Assignment 05 | Operating System CE-092

Assignment submission for Operating System subject week 5.

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Aim - Thread creation and Termination. Synchronization using mutex lock and unlock. (Use of pthread_create, ptread_join, pthread_mutex_lock and pthread_mutex_unlock library functions of Pthread library).

Pthread_create:

#include <pthread.h>

int pthread_create(pthread_t *_thread_, const pthread_attr_t *_attr_,

void *(*_start_routine_) (void *), void *_arg_);

The pthread_create() function starts a new thread in the calling process. The new thread starts execution by invoking *start_routine*(); *arg* is passed as the sole argument of *start_routine*().

The *attr* argument points to a *pthread_attr_t* structure whose contents are used at thread creation time to determine attributes for the new thread; this structure is initialized using pthread_attr_init and related functions. If *attr* is NULL, then the thread is created with default attributes.

Before returning, a successful call to pthread_create() stores the ID of the new thread in the buffer pointed to by *thread*; this identifier is used to refer to the thread in subsequent calls to other pthreads functions.

On success, pthread_create() returns 0; on error, it returns an error number, and the contents of *thread* are undefined.

Pthread_join:

#include <pthread.h>

int pthread_join(pthread_t thread, void **retval);

Compile and link with *-pthread*.

The pthread_join() function waits for the thread specified by *thread* to terminate. If that thread has already terminated, then pthread_join() returns immediately. The thread specified by *thread* must be joinable.

On success, pthread_join() returns 0; on error, it returns an error number.

Pthread mutext_lock:

#include <pthread.h>

int pthread_mutex_lock(pthread_mutex_t *_mutex_);

The mutex object referenced by *mutex* shall be locked by calling *pthread_mutex_lock*(). If the mutex is already locked, the calling thread shall block until the mutex becomes available. This operation shall return with the mutex object referenced by *mutex* in the locked state with the calling thread as its owner.

If successful, the *pthread_mutex_lock*() and *pthread_mutex_unlock*() functions shall return zero; otherwise, an error number shall be returned to indicate the error.

Pthread mutext_unlock:

#include <pthread.h>

int pthread_mutex_unlock(pthread_mutex_t *_mutex_);

The pthread_mutex_unlock() function shall release the mutex object referenced by mutex.

If successful, the *pthread_mutex_unlock*() functions shall return zero; otherwise, an error number shall be returned to indicate the error.

Task 1:

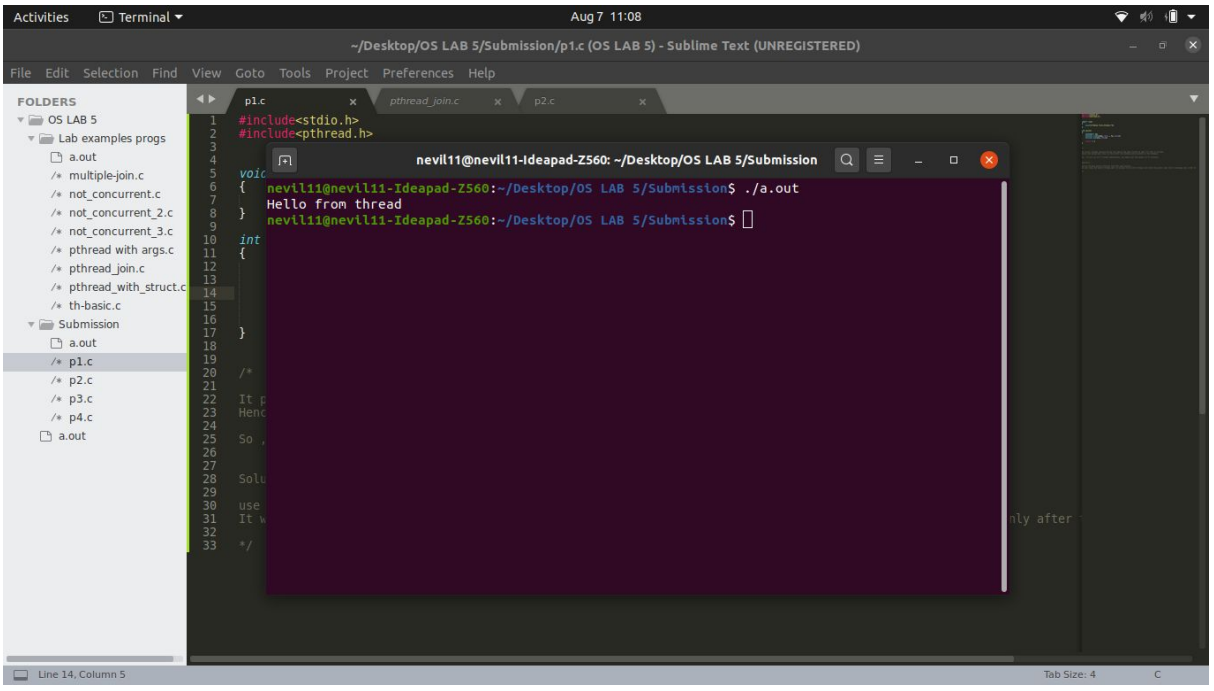
Write a program to create a thread using pthread_create.

Code:

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


void * f1()
{
    printf("Hello from thread\n");
}

int main()
{
    pthread_t t1;
    pthread_create(&t1, NULL , f1, NULL);
    // pthread_join(t1, NULL);

    return 0 ;
}


/*

It prints nothing because we are not making the main thread to wait for this t1 thread.
Hence the output got stuck in the buffer and nothing gets printed on the terminal

So , if you run it 5 6 times continuosly, you might see the output of f1 function.
```

```
Solution :

use of pthread_join() function from the same library.
It will make the parent thread wait to execute first
child thread and hence the parent will start executing
only after the child gets destroyed.

*/
```

Output:



Task 2:

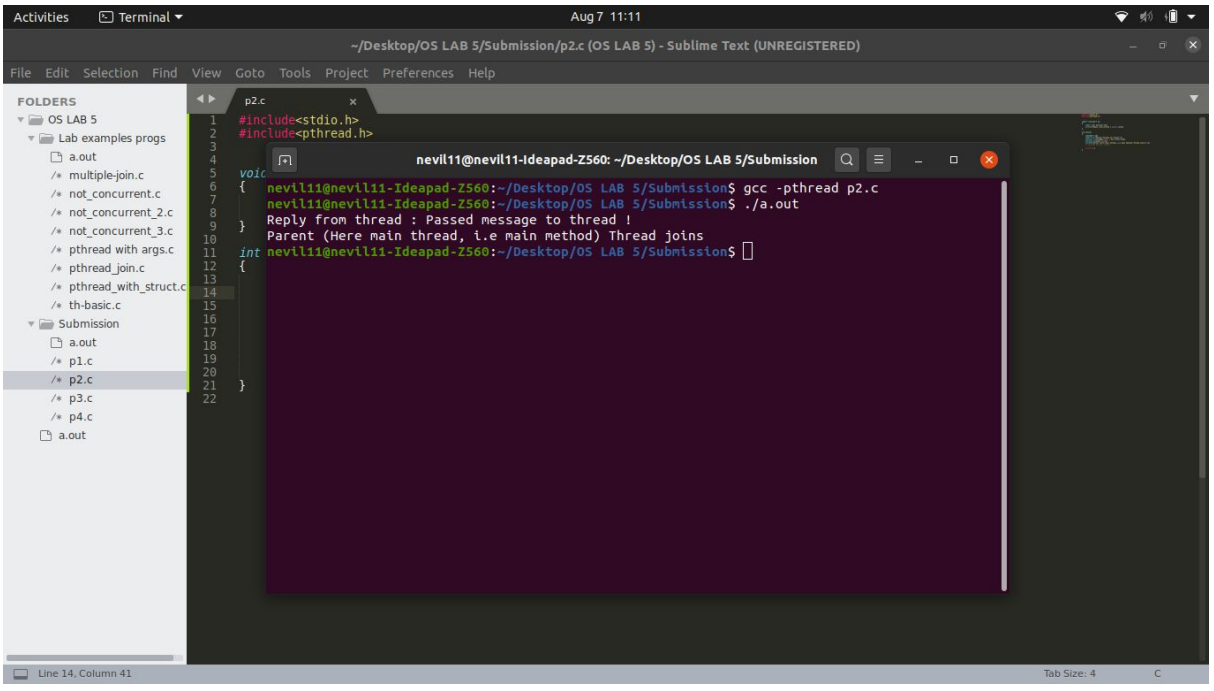
Write a program to pass a character string to the threaded function.

Code:

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

```c
void * fun(void *str)
{
    printf("Passed String: %s\n",str);
    return NULL;
}

int main()
{
    pthread_t newth1;
    char *s = "I am a string passed as arg.";
    pthread_create(&newth1,NULL,fun,s);
    pthread_join(newth1,NULL);

    printf("I am the last line in main.\n");
    return 0;
}
```

Output:



Task 3:

Write a program to implement a simple calculator using threads.

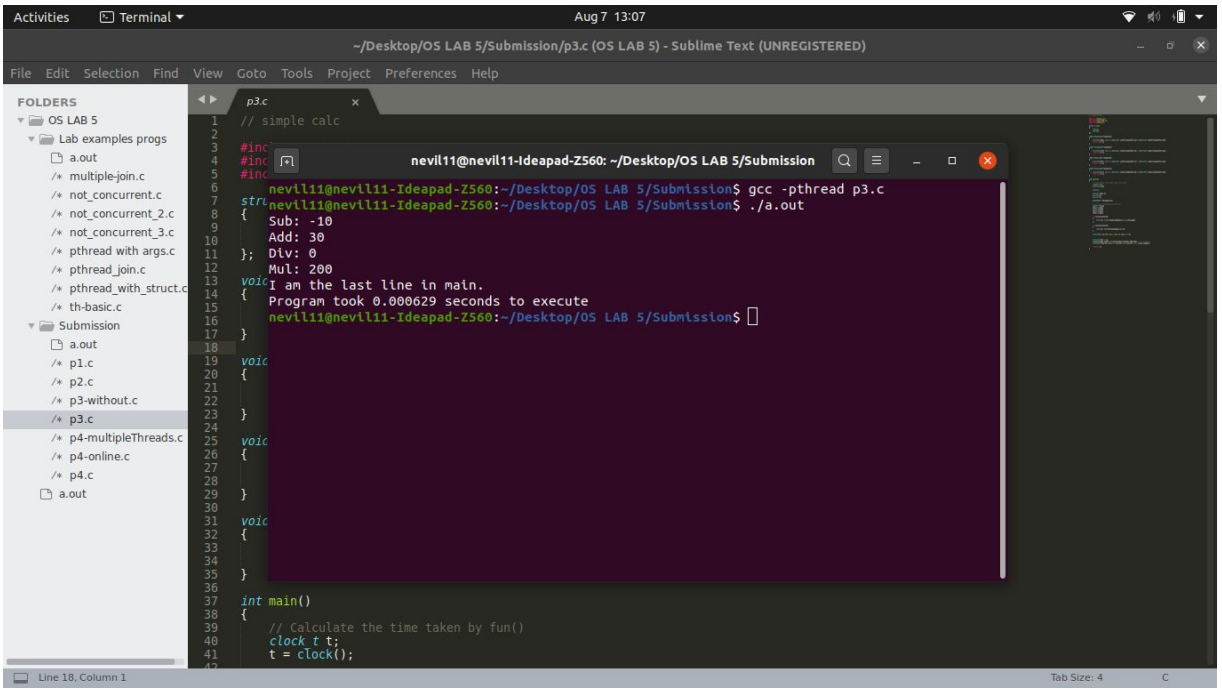
Code:

```
// simple calc

#include<stdio.h>
#include<pthread.h>
#include<time.h>

struct nums
{
    int x;
    int y;
};

void *add(void *numsref)
{
    printf("Add: %d\n", ((struct nums*)numsref)->x +
((struct nums*)numsref)->y);
    return NULL;
}

void *sub(void *numsref)
{
    printf("Sub: %d\n", ((struct nums*)numsref)->x -
((struct nums*)numsref)->y);
    return NULL;
}

void *mul(void *numsref)
{
```

```
    printf("Mul: %d\n", ((struct nums*)numsref)->x *
((struct nums*)numsref)->y);
    return NULL;
}

void *div(void *numsref)
{
    printf("Div: %d\n", ((struct nums*)numsref)->x /
((struct nums*)numsref)->y);
    return NULL;
}

int main()
{
    // Calculate the time taken by fun()
    clock_t t;
    t = clock();

    int i;

    struct nums n;
    n.x = 10;
    n.y = 20;

    pthread_t threads[4];

    // array of function pointers
    void * f[4];
    f[0] = add;
    f[1] = sub;
    f[2] = mul;
    f[3] = div;
```

```
    for(i=0;i<4;i++)
    {
        pthread_create(&threads[i],NULL,f[i],&n);
    }

    for(i=0;i<4;i++)
    {
        pthread_join(threads[i],NULL);
    }

    printf("I am the last line in main.\n");


    t = clock() - t;
    double time_taken = ((double)t)/CLOCKS_PER_SEC; // in seconds
    printf("Program took %f seconds to execute \n", time_taken);

    return 0;
}
```

Output:



Task 4:

Write a program to multiply two matrices.

Code:

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

int MAT1[10][10];
int MAT2[10][10];
int MAT3[10][10];

int r1,c1,r2,c2;

void *multiply(void *);

int main()
```

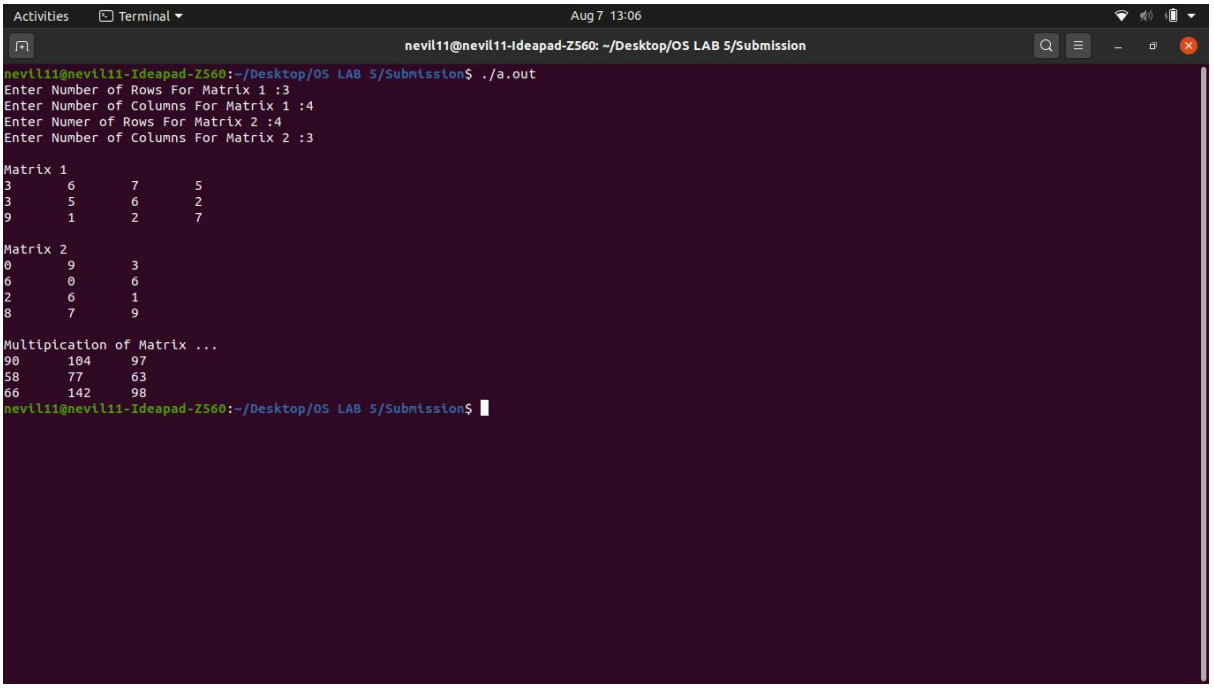
```
{
    pthread_t tid;
    int i,j,kCount;

    printf("Enter Number of Rows For Matrix 1 :");
    scanf("%d",&r1);

    printf("Enter Number of Columns For Matrix 1 :");
    scanf("%d",&c1);

    for(i=0;i<r1;i++)
        for(j=0;j<c1;j++)
            MAT1[i][j] = rand() %10;


    printf("Enter Numer of Rows For Matrix 2 :");
    scanf("%d",&r2);

    printf("Enter Number of Columns For Matrix 2 :");
    scanf("%d",&c2);

    for(i=0;i<r2;i++)
        for(j=0;j<c2;j++)
            MAT2[i][j] = rand() %10;

    if(c1!=r2)
    {
        printf("Multipication of Matrix not Possible
!!!");
    }
    else
    {
```

```
        for(i=0;i<r1;i=i+2)
        {
            for(j=0;j<c2;j=j+2)
            {
                MAT3[i][j]=0;
            }
        }

        pthread_create(&tid,NULL,multiply,NULL);

        for(i=0;i<r1;i=i+2)
        {
            for(j=0;j<c2;j++)
            {
                for(kCount=0;kCount<c1;kCount++)
                {
                    MAT3[i][j]+=MAT1[i][kCount] *
MAT2[kCount][j];
                }
            }
        }

        pthread_join(tid,NULL);
    }

    printf("\nMatrix 1 \n");

    for(i=0;i<r1;i++)
    {
        for(j=0;j<c1;j++)
        {
            printf("%d \t",MAT1[i][j]);
```

```
            }
            printf("\n");
        }

        printf("\nMatrix 2 \n");

        for(i=0;i<r2;i++)
        {
            for(j=0;j<c2;j++)
            {
                printf("%d \t",MAT2[i][j]);
            }
            printf("\n");
        }

        printf("\nMultipication of Matrix ...\n");

        for(i=0;i<r1;i++)
        {
            for(j=0;j<c2;j++)
            {
                printf("%d \t",MAT3[i][j]);
            }
            printf("\n");
        }
        return 0;
}

void *multiply(void *para)
{
        int i,j,kCount;
        for(i=1;i<r1;i=i+2)
```

```
            {
                for(j=0;j<c2;j++)
                {
                    for(kCount=0;kCount<c1;kCount++)
                    {
                        MAT3[i][j]+=MAT1[i][kCount] *
MAT2[kCount][j];
                    }
                }
            }

    pthread_exit(NULL);
}
```

Output:



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