MUTEX

Lab 06

mutex.cpp

اللهم علمنا ما ينفعنا،، وانفعنا بما علمتنا،، وزدنا علماً

Lab Objective

- To practice Mutual Exclusion in threads using Mutexes.

Mutexes

- `pthreads` includes support for MUTual Exclusion primitives.
- A mutex is useful for protecting shared data structures from concurrent modifications, and implementing critical sections.
- The idea is to lock the critical section of the code before accessing global variables and to unlock as soon as you are done.

Mutex Declaration

- A global variable of type **`pthread_mutex_t`** is required and it's defined as the following:

global variable

```
pthread_mutex_t Count_mutex = PTHREAD_MUTEX_INITIALIZER;
```

أسمي أي شي

Mutex ← global variable

unloch = 0
lock = 1

Mutex States

- A mutex has two possible states: unlocked (not owned by any thread), and locked (owned by one thread).
- A mutex can never be owned by two different threads simultaneously.
- A thread attempting to lock a mutex that is already locked by another thread is suspended until the owning thread unlocks the mutex first.
- To lock use:

Entry section

```
pthread_mutex_lock(&Count_mutex);
```

- To unlock use:

Exit section

```
pthread_mutex_unlock(&Count_mutex);
```

Practice

- In the following program, the main process creates ~~two~~ 3 threads of the function `doit`.
- That function has a loop to increment the global variable `counter` by 1 for 10 times.
- The mutex is defined in the program but not utilized around the critical section..
- Write, compile and run the program in Linux then answer the questions in the check-off section.

Steps

1. Defining and initializing global Mutex (global)
2. Destroying the Mutex (end of main)
3. **Identifying the critical section.**
4. Locking the mutex variable (entry section)
5. Unlocking the mutex variable (exit section)

```
#include <iostream>  #include<stdlib.h> #include<unistd.h>
#include "pthread.h"
using namespace std; //Output a new line
#define NLOOP 10 //Constant value

pthread_mutex_t Count_mutex = PTHREAD_MUTEX_INITIALIZER;

int counter = 0;
void * doit(void *);
int main()
{
      pthread_t tidA, tidB, tidC;
      pthread_create(&tidA, NULL, doit, NULL);
      pthread_create(&tidB, NULL, doit, NULL);
      pthread_create(&tidC, NULL, doit, NULL);

      pthread_join(tidA, NULL);
      pthread_join(tidB, NULL);
      pthread_join(tidC, NULL);

//Leaving a mutex without destorying it canaffect system performance
      pthread_mutex_destroy(&Count_mutex);
      exit(0);
}//end main
```

Defining and initializing global Mutex

Destroying the Mutex

تعريف الثريدز

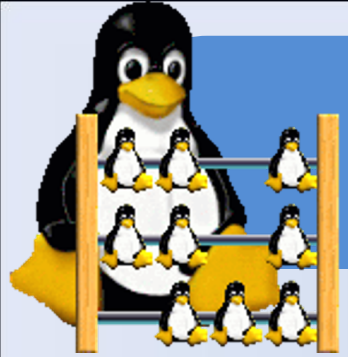
شرط أساسي عشان البرنامج ما ينتهي عمله قبل ما تخلص الثريدز

```
void * doit(void *vprt)
{
        int i, val;
        for( i = 0; i<NLOOP; i++)
        {
            val = counter;
            cout<<pthread_self()<<”"<<dec<<val+1<<endl;
            sleep(1);
            counter = val+1;
        }
        return (NULL);
} //end doit function
```

هنا الـ val تكون local خاصة بكل ثريد عشان الـ val مؤقتة
عشان كذا إذا حطينا الـ loop عند الكاونتر الي بعده سليب
ما تجي القيم زي ما توقعنا.

The critical Section

ترجع الـ ID حق الثريد



Check Off

1) Compile and run the above program as shown then record the output.
2) Add the required lock and unlock statements around the critical section. Re-compile and run the program then record the new results.
3) Explain the difference between both results.

Extra: Change the code so each thread can increment the global variable once then pass it to the next thread and so on, the output should be something as the following:

tidA 1
tidB 2
tidA 3
tidB 4 …

??? ANY QUESTIONS ???

☺