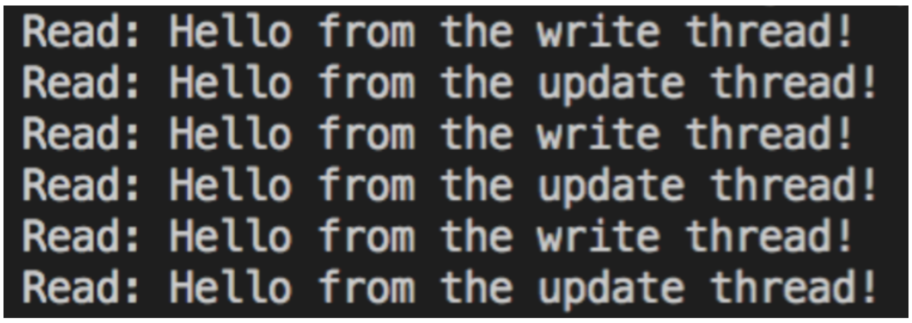
Name -Sumit Kumar Jha
Reg -20204212
Sec - CSE C

# Motilal Nehru National Institute of Technology Allahabad Prayagraj
Distributed System (CS17201)
B.Tech (CSE) – VII Sem Lab 2

1. Suppose there exists a file and you have to read, write and update the file concurrently. Write a multithreaded program such that there should be different threads for all different tasks and each thread access the file synchronously. Note: Use Mutex
Code :

```c
#include <stdio.h>
#include <stdlib.h>
#include <pthread.h>

#define FILENAME "data.txt"
pthread_mutex_t fileMutex = PTHREAD_MUTEX_INITIALIZER;

void *readFromFile(void *arg)
{
    pthread_mutex_lock(&fileMutex);
    FILE *file = fopen(FILENAME, "r");
    if (file == NULL){
        perror("Error opening file for reading");
        exit(1);
    }
    char buffer[100];
    while (fgets(buffer, sizeof(buffer), file) != NULL){
        printf("Read: %s", buffer);
    }
    fclose(file);
    pthread_mutex_unlock(&fileMutex);
    return NULL;
}

void *writeToFile(void *arg)
{
    pthread_mutex_lock(&fileMutex);
    FILE *file = fopen(FILENAME, "a");
    if (file == NULL){
        perror("Error opening file for writing");
        exit(1);
    }
    fprintf(file, "Hello from the write thread!\n");
    fclose(file);
    pthread_mutex_unlock(&fileMutex);
    return NULL;
}

void *updateFile(void *arg)
{
    pthread_mutex_lock(&fileMutex);
    FILE *file = fopen(FILENAME, "a");
    if (file == NULL){
        perror("Error opening file for updating");
        exit(1);
    }
    fprintf(file, "Hello from the update thread!\n");
    fclose(file);
    pthread_mutex_unlock(&fileMutex);
    return NULL;
}

int main()
{
    pthread_t readThread, writeThread, updateThread;

    pthread_create(&readThread, NULL, readFromFile, NULL);
    pthread_create(&writeThread, NULL, writeToFile, NULL);
    pthread_create(&updateThread, NULL, updateFile, NULL);

    // Create a thread to continuously display the file contents in the
terminal
    pthread_t displayThread;
    pthread_create(&displayThread, NULL, readFromFile, NULL);

    pthread_join(readThread, NULL);
    pthread_join(writeThread, NULL);
    pthread_join(updateThread, NULL);

    return 0;
}
```

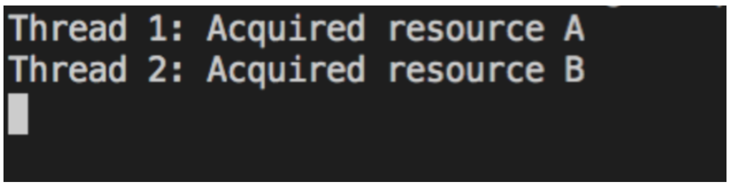


```
Read: Hello from the write thread!
Read: Hello from the update thread!
Read: Hello from the write thread!
Read: Hello from the update thread!
Read: Hello from the write thread!
Read: Hello from the update thread!
```

The codes are done different system due to linux unavailability on the local system

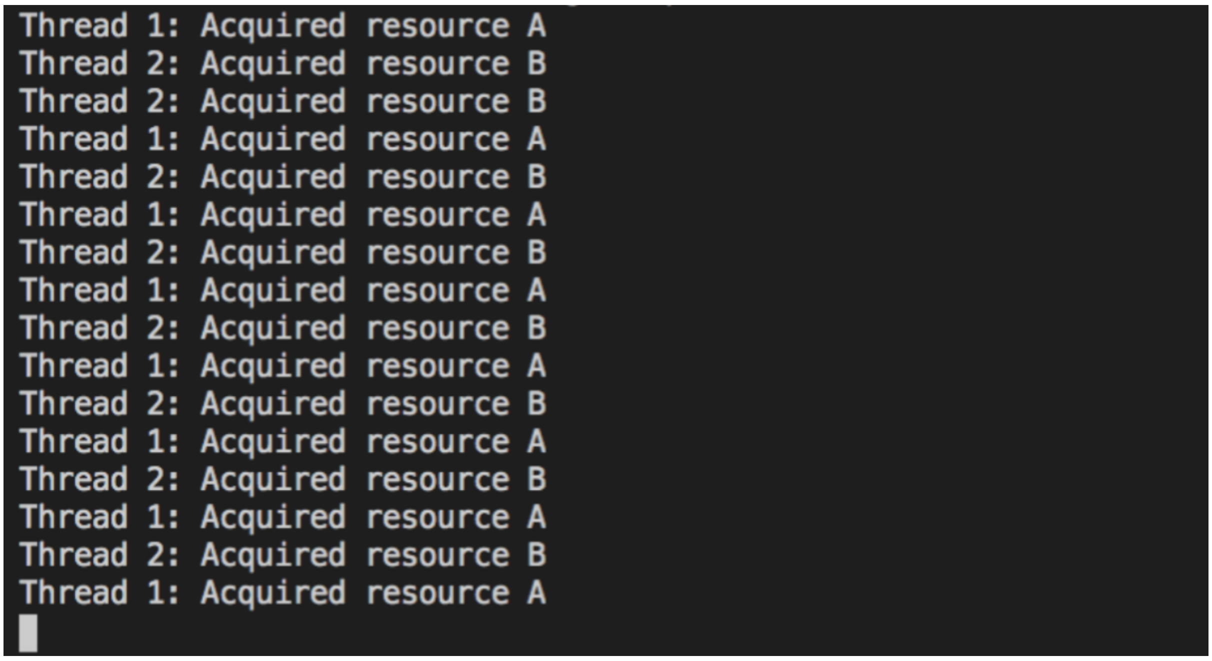
2. Write a program to implement a deadlock scenario, in which two threads are accessing two resources concurrently.
Code :

```c
#include <stdio.h>
#include <pthread.h>
#include <unistd.h>
pthread_mutex_t resourceA = PTHREAD_MUTEX_INITIALIZER;
pthread_mutex_t resourceB = PTHREAD_MUTEX_INITIALIZER;
void *thread1(void *arg)
{
    pthread_mutex_lock(&resourceA);
    printf("Thread 1: Acquired resource A\n");
    sleep(1);
    pthread_mutex_lock(&resourceB);
    printf("Thread 1: Acquired resource B\n");
    pthread_mutex_unlock(&resourceB);
    printf("Thread 1: Released resource B\n");
    pthread_mutex_unlock(&resourceA);
    printf("Thread 1: Released resource A\n");
    return NULL;
}

void *thread2(void *arg)
{
    pthread_mutex_lock(&resourceB);
    printf("Thread 2: Acquired resource B\n");
    sleep(1);
    pthread_mutex_lock(&resourceA);
    printf("Thread 2: Acquired resource A\n");
    pthread_mutex_unlock(&resourceA);
    printf("Thread 2: Released resource A\n");
    pthread_mutex_unlock(&resourceB);
    printf("Thread 2: Released resource B\n");
    return NULL;
}

int main(){
    pthread_t t1, t2;
    pthread_create(&t1, NULL, thread1, NULL);
    pthread_create(&t2, NULL, thread2, NULL);
    pthread_join(t1, NULL);
    pthread_join(t2, NULL);
    return 0;
}
```



```
Thread 1: Acquired resource A
Thread 2: Acquired resource B
```

3. Write a program to implement deadlock avoidance using conditional locking in which two threads are accessing two resources concurrently. Note: user pthread_mutex_trylock() functional locking
Code :
```c
#include <stdio.h>
#include <pthread.h>
#include <unistd.h>

pthread_mutex_t resourceA = PTHREAD_MUTEX_INITIALIZER;
pthread_mutex_t resourceB = PTHREAD_MUTEX_INITIALIZER;

void *thread1(void *arg)
{
    while (1)
    {
        if (pthread_mutex_trylock(&resourceA) == 0)
        {
            printf("Thread 1: Acquired resource A\n");
            sleep(1);
            if (pthread_mutex_trylock(&resourceB) == 0)
            {
                printf("Thread 1: Acquired resource B\n");
                pthread_mutex_unlock(&resourceB);
                printf("Thread 1: Released resource B\n");
            }
            else
            {
                pthread_mutex_unlock(&resourceA);
                continue;
            }
            pthread_mutex_unlock(&resourceB);
            pthread_mutex_unlock(&resourceA);
        }
    }
    return NULL;
}

void *thread2(void *arg)
{
    while (1)
    {
        if (pthread_mutex_trylock(&resourceB) == 0)
        {
            printf("Thread 2: Acquired resource B\n");
            sleep(1);
            if (pthread_mutex_trylock(&resourceA) == 0)
            {
                printf("Thread 2: Acquired resource A\n");
                pthread_mutex_unlock(&resourceA);
                printf("Thread 2: Released resource A\n");
            }
            else
            {
                pthread_mutex_unlock(&resourceB);
                continue;
            }
            pthread_mutex_unlock(&resourceA);
            pthread_mutex_unlock(&resourceB);
        }
    }
    return NULL;
}

int main()
{
    pthread_t t1, t2;
    pthread_create(&t1, NULL, thread1, NULL);
    pthread_create(&t2, NULL, thread2, NULL);
    pthread_join(t1, NULL);
    pthread_join(t2, NULL);
    return 0;
}
```



```
Thread 1: Acquired resource A
Thread 2: Acquired resource B
Thread 2: Acquired resource B
Thread 1: Acquired resource A
Thread 2: Acquired resource B
Thread 1: Acquired resource A
Thread 2: Acquired resource B
Thread 1: Acquired resource A
Thread 2: Acquired resource B
Thread 1: Acquired resource A
Thread 2: Acquired resource B
Thread 1: Acquired resource A
Thread 2: Acquired resource B
Thread 1: Acquired resource A
Thread 2: Acquired resource B
Thread 1: Acquired resource A
```

The codes are done different system due to linux unavailability on the local system