pthread\_create() function every thread should be inside of the Read() function. When the threads come, one of them first enter the mutex lock zone then this threads get the line number and this line number means that thread will read the this number of line. After this thread print the information about line and give us information about it's thread id. The reading process will continue in this way and every thread will get the line number when enter the mutex lock zone.

### **Upper Threads**

Mutex name : upperMutex

These thread types work a little bit similar with read threads. Differences are when the one of the upper threads start the working it will lock the replace threads mutex. Because we do not want to work these two thread types on the same line. When the upper threads jobs done it will unlock the replace threads mutex. Upper threads jobs is if the read the line indices one by one and if it is lowercase letter change the content to uppercase.

## Replace Threads

Mutex name : replaceMutex

These thread types also get the line number when enter the lock zone which is similar with upper threads and read threads. When the replace threads start the working then that thread will lock the upper threads mutex. Replace threads jobs is read the line and replace the all spaces with underscore character and write back to the same index of the array.

## Write Threads

Mutex name : writeMutex

In this thread types when the replace threads and upper threads modifications are done at least one array index. Then write threads can start to work with this array. After that, writer thread can write to same file and print the information about line and give us information about it's thread id.

## Execution

The execution starts from read threads. First, read threads read the assigned lines from txt file. After first read, upper thread or replace threads do their work. There is no order between upper and replace threads. If upper thread first locks replace threads, upper threads will start execution. After they finish, one of the upper thread will unlock replace threads and then, replace threads will start execution. On the other hand, if replace thread first locks upper threads, replace threads will start execution. After they finish, one of the replace thread will unlock upper threads and then, upper threads will start execution. While reading txt file, one of the write thread is writing the same file from the beginning.

Down below you can find one of the execution example.

Before the execution;

```
eray@eray-N551VW: ~  
Dosya Düzenle Görünüm Ara Uçbirim Yardım  
eray@eray-N551VW:~$ gcc 150116053_150116061_Project3.c -o 150116053_150116061_Project3.o -lpthread  
eray@eray-N551VW:~$  
test.txt  
-/  
Kaydet  
Düz Metin Etiket Genişliği: 8 Sat 10, Süt 24 ARY
```

This is the first line.  
This is the second line.  
This is the third line.  
This is the fourth line.  
This is the fifth line.  
This is the sixth line.  
This is the seventh line.  
This is the eighth line.  
This is the ninth line.  
This is the tenth line.

After the execution;

```
eray@eray-N551VW: ~  
Dosya Düzenle Görünüm Ara Uçbirim Yardım  
eray@eray-N551VW:~$ gcc 150116053_150116061_Project3.c -o 150116053_150116061_Project3.o -lpthread  
eray@eray-N551VW:~$ ./150116053_150116061_Project3.o -d test.txt -n 3 4 5 4  
<Thread-type and ID> <Output>  
Read_1 Read_1 read the line 1 which is This is the first line.  
Read_1 Read_1 read the line 4 which is This is the fourth line.  
Read_2 Read_2 read the line 2 which is This is the second line.  
Upper_1 Upper_1 read index 1 and converted THIS IS THE FIRST LINE.  
Upper_1 Upper_1 read index 2 and converted THIS IS THE SECOND LINE.  
Upper_1 Upper_1 read index 3 and converted THIS IS THE THIRD LINE.  
Upper_1 Upper_1 read index 4 and converted THIS IS THE FOURTH LINE.  
Upper_1 Upper_1 read index 5 and converted THIS IS THE FIFTH LINE.  
Upper_1 Upper_1 read index 6 and converted THIS IS THE SIXTH LINE.  
Read_2 Read_2 read the line 6 which is THIS IS THE SIXTH LINE.  
Read_2 Read_2 read the line 7 which is This is the seventh line.  
Read_1 Read_1 read the line 5 which is THIS IS THE FIFTH LINE.  
Read_2 Read_2 read the line 8 which is THIS IS THE EIGHTH LINE.  
Upper_4 Upper_4 read index 9 and converted THIS IS THE NINTH LINE.  
Replace3 Replace_3 read index 1 and converted THIS IS THE FIRST LINE.  
Replace3 Replace_3 read index 2 and converted THIS IS THE SECOND LINE.  
Read_3 Read_3 read the line 3 which is THIS IS THE THIRD LINE.  
Replace1 Replace_1 read index 4 and converted THIS IS THE FOURTH LINE.  
Replace1 Replace_1 read index 5 and converted THIS IS THE FIFTH LINE.  
Replace1 Replace_1 read index 6 and converted THIS IS THE SIXTH LINE.  
Replace1 Replace_1 read index 8 and converted THIS IS THE EIGHTH LINE.  
Replace1 Replace_1 read index 10 and converted THIS IS THE TENTH LINE.  
Upper_3 Upper_3 read index 10 and converted THIS IS THE TENTH LINE.  
Upper_1 Upper_1 read index 8 and converted THIS IS THE EIGHTH LINE.  
Replace3 Replace_3 read index 3 and converted THIS IS THE THIRD LINE.  
Replace4 Replace_4 read index 7 and converted THIS IS THE SEVENTH LINE.  
Read_2 Read_2 read the line 10 which is THIS IS THE TENTH LINE.  
Replace2 Replace_2 read index 9 and converted THIS IS THE NINTH LINE.  
Read_1 Read_1 read the line 9 which is THIS IS THE NINTH LINE.  
Upper_2 Upper_2 read index 7 and converted THIS IS THE SEVENTH LINE.  
Write2 Write_2 read index 1 and written THIS IS THE FIRST LINE.  
Write1 Write_1 read index 2 and written THIS IS THE SECOND LINE.  
Write1 Write_1 read index 3 and written THIS IS THE THIRD LINE.  
Write1 Write_1 read index 4 and written THIS IS THE FOURTH LINE.  
Write1 Write_1 read index 5 and written THIS IS THE FIFTH LINE.  
Write1 Write_1 read index 6 and written THIS IS THE SIXTH LINE.  
Write1 Write_1 read index 7 and written THIS IS THE SEVENTH LINE.  
Write1 Write_1 read index 8 and written THIS IS THE EIGHTH LINE.  
Write1 Write_1 read index 9 and written THIS IS THE NINTH LINE.  
Write1 Write_1 read index 10 and written THIS IS THE TENTH LINE.  
eray@eray-N551VW:~$  
test.txt  
-/  
Kaydet  
Düz Metin Etiket Genişliği: 8 Sat 10, Süt 24 ARY
```

THIS IS THE FIRST LINE.  
THIS IS THE SECOND LINE.  
THIS IS THE THIRD LINE.  
THIS IS THE FOURTH LINE.  
THIS IS THE FIFTH LINE.  
THIS IS THE SIXTH LINE.  
THIS IS THE SEVENTH LINE.  
THIS IS THE EIGHTH LINE.  
THIS IS THE NINTH LINE.  
THIS IS THE TENTH LINE.

## Conclusion

After this project we have better understanding of our knowledge and their difference with threads. We also have better knowledge of how to use the threads.