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/*
Mihir Kulkarni
33132 L9
Aim : Demonstrate reader writer problem with counting semaphores and mutex.
*/
#include <stdio.h>
#include <stdlib.h>
#include <pthread.h>
#include <semaphore.h>
#include <unistd.h>

#define TRUE 1
// #define BUFFER_SIZE 5

// int buffer[BUFFER_SIZE];
pthread_mutex_t mutex;    // binary semaphore

sem_t wrt;                // counting semaphore

int nextIn = 0, nextOut = 0; // count

int numreader = 0, count = 1;

void *reader()
{
    while(TRUE)
    {
        sleep(5);
        // Reader acquire the lock before modifying numreader
        pthread_mutex_lock(&mutex);
        numreader++;
        if(numreader == 1) {
            sem_wait(&wrt); // it will block the writer
        }
        pthread_mutex_unlock(&mutex);
        // Reading Section
        printf("Reader id (%u): read cnt as %d\n", (unsigned int)pthread_self(), count);

        // Reader acquire the lock before modifying numreader
        pthread_mutex_lock(&mutex);
        numreader--;
        if(numreader == 0) {
            sem_post(&wrt); // It will increment the writer.
        }
        pthread_mutex_unlock(&mutex);
    }
}

void *writer()
{
    int item;

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while(TRUE)
{
    sleep(3);
    sem_wait(&wrt);
    int item=2;
    count = count*item;
    printf("Writer id (%u) modified cnt to %d by multiplying with %d\n", (unsigned
int)pthread_self(), count, item);
    sem_post(&wrt);
}
}

int main()
{
    //Declaration of inputs
    int readThreads, writeThreads;
    int i, j;
    printf("\n ---READER WRITER PROBLEM---\n");
    //Input
    printf("\nEnter no. of readers :");
    scanf("%d", &readThreads);
    printf("\nEnter no. of writers :");
    scanf("%d", &writeThreads);
    printf("\n");

    //Initialization
    pthread_mutex_init(&mutex, NULL);
    //sem_init(&empty, 0, BUFFER_SIZE);
    sem_init(&wrt, 0, 1);

    pthread_t *rid, *wid;
    //Dynamic creation of threads
    rid = (pthread_t*)malloc(readThreads*sizeof(pthread_t));
    wid = (pthread_t*)malloc(writeThreads*sizeof(pthread_t));

    //pthread_t pid[producerThreads], cid[consumerThreads];

    //creating producer and consumer threads
    for(i = 0; i < readThreads; i++){
        pthread_create(&rid[i], NULL, reader, NULL);
    }

    for(j = 0; j < writeThreads; j++){
        pthread_create(&wid[j], NULL, writer, NULL);
    }
    //joining producer and consumer threads
    for(int i = 0; i < readThreads; i++) {
        pthread_join(rid[i], NULL);
    }
    for(int i = 0; i < writeThreads; i++) {
        pthread_join(wid[i], NULL);
    }
}

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//exit
pthread_mutex_destroy(&mutex);
//sem_destroy(&empty);
sem_destroy(&wrt);

return 0;
}

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mihir@pop-os: ~/TE/OS-lab/a5$ gcc -D_REENTRANT a5.c -o a5 -lpthread
mihir@pop-os: ~/TE/OS-lab/a5$ ./a5

---READER WRITER PROBLEM---

Enter no. of readers :3
Enter no. of writers :2

Writer id (865670912) modified cnt to 2 by multiplying with 2
Writer id (857278208) modified cnt to 4 by multiplying with 2
Reader id (890849024): read cnt as 4
Reader id (882456320): read cnt as 4
Reader id (874063616): read cnt as 4
Writer id (865670912) modified cnt to 8 by multiplying with 2
Writer id (857278208) modified cnt to 16 by multiplying with 2
Writer id (865670912) modified cnt to 32 by multiplying with 2
Writer id (857278208) modified cnt to 64 by multiplying with 2
Reader id (890849024): read cnt as 64
Reader id (874063616): read cnt as 64
Reader id (882456320): read cnt as 64
Writer id (865670912) modified cnt to 128 by multiplying with 2
Writer id (857278208) modified cnt to 256 by multiplying with 2
Reader id (890849024): read cnt as 256
Reader id (874063616): read cnt as 256
Reader id (882456320): read cnt as 256
Writer id (865670912) modified cnt to 512 by multiplying with 2
Writer id (857278208) modified cnt to 1024 by multiplying with 2
Writer id (865670912) modified cnt to 2048 by multiplying with 2
Writer id (857278208) modified cnt to 4096 by multiplying with 2
Reader id (874063616): read cnt as 4096
Reader id (882456320): read cnt as 4096
Reader id (890849024): read cnt as 4096
Writer id (865670912) modified cnt to 8192 by multiplying with 2
Writer id (857278208) modified cnt to 16384 by multiplying with 2
Writer id (865670912) modified cnt to 32768 by multiplying with 2
Writer id (857278208) modified cnt to 65536 by multiplying with 2
^XReader id (874063616): read cnt as 65536
Reader id (890849024): read cnt as 65536
Reader id (882456320): read cnt as 65536
Writer id (865670912) modified cnt to 131072 by multiplying with 2
Writer id (857278208) modified cnt to 262144 by multiplying with 2
^C
mihir@pop-os: ~/TE/OS-lab/a5$ 

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